DATA TRANSLATION

UM-17548-H

DT3000 Series
Getting Started Manual

Eighth Edition
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About this Manual

This manual describes how to set up and install the following components:

- DT3000 Series software
- DT3000 Series board
- DT3000 Series device driver
- DT730 or DT730-T screw terminal panel
- 5B01 or 5B08 signal conditioning backplane
- 7BP16-1, 7BP08-1, or 7BP04-1 signal conditioning backplane

It also describes how to wire signals to the board and how to verify the board's operation using the Quick Data Acq application.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for setting up a DT3000 Series board 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 Microsoft® Windows® 2000 or Windows XP.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the key features of the DT3000 Series hardware and the DT3000 Series software, and provides an overview of the DT3000 Series getting started procedure.

- Chapter 2, "Preparing to Use a DT3000 Series Board," describes how to unpack the DT3000 Series package, check the system requirements, install the DT3000 Series software, and view the DT3000 Series documentation online.
- Chapter 3, "Installing the Board and Loading the Device Driver," describes how to install the DT3000 Series board and load the DT3000 Series device driver.
- Chapter 4, "Attaching and Configuring a Screw Terminal Panel/Backplane," describes how to attach a DT730 or DT730-T screw terminal panel to a DT3000 Series board, how to attach 5B or 7B Series conditioning backplanes, and how to configure these accessories for use with a DT3000 Series board.
- Chapter 5, "Wiring Signals," describes how to wire signals to a DT3000 Series board using the DT730 screw terminal panel.
- Chapter 6, "Verifying the Operation of a DT3000 Series Board," describes how to verify the operation of a DT3000 Series board with the Quick Data Acq application
- Appendix A, "Using Your Own Screw Terminal Panel," describes additional considerations to keep in mind when designing your own screw terminal panel for use with a DT3000 Series board.

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 DT3000 Series board:

- The *DT3000 Series User's Manual* (UM-17546). Included on the Data Acquisition OMNI CD™ provided with the DT3000 Series board, this manual describes the features of the DT3000 Series boards and the DT3000 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 Getting Started Manual* (UM-18326). Included on the Data Acquisition OMNI CD provided with the DT3000 Series board, this manual describes how to develop your own application program using the Microsoft C compiler and how to use the DT-Open Layers DataAcq SDK™ to access the capabilities of Data Translation data acquisition boards.
- *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 boards in Microsoft Visual Basic® or Visual C++®.
- *DT VPI User's 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 boards.

- *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 boards.

Where To Get Help

Should you run into problems installing or using a DT3000 Series board, our Technical Support Department is available to provide technical assistance. Refer to the *DT3000 Series User's Manual* for more information (refer to page 13 for more information on viewing this manual). If you are outside the U.S. or Canada, call your local distributor, whose number is listed on Data Translation's web site (www.datatranslation.com).

Overview

DT3000 Series Key Hardware Features

The DT3000 Series is a family of high-performance, high channel-count data acquisition boards for the PCI bus. The DT3000 Series consists of the following boards: DT3001, DT3001-PGL, DT3002, DT3003, DT3003-PGL, DT3004, and DT3005. The key features of these boards are listed in Table 1.

Table 1: Key Features of DT3000 Series Boards

Board Type	Analog Inputs	Analog Input Sample Frequency	Analog Input Ranges	Analog Outputs	Digital I/O Lines	Counter/ Timers
DT3001[a]	16 SE/ 8 DI	330 kHz	±1.25 V, ±2.5 V, ±5 V, ±10 V	2[b]	8	1
DT3001-PGL[a]	16 SE/ 8 DI	330 kHz	±0.02 V, ±0.1 V, ±1 V, ±10 V	2[b]	8	1
DT3002[a]	32 SE/ 16 DI	330 kHz	±1.25 V, ±2.5 V, ±5 V, ±10 V	0	8	1
DT3003[a]	64 SE/ 32 DI	330 kHz	±1.25 V, ±2.5 V, ±5 V, ±10 V	2[b]	8	1

Table 1: Key Features of DT3000 Series Boards (cont.)

Board Type	Analog Inputs	Analog Input Sample Frequency	Analog Input Ranges	Analog Outputs	Digital I/O Lines	Counter/ Timers
DT3003-PGL[a]	64 SE/ 32 DI	330 kHz	±0.02 V, ±0.1 V, ±1 V, ±10 V	2[b]	8	1
DT3004[c]	16 SE/ 8 DI	100 kHz	±1.25 V, ±2.5 V, ±5 V, ±10 V	2[b]	8	1
DT3005[c]	16 SE/ 8 DI	200 kHz	±1.25 V, ±2.5 V, ±5 V, ±10 V	2[b]	8	1

a. The analog I/O resolution is 12 bits.
b. The analog output throughput is 200 kHz for each channel.
c. The analog I/O resolution is 16 bits.

DT3000 Series Software

The DT3000 Series Software includes the following software components, which are provided on the Data Acquisition OMNI CD:

- **DT3000 Series Device Driver** –You must install and load the device driver to use a DT3000 Series board with any of the supported software packages or utilities.
- **The Quick Data Acq application** –This application provides a quick way to get a DT3000 Series board up and running. Using the Quick Data Acq application, you can verify the features of the board, display data on the screen, and save data to disk.
- ***DT3000 Series User's Manual*** (in PDF format) –This manual describes the features of the DT3000 Series boards and how to use the DT3000 Series Device Driver with DT-Open Layers-compliant software to write an application program.
- **This manual** (in PDF format).
- **Adobe Acrobat Reader** –Allows you to view and print the PDF files.

Refer to page 11 for information on installing the software.

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using a DT3000 Series board. This diagram is repeated in each chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

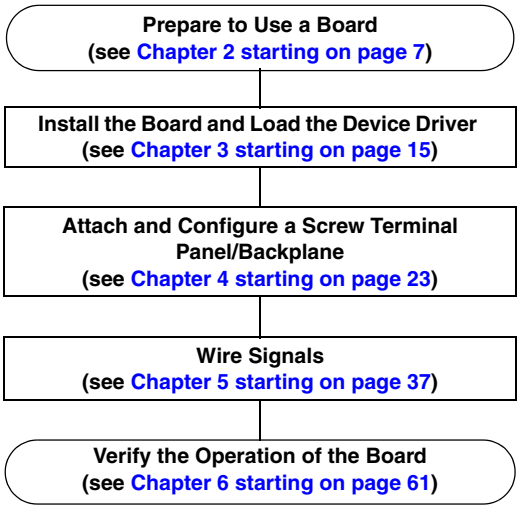
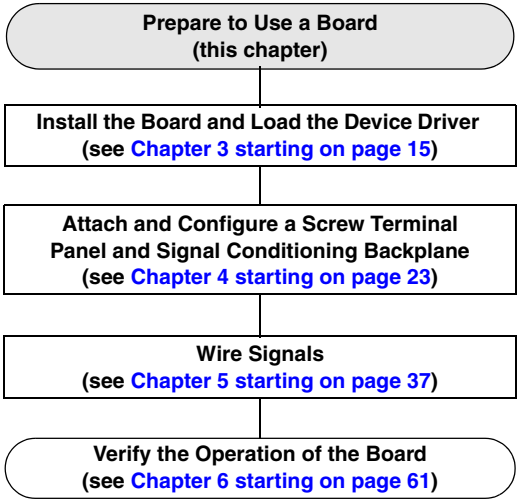


Figure 1: Getting Started Flow Diagram

Preparing to Use a DT3000 Series Board


Prepare to Use a Board
(this chapter)
Install the Board and Load the Device Driver
(see Chapter 3 starting on page 15)
Attach and Configure a Screw Terminal
Panel and Signal Conditioning Backplane
(see Chapter 4 starting on page 23)
Wire Signals
(see Chapter 5 starting on page 37)
Verify the Operation of the Board
(see Chapter 6 starting on page 61)

Unpacking

Open the shipping box and remove the wrapped DT3000 Series board.

CAUTION:

Keep the board in its protective antistatic bag until you are ready to install it; this minimizes the likelihood of electrostatic damage.

Verify that the following items are present:

- DT3000 Series data acquisition board
- 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 on Data Translation's web site (www.datatranslation.com).

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

Checking the System Requirements

For reliable operation, your DT3000 Series board requires the following minimum system requirements:

- An 80486, Pentium, or compatible processor
- At least one available PCI (revision 2.0-compliant or greater), 32-bit or 64-bit, +5 V expansion slot
- Microsoft Windows 2000 or Windows XP
- At least 32 MB available RAM
- At least one CD-ROM drive
- A 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

CAUTION:

This version of the Data Acquisition OMNI CD provides WDM-compliant device drivers and DLLs (version 5.0 or greater) for the DT3000 Series boards. Other Data Translation boards/modules may not provide WDM-compliant drivers.

You cannot use a DT3000 Series board at the same time as another Data Translation board/module unless both devices provide WDM-compliant drivers.

To install the software, perform the following steps:

1. Insert the Data Acquisition OMNI CD into your CD-ROM drive.
   *Typically, the CD opens automatically. If the CD does not open automatically, select **Run** from the Windows Start menu. Enter **x:\setup.exe** (where x is the letter of your CD-ROM drive) in the Run dialog box or use the Browse button to locate **setup.exe,** and then click **OK**.*
2. From the Data Acquisition Software setup program, click **Install Drivers**.
   A list of items that you are about to install appears.
3. Click **Install now!**
   The DT-Open Layers Data Acquisition software wizard appears.
4. Click **Next**.
   The installer prompts you for the destination location.
5. Either change the directory path and/or name using **Browse** or accept the default directory (C\Program Files\Data Translation), and then click **Next**.
   The installer prompts you to begin file installation.
6. Click **Next**.
   The installer copies the files to the destination directory.

7. Click **Finish**.
   The DT Data Acquisition Software setup program reappears.
8. Click **Quit Installer**.

Viewing the DT3000 Series Documentation Online

Note: To view the DT3000 Series documentation, you must have Adobe Acrobat Reader 5.0 or greater installed on your system. Acrobat Reader 6.0 is provided on the Data Acquisition OMNI CD. If you install Acrobat Reader 6.0 from this CD, make sure that you open Acrobat Reader and accept the license agreement before viewing the documentation.

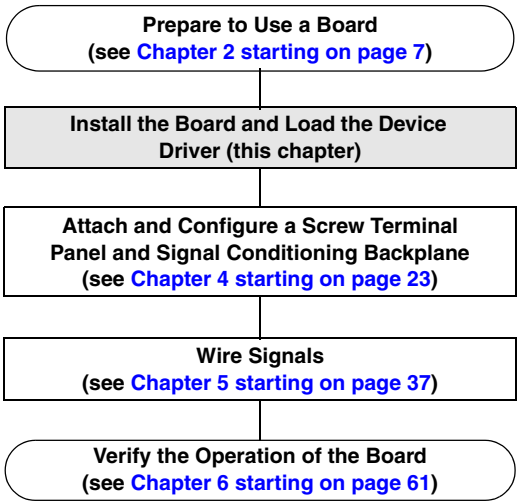
You can access the DT3000 Series documentation from the Hardware Documentation program group. From the Windows Start menu, click **Programs | Data Translation, Inc | Hardware Documentation**, and then select the appropriate document.

The following may be helpful when 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**, and then **Go Back.**
- To print the document, from the main menu, click **File**, and then **Print**.
- To increase or decrease the size of the displayed document, from the main menu, click **View**, and 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**, and then **Preferences/General**, and unchecking **Smooth Text and Images**.

Installing the Board and Loading the Device Driver



Note: All DT3000 Series boards are factory-calibrated and require no further adjustment prior to installation. If you are using the DT3000 Series board and decide later to recalibrate it, refer to the *DT3000 Series User's Manual* for instructions (see page 13 for information on viewing this manual).

Setting up the Computer

CAUTION:

To prevent electrostatic damage that can occur when handling electronic equipment, use a ground strap or similar device when performing this installation procedure.

To set up the computer, perform the following steps:

1. Turn off the computer.
2. Turn off all peripherals (printer, modem, monitor, and so on) connected to the computer.
3. Unplug the computer and all peripherals.
4. Remove the cover from you computer. Refer to your computer's user manual for instructions.

Setting up an Expansion Slot

Once you have set up the computer, set up an expansion slot by performing the following steps:

1. Select a 32-bit or 64-bit PCI expansion slot.

   PCI slots are shorter than ISA or EISA slots and are usually white or ivory. Commonly, three PCI slots (one of which may be a shared ISA/PCI slot) are available. If an ISA board exists in the shared slot, you cannot use the slot for a PCI board; if a PCI board exists in the shared slot, you cannot use the slot for an ISA board.

2. Remove the cover plate from the selected expansion slot. Retain the screw that held it in place; you will use it later to install the board.

Inserting the DT3000 Series Board into the Computer

Once you have set up an expansion slot, perform the following steps to insert the DT3000 Series board into the computer:

1. Discharge any static electricity by holding the wrapped board in one hand while placing your other hand firmly on a metal portion of the computer chassis.
2. Carefully remove the antistatic packing material from the board. (It is recommended that you save the original packing material in the unlikely event that your board requires servicing in the future.)
3. Hold the board by its edges and do not touch any of the components on the board.
4. Position the board so that the cable connectors are facing the rear of the computer, as shown in Figure 2.

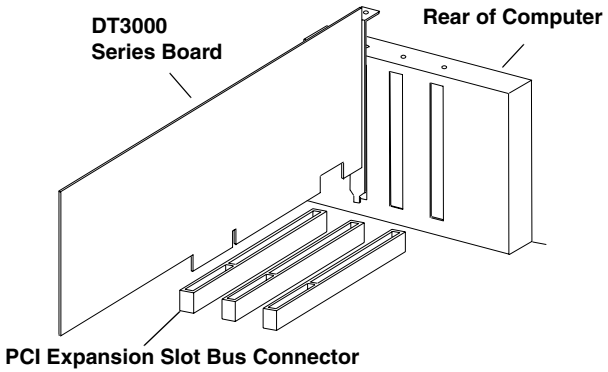


Figure 2: Inserting the DT3000 Series Board in the Computer

5. Carefully lower the board into the PCI expansion slot using the card guide to properly align the board in the slot.
6. When the bottom of the board contacts the bus connector, gently press down on the board until it clicks into place.

CAUTION:

Do not force the board into place. Moving the board from side to side during installation may damage the bus connector. If you encounter resistance when inserting the board, remove the board and try again.

7. Secure the board in place at the rear panel of the system unit using the screw removed from the slot cover.
8. Power up the computer.
9. Follow the steps on page 21.

Loading the Device Driver

To load the DT3000 Series device driver in

- Windows 2000, follow the steps on this page.
- Windows XP, follow the steps on page 22.

Windows 2000

Once you have installed the DT3000 Series driver from the Data Acquisition OMNI CD, installed a DT3000 Series board, and powered up the host computer, the New Hardware Found dialog box appears. Perform the following steps to load the device driver in Windows 2000:

1. Click **Next**.
2. Click **Search for a suitable driver for my device (recommended)**.
3. Click **Specify a location**, and click **Next**.
4. Browse to WinNT/System32/Drivers/DT3000.Inf, and then click **Open**.
5. Click **OK**.
6. Click **Next**.
   The files are copied.
7. Click **Finish**.

Once the driver is loaded, perform the steps in Chapter 4 to attach and configure the screw terminal panel and signal conditioning backplane.

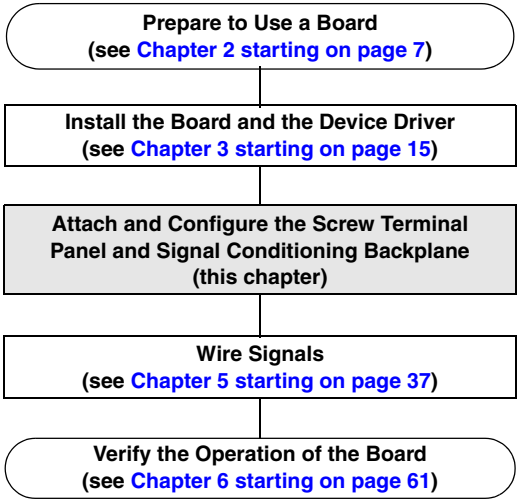
Windows XP

Once you have installed the DT3000 Series driver from the Data Acquisition OMNI CD, installed a DT3000 Series board, and powered up the host computer, the New Hardware Found dialog box appears. Perform the following steps to load the device driver in Windows XP:

1. Click **Next**.
2. Click **Search for a suitable driver for my device (recommended)**.
3. Click **Specify a location**, and click **Next**.
4. Browse to Windows/System32/Drivers/DT3000.Inf, and then click **Open**.
5. Click **OK**.
6. Click **Next**.
   The files are copied.
7. Click **Finish**.

Once the driver is loaded, perform the steps in Chapter 4 to attach and configure the screw terminal panel and signal conditioning backplane.

Attaching and Configuring a Screw Terminal Panel/ Backplane


Prepare to Use a Board
(see Chapter 2 starting on page 7)
Install the Board and the Device Driver
(see Chapter 3 starting on page 15)
Attach and Configure the Screw Terminal Panel and Signal Conditioning Backplane
(this chapter)
Wire Signals
(see Chapter 5 starting on page 37)
Verify the Operation of the Board
(see Chapter 6 starting on page 61)

Using the DT730 or DT730-T Screw Terminal Panel

The DT730 and DT730-T screw terminal panels are accessory products that provide convenient screw terminal connections for DT3000 Series boards. The DT730 is a general-purpose screw terminal panel providing analog, digital, counter/timer, external trigger, and external clock connections. The DT730-T is the same as the DT730, but also provides cold-junction compensation (CJC) for thermocouple connections.

The DT730 and DT730-T provide a J1 connector for connecting to your DT3000 Series board using the EP291 cable (included with the screw terminal panel). The DT730 and DT730-T also provide a 26-pin, J2 connector to allow connection to standard 5B and 7B Series signal conditioning backplanes.

The following section describes how to attach a DT730 or DT730-T screw terminal panel to a DT3000 Series board. The section on page 27 describes how to configure a DT730 or DT730-T screw terminal panel for use with a DT3000 Series board.

Attaching a DT730 or DT730-T Screw Terminal Panel

To connect the DT730 or DT730-T screw terminal panel to a DT3000 Series board, perform the following steps:

1. Plug one end of the EP291 flat ribbon cable into the connector at the rear of the DT3000 Series board and the other end into the DT730 or DT730-T, as shown in Figure 3.

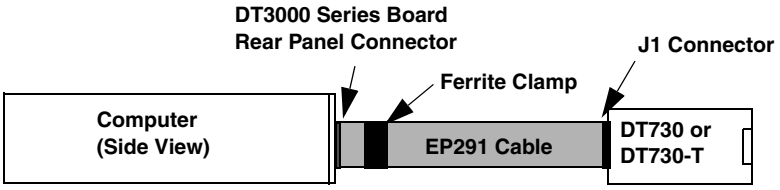


Figure 3: Connecting the DT730 or DT730-T to the DT3000 Series Board

2. To reduce EMI emissions, place the ferrite clamp, shipped with the DT3000 Series board, no more than six inches from the DT3000 Series board connector. The ferrite clamp attaches to the cable with an integral latch and grips the cable to prevent sliding.

Configuring a DT730 or DT730-T Screw Terminal Panel

Figure 4 illustrates the screw terminal and component locations for the DT730 and DT730-T.

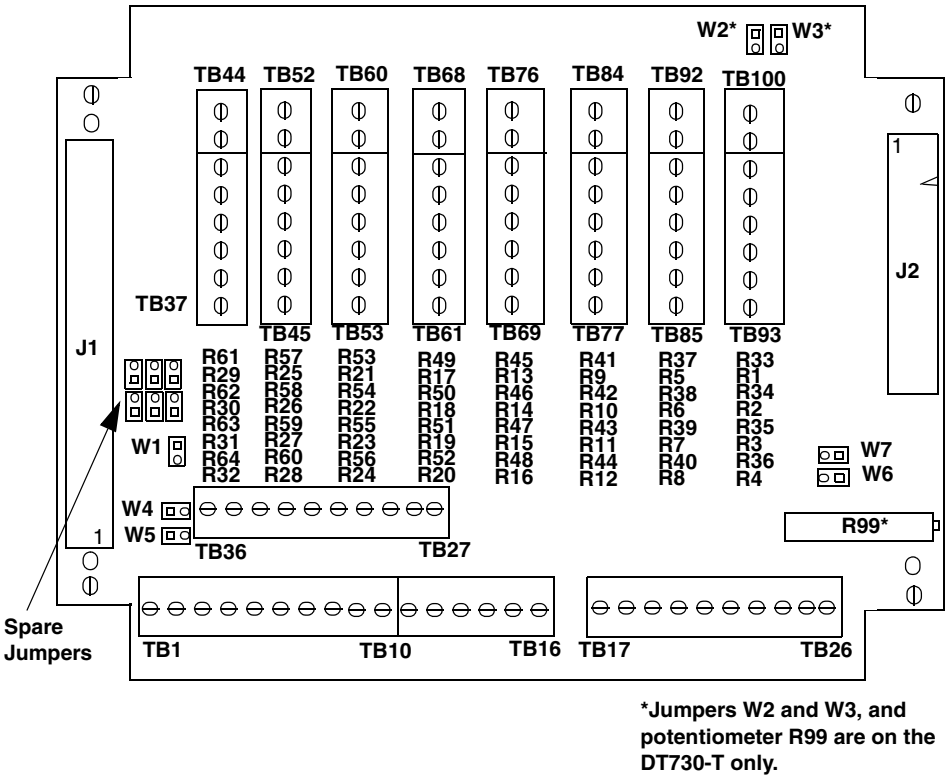


Figure 4: DT730 and DT730-T Screw Terminal Panels

Jumpers

The DT730 and DT730-T screw terminal panels contain jumpers W1, and W4 to W7. The DT730-T screw terminal panel also contains jumpers W2 and W3. Jumper W1 provides the CJC circuitry, and jumpers W4 to W7 are associated with analog outputs on the 5B01 and 7BP16-1 signal conditioning backplanes. The following subsections describe these jumpers.

Note: The screw terminal panels were initially shipped with enough jumper plugs to select every possible configuration. Spare jumper plugs are stored on the panel itself (on the posts marked spare). Save these jumper plugs for future use.

Configuring Jumper W1 - Common Ground Sense

Jumper W1 is installed when the board is shipped from the factory. This jumper connects Amp Low (TB35) to Analog Ground (TB36) on the screw terminal panel. Amp Low is connected to the low side of the board's input amplifier.

When connecting pseudo-differential analog inputs directly to the screw terminal panel, remove jumper W1 and connect Amp Low to a remote common-mode voltage to reject offset voltages common to all 64 input channels. Refer to page 49 for an example of using jumper W1.

Note: If you are using a 5B Series backplane, install jumper W3 on the backplane to connect Amp Low to Analog Ground on the backplane.

Configuring Jumpers W2 and W3 - CJC

The DT730-T screw terminal panel is provided for thermocouple connections and includes a CJC circuit for measuring temperature at the connector blocks on the screw terminal panel. Power is derived from ±Vcc on the DT3000 Series board.

Installing jumpers W2 and W3 connects the CJC circuit to channel 0. Jumper W2 connects the temperature sensor to channel 0 high; jumper W3 connects channel 0 low to analog ground.

The output is 0.50 mV/°C or 12.5 mV at 25°C.

After scaling for the gain and thermocouple type, you must add this voltage to the thermocouple voltage to remove the offset created by the temperature of the screw terminal panel when measuring thermocouple inputs on the DT730-T directly.

Note: 5B and 7B thermocouple modules provide their own CJC and return a voltage that already compensates for the CJC. Therefore, if you are using the DT730-T with a 5B or 7B thermocouple module, you do not have to compensate for offsets as you do when measuring thermocouples on the DT730-T directly.

Configuring Jumpers W4 to W7 - Analog Outputs on the 5B01 or 7BP16-1 Backplane

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

Jumpers W4 to W7 are provided if you are using the DT730 or DT730-T screw terminal panel with analog output modules on a 5B01 or 7BP16-1 signal conditioning backplane.

Install jumpers W4 and W5 to connect DAC0 from the data acquisition board to channel 14 on the 5B01 or 7BP16-1 backplane. Jumper W4 connects DAC0 to channel 14; jumper W5 connects DAC0's return.

Install jumpers W6 and W7 to connect DAC1 from the data acquisition board to channel 15 on the 5B01 or 7BP16-1 backplane. Jumper W6 connects DAC0 to channel 15; jumper W7 connects DAC1's return.

Note: If you are using analog output modules on the 5B01or 7BP16-1 backplane, ensure that you make no connections to the screw terminals corresponding to that signal on the screw terminal panel. For example, if you are using channel 14 on the 5B01 for analog output, do not use screw terminals corresponding to DAC0 on the screw terminal panel. You can read the output of the DACs as inputs.

Resistors

Locations are provided on the DT730 and DT730-T for user-installed bias return and current shunt resistors. (Resistors must be 1/4 W size.) The following subsections describe these resistors and their use.

Configuring Resistors R1 to R32 - Input Bias Return

Differential mode permits low-level signal measurement by limiting common-mode input noise. This mode provides a separate return path for each channel.

For floating signal sources, where the voltage source has no connection with earth ground, you need to provide a bias return path by adding input bias return resistors. Input bias resistors R1 through R32 connect the low sides of channels 0 to 31 to analog ground, where R1 corresponds to channel 0 and R32 corresponds to channel 31.

When input bias resistors are installed for an analog input channel, the high (or positive) side of the analog input channel returns the source input impedance through the bias return resistor to the low side of the channel, and then to analog ground.

Typical resistor values are 1 kΩ to 100 kΩ depending on the application. Refer to page 50 for an example of using an input bias return resistor.

Configuring Resistors R33 to R64 - Current Shunt

In single-ended mode, inputs share a common return path. Single-ended connections should be restricted to applications with high-level voltage inputs and short lead lengths.

Current shunt resistors R33 to R64 connect the high side of analog input channels 0 to 31 to the low side of each input. Resistor R33 corresponds to analog input channel 0; resistor R64 corresponds to analog input channel 31. Current shunt resistors typically convert 4 to 20 mA to 1 to 5 V for A/D conversion.

Note that, depending on your application, a bias current return resistor may also be required in addition to the current shunt resistor.

The typical current shunt resistor value is 250 Ω. If, for example, you add a 250 Ω resistor to location R33 and connect a 4 to 20 mA current loop input to channel 0, the input range for channel 0 is converted to 1 to 5 V. Refer to page 52 for an example of using a current shunt resistor.

Using 5B and 7B Series Conditioning Backplanes

This section describes how to attach a 5B or 7B Series signal conditioning backplane to a DT730 or DT730-T screw terminal panel and considerations when using signal conditioning accessories with DT3000 Series boards.

Attaching a 5B Series Backplane

To connect a 5B Series signal conditioning backplane to the DT730 or DT730-T screw terminal panel, perform the following steps while referring to Figure 5:

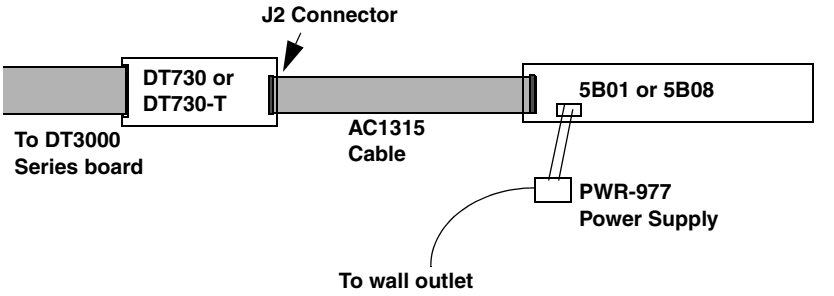


Figure 5: Connecting the 5B Series Backplane to the DT730 or DT730-T Screw Terminal Panel

1. Plug one end of the AC1315 cable into the J2 connector of the DT730 or DT730-T screw terminal panel.
2. Plug the other end of the AC1315 cable into the 26-pin connector on the 5B Series backplane.

3. Connect power supply PWR-977 to the +5 V and power ground screw terminals on the 5B Series backplane and to the wall outlet.

Attaching a 7B Series Backplane

To connect a 7B Series signal conditioning backplane to the DT730 or DT730-T screw terminal panel, perform the following steps while referring to Figure 6:

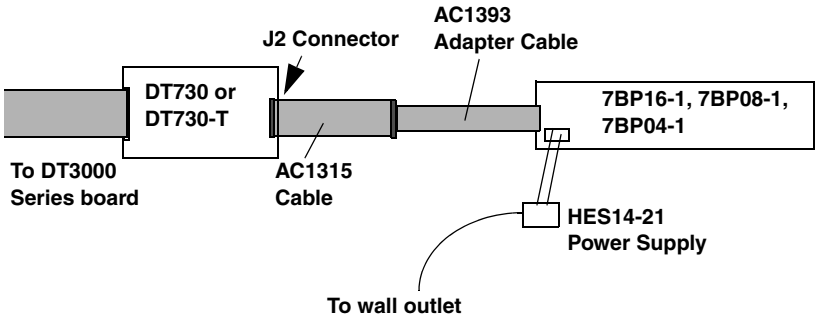


Figure 6: Connecting the 7B Series Backplane to the DT730 or DT730-T Screw Terminal Panel

1. Plug one end of the AC1315 cable into the J2 connector of the DT730 or DT730-T screw terminal panel.
2. 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.
3. Connect power supply HES14-21 to the V+A and COM screw terminals on the 7B Series backplane and to the wall outlet.

Considerations When Using 5B or 7B Series Accessories

When using the DT730 or DT730-T screw terminal panel with 5B or 7B Series signal conditioning accessories, keep the following considerations in mind:

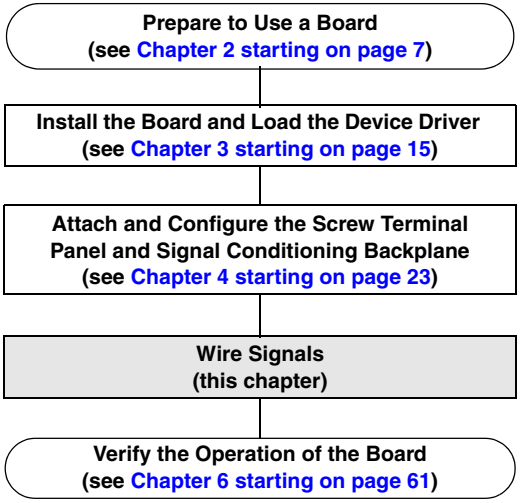
- Configure your DT3000 Series board to use single-ended mode. You must remove jumper W1 on the DT730 or DT730-T screw terminal panel, as described on page 28. If you are using a 5B Series backplane, you must also install jumper W3 on the 5B Series backplane to connect Amp Low to Analog Ground.
- The 5B08 and 7BP08-1 map to single-ended analog input channels 0 to 7, and the 7BP04-1 maps to single-ended analog input channels 0 to 3. If you are using a signal conditioning module for an analog input channel, ensure that you connect the analog input signal to the module on the signal conditioning backplane. For channels that do not use signal conditioning, connect the analog input signals to the DT730 or DT730-T screw terminal panel.
- By default, the 5B01 and 7BP16-1 backplanes map to single-ended analog input channels 0 to 15. However, by configuring jumpers W4 to W7 on the DT730 or DT730-T, as described on page 29, you can use channels 14 and 15 on the 5B01 or 7BP16-1 backplane as analog output channels 0 and 1.

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

- 5B thermocouple modules provide their own CJC and return a voltage that already compensates for CJC. Therefore, when using 5B Series modules, you do not have to compensate for offsets as you do when measuring thermocouples on the DT730-T directly.

- 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 DT300 Series board.
- Connect all unused inputs to analog common. Reading an open channel can cause settling problems on the next valid channel.
- Refer to the user's manuals and data sheets for the 5B and 7B Series for more information.

Wiring Signals



This chapter describes how to wire signals to the DT730 or DT730-T screw terminal panel. For information on how to wire signals to the 5B or 7B Series signal conditioning modules, refer to the data sheets and user's manuals for the 5B and 7B Series.

Before Wiring

This section describes wiring recommendations and the pin assignments of the DT730 and DT730-T screw terminal panel.

CAUTION:

To avoid electrical damage, ensure that power is turned off to the computer and to any attached devices before wiring signals to the STP3000 Screw terminal panel.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to the DT730 or DT730-T screw terminal panel:

- Use individually shielded twisted-pair wire (size 14 to 26 AWG) when using the DT3000 Series board 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 DT730 or DT730-T screw terminal panel and cabling next to sources that produce high electromagnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a metal shield.
- Connect the analog shield to screw terminals TB35, TB36, and TB51 through TB56 on the DT730 or DT730-T screw terminal panel.
- Connect the digital shield to the digital ground screw terminals on the screw terminal panel.
- Connect the analog and digital shields to one end only (either at the DT730, DT730-T, or the signal source).

- When first installing the board, it is recommended that you do the following:
  - Wire a function generator or a known voltage source to analog input channel 0 (use the differential configuration).
  - Wire an oscilloscope or voltage meter to analog output channel 0.
  - Wire a digital input to digital I/O Port A.
  - Wire a external clock or scope to counter/timer channel 0.
  - If you have not done so already, install the DT3000 Series software.
  - Run the Quick Data Acq application (described in Chapter 6 starting on page 61) to verify that the board is operating properly.
  - Once you have determined that the board is operating properly, wire the signals according to your application's requirements.

DT730 and DT730-T Screw Terminal Assignments

Table 2 describes each of the screw terminal assignments and identifies the resistors that are associated with each channel.

Table 2: Screw Terminal Descriptions and Resistor Use for the DT730 and DT730-T

Screw Terminal Number[a]	Signal Name		Resistor Used	
	Single-Ended	Differential	Bias Return	Current Shunt
1	Digital Ground		Not Applicable	
2	Digital Ground			
3	UCLK_OUT			
4	IADCLK0			
5	USER_GATE			
6	EADTRIG/EDATRIG			
7	USER_CLK1			
8	EADCLK1			
9	Digital Ground			
10	Digital Ground			
11	RESERVED			
12	RESERVED			
13	+5V_OUT			
14	+5V_OUT			
15	Digital Ground			
16	Digital Ground			
17	DIG_IOB3			
18	DIG_IOA3			

Table 2: Screw Terminal Descriptions and Resistor Use for the DT730 and DT730-T (cont.)

Screw Terminal Number[a]	Signal Name		Resistor Used	
	Single-Ended	Differential	Bias Return	Current Shunt
19	DIG_IOB2		Not Applicable	
20	DIG_IOA2			
21	DIG_IOB1			
22	DIG_IOA1			
23	DIG_IOB0			
24	DIG_IOA0			
25	Digital Ground			
26	Digital Ground			
27	–15V_OUT			
28	+15V_OUT			
29	Analog Common			
30	Analog Common			
31	DAC1_GND			
32	DAC1_OUT			
33	DAC0_GND			
34	DAC0_OUT			

Table 2: Screw Terminal Descriptions and Resistor Use for the DT730 and DT730-T (cont.)

Screw Terminal Number[a]	Signal Name		Resistor Used	
	Single-Ended	Differential	Bias Return	Current Shunt
35	Amp Low		Note: Jumper W1 Connects Amp Low to Analog Gnd	
36	Analog Gnd			
37	AIN63	AIN31_L	R32	R64
38	AIN55	AIN31_H		
39	AIN62	AIN30_L	R31	R63
40	AIN54	AIN30_H		
41	AIN61	AIN29_L	R30	R62
42	AIN53	AIN29_H		
43	AIN60	AIN28_L	R29	R61
44	AIN52	AIN28_H		
45	AIN59	AIN27_L	R28	R60
46	AIN51	AIN27_H		
47	AIN58	AIN26_L	R27	R59
48	AIN50	AIN26_H		
49	AIN57	AIN25_L	R26	R58
50	AIN49	AIN25_H		
51	AIN56	AIN24_L	R25	R57
52	AIN48	AIN24_H		
53	AIN47	AIN23_L	R24	R56
54	AIN39	AIN23_H		

Table 2: Screw Terminal Descriptions and Resistor Use for the DT730 and DT730-T (cont.)

Screw Terminal Number[a]	Signal Name		Resistor Used	
	Single-Ended	Differential	Bias Return	Current Shunt
55	AIN46	AIN22_L	R23	R55
56	AIN38	AIN22_H		
57	AIN45	AIN21_L	R22	R54
58	AIN37	AIN21_H		
59	AIN44	AIN20_L	R21	R53
60	AIN36	AIN20_H		
61	AIN43	AIN19_L	R20	R52
62	AIN35	AIN19_H		
63	AIN42	AIN18_L	R19	R51
64	AIN34	AIN18_H		
65	AIN41	AIN17_L	R18	R50
66	AIN33	AIN17_H		
67	AIN40	AIN16_L	R17	R49
68	AIN32	AIN16_H		
69	AIN31	AIN15_L	R16	R48
70	AIN23	AIN15_H		
71	AIN30	AIN14_L	R15	R47
72	AIN22	AIN14_H		
73	AIN29	AIN13_L	R14	R46
74	AIN21	AIN13_H		

Table 2: Screw Terminal Descriptions and Resistor Use for the DT730 and DT730-T (cont.)

Screw Terminal Number[a]	Signal Name		Resistor Used	
	Single-Ended	Differential	Bias Return	Current Shunt
75	AIN28	AIN12_L	R13	R45
76	AIN20	AIN12_H		
77	AIN27	AIN11_L	R12	R44
78	AIN19	AIN11_H		
79	AIN26	AIN10_L	R11	R43
80	AIN18	AIN10_H		
81	AIN25	AIN09_L	R10	R42
82	AIN17	AIN09_H		
83	AIN24	AIN08_L	R9	R41
84	AIN16	AIN08_H		
85	AIN15	AIN07_L	R8	R40
86	AIN07	AIN07_H		
87	AIN14	AIN06_L	R7	R39
88	AIN06	AIN06_H		
89	AIN13	AIN05_L	R6	R38
90	AIN05	AIN05_H		
91	AIN12	AIN04_L	R5	R37
92	AIN04	AIN04_H		
93	AIN11	AIN03_L	R4	R36
94	AIN03	AIN03_H		

Table 2: Screw Terminal Descriptions and Resistor Use for the DT730 and DT730-T (cont.)

Screw Terminal Number[a]	Signal Name		Resistor Used	
	Single-Ended	Differential	Bias Return	Current Shunt
95	AIN10	AIN02_L	R3	R35
96	AIN02	AIN02_H		
97	AIN09	AIN01_L	R2	R34
98	AIN01	AIN01_H		
99	AIN08	AIN00_L	R1	R33
100	AIN00	AIN00_H		

a. The screw terminal assignments match the pin numbers of the J1 connector.

Connecting Analog Input Signals

The DT730 screw terminal panel supports both voltage and current loop inputs. You can connect analog input voltage signals to the DT730 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 DT730 or DT730-T screw terminal panel, and all the input signals are referred to the same common ground. When you choose the single-ended configuration, all 32 analog input channels are available.
- **Pseudo-Differential** –Choose this configuration when noise or common-mode voltage (the difference between the ground potential of the signal source and the ground of the DT730 or DT730-T screw terminal panel or the difference 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 32 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 (> 12 bits), noise is a significant part of the signal, or common-mode voltage exists and you want the most noise rejection. When you choose the differential configuration, 16 analog input channels are available.

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

This section describes how to connect single-ended, pseudo-differential, and differential voltage inputs, as well as current loop inputs to the DT730 or DT730-T screw terminal panel.

Connecting Single-Ended Voltage Inputs

Figure 7 shows how to connect single-ended voltage inputs (channels 0, 1, and 8, in this case) to the DT730 and DT730-T screw terminal panel.

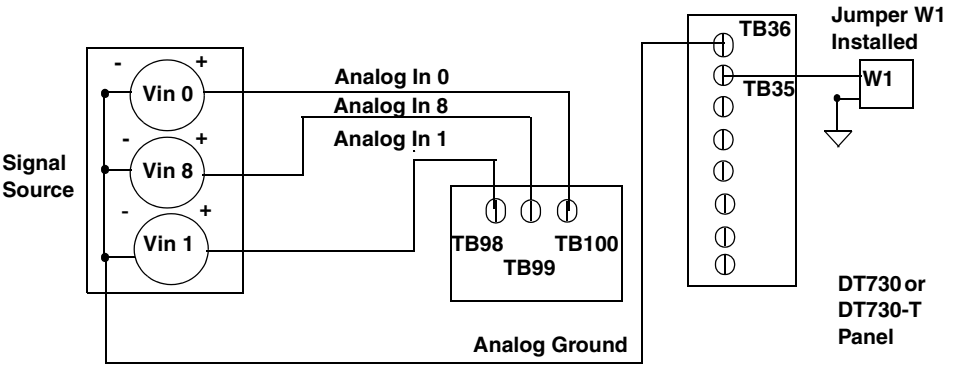


Figure 7: Connecting Single-Ended Voltage Inputs (Shown for Channels 0, 1, and 8)

Connecting Pseudo-Differential Voltage Inputs

Figure 8 shows how to connect pseudo-differential voltage inputs (channels 0, 1, and 8, in this case) to the DT730 or DT730-T screw terminal panel.

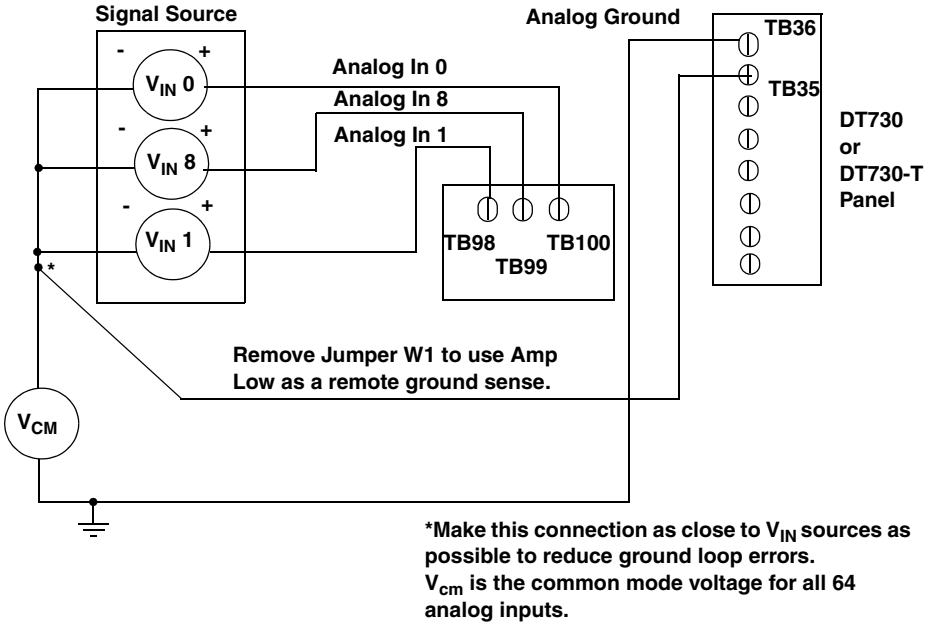


Figure 8: Connecting Pseudo-Differential Voltage Inputs (Shown for Channels 0, 1, and 8)

Connecting Differential Voltage Inputs

Figure 9A illustrates how to connect a floating signal source to the DT730 or DT730-T screw terminal panel using differential inputs and a bias return resistor.

In Figure 9B, the signal source itself provides the bias return path; therefore, you do not need to use bias return resistors. R_s is the signal source resistance while R_v is the resistance required to balance the bridge. Note that the negative side of the bridge supply must be returned to analog ground.

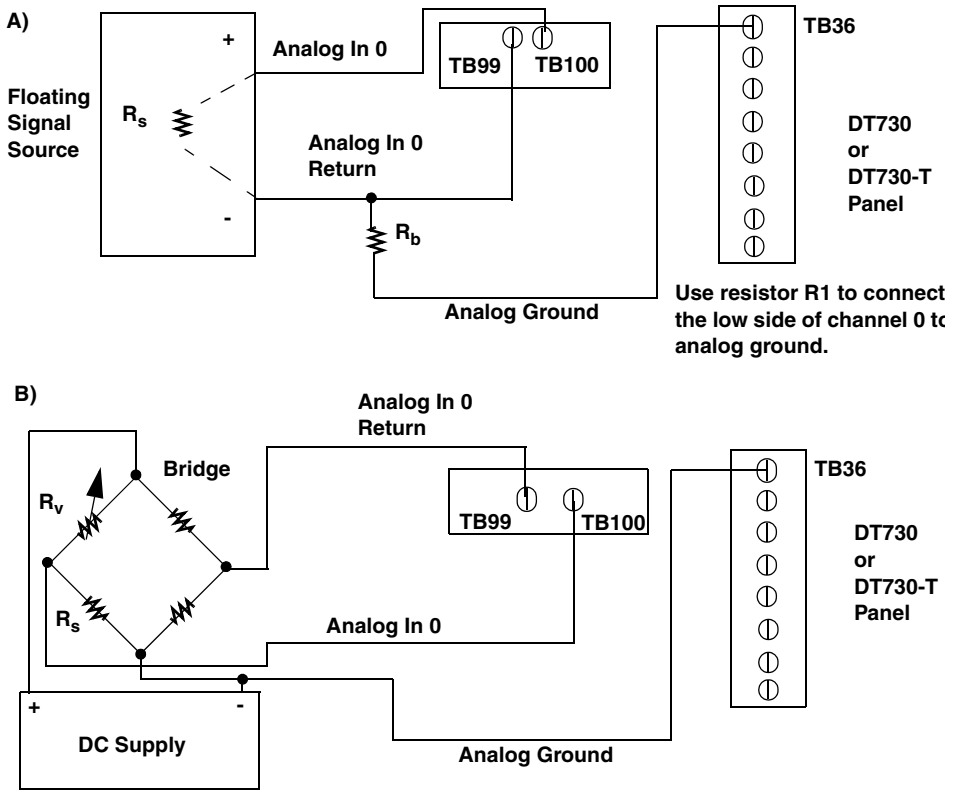


Figure 9: Connecting Differential Voltage Inputs (Shown for Channel 0) with and without Input Bias Return Resistors

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 DT730 or DT730-T screw terminal panel as shown in Figure 10, using an input bias return

resistor if the external ground signal is floating. In this case, make sure that the low side of the signal (–) is connected to ground at the signal source, not at the DT730 or DT730-T screw terminal panel, and do not tie the two grounds together.

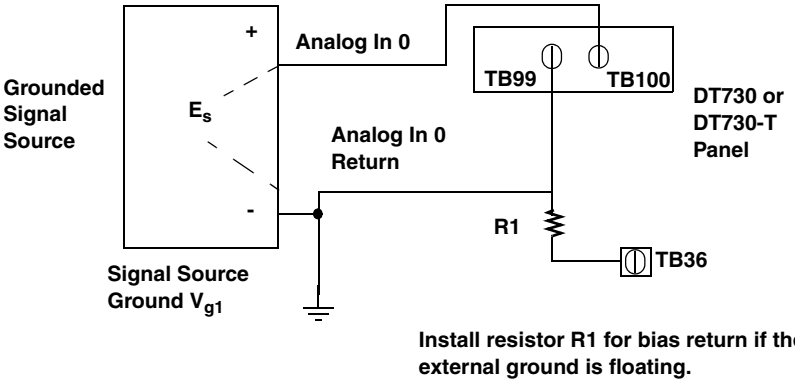
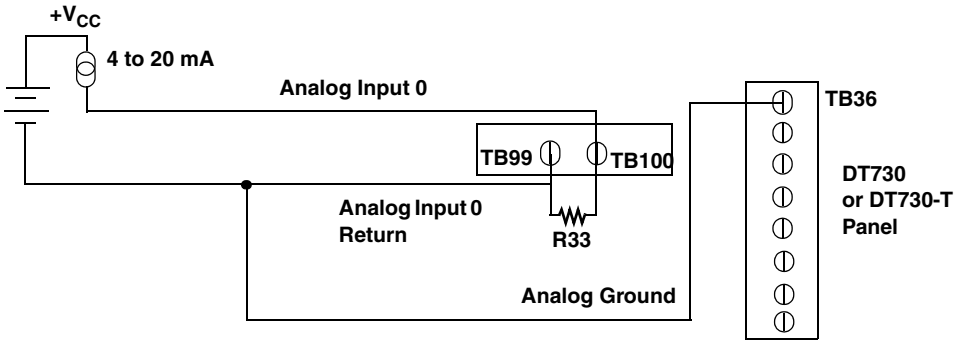


Figure 10: Connecting Differential Voltage Inputs from a Grounded Signal Source (Shown for Channel 0)

Connecting Current Loop Inputs

Figure 11 shows how to connect a current loop input (channel 0, in this case) to the DT730 or DT730-T screw terminal panel.



Use current shunt resistor R33 to convert current to voltage; 250 Ω for 4 to 20 mA = 1 to 5 V.
If needed, also use resistor R1 to provide a bias return path.

Figure 11: Connecting Current Inputs to the DT730 or DT730-T Screw Terminal Panel (Shown for Channel 0)

Connecting Analog Output Signals

Figure 12 shows how to connect an analog output voltage signal (channel 0, in this case) to the DT730 screw terminal panel.

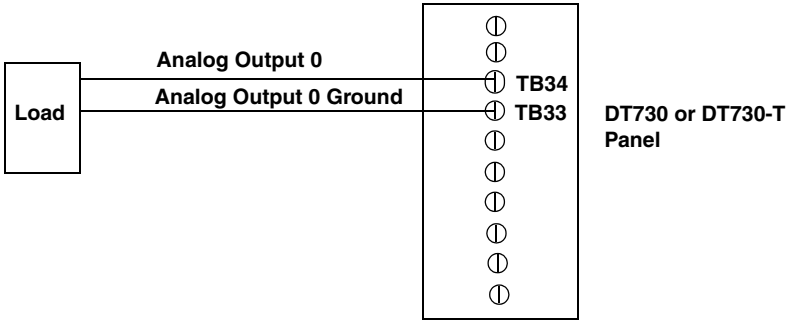


Figure 12: Connecting Analog Output Voltages (Shown for Channel 0)

Connecting Digital I/O Signals

Figure 13 shows how to connect a digital input signal (channels 0 and 1 of digital port A, in this case) to the DT730 or DT730-T screw terminal panel.

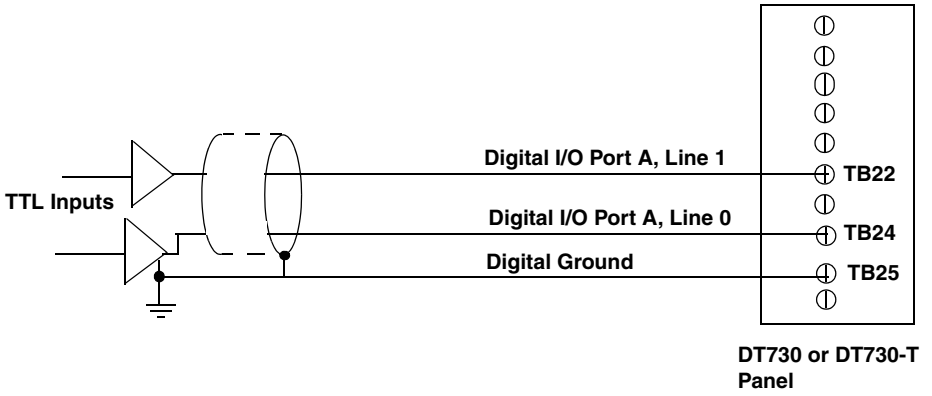


Figure 13: Connecting Digital Inputs (Channels 0 and 1, Port A Shown)

Figure 14 shows how to connect a digital output signal (channel 0 of digital port 1, in this case) to the DT730 or DT730-T screw terminal panel.

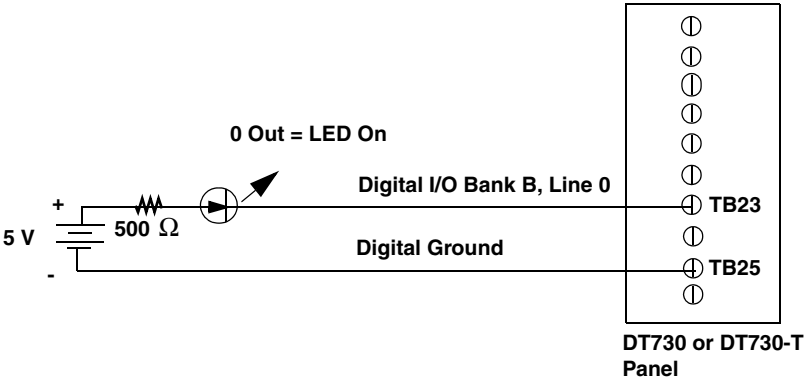


Figure 14: Connecting Digital Outputs (Channel 0, Port 1 Shown)

Connecting Counter/Timer Signals

The DT3000 Series board and DT730 screw terminal panel provide one user counter/timer channel that you can use to perform the following operations:

- Event counting
- Frequency measurement
- 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 *DT3000 Series User's Manual* for more information on using the counter/timers.

Connecting Event Counting Signals

Figure 15 shows one example of connecting event counting signals to the DT730 or DT730-T screw terminal panel. In this example, clock edges are counted while the gate is active.

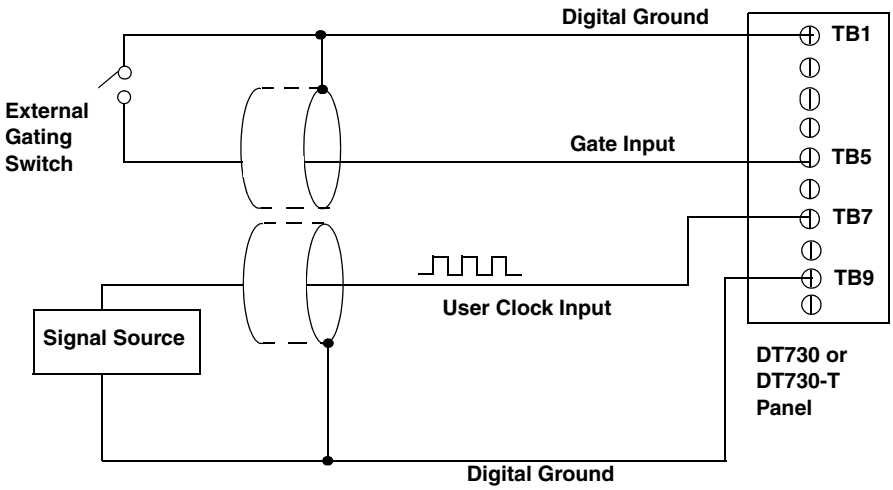


Figure 15: Connecting Event Counting Signals (Shown Using an External Gate)

5

Figure 16 shows another example of connecting event counting signals to the DT730 or DT730-T screw terminal panel. In this example, a software gate is used to start the event counting operation.

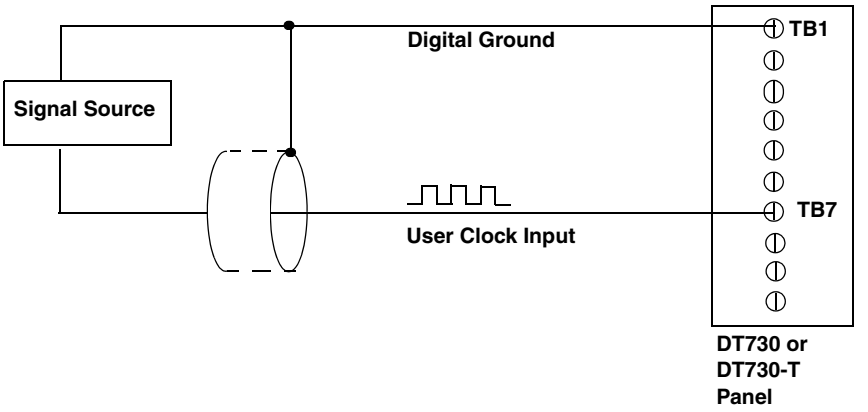


Figure 16: Connecting Event Counting Signals without an External Gate Input

Connecting Frequency Measurement Signals

On the DT3000 Series, a frequency measurement application uses the same wiring as an event counting application that does not use an external gate signal (see Figure 16).

The software uses the Windows timer to specify the duration of the frequency measurement. The frequency of the clock input is the number of counts divided by the duration of the Windows timer.

Connecting Pulse Output Signals

Figure 17 shows one example of connecting pulse output signals to the DT730 or DT730-T screw terminal panel using an external gate type.

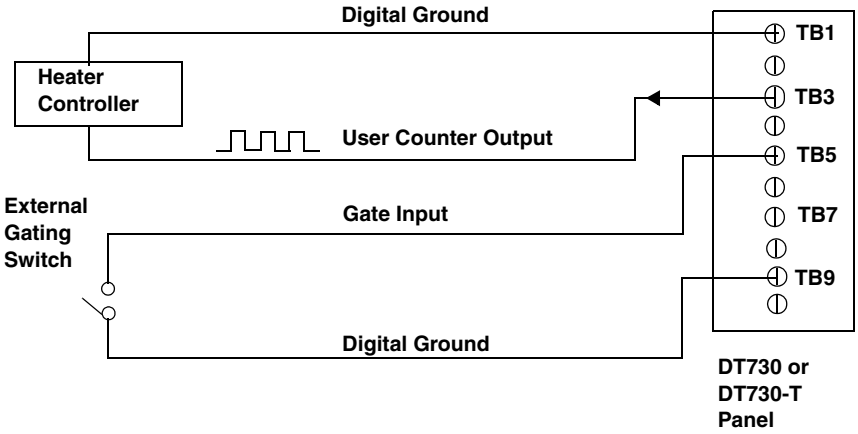


Figure 17: Connecting Pulse Output Signals (Using an External Gate)

Figure 18 shows another example of connecting a pulse output operation to the DT730 or DT730-T screw terminal panel using a software gate type.

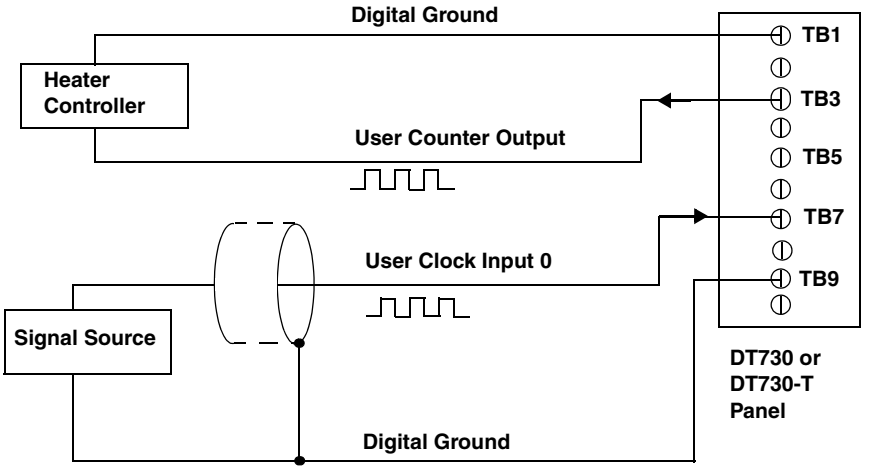
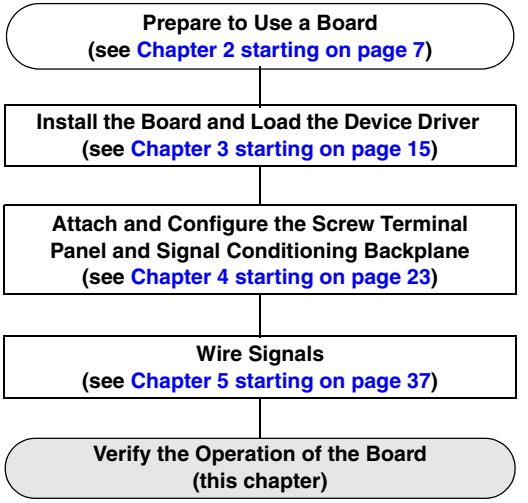


Figure 18: Connecting Pulse Output Signals (Using an External Gate)

Verifying the Operation of a DT3000 Series Board



You can verify the operation of a DT3000 Series board using the Quick Data Acq application. Quick Data Acq allows you to do the following:

- Acquire data from a single analog input channel or digital input port
- Acquire data continuously from one or more analog input channels using an oscilloscope, strip chart, or Fast Fourier Transform (FFT) view
- 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
- Save the input data to disk

Installing the Quick Data Acq Application

The Quick Data Acq application is installed automatically when you install the driver software. See “Installing the Software” on page 11.

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. 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 board; however, it may not support all of the board's features.

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

For detailed information on the supported features of the board, refer to the *DT3000 Series User's Manual* (see page 13 for information on viewing this manual).

Performing a Single-Value Analog Input Operation

To verify that the board 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 DT3000 Series board. Refer to page 50 for an example of how to connect a differential analog input.
2. In the Quick Data Acq application, click the **Acquisition** menu.
3. Click **Single Analog Input**.
4. Select the appropriate DT3000 Series board from the Board list box.
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. Select **Differential**.
8. Click **Get** to acquire a single value from analog input channel 0. *The application displays the value on the screen in both text and graphical form.*

Performing a Single-Value Analog Output Operation

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

1. Connect an oscilloscope or voltmeter to DAC0 on the board. Refer to page 53 for an example of how to connect analog output signals.
2. In the Quick Data Acq application, click the **Control** menu.
3. Click **Single Analog Output**.
4. Select the appropriate DT3000 Series board from the Board list box.

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 application displays the output value on the screen in both text and graphical form.

Performing a Continuous Analog Input Operation

To verify that the board 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 DT3000 Series board (using the differential configuration). Refer to page 50 for an example of how to connect a differential analog input.
2. In the Quick Data Acq application, click the **Acquisition** menu.
3. For this example, click **Scope**.
4. Select the appropriate DT3000 Series board from the Board list box.
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, and then click **Add** to add the channel to the channel list.
   Channel 0 is automatically added to the channel list.
7. Click **Config** from the Toolbar.
8. From the Config menu, select **ChannelType**, and then select **Differential**.

9. From the Config menu, select **Range**, and then select **Bipolar** or **Unipolar** depending on the configuration of your board.
   The default is Bipolar.
10. From the Scope view, double-click the input range of the channel to change the input range of the board (±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. Note that the display changes to reflect the selected range for all the analog input channels on the board.
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 application displays the values acquired from each channel in a unique color on the oscilloscope view.
13. Click **Stop** from the Toolbar to stop the operation.

Performing a Single-Value Digital Input Operation

To verify that the board 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 DT3000 Series board. Refer to page 54 for an example of how to connect a digital input.
2. In the Quick Data Acq application, click the **Acquisition** menu.
3. Click **Digital Input**.
4. Select the appropriate DT3000 Series board from the Board list box.
5. Select digital input port A by clicking **Port A**.

6. Click **Get**.
   The application displays the value of each digital input line in port A on the screen in both text and graphical form.

Performing a Single-Value Digital Output Operation

To verify that the board 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 DT3000 Series board. Refer to page 55 for an example of how to connect a digital output.
2. In the Quick Data Acq application, click the **Control** menu.
3. Click **Digital Output**.
4. Select the appropriate DT3000 Series board from the Board list box.
5. Select digital output port B by clicking **Port B**.
6. Click the appropriate bits to select the digital output lines to write to. If the bit is selected, a high-level signal is output to the digital output line; if the bit is not selected, a low-level signal is output to the digital output line. Optionally, you can enter an output value in the Hex text box.
7. Click **Send**.
   The application displays the value of each digital output line of digital port B on the screen in both text and graphical form.

Performing a Frequency Measurement Operation

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

1. Wire an external clock source to counter/timer 0 on the DT3000 Series board. Refer to page 58 for an example of how to connect a an external clock for a frequency measurement operation.

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

2. In the Quick Data Acq application, click the **Acquisition** menu.
3. Click **Frequency Counter**.
4. Select the appropriate DT3000 Series board from the Board list box.
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 board can perform a pulse output operation, perform the following steps:

1. Connect a scope to counter/timer 0 on the DT3000 Series board. Refer to page 59 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. In the Quick Data Acq application, click the **Control** menu.
3. Click **Pulse Generator**.
4. Select the appropriate DT3000 Series board from the Board list box.
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 pulse width determines the duty cycle of the pulse.
8. Click **Start** to generate the pulse(s).
   The application displays the results both in text and graphical form.
9. Click **Stop** to stop a continuous pulse output operation. One-shot pulse output operations stop automatically.

Using Your Own Screw Terminal Panel

Data acquisition boards can perform only as well as the input connections and signal integrity you provide. If you choose not to use the DT730 or DT730-T screw terminal panel, consideration must be given to how the signals interact in the real world as well as how they interact with each other.

This appendix describes additional considerations to keep in mind when designing your own screw terminal panel for use with a DT3000 Series board. Refer to Appendix B of the *DT3000 Series User's Manual* for connector and cable specifications.

Analog Inputs

DT3000 Series boards have three different types of analog input configurations that you can use:

- Single-ended
- Pseudo-differential
- Differential

This section describes wiring considerations for these analog input configurations.

Single-Ended Inputs

With single-ended inputs, you have the maximum number of inputs but the worst-case noise immunity without external signal conditioning.

The major problem with this configuration it that you need a common ground between the external inputs and the data acquisition board. Even with conditioning, you must consider the cable length and how the cable is routed. If the cable is over 3 feet, you must consider the ringing and cross-talk in the cable. A typical cable has 30 pF per foot of capacitance. If the source impedance is 1,000 Ω and the cable is 3 feet, then the cross talk based on the source impedance is 1,000 Ω x (30 pF x 3 ft) = 90 ns.

This seems negligible, but when you consider that it requires nine time constants to settle within 0.01%, the cross-talk becomes almost 10% of the settling time when switching channels at 100 kHz.

In addition, coupling must be considered when adjacent channels have high-speed signals, especially if these signals are TTL-type with high-speed edges.

If it is provided and not used, ensure that you connect Amp Low to the analog common of the DT3000 Series board or to ground when running in single-ended mode.

Pseudo-Differential Inputs

Pseudo-differential inputs allow one common-mode voltage for all single-ended inputs. With this type of connection, the low side of the instrumentation amplifier is used to sense an external common-mode voltage. For example, if you have a signal-conditioning rack, the Amp Low signal connects to the analog common of the external rack.

The pseudo-differential configuration allows you to use the maximum number of input channels, while placing an impedance between the external ground and the data acquisition ground or analog common. Even if it is 100 Ω, this impedance provides the bias return currents for the inputs and causes only 10 mA of current to flow with a ground potential difference of 1 V. (The input bias current is typically in milliamperes.) This is usually manageable by the common-mode range of the instrumentation amplifier and analog ground system. Consider the problems with 1 Ω of impedance between 1 V of potential difference. The resulting 1 A of current causes many problems in the analog signal integrity.

If it is available, use Amp Low as a remote ground sense when running in pseudo-differential mode.

Differential Inputs

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

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

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

Analog Outputs

The analog output channels on DT3000 Series boards have a resolution of 12 bits (even though the accuracy may be less).

Data Translation ensures that the analog outputs do not break into a high frequency oscillation with high capacitance loads that occur with long cables. Typically, the analog outputs drive 1,000 pF without degradation and bandwidth-limit with higher capacitive loads.

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

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

Digital Inputs and Counter/Timer Inputs

To prevent damage when power is removed, you must provide current limiting circuitry for TTL-type input.

On high-speed clock inputs, a ground that is located in the connector next to the clock must be connected as a twisted pair with the high-speed clock input.

Digital Outputs

If you are using the high drive capability of a DT3000 Series board, ensure that the load is returned to the digital ground provided in the connector next to the outputs.

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

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