AWG5000 Series
Arbitrary Waveform Generators
Quick Start User Manual

www.tektronix.com
071-2078-01

Tektronix

www.valuetronics.com

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- In North America, call 1-800-833-9200
- Worldwide, visit www.tektronix.com to find contacts in your area.

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Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Power Disconnect. The power cord provides Mains disconnect.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

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Terms in this Manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbols may appear on the product:

CAUTION
Refer to Manual

WARNING
High Voltage

Protective Ground
(Earth) Terminal

Earth Terminal

Chassis Ground

Standby

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Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-life Handling

Observe the following guidelines when recycling an instrument or component.

Equipment Recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.

The symbol shown to the left indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling about options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Mercury Notification. This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities or, within the United States, the Electronics Industries Alliance (www.eiae.org) for disposal or recycling information.

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead, cadmium, mercury, and hexavalent chromium.

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Preface

This manual describes the installation and operation of AWG5000 series instruments. Basic operations and concepts are presented in this manual. For more detailed information, see the online help on your instrument. The following instruments are supported by this manual:

- AWG5012
- AWG5014
- AWG5002
- AWG5004

Key Features

The following table and list describe the key features of the AWG5000 series instruments.

Model	AWG5012	AWG5014	AWG5002	AWG5004
Maximum Sampling Rate	1.2 GS/s		600 MS/s	
D/A Resolution	14 bits			
Memory Length	16,200,000 or 32,400,000 (Option 01)			
Analog Output	2	4	2	4
Maximum Amplitude and Analog Bandwidth	2.0 V_{p-p}, 250 MHz (Direct Output: Off) 0.6 V_{p-p}, 370 MHz (Direct Output: On)			
Marker Output (2/channel)	4	8	4	8
Digital Data Output	28 bits (Option 03)	N/A	28 bits (Option 03)	N/A

- Windows XP Professional operation system
- Up to 32,400,000 memory length (Option 01)
- 28 bits digital data output (Option 03, AWG5012 and AWG5002 only)
- A large 10.4 inch (264.2 mm) high resolution XGA color display
- An intuitive, graphical user interface (UI), with built-in online help
- 80 GB hard disk drive
- CD-RW/DVD
- Supports USB 2.0 interface
- LAN (1000/100/10 Base-T)
- Touch screen user interface

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Documentation

Additional information is available through a variety of sources. Review the following table to locate more information about this product.

To read about	Use these documents
Installation and Operation (overviews)	Read the Quick Start User Manual for general information about how to use your instrument.
In-depth Operation and User Interface Help	Access the user online help from the Help menu for information on virtually all controls and elements on screen. Online help includes detailed instructions for using instrument functions. (See page 10, *Accessing Online Help*.)
Programmer Commands	Access the programmer online guide from the Help menu. The programmer guide includes the syntax of remote commands.
Specifications and Performance Verification Procedures	Read the Technical Reference for specifications and the performance verification procedure. The Technical Reference PDF file is on the Document CD.

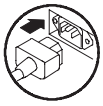
Conventions Used in this Manual

The following icons are used throughout this manual.

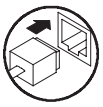
Sequence Step

Front panel power

Connect power

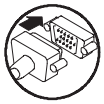


Network

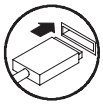


PS2

SVGA



USB



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Install Your Instrument

Unpack the instrument and check that you received all items listed as Standard Accessories. Recommended accessories and instrument options are listed in the online help. Check the Tektronix Web site (www.tektronix.com) for the most current information.

Standard Accessories

Accessory	Tektronix part number
AWG5000 series Arbitrary Waveform Generators Quick Start User Manual	
English (Option L0)	071-2078-xx
Japanese (Option L5)	071-2079-xx
Simplified Chinese (Option L7)	071-2080-xx
Traditional Chinese (Option L8)	071-2081-xx
Operating System Restore DVD	020-2762-xx
Product Software CD	020-2763-xx
Document CD	063-3994-xx
User Online Help (part of the product software)	——
Programmer Online Help (part of the product software)	——
1 Windows compatible keyboard	119-7083-00
1 Windows compatible mouse	119-7054-00
2 Stylus pens	119-6107-00
Lead Set for DC Output	012-1697-00
Front Protect Cover	200-4963-00
Accessory Pouch	016-1441-01
Power cord – one of the following:	
North America (Option A0)	161-0104-00
Universal Euro (Option A1)	161-0104-06
United Kingdom (Option A2)	161-0104-07
Australia (Option A3)	161-0104-14
Switzerland (Option A5)	161-0167-00
Japan (Option A6)	161-A005-00
China (Option A10)	161-0306-00
India (Option A11)	161-0324-00
No power cord or AC adapter (Option A99)	——

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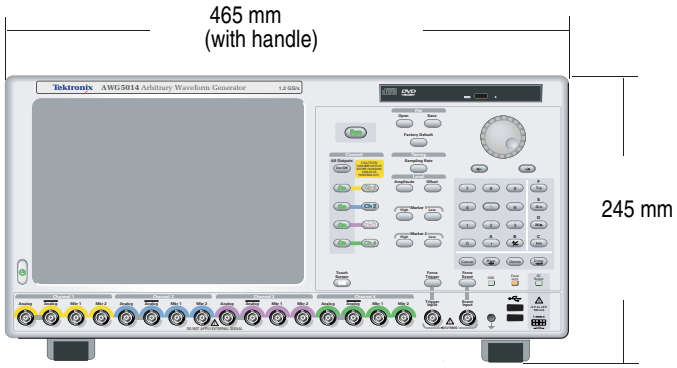
Operating Requirements

1. Place the instrument on a cart or bench, observing clearance requirements:
   - Top: 20 mm (0.8 in)
   - Left and right side: 150 mm (5.9 in)
   - Bottom: 20 mm (0.8 in)
   - Rear: 75 mm (3 in)
2. Before operating, ensure that the ambient temperature is between 10 °C and 40 °C (+50 °F to +104 °F).



CAUTION. *To ensure proper cooling, keep sides of the instrument clear of obstructions.*

Power Supply Requirements

Source Voltage and Frequency	100 VAC to 240 VAC, 47 Hz to 63 Hz
Power Consumption	Less than 560 W

Cleaning

WARNING. *To avoid personal injury, power down the instrument and disconnect it from line voltage before performing any of the following procedures.*

Inspect the arbitrary waveform generator as often as operating conditions require. To clean the exterior surface, perform the following steps:

1. Remove loose dust on the outside of the instrument with a lint-free cloth. Use care to avoid scratching the front panel display.
2. Use a soft cloth dampened with water to clean the instrument. Use an aqueous solution of 75% isopropyl alcohol for more efficient cleaning.

CAUTION. *To avoid damage to the surface of the arbitrary waveform generator, do not use any abrasive or chemical cleaning agents.*

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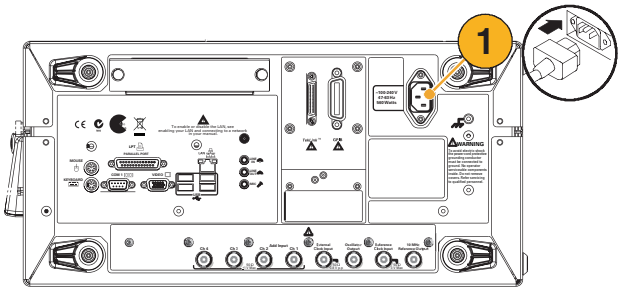
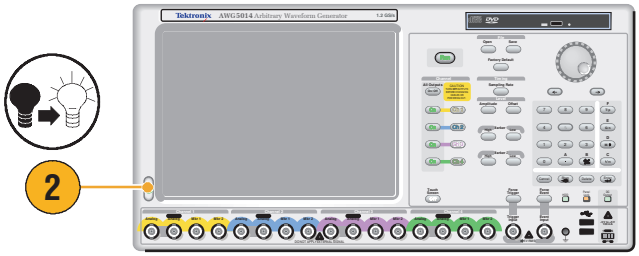
Powering On the Instrument

1. Connect the AC power cord to the rear of the instrument.



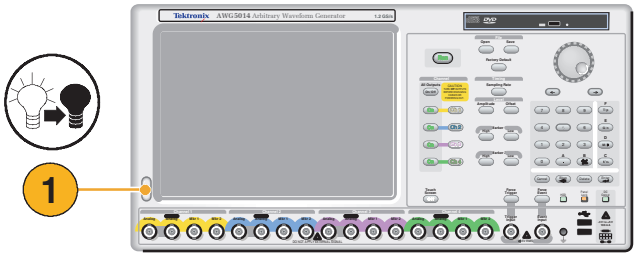
2. Use the front-panel power button to switch the instrument on.



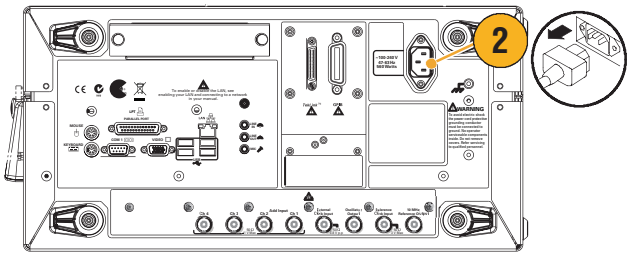
Powering Off the Instrument

1. Use the front-panel power button to start the shutdown process.

   Wait approximately 30 seconds for the instrument to power off.



2. To completely remove power to the instrument, perform the shutdown just described, and then remove the power cord from the instrument.



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Windows Interface Guidelines

Because the instrument uses the Microsoft Windows interface, you have open access to the Windows operating system. You can access the Windows desktop to load and run other Windows-based applications such as Microsoft Excel, WordPad, and Paint.

Although you have access to the Windows interface, you should avoid making operating system changes that may cause problems or annoyances while trying to use the instrument. Here are some guidelines:

- Be careful when making changes in the Control Panel. Avoid making changes to any controls with which you are unfamiliar.
- Do not delete or change any system fonts. Changing or removing fonts may affect the quality of the display.
- Avoid changing the system Display Properties, such as the Background, Appearance, Effects, or Settings. Making such changes can affect the usability of the instrument and the touch screen.
- Avoid making changes to the contents of the Windows folder or to the contents of the Program Files\Tektronix\AWG\ System folder.
- Avoid making changes to the BIOS settings. Changing the BIOS settings can affect the overall operation of the instrument.

If you think that your Windows interface may cause problems with the instrument, contact your local Tektronix support center for assistance.

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Connecting to a Network

You can connect your instrument to a network for printing, file sharing, internet access, and other functions. Consult with your network administrator and use the standard Windows utilities to configure the instrument for your network.

For setting GPIB or LAN configuration, use the GPIB/LAN Configuration dialog box from System menu. See page 68.

Controlling the instrument using a remote PC

You can use your PC to control the arbitrary waveform generator through a LAN using the Windows Remote Desktop function. If your PC has a larger screen, you can edit waveforms easily using your keyboard and mouse. You can also use a third party software installed on your PC to create a waveform and import it through a network.

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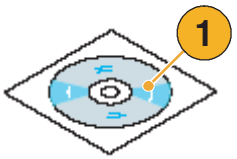
Offline Mode

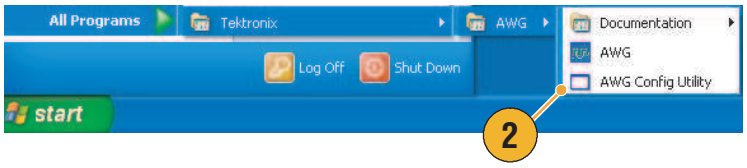
The Offline Mode is a function that you can use to run the instrument application on your PC. Install the application on your PC; the instrument hardware is not required. You can create and edit the instrument setups. The setup files that you create can be used later with your arbitrary waveform generator.

1. Use the Product Software CD provided with the instrument to install the AWG5000 series application to your PC.



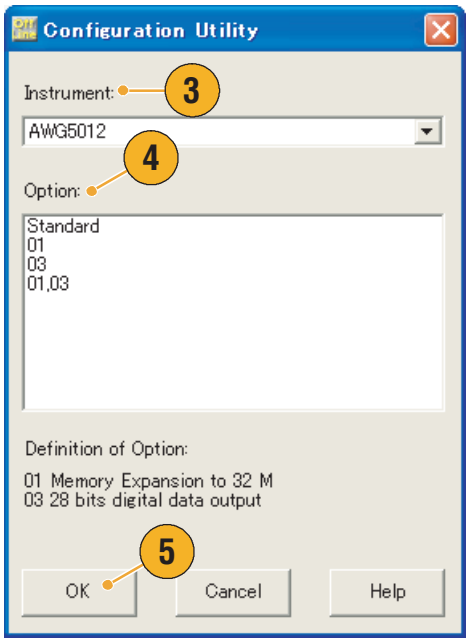
2. Before using the offline mode, you must set up the instrument configuration.

   From the Windows Start menu, select **All Programs** > **Tektronix** > **AWG** > **Config Utility**. The Configuration Utility dialog box appears.



3. Select your instrument type.
4. Select your instrument option configuration.
5. Click **OK**.

   Run the instrument application from the Start menu. The setup configuration you have made using the Configuration Utility will be reflected in the application.



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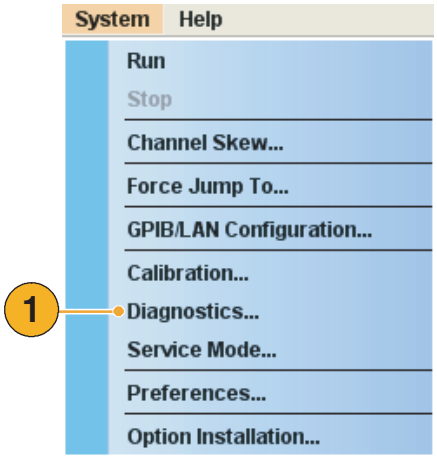
Inspect Your Instrument

Two types of diagnostics are provided to verify the functionality of your instrument:

- Power-on self test – Every time you power on the instrument, the instrument automatically performs the internal diagnostics.
- Diagnostics from the System menu – You can also run the internal diagnostics using the System menu. Use the following procedures:

1. Select **System** > **Diagnostics...** from the menu bar.

   The Diagnostics dialog box appears.



2. Confirm that the **Loop** box is not checked.

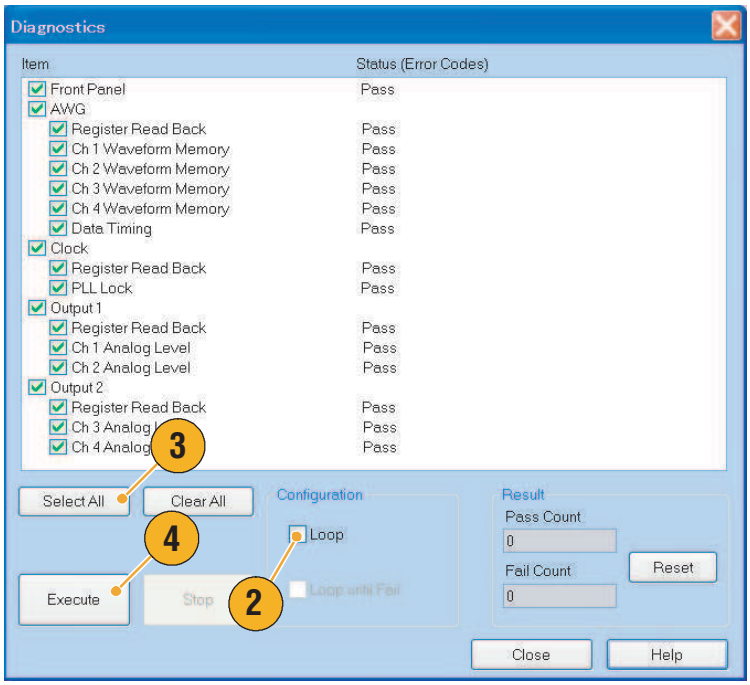
   If Loop is checked, the diagnostics runs until it is manually stopped.

3. If you click **Select All**, all diagnostic items are checked.

   You can execute all items together or you can execute only the selected item(s).

4. Click **Execute** to start the diagnostics.

   Verify that the instrument passes all tests. If diagnostic failures occur, contact your local Tektronix service personnel.



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Self Calibration

The self calibration uses internal calibration routines that check electrical characteristics such as analog level accuracy, and then adjust the internal calibration constants as necessary.

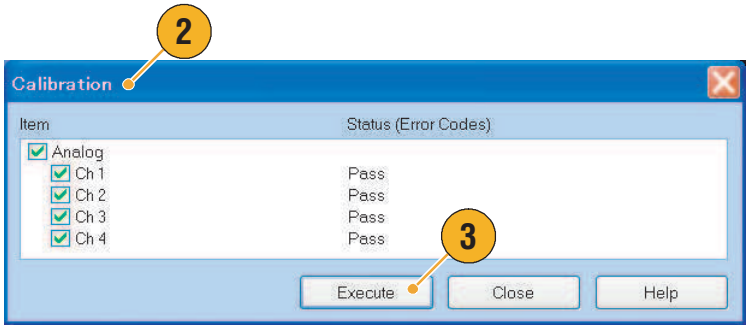
NOTE. *Power on the instrument and allow a 20 minute warm-up period before performing this procedure.*

1. Confirm that there is no output signal by verifying that the front-panel **Run** button indicator is off.

2. To perform the calibration suite, select **System** > **Calibration...** from the menu bar.

   The Calibration dialog box appears.

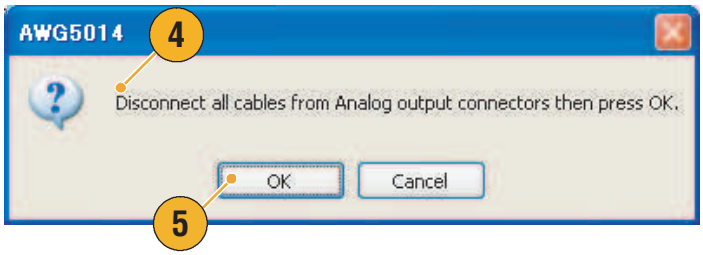
3. Select **Execute**.



4. A pop-up message asks you to remove all the cables from the Analog output connectors.

5. Remove the cables and then select **OK**. Wait until the calibration completes.

   For all calibration items, the Status control should indicate Pass. If it does not, contact your local Tektronix service personnel.



NOTE. *Self calibration is not valid until the instrument reaches a valid temperature. See page 2 for operating requirements.*

NOTE. *Perform self calibration once a year to maintain the analog output level accuracy.*

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Preventing Instrument Damage

Overheat Protection

The internal instrument temperature is monitored and the instrument is protected against overheating damage by the following actions:

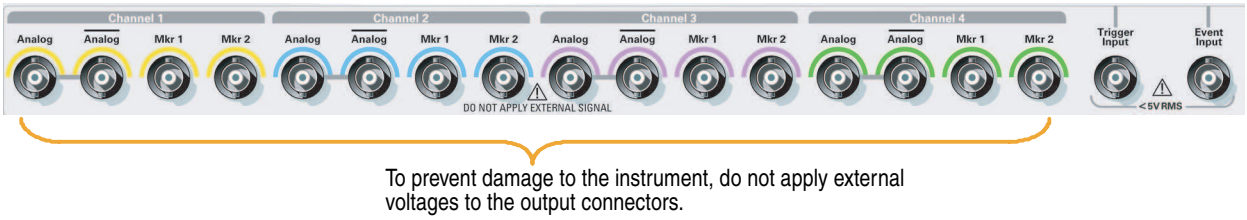
- A warning message will appear if the internal temperature reaches the first threshold level.
- The instrument will shut down if its temperature reaches the second threshold level.

If the warning message appears or the instrument shuts down, check for the following conditions (see page 2 for operating requirements):

- The ambient temperature requirement is not being met.
- The required cooling clearance is not being met.
- The instrument fan is not working properly.

Output Connectors

The arbitrary waveform generator has both output and input connectors on the front panel. Do not apply external voltage to the output connectors.



To prevent damage to the instrument, do not apply external voltages to the output connectors.

CAUTION. *Always turn off the signal outputs when you connect or disconnect cables to/from the signal outputs connectors. If you connect a DUT while the instrument signal outputs are in the On state, it may cause damage to the instrument or DUT.*

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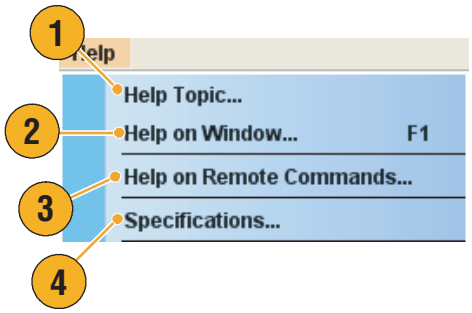
Accessing Online Help

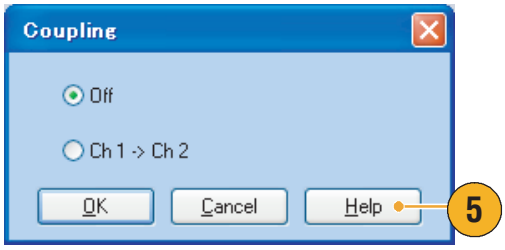
The arbitrary waveform generator provides two types of online help:

- User online help – In-depth information is available in the online help on all the features of your instrument.
- Programmer online help – The instrument offers programmer online help about remote commands.

To access the Help system, select **Help** from the menu bar.



1. To access the user online help, select **Help** > **Help Topic...**.
2. To use context-sensitive help on the current setup, select **Help** > **Help on Window...** or press **F1**.
3. To access Programmer Online Help, select **Help** > **Help on Remote Commands...**.
4. To access specifications and performance verification, select **Specifications...** to open the PDF Technical Reference Manual.
5. Most dialog boxes have a **Help** button. For contextual overviews of the dialog box, click the button to open the help system with an overview of the dialog box that is currently displayed.



Quick Tips

- You can select English or Japanese for the user online help. By default, English is selected. To change the language, use the **System** menu > **Preferences** dialog box. See page 69.

NOTE. *When you first open the Japanese user online help, a pop-up message is displayed to prompt you to install the Japanese language pack. Click* ***Install*** *to install the language pack.*

- The programmer online help is displayed only in English.

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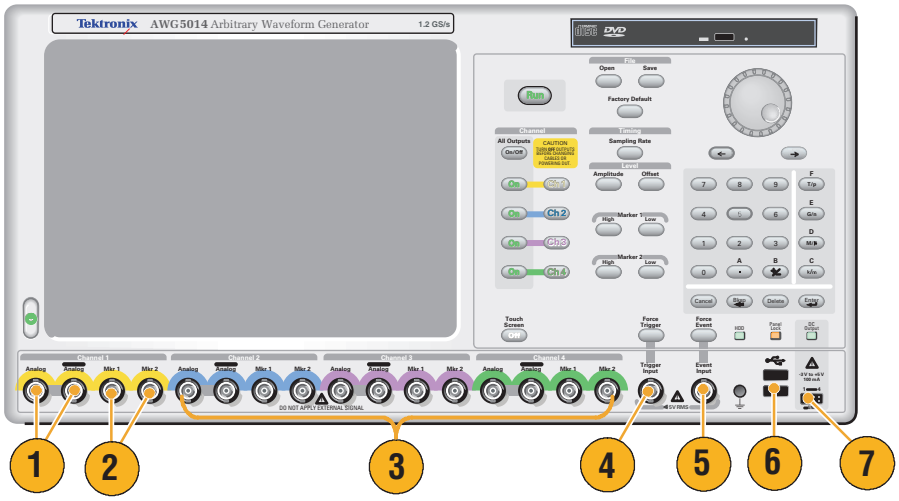
Front Panel

The following figure shows the front panel of the AWG5014:



Front Panel Connectors

Connector	Description
1. Ch 1 Analog Output	These connectors supply analog signals. Connector type: BNC
2. Ch 1 Marker Output	These connectors supply marker 1 and marker 2 signals. Connector type: BNC
3. Ch 2 to Ch 4 connectors	Analog and marker output connectors for Ch 2 to Ch 4.
4. Trigger Input	External trigger signal is applied to this connector. Connector type: BNC
5. Event Input	Event signal is applied to this connector. Connector type: BNC
6. USB	Two USB connectors are present on the front panel. Connect a USB device.
7. DC Output	This connector supplies four lines of DC voltage. Connector type: 2.54 mm 2 x 4 pin header (female)

CAUTION. *Always turn off the signal outputs when you connect or disconnect cables to/from the signal outputs connectors. If you connect a DUT while the instrument signal outputs are in the On state, it may cause damage to the instrument or DUT.*

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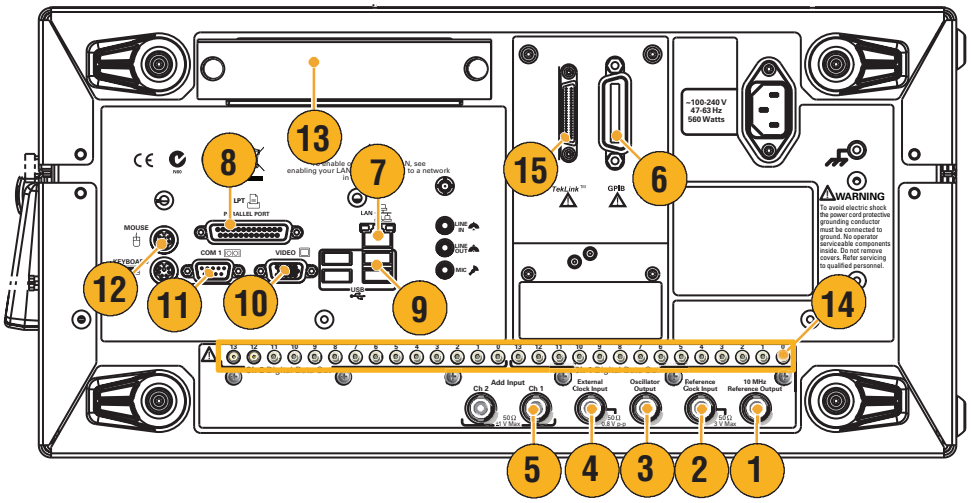
Rear Panel



Rear Panel Connectors

Connector	Description
1. 10 MHz Reference Output	Output connector for 10 MHz reference clock signal Connector Type: BNC
2. Reference Clock Input	Input connector for external reference clock Connector Type: BNC
3. Oscillator Output	Output connector for internal oscillator Connector Type: BNC
4. External Clock Input	Input connector for oscillator input Connector Type: BNC
5. Add Input	Add external signal to the output signal of arbitrary waveform generator Connector Type: BNC
6. GPIB	Use the GPIB connector to connect the instrument to a GPIB controller for GPIB operation.
7. LAN	Use the RJ-45 connector to connect the instrument to a network.
8. Parallel Port	Use the parallel port (Centronics) to connect a printer or other device.
9. USB	Use the USB connectors to connect a USB mouse, keyboard, or other USB device to the instrument.
10. Video	Use the Video port to connect a monitor for extended desktop operation.
11. COM1	Use the COM1 serial port to connect to other devices through the serial port.
12. PS-2 connector	Use the PS-2 connectors to connect a PS-2 keyboard or mouse to the instrument.
13. Removable HDD	Removable hard disk drive to secure data
14. Digital Data Out	Use these connectors to output digital data. To enable digital data output, option 03 must be installed in the AWG5002 or AWG5012. Connector Type: SMB
15. This connector is not supported.	

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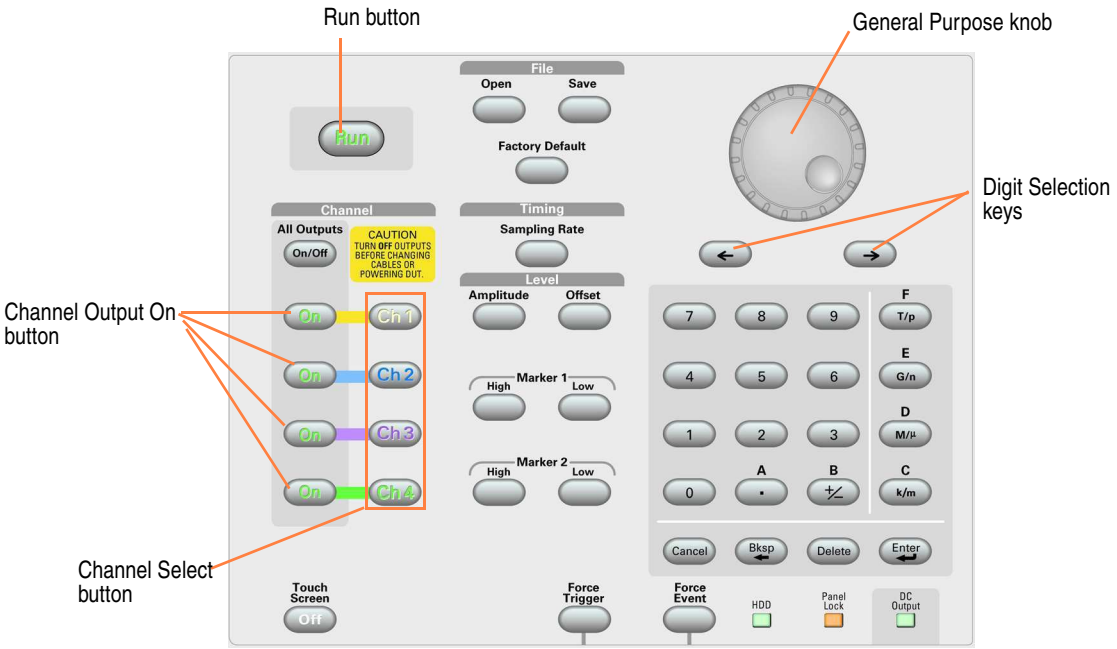
Control Panel

The following figure shows the front panel controls of a four channel model:



Run. The Run button is used to start and stop the signal generation. If the signal is being generated, the LED indicator lights up. To output the signal through the output connectors, you must push the front-panel All Outputs On/Off button or the Channel Output On button.

Touch Screen Off. When the Touch Screen is on, you can use your finger or stylus to control the screen interface. The LED is lit while the Touch Screen interface is disabled.

File Open/Save. When the Open or Save button is pushed, the corresponding dialog box is displayed. You can load or save a setup (*.AWG) file using this dialog box.

Factory Default. When this button is pushed, the specified default setups are recalled. See page 32 for details on default setups.

Timing – Sampling Rate. When you push this button, the sampling rate parameter in the Settings window is selected. Sampling Rate is common to each channel. See page 26 for Settings window.

Channel Select. These buttons are used to select a channel that you want to interact with. If a channel select button on the front panel is pushed, the selected channel page in the Settings Window will be activated.

Channel Output On. These buttons are used to enable/disable the channel output. If the output is in the On state, the LED is turned on.

CAUTION. *Do not connect a DUT (Device Under Test) to the front-panel signal output connectors when the instrument signal outputs are on.*

Do not power on or off the DUT when the arbitrary waveform generator signal outputs are on.

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All Outputs On/Off. If one or more Outputs are on, they will all be turned off when you push the All Outputs On/Off button. If all Outputs are off, they will all be turned on when you push the All Outputs On/Off button.

Amplitude. When you push this button, the amplitude parameter of the corresponding channel in the Settings window is selected. Amplitude is independent for each channel.

Offset. When you push this button, the offset parameter of the corresponding channel in the Settings window is selected. Offset is independent for each channel.

Marker 1 and Marker 2 – High/Low. When you push one of these buttons, the Marker High or Marker Low parameter of the corresponding channel in the Settings window is selected. Marker High and Marker Low are independent for each channel.

Force Trigger. When you push this button, the instrument generates an internal trigger signal.

Force Event. When you push this button, the instrument generates an internal event signal.

General Purpose Knob. The knob is used to increase or decrease a set value or select an item from a pop-up menu, pull-down menu or dialog box. Turn the knob clockwise to increase the value, and turn the knob counterclockwise to decrease the value.

Digit Select Arrow Keys. The digit select arrow keys are used to move the under bar (cursor) to a field that contains an editable number. After you specify the digit, you can change the number with the knob.

Numeric Keypad. Units prefix buttons (T/p, G/n, M/μ, and k/m) are used to complete an input with the numeric keypad. You can determine the units by pushing one of these prefix buttons without pressing the Enter key.

If you push the units prefix buttons for frequency, the units are interpreted as T (tera-), G (giga-), M (mega-), or k (kiro-). If you push the buttons for time, the units are interpreted as p (pico-), n (nano-), μ (micro-), or m (milli-).

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To Lock/Unlock the Front Panel Controls

The front panel may be locked by a remote user while the arbitrary waveform generator is being remotely controlled via GPIB or Ethernet. When the front panel is locked, all keys and buttons are disabled except the power switch. You cannot use your mouse or keyboard. However, the Windows operations are available even if the instrument front panel is locked.

To unlock the front-panel controls, use a remote command or push the front-panel **Cancel** button twice. If you exit the application, the lock state is cleared. When you restart the application, the front-panel controls are unlocked.

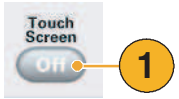
Touch Screen Interface

The arbitrary waveform generator offers two methods of making menu selections:

- Front-panel controls, keyboard, and mouse (keyboard and mouse are standard accessories)
- Front-panel controls and touch screen interface

1. You can enable or disable the touch screen interface by pushing the front-panel Touch Screen button.

   To disable the touch screen, push the front-panel Touch Screen button. When the touch screen is in the Off state, the LED is lighted. You can still access the on-screen menus with a mouse or keyboard.



NOTE. *You need to adjust the touch screen when one of the following occurs:*

- The operating system is restored
- The hard disk drive is exchanged
- The touch screen is not responding correctly

Run the touch screen program from the shortcut on the Windows desktop to adjust the touch screen.

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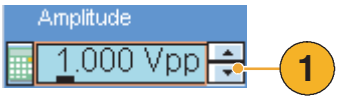
Changing Control Settings

As you configure the instrument, you may need to set a numerical parameter such as an amplitude level or offset. To set these parameters in a screen window, touch or click the parameter to select it. Once the parameter is selected, the general purpose knob is assigned to the parameter.

You can use the general purpose knob to change parameters, although the following methods are generally available.

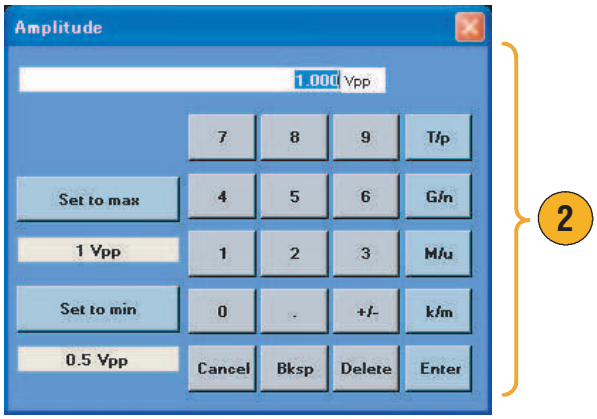
1. Some parameters have increase/decrease buttons. These buttons are also called spin buttons. Touch or click the spin buttons to change to the next available value.

   To move the underbar to a field that contains an editable number, use the digit select arrow keys (see page 14).



2. Some parameters supply a pop-up keypad or keyboard that you can use to enter a new value.

   Touch or click the keypad (or keyboard) icon to display the keypad (or keyboard).



Quick Tip

- The pop-up keyboard and keypad are also called soft keyboard and soft keypad, respectively.

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Run State Control and Output On/Off

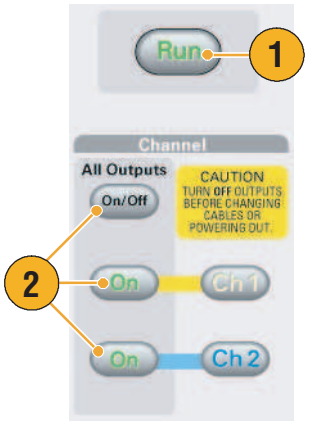
Do the following steps to control the start and stop of signal generation for the arbitrary waveform generator.

1. Use the front-panel **Run** button to start and stop the signal generation.

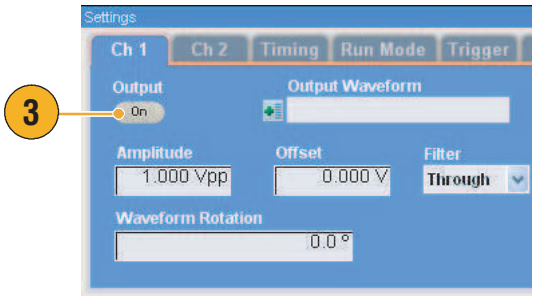
   Switching signal generation on or off is called Run State control.

   If the signal is being generated, the LED indicator lights up.

2. To output the signal through the output connectors, push the front-panel **All Outputs On/Off** button or the Channel Output **On** button.



3. Alternatively, you can use the Ch n (Channel) tab on the Settings window to enable the signal output. See page 26 for *Settings Window*.



Quick Tips

- You can turn each channel's output on/off independently.
- Analog output and marker output are enabled or disabled simultaneously.

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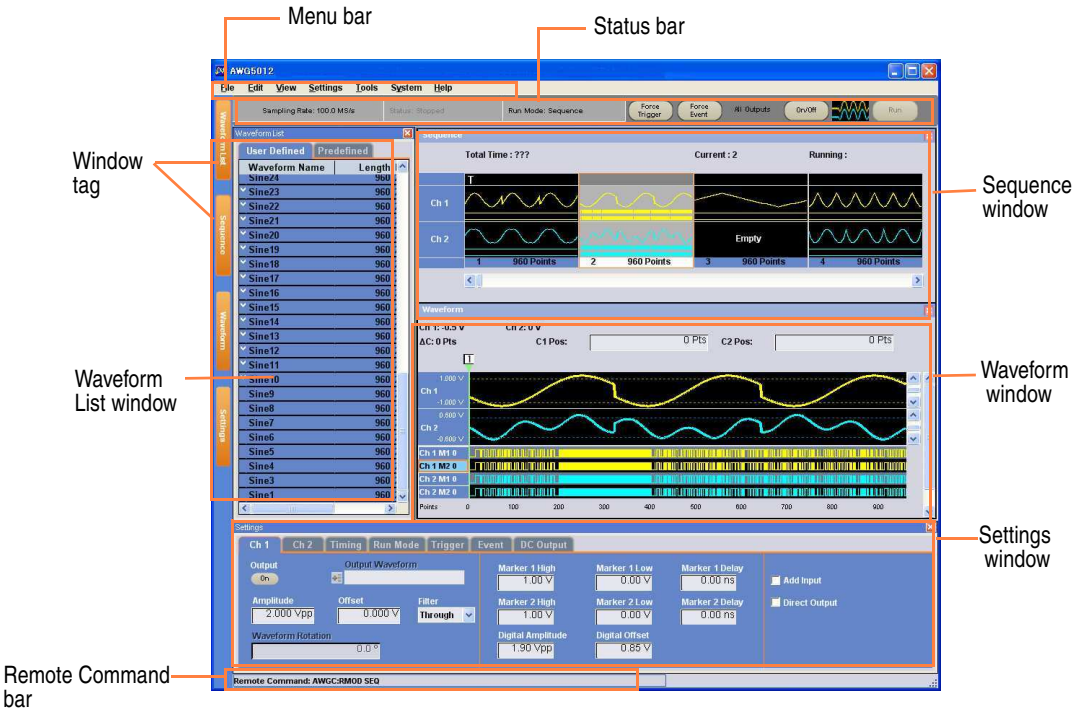
Interface and Display

The screen interface gives you access to the complete functionality of the instrument. This user interface is built on the Windows operating system.

Screen Interface



Menu Bar. The menu bar provides access to all of the instrument functions. When you select a menu item, the instrument displays the associated control window (dialog box) or the menu selection causes an immediate action.

Status Bar. The status bar, located below the menu bar, shows information about the instrument, such as sampling rate, run mode status, or output status.

Waveform List Window. User-defined waveforms and predefined waveforms are listed in this window.

Sequence Window. This window mainly provides information on output sequence.

Waveform Window. This window displays the waveform that you selected in the Waveform List or in the Sequence window.

Settings Window. This window is provided for quick access to the parameter settings.

Window Tag. Click these tags to toggle display of corresponding windows on or off.

Remote Command Bar. In this area, a remote command corresponding to current instrument operation is displayed.

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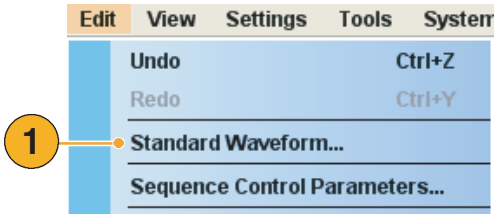
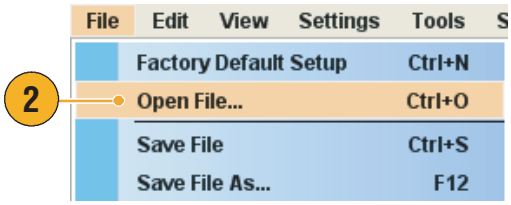
Basic Steps for Using the Arbitrary Waveform Generator

After you have powered on the instrument, use the application's menu bar or control windows to create and edit a waveform. For accessing menus and control windows, see page 20. Do the following steps to output a waveform or a sequence:

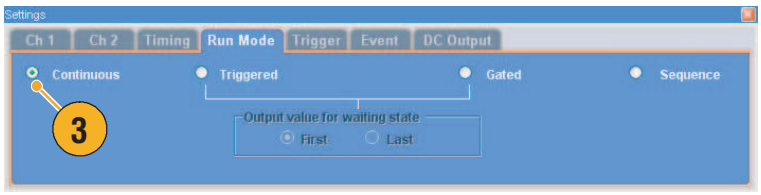
1. To create a new waveform, select **Edit** > **Standard Waveform...**. The created waveform is displayed in the Waveform List window.



2. To use an existing waveform, select **File** > **Open File...** to open a setup file, and then select a waveform in the Waveform List window.

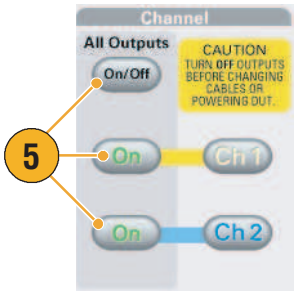


3. Confirm the Run mode. Check that the desired run mode is selected on the Run Mode tab of the Settings window.



4. To generate a signal, push the front-panel Run button or the Run button on the Status Bar.

5. Use one of the following methods to set the channel output On:
   - Front-panel Channel Output On button or All Outputs On/Off button
   - Output On button of the Ch page of Settings window



Quick Tips

- The arbitrary waveform generator supports four types of Run mode. When Run mode is set to Continuous, Triggered, or Gated, the state is called non-sequence mode.
- You can select one waveform as an output for each channel in the non-sequence mode.

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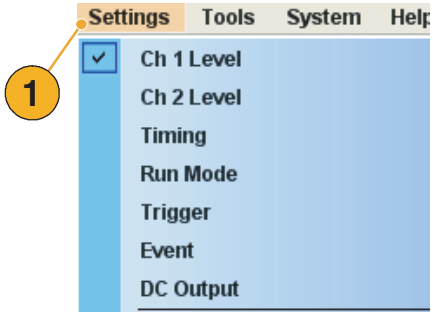
Accessing Menus and Control Windows

You can access menu commands and control windows using the following techniques:

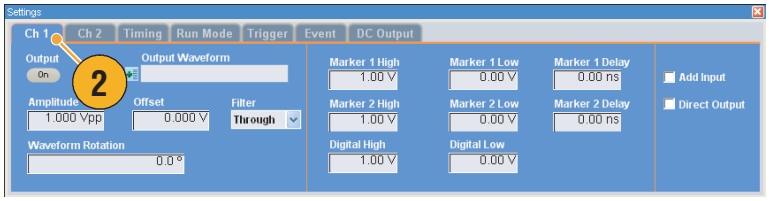
1. Click **Settings** from the menu bar, and then select a command.

   The selected item in the Settings window will become active.



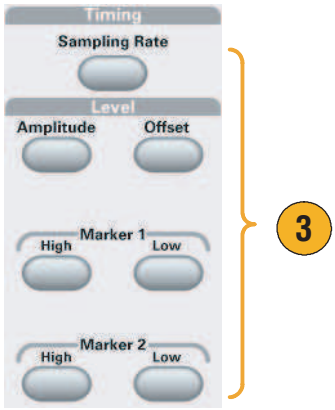
2. For a shortcut to settings menus, you can use the Settings window.

   Clicking a tab, such as Ch 1 or Timing, on the Settings window opens the corresponding page that you can use to select the instrument settings.



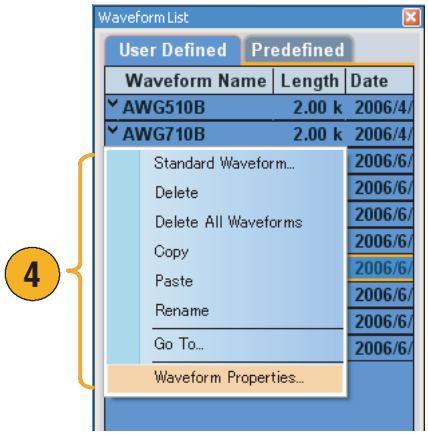
3. From the front panel, you can quickly access the parameters for sampling rate, amplitude level, offset level, and marker level.

   If you push one of these buttons, the corresponding parameter in the Settings window will be selected.



4. You can right-click the mouse to gain quick access to associated menu commands.

   For example, right-click on the Waveform List window to display the related Edit menu commands.



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Display/Hide Control Windows

The arbitrary waveform generator displays four control windows by default. You can quickly hide or display each window using the window tag.

1. By default, four windows are displayed if the Run mode is Sequence.

2. Click the Waveform List tag.
3. The Waveform List window is hidden.

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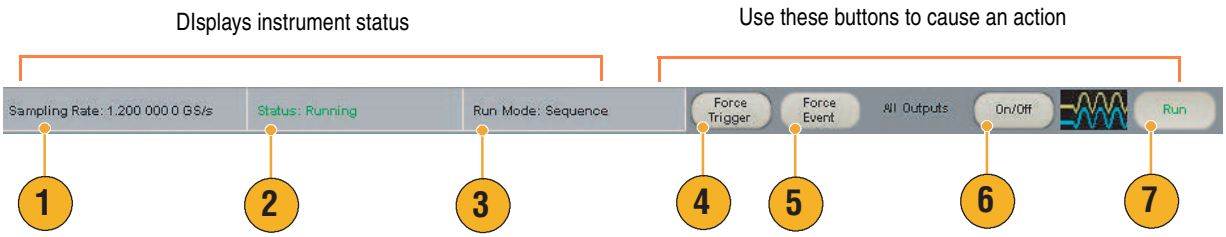
Status Bar

Status Bar has two functions. It displays the current status of the instrument, such as Sampling Rate, Run State, and Run Mode. It also has action buttons, such as Force Trigger, Force Event, All Outputs On/Off, and Run.



1. Sampling Rate	Current sampling rate setting is displayed.
2. Run Status	Current instrument status (Running or Stopped) is displayed.
3. Run Mode	Current Run Mode (see page 29) is displayed.
4. Force Trigger button	Same function as the front-panel Force Trigger button.
5. Force Event button	Same function as the front-panel Force Event button.
6. All Outputs On/Off button	Same function as the front-panel All Outputs On/Off button.
7. Run button	Same function as the front-panel Run button.

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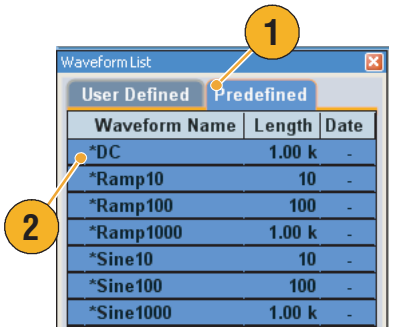
Waveform List Window

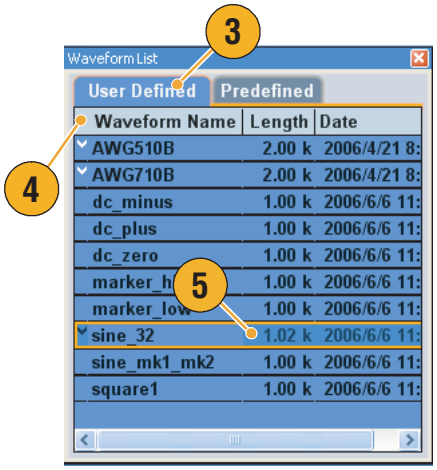
The Waveform List window lists the waveforms that are saved in the setup files (*.AWG). The instrument provides two types of waveform list (predefined and user-defined).

1. To select a predefined waveform, click the **Predefined** tab.
2. Predefined waveforms have an asterisk sign (*) to the left of the waveform name.

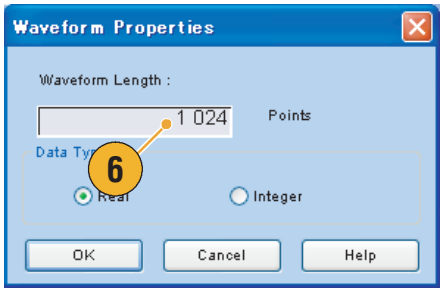
***Note**: You cannot modify, delete, or rename the predefined waveforms.*



3. To select a user-defined waveform, click the **User Defined** tab.
4. You can sort the waveform list by the order of Waveform Name, Length, or Date.
5. Each waveform length is displayed as a three-digit number in the Waveform List window.



6. If you want to know the exact waveform length, select the waveform and then right-click to display the pop-up menu. Select **Waveform Properties...** to display the Waveform Properties dialog box. You can confirm the waveform length with this dialog box.



Quick Tips

- If you right-click on this window, a pop-up menu is displayed. You can access the Edit commands, such as Delete, Copy, and Paste.
- When you create a waveform, you cannot use the same name as a predefined waveform.

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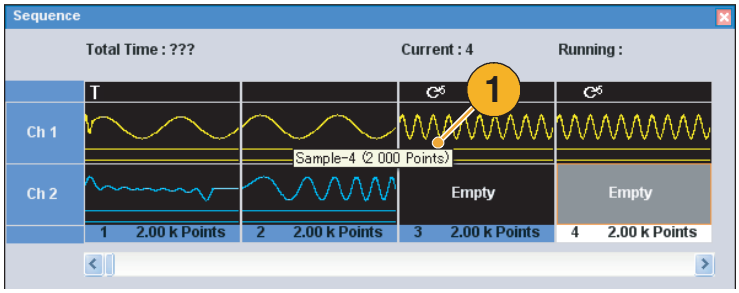
Sequence Window

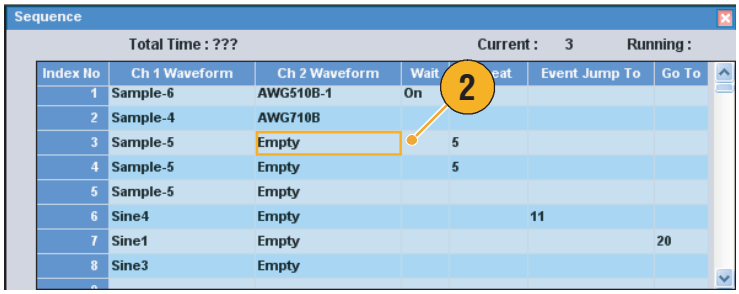
When Sequence is selected in the Run Mode, this window shows information on the status of the sequence settings. For Run Mode, see page 29.

1. This is an example of the Sequence window display. The display format is Thumbnail.

   If you hover the mouse over a sequence cell, a tooltip appears to show you the waveform name and waveform length.



2. This is an example of the Table format.



Quick Tips

- If you click on a cell in the Sequence window, the selected waveform is displayed in the Waveform window. The background color of the selected cell changes.
- The following methods are available for applying an existing waveform to a sequence:
  - Drag a waveform from the Waveform List window to a cell of the Sequence window
  - After selecting a cell in the Sequence window, use Set Waveform... or Insert Waveform... from the Edit menu
- When Continuous, Triggered, or Gated is selected in the Run mode, the Sequence window is hidden.
- The following icons are used in the Sequence window:

Display Icons	Description
T	Wait Trigger
C 26	Repeat. (Repeat count is set to 26 in this example.)
∞	Repeat (Infinite)
E 26	Event Jump. (Jump target is set to index number 26 in this example.)
26	Go To (Go To target is set to index number 26 in this example.)

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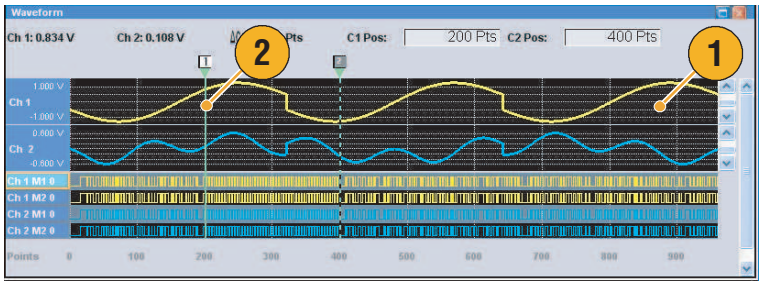
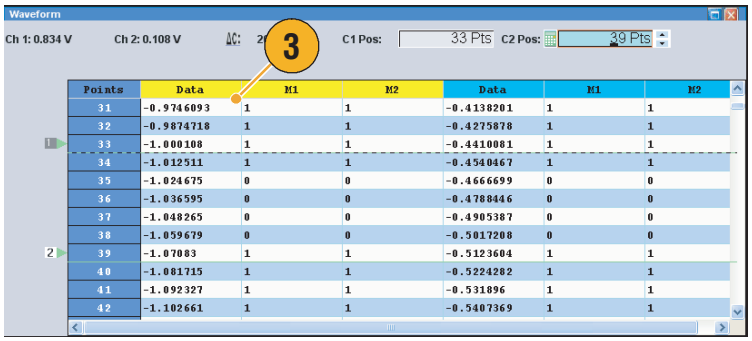
Waveform Window

A selected element in the Sequence window or a selected waveform on the Ch n page of the Settings window is displayed in the Waveform window.

1. This is an example of Graphic display format. Analog data and markers for Ch1 and Ch 2 are displayed.
2. You can edit the waveform data between two cursors.



3. This is an example of Table display format.



Quick Tips

- You can change the display format of the Sequence window or the Waveform window using the **View** menu > **Display Properties** dialog box. You can also access the Display Properties dialog box by right-clicking on the window.
- You can select displayed items in the Waveform window from analog data only, marker data only, or analog and marker data.
- To remove waveform data from the Waveform window, select **Edit** > **Clear** from the menu bar.
- You can select the vertical and horizontal units from the following using the **Display Properties** dialog box.
  - Vertical units – Voltage or Normalized Value
  - Horizontal units – Points or Time

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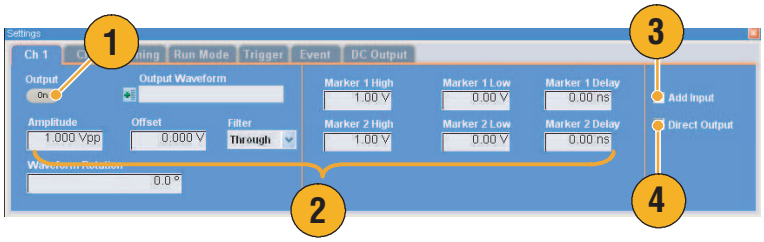
Settings Window

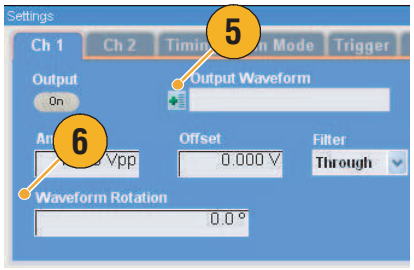
Use the Settings window tabs to quickly access the Level (Ch 1, Ch 2, Ch 3, and Ch 4), Timing, Run Mode, Trigger, Event, or DC Output parameters. You can also use the front-panel buttons for selecting frequently accessed parameters, such as amplitude, offset, marker high/low, or sampling rate. See page 20 for details about accessing menus.

Channel (Ch n) Page

1. To enable a channel output, click the Output **On** button.
2. You can set parameters for amplitude, offset, filter, and marker.
3. You can add an external signal to each channel analog output.
4. Select Direct Output On and Off.



5. When the instrument is in the non-sequence mode, you can select the output waveform data using the Output Waveform field. Click the waveform list icon to display the Waveform List dialog box.
6. You can set phase shift or delay for each analog output signal when the instrument is in the non-sequence mode.



Quick Tips

- Each channel has independent output on/off control. When the output status of Ch n is set to On, both analog output and marker output are enabled.
- When Direct Output is set to On, filter and offset settings become inactive. The analog bandwidth setting range will change.
- You can use Add Input when Direct Output is set to Off. If Direct Output is selected, Add Input is disabled.
- For Waveform Rotation, see page 62.

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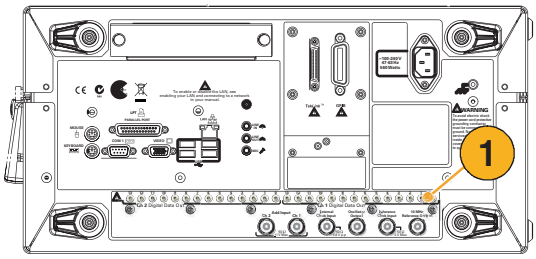
Digital Output

1. The AWG5002/AWG5012 Option 03 supports digital data output.

   The SMB connectors for 14 bit digital data output are present for Ch 1 and Ch 2 on the rear panel.

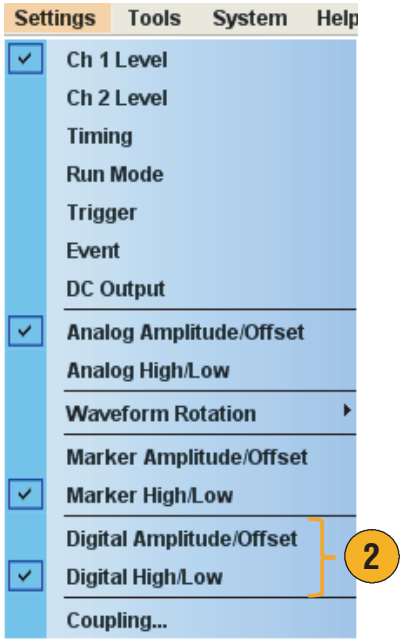


2. You can set the output parameters as follows:

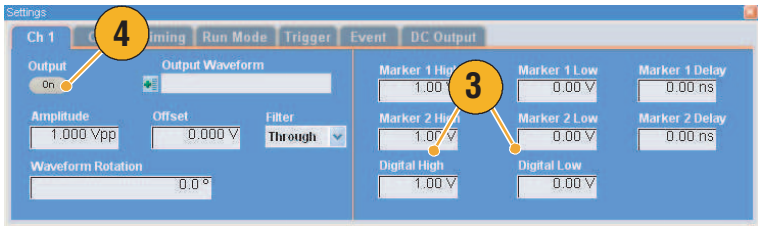
   - Digital Amplitude/Offset
   - Digital High/Low

   The digital output levels are fixed as follows:

   - –1.0 V to +2.7 V, into 50 Ω
   - 0.01 V resolution



3. Digital High/Low is selected in this example.
4. Click the Output **On** button to enable the channel output.



Quick Tip

- Each channel has independent output on/off control. When the output status of Ch n is set to On, both analog output and digital output are enabled.

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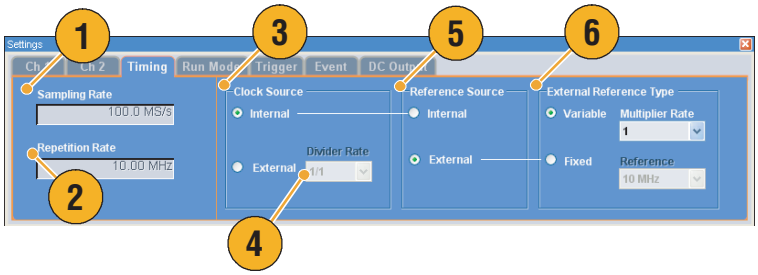
Timing Page



1. Sets Sampling Rate.
2. You can set Repetition Rate when the Run mode is other than Sequence.
3. You can select Clock Source (**Internal** or **External**).
   - If External is selected, the clock signal from External Oscillator Input is used.
   - If Internal is selected, the clock signal is generated internally.
4. Divider Rate can be set when the Clock Source is set to **External**.
5. You can select the Reference Source (**Internal** or **External**).

   Reference Source is selectable only when the Clock Source is set to **Internal**.
6. You can select the External Reference Type (**Variable** or **Fixed**).

   This parameter is selectable only when the Clock Source is set to **Internal** and the Reference Source is set to **External**.

Quick Tips

- The Sampling Rate can be set when the internal clock source is selected and one of the following conditions is met:
  - **Internal** is selected as the reference source.
  - **External** is selected as the reference source and **Fixed** is selected as the external reference type.
- The arbitrary waveform generator accepts a 10 MHz, 20 MHz, or 100 MHz frequency signal as a **Fixed** external reference source.
- You can set the Multiplier Rate when the Clock Source is set to **Internal,** the Reference Source is set to **External**, and the External Reference Type is set to **Variable**.
- Refer to the online help for the range of each parameter in the Timing page.

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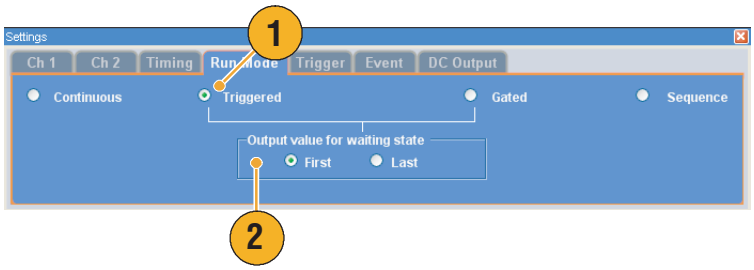
Run Mode Page

1. Select a Run mode.
2. In the Triggered or Gated mode, you can select the output value while the instrument is in the waiting-for-trigger state.
   - First – Sets the output level to the first value of the waveform
   - Last – Sets the output level to the last value of the waveform



Quick Tip

- The arbitrary waveform generator supports the following four run modes:
  - **Continuous** – A continuous waveform is output.
  - **Triggered** – A waveform is output once when the instrument receives a trigger signal. The instrument will wait for the next trigger signal after outputting the waveform.
  - **Gated** – A waveform is output only when a gate signal is asserted. A continuous waveform is output while the gate signal stays asserted.
  - **Sequence** – Multiple waveforms can be output in the order specified in the sequence.

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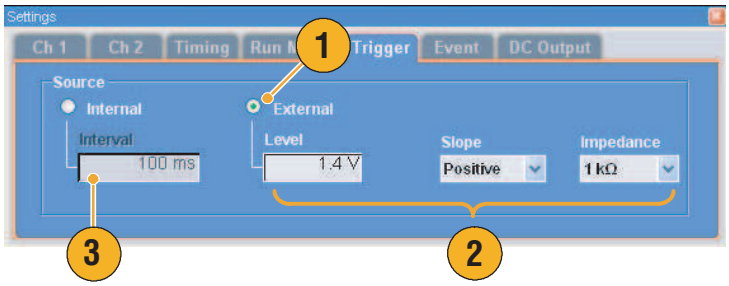
Trigger Page

1. You can select Trigger Source (**Internal** or **External**). The default is External.
2. If **External** is selected, Trigger Level, Trigger Slope, and Trigger Impedance can be set.
   - Level – Sets external trigger level.
   - Slope – Determines whether the instrument finds trigger point on the rising edge or the falling edge of the signal.
   - Impedance – Specifies external trigger impedance (1 kΩ or 50 Ω).
3. If **Internal** is selected, internal trigger Interval can be set.



Quick Tips

- Trigger parameters control the signal outputs of the instrument. Trigger parameters cannot be set if Continuous is selected in the Run Mode.
- You can also control the trigger by pushing the front-panel Force Trigger button in addition to a selected signal as the trigger source.

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Event Page

You can use the Event page when the Run mode is Sequence.

1. Sets external event input threshold level.
2. Selects the polarity of external event input signal (**Positive** or **Negative**).
   - Positive – Jump will occur when the instrument receives a positive pulse.
   - Negative – Jump will occur when the instrument receives a negative pulse.
3. Sets jump timing (**Async** or **Sync**).
   - Async – Jump will occur immediately.
   - Sync – Jump will occur after the waveform is generated.
4. Sets event input impedance (1 kΩ or 50 Ω).

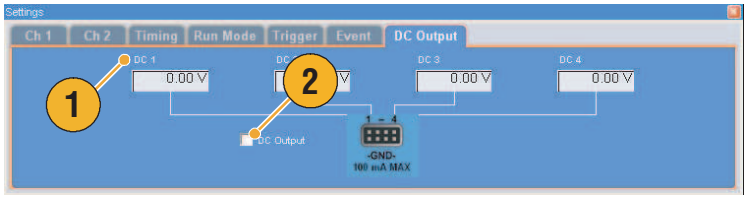
Quick Tips

- Event Jump can change the sequence order using an event signal.
- Jump timing is applied to both Event Jump and Force Jump. See page 67 for jump in sequence.
- You can also use the front-panel **Force Event** button to generate an event signal internally.

DC Output Page

1. The arbitrary waveform generator has four lines of DC output.

   The level of each output can be set independently.
2. The output state (On or Off) of the DC output is common to all DC output channels.



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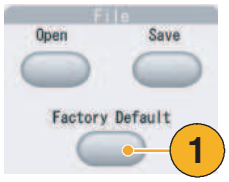
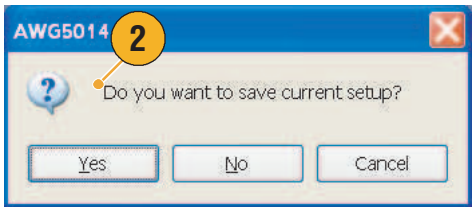
Default Setup

Push the front-panel **Factory Default** button to recall the factory default settings.

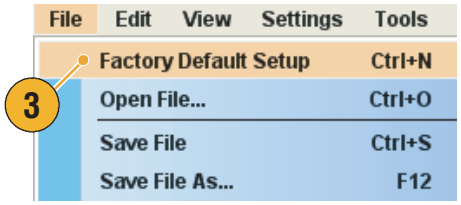
1. To quickly return to the factory default settings, push the front-panel **Factory Default** button.



2. When the instrument setups are modified, a confirmation dialog box appears. Click **Yes** to open a dialog box to save the setups.



3. You can also recall the factory default settings from the File menu.



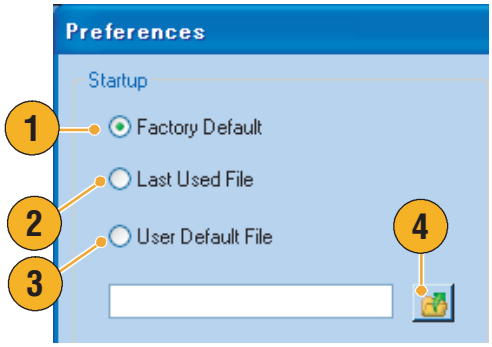
Instrument Settings at Power-on

You can select the instrument settings that are restored when you power on the instrument.

Select **System** > **Preferences...** to display the Preferences dialog box. You can select the power-on setups from the following:

1. Factory Default – The factory default settings are always restored when the instrument is powered on.
2. Last Used File – Restores the setups that were saved or recalled last time.
3. User Default File – A specified setup file is always restored when the instrument is powered on.
4. Click the icon to display a dialog box to select the setup file.

   This icon is enabled when User Default File is selected.



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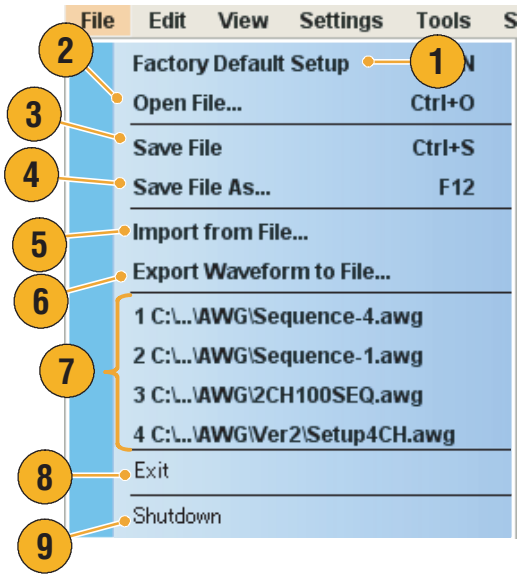
Using the File Menu

Use the File menu for basic file operations such as saving/recalling instrument setups or importing/exporting waveform data. You can also use the File menu for standard Windows operations such as loading the most recent setup files.

The following menu items are provided in the File menu. For a complete description of each menu command, refer to the instrument online help system.

1. Recalls factory default setups. See page 32.
2. Opens a dialog box to load an instrument setup.
3. Saves (Overwrites) an instrument setup.
4. Saves an instrument setup assigning a new setup file name.
5. Use these commands to import waveform data.
6. Exports waveform data to a file for use with other applications.
7. A list of setup files you accessed recently is displayed here.
8. The application closes.
9. The application closes and then the instrument shuts down.



Quick Tip

- You can also shut down the instrument by pushing the front-panel power button (On/Standby switch) while the application is running. When the power button is pushed, a dialog box asks you whether to save current setups. If you select Yes, the current setups are preserved and then the instrument will start the shutdown process.

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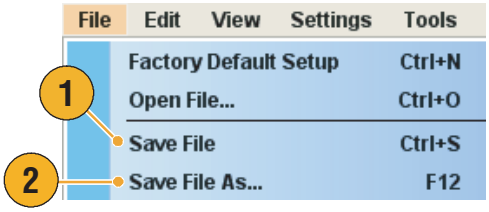
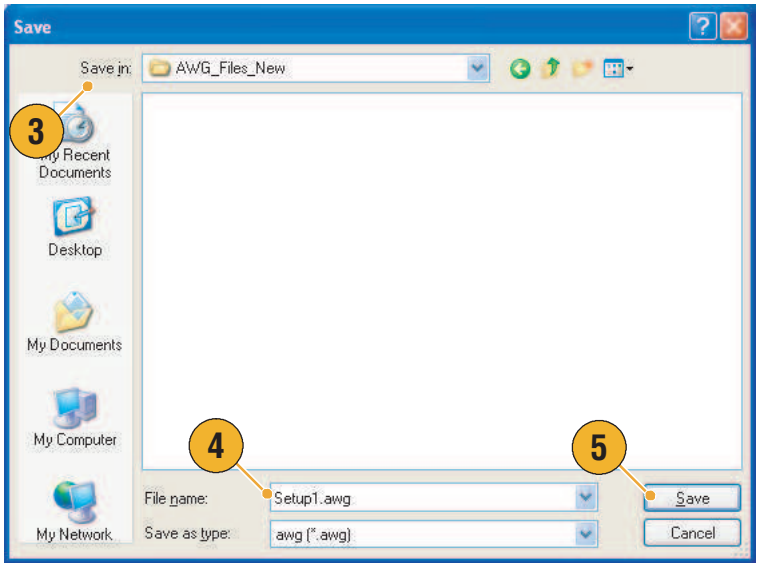
Saving an Instrument Setup

Use the following steps to save an instrument setup:

1. Select **File** > **Save File** to overwrite the existing instrument setup with an updated setup file.
2. To save the current setup to a new setup file, select **File** > **Save File As...** or push the front-panel **Save** button.
3. Select a location where you want to save the setup.
4. Type a file name or use the default name.
5. Click **Save**.





Quick Tips

- If a setup file contains Integer format waveform(s), the file size is reduced. For more information about waveform data format (Real or Integer), refer to the online help.
- To change the waveform format in the Waveform, Waveform List, or Settings window, you can use the Waveform Properties dialog box. See page 56.

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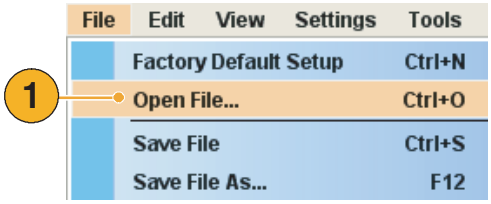
Recalling an Instrument Setup

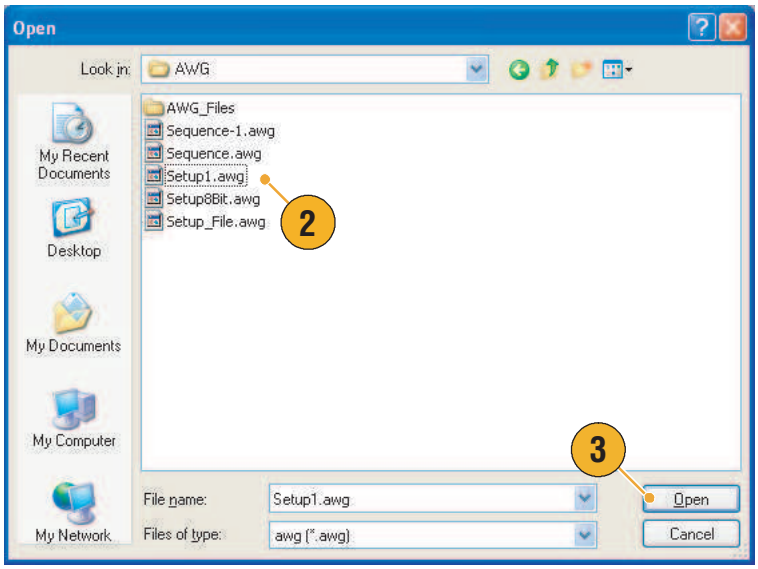
You can recall an instrument setup from the **File** menu or from Windows Explorer.

1. Select **File** > **Open File...** to open the Open File dialog box.

   You can also open the Open File dialog box by pushing the front-panel **Open** button.



2. Select a setup file.
3. Click **Open**.



Quick Tips

- The arbitrary waveform generator uses a setup file that has an extension .AWG. Only .AWG files are displayed on the Open File dialog box by default.
- Once you recall a setup, the instrument retains the setup until you execute **Save File** or **Save File As...**. If you select **Save File** after changing the instrument parameters, the instrument setup file will be automatically overwritten.
- Output status including DC Output becomes Off when a setup file is recalled.

NOTE. *The AWG5000 series and AWG7000 series setup files are compatible each other. However, if the parameter value(s) of an instrument setup file are out of range, a warning message is displayed. In this case, out of range parameter values are set to the default values.*

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Importing Waveform Data

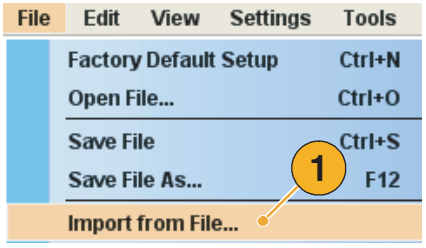
Data import functions allow you to use waveform data created outside the arbitrary waveform generator. You can import data to create a new waveform or to replace existing waveform data.

The arbitrary waveform generator supports the following file formats:

- *.AWG file created by Tektronix AWG5000 series and AWG7000 series
- The following file formats created by Tektronix arbitrary waveform generators such as AWG400/500/600/700 series:
  - *.PAT
  - *.SEQ
  - *.WFM
- *.TFW file created by Tektronix AFG3000 series arbitrary/function generator
- *.DTG file created by Tektronix DTG5000 series data timing generator
- *.WFM or *.ISF file created by Tektronix TDS/DPO series oscilloscope
- Text file (*.TXT)

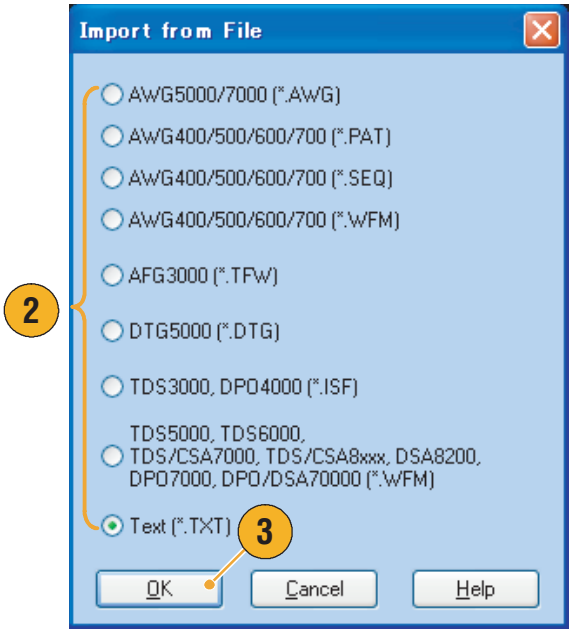
Refer to the online help system for more information about file import.

1. Select **File** > **Import from File...** to display the Import from File dialog box.



2. Select the file format that you want to import.
3. Click **OK**.

   The File Import dialog box, such as shown in step 4, is displayed.



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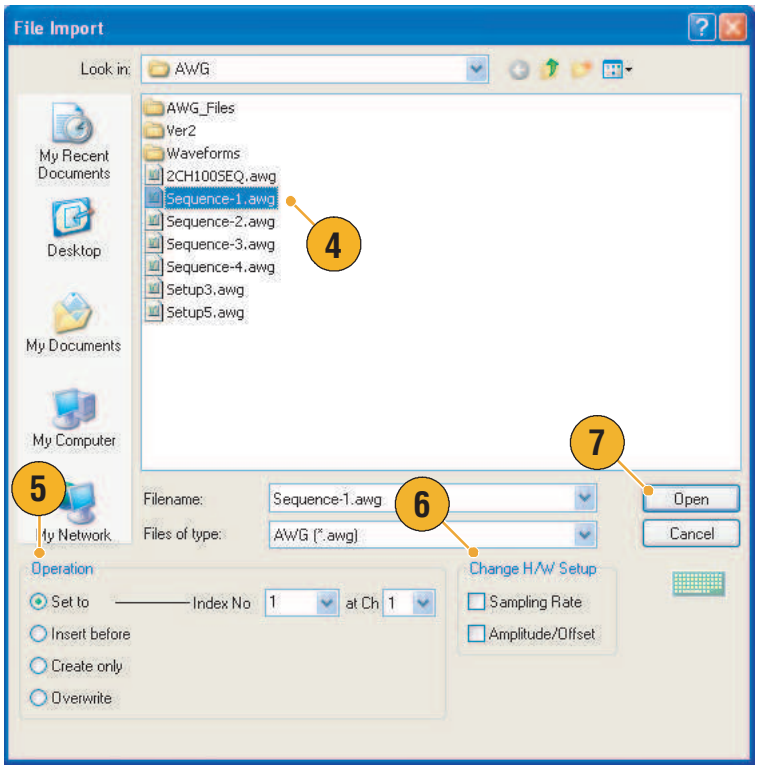
4. Select a file to import.
5. Select an import action in the Operation frame.
   - **Set to**
     Select the channel and index number. The imported waveform data will be assigned to the specified position.
   - **Insert before**
     The imported waveform data will be inserted before the specified cell of the sequence. When the run mode is non-sequence, this parameter is disabled.
   - **Create only**
     The imported waveform will be added to the Waveform List window.
   - **Overwrite**
     Specified existing waveform data is overwritten.
6. If the imported waveform data contains information on sampling rate, amplitude, or offset, you can select the attribute for the waveform using the Change H/W Setup.

   For example, if you check the Sampling Rate check box, the sampling rate will be modified to reproduce the same signal as the imported data.
7. Click **Open**.

   When the import file format is *.AWG, *.DTG, or *.TXT, a corresponding dialog box is displayed.

   When the import file format is other than *.AWG, *.DTG, or *.TXT, the selected file is imported and the waveform name(s) are listed in the Waveform List window.



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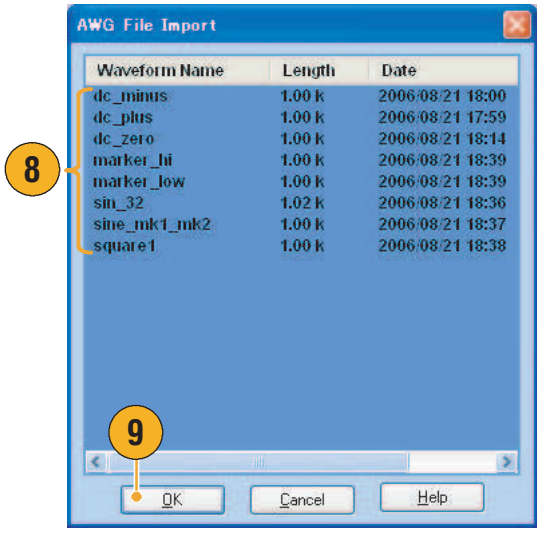
8. If the file format is Tektronix AWG5000 series or AWG7000 series, the AWG File Import dialog box is displayed.

   Select a waveform to import.

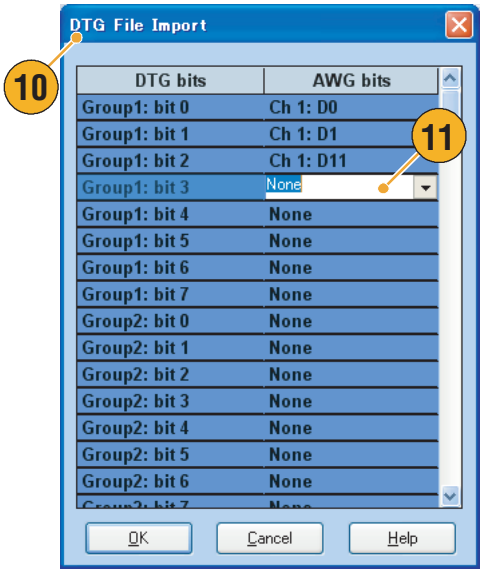
9. Click **OK**. The selected waveform is imported.

   You can select multiple waveforms.



10. If the file format is Tektronix DTG5000 series, the DTG File Import dialog box is displayed.

11. Assign each bit of imported DTG5000 series block data (DTG bits) to AWG bits.



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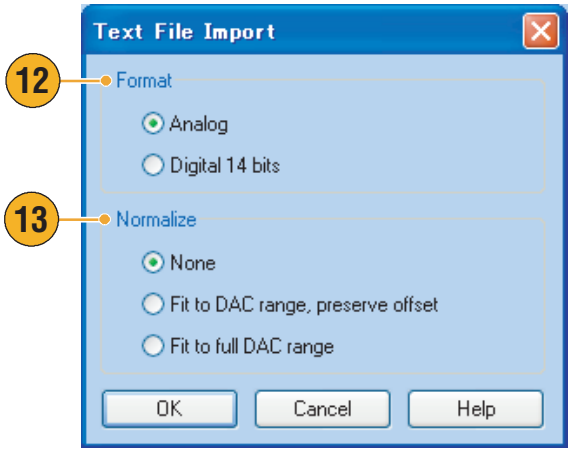
12. If text file format is selected, the Text File Import dialog box is displayed.

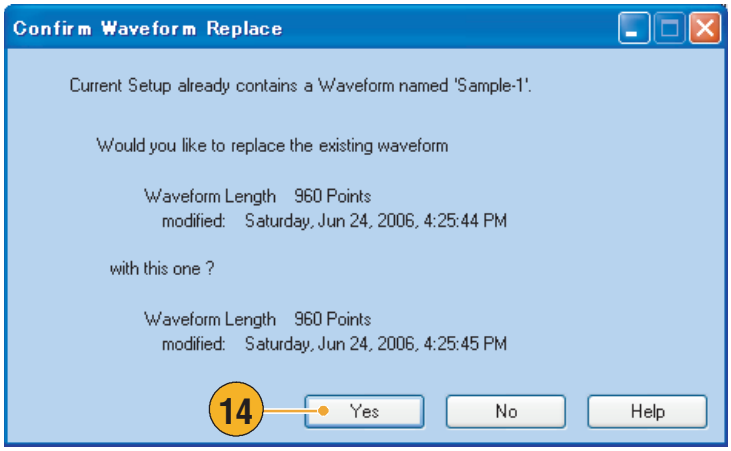
    Select the file format using the Format frame.

13. Select the normalize option using the Normalize frame.

    - **None**
      The waveform data is not normalized.
    - **Fit to DAC Range, Preserve Offset**
      The waveform data is scaled relative to 0 (zero).
    - **Fit to Full DAC Range**
      Minimum value goes to –1.0 in normalized value and the maximum value goes to +1.0 in normalized value.



14. This dialog box is displayed when you execute import and the same name waveforms already exist. Select **Yes** or **Yes to All** if you want to replace the waveform(s).



Quick Tips

- When creating a new waveform, the name of the imported file will be the name of created waveform.
- By executing the file import function, the existing waveform is changed to be the same length as the imported file.

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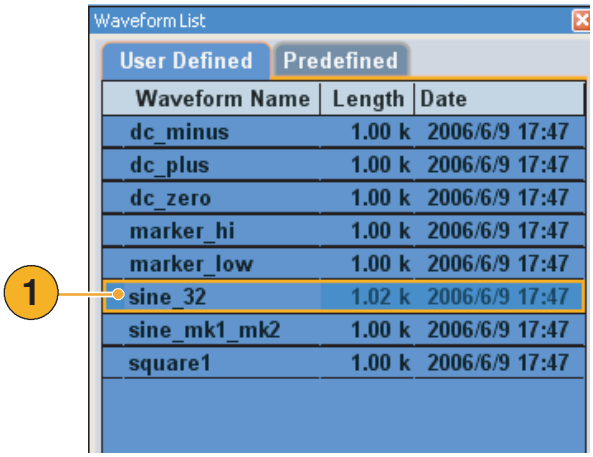
Exporting Waveform Data

The arbitrary waveform generator can export waveform data to a text file for use with other applications.

1. Select the waveform data for export. You can select a waveform from the Waveform List window.

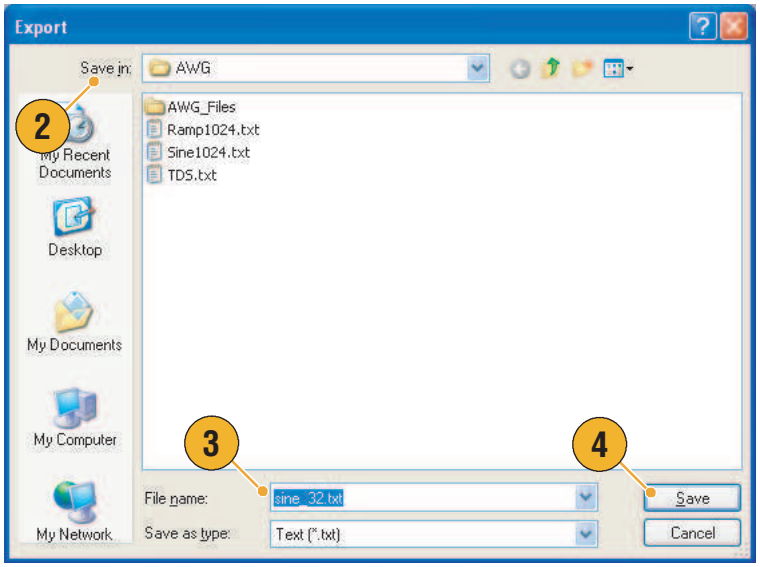


2. Select **File** > **Export Waveform to File...** to open the Export dialog box.

   Select a location to save the waveform data in Save in box.

3. The waveform name you selected in the Waveform List window is displayed.

4. Click **Save**. You can export the selected waveform data as a file format .txt.



Quick Tips

- You can select one of the following file formats for export:
  - Text (*.txt)
  - Text – Digital 14 bits (*.txt)
- In the sequence mode, you can also open the dialog box from the pop-up menu displayed by right-clicking on a cell.

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Using the Edit Menu

Use the **Edit** menu to create a new waveform or modify an existing waveform.

1. Select **Undo** to cancel the last process.

   Undo does not apply to cursor position, zoom, and scroll functions.

2. Select **Redo** to repeat the last process.
3. Opens the Standard Waveform dialog box.
4. Opens the Sequence Control Parameters dialog box.
5. Opens the Cut or Delete dialog box.

   In the sequence, Cut or Delete causes an immediate action.

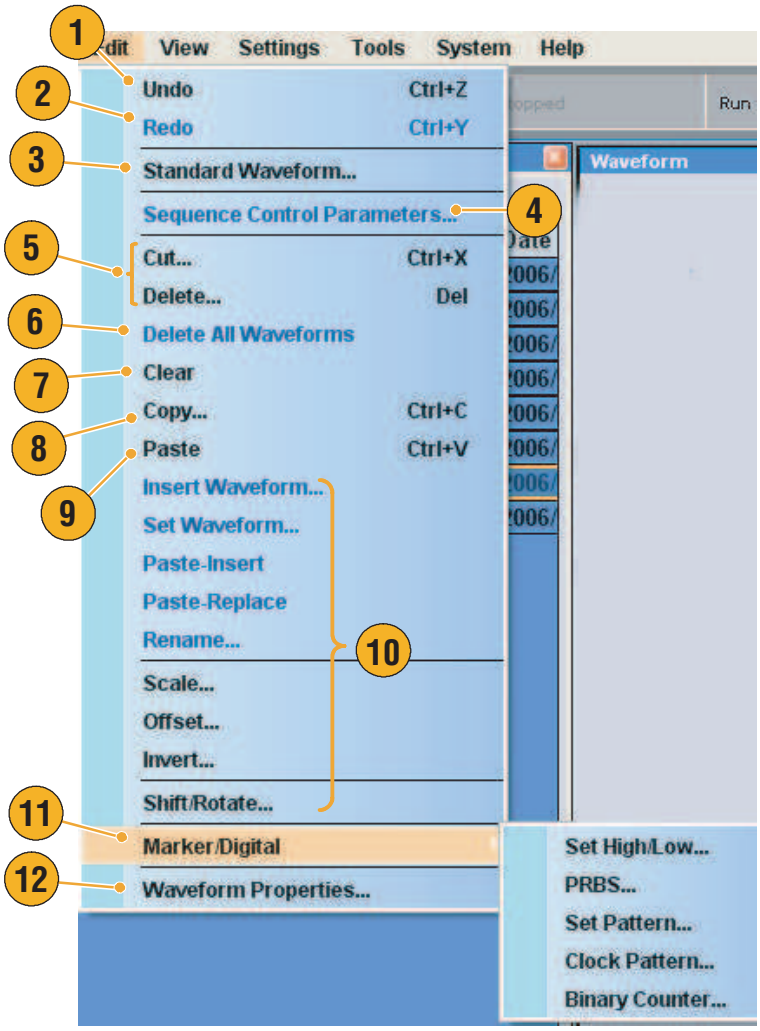
6. Select **Delete All Waveforms** to delete all the waveform data in the setup file.
7. **Clear** removes contents of selected element(s) in the Sequence window. Remaining elements do not shift.

   In the Waveform window, **Clear** removes the selected waveform data.

8. Opens the Copy dialog box.

   In the sequence, Copy causes an immediate action.

9. Select **Paste** to copy the content of clipboad.
10. Opens various edit-related dialog boxes.
11. Opens the Marker related submenu.
12. Opens Waveform Properties dialog box.



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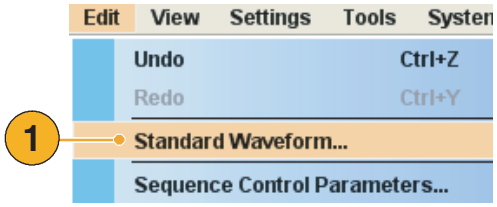
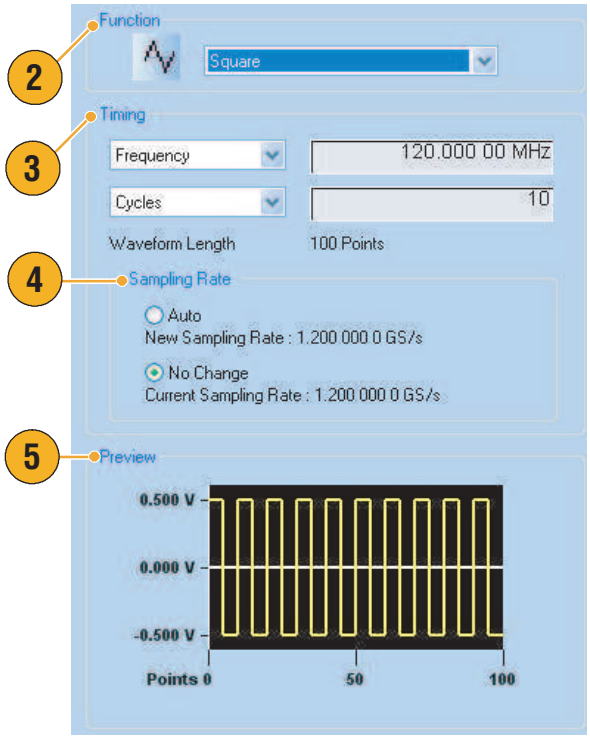
Creating a Standard Waveform

You can create a new waveform using the standard waveform dialog box.

1. Select **Edit** > **Standard Waveform...** to open the Standard Waveform dialog box.



2. Use **Function** to select a waveform type. You can select a waveform from Sine, Triangle, Square, Ramp, Gaussian Noise, and DC.
3. Use **Timing** to set parameters for Frequency, Waveform Length, and Cycle.
4. Select **Auto** or **No Change** in Sampling Rate.
   - **Auto**
     Sampling rate and waveform length are automatically set to appropriate values.
   - **No Change**
     Sampling rate is not changed. You can select any two parameters from frequency, waveform length, and cycle. The remaining parameter will be calculated automatically.
5. A waveform is displayed on the Preview screen.



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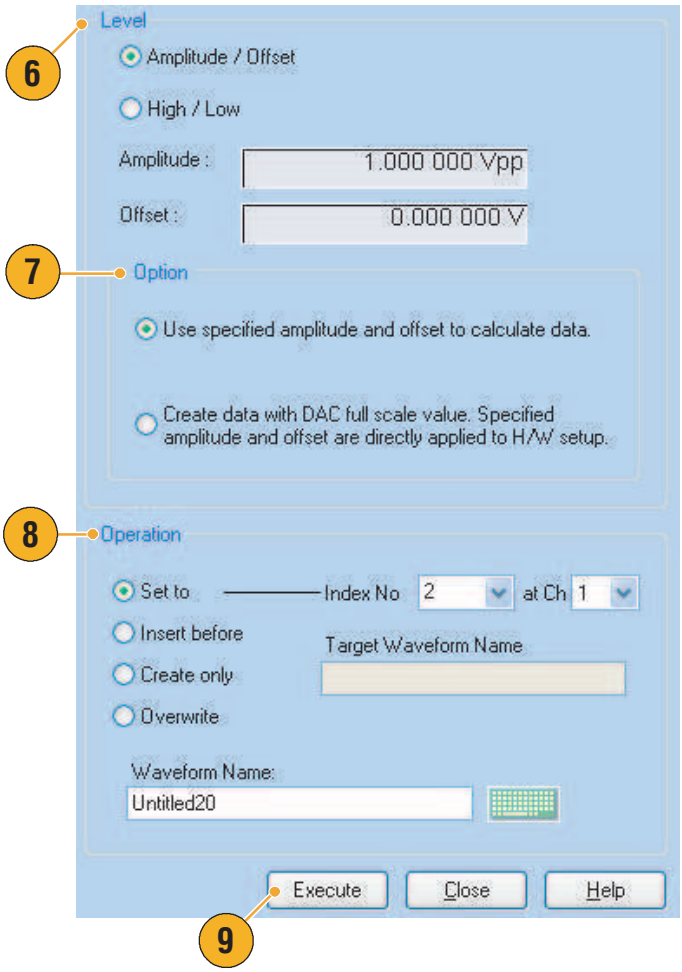
6. Use **Level** to set parameters for Amplitude/Offset or High/Low.
7. Use **Option** to select the amplitude/offset settings. This frame is displayed when you set the vertical units to Voltage.

   If you set the vertical units to Normalized Value, this frame is disabled. Refer to page 59 for vertical units setting.
8. Select an edit action in the Operation frame.
   - **Set to**
     Specifies the channel and index number. The created waveform is assigned to the specified position.
   - **Insert before**
     The created waveform is inserted before the specified cell of the sequence. When this command is executed, the remaining data is shifted. When the Run mode is non-sequence, this parameter is disabled.
   - **Create only**
     Creates a new waveform, but the waveform is not loaded. Enter the waveform name in the Waveform Name box. The created waveform is listed in the Waveform List window.
   - **Overwrite**
     Specified existing waveform data is overwritten. When you select Overwrite, a waveform currently being loaded is displayed in the Target Waveform Name box. The Waveform Name box is disabled.
9. Click **Execute** to create a waveform.



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Using Cut, Copy, Paste and Delete (Waveform Window)

You can cut or copy specified area to the instrument's internal clipboard. Cut or copied data can be pasted to a specified position in either Graphic or Table mode. When executing these operations, items and range are usually specified.

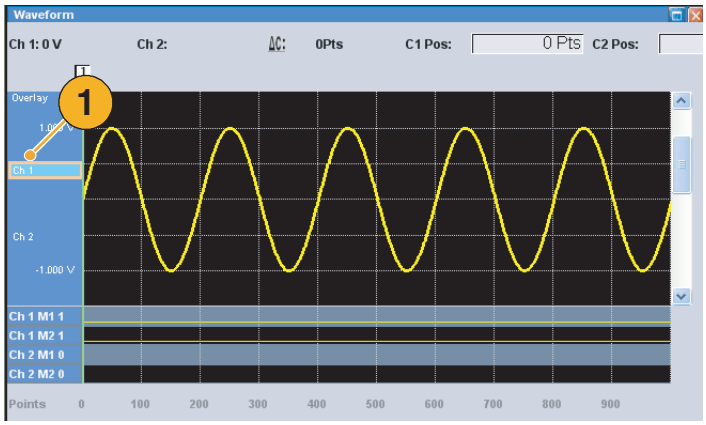
- You can select item(s) to cut or copy from the following:
  - All – Cut or copy all items
  - Ch n Analog data
  - Ch n Marker 1 data/Marker 2 data
- You can specify the range to cut or copy from the following:
  - All – Cut or copy all data.
  - Between Cursors – Cut or copy the area between the two cursors.
  - Selected (Table mode only) – Select the cut or copy area by dragging the mouse in the Table mode. In this case, the Cut dialog box automatically checks Selected in the Range field.

NOTE. *The internal clipboard resides in the instrument application software. It is different from Windows clipboard. You cannot transfer data from other applications like Microsoft Excel into the instrument clipboard. Data transfer from other applications is possible using the import/export functions.*

Example of Cut (Waveform Window)

You can execute Cut operation for both Graphic mode and Table mode in the Waveform window.

1. Select the item(s) you want to cut.



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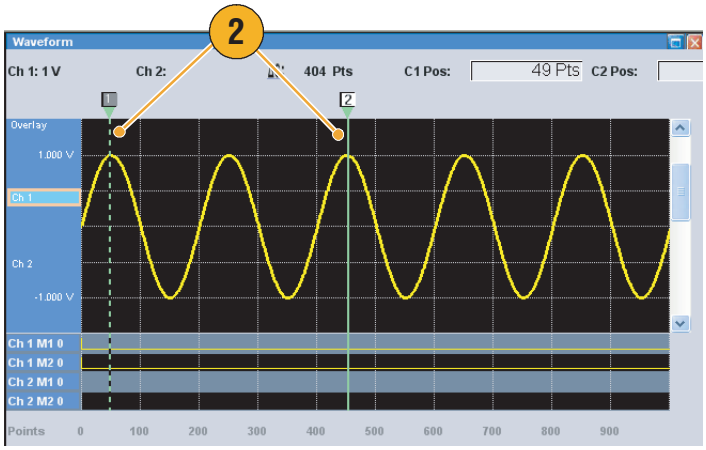
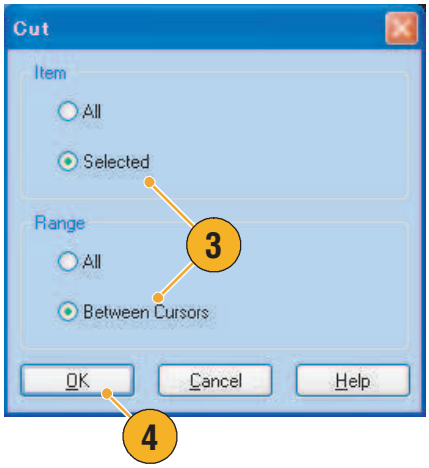
2. Specify the range using cursors.



3. Select **Edit** > **Cut**... to open the Cut dialog box. You can also select Cut from the pop-up menu displayed by right-clicking in the Waveform window.

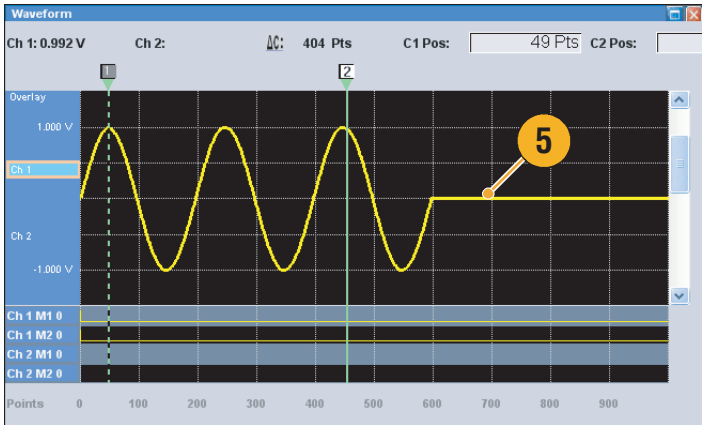
   If you need to change the Item or Range settings, use this dialog box.

4. Click **OK**.



5. The selected portion of the waveform is cut. The waveform is shifted and the default value will be filled.

***NOTE**. If part of items are cut or deleted, the waveform length will not be shortened. The data is shifted. The portion after the shifted area will be filled with default value.*



Quick Tips

- Delete is the same as Cut except that Delete does not change the contents of the internal clipboard.
- If all items are cut or deleted, the waveform length will be shortened accordingly.

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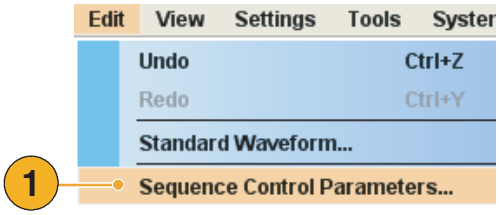
Defining a Sequence

It is sometimes necessary to create long waveform files to fully implement a DUT test. Where portions of the waveforms are repeated, a waveform sequencing function can save you a lot of memory-intensive waveform programming.

Sequencer is used for mainly the following two purposes:

- Output longer waveform than hardware memory
- Change the output waveform quickly (such as ATE applications)

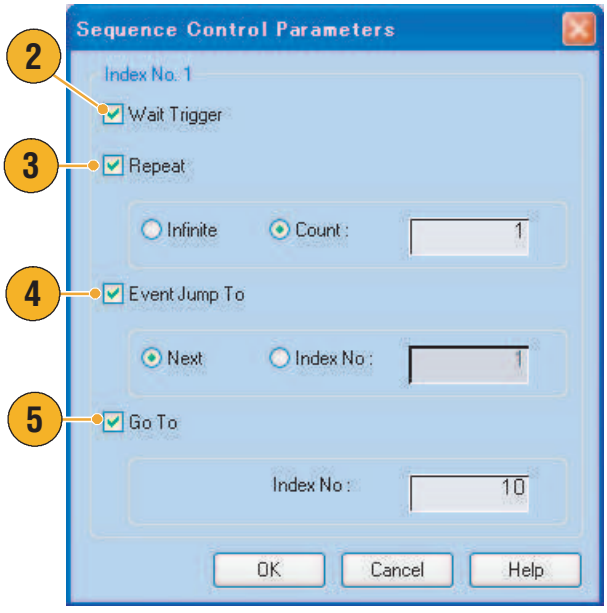
1. To define a sequence, select **Edit** > **Sequence Control Parameters...** to open the dialog box.



2. The sequencer will wait for the trigger before generating a waveform if **Wait Trigger** is checked.
3. A waveform can be repeated if the **Repeat** Count is specified for each element of the sequence.
4. **Event Jump To** changes the sequencing of the waveform by the external event.

   See the Quick Tips below for supported event signals.
5. If you specify **Go To** target for each sequence element, the sequencer jumps to the element specified by Go To target immediately after generating the waveform specified in a sequence element.

   If the Go To target is not specified, the sequencer moves on to the next element.



Quick Tips

- If Sequence is selected in the Run mode, the sequencer executes the sequence definition. Sequence definition consists of a series of sequence elements. Each sequence element has the following information:
  - References to the waveform for each channel
  - Sequence control parameters (Wait, Repeat, Event Jump To and Go To)
- Sequence is executed in turn from the first element (Element Index = 1) to the last element. If an element has Jump To or Go To, the sequencer follows that definition.

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- The following signals are supported as an event:
  - A signal applied to the front-panel Event Input connector
  - When the front-panel Force Event button is being pushed
  - Remote command

NOTE. *There are two sequencer modes in the arbitrary waveform generator to execute the created sequence: The hardware sequencer mode and the software sequencer mode. Refer to the online help for details about the difference between the hardware and software sequencer modes.*

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Editing a Sequence

The following commands are provided for sequence edit:

Clear. Clear removes the contents of selected element(s). Unselected elements do not shift. You can clear multiple non-contiguous elements.

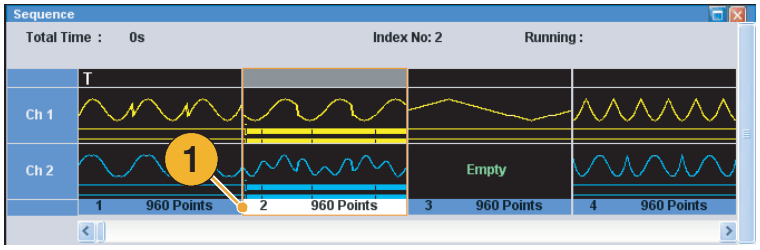
Copy, Paste-Insert and Paste-Replace. You can copy or paste data on one or more contiguous elements. The data in the clipboard will be inserted or replaced at the specified position of the sequence. If Paste-Insert is executed, the existing data is shifted.

Cut Example (Sequence Window)

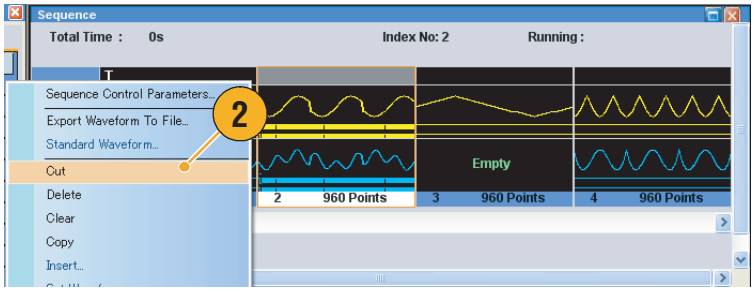
You can do a Cut or Delete on one or more contiguous elements.

1. Select the element(s) to cut. In this example, Index number 2 is the target of Cut.

***NOTE**. Cut and Delete can be done by the units of element.*

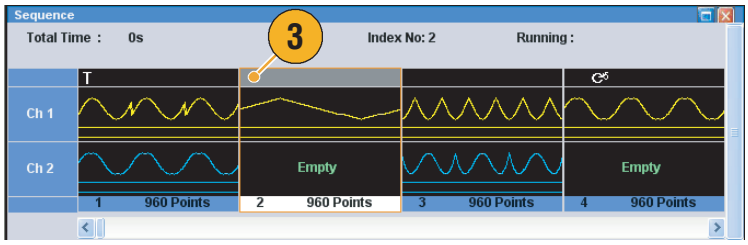


2. Select **Cut** from the Edit menu or the pop-up menu.



3. Cut is executed and the remaining data in the sequence are shifted.

***NOTE**. Cut data is placed in the clipboard. Deleted data is removed from the sequence and cannot be recovered.*



Quick Tip

- For more information on the edit commands for sequence, refer to the online help.

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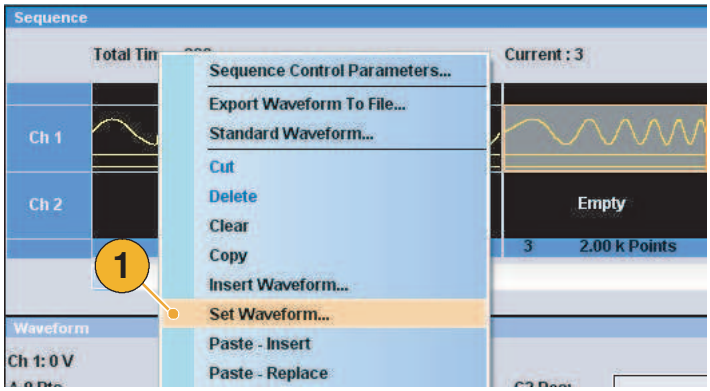
Using Set Waveform and Insert Waveform

You can insert or replace a waveform in the Sequence window.

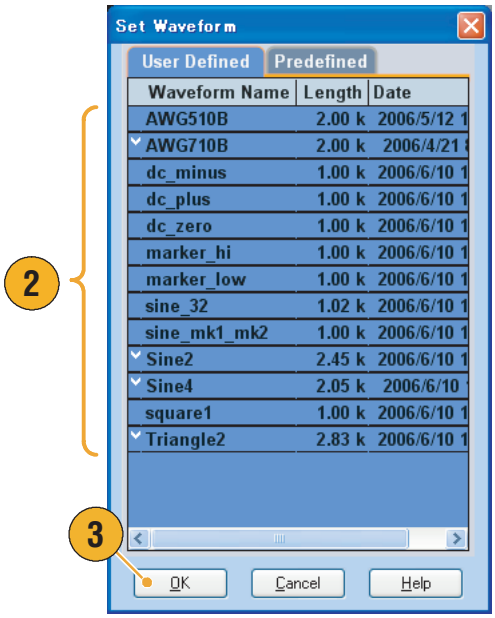
- **Set Waveform** – Use to assign or replace the selected waveform at the specified position in the Sequence window.
- **Insert Waveform** – Use to insert the selected waveform at the specified position in the Sequence window.

1. Right-click on the Sequence window cell you want to set or insert a waveform to display the pop-up menu, and then select **Set Waveform...** or **Insert Waveform...**

   You can also access these functions from the Edit menu.



2. Select a waveform you want to set or insert from the displayed list.
3. Click **OK** to set or insert the waveform.



Quick Tip

- You can select and drag a waveform from the Waveform List window to the Sequence window. This is an easier way to set or insert a waveform to the Sequence window.

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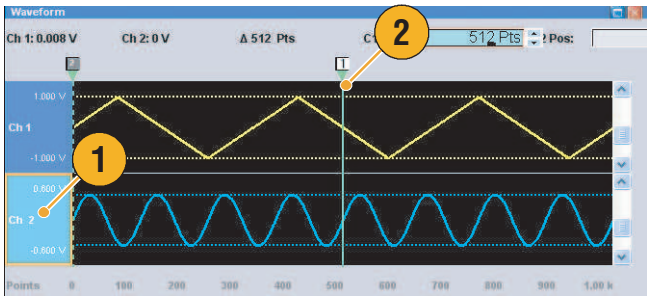
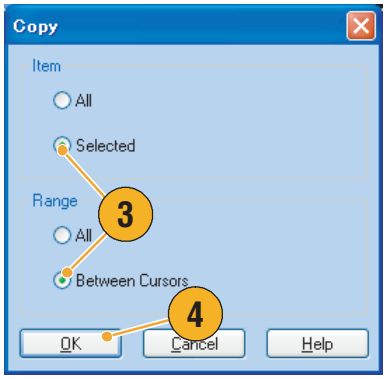
Using Paste-Insert and Paste-Replace

You can insert or replace waveform data in the clipboard in the Waveform window or Sequence window. The following example shows a Paste-Insert operation in the Waveform window.

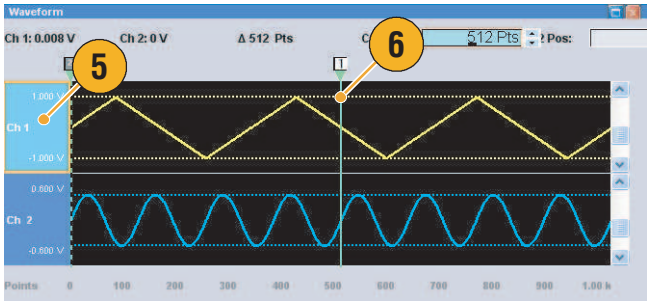
1. Select the Ch 2 waveform.
2. Select the range of copy using the cursors.



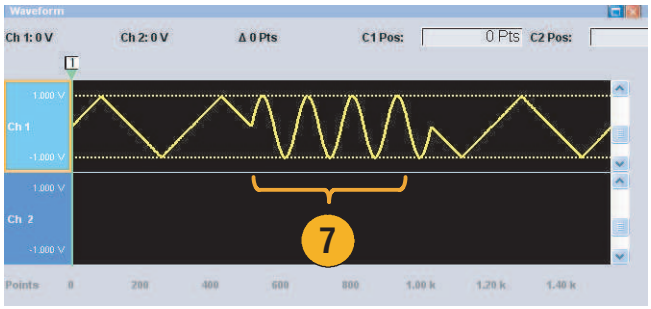
3. Select **Edit** > **Copy...** to display the dialog box and then specify Item and Range to copy.
4. Click **OK**.



5. Select the Ch 1 waveform.
6. Specify the position to Paste-Insert the waveform data.



7. Select **Edit** > **Paste-Insert** to insert the copied data to the specified position on the Ch 1 waveform.



Quick Tips

- Executing Paste-Insert will shift the existing data.
- Executing Paste-Replace will not shift the existing data.

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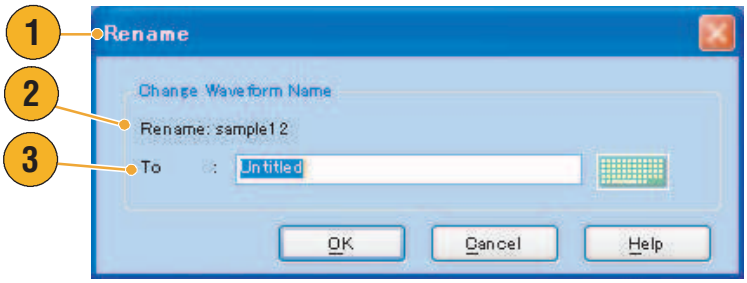
Using Rename

You can change the waveform name in the Waveform List window.

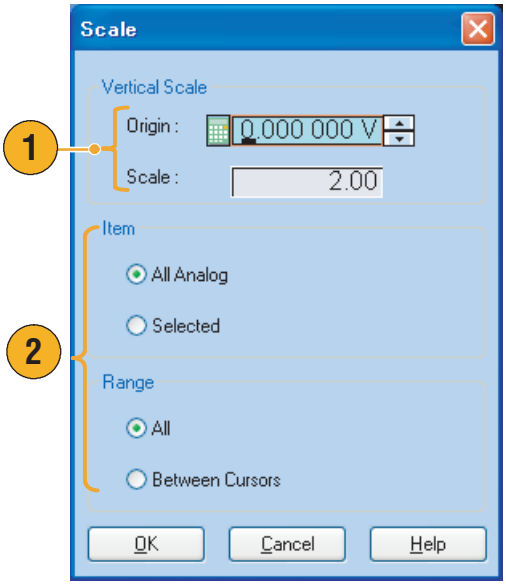
1. Select a waveform in the Waveform List window, and then select **Edit** > **Rename** from the menu bar to open the Rename dialog box.
2. The waveform name is displayed.
3. Enter the new waveform name in the To field.



Using Other Edit Menu Commands

Scale. You can scale the specified range of analog data using **Scale** from the **Edit** menu.

1. Vertical scale origin and scale factor can be set. The scale factor does not have the units.
2. For item and range, refer to page 44.



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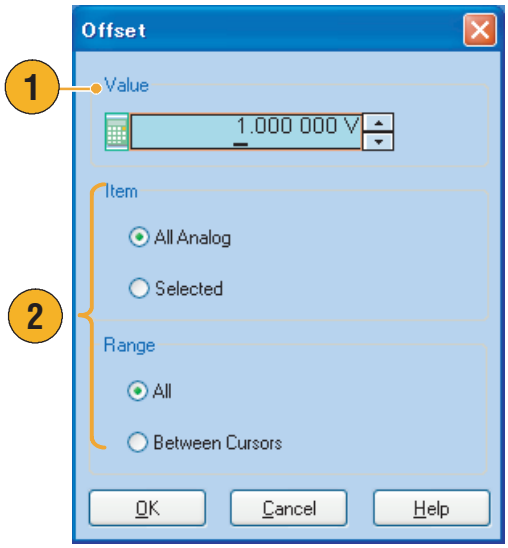
Offset. You can add constants to the specified range of analog data using **Offset** from the Edit menu.

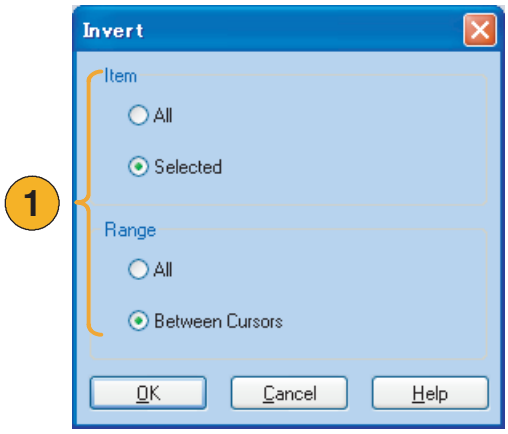
1. Offset can be set by voltage or normalized value.
2. For item and range, refer to page 44.



Invert. Data values in the specified range can be inverted using **Invert** from the Edit menu.

1. For item and range, refer to page 44.

   For analog data, a positive value will become negative. For marker data, low (0) becomes high (1).



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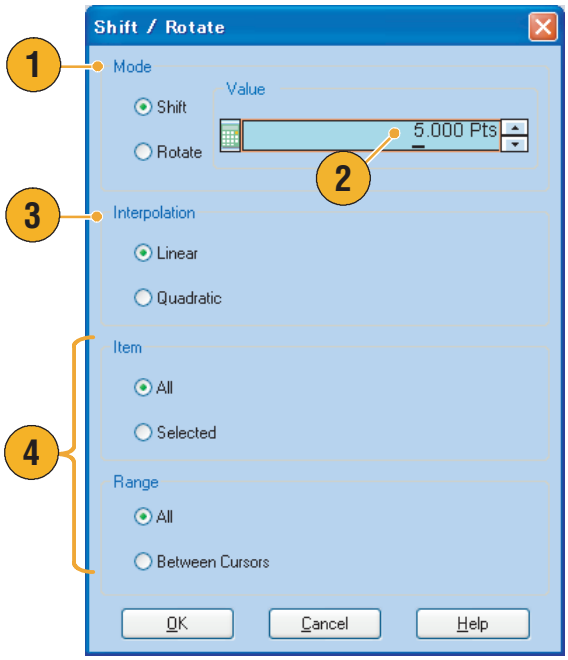
Horizontal Shift/Rotate. You can shift or rotate the specified range of waveform data horizontally using **Shift/Rotate** from the Edit menu.

1. Select **Mode** (Shift or Rotate).
2. Enter the value for the Shift or Rotate range.
3. Linear or Quadratic interpolation can be selected for fractional shift or rotation.
4. For item and range, refer to page 44.

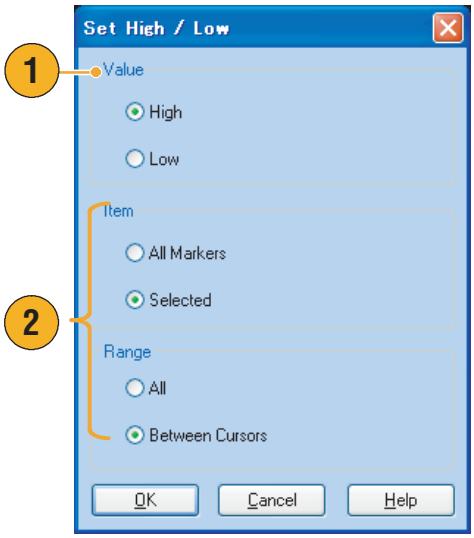


Quick Tips

- Horizontal Rotate is used to check if the waveform data is connected smoothly from the end of the first waveform to the beginning of the second waveform. This is especially useful when the waveform is looped by the sequencer.
- Horizontal Shift/Rotate is applied for analog data and marker.

Set High/Low. You can set the specified range of marker data to high or low using **Set High/Low** from the Edit menu.

1. Select High or Low.
2. For item and range, refer to page 44.



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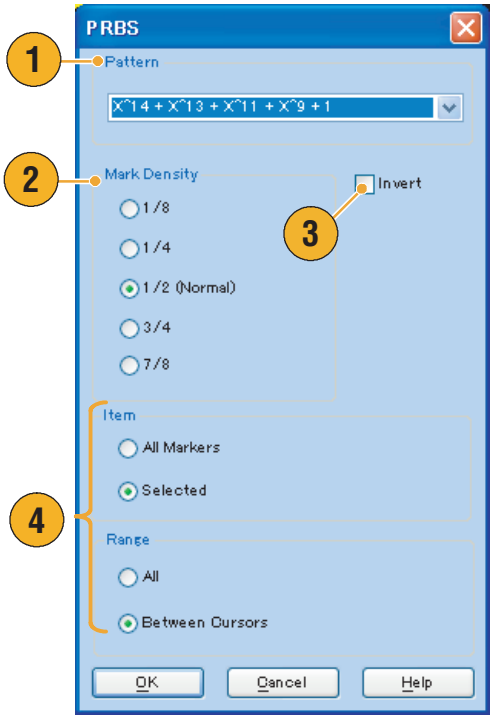
PRBS. You can replace a specified range of waveform data with a PRBS pattern.

1. Select a PRBS pattern.
2. Select a Mark Density.
3. Invert can be set to On or Off.
4. For item and range, refer to page 44.

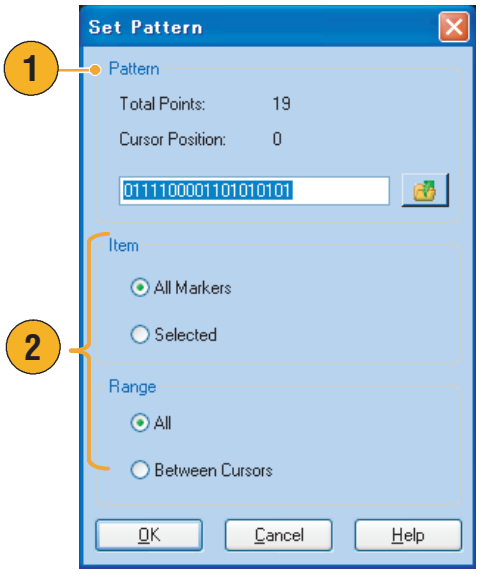


Set Pattern. You can fill the specified area of marker data with a selected digital pattern.

1. You can enter a pattern directly, or load a text file from the internal hard drive or an external memory device.

   The maximum length of a bit pattern is 1000.
2. For item and range, refer to page 44.

   If multiple items are specified as a target for Set Pattern, the same data will be filled in for all items.



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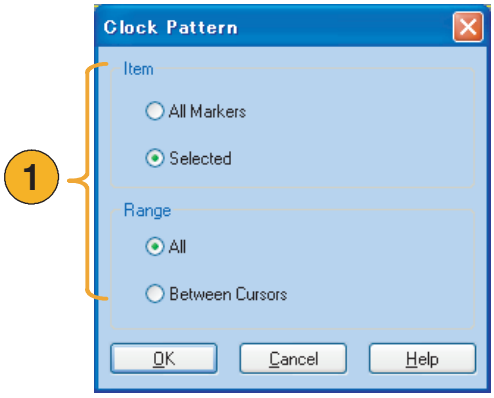
Clock Pattern. You can fill a specified area of marker data with the 1010 clock pattern.

1. Use this dialog box to change the Item or Range.

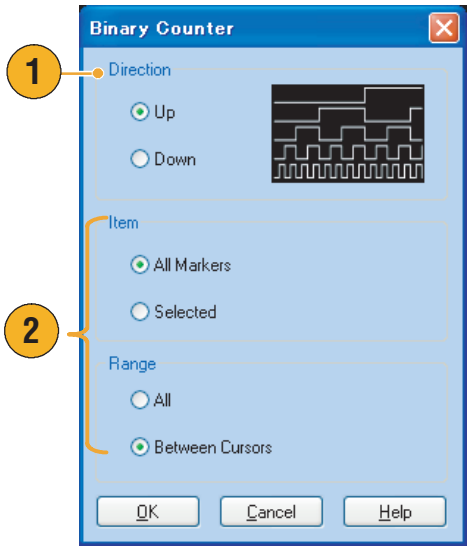


Binary Counter. You can fill the specified area of marker data with binary counter pattern.

1. You can select the direction (Up counter or Down counter).

   The up counter begins from all 0, and the down counter begins from all 1.

2. For item and range, refer to page 44.



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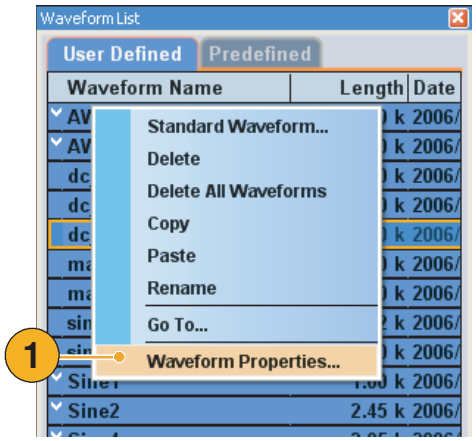
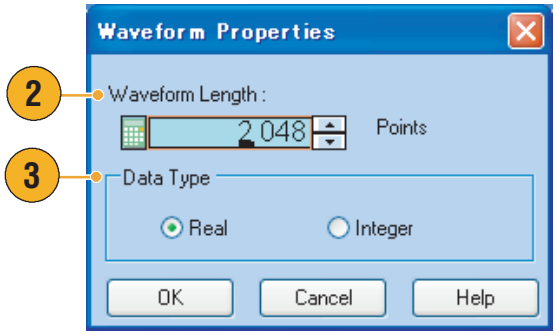
Waveform Properties. You can confirm or change properties of waveform data using the Waveform Properties dialog box.

1. Select a waveform in the Waveform List window, and then select **Edit** > **Waveform Properties...** from the menu bar to display the dialog box.

   You can also access this dialog box from the pop-up menu displayed by right-clicking in the Waveform List window.



2. You can confirm or change the waveform length.
3. You can confirm or change the waveform data type (Real or Integer).



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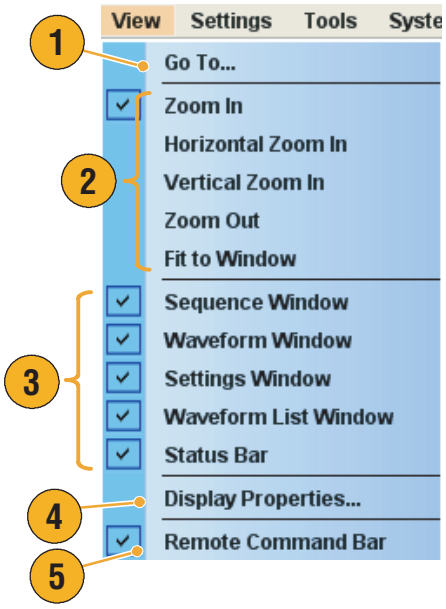
Using the View Menu

Use the **View** menu to control the arbitrary waveform generator screen display. The choices are as follows:

1. Opens the Go To... dialog box.
2. You can select one of these zoom functions. See page 61.
3. Check to display these control windows and status bar.
4. Opens the Display Properties dialog box.
5. Check to display the Remote Command Bar. See page 18.



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Using Go To Dialog Box

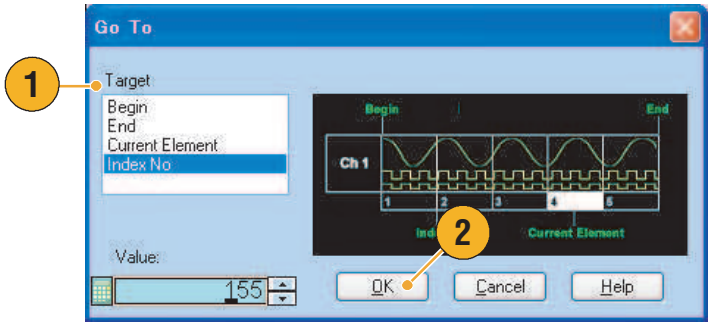
This dialog box is used to move to a specified position in the sequence, or to specify an index number to go to.

1. Select **View** > **Go To...** in the Sequence window to display the Go To dialog box.

   Select the Go To target or enter an index number in the Value field.

   You cannot specify the Go To target using a parameter of time.

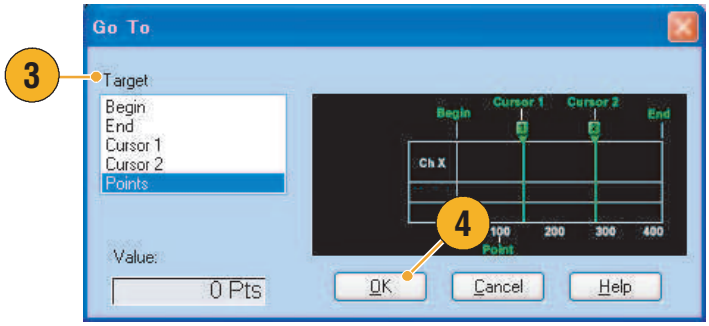
2. Click **OK**. The display will shift to the specified position.



3. Select **View** > **Go To...** in the Waveform window to display the Go To dialog box.

   Select the Go To target or enter Points or Time value in the Value field.

4. Click **OK**. The display will shift to the specified position.



Quick Tip

- You can also use the Go To dialog box in the Waveform List window.

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Using Display Properties Dialog Box

You can configure the appearance of waveform edit and sequence edit windows of your arbitrary waveform generator.

1. Select **View** > **Display Properties...** to display the Display Properties dialog box.

   Click the Waveform Window tab.

2. You can select the Waveform window display format (**Graphic** or **Table**).

3. When **Overlay** is specified, analog data from multiple channels can be displayed overlaid.

4. When **Graphic** is specified, you can turn the Grid On and Off.

5. When **Table** is specified, you can select the table display format from the following:

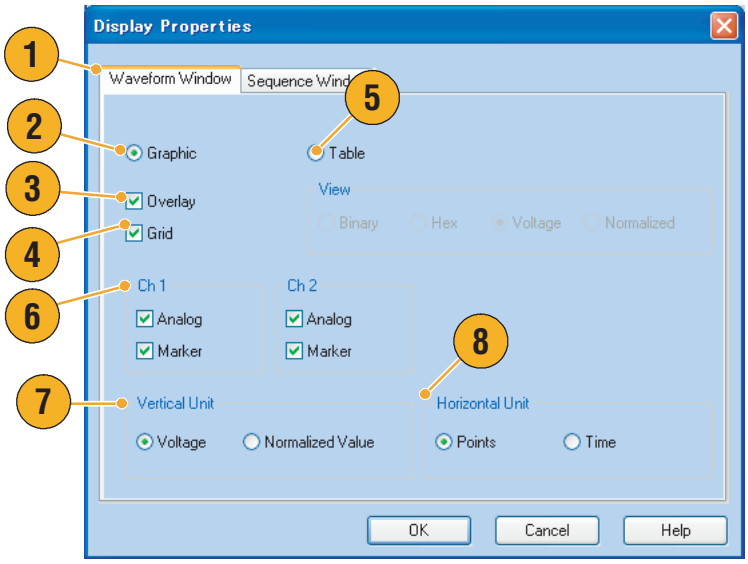
   - Binary
   - Hex
   - Voltage
   - Normalized Value

6. You can select displayed items for each channel in the Waveform window.

7. You can select the vertical units.

8. You can select the horizontal units.

   The vertical and horizontal units settings are common to all channels.



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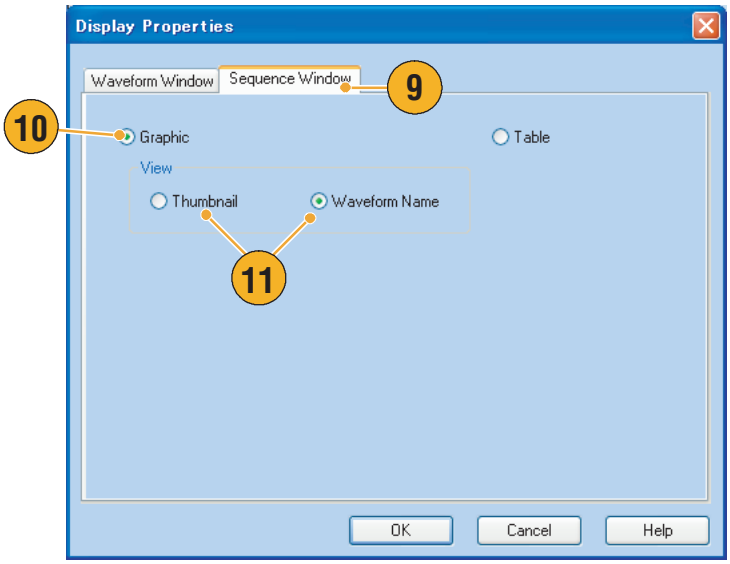
9. Click the Sequence Window tab.
10. Select **Graphic** or **Table** for the Sequence window display format. The display format is common to all channels.
11. If Graphic is specified, you can select the display format (**Thumbnail** or **Waveform Name**).



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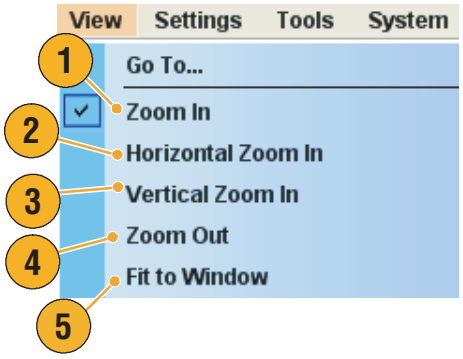
Using Zoom

Use the Zoom function to magnify or reduce a waveform display. The choices are as follows:



1. **Zoom In**
   Use **Zoom In** to magnify a waveform horizontally and vertically at the same time.
2. **Horizontal Zoom In**
   Use **Horizontal Zoom In** to magnify a waveform horizontally.
3. **Vertical Zoom In**
   Use **Vertical Zoom In** to magnify a waveform vertically.

   You can select the vertical scale definition when zooming vertically. Use the Preferences dialog box. See page 69.
4. **Zoom Out**
   Use **Zoom Out** to return the previous zoom factor. You can use Zoom Out only after the waveform is magnified.
5. **Fit to Window**
   Use **Fit to Window** to fit the waveform in the window and restore the waveform to its state before the first zoom in. You can use Fit to Window only after the waveform is magnified.

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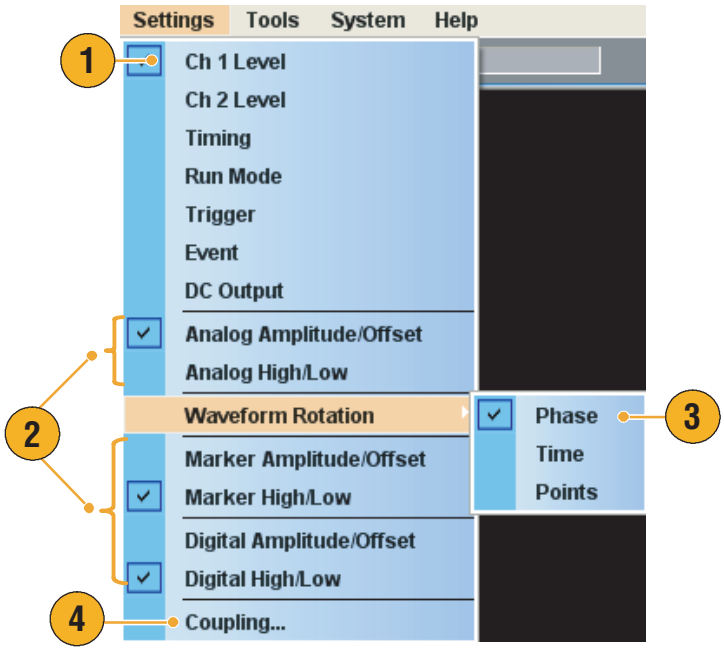
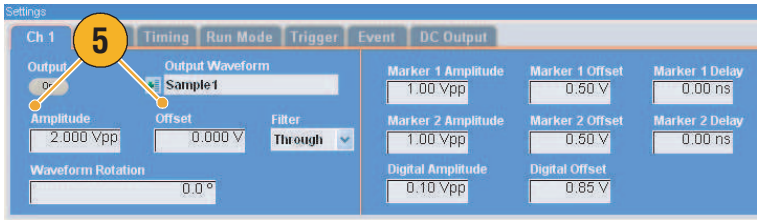
Using the Settings Menu

Use the Settings menu to control the display items on the Settings window.

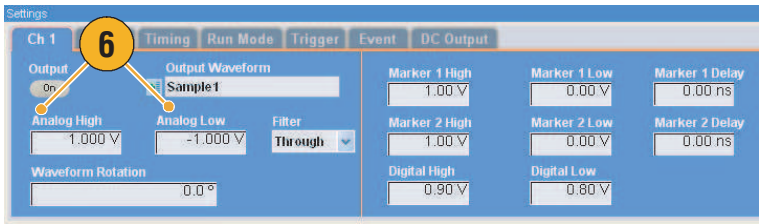
1. Click one of these commands to make the corresponding page of the Settings window active.
2. These menu items allow you to select Analog, Marker, and Digital Amplitude/Offset or High/Low settings.
3. Select setting units for Waveform Rotation. You can use the Channel page of the Settings window for parameter input.
4. Opens the Coupling dialog box.



5. If Analog (Marker or Digital) Amplitude/Offset is selected, the parameters for Amplitude and Offset are displayed in the Channel page of the Settings window.



6. If Analog (Marker or Digital) High/Low is selected, the parameters for Analog (Marker or Digital) High and Analog (Marker or Digital) Low are displayed in the Channel page of the Settings window.



Quick Tips

- The Waveform Rotation can be set independently for each channel.
  - Analog Phase – Can be set by degree (°).
  - Analog Delay – Can be set by time or points.
- The Waveform Rotation setting does not affect the Waveform window display.

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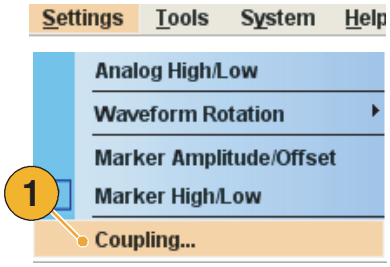
Channel Coupling

You can change the parameter values for multiple channels at a time. This function is called Channel Coupling.

1. Select **Settings** > **Coupling...** to open the Coupling dialog box.

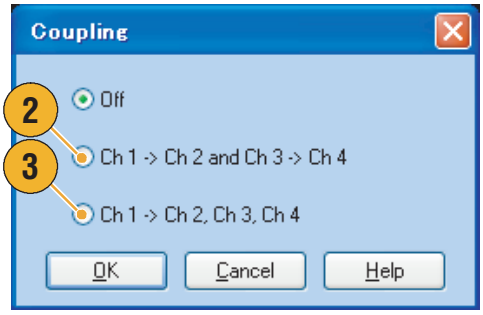
   You can also open this dialog box from the pop-up menu displayed by right-clicking on the Channel page of the Settings window.



2. Select a coupling method.

   Ch 1 –> Ch 2 and Ch 3 –> Ch 4 means that Ch 1 and Ch 2, and Ch 3 and Ch 4 are coupled, respectively.

3. Select **Ch 1 –>Ch 2, Ch 3, Ch 4** to couple the Ch 1 parameters with Ch 2, Ch 3, and Ch 4 parameters.



Quick Tips

- **Ch 1 –>Ch 2, Ch 3, Ch 4** means that Ch 1 parameters are coupled with Ch 2, Ch 3 and Ch 4 parameters. With the Channel Coupling in the On state, the Ch 1 parameters are applied to the instrument hardware settings of the other three channels. You cannot select parameters for channel coupling in the Channel page of the Settings window. The disabled parameters are grayed out.
- The following parameters are excluded from channel coupling:
  - Channel skew
  - Output waveform
  - Sequence waveform
  - External signal add function
  - Waveform Rotation
  - Marker Delay
  - Parameters that are not related to the output signal, such as marker display on/off

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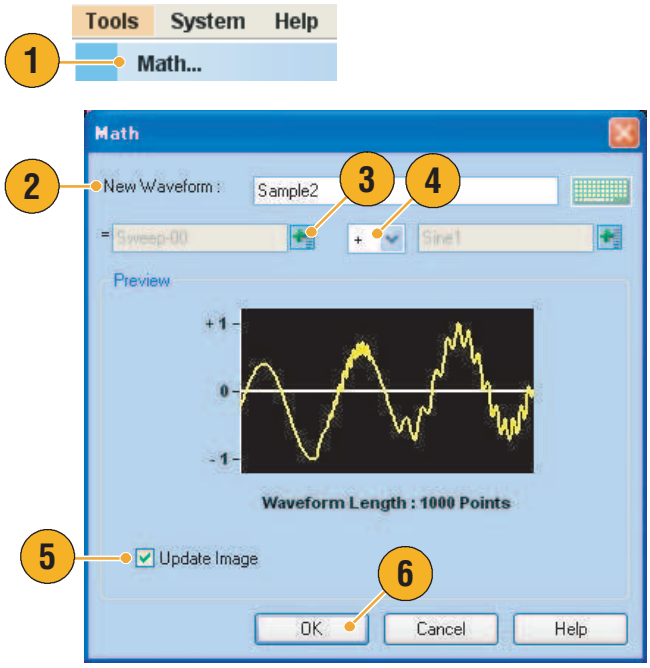
Using the Tools Menu

Use the Tools menu to perform the math operations or select normalize option settings.

Math Waveforms

You can use the Math dialog box to perform mathematical operations on the waveform you are editing. The analog data of two waveforms can be added, subtracted, or multiplied. The created waveform data can be added to the Waveform List.

1. Select **Tools** > **Math...** to display the Math dialog box.
2. You can enter a waveform name in the New Waveform field. The default waveform name is Untitled1.
3. Select a waveform from the waveform list. Click the icon to display the Waveform List dialog box.
4. Select a math operator.
5. If **Update Image** is checked, the calculation results will be reflected on the graph.
6. Click **OK** to add the new waveform to the Waveform List window.



Quick Tips

- A new waveform will be created as the result of waveform math operation. For the marker data, the data of the first operand waveform will be copied to the new waveform.
- The math operation is executed for all analog waveform data.
- If the length of two waveforms is not the same, the length of the result is the same as the length of the shorter waveform. The beginning part of the longer waveform is used for the calculation.

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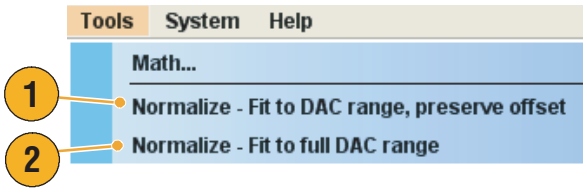
Normalize Option

You can select normalize options when analog data is normalized. Normalize is executed for the entire analog waveform data.

Select one of the following options from the Tools menu:

1. **Fit to DAC Range, Preserve Offset**
   The waveform data is scaled relative to 0 (zero).
2. **Fit to Full DAC Range**
   Minimum value goes to –1.0 in normalized value and the maximum value goes to +1.0 in normalized value.



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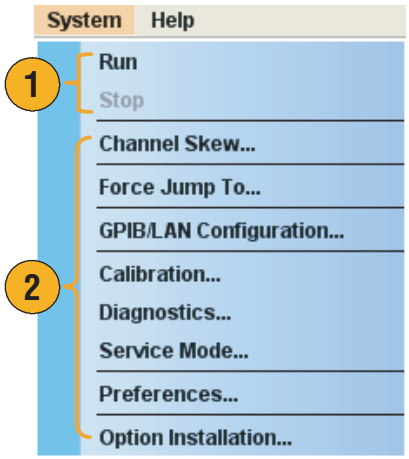
Using the System Menu

The System menu provides access to the instrument system configuration such as signal generation control, instrument calibration, and instrument diagnostics. You can also set the user preferences such as power-on settings or LCD brightness using the System menu.

1. Select **System** > **Run** or **Stop** to control the signal generation start and stop. See page 17 for Run State.
2. Click one of these commands to open the corresponding dialog box.



Quick Tip

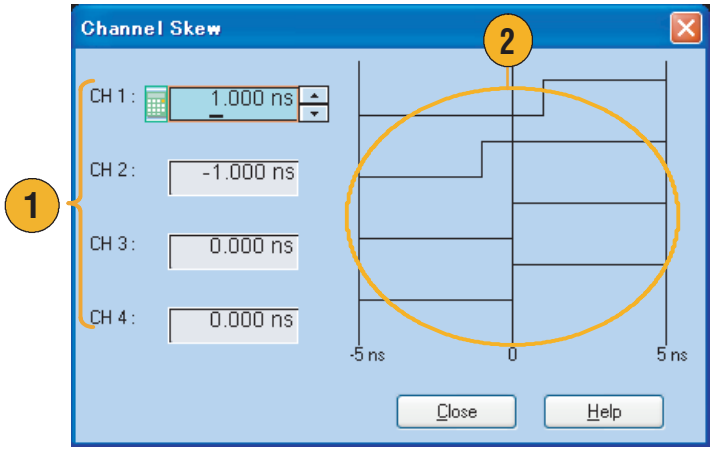
- Selecting **Run** from the System menu causes the same effect as pushing the front-panel **Run** button or the Status Bar **Run** button.

Channel Skew Adjustment

The channel skew adjusts the skew (delay) of each channel output.

Select **System** > **Channel Skew...** to open the Channel Skew dialog box.

1. You can adjust the skew for each channel independently. This adjustment applies to analog output and marker output.
2. Adjusting the skew value will update the dialog box display.



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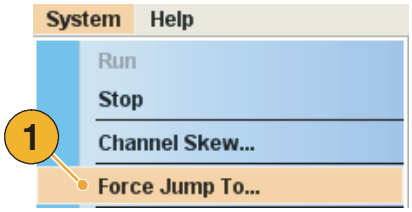
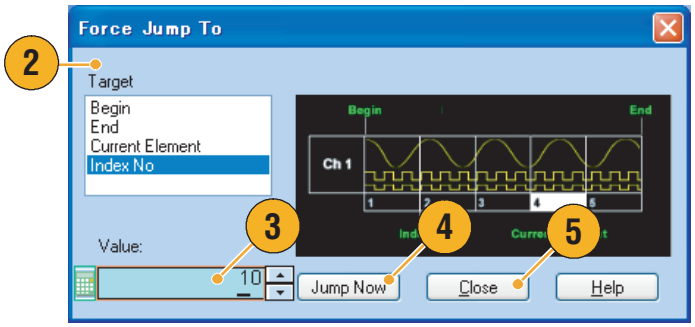
Using Force Jump To Dialog Box

Force Jump allows you to jump to a position that you choose. This function is used in sequence mode.

1. Select **System** > **Force Jump To...** to open the Force Jump To dialog box.



2. Specify a jump target or select Index No.
3. When Index No is selected as jump target, enter the index number using the Value: field.
4. Click **Jump Now** to change the waveform output to the position specified by jump target.
5. Click **Close** to close the dialog box.



Quick Tips

- The arbitrary waveform generator has an Event Jump function which changes the sequence using an event signal. Use the Event page of the Settings window to set parameters for Event Jump. See page 31 for the Event page.
- Use the Sequence Control Parameters dialog box from the Edit menu to set the jump target of Event Jump. See page 46 for the dialog box.
- Force Jump is similar to Event Jump. In the case of Force Jump, you must specify the jump target explicitly by using the Force Jump To dialog box.
- Force Jump is independent from Event Jump. Force Jump can be executed regardless of the Event Jump setting.

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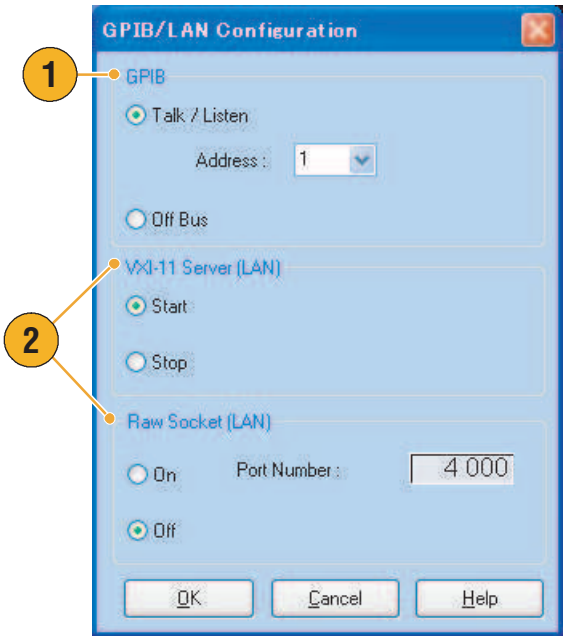
Setting GPIB/LAN

Select **System** > **GPIB/LAN Configuration** to open the GPIB/LAN Configuration dialog box.

1. Set the instrument GPIB bus communication:
   - **Talk/Listen** – Select this mode to remotely control the instrument from an external host computer.
   - **Off Bus**– Select this mode to disconnect the instrument from the GPIB bus.
2. The instrument supports the following two LAN connections:
   - VXI-11
   - Raw Socket



Quick Tip

- The following operations cannot be performed through a GPIB or LAN connection:
  - Editing a waveform
  - Changing size or name of waveform
  - Converting the waveform format
  - Importing waveform data from the AWG5000 series and AWG7000 series setup (*.AWG) file
  - Importing a Tektronix DTG5000 series file (*.DTG)
  - Importing a Tektronix AWG400/500/600/700 series SEQ file
  - Exporting a file

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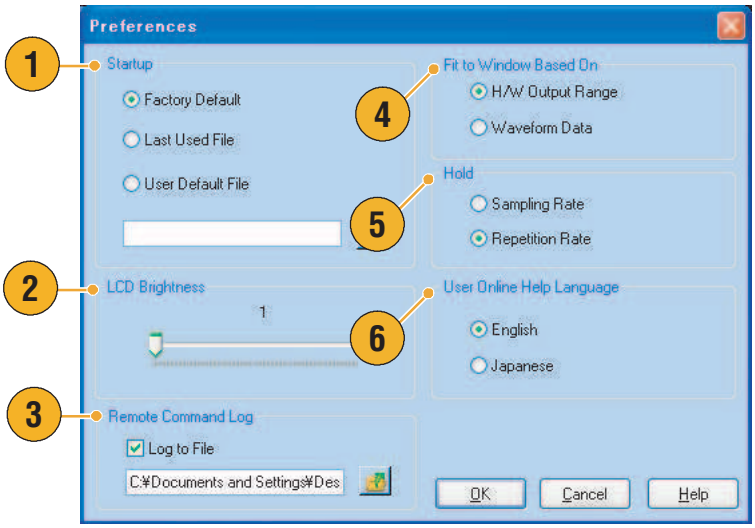
Setting the User Preferences

Select **System** > **Preferences...** to open the Preferences dialog box.



1. Startup – Select a power-on setting. See page 32.
2. LCD Brightness – Set the LCD brightness.
3. Remote Command Log – You can record the sequence of GPIB commands you used with your instrument.
4. Fit to Window Based On – Select the vertical scale setting when you use the Zoom Fit function.
   - **H/W Output Range**
     Vertical scale is set based on the instrument hardware limitation.
   - **Waveform Data**
     Vertical scale is set based on the waveform data.
5. Hold – Select which parameter is held when the effective waveform length is modified.
   - Sampling Rate
   - Repetition Rate
6. User Online Help Language – Select a language in which to display on the User Online Help.

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Option Installation

Use the Option Installation dialog box to enable the upgrades that you purchased from Tektronix for your instrument. For the most current list of upgrades, go to www.tektronix.com or contact your local Tektronix representative.

1. Select **System** > **Option Installation...** to open the Option Installation dialog box.
2. Click **Continue** to open the second dialog box.

   Enter the Option Installation Key provided by Tektronix, and follow the on-screen instructions to install the option.

NOTE. *After entering the option key, you must restart the instrument application to activate the option.*

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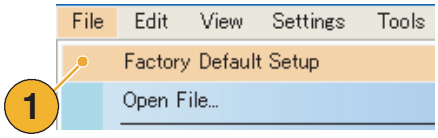
Tutorials

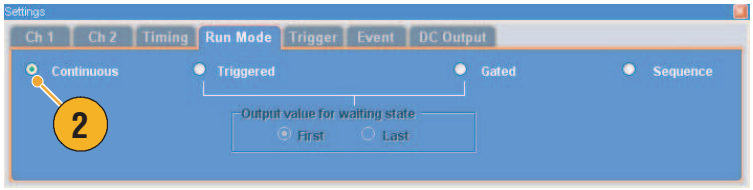
The examples in this section show how to use your instrument to do common arbitrary waveform generator tasks. These examples use the dual-channel model.

Creating and Editing a Standard Waveform

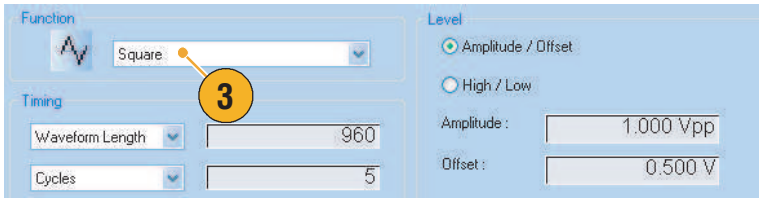
1. Recall the default setup.



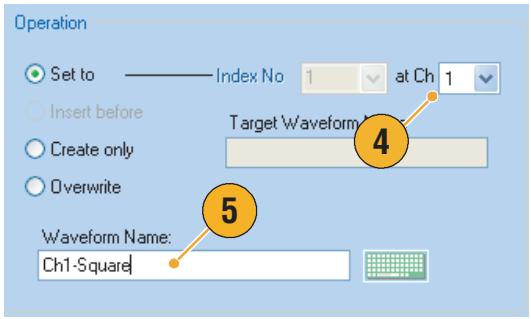
2. Select **Continuous** from the Run Mode page of the Settings window.



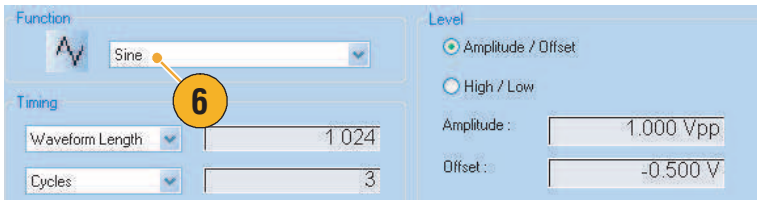
3. Use the Standard Waveform dialog box to create the square waveform shown below:
   - Waveform Length: 960 points
   - Cycles: 5
   - Amplitude: 1.0 V_{p-p}
   - Offset: 0.5 V



4. Set the waveform created in step 3 to Ch 1.
5. Assign the waveform name "Ch1-Square" to the waveform.



6. Use the Standard Waveform dialog box to create the sine waveform shown below:
   - Waveform Length: 1024 points
   - Cycles: 3
   - Amplitude: 1.0 V_{p-p}
   - Offset: –0.5 V



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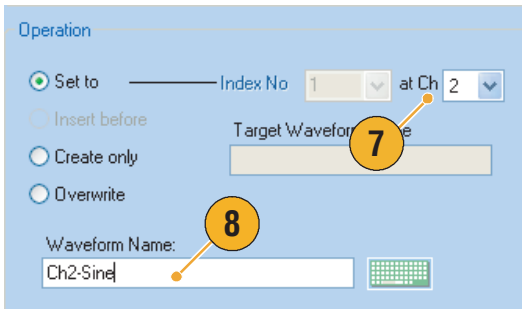
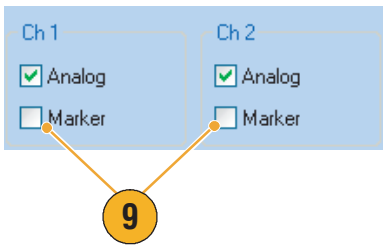
7. Set the waveform created in step 6 to Ch 2.
8. Assign the waveform name “Ch2-Sine” to the waveform.

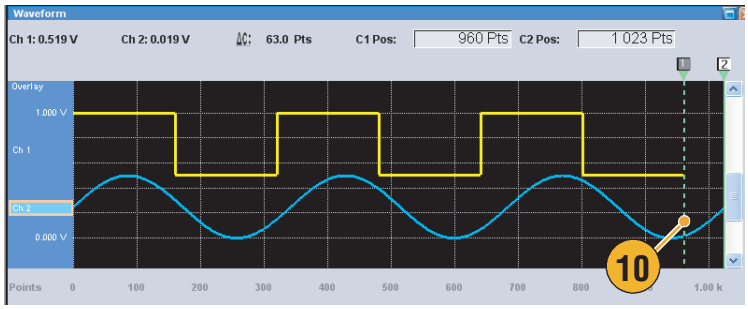


9. To edit analog waveform data, hide the Ch 1 and Ch 2 Marker data using the Display Properties dialog box.

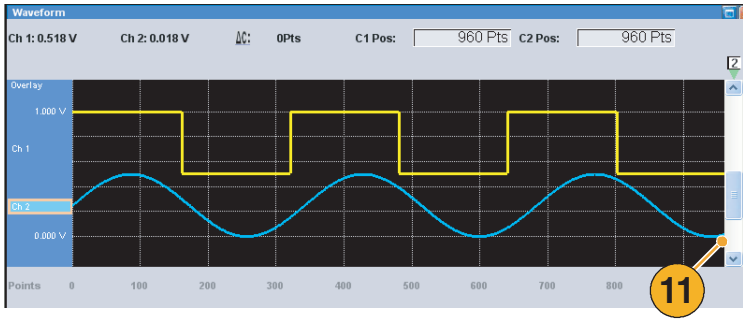


10. Delete points from the end of the Ch 2 waveform to make it the same length as the Ch 1 waveform.

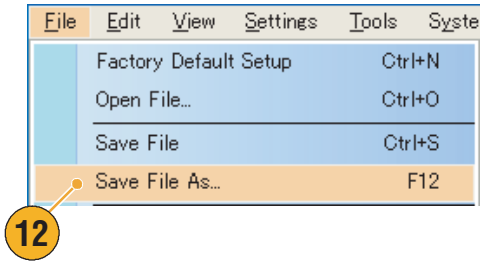
    Use cursors to set the range.



11. Ch 1 and Ch 2 waveforms have the same waveform length. You can now output the signal.



12. Save the setup.



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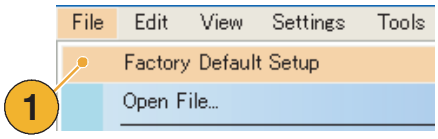
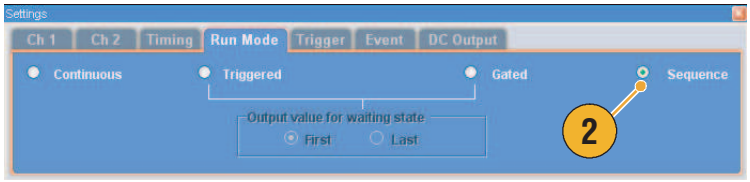
Editing a Sequence

1. Recall the default setup.

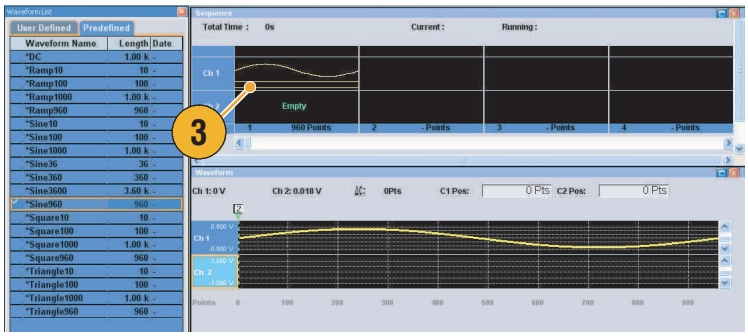


2. Select **Sequence** from the Run Mode page of the Settings window.



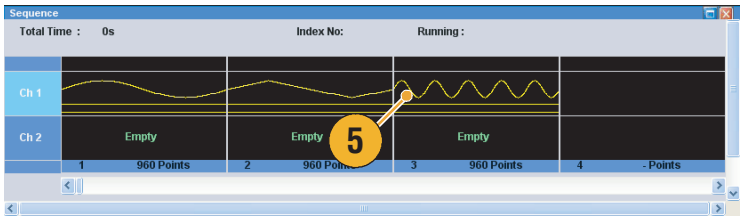
3. Select ***Sine960** from the Predefined page of the Waveform List window, and set the waveform to the first cell of Ch 1 sequence.

   Refer to page 24 to learn how to assign an existing waveform to a cell in the sequence.

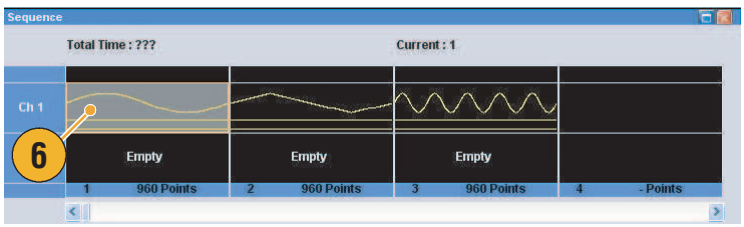


4. Select ***Triangle960** from the Predefined page of the Waveform List window, and set the waveform to the second cell of Ch 1 sequence.

5. Create a sine waveform with the following attributes and set the waveform to the third cell of Ch 1 sequence.
   - Waveform Length: 960 points
   - Cycles: 5
   - Amplitude: 1.0 V_{p-p}
   - Offset: 0.0 V
   - Waveform Name: Sine-1



6. Select the first element in the Sequence window. The selected cell is highlighted.



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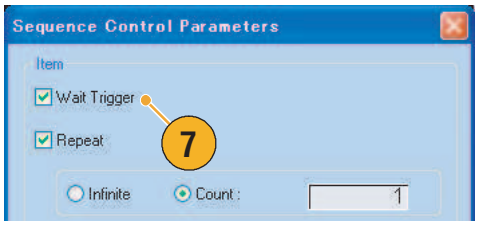
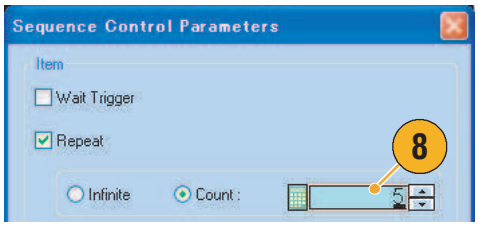
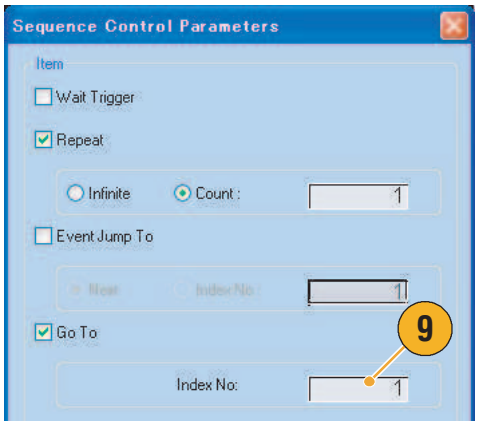
7. Set **Wait Trigger** to the index number 1 using the Sequence Control Parameters dialog box. This makes the sequence wait a trigger before generating the first element.



8. Set **Repeat Count** to 5 at the index number 2. This makes the sequence repeat the second element five times.

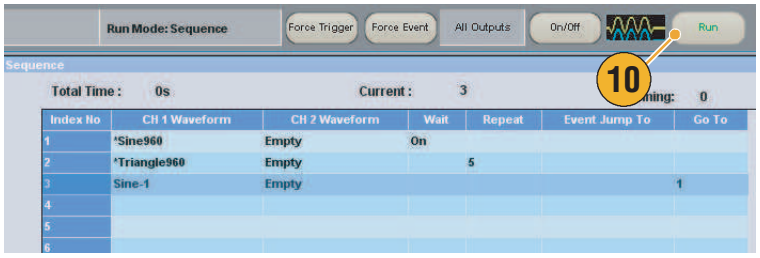


9. Set **Go To** target to 1 at the index number 3. This makes the sequence jump to index number 1 after generating the index number 3.



10. Click the **Run** button to confirm that the sequence works properly. The animation window next to the Run button will be activated when the instrument is in the running state.

    This screen image shows Table mode is selected in the Sequence window.



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