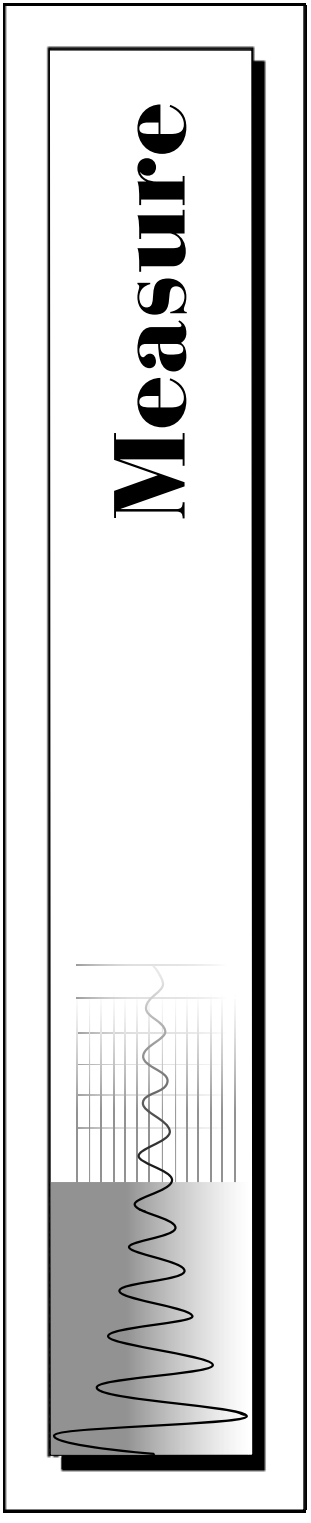

Measure™ Data Acquisition User Manual

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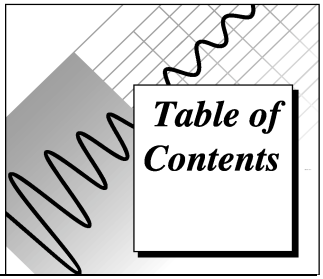


Appendix B
Error Codes

Appendix C
Troubleshooting

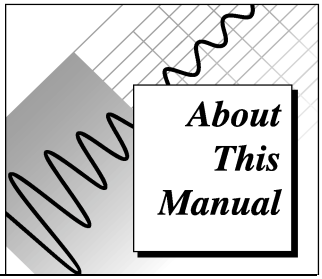
Appendix D
Customer Communication

Glossary

Index

Figures

Tables



The *Measure Data Acquisition User Manual* describes how to use the Measure Data Acquisition Add-In with National Instruments data acquisition boards to acquire data into Microsoft Excel. You should be familiar with the operation of Microsoft Excel, your computer, your computer's operating system, and your data acquisition (DAQ) board.

Organization of This Manual

The *Measure Data Acquisition User Manual* is organized as follows.

- Chapter 1, *Introduction*, helps you install the Measure Data Acquisition (DAQ) Add-In. You should have installed and configured your DAQ hardware already.
- Chapter 2, *Getting Started with Data Acquisition Tasks*, contains a tutorial for the following basic functions: selecting a data acquisition task, configuring an analog input task, configuring an analog output task, adding tasks to the DAQ menu, saving tasks, and managing tasks in a workbook.
- Chapter 3, *Using SCXI with Measure DAQ*, describes how to use the Measure Data Acquisition Add-In in Excel with your Signal Conditioning Extension for Instrumentation (SCXI) equipment.
- Chapter 4, *Analog Input Reference*, introduces some basic concepts of data acquisition and contains a reference for analog input configuration, hardware digital triggering, analog input modes, and advanced timing. You should be familiar with the hardware characteristics of your data acquisition device.
- Chapter 5, *Analog Output Reference*, introduces some concepts of data acquisition and contains a reference for basic and advanced Analog Output Configuration.

- Chapter 6, *Using Measure Data Acquisition Tasks with VBA*, describes how to run tasks from within Visual Basic for Applications.
- Appendix A, *DAQ Hardware Capabilities*, contains tables that summarize the analog I/O capabilities of National Instruments data acquisition devices you might use with Measure for Windows.
- Appendix B, *Error Codes*, describes the errors that can occur while using the Measure DAQ Add-In.
- Appendix C, *Troubleshooting*, describes solutions to problems that you might encounter using the Measure DAQ Add-In.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.
- The *Glossary* contains an alphabetical list and descriptions of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.
- The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual.

bold	Bold text denotes a parameter, or the introduction of menus, menu items, or dialog box buttons or options.
bold italic	Bold italic text denotes a note, caution, or warning.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.

`monospace`	Text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, and extensions, and for statements and comments taken from program code.
»	The **»** symbol leads you through nested menu items, and dialog box options to a final action. The sequence **Files»Page Setup» Options»Substitute Fonts** directs you to pull down the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** option from the last dialog box.
☞ **Note:**	***This icon to the left of bold italicized text denotes a note, which alerts you to important information.***

Related Documentation

The *NI-DAQ User Manual for PC Compatibles* contains information that you may find helpful as you read this manual.

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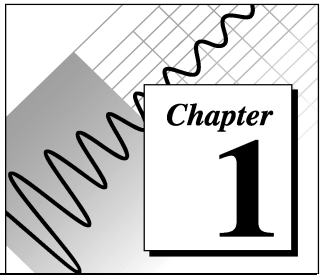
National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix D, *Customer Communication*, at the end of this manual.



Introduction

This chapter helps you install the Measure Data Acquisition (DAQ) Add-In. You should have installed and configured your DAQ hardware already. If you have not done so, please refer to the NI-DAQ documentation that came with your device for instructions on installation and configuration.

Using Measure with Your DAQ Device

Measure is designed to work with many different National Instruments DAQ devices. Before you can use Measure, you must install and configure your DAQ device and the NI-DAQ driver software that came with your DAQ device. NI-DAQ is the low-level driver software that controls your DAQ device. Measure is a higher-level software development tool that communicates to your DAQ device through NI-DAQ. Refer to the documentation that comes with your DAQ device to learn how to install it properly.

Once you install your DAQ device, you must install and configure your NI-DAQ driver software.

You use the NI-DAQ Configuration Utility to set up your DAQ device. For some DAQ devices, such as the E Series boards, you do not have to configure many settings. For other devices, you might be required to set jumpers or switches on your device to configure it to work in your system. Refer to the documentation that came with your DAQ device to install your NI-DAQ driver software. The filename for the NI-DAQ Configuration Utility is `WDAQCONF.EXE` in NI-DAQ versions 4.0 and earlier. In NI-DAQ versions 5.0 and later, the filename is `NICFG16.EXE` for Windows 3.1 and `NIDAQCFG.EXE` for Windows 95/98 or Windows NT 4.0.

Configuring Channels with the Channel Wizard

The NI-DAQ Configuration Utility is a Windows application you can use to configure the analog input channels on your DAQ device. The Channel Wizard feature helps you define the physical quantities you are measuring on each DAQ hardware channel. As you configure channels in the Channel Wizard, you give each channel configuration a unique name that is used when addressing your channels in Measure. The channel configurations you define are saved in a file that instructs the NI-DAQ driver how to scale and process each DAQ channel by its name. National Instruments recommends that you use the Channel Wizard to configure the analog input channels for your DAQ device.

Refer to the NI-DAQ Configuration Utility online help for specific instructions on how to use the Channel Wizard. In Windows 95/98 or Windows NT 4.0, you can find the help file in **Start»Programs» National Instruments DAQ»NI-DAQ Help**.

DAQ Device Overview

Measure is an easy-to-use spreadsheet interface for acquiring data with a wide range of National Instruments DAQ devices. Because Measure works with so many different devices, the functionality and performance of the software often varies based on the particular DAQ device you use. Although Measure senses the type of DAQ device you are using, you might select options in the task configuration that are not supported by your particular device. Measure notifies you when such a conflict occurs when you close the configuration window, or when you test the task you have defined. Make sure to test each task once you define it.

The following pages contain a tutorial to show you how to use Measure. Refer to the *Managing Tasks in a Workbook* section in Chapter 2, *Getting Started with Data Acquisition Tasks*, for detailed information on the analog input and output settings you can configure with Measure.

Installing Measure

1. Insert the Measure 2.0 CD into the CD-ROM drive .
2. Select **Start»Run** from the taskbar in Windows 95 or **File»Run** from the Program Manager in other versions of Windows.
3. Type *X*:\SETUP in the box labeled Command Line, and then select **OK**.
4. Select a location for the setup program to install Measure for Windows.
5. Deselect any Add-Ins that you do not want to install.
6. Select **OK**.

The setup program copies the program files and on-line help files to the directory that you choose and creates a program group. Setup also automatically configures Excel to load the DAQ Add-In when you launch Excel. If you do not want Excel to automatically load the DAQ Add-In, remove the Add-In manually as described in the following section.

Manually Adding or Removing the DAQ Add-In

To add the DAQ Add-In manually, complete the following steps.

1. In Excel, select **Tools**»**Add-Ins**.
2. In the Add-Ins dialog box, search the Add-Ins Available list box for the **Measure Data Acquisition Add-In** entry. Click in the checkbox next to the Measure Data Acquisition Add-In entry. If you cannot find the entry, click the **Browse** button and look for DAQ.XLA in the directory where you installed Measure.

To remove the DAQ Add-In manually, deselect the checkbox next to it, as shown in Figure 1-1. The next time you launch Excel, Excel will not load the DAQ Add-In automatically.

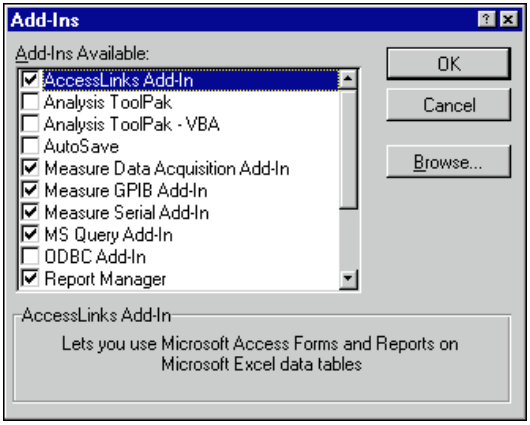
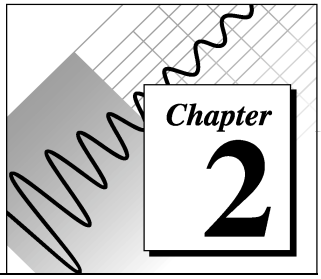


Figure 1-1. Add-Ins Dialog Box

Uninstalling Measure

To uninstall Measure, remove Serial, Data Acquisition, and GPIB Add-Ins from the Add-Ins list in Excel. Double-click the **Uninstall** icon in the Measure folder to remove Measure from your computer.

Getting Started with Data Acquisition Tasks



After you install and configure your hardware and install the Measure Data Acquisition Add-In, you are ready to acquire data. This chapter contains a tutorial for each of the following basic functions.

- Selecting a Data Acquisition task
- Configuring an Analog Input task
- Configuring an Analog Output task
- Adding tasks to the DAQ menu
- Saving tasks
- Managing tasks in a workbook

You only need to read the sections for the functions that you use in your application.

Selecting a Data Acquisition Task

This section contains step-by-step instructions for configuring analog input and output tasks with Measure. To configure tasks, complete the following steps.

1. Launch Excel.
2. Select **DAQ»Configure DAQ Tasks** to display the DAQ Tasks dialog box, as shown in Figure 2-1.

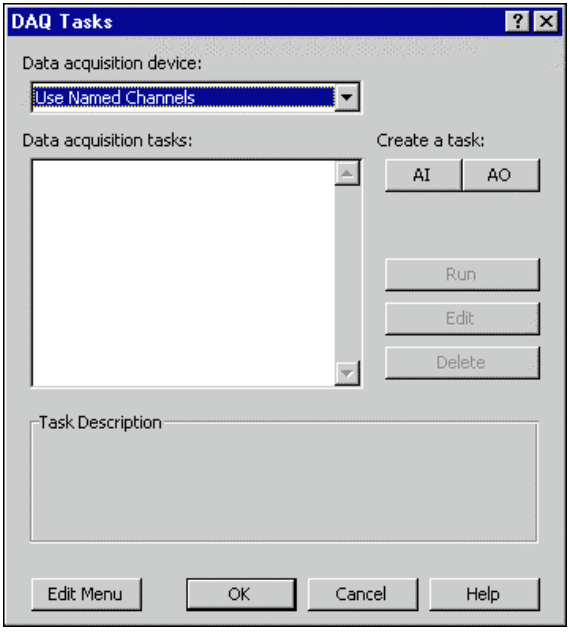


Figure 2-1. DAQ Tasks Dialog Box

The DAQ Tasks dialog box manages the I/O operations, or tasks, that you define with Measure. From this dialog box, you can create new tasks, edit existing tasks, and run I/O tasks interactively to test their operation.

3. Select a DAQ device from the Data acquisition device drop-down listbox at the top of the dialog box. The list of devices available in the drop-down listbox is taken from the devices that you have configured. If you configured your channels with the Channel Wizard, select Use Named Channels in the list box. If you have not run the configuration utility yet, refer to the documentation that came with your DAQ hardware.
4. Click on the **AI** button to display the Analog Input Configuration dialog box, as shown in Figure 2-2.

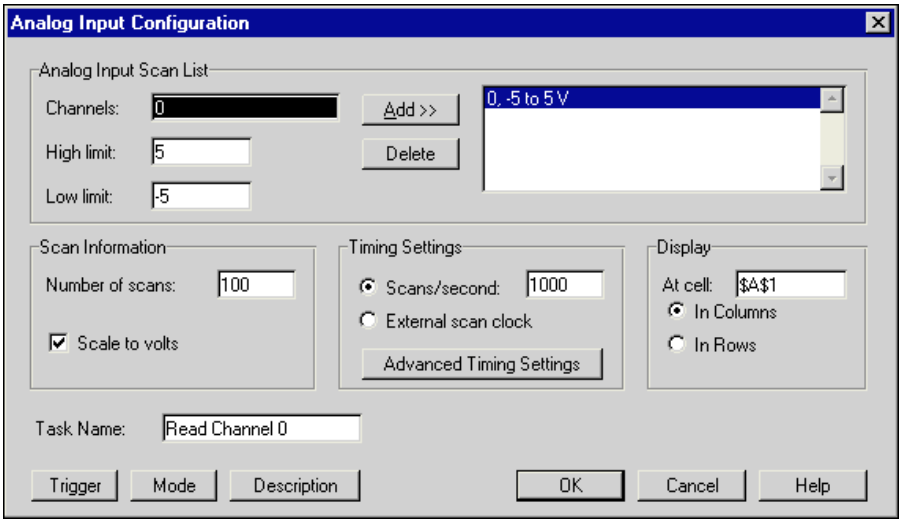


Figure 2-2. Analog Input Configuration

Configuring an Analog Input Task

From the Analog Input Configuration dialog box, you can specify all the parameters for an analog input operation. In the following steps, you create a simple analog input task. Refer to Chapter 4, *Analog Input Reference*, for more detailed information about the different options for analog input.

1. The Analog Input Scan List at the top of the dialog box is where you specify the input channels on your DAQ device from which you would like to acquire data. For each input channel you add to the scan list, you must specify a high- and low-voltage limit for the signals you read. Measure puts default values for your device in the high- and low-limit fields. Measure uses these limits to configure the gain settings on your DAQ device for maximum measurement accuracy.

   Type `0` in the Channel field and click on the **Add>>** button to place the channel into your scan list. If you are using named channels, type the channel name in the Channel field and click on the **Add>>** button to place the named channel in you scan list.

   You cannot mix channels from multiple devices within a task.

☞ **Note:** ***The High limit and Low limit fields and the* Mode *button are disabled in the Analog Input Configuration dialog box when you select Use Named Channels for your data acquisition device in the DAQ Tasks dialog box.***

2. In the Scan Information section of the dialog box, you specify how many scans of your channel list are to be acquired. A scan is a single measurement from each channel in your scan list. In this example in which there is only one channel specified, the number of scans is equal to the number of points acquired from Channel 0. If you specified two channels in your channel list, 100 scans would result in 200 points of data acquired (100 from each channel).

   Type `100` in the Number of Scans field.

3. The Scan Rate section of the dialog box is where you specify how fast you would like to acquire the data. The default setting of 1000 scans per second means that you acquire a single point from each channel in your channel list 1000 times per second.

   Type `1000` in the Scans/second field.

4. The Display section of the dialog box is where you specify the cells on your worksheet to contain the acquired data. You manually can type in a spreadsheet address, such as `$A$1`, or you can highlight the input field and use your mouse to select an area on the spreadsheet to place your acquired data. Measure begins with the upper-left most cell in the range that you supply and places the data in rows or columns from that point in the worksheet.

   Type `$A$1` to place the 100 elements of data in the first column of your worksheet.

5. Type the name `Read Channel 0` in the Task Name field.

6. Click on the **Description** button to add a description for your task under development, as shown in Figure 2-3. Type `Acquire 100 points of data from channel 0` in the Task Description dialog box, and click on the **OK** button.

   Now you have finished specifying your first Measure analog input task.

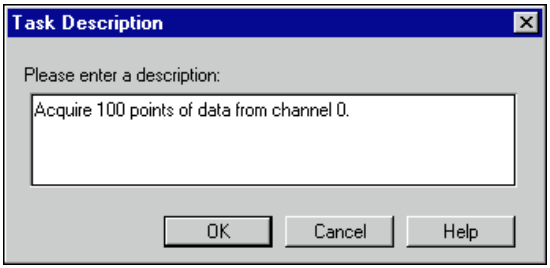


Figure 2-3. Task Description Dialog Box

7. Click on the **OK** button to return to the DAQ Tasks dialog box, as shown in Figure 2-4. Notice that you now have a task named `Read Channel 0` in your task list and that the description for this new task appears in the dialog box as well.

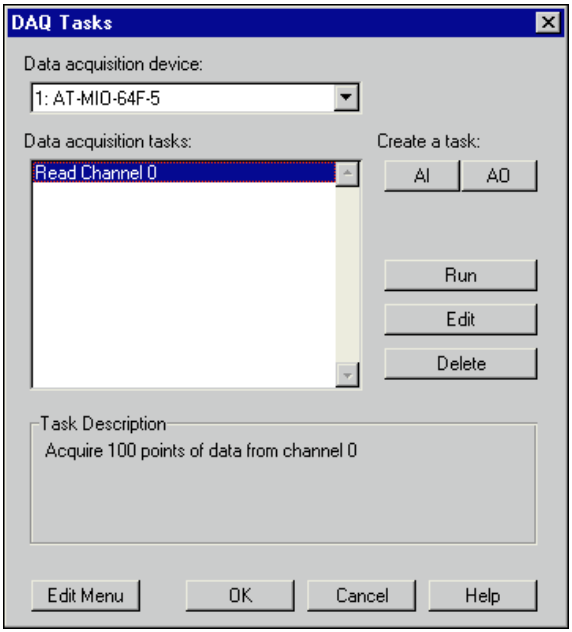


Figure 2-4. DAQ Tasks Dialog Box

8. Click on the **Run** button to execute the task. When the task completes, there are 100 datapoints in column A of your worksheet.

Configuring an Analog Output Task

If your DAQ device has analog output channels, you can use Measure to generate analog output signals based on values in your spreadsheet. You use analog output tasks to generate signals. You specify an area on your worksheet that contains data values, and Measure converts these values to voltages and outputs them through an analog output channel of your DAQ device. For more information on analog output tasks, refer to Chapter 5, *Analog Output Reference*.

1. In the DAQ Tasks dialog box, click on the **AO** button to display the Analog Output Configuration dialog box, as shown in Figure 2-5.

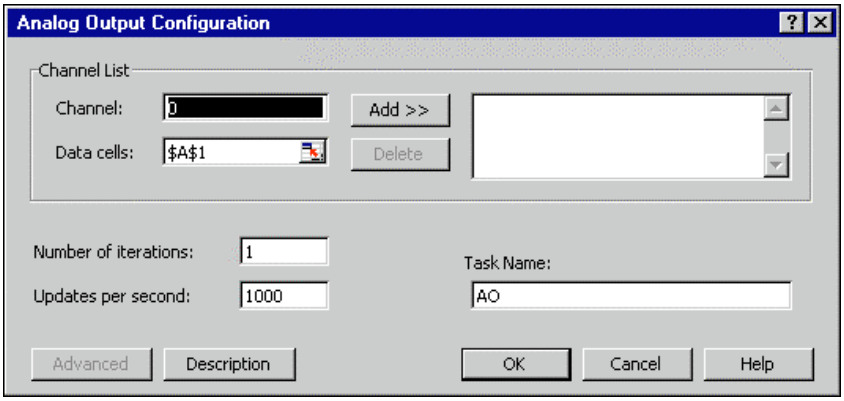


Figure 2-5. Analog Output Configuration Dialog Box

☞ **Note:** ***The* Advanced *button is disabled in the Analog Output Configuration dialog box when you select Use Named Channels for your data acquisition device in the DAQ Tasks dialog box.***

2. Type `0` in the Channel input field. If you are using named channels, type the channel name in the Channel field.
3. Type `$A$1:$A$10` in the Data cells input field. You can type this range manually, or highlight the input field and drag particular areas of your worksheet to specify a cell range. This parameter specifies which cell values are used as analog output values.
4. Click on the **Add** button.

5. Type `10` in the Number of iterations input field. The number of iterations determines how many times Measure outputs the values specified in the cell range. You can type a value of `0` in this field for continuous output of the values.
6. Type `1000` in the Updates per second input field. As in acquiring data, you must specify an update rate to determine how fast the data outputs through the analog output channel.
7. Type `Output 10 iterations` in the Task Name input field.
8. Click on the **Description** button, and type `Output 10 iterations of data on analog output Channel 0` for the description of your analog output task. Click on the **OK** button.
9. Now you have finished configuring your first Measure analog output task. Click on the **OK** button to return to the DAQ Tasks dialog box. Notice that your new analog output task appears in the task list, as shown in Figure 2-6.

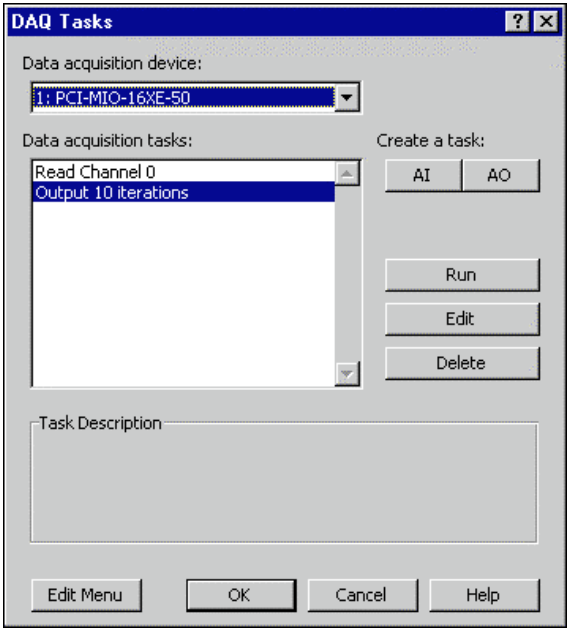


Figure 2-6. DAQ Tasks Dialog Box

10. Highlight the `Output 10 iterations` task and click on the **Run** button to execute the analog output task. Make sure you have valid voltage data in cells A1:A10 before running the task.

Adding Tasks to the DAQ Menu

Now that the two tasks are configured and tested from the DAQ Tasks dialog box, you might want to make them more accessible from your spreadsheet. With Measure, you can easily add these tasks to the **DAQ** menu.

1. Select **DAQ»Configure DAQ Tasks**.
2. Click on the **Edit Menu** button to display the Edit DAQ Menu dialog box, as shown in Figure 2-7.

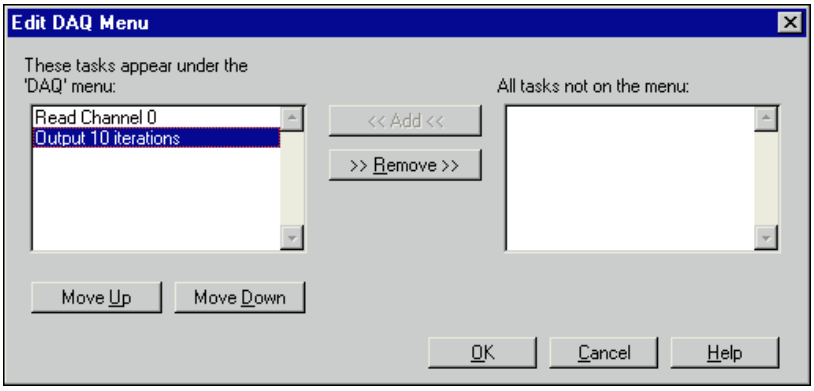


Figure 2-7. Adding Tasks to the DAQ Menu

3. Highlight each of the tasks in the window on the right and click on the **Add** button to add them to the **DAQ** menu.
4. Click on the **OK** button to return to the **Configure DAQ Tasks** menu. Click on the **OK** button to return to the Excel worksheet.
5. Pull down the **DAQ** menu. Notice that two new entries now appear in the **DAQ** menu, as shown in Figure 2-8. Now you can select these tasks and execute them from the worksheet without going into the Measure dialog boxes.

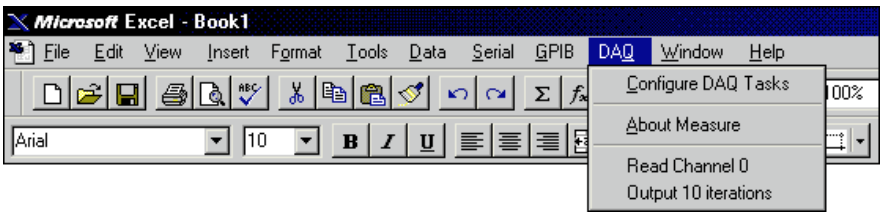


Figure 2-8. The DAQ Menu

Saving Tasks

Each of your tasks are stored in your workbook automatically when you click on the **OK** button in the DAQ Tasks dialog box. If you configure a new task, but click on the **Cancel** button from the DAQ Tasks dialog box, Measure does not store your new task in your workbook.

Your tasks are saved as part of the Excel workbook. Each time you launch Excel and open a workbook that contains Measure tasks, they appear in the task list of the DAQ Tasks dialog box.

Managing Tasks in a Workbook

This section describes how to use the DAQ Tasks dialog box, as shown in Figure 2-9, to manage the tasks in a workbook. You can open this dialog box by selecting **DAQ**»**Configure DAQ Tasks** from the menu bar.

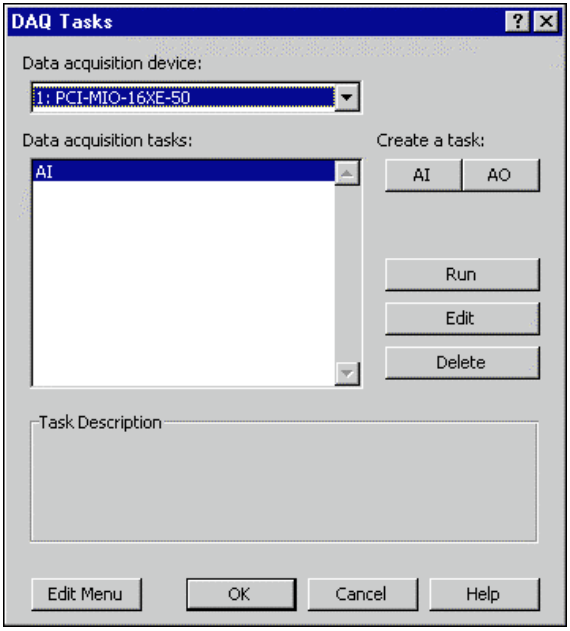


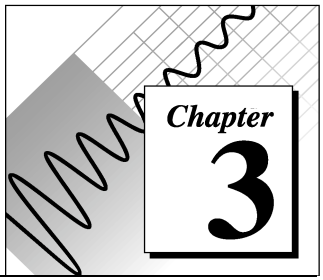
Figure 2-9. DAQ Tasks Dialog Box

Table 2-1 contains a list of the DAQ Tasks dialog box options with descriptions of their use.

Table 2-1. DAQ Tasks Dialog Box Options

Option/Button	Description
Data acquisition device	Select the National Instrument data acquisition device for which you want to create a task. Measure scans your NI-DAQ configuration for installed devices and lists only those devices that Measure supports.
Data acquisition tasks	Measure lists all the tasks that you have created for a data acquisition device. Select a task if you wish to run, edit, or delete it.
Task Description	Measure displays the description of the selected task. You can assign a description to a task when you create or edit it.
Edit Menu	Add or delete tasks from the **DAQ** menu.
AI	Create an Analog Input task for the selected data acquisition device.
AO	Create an Analog Output task for the selected data acquisition device.
Run	Run the selected data acquisition task.
Edit	Edit the selected data acquisition task.
Delete	Delete the selected data acquisition task.
OK	Store in the active workbook all the changes that you made (creation of tasks, changes to existing tasks, deletions of tasks, additions or deletions to the **DAQ** menu).
Cancel	Ignore all the changes that you made (creation of tasks, changes to existing tasks, deletions of tasks, additions or deletions to the **DAQ** menu).

Using SCXI with Measure DAQ



This chapter describes how to use the Measure data acquisition (DAQ) Add-In in Excel with your Signal Conditioning Extension for Instrumentation (SCXI) equipment.

SCXI is a set of modules and terminal blocks used as a signal condition front-end for your data acquisition devices. These modules perform tasks such as multiplexing large numbers of signals, amplifying low-level signals, providing isolation between your data acquisition devices and transducers, and so on.

To use your SCXI modules with Measure, you must first configure all your DAQ hardware using the NI-DAQ Configuration Utility. In the configuration utility, you must assign a device number to each of your DAQ devices and define the connections to your SCXI modules. In most cases, your DAQ device is a plug-in board in your computer, although it also can be a PC Card (PCMCIA) format DAQCard or a SCXI-1200 module. You use the DAQ devices for the actual A/D conversions of your analog input signals and for controlling SCXI modules. Each SCXI module is controlled by one DAQ device and is assigned as such in the configuration utility. If you have any questions about the NI-DAQ Configuration Utility, consult the NI-DAQ documentation.

Once you have configured the SCXI system, using the Measure DAQ Add-In is very similar to using other DAQ devices. The only difference in the operation is the use of the channel string in the scan list to specify the channels on specific SCXI modules you want to acquire. All other parameters of the DAQ Add-In operate the same.

SCXI Operating Modes

You can operate SCXI modules in two different modes-*multiplexed* and *parallel*. In the multiplexed mode, all analog input channels for each SCXI module are multiplexed (routed) onto one input channel of

your data acquisition device. The multiplexed mode is the default and recommended mode to use with SCXI. In the parallel mode, each SCXI module is directly connected to one data acquisition device and each analog input channel on a SCXI module is connected to a separate analog input channel on the data acquisition device. Not all data acquisition devices or SCXI modules support the parallel mode. Consult your data acquisition hardware user manual for more information.

SCXI Analog Input

The following information is not relevant if you used the Channel Wizard to configure your channels.

To configure channels on a SCXI analog input module in the DAQ task configuration, select the DAQ device in the main DAQ Tasks dialog box to which the SCXI module is directly or indirectly connected. Then, click on the **AI** button to create an AI task or the **Edit** button to modify an existing AI task. In the Analog Input Configuration dialog box, specify the SCXI channel(s) you want to acquire in the Channels field by entering a channel string. This channel string provides information about the DAQ device channel, SCXI chassis number, SCXI module number, and SCXI channel number. The channel string has the following format:

```
ob0!scx!mdy!z
```

In the SCXI channel string, `x` represents the chassis number, `y` the module number, and `z` the channel number.

'`ob0`' in the SCXI channel string indicates which onboard channel (on the DAQ device) to use to acquire the data. In the SCXI multiplexed mode (default mode), all SCXI channels from one SCXI chassis are multiplexed onto one onboard channel. Usually, this is Channel 0 (`ob0` in the SCXI string), unless you are using more than one SCXI chassis; in which case each additional chassis uses the next onboard channel (i.e. Chassis 2 uses onboard Channel 1, and so on).

'`scx`' represents the chassis number where `x` is replaced by the actual number (e.g. `sc1`). The chassis are numbered starting with `1` and the chassis number is assigned in the NI-DAQ Configuration Utility.

'`mdy`' represents the module number where `y` is replaced with the actual number (e.g. `md2`). The modules are numbered `1` through *n* on

each SCXI chassis with module `1` being in the left-most slot of the SCXI chassis and module *n* in the right-most slot.

'`z`' in the SCXI channel string represents the actual channel number (e.g. `3`). Channels on the SCXI modules are numbered starting at zero. You specify a range of channels on your SCXI modules by listing the first and last channel separated with a colon (e.g. `0:5`).

You use the SCXI channel string only when the SCXI is operating in multiplexed mode and channels are multiplexed onto one or more channels of the data acquisition device. In parallel mode, specify the channel of your data acquisition device to acquire. Each channel on your DAQ device is mapped in hardware to one channel on a SCXI module in parallel mode.

Multiple SCXI Modules and Chassis

The following information is not relevant if you used the Channel Wizard to configure your channels.

In the scan list of your DAQ AI task, you can specify channels from multiple SCXI modules or chassis by adding multiple entries to the scan list. Repeat the Add operation for each SCXI module. However, you can specify only one group of consecutive channels per SCXI module in the scan list. You must specify consecutive channels in an incremental order (e.g. `ob0!sc1!md1!0:5, ob0!sc1!md2!10:19`). In the DAQ Tasks dialog box, the channel setting would be listed as follows. The two lines in the scan list on the right are added separately by twice filling in the channel field on the left and clicking on the **Add>>** button, as shown in Figure 3-1.

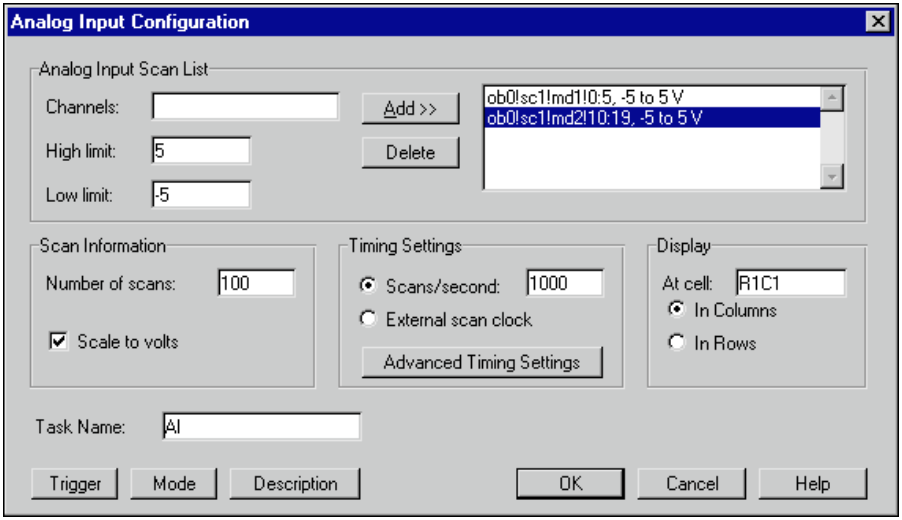


Figure 3-1. Selecting the **Add>>** button

Table 3-1 lists other possible combinations for SCXI channel strings.

Table 3-1. SCXI Channel Strings Syntax

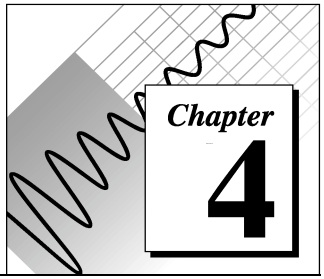
String Syntax	Description
`ob0!sc1!md2!5`	Channel 5 on module 2 of SCXI Chassis 1 is read through onboard Channel 0.
`ob0!sc1!md2!0:7` `ob0!sc1!md4!5:12`	Channels 0-7 on Module 2 and Channels 5-12 on Module 4 of Chassis 1 are read through onboard Channel 0.
`ob0!sc1!md3!3:4` `ob1!sc2!md1!20:24`	Channels 3 and 4 of Module 3 of Chassis 1 are read through onboard Channel 0, and Channels 20-24 of Module 1 on Chassis 2 are read through onboard Channel 1.

In the parallel mode, each analog input SCXI module is connected directly to a DAQ device and you must specify the channels of your DAQ device in the channel list, not the SCXI channel string.

☞ **Note:** ***The SCXI-1200 does not support the parallel mode with other SCXI modules.***

SCXI Analog Output

Only the SCXI-1124 module supports AO channels. This module has six AO channels per module. The channels support only single-point updates, and there is no waveform generation. SCXI AO channel strings are structured the same as SCXI AI channel strings but without the '`ob0`' in front.



Analog Input Reference

This chapter introduces some basic concepts of data acquisition and contains a reference for analog input configuration, hardware digital triggering, analog input modes, and advanced timing. You should be familiar with the hardware capabilities of your data acquisition device.

DAQ Device Overview

Measure works with a wide variety of National Instrument DAQ devices. This chapter provides a technical overview and reference information about using Measure for analog input operations. Many of the parameters that you can set up with Measure vary depending on your DAQ device. For example, DAQ devices vary in acquisition speed which affects how fast you can acquire data using Measure. In addition, some DAQ devices have more extensive triggering capabilities than other DAQ devices. Measure does not disable any of its options according to the selected DAQ device. When selecting options which are not supported by a particular DAQ device, you get an error message during configuration or testing. Refer to the documentation included with your DAQ hardware to learn more about the particular capabilities of your DAQ device.

Analog Input Configuration Overview

Select **DAQ**»**Configure DAQ Tasks** and then click on the **AI** button to open the Analog Input Configuration dialog box, as shown in Figure 4-1. The following sections describe the fields within the Analog Input Configuration dialog box, and Table 4-2 explains the remaining options at the bottom of the Analog Input Configuration dialog box.

☞ **Note:** ***The High limit and Low limit fields and the* Mode *button are disabled in the Analog Input Configuration dialog box when you select Use Named Channels for your data acquisition device in the DAQ Tasks dialog box.***

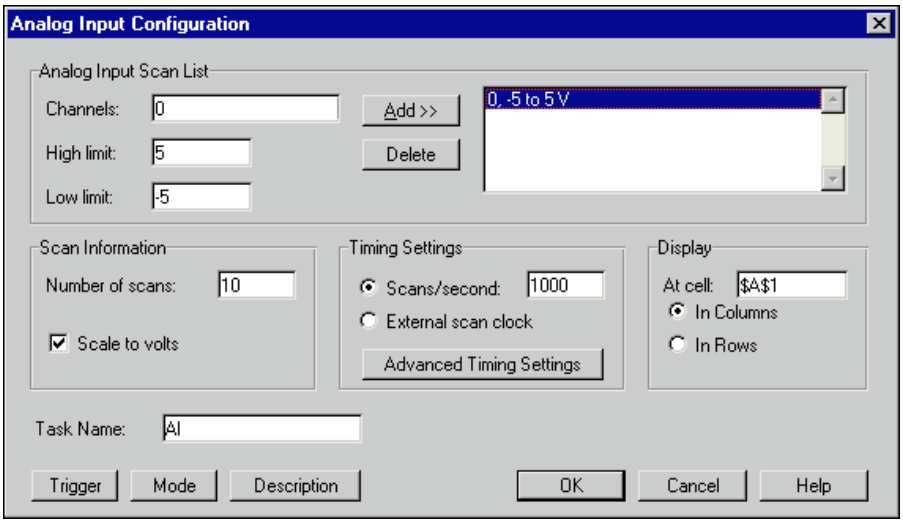


Figure 4-1. Analog Input Configuration Dialog Box

Analog Input Scan List

To configure an acquisition, you must select the channels that you want to scan by entering a channel string in the Channels field. If you configured your channel with the Channel Wizard, you must select the channels you want by entering a channel name in the Channels field. A *scan* is one acquisition or reading from each channel in the Analog Input Scan List. The scan list can have multiple entries of one or more channels. Each entry has its own set of high and low limits which determines the gains on the channels in the entry.

Channels

Specify channels to add to the scan list. A channel string can consist of a named channel defined with the Channel Wizard, a single channel, a list of channels delimited by commas, a range of channels denoted by the first and last channel of the range separated by a colon, or any combination of the previous three types of syntax. The order that you specify the channels in your channel string from left-to-right is the order that Measure scans the channels. The following is a table of valid channel strings.

Table 4-1. Examples of Valid Channel Strings

Valid Channel Strings	Channels in the Scan List
9	9
3,1	3, 1
4:7	4, 5, 6, 7
9,4:7,3,1	9, 4, 5, 6, 7, 3, 1
0,1 (using one AMUX board)	0, 1, 2, 3, 4, 5, 6, 7 on the AMUX board
0 (using two AMUX boards)	0, 1, 2, 3 on the first AMUX board and 0, 1, 2, 3 on the second AMUX board
`ob0!sc1!md1!0:3`	0, 1, 2, 3 on the SCXI module in the first slot of the first chassis
`0b0!sc1!md3!0:4, ob0!sc!md4!7`	0, 1, 2, 3, 4 on the SCXI module in the third slot of the first chassis and 7 on the SCXI module in the fourth slot of the first chassis
`ob0!sc1!md2!20:22, ob1!sc2!md3!5:8`	20, 21, 22 on the SCXI module in the second slot of the first chassis and 5, 6, 7, 8 on the SCXI module in the third slot of the second chassis

For more information about using SCXI, refer to Chapter 3, *Using SCXI with Measure DAQ*.

☞ **Note:** ***Some devices, such as the 1200-Series, have a fixed scanning order. If you are using a device that has a fixed scanning order and you want to scan multiple channels, you must list the channels in the scan list in descending order with the last channel in the scan list being Channel 0 (for example, 3, 2, 1, 0). If you are using such a device in differential mode, you must use the even-numbered channels (for example, 6, 4, 2, 0).***

High Limit

Enter the upper voltage limit for the channels in the channel string. This voltage is the maximum voltage that is measured at any of the analog input channels that you specify in the channel string. You can add more than one channel string to your scan list and each channel string can have a different set of high and low limits. When you create an AI task, Measure enters the default value for the device. If you are using named channels, this field is not available.

Low Limit

Enter the lower voltage limit for the channels in the channel string. This voltage is the minimum voltage measured at any of the analog input channels that are specified in the channel string. You can add more than one channel string to your scan list and each channel string can have a different set of high and low limits. When you create an AI task, Measure enters the default value for your device. If you are using named channels, this field is not available.

☞ **Note:** ***Not all devices can have scan lists in which different channels can have different high and low limit settings.***

Scan Information

The following options apply to all channels in the scan list.

Number of Scans

Specify the number of scans for the acquisition. The number of scans is the number of data acquisitions or readings to acquire from each channel.

Scale to Volts

Select this option if you want Measure to display the acquired data in volts. Otherwise, Measure displays the data as the binary values read from the analog-to-digital converter (ADC).

Timing Settings

A scan as a snapshot of the voltages present on your channels at a given instant. The *scan rate* determines how many scans per second Measure executes, which means that Measure samples each channel at the scan rate you choose. If you set your scan rate to 10 scans per

second, you are taking 10 snapshots each second of all the channels in your scan list. If Channel 2 is in your scan list, you sample Channel 2 ten times per second. Your scan rate is your sampling rate per channel.

In reality, your device does not take a snapshot of all your channels instantaneously, unless it has the capability to do simultaneous sampling. Rather, for each scan (as timed by the scan clock), the device proceeds from one channel in the scan list to the next depending on the channel clock rate. The faster the channel clock rate, the more closely in time the channels are sampled within each scan. The reciprocal of the channel clock rate is called the interchannel delay, or channel interval, as shown in Figure 4-2.

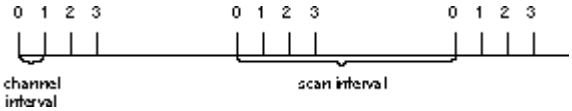


Figure 4-2. Scan Clock and Channel Clock

Measure automatically calculates the smallest, safe interchannel delay for your given configuration and device. If you select a scan rate that requires an interchannel delay smaller than the safest interchannel delay, Measure returns a warning and uses round-robin scanning. Round-robin scanning means that the interval between the last channel in one scan and the first channel of the following scan is the same as the interval between any two channels in the middle of the scan, as shown in Figure 4-3.

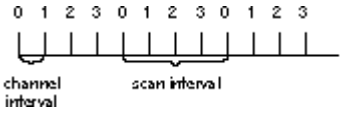


Figure 4-3. Round Robin Scanning

Scans/Second

Enter a scan rate for the acquisition in this field.

External Scan Clock

Select this option if you want to use an external signal for generating the scan rate. Measure uses the signal on an I/O line on the connector of your DAQ device for generating the scan clock.

☞ **Note:** ***For MIO-E Series devices, the external scan clock signal is connected to the PFI7 pin. For most other devices, the external scan clock signal is connected to the OUT2 line. Refer to the user manual for your DAQ device for more information.***

Display

When determining where to display the acquired data, Measure uses three pieces of information you specify.

- Address of the upper-left cell in the range you select
- Orientation of the channels you select (in rows or columns)
- Number of channels in the scan list

For example, if your scan list has four channels and the upper-left cell of the range has the address **A5** and you specify **In columns** for the orientation, Measure displays the first scan of data in cells **A5:D5**, the second in **A6:D6** and so on. The acquired data from the first channel in your scan list is displayed in the column headed by cell **A5**, the acquired data from the second channel in your scan list is displayed in the column headed by cell **B5**, and so on.

At Cell

Specify the target range of the acquired data. Either explicitly type the cell address, or highlight the text in this field and select a cell on any worksheet in the workbook. Measure automatically records the address of your selection in this field.

In Columns

Select this option if you want to display your data in a channel per column orientation.

In Rows

Select this option if you want to display your data in a channel per row orientation.

Table 4-2 contains a list of the choices for the Analog Input Configuration dialog box with descriptions of their use.

Table 4-2. Analog Input Configuration Buttons/Options

Option/Button	Description
Task Name	When you create a new AI task, Measure suggests a unique name for your new task. You can specify a name that is unique to the currently active workbook for this task.
Trigger	Most data acquisition devices have a hardware digital trigger input (TTL level). Click this button to configure a digital trigger for your device.
Mode	Change the analog input mode from the setting that you specify when you run the NI-DAQ Configuration Utility. Measure automatically selects the option that reflects the current setting for your device.
Description	Enter a short description of your task. Measure displays a description of a task below the task list in the DAQ Tasks dialog box. Also, if you add your task to the **DAQ** menu, Measure displays the task description in the Excel status bar at the bottom of its window when you select the task in the menu.
OK	Verify configuration and add a new task or update an existing task in the data acquisition tasks lists. Return to the DAQ Tasks dialog box.
Cancel	Ignore changes and return to the DAQ Tasks dialog box.

Trigger Reference

On most DAQ Series devices, you can configure a digital trigger that starts an acquisition, that stops an acquisition, or both. To set up a hardware trigger, select **Analog Input Configuration»Trigger** to open the Hardware Digital Trigger dialog box, as shown in Figure 4-4.

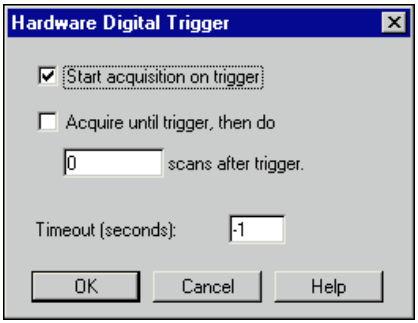


Figure 4-4. Hardware Digital Trigger Dialog Box

Table 4-3 contains a list of Hardware Digital Trigger choices with descriptions of their use.

Table 4-3. Choices for Hardware Digital Trigger

Choices for Hardware Digital Trigger	Description
Start acquisition on trigger	Select this option if you want to start your acquisition on the rising edge of the `PFI0/EXTTRIG/STARTTRIG` (depending on the board you are using) input on the connector. Otherwise, Measure starts the acquisition with a software trigger.
Acquire until trigger	Select this option if you want to stop your acquisition on the rising edge of the `PFI1/EXTTRIG/STOPTRIG` (depending on the board you are using) signal on the connector. Otherwise, the acquisition ends after Measure acquires all the scans.
scans after trigger	Specify the number of scans to acquire after the stop trigger occurs.
Timeout (seconds)	Specify a timeout value in seconds. If you want Measure to calculate a timeout value for you, enter `-1`. If you specify an externally generated scan clock and a timeout value of `-1`, Measure disables the timeout. You can stop the acquisition by pressing the <Q> key.

Mode Reference

The Analog Input Mode applies to all the channels in your scan list. Select **Analog Input Configuration»Mode** to open the Analog Input Mode dialog box, as shown in Figure 4-5.

☞ **Note:** ***The* Mode *button is disabled in the Analog Input Configuration dialog box when you select Use Named Channels for your data acquisition device in the DAQ Tasks dialog box.***

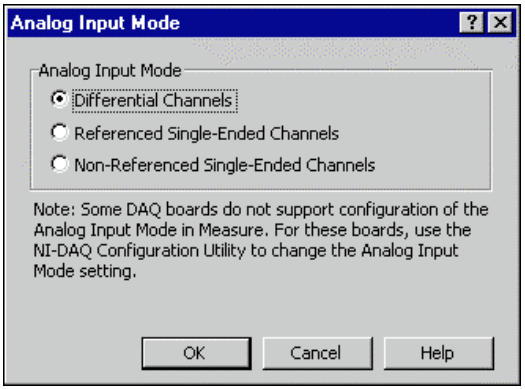


Figure 4-5. Analog Input Mode Dialog Box

Table 4-4 contains a list of Analog Input Mode choices with descriptions of their use.

Table 4-4. Choices for Analog Input Mode Dialog Box

Choices for Analog Input Mode	Description
Differential Channels	Select this option if you want each channel to use two analog channel input lines. One line connects to the positive input of the device amplifier, and the other connects to the negative input of the amplifier. Refer to the user manual for your DAQ device for more information about input modes available on your device.
Referenced Single-Ended Channels	Select this option if you want each channel to use one analog input channel line, which connects to the positive input of the amplifier. The negative input of the amplifier is internally tied to analog input ground `AIGND`. Refer to the user manual for your DAQ device for more information about input modes available on your device.
Non-Referenced Single-Ended Channels	Select this option if you want each channel to use one analog input channel line, which connects to the positive input of the amplifier. The negative input of the amplifier connects to the analog input sense `AISENSE` input. Refer to the user manual for your DAQ device for more information about input modes available on your device.

☞ **Note:** ***The Analog Input Mode on some devices is not configurable within Measure. If you have such a device, you must exit Measure and change the mode using the NI-DAQ Configuration Utility. If you have a device with jumpers, you must exit Measure, power down your computer, change the jumpers, and run the NI-DAQ Configuration Utility to configure the new setting. Refer to the NI-DAQ User Manual that came with your device for more information.***

Advanced Timing Settings

Usually, you do not configure the advanced timing settings because Measure automatically selects reasonable values for you. In some cases, however, you might want to select an interchannel delay or an external channel clock. You can configure these settings through the Advanced Timing Settings dialog box, as shown in Figure 4-6.

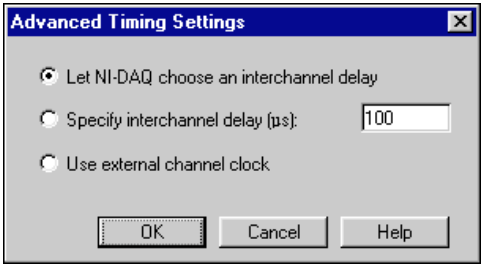


Figure 4-6. Advanced Timing Settings Option

Table 4-5 contains a list of the Advanced timing settings with descriptions of their use.

Table 4-5. Choices for Advanced Timing

Choice for Advanced Timing	Description
Let NI-DAQ choose an interchannel delay	NI-DAQ calculates an interchannel delay for you, based on your hardware, the limit settings for the task, and the scan rate for the task.
Specify interchannel delay (µS)	Measure uses the interchannel delay you specify in microseconds.
Use external channel clock	Measure configures your DAQ device to use an external channel clock.

Analog Output Reference

Chapter 5

This chapter introduces some concepts of data acquisition and contains a reference for basic and advanced analog output configuration. You should be familiar with the hardware capabilities of your data acquisition device.

Analog Output Configuration Overview

Select **DAQ»Configure DAQ Tasks** and click on the **AO** button to open the Analog Output Configuration dialog box, as shown in Figure 5-1.

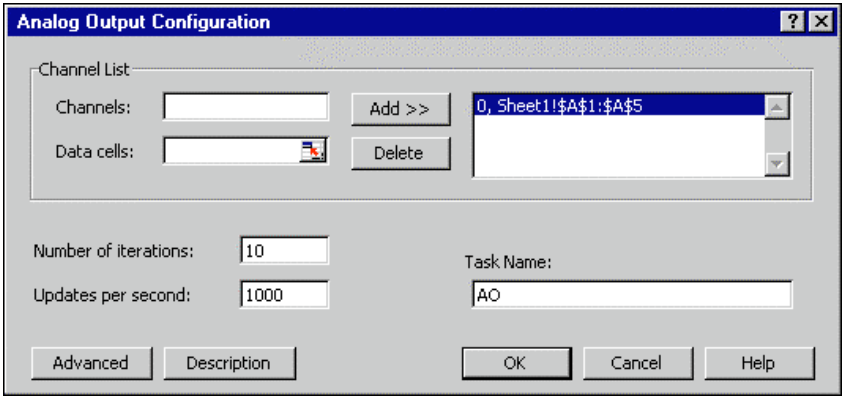


Figure 5-1. Analog Output Configuration Dialog Box

☞ **Note:** ***The* Advanced *button is disabled in the Analog Output Configuration dialog box when you select Use Named Channels for your data acquisition device in the DAQ Tasks dialog box.***

Table 5-1 describes the fields within the Analog Output Configuration dialog box.

Table 5-1. Analog Output Configuration Reference

Option	Description
Channel	Specify the analog output channel on which to generate a signal. You can specify only one channel at a time.
Data cells	Specify the source range of the voltage values to write to the digital-to-analog converter (DAC) for the channel. Either explicitly type the cell address, or highlight the text in this field and then select a row of cells or a column of cells on any worksheet in the workbook. Measure automatically records the address of your selection in this field.
Add>>	Click this button after specifying a channel and a data cells range.
Remove	Click this button to remove any channels or source ranges that you selected in the list box.
Number of iterations	Specify the number of times Measure should iterate through the waveform that you specified for a channel. If you specify `0` for the number of iterations, Measure indefinitely iterates through the waveform until you run another signal generation task on that same device or until you exit Excel.
Updates per second	Specify the rate at which Measure writes the voltage values to the DAC. If you specified more than one channel in your channel list, all channels will have the same update rate.
Task Name	When you create a new AO task, Measure suggests a unique name for your new task. You can change the name in the Task name edit box; However, the name must be unique to the active workbook.
Description	Click on this button to enter a short description of your task. Measure displays a description of a task below the task list in the DAQ Tasks dialog box. Also, if you add your task to the DAQ menu, Measure displays the task description in the Excel status bar at the bottom of its window when you select the task from the menu.
Advanced	Click on this button to configure more of the advanced properties for the analog output task.

Option	Description
OK	Verify configuration and add a new task or update an existing task in the data acquisition tasks lists. Return to the DAQ Tasks dialog box.
Cancel	Ignore changes and return to the DAQ Tasks dialog box.

☞ **Note:** ***If you want to generate waveforms on more than one channel, you must add each channel separately to the channel list. Also, Measure requires that all channels have the same number of voltage values to generate. If the range of data for one channel is larger than for another channel in the scan list, the shorter range of data is padded with the value*** `0` ***when Measure generates the waveforms.***

Advanced Configuration

For most tasks, it is not necessary to use the Advanced Analog Output Configuration dialog box, as shown in Figure 5-2. You cannot use it if you selected Use Named Channel as your data acquisition device. With this dialog box, you can change the output range of your device by specifying new high and low limits, or you can specify a current channel type, if your device supports it. Refer to Table 5-2 for detailed information.

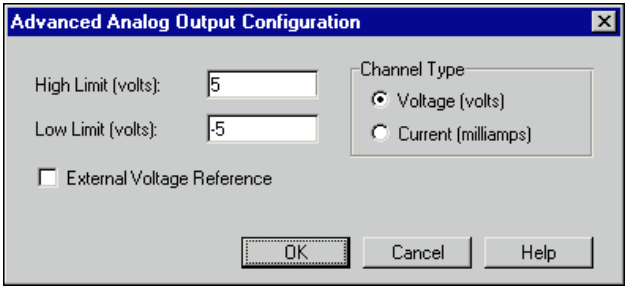
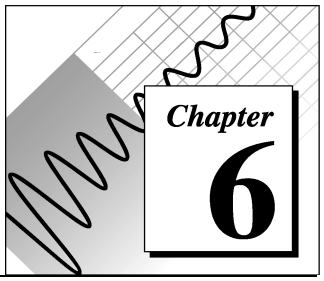


Figure 5-2. Advanced Analog Output Configuration Dialog Box

Table 5-2. Advanced Analog Output Configuration Options

Option	Description
High Limit (volts)	The high limit is equal to your reference voltage and is the maximum voltage the DAC can produce. If you have an AT-AO-6/10 board and your Channel Type is current, you can calculate the maximum possible current with the following equation. `Imax = Vref + 2.5/0.625  mA` The following list contains the default settings for high limit. If you want to use a high limit that differs from the ones given in this list, you must supply an external voltage reference on the `EXTREF` pin of the connector and select the External Voltage Reference option. Most devices: 10.0 V Lab/1200 Series**:** -5.0 V or 10.0 V
Low Limit (volts)	The low limit is either 0.0 Volts or a value equal to, but opposite in sign, to the upper limit.
External Voltage Reference	Select this option if you want to supply an external voltage reference on the `EXTREF` pin of the connector.

Using Measure Data Acquisition Tasks with VBA



This chapter describes how to run tasks from within Visual Basic for Applications. There are two ways to execute DAQ Add-In functions in a VBA module.

1. Indirectly, you can use `Application.Run`

```
returnValue=Application.Run("FuncName", arg1)

Application.Run "FuncName", arg1
```

2. Directly, after you add a reference to the DAQ Add-In. To add a reference to the DAQ Add-In, select **Tools**»**References** and select the checkbox next to the Data Acquisition Add-In.

```
returnValue = FuncName(arg1)

FuncName arg1
```

Function Reference

The DAQ Add-In has one function that you can call to run a task that has been configured already and one function to translate an error code to an error description.

DAQ

Runs the task named `TaskName`.

Syntax

```
Function DAQ(TaskName as String, [NewTargetRange as String],
[ReferenceStyle as Variant]) as Integer
```

Parameters

Option	Description
TaskName	The name of a task in the active workbook.
NewTargetRange	The address of a range on a worksheet that receives the acquired data. If you fail to specify a worksheet explicitly in the address of this macro, Measure assumes that the range is on the active worksheet. If no worksheet is active, Measure returns an error. If this parameter is missing, Measure uses the previously configured range.
ReferenceStyle	Use either **xlA1** or **xlR1C1** to indicate the type of range address being passed into `NewTargetRange`. If this parameter is missing, then Excel's current reference type is assumed.

Return Value

Returns `0` if successful, otherwise returns an error code. Refer to Appendix B, *Error Codes* for more information.

Example

```
'Referenced not added to DAQ Add-In; use indirect method
Sub RunMyTask()
    Dim iErr As Integer
    iErr = Appliction.Run("DAQ", "AI1")
    If iErr <> 0 Then
        MsgBox Application.Run("GetDAQErrorMessage", iErr)
    End If
End Sub

'Referenced added to DAQ Add-In; use direct method
Sub RunMyTask()
    Dim iErr As Integer
    iErr = DAQ("AI1")
    If iErr <> 0 Then
        MsgBox GetDAQErrorMessage(iErr)
    End If
End Sub
```

GetDAQErrorMessage

Finds and returns a description of an error code returned by the DAQ function.

Syntax

```
Function GetDAQErrorMessage(ErrorCode As Integer) As String
```

Parameters

Option	Description
ErrorCode	A non-zero number returned by the DAQ function that indicates an error.

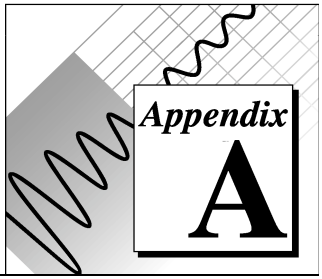
Return Value

A short description of the error code.

Example

See the previous example for the DAQ function.

DAQ Hardware Capabilities



This appendix contains tables that summarize the analog I/O capabilities of National Instruments data acquisition (DAQ) devices you might use with Measure for Windows. The devices in this appendix are grouped into categories. The DAQ device categories for these tables include the following.

- MIO and AI Devices
- Lab, 1200 Series, and Portable Devices
- SCXI Modules
- Analog Output Only Devices

MIO and AI Device Hardware Capabilities

Table A-1. Analog Input Configuration Programmability – MIO and AI Devices

Device	Gain	Range	Polarity	SE/DIFF	Coupling
All MIO-E Series Devices[1] All AI-E Series Devices	By channel	By channel	By channel	By channel	DC AC, DC (for PCI-6110E, PCI-6111E)
AT-MIO-16F-5	By channel	By group	By group	By group	DC
AT-MIO-64F-5 AT-MIO-16X	By channel	By channel	By channel	By channel	DC
AT-MIO-16/16D	By channel	By device	By device	By device	DC

1 The 64-channel MIO E-series boards have unusual scan strings when the analog input is differential. For example, the possible channels needed to acquire data from a differential input situation is 0:7, 16:23, and etc.

"By device" means you select the value of a parameter with hardware jumpers, and the selection affects any group of channels on the device. "By group" means you program the selection through software, and the selection affects all the channels used at the same time. "By channel" means you program the selection with hardware jumpers or through software on a per channel basis. When a specific value for a parameter is shown, that parameter value is fixed.

Table A-2. Analog Input Characteristics – MIO and AI Devices (Part 1)

Device	Number of Channels	Resolution	Gains[1]	Range (V)[1]	Input FIFO (words)	Scanning[2]
AT-MIO-16E-1 AT-MIO-16E-2 AT-MIO-16E-10 AT-MIO-16DE-10 PCI-MIO-16E-1 PCI-MIO-16E-4	16SE, 8DI	12 bits	0.5, 1, 2, 5, 10, 20, 50, 100	±5, 0 to 10	512; E-1: 8,192; E-2 and E4: 2,048	Up to 512
PCI-6110E PCI-6111E	4 DI 2 DI	12 bits 12 bits	0.2, 0.5, 1.2, 5, 10, 20, 50	±10	512	Up to 4 Up to 2
AT-MIO-64E-1[3]	64SE, 32DI	12 bits	0.5, 1, 2, 5, 10, 20, 50, 100	±5, 0 to 10	2,048	Up to 512
PCI-MIO-16XE-10 PCI-6032E (AI-16XE-10)	16SE, 8DI	16 bits	1, 2, 5, 10, 20, 50,100	±10, 0 to 10	512	Up to 512
PCI-6031E (MIO-64XE-10) [3] PCI-6033E (AI-64XE-10) [3] VXI-MIO-64XE-10 [3]	64SE, 32DI	16bit	1, 2, 5, 10, 20, 50, 100	±10, 0 to 10	512	Up to 512
PCI-6071E (MIO-64E-1) [3] VXI-MIO-64E-1 [3]	64SE, 32DI	12	0.5, 1, 2, 5, 10, 20, 50, 100	5 to -5 and 0 to 10	8192	Up to 512
PXI-6040E (MIO-16E-4) PXI-6070E (MIO-16E-1)	16SE, 8DI	12 bit	0.5, 1, 2, 5, 10, 20, 50, 100	5 to -5 and 0 to 10	1024 (6040E) 8192 (6070E)	Up to 512
AT-MIO-16F-5 AT-MIO-64F-5**	16SE, 8DI 64SE, 32DI	12 bits	0.5, 1, 2, 5, 10, 20, 50, 100	±5, ±10, 0 to 10	16F-5: 256; 64F-5: 512	Up to 512
AT-MIO-16X	16SE, 8DI	16	1, 2, 5, 10, 20, 50, 100	±10, 0 to 10	512	Up to 512
AT-MIO-16(L) AT-MIO-16(H) AT-MIO-16D(L) AT-MIO-16D(H)	16SE, 8DI	12	(L) 1, 10, 100, 500; (H): 1, 2, 4, 8	±5, ±10, 0 to 10	16 (L,H); 512 (DL, DH)	Up to 16

1 You can determine the limit settings of your device by multiplying the range and the voltage values together. For more information on limit settings in LabVIEW, refer to the Basics LabVIEW Data Acquisition Concepts chapter in the LabVIEW Data Acquisition Basics Manual.

2 Scanning = channels, in any order.

3 The valid channels for the 64-channel MIO E-series boards in Differential Mode are 0-7, 16-23, 32-39, and 48-55.

** The valid channels for the AT-MIO-64F-5 in Differential Mode are 0-7 and 16-39.

Table A-3. Analog Input Characteristics — MIO and AI Devices (Part 2)

Device	Triggers1	Max Sampling Rate (S/s)	Transfer Method
AT-MIO-16E-1 AT-MIO-16E-2 AT-MIO-64E-11 AT-MIO-16E-10 AT-MIO-16DE-10 AT-MIO-16XE-10 PCI-MIO-16E-1 PCI-MIO-16XE-10 PCI-MIO-16E-4 PXI-6040E (MIO-16E-4) PXI-6070E (MIO-16E-1) PCI-6071E (MIO-64E-1) PCI-6031E (MIO-64XE-10) PCI-6032E (AI-16XE-10) PCI-6033E (AI-64XE-10) PCI-6110E PCI-6111E VXI-MIO-64E-1 VXI-MIO-64XE-10	SW, Pre, Post, (and Analog on E-1, E-2, E-3, E-4 PCI-6110E, and PCI-6111E)	E-1: 1 M, E-2 and E-3: 500 k, E-4: 250 k, E-10 and DE-10: 100 k PCI-6110E and PCI-6111E: 5M	DMA, interrupts
All MIO-16XE-50 Devices	SW, Pre, Post	20 k	DMA (interrupts on DAQPad-MIO-16XE-50)
AT-MIO-16F-5 AT-MIO-64F-5	SW, Pre, Post	200 k	DMA, interrupts
AT-MIO-16X AT-MIO-16/16D	SW, Pre, Post	100 k	DMA, interrupts

1 SW=Software Triggering (also called conditional retrieval), Pre=Pretrigger, Post=Posttrigger.

Table A-4. Internal Channel Support – MIO and AI Devices

Device	Internal Channels
AT-MIO-16XE-10 AT-MIO-16XE-50 DAQPad-MIO-16XE-50	_AIGnd , _Ref5V , _AOGnd , _AO0vsAOGnd , _AO0vsRef5V , _A01 , _AO1vsRef5V
DAQCard-AI-16E-4	_AIGnd , _Ref5V , _A0Gnd
PCI-MIO-16XE-10 PCI-MIO-16XE-50 PXI-6030E PXI-6011E PCI-6031 CPCI-6030E CPCI-6011E VXI-MIO-64XE-10	_AIGnd , _Ref5V , _AOGnd , _AO0vsAOGnd , _AO0vsRef5V , _AO1vsAOGnd , _AO1vsRef5V , _AO1VsAO0 , _DevTemp
PCI-MIO-16E-1 PCI-MIO-16E-4 PXI-6070E PXI-6040E PCI-6071E CPCI-6070E CPCI-6040E VXI-MIO-64E-1	_AIGnd , _Ref5V , __CMRef5V , __AOGnd , __AO0vsAOGnd , _AO0vsRef5V , __AO1vsAOGnd , _AO1vsRef5V , __AO1VsAO0 , __DevTemp
AT-AI-16XE-10 PCI-6032E PCI-6033E DAQCard-AI-16XE-50	_AIGnd , _Ref5V , __A0Gnd
AT-MIO-16E-1 AT-MIO-16E-2 AT-MIO-16E-3 AT-MIO-16DE-10 AT-MIO-16E-10 DAQPad-6020E	_AIGnd , _Ref5V , _CMRef5V , _AOGnd , _AO0vsAOGnd , _AO0vsRef5V , _AO1vsAOGnd , _AO1vsRef5V

Table A-5. Analog Output Characteristics – MIO and AI Devices

Device	Channel Numbers	DAC Type	FIFO Size	Output Limits (V)	Update Clocks	Transfer Method
AT-MIO-16E-1 AT-MIO-16E-2 AT-MIO-64E-3 VXI-MIO-64E-1	0, 1	12-bit double buffered	2048	0 to 10, ±10, ±Vref, 0 to Vref ±Vref	Update clock 1 or external update.	DMA, interrupts
AT-MIO-16E-10 AT-MIO-16DE-10		12-bit double buffered	0	±10, 0 to 10, 0 to Vref, ±Vref	Update clock 1 or external update.	DMA, Interrupts
AT-MIO-XE-50		12-bit double buffered	0	±10	Update clock 1 or external update.	DMA, Interrupts
DAQPad-MIO-16XE-50		12-bit double buffered	0	±10	Update clock 1 or external update.	Interrupts
AT-MIO-16XE-10 VXI-MIO-64XE-10 PCI-MIO-16XE-10 CPCI-6030E PXI-6030E PCI-6031E		16-bit double buffered	2048	±10, 0 to 10	Update clock 1 or external update.	DMA, Interrupts
PCI-MIO-16E-1 CPCI-6070E PXI-6070E PCI-6071E		12-bit double buffered	2048	±10, 0 to 10	Update clock 1 or external update.	DMA, Interrupts
PCI-MIO-16E-4 CPCI-6040E PXI-6040E		12-bit double buffered	512	±10, 0 to 10	Update clock 1 or external update.	DMA, Interrupts
PCI-MIO-16XE-50 CPCI-6011E PXI-6011E		12-bit double buffered	0	±10	Update clock 1 or external update.	DMA, Interrupts
DAQPad-6020E		12-bit double buffered	0	±10, 0 to 10	Update clock 1 or external update.	DMA, Interrupts
PCI-6110E PCI-6111E		16-bit double buffered	4096	±10	Update clock 1 or external update.	DMA, Interrupts

Device	Channel Numbers	DAC Type	FIFO Size	Output Limits (V)	Update Clocks	Transfer Method
AT-MIO-16F-5 AT-MIO-64F-5	0, 1	12-bit double buffered (64F-5: 2 K FIFO)		0 to 10, ±10, ±Vref, 0 to Vref	Update clock 1 is first available of ctr 5, 2, 1 or external update. Default is 5. Timebase signal range is 5,000,000, 1,000,000, 100,000, 10,000, 1,000, and 100.	DMA, interrupts
AT-MIO-16X	0, 1	16-bit double buffered (2 K FIFO)		±10, 0 to 10, ±Vref, 0 to Vref	Update clock 1 is first available on ctr 5, 2, 1, or external update. Timebase signal range is 5,000,000, 1,000,000, 100,000, 10,000, 1,000, 100.	DMA, interrupts
AT-MIO-16/16D	0, 1	12-bit double buffered		0 to 10, ±10, ±Vref, 0 to Vref	Update clock 1 is ctr2 or external update. Timebase signal range is 1,000,000, 100,000, 10,000, 1,000, and 100.	Interrupts

Table A-6. Analog Output Characteristics – E series devices

Device	Reglitching Capable	Ground Reference Capable	Can Control FIFO Request Modes	AO Gating, Pause/Resume Supported	Multiple Buffers Supported
AT-MIO-16E-1 AT-MIO-16E-2 AT-MIO-64E-3 VXI-MIO-64E-1	Yes	No	No	No	Yes
AT-MIO-16E-10 AT-MIO-16DE-10	No	No	No	Yes	Yes
AT-MIO-XE-50	No	No	No	No	Yes
DAQPad-MIO-16XE-50	No	No	No	No	Yes
AT-MIO-16XE-10	No	No	No	Yes	Yes
VXI-MIO-64XE-10	No	No	No	No	Yes
PCI-MIO-16E-1 CPCI-6070E PXI-6070E PCI-6071E	Yes	Yes	Yes	Yes	No
PCI-MIO-16E-4 CPCI-6040E PXI-6011E	No	Yes	Yes	Yes	No
PCI-MIO-16XE-50 CPCI-6011E PXI-6011E	No	No	No	Yes	No
PCI-MIO-16XE-10 CPCI-6030E PXI-6030E PCI-6031E	No	No	Yes	Yes	No
DAQPad-6020E	No	Yes	No	Yes	No
PCI-6110E PCI-6111E	No	No	Yes	Yes	No
* Short form factor AT-MIO-16E-10 only					

Lab, 1200 Series, and Portable Devices Hardware Capabilities

☞ ***Note:*** ***With all the MIO and AI Device You must have a scan string that is contiguous, from highest to lowest channel number, and the scan string must include zero.***

Table A-7. Analog Input Configuration Programmability – Lab, 1200 Series, and Portable Devices

Device	Gain	Range	Polarity	SE/DIFF	Coupling
Lab-PC+	By group	By group	By device	By device	DC
SCXI-1200 DAQPad-1200 DAQCard-1200 PCI-1200	By group	By group	By group	By group	DC
DAQCard-500	1	Only 1 range available	Bipolar	SE	DC
DAQCard-516 PC-516	1	Only 1 range available	Bipolar	By group	DC
DAQCard-700	1	By group	Bipolar	By group	DC
PC-LPM-16	1	By device	Bipolar	SE	DC

☞ ***Note:*** ***"By device" means you select the value of a parameter with hardware jumpers, and the selection affects any group of channels on the device. "By group" means you program the selection through software, and the selection affects all the channels used at the same time. "By channel" means you program the selection with hardware jumpers or through software on a per channel basis. When a specific value for a parameter is shown, that parameter value is fixed.***

Table A-8. Analog Input Characteristics – Lab, 1200 Series, and Portable Devices (Part 1)

Device	Number of Channels	Resolution (bits)	Gains[1]	Range (V)[1]	Input FIFO (samples)
Lab-PC+* SCXI-1200 DAQPad-1200 DAQCard-1200* PCI-1200	8SE, 4DI	12	1, 2, 5, 10 20, 50, 100	±5, 0 to 10	2,048; Lab-PC: 512
DAQCard-500	8SE	12	1	±5	16
DAQCard-516 PC-516	8SE,4DI	16	1	±5V	512
DAQCard-700	16SE, 8DI	12	1	±10, ±5, ±2.5	512
PC-LPM-16	16SE	12	1	±5, ±2.5, 0 to 10, 0 to 5	16

1 You can determine the limit settings of your device by multiplying the range and the voltage values together. For more information on limit settings in LabVIEW, refer to the Basics LabVIEW Data Acquisition Concepts chapter in the LabVIEW Data Acquisition Basics Manual.

* The valid channels for the Lab-PC+ and DAQCard-1200 in Differential Mode are 6, 4, 2, and 0.

Table A-9. Analog Input Characteristics – Lab, 1200 Series, and Portable Devices (Part 2)

Device	Scanning	Triggers	Max Sampling Rate (S/s)	Transfer Method
Lab-PC+ SCXI-1200 DAQPad-1200 DAQCard-1200 PCI-1200	Any single channel; for multiple channels, N through 0, where N<=7.	Software trigger, pretrigger, and posttrigger with digital trigger	100 k; Lab-PC+: 83 k	Interrupts; Lab-PC+: Interrupts, DMA
DAQCard-500 DAQCard-516 PC-516	Any single channel; for multiple channels, N through 0, where N<=7	Software trigger only	50 k	Interrupts
DAQCard-700	Any single channel; for multiple channels, N through 0, where N<=15	Software trigger only	100 k	Interrupts
PC-LPM-16	Any single channel; for multiple channels, N through 0, where N<=15	Software trigger only	50 k	Interrupts

Table A-10. Analog Output Characteristics – Lab, 1200 Series, and Portable Devices

Device	Channel #s	DAC Type	Output Limits (V)	Update Clocks	Waveform Grouping	Transfer Methods
Lab-PC+ SCXI-1200 DAQPad-1200 DAQCard-1200 PCI-1200	0, 1	12-bit double-buffered	0 to 10, ±5	Update clock 1 is ctrA2 or external update; timebase signal range is 1,000,000, 100,000, 10,000, 1,000, and 100	0, 1, or 0 and 1	Interrupts

☞ ***Note: The DAQCard-516 and PC 516 devices do not have analog output.***

SCXI Module Hardware Capabilities

Table A-11. Analog Input Characteristics – SCXI Modules

Module	Number of Channels	Input Voltage Range (V)	Gains[1]	Filter[1]	Excitation Channels[1]	Mode Support
SCXI-1100	32 DI	±10	1, 2, 5, 10, 20, 50, 100, 200, 500, 1,000, 2,000 (SW/M)1	lowpass filter (or no filter) with 10 kHz or 4 Hz cutoff frequency (JS/M)1	--	multiplexed
SCXI-1102 SXCI-1102B SCXI-1102C VXI-SC-1102 VXI-SC-1102B VXI-SC-1102C	32 DI	±10	1, 100 (SW/C)1	1 Hz lowpass on each channel	--	multiplexed
SCXI-1120 SCXI-1121	8 DI (SCXI-1120) 4 DI (SCXI-1121)	±5	1, 2, 5, 10, 20, 50, 100, 200, 500, 1,000, and 2,000 (JS/C)1	lowpass filter with 10 kHz or 4 Hz cutoff frequency (JS/C)1	SCXI-1121 only: 4 voltage or current excitation JS/C 1 (channels)	multiplexed or parallel

Module	Number of Channels	Input Voltage Range (V)	Gains[1]	Filter[1]	Excitation Channels[1]	Mode Support
SCXI-1120D	8 DI (SCXI-1120) 4 DI (SCXI-1121)	±5	0.5, 1, 2.5, 5, 10, 25, 50, 100, 250, 500, 1,000	4,500, 24,500 Hz	SCXI-1121 only: 4 voltage or current excitation JS/C 1 (channels)	multiplexed or parallel
SCXI-1122	16 DI or 8 DI and 8 excitation SW/M1 channels	±10	0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1,000, 2,000 (SW/M)1	lowpass filter with 4kHz or 4 Hz cutoff frequency	8 voltage or current excitation channels in 4-wire scanning mode	multiplexed
SCXI-1140	8 DI, sample and hold	±10	1, 10, 100, 200, 500 (DS/C)1	none	--	multiplexed or parallel
SCXI-1141	8 DI	±5	1, 2, 5, 10, 20, 50, 100 (SWy/C)1	elliptic lowpass filter with 10Hz to 25KHz cutoff frequency2 (SW/M)1 (disabled on a per channel basis)	--	multiplexed or parallel

1 DS/C = dip switch-selectable per channel, JS/C = jumper-selectable per channel, JS/M = jumper-selectable per module, SW/C = software-selectable per channel, SW/M = software-selectable per module

2 The SCXI-1141 has an automatic filter setting. LabVIEW sets the filter frequency based on the scan rates used with the module.

Table A-12. Analog Output Characteristics – SCXI Modules

Module	Number of Channels	Output Voltage Range (V or mA)	Mode Support
SCXI-1124	6 voltage or current	0 to1, 0 to 5, 0 to 10, ±1, ±5, ±10 (software-selectable) or 0 to 20 mA	multiplexed

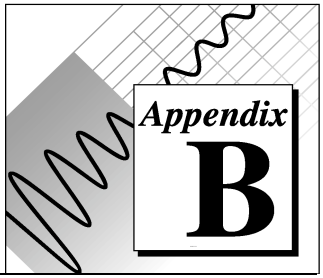
Table A-13. Terminal Block Selection Guide – SCXI Modules

SCXI Module	Terminal Blocks	Cold-Junction Compensation Sensor (CJC)
SCXI-1100 SCXI-1102	SCXI-1303 SCXI-1300	Thermistor IC Sensor
SCXI-1120 SCXI-1121 SCXI-1120D	SCXI-1320 SCXI-13211 SCXI-1327 SCXI-1328	IC Sensor IC Sensor Thermistor Thermistor
SCXI-1122	SCXI-1322	Thermistor
SCXI-1124	SCXI-1325	--
SCXI-1140	SCXI-1301 SCXI-1304	-- --
SCXI-1141	SCXI-1304	--
SCXI-1180	SCXI-1302	--
SCXI-1181	SCXI-1300 SCXI-1301	IC Sensor --
SCXI-1200	SCXI-1302 CB-50	-- --
VXI-SC-1102 VXI-SC-1102B VXI-SC-1102C	VXI-TB-1303 VXI-TB-96	Thermistor
1 SCXI-1121 only		

Analog Output Only Devices Hardware Capabilities

Table A-14. Analog Output Characteristics – Analog Output Only Devices

Device	Channel #s	DAC Type	Output Limits (V)	Update Clocks	Waveform Grouping	Transfer Method
AT-AO-6 AT-AO-10	0 through 5, 6 through 9*	12-bit double-buffered with 1 K FIFO for update clock 1 channels	±10V, ±Vref1, 0 to 10, 0 to Vref1, 4 to 20 mA,	Update clock 1 is ctr0 or external update. Update clock 1 channels are 0, 1, 2, 3, 4, 5, 6*, 7*, 8*, 9*, 0 to 1, 0 to 3, 0 to 5, 0 to 7*, 0 to 9*. Update clock 2 is ctr1. Update clock 2 channels are 2, 3, 4, 5, 6*, 7*, 8*, 9*, 2 to 3, 2 to 5, 2 to 7*, 2 to 9*; timebase signal range is 1,000,000, 100,000, 10,000, 1,000, 100	For update clock 1 channels are any one channel N or set of channel pairs: 0-N; for update clock 2 channels are 2-N, same rules as above: N#6, N#10*	Update clock 1 channels: DMA, interrupts; update clock 2 channels: interrupts
PC-AO-2DC (Plug and Play)	0, 1		0 to 10V, ±5V, 0-20mA sink software-selectable			
DAQCard-AO-2DC	0, 1		0 to 10V, ±5V, 0--20mA sink software-selectable			
VXI-AO-48XDC	voltage 0 through 47, current 0 through 47	18-bit	-10.1 V to +10.1 V, 0.1 mA to 20.1 mA source, voltage and current channels are independent			



Error Codes

This appendix describes the errors that can occur while using the Measure DAQ Add-In.

Table B-1. Data Acquisition Error Codes

Error Code	Error Description
-2001	Unable to find task.
-2002	The worksheet that is specified in the task's configuration does not exist.
-2003	The range that is specified in the task's configuration is not valid.
-2004	Excel is out of memory. Use a smaller range.
-2101	An analog output channel string represents multiple analog output channels. Measure requires that each analog output channel string contain only one analog output channel.
-10001	An error was detected in the input string; the arrangement or ordering of the characters in the string is not consistent with the expected ordering.
-10002	An error was detected in the input string; the syntax of the string is correct, but certain values specified in the string are inconsistent with other values specified in the string.
-10003	The value of a numeric parameter is invalid.
-10004	The value of a numeric parameter is inconsistent with another one, and therefore the combination is invalid.
-10005	The device is invalid.
-10006	The line is invalid.
-10007	A channel, port, or counter is out of range for the device type or device configuration; or the combination of channels is not allowed; or the scan order must be reversed (0 last).
-10008	The group is invalid.
-10009	The counter is invalid.
-10010	The count is too small or too large for the specified counter, or the given I/O transfer count is not appropriate for the current buffer or channel configuration.
-10011	The analog input scan rate is too fast for the number of channels and the channel clock rate; or the given clock rate is not supported by the associated counter channel or I/O channel.

-10012	The analog input or analog output voltage range is invalid for the specified channel, or you are writing an invalid voltage to the analog output.
-10013	The driver returned an unrecognized or unlisted error code.
-10014	The group size is too large for the board.
-10015	The time limit is invalid.
-10016	The read count is invalid.
-10017	The read mode is invalid.
-10018	The offset is unreachable.
-10019	The frequency is invalid.
-10020	The timebase is invalid.
-10021	The limits are beyond the range of the board.
-10022	Your data array contains an incomplete update, or you are trying to write past the end of the internal buffer, or your output operation is continuous and the length of your array is not a multiple of one half of the internal buffer size.
-10023	The write mode is out of range or is disallowed.
-10024	Adding the write offset to the write mark places the write mark outside the internal buffer.
-10025	The requested input limits exceed the board's capability or configuration. Alternative limits were selected.
-10026	The requested number of buffers or the buffer size is not allowed. For example, the buffer limit for Lab and 1200 devices is 64K samples, or the board does not support multiple buffers.
-10027	For DAQEvents 0 and 1 general value A must be greater than 0 and less than the internal buffer size. If DMA is used for DAQEvent 1, general value A must divide the internal buffer size evenly, with no remainder. If the TIO-10 is used for DAQEvent 4, general value A must be 1 or 2.
-10028	The cutoff frequency specified is not valid for this device.
-10029	The function you are calling is no longer supported in this version of the driver.
-10030	The specified baud rate for communicating with the serial port is not valid on this platform.
-10031	The specified SCXI chassis does not correspond to a configured SCXI chassis.
-10032	The SCXI module slot that was specified is invalid or corresponds to an empty slot.
-10033	The window handle passed to the function is invalid.
-10034	No configured message matches the one you tried to delete.
-10035	The specified attribute is not relevant.
-10036	The specified year is invalid.
-10037	The specified month is invalid.
-10038	The specified day is invalid.

-10039	The specified input string is too long. For instance, DAQScope 5102 devices can only store a string up to 32 bytes in length on the calibration EEPROM. In that case, please shorten the string.
-10080	The gain is invalid.
-10081	The pretrigger sample count is invalid.
-10082	The posttrigger sample count is invalid.
-10083	The trigger mode is invalid.
-10084	The trigger count is invalid.
-10085	The trigger range or trigger hysteresis window is invalid.
-10086	The external reference is invalid.
-10087	The trigger type is invalid.
-10088	The trigger level is invalid.
-10089	The total count is inconsistent with the buffer size and pretrigger scan count or with the board type.
-10090	The individual range, polarity, and gain settings are valid but the combination is not allowed.
-10091	You have attempted to use an invalid setting for the iterations parameter. The iterations value must be 0 or greater. Your device might be limited to only two values, 0 and 1.
-10092	Some devices require a time gap between the last sample in a scan and the start of the next scan. The scan interval you have specified does not provide a large enough gap for the board. See your documentation for an explanation.
-10093	FIFO mode waveform generation cannot be used because at least one condition is not satisfied.
-10094	The **calDAC** constant passed to the function is invalid.
-10095	The calibration stimulus passed to the function is invalid.
-10100	The requested digital port width is not a multiple of the hardware port width or is not attainable by the DAQ hardware.
-10120	Invalid application used.
-10121	Invalid **counterNumber** used.
-10122	Invalid **paramValue** used.
-10123	Invalid **paramID** used.
-10124	Invalid **entityID** used.
-10125	Invalid action used.
-10200	Unable to read data from EEPROM.
-10201	Unable to write data to EEPROM.
-10202	You cannot write into this location or area of your EEPROM because it is write-protected. You may be trying to store calibration constants into a write-protected area; if this is the case, you should select user area of the EEPROM instead.

-10240	The driver interface could not locate or open the driver.
-10241	One of the driver files or the configuration utility is out of date, or a particular feature of the Channel Wizard is not supported in this version of the driver.
-10242	The specified function is not located in the driver.
-10243	The driver could not locate or open the configuration file, or the format of the configuration file is not compatible with the currently installed driver.
-10244	The driver encountered a hardware-initialization error while attempting to configure the specified device.
-10245	The driver encountered an operating-system error while attempting to perform an operation, or the operating system does not support an operation performed by the driver.
-10246	The driver is unable to communicate with the specified external device.
-10247	The CMOS configuration-memory for the device is empty or invalid, or the configuration specified does not agree with the current configuration of the device, or the EISA system configuration is invalid.
-10248	The base addresses for two or more devices are the same; consequently, the driver is unable to access the specified device.
-10249	The interrupt configuration is incorrect given the capabilities of the computer or device.
-10250	The interrupt levels for two or more devices are the same.
-10251	The DMA configuration is incorrect given the capabilities of the computer/DMA controller or device.
-10252	The DMA channels for two or more devices are the same.
-10253	Unable to find one or more jumperless boards you have configured using the NI-DAQ Configuration Utility.
-10254	Cannot configure the DAQCard because 1) the correct version of the card and socket services software is not installed; 2) the card in the PCMCIA socket is not a DAQCard; or 3) the base address and/or interrupt level requested are not available according to the card and socket services resource manager. Try different settings or use AutoAssign in the NIDAQ configuration utility.
-10255	There was an error in initializing the driver for Remote SCXI.
-10256	There was an error in opening the specified COM port.
-10257	Bad base address specified in the configuration utility.
-10258	Bad DMA channel 1 specified in the configuration utility or by the operating system.
-10259	Bad DMA channel 2 specified in the configuration utility or by the operating system.
-10260	Bad DMA channel 3 specified in the configuration utility or by the operating system.
-10261	The user mode code failed when calling the kernel mode code.

-10340	No RTSI signal/line is connected, or the specified signal and the specified line are not connected, or your connection to an RDA server either cannot be made or has been terminated.
-10341	The RTSI signal/line cannot be connected as specified.
-10342	The specified RTSI signal is already being driven by a RTSI line, or the specified RTSI line is already being driven by a RTSI signal.
-10343	The specified SCXI configuration parameters are invalid, or the function cannot be executed with the current SCXI configuration.
-10344	The Remote SCXI unit is not synchronized with the host. Reset the chassis again to resynchronize it with the host.
-10345	The required amount of memory cannot be allocated on the Remote SCXI unit for the specified operation.
-10346	The packet received by the Remote SCXI unit is invalid. Check your serial port cable connections.
-10347	There was an error in sending a packet to the remote chassis. Check your serial port cable connections.
-10348	The Remote SCXI unit is in reprogramming mode and is waiting for reprogramming commands from the host (NI-DAQ Configuration Utility).
-10349	The module ID read from the SCXI module conflicts with the configured module type.
-10360	The DSP driver was unable to load the kernel for its operating system.
-10370	The scan list is invalid; for example, you are mixing AMUX-64T channels and onboard channels, scanning SCXI channels out of order, or have specified a different starting channel for the same SCXI module. Also, the driver attempts to achieve complicated gain distributions over SCXI channels on the same module by manipulating the scan list and returns this error if it fails.
-10400	The specified resource is owned by the user and cannot be accessed or modified by the driver.
-10401	The specified device is not a National Instruments product, the driver does not support the device (for example, the driver was released before the device was supported), or the device has not been configured using the NI-DAQ Configuration Utility.
-10402	No device is located in the specified slot or at the specified address.
-10403	The specified device does not support the requested action (the driver recognizes the device, but the action is inappropriate for the device).
-10404	No line is available.
-10405	No channel is available.
-10406	No group is available.
-10407	The specified line is in use.
-10408	The specified channel is in use.
-10409	The specified group is in use.

-10410	A related line, channel, or group is in use; if the driver configures the specified line, channel, or group, the configuration, data, or handshaking lines for the related line, channel, or group will be disturbed.
-10411	The specified counter is in use.
-10412	No group is assigned, or the specified line or channel cannot be assigned to a group.
-10413	A group is already assigned, or the specified line or channel is already assigned to a group.
-10414	The selected signal requires a pin that is reserved and configured only by NI-DAQ. You cannot configure this pin yourself.
-10415	This function does not support your DAQ device when an external multiplexer (such as an AMUX-64T or SCXI) is connected to it.
-10440	The specified resource is owned by the driver and cannot be accessed or modified by the user.
-10441	No memory is configured to support the current data-transfer mode, or the configured memory does not support the current data-transfer mode. (If block transfers are in use, the memory must be capable of performing block transfers.)
-10442	The specified memory is disabled or is unavailable given the current addressing mode.
-10443	The transfer buffer is not aligned properly for the current data-transfer mode. For example, the buffer is at an odd address, is not aligned to a 32-bit boundary, is not aligned to a 512-bit boundary, and so on. Alternatively, the driver is unable to align the buffer because the buffer is too small.
-10444	No more system memory is available on the heap, or no more memory is available on the device, or insufficient disk space is available.
-10445	The transfer buffer cannot be locked into physical memory. On PC AT machines, portions of the DMA data acquisition buffer may be in an invalid DMA region, for example, above 16 megabytes.
-10446	The transfer buffer contains a page break; system resources may require reprogramming when the page break is encountered.
-10447	The operating environment is unable to grant a page lock.
-10448	The driver is unable to continue parsing a string input due to stack limitations.
-10449	A cache-related error occurred, or caching is not supported in the current mode.
-10450	A hardware error occurred in physical memory, or no memory is located at the specified address.
-10451	The driver is unable to make the transfer buffer contiguous in virtual memory and therefore cannot lock it into physical memory; thus, the buffer cannot be used for DMA transfers.
-10452	No interrupt level is available for use.
-10453	The specified interrupt level is already in use by another device.

-10454	No DMA controller is available in the system.
-10455	No DMA channel is available for use.
-10456	The specified DMA channel is already in use by another device.
-10457	DMA cannot be configured for the specified group because it is too small, too large, or misaligned. Consult the device user manual to determine group ramifications with respect to DMA.
-10458	The storage disk you specified is full.
-10459	The NI-DAQ DLL could not be called due to an interface error.
-10460	You have mixed VIs from the DAQ library and the _DAQ compatibility library (LabVIEW 2.2 style VIs). You may switch between the two libraries only by running the DAQ VI Device Reset before calling _DAQ compatibility VIs or by running the compatibility VI Board Reset before calling DAQ VIs.
-10461	The specified resource is unavailable because it has already been reserved by another entity.
-10462	The specified resource has not been reserved, so the action is not allowed.
-10480	The scan list is too large to fit into the mux-gain memory of the board.
-10481	You must provide a single buffer of interleaved data, and the channels must be in ascending order. You cannot use DMA to transfer data from two buffers; however, you may be able to use interrupts.
-10540	At least one of the SCXI modules specified is not supported for the operation.
-10541	CTRB1 will drive COUTB1, however CTRB1 will also drive TRIG1. This may cause unpredictable results when scanning the chassis.
-10560	The DSP handle input is not valid .
-10561	Either DAQ or WFM can use a PC memory buffer, but not both at the same time.
-10600	No setup operation has been performed for the specified resources. Or, some resources require a specific ordering of calls for proper setup.
-10601	The specified resources have already been configured by a setup operation.
-10602	No output data has been written into the transfer buffer.
-10603	The output data associated with a group must be for a single channel or must be for consecutive channels.
-10604	Once data generation has started, only the transfer buffers originally written to may be updated. If DMA is active and a single transfer buffer contains interleaved channel-data, new data must be provided for all output channels currently using the DMA channel.
-10605	No data was written to the transfer buffer because the final data block has already been loaded.
-10606	The specified resource is not armed.
-10607	The specified resource is already armed.
-10608	No transfer is in progress for the specified resource.

-10609	A transfer is already in progress for the specified resource, or the operation is not allowed because the device is in the process of performing transfers, possibly with different resources.
-10610	A single output channel in a group may not be paused if the output data for the group is interleaved.
-10611	Some of the lines in the specified channel are not configured for the transfer direction specified. For a write transfer, some lines are configured for input. For a read transfer, some lines are configured for output.
-10612	The specified line does not support the specified transfer direction.
-10613	The specified channel does not support the specified transfer direction.
-10614	The specified group does not support the specified transfer direction.
-10615	The clock configuration for the clock master is invalid.
-10616	The clock configuration for the clock slave is invalid.
-10617	No source signal has been assigned to the clock resource.
-10618	The specified source signal cannot be assigned to the clock resource.
-10619	A source signal has already been assigned to the clock resource.
-10620	No trigger signal has been assigned to the trigger resource.
-10621	The specified trigger signal cannot be assigned to the trigger resource.
-10622	The pretrigger mode is not supported or is not available in the current configuration, or no pretrigger source has been assigned.
-10623	No posttrigger source has been assigned.
-10624	The delayed trigger mode is not supported or is not available in the current configuration, or no delay source has been assigned.
-10625	The trigger configuration for the trigger master is invalid.
-10626	The trigger configuration for the trigger slave is invalid.
-10627	No signal has been assigned to the trigger resource.
-10628	A signal has already been assigned to the trigger resource.
-10629	The specified operating mode is invalid, or the resources have not been configured for the specified operating mode.
-10630	The parameters specified to read data were invalid in the context of the acquisition. For example, an attempt was made to read 0 bytes from the transfer buffer, or an attempt was made to read past the end of the transfer buffer.
-10631	Continuous input or output transfers are not allowed in the current operating mode, or continuous operation is not allowed for this type of device.
-10632	Certain inputs were ignored because they are not relevant in the current operating mode.
-10633	The specified analog output regeneration mode is not allowed for this board.
-10634	No continuous (double buffered) transfer is in progress for the specified resource.

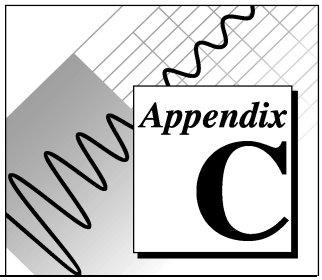
-10635	Either the SCXI operating mode specified in a configuration call is invalid, or a module is in the wrong operating mode to execute the function call.
-10636	You cannot start a continuous (double-buffered) operation with a synchronous function call.
-10637	Attempted to configure a buffer after the buffer had already been configured. You can configure a buffer only once.
-10680	All channels of this board must have the same gain.
-10681	All channels of this board must have the same range.
-10682	All channels of this board must be the same polarity.
-10683	All channels of this board must have the same coupling.
-10684	All channels of this board must have the same input mode.
-10685	The clock rate exceeds the board's recommended maximum rate.
-10686	A configuration change has invalidated the scan list.
-10687	A configuration change has invalidated the acquisition buffer, or an acquisition buffer has not been configured.
-10688	The number of total scans and pretrigger scans implies that a triggered start is intended, but triggering is not enabled.
-10689	Digital trigger B is illegal for the number of total scans and pretrigger scans specified.
-10690	This board does not allow digital triggers A and B to be enabled at the same time.
-10691	This board does not allow an external sample clock with an external scan clock, start trigger, or stop trigger.
-10692	The acquisition cannot be started because the channel clock is disabled.
-10693	You cannot use an external scan clock when doing a single scan of a single channel.
-10694	The scan rate is above the maximum or below the minimum for the hardware, gains, and filters used.
-10695	You have set up an operation that requires the use of interrupts. DMA is not allowed. For example, some DAQ events, such as messaging and LabVIEW occurrences, require interrupts.
-10696	Multi-rate scanning cannot be used with the AMUX-64, SCXI, or pretriggered acquisitions.
-10697	Unable to convert your timebase/interval pair to match the actual hardware capabilities of this board.
-10698	You cannot use this combination of scan and sample clock timebases for this board.
-10699	You cannot use this combination of scan and sample clock source polarities for this operation and board.
-10700	You cannot use this combination of scan and convert clock signal sources for this operation and board.

-10701	The call had no effect because the specified channel had not been set for later internal update.
-10702	Pretriggering and posttriggering cannot be used simultaneously on the Lab and 1200 series devices.
-10710	The specified port has not been configured for handshaking.
-10720	The specified counter is not configured for event-counting operation.
-10740	A signal has already been assigned to the SCXI track-and-hold trigger line, or a control call was inappropriate because the specified module is not configured for one-channel operation.
-10780	When you have an SC2040 attached to your device, all analog input channels must be configured for differential input mode.
-10781	The polarity of the output channel cannot be bipolar when outputting currents.
-10782	The specified operation cannot be performed with the SC-2040 configured in hold mode.
-10783	Calibration constants in the load area have a different polarity from the current configuration. Therefore, you should load constants from factory.
-10800	The operation could not complete within the time limit.
-10801	An error occurred during the calibration process. Possible reasons for this error include incorrect connection of the stimulus signal, incorrect value of the stimulus signal, or malfunction of your DAQ device.
-10802	The requested amount of data has not yet been acquired.
-10803	The on-going transfer has been stopped. This is to prevent regeneration for output operations, or to reallocate resources for input operations.
-10804	The transfer stopped prior to reaching the end of the transfer buffer.
-10805	The clock rate is faster than the hardware can support. An attempt to input or output a new data point was made before the hardware could finish processing the previous data point. This condition may also occur when glitches are present on an external clock signal.
-10806	No trigger value was found in the input transfer buffer.
-10807	The trigger occurred before sufficient pretrigger data was acquired.
-10808	An error occurred in the parallel port communication with the DAQ device.
-10809	Attempted to start a pulse width measurement with the pulse in the phase to be measured (e.g., high phase for high-level gating).
-10810	An unexpected error occurred inside the driver when performing this given operation.
-10840	The contents or the location of the driver file was changed between accesses to the driver.
-10841	The firmware does not support the specified operation, or the firmware operation could not complete due to a data-integrity problem.
-10842	The hardware is not responding to the specified operation, or the response from the hardware is not consistent with the functionality of the hardware.

-10843	Because of system limitations, the driver could not write data to the device fast enough to keep up with the device throughput. This error may be returned erroneously when an `overRunErr` has occurred.
-10844	New data was not written to the output transfer buffer before the driver attempted to transfer the data to the device.
-10845	Because of system limitations, the driver could not read data from the device fast enough to keep up with the device throughput; the onboard device memory reported an overflow error.
-10846	The driver wrote new data into the input transfer buffer before the previously acquired data was read.
-10847	New buffer information was not available at the time of the DMA chaining interrupt; DMA transfers will terminate at the end of the currently active transfer buffer.
-10848	The driver could not obtain a valid reading from the transfer-count register in the DMA controller.
-10849	The configuration file or DSP kernel file could not be opened.
-10850	Unable to close a file.
-10851	Unable to seek within a file.
-10852	Unable to read from a file.
-10853	Unable to write to a file.
-10854	An error occurred accessing a file.
-10855	NI-DAQ does not support the current operation on this particular version of the operating system.
-10856	An unexpected error occurred from the operating system while performing the given operation.
-10857	An unexpected error occurred inside the kernel of the device while performing this operation.
-10858	The system has reconfigured the device and has invalidated the existing configuration. The device requires reinitialization to be used again.
-10880	A change to the update rate is not possible at this time because 1) when waveform generation is in progress, you cannot change the interval timebase or 2) when you make several changes in a row, you must give each change enough time to take effect before requesting further changes.
-10881	You cannot do another transfer after a successful partial transfer.
-10882	The data collected on the Remote SCXI unit was overwritten before it could be transferred to the buffer in the host. Try using a slower data acquisition rate if possible.
-10883	New data could not be transferred to the waveform buffer of the Remote SCXI unit to keep up with the waveform update rate. Try using a slower waveform update rate if possible.
-10884	Could not rearrange data after a pretrigger acquisition completed.

-10920	One or more data points may have been lost during buffered GPCTR operations due to speed limitations of your system.
-10940	No response was received from the Remote SCXI unit within the specified time limit.
-10941	Reprogramming the Remote SCXI unit was unsuccessful. Please try again.
-10942	An invalid reset signature was sent from the host to the Remote SCXI unit.
-10943	The interrupt service routine on the remote SCXI unit is taking longer than necessary. You do not need to reset your remote SCXI unit, however, please clear and restart your data acquisition.

Troubleshooting



This appendix describes solutions to problems that you might encounter using the Measure DAQ Add-In.

Problem: No DAQ menu appears.

Solution: From the **Tools»Add-Ins**. Click on the **Browse** button and look for `DAQ.XLA` in the directory where you installed Measure. Once you find it, select it and click on the **OK** button. If a dialog box appears with the message `Replace existing 'DAQ.XLA'?` click on the **Yes** button. You will see a Measure Data Acquisition Add-In entry in the list box and the checkbox next to it will be checked. Click on the **OK** button.

Problem: The list of data acquisition devices is empty.

Solution: Verify with the NI-DAQ Configuration Utility that you have properly installed and configured your device. Verify that your device is supported by Measure. Refer to Appendix A*, DAQ Hardware Capabilities.*

Problem: You are using Windows 3.1 or Windows for Workgroups 3.11 and you get a dialog box entitled Measure with the message, `Error –10243 The driver could not locate or open the configuration file, or the format of the configuration file is not compatible with the currently installed driver.`

Solution: Delete the `WDAQCONF.CFG` file in your Windows directory. Then reconfigure your hardware using the NI-DAQ Configuration Utility. If the problem persists, contact National Instruments for an updated version of the NI-DAQ driver.

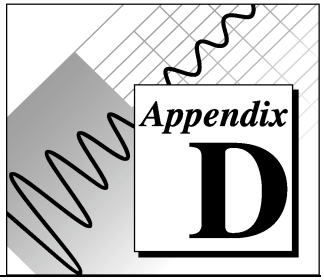
Problem: You get a dialog box entitled Measure with a message that begins `Fatal error.`

Solution: Congratulations! It is likely that you have found a deficiency in our code! Please write down the information in the dialog box as well as the actions that you took preceding the error. Try to reproduce the error. Then, call National Instruments technical support.

Problem: After you remove the Measure Data Acquisition Add-In in the Add-Ins dialog box, a dialog box entitled Microsoft Excel appears with the message `Cannot access 'DAQ.XLA'.`

Solution: Click on the **Cancel** button. This behavior, which occurs because of Microsoft Excel or the OLE libraries, is harmless and you can safely ignore it.

Customer Communication



For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call (512) 795-6990. You can access these services at:

United States: (512) 794-5422 or (800) 327-3077
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 1 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as anonymous and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the `/support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at (512) 418-1111.

E-Mail Support (Currently USA Only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

support@natinst.com

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

	Telephone	Fax
Australia	03 9879 5166	03 9879 6277
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Brazil	011 288 3336	011 288 8528
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 725 725 11	09 725 725 55
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 6120092	03 6120095
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
United Kingdom	01635 523545	01635 523154
United States	512 795 8248	512 794 5678

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____ Model _____ Processor _____

Operating system: Windows 3.1, Windows for Workgroups 3.11, Windows NT 3.1, Windows NT 3.5, Windows 95, other (include version number)_____

Version of Excel (look at Excel's About box): 5.0, 5.0c, other_____

Clock Speed _____MHz RAM _____MB Display adapter _____

Mouse _____yes _____no Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

_____

_____

_____

List any error messages _____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

Data Acquisition Hardware Revision _____

Interrupt Level of Hardware _____

DMA Channels of Hardware _____

Base I/O Address of Hardware _____

NI-DAQ Version _____

Other Products

Computer Make and Model _____

Microprocessor _____

Clock Frequency _____

Type of Video Board Installed _____

Operating System _____

Operating System Version _____

Operating System Mode _____

Programming Language _____

Programming Language Version _____

Other Boards in System _____

Base I/O Address of Other Boards _____

DMA Channels of Other Boards _____

Interrupt Level of Other Boards _____

For each instrument you are using:

Name of instrument _____

Manufacturer of instrument _____

Parity: None, Even, Odd, Mark, Space

Baud rate _____

Stop bits _____

Data bits _____

Flow control: Hardware, Software, None

Version of Measure: (look at the about box) _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: *Measure™ Data Acquisition User Manual*

Edition Date: August 1998

Part Number: 321004C-01

Please comment on the completeness, clarity, and organization of the manual.

If you find errors in the manual, please record the page numbers and describe the errors.

Thank you for your help.

Name _____

Title _____

Company _____

Address _____

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Austin, TX 78730-5039

Fax to: Technical Publications
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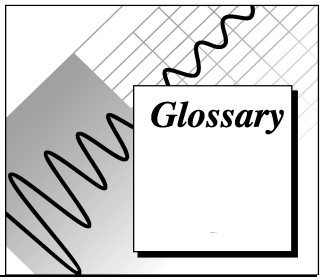


Prefix	Meaning	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

Numbers/Symbols

1D	One-dimensional.
2D	Two-dimensional.

A

A/D	Analog-to-digital.
ADC	Analog-to-digital converter. An electronic device, often an integrated circuit, that converts an analog voltage to a digital number.
ADC resolution	The resolution of the ADC, which is measured in bits. An ADC with 16 bits has a higher resolution, and thus a higher degree of accuracy than a 12-bit ADC.
AI	Analog input.

Analog Input Configuration	The specification of the analog input channels, input limits, input mode, and scan rate that Measure will use to acquire a waveform.
Analog Output Configuration	The specification of the analog output channels, output limits, data points, and update rate that Measure will use to generate a waveform.
analog trigger	A trigger that occurs at a user-selected point on an incoming analog signal. Triggering can be set to occur at a specified level on either an increasing or a decreasing signal (positive or negative slope). Analog triggering can be implemented either in software or in hardware. When implemented in software (Measure), all data is collected, transferred into system memory, and analyzed for the trigger condition. When analog triggering is implemented in hardware, no data is transferred to system memory until the trigger condition has occurred.
AO	Analog output.
array	Ordered, indexed set of data elements of the same type.
Asynchronous	A method of data communications in which information is transmitted one character at a time. A start bit precedes each character and a stop bit follows each character. The start bit signals the beginning of the character transmission and the stop bit indicates its completion. The Serial Add-In uses asynchronous communications in its data exchanges.

B

bipolar	A signal range that includes both positive and negative values–for example, -5 to 5 V.
buffer	Temporary storage for acquired or generated data.
Byte	The standard method of representing numbers or characters in a computers. Eight binary digits (bits) make up a byte.

C

channel	Pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
channel clock	The clock controlling the time interval between individual channel sampling within a scan. Boards with simultaneous sampling do not have this clock.
clock	Hardware component that controls timing for reading from or writing to groups.
conversion device	Device that transforms a signal from one form to another. For example, analog-to-digital converters (ADCs) for analog input, digital-to-analog converters (DACs) for analog output, digital input or output ports, and counter/timers are conversion devices.
coupling	The manner in which a signal is connected from one location to another.

D

D/A	Digital-to-analog.
DAC	Digital-to-analog converter. An electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current.
data acquisition	Process of acquiring data, typically from A/D or digital input plug-in boards.
device	A plug-in data acquisition board that can contain multiple channels and conversion devices.
device number	The slot number or board ID number assigned to the board when you configured it.
DIFF	Differential. A differential input is an analog input consisting of two terminals, both of which are isolated from computer ground and whose difference you measure.

DMA — Direct memory access. A method by which data you can transfer data to computer memory from a device or memory on the bus (or from computer memory to a device) while the processor does something else. DMA is the fastest method of transferring data to or from computer memory.

driver — Software that controls a specific hardware device, such as a data acquisition board.

E

EISA — Extended Industry Standard Architecture.

external trigger — A voltage pulse from an external source that triggers an event such as A/D conversion.

F

FIFO — A first-in-first-out memory buffer. In a FIFO, the first data stored is the first data sent to the acceptor.

G

gain — The factor by which a signal is amplified, sometimes expressed in decibels.

I

input limits — The upper and lower voltage inputs for a channel. You must use a pair of numbers to express the input limits. The VIs can infer the input limits from the input range, input polarity, and input gain(s). Similarly, if you wire the input limits, range, and polarity, the VIs can infer the onboard gains when you do not use SCXI.

input range — The difference between the maximum and minimum voltages an analog input channel can measure at a gain of 1. The input range is a scalar value, not a pair of numbers. By itself the input range

	does not uniquely determine the upper and lower voltage limits. An input range of 10 V could mean an upper limit of +10 V and a lower of 0 V or an upper limit of +5 V and a lower limit of -5 V. The combination of input range, polarity, and gain determines the input limits of an analog input channel. For some boards, jumpers set the input range and polarity, while you can program them for other boards. Most boards have programmable gains. When you use SCXI modules, you also need their gains to determine the input limits.
interrupt	A signal indicating that the central processing unit should suspend its current task to service a designated activity.
I/O	Input/output. The transfer of data to or from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.
ISA	Industry Standard Architecture.

K

Kwords	1,024 words of memory.

M

MB	megabytes of memory
multiplexer	A set of semiconductor or electromechanical switches with a common output that can select one of a number of input signals and that you commonly use to increase the number of signals measured by one ADC.

N

NRSE	Nonreferenced single-ended.

O

onboard channels	Channels provided by the plug-in data acquisition board.

output limits	The upper and lower voltage or current outputs for an analog output channel. The output limits determine the polarity and voltage reference settings for a board.

P

PGIA	Programmable gain instrumentation amplifier.
postriggering	The technique you use on a data acquisition board to acquire a programmed number of samples after trigger conditions are met.
pretriggering	The technique you use on a data acquisition board to keep a continuous buffer filled with data, so that when the trigger conditions are met, the sample includes the data leading up to the trigger condition.

R

Range	A group of rows and columns on a spreadsheet.
RMS	Root mean square.
RSE	Referenced single-ended.

S

scan	One reading from each channel or port in an analog or digital input group.
scan clock	The clock controlling the time interval between scans. On boards with interval scanning support (for example, the AT-MIO-16F-5), this clock gates the channel clock on and off. On boards with simultaneous sampling (for example, the EISA-A2000), this clock clocks the track-and-hold circuitry.
scan rate	The number of scans per second. For example, at a scan rate of 10Hz, Measure samples each channel in a group 10 times per second.
scan width	The number of channels in the channel list or number of ports in the port list you use to configure an analog or digital input group.

SCXI	Signal Conditioning eXtensions for Instrumentation. The National Instruments product line for conditional low-level signals within an external chassis near sensors, so only high-level signals in a noisy environment are sent to data acquisition boards.
sec	Seconds
single-ended inputs	Analog inputs that you measure with respect to a common ground.
software trigger	A programmed event that triggers an event such as data acquisition.
Synchronous	A method of data communications in which a prearranged number of bits are transferred per second. Synchronization occurs before and after the transmission of blocks of data, rather than before and after every character. There are no start bits or stop bits, as there are in asynchronous communications. All transmitted bits represent information or are parity bits. See Asynchronous.

T

trigger	A condition for starting or stopping clocks.

U

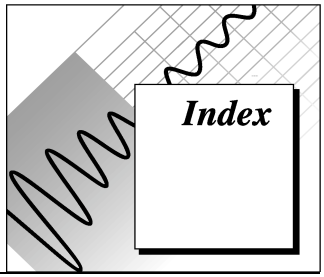
unipolar	A signal range that is always positive—for example, 0 to 10 V.
update	The output equivalent of a scan. One update is one write to each channel or port in the group. Updates apply to both analog output and digital output groups.
update rate	The number of output updates per second.
update width	The number of channels in the channel list or number of ports in the port list you use to configure an analog or digital output group.

V

V	volts.
Visual Basic for Applications (VBA)	The programming language built into Microsoft Excel.
Vref	Voltage reference.

W

waveform	Multiple voltage readings taken at a specific sampling rate.



A

B

C

D

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