DATA TRANSLATION

UM-17471-G

DT9800 Series
Getting Started Manual

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Data Translation, Inc.
100 Locke Drive
Marlboro, MA 01752-1192
(508) 481-3700
www.datatranslation.com
Fax: (508) 481-8620
E-mail: info@datx.com

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About this Manual

This manual describes how to install and set up your DT9800 Series function module and device driver, and verify that your module is working properly.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for installing and setting up DT9800 Series function modules to perform data acquisition operations. It is assumed that you are familiar with the requirements of your application. It is also assumed that you are familiar with the Microsoft® Windows® 98, Windows Me (Millennium Edition), Windows 2000, Windows XP, or the Macintosh® operating system.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the key features of the DT9800 Series hardware and the DT9800 Series software, and provides an overview of the DT9800 Series getting started procedure.
- Chapter 2, "Preparing to Use a Function Module," describes how to unpack the DT9800 Series package, check the system requirements, install the DT9800 Series software using Windows 98, Windows Me, Windows 2000, Windows XP, or MAC OS 9.0, and view the DT9800 Series documentation online.
- Chapter 3, "Installing a Function Module," describes how to install the DT9800 Series function module.
- Chapter 4, "Configuring the Module and/or Device Driver," describes how to configure the device driver and the function module.

- Chapter 5, "Wiring Signals," describes how to wire signals to a DT9800 Series function module.
- Chapter 6, "Verifying the Operation of a Function Module," describes how to verify the operation of the function module with the Quick Data Acq application.

An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

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

Related Information

Refer to the following documents for more information on using the DT9800 Series module:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation® web site (www.datatranslation.com).
- *DT9800 Series User's Manual* (UM-17473), included on the Data Acqusition OMNI CD™ provided with the DT9800 Series function module. This manual describes the features of the DT9800 Series function modules and the DT9800 Series Device Driver in detail.

- *DT Measure Foundry Getting Started Manual* (UM-19298) and online help. These documents describe how to use DT Measure Foundry™ to build drag-and-drop test and measurement applications for Data Translation® data acquisition devices without programming.
- *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™ in Windows 98, Windows Me, Windows 2000, or Windows XP to access the capabilities of Data Translation data acquisition devices. This manual is included on the Data Acquisition OMNI CD.
- *DTx-EZ Getting Started Manual* (UM-15428). This manual describes how to use the ActiveX controls provided in DTx-EZ™ to access the capabilities of Data Translation data acquisition devices in Microsoft Visual Basic® or Visual C++®.
- *DT VPI User Manual* (UM-16150). This manual describes how to use DT VPI™ and the Agilent® VEE™ visual programming language to access the capabilities of Data Translation data acquisition devices.
- *DT-LV Link Getting Started Manual* (UM-15790). This manual describes how to use DT-LV Link™ with the LabVIEW® graphical programming language to access the capabilities of Data Translation data acquisition devices.
- Microsoft Windows 98, Windows Me, Windows 2000, Windows XP, or Macintosh documentation.
- USB web site (http://www.usb.org).

Where To Get Help

Should you run into problems installing or using a DT9800 Series function module, our Technical Support Department is available to provide technical assistance. Refer to the *DT9800 Series User's Manual* for information on how to contact the Technical Support Department (refer to page 14 for information on viewing this manual). If you are outside the U.S. or Canada, call your local distributor, whose number is listed in your Data Translation product handbook.

1

Overview

DT9800 Series Key Hardware Features

The DT9800 Series includes the following subseries: DT9800 Standard, DT9800-MAC, DT9800-EC, and DT9800-EC-I Series.

The DT9800-EC Series modules are not isolated; the DT9800 Standard Series, DT9800-MAC Series, and DT9800-EC-I Series modules are isolated. In addition, the DT9800-EC and DT9800-EC-I Series modules support the use of optional backplanes and screw terminal panels that provide signal conditioning and other features, and the DT9805 and DT9806 support thermocouple inputs. Table 1 lists the function modules in each series and the key features of each module.

Table 1: Key Features Among the DT9800 Series

Series	Operating System	Function Modules	# of Analog Inputs	Analog Input Sample Rate	# of Analog Outputs	# of Digital I/O Lines	# of Counter /Timers
DT9800 Standard Series	Windows	DT9801[a]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9802[a]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2
		DT9803[b]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9804[b]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2
		DT9805[c]	16 SE/ 8 DI/ 7 thermo-couples and 1 CJC	50 kS/s	0	8 input, 8 output	2

Table 1: Key Features Among the DT9800 Series (cont.)

Series	Operating System	Function Modules	# of Analog Inputs	Analog Input Sample Rate	# of Analog Outputs	# of Digital I/O Lines	# of Counter /Timers
DT9800 Standard Series (cont.)	Windows	DT9806[c]	16 SE/ 8 DI/ 7 thermo-couples and 1 CJC	50 kS/s	2	8 input, 8 output	2
DT9800-MAC Series	Macintosh	DT9801-MAC[a]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9802-MAC[a]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2
		DT9803-MAC[b]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9804-MAC[b]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2
DT9800-EC Series[d]	Windows	DT9801-EC[a]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9802-EC[a]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2
		DT9803-EC[b]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9804-EC[b]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2

Table 1: Key Features Among the DT9800 Series (cont.)

Series	Operating System	Function Modules	# of Analog Inputs	Analog Input Sample Rate	# of Analog Outputs	# of Digital I/O Lines	# of Counter /Timers
DT9800-EC-I Series	Windows	DT9801-EC-I[a]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9802-EC-I[a]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2
		DT9803-EC-I[b]	16 SE/ 8 DI	100 kS/s	0	8 input, 8 output	2
		DT9804-EC-I[b]	16 SE/ 8 DI	100 kS/s	2	8 input, 8 output	2

a. The resolution is 12 bits.
b. The resolution is 16 bits.
c. Supported analog input gains on the DT9805 and DT9806 are 1, 10, 100, and 500; all other modules provide analog input gains of 1, 2, 4, and 8.
d. The DT9800-EC Series modules are not isolated; the DT9800-EC-I Series modules and all other modules are isolated.

DT9800 Series Software

The DT9800 Series software, which is shipped on the Data Acquisition OMNI CD, includes the following software components:

- **DT9800 Series Device Driver** – This software must be installed and loaded before you can use a DT9800 Series module with any of the supported software packages or utilities.
- **The Quick Data Acq application** – This application provides a quick way to get a DT9800 Series module up and running. Using the Quick Data Acq application, you can verify the features of the module, display data on the screen, and save data to disk.
- **Calibration Utility** – This software allows you to calibrate the analog I/O circuitry of the module. Note that this software is not provided for the Macintosh at this time. Refer to the *DT9800 Series User's Manual* for information on using this utility.
- ***DT9800 Series User's Manual*** (in PDF format) – This describes the features of the DT9800 Series modules and how to use the DT9800 Series Device Driver with DT-Open Layers-compliant software to write an application program.
- **This manual** (in PDF format).
- **Rev 4.0 of Adobe Acrobat Reader** – Allows you to view and print the PDF files.

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using the DT9800 Series function modules. This diagram is repeated in each chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

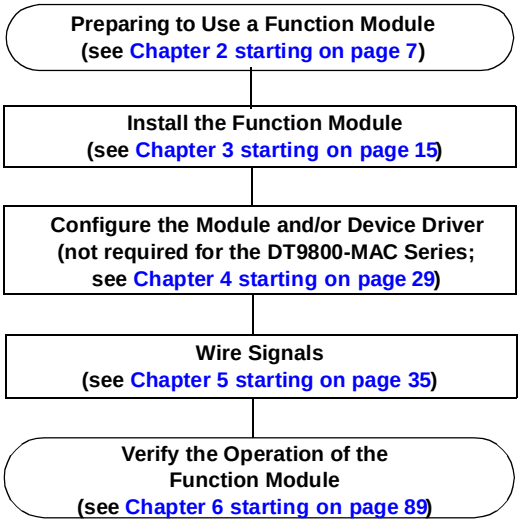
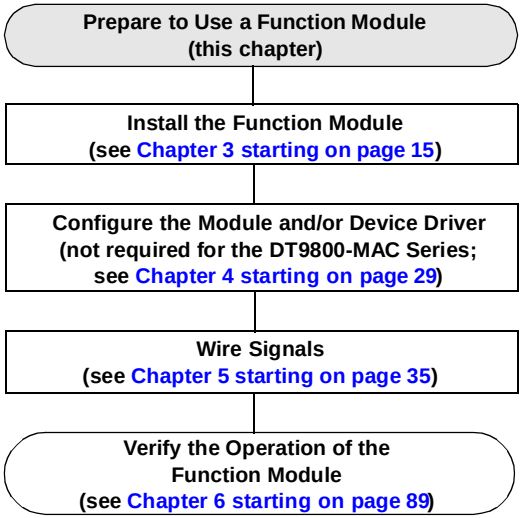


Figure 1: Getting Started Flow Diagram

2

Preparing to Use a Function Module


Prepare to Use a Function Module
(this chapter)
Install the Function Module
(see Chapter 3 starting on page 15)
Configure the Module and/or Device Driver
(not required for the DT9800-MAC Series;
see Chapter 4 starting on page 29)
Wire Signals
(see Chapter 5 starting on page 35)
Verify the Operation of the
Function Module
(see Chapter 6 starting on page 89)

Unpacking

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

- DT9800 Series function module,
- EP310 USB cable,
- Color labels for the screw terminal blocks (for DT9800 Standard and DT9800-MAC Series modules only), and
- For the Macintosh, the DT9800 Series Software and Documentation CD-ROM; for Windows 98, Windows Me, Windows 2000, or Windows XP, the Data Acquisition OMNI CD.

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. 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 in your Data Translation Product Handbook.

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

Checking the System Requirements

For reliable operation, your DT9800 Standard Series function modules require the items listed in Table 2.

Table 2: Minimum System Requirements

Function Module	Feature	Minimum Requirements
DT9800 Standard Series, DT9800-EC Series, and DT9800-EC-I Series	Operating System	Windows 98, Windows Me, Windows 2000, or Windows XP
	Processor	80486, Pentium, or compatible
	USB Ports	One or more
	RAM	16 MB or more
	CD-ROM Drives	One or more
	Monitor	VGA, or compatible, display (640 x 480 or higher, 256 colors recommended)
DT9800-MAC Series	Operating System	MAC OS 9.0
	Processor	iMac, iBook, or Power Mac G4
	USB Ports	One or more
	RAM	32 MB or more
	CD-ROM Drives	One or more
	Monitor	VGA, or compatible, display (640 x 480 or higher, 256 colors recommended)

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

Installing the Software

If you are using Windows 98, Windows Me, Windows 2000, or Windows XP continue with the instructions in the next section. If you are using the Macintosh, continue with the instructions on page 13.

Installing the Software in Windows 98, Windows Me, Windows 2000, or Windows XP

CAUTION:

This version of the software provides WDM-compliant device drivers and DLLs (version 5.0 or greater). Other Data Translation boards may not provide WDM-compliant files.

You cannot use a DT9800 Series board at the same time as another Data Translation board unless both devices provide WDM-compliant files.

To install the software, perform the following steps:

1. Insert the Data Acquisition OMNI CD into your CD-ROM drive.
2. Click **Start** from the Task Bar, then click **Run**.
   The Run dialog box appears.
3. In the Command Line edit box, enter **D:\LAUNCH.EXE**.
   If your CD-ROM is not in drive D:, enter the letter of the drive where your CD-ROM is located.
4. Click **OK**.
   The Data Acquisition Software setup program starts.
5. Click **Install Products**.
   A list of software products that you can install appears.
6. Click **Device Drivers**.
   The DT-Open Layers Data Acquisition software wizard appears.

7. Click **Next**.
   You are prompted for the destination location.
8. Either change the directory path and/or name using **Browse** or accept the default directory, then click **Next**.
   You are prompted to select the software components to install.
9. Select **DT9800 Series**, then click **Next**.
   You are prompted for the program folder name.
10. Either change the program folder name or accept the default program folder name, then click **Next**.
    The files are copied to the destination directory.
11. Click **Finish**.
    The DT Data Acquisition Software setup program reappears.
12. Click **Main Menu**.
13. Click **Exit**.

Installing the Software on the Macintosh

You can install the software on the Macintosh in one of the following ways:

- If you have an Internet connection and OS 9, you can download the latest software (including drivers and the Quick Data Acq application) from the DataTranslation web site. For more information, refer to "Connecting Directly to the Host Computer" on page 17 or "Connecting to a Self-Powered USB Hub" on page 19.
- If you want to install the software on the supplied CD-ROM, perform the following steps:

  1. Insert the DT9800 Series CD-ROM into your CD-ROM drive.
  2. Drag the contents of the DT9800 Drivers folder from the CD-ROM to the System folder on your hard disk. This folder contains the USB DT9800 Data Acq Driver and USB DT9800 Data Acq Loader files.
  3. Click **OK** to place the files in the Extensions folder.

Viewing the DT9800 Series Documentation Online

Once you have installed the DT9800 Series software, you can view the DT9800 Series documentation by clicking the manual title. For Windows 98, Windows Me, Windows 2000, and Windows XP, you can access the manuals from the Data Translation, Inc\DT9800 Series program group. For the Macintosh, you can access the manuals from the Quick Data Acq folder.

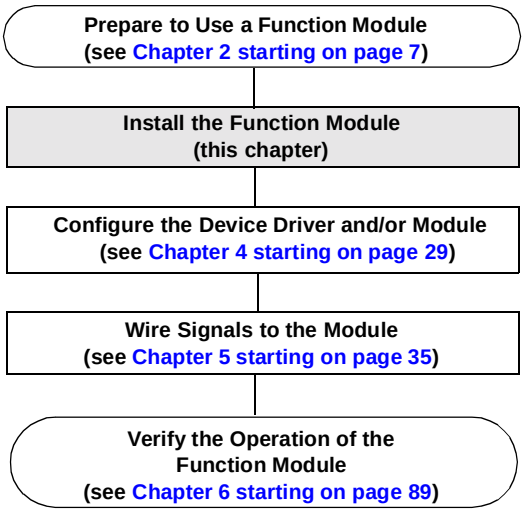
To view the documentation, you need Adobe Acrobat Reader, version 4.0. For Windows 98, Windows Me, Windows 2000, and Windows XP, Adobe Acrobat Reader is included on the CD-ROM. For the Macintosh, you can download Adobe Acrobat Reader from the Adobe web site at www.adobe.com.

Here are a few helpful hints about using Adobe Acrobat Reader:

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

3

Installing a Function Module



Note: All DT9800 Series modules are factory-calibrated and require no further adjustment prior to installation. If you are using the DT9800 Standard, DT9800-EC, or DT9800-EC-I Series modules and decide later to recalibrate them, refer to the *DT9800 Series User's Manual* for instructions (see page 14 for information on viewing this manual).

DT9800-MAC Series modules currently do not support software calibration.

Attaching the Module to the Computer

You can attach a DT9800 Series module to the host computer in one of two ways:

- Connect directly to a USB port of the host computer, described on this page. Use this method if one or two DT9800 Series function modules are sufficient for your application.
- Connect to one or more self-powered USB hubs, described on page 19. Use this method if your application requires more than two DT9800 Series function modules connected to the host computer.

Note: DT9800 Series modules are low-power devices (using less than 500 mA); therefore, they do not require external power supplies.

Connecting Directly to the Host Computer

Generally, host computers have two USB ports. These ports are completely independent. To connect a DT9800 Series function module directly to a USB port of the computer, perform the following steps:

1. Attach one end of the EP310 cable, which is shipped with the DT9800 Series function module, to the USB port on the module.
2. Attach the other end of the EP310 cable to one of the USB ports on the host computer, as shown in Figure 2.
   The operating system automatically detects the USB device.

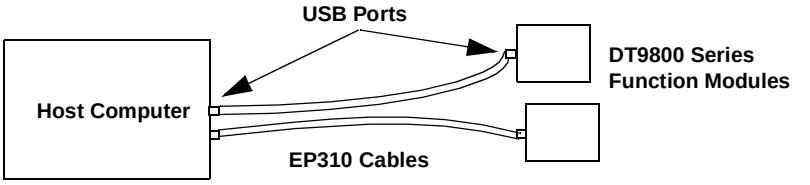


Figure 2: Attaching the DT9800 Series Function Module Directly to the Host Computer

3. If you previously installed the DT9800 Series Device Driver, ignore the remaining steps, and repeat steps 1 and 2 to attach another DT9800 Series function module to the host computer, if desired.

   If you are using Windows 98, Windows Me, Windows 2000, or Windows XP, and you have not yet installed the DT9800 Series Device Driver, the New Hardware Found wizard appears. Click **Next** to have the wizard search for the DT9800 Series Device Driver, then proceed to step 4.

   If you are using the Macintosh, you did not install the software from the CD-ROM, and you have an Internet connection and OS 9, you are prompted to install the latest software from the Data Translation web site. Follow the instructions on the screen for automatic software update. This allows you to download and install the DT9800 Series drivers, and optionally, the Quick Data Acq software and required files. Then, proceed to step 8.

4. Click the option to search for the driver, then click **Next**.

5. Click the option to specify the location, then enter **x:\Products\Core\DT9800** as the path from which to copy files (where *x* is the letter of your CD-ROM drive), then click **Next**.

6. Click **Next**.

7. Click **Finish**.
   A New Hardware Found dialog box appears indicating that Windows is installing the driver for the USB device.

8. Repeat the steps 1 to 2 to attach another DT9800 Series function module to the host computer, if desired.

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

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

Connecting to a Self-Powered USB Hub

Self-powered USB hubs are USB hubs that are powered by their own external power supply. Theoretically, you can connect up to five self-powered USB hubs to a USB port on the host computer. However, the practical number of DT9800 Series function modules that you can connect to a single USB port depends on the throughput you want to achieve. Each of the hubs supports up to four DT9800 Series function modules.

Note: The bandwidth of the USB bus is 12 Mbits / second. Each DT9800 Series function module running at full speed (100 kHz) requires 200 kB of this bandwidth. Therefore, if you want to achieve full throughput on each function module, you should connect no more than four DT9800 Series function modules to a single USB port.

To connect a DT9800 Series function module to a self-powered USB hub, perform the following steps:

1. Attach one end of the EP310 cable to the DT9800 Series module and the other end of the EP310 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 EP310 cable.
   The operating system automatically detects the USB device.
4. If you are using Windows 98, Windows Me, Windows 2000, Windows XP, or the Macintosh and previously installed the DT9800 Series Device Driver, ignore the remaining steps, and repeat steps 1 to 3 until you have attached the number of hubs (up to five) and function modules (up to four per hub) that you desire.

   If you are using Windows 98, Windows Me, Windows 2000, or Windows XP, and you have not installed the DT9800 Series Device Driver, the New Hardware Found wizard appears. Click **Next** to have the wizard search for the DT9800 Series Device Driver. Proceed to step 5.

   If you are using the Macintosh, you did not install the software from the CD-ROM, and you have an internet connection and OS 9, you are prompted to install the latest software from the Data Translation web site. Follow the instructions on the screen for automatic software update. This allows you to download and install the DT9800 Series drivers, and optionally, the Quick Data Acq software and required files. Then, proceed to step 10.
5. Click the option to search for the driver, then click **Next**.
6. Click the option to specify the location, then enter **x:\Products\Core\DT9820** as the path from which to copy files (where *x* is the letter of your CD-ROM drive), then click **Next**.
7. Click **Next**.

8. Click **Finish**.
A New Hardware Found dialog box appears indicating that Windows is installing the driver for the USB device.

9. Repeat steps 1 to 3 until you have attached the number of hubs (up to five) and function modules (up to four per hub) that you desire. Refer to Figure 3.
The operating system automatically detects the USB devices as they are installed.

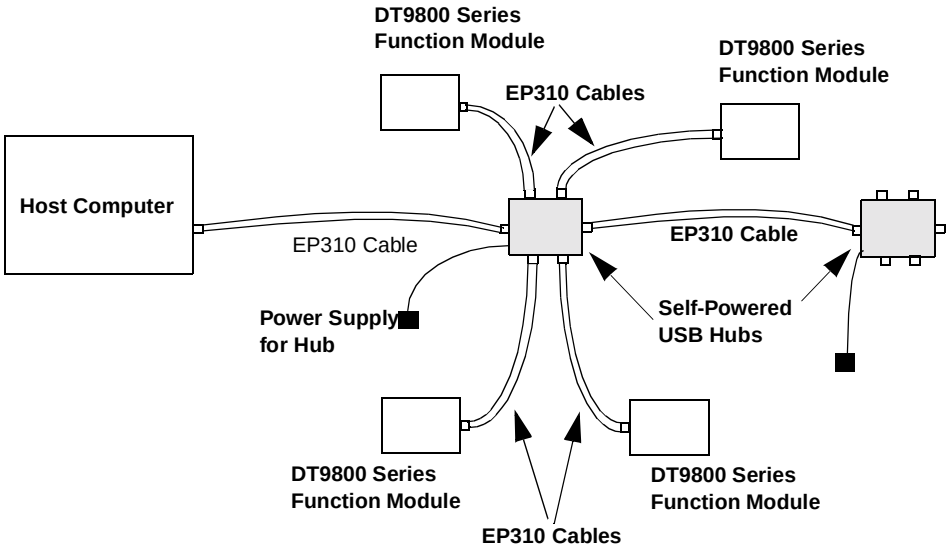


Figure 3: Attaching DT9800 Series Function Modules to the Host Computer Using Self-Powered USB Hubs

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

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

If you are using a DT9800-EC or DT9800-EC-I Series module, continue with the next section. Otherwise, continue with the instructions on wiring in Chapter 4 starting on page 29.

Attaching Backplanes/Panels to the DT9800-EC or DT9800-EC-I Series

Only the DT9800-EC and DT9800-EC-I Series function modules support Analog Devices 5B and 7B Series backplanes, the Opto-22 PB16H digital I/O backplane, and the Data Translation STP-EZ backplane and AC1324 screw terminal panel.

The DT9800-EC and DT9800-EC-I Series function modules provide the following three connectors:

- Connector J6 – Supports 5B and 7B Series backplanes or an AC1324 screw terminal panel for analog input connections.

  Specific 5B and 7B Series backplanes that are supported include the following:

  – 5B01 – a 16-channel backplane for 5B Series signal conditioning modules,

  – 5B08 – an 8-channel backplane for 5B Series signal conditioning modules,

  – 7BP16-1 – a 16-channel backplane for 7B Series signal conditioning modules,

  – 7BP08-1 – an 8-channel backplane for 7B Series signal conditioning modules, and

  – 7BP04-1 – a 4-channel backplane for 7B Series signal conditioning modules.

- Connector J5 – Supports an AC1324 screw terminal panel for analog output, dynamic digital output, counter/timer, and power connections.
- Connector J4 – Supports the STP-EZ and the PB16H digital I/O backplane. The PB16H supports eight digital inputs at locations 0 to 7, and eight digital outputs at locations 8 to 15.

Figure 4 shows the location of these connectors on the DT9800-EC and DT9800-EC-I Series function modules.

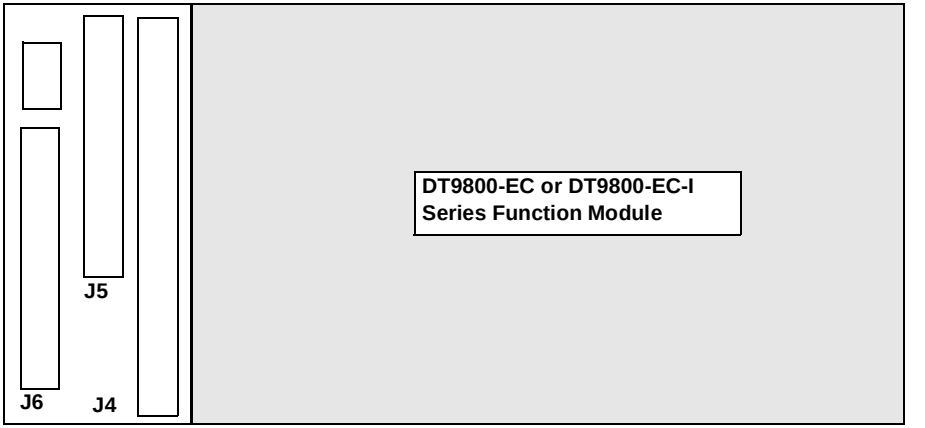


Figure 4: J6, J5, and J4 Connectors

This section describes how to connect a 5B or 7B Series backplane, a AC1324 screw terminal panel, and/or a PB16H Opto-22 backplane to your DT9800-EC or DT9800-EC-I Series function module.

Attaching a 5B or 7B Series Backplane

To connect a 5B01, 5B08, 7BP16-1, 7BP08-1, or 7BP04-1 signal conditioning backplane to a DT9800-EC or DT9800-EC-I Series function module, perform the following steps:

1. Plug one end of an AC1315 cable into the J6 connector of the DT9800-EC or DT9800-EC-I Series function module, as shown in Figure 5.

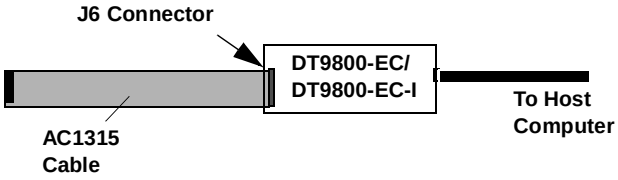


Figure 5: Connecting the AC1315 Cable to the DT9800-EC or DT9800-EC-I Series Function Module

2. If you are using a 5B Series backplane, plug the other end of the AC1315 cable into the 26-pin connector on the 5B Series backplane, as shown in Figure 6.

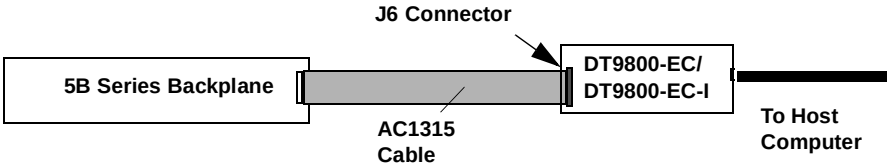


Figure 6: Connecting the AC1315 Cable to the 5B Series Backplane

If you are using a 7B Series backplane, plug the other end of the AC1315 cable into the 26-pin connector of the AC1393 adapter cable; then, attach the 25-pin connector of the AC1393 adapter cable to the 7B Series backplane, as shown in Figure 7.

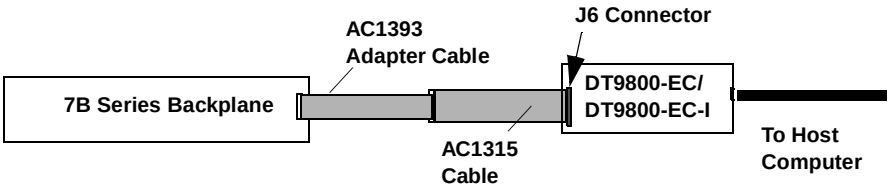


Figure 7: Connecting the AC1315 Cable to the AC1393 Adapter Cable and to the 7B Series Backplane

Attaching an AC1324 Screw Terminal Panel

To connect an AC1324 screw terminal panel to a DT9800-EC or DT9800-EC-I Series function module, perform the following steps:

1. Plug one end of an AC1315 cable into the J6 or J5 connector of the DT9800-EC or DT9800-EC-I Series function module.
2. Plug the other end of the AC1315 cable into the 26-pin connector on the AC1324 screw terminal panel, as shown in Figure 8.

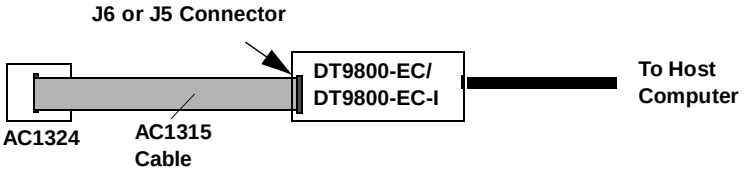


Figure 8: Connecting the AC1324 Screw Terminal Panel to the DT9800-EC or DT9800-EC-I Series Function Module

Attaching a PB16H Opto-22 Backplane

To connect a PB16H Opto-22 backplane to a DT9800-EC or DT9800-EC-I Series function module, perform the following steps:

1. Plug one end of an EP035 cable into the J4 connector of the DT9800-EC or DT9800-EC-I Series function module.
2. Plug the other end of the EP035 cable into the 50-pin connector on the PB16H Opto-22 backplane, as shown in Figure 9.

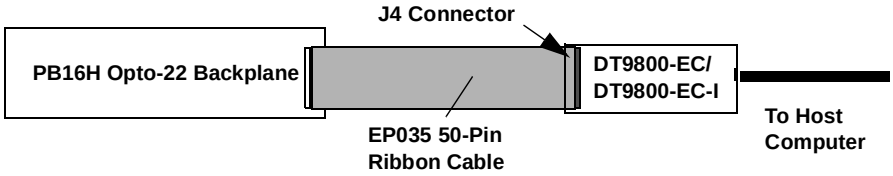


Figure 9: Connecting the PB16H Opto-22 Backplane to the DT9800-EC or DT9800-EC-I Series Function Module

Attaching an STP-EZ Screw Terminal Panel

To connect an STP-EZ screw terminal panel to a DT9800-EC or DT9800-EC-I Series function module, perform the following steps:

1. Attach one end of the 50-pin cable that is shipped with the STP-EZ screw terminal panel into connector J4 on the DT9800-EC or DT9800-EC-I board.
2. Attach the other end of the cable to the J1 connector on the STP-EZ screw terminal panel, as shown in Figure 10.

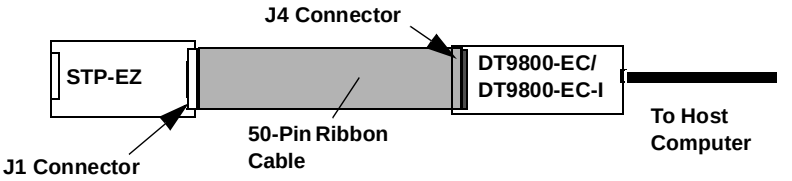
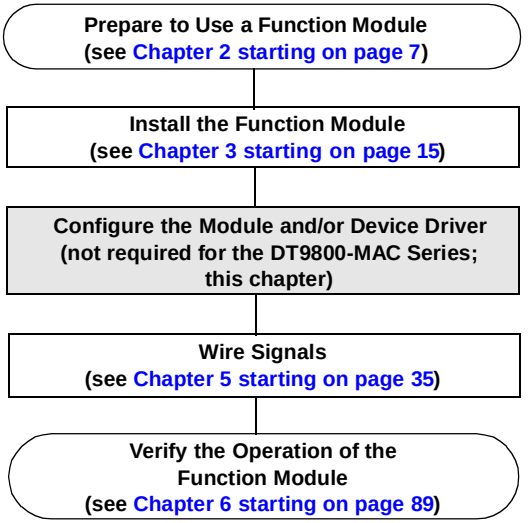


Figure 10: Connecting the STP-EZ to the DT9800-EC or DT9800-EC-I Function Module

4

Configuring the Module and/or Device Driver



If you are using a DT9800 Standard Series, DT9800-EC Series, or DT9800-EC-I Series module, you must configure the device driver; refer to page 31 for information.

In addition, if you are using a DT9800-EC or DT9800EC-I Series module, you must configure the module; refer to page 33 for information.

If you are using a DT9800-MAC function module, it is not necessary to configure the DT9800 Series Device Driver or function module. Therefore, skip this chapter and continue with the instructions for wiring signals in Chapter 5 starting on page 35.

Configuring the DT9800 Series Device Driver

This section describes how to configure the device driver for a DT9800 Standard Series, DT9800-EC Series, or DT9800-EC-I Series function module to use or not use bias-return termination resistance.

To configure the device driver, perform the following steps:

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 DT9800 Series function module that you want to configure, then click **Advanced**.
   The DT9800 Configuration dialog box appears.
4. If you are using differential analog input channels, it is recommended 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.

   If you are using single-ended analog input channels, clear the checkbox for each analog input channel so that bias return resistance is not used.
5. To continuously power the analog and / or digital outputs, select the **Power Always On** checkbox. The DT9800 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.

6. Click **OK**.
7. If you want to rename the function module, click **Edit Name**; otherwise, go to step 9.
8. Enter a new name for the function module, then click **OK**.

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

---

9. When you are finished configuring the function module, click **Close**.
10. Repeat steps 3 to 9 for the other function modules that you want to configure.
11. Close the Control Panel.

If you are using a DT9800-EC or DT9800-EC-I function module, continue with the next section. Otherwise, continue with the instructions on wiring in Chapter 5 starting on page 35.

Configuring the DT9800-EC and DT9800-EC-I Series Function Modules

This section describes how to configure a DT9800-EC or DT9800-EC-I function module for use with analog output modules on the 5B01 and 7BP16-1 signal conditioning backplanes.

Note: You cannot use analog output modules on the 5B08, 7BP04-1, or 7BP08-1 backplane.

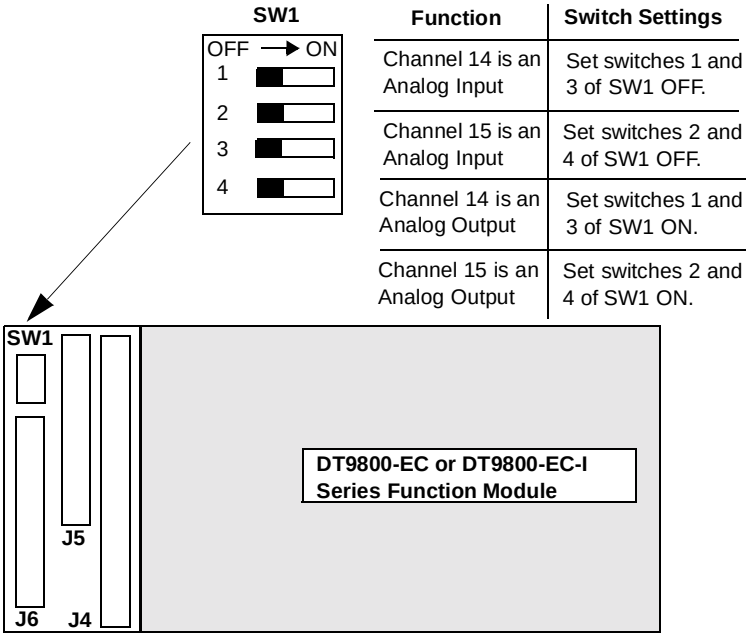
By default, the 5B01 and 7BP16-1 backplanes map to single-ended analog input channels 0 to 15. However, you can use channels 14 and 15 on the 5B01 or 7BP16-1 backplane as analog output channels 0 and 1.

You can determine how channels 14 and 15 are used on the 5B01 and 7BP16-1 backplanes using DIP switch block SW1 on the DT9800-EC and DT9800-EC-I function modules. DIP switch SW1 contains switches 1 to 4.

To use channels 14 and 15 on the 5B01 or 7BP16 backplane as analog inputs, slide all the switches of DIP switch SW1 on the DT9800-EC or DT9800-EC-I Series module to the OFF position. To use channel 14 on the 5B01 or 7BP16 backplane as analog output channel 0, set switches 1 and 3 of DIP switch SW1 on the DT9800-EC or DT9800-EC-I Series module to the ON position.

To use channel 15 on the 5B01 or 7BP16 backplane as analog output channel 1, set switches 2 and 4 of DIP switch SW1 on the DT9800-EC or DT9800-EC-I Series modules to the ON position.

Refer to Figure 11 for the location of DIP switch SW1.



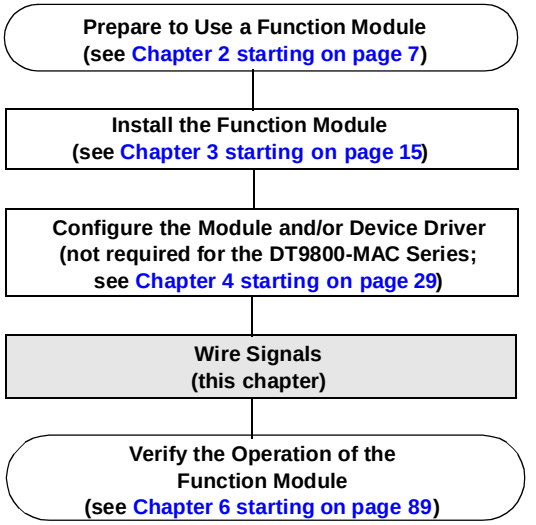
Function	Switch Settings
Channel 14 is an Analog Input	Set switches 1 and 3 of SW1 OFF.
Channel 15 is an Analog Input	Set switches 2 and 4 of SW1 OFF.
Channel 14 is an Analog Output	Set switches 1 and 3 of SW1 ON.
Channel 15 is an Analog Output	Set switches 2 and 4 of SW1 ON.

Figure 11: DIP Switch SW1

For example, assume that you are using a 5B01 with the DT9801-EC and that you want to use analog output channels 0 and 1. In this case, ensure that you wire DAC0 signals to channel 14 and DAC1 signals to channel 15 on the 5B01 backplane. Then, set all the switches of DIP switch SW1 on the DT9800-EC or DT9800-EC-I Series module to the ON position.

5

Wiring Signals


Prepare to Use a Function Module
(see Chapter 2 starting on page 7)
Install the Function Module
(see Chapter 3 starting on page 15)
Configure the Module and/or Device Driver
(not required for the DT9800-MAC Series;
see Chapter 4 starting on page 29)
Wire Signals
(this chapter)
Verify the Operation of the
Function Module
(see Chapter 6 starting on page 89)

Wiring Signals to the DT9800 Standard or DT9800-MAC Series

Before wiring signals to a DT9800 Standard or DT9800-MAC Series function module, peel off the color labels provided in the shipping box and attach one to the outside of each screw terminal block. Ensure that you match the color of the peel-off label to the color on the label on top of the unit. This way, if you later remove the screw terminal blocks, you will know where to reattach them.

CAUTION:

To avoid electrostatic sensitivity, it is recommended that you unplug your DT9800 Series module from the computer before wiring signals.

In addition, to ensure that your function module performs as expected, insert each screw terminal block into the location on the DT9800 Standard or DT9800-MAC Series function module with the matching color.

Keep the following recommendations in mind when wiring signals to the DT9800 Standard or DT9800-MAC Series function modules:

- Use individually shielded twisted-pair wire (size 14 to 26 AWG) when using the DT9800 Standard or DT9800-MAC Series function 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 DT9800 Standard or DT9800-MAC Series function 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 DT9800 Standard or DT9800-MAC Series function 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 channel 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 of port A.
  - Wire a digital output to digital output line 0 of port B.
  - Wire an external clock or scope to counter/timer channel 0.
  - Then, run the Quick Data Acq application (described in Chapter 6 starting on page 89) to verify that the function module is operating properly.

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

Figure 12 shows the assignments of the screw terminals on the DT9800 Standard Series and DT9800-MAC Series function modules. The screw terminal blocks are removable for your convenience.

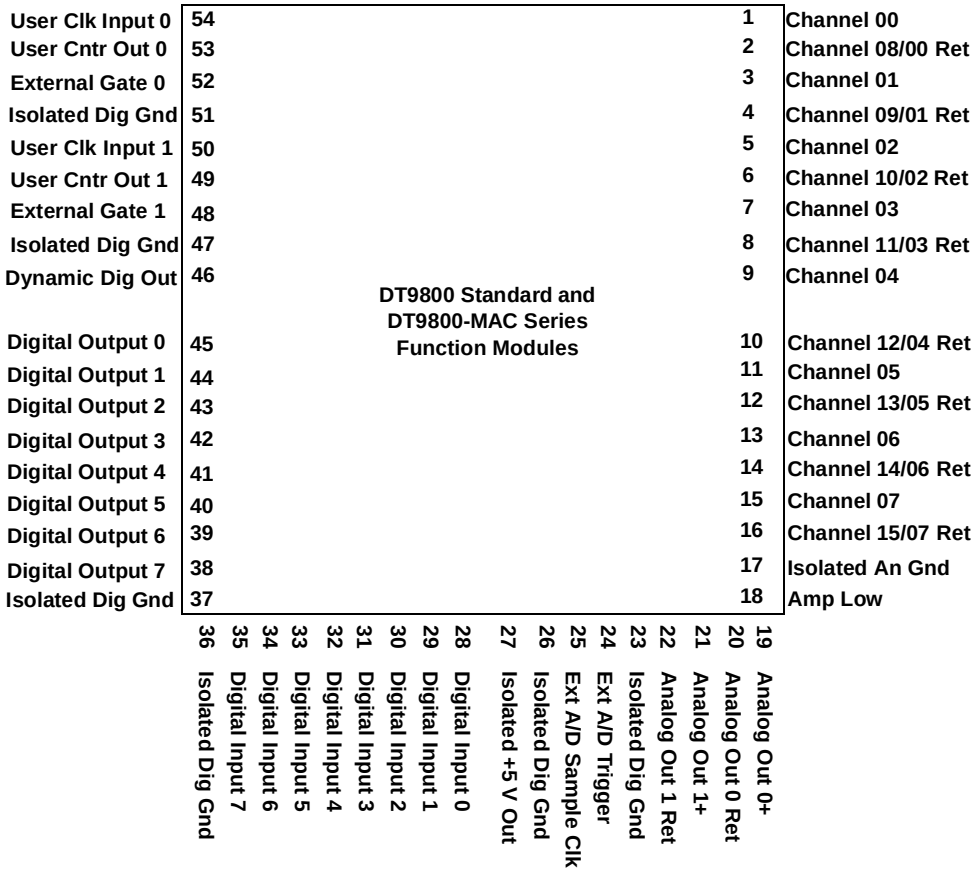


Figure 12: DT9800 Standard Series and DT9800-MAC Series Screw Terminal Assignments

Note: Screw terminals TB19 through TB22 are not used on DT9801, DT9801-MAC, DT9803, DT9803-MAC, and DT9805 function modules since these modules do not support analog output.

Connecting Analog Input Signals

The DT9800 Standard and DT9800-MAC Series function modules support both voltage and current loop inputs.

You can connect analog input signals to a DT9800 Standard or DT9800-MAC Series function module in the following configurations:

- **Single-ended** – Choose this configuration when you want to measure high-level signals, noise is not significant, the source of the input is close to the function module, and all the input signals are referred to the same common ground. When you choose the single-ended configuration, all 16 analog input channels are available on the DT9800 Standard and DT9800-MAC Series.
- **Pseudo-Differential** – Choose this configuration when noise or common-mode voltage (the difference between the ground potentials of the signal source and the ground of the function module or between the grounds of other signals) exists and the differential configuration is not suitable for your application. This option provides less noise rejection than the differential configuration; however, all 16 analog input channels are available on the DT9800 Standard and DT9800-MAC Series.
- **Differential** – Choose this configuration when you want to measure thermocouple or low-level signals (less than 1 V), you are using an A/D converter with high resolution (greater than 12 bits), noise is a significant part of the signal, or common-mode voltage exists. When you choose the differential configuration, eight analog input channels are available on the DT9800 Standard and DT9800-MAC Series.

This section describes how to connect single-ended, pseudo-differential, and differential voltage inputs, as well as current loop and thermocouple inputs to the DT9800 Standard or DT9800-MAC Series function module.

Connecting Single-Ended Voltage Inputs

Figure 13 shows how to connect single-ended voltage inputs (channels 0, 1, and 8, in this case) to a DT9800 Standard or DT9800-MAC Series function module.

Note: If you are using single-ended inputs, set up the software so that bias return resistance is not used. For more information, refer to page 31 for the DT9800 Standard Series or page 104 for the DT9800-MAC Series.

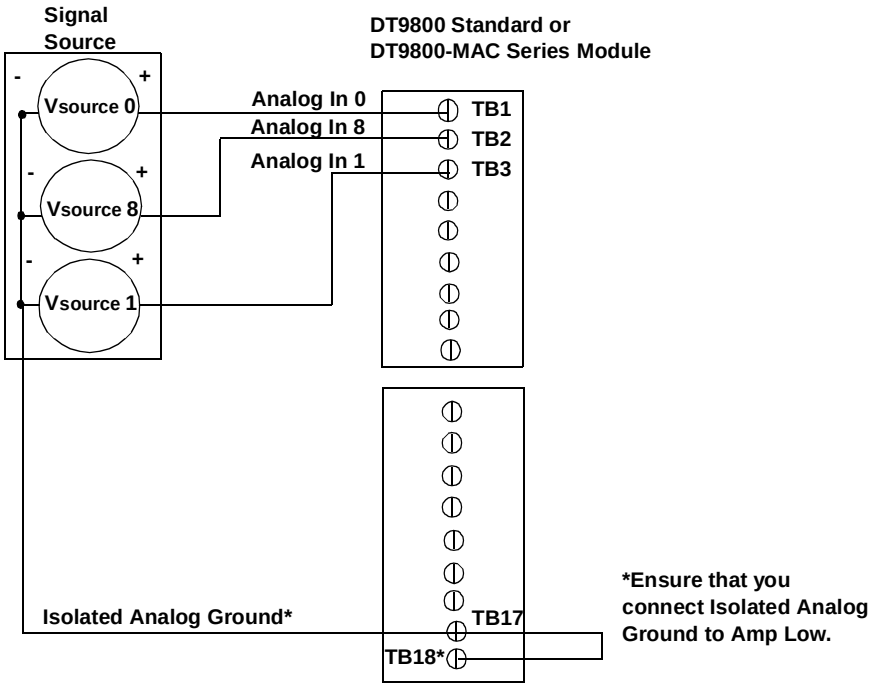
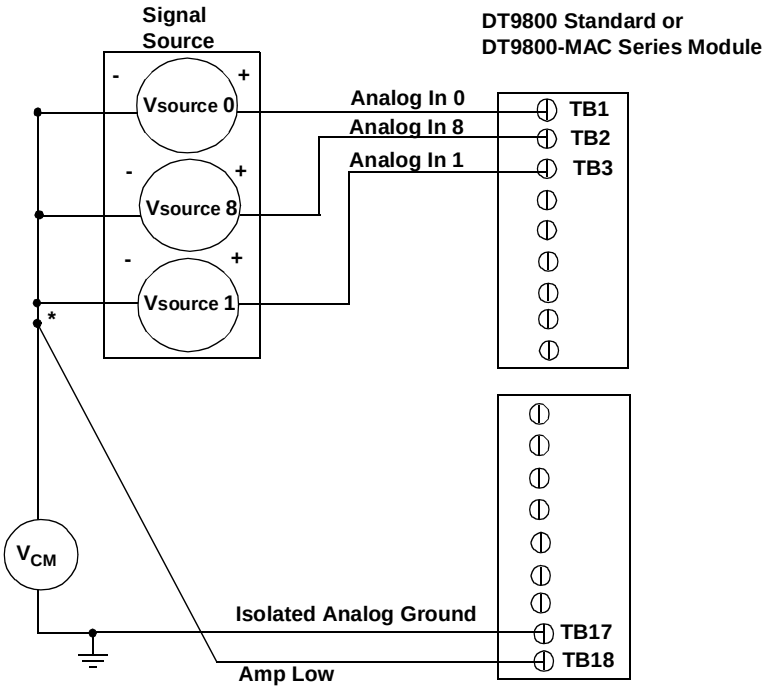


Figure 13: Connecting Single-Ended Voltage Inputs (Shown for Channels 0, 1, and 8)

Connecting Pseudo-Differential Voltage Inputs

Figure 14 shows how to connect pseudo-differential voltage inputs (channels 0, 1, and 8, in this case) to a DT9800 Standard or DT9800-MAC Series function module.



*Make this connection as close to V_{IN} sources as possible to reduce ground loop errors. V_{cm} is the common mode voltage for all 16 analog inputs.

Figure 14: Connecting Pseudo-Differential Voltage Inputs (Shown for Channels 0, 1, and 8)

Note: If you are using pseudo-differential inputs, set up the software so that bias return resistance is not used. For more information, refer to page 31 for the DT9800 Standard Series or page 104 for the DT9800-MAC Series.

Connecting Differential Voltage Inputs

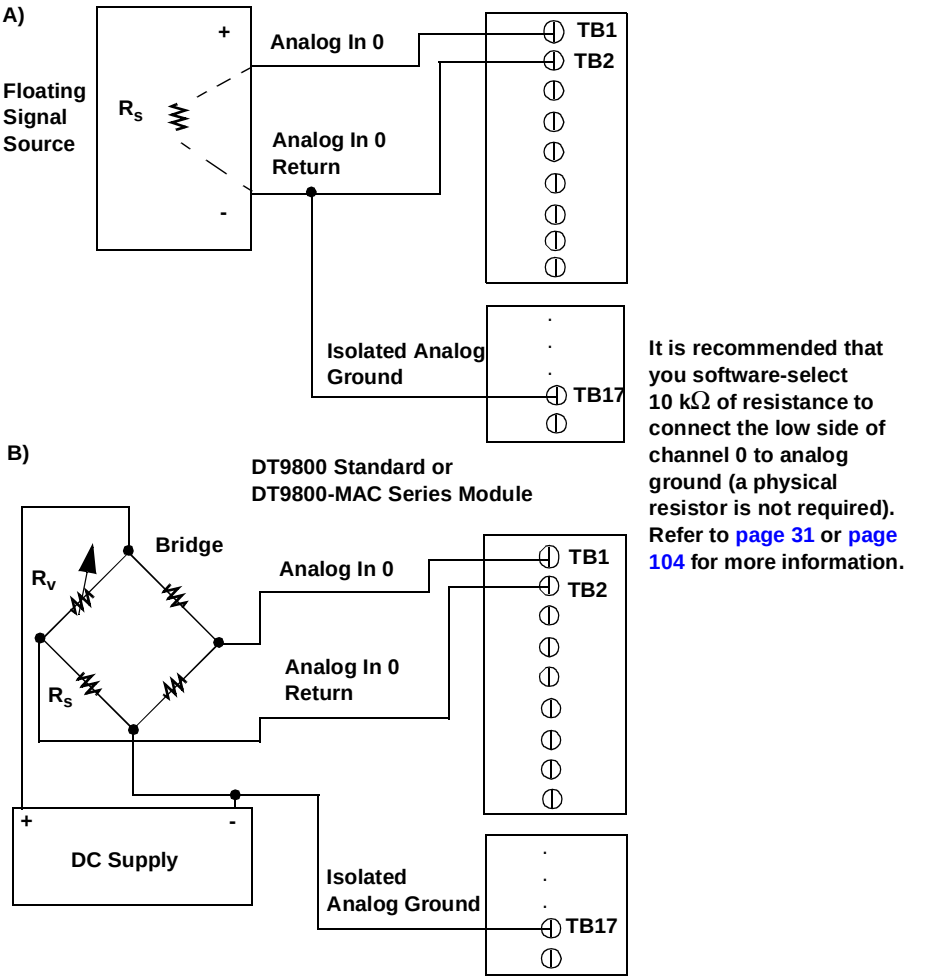
Figure 15A illustrates how to connect a floating signal source to a DT9800 Standard or DT9800-MAC Series function module using differential inputs. (A floating signal source is a voltage source that has no connection with earth ground.)

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 page 31 for the DT9800 Standard Series or page 104 for the DT9800-MAC Series.

Figure 15B illustrates how to connect a nonfloating signal source to a DT9800 Series function 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.



It is recommended that you software-select 10 kΩ of resistance to connect the low side of channel 0 to analog ground (a physical resistor is not required). Refer to page 31 or page 104 for more information.

Figure 15: Connecting Differential Voltage Inputs (Shown for Channel 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 DT9800 Standard or DT9800-MAC Series function module as shown in Figure 16. In this case, make sure that the low side of the signal (–) is connected to ground at the signal source, not at the DT9800 Standard or DT9800-MAC Series function module, and do not tie the two grounds together.

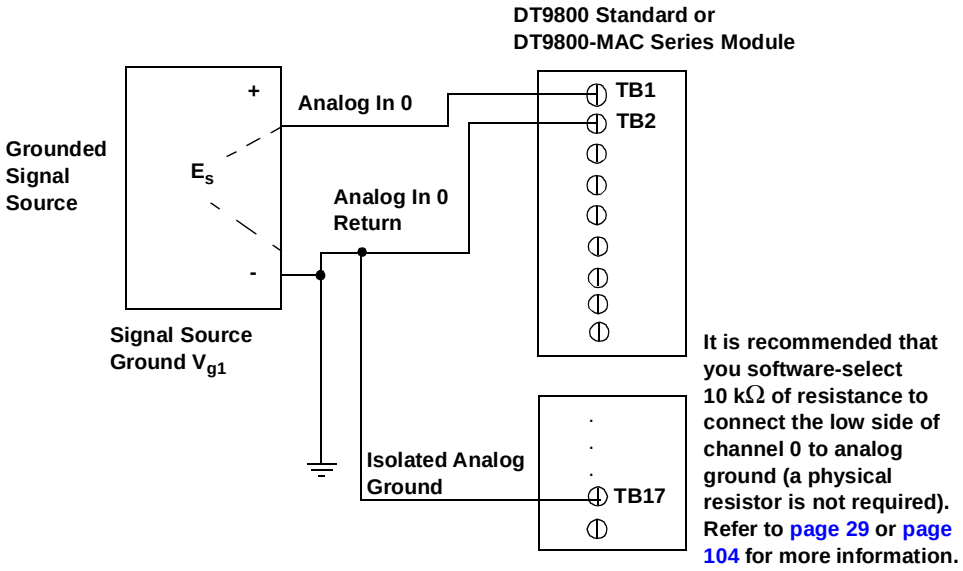


Figure 16: Connecting Differential Voltage Inputs from a Grounded Signal Source (Shown for Channel 0)

Connecting Current Loop Inputs

Figure 17 shows how to connect a current loop input (channel 0, in this case) to a DT9800 Standard or DT9800-MAC Series function module.

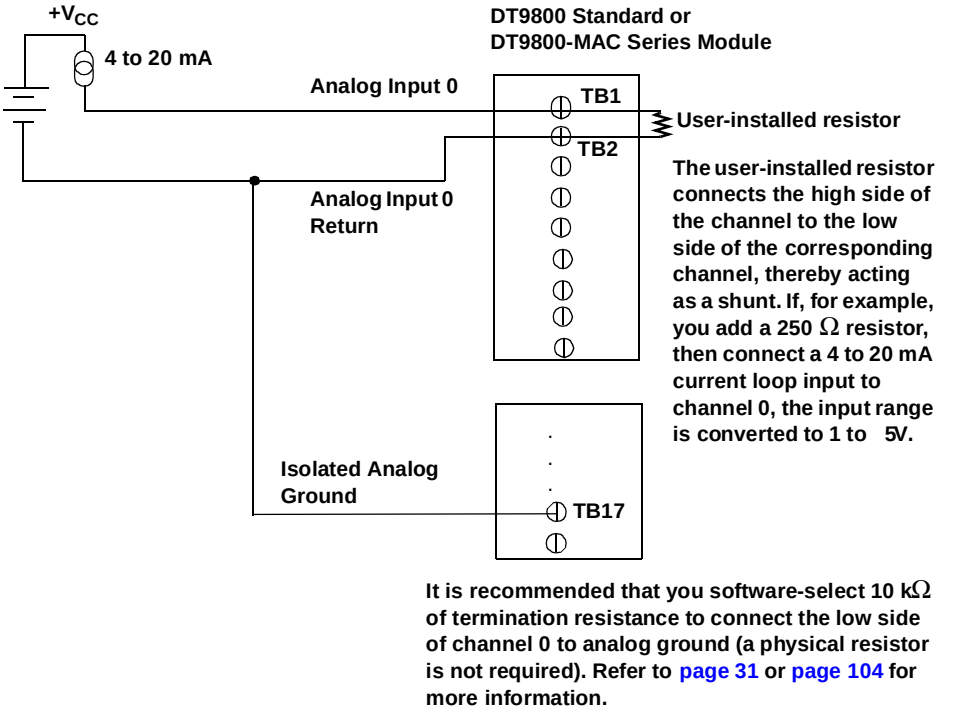


Figure 17: Connecting Current Inputs (Shown for Channel 0)

Note: If you are using current loop inputs, set up the software so that bias return resistance is used. For more information, refer to page 31 for the DT9800 Standard Series or page 104 for the DT9800-MAC Series.

Connecting Thermocouple Inputs

The DT9805 and DT9806 function modules provide cold junction compensation (CJC) on channel 0 at 10 mV / °C. You can attach up to seven thermocouples to the DT9805 or DT9806 module using channel 0 as a CJC. The accuracy of the CJC is ±1° from 5° to 45° C.

Figure 18 shows how to connect a thermocouple input to channel 1 of a DT9805 or DT9806 function module.

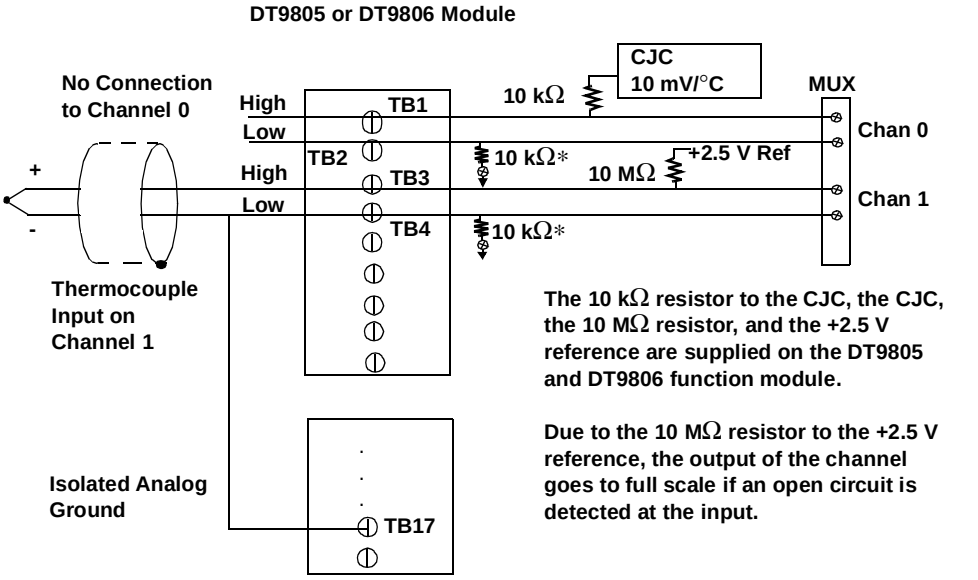


Figure 18: Connecting Thermocouple Inputs (Shown for Channel 1)

Note: You can connect voltages instead of thermocouples to the DT9805 and DT9806 modules. In this case, ensure that the signal you attach to channel 0 is capable of driving 10 kΩ, and that the signals you attach to channels 1, 2, 3, 4, 5, 6, and 7 are capable of driving 10 MΩ.

Connecting Analog Output Signals

Figure 19 shows how to connect an analog output voltage signal (channel 0, in this case) to a DT9802, DT9802-MAC, DT9804, DT9804-MAC, or DT9806 function module.

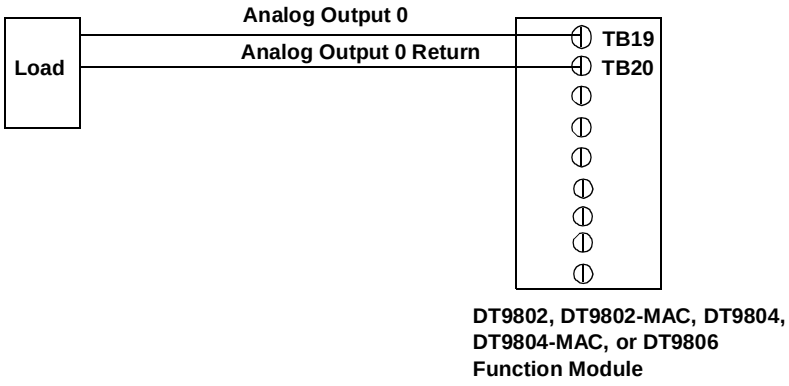


Figure 19: Connecting Analog Output Voltages (Shown for Channel 0)

Connecting Digital I/O Signals

Figure 20 shows how to connect digital input signals (lines 0 and 1, Port A, in this case) to a DT9800 Standard or DT9800-MAC Series function module.

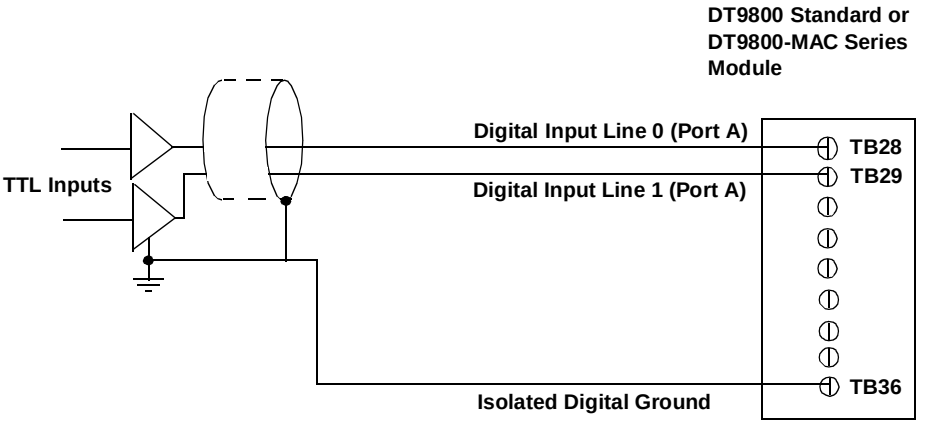


Figure 20: Connecting Digital Inputs (Shown for Lines 0 and 1, Port A)

Figure 21 shows how to connect a digital output (line 0, Port B, in this case) to a DT9800 Standard or DT9800-MAC Series function module.

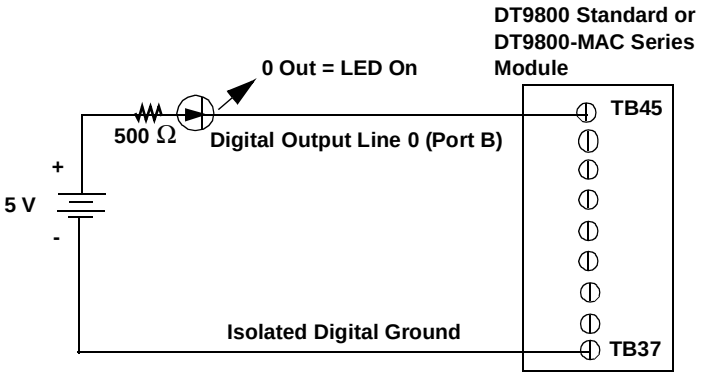


Figure 21: Connecting Digital Outputs (Shown for Line 0, Port B)

Connecting Counter/Timer Signals

DT9800 Standard and DT9800-MAC Series function modules provide two user counter / timer channels that you can use to perform the following operations:

- Event counting,
- Frequency measurement, and
- Pulse output (rate generation, one-shot, and repetitive one-shot).

This section describes how to connect counter / timer signals to perform these operations. Refer to the *DT9800 Series User's Manual* for more information on using the counter / timers (see page 14 for information on viewing this manual).

Connecting Event Counting Signals

Figure 22 shows one example of connecting event counting signals to a DT9800 Standard or DT9800-MAC Series function module using user counter 0. In this example, rising clock edges are counted while the gate is active.

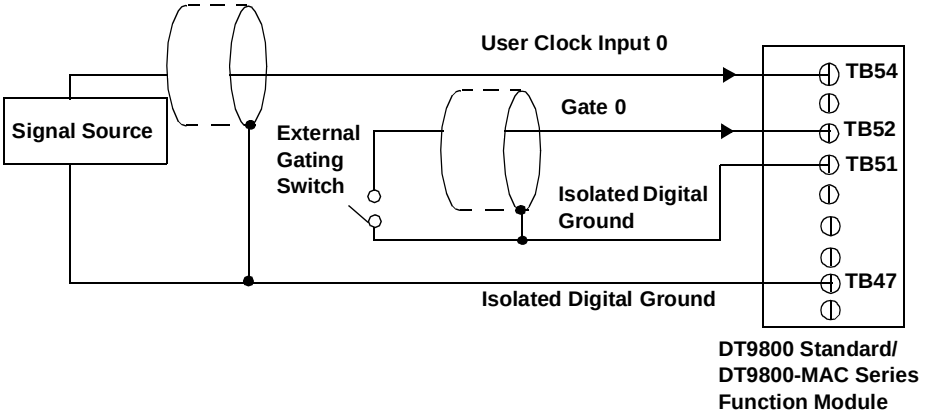


Figure 22: Connecting Event Counting Signals (Shown for Clock Input 0 and External Gate 0)

Figure 23 shows another example of connecting event counting signals to a DT9800 Standard or DT9800-MAC Series function module using user counter 0. In this example, a software gate is used to start the event counting operation; however, this connection is not required.

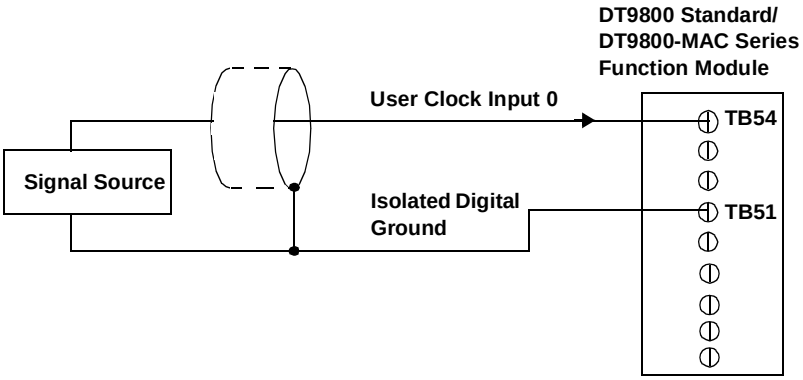


Figure 23: Connecting Event Counting Signals without an External Gate Input (Shown for Clock Input 0)

Figure 24 shows an example of how to cascade two counters externally to perform an event counting operation using user counters 0 and 1. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not need to make the external cascading connections.

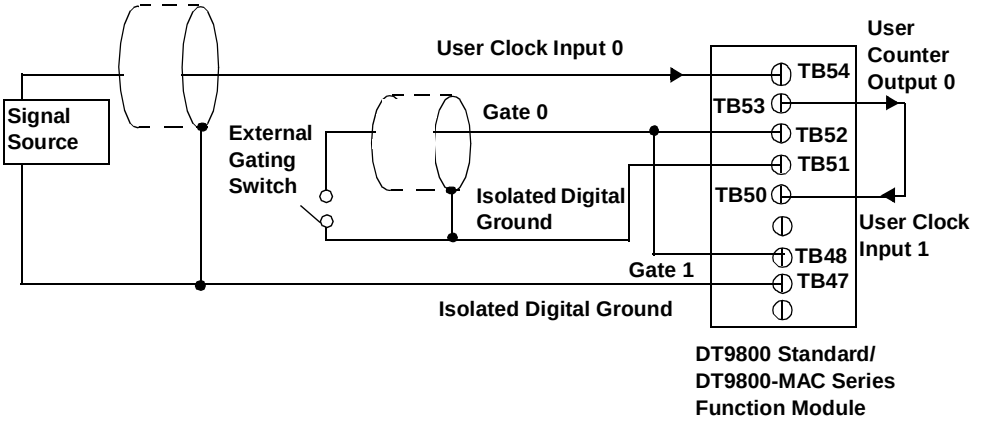


Figure 24: Cascading Counters (Shown for Event Counting Using Counters 0 and 1 and External Gate 0)

Connecting Frequency Measurement Signals

This section describes two examples of how to connect frequency measurement signals to a DT9800 Standard or DT9800-MAC Series function module.

The first configuration uses the same wiring as an event counting application that does not use an external gate signal (see Figure 23 on page 53); a system timer specifies the duration of the frequency measurement. In this configuration, the frequency of the clock input is the number of counts divided by the duration of the Windows timer.

If you need more accuracy than the system timer provides, you can connect a pulse of a known duration (such as a one-shot output of another user counter) to the external gate input, as shown in Figure 25. In this configuration, the frequency of the clock input is the number of counts divided by the period of the external gate input.

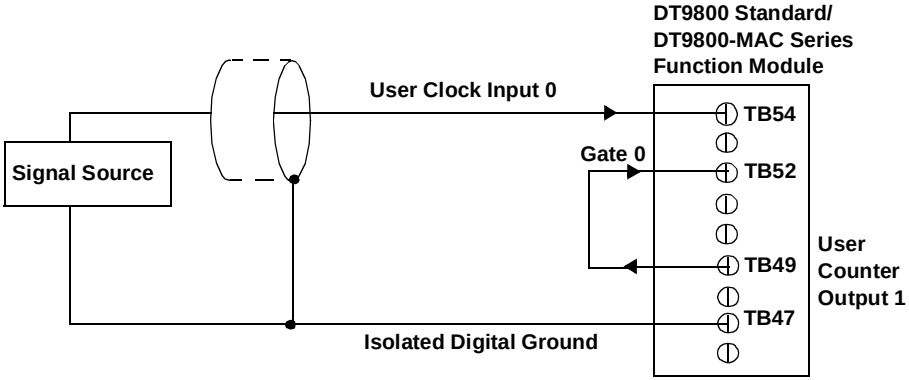


Figure 25: Connecting Frequency Measurement Signals (Shown for Clock Input 0 and External Gate 0)

Connecting Pulse Output Signals

Figure 26 shows one example of connecting pulse output signals to a DT9800 Standard or DT9800-MAC Series function module using user counter 0.

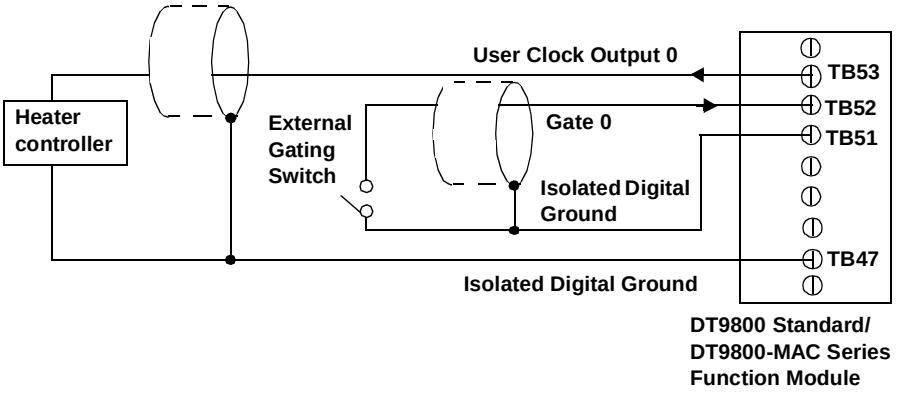


Figure 26: Connecting Pulse Output Signals (Shown for Counter Output 0 and Gate 0)

Figure 27 shows an example of how to externally cascade two counters to perform a rate generation operation using user counters 0 and 1. Note that you can also cascade counters internally using software; if you internally cascade the counters, you do not need to make the external cascading connections. In this example, counter 1 gate is logic high.

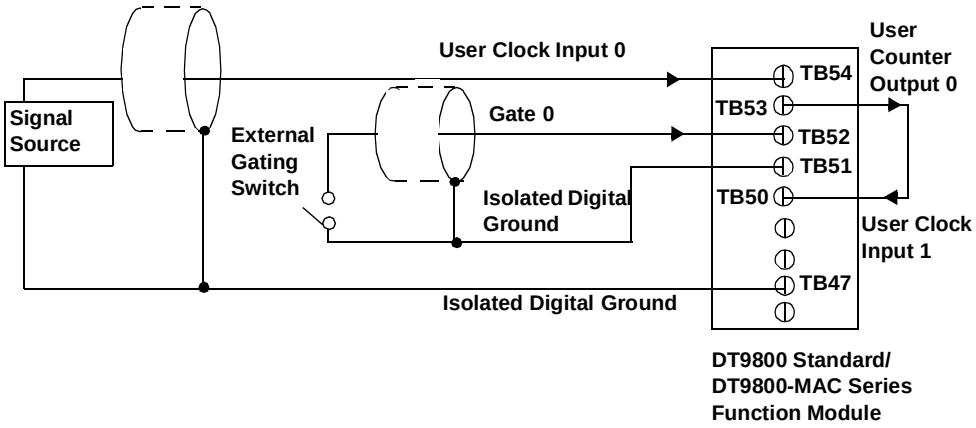


Figure 27: Cascading Counters (Shown for Rate Generation Using Counters 0 and 1 and External Gate 0)

Figure 28 shows an example of how to cascade two counters externally to perform a one-shot operation using user counters 0 and 1. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not need to make the external cascading connections. In this example, counter 0 gate is logic high.

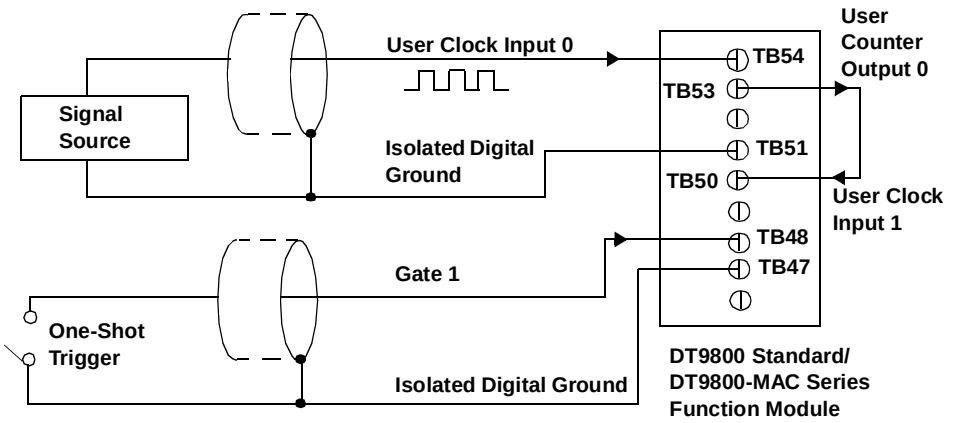


Figure 28: Cascading Counters (Shown for One-Shot Using Counters 0 and 1 and External Gate 1)

Wiring Signals to the DT9800-EC or DT9800-EC-I Series

CAUTION:

To avoid electrostatic sensitivity, it is recommended that you unplug your DT9800 Series module from the computer before wiring signals.

When first installing the module, try wiring the signals as follows:

- Wire a function generator or a known voltage source to analog input channel 0 using the differential configuration.
- Wire an oscilloscope or voltage meter to analog output channel 0.
- Wire a digital input to digital input Port A.
- Wire an external clock or scope to counter / timer channel 0.
- When you finish wiring the signals, run the Quick Data Acq application (described in Chapter 6 starting on page 89) to verify that the function module is operating properly.
  Once you have determined that the function module is operating properly, wire the signals according to your application's requirements.

Table 3 lists the pin assignments for connector J6, Table 4 lists the pin assignments for connector J5, and Table 5 lists the pin assignments for connector J4 on the DT9800-EC and DT9800-EC-I Series function modules.

Table 3: Connector J6 Pin Assignments

J6 Pin #[a]	AC1324 Screw Terminal[a]	Signal Name	J6 Pin #[a]	AC1324 Screw Terminal[a]	Signal Name
1	TB1	Analog Input 0	2	TB2	Analog Input 0 Return/ Analog Input 8
3	TB3	Isolated Analog Ground[b]	4	TB4	Analog Input 1 Return/ Analog Input 9
5	TB5	Analog Input 1	6	TB6	Isolated Analog Ground[b]
7	TB7	Analog Input 2	8	TB8	Analog Input 2 Return/ Analog Input 10
9	TB9	Isolated Analog Ground[b]	10	TB10	Analog Input 3 Return/ Analog Input 11
11	TB11	Analog Input 3	12	TB12	Isolated Analog Ground[b]
13	TB13	Analog Input 4	14	TB14	Analog Input 4 Return/ Analog Input 12
15	TB15	Isolated Analog Ground[b]	16	TB16	Analog Input 5 Return/ Analog Input 13
17	TB17	Analog Input 5	18	TB18	Isolated Analog Ground[b]
19	TB19	Analog Input 6	20	TB20	Analog Input 6 Return/ Analog Input 14
21	TB21	Not Connected	22	TB22	Analog Input 7 Return/ Analog Input 15

Table 3: Connector J6 Pin Assignments (cont.)

J6 Pin #[a]	AC1324 Screw Terminal[a]	Signal Name	J6 Pin #[a]	AC1324 Screw Terminal[a]	Signal Name
23	TB23	Analog Input 7	24	TB24	Isolated Analog Ground[b]
25	TB25	Amp Low	26	TB26	External A/D Trigger

a. Analog input signals 8 to 15 are not available on the 5B08 or 7BP08-1 backplane. Analog input signals 4 to 15 are not available on the 7BP04-1 backplane.
b. This signal is not isolated on the DT9800-EC Series.

Table 4: Connector J5 Pin Assignments

J5 Pin #	AC1324 Screw Terminal	Signal Name	J5 Pin #	AC1324 Screw Terminal	Signal Name
1	TB1	Analog Output 0	2	TB2	Analog Output 0 Return
3	TB3	Analog Output 1	4	TB4	Analog Output 1 Return
5	TB5	Isolated Digital Ground[a]	6	TB6	External A/D Trigger
7	TB7	External A/D Sample Clock	8	TB8	Isolated Digital Ground[a]
9	TB9	Isolated +5 V Output[a,b]	10	TB10	Not Connected
11	TB11	Not Connected	12	TB12	Dynamic Digital Output
13	TB13	Isolated Digital Ground[a]	14	TB14	User External Gate 1

Table 4: Connector J5 Pin Assignments (cont.)

J5 Pin #	AC1324 Screw Terminal	Signal Name	J5 Pin #	AC1324 Screw Terminal	Signal Name
15	TB15	User Counter Output 1	16	TB16	User Clock Input 1
17	TB17	Isolated Digital Ground[a]	18	TB18	User External Gate 0
19	TB19	User Counter Output 0	20	TB20	User Clock Input 0
21	TB21	Not Connected	22	TB22	Not Connected
23	TB23	Not Connected	24	TB24	Not Connected
25	TB25	Not Connected	26	TB26	Not Connected

a. This signal is not isolated on the DT9800-EC Series.

b. +5 V output is available only when one of the subsystems is activated, which, in turn, activates power to the module. This signal can be used as an input to power the digital output latch so that the outputs retain their states during power down.

Table 5: Connector J4 Pin Assignments

J4 Pin #	STP-EZ Screw Terminal	Signal Name	J4 Pin #	STP-EZ Screw Terminal	Signal Name
1	TB1	Not Connected	2	TB2	Digital Ground
3	TB3	Not Connected	4	TB4	Digital Ground
5	TB5	Not Connected	6	TB6	Digital Ground
7	TB7	Not Connected	8	TB8	Digital Ground
9	TB9	Not Connected	10	TB10	Digital Ground
11	TB11	Not Connected	12	TB12	Digital Ground
13	TB13	Not Connected	14	TB14	Digital Ground

Table 5: Connector J4 Pin Assignments (cont.)

J4 Pin #	STP-EZ Screw Terminal	Signal Name	J4 Pin #	STP-EZ Screw Terminal	Signal Name
15	TB15	Not Connected	16	TB16	Digital Ground
17	TB17	Digital Output 7	18	TB18	Digital Ground
19	TB19	Digital Output 6	20	TB20	Digital Ground
21	TB21	Digital Output 5	22	TB22	Digital Ground
23	TB23	Digital Output 4	24	TB24	Digital Ground
25	TB25	Digital Output 3	26	TB26	Digital Ground
27	TB27	Digital Output 2	28	TB28	Not Connected
29	TB29	Digital Output 1	30	TB30	Not Connected
31	TB31	Digital Output 0	32	TB32	Not Connected
33	TB33	Digital Input 7	34	TB34	Not Connected
35	TB35	Digital Input 6	36	TB36	Not Connected
37	TB37	Digital Input 5	38	TB38	Not Connected
39	TB39	Digital Input 4	40	TB40	Not Connected
41	TB41	Digital Input 3	42	TB42	Not Connected
43	TB43	Digital Input 2	44	TB44	Not Connected
45	TB45	Digital Input 1	46	TB46	Not Connected
47	TB47	Digital Input 0	48	TB48	Not Connected
49	TB49	Not Connected	50	TB50	Not Connected

Connecting Analog Input Signals

This section describes how to connect analog input signals to a DT9800-EC or DT9800-EC-I Series module using a 5B01, 5B08, 7BP16-1, 7BP08-1, or 7BP04-1 signal conditioning backplane, or an AC1324 screw terminal panel.

Using 5B or 7B Series Signal Conditioning Modules

When using DT9800-EC or DT9800-EC-I Series function modules with 5B and 7B Series signal conditioning backplanes and modules, keep the following considerations in mind:

- The 7BP04-1 backplane maps to single-ended analog input channels 0 to 3.
- The 5B08 and 7BP08-1 backplanes map to single-ended analog input channels 0 to 7.
- By default, the 5B01 and 7BP16-1 backplanes map to single-ended analog input channels 0 to 15. However, you can use channels 14 and 15 on the 5B01 or 7BP16-1 backplane as analog output channels 0 and 1 by configuring DIP switch SW1 on the function module. Refer to page 33 for more information on configuring DIP switch SW1.
- Install jumper W3 on the 5B Series backplane to connect Amp Low to Analog Ground on the backplane.
- 5B and 7B Series thermocouple modules provide their own CJC and return a voltage that already compensates for CJC. Therefore, when using 5B or 7B Series modules, you do not have to compensate for offsets.
- The output of many 5B modules is ±5 V. The output of many 7B modules is 0 to 10 V. Ensure that you select an input range that matches the output of the 5B or 7B modules that you are using. For example, if you are using 5B modules that have an output of ±5 V, use a bipolar input range and a gain of 2 on the DT9800-EC Series function module.

- Connect all unused inputs to analog common. Reading an open channel can cause settling problems on the next valid channel.

Refer to the *5B Series User's Manual* and 5B Series data sheets or the *7B Series User's Manual* for detailed information on using the backplanes and modules, including how to configure jumpers on the backplane, install modules, wire signals to the modules, and connect power to the backplanes.

Using an AC1324 Screw Terminal Panel

The DT9800-EC and DT9800-EC-I Series function modules support both voltage and current loop inputs through connector J6. You attach the AC1324 screw terminal to connector J6 on the DT9800-EC or DT9800-EC-I Series function module as shown in Figure 29.

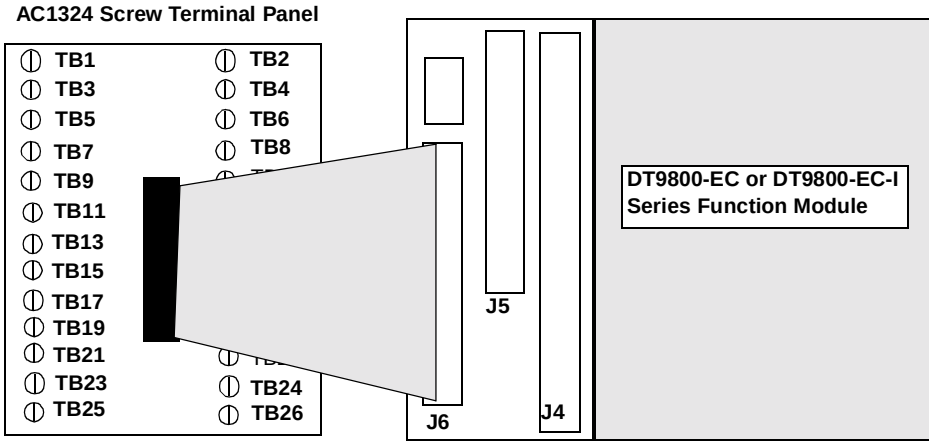


Figure 29: Attaching the AC1324 Screw Terminal Panel to Connector J6 of the DT9800-EC/EC-I for Analog Inputs

You can connect analog input voltage signals to an AC1324 screw terminal panel in the following configurations:

- **Single-ended** – Choose this configuration when you want to measure high-level signals, noise is not significant, the source of the input is close to the DT9800-EC or DT9800-EC-I Series function module, and all the input signals are referred to the same common ground. When you choose the single-ended configuration, all 16 analog input channels are available.
- **Pseudo-Differential** – Choose this configuration when noise or common-mode voltage (the difference between the ground potentials of the signal source and the ground of the DT9800-EC or DT9800-EC-I Series function module or between the grounds of other signals) exists and the differential configuration is not suitable for your application. This option provides less noise rejection than the differential configuration; however, all 16 analog input channels are available.
- **Differential** – Choose this configuration when you want to measure low-level signals (less than 1 V), you are using an A/D converter with high resolution (greater than 12 bits), noise is a significant part of the signal, or common-mode voltage exists. When you choose the differential configuration, eight analog input channels are available.

Note: It is recommended that you connect all unused analog input channels to analog ground.

Keep the following recommendations in mind when wiring analog input signals to the AC1324 screw terminal panel:

- Use individually shielded twisted-pair wire (size 14 to 26 AWG) when using the DT9800-EC or DT9800-EC-I Series function module and AC1324 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 DT9800-EC or DT9800-EC-I Series function module, AC1324, 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 DT9800-EC or DT9800-EC-I Series function module is operational.

This section describes how to connect single-ended, pseudo-differential, and differential voltage inputs, as well as current loop inputs to the AC1324 screw terminal panel. For a description of the screw terminal blocks on the AC1324 screw terminal panel, refer to Table 3 on page 60.

Connecting Single-Ended Voltage Inputs

Figure 30 shows how to connect single-ended voltage inputs (channels 0, 1, and 2, in this case) to the AC1324 screw terminal panel.

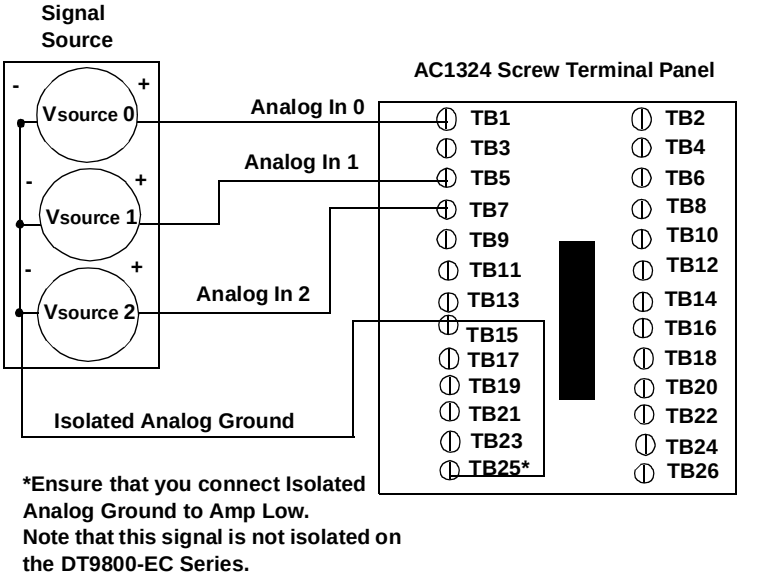
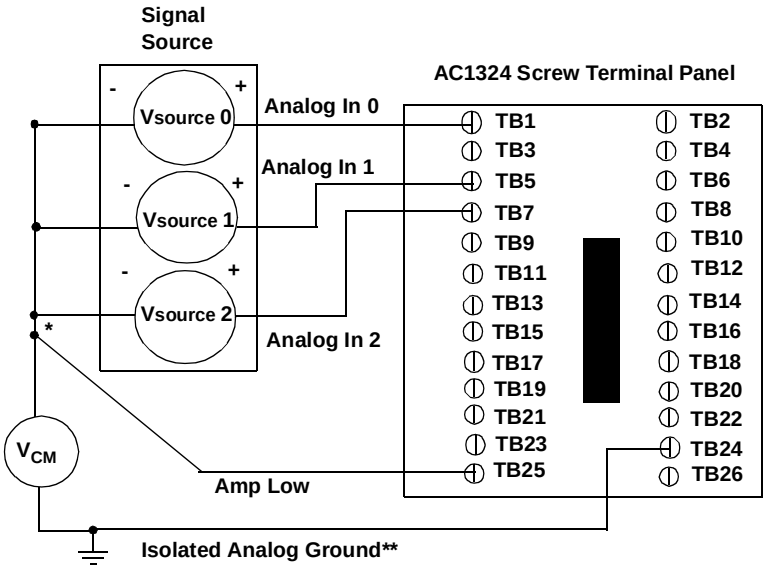


Figure 30: Connecting Single-Ended Voltage Inputs (Shown for Channels 0, 1, and 2)

Note: If you are using single-ended inputs, set up the software so that bias return resistance is not used. For more information, refer to page 31.

Connecting Pseudo-Differential Voltage Inputs

Figure 31 shows how to connect pseudo-differential voltage inputs (channels 0, 1, and 2, in this case) to the AC1324 screw terminal panel.



***Make this connection as close to V_{IN} sources as possible to reduce ground loop errors. V_{cm} is the common mode voltage for all 16 analog inputs.**

****This signal is not isolated on the DT9800-EC Series.**

Figure 31: Connecting Pseudo-Differential Voltage Inputs (Shown for Channels 0, 1, and 2)

Note: If you are using pseudo-differential inputs, set up the software so that bias return resistance is not used. For more information, refer to page 31.

Connecting Differential Voltage Inputs

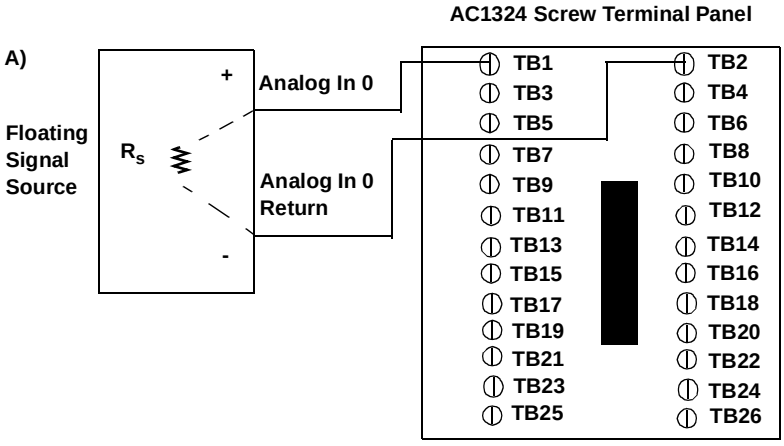
Figure 32A illustrates how to connect a floating signal source to a DT9800-EC or DT9800-EC-I Series function module using differential inputs. (A floating signal source is a voltage source that has no connection with earth ground.)

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 the bias return resistance, refer to page 31.

Note: Analog ground is not isolated on the DT9800-EC Series.

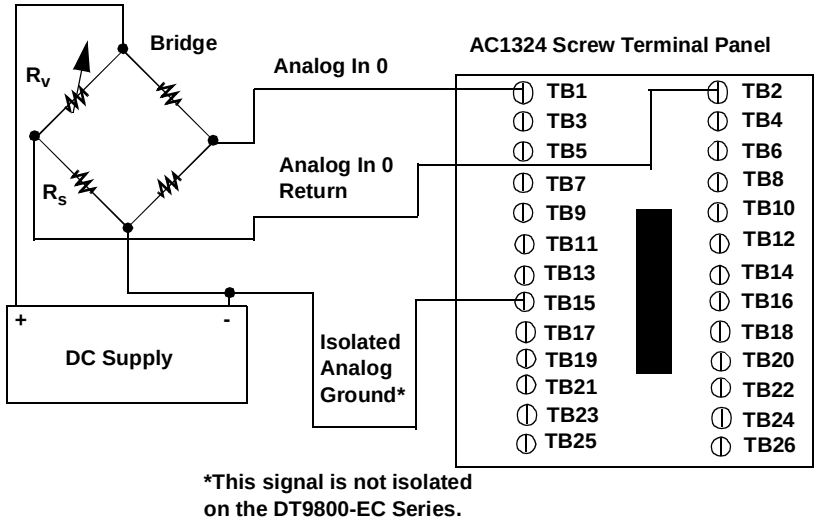
Figure 32B illustrates how to connect a nonfloating signal source to a DT9800-EC or DT9800-EC-I Series function module using differential inputs. In this case, the signal source itself provides the bias return path; therefore, you do not need to provide bias return resistance through software.

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.



When configuring the DT9800 Series Device Driver, it is recommended that you software-select 10 kΩ of resistance to connect the low side of channel 0 to analog ground (a physical resistor is not required). For more information, refer to page 31.

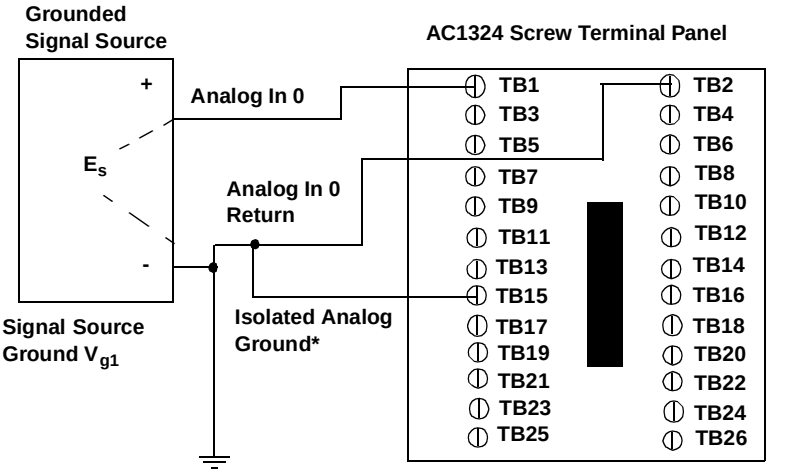
B)



***This signal is not isolated on the DT9800-EC Series.**

Figure 32: Connecting Differential Voltage Inputs (Shown for Channel 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 AC1324 screw terminal panel as shown in Figure 33. In this case, make sure that the low side of the signal (–) is connected to ground at the signal source, not at the AC1324 screw terminal panel, and do not tie the two grounds together.



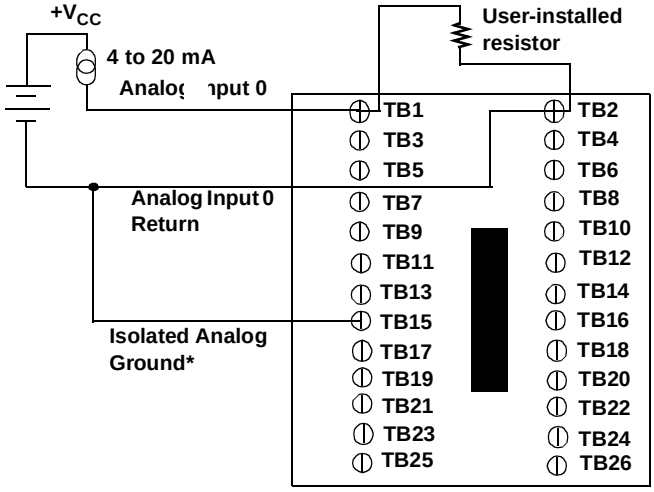
***This signal is not isolated on the DT9800-EC Series.**

When configuring the DT9800 Series Device Driver, it is recommended that you software-select 10 kΩ of resistance to connect the low side of channel 0 to analog ground (a physical resistor is not required). For more information, refer to page 31.

Figure 33: Connecting Differential Voltage Inputs from a Grounded Signal Source (Shown for Channel 0)

Connecting Current Loop Inputs

Figure 34 shows how to connect a current loop input (channel 0, in this case) to an AC1324 screw terminal panel.



AC1324 Screw Terminal Panel

***This signal is not isolated on the DT9800-EC Series.**

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, then connect a 4 to 20 mA current loop input to channel 0, the input range is converted to 1 to 5 V.

When configuring the DT9800 Series Device Driver, it is recommended 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). For more information, refer to page 31.

Figure 34: Connecting Current Inputs (Shown for Channel 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 page 31.

Connecting Analog Output Signals

The DT9800-EC and DT9800-EC-I Series function modules support analog outputs through connector J5. This section shows how to wire analog output signals to an AC1324 screw terminal panel attached to connector J5.

You attach the AC1324 screw terminal to connector J5 on the DT9800-EC or DT9800-EC-I Series function module as shown in Figure 35.

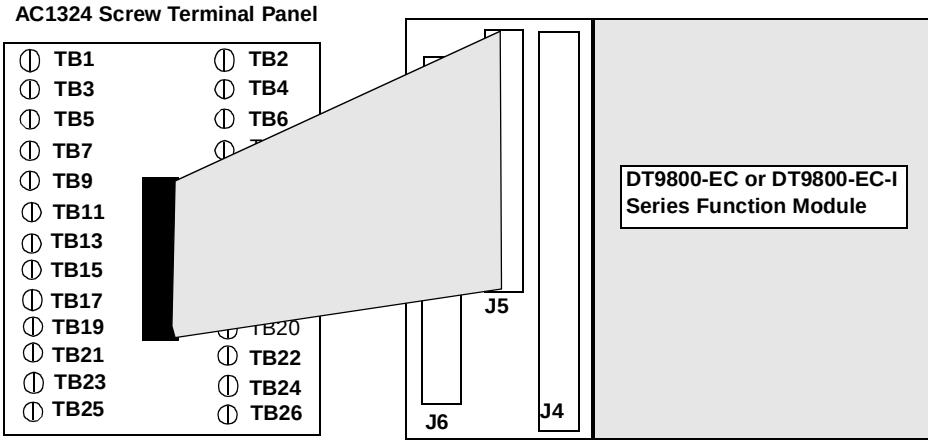


Figure 35: Attaching the AC1324 Screw Terminal Panel to Connector J5 of the DT9800-EC/EC-I Series for Analog Outputs

Figure 36 shows how to connect an analog output voltage signal (channel 0, in this case) to an AC1324 screw terminal. For a description of the screw terminal blocks, refer to Table 4 on page 61.

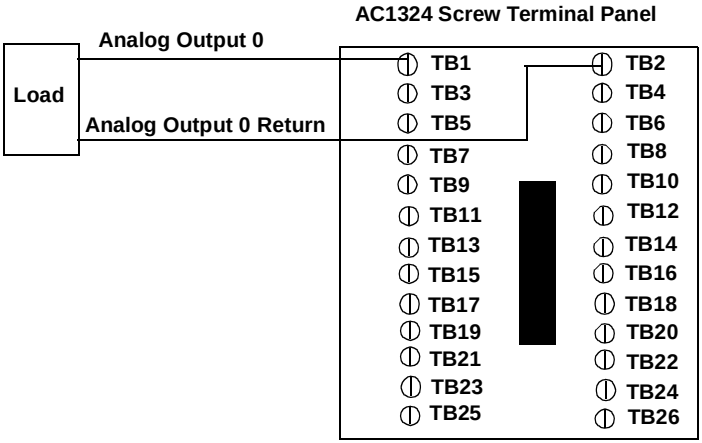


Figure 36: Connecting Analog Output Voltages Using an External +10 V Reference (Shown for Channel 0)

Connecting Digital I/O Signals

The DT9800-EC and DT9800-EC-I Series function modules support digital I/O signals through connector J4. This section shows how to wire digital I/I signals to an STP-EZ screw terminal panel attached to connector J4.

You attach the STP-EZ screw terminal to connector J4 on the DT9800-EC or DT9800-EC-I Series function module as shown in Figure 37.

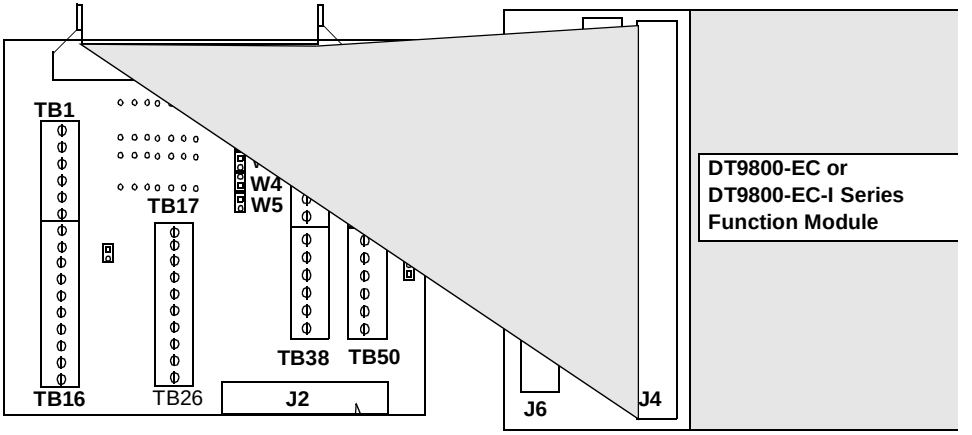


Figure 37: Attaching the STP-EZ Screw Terminal Panel to Connector J4 of the DT9800-EC/EC-I Series for Digital I/O

Figure 38 shows how to connect digital input signals (lines 0 and 1 of Port A, in this case) to an STP-EZ screw terminal. For a description of the screw terminal blocks, refer to Table 5 on page 62.

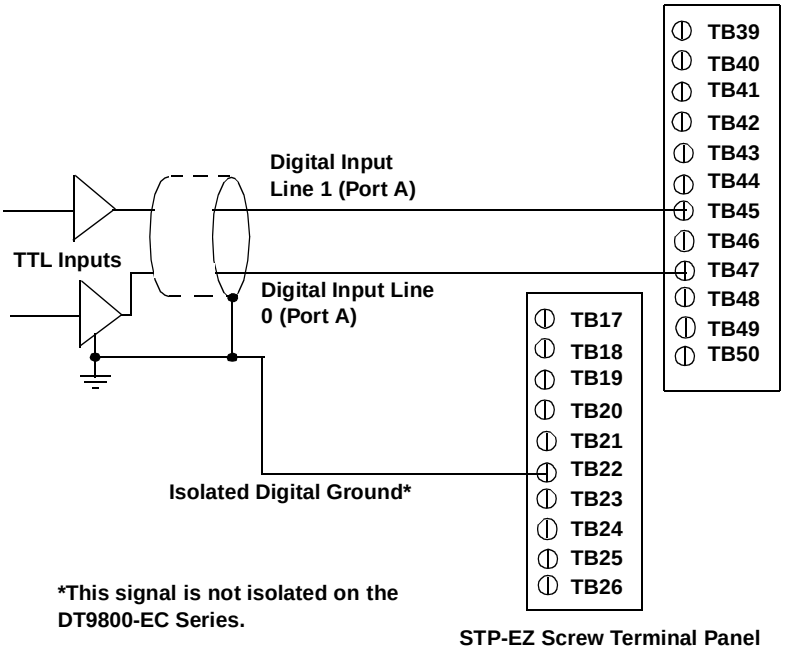


Figure 38: Connecting Digital Inputs (Shown for Lines 0 and 1, Port A)

Figure 39 shows how to connect a digital output (line 0 of Port B, in this case) to an STP-EZ screw terminal panel.

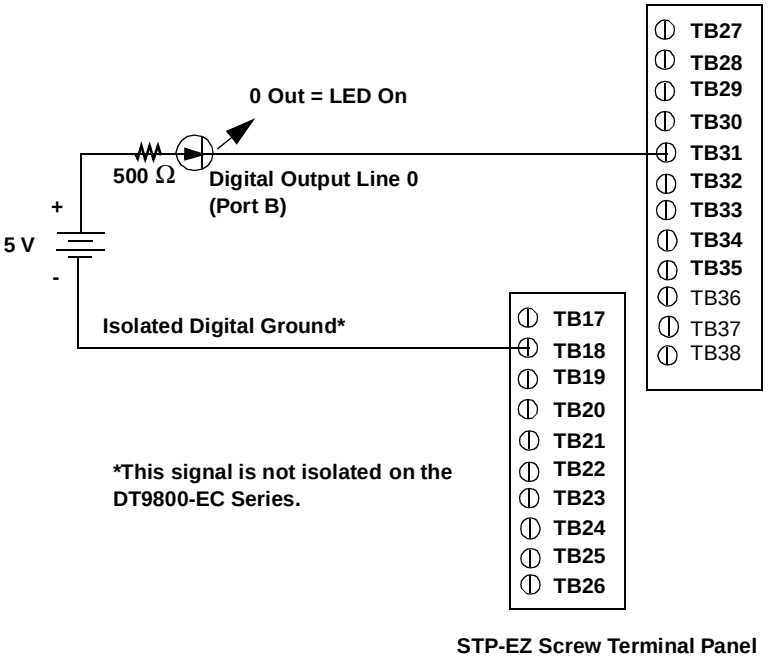


Figure 39: Connecting Digital Outputs (Shown for Line 0, Port B)

If you want the digital outputs to retain their values during power down, you must connect +5 V external power to the +5 V isolated power signal of connector J5 on the function module and activate one of the subsystems on the module, which, in turn, activates power to the module.

Figure 40 shows how to connect the AC1324 screw terminal to connector J5 on the DT9800-EC or DT9800-EC-I Series function module.

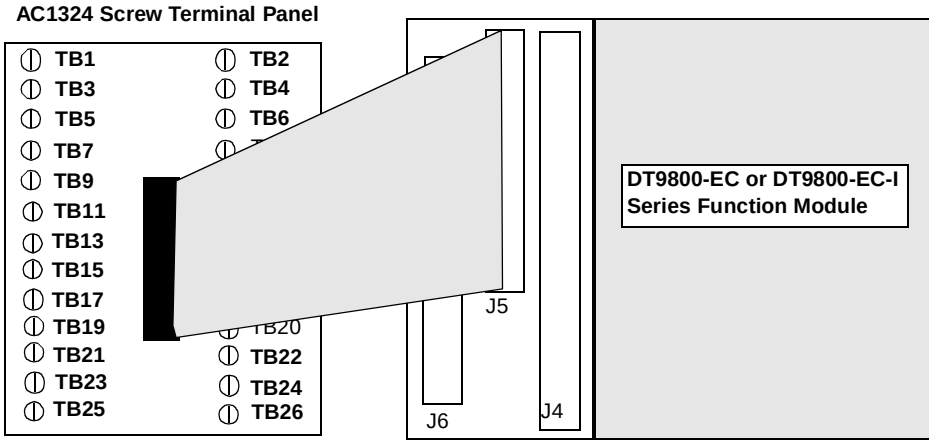


Figure 40: Attaching the AC1324 Screw Terminal Panel to Connector J5 of the DT9800-EC/EC-I Series for +5 V Power

Figure 41 shows how to wire +5 V external power to the AC1315 screw terminal panel.

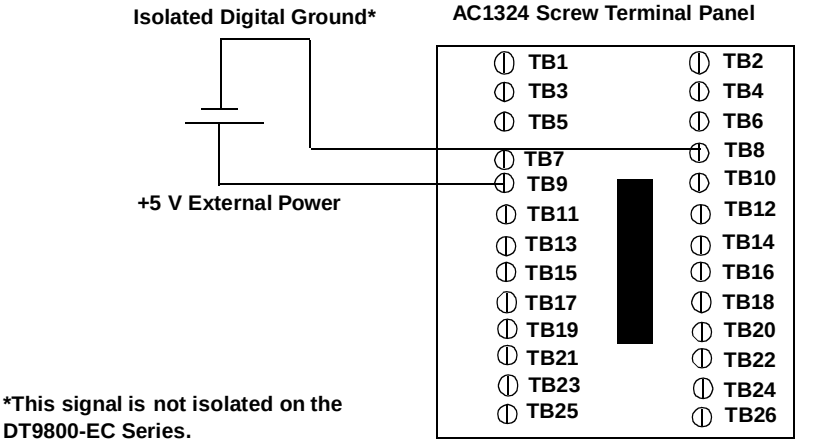


Figure 41: Connecting +5V External Power to Retain Digital Output States

Connecting Counter/Timer Signals

The DT9800-EC and DT9800-EC-I Series function modules support two counter/timer channels through connector J5. This section shows how to wire counter/timer signals to an AC1324 screw terminal panel attached to connector J5.

You attach the AC1324 screw terminal to connector J5 on the DT9800-EC or DT9800-EC-I Series function module as shown in Figure 42.

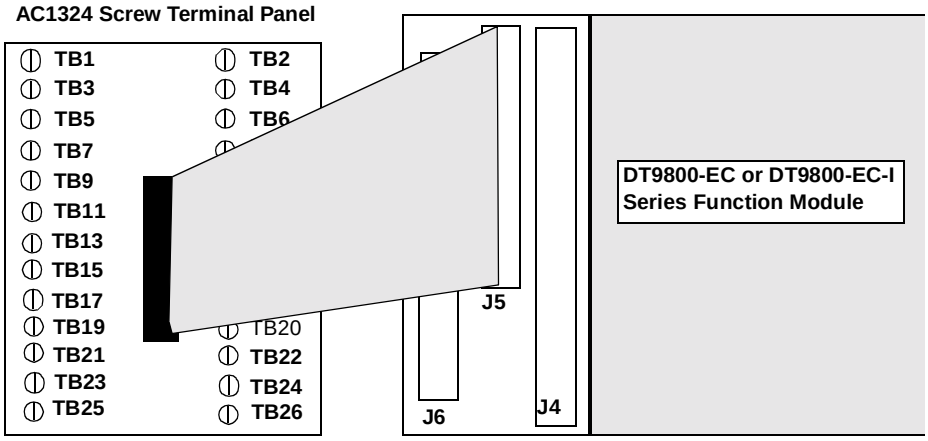


Figure 42: Attaching the AC1324 Screw Terminal Panel to Connector J5 of the DT9800-EC/EC-I Series for Counter/Timer Signals

You can perform the following operations using these counter / timer channels:

- Event counting,
- Frequency measurement, and
- Pulse output (rate generation, one-shot, and repetitive one-shot).

The following sections describe how to wire counter / timer signals to an AC1324 screw terminal panel to perform these operations. For a description of the screw terminal blocks, refer to Table 4 on page 61.

Connecting Event Counting Signals

Figure 43 shows one example of connecting event counting signals to user counter 0 using an AC1324 screw terminal panel attached to connector J5. In this example, rising clock edges are counted while the gate is active.

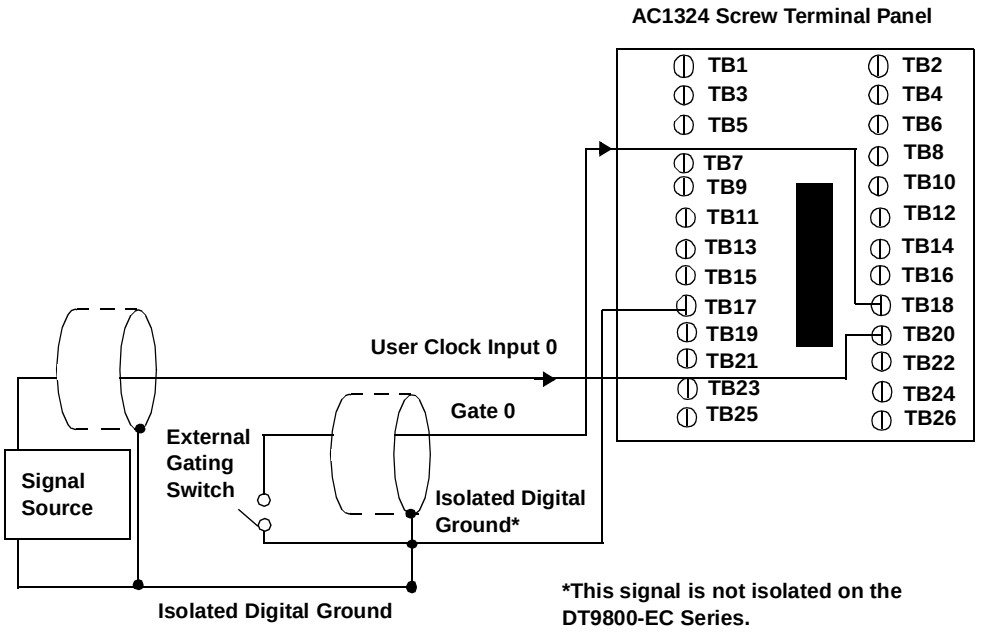


Figure 43: Connecting Event Counting Signals (Shown for Clock Input 0 and External Gate 0)

Figure 44 shows another example of connecting event counting signals to user counter 0 using an AC1324 screw terminal panel attached to connector J5. In this example, a software gate is used to start the event counting operation; however, this connection is not required.

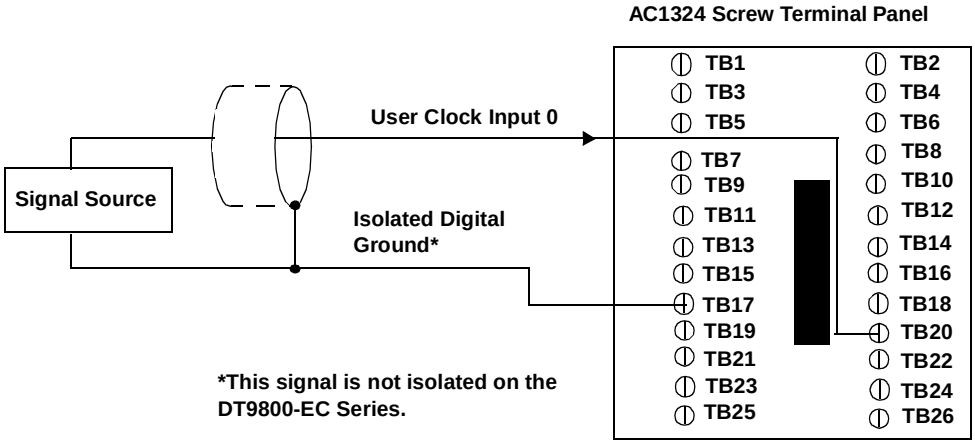
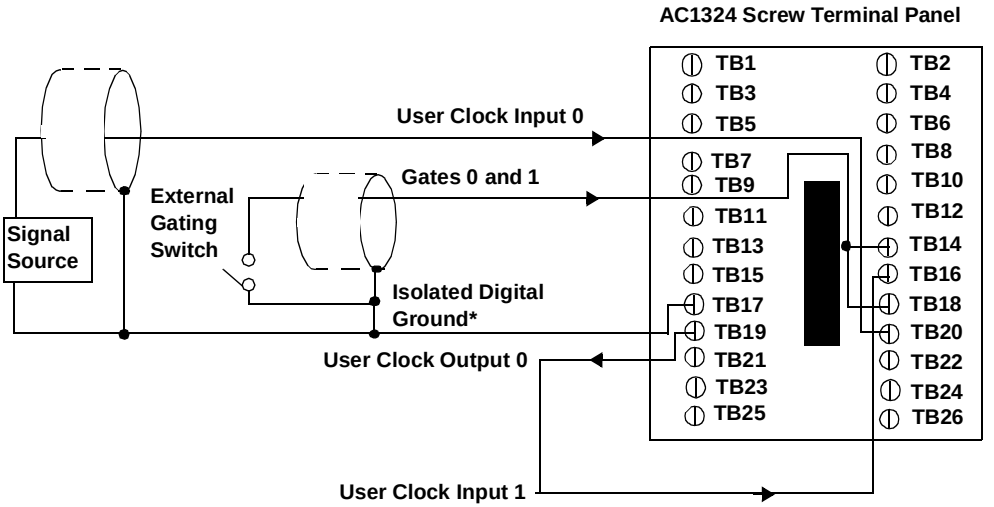


Figure 44: Connecting Event Counting Signals without an External Gate Input (Shown for Clock Input 0)

5

Figure 45 shows an example of how to cascade counters 0 and 1 externally to perform an event counting operation using an AC1324 screw terminal panel attached to connector J5. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not need to make the external cascading connections.



*This signal is not isolated on the DT9800-EC Series.

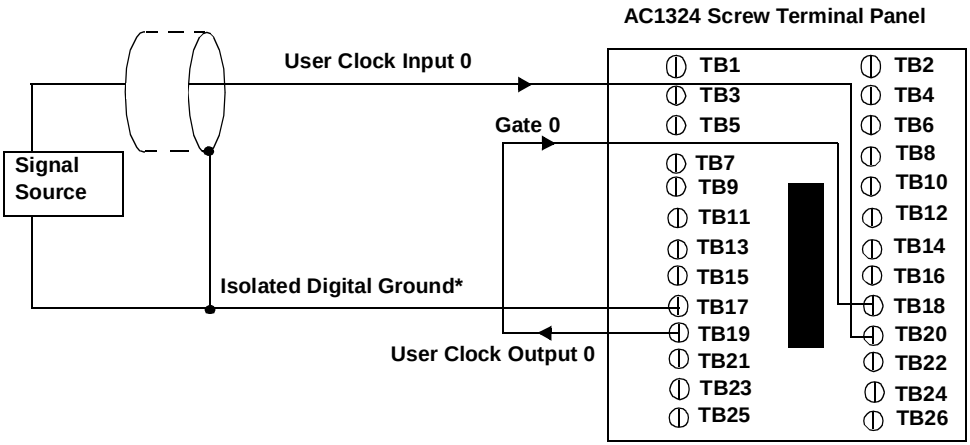
Figure 45: Cascading Counters (Shown for Event Counting Using Counters 0 and 1 and External Gate 0)

Connecting Frequency Measurement Signals

This section describes two examples of how to connect frequency measurement signals to an AC1324 screw terminal panel attached to connector J5.

The first configuration uses the same wiring as an event counting application that does not use an external gate signal (see Figure 44 on page 83); the software uses the Windows timer to specify the duration of the frequency measurement. In this configuration, the frequency of the clock input is the number of counts divided by the duration of the Windows timer.

If you need more accuracy than the Windows timer provides, you can connect a pulse of a known duration (such as a one-shot output of another user counter) to the external gate input, as shown in Figure 46. In this configuration, the frequency of the clock input is the number of counts divided by the period of the external gate input.



***This signal is not isolated on the DT9800-EC Series.**

Figure 46: Connecting Frequency Measurement Signals (Shown for Clock Input 0 and External Gate 0)

Connecting Pulse Output Signals

Figure 47 shows one example of connecting pulse output signals to user counter 0 using an AC1324 screw terminal panel attached to connector J5.

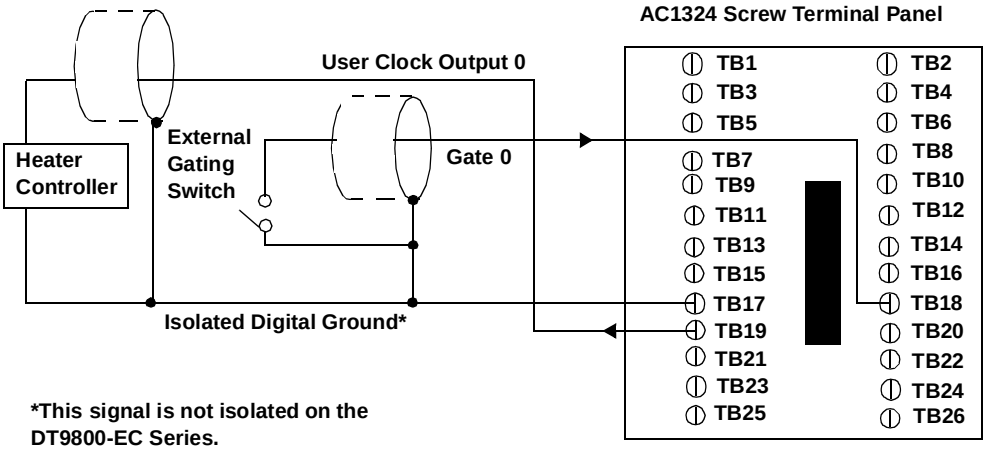
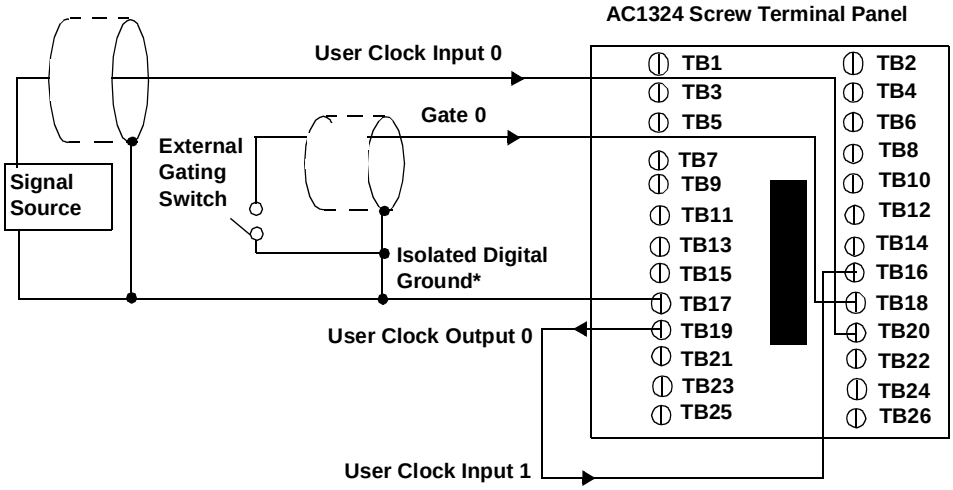


Figure 47: Connecting Pulse Output Signals (Shown for Counter Output 0 and Gate 0)

Figure 48 shows an example of how to externally cascade user counters 0 and 1 to perform a rate generation operation using an AC1324 screw terminal panel attached to connector J5. Note that you can also cascade counters internally using software; if you internally cascade the counters, you do not need to make the external cascading connections. In this example, counter 1 gate is logic high.



***This signal is not isolated on the DT9800-EC Series.**

Figure 48: Cascading Counters (Shown for Rate Generation Using Counters 0 and 1 and External Gate 0)

Figure 49 shows an example of how to cascade user counters 0 and 1 externally to perform a one-shot operation using an AC1324 screw terminal panel attached to connector J5. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not need to make the external cascading connections. In this example, counter 0 gate is logic high.

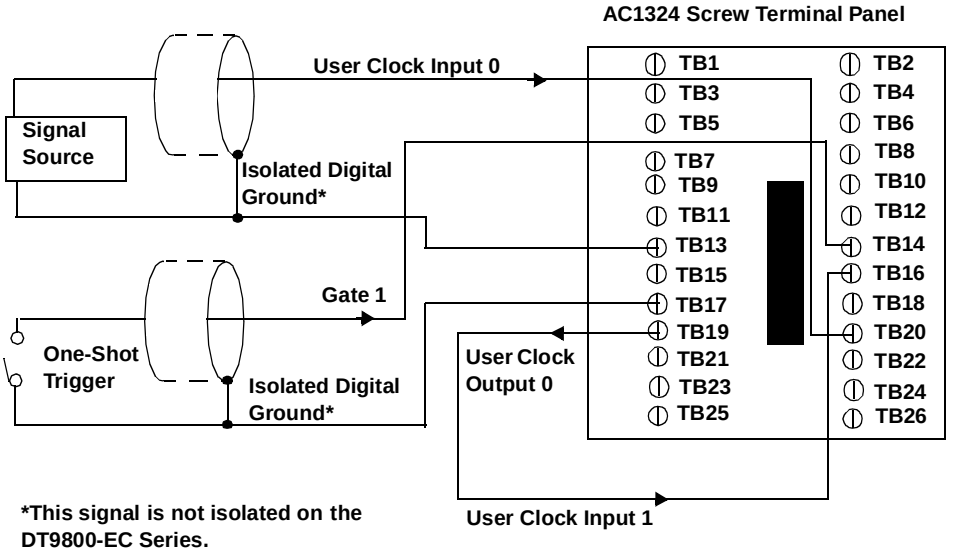


Figure 49: Cascading Counters (Shown for One-Shot Using Counters 0 and 1 and External Gate 1)

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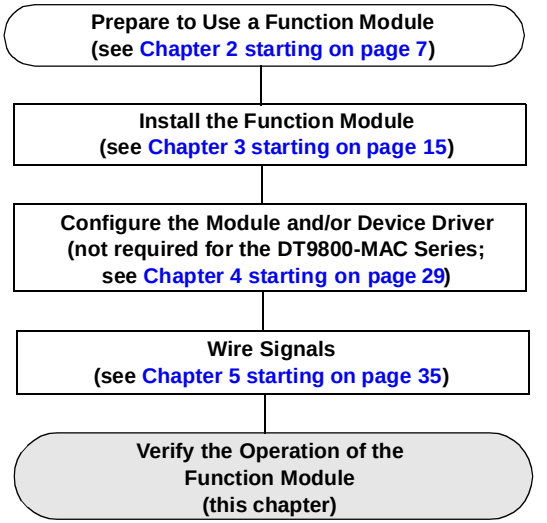
Verifying the Operation of a Function Module



You can verify the operation of a DT9800 Series function module using the Quick Data Acq application. If you are using Windows 98, Windows Me, Windows 2000, or Windows XP, refer to page 91. If you are using the Macintosh, refer to page 102.

Using Windows 98, Windows Me, Windows 2000, or Windows XP

If you are using Windows 98, Windows Me, Windows 2000, or Windows XP, Quick Data Acq allows you to perform the following operations:

- 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;
- Measure the frequency of events;
- Output data from a single analog output channel or digital output port;
- Output pulses either continuously or as a one-shot; and
- Save the input data to disk.

Installing the Quick Data Acq Application

To install the Quick Data Acq application, perform the following steps:

1. Insert the Data Acquisition OMNI CD into your CD-ROM drive.
2. Click **Start** from the Task Bar, then click **Run**.
   The Run dialog box appears.
3. In the Command Line edit box, enter **D:\LAUNCH.EXE**.
   If your CD-ROM is not in drive D:, enter the letter of the drive where your CD-ROM is located.
4. Click **OK**.
   The Data Acquisition Software setup program starts.
5. Click **Install Products**.
   A list of software products that you can install appears.

6. Click **Quick Data Acq**.
   The Quick Data Acq setup wizard appears.
7. Click **Next**.
   You are prompted for the destination location.
8. Either change the directory path and/or name using **Browse** or accept the default directory, then click **Next**.
   You are prompted to select the software components to install.
9. Click **Typical**, then click **Next**.
   You are prompted for the program folder name.
10. Either change the program folder name or accept the default program folder name, then click **Next**.
    The files are copied to the destination directory.
11. Select **Launch DT MiniApp** if you want to view the Quick Data Acq application when the setup program is finished; otherwise, leave this selection unchecked.
12. Click **Finish**.
    The DT Data Acquisition Software setup program reappears.
13. Click **Main Menu**.
14. Click **Exit**.

Running the Quick Data Acq Application

To run the Quick Data Acq application, perform the following steps:

1. If you have not already done so, power up your computer and any attached peripherals.
2. Ensure that you installed the Quick Data Acq application software from the Data Acquisition OMNI CD using the instructions starting on page 11.
3. Select **Quick Data Acq** from the Data Translation, Inc\Quick Data Acq program group.

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

For information on each of the features provided, use the online help for the Quick Data Acq application by pressing F1 from any view or selecting the **Help** menu.

For detailed information on the supported features of the module, refer to the *DT9800 Series User's Manual* (see page 14 for information on viewing this manual).

Performing a Single-Value Analog Input Operation

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

1. Connect a voltage source, such as a function generator, to analog input channel 0 (differential mode) on the DT9800 Series function module. Refer to page 44 (for the DT9800 Standard Series) or page 71 (for the DT9800-EC Series) for an example of how to connect a differential analog input.
2. Click the **Acquisition** menu.
3. Click **Single Analog Input**.
4. Select the appropriate DT9800 Series function module from the Board list box.
5. Once you select the function module, the LED on the module turns red.
6. In the Channel list box, select analog input channel 0.
7. In the Range list box, select the range for the channel. The default is ±10 V.
8. Select **Differential**.
9. Click **Get** to acquire a single value from analog input channel 0. *The value is displayed on the screen in both text and graphical form.*

Performing a Single-Value Analog Output Operation

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

1. Connect an oscilloscope or voltmeter to DAC0 on the function module. Refer to page 49 (for the DT9802, DT9804, or DT9806) or page 75 (for the DT9802-EC, DT9802-EC-I, DT9804-EC, or DT9804-EC-I) for an example of how to connect analog output signals.
2. Click the **Control** menu.
3. Click **Single Analog Output**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. In the Channel list box, select analog output channel 0.
6. In the Range list box, select the output range of DAC0. The default is ±10 V.
7. Enter an output value, or use the slider to select a value to output from DAC0.
8. Click **Send** to output a single value from DAC0. *The value that is output is displayed on the screen in both text and graphical form.*

Performing a Continuous Analog Input Operation

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

1. Connect known voltage sources, such as the outputs of a function generator, to analog input channels 0 and 1 on the DT9800 Series function module (using the differential configuration). Refer to page 44 (for the DT9800 Standard Series) or page 71 (for the DT9800-EC or DT9800-EC-I Series) for an example of how to connect a differential analog input.
2. Click the **Ac**quisition menu.
3. For this example, click Scope.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. In the Sec / Div list box, select the number of seconds per division (.1 to .00001) for the display.
6. In the Channels list box, select analog input channel 1, then click **Add** to add the channel to the channel list.
   Note that, by default, channel 0 is included in the channel list.
7. Click **Config** from the Toolbar.
8. From the Config menu, select **ChannelType**, then select **Differential**.
9. From the Config menu, select **Range**, then select **Bipolar** or **Unipolar** depending on the configuration of your module.
   The default is Bipolar.

10. From the Scope view, double-click the input range of the channel to change the input range of the module (±10 V, ±5 V, ±2.5 V, ±1.25 V for bipolar ranges or 0 to 10 V, 0 to 5 V, 0 to 2.5 V or 0 to 1.25 V for unipolar ranges). The default is ±10 V.
The display changes to reflect the selected range for all the analog input channels on the module.

11. 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.

12. Click **Start** from the Toolbar to start the continuous analog input operation.
The values acquired from each channel are displayed 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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13. Click **Stop** from the Toolbar to stop the operation.

Performing a Single-Value Digital Input Operation

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

1. Connect a digital input to digital input line 0 of port A on the DT9800 Series function module. Refer to page 50 (for the DT9800 Standard Series) or page 77 (for the DT9800-EC or DT9800-EC-I Series) for an example of how to connect a digital input.

2. Click the **Acquisition** menu.

3. Click **Digital Input**.

4. Select the appropriate DT9800 Series function module from the Board list box.

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

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

Performing a Single-Value Digital Output Operation

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 DT9800 Series function module. Refer to page 50 (for the DT9800 Standard Series) or page 78 (for the DT9800-EC or DT9800-EC-I Series) for an example of how to connect a digital output.
2. Click the **Control** menu.
3. Click **Digital Output**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

5. Select digital output port B by clicking **Port B**.
6. 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.

7. Click **Send**.
   The value of each digital output line of digital port B is output and displayed on the screen in both text and graphical form.

Performing a Frequency Measurement Operation

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

1. Wire an external clock source to counter / timer 0 on the DT9800 Series function module. Refer to page 55 (for the DT9800 Standard Series) or page 85 (for the DT9800-EC or DT9800-EC-I Series) for an example of how to connect an external clock.

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

2. Click the **Acquisition** menu.
3. Click **Frequency Counter**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

5. In the Count Duration text box, enter the number of seconds during which events will be counted.
6. Click **Start** to start the frequency measurement operation.
   The operation automatically stops after the number of seconds you specified has elapsed, and the frequency is displayed on the screen.

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

Performing a Pulse Output Operation

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

1. Connect a scope to counter / timer 0 on the DT9800 Series function module. Refer to page 56 (for the DT9800 Standard Series) or page 86 (for the DT9800-EC or DT9800-EC-I Series) for an example of how to connect a scope (a pulse output) to counter / timer 0.

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

2. Click the **Control** menu.
3. Click **Pulse Generator**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

5. Select either **Continuous** to output a continuous pulse stream or **One Shot** to output one pulse.
6. Select either **Low-to-high** to output a rising-edge pulse (the high portion of the total pulse output period is the active portion of the signal) or **High-to-low** to output a falling-edge pulse (the low portion of the total pulse output period is the active portion of the signal).

7. Enter a percentage or use the slider to select a percentage for the pulse width. The percentage determines the duty cycle of the pulse.

8. Click **Start** to generate the pulse(s).
   The results are displayed both in text and graphical form.

9. Click **Stop** to stop a continuous pulse output operation. One-shot pulse output operations stop automatically.

Using the Macintosh

If you are using the Macintosh, Quick Data Acq allows you to perform the following operations:

- 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 or strip chart view;
- Output a single data point to an analog output channel and digital output line;
- Measure the frequency of events on counter/timer 0;
- Read events on counters 0 and/or 1;
- Output pulses on counter/timer 0 and/or 1; and
- Save the analog input data to disk.

Installing the Quick Data Acq Application

To install the Quick Data Acq application on the Macintosh, perform the following steps:

1. Insert the DT9800 Series CD-ROM into your CD-ROM drive.
2. Copy the Quick Data Acq folder from the CD-ROM to your hard drive. This folder contains the Quick Data Acq application and the product documentation.
3. Copy the Quick Data Acq Help folder to the Help folder inside your System folder. This folder contains the USB DT9800 Data Acq Driver and USB DT9800 Data Acq Loader files.

Running the Quick Data Acq Application

To run the Quick Data Acq application on the Macintosh, perform the following steps:

1. If you have not already done so, power up your computer and any attached peripherals.
2. Ensure that you installed the Quick Data Acq software using the instructions starting on page 13.
3. Double-click the Quick Data Acq file, which is located in the Quick Data Acq folder on your hard disk.

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

For information on each of the features provided, use the online help for the Quick Data Acq application by selecting the **Help** menu or by double-clicking the Quick Data Acq Help file, located in the Quick Data Acq Help older on your hard disk.

For detailed information on the supported features of the module, refer to the *DT9800 Series User's Manual* (see page 14 for information on viewing this manual).

Performing a Single-Value Analog Input Operation

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

1. Connect a voltage source, such as a function generator, to analog input channel 0 (differential mode) on the DT9800 Series function module. Refer to page 44 for an example of how to connect a differential analog input.
2. Click the **Acquisition** menu.
3. Click **Single Value Analog In**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. In the Channel list box, select analog input channel 0.
6. In the Range list box, select the range for the channel. The default is ±10 V.
7. Check the box next to **Differential**.
8. Ensure that the bias return resistors are set by selecting the **Edit** menu, then selecting **Preferences**. All the differential channels should have a checkmark next to them for the selected DT9800 Series module.

Note: If later you change the channel configuration to single-ended or pseudo-differential, ensure that the bias return resistors are not used (not checked) for each of the analog input channels.

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9. Click **Get** to acquire a single value from analog input channel 0.
   The value is displayed on the screen in both text and graphical form.
10. When you are finished with this view, click the top left corner of the window to close the view.

Performing a Single-Value Analog Output Operation

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

1. Connect an oscilloscope or voltmeter to DAC0 on the function module. Refer to page 49 for an example of how to wire analog output signals.
2. Click the **Control** menu.
3. Click **Single Value Analog Out**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. In the Channel list box, select analog output channel 0.
6. In the Range list box, select the output range of DAC0.
   The default is ±10 V.
7. Enter the output value, or use the slider to select the value to output from DAC0.
8. Click **Send** to output a single value from DAC0.
   The value that is output is displayed on the screen in both text and graphical form.
9. When you are finished with this view, click the top left corner of the window to close the view.

Performing a Continuous Analog Input Operation

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

1. Connect known voltage sources, such as the outputs of a function generator, to analog input channels 0 and 1 on the DT9800 Series function module (using the differential configuration). Refer to page 44 for an example of how to connect differential signals.
2. Click the **Acquisition** menu.
3. For this example, click **Scope**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. In the Sec / Div list box, select the number of seconds per division (.1 to .00001) for the display.
6. In the Channels list box, select analog input channel 1, then click **Add** to add the channel to the channel list.
   Note that, by default, channel 0 is included in the channel list.
7. Click **Config** from the top of the window.
8. From the Config menu, select **Channel Type**, then select **Differential**.
9. Ensure that the bias return resistors are set by selecting the **Edit** menu, then selecting **Preferences**. All the differential channels should have a checkmark next to them for the selected DT9800 Series module.

Note: If later you change the channel configuration to single-ended or pseudo-differential, ensure that the bias return resistors are not used (not checked) for each of the analog input channels.

10. From the Config menu, select **Range**, then select **Bipolar** or **Unipolar** depending on the configuration of your module. The default is Bipolar.

11. From the Scope view, double-click the input range of the channel to change the input range of the module (±10 V, ±5 V, ±2.5 V, ±1.25 V for bipolar ranges or 0 to 10 V, 0 to 5 V, 0 to 2.5 V or 0 to 1.25 V for unipolar ranges). The default is ±10 V.
The display changes to reflect the selected range for all the analog input channels on the module.

12. 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.

13. Click **Start** from the top of the window to start the continuous analog input operation.
The values acquired from each channel are displayed 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).

14. For Auto trigger operations, click **Stop** from the top of the window to stop the operation. For Manual operations, the operation stops automatically.

Performing a Single-Value Digital Input Operation

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

1. Connect a digital input to digital input line 0 of port A on the DT9800 Series function module. Refer to page 50 for an example of how to connect a digital input.
2. Click the **Acquisition** menu.
3. Click **Single Value Digital In**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. Select the digital input port by clicking **A**.
6. Click **Get**.
   The value of each digital input line is displayed on the screen in both text and graphical form.

Performing a Single-Value Digital Output Operation

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 DT9800 Series function module. Refer to page 50 for an example of how to connect a digital output.
2. Click the **Control** menu.
3. Click **Single Value Digital Out**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

5. Select the digital output port by clicking **B**.
6. Click the appropriate bits to select the type of signal to output 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.
7. Click **Send**.
   The value of each digital output line is output and displayed on the screen in both text and graphical form.

Performing a Frequency Measurement Operation

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

1. Wire an external clock source to counter / timer 0 on the DT9800-MAC Series function module. Refer to page 55 for an example of how to connect an external clock.
2. Click the **Acquisition** menu.
3. Click **Measure Frequency**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

5. In the Duration text box, enter the number of seconds during which events will be counted.

6. Click **Get** to start the frequency measurement operation.
   The operation automatically stops after the number of seconds you specified has elapsed, and the frequency (in Hertz) is displayed on the screen.

Performing an Event Counting Operation

To verify that the module can perform an event counting operation, perform the following steps:

1. Wire an external clock source to counter / timer 0 on the DT9800-MAC Series function module. Refer to page 52 for an example of how to connect an external clock.
2. Click the **Acquisition** menu.
3. Click **Count/Read Events**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. For this example, click the box to enable counter 0.
6. Click **Start** to start the event counting operation.
7. To read the number of events, click **Read**; to stop the event counting operation, click **Stop**.

Performing a Pulse Output Operation

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

1. Connect a scope to counter / timer 0 on the DT9800-MAC Series function module. Refer to page 56 for an example of how to connect a scope (a pulse output) to counter / timer 0.
2. Click the **Control** menu.
3. Click **Pulse/Counter 0 Out**.
4. Select the appropriate DT9800 Series function module from the Board list box.

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

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5. Select either **Continuous** to output a continuous pulse stream or **One Shot** to output one pulse.
6. Select either **Low-to-high** to output a rising-edge pulse (the high portion of the total pulse output period is the active portion of the signal) or **High-to-low** to output a falling-edge pulse (the low portion of the total pulse output period is the active portion of the signal).
7. Use the slider to select the frequency (in Hz) of the pulse output signal.
8. Use the slider to select a percentage for the pulse width. The pulse width determines the duty cycle of the pulse.
9. Click **Start** to generate the pulse(s).
10. Click **Stop** to stop a continuous pulse output operation. One-shot pulse output operations stop automatically.

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