

Getting Started with VirtualBench™

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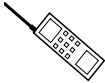
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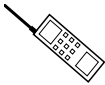
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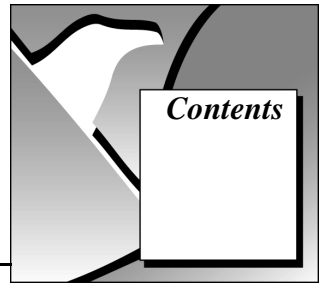
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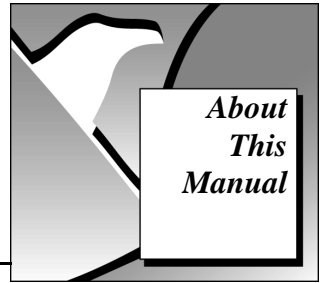
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Customer Communication




The VirtualBench suite of tools is a high-performance, easy-to-use virtual instruments application program for Microsoft Windows 3.1x, Windows 95, or Windows NT. *Getting Started with VirtualBench* gives you step-by-step instructions on how to use each instrument. It also includes a description of the front panel of each instrument.

Conventions Used in This Manual

The following conventions are used in this manual:

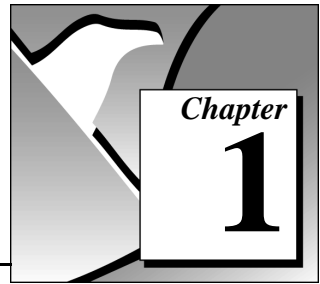
- | | |
|---------------------------|--|
| bold | Bold text denotes a parameter, menu name, palette name, menu item, return value, function panel item, or dialog box button or option. |
| <i>italic</i> | Italic text denotes mathematical variables, emphasis, a cross reference, or an introduction to a key concept. |
| <i>bold italic</i> | Bold italic text denotes an activity objective, note, caution, or warning. |
| monospace | Text in this font denotes text or characters that you should literally enter from the keyboard. Sections of code, programming examples, and syntax examples also appear in this font. This font also is used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, variables, filenames, and extensions, and for statements and comments taken from program code. |
| <> | Angle brackets enclose the name of a key on the keyboard, for example, <PageDown>. |
| » | The » symbol leads you through nested menu items and dialog box options to a final action. The sequence File»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. |

- paths Paths in this manual are denoted using backslashes (\) to separate drive names, directories, and files, as in
C:\dir1name\dir2name\filename.
-  This icon to the left of bold, italicized text denotes a note, which alerts you to important information.

Customer Communication

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 the appendix, *Customer Communication*, at the end of this manual.

Welcome to VirtualBench



Welcome to VirtualBench, a suite of high-performance, easy-to-use virtual instruments for Microsoft Windows 3.1x, Windows 95, and Windows NT. This document contains installation instructions, lists of system requirements and new features, and updated information to help you get started with VirtualBench.

VirtualBench Installation for Windows

You must install VirtualBench along with two other items:

- A National Instruments data acquisition (DAQ) device
- NI-DAQ driver software

Minimum System Requirements

To run VirtualBench you must have the following:

- MS-DOS, version 5.0 or later
- Microsoft Windows 3.1 or later; Microsoft Windows 95 or Microsoft Windows NT 4.0 or later
- Personal computer using at least a 33 MHz 80486 or higher microprocessor (National Instruments recommends a 66 MHz 80486 or higher microprocessor.)
- VGA resolution (or higher) video adapter
- Math coprocessor or one of the following coprocessor emulation programs:
 - WEMM387.386 from WATCOM
 - Q387 from Quickware
- Minimum of 16 MB of RAM
- 30 MB free hard disk space
- Microsoft-compatible mouse

- NI-DAQ 4.9.0 if you plan to use an AT-DSP2200, AT-A2150, or EISA-A2000 DAQ device
- NI-DAQ 5.0 or later if you plan to use Microsoft Windows NT 4.0 or later, or if you plan to use any of the following new DAQ devices:
 - PCI-MIO-16E-1 – AT-DIO-32HS
 - PCI-MIO-16E-4 – AT-5102
 - PCI-MIO-16XE-10 – AT-5411
 - PCI-MIO-16XE-50 – DAQCard-5102
 - PCI-1200 – DAQCard-4050
 - PCI-DIO-96 – PC-DIO-96PNP
 - PCI-DIO-32HS – PC-DIO-24PNP
 - PCI-5411 – SCXI-1120D
 - VXI-AO-48XDC – VXI-MIO
 - VXI-SC-1000 – PCI-5102

Installing VirtualBench under Windows 3.1x

To install VirtualBench from CD, perform the following steps:

1. Open the Windows Program Manager by double-clicking on the Program Manager icon.



Note: *It is recommended that you not run other applications while you install VirtualBench.*

2. Insert your VirtualBench CD into your CD-ROM drive.
3. Select **Run** from the **File** menu in the Program Manager.
4. Enter X:\WIN31\DISK1\SETUP (where X is your CD drive) in the input box and click on **OK**.
5. Follow the instructions that appear in the dialog boxes.

To install VirtualBench from diskettes, perform the following steps:

1. Make backup copies of your VirtualBench diskettes and store the originals in a safe place.
2. Open the Windows Program Manager by double-clicking on the Program Manager icon.



Note: *It is recommended that you not run other applications while you install VirtualBench.*

3. Insert Disk 1 into your 3.5-inch floppy disk drive.
4. Select **Run** from the **File** menu in the Program Manager.
5. Enter A:setup or B:setup (depending on the pathname of your floppy disk drive) in the input box and click on **OK**.
6. Follow the instructions that appear in the dialog boxes.

Installing VirtualBench under Windows 95/NT 4.0

To install VirtualBench from CD, perform the following steps:

1. Insert your VirtualBench CD into your CD-ROM drive.



Note: *At this point your operating system may prompt you to run SETUP.EXE. You should ignore this prompt. Select Close and continue to the next step.*

2. Select **Run** from the Windows 95/NT **Start** menu.
3. Enter X:\WIN95-NT\DISK1\SETUP (where X is your CD drive) in the input box and click on **OK**.
4. Follow the instructions that appear in the dialog boxes.

To install VirtualBench from diskettes, perform the following steps:

1. Make backup copies of your VirtualBench diskettes and store the originals in a safe place.
2. Insert Disk 1 into your 3.5-inch floppy disk drive.



Note: *It is recommended that you not run other applications while you install VirtualBench.*

3. Select **Run** from the **Start** menu.
4. Enter A:setup or B:setup (depending on the pathname of your floppy disk drive) in the input box and click on **OK**.
5. Follow the instructions that appear in the dialog boxes.

What Is Installed by the Setup Program

If you purchased the full VirtualBench suite, the setup program installs the VirtualBench engine and nine virtual instruments: the oscilloscope (Scope), dynamic signal analyzer (DSA), digital multimeter (DMM), function generator (FG), logger, arbitrary waveform generator (Arb), DC analog output controller (AODC), digital input/output controller (DIO), and device calibrator. Each instrument comes with online help.

If you did not purchase the full VirtualBench suite, the setup program for VirtualBench installs the VirtualBench engine and the instruments you purchased. The VirtualBench toolbar enables only the buttons for the instruments you purchased. However, you can access online help for all the VirtualBench instruments.



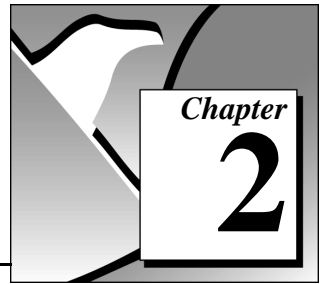
Note: *Do not rename the VirtualBench folders: scope, logger, dmm, fg, dsa, arb, aodc, dio, and cal. VirtualBench must have this folder hierarchy to work correctly.*



Note: *Be sure to view the VirtualBench readme.txt file in Disk 1 of the VirtualBench installation disk for the latest information concerning the installation and use of VirtualBench.*

Connecting Signals to Your Data Acquisition Device

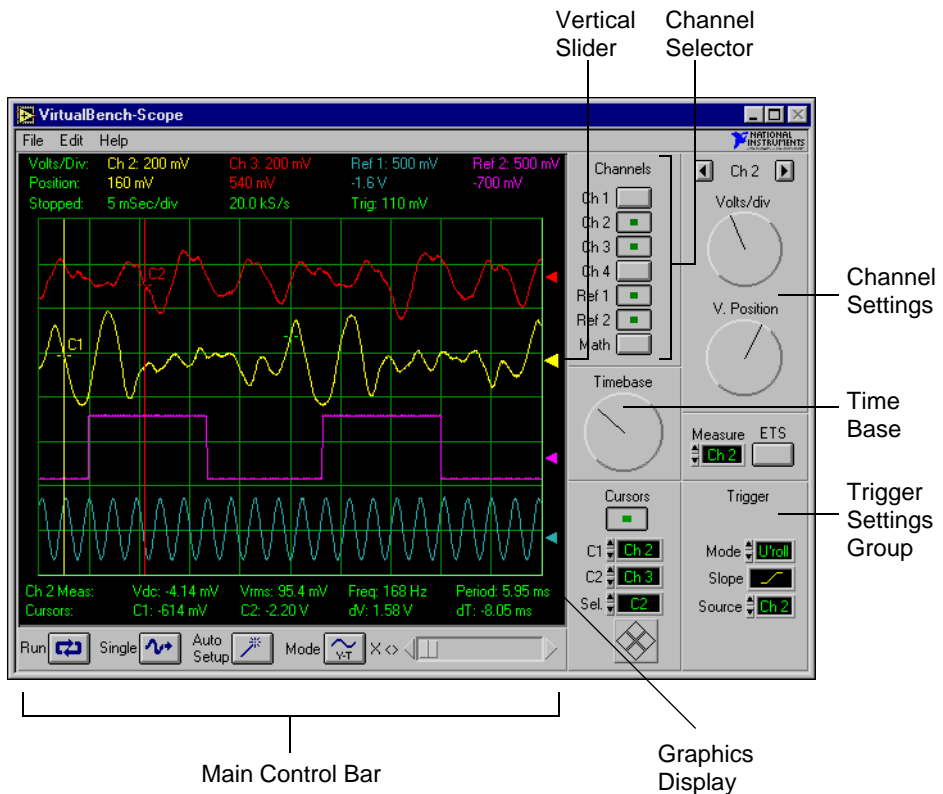
Refer to the user manual for your National Instruments DAQ device for instructions on connecting signals to your device.



VirtualBench-Scope

In Windows 3.1x, you launch VirtualBench-Scope by double-clicking on the **Scope** icon in the VirtualBench window within the Program Manager. In Windows 95/NT 4.0, you launch VirtualBench-Scope by selecting **Start»Programs»VirtualBench»VirtualBench-Scope**.

Front Panel Features



The front panel of VirtualBench-Scope has the following features:

- **Channel Selector**—selects a waveform for display on the Graphics display.
- **Channel Settings**—adjusts the vertical sensitivity of the selected channel. Turning the knob clockwise increases the sensitivity (each vertical division represents a smaller voltage value).
- **Timebase**—allows you to change the timebase setting. Turning the knob clockwise results in a shorter time period displayed in the Graphics display (each horizontal division represents a shorter time period).
- **Graphics Display**—displays waveforms.
- **Vertical Slider**—adjusts voltage offset for each channel. This slider is useful when you want to view multiple waveforms in the Graphics display.
- **Trigger Settings Group**—controls the conditions required for a signal to be acquired; for example, whether to wait for a digital trigger before acquiring data, or whether to acquire data in free-run mode (no triggering).
- **Main Control Bar Buttons**
 - **Run**—acquires data continuously. When clicked off, the VirtualBench-Scope is placed in idle mode.
 - **Single**—instructs VirtualBench-Scope to perform a single-sweep acquisition.
 - **Auto Setup**—starts configuration of the scope for the best timebase, volts per division, and trigger setting for each channel currently selected with the channel selector.
 - **Mode**—sets the mode of the scope to either Volts versus Time or X versus Y mode.
 - **X Scroll**—scrolls along the X-axis or time axis.

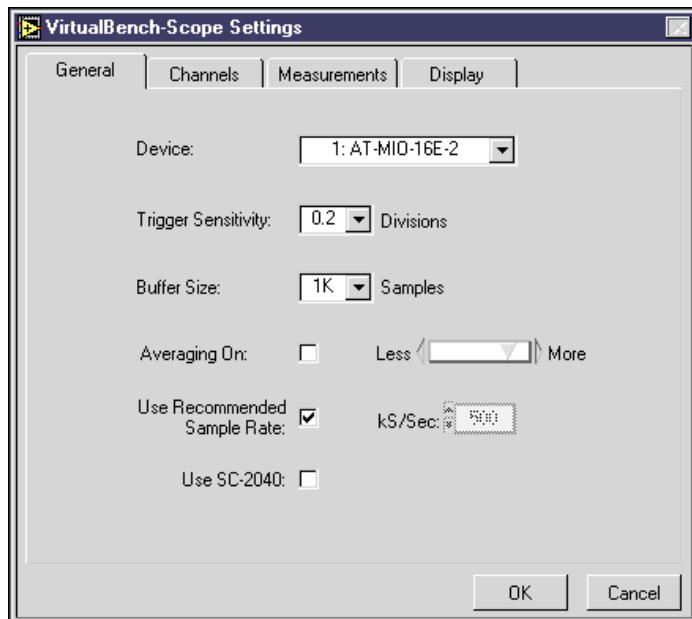


Note: *Please refer to the VirtualBench-Scope Online Help for additional help on the front panel items.*

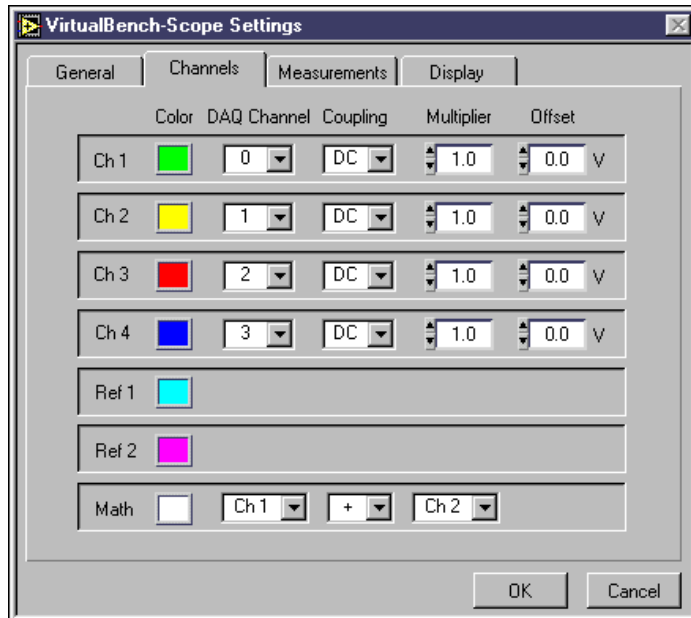
Acquiring Data

You can start acquiring signals with VirtualBench-Scope by completing the following steps:

1. Connect a signal to the Channel 0 input of your National Instruments DAQ device. See the user manual of your DAQ device for details. For example, on a 68-pin MIO E-series device, connect a signal to pins 68 (ACH0) and 67 (AIGND) for a Referenced Single Ended input.
2. Configure VirtualBench-Scope.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Select the National Instruments device you want to use from the General tab of the Settings dialog box. If a device does not appear in the Device menu ring, make sure you have properly configured the device using the NI-DAQ Configuration Utility.



- c. Specify which channels on the data acquisition device correspond to the VirtualBench-Scope channels, using the Channels tab. For an MIO E-series device, you would select VirtualBench-Scope Ch 1 to be representative of DAQ Channel 0.



d. Click on **OK** to use these settings.

- Save your settings by selecting **Edit»Save Settings** from the pull-down menu on the front panel. Enter the name of the file you want to save, for example `MyScope.set`.

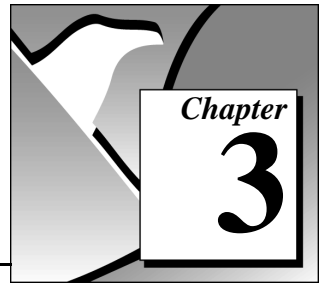


Note: *When you launch VirtualBench-Scope, it automatically uses the settings from when you last used VirtualBench-Scope.*

- Enable the **CH 1** button in the Channel Selector (Acquire) group. Make sure all other channels are disabled.
- Click on **AutoSetup** on the Main Control bar.
- Click on **Run** to stop the acquisition.



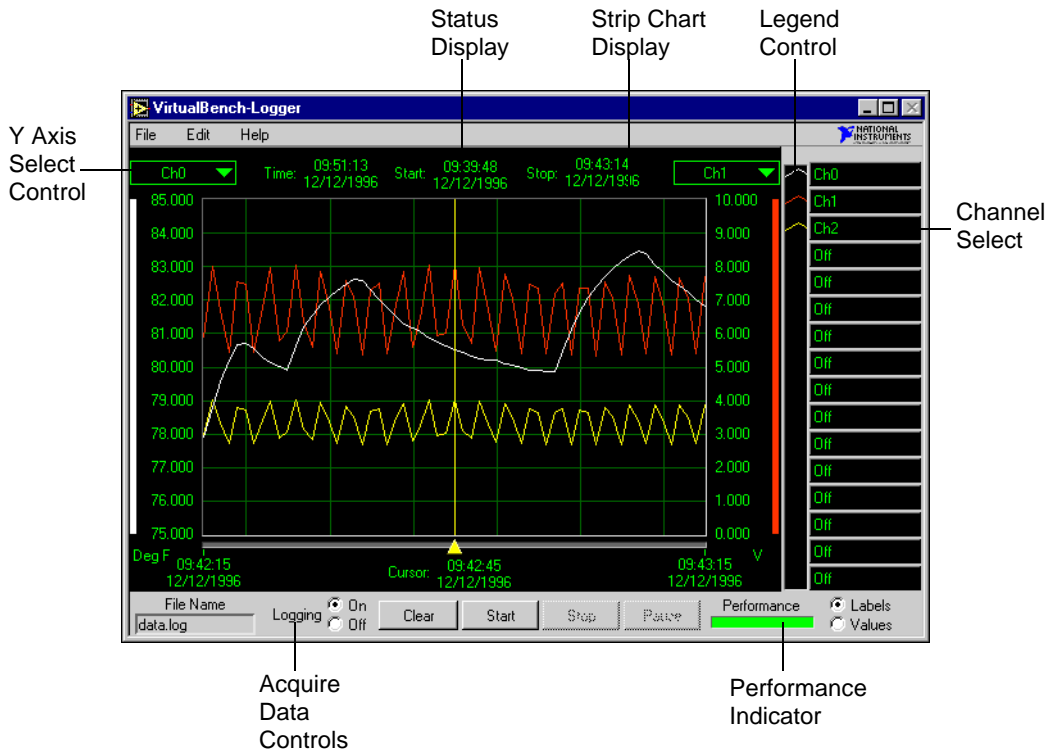
Note: *Please refer to the VirtualBench-Scope Online Help for additional help on configuring VirtualBench-Scope for your specific application.*



VirtualBench-Logger

In Windows 3.1x, you launch VirtualBench-Logger by double-clicking on the **Logger** icon in the VirtualBench program group. In Windows 95/NT 4.0, you launch VirtualBench-Logger by selecting **Start»Programs»VirtualBench»VirtualBench-Logger**.

Front Panel Features



The front panel of VirtualBench-Logger has the following features:

- **Strip Chart Display**—displays the logged data.
- **Y-Axis Select Controls**—selects which channel Y scale to display on either the left or right Y axis of the Strip Chart Display.
- **Status Display**—shows the Current Time, Start Time, and Stop Time of the current data acquisition.
- **Channel Select Control**—selects which channels to display on the Strip Chart Display. You can use the Labels/Values radio buttons below the Channel Select control to switch between the Channel Labels and the Channel Values.
- **Legend Control**—changes the trace attributes of each Display Channel. Clicking on a trace in the Legend Control brings up a menu that allows you to make changes to the Point Style, Line Style, Interpolation method, and Color of the trace.
- **Acquire Data Controls**
 - **Logging On/Off**—starts or stops logging of data to disk when you run the instruments.
 - **Clear Chart**—clears the Strip Chart Display. Clicking on this button does not affect the acquisition of data.
 - **Start**—starts the acquisition of data using the current logger configuration.
 - **Stop**—stops the acquisition of data and data logging when enabled.
 - **Pause**—temporarily stops the flow of data to the Strip Chart and Log file when enabled.
- **Performance Indicator**—shows how efficiently VirtualBench-Logger is running in data acquisition mode. You should strive to keep VirtualBench-Logger running as efficiently as possible. As the performance decreases, the indicator turns red to indicate poor performance. When the performance reaches 0, an error message pops up and the Logger stops collecting data.

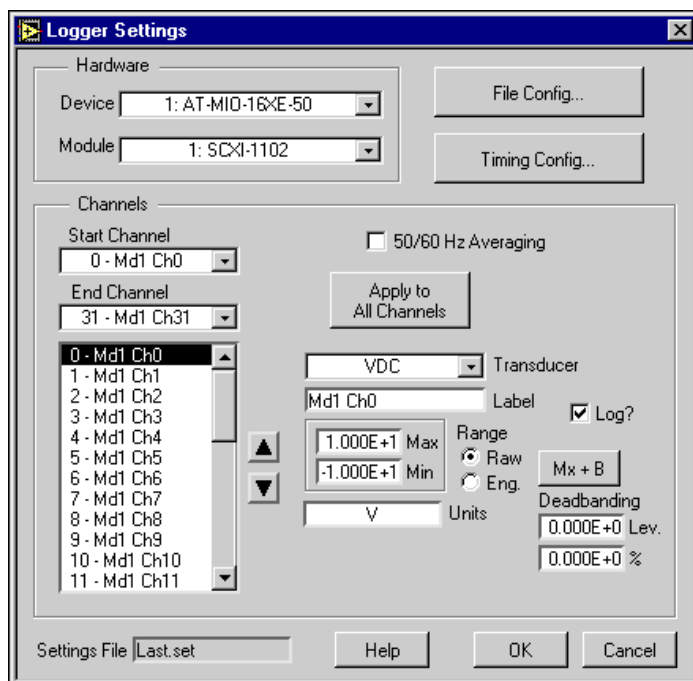


Note: *Please refer to the VirtualBench-Logger Online Help for additional help on the front panel items.*

Acquiring Data

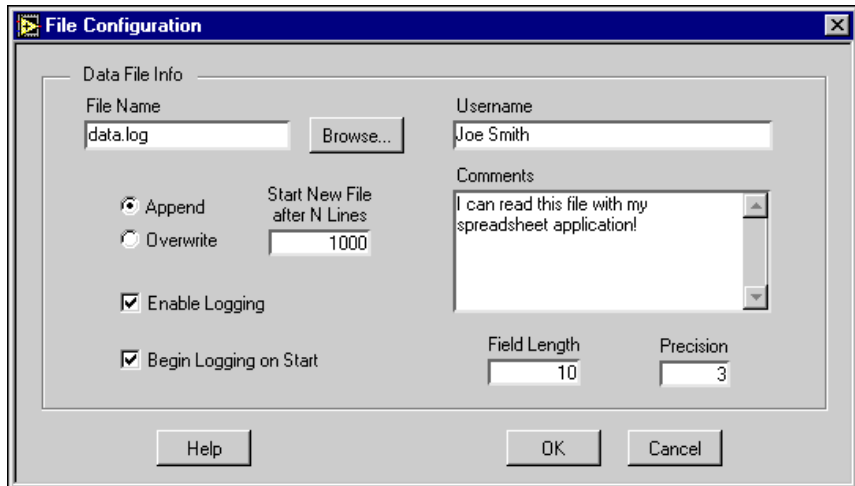
You can start acquiring data with VirtualBench-Logger by following these steps:

1. Connect several known voltage signals to the input channels of your DAQ device. See the user manual of your DAQ device for details. It is recommended that you use known reference signals to verify proper operation of VirtualBench-Logger and your DAQ device.
2. Configure VirtualBench-Logger.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Select the Device and SCXI Module that you want to use. The SCXI Module list is disabled when no SCXI modules are configured for the selected device. If a device does not appear in the Device list, make sure you have properly configured the device in the NI-DAQ Configuration Utility.

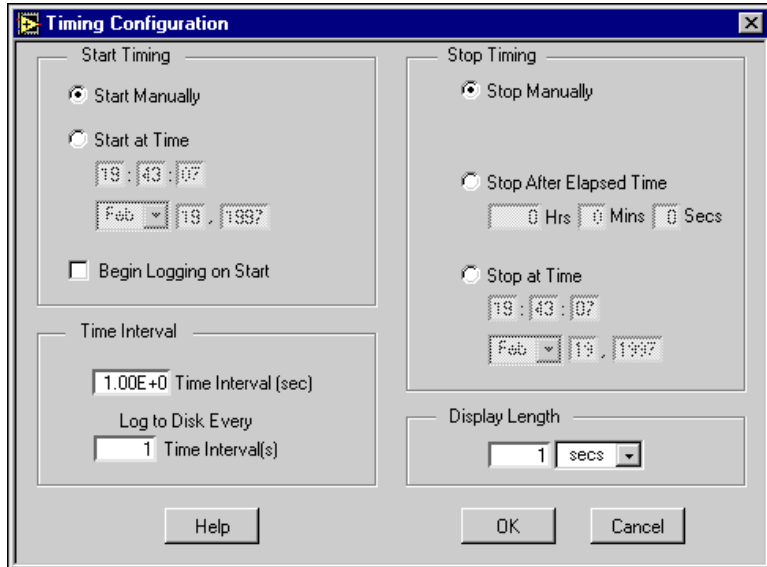


- c. Set the Start and End Channel appropriately for the channels that you connected signals to in step one.

- d. Set the channel attributes for each channel from the Start to End Channel. Give each channel an appropriate label for easy identification on the Strip Chart display.
- e. Click on the **File Config** button. Specify the name of the Log file where the logged data is stored on disk. Specify the location of this file by using the **Browse** button. Select **Enable Logging** and **Begin Logging on Start**. Click on **OK**.



- f. Click on the **Timing Config** button. Set the Start and Stop Timing to start and stop manually respectively. Set the Time Interval to 1 . 00 seconds. Set the Display Length to one minute. Set Log to Disk every n Time Intervals to 2. Click on **OK**.

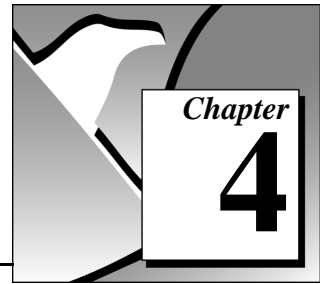


- g. Click on **OK** in the Logger Settings dialog box to return to the front panel.
3. Select the channels that you want to display on the strip chart using the Channel Select Control.
4. Use the right and left Y-axis Controls to select the display channels Y scale to display on the strip chart.
5. Click on **Start** in the Data Acquisition Controls area. The VirtualBench-Logger begins acquiring data at one-second intervals and displays it on the strip chart. If no data displays, check the signal connections to your DAQ device or check the Range Limits for the channels you selected in the Logger Settings dialog box.
6. Click on the **Stop** button to stop the acquisition.

**Note:**

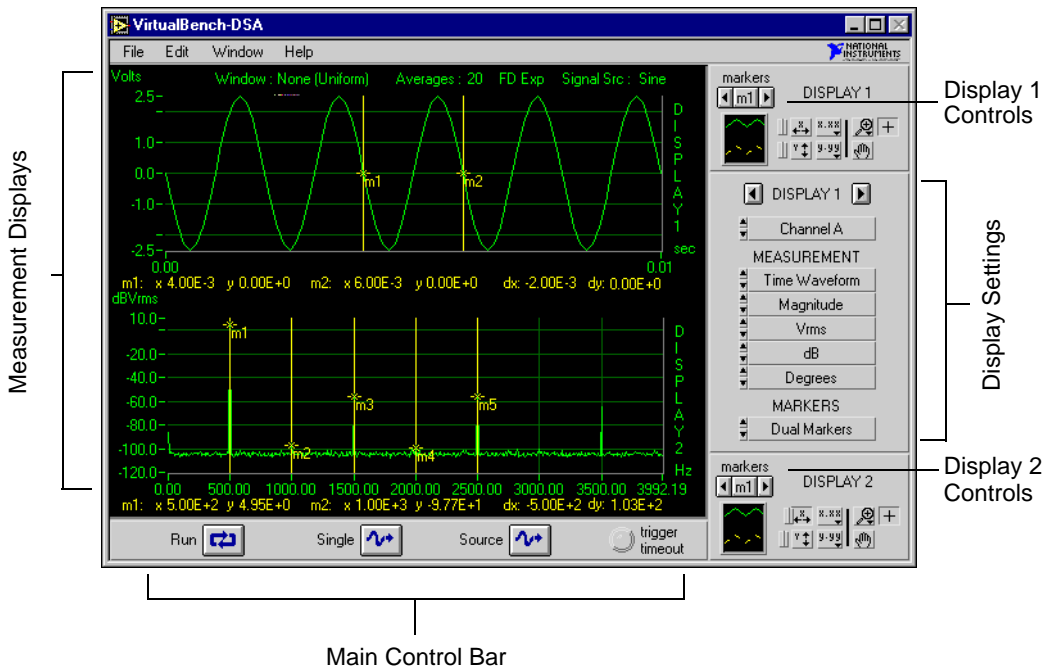
Please refer to the VirtualBench-Logger Online Help for additional help on configuring VirtualBench-Logger for your specific application.

VirtualBench-DSA



In Windows 3.1x, you launch VirtualBench-DSA (Dynamic Signal Analyzer) by double-clicking on the **DSA** icon in the VirtualBench program group. In Windows 95/NT 4.0, you launch VirtualBench-DSA by selecting **Start»Programs»VirtualBench»VirtualBench-DSA**.

Front Panel Features



The front panel of VirtualBench-DSA has the following features:

- **Display Settings Control**—provides individual control of the measurements being performed on Display 1 and 2. You can switch between Display 1 and 2 by clicking on the left and right arrow buttons above the Display Settings Control. You can select the channels, function, magnitude/phase mode, magnitude unit,

log/linear mode, phase unit, and markers in this control. You can refer to the online help for a detailed description of each component.

- **Display 1/Display 2 Controls**—changes the marker positions and display attributes of the respective displays.
- **Main Control Bar Buttons**—contains the **Run**, **Single**, and **Source** controls.
 - **Run**—acquires data continuously. When clicked off, the DSA is in idle mode.
 - **Single**—acquires a single frame of data.
 - **Source**—turns on the source using the selection made in the Source Configuration dialog box.



Note: *The Source button is only available when you use an AT-DSP2200 device with VirtualBench-DSA.*

- **Trigger Timeout**—turns yellow when a trigger does not occur within the time specified by the Trigger Timeout in the Trigger Configuration dialog box.

- **Measurement Displays**—displays measurements, reference waveforms, and markers for marker measurements.

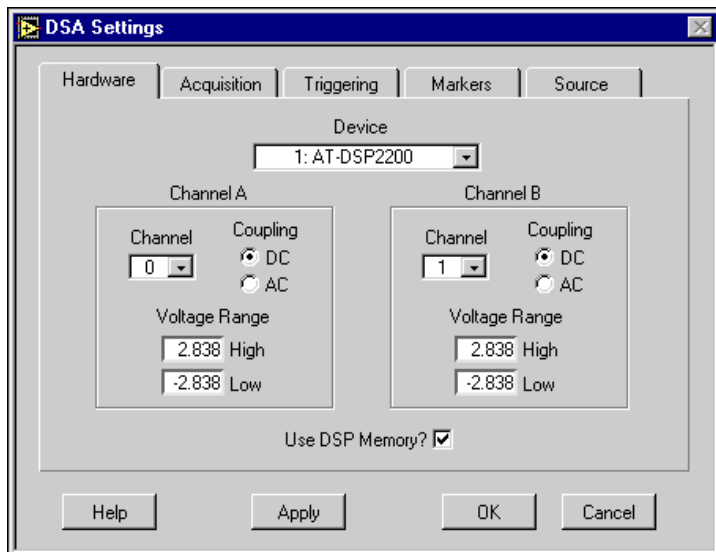


Note: *Please refer to the VirtualBench-DSA Online Help for additional help on the front panel items.*

Acquiring and Measuring Signals

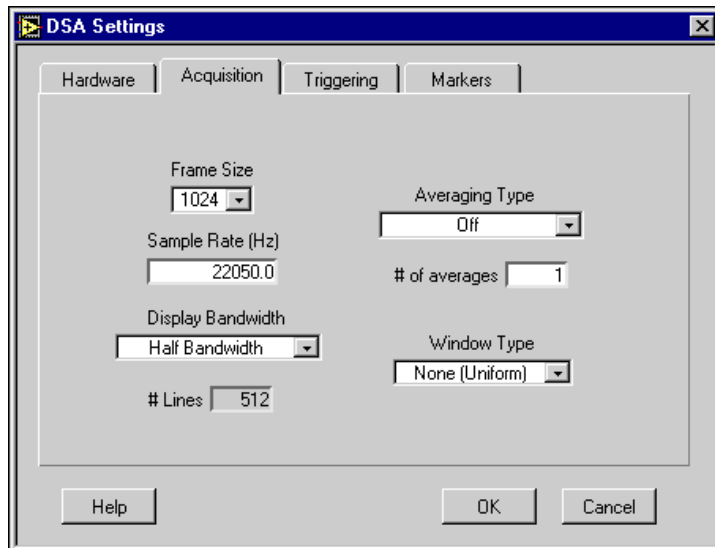
You can start acquiring and measuring signals with VirtualBench-DSA by following these steps:

1. Connect a signal to the Channel 0 or 1 input of your DAQ device. Please refer to the user manual of your DAQ device for details.
2. Configure the DSA.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Select the Hardware tab, from the DSA Settings dialog box.



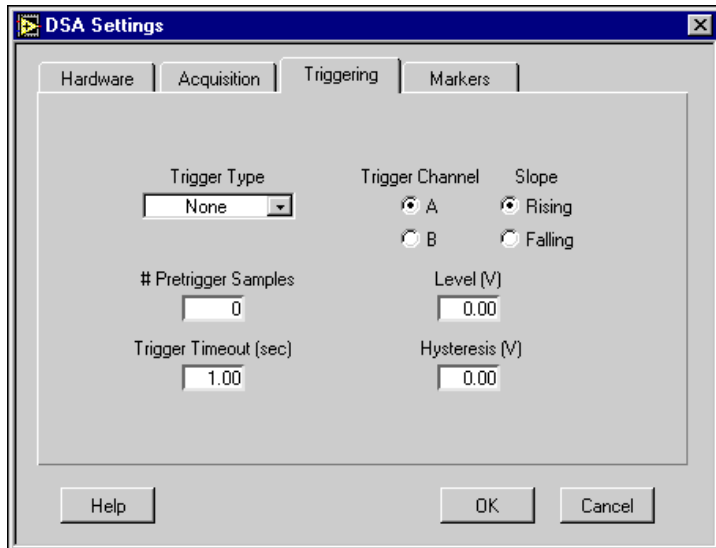
- c. Select the Device that you want to use for the data acquisition. The device must be successfully configured in the NI-DAQ Configuration Utility to appear in the Device list.
- d. Set Channel A or B to Channel 0 or 1, depending on where you connected the signal in step one.
- e. Change the Input Voltage Range to reflect the upper and lower limit of your signal (in volts).

- f. Click on the Acquisition tab in the DSA Settings dialog box.



- g. Set the Frame Size control to 1024. VirtualBench-DSA will analyze data in blocks of 1024 points.
- h. Select a Sample Rate that is at least twice the maximum frequency that you are trying to measure.
- i. Select the Averaging Type as OFF and Window Type as None (Uniform).

- j. Click on the Triggering tab in the DSA Settings dialog box.



- k. Set the Trigger Type to none. This setting puts the acquisition in a Freerun mode.
1. Click on **OK**.
3. Change the display indicator (left and right arrow buttons) to Display 1, in the Display Settings control.
 4. Select Channel A or B (depending on where you connected your signal), in the Channel Selector of the Display Settings control.
 5. Select Time Waveform, in the Function Selector of the Display Settings control. Choose the mode as Magnitude, the Units as Vrms, and the Scale as Linear.
 6. Select Markers Off in the Markers section.
 7. Use the left or right arrow buttons to change the display indicator to Display 2, in the Display Settings control.
 8. Select Pwr Spectrum. Select the mode Magnitude, the Units Vrms, and the Scale dB, in the Function Selector of the Display Settings control.
 9. Click on the **Single** button. VirtualBench-DSA displays a single frame of data. The Time Waveform is on Display 1, and the Power Spectrum on Display 2. If no data is visible, click on the Autoscale Y Axis button (the button with the y and up/down arrows) in the

Display Control. Check your signal connections if data is still not visible.

10. Click on **Run**. VirtualBench-DSA continuously acquires and displays frames of data.
11. Click on **Run** again to stop acquisition.

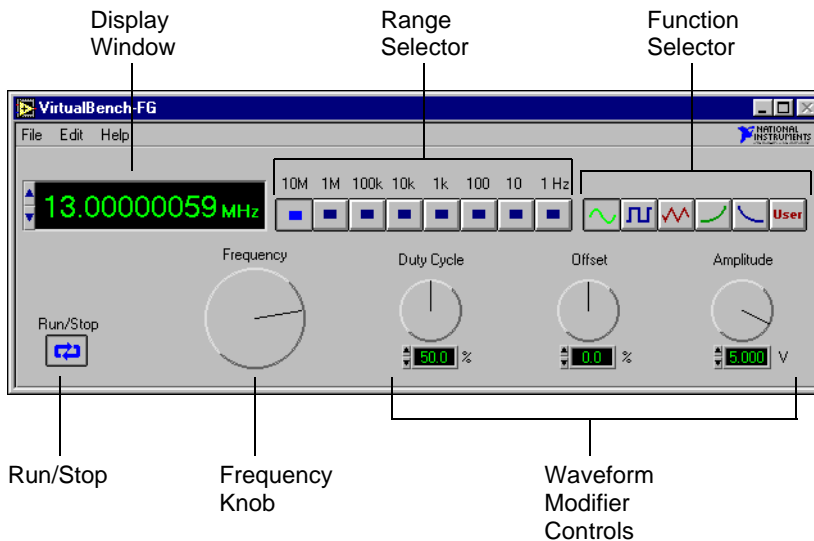


Note: *Please refer to the VirtualBench-DSA Online Help for additional help on configuring VirtualBench-DSA for your specific application.*

VirtualBench-FG

In Windows 3.1x, you launch VirtualBench-FG (Function Generator) by double-clicking on the **FG** icon in the VirtualBench program group. In Windows 95/NT 4.0, you launch VirtualBench-FG by selecting **Start»Programs»VirtualBench»VirtualBench-FG**.

Front Panel Features



The front panel of VirtualBench-FG has the following features:

- **Display Window**—shows the actual waveform frequency being generated.
- **Range Selector**—selects the frequency range of VirtualBench-FG.
- **Function Selector**—selects which type of waveform is to be generated by VirtualBench-FG.
- **Frequency Knob**—controls the frequency of the waveform within the range selected by the Range Selector.

- **Waveform Modifier Controls**—modifies some of the properties of the waveform.
 - **Duty Cycle**—adjusts the duty cycles of the Sine Wave, Square Wave, and Triangle Wave.
 - **Offset**—adjusts the DC offset of the waveform.
 - **Amplitude**—adjusts the peak amplitude of the generated waveform.
- **Run**—starts or stops waveform generation.

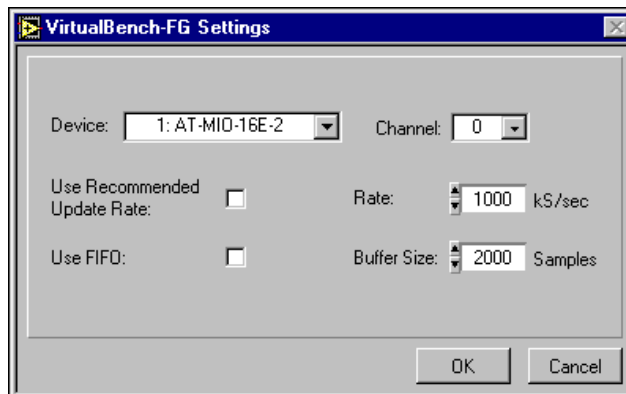


Note: *Please refer to the VirtualBench-FG Online Help for additional help on the front panel items.*

Generating a Waveform

You can configure VirtualBench-FG to generate a waveform by performing the following steps.

1. Configure the output.
 - a. Select **Settings** from the **Edit** menu on the front panel.



- b. Select the Device that you want to use for waveform generation. The device must be successfully configured in the NI-DAQ Configuration Utility to appear in this list.
 - c. Set the Device Channel to 0 or 1.
 - d. Click on **OK**.

2. Connect a device or scope to the output of the analog output device that you specified in step one. See your DAQ device user manual for details.
3. Click on **Run**. VirtualBench-FG continuously generates an analog waveform at the output pin.
4. Click on **Run** again to stop the waveform generation.

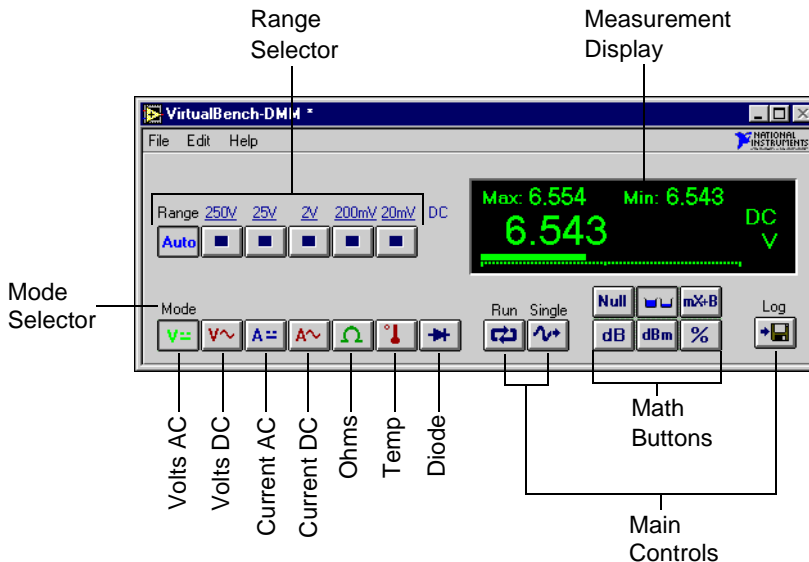
**Note:**

Please refer to the VirtualBench-FG Online Help for additional help on configuring VirtualBench-FG for your specific application.

VirtualBench-DMM

In Windows 3.1x, you launch VirtualBench-DMM (Digital Multimeter) by double-clicking on the **DMM** icon in the VirtualBench program group. In Windows 95/NT 4.0, you launch VirtualBench-DMM by selecting **Start»Programs»VirtualBench»VirtualBench-DMM**.

Front Panel Features



The front panel of VirtualBench-DMM has the following features:

- **Measurement Display**—displays measurements.
- **Mode Selector**—selects which measurement mode you want to use. The modes, from left to right, are as follows:
 - **Volts DC**—measures the DC component of a voltage signal.
 - **Volts AC**—measures the AC component of a voltage signal.
 - **Current DC**—measures the DC component of a current source.

- **Current AC**—measures the AC component of a current source.
- **Ohms**—measures resistance.
- **Temperature**—measures temperature.
- **Diode**—measures the voltage drop across a diode.



Note: *Diode mode is only available when you are using the DAQCard-4050.*

- **Range Selector**—determines the measurement range. This range is different for each measurement mode. AutoRange mode selects the best range to fit the input signal.
- **Main Control Buttons**
 - **Run**—starts or stops the DMM acquisition.
 - **Single**—acquires a single measurement.
 - **Log**—enables logging.
- **Math Control Buttons**
 - **Null**—selects Relative mode. When you select this button, all subsequent measurements are made relative to the measurement made when this button was pressed.
 - **Max/Min**—displays the maximum and minimum values since the button was first pressed.
 - **dB**—displays the decibel value of your signal.
 - **dBm**—displays the decibel power level with respect to one mW.
 - **mX+B**—manipulates normal display readings (X) according to the calculation $mX+B$.
 - **%**—displays the current value as a percentage of a reference.

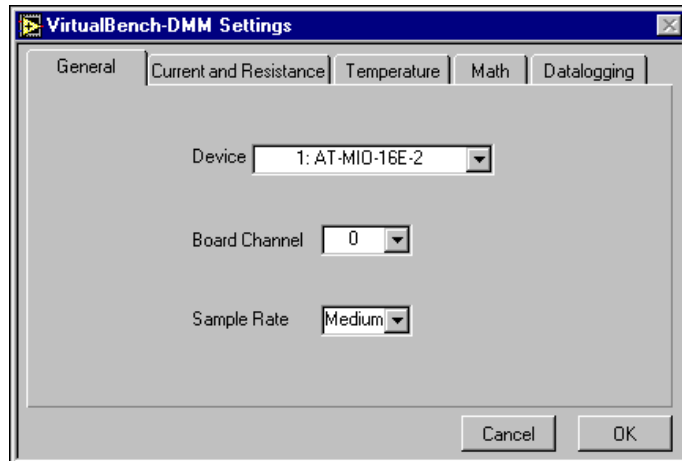


Note: *Please refer to the VirtualBench-DMM Online Help for additional help on the front panel items.*

Measuring a Signal

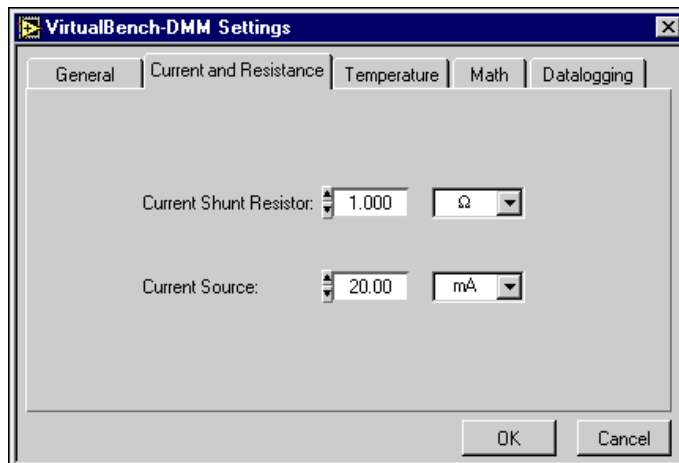
You can start measuring signals with VirtualBench-DMM by following these steps:

1. Configure VirtualBench-DMM.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Select the General tab.



- c. Select the Device and SCXI Module that you want to use. The SCXI Module list is not visible when no SCXI modules are configured for the selected device. If a device does not appear in the Device List, make sure you have properly configured the device in the NI-DAQ Configuration Utility.
 - d. Set the channel to the source of your signal.
 - e. Set the Sample Rate to Medium.
 - f. Click on **OK**.
2. Measure voltage. (VirtualBench-DMM measures AC and DC voltage without any external hardware.)
 - a. Connect a signal (AC or DC) to the Channel input that you specified in step one. See the user manual of your DAQ device for details.
 - b. Click on the first (VDC) or second (VAC) button in the Mode Selector, depending on which type of voltage you connected in substep "a" of step two.

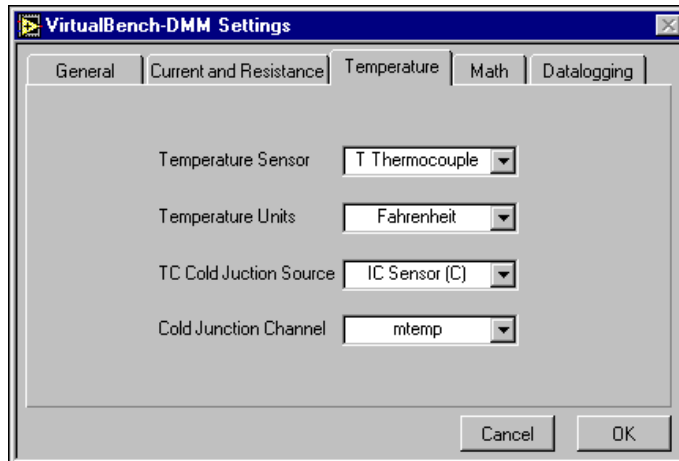
- c. Click on **Run**. VirtualBench-DMM continuously acquires and displays voltage measurements in the display window.
 - d. Check to see that the input signal does not exceed the range of your DAQ device, and that the input signal does not exceed the selected range, when the DMM display shows +CLIP or -CLIP.
 - e. Click on **Run** again to stop the measurement.
3. Measure current. VirtualBench-DMM requires the use of a precision external shunt resistor to measure current.
 - a. Connect a precision shunt resistor across the input of the Channel that you specified in step one. See the user manual of your DAQ device for details.
 - b. Connect your current signal to the same terminals.
 - c. Select **Settings** from the **Edit** menu on the front panel.
 - d. Select the Current and Resistance tab.



- e. Enter the value of the shunt resistor that you placed across the channel specified in step one input of your DAQ device.
- f. Click on **OK**.
- g. Click on the third (**IDC**) or fourth (**IAC**) button in the Mode Selector, depending on which type of voltage you connected in substep "b" of step three.
- h. Click on **Run**. VirtualBench-DMM continuously acquires and displays current measurements in the display window.

- i. Check to see that the input signal does not exceed the range of your DAQ device, and that the input signal does not exceed the selected range, when the DMM display shows +CLIP or -CLIP.
 - j. Click on **Run** again to stop the measurement.
4. Measure resistance. If you are not using a DAQCard-4050 device, VirtualBench-DMM requires the use of a precision external current source to measure resistance.
- a. If you are not using the DAQCard-4050, go to step b. If you are using a DAQCard-4050, connect the resistor to be measured to the terminals of the device and go to step g.
 - b. Connect a precision current source to the channel that you specified in step one. See the user manual of your DAQ device for details.
 - c. Connect your resistance to be measured across the same terminals.
 - d. Select **Settings** from the **Edit** menu on the front panel.
 - e. Select the Current and Resistance tab.
 - f. Enter the value of the current source that you placed at the Channel specified in step one input of your DAQ device.
 - g. Click on **OK**.
 - h. Click on the fifth (**Resistance**) button in the Mode Selector.
 - i. Click on **Run**. VirtualBench-DMM continuously acquires and displays resistance measurements in the display window.
 - j. Check to see that the input signal does not exceed the range of your DAQ device, and that the input signal does not exceed the selected range, when the DMM display shows +CLIP or -CLIP.
 - k. Click on **Run** again to stop the measurement.
5. Measure Temperature. VirtualBench-DMM requires the use of a thermistor, IC sensor, or thermocouple to make precise temperature measurements.
- a. Connect a precision temperature sensor to the channel that you specified in step one. See the user manual of your DAQ device for details.
 - b. Select **Settings** from the **Edit** menu on the front panel.

- c. Select the Temperature tab.



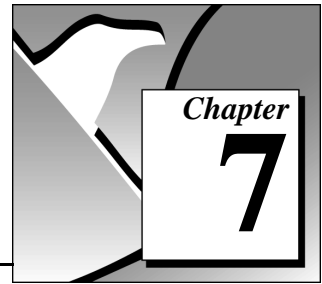
- d. Select the type of sensor that you connected to the channel specified in step one, in substep "a", from the Temperature Sensor list.
- e. Select the Temperature Units you want the temperature to be displayed.
- f. Select the cold junction sensor type from the Source list, when you are using a thermocouple. Select the channel to which the cold junction sensor is connected.
- g. Click on **OK**.
- h. Click on the sixth (**Temperature**) button in the Mode Selector.
- i. Click on **Run**. VirtualBench-DMM continuously acquires and displays Temperature measurements in the display window.
- j. Check to see that the input signal does not exceed the range of your DAQ device, and that the input signal does not exceed the selected range, when the DMM display shows +CLIP or -CLIP.
- k. Click on **Run** again to stop the measurement.



Note: *Please refer to the VirtualBench-DMM Online Help for additional help on configuring VirtualBench-DMM for your specific application.*

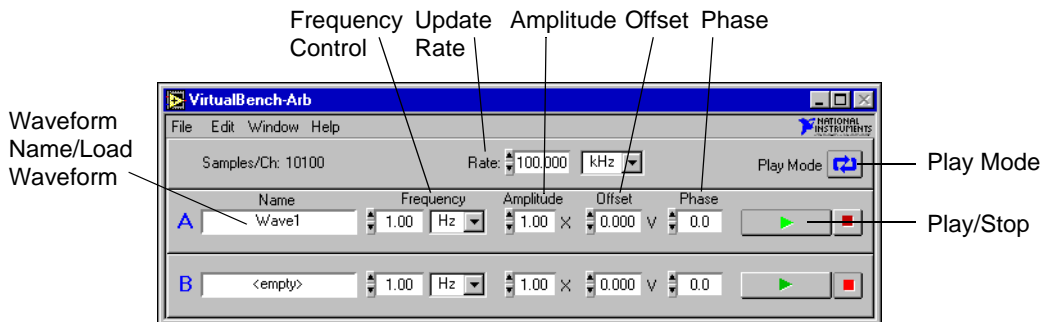
6. Measuring a diode. If you are using a DAQCard-4050 device, you may measure the voltage drop across a diode, up to two volts.
 - a. Connect the diode to the terminals of the DAQCard-4050.
 - b. Click on the sixth (diode) button in the mode selector.
 - c. Click on **Run**.
 - d. Click on **Run** again to stop the measurement.

VirtualBench-Arb



In Windows 3.1x, you launch VirtualBench-Arb (Arbitrary Waveform Generator) by double-clicking on the **Arb** icon in the VirtualBench program group. In Windows 95/NT 4.0, you launch VirtualBench-Arb by selecting **Start»Programs»VirtualBench»VirtualBench-Arb**.

Waveform Generator Front Panel Features

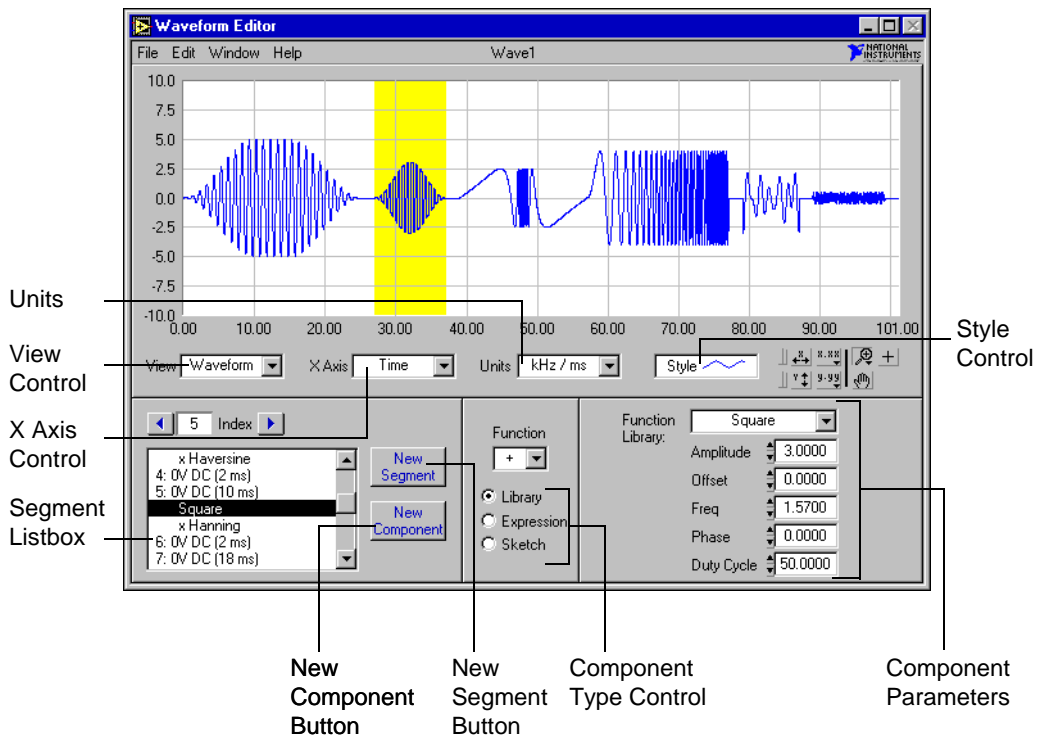


The key features of the Waveform Generator front panel of VirtualBench-Arb are:

- **Waveform Name/Load Waveform Control**—shows the name of the waveform, if any, that currently loads into the channel buffer. Select this window to load from a file to a waveform.
- **Play Mode**—plays the waveform continuously. When deselected, plays the waveform only once.
- **Update Rate**—controls the update rate of the waveform. This control does not affect the play speed of waveform files (.wfm) but does affect waveform quality. With text and sound (.wav) files, the update rate determines the play speed by controlling the number of samples of the waveform that are played per second.
- **Frequency Control**—modifies the rate at which waveform files (.wfm) are played. The waveform rate is multiplied by this value to determine the actual play speed. Text and sound (.wav) files are unaffected by this control.

- **Amplitude Control**—scales the waveform by a specified amount.
- **Offset Control**—adds a voltage offset to the waveform.
- **Phase Control**—shifts the waveform buffer by a certain phase, specified in degrees.
- **Play/Stop Control**—starts or stops waveform generation for one channel.

Waveform Editor Front Panel Features



The Waveform Editor front panel of VirtualBench-Arb has the following features:

- **View Control**—selects the waveform view displayed on the graph. **Waveform** displays the entire waveform. **Segment** displays the first of the selected segments. **Component** displays only the first selected component.
- **X Axis Control**—selects the X-axis units. **Time** displays the waveform as a function of time. **Frequency** displays the power spectrum of the waveform.
- **Units Control**—selects the active units currently being used for the display and control values.
- **Style Control**—changes the graph attributes.
- **Segment Listbox Control**—selects the segment or component to be edited. A segment is preceded by a number and indicates a unique section of the waveform. The value in parentheses indicates the segment length. Indented text in the list box represents a waveform component.
- **New Segment Button**—inserts a new waveform segment immediately after the current selection.
- **New Component Button**—inserts a new component immediately after the current selection.
- **Component Type Control**—selects the type of component. A waveform Library function is one of 20 predefined waveform patterns. An Expression is a single-variable function evaluated over an interval. A Sketch is a waveform drawn by the mouse.

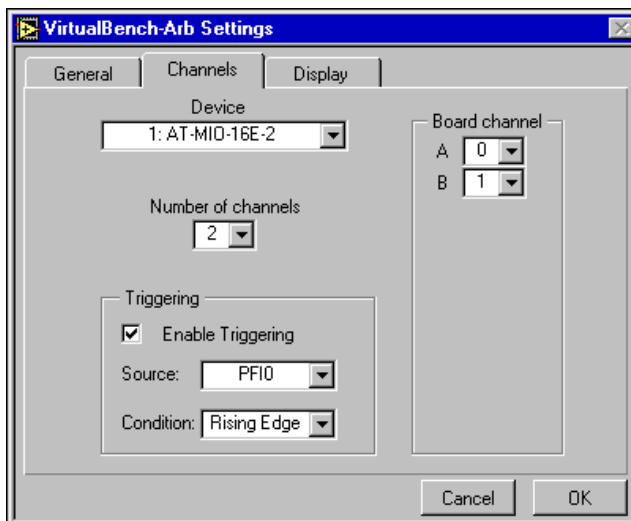


Note: *Please refer to the VirtualBench-Arb Online Help for additional help on the front panel items.*

Generating a Waveform

You can start generating waveforms with VirtualBench-Arb by following these steps:

1. Configure VirtualBench-Arb.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Select the Channels tab.



- c. Select the Device that you want to use for waveform generation. To appear in the Device list, the device must be successfully configured in the NI-DAQ Configuration Utility.
 - d. Select the number of channels to be used for waveform generation. For example, select 1 to generate waveforms on only one channel.
 - e. Select the corresponding DAQ device channels to map to the VirtualBench-Arb alphabetical channel names.
 - f. Click on **OK**.
2. Creating a New Waveform.
 - a. Select **Window»Waveform Editor**.
 - b. Enter the duration of the waveform in the Duration control to set the duration of the first segment.

- c. Click on **New Component**. By default, every time you click on **New Component**, a new library component is added to any existing waveform.
 - d. Select the type of component: Library, Expression, or Sketch. The following steps further describe how to use these options.
3. Creating a Waveform using the Library Functions.
 - a. Enter the duration of the waveform in the Duration control. This control sets the duration of the first segment in the waveform.
 - b. Click on **New Component**. This action adds a component to the first segment.
 - c. Be sure that **Library** is selected in the Component Type control.
 - d. Select a waveform from the library and modify the parameters if necessary.
 - e. Click on **New Component** again to add a new component. This component adds to the first to produce the final segment. Change the Function selector to perform subtraction, multiplication, division, or frequency modulation.
 - f. Click on **New Segment** to add additional waveform segments to the end of the waveform.
 4. Creating a Waveform from a Mathematical Expression.
 - a. Create a new segment by clicking on **New Segment**.
 - b. Create a new component in the segment by clicking on **New Component**.
 - c. Select **Expression** from the Component Type control.
 - d. Enter an expression in terms of variable x , in the expression box. Any error is indicated in red, with the character position of the error placed in parentheses.
 - e. Enter the range for x in the From: and To: input boxes. The expression is evaluated over this range.
 - f. You can change the number of cycles of the waveform by changing the **Cycles** control.
 5. Creating a Waveform from a Freehand Sketch.
 - a. Create a new segment by clicking on **New Segment**.
 - b. Create a new component in the segment by clicking on **New Component**.

- c. Select **Sketch** from the Component Type control.
 - d. Click on **Draw**. Notice that this changes from **View** to **Component** mode, so that only the current component is displayed.
 - e. Click and drag over the graph to create a waveform using the mouse. Change the mode to line by clicking on the **Mode** button. This mode allows you to draw straight lines.
 - f. Click on **Draw** again to finish editing.
6. Save your waveform by selecting **File»Save**.
 7. Close the Waveform Editor front panel.
 8. In the front panel of the Waveform Generator, click on the Waveform Name/Load Waveform control to bring up the file dialog box. Select the waveform file that you saved in step six.
 9. Adjust the **Rate** control to an appropriate update rate. Select a rate that is at least twice the maximum frequency component of your signal.
 10. Click on the **Play** button (the button containing a green triangle) to begin waveform generation.
 11. Click on the **Stop** button (the button containing a red square) to end signal generation.



Note:

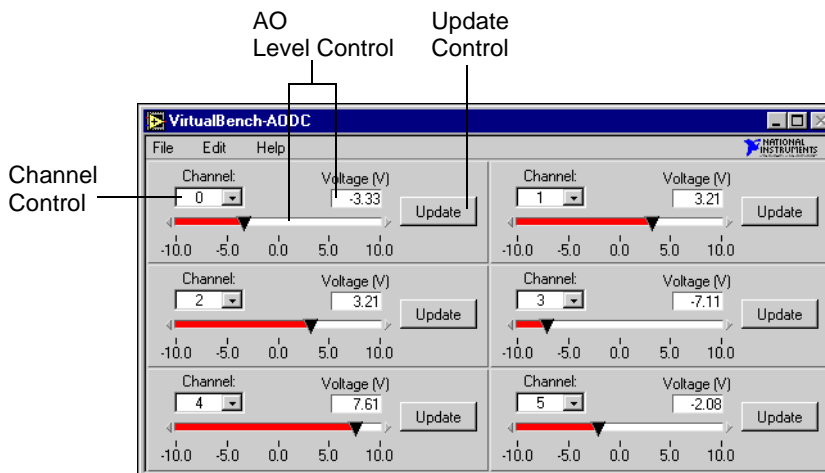
Please refer to the VirtualBench-Arb Online Help for additional help on configuring VirtualBench-Arb for your specific application.

VirtualBench-AODC



In Windows 3.1x, you launch VirtualBench-AODC (Analog Output Direct Current) by double-clicking on the **AODC** icon in the VirtualBench program group. In Windows 95/NT4.0, you launch VirtualBench-AODC by selecting **Start»Programs»VirtualBench»VirtualBench AODC**.

Front Panel Features



The front panel of VirtualBench-AODC has the following features:

- **Channel Control**—allows you to independently assign the selected analog output control to any of your device analog output channels.
- **AO Level Control**—manipulates the analog output level of the assigned analog output channel. The analog output channel is not actually changed until the **Update** button is clicked on.
- **Update Control**—updates the channel selected in the Channel control with the voltage/current specified in the AO Level control.



Note: *Please refer to the VirtualBench-AODC Online Help for additional help on the front panel items.*

Controlling Analog Output

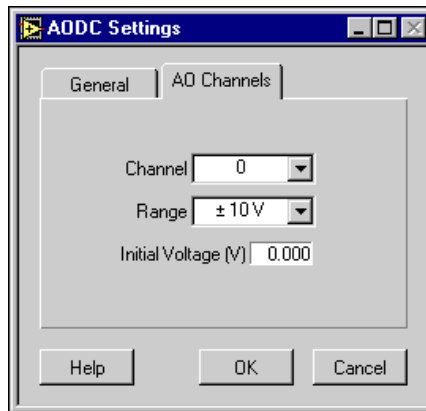
You can start controlling analog output with VirtualBench-AODC by following these steps:

1. Configure VirtualBench-AODC.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Click on the General tab in the AODC Settings dialog box.



- c. Select the Device and SCXI Module that you want to use. The SCXI Module list is disabled if no SCXI modules are configured for the selected device. The device must be successfully configured in the NI-DAQ Configuration Utility to appear in this list.

- d. Click on the AO Channels tab on the AODC Settings dialog box.

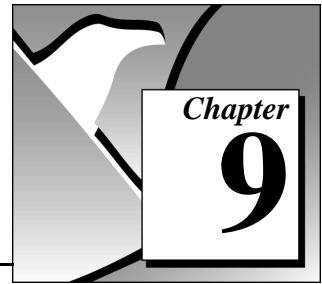


- e. Select the **Range** and **Initial Voltage (V)** or **Current (mA)** for each channel in the **Channels** list.
 - f. Click on **OK** to use these settings.
2. Use the **Channel** control to assign an analog output channel from your DAQ device to that particular **AO Level** control.
 3. Use the slider or digital controls in the **AO Level** control to set the output level.
 4. Click on **Update** to update the analog output channel with the new value you specified in **AO Level** control.



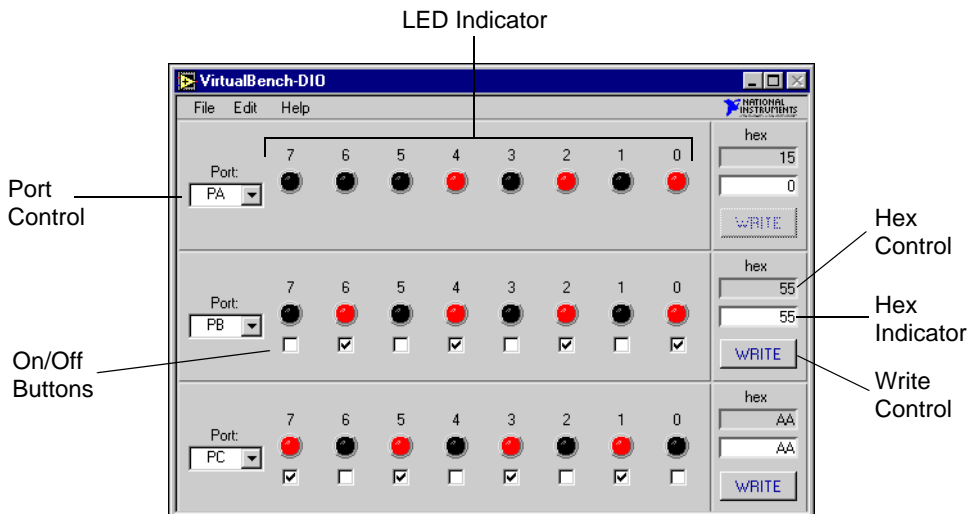
Note: *Please refer to the VirtualBench-AODC Online Help for additional help on configuring VirtualBench-AODC for your specific application.*

VirtualBench-DIO



In Windows 3.1x, you launch VirtualBench-DIO (Digital Input/Output) by double-clicking on the **DIO** icon in the VirtualBench program group. In Windows 95/NT 4.0, you launch VirtualBench-DIO by selecting **Start»Programs»VirtualBench»VirtualBench DIO**.

Front Panel Features



The front panel of VirtualBench-DIO has the following features:

- **Port Control**—allows you to independently assign the selected digital port control group to any of your device digital ports.
- **LED Indicator**—shows the current state of the assigned digital port.
- **On/Off Buttons**—sets the digital state of the assigned digital port. The state of the digital port is not actually changed until the **Write** button is clicked on. These buttons only appear for ports or lines configured for output.

- **Hex Control**—sets the digital state, in hexadecimal form, of the assigned digital port. The state of the digital port is not actually changed until the **Write** button is clicked on.
- **Hex Indicator**—shows the current state, in hexadecimal form, of the assigned digital port.
- **Write Control**—sets the assigned digital port to the state shown on the On/Off checkboxes or Hex Control. The **Write** button is disabled if the digital port is configured for read mode.

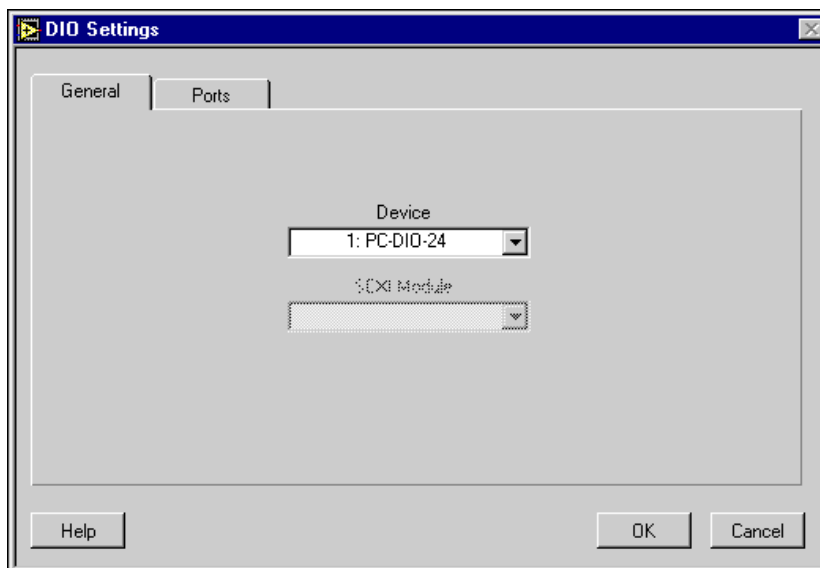


Note: *Please refer to the VirtualBench-DIO Online Help for additional help on the front panel items.*

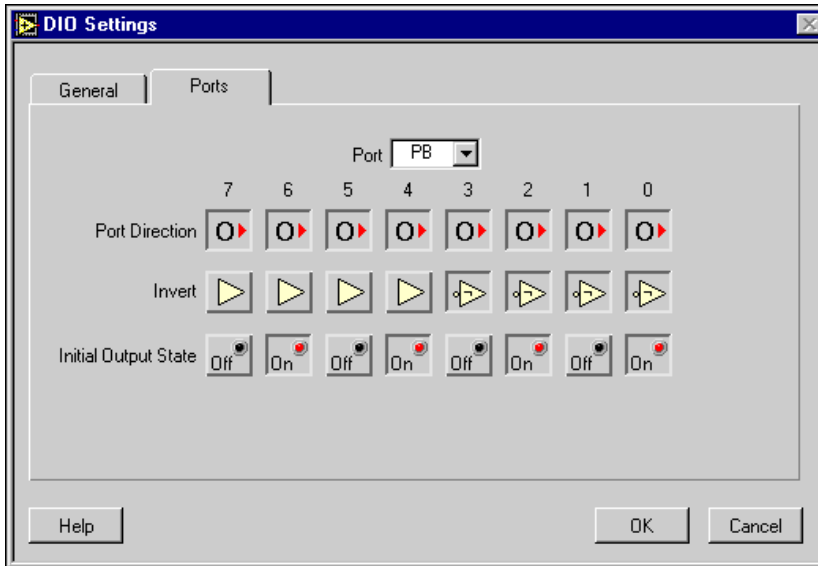
Reading from and Writing to Digital Ports

You can start reading from and writing to the digital ports of your National Instruments device with VirtualBench-DIO by following these steps:

1. Configure VirtualBench-DIO.
 - a. Select **Settings** from the **Edit** menu on the front panel.
 - b. Click on the General tab in the DIO Settings dialog box.



- c. Select the Device and SCXI Module that you want to use. The SCXI Module list is disabled if no SCXI modules are configured for the selected device. The device must be successfully configured in the NI-DAQ Configuration Utility to appear in this list.
- d. Click on the Ports tab in the DIO Settings dialog box.

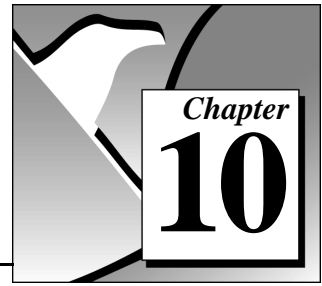


- e. Select the preferred Port Direction, Inversion, and Initial Output State for every port in the Port list.
 - f. Click on **OK** to use these settings.
2. Use the **Port Control** to assign a digital port from your DAQ device to that particular port control group.
 3. Change the output state of a particular port by selecting or deselecting the **On/Off** buttons or **Hex control** to the preferred state and finally clicking on the **Write** button to change the port to the new state.
 4. Read the states displayed on the LEDs. If the port is configured as input, no additional settings are needed.

**Note:**

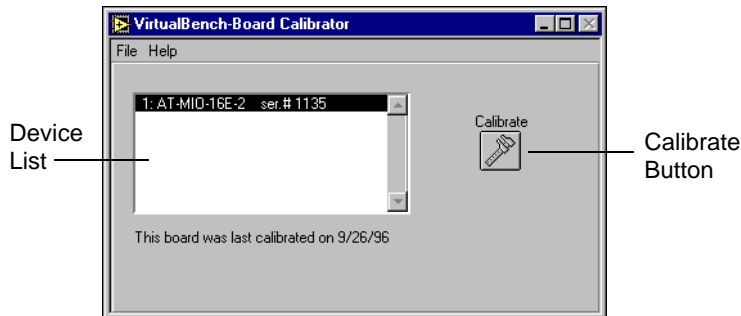
Please refer to the VirtualBench-DIO Online Help for additional help on configuring VirtualBench-DIO for your specific application.

VirtualBench- Device Calibrator



In Windows 3.1x, you launch the VirtualBench-Device Calibrator by double-clicking on the **Calibrate** icon in the VirtualBench program group. In Windows 95/NT4.0, you launch the VirtualBench-Device Calibrator by selecting **Start»Programs»VirtualBench»VirtualBench Device-Cal.**

Front Panel Features



The front panel of the VirtualBench-Device Calibrator has the following features:

- **Device List**—shows all the devices installed in your computer that are self-calibrating, and the last calibrated date. The device must be successfully configured in the NI-DAQ Configuration Utility to appear in this list.
- **Calibrate Button**—begins the calibration process.

You can use the VirtualBench-Device Calibrator to calibrate the analog input circuitry of the following DAQ devices: E-series, AT-MIO-16F-5, AT-MIO-64F-5, AT-MIO-16X, and PC-LPM-16. Special connections are not necessary; VirtualBench-Device Calibrator automatically accesses the calibration features of these devices.

Calibrating a DAQ Device

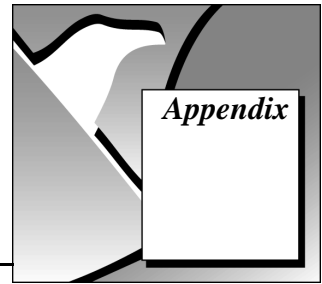
You can calibrate your device with VirtualBench-Device Calibrator by following these steps:

1. Wait at least 15 minutes after both your computer and device are powered on before calibrating your device.
2. Select the device you want to calibrate from the Device List.
3. Click on **Calibrate**. Calibration of your device may take some time. Do not be alarmed if calibration takes up to 20 seconds.
4. Wait for calibration to complete before using any other VirtualBench instrument.



Note: *Please refer to the VirtualBench-Device Calibrator Online Help for additional help on configuring VirtualBench-Device Calibrator for your specific application.*

Customer Communication



For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a fax-on-demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by applications engineers.

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
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: 01 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.



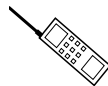
E-Mail Support (currently U.S. only)

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	02 9874 4100	02 9874 4455
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
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	09 527 2321	09 502 2930
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 5734815	03 5734816
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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
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Taiwan	02 377 1200	02 737 4644
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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 (include version number) _____

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 reproduce the problem: _____

VirtualBench 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

DAQ hardware _____

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DMA channels of hardware _____

Base I/O address of hardware _____

Programming choice _____

VirtualBench and NI-DAQ version _____

Other boards in system _____

Base I/O address of other boards _____

DMA channels of other boards _____

Interrupt level of other boards _____

Other Products

Computer make and model _____

Microprocessor _____

Clock frequency or speed _____

Type of video board installed _____

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 _____

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: *Getting Started with VirtualBench™*

Edition Date: March 1997

Part Number: 321518A-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.

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