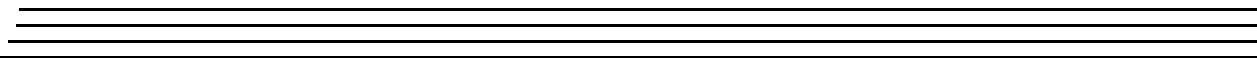
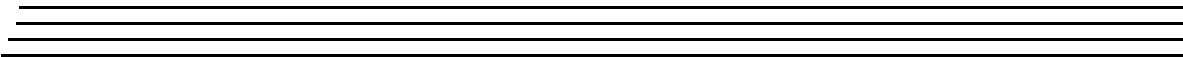
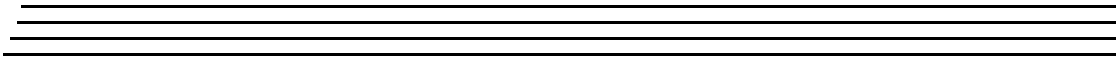




UM-21551-B

DT9836 Series User's Manual



**Second Edition
March, 2006**

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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.

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About this Manual

The first part of this manual describes how to install and set up your DT9836 Series module and device driver, and verify that your module is working properly. It incorporates the content of the former Getting Started manual.

The second part of this manual describes the features of the DT9836 Series modules, the capabilities of the DT9836 Series Device Driver, and how to program the DT9836 Series modules using DT-Open Layers software. Troubleshooting information is also provided.

Note: The DT9836 Series module is available either installed in a metal BNC connection box, or as a board-level OEM version that you can install in your own custom application. If the information in this manual applies to all versions of the DT9836 Series module, the manual uses the product name "DT9836 Series module." Otherwise, the specific product name is mentioned.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the DT9836 Series modules for data acquisition operations in the Microsoft® Windows® 2000 or Windows XP operating system. 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 DT9836 Series module, as well as the supported software and accessories for the modules.
- [Chapter 2, “Preparing to Use a Module,”](#) describes how to unpack the DT9836 Series package, check the system requirements, install the DT9836 Series software under Windows 2000 or Windows XP, and view the DT9836 Series documentation online.
- [Chapter 3, “Setting Up and Installing the Module,”](#) describes how to install a DT9836 Series module, how to apply power to the module, and how to configure the device driver.
- [Chapter 4, “Wiring Signals to the BNC Connection Box,”](#) describes how to wire signals to a DT9836 Series BNC connection box.
- [Chapter 5, “Verifying the Operation of a Module,”](#) describes how to verify the operation of the DT9836 Series module with the Quick Data Acq application.
- [Chapter 6, “Principles of Operation,”](#) describes all of the features of the DT9836 Series module and how to use them in your application.
- [Chapter 7, “Supported Device Driver Capabilities,”](#) lists the data acquisition subsystems and the associated features accessible using the DT9836 Series Device Driver.
- [Chapter 8, “Programming Flowcharts,”](#) describes the processes you must follow to program the subsystems of the DT9836 Series module using DT-Open Layers-compliant software.
- [Chapter 9, “Troubleshooting,”](#) provides information that you can use to resolve problems with the DT9836 Series module and device driver, should they occur.

- [Chapter 10, “Calibration,”](#) describes how to calibrate the analog I/O circuitry of the DT9836 Series modules.
- [Appendix A, “Connector Pin Assignments,”](#) shows the pin assignments for the connectors and the screw terminal assignments for the screw terminals on the DT9836 Series modules.
- [Appendix B, “Ground, Power, and Isolation,”](#) describes the electrical characteristics of the DT9836 Series module.
- [Appendix C, “Specifications,”](#) lists the specifications of the DT9836 Series modules.
- 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 DT9836 Series modules:

- *Benefits of the Universal Serial Bus for Data Acquisition*. This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation web site (www.datatranslation.com).

- *DT Measure Foundry Getting Started Manual* (UM-19298) and online help. These documents describe how to use DT Measure Foundry™ to build drag-and-drop test and measurement applications for Data Translation® data acquisition devices without programming.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the DT-Open Layers DataAcq SDK to access the capabilities of Data Translation data acquisition devices.
- *DTx-EZ Getting Started Manual* (UM-15428). This manual describes how to use the ActiveX controls provided in DTx-EZ to access the capabilities of Data Translation data acquisition devices in Microsoft Visual Basic® or Visual C++®.
- *DT-LV Link Getting Started Manual* (UM-15790). This manual describes how to use DT-LV Link with the LabVIEW graphical programming language to access the capabilities of Data Translation data acquisition devices.
- Microsoft Windows 2000 or Windows XP documentation.
- USB web site (<http://www.usb.org>).

Where To Get Help

Should you run into problems installing or using a DT9836 Series module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to [Chapter 9](#) for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).



Overview

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DT9836 Hardware Features

The DT9836 Series is a family of high-performance, multifunction data acquisition modules for the USB (Ver. 2.0 or Ver. 1.1) bus. The key hardware features of the DT9836 Series modules are as follows:

- Available either installed in a metal BNC connection box, or as a board-level OEM version that you can install in your own custom application.
- Simultaneous operation of analog input, analog output, digital I/O, and counter/timer subsystems.
- Analog input subsystem:

16-bit A/D converters.

Throughput rate up to 225 kSamples/s.

Either 12 or 6 single-ended separate, simultaneous analog input channels. The number of channels provided depend on the model you purchase.

Input ranges of ± 10 and ± 5 V.

17- or 23-location channel list. You can read digital inputs, the two 32-bit counters, and the three 32-bit quadrature decoders using the A/D subsystem and the A/D clock. This synchronizes digital, counter, and quadrature decoder inputs with the analog measurements. The maximum sampling rate when using the channel list is 225 kSamples/s.

- Analog output subsystem:

Two 16-bit D/A converters (if your module includes D/A converters).

Output rate up to 500 kSamples/s.

Output range of ± 10 V.

The DACs are deglitched to prevent noise from interfering with the output signal.

Output channel list. You can cycle through the output channel list using continuous output mode or waveform generation mode.

- Digital I/O subsystem:

One digital input port, consisting of 16 digital input lines. You can program any of the first eight digital input lines to perform interrupt-on-change operations. You can read the value of the digital input port using the analog input channel-gain list.

One digital output port, consisting of 16 digital output lines. You can output the value of the digital output port using the output channel list.

- Two 32-bit counter/timer (C/T) channels that perform event counting, up/down counting, frequency measurement, edge-to-edge measurement, continuous pulse output, one-shot, and repetitive one-shot operations. You can read the value of one or more of the C/T channels using the analog input channel list.
- Three 32-bit quadrature decoders that can provide relative or absolute position of quadrature encoder input and calculate rotational speed. You can read the value of one or more of the quadrature decoder channels using the analog input channel list.
- External or internal clock source.
- Trigger operations using a software command, an analog threshold value, or an external digital trigger.
- 500 V galvanic isolation barrier that prevents ground loops to maximize analog signal integrity and protect your computer.

The key differences among the DT9836 Series modules are summarized in [Table 1](#). Note that all modules provide 16 digital input lines, 16 digital output lines, 16-bit resolution, two counter/timers, three quadrature decoders, and a throughput rate of up to 225 kSamples/s.

Table 1: Summary of DT9836 Series Modules

Module	Analog Inputs	Analog Outputs	Packaging
DT9836-12-2-OEM	12 single-ended	2	OEM
DT9836-12-2-BNC	12 single-ended	2	BNC
DT9836-12-0-OEM	12 single-ended	0	OEM
DT9836-12-0-BNC	12 single-ended	0	BNC
DT9836-6-2-OEM	6 single-ended	2	OEM
DT9836-6-2-BNC	6 single-ended	2	BNC
DT9836-6-0-OEM	6 single-ended	0	OEM
DT9836-6-0-BNC	6 single-ended	0	BNC

Notes:

- *OEM* packaging refers to the board-level version; the power supply is not included.
- *BNC* packaging refers to a connection box with BNCs for the specified number of analog inputs, 2 BNCs for analog outputs (if included), 1 BNC for an external A/D clock, 1 BNC for an external DAC clock, 1 BNC for an external A/D trigger, and 1 BNC for an external DAC trigger.

Supported Software

The following software is available for use with the DT9836 Series modules and is on the Data Acquisition OMNI CD:

- **DT9836 Series Device Driver** – The device driver allows you to use a DT9836 Series module with any of the supported software packages or utilities. Refer to the *DT9836 Series Getting Started Manual* (UM-21553) for more information on loading and configuring the device driver.
- **Quick Data Acq application** – The Quick Data Acq application provides a quick way to get up and running using a DT9836 Series module. Using this application, you can verify key features of the modules, display data on the screen, and save data to disk. Refer to the *DT9836 Series Getting Started Manual* (UM-21553) for more information on using the Quick Data Acq application.
- **DT Measure Foundry** – An evaluation version of this software is included or provided via a link on the Data Acquisition OMNI CD. DT Measure Foundry is a drag-and-drop test and measurement application builder designed to give you top performance with ease-of-use development. Order the full development version of this software package to develop your own application using real hardware.
- **DataAcq SDK** – Use the Data Acq SDK if you want to develop your own application software for the DT9836 Series modules using the Microsoft C compiler; 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 DT9836 Series modules using Microsoft Visual Basic or Visual C++; DTx-EZ complies with the DT-Open Layers standard.
- **DAQ Adaptor for MATLAB** – Data Translation's DAQ Adaptor provides an interface between the MATLAB Data Acquisition (DAQ) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.

- **DT-LV Link** – Use DT-LV Link if you want to use the LabVIEW graphical programming language to access the capabilities of the DT9836 Series modules.

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

Accessories

You can purchase the following optional items from Data Translation for use with the OEM version of the DT9836 Series module:

- **EP361** – +5V power supply and cable.
- **EP353** – Accessory panel that provides one 37-pin, D-sub connector for attaching analog input signals and one 26-pin connector for attaching a 5B Series signal conditioning backplane.
- **EP355** – Screw terminal panel that provides 14-position screw terminal blocks for attaching counter/timer, digital I/O, trigger, and clock signals. (Not for analog input use with this module.)
- **EP356** – Accessory panel that provides two 37-pin, D-sub connectors for attaching digital I/O, analog output, counter/timer, trigger, and clock signals.
- **EP333** – 2-meter shielded cable with two 37-pin connectors that connect an EP356 accessory panel to an STP37 screw terminal panel.
- **EP360** – 2-meter shielded cable with two 37-pin connectors that connect an EP353 accessory panel to an STP37 screw terminal panel.

Getting Started Procedure

1

The flow diagram shown in [Figure 1](#) illustrates the steps needed to get started using the DT9836 Series module. 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.

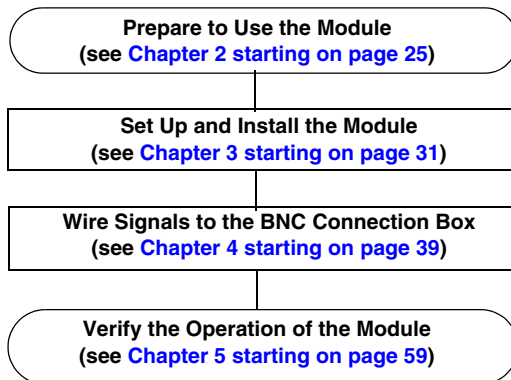


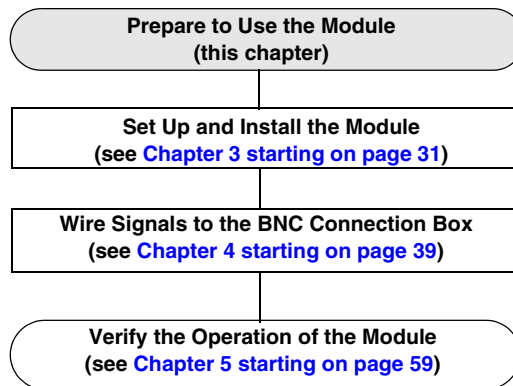
Figure 1: Getting Started Flow Diagram

Part 1:
Getting Started



Preparing to Use a Module

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Unpacking

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

- BNC connection box or OEM version of the DT9836 Series module
- Data Acquisition OMNI CD

Note that if you purchased a BNC connection box, a USB cable and an EP361 power supply and power cable should also be included. Additionally, the BNC box includes a 37-pin mating connector (AMP #747917-2).

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 481-3700. 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 module, check the system requirements, as described in the next section.

Checking the System Requirements

For reliable operation, your DT9836 Series module requires the following:

- PC with Pentium 233 MHz (or higher) processor.
- Windows 2000 or Windows XP (Professional Edition) operating system.

For USB Ver. 2.0 support, make sure that you install Service Pack 2 (for Windows XP) or Service Pack 4 (for Windows 2000). In addition, for some systems, you may have to disable standby mode. If you are not sure whether you are using USB Ver. 1.1 or Ver. 2.0, run the Open Layers Control Panel applet, described on [page 38](#).

- One or more USB ports (Ver. 2.0 or Ver. 1.1). USB Ver. 2.0 is strongly recommended; USB Ver. 1.1 will severely degrade performance.
- 64 MB (or more) of RAM; 128 MB (or more) recommended.
- One or more CD-ROM drives.
- Super VGA (800 x 600 or higher resolution) display monitor.

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

Installing the Software

2

To install the software, do the following:

1. Insert the Data Acquisition OMNI CD into your CD-ROM drive.
*Typically, the CD runs automatically. If the CD does not run 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**.

Once you have installed the DT9836 Series software, you can view the DT9836 Series documentation, as described in the next section.

Viewing the Documentation Online

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

You can access the DT9836 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.

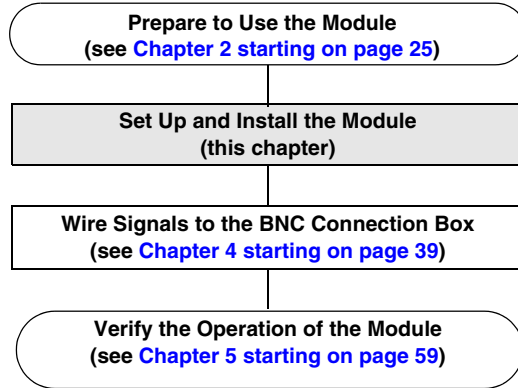
The following may be helpful when using Adobe Acrobat Reader:

- 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, Acrobat Reader smoothes text and monochrome images, sometimes 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**.



Setting Up and Installing the Module

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Note: The DT9836 Series module is factory-calibrated. If you decide that you want to recalibrate the analog input or analog output circuitry, refer to the instructions in [Chapter 10](#).

Applying Power to the Module

The BNC connection box is shipped with an EP361 +5V power supply and cable. For the OEM version of the DT9836 Series module, you must provide your own +5 V power source or purchase the EP361 power supply and cable from Data Translation.

To apply power to the module, do the following:

1. Connect the +5 V power supply to the power connector on the DT9836 Series module. Refer to [Figure 2](#).

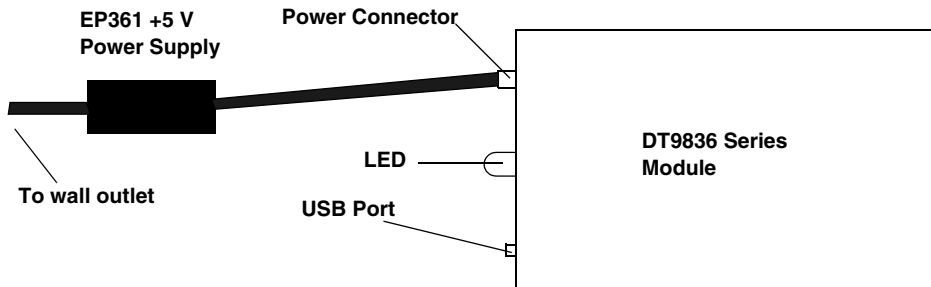


Figure 2: Attaching a +5 V Power Supply to the DT9836 Series Module

2. Plug the power supply into a wall outlet.

For more detailed information about ground, power, and isolation connections on a DT9836 Series module, refer to [Appendix B](#) starting on [page 197](#).

Attaching Modules to the Computer

This section describes how to attach DT9836 Series modules to the host computer.

Notes: Most computers have several USB ports that allow direct connection to USB devices. If your application requires more DT9836 Series modules than you have USB ports for, you can expand the number of USB devices attached to a single USB port by using expansion hubs. For more information, refer to [page 36](#).

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

You must install the device driver before connecting your DT9836 Series module(s) to the host computer. See [“Installing the Software” on page 29](#).

Connecting Directly to the USB Ports

To connect a DT9836 Series module directly to a USB port on your computer, do the following:

1. Make sure that you have attached a power supply to the module.
2. Attach one end of the USB cable to the USB port on the module.
3. Attach the other end of the USB cable to one of the USB ports on the host computer, as shown in [Figure 3](#).

The operating system automatically detects the USB module and starts the Found New Hardware wizard.

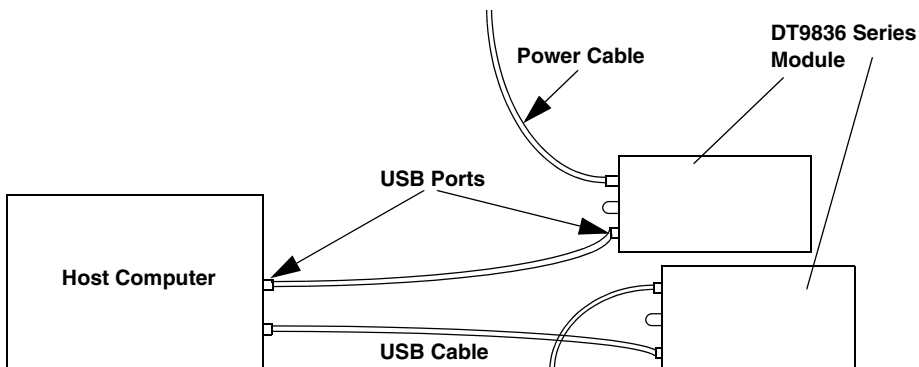


Figure 3: Attaching the Module to the Host Computer

4. Click Next and/or Finish as required in the wizard. Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands. Click Next and/or Finish again.
If the power supply and module are attached correctly, the LED turns green.
5. Repeat the steps to attach another DT9836 Series module to the host computer, if desired.

Connecting to an Expansion Hub

Expansion hubs are powered by their own external power supply. Theoretically, you can connect up to five expansion hubs to a USB port on the host computer. However, the practical number of DT9836 Series modules that you can connect to a single USB port depends on the throughput you want to achieve. Each of the hubs supports up to four modules.

To connect multiple DT9836 Series modules to an expansion hub, do the following:

1. Make sure that you have attached a power supply to the module.
2. Attach one end of the USB cable to the module and the other end of the USB cable to an expansion hub.
3. Connect the power supply for the expansion hub to an external power supply.
4. Connect the expansion hub to the USB port on the host computer using another USB cable.
The operating system automatically detects the USB module and starts the Found New Hardware wizard.
5. Click Next and/or Finish as required in the wizard. Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands. Click Next and/or Finish again.
If the power supply and module are attached correctly, the LED turns green.
6. Repeat these steps until you have attached the number of expansion hubs (up to five) and modules (up to four per hub) that you require. Refer to [Figure 4](#).
The operating system automatically detects the USB devices as they are installed.

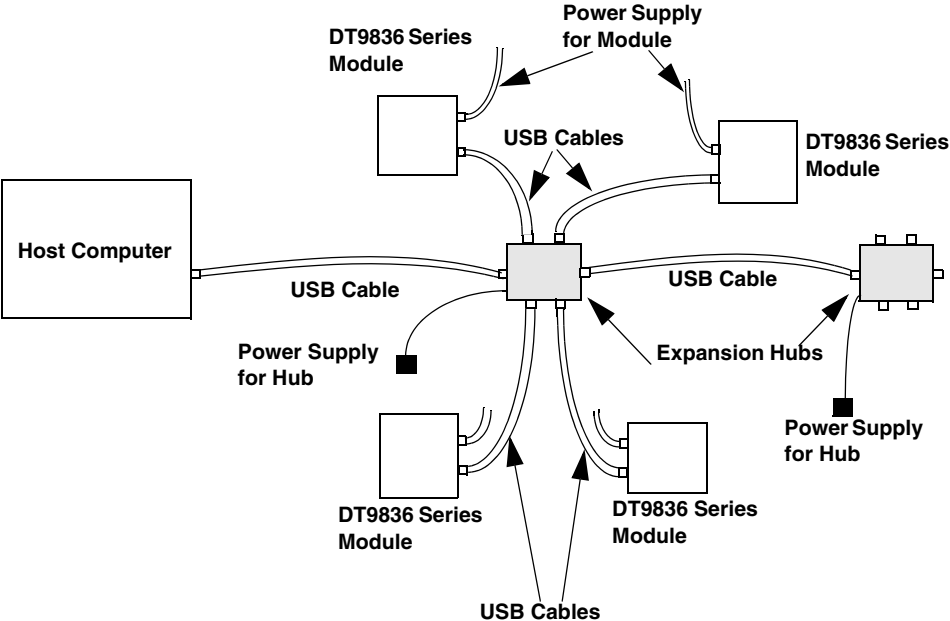


Figure 4: Attaching Multiple Modules Using Expansion Hubs

Configuring the DT9836 Series Device Driver

To configure the device driver for the DT9836 Series module, do the following:

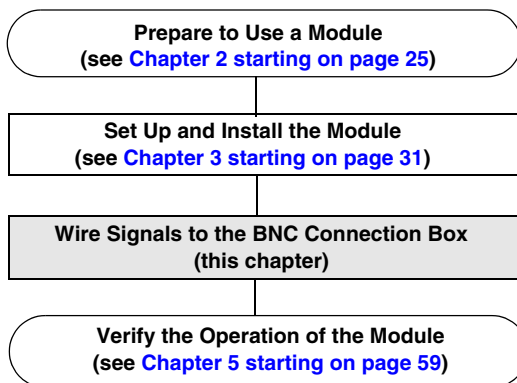
1. If you have not already done so, power up the host computer and all peripherals.
2. From the Windows Start menu, select **Settings | Control Panel**.
3. From the Control Panel, double-click **Open Layers Control Panel**.
The Data Acquisition Control Panel dialog box appears.
4. Click the DT9836 Series module that you want to configure, and then click **Advanced**.
The Configurable Board Options dialog box appears.
5. If required, select the digital input line(s) that you want to use for interrupt-on-change operations. When any of the selected lines changes state, the module reads the entire 16-bit digital input value and generates an interrupt.
6. Click **OK**.
7. If you want to rename the module, click **Edit Name**, enter a new name for the module, and then click **OK**. The name is used to identify the module in all subsequent applications.
8. Repeat steps 4 to 7 for the other modules that you want to configure.
9. When you are finished configuring the modules, click **Close**.

Continue with the instructions on wiring in [Chapter 4 starting on page 39](#).



Wiring Signals to the BNC Connection Box

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Preparing to Wire Signals

CAUTION:

To avoid electrostatic sensitivity, unplug your BNC connection box from the computer before wiring signals.

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

Note: If you are using the D-sub connectors on the BNC box or the OEM version of the DT9836 Series module, use this chapter for conceptual information, and then refer to [Appendix A](#) for connector pin assignments and accessory panel information.

4

Wiring Recommendations

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

- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the box and cabling next to sources that produce high electromagnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- Prevent electrostatic discharge to the I/O while the box is operational.
- Connect all unused analog input channels to analog ground.

Wiring to the BNC Box

The BNC connection box contains both BNC connectors and 37-pin, D-sub connectors. An example of a BNC connection box is shown in [Figure 5](#).

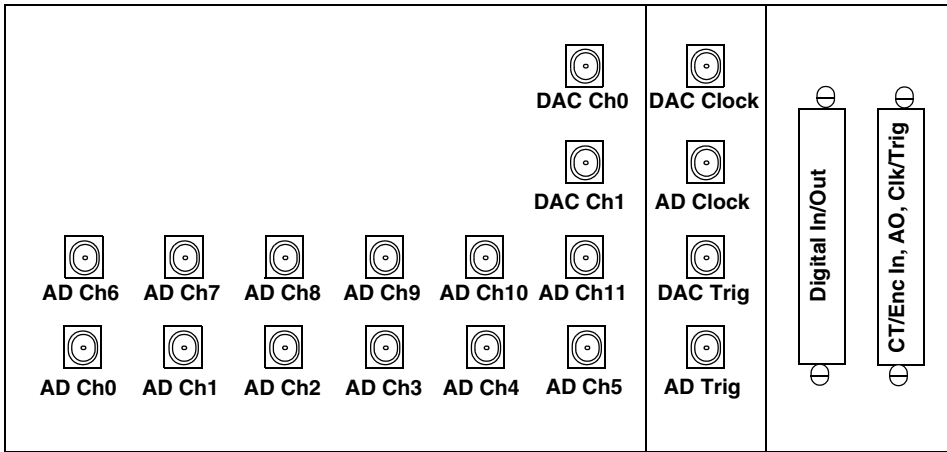


Figure 5: BNC Connection Box

You can wire signals to the BNC connection box as follows. Refer to [Appendix A](#) for information about the required D-sub mating connectors if you choose to use the D-sub connectors.

- **Analog input signals** – You can wire analog input signals using the BNC connectors labelled AD Ch0 to AD Ch11.
- **Analog output signals** – You can wire analog output signals (if your DT9836 model supports them) in one of the following ways:

Using the BNC connectors labelled DAC Ch0 to DAC Ch1.

Using the appropriate pins on the CT/Enc In, Analog Output, Clk/Trig connector. You can access the pins by building your

own cable/panel. Refer to [page 47](#) for connector pin assignments.

- **Digital I/O signals** – To wire digital I/O signals, you must use the appropriate pins on the Digital I/O connector. You can access the pins by building your own cable/panel. Refer to [page 46](#) for connector pin assignments.
- **Counter/timer signals** – To wire counter/timer signals, you must use the appropriate pins on the CT/Enc In, Analog Output, Clk/Trig connector. You can access the pins by building your own cable/panel. Refer to [page 47](#) for connector pin assignments.
- **External A/D clock or trigger signal** – You can wire external clock/trigger signals in one of the following ways:

Using the BNC connectors labelled AD Clock for A/D clock signals and AD Trig for A/D trigger signals.

Using the appropriate pins on the CT/Enc In, Analog Output, Clk/Trig connector. You can access the pins by building your own cable/panel. Refer to [page 47](#) for connector pin assignments.

- **External DAC clock or trigger signal** – If your version of the DT9836 module supports analog output operations, you can wire external clock/trigger signals in one of the following ways:

Using the BNC connectors labelled DAC Clock for D/A clock signals and DAC Trig for D/A trigger signals.

Using the appropriate pins on the CT/Enc In, Analog Output, Clk/Trig connector. You can access the pins by building your own cable/panel. Refer to [page 47](#) for connector pin assignments.

The following sections describe how to wire signals using the BNC or D-sub connectors.

Wiring Signals to the BNC Connectors

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

The number of BNC connectors available on the box varies, depending on the version of the box that you are using. For example, the DT9836-12-BNC version, shown in [Figure 5](#) above, contains 18 BNC connectors (12 BNC connectors for single-ended analog inputs, two BNC connectors for analog outputs, and four BNC connectors for external clocks and triggers).

As another example, the DT9836-6-BNC version, shown in [Figure 6](#), contains 12 BNC connectors (six BNC connectors for analog inputs, two BNC connectors for analog outputs, and four BNC connectors for external clocks and triggers).

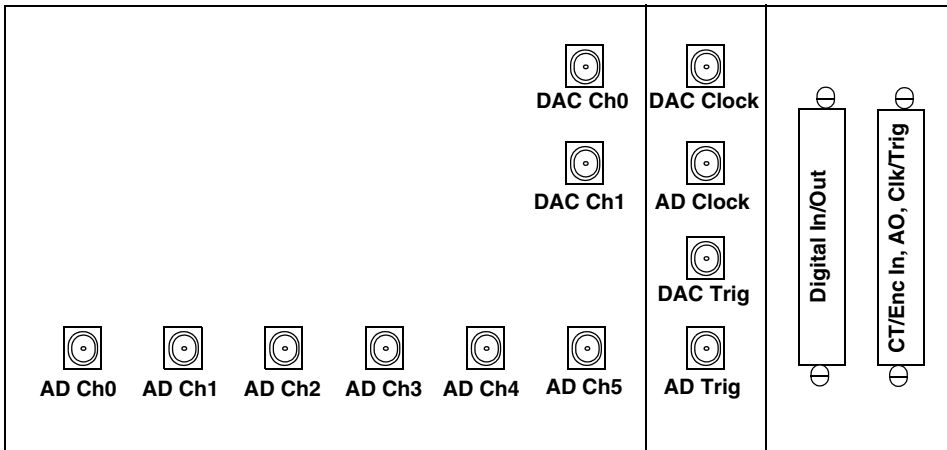


Figure 6: DT9836-6-BNC Version of the BNC Connection Box

Wiring Signals to the D-Sub Connectors

If you want to connect digital I/O or counter/timer signals to the BNC connection box, you can use the 37-pin, D-sub connectors. These connectors are described in the following sections.

Note: D-sub connectors are not available on the BNC connection box for analog input.

Digital In/Out Connector

The Digital In/Out connector allows you to access the digital I/O signals. [Table 2](#) lists the pin assignments for the Digital In/Out connector on the BNC connection box.

Table 2: Digital In/Out Connector Pin Assignments

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

CT/Enc In, Analog Out, Clk/Trig Connector

The CT/Enc In, Analog Output, Clk/Trig connector lets you access the counter/timer, analog output, external clock, and external trigger

signals. [Table 3](#) lists the pin assignments for this connector on the BNC connection box.

Table 3: CT/Enc In, Analog Out, Clk/Trig Connector

Pin	Signal Description	Pin	Signal Description
1	Analog Output 0	20	Analog Output 0 Return
2	Analog Output 1	21	Analog Output 1 Return
3	Reserved	22	Reserved
4	Reserved	23	Reserved
5	Digital Ground	24	Digital Ground
6	External DAC Clock	25	External DAC Trigger
7	External ADC Clock	26	External ADC Trigger
8	Counter 0 Clock	27	Digital Ground
9	Counter 0 Out	28	Counter 0 Gate
10	Counter 1 Clock	29	Digital Ground
11	Counter 1 Out	30	Counter 1 Gate
12	Quad Dec 0 (C/T 2) A	31	Digital Ground
13	Quad 0 (C/T 2) Index	32	Quad Dec 0 (C/T 2) B
14	Quad Dec 1 (C/T 3) A	33	Digital Ground
15	Quad 1 (C/T 3) Index	34	Quad Dec 1 (C/T 3) B
16	Quad Dec 2 (C/T 4) A	35	Digital Ground
17	Quad 2 (C/T 4) Index	36	Quad Dec 2 (C/T 4) B
18	Digital Ground	37	Digital Ground
19	No Connect		

Connecting Analog Input Signals

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

This section describes how to connect single-ended voltage inputs to a BNC connection box.

Connecting Single-Ended Voltage Inputs

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

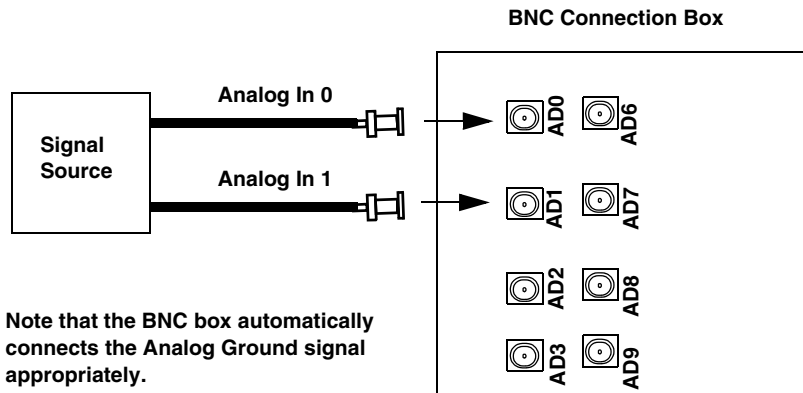


Figure 7: Connecting Single-Ended Inputs to the BNC Connection Box

Connecting Analog Output Signals

Figure 8 shows how to connect an analog output voltage signal (channel 0, in this case) to the BNC connectors on the BNC connection box.

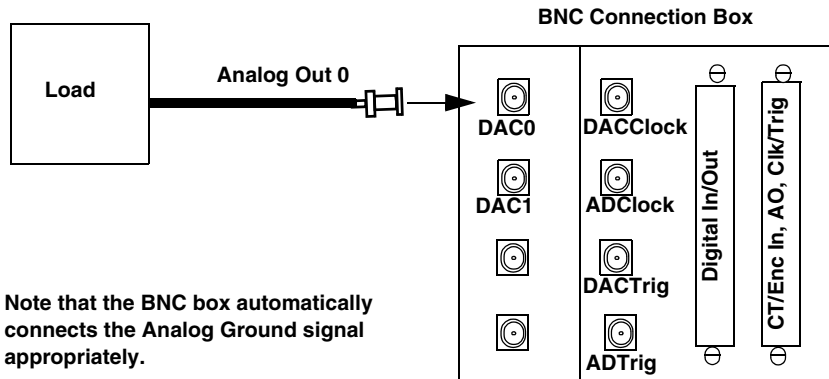


Figure 8: Connecting Analog Outputs to the BNC Connector Box

Connecting Digital I/O Signals

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

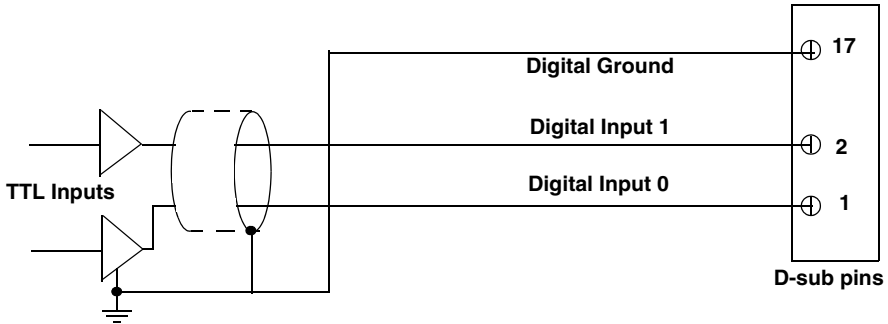


Figure 9: Connecting Digital Inputs to the D-sub Pins

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

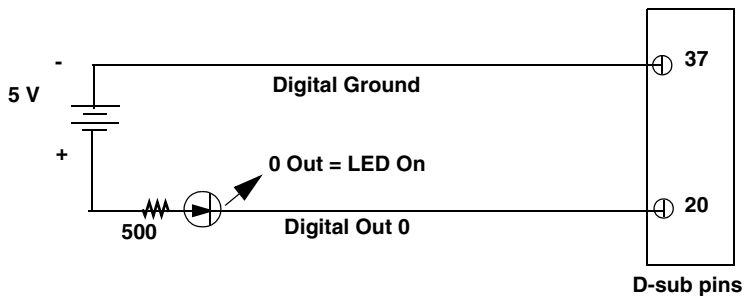


Figure 10: Connecting Digital Outputs to the D-sub Pins

Connecting Counter/Timer Signals

The BNC connection box provides two counter/timer channels that you can use to perform the following operations:

- Event counting
- Up/down counting
- Frequency measurement
- Pulse width/period measurement
- Edge-to-edge measurement
- Pulse output (continuous, one-shot, and repetitive one-shot)

This section describes how to connect counter/timer signals. Refer to [Chapter 6](#) for more information about using the counter/timers.

4

Event Counting

[Figure 11](#) shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins to perform an event counting operation on counter/timer 0 using an external gate.

The counter counts the number of rising edges that occur on the Counter 0 Clock input when the Counter 0 Gate signal is in the active state (as specified by software). Refer to [“Counter/Timer Operation Modes” on page 98](#) for more information.

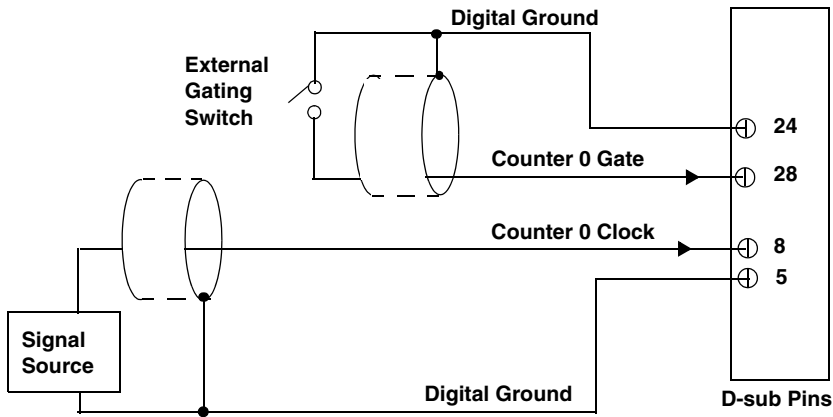


Figure 11: Connecting Counter/Timer Signals to the D-sub Pins for an Event Counting Operation Using an External Gate

Figure 12 shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins to perform an event counting operation on counter/timer 0 without using a gate. The counter counts the number of rising edges that occur on the Counter 0 Clock input.

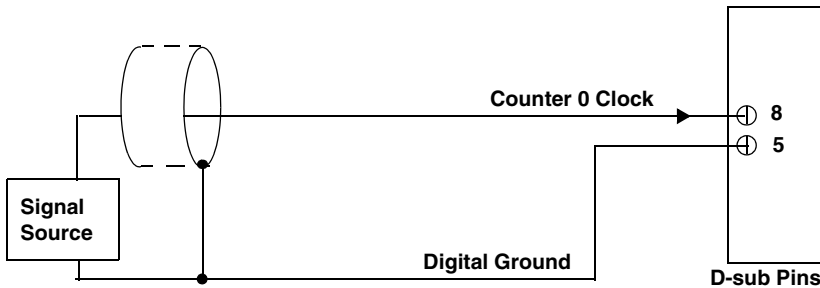


Figure 12: Connecting Counter/Timer Signals to the D-sub Pins for an Event Counting Operation Without Using a Gate

Up/Down Counting

Note: To use up/down counting mode, you need the latest version of DT-Open Layers.

Figure 13 shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins to perform an up/down counting operation on counter/timer 0. The counter keeps track of the number of rising edges that occur on the Counter 0 Clock input. The counter increments when the Counter 0 Gate signal is high and decrements when the Counter 0 Gate signal is low.

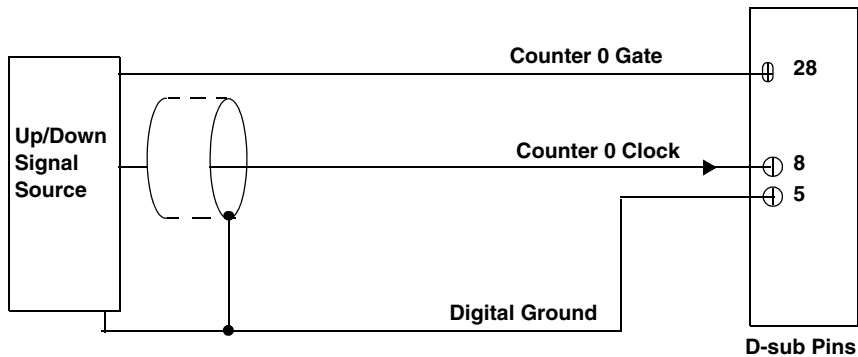


Figure 13: Connecting Counter/Timer Signals to the D-sub Pins for an Up/Down Counting Operation

Frequency Measurement

One way to measure frequency is to use the same wiring as a standard event counting application that does not use a gate (see [Figure 12 on page 52](#)), and then call the `olDaMeasureFrequency` function to determine the duration of the frequency measurement. The frequency of the Counter 0 Clock signal is the number of counts divided by the duration of the `olDaMeasureFrequency` function.

If you need more accuracy than the `olDaMeasureFrequency` function provides, you can connect a pulse of a known duration (such as a one-shot output of counter/timer 1) to the Counter 0 Gate input.

[Figure 14](#) shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins. In this case, the frequency of the Counter 0 clock input is the number of counts divided by the period of the Counter 0 Gate input signal.

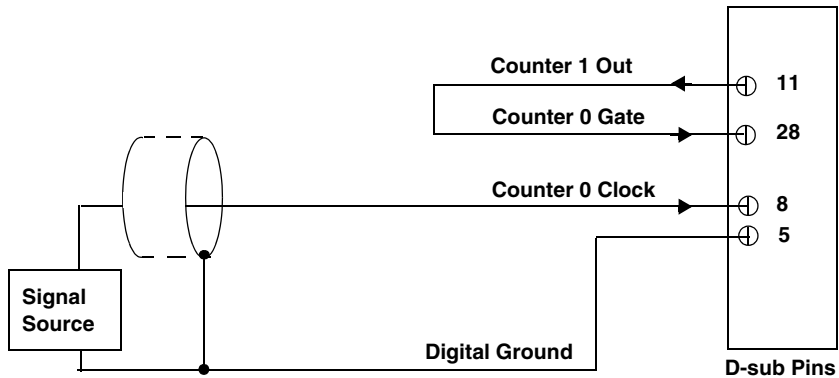


Figure 14: Connecting Counter/Timer Signals to the D-sub Pins for a Frequency Measurement Operation Using an External Pulse

Period/Pulse Width Measurement

Figure 15 shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins to perform a period/pulse width measurement operation on counter/timer 0. You specify the active pulse (high or low) in software. The pulse width is the percentage of the total pulse period that is active. Refer to [“Pulse Output Types and Duty Cycles” on page 97](#) for more information about pulse periods and pulse widths.

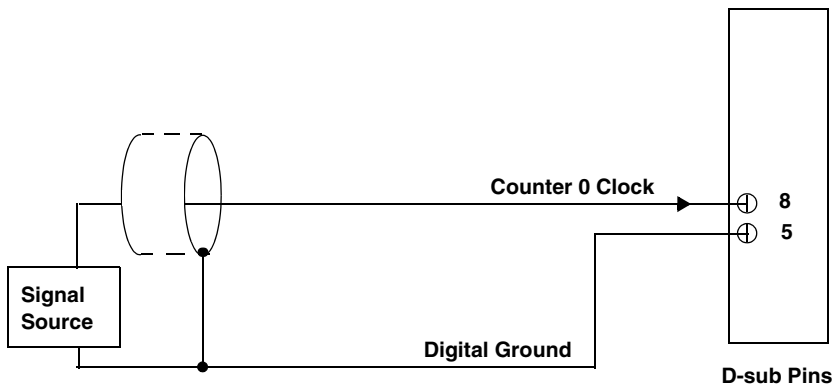


Figure 15: Connecting Counter/Timer Signals to the D-sub Pins for a Period/Pulse Width Measurement Operation

Edge-to-Edge Measurement

Note: To use edge-to-edge measurement mode, you need the latest version of DT-Open Layers.

Figure 16 shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins to perform an edge-to-edge measurement operation on two signal sources. The counter measures the time interval between the start edge (in this case, a rising edge on the Counter 0 Clock signal) and the stop edge (in this case, a falling edge on the Counter 0 Gate signal).

You specify the start edge and the stop edge in software. Refer to “Edge-to-Edge Measurement” on page 101 for more information.

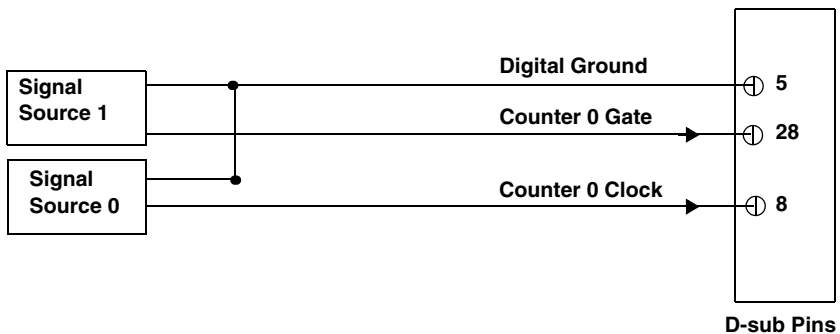


Figure 16: Connecting Counter/Timer Signals to the D-sub Pins for an Edge-to-Edge Measurement Operation

Pulse Output

Figure 17 shows how to connect counter/timer signals to the CT/Enc In, Analog Output, Clk/Trig D-sub pins to perform a pulse output operation on counter/timer 0; in this example, an external gate is used.

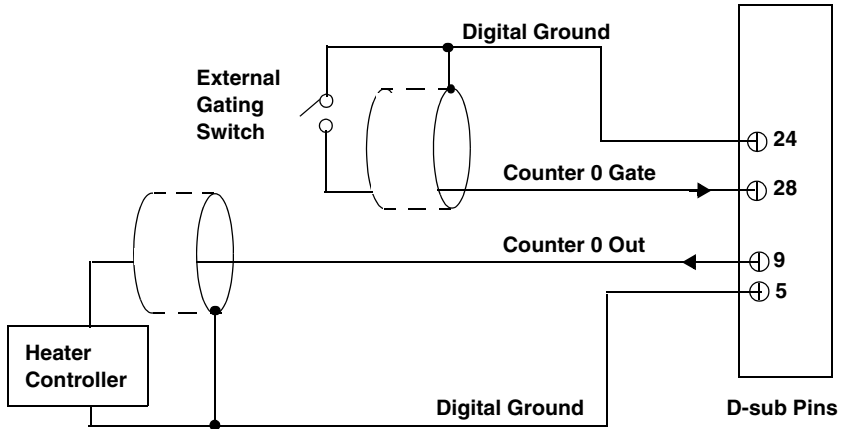
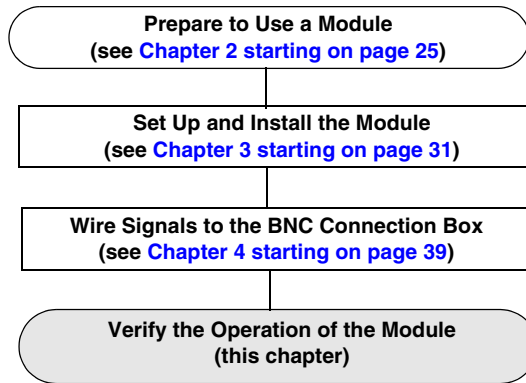


Figure 17: Connecting Counter/Timer Signals to the D-sub Pins for a Pulse Output Operation Using an External Gate



Verifying the Operation of a Module

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You can verify the operation of a DT9836 Series module using the Quick Data Acq application. Quick Data Acq lets you do the following:

- Acquire data from a single analog input channel or digital input port
- Acquire data continuously from one or more analog input channels using an oscilloscope, strip chart, or Fast Fourier Transform (FFT) view
- 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 29](#).

Running the Quick Data Acq Application

To run the Quick Data Acq application, do the following:

1. If you have not already done so, power up your computer and any attached peripherals.
2. Ensure that you installed the Quick Data Acq application software from the Data Acquisition OMNI CD using the instructions starting on [page 29](#).
3. Select **Quick Data Acq** from the **Data Translation, Inc | Quick Data Acq** program group.

Note: The Quick Data Acq application lets you verify basic operations on the module; however, it may not support all of the module’s features. For information about each of the supported features, use the online help for the Quick Data Acq application by pressing **F1** from any view or selecting the **Help** menu, or refer to the *DT9836 Series User’s Manual*.

Testing Single-Value Analog Input

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

1. Connect a voltage source, such as a function generator, to analog input channel 0 on the DT9836 Series module. Refer to [page 48](#) for an example of how to connect an analog input.
2. In the Quick Data Acq application, choose **Single Analog Input** from the **Acquisition** menu.
3. Select the appropriate DT9836 Series module from the **Board** list box.
4. In the **Channel** list box, select analog input channel 0.
5. In the **Range** list box, select the range for the channel. The default is ± 10 V.
6. Select **Single Ended**.
7. Click **Get** to acquire a single value from analog input channel 0. *The application displays the value on the screen in both text and graphical form.*

Testing Single-Value Analog Output

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

1. Connect an oscilloscope or voltmeter to analog output channel 0 on the module. Refer to [page 49](#) for an example of how to connect analog output signals.
2. In the Quick Data Acq application, choose **Single Analog Output** from the **Control** menu.
3. Select the appropriate DT9836 Series module from the **Board** list box.
4. In the **Channel** list box, select analog output channel 0.
5. In the **Range** list box, select the output range of DAC0. The default is ± 10 V.
6. Enter an output value, or use the slider to select a value, to output from DAC0.
7. Click **Send** to output a single value from analog output channel 0.

The application displays the output value both on the slider and in the text box.

Testing Continuous Analog Input

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

1. Connect known voltage sources, such as the outputs of a function generator, to analog input channels 0 and 1 on the DT9836 Series module.
2. In the Quick Data Acq application, choose **Scope** from the **Acquisition** menu.
3. Select the DT9836 Series module from the **Board** list box.
4. In the **Sec/Div** list box, select the number of seconds per division (.1 to .00001) for the display.
5. In the **Channel** list box, select analog input channel 1, and then click **Add** to add the channel to the channel list. Note that, by default, channel 0 is included in the channel list.
6. Click **Config** from the Toolbar.
7. In the **Config** dialog, select **ChannelType**, and then select **Single Ended**.
8. In the **Config** dialog, select **Range**, and then select **Bipolar**.
9. Click **OK** to close the dialog box
10. From the Scope view, double-click the input range of the channel to change the input range of the module (± 10 V or ± 5 V). The default is ± 10 V.
The display changes to reflect the selected range for all the analog input channels on the module.
11. In the **Trigger** box, select **Auto** to acquire data continuously from the specified channels or **Manual** to acquire a burst of data from the specified channels.

12. Click **Start** from the Toolbar to start the continuous analog input operation.

The 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.

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 DT9836 Series module. Refer to [page 50](#) for information about how to connect a digital input.
2. In the Quick Data Acq application, choose **Digital Input** from the **Acquisition** menu.
3. Select the appropriate DT9836 Series module from the **Board** list box.
4. Click **Get**.

The application displays the entire 16-bit digital input value (0 to FFFF) in both the Data box and the Digital Input box.

In addition, application shows the state of the lower eight digital input lines (lines 0 to 7) in the graphical display. If an indicator light is lit (red), the line is high; if an indicator light is not lit (black), the line is low.

Note: Although the DT9836 Series modules contain 16 digital input lines, the Quick Data Acq application shows indicator lights for the lower eight digital input lines only. The 16-bit value is the correct value for all 16 lines.

Testing Single-Value Digital Output

Note: Although the DT9836 Series modules contain 16 digital output lines, the Quick Data Acq application allows you to perform a digital output operation on the lower eight digital output lines (lines 0 to 7) only.

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

1. Connect a digital output to digital output line 0 on the DT9836 Series module. Refer to [page 45](#) for information about how to connect a digital output.
2. In the Quick Data Acq application, choose **Digital Output** from the **Control** menu.
3. Select the appropriate DT9836 Series module from the **Board** list box.
4. Click the appropriate indicator lights to select the types of signals to write from the digital output lines. If you select a light, the module outputs a high-level signal; if you do not select a light, the module outputs a low-level signal. You can also enter an output value for the lower eight digital output lines (0 to FF) in the **Hex** text box.
5. Click **Send**.
The values of the lower eight digital output lines are output appropriately.

Testing Frequency Measurement

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

1. Wire an external clock source to counter/timer 0 on the DT9836 Series module. Refer to [page 51](#) for an example of how to connect an external clock.

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

2. In the Quick Data Acq application, choose **Measure Frequency** from the **Acquisition** menu.
3. Select the appropriate DT9836 Series module from the **Board** list box.
4. In the **Count Duration** text box, enter the number of seconds during which events will be counted.
5. Click **Start** to start the frequency measurement operation.
The operation automatically stops after the number of seconds you specified has elapsed, and the frequency is displayed on the screen.
6. Click **Stop** to stop the frequency measurement operation.

Testing Pulse Output

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

1. Connect a scope to counter/timer 0 on the DT9836 Series module. Refer to [page 57](#) 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, choose **Pulse Generator** from the **Control** menu.
3. Select the appropriate DT9836 Series module from the **Board** list box.
4. Select either **Continuous** to output a continuous pulse stream or **One Shot** to output one pulse.
5. Select either **Low-to-high** to output a rising-edge pulse (the high portion of the total pulse output period is the active portion of the signal) or **High-to-low** to output a falling-edge pulse (the low portion of the total pulse output period is the active portion of the signal).
6. Under **Pulse Width**, enter a percentage or use the slider to select a percentage for the pulse width. The percentage determines the duty cycle of the pulse.
7. Click **Start** to generate the pulse(s).
The application displays the results both in text and graphical form.
8. Click **Stop** to stop a continuous pulse output operation. One-shot pulse output operations stop automatically.

Part 2:
Using Your Module



Principles of Operation

Analog Input Features	73
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Digital I/O Features	91
Counter/Timer Features	93

Figure 18 shows a block diagram of the DT9836 Series modules.

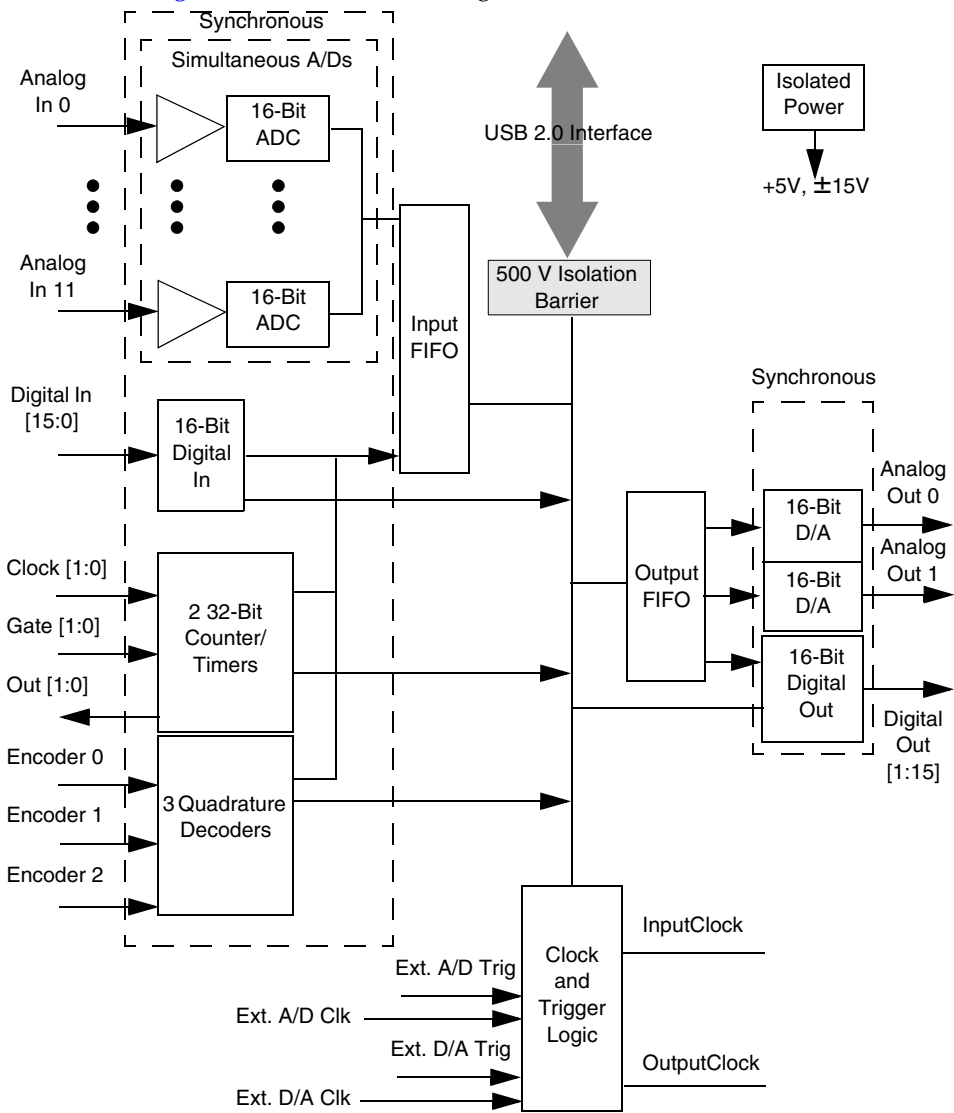


Figure 18: Block Diagram of the DT9836 Series Modules

Analog Input Features

This section describes the following features of analog input (A/D) operations on the DT9836 Series module:

- Input resolution, described below
- Analog input channels, described below
- Input ranges, described on [page 76](#)
- Input sample clock sources, described on [page 77](#)
- Analog input conversion modes, described on [page 78](#)
- Input triggers, described on [page 80](#)
- Data format and transfer, described on [page 81](#)
- Error conditions, described on [page 82](#)

6

Input Resolution

Input resolution is fixed at 16 bits; you cannot specify the resolution in software.

Analog Input Channels

You can connect the analog input channels in single-ended mode. In this mode the source of the input should be close to the module, and all the input signals are referred to the same common ground. The BNC connection box is shipped in a single-ended channel configuration.

Note: To maintain simultaneous operation, all analog input connections must have the same lead lengths. Do not use the STP37 screw terminal panel with the analog input subsystem.

The DT9836 Series modules can acquire data from a single analog input channel or from a group of analog input channels. Analog input channels are numbered 0 to 11 or 0 to 5.

The following subsections describe how to specify the channels.

Specifying a Single Analog Input Channel

The simplest way to acquire data from a single analog input channel is to specify the channel for a single-value analog input operation using software; refer to [page 78](#) for more information about single-value operations.

You can also specify a single channel using the analog input channel-gain list, described in the next section.

Specifying One or More Analog Input Channels

You can read data from one or more analog input channels using an analog input channel-gain list. Because these modules feature simultaneous sampling, the order of the channels in the channel-gain list does not matter. You cannot specify the same channel more than once in the list.

Using software, specify the channels you want to sample. You can enter up to 23 entries in the channel-gain list (17 for the 6-channel version of the module), including digital input, two 32-bit counter/timers, and three 32-bit quadrature decoders. Channels 0–11 (or 0–5) are reserved for analog input. Refer to [page 78](#) for more information about the supported conversion modes.

Specifying the Digital Input Port in the Analog Input Channel-Gain List

The DT9836 Series modules allow you to read the digital input port (all 16 digital input lines) using the analog input channel-gain list. This feature is particularly useful when you want to correlate the timing of analog and digital events.

To read the digital input port, specify channel 6 or channel 12 in the analog input channel-gain list. Use channel 6 for modules with 6 channels; use channel 12 for modules with 12 channels. You can enter channel 6 or 12 anywhere in the list.

The digital input port is treated like any other channel in the analog input channel-gain list; therefore, all the clocking, triggering, and conversion modes supported for analog input channels are supported for the digital input port, if you specify them this way.

Specifying Counter/Timers in the Analog Input Channel-Gain List

The DT9836 Series modules allow you to read the value of the 32-bit counter/timer channels (including quadrature decoders) using the analog input channel-gain list. This feature is particularly useful when you want to correlate the timing of analog and counter/timer events.

To read a counter/timer channel, specify the appropriate channel number in the analog input channel-gain list (refer to [Table 4 on page 76](#)). You can enter a channel number anywhere in the list.

You need two channel-gain list entries to read one 32-bit counter value. The first entry stores the lower 16-bit word, and the second entry stores the upper 16-bit word. You must specify both channel-gain list entries if you include a counter/timer channel.

[Table 4](#) lists the channel number(s) to use for each counter/timer.

Table 4: Using Counter/Timers in Analog Input Channel-Gain List

Counter/Timer Channel	Description	Channel to Specify in Channel-Gain List for:	
		DT9836-12	DT9836- 6
C/T_0_LOW	Lower 16 bits (0 to 15) of C/T 0	Channel 13	Channel 7
C/T_0_HI	Upper 16 bits (16 to 31) of C/T 0	Channel 14	Channel 8
C/T_1_LOW	Lower 16 bits of C/T 1	Channel 15	Channel 9
C/T_1_HI	Upper 16 bits of C/T 1	Channel 16	Channel 10
C/T_2_LOW	Lower 16 bits of Q/D 0 (C/T 2)	Channel 17	Channel 11
C/T_2_HI	Upper 16 bits of Q/D 0 (C/T 2)	Channel 18	Channel 12
C/T_3_LOW	Lower 16 bits of Q/D 1 (C/T 3)	Channel 19	Channel 13
C/T_3_HI	Upper 16 bits of Q/D 1 (C/T 3)	Channel 20	Channel 14
C/T_4_LOW	Lower 16 bits of Q/D 2 (C/T 4)	Channel 21	Channel 15
C/T_4_HI	Upper 16 bits of Q/D 2 (C/T 4)	Channel 22	Channel 16

The counter/timer channel is treated like any other channel in the analog input channel-gain list; therefore, all the clocking, triggering, and conversion modes supported for analog input channels are supported for the counter/timers, if you specify them this way.

Input Ranges

The DT9836 Series modules provide an input range of -10 to +10 V or -5 to +5 V. Use software to specify the range as -10 to +10 V or -5 to +5 V.

Note: This is the range for the entire analog input subsystem, not the range per channel.

You do not need to (and cannot) set gain values for DT9836 Series modules. The gain is preset at 1.

Input Sample Clock Sources

DT9836 Series modules allow you to use one of the following clock sources to pace analog input operations:

- **Internal A/D clock** – Using software, specify the clock source as internal and the clock frequency at which to pace the operation. The minimum frequency supported is 0.75 Samples/s; the maximum frequency supported is 225 kSamples/s.

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

- **External A/D clock** – An external A/D clock is useful when you want to pace acquisitions at rates not available with the internal A/D clock or when you want to pace at uneven intervals.

Connect an external A/D clock to the AD Clock BNC connector on the DT9836 Series module. Conversions start on the falling edge of the external A/D clock input signal.

Using software, specify the clock source as external. The clock frequency is always equal to the frequency of the external A/D sample clock input signal that you connect to the module.

Note: If you specify the digital input port and/or the counter/timer or quadrature decoder channels in the channel-gain list, the input sample clock (internal or external) also paces the acquisition of the digital input port and/or counter/timer channels.

Analog Input Conversion Modes

DT9836 Series modules support the following conversion modes:

- **Single-value operations** are the simplest to use. Using software, you specify the analog input channel. The module acquires the data from the specified channel and returns the data immediately. For a single-value operation, you cannot specify a clock source, trigger source, scan mode, or buffer.

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

- **Continuous Scan mode** takes full advantage of the capabilities of the DT9836 Series modules. For a scan, you can specify a channel-gain list, clock source, trigger source, scan mode, buffer, and buffer wrap mode using software. Continuous scan mode is supported. This mode is described in the following subsections.

Using software, you can stop a scan by performing either an orderly stop or an abrupt stop. In an orderly stop, the module finishes acquiring the current buffer, stops all subsequent acquisition, and transfers the acquired data to host memory; any subsequent triggers are ignored.

In an abrupt stop, the module stops acquiring samples immediately; the current buffer is not completely filled, it is returned to the application only partially filled, and any subsequent triggers are ignored.

Continuous Scan Mode

Use continuous scan mode if you want to accurately control the period between successive simultaneous conversions of all channels in a channel-gain list.

When it detects an initial trigger, the module simultaneously samples all of the input channels, including the digital inputs, counter/timers, and quadrature decoder counts, and converts the analog inputs. If the channel is included in the channel-gain list, the sampled data is placed in the allocated buffer(s) and the operation continues until the allocated buffers are filled or until you stop the operation. Refer to [page 81](#) for more information about buffers.

The conversion rate is determined by the frequency of the input sample clock; refer to [page 77](#) for more information about the input sample clock. The sample rate, which is the rate at which a single entry in the channel-gain list is sampled, is the same as the conversion rate due to the simultaneous nature of the module.

To select continuous scan mode, use software to specify the data flow as continuous and to specify the initial trigger (the trigger source that starts the operation). You can select a software trigger, an external TTL trigger, or an analog threshold trigger as the initial trigger. Refer to [page 80](#) for more information about the supported trigger sources.

[Figure 19](#) illustrates continuous scan mode using a channel-gain list with three entries: channel 0, channel 1, and channel 2. In this example, analog input data is acquired simultaneously on all channels on each clock pulse of the input sample clock. Data is acquired continuously.

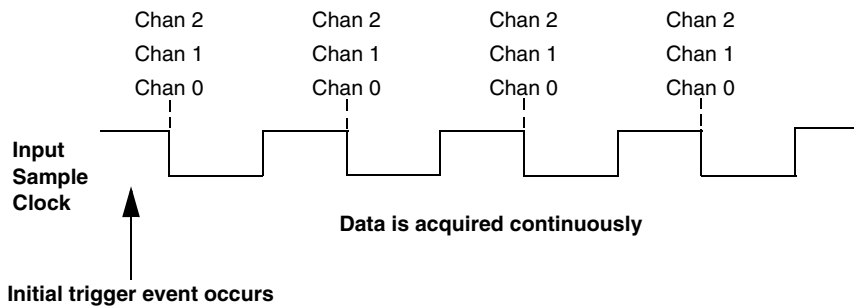


Figure 19: Continuous Scan Mode

Input Triggers

A trigger is an event that occurs based on a specified set of conditions. Acquisition starts when the module detects the initial trigger event and stops when the specified number of samples has been acquired (if the buffer wrap mode is none, described on [page 82](#)), or when you stop the operation.

The DT9836 Series module supports the following trigger sources:

- **Software trigger** A software trigger event occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source as a software trigger.
- **External digital (TTL) trigger** An external digital (TTL) trigger event occurs when the DT9836 Series module detects a transition (high-to-low or low-to-high) on the AD Trig BNC connector on the module. Using software, specify the trigger source as a rising-edge external digital trigger (external) or a falling-edge external digital trigger (extra).
- **Analog threshold trigger** – An analog threshold trigger event occurs when the signal on the first channel in the analog input

channel-gain list rises above (low-to-high transition) a programmable threshold level. Using software, specify the trigger source as a positive threshold trigger (threshpos).

You must use analog input channel 0 as the analog trigger. The analog trigger channel must be the first entry in the analog input channel-gain list.

You specify the threshold level in the `olDaPutSingleValue` function, using D/A subsystem 1. Specify a value between 0 and 255, where 0 equals 0 V and 255 equals +10 V.

Data Format and Transfer

DT9836 Series modules use offset binary data encoding, where 0000 represents negative full-scale, and FFFFh represents positive full-scale. Use software to specify the data encoding as binary. The ADC outputs FFFFh for above-range signals, and 0000 for below-range signals.

Before you begin acquiring data, you must allocate buffers to hold the data. A Buffer Done message is returned whenever a buffer is filled. This allows you to move and/or process the data as needed.

Note: We recommend that you allocate buffers that are even multiples of 256. Also, if running at higher clock frequencies, increase your buffer size accordingly. As a guideline, size the buffers to hold one-half second of data. By this guideline, $\text{BufferSize} = (\text{SampleRate} * \text{NumberOfChannels}) / 2$, rounded up to the nearest multiple of 256.

We recommend that you allocate a minimum of three buffers for analog input operations, specifying one of the following buffer wrap modes in software:

- **None** – Data is written to multiple allocated input buffers continuously; when no more empty buffers are available, the operation stops. If wrap mode is none, the module guarantees gap-free data.
- **Multiple** – Data is written to multiple allocated input buffers continuously; if no more empty buffers are available, the module overwrites the data in the current buffer, starting with the first location in the buffer. This process continues indefinitely until you stop it. If wrap mode is multiple, the module does not guarantee gap-free data.

Error Conditions

The DT9836 Series module reports any overrun errors by sending an `OLDA_WM_OVERRUN_ERROR` message to the application program. This message indicates that data buffers are not being sent from the host to the module fast enough, and so the A/D converter ran out of buffers. To avoid this error, try one or more of the following:

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

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

Analog Output Features

An extra analog output (D/A) subsystem is provided on these modules (including those without user D/A connectors). The highest-numbered D/A subsystem is dedicated to analog threshold triggering only (refer to [page 80](#) for more information on analog threshold triggering).

This section describes the following features of analog output operations:

- Output resolution, described below
- Analog output channels, described below
- Output ranges and gains, described on [page 85](#)
- Output triggers, described on [page 85](#)
- Output clocks, described on [page 86](#)
- Data format and transfer, described on [page 89](#)
- Error conditions, described on [page 90](#)

Output Resolution

Input resolution is fixed at 16 bits; you cannot specify the resolution in software.

Analog Output Channels

Some DT9836 Series modules support two DC-level analog output channels (DAC0 and DAC1). Refer to [Chapter 4](#) for information about how to wire analog output signals to the module.

The DACs are deglitched to prevent noise from interfering with the output signal. They power up to a value of $0\text{ V} \pm 10\text{ mV}$. Unplugging the module resets the DACs to 0 V.

The DT9836 Series modules can output data to a single DAC or sequentially to one or more DACs and/or the digital output port. The following subsections describe how to specify the DACs/port.

Specifying a Single Analog Output Channel

The simplest way to output data to a single DAC is to specify the channel for a single-value analog output operation using software; refer to [page 86](#) for more information about single-value operations.

You can also specify a single DAC using the output channel list, described in the next section.

Specifying Multiple Analog Output Channels and/or the Digital Output Port

You can output data to one or more DACs and/or the digital output port using the output channel list. This feature is particularly useful when you want to correlate the timing of analog and digital output events.

Using software, specify the data flow mode as continuous for the D/A subsystem (described on [page 86](#)) and specify the output channels you want to update, where 0 is DAC0, 1 is DAC1, and 2 is the digital output port. You can enter a maximum of 3 entries in the output channel list and the channels must be in order.

Note that you can skip a channel in the list, however, if you do not want to update it. For example, if you want to update only DAC1 and the digital output port, specify channels 1 and 2 in the output channel list. If you want to update all the DACs and the digital output ports, specify channels 0, 1, and 2 in the output channel list. The channels are output in order from the first entry in the list to the last entry in the list.

Note: The digital output port is treated like any other channel in the output channel list; therefore, all the clocking, triggering, and conversion modes supported for analog output channels are supported for the digital output port, if you specify the digital output port in the output channel list.

Output Ranges and Gains

Each DAC on the DT9836 Series module can output bipolar analog output signals in the range of ± 10 V.

Output Triggers

A trigger is an event that occurs based on a specified set of conditions. The DT9836 Series modules support the following output trigger sources:

- **Software trigger** – A software trigger event occurs when you start the analog output operation. Using software, specify the trigger source as a software trigger.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the DT9836 Series module detects a transition (high-to-low or low-to-high) on the DAC Trig BNC connector on the module. Using software, specify the trigger source as external and the polarity as high-to-low transition or low-to-high transition.

Output Clocks

DT9836 Series modules allow you to use one of the following clock sources to pace analog output operations:

- **Internal DAC clock** – Using software, specify the clock source as internal and the clock frequency at which to pace the operation. The minimum frequency supported is 0.75 Samples/s; the maximum frequency supported is 500 kSamples/s.
- **External DAC clock** – An external DAC clock is useful when you want to pace conversions at rates not available with the output sample clock or when you want to pace at uneven intervals.

Connect an external DAC clock to the DAC Clock BNC connector on the DT9836 Series module. Analog output operations start on the rising edge of the external DAC clock signal.

Using software, specify the clock source as external. The clock frequency is always equal to the frequency of the external DAC clock signal that you connect to the module.

Output Conversion Modes

DT9836 Series modules support the following conversion modes:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. Use software to specify the analog output channel that you want to update, and the value to output from that channel. For a single-value operation, you cannot specify a clock source, trigger source, or buffer. Single-value operations stop automatically when finished; you cannot stop a single-value operation.
- **Continuous analog output operations** take full advantage of the capabilities of the DT9836 Series modules. In this mode, you can specify an output channel list, clock source, trigger source, buffer, and buffer wrap mode. Two continuous analog output modes are supported: streaming and waveform generation mode. These modes are described in the following subsections.

Note that in waveform mode, each channel in the output channel list must write the same number of values, use the same output clock (refer to [page 86](#)), and use the same output trigger (refer to [page 85](#)).

Streaming Analog Output

6

Use streaming analog output mode if you want to accurately control the period between conversions of individual channels in the output channel list (refer to [page 84](#) for information on specifying the output channel list).

Use software to fill the output buffer with the values that you want to write to the DACs and to the digital output port, if applicable. For example, if your output channel list contains only DAC0 and the digital output port, specify the values in the output buffer as follows: the first output value for DAC0, the first output value for the digital output port, the second output value for DAC0, the second output value for the digital output port, and so on.

When it detects a trigger, the module starts writing the values from the output buffer to the channels specified in the output channel list. The operation repeats continuously until all the data is output from the buffers.

Make sure that the host computer transfers data to the output channel list fast enough so that the list does not empty completely; otherwise, an underrun error results.

To select streaming analog output mode, use software to specify the data flow as continuous, the buffer wrap mode as none, and the trigger source as any of the supported trigger sources. Refer to [page 85](#) for more information about the supported trigger sources.

To stop a streaming analog output operation, you can stop sending data to the module, letting the module stop when it runs out of data, or you can perform either an orderly stop or an abrupt stop using

software. In an orderly stop, the module finishes outputting the current buffer, and then stops; all subsequent triggers are ignored. In an abrupt stop, the module stops outputting samples immediately; all subsequent triggers are ignored.

Waveform Generation

Use waveform generation mode if you want to output a waveform repetitively.

Note: The waveform pattern size must be the same for all output channels, and the total number of samples must be a multiple of the total number of output channels.

Use software to fill the output buffer with the values that you want to write to the channels in the output channel list. For example, if your output channel list contains only DAC0 and the digital output port, specify the values in the output buffer as follows: the first output value for DAC0, the first output value for the digital output port, the second output value for DAC0, the second output value for the digital output port, and so on.

When it detects a trigger, the host computer transfers the entire waveform pattern to the module, and the module starts writing output values to the output channels, as determined by the output channel list. A single buffer is output repeatedly. Use software to allocate the memory and specify the waveform pattern.

To select waveform generation mode, use software to specify the data flow as continuous, the buffer wrap mode as single (refer to [page 89](#)), and the trigger source as any of the supported trigger sources (refer to [page 85](#)).

Data Format and Transfer

Data from the host computer must use offset binary data encoding for analog output signals, where 0000 represents -10 V, and FFFFh represents +10 V. Using software, specify the data encoding as binary.

Before you begin writing data to the output channels, you must allocate and fill buffers with the appropriate data. A Buffer Done message is returned whenever a buffer is transferred to the module. This allows you to reuse that buffer, and refill it with additional output data.

Note: We recommend that you allocate buffers that are even multiples of 256. Also, if running at higher clock frequencies, increase your buffer size accordingly. As a guideline, size the buffers to hold one-half second of data. By this guideline, $\text{BufferSize} = (\text{SampleRate} * \text{NumberOfChannels}) / 2$, rounded up to the nearest multiple of 256.

Specify one of the following buffer wrap modes in software:

- **None** – Data is written from multiple output buffers continuously; when no more buffers of data are available, the operation stops. If wrap mode is none, the module guarantees gap-free data.
- **Single** – Data is written from a single output buffer continuously; when all the data in the buffer is written, the module returns to the first location of the buffer and continues writing data. This process continues indefinitely until you stop it.

If wrap mode is single and the allocated output buffer is equal to or less than the size of the FIFO on the module, the data is written once to the module. The module recycles the data, allowing you

to output the same pattern continuously without any further CPU or USB bus activity.

Note: If the size of your buffers is less than 128K and you stop the analog output operation, the operation stops after the current buffer and the next buffer have been output.

Error Conditions

The DT9836 Series module reports any underrun errors by sending an `OLDA_WM_UNDERRUN_ERROR` message to the application. This message indicates that data buffers are not being sent from the host to the module fast enough, and so the D/A converter ran out of data. To avoid this error, try one or more of the following:

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

Digital I/O Features

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

- Digital I/O lines, described below
- Operation modes, described on [page 92](#)

Digital I/O Lines

DT9836 Series modules support one digital input port, consisting of 16 digital input lines (lines 0 to 15) and one digital output port, consisting of 16 digital output lines (lines 0 to 15).

You can read all 16 digital input lines or write all 16 digital output lines with a single-value digital I/O operation. Refer to [page 92](#) for more information about single-value operations.

In addition, you can specify the digital input port in an analog input channel-gain list to perform a continuous digital input operation, or you can specify the digital output port in an output channel list to perform a continuous digital output operation. Refer to [page 92](#) for more information about continuous digital I/O operations.

A digital line is high if its value is 1; a digital line is low if its value is 0. On power up or reset, a low value (0) is output from each of the digital output lines.

The DT9836 Series modules allow you to program the first eight digital input lines to perform interrupt-on-change operations. Refer to [page 92](#) for more information.

Operation Modes

The DT9836 Series modules support the following digital I/O operation modes:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. You use software to specify the digital I/O port and a gain of 1 (the gain is ignored). Data is then read from or written to all the digital I/O lines. For a single-value operation, you cannot specify a clock or trigger source.

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

- **Continuous digital I/O** takes full advantage of the capabilities of the DT9836 Series modules using the analog I/O clock source, scan mode, trigger source, buffer, and buffer wrap mode.

Digital input – For digital input operations, enter the digital input port (all 16 digital input lines) as channel 6 (for modules with 6 A/D channels) or 12 (for modules with 12 A/D channels) in the analog input channel-gain list; refer to [page 75](#) for more information. The analog input sample clock (internal or external) paces the reading of the digital input port (as well as the acquisition of the analog input and counter/timer channels); refer to [page 77](#) for more information.

Digital output – For digital output operations, enter the digital output port (all 16 digital output lines) as channel 2 in the output channel list; refer to [page 84](#) for more information. The analog output clock (internal or external) paces the update of the digital output port (as well as the update of the analog output channels); refer to [page 86](#) for more information.

- **Interrupt-on-change operations** – You can use the Open Layers Control Panel applet to select any of the first eight digital input lines to perform interrupt-on-change operations. Use software to set the digital I/O subsystem to continuous mode. When any one

of the specified bits changes state, the module reads the entire 16-bit digital input value and generates an interrupt. Refer to [“Digital Input Interrupt-On-Change” on page 132](#) for more information.

Counter/Timer Features

This section describes the following features of counter/timer (C/T) operations:

- C/T channels, described below
- C/T clock sources, described on [page 95](#)
- Gate types, described on [page 96](#)
- Pulse types and duty cycles, described on [page 97](#)
- C/T operation modes, described on [page 98](#)
- Quadrature decoders, described on [page 105](#)

C/T Channels

The DT9836 Series modules provide five 32-bit counter/timers -- two general-purpose counters and three quadrature decoder counters.

The general-purpose counters are numbered 0 and 1. Each general-purpose counter accepts a clock input signal and gate input signal and outputs a pulse (pulse output signal), as shown in [Figure 20](#).

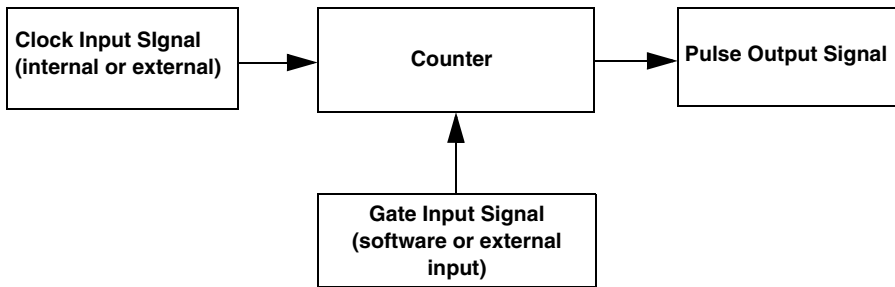


Figure 20: Counter/Timer Channel

The quadrature decoder counters are numbered 2, 3, and 4. Each quadrature counter accepts an A, B, and Index input and is used to interface with a quadrature encoder sensor.

To specify the counter/timer to use in software, specify the appropriate C/T subsystem. For example, counter/timer 0 corresponds to C/T subsystem element 0, and quadrature decoder 0 corresponds to C/T subsystem element 2.

Using software, you can also specify one or more of the counter/timers in the analog input channel-gain list. You need two channel-gain list entries to read a 32-bit counter or quadrature decoder value. The first entry stores the lower 16-bit word, and the second entry stores the upper 16-bit word. Refer to [page 75](#) for more information about using C/Ts in the channel-gain list.

C/T Clock Sources

The following clock sources are available for the general-purpose counter/timers:

- **Internal C/T clock** – Through software, specify the clock source as internal, and specify the frequency at which to pace the operation (this is the frequency of the Counter n Out signal). This is typically used in rate generation mode.
- **External C/T clock** – An external C/T clock is useful when you want to pace counter/timer operations at rates not available with the internal C/T clock or if you want to pace at uneven intervals. The frequency of the external C/T clock can range up to 18 MHz.

Connect the external clock to the Counter n Clock input signal on the DT9836 Series module. Counter/timer operations start on the rising edge of the clock input signal.

Note: You typically use the external C/T clock (the clock connected to the Counter n Clock input signal) to measure frequency (event counting), or to measure the time interval between edges (measure mode). The external C/T clock is not generally used for rate generation.

If you specify a counter/timer in the analog input channel-gain list, the A/D clock determines how often you want to read the counter value. Refer to [page 77](#) for more information about the A/D clock.

Gate Types

Note: This section does not apply to quadrature decoders.

The edge or level of the Counter n Gate signal determines when a counter/timer operation is enabled. DT9836 Series modules provide the following gate types:

- **None** A software command enables any counter/timer operation immediately after execution.
- **Logic-low level external gate input** – Enables a counter/timer operation when the Counter n Gate signal is low, and disables the counter/timer operation when the Counter n Gate signal is high. Note that this gate type is used for event counting and rate generation modes; refer to [page 98](#) for more information about these modes.
- **Logic-high level external gate input** – Enables a counter/timer operation when the Counter n Gate signal is high, and disables a counter/timer operation when the Counter n Gate signal is low. Note that this gate type is used for event counting and rate generation modes; refer to [page 98](#) for more information about these modes.
- **Falling-edge external gate input** – Enables a counter/timer operation when a high-to-low transition is detected on the Counter n Gate signal. In software, this is called a low-edge gate type. Note that this gate type is used for edge-to-edge measurement, one-shot, and repetitive one-shot mode; refer to [page 98](#) for more information about these modes.
- **Rising-edge external gate input** – Enables a counter/timer operation when a low-to-high transition is detected on the Counter n Gate signal. In software, this is called a high-edge gate type. Note that this gate type is used for edge-to-edge

measurement, one-shot, and repetitive one-shot mode; refer to [page 98](#) for more information about these modes.

Specify the gate type in software.

Pulse Output Types and Duty Cycles

6

Note: This section does not apply to quadrature decoders.

The DT9836 Series modules can output the following types of pulses from each counter/timer:

- **High-to-low transitions** – The low portion of the total pulse output period is the active portion of the counter/timer clock output signal.
- **Low-to-high transitions** – The high portion of the total pulse output period is the active portion of the counter/timer pulse output signal.

You specify the pulse output type in software.

The duty cycle (or pulse width) indicates the percentage of the total pulse output period that is active. For example, a duty cycle of 50 indicates that half of the total pulse output is low and half of the total pulse output is high. You specify the duty cycle in software.

[Figure 21](#) illustrates a low-to-high pulse with a duty cycle of approximately 30%.

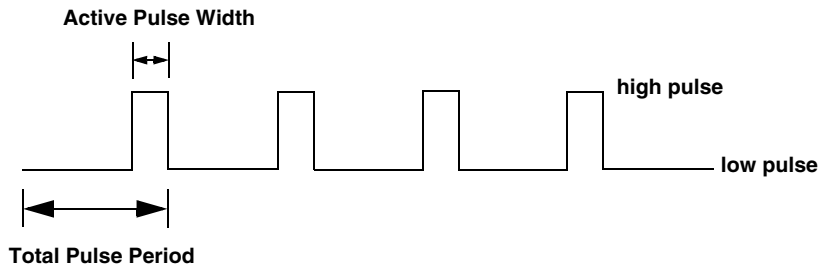


Figure 21: Example of a Low-to-High Pulse Output Type

Counter/Timer Operation Modes

Note: This section does not apply to quadrature decoders.

DT9836 Series modules support the following counter/timer operation modes:

- Event counting
- Up/down counting
- Frequency measurement
- Edge-to-edge measurement
- Rate generation
- One-shot
- Repetitive one-shot

Note: The active polarity for each counter/timer operation mode is software-selectable.

The following subsections describe these modes in more detail.

6

Event Counting

Use event counting mode if you want to count the number of rising edges that occur on the Counter n Clock input when the Counter n Gate signal is active (low-level or high-level). Refer to [page 96](#) for information about specifying the active gate type.

You can count a maximum of 4,294,967,296 events before the counter rolls over to 0 and starts counting again.

Using software, specify the counter/timer mode as event counting (count), the C/T clock source as external, and the active gate type as low-level or high-level.

Make sure that the signals are wired appropriately. Refer to [“Event Counting” on page 51](#) for an example of connecting an event counting application.

Up/Down Counting

Use up/down counting mode if you want to increment or decrement the number of rising edges that occur on the Counter n Clock input, depending on the level of the Counter n Gate signal.

If the Counter n Gate signal is high, the C/T increments; if the specified gate signal is low, the C/T decrements.

Using software, specify the counter/timer mode as up/down counting (up/down), and the C/T clock source as external. Note that you do not specify the gate type in software.

Make sure that the signals are wired appropriately. Refer to [“Up/Down Counting” on page 53](#) for an example of connecting an up/down counting application.

Note: Initialize the counter/timer so that the C/T never increments above FFFFFFFFh or decrements below 0.

Frequency Measurement

Use frequency measurement mode if you want to measure the number of rising edges that occur on the Counter *n* Clock input over a specified duration.

Using software, specify the counter/timer mode as frequency measurement (count) or event counting (count), the clock source as external, and the time over which to measure the frequency.

You can use the Windows timer (which uses a resolution of 1 ms), or if you need more accuracy than the Windows timer provides, you can connect a pulse of a known duration (such as a one-shot output of another user counter) to the Counter *n* Gate input signal.

If you use a known pulse, use software to set up the counter/timers as follows:

1. Set up one of the counter/timers for one-shot mode, specifying the clock source as internal, the clock frequency, the gate type that enables the operation as rising edge or falling edge, the polarity of the output pulse as high-to-low transition or low-to-high transition, the pulse width, and the duty cycle of the output pulse.

2. Set up the counter/timer that will measure the frequency for event counting mode, specifying the type of clock pulses to count and the gate type (this should match the pulse output type of the counter/timer set up for one-shot mode).
3. Start both counters (pulses are not counted until the active period of the one-shot pulse is generated).
4. Read the number of pulses counted. (Allow enough time to ensure that the active period of the one-shot occurred and that events have been counted.)
5. Determine the measurement period using the following equation:

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

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

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

Make sure that the signals are wired appropriately. One way to wire a frequency measurement operation is to use the same wiring as an event counting application, but not use an external gate signal. Refer to [“Frequency Measurement” on page 54](#) for an example of connecting a frequency measurement application.

Edge-to-Edge Measurement

Use edge-to-edge measurement mode if you want to measure the time interval between a specified start edge and a specified stop edge.

The start edge and the stop edge can occur on the rising edge of the Counter *n* Gate input, the falling edge of the Counter *n* Gate input, the rising edge of the Counter *n* Clock input, or the falling edge of the Counter *n* Clock input. When the start edge is detected, the

counter/timer starts incrementing, and continues incrementing until the stop edge is detected. The C/T then stops incrementing until it is enabled to start another measurement.

You can use edge-to-edge measurement to measure the following:

- Pulse width of a signal pulse (the amount of time that a signal pulse is in a high or a low state, or the amount of time between a rising edge and a falling edge or between a falling edge and a rising edge). You can calculate the pulse width as follows:

$$\text{Pulse width} = \text{Number of counts} / 18 \text{ MHz}$$

- Period of a signal pulse (the time between two occurrences of the same edge - rising edge to rising edge or falling edge to falling edge). You can calculate the period as follows:

$$\text{Period} = 1 / \text{Frequency}$$

$$\text{Period} = \text{Number of counts} / 18 \text{ MHz}$$

- Frequency of a signal pulse (the number of periods per second). You can calculate the frequency as follows:

$$\text{Frequency} = 18 \text{ MHz} / \text{Number of Counts}$$

When the operation is complete, you can read the value of the counter.

Using software, specify the counter/timer mode as edge-to-edge measurement mode (measure), the C/T clock source as internal, the start edge type, and the stop edge type.

Make sure that the signals are wired appropriately. Refer to [“Edge-to-Edge Measurement” on page 56](#) for an example of connecting an edge-to-edge measurement application.

Rate Generation

Use rate generation mode to generate a continuous pulse output signal from the Counter *n* Out line; this mode is sometimes referred

to as continuous pulse output or pulse train output. You can use this pulse output signal as an external clock to pace other operations, such as analog input, analog output, or other counter/timer operations.

The pulse output operation is enabled whenever the Counter n Gate signal is at the specified level. While the pulse output operation is enabled, the counter outputs a pulse of the specified type and frequency continuously. As soon as the operation is disabled, rate generation stops.

The period of the output pulse is determined by the C/T clock source (either internal using a clock divider, or external). You can output pulses using a maximum frequency of 18 MHz (this is the frequency of the Counter n Out signal). Refer to [page 95](#) for more information about the C/T clock sources.

Using software, specify the counter/timer mode as rate generation (rate), the C/T clock source as either internal or external, the clock divider (for an internal clock), the polarity of the output pulses (high-to-low transition or low-to-high transition), the duty cycle of the output pulses, and the active gate type (low-level or high-level). Refer to [page 97](#) for more information about pulse output signals and to [page 96](#) for more information about gate types.

Make sure that the signals are wired appropriately. Refer to [“Period/Pulse Width Measurement” on page 55](#) for an example of connecting a rate generation application.

One-Shot

Use one-shot mode to generate a single pulse output signal from the Counter n Out line when the specified edge is detected on the Counter n Gate signal. You can use this pulse output signal as an external digital (TTL) trigger to start other operations, such as analog input or analog output operations.

After the single pulse is output, the one-shot operation stops. All subsequent clock input signals and gate input signals are ignored.

The period of the output pulse is determined by the C/T clock source (either internal using a clock divider, or external). Note that in one-shot mode, the internal C/T clock is more useful than an external C/T clock; refer to [page 95](#) for more information about the C/T clock sources.

Using software, specify the counter/timer mode as one-shot, the clock source as internal (recommended), the clock divider, the polarity of the output pulse (high-to-low transition or low-to-high transition), the duty cycle of the output pulse, and the active gate type (rising edge or falling edge). Refer to [page 97](#) for more information about pulse output types and to [page 96](#) for more information about gate types.

Note: In the case of a one-shot operation, use a duty cycle as close to 100% as possible to output a pulse immediately. Using a duty cycle closer to 0% acts as a pulse output delay.

Make sure that the signals are wired appropriately. Refer to [“Period/Pulse Width Measurement” on page 55](#) for an example of connecting a one-shot application.

Repetitive One-Shot

Use repetitive one-shot mode to generate a pulse output signal from the Counter *n* Out line whenever the specified edge is detected on the Counter *n* Gate signal. You can use this mode to clean up a poor clock input signal by changing its pulse width, and then outputting it.

The module continues to output pulses until you stop the operation. Note that any Counter n Gate signals that occur while the pulse is being output are not detected by the module.

The period of the output pulse is determined by the C/T clock source (either internal using a clock divider, or external). Note that in repetitive one-shot mode, the internal C/T clock is more useful than an external clock; refer to [page 95](#) for more information about the C/T clock sources.

Using software, specify the counter/timer mode as repetitive one-shot (oneshot-rpt), the polarity of the output pulses (high-to-low transition or low-to-high transition), the duty cycle of the output pulses, the C/T clock source as internal (recommended), the clock divider, and the active gate type (rising edge or falling edge). Refer to [page 97](#) for more information about pulse output types and to [page 96](#) for more information about gates.

Note: In the case of a repetitive one-shot operation, use a duty cycle as close to 100% as possible to output a pulse immediately. Using a duty cycle closer to 0% acts as a pulse output delay.

Make sure that the signals are wired appropriately. Refer to “[Period/Pulse Width Measurement](#)” on [page 55](#) for an example of connecting a repetitive one-shot application.

Quadrature Decoders

The counter/timer subsystem includes three quadrature decoders, which allow simultaneous decoding of three quadrature encoded inputs. The quadrature decoders may be used to provide relative or absolute position, or determine rotational speed by calculating the difference between samples.

Each quadrature decoder supports "A," "B," and "Index" inputs. The A and B input relationships are used to increment or decrement the positional count; the Index input can be used to zero-out the positional count.

Figure 22 shows an example of a quadrature decoder mode. In this case, the A input leads the B input, up counting with a 90 degree Index.

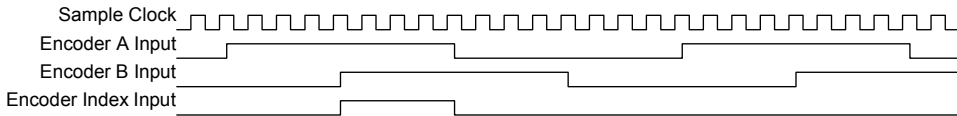


Figure 22: Example Quadrature Decoder Mode

Program quadrature decoder operation using the **oldaSetQuadDecoder** function in DT OpenLayers. Using software, you can specify the following parameters for a quadrature decoder operation:

- The pre-scale value that is used to filter the onboard clock. Using a pre-scale value can remove ringing edges and unwanted noise for more accurate data.
- The mode of operation (X1 or X4 mode) to match the quadrature encoder mode.
- The index mode, which either enables the Index signal or disables the Index signal.

You can read the value of the counter/timer subsystem to determine relative or absolute position and/or rotational speed.

To determine the rotation of a quadrature encoder, use the following formula:

$$\text{Rotation degrees} = \frac{\text{Count}}{4 * N} \times 360 \text{ degrees}$$

where N is the number of pulses generated by the quadrature encoder per rotation. For example, if every rotation of the quadrature encoder generated 10 pulses, and the value read from the quadrature decoder is 20, the rotation of the quadrature encoder is 180 degrees ($20/40 \times 360$ degrees).



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The DT9836 Series Device Driver provides support for the analog input (A/D), analog output (D/A), digital input (DIN), digital output (DOUT), and counter/timer (C/T) subsystems. For information on how to configure the device driver, refer to [Chapter 3](#).

Table 5: DT9836 Series Subsystems

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Total Subsystems on Module	1	1 ^a	1	1	5 ^b

- a. Zero or one, depending upon model purchased, excluding the special D/A subsystem reserved for analog threshold triggering.
- b. Two general-purpose counter/timers, and three quadrature decoders.

The tables in this chapter summarize the features available for use with the DataAcq SDK and the DT9836 Series modules. The DataAcq SDK provides functions that return support information for specified subsystem capabilities at run-time.

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 parameter used to describe that capability in the DataAcq SDK.

Note: Blank fields represent unsupported options.

The DataAcq SDK uses the functions `oIDaGetSSCaps` (for those queries starting with OLSSC) and `oIDaGetSSCapsEx` (for those queries starting with OLSSCE) to return the supported subsystem capabilities for a device.

For more information, refer to the description of these functions in the DataAcq SDK online help. See the *DataAcq User's Manual* for information on launching this help file.

Data Flow

Table 6: DT9836 Series Data Flow Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Single-Value Operation Support OLSSC_SUP_SINGLEVALUE	Yes	Yes	Yes	Yes	Yes
Continuous Operation Support OLSSC_SUP_CONTINUOUS	Yes	Yes	Yes ^a	Yes ^b	Yes ^c
Continuous Operation until Trigger Event Support OLSSC_SUP_CONTINUOUS_PRETRIG					
Continuous Operation before & after Trigger Event OLSSC_SUP_CONTINUOUS_ABOUTTRIG					
DT-Connect Support OLSSC_SUP_DTCONNECT					
Continuous DT-Connect Support OLSSC_SUP_DTCONNECT_CONTINUOUS					
Burst DT-Connect Support OLSSC_SUP_DTCONNECT_BURST					

- a. The DIN subsystem supports continuous mode by allowing you to read the digital input port (all 16 digital input lines) using the analog input channel-gain list.
- b. The DOUT subsystem supports continuous mode by allowing you to output data from the digital output port (all 16 digital output lines) using the output channel list.
- c. The C/T subsystem supports continuous mode by allowing you to read the value of one or more of the 2 general-purpose counter/timer channels or 3 quadrature decoders using the analog input channel-gain list.

Buffering

Table 7: DT9836 Series Buffering Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Buffer Support OLSSC_SUP_BUFFERING	Yes	Yes			
Single Buffer Wrap Mode Support OLSSC_SUP_WRPSINGLE	Yes	Yes			
Multiple Buffer Wrap Mode Support OLSSC_SUP_WRPMULTIPLE	Yes	Yes			
Inprocess Buffer Flush Support OLSSC_SUP_INPROCESSFLUSH	Yes ^a				
Waveform Generation Mode Support OLSSC_SUP_WAVEFORM_MODE		Yes			

- a. The data from the DT9836 module is transferred to the host in 4,096-byte (2,048-sample) segments. If the application calls **oIDaFlushFromBufferInprocess** before the module has transferred 2,048 samples to the host, the buffer on the done queue will contain 0 samples. Your application program must deal with these situations when flushing an inprocess buffer.

DMA

Table 8: DT9836 Series DMA Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Number of DMA Channels OLSSC_NUMDMACHANS	0	0	0	0	0
Supports Gap Free Data with No DMA OLSSC_SUP_GAPFREE_NODMA	Yes	Yes			
Supports Gap Free Data with Single DMA OLSSC_SUP_GAPFREE_SINGLEDMA					
Supports Gap Free Data with Dual DMA OLSSC_SUP_GAPFREE_DUALDMA					

Triggered Scan Mode

Table 9: DT9836 Series Triggered Scan Mode Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Triggered Scan Support OLSSC_SUP_TRIGSCAN					
Maximum Number of CGL Scans per Trigger OLSSC_MAXMULTISCAN	1	0	0	0	0
Supports Scan per Trigger Event Triggered Scan OLSSC_SUP_RETRIGGER_SCAN_PER_TRIGGER					
Supports Internal Retriggered Triggered Scan OLSSC_SUP_RETRIGGER_INTERNAL					
Extra Retrigger Support OLSSC_SUP_RETRIGGER_EXTRA					
Maximum Retrigger Frequency OLSSCE_MAXRETRIGGER	0	0	0	0	0
Minimum Retrigger Frequency OLSSCE_MINRETRIGGER	0	0	0	0	0

Gain

Table 10: DT9836 Series Gain Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Maximum Channel-Gain List Depth OLSSC_CGLDEPTH	17 or 23	3	1	1	0
Sequential Channel-Gain List Support OLSSC_SUP_SEQUENTIAL_CGL	Yes	Yes			
Zero Start Sequential Channel-Gain List Support OLSSC_SUP_ZEROSEQUENTIAL_CGL	Yes	Yes			
Random Channel-Gain List Support OLSSC_SUP_RANDOM_CGL	Yes				
Simultaneous Sample-and-Hold Support OLSSC_SUP_SIMULTANEOUS_SH	Yes				
Channel List Inhibit Support OLSSC_SUP_CHANNELLIST_INHIBIT					
Programmable Gain Support OLSSC_SUP_PROGRAMGAIN	Yes				
Number of Gains OLSSC_NUMGAINS	1	1	1	1	0
Noncontiguous Channels in Channel-Gain List OLSSC_NONCONTIGUOUS_CHANNELNUM	16	0	0	0	0
AutoRanging Support OLSSC_SUP_SINGLEVALUE_AUTORANGE					

Synchronous Digital I/O

Table 11: DT9836 Series Synchronous Digital I/O Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Synchronous Digital I/O Support OLSSC_SUP_SYNCHRONOUS_DIGITALIO					
Maximum Synchronous Digital I/O Value OLSSC_MAX_DIGITALIOLIST_VALUE	0	0	0	0	0

7

Channels

Table 12: DT9836 Series Channel Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Number of Channels OLSSC_NUMCHANNELS	17 or 23 ^a	2	1	1	1
SE Support OLSSC_SUP_SINGLEENDED	Yes				
SE Channels OLSSC_MAXSECHANS	6 or 12	0	0	0	0
DI Support OLSSC_SUP_DIFFERENTIAL		Yes	Yes	Yes	Yes
DI Channels OLSSC_MAXDICHANS	0	2	1	1	1
DT2896 Channel Expansion Support OLSSC_SUP_EXP2896					
DT727 Channel Expansion OLSSC_SUP_EXP727					

- a. For modules with 6 channels, channels 0 to 5 read the analog input channels; channel 6 reads all 16 bits from the DIN subsystem; channels 7 to 16 read the C/T channels. For modules with 12 channels, channels 0 to 11 read the analog input channels; channel 12 reads all 16 bits from the DIN subsystem; channels 13 to 22 read the C/T channels.

Filters

Table 13: DT9836 Series Filter Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Filter/Channel Support OLSSC_SUP_FILTERPERCHAN					
Number of Filters OLSSC_NUMFILTERS	1	1	1	1	0

Ranges

Table 14: DT9836 Series Range Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Number of Voltage Ranges OLSSC_NUMRANGES	2	1	0	0	0
Range per Channel Support OLSSC_SUP_RANGEPERCHANNEL					

Resolution

Table 15: DT9836 Series Resolution Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Software Programmable Resolution OLSSC_SUP_SWRESOLUTION					
Number of Resolutions OLSSC_NUMRESOLUTIONS	1	1	1	1	1

Triggers

Table 16: DT9836 Series Trigger Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Software Trigger Support OLSSC_SUP_SOFTTRIG	Yes	Yes	Yes	Yes	Yes
External Trigger Support OLSSC_SUP_EXTERNTRIG	Yes ^a	Yes			Yes
Positive Threshold Trigger Support OLSSC_SUP_THRESHTRIGPOS	Yes				
Negative Threshold Trigger Support OLSSC_SUP_THRESHTRIGNEG					
Analog Event Trigger Support OLSSC_SUP_ANALOGEVENTTRIG					
Digital Event Trigger Support OLSSC_SUP_DIGITALEVENTTRIG					
Timer Event Trigger Support OLSSC_SUP_TIMEREVENTTRIG					
Number of Extra Triggers OLSSC_NUMEXTRATRIGGERS	1	1	0	0	0

- a. OL_TRG_EXTERN is the rising-edge external digital (TTL) trigger input; OL_TRG_EXTRA is the falling-edge digital external (TTL) trigger input; OL_TRG_THRESHPOS is the positive-edge analog threshold trigger from an analog input channel.

Clocks

Table 17: DT9836 Series Clock Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Internal Clock Support OLSSC_SUP_INTCLOCK	Yes	Yes	Yes	Yes	
External Clock Support OLSSC_SUP_EXTCLOCK	Yes	Yes			Yes
Simultaneous Input/Output on a Single Clock Signal OLSSC_SIMULTANEOUS_CLOCKING	Yes	Yes			
Number of Extra Clocks OLSSC_NUMEXTRACLOCKS	0	0	0	0	0
Base Clock Frequency OLSSCE_BASECLOCK	36 MHz	36 MHz	0	0	36 MHz
Maximum Clock Divider OLSSCE_MAXCLOCKDIVIDER	0	0	1	1	2,147, 483,647
Minimum Clock Divider OLSSCE_MINCLOCKDIVIDER	0	0	1	1	2
Maximum Throughput OLSSCE_MAXTHROUGHPUT	225 kHz	500 kHz	0	0	18 MHz
Minimum Throughput OLSSCE_MINTHROUGHPUT	0.0084 Hz	0.0084 Hz	0	0	0.0084 Hz

Counter/Timers

Table 18: DT9836 Series Counter/Timer Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Cascading Support OLSSC_SUP_CASCADING					
Event Count Mode Support OLSSC_SUP_CTMODE_COUNT					Yes ^a
Generate Rate Mode Support OLSSC_SUP_CTMODE_RATE					Yes ^a
One-Shot Mode Support OLSSC_SUP_CTMODE_ONESHOT					Yes ^a
Repetitive One-Shot Mode Support OLSSC_SUP_CTMODE_ONESHOT_RPT					Yes ^a
Up/Down Counting Mode Support OLSSC_SUP_CTMODE_UP_DOWN					Yes ^a
Edge-to-Edge Measurement Mode Support OLSSC_SUP_CTMODE_MEASURE					Yes ^{a b}
Continuous Edge-to-Edge Measurement Mode Support OLSSC_SUP_CTMODE_CONT_MEASURE					Yes ^a
High to Low Output Pulse Support OLSSC_SUP_PLS_HIGH2LOW					Yes ^a
Low to High Output Pulse Support OLSSC_SUP_PLS_LOW2HIGH					Yes ^a
None (internal) Gate Type Support OLSSC_SUP_GATE_NONE					Yes ^a
High Level Gate Type Support OLSSC_SUP_GATE_HIGH_LEVEL					Yes ^{a c}
Low Level Gate Type Support OLSSC_SUP_GATE_LOW_LEVEL					Yes ^{a c}
High Edge Gate Type Support OLSSC_SUP_GATE_HIGH_EDGE					Yes ^{a c}

Table 18: DT9836 Series Counter/Timer Options (cont.)

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Low Edge Gate Type Support OLSSC_SUP_GATE_LOW_EDGE					Yes ^{a c}
Level Change Gate Type Support OLSSC_SUP_GATE_LEVEL					
High Level Gate Type with Input Debounce OLSSC_SUP_GATE_HIGH_LEVEL_DEBOUNCE					
Low Level Gate Type with Input Debounce Support OLSSC_SUP_GATE_LOW_LEVEL_DEBOUNCE					
High Edge Gate Type with Input Debounce OLSSC_SUP_GATE_HIGH_EDGE_DEBOUNCE					
Low Edge Gate Type with Input Debounce Support OLSSC_SUP_GATE_LOW_EDGE_DEBOUNCE					
Level Change Gate Type with Input Debounce OLSSC_SUP_GATE_LEVEL_DEBOUNCE					
Fixed Pulse Width Support OLSSC_SUP_FIXED_PULSE_WIDTH					
Quadrature Decoder OLSSC_SUP_QUADRATURE_DECODER					Yes ^d

- a. On general-purpose counter/timers only (not quadrature decoders).
- b. Edge-to-edge measurement mode is supported on both the gate and clock signals; rising and falling edges are both supported.
- c. High-edge and low-edge are supported for one-shot and repetitive one-shot modes.
High-level and low-level are supported for event counting, up/down counting, frequency measurement, edge-to-edge measurement, and rate generation modes.
- d. On quadrature decoder connectors only.

Miscellaneous

Table 19: DT9836 Series Miscellaneous Options

DT9836 Series	A/D	D/A	DIN	DOUT	C/T
Simultaneous Start List Support OLSSC_SUP_SIMULTANEOUS_START	Yes	Yes			
Pause Operation Support OLSSC_SUP_PAUSE					
Asynchronous Operation Support OLSSC_SUP_POSTMESSAGE	Yes	Yes	Yes ^a		Yes
Binary Encoding Support OLSSC_SUP_BINARY	Yes	Yes	Yes	Yes	Yes
Twos Complement Support OLSSC_SUP_2SCOMP					
Interrupt Support OLSSC_SUP_INTERRUPT			Yes		Yes
FIFO in Data Path Support OLSSC_SUP_FIFO	Yes	Yes			
Output FIFO Size OLSSC_FIFO_SIZE_IN_K	2	128			
Data Processing Capability OLSSC_SUP_PROCESSOR	Yes		Yes	Yes	Yes
Software Calibration Support OLSSC_SUP_SWCAL	Yes ^b	Yes ^b			

- a. The DIN subsystem supports the posting of messages only if the digital input port is configured for continuous mode and if you used the Open Layers Control Panel applet to select any of the first eight digital input lines to perform interrupt-on-change operations. The device driver posts the `OLDA_WM_EVENTDONE_WITH_DATA` message when a bit changes state. The 16-bit value of the digital input port is also returned.
- b. DT9836 Series modules are calibrated at the factory. If you want to readjust the calibration of the analog input or analog output circuitry, refer to [Chapter 10](#) starting on [page 167](#).



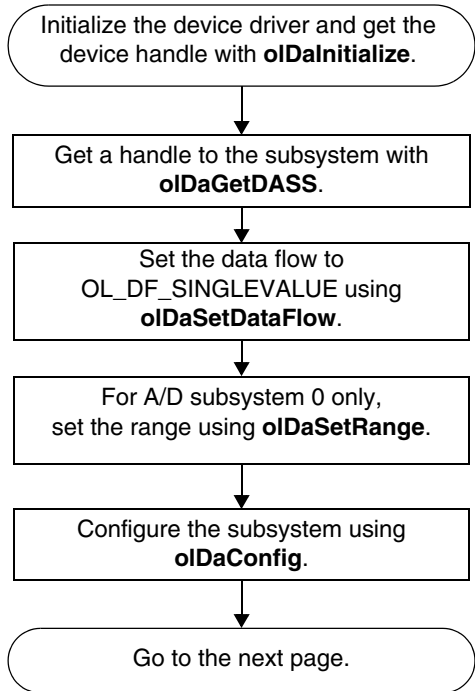
Programming Flowcharts

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The following flowcharts show the steps required to perform data acquisition operations using DT-Open Layers. For illustration purposes, the DataAcq SDK functions are shown; however, the concepts apply to all DT-Open Layers software.

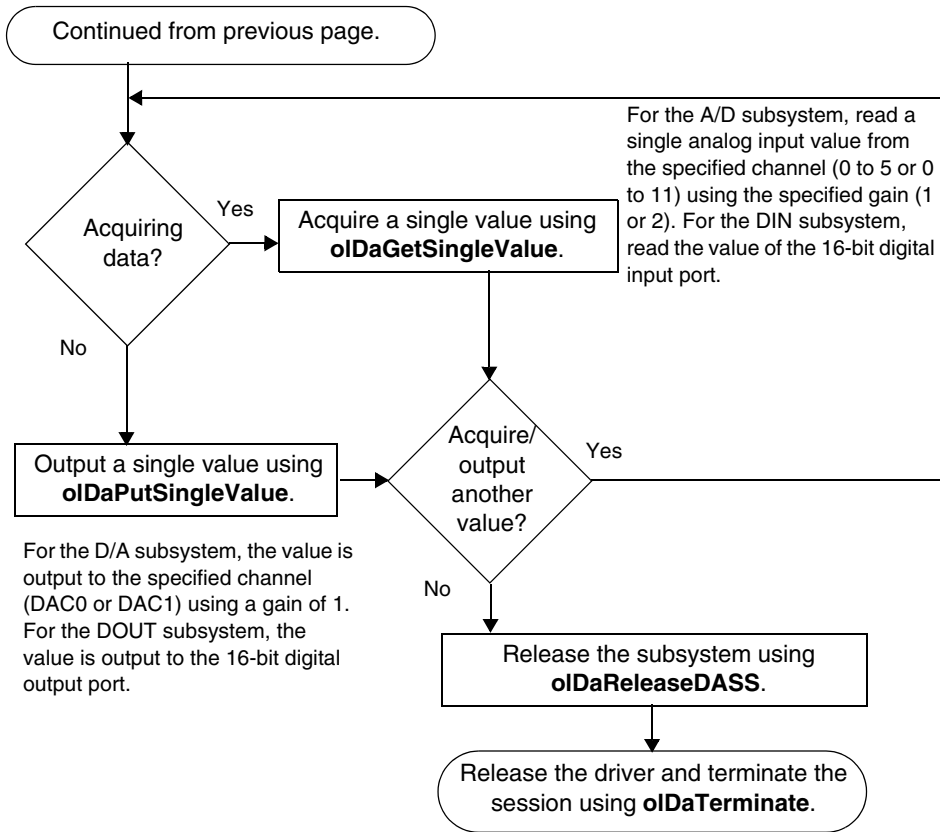
Note that many steps represent several substeps; if you are unfamiliar with the detailed operations involved with any one step, refer to the indicated page for detailed information. Optional steps appear in shaded boxes.

Single-Value Operations

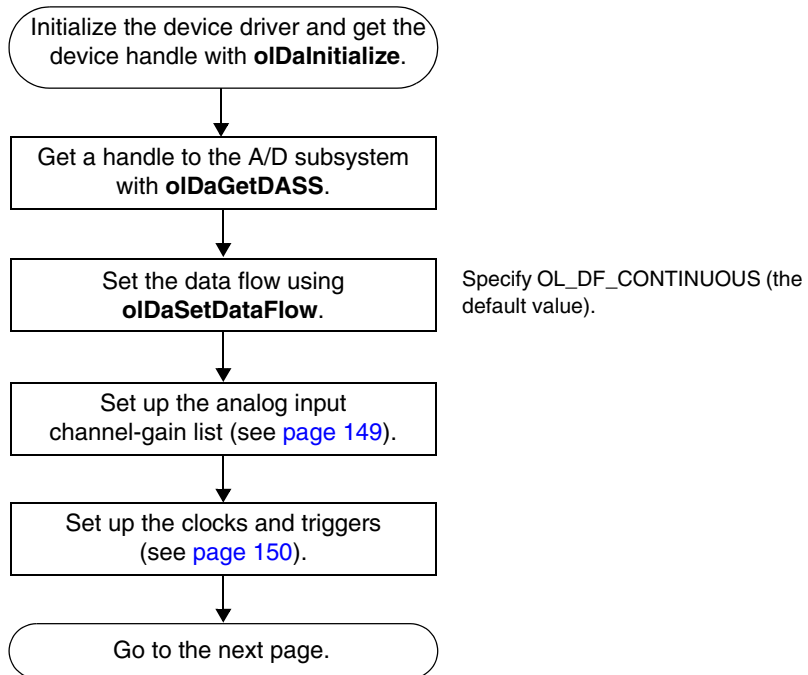


Specify A/D subsystem 0 for an analog input operation, D/A subsystem 0 for an analog output operation, DIN subsystem 0 for a digital input operation, or DOUT subsystem 0 for a digital output operation.

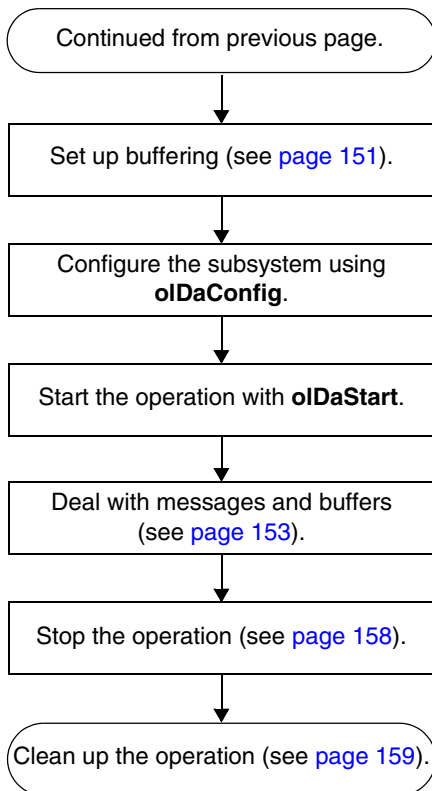
Single-Value Operations (cont.)



Continuous A/D Operations

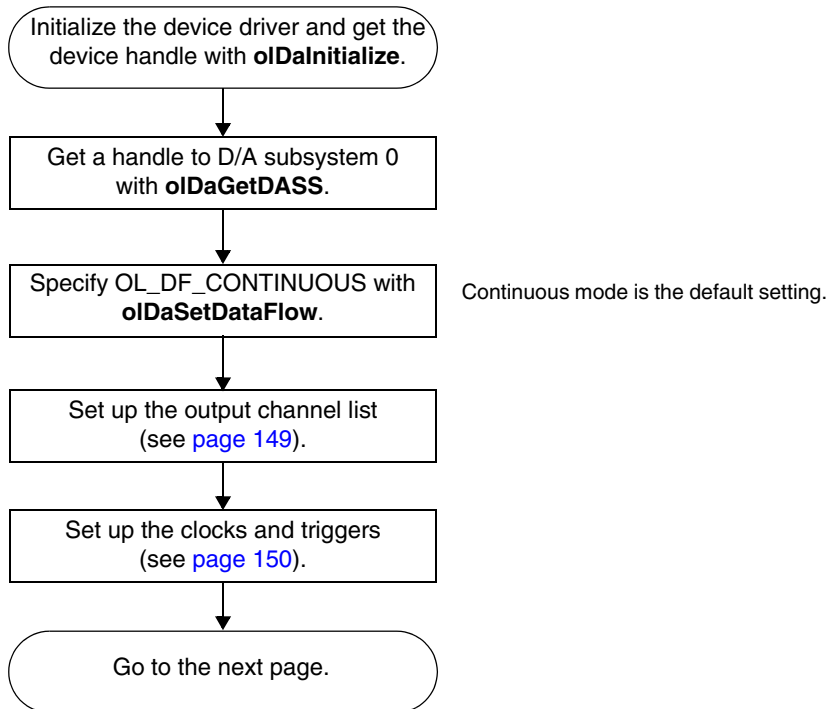


Continuous A/D Operations (cont.)

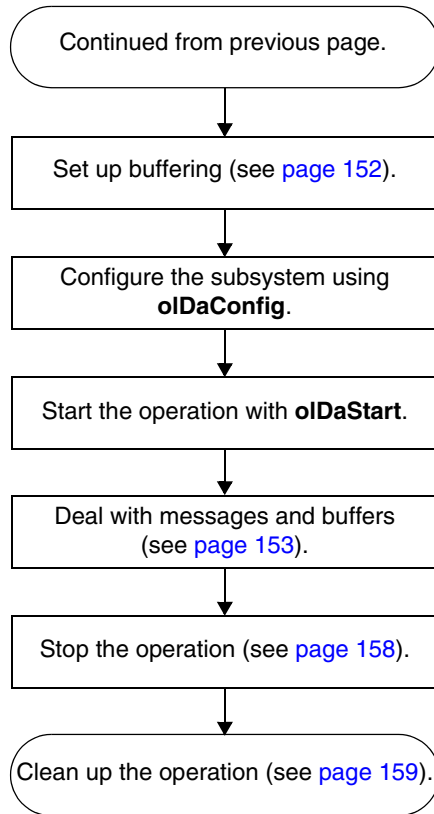


After you configure the subsystem, you can use **oIDaGetClockFrequency** to return the actual frequency of the internal clock; you can use **oIDaGetRetriggerFrequency** to return the actual frequency of the internal retrigger clock.

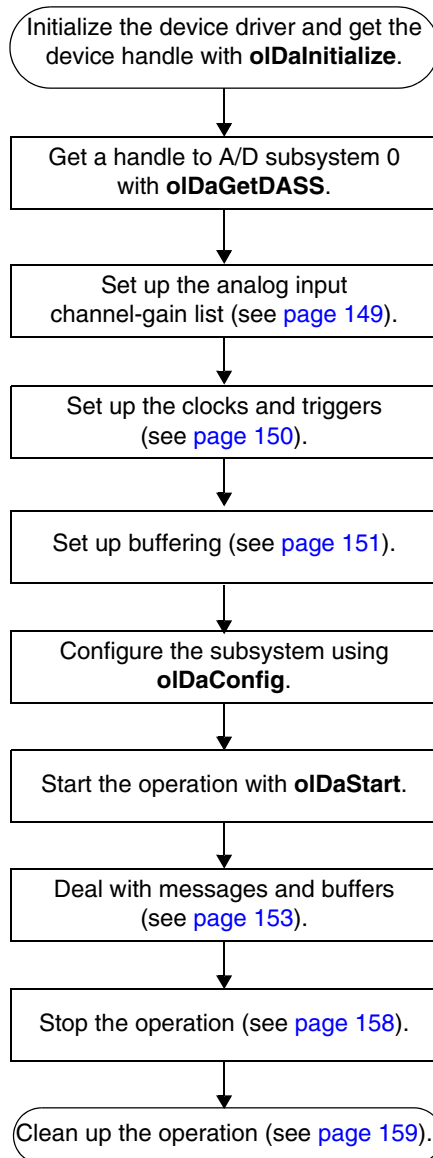
Continuous D/A Operations



Continuous D/A Operations (cont.)

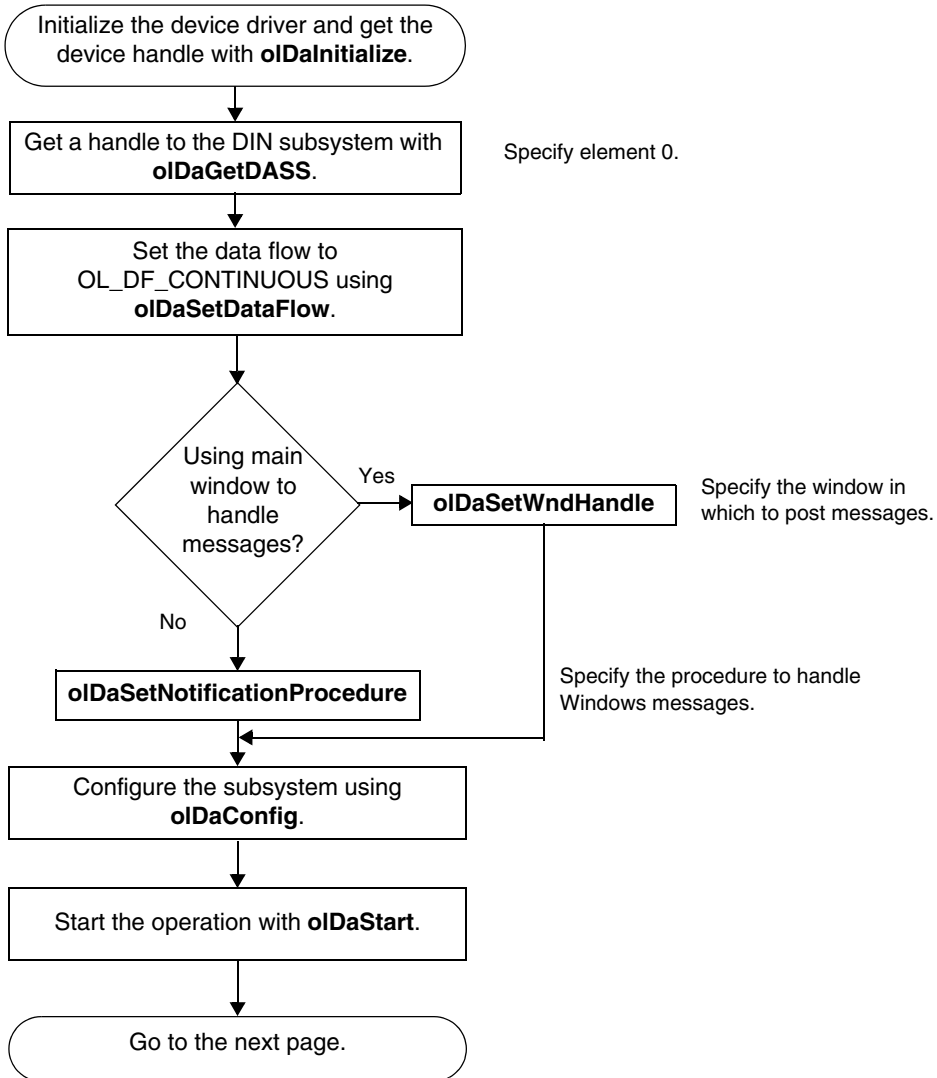


Continuous Digital Input Operations

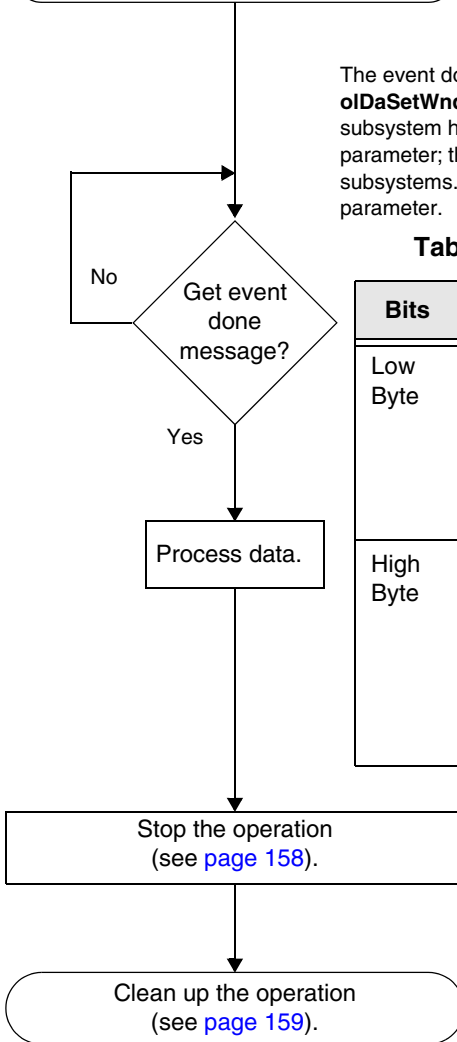


Specify channel 6 or 12 as the digital input port depending on how many analog input channels your board supports; specify a gain of 1.

Digital Input Interrupt-On-Change



Continued from previous page.



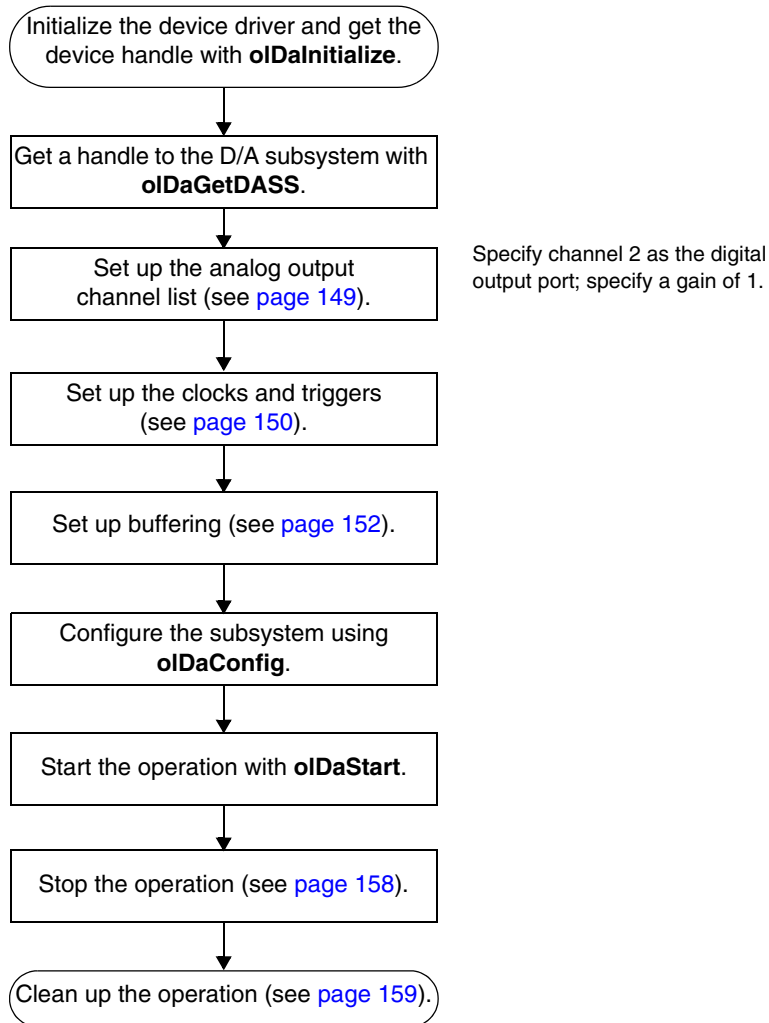
The event done message is `OLDA_WM_EVENT_DONE`. In `oIdaSetWndHandle` or `oIdaSetNotificationProcedure`, the subsystem handle, `HDASS`, is returned in the `wParam` parameter; this allows one window to handle messages from both subsystems. The subsystem status is returned in the `IParam` parameter.

Table 1: Subsystem Status in IParam

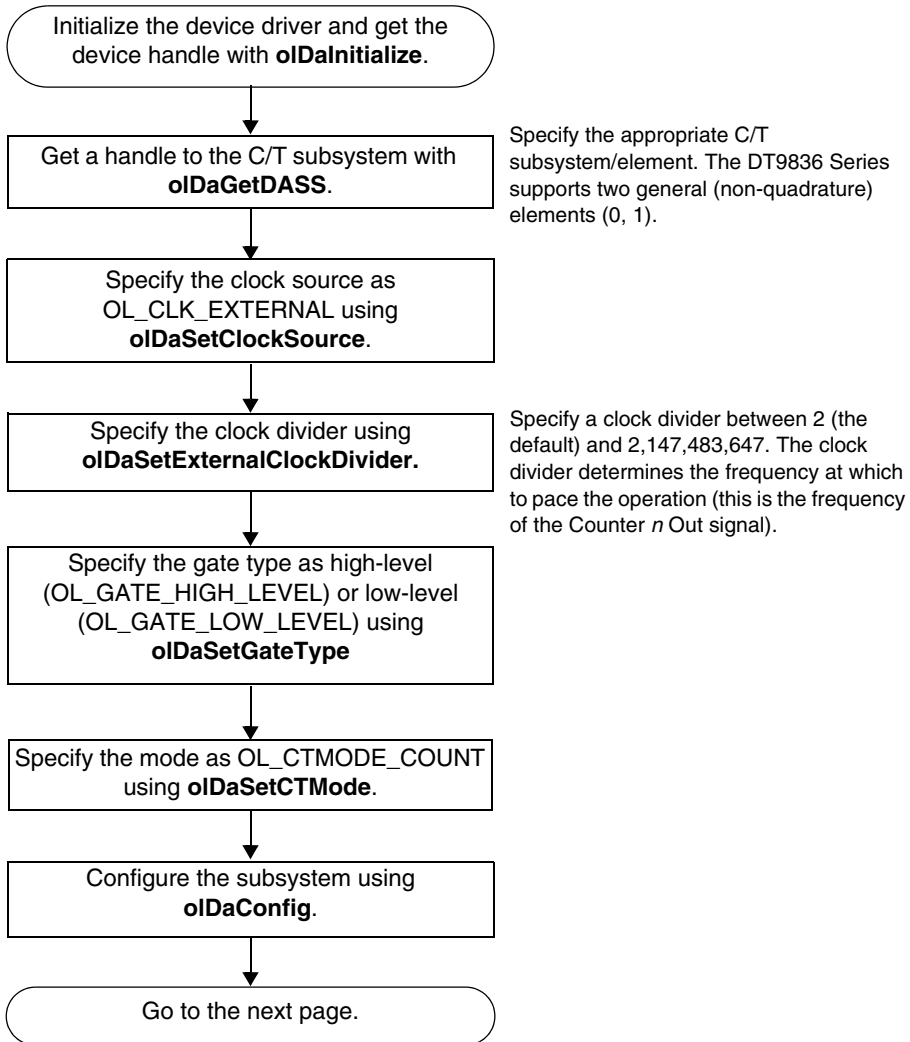
Bits	Definition
Low Byte	Bits 0 to 7 of this 32-bit word represent the actual state of the digital input lines of the board. Bit 0 corresponds to digital input line 0; bit 7 corresponds to digital input line 7. If a bit is set to 1, the associated digital input line is active.
High Byte	Bits 8 to 15 of this 32-bit word represent the digital input lines that caused the interrupt to occur. Bit 8 corresponds to digital input line 0; bit 15 corresponds to digital input line 7. If a bit is set to 1, the associated digital input line caused the interrupt to occur (i.e., changed state).



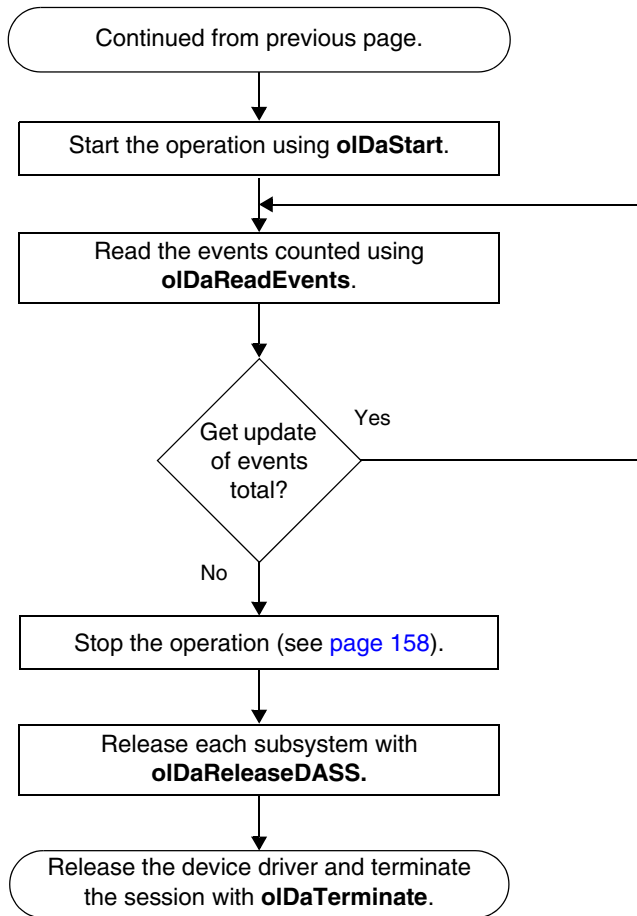
Continuous Digital Output Operations



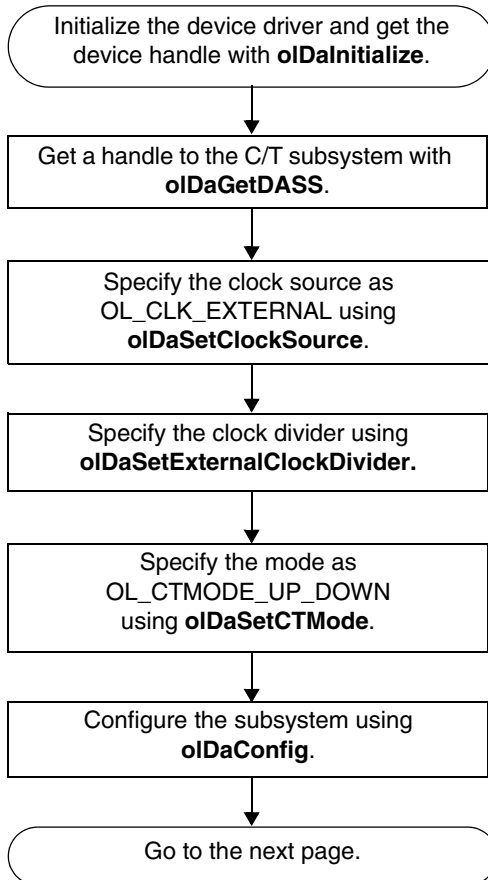
Event Counting Operations



Event Counting Operations (cont.)



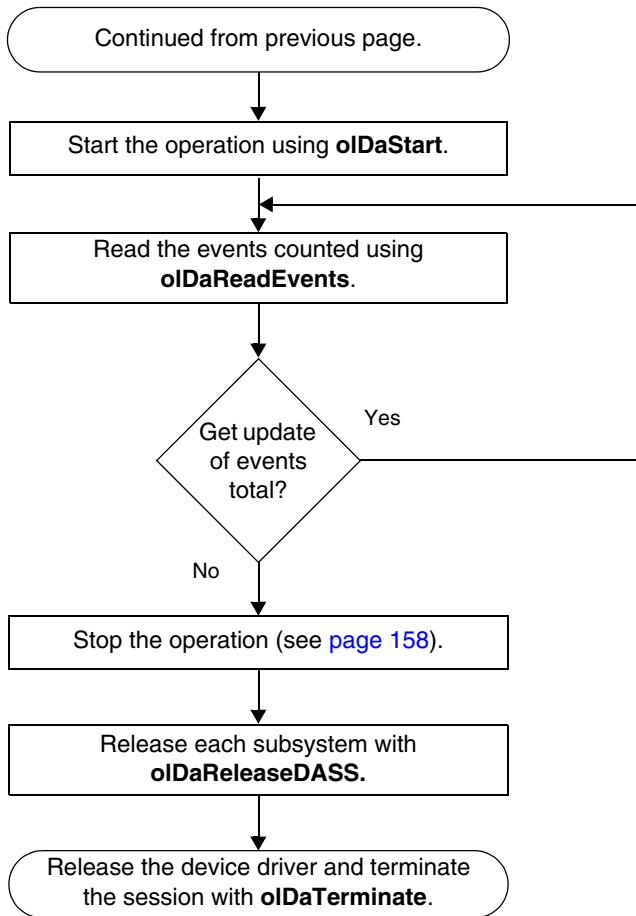
Up/Down Counting Operations



Specify the appropriate C/T subsystem/element. The DT9836 Series supports two general (non-quadrature) elements (0, 1).

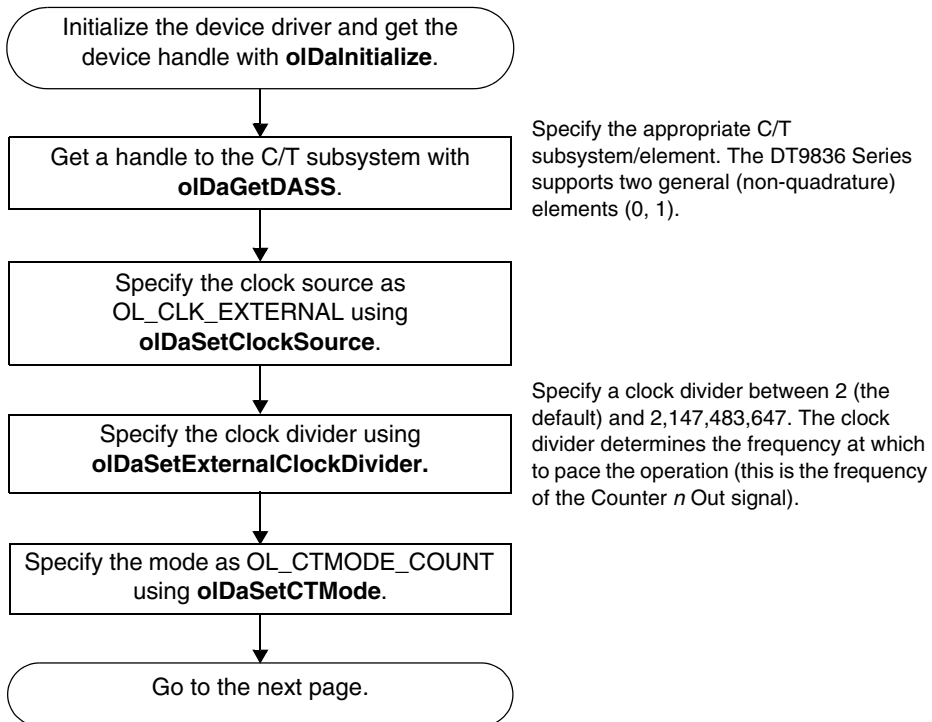
Specify a clock divider between 2 (the default) and 2,147,483,647. The clock divider determines the frequency at which to pace the operation (this is the frequency of the Counter *n* Out signal).

Up/Down Counting Operations (cont.)

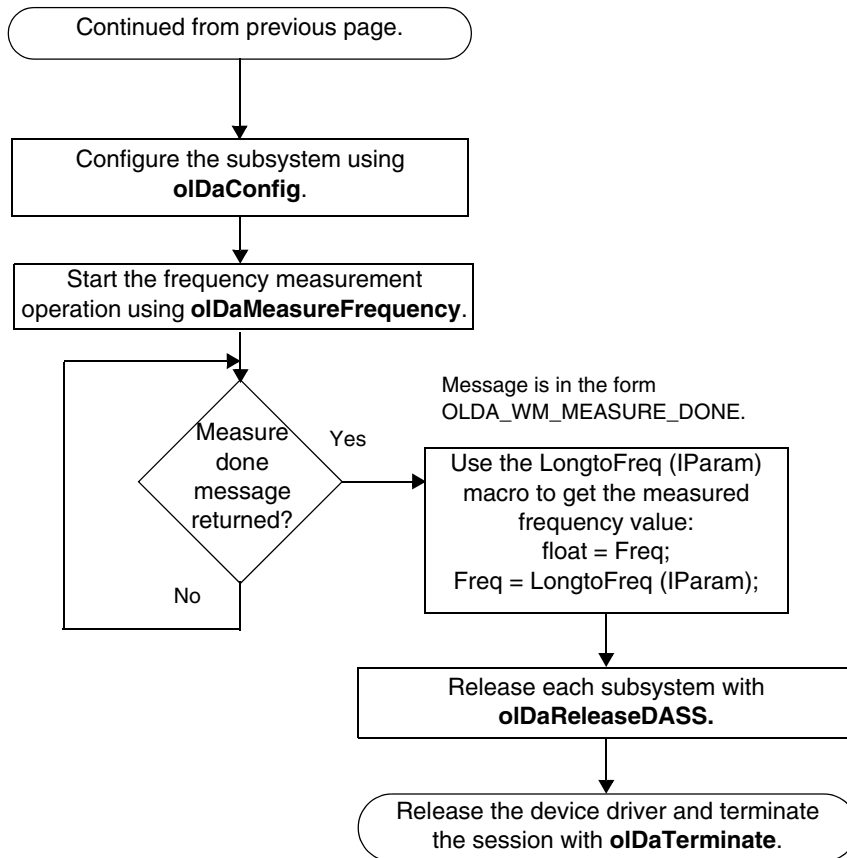


Frequency Measurement Operations

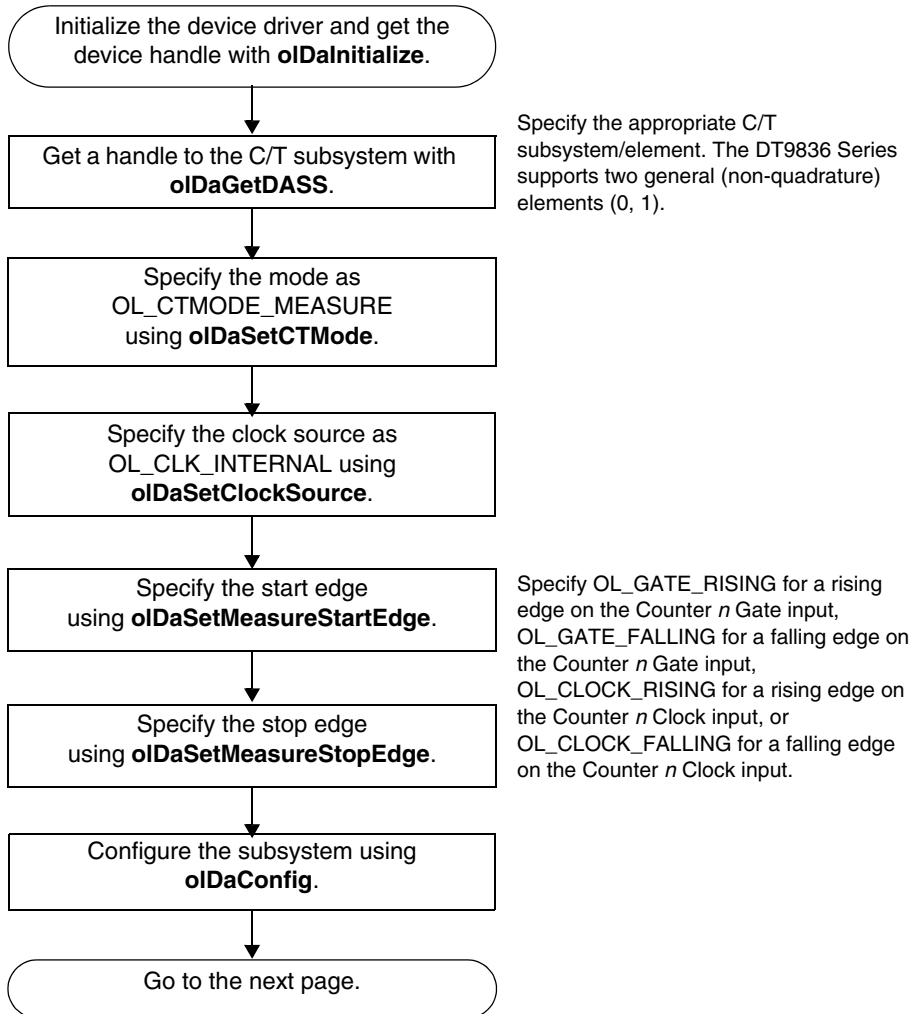
The following flowchart shows the steps required to perform a frequency measurement operation using the Windows timer. If you need more accuracy the Windows timer provides, refer to [page 100](#) of this manual or to your *DataAcq SDK User's Manual* for more information.



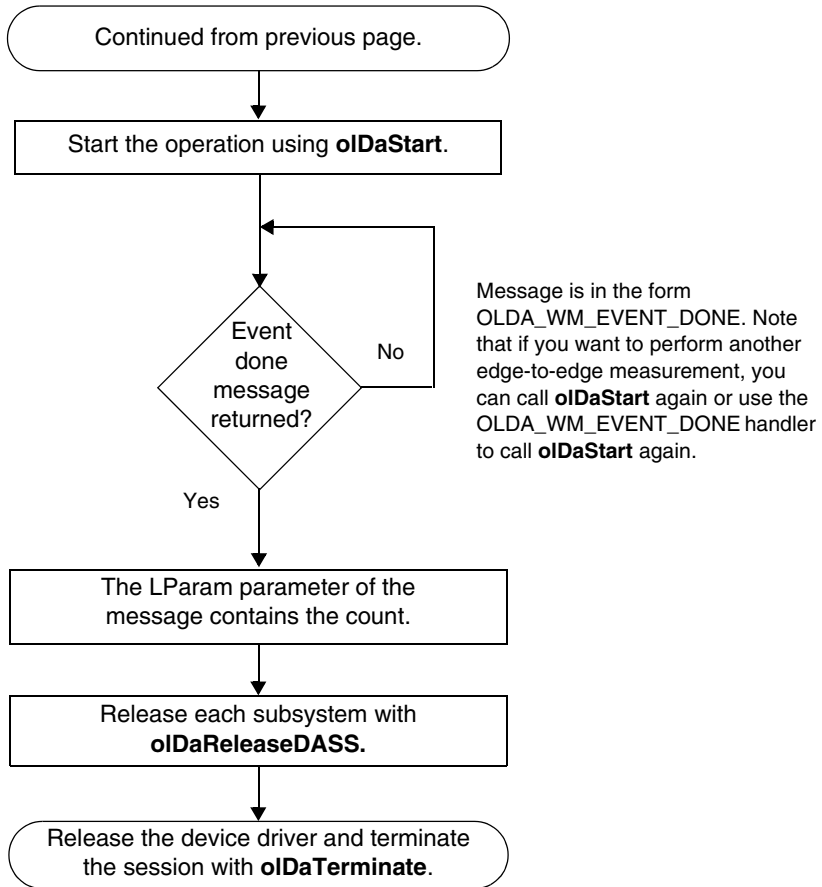
Frequency Measurement Operations (cont.)



Edge-to-Edge Measurement Operations



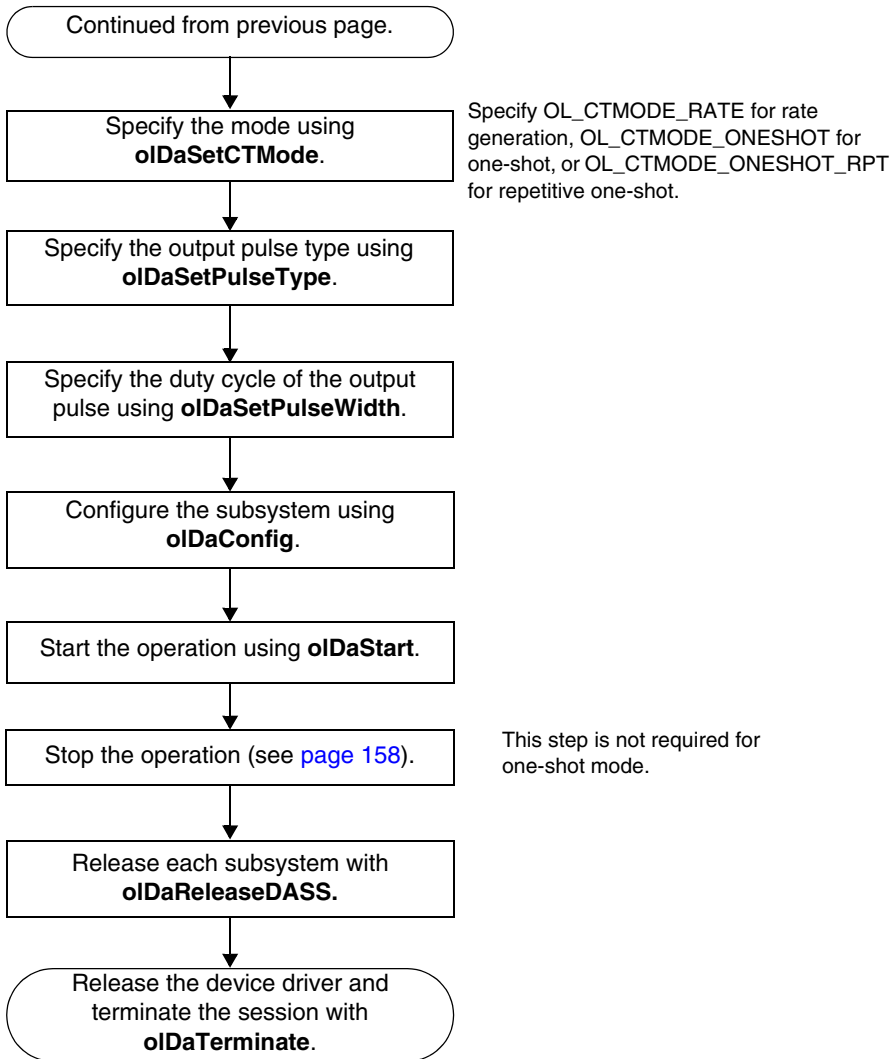
Edge-to-Edge Measurement Operations (cont.)



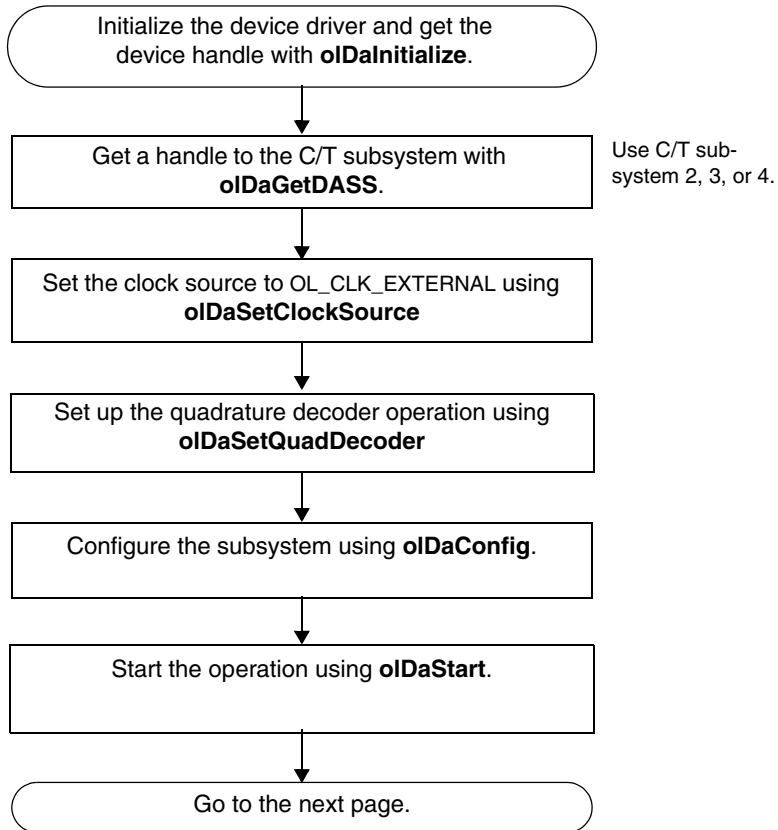
Pulse Output Operations

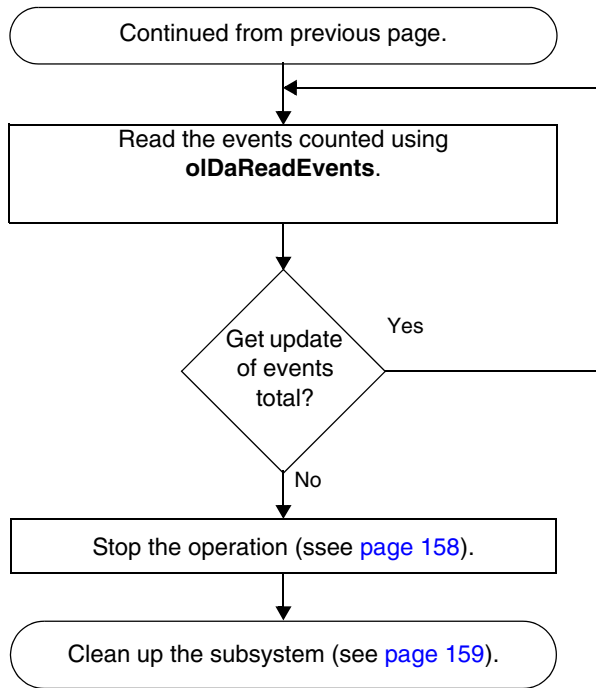


Pulse Output Operations (cont.)

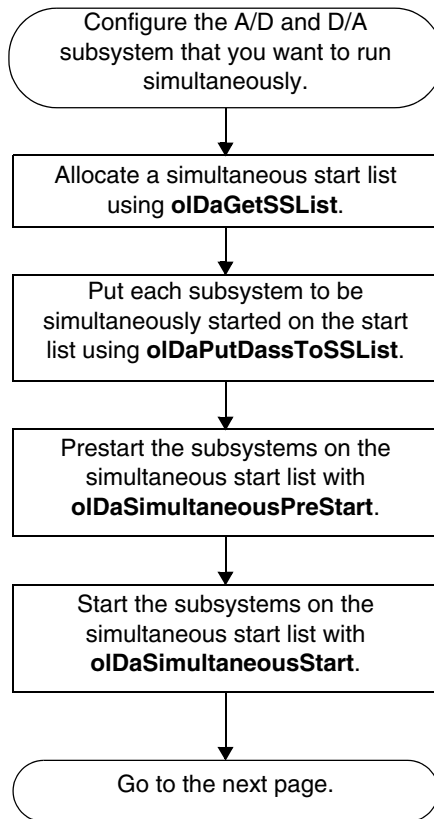


Quadrature Decoder Operations



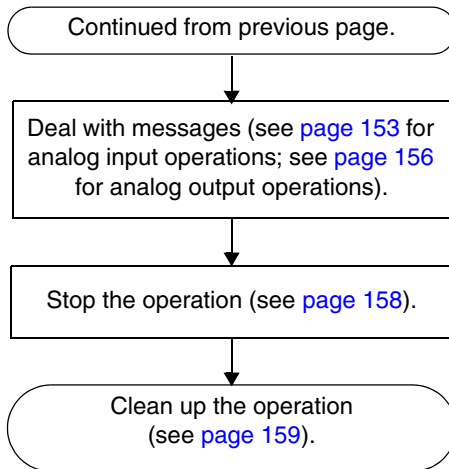


Simultaneous Operations

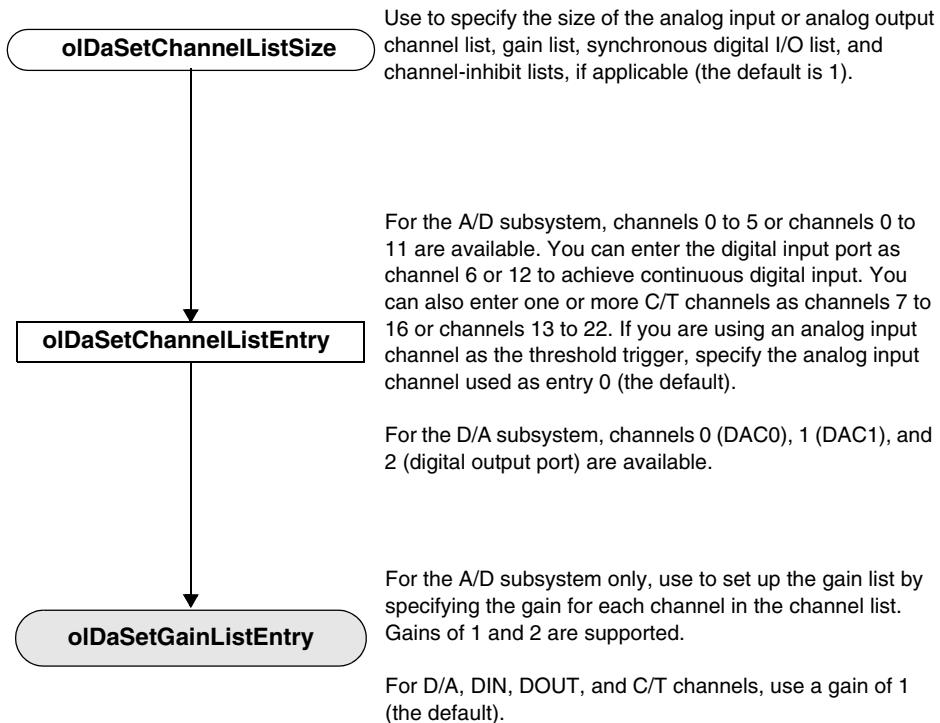


See the previous flow diagrams in this chapter; note that you cannot perform single-value operations simultaneously.

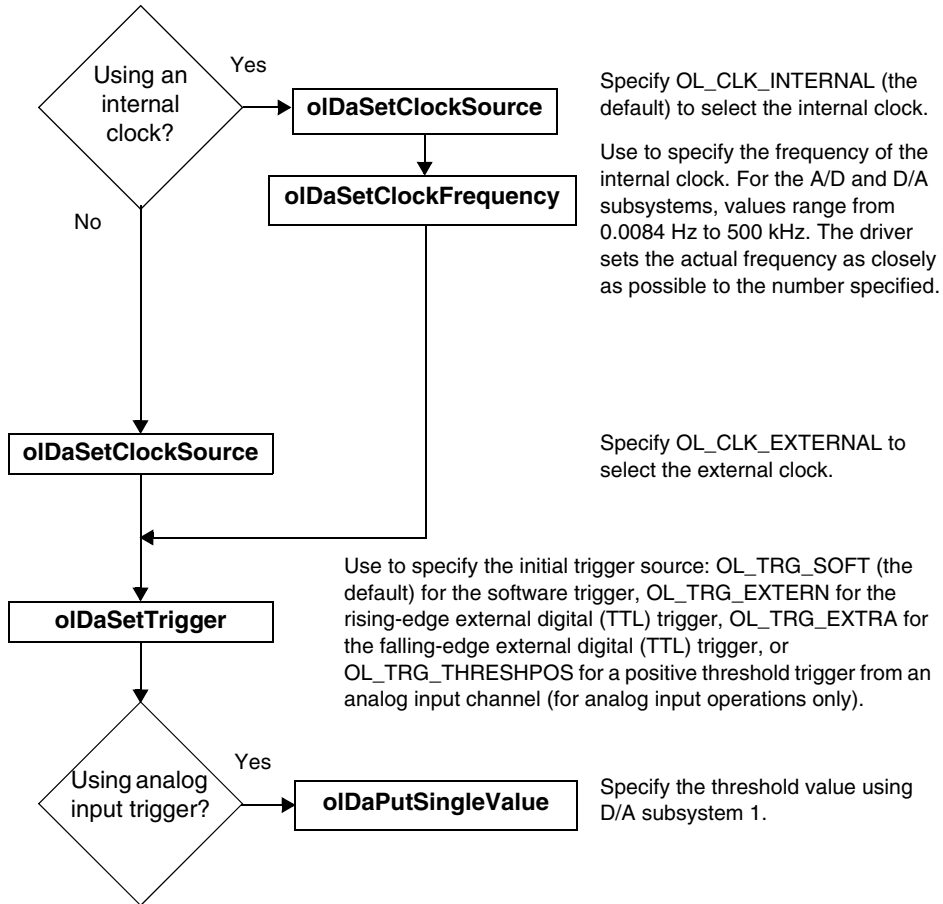
Simultaneous Operations (cont.)



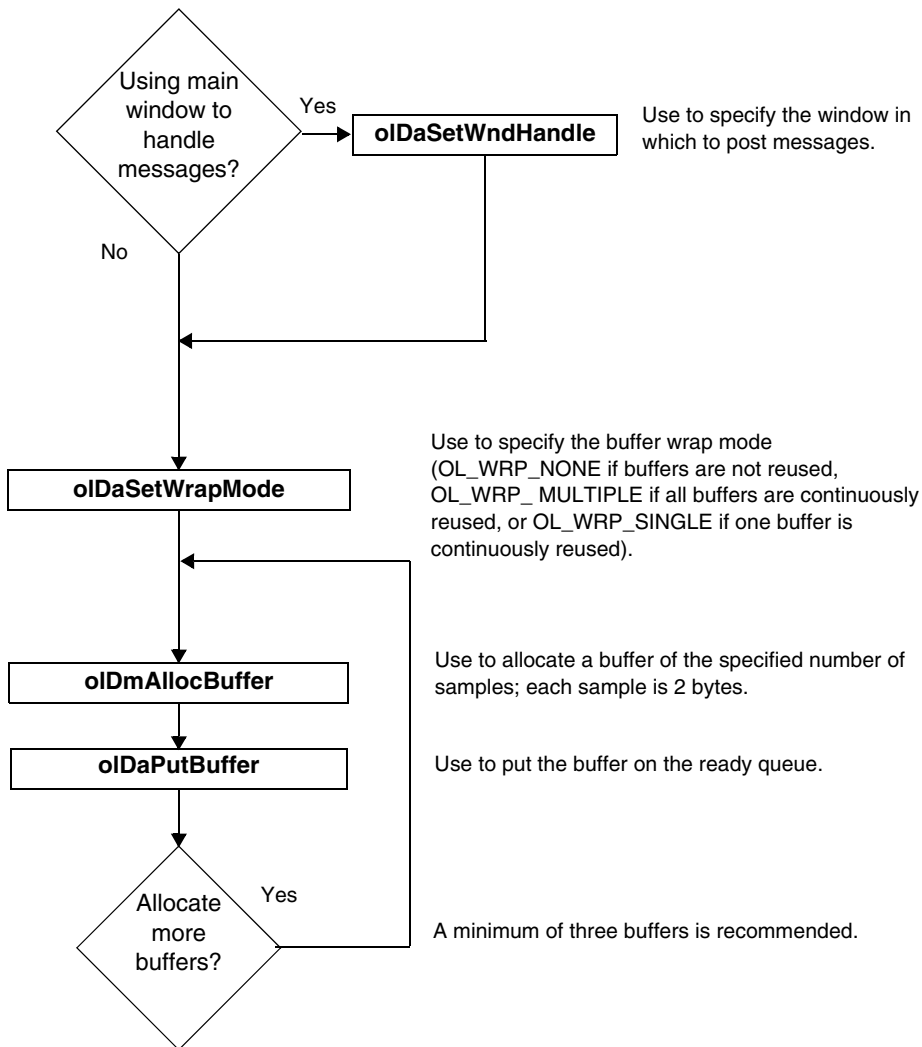
Set Up Channel List and Channel Parameters



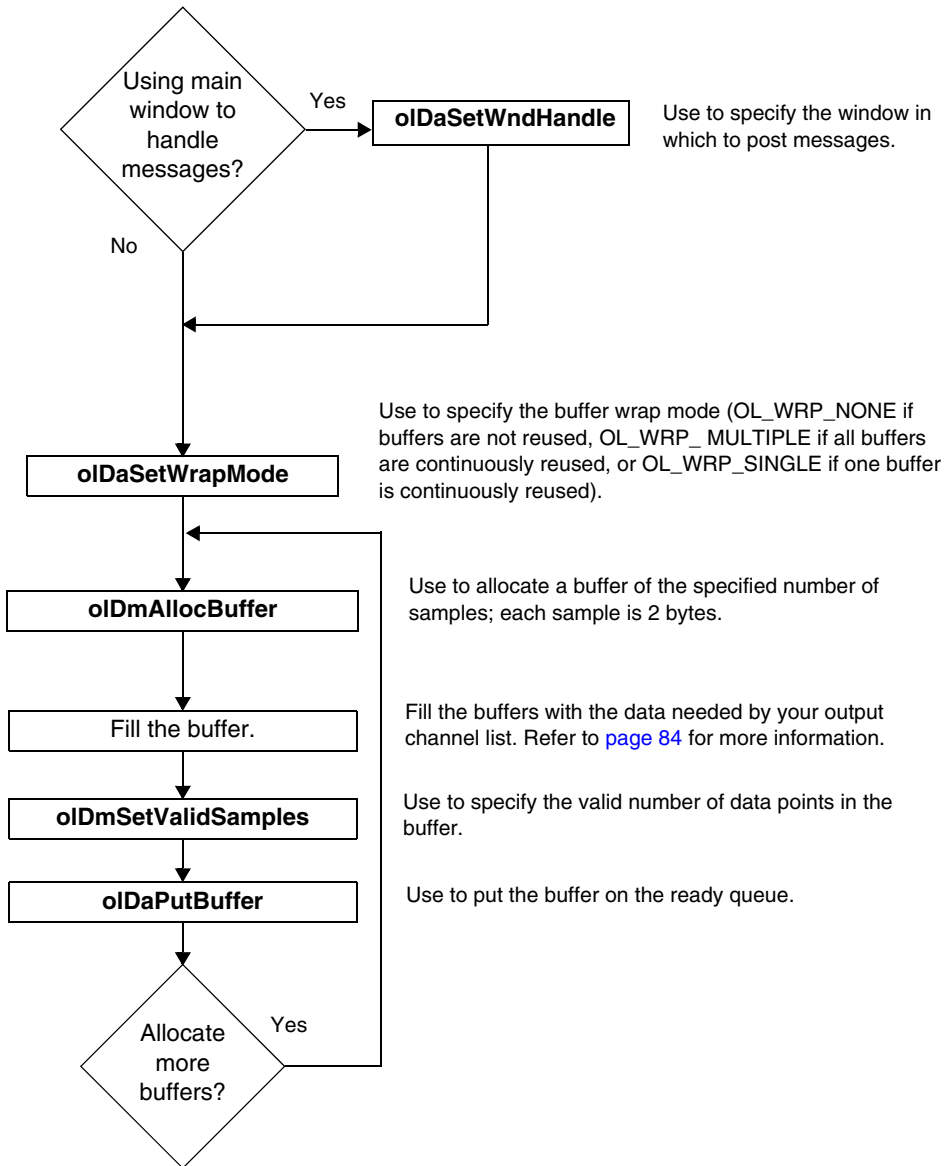
Set Clocks and Triggers



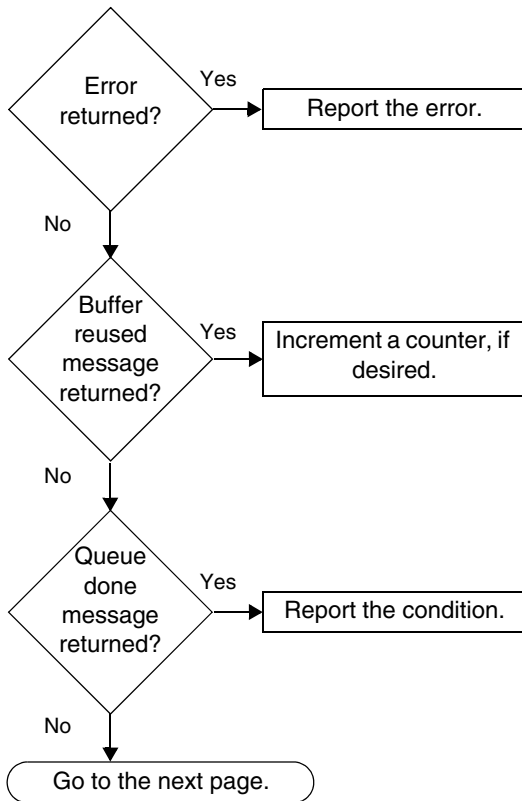
Set Up A/D Buffering



Set Up D/A Buffering



Deal with A/D Messages and Buffers

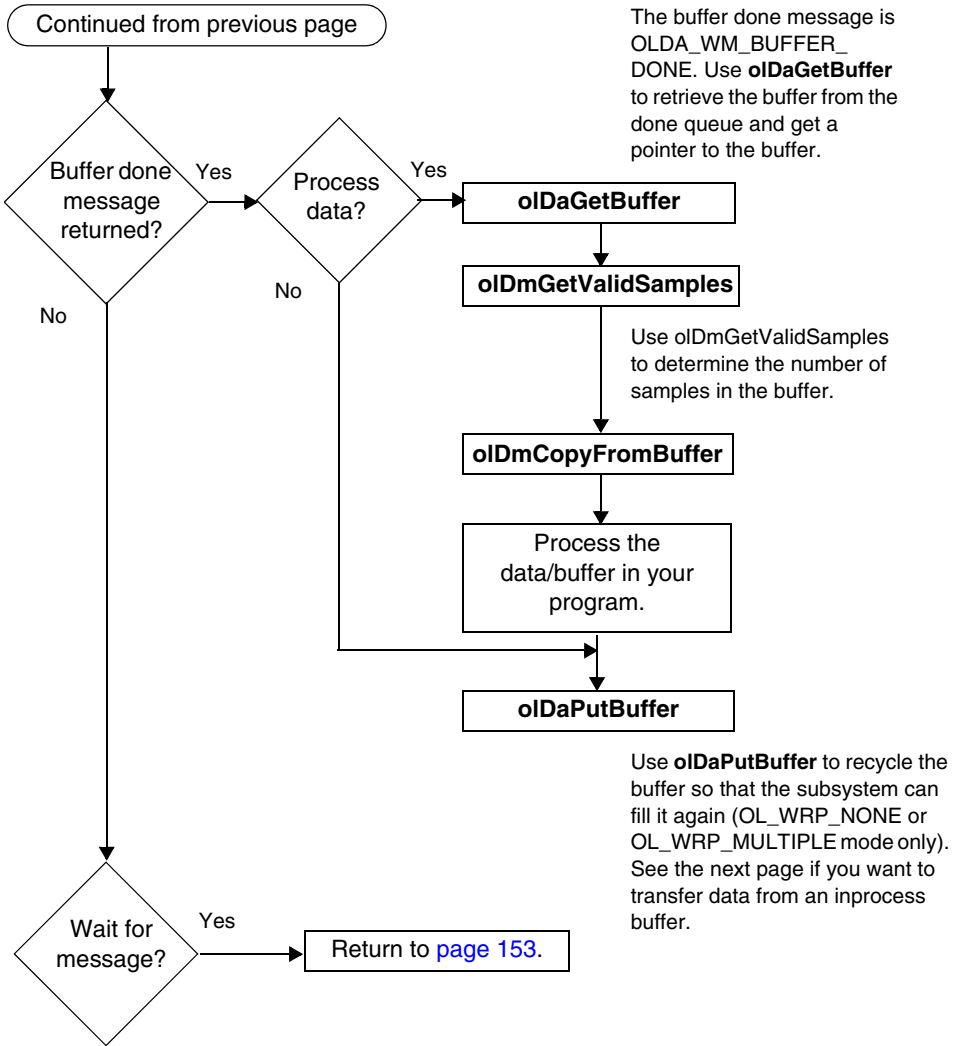


The most likely error messages include `OLDA_WM_OVERRUN` and `OLDA_WM_TRIGGER_ERROR`.

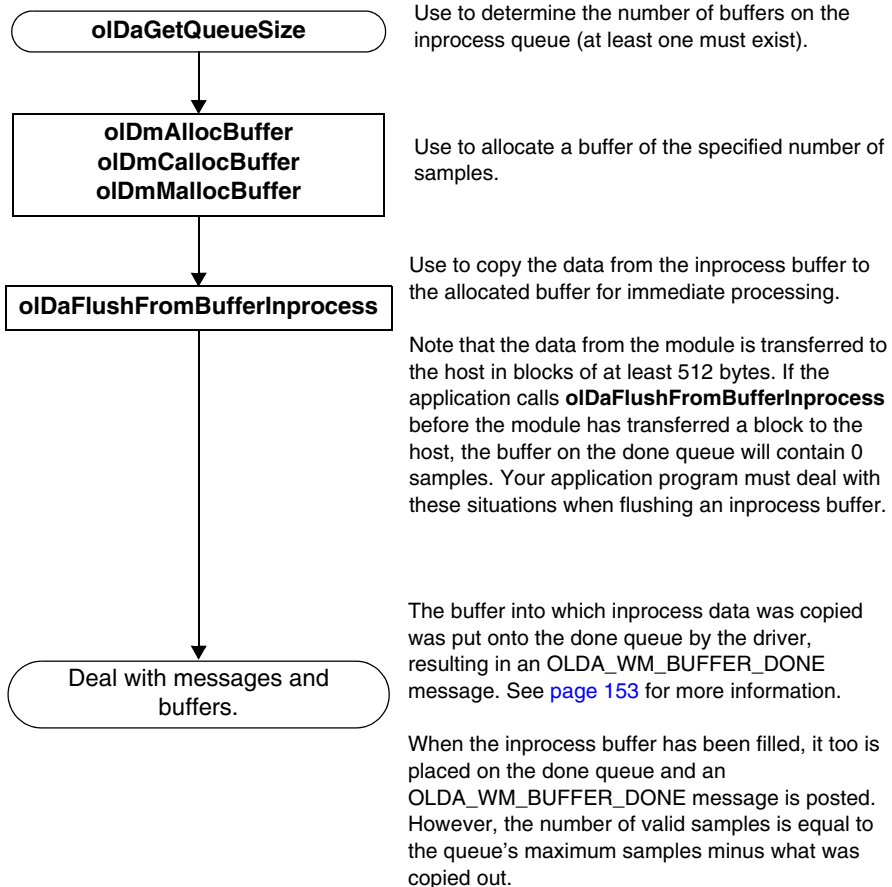
The buffer reused message is `OLDA_WM_BUFFER_REUSED`.

The queue done messages are `OLDA_WM_QUEUE_DONE` and `OLDA_WM_QUEUE_STOPPED`. After reporting that the acquisition has stopped, you can clean up the operation (see [page 159](#)).

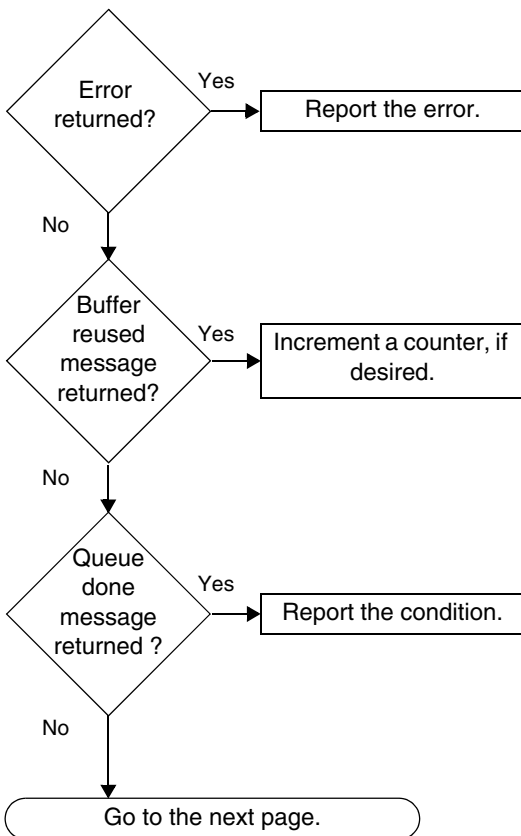
Deal with A/D Messages and Buffers (cont.)



Transfer Data from an Inprocess Buffer



Deal with D/A Messages and Buffers

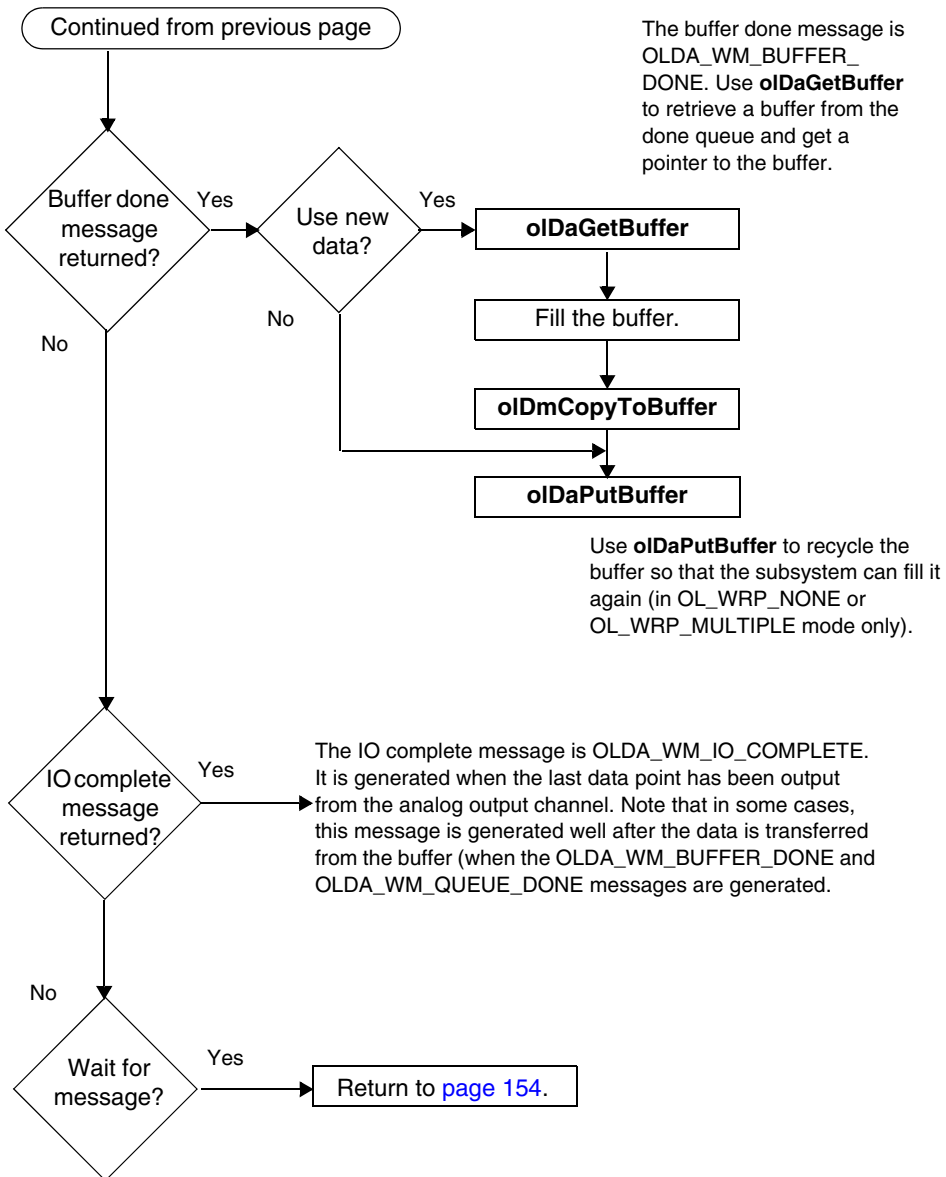


The most likely error messages include `OLDA_WM_UNDERRUN` and `OLDA_WM_TRIGGER_ERROR`.

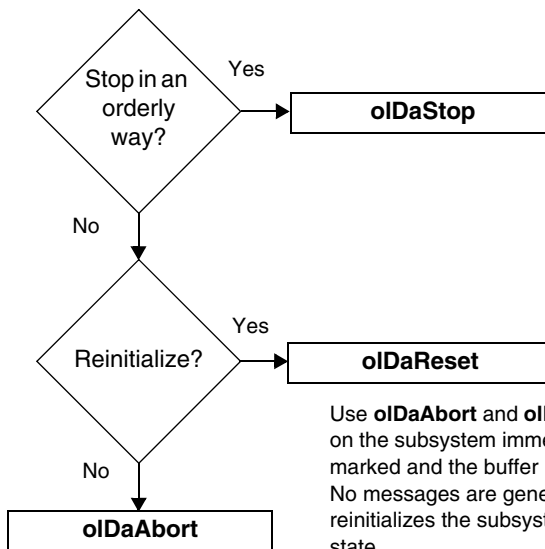
The buffer reused message is `OLDA_WM_BUFFER_REUSED`.

The queue done messages are `OLDA_WM_QUEUE_DONE` and `OLDA_WM_QUEUE_STOPPED`. After reporting that the acquisition has stopped, you can clean up the operation (see [page 159](#)).

Deal with D/A Messages and Buffers (cont.)



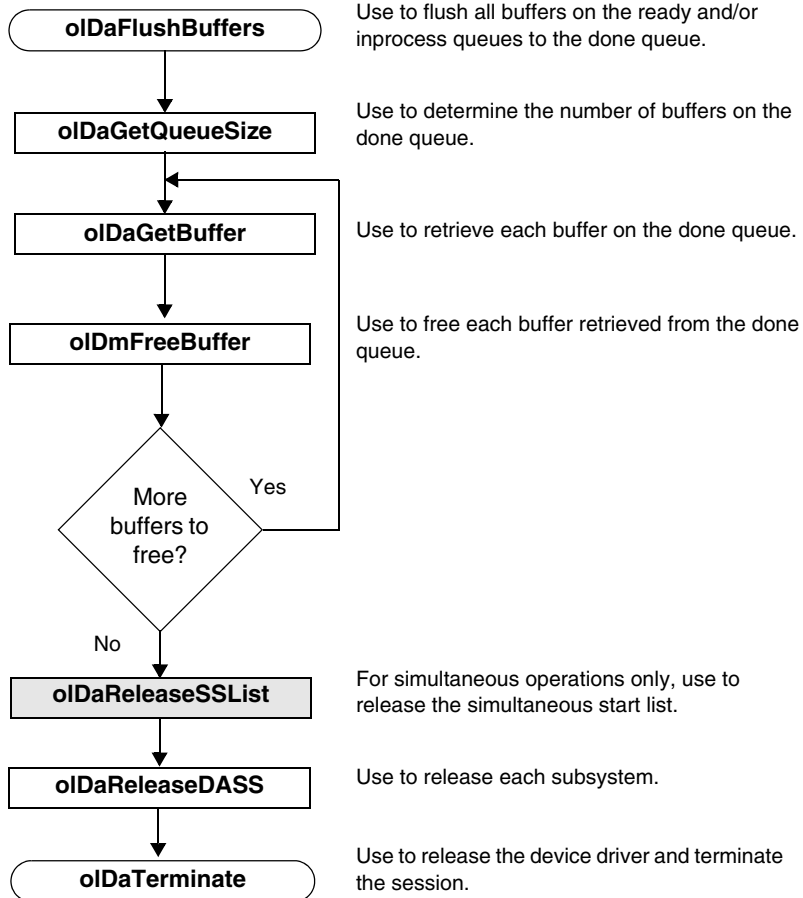
Stop the Operation



Waits until the last sample of the current buffer is filled, and then stops. The driver posts a Buffer Done and Queue Stopped message.

Use **oIDaAbort** and **oIDaReset** to stop the operation on the subsystem immediately; the valid samples are marked and the buffer is placed on the done queue. No messages are generated. In addition, **oIDaReset** reinitializes the subsystem to the driver's default state.

Clean Up the Operation





Troubleshooting

General Checklist	162
Technical Support.....	165
If Your Module Needs Factory Service.....	166

General Checklist

Should you experience problems using a DT9836 Series module, do the following:

1. Read all the documentation provided for your product. Make sure that you have added any “Read This First” information to your manual and that you have used this information.
2. Check the 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. Check that you have wired your signals properly using the instructions in [Chapter 4](#).
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.

If you still experience problems, try using the information in [Table 2](#) to isolate and solve the problem. If you cannot identify the problem, refer to [page 165](#).

Table 2: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module does not respond.	The module configuration is incorrect.	Check the configuration of your device driver; see the instructions in Chapter 3 .
	The module is damaged.	Contact Data Translation for technical support; refer to page 165 .
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 4 .
	The module is overheating.	Check environmental and ambient temperature; consult the module's specifications on page 210 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring; see the instructions in Chapter 4 .
Device failure error reported.	The DT9836 Series module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections; see the instructions in Chapter 4 .
	The DT9836 Series module was removed while an operation was being performed.	Ensure that your DT9836 Series module is properly connected; see the instructions in Chapter 3 .

Table 2: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 4 .
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 4 .
	The module is set up for differential inputs while the transducers are wired as single-ended inputs or vice versa.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 4 .
	The DT9836 Series module is out of calibration.	DT9836 Series modules are calibrated at the factory. If you want to readjust the calibration of the analog input or analog output circuitry, refer to Chapter 10 starting on page 167 .
USB 2.0 is not recognized.	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack (version 2 for Windows XP or version 4 for Windows 2000). If you are unsure of whether you are using USB 2.0 or USB 1.1, run the Open Layers Control Panel applet, described in Chapter 3 .
	Standby mode is enabled on your PC.	For some PCs, you may need to disable standby mode on your system for proper USB 2.0 operation. Consult Microsoft for more information.

Technical Support

If you have difficulty using a DT9832 Series module, Data Translation's Technical Support Department is available to provide technical assistance.

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

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

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

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

If Your Module Needs Factory Service

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

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

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

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

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

Place in a secure shipping container.

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

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



Calibration

Using the Calibration Utility	169
Calibrating the Analog Input Subsystem	170
Calibrating the Analog Output Subsystem	173

DT9836 Series modules are calibrated at the factory and should not require calibration for initial use. We recommend that you check and, if necessary, readjust the calibration of the analog input and analog output circuitry on the DT9836 Series modules every six months using the DT9832 / DT9836 Calibration Utility.

Note: Ensure that you installed the DT9836 Series Device Driver prior to using the DT9832 / DT9836 Calibration Utility. Refer to [Chapter 2](#) for more information on installing the device driver.

This chapter describes how to calibrate the analog input and output subsystems of DT9836 Series modules using the DT9832 / DT9836 Calibration Utility.

Using the Calibration Utility

Start the DT9832 / DT9836 Calibration Utility as follows:

1. Ensure that you installed the software using the instructions in [Chapter 2](#).
2. Click **Start** from the Task Bar, and then select **Programs | Data Translation, Inc | Calibration Utilities | DT9836 Calibration Utility**.

The main menu of the DT9832 / DT9836 Calibration Utility appears.

3. Select the module to calibrate, and then click **OK**.

Once the DT9832 / DT9836 Calibration Utility is running, you can calibrate the analog input circuitry (either automatically or manually), described on [page 170](#), or the analog output circuitry of the DT9836 Series module, described on [page 173](#).

Calibrating the Analog Input Subsystem

This section describes how to use the DT9832 / DT9836 Calibration Utility to calibrate the analog input subsystem of a DT9836 Series module.

The DT9836 Series module has separate calibration for each A/D input channel. You can choose to calibrate either an individual channel or all channels on the board.

Connecting a Precision Voltage Source

To calibrate the analog input circuitry, you need to connect an external +9.3750 V precision voltage source to the DT9836 Series module. Connect the precision voltage source to the first channel you want to calibrate; for example, Analog In 0 (AD Ch0).

Using the Auto-Calibration Procedure

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

1. Select the **A/D Calibration** tab of the DT9832 / DT9836 Calibration Utility.
2. Choose either a single channel or all channels from the **Type of Calibration** drop-down list box in the **Automatic Calibration** area.
3. Set the voltage supply on your selected channel to 0.000V.
4. Click the Auto Calibration **Start** button.
A message appears notifying you to verify that 0.000 V is applied to the channel.
5. Verify that the supplied voltage to your selected channel is 0.000 V, and then click **OK**.
The offset value is calibrated. When the offset calibration is complete, a

message appears notifying you to set the input voltage of the channel to +9.375 V.

6. Check that the supplied voltage to your selected channel is +9.375 V, and then click **OK**.
The gain value is calibrated and a completion message appears.
7. If you chose to calibrate all channels, then the preceding four steps repeat for all other A/D channels on the board the calibration utility prompts you to attach the precision voltage source to the next channel). Follow the on-screen prompts to proceed through the rest of the channels.

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

Using the Manual Calibration Procedure

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

1. Adjust the offset as follows:
 - a. Verify that 0.000 V is applied to AD Ch0, and that A/D Channel Select is set to Channel 0.
The current voltage reading for this channel is displayed in the A/D Value window.
 - b. Adjust the offset by entering values between 0 and 255 in the Offset edit box, or by clicking the up/down buttons until the A/D Value is 0.000 V.
2. Adjust the gain as follows:
 - a. Verify that +9.375 V is applied to AD Ch0, and that A/D Channel Select is set to Channel 0.

The current voltage reading for this channel is displayed in the A/D Value window.

- b.** Adjust the gain by entering values between 0 and 255 in the Gain edit box, or by clicking the up/down buttons until the A/D Value is 9.3750 V.

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

Once you have finished this procedure, continue with [“Calibrating the Analog Output Subsystem.”](#)

Calibrating the Analog Output Subsystem

This section describes how to use the DT9832 / DT9836 Calibration Utility to calibrate the analog output subsystem of a DT9836 Series module.

To calibrate the analog output circuitry, you need to connect an external precision voltmeter to analog output channels 0 and 1 of the DT9836 Series module.

Do the following to calibrate the analog output circuitry:

1. Select the **D/A Calibration** tab of the DT9832 / DT9836 Calibration Utility.
2. Connect an external precision voltmeter to Analog Output 0 (DAC Ch0) of the DT9836 Series module.
3. In the DAC Output Voltage box, select **-9.375 V**.
4. Adjust the offset by entering values between 0 and 255 in the DAC 0 Offset edit box or by clicking the up/down buttons until the voltmeter reads -9.375 V.
5. In the DAC Output Voltage box, select **9.375 V**.
6. Adjust the gain by entering values between 0 and 255 in the DAC 0 Gain edit box or by clicking the up/down buttons until the voltmeter reads 9.375 V.
7. Connect an external precision voltmeter to Analog Output 1 (DAC Ch1) of the DT9836 Series module.
8. In the DAC Output Voltage box, select **-9.375 V**.
9. Adjust the offset by entering values between 0 and 255 in the DAC 1 Offset edit box or by clicking the up/down buttons until the voltmeter reads -9.375 V.
10. In the DAC Output Voltage box, select **9.375 V**.
11. Adjust the gain by entering values between 0 and 255 in the DAC 1 Gain edit box or by clicking the up/down buttons until the voltmeter reads 9.375 V.

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

Once you have finished this procedure, the analog output circuitry is calibrated. To close the DT9832 / DT9836 Calibration Utility, click the close box in the upper right corner of the window.



Connector Pin Assignments

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EP353 Accessory Panel Connectors	187
EP356 Accessory Panel Connectors	191
EP355 Screw Terminal Assignments	195

OEM Version Connectors

This section describes the pin assignments for the J2 and J3 connectors on the OEM version of the DT9836 Series modules, as well as the secondary power connector, TB1. You can access these pins by building your own cable and screw terminal panel; refer to [Appendix C](#) for information about the required mating connectors. [Figure 23](#) shows the orientation of the pins on these connectors.

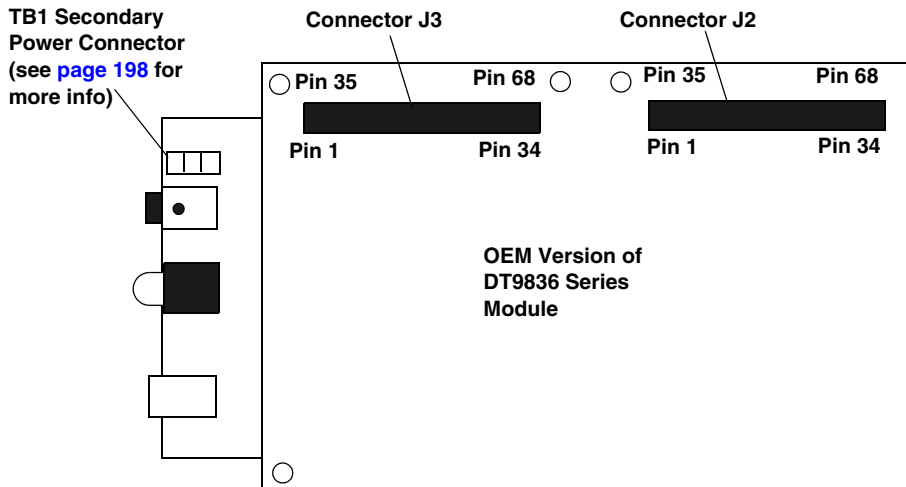


Figure 23: Connectors on OEM Version of DT9836 Module

Note: If you are using the BNC connection box, refer to [Chapter 4](#) and [“BNC Box Connectors” on page 183](#) for wiring information.

OEM J2 Connector

Table 3 lists the pin assignments for connector J2 on the OEM version of the DT9836 Series module.

Table 3: Pin Assignments for Connector J2 on the OEM Version of Module

J2 Pin Assignment	Signal Description	J2 Pin Assignment	Signal Description
1	+5 V Analog (0.5 amps)	35	Digital Ground
2	Reserved	36	Analog Ground
3	Analog Ground	37	Analog Ground
4	Reserved	38	Reserved
5	Analog Ground	39	Analog Ground
6	Reserved	40	Reserved
7	Analog Ground	41	Analog Ground
8	Reserved	42	Reserved
9	Analog Ground	43	Analog Ground
10	Reserved	44	Reserved
11	Analog Ground	45	Analog Ground
12	Reserved	46	Reserved
13	Analog Ground	47	Analog Ground
14	Reserved	48	Reserved
15	Analog Ground	49	Analog Ground
16	Reserved	50	Reserved
17	Analog Ground	51	Analog Ground
18	Reserved	52	Reserved

**Table 3: Pin Assignments for Connector J2 on the
OEM Version of Module (cont.)**

J2 Pin Assignment	Signal Description	J2 Pin Assignment	Signal Description
19	Analog Ground	53	Analog Ground
20	Reserved	54	Reserved
21	Analog Ground	55	Analog Ground
22	Reserved	56	Reserved
23	Analog Ground	57	Analog Ground
24	Analog In 5	58	Analog In 11 ^a
25	Analog Ground	59	Analog Ground
26	Analog In 4	60	Analog In 10 ^a
27	Analog Ground	61	Analog Ground
28	Analog In 3	62	Analog In 9 ^a
29	Analog Ground	63	Analog Ground
30	Analog In 2	64	Analog In 8 ^a
31	Analog Ground	65	Analog Ground
32	Analog In 1	66	Analog In 7 ^a
33	Analog Ground	67	Analog Ground
34	Analog In 0	68	Analog In 6 ^a

a. Reserved on DT9836-6 series modules.

OEM J3 Connector

Table 4 lists the pin assignments for connector J3 on the OEM version of the DT9836 Series module.

Table 4: Pin Assignments for Connector J3 on the OEM Version of Module

J3 Pin Assignment	Signal Description	J3 Pin Assignment	Signal Description
1	Quad 2 (C/T 4) Index	35	Quad Dec 2 (C/T 4) B
2	Quad Dec 2 (C/T 4) A	36	Digital Ground
3	Quad 1 (C/T 3) Index	37	Quad Dec 1 (C/T 3) B
4	Quad Dec 1 (C/T 3) A	38	Digital Ground
5	Quad 0 (C/T 2) Index	39	Quad Dec 0 (C/T 2) B
6	Quad Dec 0 (C/T 2) A	40	Digital Ground
7	Counter 1 Out	41	Counter 1 Gate
8	Counter 1 Clock	42	Digital Ground
9	Counter 0 Out	43	Counter 0 Gate
10	Counter 0 Clock	44	Digital Ground
11	Digital Ground	45	Reserved
12	Digital Input 15	46	Digital Output 15
13	Digital Input 14	47	Digital Output 14
14	Digital Input 13	48	Digital Output 13
15	Digital Input 12	49	Digital Output 12
16	Digital Input 11	50	Digital Output 11
17	Digital Input 10	51	Digital Output 10
18	Digital Input 9	52	Digital Output 9

**Table 4: Pin Assignments for Connector J3 on the
OEM Version of Module (cont.)**

J3 Pin Assignment	Signal Description	J3 Pin Assignment	Signal Description
19	Digital Input 8	53	Digital Output 8
20	Digital Input 7	54	Digital Output 7
21	Digital Input 6	55	Digital Output 6
22	Digital Input 5	56	Digital Output 5
23	Digital Input 4	57	Digital Output 4
24	Digital Input 3	58	Digital Output 3
25	Digital Input 2	59	Digital Output 2
26	Digital Input 1	60	Digital Output 1
27	Digital Input 0	61	Digital Output 0
28	External ADC Clock	62	External ADC Trigger
29	External DAC Clock	63	External DAC Trigger
30	Digital Ground	64	Digital Ground
31	+5 V	65	Digital Ground
32	Reserved	66	Reserved
33	Analog Out 1 ^a	67	Analog Out 1 Return ^a
34	Analog Out 0 ^a	68	Analog Out 0 Return ^a

a. Reserved on DT9836-6-0-OEM, DT9836-6-0-BNC, DT9836-12-0-OEM, and DT9836-12-0-BNC modules

OEM Wiring Methods

You can connect signals directly through the J2 and J3 connectors on the OEM version of the DT9836 Series module, or you can connect signals using the connectors and screw terminals on the following accessories:

- **EP353** This accessory panel plugs into connector J2 of the OEM version of the DT9836 Series module. It provides one 37-pin, D-sub connector for attaching analog input signals and one 26-pin connector for attaching a AC1315 cable/5B Series signal conditioning backplane.

Refer to [page 187](#) for more information about attaching the EP353 to the OEM version of the DT9836 Series module and for information about the connector pin assignments.

- **EP356** This accessory panel plugs into connector J3 of the OEM version of the DT9836 Series module. It provides two 37-pin, D-sub connectors. Use connector J1 of the EP356 to attach digital I/O signals, and use connector J2 of the EP356 to attach analog output, counter/timer, trigger, and clock signals.

Refer to [page 191](#) for more information about attaching the EP356 to the OEM version of the DT9836 Series module and for information about the connector pin assignments.

A

OEM TB1 Connector

Table 5 lists the pin assignments for connector TB1 on the OEM version of the DT9836 Series modules.

Table 5: Pin Assignments for Connector TB1 on the OEM Version of Module

TB1 Pin Assignment	Signal Description
1	+5 V
2	Ground
3	Shield (Chassis Ground)

BNC Box Connectors

This section describes the pin assignments for the D-sub connectors on the BNC connection box. Note that the BNC connectors are labeled on the box.

A

Digital I/O Connector

Figure 24 shows the orientation of the pins on the Digital In/Out connector on the BNC connection box.

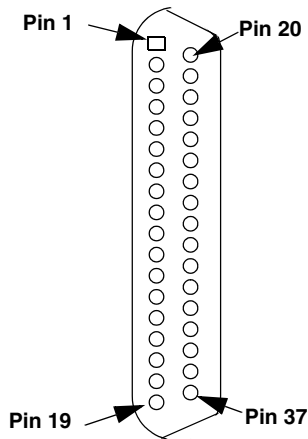


Figure 24: Orientation of the Digital In/Out Connector on the BNC Connection Box

Table 6 lists the pin assignments for the Digital In/Out connector on the BNC connection box.

**Table 6: BNC Connection Box
Digital In/Out Connector Pin Assignments**

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

CT/Enc In, Analog Out, Clk/Trig Connector

Figure 24 shows the orientation of the pins on the CT/Enc In, Analog Out, Clk/Trig connector on the BNC connection box.

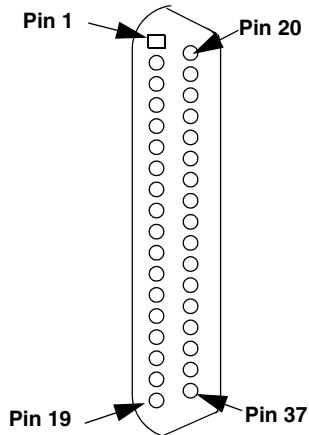


Figure 25: Orientation of the CT/Enc In, Analog Out, Clk/Trig Connector on the BNC Connection Box

Table 7 lists the pin assignments for the CT/Enc In, Analog Out, Clk/Trig connector on the BNC connection box.

A

Table 7: BNC Connection Box CT/Enc In, Analog Out, Clk/Trig Connector Pin Assignments

Pin Assignment	Signal Description	Pin Assignment	Signal Description
1	Analog Output 0	20	Analog Output 0 Return
2	Analog Output 1	21	Analog Output 1 Return
3	Reserved	22	Reserved
4	Reserved	23	Reserved
5	Digital Ground	24	Digital Ground
6	External DAC Clock	25	External DAC Trigger
7	External ADC Clock	26	External ADC Trigger
8	Counter 0 Clock	27	Digital Ground
9	Counter 0 Out	28	Counter 0 Gate
10	Counter 1 Clock	29	Digital Ground
11	Counter 1 Out	30	Counter 1 Gate
12	Quad Dec 0 (C/T 2) A	31	Digital Ground
13	Quad 0 (C/T 2) Index	32	Quad Dec 0 (C/T 2) B
14	Quad Dec 1 (C/T 3) A	33	Digital Ground
15	Quad 1 (C/T 3) Index	34	Quad Dec 1 (C/T 3) B
16	Quad Dec 2 (C/T 4) A	35	Digital Ground
17	Quad 2 (C/T 4) Index	36	Quad Dec 2 (C/T 4) B
18	Digital Ground	37	Digital Ground
19	No Connect		

EP353 Accessory Panel Connectors

To attach an EP353 accessory panel to the OEM version of the DT9836 Series module, plug the EP353 panel into connector J2 on the module, as shown in [Figure 26](#).

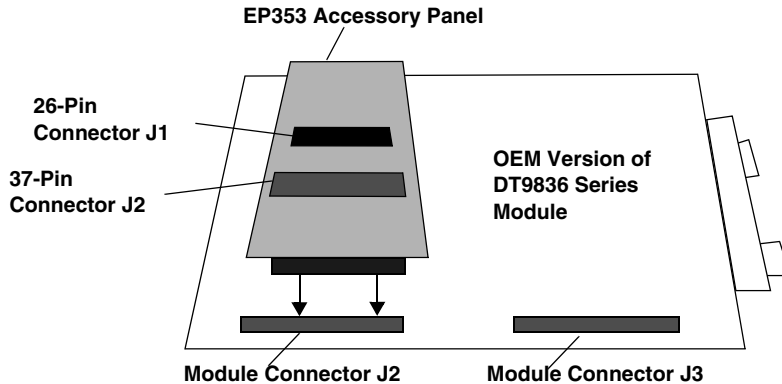


Figure 26: Connecting the EP353 Accessory Panel to Connector J2

Connector J1

[Figure 30](#) shows the orientation of the pins for connector J1 on the EP353 panel.

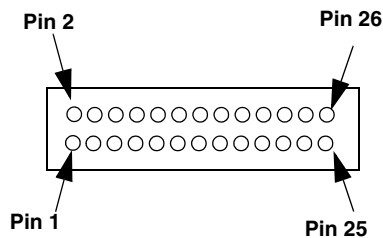


Figure 27: Orientation of the Pins for Connectors J1 on the EP353 Panel

A

You can use connector J1 and an AC1315 cable to attach a 5B Series signal conditioning backplane to the EP353 accessory panel.

Table 8 lists the pin assignments for connector J1 on the EP353 accessory panel.

Table 8: EP353 Connector J1 Pin Assignments

J1 Pin Assignment	Signal Description	J1 Pin Assignment	Signal Description
1	Analog In 0	2	Analog In 6 ^a
3	Analog Ground	4	Analog In 7 ^a
5	Analog In 1	6	Analog Ground
7	Analog In 2	8	Analog In 8 ^a
9	Analog Ground	10	Analog In 9 ^a
11	Analog In 3	12	Analog Ground
13	Analog In 4	14	Analog In 10 ^a
15	Analog Ground	16	Analog In 11 ^a
17	Analog In 5	18	Analog Ground
19	Reserved	20	Reserved
21	Analog Ground	22	Reserved
23	Reserved	24	Analog Ground
25	Reserved	26	Reserved

a. Reserved on DT9836-6 Series modules.

Connector J2

Use EP353 connector J2 to attach analog input signals to the EP353 accessory panel. [Figure 28](#) shows the orientation of the pins for connector J2 on the EP353 panel.

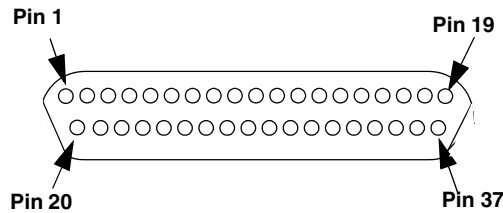


Figure 28: Orientation of the Pins for Connectors J2 on the EP353 Panel

You can access the pins on connector J2 either by using the EP360 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. Refer to [Appendix C](#) for information about the required mating connectors.

[Table 9](#) lists the pin assignments for connector J2 on the EP353 accessory panel.

A

Table 9: EP353 Connector J2 Pin Assignments

Pin Assignment	Signal Description	Pin Assignment	Signal Description
1	Analog In 0	20	Analog In 6 ^a
2	Analog In 1	21	Analog In 7 ^a
3	Analog In 2	22	Analog In 8 ^a
4	Analog In 3	23	Analog In 9 ^a
5	Analog In 4	24	Analog In 10 ^a
6	Analog In 5	25	Analog In 11 ^a
7	Reserved	26	Reserved
8	Reserved	27	Reserved
9	Reserved	28	Reserved
10	Reserved	29	Reserved
11	Reserved	30	Reserved
12	Reserved	31	Reserved
13	Reserved	32	Reserved
14	Reserved	33	Reserved
15	Reserved	34	Reserved
16	Reserved	35	Reserved
17	Reserved	36	Analog Ground
18	+5 V Analog	37	Digital Ground
19	Chassis Ground		

a. Reserved on DT9836-6 Series modules.

EP356 Accessory Panel Connectors

To attach an EP356 accessory panel to the OEM version of the DT9836 Series module, plug the EP356 panel into connector J3 on the module, as shown in [Figure 29](#).

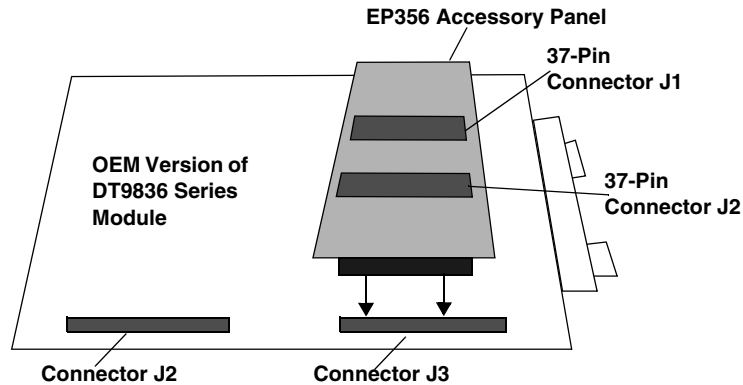


Figure 29: Connecting the EP356 Panel to the OEM Module

[Figure 30](#) shows the orientation of the pins for connectors J1 and J2 on the EP356 panel.

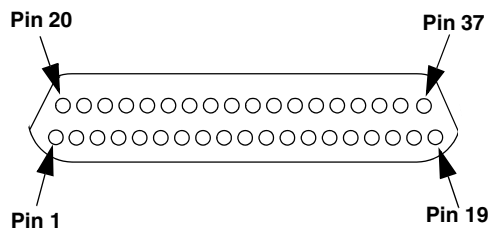


Figure 30: Orientation of the Pins for Connectors J1 and J2 of the EP356 Panel

A

Connector J1

Use connector J1 on the EP356 accessory panel to attach digital I/O signals. You can access the pins on the connector J1 either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. To build your own cable/panel, refer to [Appendix C](#) for information about the required mating connectors.

[Table 10](#) lists the pin assignments for connector J1 on the EP356 panel.

Table 10: EP356 Connector J1 Pin Assignments

Pin Assignment	Signal Description	Pin Assignment	Signal Description
1	Digital Input 0	20	Digital Out 0
2	Digital Input 1	21	Digital Out 1
3	Digital Input 2	22	Digital Out 2
4	Digital Input 3	23	Digital Out 3
5	Digital Input 4	24	Digital Out 4
6	Digital Input 5	25	Digital Out 5
7	Digital Input 6	26	Digital Out 6
8	Digital Input 7	27	Digital Out 7
9	Digital Input 8	28	Digital Out 8
10	Digital Input 9	29	Digital Out 9
11	Digital Input 10	30	Digital Out 10
12	Digital Input 11	31	Digital Out 11
13	Digital Input 12	32	Digital Out 12
14	Digital Input 13	33	Digital Out 13

Table 10: EP356 Connector J1 Pin Assignments (cont.)

Pin Assignment	Signal Description	Pin Assignment	Signal Description
15	Digital Input 14	34	Digital Out 14
16	Digital Input 15	35	Digital Out 15
17	Digital Ground	36	Reserved
18	Digital Ground	37	Digital Ground
19	Chassis Ground		

A

Connector J2

Use connector J2 on the EP356 accessory panel to attach analog output, counter/timer, trigger, and clock signals. You can access the pins on the connector J1 either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. To build your own cable/panel, refer to [Appendix C](#) for information about the required mating connectors.

[Table 11](#) lists the pin assignments for connector J2 on the EP356 panel.

Table 11: EP356 Connector J2 Pin Assignments

Pin Assignment	Signal Description	Pin Assignment	Signal Description
1	Analog Out 0 ^a	20	Analog Out 0 Return ^a
2	Analog Out 1 ^a	21	Analog Out 1 Return ^a
3	Reserved	22	Reserved
4	+5 V	23	Digital Ground
5	Digital Ground	24	Digital Ground
6	External DAC Clock	25	External DAC Trigger
7	External ADC Clock	26	External ADC Trigger
8	Counter 0 Clock	27	Digital Ground
9	Counter 0 Out	28	Counter 0 Gate
10	Counter 1 Clock	29	Digital Ground
11	Counter 1 Out	30	Counter 1 Gate
12	Quad Dec 0 (C/T 2) A	31	Digital Ground
13	Quad 0 (C/T 2) Index	32	Quad Dec 0 (C/T 2) B
14	Quad Dec 1 (C/T 3) A	33	Digital Ground
15	Quad 1 (C/T 3) Index	34	Quad Dec 1 (C/T 3) B
16	Quad Dec 2 (C/T 4) A	35	Digital Ground
17	Quad 2 (C/T 4) Index	36	Quad Dec 2 (C/T 4) B
18	Digital Ground	37	Digital Ground
19	Chassis Ground		

a. Reserved on DT9836-6-0-OEM, DT9836-6-0-BNC, DT9836-12-0-OEM, and DT9836-12-0-BNC modules

EP355 Screw Terminal Assignments

The EP355 screw terminal panel is used with the OEM version of the DT9836 Series module on connector J3 of the module.

The screw terminal assignments correspond to the pin assignments on the J3 connector on the OEM version of the DT9836 Series module itself. Refer to [Table 4 on page 179](#), using the pin numbers to reference the screw terminals on the EP355.

A



Ground, Power, and Isolation

Secondary Power Connector	198
Ground, Power, and Isolation Connections	199

Secondary Power Connector

The OEM version of the DT9836 Series module provides a secondary power connector, which is useful for embedded applications. The location of the connector is shown in [Figure 31](#).

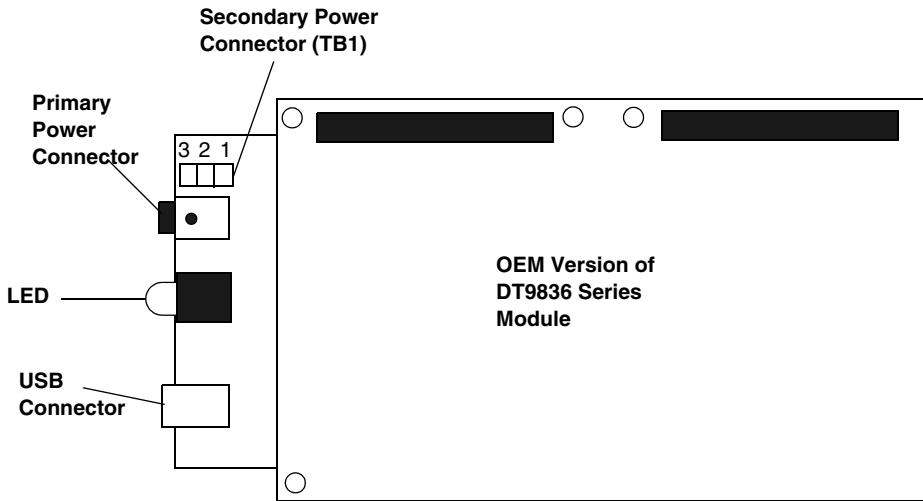


Figure 31: Secondary Power Connector

The pin assignments for the secondary power connector (TB1) are as follows:

- **Pin 1** = +5 V
- **Pin 2** = Ground
- **Pin 3** = Shield (chassis ground)

Ground, Power, and Isolation Connections

Figure 32 illustrates how ground, power, and isolation are connected on a DT9836 Series module.

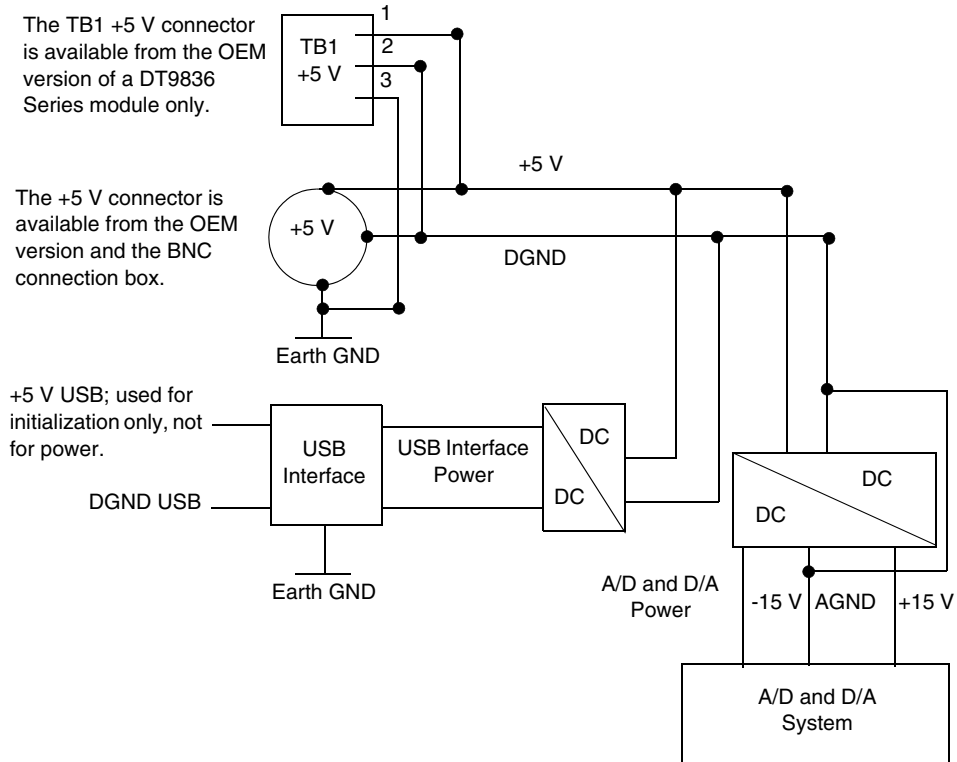


Figure 32: Ground, Power, and Isolation Connections

Keep the following in mind:

- Earth ground on the DT9836 module is not connected to DGND or AGND.
- Earth ground is connected to the aluminum case of the BNC connection box.
- You should connect earth ground to the power supply earth.
- You should isolate the +5V/DGND input. Note that the EP361 power supply (shipped with the BNC connection box and available from Data Translation for the OEM version of the module) has no connection between +5V/DGND and earth ground.
- The USB connector case is connected to earth ground.
- The USB data lines and USB GND are not connected to earth ground.
- The USB DGND is connected to the USB GND of the PC USB port.



Specifications

Table 12 lists the specifications for the A/D subsystem on the DT9836 Series modules.

Table 12: A/D Subsystem Specifications

Feature	Specifications
Number of analog input channels ^a	6 or 12 single-ended Simultaneous
Resolution	16 bits
Range	± 10 V, ± 5 V
Throughput per channel	225 kSamples/s
Channel bandwidth	2.5 MHz to -3 dB point
Sample-and-hold Aperture uncertainty: Aperture delay: Aperture match: Gain match: Zero match:	1 ns 35 ns 5 ns $\pm 0.015\%$ ± 1.5 mV
System accuracy, to % of FSR Gain = 1:	$\pm 0.015\%$
Bipolar input range	± 10 V, ± 5 V
Data encoding	Offset binary
Maximum input voltage (without damage) Power on: Power off:	± 30 V ± 20 V
Input impedance	100 M Ω 10 pF
Input bias current	± 1 nA
Integral nonlinearity	$\pm 0.015\%$
Differential nonlinearity	$\pm 0.003\%$

Table 12: A/D Subsystem Specifications (cont.)

Feature	Specifications
Inherent quantizing error	$\pm 1/2$ LSB
Drift Zero: Gain:	± 25 V/ C ± 50 ppm of FSR/ C
ESD protection Arc: Contact:	8 kV 4 kV

- a. The the number of channels available depends on the model you purchase.



Table 13 lists the specifications for the D/A subsystem on the DT9836 Series modules.

Table 13: D/A Subsystem Specifications

Feature	Specifications
Number of analog output channels	2 Simultaneous
Resolution	16 bits
Settling time to 0.01% of FSR	2.0 μ s, 100 mV steps 5.0 μ s, 10 V steps
Throughput	500 kSamples/s per channel
Slew rate	10 V/ μ s
Glitch energy	12 nV/s, typical
Output range	\pm 10 V
Data encoding	Offset binary
Output current	\pm 5 mA maximum load
Output impedance	0.1 Ω maximum
Capacitive driver capability	0.004 F
Protection	Short circuit to analog ground
Integral nonlinearity	1.0 LSB
Differential nonlinearity	1.0 LSB
Inherent quantizing error	\pm 1/2 LSB
Error Zero: Gain:	Adjustable to 0 Adjustable to 0

Table 13: D/A Subsystem Specifications (cont.)

Feature	Specifications
Drift Zero (bipolar): Gain:	± 10 ppm of FSR/ C ± 30 ppm of FSR/ C
FIFO	128 kSamples, total
ESD protection Arc: Contact:	8 kV 4 kV



Table 14 lists the specifications for the DIN/DOUT subsystems on the DT9836 Series modules.

Table 14: DIN/DOUT Subsystem Specifications

Feature	Specifications
Number of digital I/O lines	32 (16 in, 16 out)
Number of ports	2 (16 bits each)
Input termination	Inputs tied to +3.3 V through 15 k pull-up resistors
Logic family	LVTTL
Logic sense	Positive true
Inputs Input type: Input logic load: High input voltage: Low input voltage: Low input current:	Level-sensitive 1 LVTTL 2.0 V minimum 0.8 V maximum –0.4 mA maximum
Outputs Fan out: High output: Low output: High output current: Low output current:	12 mA 2.0 V minimum 0.8 V maximum –12 mA maximum 12 mA maximum
Interrupt on change	Yes
Clocked with sample clock	Yes
Software I/O selectable	No

Table 15 lists the specifications for the C/T subsystems on the DT9836 Series modules.



Table 15: C/T Subsystem Specifications

Feature	Specifications
Number of channels	5 (2 C/T, 3 quadrature decoders)
Resolution	32 bits per channel
Minimum pulse width (minimum amount of time it takes a C/T to recognize an input pulse)	55.5 ns
Logic family	LVTTTL
Inputs Input logic load: High input voltage: Low input voltage: Low input current:	1 LVTTTL 2.0 V minimum 0.8 V maximum -0.4 mA maximum
Outputs Fan out: High output: Low output: High output current: Low output current:	12 mA 2.0 V minimum 0.8 V maximum -12 mA maximum 12 mA maximum

Table 16 lists the specifications for the external A/D and D/A triggers on the DT9836 Series modules.

Table 16: External A/D and D/A Trigger Specifications

Feature	Specifications
Trigger sources Internal: External:	Software-initiated Software-selectable
Input type	Edge-sensitive
Logic family	LVTTL
Inputs Input logic load: Input termination: High input voltage: Low input voltage: High input current: Low input current:	1 LVTTL 2.2 k Ω pull-up to +3.3 V 2.0 V minimum 0.8 V maximum 25 μ A maximum –0.25 mA maximum
Minimum pulse width High: Low:	25 ns 25 ns
Triggering modes Single scan: Continuous scan: Triggered scan:	Yes Yes No



Table 17 lists the specifications for the internal A/D and D/A clocks on the DT9836 Series modules.

Table 17: Internal A/D and D/A Clock Specifications

Feature	Specifications
Reference frequency	36 MHz
Divisor range	3 to 4,294,967,295
Usable range A/D clock: D/A clock:	0.00838 Hz to 225 kHz 0.00838 Hz to 500 kHz

Table 18 lists the specifications for the external A/D and D/A clocks on the DT9836 Series modules.

Table 18: External A/D and D/A Clock Specifications

Feature	Specifications
Input type	Edge-sensitive, rising or falling edge programmable
Logic family	LVTTL
Inputs Input logic load: Input termination: High input voltage: Low input voltage: Low input current:	1 LVTTL 2.2 k Ω pull-up to +3.3 V 2.0 V 0.8 V 1.2 mA
Oscillator frequency	DC to 225 kHz (A/D); DC to 500 kHz (D/A)
Minimum pulse width High: Low:	25 ns 25 ns

Table 19 lists the power, physical, and environmental specifications for the DT9836 Series modules.

Table 19: Power, Physical, and Environmental Specifications

Feature	Specifications
Power, +5 V	±5% @ 2 A maximum
Physical Dimensions (OEM): Dimensions (BNC): Weight (OEM):	190 mm x 100 mm 215.9 mm x 105.9 mm x 50 mm 4.6 ounces
Environmental Operating temperature range: Storage temperature range: Relative humidity:	0 C to 55 C 25 C to 85 C to 95%, noncondensing



Table 20 lists the mating cable connectors for the connectors on the BNC connection box, the OEM version of the DT9836 Series module, and the EP353 and EP356 accessory panels.

Table 20: Mating Cable Connectors

Module/Panel	Connector	Part Number on Module (or Equivalent)	Mating Cable Connector
BNC connection box	Analog input	AMP/Tyco 747375-8	AMP/Tyco 747917-2
	Digital I/O	AMP/Tyco 747301-8	AMP/Tyco 747916-2
	C\T, DAC, Clk, Trig	AMP/Tyco 747301-8	AMP/Tyco 747916-2
OEM version	J2	AMP/Tyco 1-104068-8	AMP/Tyco 1-111196-7
	J3	AMP/Tyco 1-104068-8	AMP/Tyco 1-111196-7
	TB1 ^a	PCD, Inc. ELVH03500	PCD, Inc. ELVP03100
EP353 accessory panel	J1	AMP/Tyco 102321-6	AMP/Tyco 746288-6
	J2	AMP/Tyco 747375-8	AMP/Tyco 747917-2
EP356 accessory panel	J1	AMP/Tyco 747301-8	AMP/Tyco 747916-2
	J2	AMP/Tyco 747301-8	AMP/Tyco 747916-2

a. Secondary power connector.

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