DATA TRANSLATION

UM-19140-K

DT351 User's Manual

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Radio and Television Interference

This equipment has been tested and found to comply with CISPR EN55022 Class A and EN50082-1 (CE) requirements and also with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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

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

Canadian Department of Communications Statement

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

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

Table of Contents

About this Manual

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

- DT351 software
- DT351 board
- STP37 screw terminal panel

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

This also manual describes the features of the DT351 board, the capabilities of the DT351 Device Driver, and how to program the DT351 board using DT-Open Layers for .NET Class Library™ software. Troubleshooting and calibration information are also provided.

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

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

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the DT351 board for data acquisition operations in Microsoft® Windows® XP, Windows Vista®, or Windows 7. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the board, as well as the supported software and accessories for the board, and provides an overview of the getting started procedure.
- Chapter 2, "Installing the Board," describes how to install the DT351 board and load the DT351 Device Driver.
- Chapter 3, "Loading and Configuring the Device Driver," describes how to configure the device driver to use interrupts.
- Chapter 4, "Attaching a Screw Terminal Panel," describes how to attach and configure the STP37 screw terminal panel.
- Chapter 5, "Wiring Signals," describes how to wire signals to the STP37 screw terminal panel.

- Chapter 6, "Verifying the Operation of a DT351 Board," describes how to verify the operation of a DT351 board with the Quick DataAcq application.
- Chapter 7, "Principles of Operation," describes all of the board's features and how to use them in your application.
- Chapter 8, "Supported Device Driver Capabilities," lists the data acquisition subsystems and the associated features accessible using the DT351 Device Driver.
- Chapter 9, "Troubleshooting," provides information that you can use to resolve problems with the board and the device driver, should they occur.
- Appendix A, "Specifications," lists the specifications of the board.
- Appendix B, "Connector Pin Assignments," shows the pin assignments for the connectors on the board and for the STP37 screw termination panel.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

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

Related Information

Refer to the following documents for more information on using the DT351 board:

- *Measure Foundry Manual* (UM-19298) and online help. These documents describe how to use Measure Foundry™ to build drag-and-drop test and measurement applications for Data Translation® data acquisition devices.
- *DT-Open Layers for .NET User's Manual* (UM-22161). For programmers who are developing their own application programs using Visual C# or Visual Basic .NET, this manual describes how to use the DT-Open Layers for .NET Class Library to access the capabilities or Data Translation data acquisition devices.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the
DT-Open Layers™ Data Acq SDK to access the capabilities of Data Translation data acquisition boards. This manual is provided 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's data acquisition boards in Microsoft® Visual Basic® or Visual C++®.
- *LV-Link Online Help*. This help file describes how to use LV-Link™ with the LabVIEW™ graphical programming language to access the capabilities of Data Translation data acquisition devices.

- *PCI Specification:* PCI Local Bus Specification, PCI Special Interest Group, Portland, OR. (Revision 2.1s).
- *PLX PCI9030 Data Book:* PLX Technology, Inc. (www.plxtech.com).
- Microsoft Windows XP, Windows Vista, or Windows 7 documentation.

Where To Get Help

Should you run into problems installing or using a DT351 board, the Technical Support Department is available to provide technical assistance. Refer to Chapter 9 starting on page 69 for more information. If you are outside the U.S. or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).

Overview

Features

Ideal for the control of electrical devices and for monitoring digital signals, the DT351 is an isolated digital I/O board that you can use to control electrical devices and monitor digital signals. It provides the following major features:

- Half-size board for the PCI bus
- 8 channel-to-channel opto-isolated digital input lines
- 8 channel-to-channel opto-isolated digital output lines
- DC input signal sensing from 3.5 V to 32 V
- Output loads of up to 100 mA
- 37-pin shielded I/O connector
- 250 VDC isolation between the inputs and the outputs and between the digital I/O lines and the system's PCI bus
- Over-current fuse protection
- PCI interrupt-request generated on change of any of the eight inputs

For a discussion of these features in detail, refer to Chapter 7 starting on page 53.

Supported Software

The following software is available for use with the DT351 board and is shipped on the Data Acquisition OMNI CD:

- **DT351 Device Driver** – You *must* install this device driver to use the DT351 board with any of the following supported software packages or utilities.
- **The Quick DataAcq application** – The Quick DataAcq application provides a quick way to get a DT351 board up and running. Using the Quick DataAcq application, you can verify the features of the board and display data on the screen.
- **Measure Foundry** – An evaluation version of this software is included on the Data Acquisition OMNI CD. Measure Foundry is drag-and-drop test and measurement application builder designed to give you top performance with ease-of-use development. Order the full development version of this software package to develop your own application using real hardware.
- **DT-Open Layers for .NET Class Library** – Use this class library if you want to use Visual C# or Visual Basic for .NET to develop your own application software for the DT351 board using Visual Studio 2003 or Visual Studio 2005; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for the DT351 board using Windows Windows XP, Windows Vista, or Windows 7; the DataAcq SDK complies with the DT-Open Layers standard.
- **DTx-EZ** – DTx-EZ provides ActiveX controls, which allow you to access the capabilities of the DT351 boards using Microsoft Visual Basic or Visual C++; DTx-EZ complies with the DT-Open Layers standard.
- **DAQ Adaptor for MATLAB** – Data Translation's DAQ Adaptor provides an interface between the MATLAB Data Acquisition (DAQ) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- **LV-Link** – An evaluation version of this software is included on the Data Acquisition OMNI CD. Use LV-Link if you want to use the LabVIEW graphical programming language to access the capabilities of the DT351 boards.

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

Accessories

The following optional accessories are available for the DT351 board:

- **STP37 screw terminal panel** – The STP37 permits easy screw terminal connections to the DT351 board. The STP37 screw terminal panel contains LED indicators to monitor the digital output lines.
- **EP333 cable** – The EP333 is a 2-meter shielded cable with two 37-pin connectors that connects the DT351 to the STP37.

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using a DT351 board. This diagram is repeated in each getting started chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

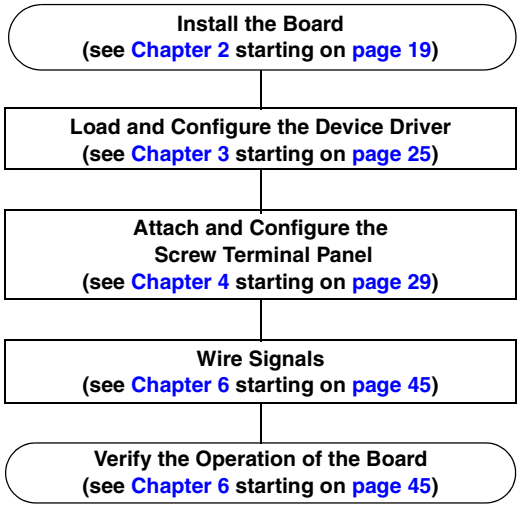
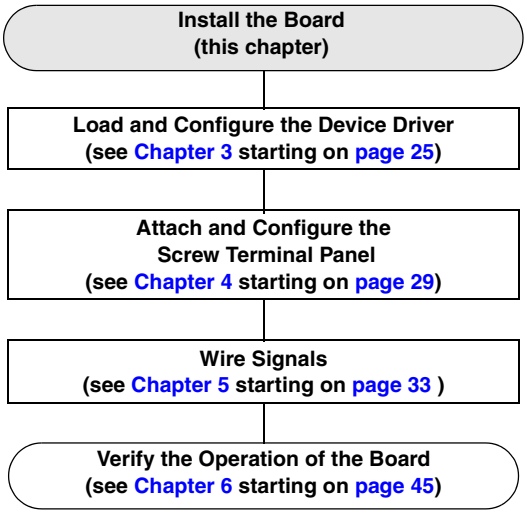


Figure 1: Getting Started Flow Diagram

Part 1: Getting Started

Installing the Board


Install the Board
(this chapter)
Load and Configure the Device Driver
(see Chapter 3 starting on page 25)
Attach and Configure the
Screw Terminal Panel
(see Chapter 4 starting on page 29)
Wire Signals
(see Chapter 5 starting on page 33)
Verify the Operation of the Board
(see Chapter 6 starting on page 45)

Unpacking

Open the shipping box and remove the wrapped DT351 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:

- DT351 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, ext 1323. An application engineer will guide you through the appropriate steps for replacing missing or damaged items. If you are located outside the United States, call your local distributor, listed on Data Translation's web site (www.datatranslation.com).

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, do the following:

1. Install the software from the Data Acquisition OMNI CD or Data Translation web site.

Note: If you are using Windows 7, you **must** install the device driver before installing the board in the computer.

2. Turn off the computer.
3. Turn off all peripherals (printer, modem, monitor, and so on) connected to the computer.
4. Unplug the computer and all peripherals.
5. 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 as follows:

1. **Select a PCI expansion slot.**

   PCI slots are shorter than ISA slots, and are usually white or ivory.

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 DT351 Board into the Computer

Once you have set up an expansion slot, do the following to insert the DT351 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.

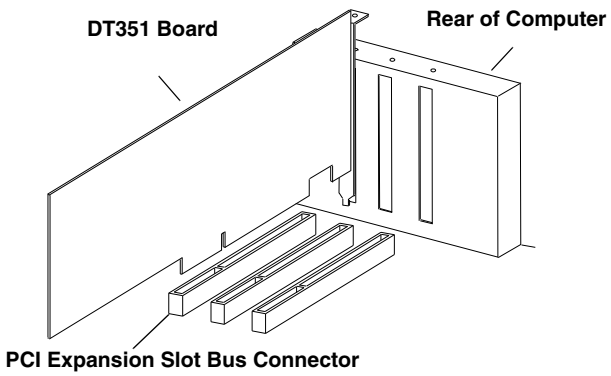


Figure 2: Inserting the DT351 Board in the Computer

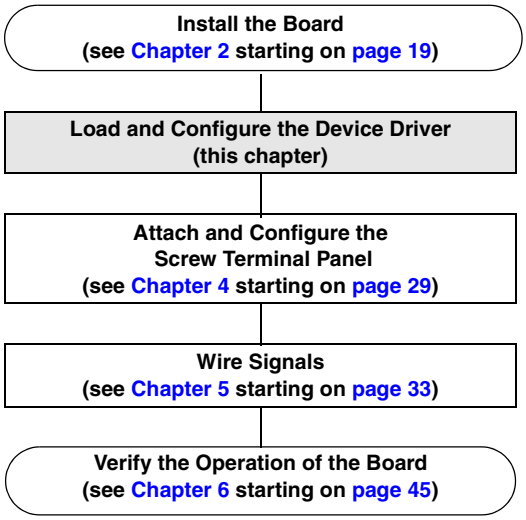
5. Carefully lower the board into the PCI expansion slot using the card guide to properly align the board in the slot.
6. When the bottom of the board contacts the bus connector, gently press down on the board until it clicks into place.

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.
   If you installed the DT351 software, the DT351 device driver is loaded automatically. If you have not installed the software, ensure that you do now.

Loading and Configuring the Device Driver


Install the Board
(see Chapter 2 starting on page 19)
Load and Configure the Device Driver
(this chapter)
Attach and Configure the
Screw Terminal Panel
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Wire Signals
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Loading the Device Driver

To load the DT351 device driver in

- Windows XP, follow the steps on page 27.
- Windows Vista, follow the steps on page 27.
- Windows 7, follow the steps on page 27.

Windows XP

Once you have installed a DT351 board and powered up the host computer, the New Hardware Found dialog box appears. Do the following 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\Inf\DT351.Inf, and then click **Open**.
5. Click **OK**.
6. Click **Next**.
   The files are copied.
7. Click **Finish**.

Windows Vista

Once you have installed the software from the Data Acquisition OMNI CD, installed a DT351 board, and powered up the host computer, the New Hardware Found dialog box appears. Do the following to load the device driver in Windows Vista:

1. Click **Locate and install driver software (recommended)**.
   The popup message "Windows needs your permission to continue" appears.
2. Click **Continue**.
   The Windows Security dialog box appears.
3. Click **Install this driver software anyway**.
   The driver files are installed.

Windows 7

Once you have installed the software from the Data Acquisition OMNI CD, installed a DT351 board, and powered up the host computer, the hardware is found automatically. Follow the steps on page 28 to configure the driver.

Configuring the Device Driver

To configure the device driver, do the following:

1. If you have not already done so, power up the host computer and all peripherals.
2. From the Control Panel, double-click the **Open Layers Data Acquisition Control Panel** icon.
   The Open Layers dialog box appears.
3. Click the DT351 board that you want to configure, and then click **Advanced**.
   The DT351 Control Panel dialog box appears.
4. Check the bits of the digital input that you want to generate an interrupt when the bit changes state, where bit 0 corresponds to digital input line 0 and bit 7 corresponds to digital input line 7. Refer to Chapter 2 of the *DT351 User's Manual* for more information on interrupts.
5. Click **OK**.
6. If you want to rename the board, click **Edit Name**; otherwise, go to step 8.

Note: Each module must have a unique name. This name is used to identify the module in all subsequent applications.

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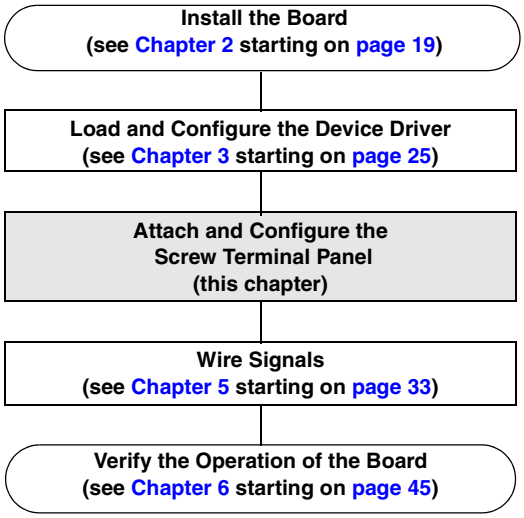
7. Enter a new name for the board, and then click **OK**.
8. When you are finished configuring the board, click **Close**.
9. Repeat steps 3 to 8 for the other boards that you want to configure.
10. Close the Control Panel.

4

Attaching a Screw Terminal Panel


Install the Board
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(this chapter)
Wire Signals
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Before you can wire signals, you need to attach the STP37 screw terminal panel to the DT351 board. Connect the STP37 to the J1 connector on your DT351 board using the EP333 cable.

Figure 3 illustrates how to attach the STP37 screw terminal panel to the DT351 board.

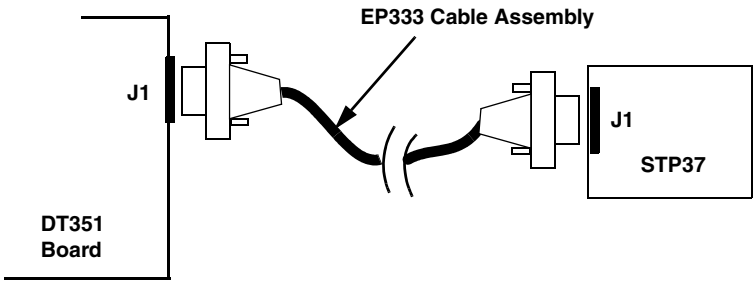
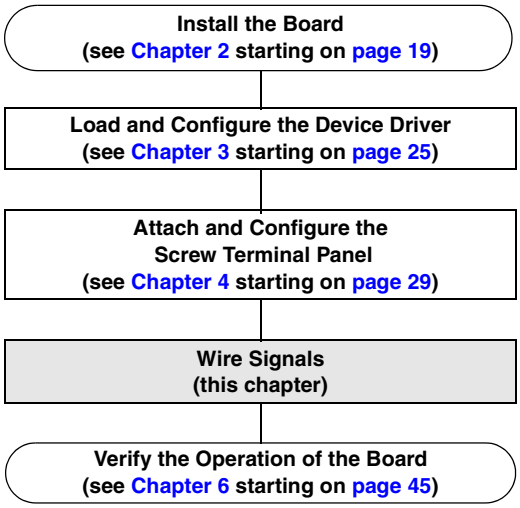


Figure 3: Connecting the DT351 to the STP37

Wiring Signals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(this chapter)
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(see Chapter 6 starting on page 45)

Preparing to Wire Signals

This section describes wiring recommendations and the pin assignments of the STP37 screw terminal panel.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to the STP37 screw terminal panel:

- Follow standard ESD procedures when wiring signals to the board.
- Use individually shielded twisted-pair wire (size 14 to 26 AWG) when using the DT351 board in a highly noisy electrical environment.
- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the STP37 screw terminal panel and cabling next to sources that produce high electro-magnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- When first installing the board, it is recommended that you do the following:
  - Wire a digital input signal to digital input line 0.
  - Wire an LED or other indicator to digital output line 0.
  - If you have not done so already, install the DT351 software.
  - Run the Quick DataAcq application (described in Chapter 6 starting on page 45) 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.

Screw Terminal Assignments

Figure 4 shows the layout of the STP37 screw terminal panel and lists the screw terminal assignments.

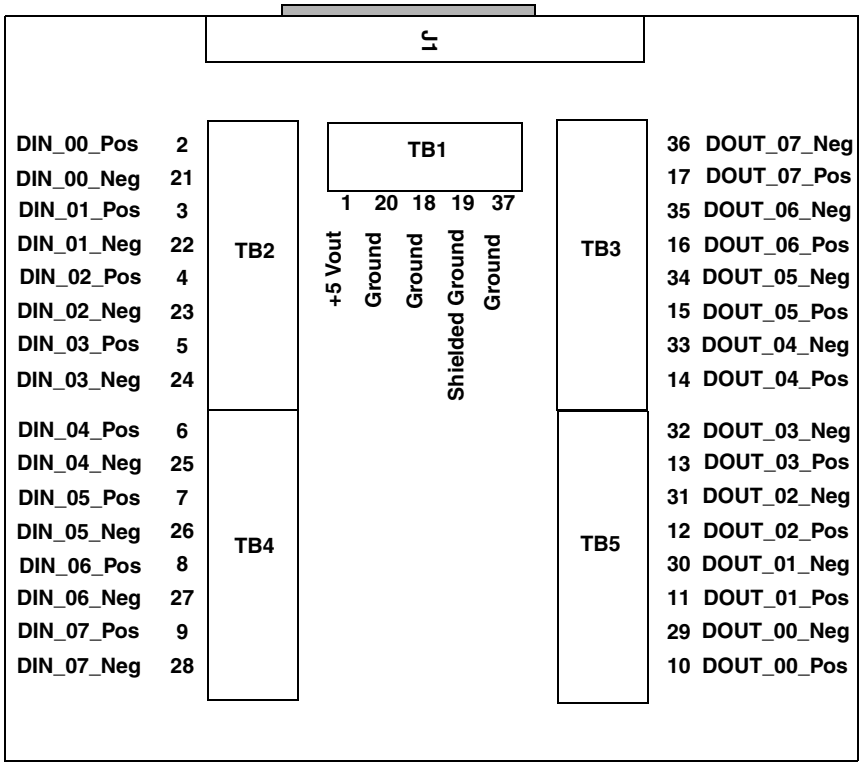


Figure 4: STP37 Screw Terminal Panel

Wiring Digital Input Signals

The DT351 can accept up to eight isolated digital input signals. Figure 5 shows how to connect a TTL digital input signal (input line 0, in this case) to the STP37 screw terminal panel.

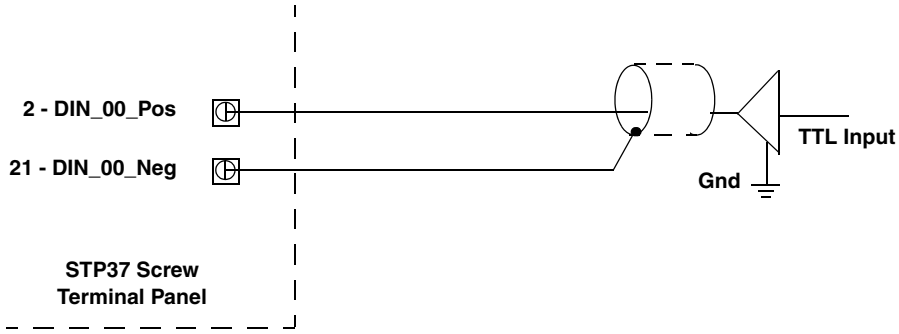


Figure 5: Connecting a TTL Digital Input to the STP37 Screw Terminal Panel

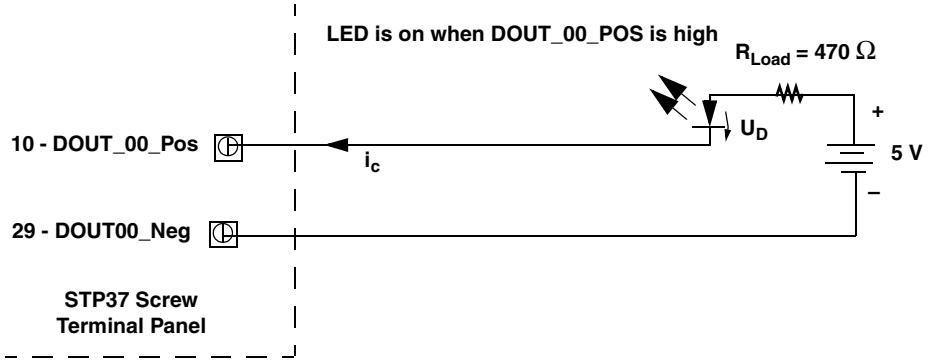
Wiring Digital Output (Open Collector) Signals

The DT351 provides eight outputs for driving external loads, such as solenoid valves, indicators, solid-state relays, and other low-power DC loads. These outputs are in the form of open-collector (current-sinking) transistors capable of switching loads up to 120 mA.

Generally, open-collector outputs have the collector terminal of the output transition left open, or unconnected, to allow greater flexibility. In fact, the DT351 outputs provide open collectors and emitters, since each channel is completely isolated. This arrangement provides a further advantage in that it allows you to configure the circuitry using either positive or negative logic.

A DT351 open-collector output performs much like a switch contact. When the output is turned off, no current can flow through the transistor. This is equivalent to an open switch contact, since the device being controlled is turned off. When the output is turned on, current flows through the transistor just as though a switch contact had been closed. The controlled device turns on in response to the flow of current.

Figure 6 shows an example of connecting a digital output signal to the STP37 screw terminal panel. When the DOUT_00_POS is high, the transistor turns on, current flows, and the LED turns on.



Note: The collector circuit (i_c) is protected by 125 mA fast-acting fuses on each channel. Therefore, you must consider i_c and R_{LOAD}. In this example, the collector current is approximately 6.4 mA, determined as follows:

$$i_c = \frac{V_{suppy} - U_D - U_{CE}}{R_{LOAD}}$$

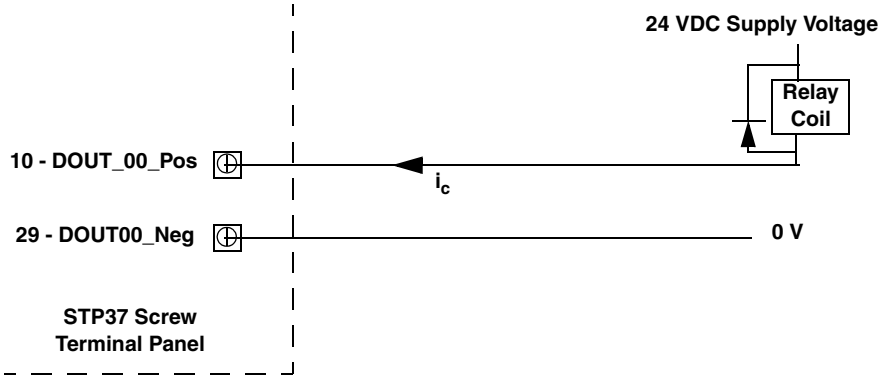
U_D is the forward voltage drop across the diode (red is approximately 1.2 V) and U_{CE} is the forward voltage drop across the DT351 transistor collector-emitter junction (0.8 V).

$$i_c = \frac{5\ V - 1.2\ V - 0.8\ V}{470\ \Omega} = 6.4\ mA$$

Note also that you can use +5 V from screw terminal +5 V (J1 pin 1) on the STP37 and 0 V from screw terminal Shielded Ground (J1 pin 19) on the STP37, if you wish, instead of providing them as shown in this example.

Figure 6: Connecting a Digital Output to the STP37 Screw Terminal Panel

Figure 7 shows an example of connecting a switching external load (such as relay) to the STP37 screw terminal panel. When the DOUT_00_POS is high, the transistor turns on, and current flows through the relay.



Note: The collector circuit (i_c) is protected by 125 mA fast-acting fuses on each channel. Therefore, you must consider i_c and R_{LOAD}. In this example, the collector current is approximately 23 mA, determined as follows:

$$i_c = \frac{V_{suppy} - U_{CE}}{R_{LOAD}}$$

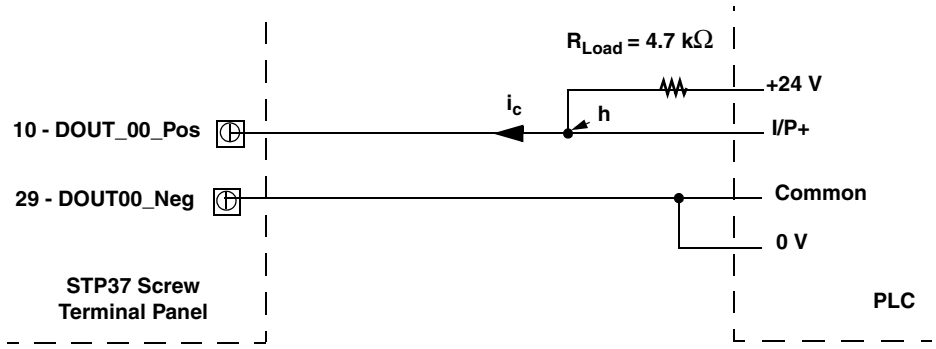
U_{CE} is the forward voltage drop across the DT351 transistor collector-emitter junction (0.8 V).

$$i_c = \frac{24\ V - 0.8\ V}{1\ k\Omega} = 23\ mA$$

When driving relays, it is standard practice to use a protection diode, such as an IN4004, to prevent back-voltage that can damage the DT351 output circuit.

Figure 7: Connecting a Switching External Supply to the STP37 Screw Terminal Panel

Figure 8 shows an example of connecting a programmable logic controller (PLC) device to the STP37 screw terminal panel using negative logic. When the DOUT_00_POS is high, the transistor turns on, point *h* in Figure 8 is pulled down to approximately 0.8 V; therefore, the output is low to the PLC.



Note: The collector circuit (i_c) is protected by 125 mA fast-acting fuses on each channel. Therefore, you must consider i_c and R_{LOAD}. In this example, the collector current is approximately 5 mA, determined as follows:

$$i_c = \frac{V_{suppy} - U_{CE}}{R_{LOAD}}$$

U_{CE} is the forward voltage drop across the DT351 transistor collector-emitter junction (0.8 V).

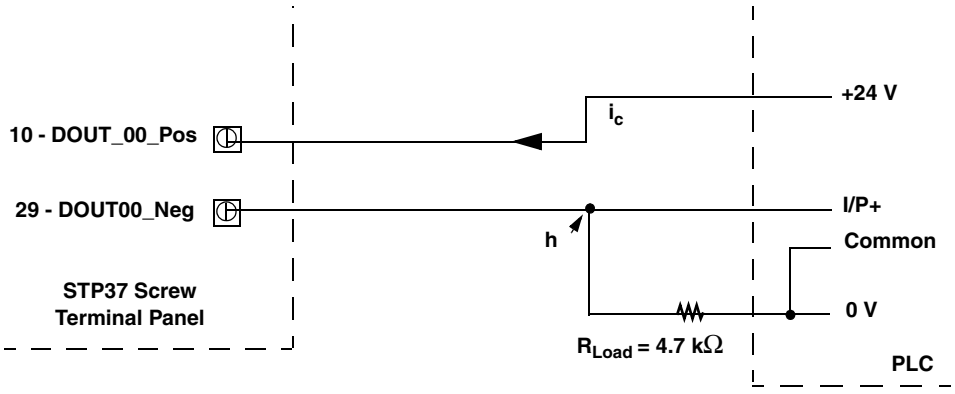
$$i_c = \frac{24\ V - 0.8\ V}{4.7\ k\Omega} = 5\ mA$$

The 4.7 kΩ resistor acts as a pull-up for the PLC input and limits the current flow to below 125 mA.

This example uses negative logic; 24 V and 0 V are shown but can be substituted with an external PSU, if required.

Figure 8: Connecting a PLC to the STP37 Screw Terminal Panel Using Negative Logic

Figure 9 shows an example of connecting a PLC device to the STP37 screw terminal panel using positive logic. When the DOUT_00_POS is high, the transistor turns on, point *h* in Figure 9 rises to approximately 23.4 V; therefore, the output is high to the PLC.



Note: The collector circuit (i_c) is protected by 125 mA fast-acting fuses on each channel. Therefore, you must consider i_c and R_{LOAD}. In this example, the collector current is approximately 5 mA, determined as follows:

$$i_c = \frac{V_{suppy} - U_{CE}}{R_{LOAD}}$$

U_{CE} is the forward voltage drop across the DT351 transistor collector-emitter junction (0.8 V).

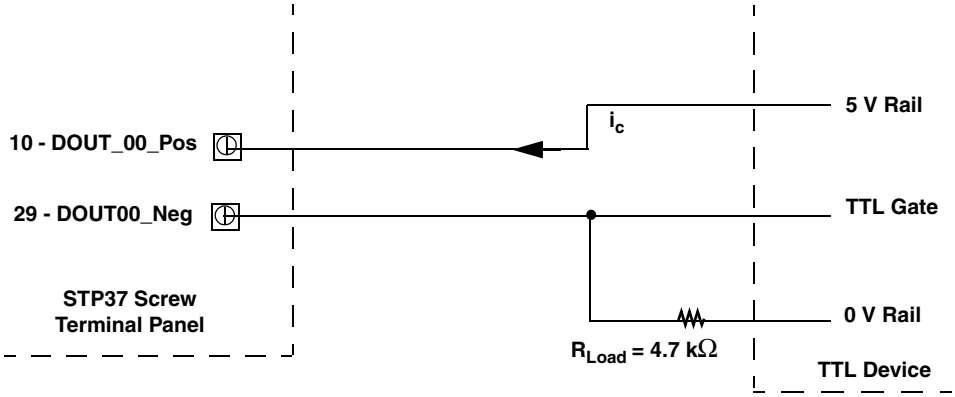
$$i_c = \frac{24\ V - 0.8\ V}{4.7\ k\Omega} = 5\ mA$$

The 4.7 kΩ resistor acts as a pull-down for the PLC input and limits the current flow to below 125 mA.

This example uses positive logic; 24 V and 0 V are shown but can be substituted with an external PSU, if required.

Figure 9: Connecting a PLC Input to the STP37 Screw Terminal Panel Using Positive Logic

Figure 10 shows an example of connecting a TTL device to the STP37 screw terminal panel using positive logic.

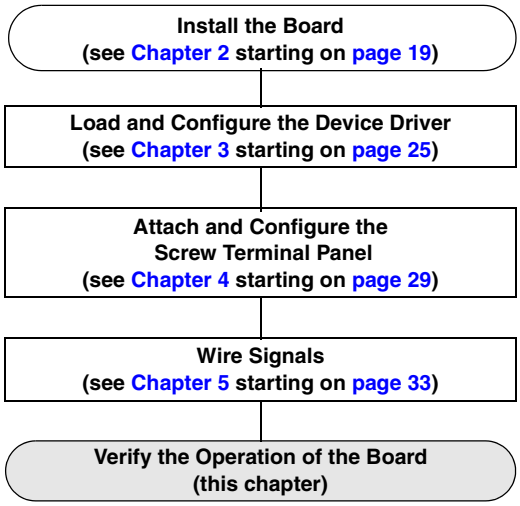


Note: For most TTL families, logic high ranges from 2.0 to 5.0 V and logic low ranges from 0 to 0.8 V.

Normally, positive logic (shown in this example) is used to drive a TTL gate to reduce current consumption. Negative logic causes the TTL inputs to consume more current.

Figure 10: Connecting a TTL Device to the STP37 Screw Terminal Panel Using Positive Logic

Verifying the Operation of a DT351 Board



You can verify the operation of a DT351 Series module using the Quick DataAcq application. Quick DataAcq lets you do the following:

- Acquire data from a single digital input port
- Output data from a single digital output port

This chapter describes how to run the Quick DataAcq application.

Running the Quick DataAcq Application

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

To run the Quick DataAcq application, do the following:

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

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

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

Testing Single-Value Digital Input

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

1. Connect a digital input to digital input line 0 on the DT351 board. Refer to page 37 for more information on connecting digital inputs.
2. In the Quick DataAcq application, choose **Digital Input** from the **Acquisition** menu.
3. Select the appropriate DT351 board from the Board list box.
4. Click **Port A**.
5. Click **Get**.
   The application displays the value of each digital input line on the screen in both text and graphical form.

Testing Single-Value Digital Output

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 on the DT351 board. Refer to page 38 for an example of how to connect a digital output.
2. In the Quick DataAcq application, choose **Digital Output** from the **Control** menu.
3. Select the appropriate DT351 board from the Board list box.
4. Click **Port A**.
5. Click the appropriate bits to select the type of data to write to the digital output lines. If the bit is selected, a low-level signal is output to the digital output line; if the bit is not selected, a high-level signal is output to the digital output line. Optionally, you can enter an output value in the Hex text box.
6. Click **Send**.
   The application displays the value of each digital output line on the screen in both text and graphical form.

Part 2: Using Your Module

Principles of Operation

This chapter describes the digital I/O features of the DT351 board. To frame the discussions, refer to the block diagram shown in
Figure 11.

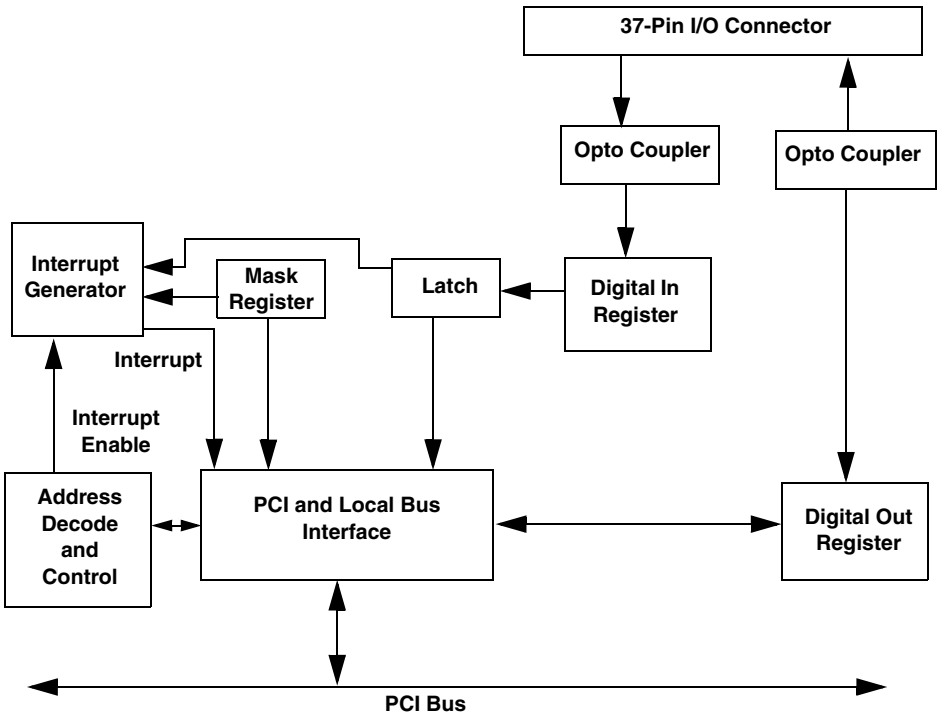


Figure 11: DT351 Block Diagram

Digital I/O Lines

DT351 boards support eight dedicated digital input lines through the digital input (DIN) subsystem and eight dedicated digital output lines through the digital output (DOUT) subsystem.

Channel-to-channel isolation of 250 VDC is provided by physical separation of the inputs and outputs and separate ground runs. In addition, the digital I/O lines are isolated from the system's PCI bus by 250 VDC. Digital output line protection is provided by fast-acting fuses on each line. Fuses open when the load exceeds 300 mA. Note that these fuses reset themselves when needed.

You can specify the digital input line to read in a single-value digital I/O or continuous operation. You can specify the digital output line to write to in a single-value digital I/O operation. Refer to page 57 for more information on digital I/O operation modes.

The resolution is fixed at 8, which means that you can read or write to all the lines of the digital I/O port at once.

On power up or reset, no digital data is output from the board.

Note: For digital input lines, a value of 0 indicates the input is low; a value of 1 indicates that the input is high.

For digital outputs, the values are inverted. Therefore, a value of 0 indicates that the output is high; a value of 1 indicates that the output is low.

If you write a digital output value, then read the value using a digital input, you must wait approximately 1 ms to ensure accurate data. This delay is due to the isolation circuitry.

Interrupts

The DT351 board can generate a PCI-bus interrupt when any of the digital input lines changes state. This feature is useful when you want to monitor critical signals or when you want to signal the host computer to transfer data to or from the board. You enable the interrupts on a line-by-line basis during DT351 driver configuration; refer to page 28 for more information. Use software to determine which digital line changed state; refer to page 57 for more information.

The DT351 board provides debouncing circuitry for the digital inputs; this means that any state changes that result from noise sources, slow rise or fall times, or switch bounce on the input source are ignored for approximately 1 ms. Debouncing the inputs prevents most situations where multiple interrupts can occur for one state change.

In some cases, though, particularly with digital signals that are derived from mechanical switches, you may need to add more debouncing in your application program; refer to the Knowledgebase section of the Data Translation web site (www.datatranslation.com) for information on adding debouncing code to your application program.

Operation Modes

DT351 boards support the following digital I/O operation modes:

- **Single-value operations** are the simplest to use but do not allow you to check the interrupt status. Use software to specify the DIN or DOUT subsystem, a resolution of 8, and a gain of 1 (the gain is ignored). Data is then read from or written to the appropriate digital I/O lines.

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

- **Continuous digital input** allows you to read digital input values as well as check the interrupt status of the digital input lines. Use software to specify the DIN subsystem element and continuous mode. Once the operation is configured and started, an event is generated when an interrupt occurs. You can determine which digital input lines changed state as well as the current value of the digital input lines at the time the interrupt occurred.

Note: If you are using the DataAcq SDK to perform a continuous digital input operation, use the *lParam* parameter of the **olDaSetWndHandle** or **olDaSetNotificationProcedure** function to determine which digital input line changed state and the status of the digital input port when the interrupt occurred.

The low word of *lParam* contains the digital lines (bits) that changed state, where bit 0 corresponds to digital input line 0 and bit 7 corresponds to digital input line 0.

The high word of lParam contains the state of the digital input subsystem, where bit 16 corresponds to digital input line 0 and bit 23 corresponds to digital input line 7. If a bit is set to 1, the associated digital input line changed state.

The resolution reflects the number of significant bits in *lParam.*

Supported Device Driver Capabilities

The DT351 Device Driver provides support for the analog input (A/D), analog output (D/A), digital input (DIN), digital output (DOUT), counter/timer (C/T), and quadrature decoder (QUAD) subsystems. For information on how to configure the device driver, refer to page 28.

Table 1: DT351 Subsystems

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Total Subsystems on Board	0	0	1	1	0	0

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT351 boards. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

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

Note: Blank fields represent unsupported options.

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

Data Flow and Operation Options

Table 2: DT351 Data Flow and Operation Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Single-Value Operation Support **SupportsSingleValue**			Yes	Yes		
Simultaneous Single-Value Output Operations SupportsSetSingleValues						
Continuous Operation Support **SupportsContinuous**			Yes			
Continuous Operation until Trigger **SupportsContinuousPreTrigger**						
Continuous Operation before & after Trigger **SupportsContinuousPrePostTrigger**						
Waveform Operations Using FIFO Only **SupportsWaveformModeOnly**						
Simultaneous Start List Support **SupportsSimultaneousStart**						
Supports Programmable Synchronization Modes **SupportsSynchronization**						
Synchronization Modes **SynchronizationMode**						
Interrupt Support **SupportsInterruptOnChange**			Yes[a]			
Output FIFO Size **FifoSize**						
Auto-Calibrate Support **SupportsAutoCalibrate**						

a. The DT351 board can generate a PCI-bus interrupt when any of the digital input lines changes state. This feature is useful when you want to monitor critical signals or when you want to signal the host computer to transfer data to or from the board. You enable the interrupts on a line-by-line basis during DT351 driver configuration; refer to page 28 for more information on configuring the driver. If you are using the DataAcq SDK, refer to page 56 for more information on determining which digital input lines changed state.

Buffering

Table 3: DT351 Buffering Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Buffer Support **SupportsBuffering**						
Single Buffer Wrap Mode Support **SupportsWrapSingle**						
Inprocess Buffer Flush Support **SupportsInProcessFlush**						

Triggered Scan Mode

Table 4: DT351 Triggered Scan Mode Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Triggered Scan Support **SupportsTriggeredScan**						
Maximum Number of CGL Scans per Trigger **MaxMultiScanCount**			0	0		
Maximum Retrigger Frequency **MaxRetriggerFreq**			0	0		
Minimum Retrigger Frequency **MinRetriggerFreq**			0	0		

Data Encoding

Table 5: DT351 Data Encoding Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Binary Encoding Support **SupportsBinaryEncoding**			Yes	Yes		
Twos Complement Support **SupportsTwosCompEncoding**						
Returns Floating-Point Values **ReturnsFloats**						

Channels

Table 6: DT351 Channel Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Number of Channels **NumberOfChannels**			1	1		
SE Support **SupportsSingleEnded**						
SE Channels **MaxSingleEndedChannels**			0	0		
DI Support **SupportsDifferential**			Yes	Yes		
DI Channels **MaxDifferentialChannels**			1	1		
Maximum Channel-Gain List Depth **CGLDepth**			0	0		
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**						
Channel-List Inhibit **SupportsChannelListInhibit**						

Gain

Table 7: DT351 Gain Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Programmable Gain Support **SupportsProgrammableGain**						
Number of Gains **NumberOfSupportedGains**			1	1		
Gains Available **SupportedGains**			1	1		

Ranges

Table 8: DT351 Range Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Number of Voltage Ranges **NumberOfRanges**			0	0		
Available Ranges **SupportedVoltageRanges**						
Current Output Support **SupportsCurrentOutput**						

Resolution

Table 9: DT351 Resolution Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Software Programmable Resolution **SupportsSoftwareResolution**						
Number of Resolutions **NumberOfResolutions**			1	1		
Available Resolutions **SupportedResolutions**			8	8		

Thermocouple and RTD Support

Table 10: DT351 Thermocouple and RTD Support Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Thermocouple Support **SupportsThernocouple**						
RTD Support **SupportsRTD**						
Resistance Support **ReturnsOhms**						
Voltage Converted to Temperature in Hardware **SupportsTemperatureDataInStream**						
Supported Thermocouple Types **ThermocoupleType**						
Supported RTD Types **RTDType**						
Supports CJC Source Internally in Hardware **SupportsCjcSourceInternal**						
Supports CJC Channel **SupportsCjcSourceChannel**						
Available CJC Channels **CjcChannel**						
Supports Interleaved CJC Values in Data Stream **SupportsInterleavedCjcTemperaturesInStream**						
Supports Programmable Filters **SupportsTemperatureFilters**						
Programmable Filter Types **TemperatureFilterType**						

IEPE Support

Table 11: DT351 IEPE Support Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Software Programmable AC Coupling **SupportsACCoupling**						
Software Programmable DC Coupling **SupportsDCCoupling**						
Software Programmable External Excitation Current Source **SupportsExternalExcitationCurrentSrc**						
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**						
Available Excitation Current Source Values **SupportedExcitationCurrentValues**						

Triggers

Table 12: DT351 Trigger Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Software Trigger Support **SupportsSoftwareTrigger**			Yes	Yes		
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**						
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**						
External Positive TTL Trigger Support for Single-Value Operations **SupportsSvPosExternalTTLTrigger**						
External Negative TTL Trigger Support for Single-Value Operations **SupportsSvNegExternalTTLTrigger**						
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**						
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**						
Digital Event Trigger Support **SupportsDigitalEventTrigger**						

Clocks

Table 13: DT351 Clock Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Internal Clock Support **SupportsInternalClock**						
External Clock Support **SupportsExternalClock**						
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**						
Base Clock Frequency **BaseClockFrequency**			0	0		
Maximum Clock Divider **MaxExtClockDivider**			1	1		
Minimum Clock Divider **MinExtClockDivider**			1.0	1.0		
Maximum Frequency **MaxFrequency**			0	0		
Minimum Frequency **MinFrequency**			0	0		

Counter/Timers

Table 14: DT351 Counter/Timer Options

DT351	A/D	D/A	DIN	DOUT	C/T	QUAD
Cascading Support **SupportsCascading**						
Event Count Mode Support **SupportsCount**						
Generate Rate Mode Support **SupportsRateGenerate**						
One-Shot Mode Support **SupportsOneShot**						
Repetitive One-Shot Mode Support **SupportsOneShotRepeat**						
Up/Down Counting Mode Support **SupportsUpDown**						
Edge-to-Edge Measurement Mode Support **SupportsMeasure**						
Continuous Edge-to-Edge Measurement Mode Support **SupportsContinuousMeasure**						
High to Low Output Pulse Support **SupportsHighToLowPulse**						
Low to High Output Pulse Support **SupportsLowToHighPulse**						
Variable Pulse Width Support **SupportsVariablePulseWidth**						
None (internal) Gate Type Support **SupportsGateNone**						
High Level Gate Type Support **SupportsGateHighLevel**						
Low Level Gate Type Support **SupportsGateLowLevel**						
High Edge Gate Type Support **SupportsGateHighEdge**						
Low Edge Gate Type Support **SupportsGateLowEdge**						
Level Change Gate Type Support **SupportsGateLevel**						
Clock-Falling Edge Type **SupportsClockFalling**						
Clock-Rising Edge Type **SupportsClockRising**						
Gate-Falling Edge Type **SupportsGateFalling**						
Gate-Rising Edge Type **SupportsGateRising**						
Interrupt-Driven Operations **SupportsInterrupt**						

Troubleshooting

General Checklist

Should you experience problems using a DT351 board, do the following:

1. Read all the documentation provided for your product. Make sure that you have added any "Read This First" information to your manual and that you have used this information.
2. Check the Data Acquisition OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated in Chapter 2.
4. Check that you have installed your hardware properly using the instructions in Chapter 3.
5. Check that you have installed and configured the device driver properly using the instructions in Chapter 3.
6. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.

If you still experience problems, try using the information in Table 15 to isolate and solve the problem. If you cannot identify the problem, refer to page 72.

Table 15: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Board does not respond.	The board configuration is incorrect.	Check the configuration of your device driver to ensure that the board name and type are correct.
	The board is incorrectly aligned in a PCI expansion slot.	Check that the slot in which your DT351 board is located is a PCI slot and that the board is correctly seated in the slot.
	The board is damaged.	Contact Data Translation for technical support; refer to page 72.
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources.
	The board is overheating.	Check environmental and ambient temperature; consult the board's specifications on page 77 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections.

Table 15: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Computer does not boot.	Board is not seated properly.	Check that the slot in which your DT351 board is located is a PCI slot, that the board is correctly seated in the slot, and that the board is secured in the slot with a screw.
	The power supply of the computer is too small to handle all the system resources.	Check the power requirements of your system resources and, if needed, get a larger power supply; consult the board's specifications on page 77 of this manual.
System lockup.	Board is not seated properly.	Check that the slot in which your DT351 board is located is a PCI slot, that the board is correctly seated in the slot, and that the board is secured in the slot with a screw.
Digital outputs do not work properly.	Outputs not TTL-compatible.	The wiring requirements for isolated signals are different than for nonisolated outputs. Wire your digital output signals as shown in *Chapter 4*.

Technical Support

If you have difficulty using a DT351 board, Data Translation's Technical Support Department is available to provide technical assistance.

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

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

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

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

If Your Board Needs Factory Service

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

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

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

2. Using the original packing materials, if available, package the module as follows:

   – Wrap the board in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the module.

   – Place in a secure shipping container.

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

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

Specifications

Digital I/O Specifications

Table 16 lists digital I/O specifications of the DT351 board.

Table 16: Digital I/O Specifications

Feature	Specification
Digital Input High Input Voltage Range	3.5 to 32 VDC
Digital Input Low Input Voltage Range	< 1.0 VDC
Digital Input Resistance	~3.3 kΩ
Digital Input Turn On/Off Time (@12 VDC input)	< 1 ms
Digital Output Maximum Load Current	100 mA (DC)
Digital Output Maximum Load Voltage	60 V (DC)
Digital Output Dark Current	100 µA (maximum)
Digital Output Turn On/Off Time	< 1 ms
Digital Output Lines Overcurrent Protection Fuse Point	> 140 mA
Digital Output Lines Transient Voltage Protection	600 Watts @ 1 ms
ESD Per Mil 38510 Class 2	1,500 V
Channel-to-Channel Isolation	250 VDC
Channel-to-Host System Isolation	250 VDC

Physical Specifications

Table 17 lists the physical specifications of the DT351.

Table 17: DT351 Physical Specifications

Parameter	Specification
Dimensions	4.2” x 6.9” x 0.2” (10.7 x 17.5 x 0.5 cm)
Weight	4.3 oz (121.9 gm)
Temperature Range Operating: Storage:	 0° C to +70° C –25 °C to 85° C
Relative Humidity Range Operating: Storage:	 25 to 85% (noncondensing) 95% (noncondensing)
Altitude Operating: Storage:	 to 2.3 km (10,000 ft) maximum to 9.2 km (40,000 ft) maximum
Connector 37-pin AMP SCSI 2: Mating Connector Kit (includes plug and shell):	 AMP 747847-4 AMP 747563-1

Connector Pin Assignments

Connector J1 on the DT351 Board

Table 18 lists the pin assignments for connector J1 of the DT351 board.

Table 18: Connector J1 Pin Assignments

J1 Pin	Signal Name	J1 Pin	Signal Name
1	+5V_Out	2	DIN_00_POS
3	DIN_01_POS	4	DIN_02_POS
5	DIN_03_POS	6	DIN_04_POS
7	DIN_05_POS	8	DIN_06_POS
9	DIN_07_POS	10	DOUT_00_POS
11	DOUT_01_POS	12	DOUT_02_POS
13	DOUT_03_POS	14	DOUT_04_POS
15	DOUT_05_POS	16	DOUT_06_POS
17	DOUT_07_POS	18	Ground
19	Shielded Ground	20	Ground
21	DIN_00_NEG	22	DIN_01_NEG
23	DIN_02_NEG	24	DIN_03_NEG
25	DIN_04_NEG	26	DIN_05_NEG
27	DIN_06_NEG	28	DIN_07_NEG
29	DOUT_00_NEG	30	DOUT_01_NEG
31	DOUT_02_NEG	32	DOUT_03_NEG
33	DOUT_04_NEG	34	DOUT_05_NEG
35	DOUT_06_NEG	36	DOUT_07_NEG
37	Ground		

Screw Terminal Assignments for the STP37

Table 19 lists the screw terminal assignments for the STP37 screw terminal panel.

Table 19: STP37 Screw Terminal Assignments

Terminal Block	Screw Terminal	Signal Name	Terminal Block	Screw Terminal	Signal Name
TB1	1	+5V_Out	TB2	2	DIN_00_POS
TB2	3	DIN_01_POS	TB2	4	DIN_02_POS
TB2	5	DIN_03_POS	TB4	6	DIN_04_POS
TB4	7	DIN_05_POS	TB4	8	DIN_06_POS
TB4	9	DIN_07_POS	TB5	10	DOUT_00_POS
TB5	11	DOUT_01_POS	TB5	12	DOUT_02_POS
TB5	13	DOUT_03_POS	TB3	14	DOUT_04_POS
TB3	15	DOUT_05_POS	TB3	16	DOUT_06_POS
TB3	17	DOUT_07_POS	TB1	18	Ground
TB1	19	Shielded Ground	TB1	20	Ground
TB2	21	DIN_00_NEG	TB2	22	DIN_01_NEG
TB2	23	DIN_02_NEG	TB2	24	DIN_03_NEG
TB4	25	DIN_04_NEG	TB4	26	DIN_05_NEG
TB4	27	DIN_06_NEG	TB4	28	DIN_07_NEG
TB5	29	DOUT_00_NEG	TB5	30	DOUT_01_NEG
TB5	31	DOUT_02_NEG	TB5	32	DOUT_03_NEG
TB3	33	DOUT_04_NEG	TB3	34	DOUT_05_NEG
TB3	35	DOUT_06_NEG	TB3	36	DOUT_07_NEG
TB1	37	Ground			

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