ArbExpress® AXW100
Waveform Creation and Editing Tool for AWG/AFG

Printable Help

Tektronix

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ArbExpress® AXW100 Waveform Creation and Editing Tool for Tektronix AWG/AFG version 3.3

Online Help part number: 076-0001-12

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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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About ArbExpress Version 3.3 AXW100 Software

ArbExpress AXW100 Waveform Creation and Editing Tool for Tektronix AWG/AFG is PC-based software that runs on the Windows 7 Enterprise, Windows 98, Windows NT, Windows 2000, Windows XP Professional, and Windows Me operating systems.

ArbExpress generates waveforms for Tektronix signal-source instruments. You can create and edit waveforms: transfer waveforms to and from Tektronix oscilloscopes, Arbitrary Waveform Generators (AWG), and Arbitrary Function Generators (AFG), and remotely control AWGs and AFGs. ArbExpress generates the following standard waveforms: — Sine, Square, Triangle, Pulse, DC, Exponential Rise, Exponential Decay, Noise, Sinc, Sweep, Multi-Tone, and Lorentz.

Configuration

The minimum requirements for the ArbExpress AXW100 application:

OS supported	Minimum requirements
Windows 7 Enterprise	Pentium III @ 800 MHz and higher
Windows XP Professional Service Pack 1	256 MB RAM
Or	300 MB Free Disk Space
Windows 2000	Microsoft Windows® Internet Explorer® 5.01
Or	800 X 600 Display Resolution
Windows 98/Me	
Or	
Windows NT Service Pack 6a	

The following table lists the conditions under which ArbExpress uses TekVisa version 4.0.0.80 and newer to send data to a Tektronix arbitrary waveform generator. If TekVisa is not already installed on your PC, you can download the software from www.tektronix.com/software.

Communication type	AWG/AFG	Oscilloscope
LAN	The AWG400, AWG500, AWG600, and AWG700 series of instruments are supported through raw sockets (TekVisa may not be required [1]).	TekVisa required
	The AFG2000 and AFG3000 series of instruments are supported through VXI 11 server.	
	These instruments are not supported through raw sockets (TekVisa is required).	
	MDO3000 Series oscilloscopes with MDO3AFG option enabled.	
GPIB	TekVisa required	TekVisa required
RS232	Not supported	TekVisa required
USB	TekVisa required [2]	TekVisa required

[1]   * AFG300 and AWG2000 series instruments do not support LAN

[2]   ** Only the AFG 2000 and AFG3000 series instruments support USB

ArbExpress supports file transfer and control from MATLAB version 6.1, release 12.1. To use this feature, install TekVisa.

Installation

This section describes how to install the ArbExpress AXW100 application using the InstallShield Wizard.

1. Insert the ArbExpress CD-ROM into the CD-ROM drive.

2. If the installation program does not automatically start, double–click *setup.exe* in the folder **\ArbExpress** on the CD-ROM. The installation wizard opens.

3. Follow the onscreen instructions. To navigate through the wizard, click **Next** or **Back** to move to the next or previous screen.

   The installation wizard sequence of screens:

   - Welcome

   - License Agreement

   - Choose Destination Location

   - Start Copying Files

   - Setup Status

   - View Release Notes

4. In the Welcome screen, click **Next**.

5. In the License Agreement screen:

  a. Read the License Agreement carefully.

  b. Select **I accept the terms of the License agreement**, and then click **Next**.

6. In the Choose Destination Location screen:

  a. To install ArbExpress in the default folder **C:\Program Files\Tektronix\ArbExpress**, click **Next**.

   —or—

  b. To install ArbExpress elsewhere, click **Browse**.

7. In the Start Copying Files screen, click **Next**.

The Setup Status screen opens and displays a progress bar. ArbExpress is installed in the folder you selected in the Choose Destination Location screen, and a shortcut is added to the Start menu.

When the installation is complete, the message "ArbExpress Software Setup completed successfully" is displayed. If TekVisa is not already on your computer, ArbExpress displays a message to install them. The installation programs are located on the ArbExpress CD-ROM in the folders **\TekVisa** and **\DotNet Framework**.

If the USB Device Driver does not install automatically, you must install it manually:

  a. Power on the USBTMC-compliant instrument and connect it to the computer.

  b. In the Found New Hardware wizard, follow the onscreen instructions.

  c. Choose **Install from a list or specific location**.

  d. Select **Don't choose, I will choose the driver to install**.

  e. For the location of the driver, enter **C:\vxipnp\winnt\tekvisa\bin**.

  f. Select *TekUSB.inf*, and then click **Open**.

   The driver is installed. For more information, see the TekVisa *readme.pdf* file.

8. Click **Finish** to exit.

Using Help

Select Help on the right side of the application menu bar to show the Help.

Table of Contents (TOC) tab — organizes the Help into book-like sections. Select a book icon to open a section; select any of the topics listed under the book.

Index tab — enables you to scroll through alphabetical list of keywords. Select the topic of interest to show the appropriate help page.

Search tab — allows a text-based search.

To search with the Search tab:

1. Type the word or phrase you want to find in the search box.

2. Select some matching words in the next box to narrow your search.

3. Choose a topic in the lower box, and then click **Display**.

■   To print a topic, click **Print** on the Help Topics menu bar.

■   Select Options from the menu bar to access other commands, such as annotating a topic or keeping the help window on top, or to use system colors.

■   Click **Back** to return to the previous help window. Use the hyperlink to jump from one topic to another. If the **Back** button is grayed out or a jump is not available, click **Help Topics** to return to the originating help folder.

■   Browse buttons (**Next** and **Previous**) allow you to move forward and backward through topics in the order of the Table of Contents (TOC).

Notes indicate particularly important information.

*NOTE. Certain aspects of the online help are unique. Blue-underlined text indicates a jump (hyperlink) to another topic. Click the blue text to jump to the related topic. For example, select the blue text to jump to the topic on Online Help and Related Documentation and the **Back** button to return to the previous page.*

You can tell when the cursor is over an active hyperlink (button, jump, or pop-up), because the cursor arrow changes to a small hand.

For help on specific dialog boxes, display the TOC for this help file, and then navigate to Operating Basics > Dialog Boxes.

See Also:

Printing from the Online Help

You can print topics and information from the Help viewer. Some help topics have color images that might not print if you use a monochrome printer. Instead, print the topic from the PDF file that corresponds to the Online Help. You can find the file in the main directory on the CD-ROM disk. Images in the PDF file are gray scale, so the relevant information appears in print.

To print a single topic:

1. Find the topic in the Table of Contents (TOC) pane.

2. Click **Print** from the menu.

3. Click **Print the selected topic**.

4. Click **OK**.

To print all topics in a TOC book:

1. Find the book in the TOC pane.

2. Click **Print** from the menu.

3. Click **Print the selected heading and all subtopics**.

4. Click **OK**.

TIP. If topics include expanding or drop-down hotspots, click the hotspots to display the information before you print.

Basic Operations

ArbExpress AXW100 Waveform Creation and Editing Tool for Tektronix AWG/AFG is Windows-based software with a graphical user interface that you can use to create, edit, and transfer standard waveforms to an Arbitrary Waveform Generator, an Arbitrary Function Generator, or an oscilloscope.

In this online help, all menu selections are indicated as **Menu name > Menu options**. You can access a command or a menu option in more than one way. Several main menu options are available as toolbars that you can use instead of selecting the option from the main menu. You can show or hide the toolbars and also create customized toolbars. Shortcut menus, which open with a right-click, are provided for waveform editing, connecting to an instrument, and transferring a waveform to an arbitrary waveform generator or an arbitrary function generator.

The Shortcut View on the left of the screen shows options that are available in the main menu or in the toolbars. The Shortcut View provides the most common commands.

Some dialog boxes also have a Help button that displays help for that dialog box. Some other dialog boxes have a toolbar for basic operations like Open, Save, Connect, Disconnect, and Show/Hide Properties.

The following figure shows the application screen, the menu, and the toolbars.
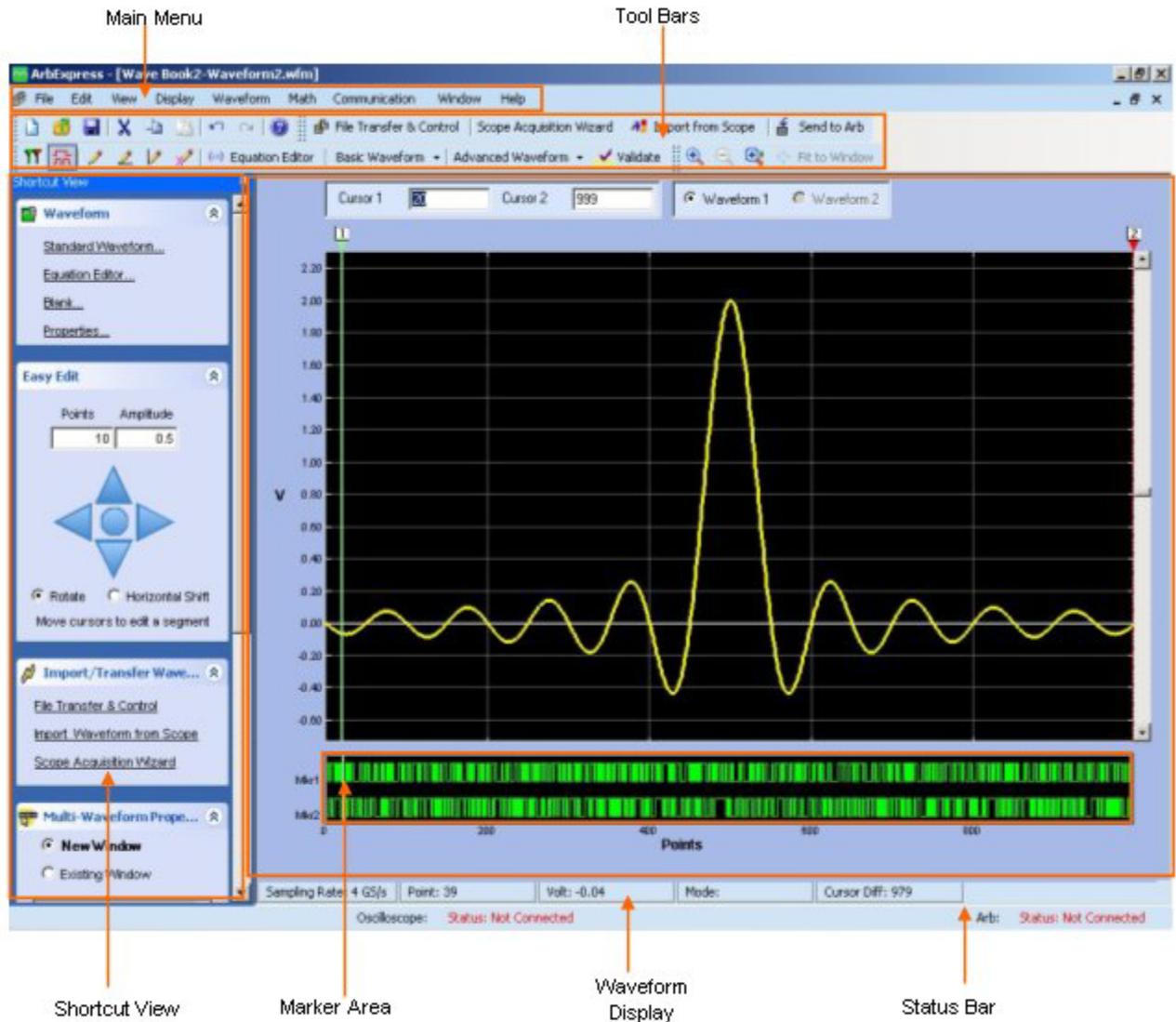
In the ArbExpress software, you can enter values in fields in different ways. In some fields, you type in the values. In others, you select from a drop-down list, and in others, you can use the spin-box to increase or decrease the values. You can type in the characters K for Kilo, G for Giga, M for Mega, u for Micro, m for milli, and n for nano.

File Name Extensions

The application uses these file name extensions to identify the file type. The following table lists the file name extensions.

File name extensions	Description
.wfm	Oscilloscope waveform files AWG waveform files created by AWG400-700, and AWG2000 series of waveform generators
.pat	AWG pattern format files
.tfw	Waveform files for the AFG2000 and AFG3000 series arbitrary/function generators
.isf	Waveform files for the TDS3000 instruments
.csv	Comma separated variable files
.txt	Text files
.equ/.eqa	Equation files
.set	AWG setup information files
.p	MATLAB compiled files
.m	MATLAB equation files
.ico	Icon files
.chm	Compiled HTML Help files
.dll	Application extension files
.exe	Application file

Application File Names and Directories

The application uses specific directories to save files. The following table lists the default directory names.

Directory	Function
C:\Program Files\Tektronix\ArbExpress\System	Stores the application file — .exe, .dll, Release notes.c, and .chm
C:\Program Files\Tektronix\ArbExpress\Documentation	Stores the user manual and the installation manual (.pdf)
C:\Program Files\Tektronix\ArbExpress\Samples\Waveform	Stores the sample waveform files (.wfm)
C:\Program Files\Tektronix\ArbExpress\Samples\Equation	Stores the sample equation files (.eqa)
C:\Program Files\Tektronix\ArbExpress\Samples\Tools\Mat-lab	Stores the sample MATLAB equation files (.m)

You can install ArbExpress in a directory of your choice.

Starting the Application

1. Run the application from the Windows Start menu by clicking **Start > Programs > Tektronix ArbExpress > ArbExpress Application**.

    —*or*—

2. Go to the folder where you have installed ArbExpress, and double-click ArbExpress.exe.

    —*or*—

3. Start the application from OpenChoice Instrument Manager.

Opening a Waveform

File > Open

To open a waveform, select **File > Open**. Browse and select the waveform file to open. You can open files with .wfm, .pat, TekScope .wfm, .tfw, .csv, and .txt, extensions.

When more than one waveform is opened in a window, the active waveform is a solid line and the inactive waveform is a dashed line.

Working with Waveforms

■   To select the active waveform, select Waveform1 or Waveform2.

■   Set the cursor positions by entering values in the Cursor1 and Cursor2 fields.

■   Drag the cursors to change the cursor readout values.

■   A tool tip dynamically displays the voltage values at the cursor position.
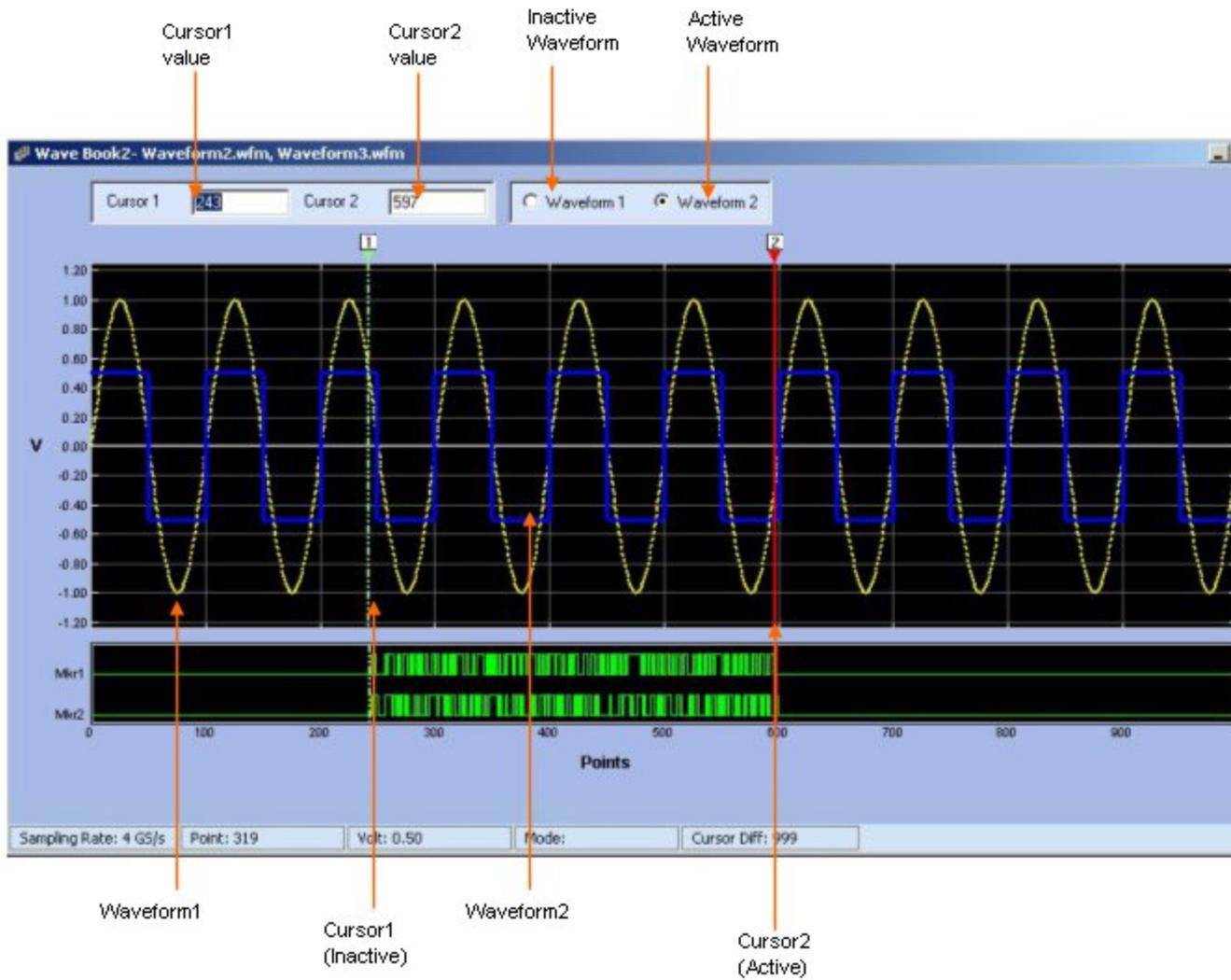
See Also:

Creating a Waveform (see page 12)

Saving a Waveform (see page 13)

Closing a Waveform (see page 14)

Creating a Waveform

File > Blank sheet

File > Standard Waveform

File > Equation Editor

The **File** menu contains three options for creating a waveform: Blank Sheet, Standard Waveform, and Equation Editor.

■   Blank Sheet — opens a blank sheet in a window. By default, the application opens the waveform with 1024 points, which you can change using **Waveform > Properties**. After you specify the number of points using Waveform Properties, the next time you create a new blank sheet, the application opens a blank sheet using the number of points that you specified.

Example

1.   Click **File > Blank Sheet**.

2.   Click **Waveform > Properties**, and then change the number of points to 500.

3.   Click **File > Blank Sheet**.

     The new blank sheet has 500 points.

4.   Click **File > Blank Sheet**.

     The new blank sheet has 1024 points.

■   Standard Waveform — displays the Standard Waveform dialog box. Use the Standard Waveform to create any of the standard waveforms that are available.

■   Equation Editor — displays the Equation Editor dialog box (see page 46). Use the Equation Editor to create a waveform or edit an existing waveform equation.

See Also:

Sine Wave (see page 79)

Square Wave (see page 82)

Triangle Wave (see page 85)

Pulse Wave (see page 88)

Noise Wave (see page 91)

DC Wave (see page 94)

Saving a Waveform

File > Save

File >Save As

You can save the waveform in the following formats: AWG Wfm (.wfm), AWG Pat (.pat), AWG 2000 Wfm (.wfm), AWG. csv (.csv), MDO3000 csv (.csv), and AFG Tfw (.tfw).

The application automatically saves a .set file with the same name as the waveform file. The .set file contains the voltage values and the offset of the waveform, and the .wfm file contains the normalized waveform.

See Also:

Closing a Waveform

File> Close

When you close a waveform, the application closes the current window. If the waveform is not saved, you are prompted to save it. In a multiple waveform display, Close closes the active waveform.

See Also:

Creating a Waveform (see page 12)

Opening a Waveform (see page 10)

Saving a Waveform (see page 13)

Exiting the Application

File> Exit

If you have not saved the waveforms, you are prompted to do so.

Shortcut Keys

You can use the following shortcut keys for the application commands:

Menu item	Shortcut key
File> Blank Sheet	Ctrl + N
File> Standard Waveform	Ctrl + W
File> Open	Ctrl + O
File> Save	Ctrl + S
File> Exit	Ctrl + E
Edit> Undo	Ctrl + Z
Edit> Redo	Ctrl + Y
Edit> Cut	Ctrl + X
Edit> Copy	Ctrl + C
Edit> Paste	Ctrl + V
Edit> Select All	Ctrl + A
Edit> Invert	Ctrl + I
Edit> Mirror	Ctrl + M
Edit> Freehand	Ctrl + F
Display> Zoom In	Alt + Shift + Z
Display> Zoom Out	Alt + Shift + X
Display> Fit to Window	Alt + Shift + F
Display> Cursor	Ctrl + Shift + C
Display> Marker	Ctrl + Shift + M
Display> Properties	Ctrl + Shift + P

Menus

The application menu bar changes depending on whether a waveform is displayed. If no waveform is open, the menu bar is:

When a waveform is open, the menu bar is:

See Also:

File Menu (see page 18)

Edit Menu (see page 19)

View Menu (see page 21)

Display Menu (see page 21)

Waveform Menu (see page 23)

Math Menu (see page 24)

Communication Menu (see page 26)

Window Menu (see page 27)

File Menu
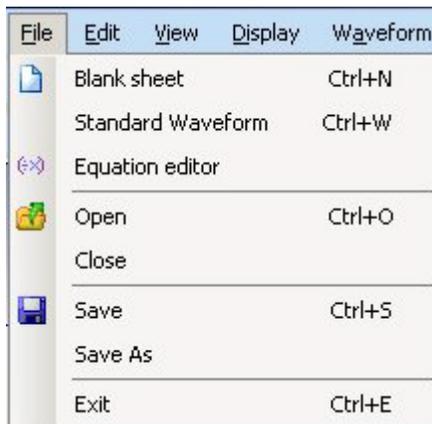
Menu selection	Description
Blank sheet (see page 12)	Opens a blank waveform file (.wfm)
Standard Waveform (see page 12)	Opens the Standard Waveform dialog box that you can use to create standard waveforms
Equation Editor (see page 12)	Opens the Equation Editor dialog box that you can use to create waveforms
Open (see page 10)	Opens a waveform file (.wfm, .pat, .tfw, . csv, .txt)
Close (see page 14)	Closes an open waveform file
Save (see page 13)	Saves changes to the currently open waveforms
Save As (see page 13)	Saves files to a different file name using the Save as dialog box (.wfm, AWG wfm, AWG2000 wfm), .pat, .csv, .tfw)
Exit (see page 15)	Exits the application

See Also:

Edit Menu

The Edit menu is visible only if a waveform window is open.
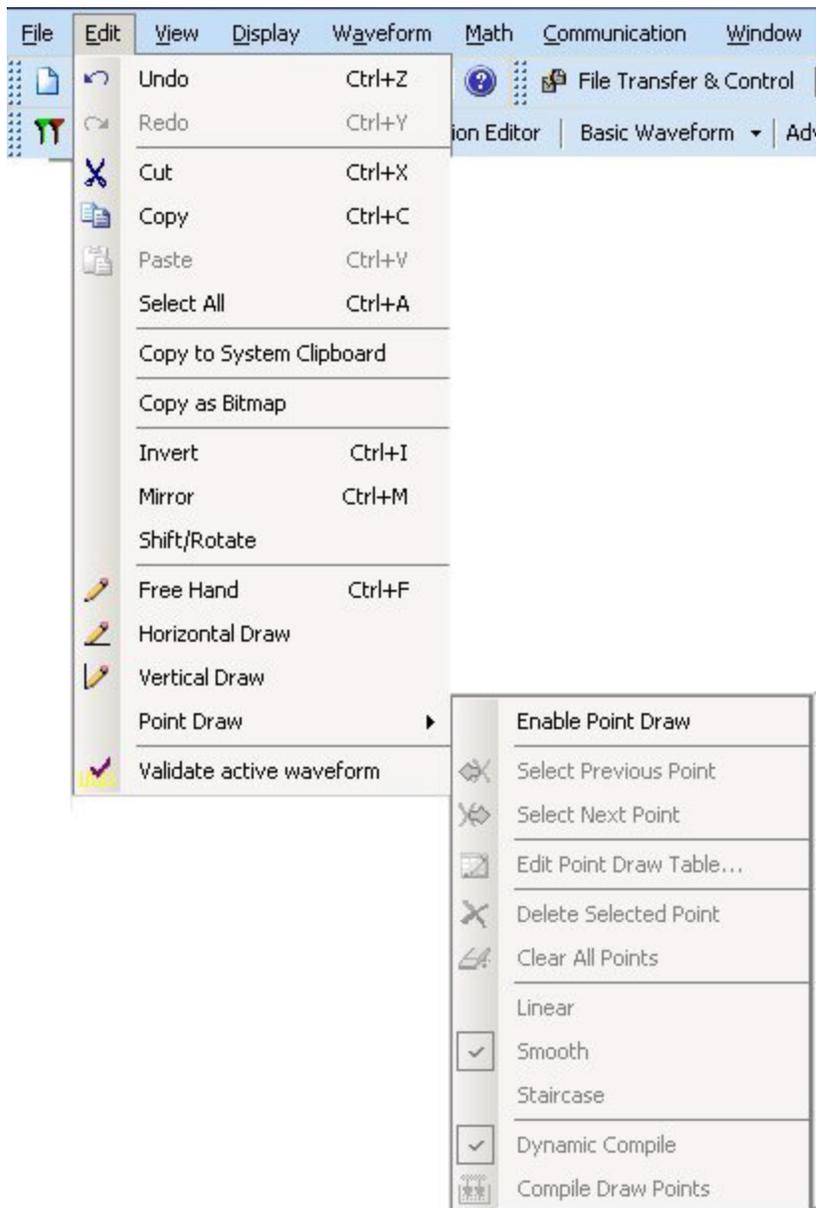
Menu selection	Description
Undo (see page 117)	Undoes the last operation performed on a waveform
Redo (see page 117)	Redoes the last operation performed on a waveform
Cut (see page 118)	Cuts the portion of a waveform that is between cursors
Copy (see page 118)	Copies the portion of a waveform that is between cursors
Paste (see page 119)	Displays the paste options allowing you to choose where to paste
Select All (see page 120)	Selects and copies the entire waveform into the memory
Copy to System Clipboard (see page 121)	Copies the waveform that can be pasted in Microsoft Excel or Microsoft Word
Copy as Bitmap (see page 122)	Copies the selected waveform window as a bitmap that can be pasted into Microsoft Word or Microsoft Excel
Invert (see page 122)	Inverts the portion of a waveform between the cursors
Mirror (see page 123)	Mirrors the portion of a waveform between the cursors
Shift/Rotate (see page 44)	Shifts the waveform by the defined amplitude or rotates the waveform by a defined number of points
Freehand (see page 123)	Draws a waveform along the path you trace
Horizontal Draw (see page 124)	Allows drawing only horizontally
Vertical Draw (see page 124)	Allows drawing only vertically
Point Draw (see page 125)	The submenu options are: Enable Point Draw, Edit Point Draw Table..., Linear, Smooth, Staircase, Dynamic Compile, Compile Point Draw, Next Point Draw Point, Previous Point Draw Point, Delete Point, Clear All.
Validate active waveform	Verifies whether the active waveform can be generated in the target instrument

See Also:

Operating Basics   View Menu

View Menu
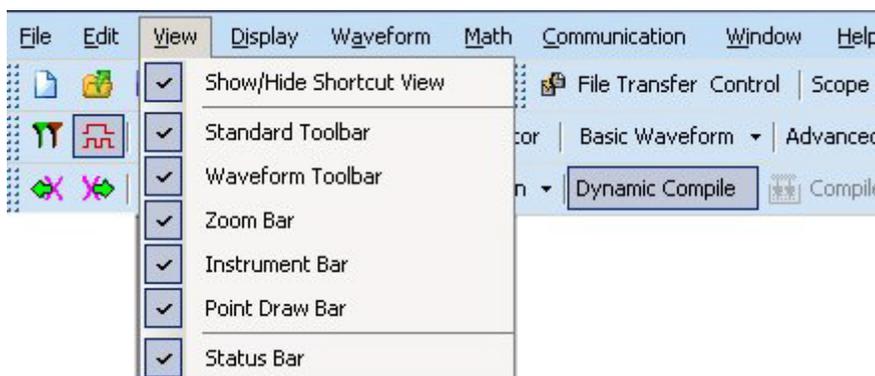
Menu selection	Description
Show/Hide Shortcut View (see page 36)	Displays and hides the shortcut view
Standard Toolbar (see page 31)	Displays and hides the standard toolbar
Waveform Toolbar (see page 31)	Displays and hides the waveform toolbar
Zoom Bar (see page 33)	Displays and hides the zoom toolbar
Instrument Bar (see page 34)	Displays and hides the instrument bar
Point Draw Toolbar (see page 35)	Displays the point draw toolbar
Status Bar (see page 36)	Displays and hides the status bar

See Also:

File Menu (see page 18)

Edit Menu (see page 19)

Display Menu (see page 21)

Waveform Menu (see page 23)

Math Menu (see page 24)

Communication Menu (see page 26)

Window Menu (see page 27)

Help Menu (see page 28)

Display Menu

The Display menu is available only when a waveform is displayed in the window.

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Menu selection	Description
Zoom In (see page 114)	Zooms in to the area selected
Zoom Out (see page 114)	Zooms out from the point selected
Horizontal Zoom In (see page 115)	Zooms in horizontally from the point selected
Fit to Window (see page 115)	Restores the view to the state that it was before the first zoom operation
Cursor (see page 113)	Shows or hides the cursors
Cursor Position... (see page 113)	Positions the cursor exactly at the points or time specified
Marker (see page 112)	Shows or hides horizontal markers that you can set patterns and triggers
Crosshair (see page 116)	Changes the cursor type to crosshair
Graticule (see page 116)	Shows or hides the graticule for the waveform
Time Scale (see page 116)	Displays time along the X-axis
Properties... (see page 116)	Displays the properties – color, line style, line width, and cursor colors – of the selected waveform

See Also:

File Menu (see page 18)

Edit Menu (see page 19)

View Menu (see page 21)

Waveform Menu (see page 23)

Math Menu (see page 24)

Communication Menu (see page 26)
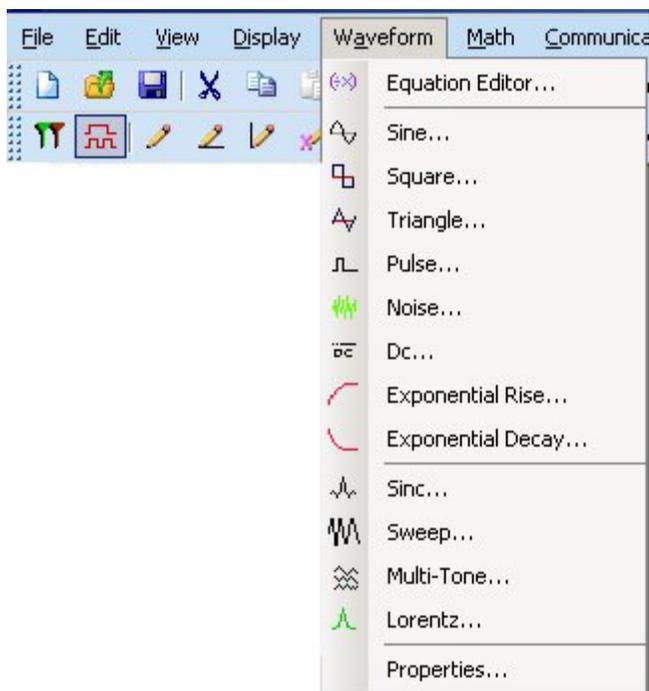
Waveform Menu

Menu selection	Description
[Equation Editor... (see page 75)](#)	Creates a waveform using the equation editor
[Sine... (see page 79)](#)	Creates a sine wave
[Square... (see page 82)](#)	Creates a square wave
[Triangle... (see page 85)](#)	Creates a triangular wave
[Pulse... (see page 88)](#)	Creates a pulse wave
[Noise... (see page 91)](#)	Creates a noise wave
[Dc... (see page 94)](#)	Creates a DC wave
[Exponential Rise... (see page 96)](#)	Creates a exponential rise wave
[Exponential Decay... (see page 98)](#)	Creates a exponential decay wave
[Sinc... (see page 101)](#)	Creates a sinc wave
[Sweep... (see page 103)](#)	Creates a sweep wave
[Multi-Tone... (see page 106)](#)	Creates a multi-tone wave

Menu selection	Description
Lorentz ... (see page 109)	Creates a Lorentz wave
Properties... (see page 42)	Displays the multi-waveform properties, waveform properties, and preferences

See Also:

Math Menu

The Math menu is available only when a waveform window is open.
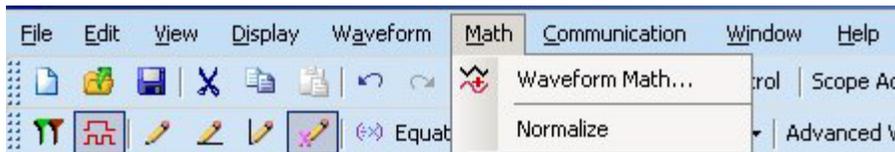
Menu Selection	Description
Waveform Math...	
Operations:	
Add	Adds the points of the selected waveforms and displays the resulting waveform
Subtract	Subtracts the points of the selected waveforms and displays the resulting waveform
Multiply	Multiplies the points of the selected waveforms and displays the resulting waveform
Divide	Divides the points on the waveform and displays the resulting waveform (available only when applying a scalar value)

Menu Selection	Description
Scalar Value	Performs a scalar operation (addition, subtraction, multiplication, division) on the waveform
Copy from Clipboard	Performs an operation (addition, subtraction, multiplication, division) on the selected waveform with points copied to the clipboard
Normalize (see page 157)	Scales the waveform signal value to a ±1.0 range, with 0 as the center

See Also:

Communication Menu
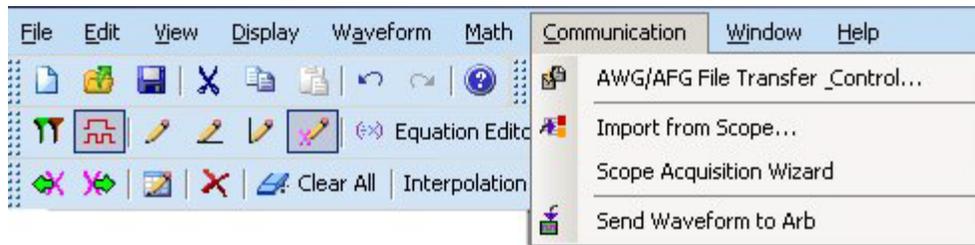
Menu selection	Description
AWG / AFG File Transfer... (see page 135)	Connects and transfers files to and from an arbitrary waveform or function generator and allows you to change instrument parameters like clock frequency, voltage, offset and others of the instrument connected
Import from Scope... (see page 144)	Connects and acquires a waveform from an oscilloscope
Scope Acquisition Wizard (see page 149)	Guides you through steps to acquire data from a connected oscilloscope
Send Waveform to Arb (see page 148)	Sends the waveform to a connected AWG/AFG

See Also:

File Menu (see page 18)

Edit Menu (see page 19)

View Menu (see page 21)

Display Menu (see page 21)

Waveform Menu (see page 23)

Math Menu (see page 24)

Window Menu (see page 27)

Help Menu (see page 28)

Window Menu
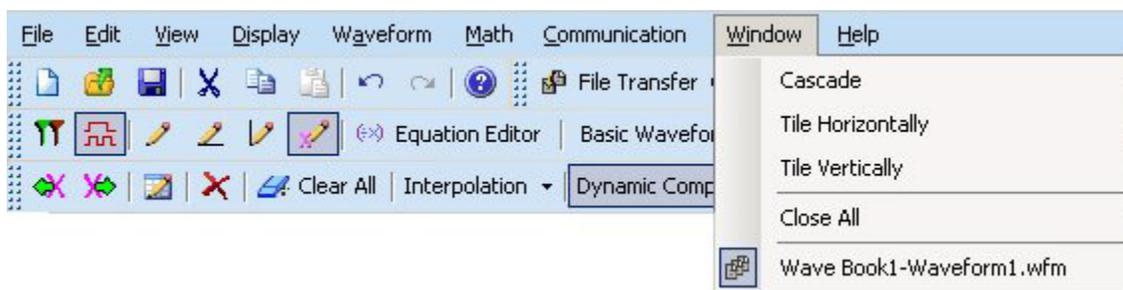
Menu selection	Description
Cascade	Arranges the open windows in the application client area from upper-left to lower-right so that they overlap one another
Tile Horizontally	Arranges the open windows horizontally in the application client area without overlapping
Tile Vertically	Arranges the open windows vertically in the application client area without overlapping
Close All	Closes all open windows in the client area
List of open windows	Allows you to jump to an open or inactive window

See Also:

File Menu (see page 18)

Edit Menu (see page 19)

View Menu (see page 21)

Display Menu (see page 21)

Waveform Menu (see page 23)

Math Menu (see page 24)

Communication Menu (see page 26)

Window Menu (see page 27)

Help Menu (see page 28)

Help Menu

The Help menu is always visible.
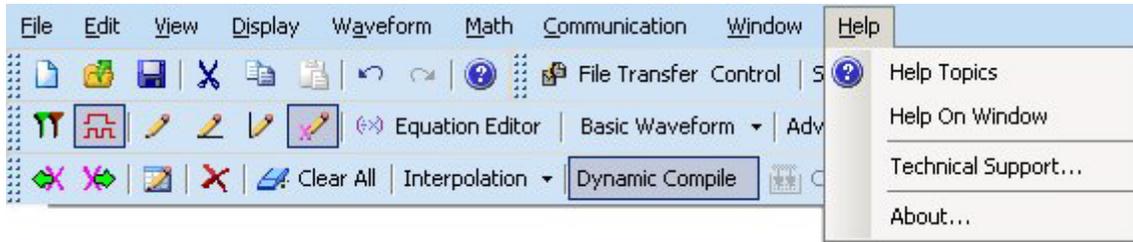
Menu selection	Description
Help Topics	Displays the Help contents
Help on Window	Displays the help topic for the active window
Technical Support...	Displays the Tektronix Technical Support Web site for the ArbExpress application
About...	Displays version and copyright information

See Also:

File Menu (see page 18)

Edit Menu (see page 19)

View Menu (see page 21)

Display Menu (see page 21)

Waveform Menu (see page 23)

Math Menu (see page 24)

Communication Menu (see page 26)

Window Menu (see page 27)

Use Shortcut Menu for Waveforms

View the shortcut menu by right-clicking inside an open waveform window.

Open
Save
Close
Cut
Copy
Paste
Select All
Zoom ▶
Time Scale
Set Cursor Position
FreeHand
Horizontal Draw
Vertical Draw
Point Draw
Waveform Properties
Send Waveform to Arb
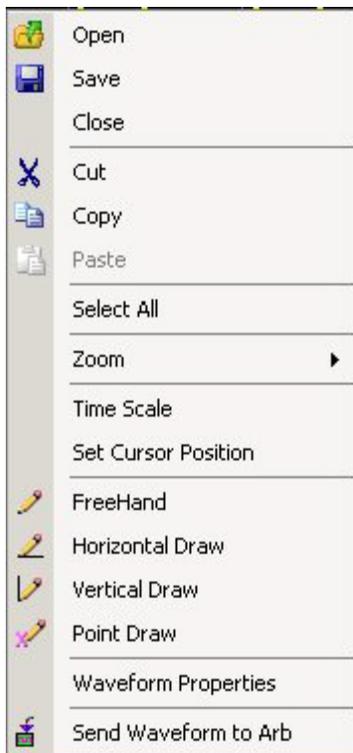
Menu selection	Description
Open (see page 10)	Opens a waveform file (.wfm, .pat, .csv, .txt)
Save	Saves the currently selected waveform
Close	Closes the currently selected waveform
Cut (see page 118)	Cuts the portion of a waveform that is between cursors
Copy (see page 118)	Copies the portion of a waveform that is between cursors
Paste (see page 119)	Pastes the selected portion of a waveform at the cursor which has a lower value
Select All (see page 120)	Selects and copies the entire waveform into the memory
Zoom (see page 114)	Opens a submenu with options to zoom in, zoom out, and Fit to Window
Time Scale (see page 116)	Displays the waveform with time as the X-axis and voltage along the Y-axis
Set Cursor Position (see page 113)	Positions the cursor exactly at the points or time specified
Freehand (see page 123)	Draws a waveform along the path you trace
Horizontal Draw (see page 124)	Allows drawing only horizontally
Vertical Draw (see page 124)	Allows drawing only vertically
Waveform Properties (see page 42)	The dialog box has three tabs: Active Waveform, Multi-waveform, and Preferences.
Send Waveform to Arb (see page 148)	Sends the waveform to the connected instrument

In Point Draw mode, right-click inside an open waveform window to display the following shortcut menu:
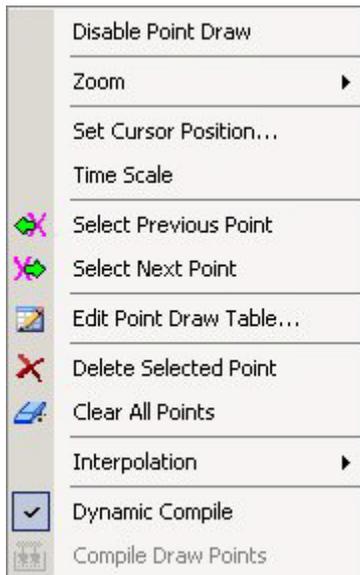
Menu item	Description
Disable Point Draw	Disables point draw mode
Zoom	Has options that you can use to Zoom In, Zoom Out, Horizontal Zoom In, and Fit to Window
Set Cursor Position...	Opens the Cursor Position dialog box that you can use to set the cursor position in points or seconds
Time Scale	Changes the values on X axis into time domain
Select Previous Point	Highlights the previous point in the sequence
Select Next Point	Highlights the next point in the sequence
Edit Point Draw Table...	Opens the point draw table where you can edit the points and set the interpolation method
Delete Selected Point	Deletes the selected point
Clear All Points	Clears the display of all the points but the continues to display the waveform
Interpolation	Sets the interpolation method to use while generating the waveform. You can choose form Smooth, Linear, and Staircase.
Dynamic Compile	Compiles the waveform as you click the points using the interpolation method you have chosen
Compile Draw Points	Compiles the waveform using the interpolation method you have chosen only when you click Compile

Standard Toolbar

View> Standard Toolbar

The standard toolbar is displayed, by default, below the main menu. You can place the toolbar anywhere in the application window.

The toolbar has icons for the standard functions — New blank waveform, Open existing waveform, Save the waveform, Cut waveform between cursors, Copy waveform between cursors, Paste waveform, Undo, Redo, and Help.
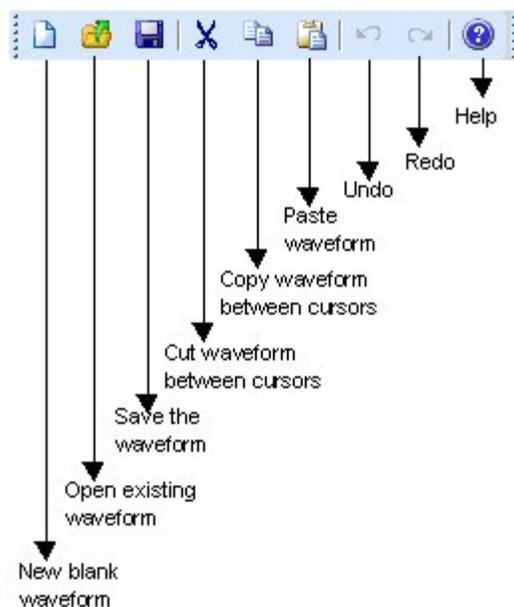
See Also:

Waveform Toolbar

View> Waveform Toolbar

The waveform toolbar is displayed, by default, below the standard toolbar. You can place the toolbar anywhere within the application window. The waveform toolbar has icons for the functions — Cursors, Markers, Freehand Draw, Horizontal Draw, Vertical Draw, Equation Editor, Basic Waveform, Advanced Waveform, and Validate.

See Also:

Zoom Bar

View> Zoom Bar

The zoom toolbar is displayed, by default, alongside the waveform toolbar. You can place the toolbar anywhere within the application window. The zoom toolbar has icons for the functions — Zoom In, Zoom Out, Zoom In Horizontally, and Fit to Window.
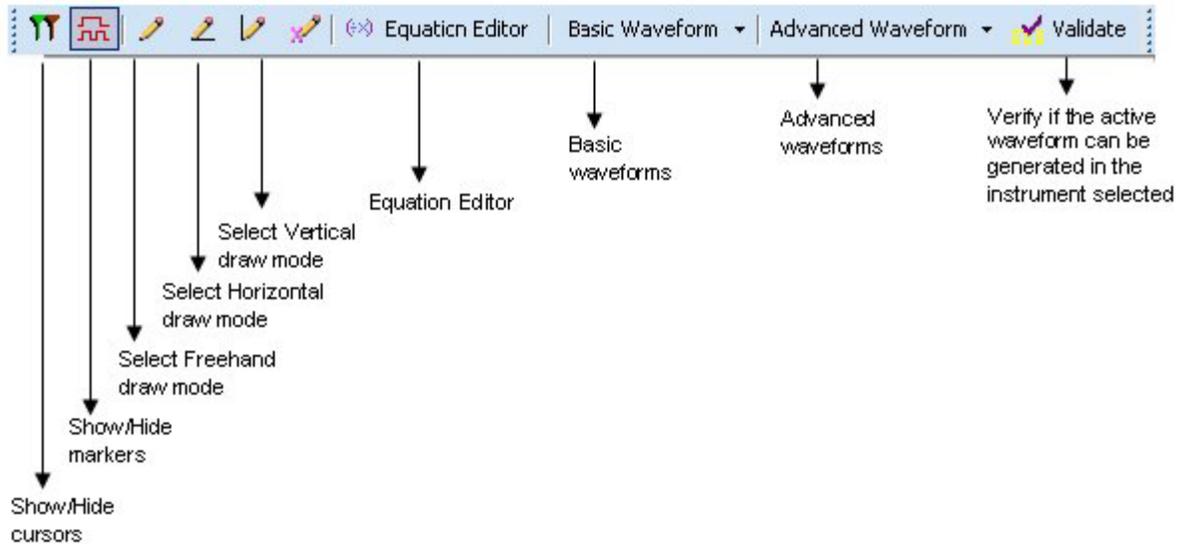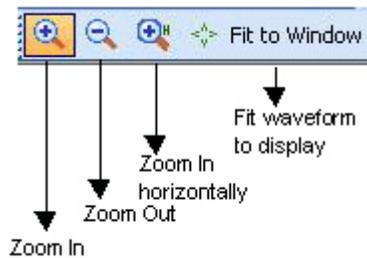
See Also:

Standard Toolbar (see page 31)

Waveform Toolbar (see page 31)

Instrument Bar (see page 34)

Status Bar (see page 36)

Instrument Bar

View> Instrument Toolbar

The instrument toolbar is displayed, by default, below the main menu. You can place the toolbar anywhere within the application window. The toolbar has icons for the standard functions — File Transfer and Control, Scope Acquisition Wizard, Import from Scope, and Send Waveform to Arb.
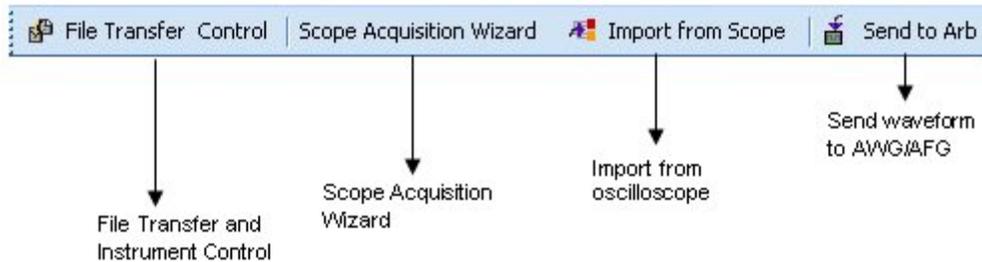
See Also:

Standard Toolbar (see page 31)

Waveform Toolbar (see page 31)

Zoom Bar (see page 33)

Status Bar (see page 36)

Point Draw Toolbar

The point draw toolbar is displayed, by default, below the main menu. You can place the toolbar anywhere within the application window.

The toolbar has icons for the functions — Enable Point Draw, Select Draw Point, Previous PD Point, Next PD point, Delete Point, Edit PD Table, Interpolation Method, Dynamic Compile, and Compile.

See Also:

Status Bar

View> Status Bar

The application has two status bars: the Application status bar, and the Waveform status bar.

The Application status bar is displayed at the bottom of the application window. It shows the type of instrument that is connected and its status. You can turn on or off the Application Status bar from the View menu.

Oscilloscope:	Status: Not Connected		Arb:	Status: Not Connected

The Waveform status bar displays the sampling rate, points, signal voltage, editing mode, and cursor difference. When you view a standard waveform, the voltage readout on the status bar displays the height of the waveform where it crosses the active cursor or the vertical line of the pointer/crosshair. In draw mode, the voltage readout is the actual vertical height of the draw pointer.

Sampling Rate: 0.0 GS/s	Point: 944	Volt: 0.920	Mode:	Cursor Diff: 999
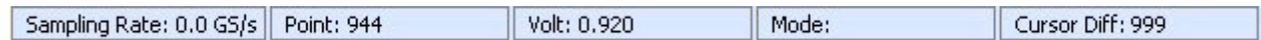
See Also:

Standard Toolbar (see page 31)

Waveform Toolbar (see page 31)

Zoom Bar (see page 33)

Instrument Bar (see page 34)

Shortcut View

The Shortcut View occupies the left part of the display. You can keep the shortcut view open by clicking the pin at the top right corner of the panel. You can show or hide each selection in the shortcut panel by pressing the double arrow at the top right corner of each panel.

Menu selection	Description
New Waveform (see page 38)	Allows you to create a new or blank waveform, standard waveform, or a new equation
Easy Edit (see page 39)	Allows you to shift or rotate the waveform

Menu selection	Description
Import/Transfer Waveform (see page 41)	Allows you to acquire or import waveform from an oscilloscope
Multi-Waveform Properties (see page 40)	It also allows you to open a existing waveform in either a new window or an existing window

New Waveform View

View > Shortcut View

Use the New Waveform panel in the Shortcut View to create a standard waveform, a waveform using the equation editor, or a blank waveform. You can view and modify the properties of one or more waveforms, and set preferences. A single window displays a maximum of two waveforms.

Menu selection	Description
Standard Waveform...	Displays a Standard Function dialog box where you can select the type of waveform to generate and set the parameters
Equation Editor...	Displays the Equation Editor dialog box where you can select an equation from the standard equations provided, modify it, or create a new equation
Blank...	Displays a blank screen where you can draw or generate a waveform
Properties...	The dialog box has three tabs: Multi-waveform, Waveform, and Preferences

See Also:

Sine Wave (see page 79)

Square Wave (see page 82)

Triangle Wave (see page 85)

Pulse Wave (see page 88)

Noise Wave (see page 91)

Easy Edit

View > Shortcut View

Use the Easy Edit bar to shift or rotate the waveform by a defined number of points and amplitude. You can shift the waveform or the portion of the waveform that is between cursors left, right, up, or down. You can rotate the waveform left or right.
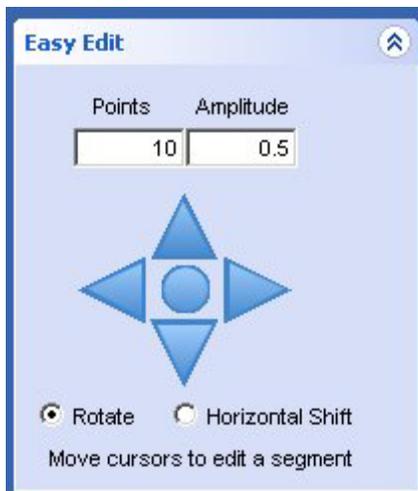
Type the number of points and amplitude by which to rotate or shift the waveform. If the option Rotate Waveform is checked, the waveform is rotated. If the selection is cleared, the waveform is shifted.

Multi-Waveform Properties

View > Shortcut View

Use the Multi-Waveform Properties panel in the Shortcut View to select the window for opening a new or existing waveform.

When you select the New Window option, the waveform is opened in a new window.

When you select the Existing Window option, the waveform is opened in an existing window. Select the existing window using the Wave Book list box in the panel.

To display the waveform in an existing window, ensure that the new waveform has:

■ The same sampling rate as the existing waveform; if the sampling rate is different, then select **Change the Incoming waveform's Sampling rate** to change the sampling rate of the new waveform to match that of the existing waveform. Or, select **Change the Existing waveform's Sampling rate** to change the sampling rate of the existing waveform to match that of the incoming waveform.

■ Equal number of points as the existing waveform.

Import or Transfer Waveform

View > Shortcut View

Use the Import/Transfer Waveform panel in the Shortcut View to import a waveform from a file or acquire it from an oscilloscope, File Transfer and Control, and Scope Acquisition Wizard.

Menu selection	Description
File Transfer and Control	Displays the File Transfer and Control dialog box, which you can use to transfer files to an AWG/AFG and control the instrument.
Import Waveform from Scope	Displays the Import Waveform from Scope dialog box, which you can use to import a waveform from and oscilloscope
Scope Acquisition Wizard	Launches the Scope Acquisition Wizard, which you can use to acquire data from a connected oscilloscope

See Also:

Import from Oscilloscope (see page 144)

File Transfer and Control (see page 135)

Scope Acquisition Wizard (see page 149)

Dialog Boxes

Most of the ArbExpress application dialog boxes have a corresponding help topic. To display descriptions for the dialog boxes, display the dialog box and click **Help**.

For help on specific dialog boxes, display the Table of Contents for this help file, and then navigate to Operating Basics > Dialog Boxes.

Waveform Properties Dialog Box

Waveform > Properties

Use this dialog box to view and modify properties of multiple waveforms, a selected waveform, and the application preferences. The dialog box has three tabs: Active Waveform, Multi-waveform, and Preferences.

Active Waveform

Select the Waveform tab to view and modify the properties of the selected waveform. For multiple waveform display, choose the waveform by selecting the Waveform1 or Waveform2 button located just above the waveform display.

To save the waveform, click **File > Save** or **File > Save As**.

Option	Description
Instrument	Select the instrument from the list.
Sampling Rate	Displays the sampling rate of the selected waveform.
Resampling waveform using	Shows the number of points used for resampling.
Select resampling method	Select the algorithm to use when resampling and recreating the waveform (Sinc, linear, or Add Points with zero amplitude). Marker data is not resampled, but marker data may be added or removed.
Normalize the waveform before saving the file	Normalizes the waveform before saving it. The waveform amplitude is set between – 1 and +1 before the waveform is saved.

Multi-waveform

Select the Multi-waveform tab to set up the window in which to display the waveforms.

When more than one waveform is displayed in a window or a wave book, you can select the waveform to edit or work with by selecting the Waveform1 or Waveform2 button located just above the waveform display. When you open or display a second waveform in the same window or wave book, the first waveform is shown as a dotted line.

NOTE. *A window or wave book can display a maximum of two waveforms. If you try to open or display more than two waveforms in a single window or wave book, you are prompted with the message "Only two waveforms can be opened or created in a Wave Book".*

NOTE. Only waveforms with the same number of samples can be displayed in a wave book.

Option	Description
New Window	Displays or opens the waveform in a new window
Existing Window	Displays or opens the waveform in an existing window
Wave book	Displays the list of wave books to choose to display the waveform
Change the incoming waveform's clock	Changes the incoming or new waveform clock to match the clock of the existing waveform
Change the existing waveform's clock	Changes the existing waveform clock to match the incoming or new waveform clock

Preferences

Use the Preferences tab to set preferences for a waveform.

Option	Description
Save .set file along with .wfm and .pat files	The .set file contains the voltage and offset of the waveform. Enable this before creating a waveform
Show paste option before pasting	Displays the Paste option dialog box before pasting the contents
Always enables the instrument's outputs after transferring the waveform	Switches on the destination channel to which the waveform is transferred and sets the instrument in the Run mode

Paste Option Dialog Box

Edit > Paste

Use this dialog box to paste the copied portion of the waveform.

If you select **Don't show this again and always paste at active cursor**, the application does not display the Paste Options dialog box and always pastes the contents at the active cursor.

Option	Description
Paste at active cursor	Pastes the contents at the active cursor. The active cursor in indicated by a solid line.
Prepend to the waveform	Pastes the copied contents at the beginning of the waveform
Append to the waveform	Pastes the copied contents at the end of the waveform
Replace between cursors	Pastes the copied contents the between the cursors
Don't show this again and always paste at active cursor	If checked, always pastes the copied contents at the active cursors and does not display the dialog box next time

Shift/Rotate Dialog Box

Edit > Shift/Rotate

Use this dialog box to set the number of points and amplitude by which to shift or rotate the waveform or the portion of the waveform that is between cursors. The amplitude value is used only during waveform shift and not during waveform rotation.

The direction of rotation is either left or right. The direction of shift is either up, down, left, or right.

Option	Description
Points	Sets the number of points by which to rotate the waveform
Amplitude	Sets the amplitude by which to shift the waveform
Vertical Segment	
Shift Up	Shifts the waveform up by the specified amplitude
Shift Down	Shifts the waveform down by the specified amplitude
Horizontal Segment	
Rotate Right	Rotates the waveform to the right by the specified number of points
Rotate Left	Rotates the waveform to the left by the specified number of points
Shift Right	Shifts the waveform to the right by the specified number of points
Shift Left	Shifts the waveform to the left by the specified number of points

Point Draw Table Dialog Box

Edit > Point Draw > Edit Point Draw Table

Use this dialog box to enter waveform points in a blank table or edit a point draw table that has points in it already. This table works similarly to a Microsoft Excel worksheet.

Option	Description
Insert Point	Inserts a row (point) above the selected row
Delete Point	Delete the selected row (point)
Clear All	Clears all the rows (points) in the table
Interpolation	Sets the interpolation method to Linear, Smooth, or Staircase
X Value	Displays the X value in Positions (points) or in Time (seconds)

The application checks the values you enter for the following:

■ X-value (sampling point) must always be unique. If you try to repeat this value, the message, "Values of the sampling index should be unique" appears.

■ If you leave the amplitude (Y) blank, the applications fills it with a zero.

■ If you enter a Y value but no corresponding X value, an error appears.

Click **OK**. If the application finds no errors, the point draw table closes and the waveform in the **Wave Book** window is updated to reflect the changes that you made in the point draw table.

Cursor Position Dialog Box

Display > Cursor Position

Use this dialog box to specify the cursor position in points or seconds.

Option	Description
Points/Seconds	
Points	Select Points to set the cursor position in points.
Seconds	Select Seconds to set the cursor position in seconds.
Cursor Position	
Cursor 1	Enter the position for Cursor 1 in the units selected in the previous option.
Cursor 2	Enter the position for Cursor 2 in the units selected in the previous option.

Display Properties Dialog Box

Display > Properties

Use this dialog box to view the waveform display properties.

Option	Description
Waveform Name	Lists the waveforms available in the active window
Enable Graticule	Displays the graticule when checked
Background Color	Changes the background color of the waveform window
Waveform Properties	
Color	Displays the waveform color and allows you to change the waveform color
Line Style	Displays the waveform line style and allows you to change the style
Line Width	Displays the waveform line width and allows you to change the line width
Marker Color	
Marker1	Displays the color of Marker1 and allows you to change it
Marker2	Displays the color of Marker2 and allows you to change it
Cursor Color	
Cursor1	Displays the color of Cursor1 and allows you to change it
Cursor2	Displays the color of Cursor2 and allows you to change it
Preview	Displays the preview of the waveform

When more than one waveform is displayed in one wave book or window, the inactive waveform has a dashed line and the active waveform has a solid line.

See Also:

Equation Editor Dialog Box

File > Equation Editor, Waveform > Equation Editor

Use this dialog box to create a waveform using the Equation Editor.

Option	Description
Number of Points	Indicates the number of samples, typically in one cycle of the waveform
Sampling Rate	Indicates the number of samples per second
Total Range	Indicates the duration of the waveform in seconds
Lock Total Range	Locks the Total Range value when checked. You can then edit only the other two variables.

The **Equation Editor** window has a toolbar that has icons for opening a file and saving a file. Click **Open** to open an equation file (.equ) from the sample files. Use the other toolbar icons to perform operations such as Close, Cut, Copy, and Paste.
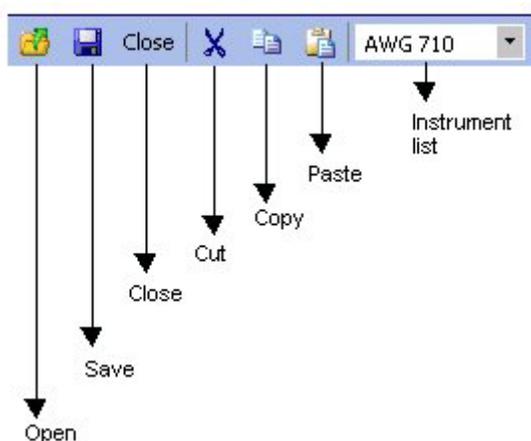
You can create an equation using either of these two methods:

- Editing an existing equation. Sample equations are provided in the **\ArbExpress\Samples\Equation** folder.

1. From the **Equation Editor** window, click the **Open** icon.

2. Browse the equations (.equ or .eqa) listed in the folder **\ArbExpress\Samples\Equation.**

3. Edit the equation using the **Edit** menu or by placing the pointer over the equation.

- Using the functions, operators, and constants

1. Create an equation in the edit area, using the functions and operators available under **Function**. Always define a range first.

2. Under **Settings**, set the Total Range to the sum of all the ranges you have defined in the equation. To do this, enter the **Number of Points** and **Sampling Rate**. After you set the total range, you can lock it and change the number of points or sampling rate.

3. Click **Compile**. The compiled equation is displayed in Preview. The compilation status and messages are displayed in Output.

If the equation compiles without any errors, the application displays the waveform in the specified window. If compilation errors occur, the application displays a message in the output pane. The **OK** button is enabled only if the compilation is successful.

The application supports the AWG2000 equation editor model. Equations created using the equation editor cannot be used on the AWG400 through AWG700 series waveform generators. For more information, see Equation Editor Reference (see page 201). Equations created using the equation editor cannot be used on the AWG400 through AWG700 series waveform generators.

To transfer the waveform to an AWG or AFG, click Send to Arb (see page 148). This button is enabled only when an instrument (AWG or AFG) is connected. You can select the channel to send the waveform to.

To view or vary the waveform properties, click Multi-Waveform Properties (see page 42). The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Equation Editor** dialog box.*

Sine Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a sine waveform.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Show Advanced Mode	Select this to show the advanced options for the horizontal parameters.
Frequency	Enter M for Megahertz, and G for Gigahertz.
Cycles	Enter the number of cycles in the waveform.
Phase	Enter the phase in degrees.

Advanced Options

Horizontal	
Frequency	Displays the frequency as Samples per Second divided by Number of Points per Cycle. You can set the frequency by entering the number of Samples per Second and the Number of Points per cycle.
	You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency.
Samples/sec	You can lock the desired Samples per Second and adjust either the Frequency or the Points per Cycle to achieve the sampling rate.
Points/cycle	You can lock the desired Points per Cycle and adjust either the Frequency or the Samples per Second to achieve the number of points per cycles.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Phase in degrees, and Cycles. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3251C, AFG3252, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click Send to Arb (see page 148). **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click Multi-Waveform Properties (see page 42). The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Square Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a square waveform.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Show Advanced Mode	Select this to show the advanced options for the horizontal parameters.
Frequency	Enter M for Megahertz, and G for Gigahertz.
Cycles	Enter the number of cycles in the waveform.
Phase	Enter the phase in degrees.
Duty Cycle	Enter the Duty Cycle as a percentage of the waveform width.

Advanced Options

Horizontal		
Frequency		Displays the frequency as Samples per Second divided by Number of Points per Cycle. You can set the frequency by entering the number of Samples per Second and the Number of Points per cycle.
		You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency.
Samples/sec		You can lock the desired Samples per Second and adjust either the Frequency or the Points per Cycle to achieve the sampling rate.
Points/cycle		You can lock the desired Points per Cycle and adjust either the Frequency or the Samples per Second to achieve the number of points per cycles.
Transitions		
Rise Time		Enter the Rise time in number of points or in seconds.
	Ramp	Select Ramp.
	$Sine^2$	Select $Sine^2$.
Fall Time		Enter the Fall time in points or seconds.
	Ramp	Select Ramp.
	$Sine^2$	Select $Sine^2$.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Phase in degrees, Cycles, and Duty Cycle. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. Under Transitions (10%-90%), set the Rise Time and Fall Time parameters. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Triangle Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a triangle waveform.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between − 1 and + 1.
Horizontal	
Show Advanced Mode	Select this to show the advanced options for the horizontal parameters.
Frequency	Enter M for Megahertz, and G for Gigahertz .
Cycles	Enter the number of cycles in the waveform.
Phase	Enter the phase in degrees.

Advanced Options

Horizontal		
Frequency		Displays the frequency as Samples per Second by Number of Points per Cycle. You can set the frequency by entering the number of Samples per Second and the Number of Points per cycle.
		You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency.
Samples/sec		You can lock the desired Samples per Second and adjust either the Frequency or the Points per Cycle to achieve the sampling rate.
Points/cycle		You can lock the desired Points per Cycle and adjust either the Frequency or the Samples per Second to achieve the number of points per cycle.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Phase in degrees, and Cycles. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click Send to Arb (see page 148). **Send to Arb** is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected.

To view or vary the waveform properties, click Multi-Waveform Properties (see page 42). The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Pulse Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a pulse waveform.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between − 1 and + 1.
Horizontal	
Show Advanced Mode	Select this to show the advanced options for the horizontal parameters.
Frequency	Enter M for Megahertz, and G for Gigahertz.
Cycles	Enter the number of cycles in the waveform.
Delay	Enter the delay in seconds.
Pulse Width (50%)	Enter the pulse width in seconds, typically 50% of the entire waveform width.

Advanced Options

Horizontal	
Frequency	Displays the frequency as Samples per Second divided by Number of Points per Cycle. You can set the frequency by entering the number of Samples per Second and the Number of Points per cycle.
	You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency.
Samples/sec	You can lock the desired Samples per Second and adjust either the Frequency or the Points per Cycle to achieve the sampling rate.
Points/cycle	You can lock the desired Points per Cycle and adjust either the Frequency or the Samples per Second to achieve the number of points per cycle.
Transitions	
Pulse Direction	Select the pulse direction.
Positive	Select positive pulse direction.
Negative	Select negative pulse direction.
Rise Time	Enter the Rise time in number of points or in seconds.
Ramp	Select Ramp.
Sine^2	Select Sine^2.
Fall Time	Enter the Fall time in points or in seconds.
Ramp	Select Ramp.
Sine^2	Select Sine^2.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Delay, Cycles, and Pulse Width. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. Under Transitions (10%-90%), set the Pulse Direction, Rise Time, and Fall Time parameters. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Noise Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a noise waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between − 1 and + 1.
Horizontal	
Gaussian White Noise	Select this to create a Gaussian White Noise waveform.
Pink Noise	Select this to create a Pink Noise waveform.

Option	Description
Sampling Rate	Enter the sampling rate for the waveform.
Total Number of Points	Enter the total number of points.

For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3051C, AFG3052C, AFG3151C, and AFG3152C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

DC Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a DC waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Offset	Enter the offset of the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between −1 and + 1.
Horizontal	
Sampling Rate	Enter the sampling rate for the waveform.
Total Number of Points	Enter the total number of points in the waveform.

For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3051C, AFG3052C, AFG3151C, and AFG3152C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Exponential Rise Wave Dialog Box

File > Standard Waveform

Use this dialog box to create an exponential rise waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Sampling Rate	Enter the sampling rate for the waveform.
Cycles	Enter the number of cycles in the waveform.
Phase	Enter the phase in degrees.
Total Number of Points	Enter the total number of points in the waveform.
Damp Factor	Enter the damp factor.

For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Phase in degrees, Cycles, Total Number of Points, and Damp Factor. The Sampling Rate is a fixed value for the selected instrument.

The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3051C, AFG3052C, AFG3151C, and AFG3152C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click Send to Arb (see page 148). **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click Multi-Waveform Properties (see page 42). The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Exponential Decay Wave Dialog Box

File > Standard Waveform

Use this dialog box to create an exponential decay waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.

Option	Description
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Sampling Rate	Enter the sampling rate for the waveform.
Cycles	Enter the number of cycles in the waveform.
Phase	Enter the phase in degrees.
Total Number of Points	Enter the total number of points in the waveform.
Damp Factor	Enter the damp factor.

For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Phase in degrees, Cycles, Total Number of Points, and Damp Factor. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Sweep Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a Sweep waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between − 1 and + 1.
Horizontal	
Start Frequency	Enter the frequency that you want at the beginning of the waveform.
End Frequency	Enter the frequency that you want at the end of the waveform.
Time Duration*	Enter the time between the start and end of the waveform.

Option	Description
Sampling Rate	Enter the sampling rate for the waveform.
Total Number of Points**	Enter the total number of points that make up the waveform.

1 * For the AFG2000 and AFG3000 series of instruments, type the Start Frequency, End Frequency, and Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. The Time Duration is calculated according to the following equation:

$$TimeDuration = \frac{TotalPoints}{SamplingRate}$$

For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3051C, AFG3052C, AFG3151C, AFG3152C, and MDO3000 series instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

2 ** The field Total Number of Points is disabled for the AWG7xx, AWG6xx, AWG5xx, AWG4xx, AWG2xxx, and AFG3xx series of instruments. The application calculates the Total Number of Points as the product of Time Duration and Sampling Rate.

$$TotalPoints = TimeDuration \times SamplingRate$$

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Sinc Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a Sinc waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Sampling Rate	Enter the sampling rate for the waveform.
Phase	Enter the phase in degrees.
Cycles	Enter the number of cycles in the waveform.
Total Number of Points	Enter the total number of points in the waveform.
Number of Zero Crossings	Enter the number of zero crossings for the waveform.

For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Phase in degrees, Cycles, Total Number of Points, and Number of Zero Crossings. The Sampling Rate is a fixed value for the selected

instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Multi-Tone Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a Multi-Tone waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.

Option	Description
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Start Frequency	Enter the frequency that you want at the beginning of the waveform.
End Frequency	Enter the frequency that you want at the end of the waveform.
Tone Spacing*	Enter the frequency interval between the frequencies that make up waveform.
Sampling Rate	Enter the sampling rate for the waveform.
Total Number of Points**	Enter the total number of points.

1   * For the AFG2000 and AFG3000 series of instruments, type the Start Frequency, End Frequency, and Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points.

The Tone Spacing is calculated according to the following equation:

$$ToneSpacing = \frac{SamplingRate}{TotalPoints}$$

For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3051C, AFG3052C, and MDO3000 series instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

2   **The field Total Number of Points is disabled for the AWG7xx, AWG6xx, AWG5xx, AWG4xx, AWG2xxx, and AFG3xx series of instruments. The Total Number of Points is calculated according to the following equation:

$$TotalPoints = \frac{SamplingRate}{ToneSpacing}$$

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

Lorentz Wave Dialog Box

File > Standard Waveform

Use this dialog box to create a Lorentz waveform. The waveform has no advanced options.

Option	Description
Settings	
Function	Select a standard function from the list.
Instrument	Select an instrument from the list.
Vertical	
Amp/Offset	Select Amp/Offset to set the amplitude and offset for the selected waveform.
Amplitude	Enter the amplitude of the waveform in volts.
Offset	Enter the offset of the waveform in volts.
Max/Min	Select Max/Min to set the amplitude voltage range for the selected waveform.
Maximum	Enter the maximum amplitude or the waveform in volts.

Option	Description
Minimum	Enter the minimum amplitude or the waveform in volts.
Full DAC Value	Select Full DAC Value to set the waveform values between – 1 and + 1.
Horizontal	
Sampling Rate	Enter the number of samples per second.
Phase	Enter the phase in degrees.
Cycles	Enter the number of cycles in the waveform.
Total Number of Points*	Enter the total number of points in the waveform.
Time Delay**	Enter the delay in seconds.
Half Width	Enter the half width.

1   * The field Total Number of Points is disabled for the AWG7xx, AWG6xx, AWG5xx, AWG4xx, AWG2xxx, and AFG3xx series of instruments. Type the Sampling Rate of the waveform, the number of Cycles, and the Phase in degrees. Enter the Time Delay and Half Width. The Total number of points is given by: The Total number of points is given by:

$$TotalPoints = TimeDelay \times SamplingRate \times Cycles$$

2   ** For the AFG2000 and AFG3000 series of instruments, type the Phase in degrees, Cycles, Half Width, and Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points for the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz.

For AFG3xx, AFG2000, and AFG3000 series of instruments Time Delay is calculated according to the following equation:

To preview the waveform, click **Preview**.

To restore the default values for the waveform, click **Default**.

To save your current values and create the waveform, click **OK**.

To send the waveform directly to an arbitrary waveform or function generator that is connected, click . **Send to Arb** is enabled only when an instrument (AWG or AFG) is connected.

To view or vary the waveform properties, click . The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click **Preview**:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Select one of the options and click **OK**.

File Transfer and Instrument Control Dialog Box

Communication > AWG/AFG File Transfer and Control

Use this dialog box to control the instrument from the application.

Option	Description
Arb List	Lists the instruments that can be connected
Instrument Folders	Lists the folders on the instruments hard disk drive
Instrument Files	Lists the files in the folder selected on the instrument hard disk
PC Folders	Lists the folders on the PC hard disk
PC Files	Lists the files in the folder selected on the PC hard disk
Instrument Control	
Channel Selector	Selects the channel that you want to control
Output ON	Turns the output on or off
Load File to AWG	Enter or select the file to load. You can drag and drop the file from the Instrument file list and the file name automatically appears here.
Vertical	Control the vertical parameters.
Filter	Use this to filter frequencies greater than the value specified.
Amplitude	Enter the voltage for the waveform.
Offset	Enter or select the offset for the waveform.
Marker1	
High	Set the High value for Marker1.
Low	Set the Low value for Marker1.
Marker2	
High	Set the High value for Marker2.
Low	Set the Low value for Marker2.

Instrument Control

Clock	Enter the clock frequency.
Run/Stop	Changes the instrument from the Run to Stop mode or vice versa.
Apply	Applies the changes to the waveform.

For the AFG3xx series, you can transfer the waveform files in the following directions — PC to Edit memory, PC to User memory, and Edit memory to User memory.

For the AFG2000 and AFG3000 series, you can transfer the waveform in the following directions — PC to Edit memory, PC to User memory, Edit memory to User memory, and Edit memory to PC.

For the MDO3000 series, you can transfer the waveform in the following directions — PC to Edit memory and Edit memory to PC.

When you transfer a waveform from the Edit memory to the PC, the file has the name EMEM<n> in the destination folder. When you transfer a waveform from the PC to the Edit memory, the EMEM<n> waveform text box shows the waveform file name. When you drag the EMEM<n> file to User<n>, the User<n> text box shows the file name as EMEM<n>.

When you drag a file from the PC Files list and drop it to the destination Edit or User memory, the destination text "Drag source file and drop here" is replaced with the name of the transferred file. When you close the dialog box or reinvoke it, the destination text reappears.

Waveform Math Dialog Box

Math > Waveform Math

Use this dialog box to perform mathematical operation on the selected portion of the waveform. To operate with the selected waveform, you can either use a standard waveform, a scalar value, or a waveform that you have copied to the clipboard.

The mathematical operations that are available are Add, Subtract, Multiply, and Divide. Division is applicable only when you use a scalar value or copy from the clipboard.

Option	Description
Waveform Library	
Select the waveform	This appears in the Math Source preview.
Amplitude Pk-Pk	Type the amplitude in volts of the selected waveform
Cycles	Type the number of cycles of the selected waveform.
Phase	Type the phase in degrees of the selected waveform.
Duty Cycle/Pulse Width/Damp Factor	Type the duty cycle, pulse width, or the Damp Factor for the selected waveform.
Scalar Value	
Amplitude	Type the amplitude in volts.
Copy from clipboard	Uses the waveform copied to the memory to perform math operations.
Operation	
Add	Adds every point of the selected waveform to every point on the math source waveform.
Subtract	Subtracts every point of the selected waveform from every point on the math source waveform.
Multiply	Multiplies every point on the selected waveform with every point of the math source waveform.
Divide	Divides every point on the selected waveform with every point of the math source waveform This operation is not available when you select a standard waveform from the list to operate with.
Only between cursors	Select this to perform the operation only on that section of the waveform between the cursors.

The resultant waveform is displayed in the Resultant Waveform preview.

Filter Setup Dialog Box

Communication > AWG/AFG File Transfer and Control >

Use this dialog box to set the filters for displaying waveform files.

1. Select one or more file type to show: . wfm, .tfw, .isf, .pat, . csv, . txt, *.*. The default filter type is *.*.

2. Click **Default** to restore the default file type.

3. Click **Enable** to enable the **Filter On/Off** button. If the filter is set to On, clicking **Enable** changes nothing.

Set IP Address Dialog Box

Communication > AWG File Transfer and Control > Set IP Address (from the shortcut menu)

Use this dialog box to set the IP Address of the instrument you want to connect to. The application displays the last ten recently connected instruments and their IP addresses. If you select any of these, the corresponding IP address appears in the IP address field.

Instrument Properties Dialog Box

Communication > File Transfer >

Use this dialog box to view the instrument properties.

Option	Description
Instrument Model	Displays the model of the selected instrument
Connection Status	Displays the status of the instrument — connected or not connected
Interface String	Displays the resource string or IP address of the connected instrument
Bus Type	Displays the bus type: Serial, GPIB, or Ethernet

Import from Oscilloscope Dialog Box

Use the **Import from Scope** dialog box to connect to a Tektronix Oscilloscope and import a waveform into ArbExpress in the AWG7xx waveform file format. Currently ArbExpress supports the TDS1000, TDS2000, TDS3000, TDS5000, TDS6000, TDS7000, TBS1000, DPO2000, DPO3000, DPO4000, MSO2000, MSO3000, MSO4000, MDO3000, and MDO4000 families of oscilloscopes. The following steps describe how to use this dialog box.

Before you show the **Import from Scope** dialog box, refresh the TekVisa resource list.

Before Connecting

Ensure that the oscilloscope you intend to connect to is detected by the TekVisa Resource manager tool. Without this, ArbExpress will not show it in its Scope list. Refer to the help on VisaRM for information on how to search for an oscilloscope using the TekVisa Resource Manager tool.

Connecting to an Oscilloscope

The Scope list shows the oscilloscopes to which you can connect. You can choose any one of them and connect to it. Once successfully connected, the Scope list shows the available data sources — Channels, Reference waveforms, and Math waveforms in the oscilloscope.

Importing a Waveform

To import a waveform, you must first select a data source (a channel, ref or math). When you select one of the available data sources, its status is displayed in the bottom half of the dialog box. After selecting the data source, you can either drag and drop the source into one of the folders on the hard disk, or select the **Acquire** option from the shortcut menu for the selected data source and paste it in a folder on the PC. When the transfer is complete, a waveform file with the name of the form `<model number>_<channel number>.wfm` is created in the selected folder.

NOTE. *If you have a Ref waveform of a particular record length, you can successfully import the waveform only if the oscilloscope current record length is the same as the Ref waveform record length.*

Changing Parameters of a Channel

Right-click a channel to change the parameters. You can change the following parameters:

- Run Mode (single sequence or continuous mode)

- Record length (except for TDS1000, TDS2000, and TBS1000 family of oscilloscopes)

- ■ Acquisition mode (supports Sample, Peak Detect and Average modes on all families of oscilloscopes. In addition to these three, supports Hi Res, and Peak to Peak modes for TDS5000, TDS6000 and TDS7000 series of oscilloscope)

- ■ Acquire

Directly Transferring a Waveform from the Oscilloscope to a Waveform View

You can acquire a waveform from the oscilloscope and open it in a Waveform view in a single action. To do this, you have to select a data source as described above. Then click the "Open in New Window" button on the oscilloscope toolbar. The file is transferred and saved to the current directory and then opened in a Waveform View. You can close the **Import from Scope** dialog box to work with the acquired waveform.

NOTE. *Closing the dialog box does not close the connection.*

Set Pattern Dialog Box

Display > Marker

Use this dialog box to create a marker pattern. Right-click within the marker display area, and select **Set Pattern** from the shortcut menu.

Option	Description
Target	
Marker1	Select Marker1 as the target to set the pattern for Marker1.
Marker2	Select Marker2 as the target to set the pattern for Marker2.
Data	
Hex	Select Hexadecimal as the data type to set the pattern in hexadecimal.
Binary	Select Binary as the data type to set the pattern in binary.
Pattern	Use characters 0 – 9 and A– F to create a hexadecimal pattern, and 0 and 1 to create a binary pattern.

Using the Equation Editor

File > Equation Editor

Waveform > Equation Editor

You can create waveforms using the equation editor. The application provides a set of sample equations that you can use directly or modify and use.
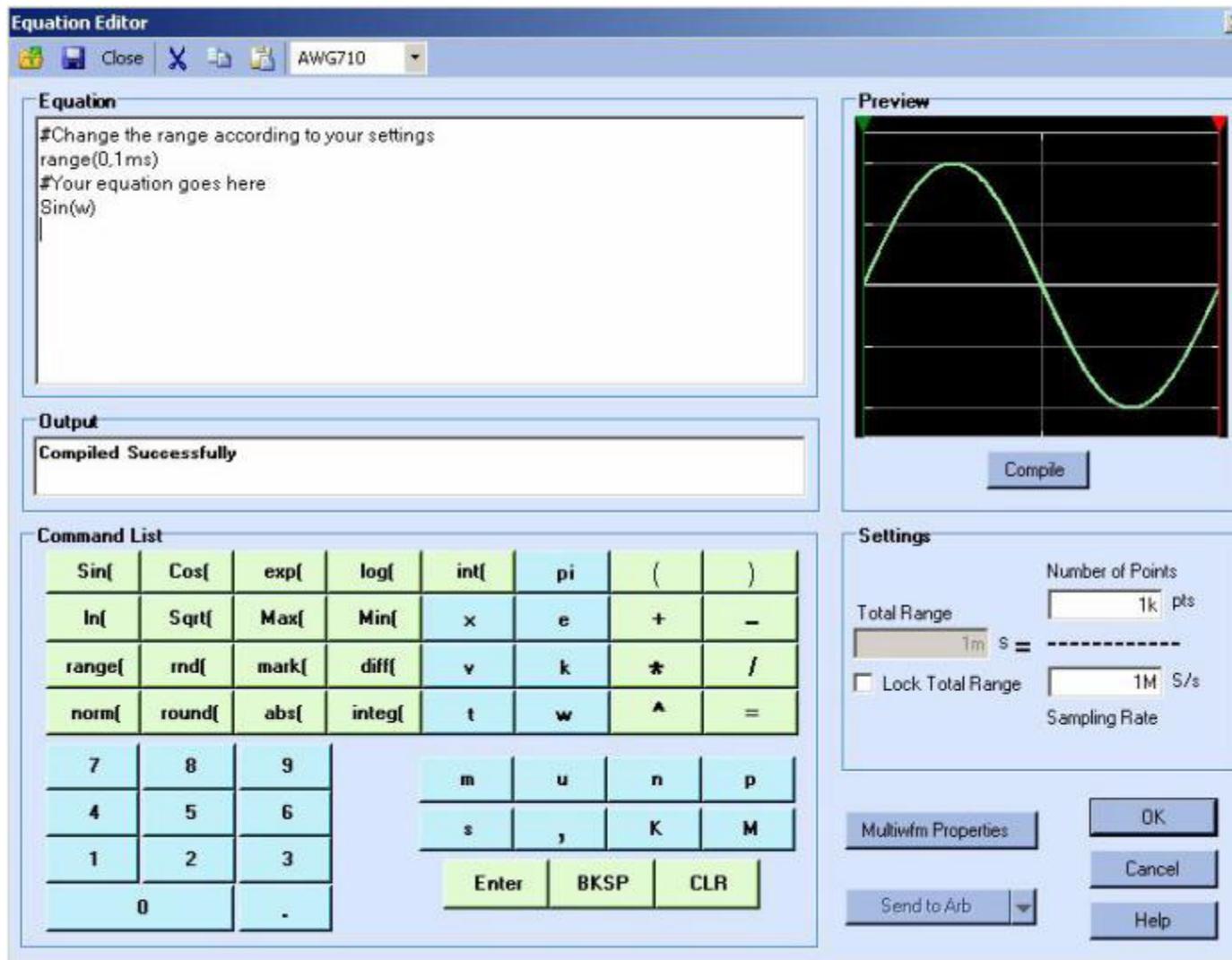
Use the Equation pane to edit the equations, use the Command list to select the commands, functions, units and operations, use the Settings pane to set the Total Range, and use the Preview pane to preview the

waveform after the equation is compiled. The **OK** button is enabled only when the equation compiles successfully.

Equation Editor Tool Bar
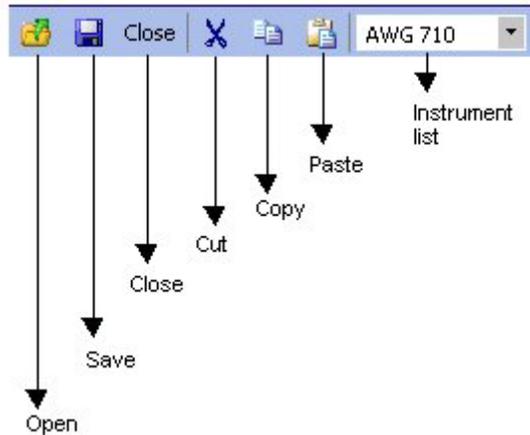
The equation editor toolbar has icons for standard functions — Open, Save, Close, Cut, Copy, Paste, and Instrument list.

Creating an Equation

To use a sample equation:

1. Select **Waveform > Equation Editor**.

2. From the Equation Editor window, select **File > Open**.

3. Browse the equations (.equ or .eqa) listed in the folder `\ArbExpress\Samples\Equation`.

4. Edit the equation using the Command list options or by placing the pointer over the equation and typing in the equation.

NOTE. Ensure that the total range you specify in the equation and the total range defined in the Settings match.

To create a new equation:

1. Select **Waveform > Equation Editor**. The equation editor screen is displayed with a sample equation.

2. Create an equation in the Equation pane, using the functions and operators available in the Command list. Always define a range first.

3. Under Settings, set the Total Range to the sum of all the ranges you have defined in the equation. To do this, enter the Number of Points and Sampling Rate. After you set the Total Range, you can lock it and change the Number of Points or the Sampling Rate.

For the AFG2000, AFG3000, or MDO3000 series of instruments, the sampling rate is replaced with the Equivalent Sampling Rate. If you lock the Total Range, the Equivalent Sampling Rate is the calculated depending upon the Number of Points. The application displays the sampling rate of the current instrument.

If the total range defined in the equation is greater than the total range in Settings, the equation fails to compile. The output pane displays a message and the error.

Equation

```
#Change the range according to your settings
range(0,1ms)
#Your equation goes here
Sin(w)
range(1ms,2ms)
Cos(w)
```

Settings

Number of Points

Total Range

2000 pts

0.0002 s =   - - - - - - - - - - - - -

☐ Lock Total Range   10000000 S/s

Sampling Rate
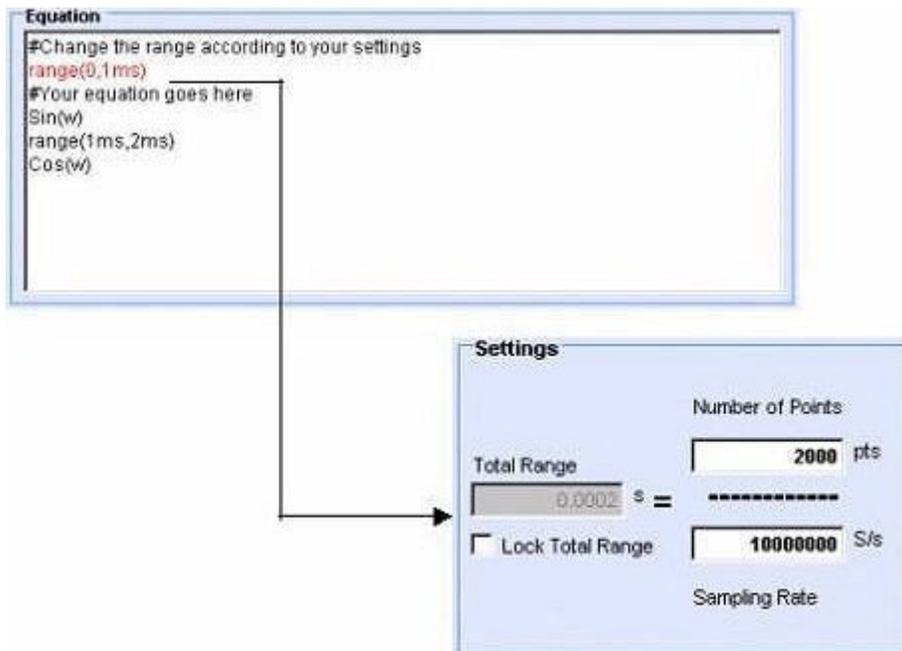
If the number of points specified in the Settings is more than the range specified in the equation, then the available extra points have a value of zero.
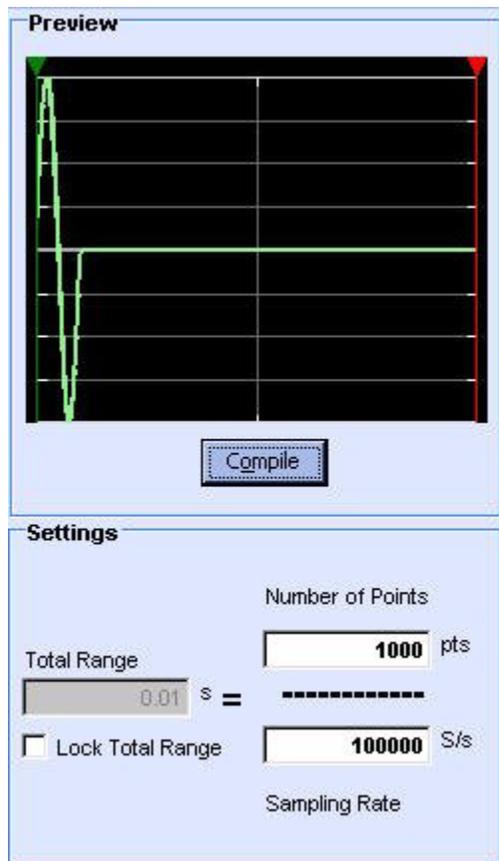
4. Click **Compile**. The compiled equation is displayed in Preview. The compilation status and messages are displayed in Output. If the compilation is successful, you can click **OK**.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected. You can select the channel to send the waveform to. A progress bar displays the status of the operation. In the AFG3xx, AFG2000, AFG3000, and MDO3000 series, the waveform is sent to the edit memory. A message "Are you sure you want to overwrite EMEM<n> with this file?" warns you that the instrument edit memory will be overwritten.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Equation Editor** dialog box.*

The application supports the AWG2000 equation editor model and follows the same syntax. See Equation Editor Reference (see page 201) for more details. Equations created using the equation editor cannot be used on the AWG400 through AWG700 series waveform generators.

See Also:

Sine Wave

File > Standard Waveform
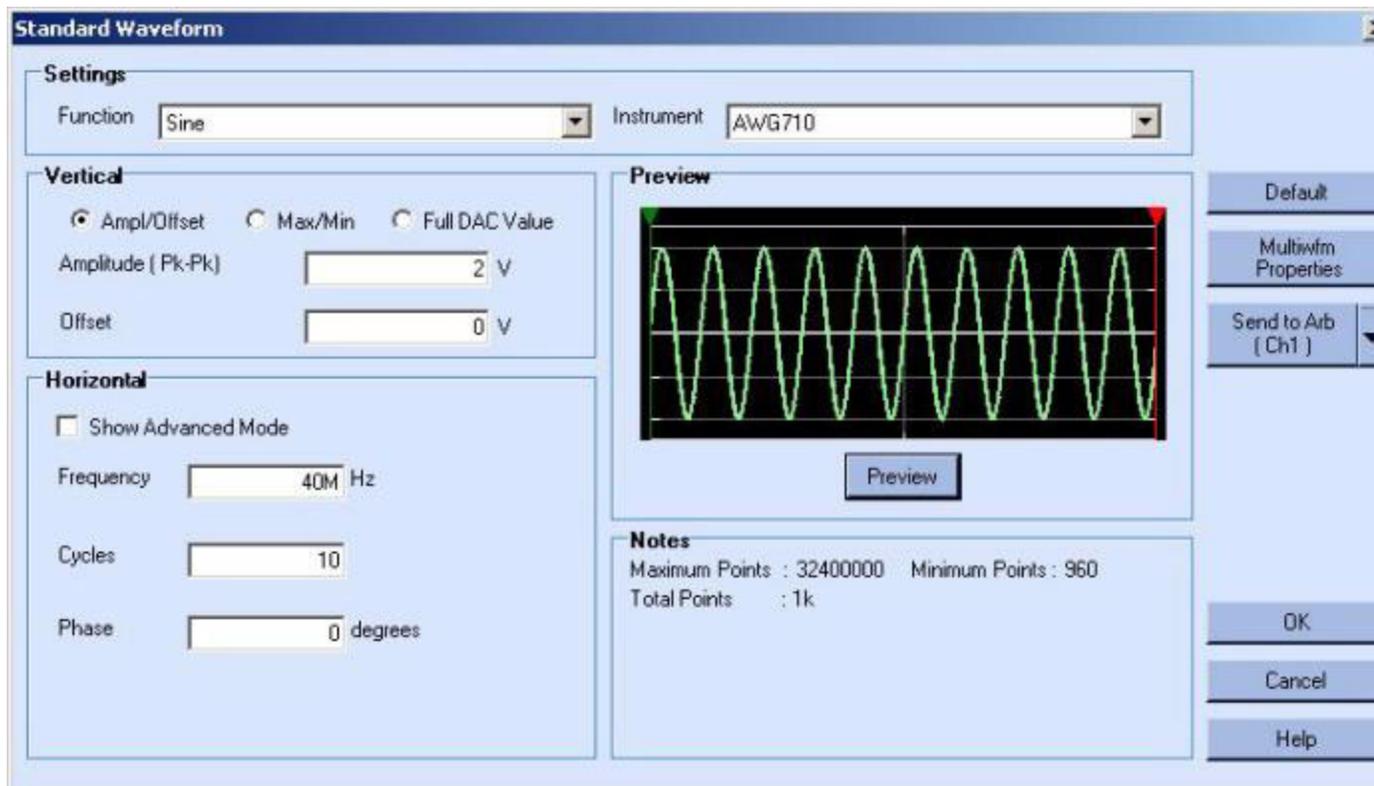
To create a sine wave:

1. Under **Settings**, set the Function to Sine, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

    ‑   **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which the waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

    ‑   **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

    ‑   **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Frequency of the waveform in Hertz, the number of Cycles, and the Phase in degrees. Select **Show Advanced Mode** to show advanced parameter options for the sine wave.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Phase in degrees, and Cycles. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. If you have selected **Show Advanced Mode**, set the Frequency as the number of samples per second divided by the number of points per cycle. You can lock any one of the parameters – Frequency, Samples/sec, or Points/cycle – and vary the other two.

5. Click **Preview** to view the waveform.

If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 series) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

6. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

*NOTE. To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Square Wave

File > Standard Waveform
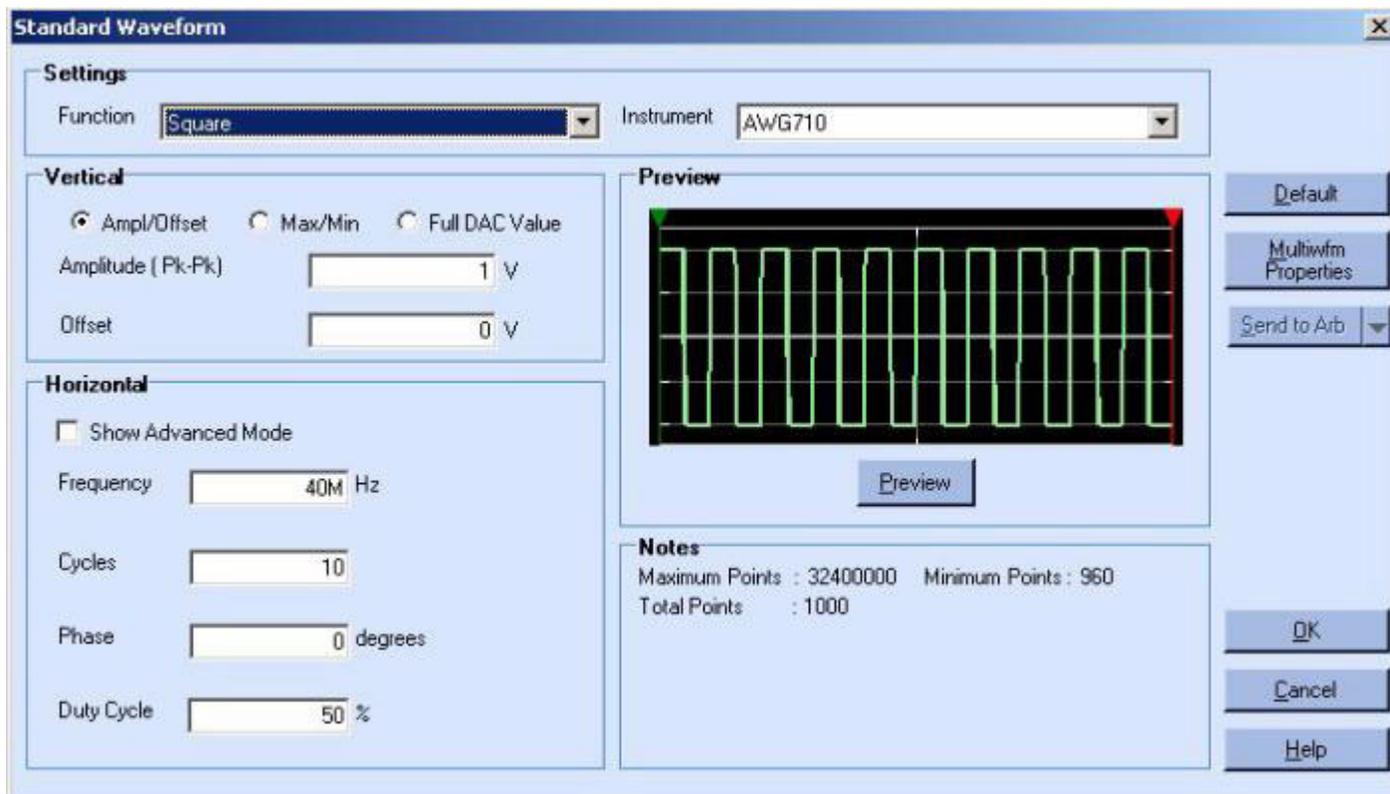
To create a square wave:

1. Under **Settings**, set the Function to Square, and set the **Instrument** to the target instrument.

2. Under **Vertical**, you can choose one of the following:

    -   **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which the waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

    -   **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

    -   **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Frequency of the waveform in hertz, the number of Cycles, and the Phase in degrees. Set the **Duty Cycle** to a percentage. Select **Show Advanced Mode** to show advanced parameter options for the square wave.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For these instruments, type the Total Number of Points, Frequency in Hertz, Phase in degrees, Cycles, and Duty Cycle. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. Under Transitions (10%-90%), set the Rise Time and Fall Time parameters. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. If you have selected **Show Advanced Mode**, set the Frequency as the number of samples per second divided by the number of points per cycle. You can lock any one of the parameters – Frequency, Samples/sec, or Points/cycle– and vary the other two. Another pane titled Transitions (10%-90%) appears.

   - Set the number of points for **Rise Time** and select rise type to Ramp or Sine[2].

   - Set the number of points for **Fall Time** and the fall type to Ramp or Sine[2]. The equivalent value is displayed in seconds.

5. Click **Preview** to view the waveform.

   If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected. You can select the channel to send the waveform to.

Click the Multi-Waveform Properties (see page 42) button to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

6. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Triangle Wave

File > Standard Waveform
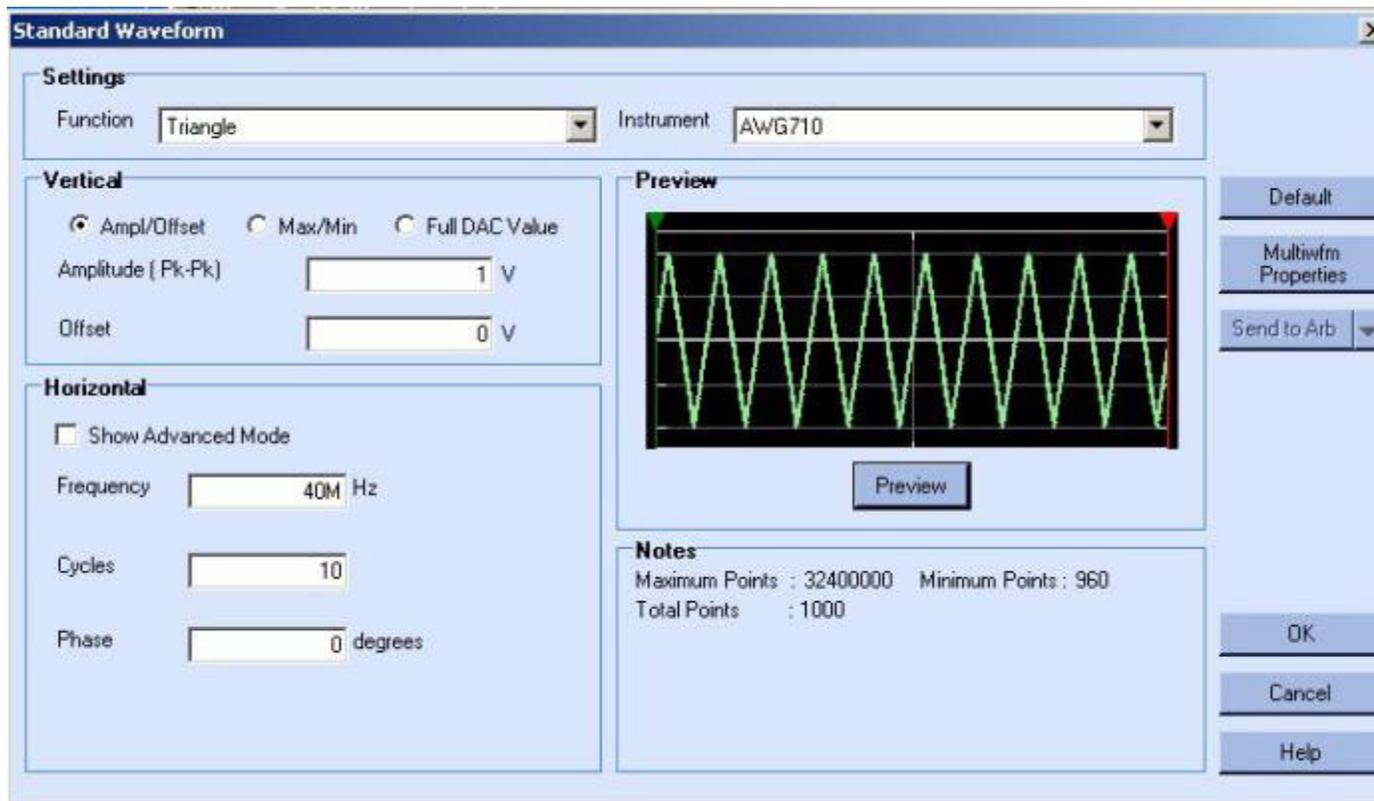
To create a triangular wave:

1. Under **Settings**, set the **Function** to Triangle, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

    -   **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which the waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

    -   **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

    -   **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Frequency of the waveform in Hertz, the number of Cycles, and the Phase in degrees. Select **Show Advanced Mode** to show advanced parameter options for the triangle wave. You can lock any one of the parameters – Frequency, Samples/sec, or Points/cycle – and vary the other two.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Phase in degrees, and Cycles. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click <u>Send to Arb (see page 148)</u> to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected. You can select the channel to send the waveform to.

Click <u>Multi-Waveform Properties (see page 42)</u> to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

*NOTE. To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Pulse Wave

File > Standard Waveform

To create a pulse wave:

1. Under **Settings**, set the **Function** to Pulse, and set the **Instrument** to the target instrument.

2. Under **Vertical**, you can choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which the waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Frequency of the waveform in Hertz, the number of Cycles, the Delay in seconds, and the Pulse Width in seconds. Select **Show Advanced Mode** to show advanced parameter options for the pulse wave. You can lock any one of the parameters – Frequency, Samples/sec, or Points/cycle– and vary the other two.

The **Show Advanced Mode** option is not available for the AFG2000, AFG3000, or MDO3000 series of instruments. For the AFG2000 and AFG3000 series of instruments, type the Total Number of Points, Frequency in Hertz, Delay, Cycles, and Pulse Width. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. Under Transitions (10%-90%), set the Pulse Direction, Rise Time, and Fall Time parameters. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. If you selected **Show Advanced Mode**, the **Transitions (10%-90%)** pane appears.

   - Set the **Pulse Direction** to Positive or Negative.

   - Set the number of points for **Rise Time** and the rise type to Ramp or Sine^2.

   - Set the number of points for **Fall Time** and the fall type to Ramp or Sine^2. The equivalent value is displayed in seconds.

5. Click **Preview** to view the waveform.

   If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

6. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

*NOTE.   To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Noise Wave

File > Standard Waveform
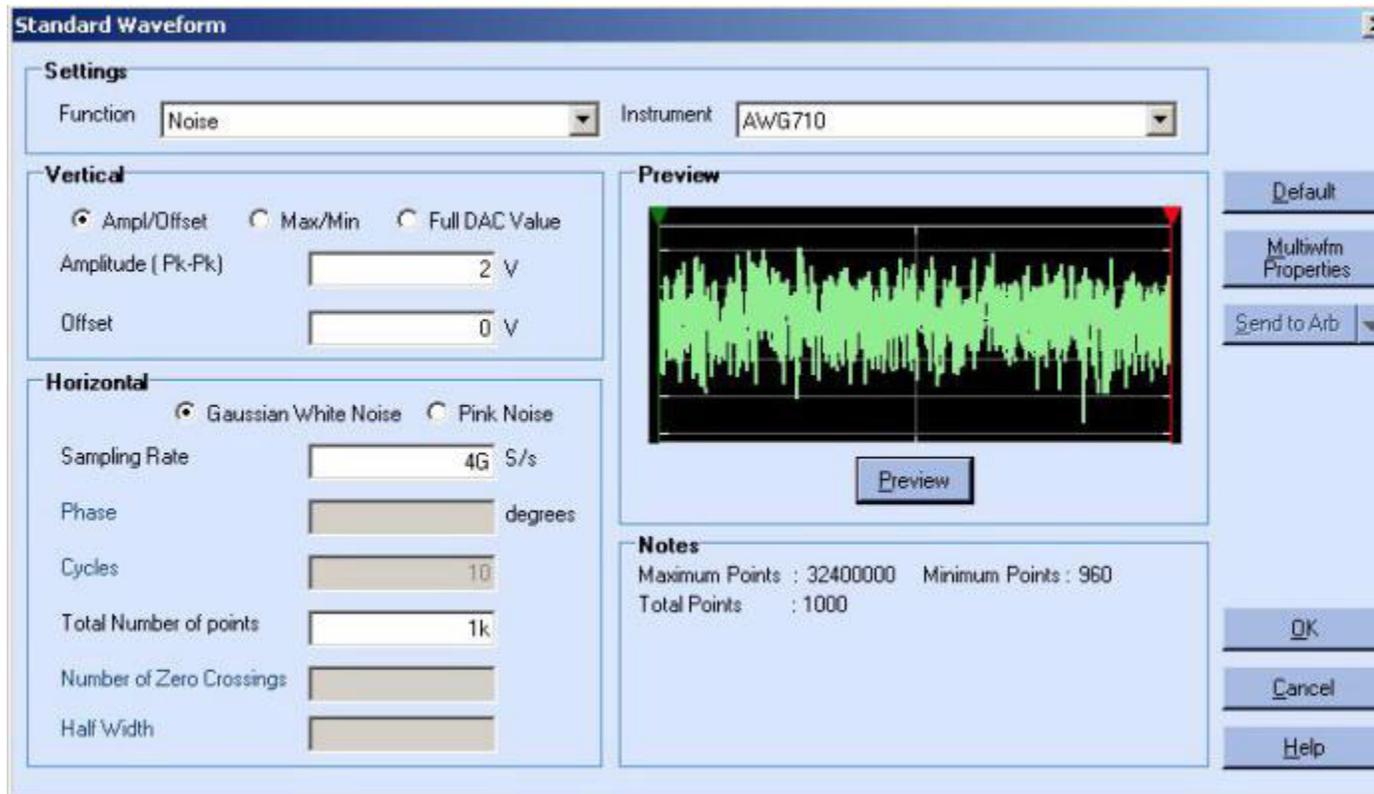
To create a noise wave:

1. Under **Settings**, set the **Function** to Noise, and set the **Instrument** to the target instrument.

2. Under **Vertical**, you can choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, select Gaussian White Noise or Pink Noise. Enter the Sampling Rate and the Total Number of Points for the waveform. For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C,

AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

The following figures show a preview of the Gaussian White Noise and Pink Noise waveforms.

If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

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5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*


See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

DC Wave

File > Standard Waveform
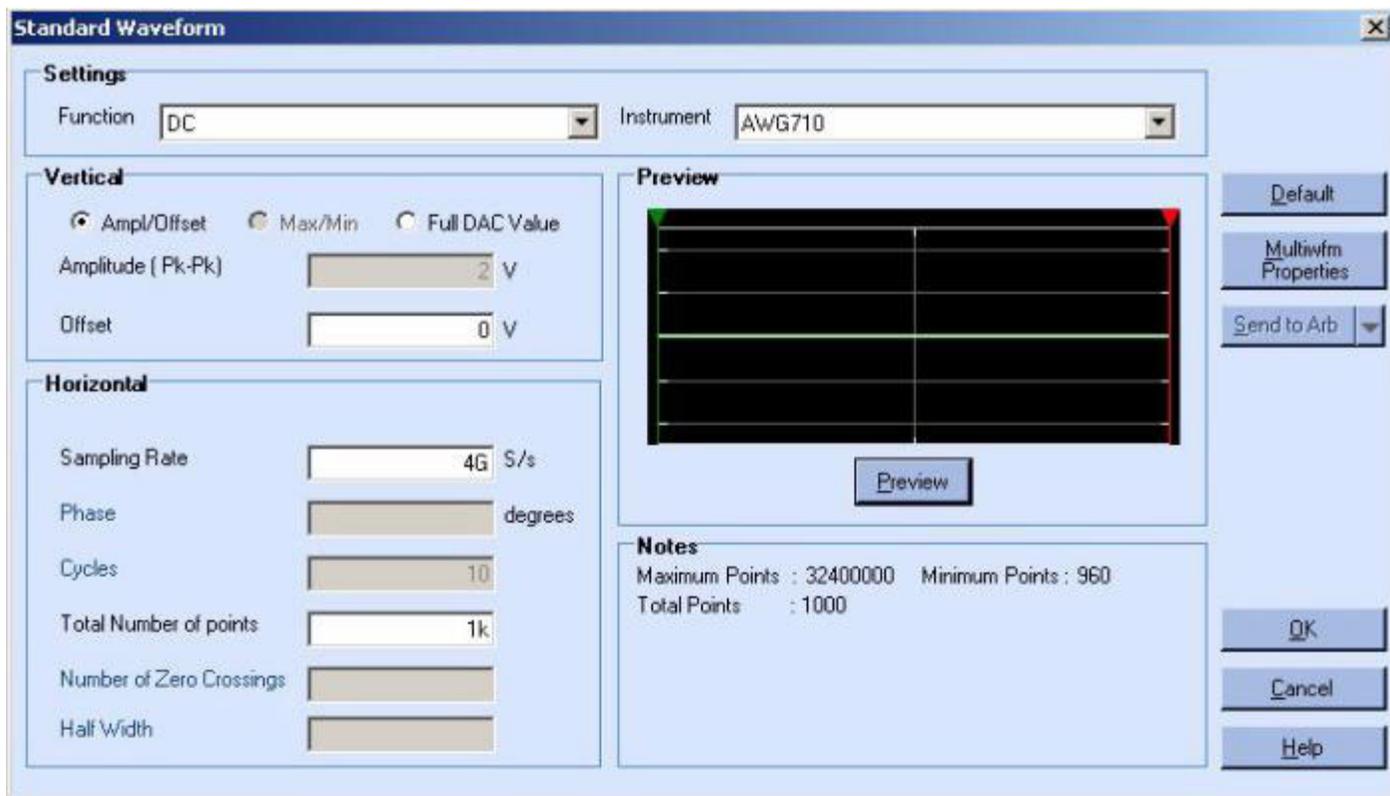
To create a DC wave:

1. Under **Settings**, set the **Function** to DC, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

   – **Amp/Offset** — to enter the Offset value. Enter the offset value. This value cannot exceed the maximum offset supported by the instrument.

   – **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, enter the Sampling Rate and the Total Number of Points for the waveform. For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate

changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Exponential Rise Wave

File > Standard Waveform

To create an exponential rise wave:

1. Under **Settings**, set the **Function** to Exponential Rise, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which the waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, enter the Sampling Rate of the waveform, the Phase in degrees, and the number of Cycles per second. Enter the Total number of Points, and Damp Factor.

For the AFG2000 and AFG3000 series of instruments, type the Phase in degrees, Cycles, Total Number of Points, and Damp Factor. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, AFG3052C, and MDO3000 series instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click the Multi-Waveform Properties (see page 42) button to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

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5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*


See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Exponential Decay Wave

File > Standard Waveform
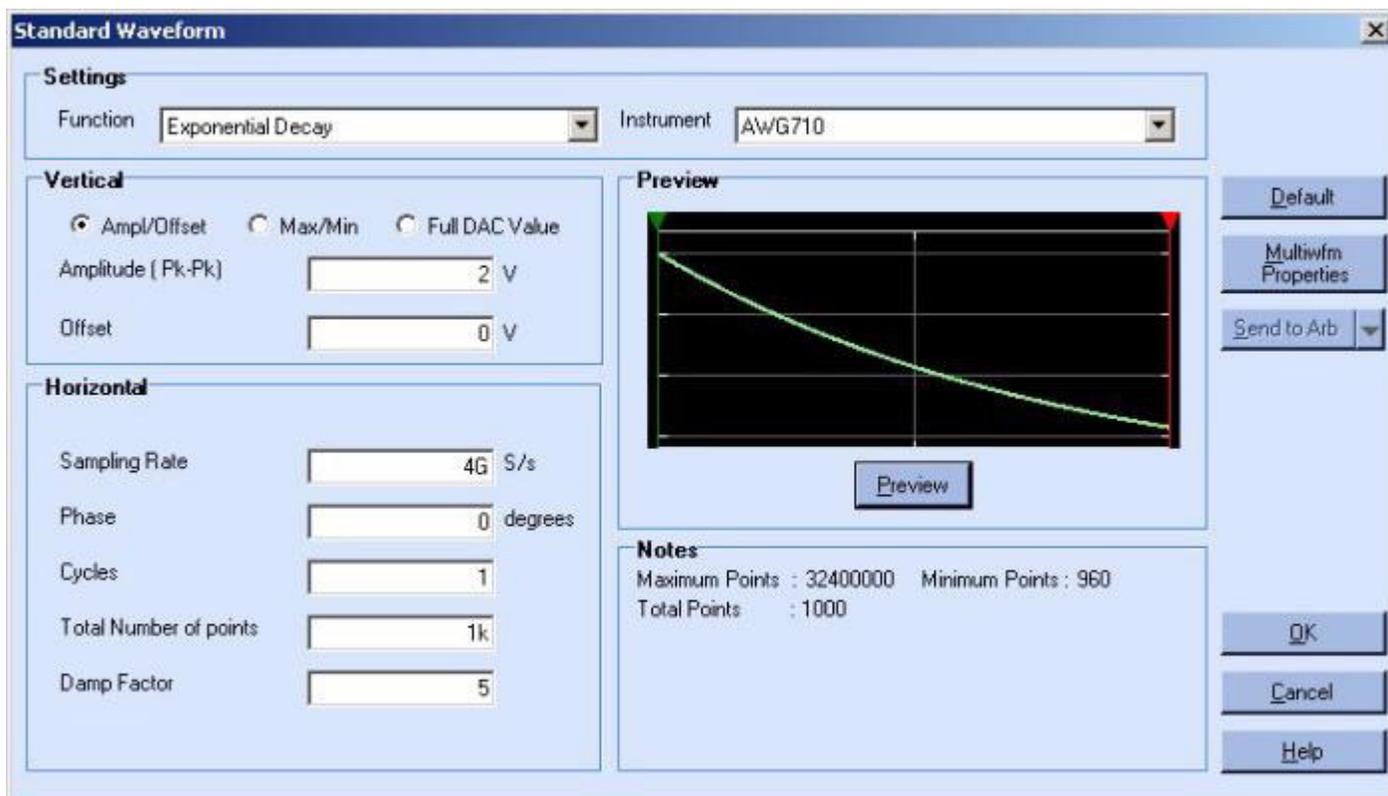
To create an exponential decay wave:

1. Under **Settings**, set the **Function** to Exponential Decay, and set the **Instrument** to the target instrument.

2. Under **Vertical**, you can choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which the waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, enter the Sampling Rate of the waveform, the Phase in degrees, and the number of Cycles per second. Enter the Total number of Points, and Damp Factor.

   For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Phase in degrees, Cycles, Total Number of Points, and Damp Factor. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

   If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

   Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

*NOTE. To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Sinc Wave

File > Standard Waveform
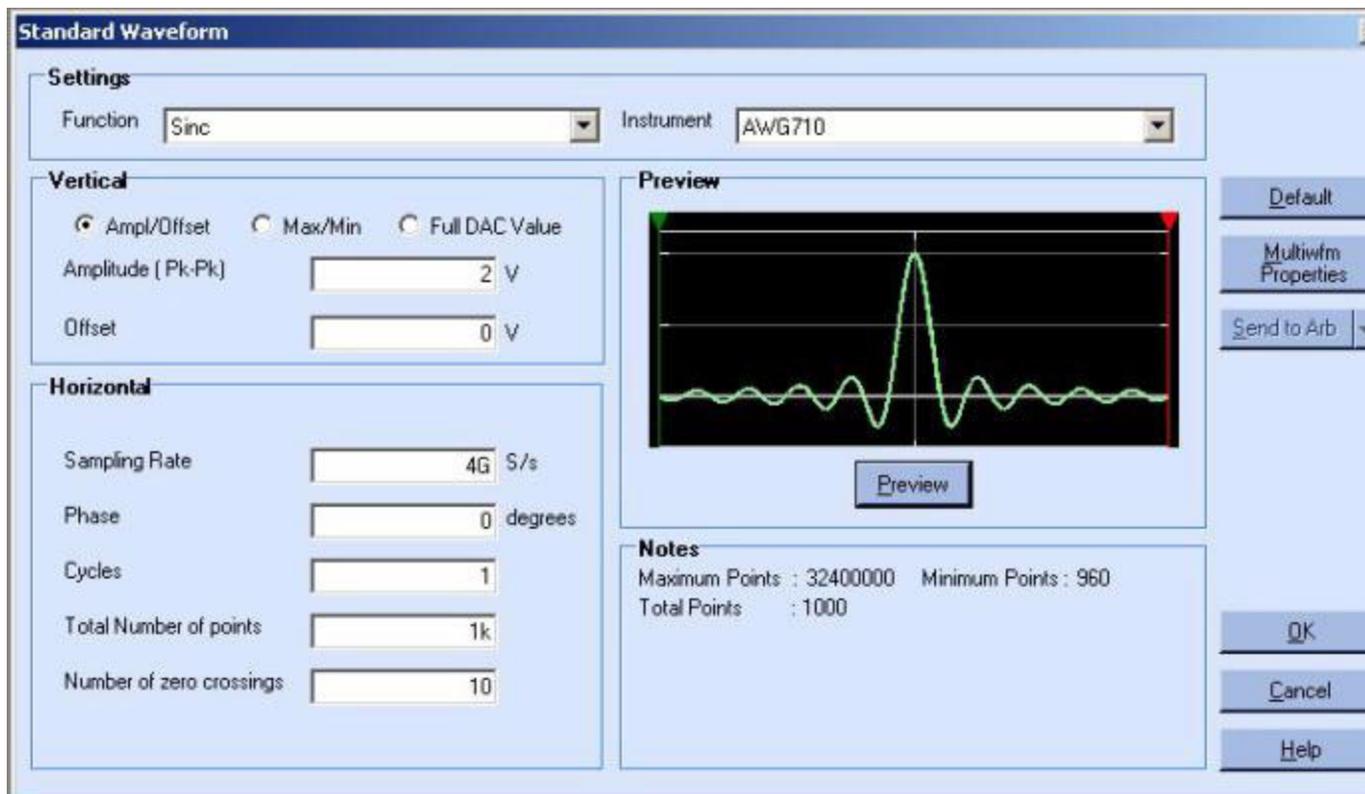
To create a sinc wave:

1. Under **Settings**, set the **Function** to Sinc, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

    -   **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

    -   **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

    -   **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Sampling Rate of the waveform, the number of Cycles, and the Phase in degrees. Enter the Total number of Points and the Number of Zero Crossings.

    For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Phase in degrees, Cycles, Total Number of Points, and Number of Zero Crossings. The Sampling Rate is a fixed value for the

selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

    If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Sweep Wave

File > Standard Waveform
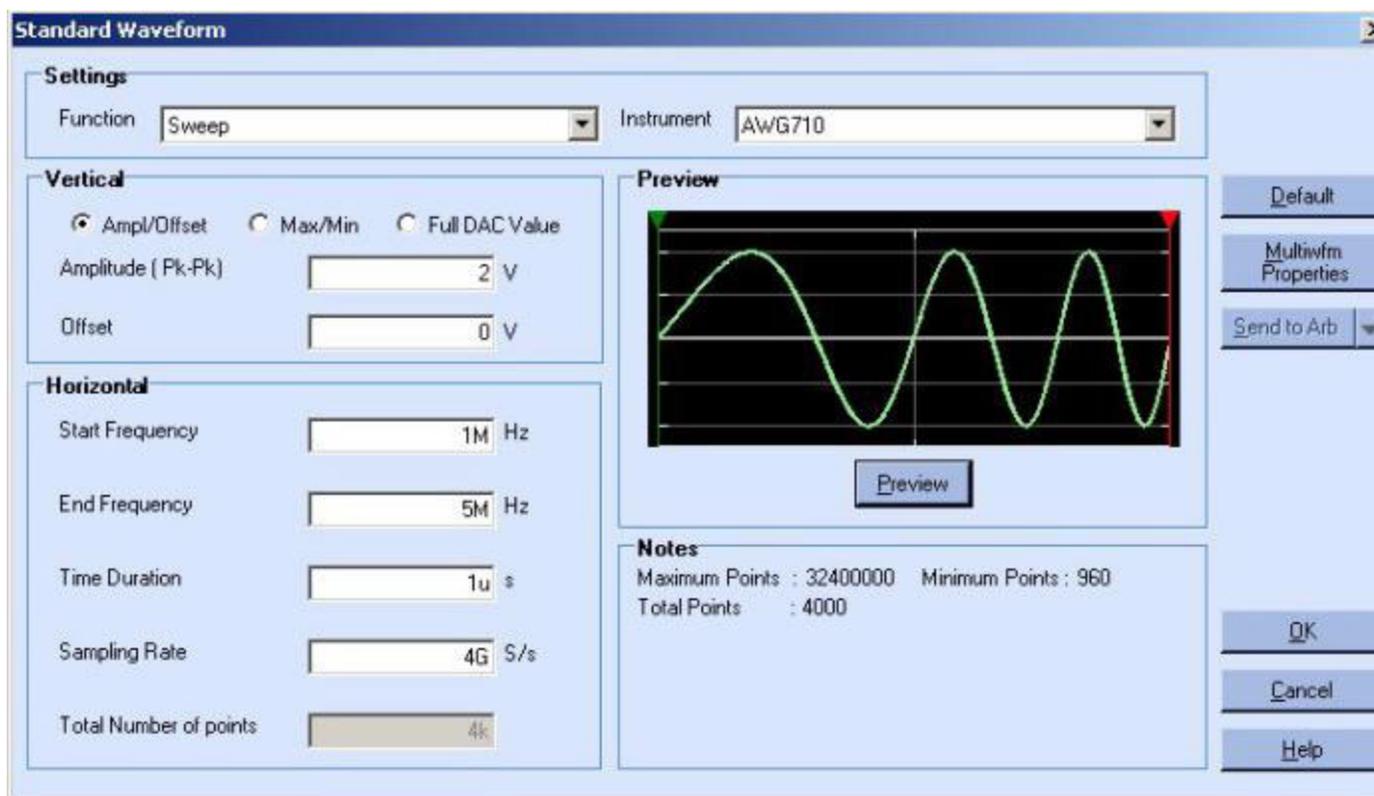
To create a sweep wave:

1. Under **Settings**, set the **Function** to Sweep, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Start Frequency, End Frequency, Time Duration, and Sampling Rate. The application calculates the Total Number of Points as the product of Time Duration and Sampling Rate. This is applicable for the AWG7xx, AWG6xx, AWG5xx, AWG4xx, AWG2xxx, and AFG3xx series of instruments.

$$TotalPoints = TimeDuration \times SamplingRate$$

For the AFG2000 and AFG3000 series of instruments, type the Start Frequency, End Frequency, and Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. The Time Duration is calculated according to the following equation:

$$TimeDuration = \frac{TotalPoints}{SamplingRate}$$

For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, AFG3052C, and MDO3000 series instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

*NOTE. The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

*NOTE. To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Multi-Tone Wave

File > Standard Waveform
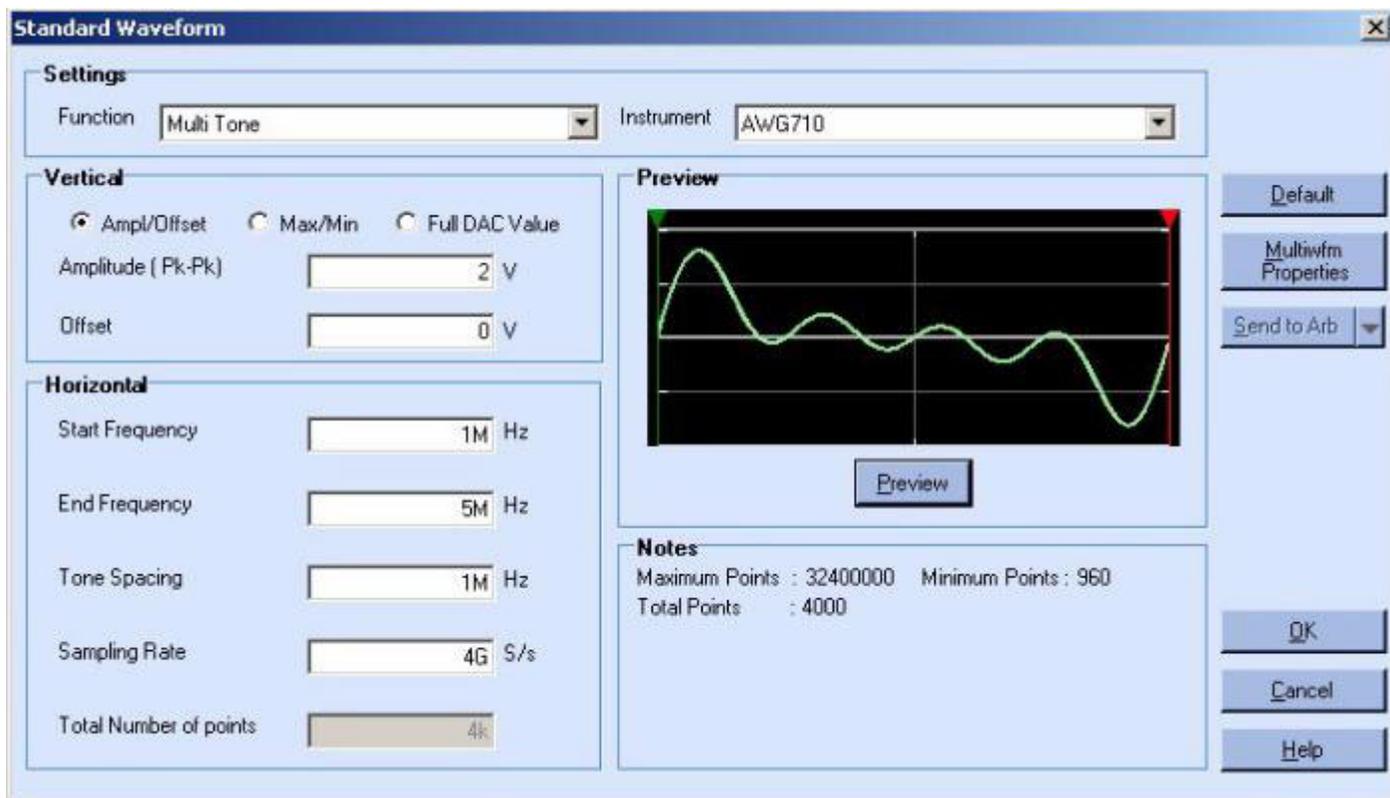
To create a multi-tone wave:

1. Under **Settings**, set the **Function** to Multi Tone, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Start Frequency, End Frequency, Tone Spacing, and Sampling Rate. The Total Number of Points is calculated according to the following equation:

$$TotalPoints = \frac{SamplingRate}{ToneSpacing}$$

For the AFG2000 and AFG3000 series of instruments, type the Start Frequency, End Frequency, and Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points.

The Tone Spacing is calculated according to the following equation:

$$ToneSpacing = \frac{SamplingRate}{TotalPoints}$$

For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, AFG3052C, and MDO3000 series instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

4. Click **Preview** to view the waveform.

   If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click <u>Send to Arb (see page 148)</u> to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click <u>Multi-Waveform Properties (see page 42)</u> to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

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5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

<u>Valid Parameter Ranges (see page 197)</u>

<u>Default Settings (see page 190)</u>

Lorentz Wave

File > Standard Waveform
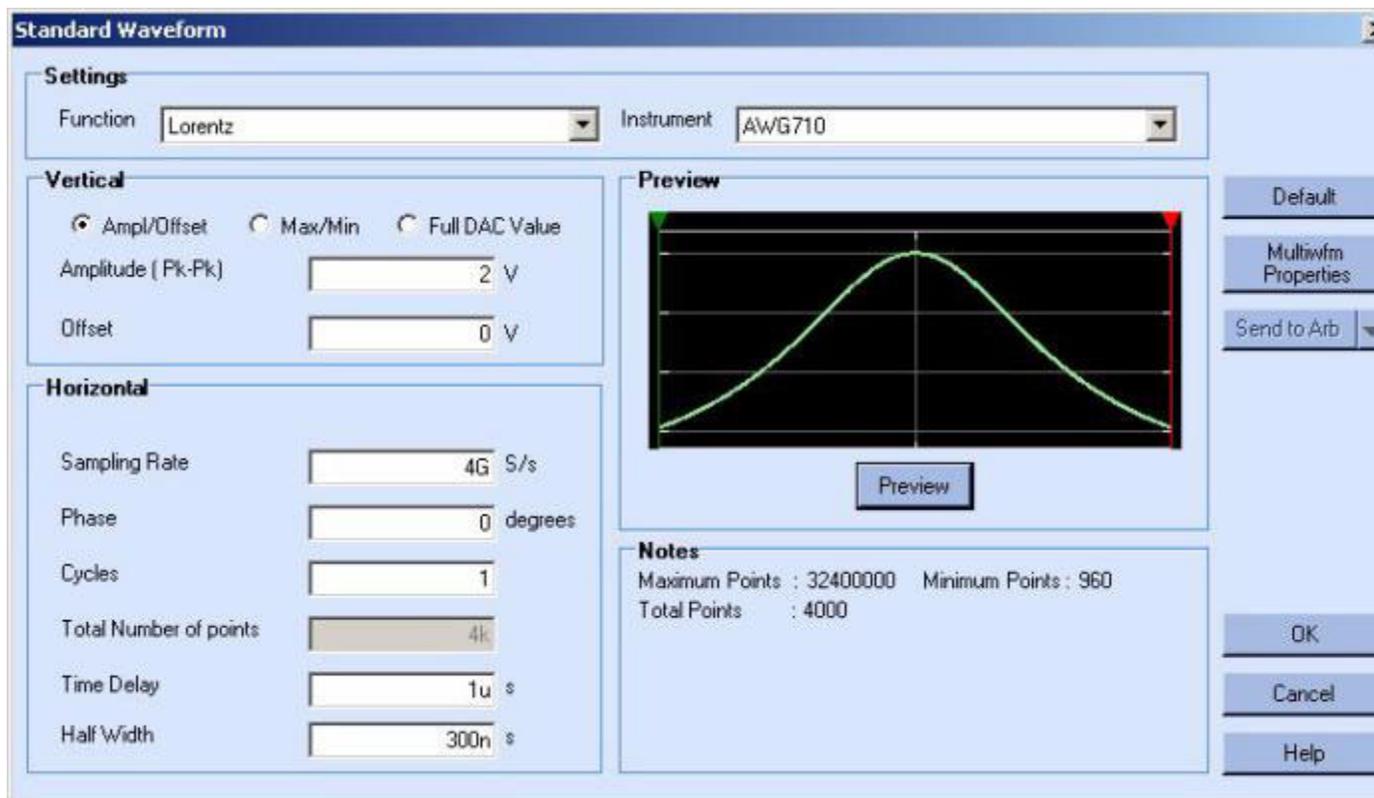
To create a Lorentz wave:

1. Under **Settings**, set the **Function** to Lorentz, and set the **Instrument** to the target instrument.

2. Under **Vertical**, choose one of the following:

   - **Amp/Offset** — to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis) and the offset specifies the volts by which waveform will be offset from the origin along the Y-axis . The sum of the amplitude and offset must not exceed the voltage range supported by the target instrument.

   - **Max/Min** — to enter the Maximum and Minimum voltage values for the waveform.

   - **Full DAC Value** — to create a waveform for the maximum amplitude supported by the instrument.

3. Under **Horizontal**, type the Sampling Rate of the waveform, the number of Cycles, and the Phase in degrees. Enter the Time Delay and Half Width. The Total number of Points is given by:

$$TotalPoints = TimeDelay \times SamplingRate \times Cycles$$

For the AFG2000, AFG3000, or MDO3000 series of instruments, type the Phase in degrees, Cycles, Half Width, and Total Number of Points. The Sampling Rate is a fixed value for the selected instrument. The Sampling Rate depends on the total number of points. For the AFG3101, AFG3102, AFG3101C, AFG3102C, AFG3151C, AFG3152C, AFG3051C, and AFG3052C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 1 GHz to 250 MHz. For the AFG3251, AFG3252, AFG3251C, and AFG3252C instruments, if the total number of points exceeds 16,384 (16 K points), the sampling rate changes from 2 GHz to 250 MHz. For the MDO3000 series of instruments, the sampling rate is limited to 250 MHz.

For AFG3xx, AFG2000, and AFG3000 series of instruments, Time Delay is calculated according to the following equation:

$$Time\ Delay = \frac{TotalPoints}{SamplingRate \times Cycles}$$

4. Click **Preview** to view the waveform.

    If the number of points is fewer than the number of points supported by the instrument, the following options appear:

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this and change the parameters to increase the total number of points in the waveform to achieve the minimum number of points.
Add zeros to achieve minimum number of points	Select this to achieve the minimum number of points by appending points of zero voltage to the waveform.
Add last vector to achieve minimum number of points	Select this to achieve the minimum number of points by appending points with the voltage value of the last point to the waveform.

Click **Default** to restore the default values for the parameters.

Click Send to Arb (see page 148) to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG, AFG, or MDO3000 with MDO3AFG option enabled) is connected. You can select the channel to send the waveform to.

Click Multi-Waveform Properties (see page 42) to view or vary the waveform properties. The **Waveform Properties** dialog box opens.

NOTE. *The **Active Waveform** tab is disabled when invoked from the **Standard Waveform** dialog box.*

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5. Click **OK** to display the waveform in a new or an existing window. The window values are saved for this waveform type and the selected instrument.

NOTE. *To display the waveform in a new or existing window, select **Multi-Waveform Properties** in the Shortcut view.*

See Also:

Valid Parameter Ranges (see page 197)

Default Settings (see page 190)

Marker

Display > Marker

Selecting **Display > Marker** from the menu toggles the display of the markers.

Select a marker to edit it. Right-click in the marker field to display a shortcut menu listing the following options:

Option	Description
Create 0/1 pattern	Fills the entire marker area with a 0/1 pattern
Random pattern	Fills the entire marker area with a random pattern
Clear Pattern	Clears the entire marker area
Invert Pattern	Inverts the marker area values
Freehand	Use the mouse to enter 0,1 data in the marker area by clicking the mouse to place a data point.
Shift	Shifts marker bits one point to the right or left
Right	Shifts the marker bits one point to the right
Left	Shifts the marker bits one point to the left
Set Pattern	Displays a dialog box where you can set the pattern type (Hexadecimal or Binary) for the markers
Make High	Sets the data values to high
Make Low	Sets the data values to low
Rotate	Rotates marker bits one point to the right or left
Right	Rotates the marker bits one point to the right
Left	Rotates the marker bits one point to the left

Edit Markers

To edit markers, select a marker and right-click in the marker pane. From the shortcut menu, select **Freehand** to edit marker patterns. Click the points on the marker to edit. Right-click to end freehand editing.

A tool-tip 'Right-click to end' appears when you are in the freehand editing mode.

Cursor

Display > Cursor

Selecting **Display > Cursor** from the menu toggles the display of the cursors.

Point to a cursor and select it. The selected cursor or the active cursor is displayed with a solid line and the other cursor is displayed with a dash-dot line.

See Also:

Cursor Position (see page 113)

Properties (see page 116)

Cursor Position

Display > Cursor Position

Selecting **Display > Cursor Position** from the menu sets the cursor position in points or seconds.

You can also double-click the cursor head to display the cursor position dialog box.

See Also:

Cursor (see page 113)

Properties (see page 116)

Zoom In

Display > Zoom In

Select **Display > Zoom In** from the menu. You can zoom the area of interest by doing either of the following:

- Clicking near a point

- Selecting an area of interest

ArbExpress supports unlimited zoom. The zoom extent is limited by the number of points (10) displayed on the X-axis.

See Also:

Zoom Out

Display > Zoom Out

Select **Display > Zoom Out** from the menu to zoom out. You can use Zoom out only after you have zoomed in. If the markers are displayed, the corresponding marker area is also zoomed.

See Also:

Horizontal Zoom In

Display > Horizontal Zoom In

Select **Display > Horizontal Zoom In** to zoom the area of interest horizontally. The voltage values displayed on the Y-axis remain unchanged during horizontal zoom. You can zoom the area of interest doing either of the following:

- Clicking near a point

- Selecting an area of interest

If the markers are displayed, the corresponding marker area is also zoomed. ArbExpress supports unlimited zoom. The zoom extent is limited by the number of points (10) displayed on the X-axis.

See Also:

Fit to Window

Display > Fit to Window

Select this to fit the waveform in the window and restore the waveform to its state before the first zoom in. This option is enabled only after a zoom in or a horizontal zoom. If you have turned on marker display, Fit to Window also fits the markers within the marker window.

See Also:

Crosshair

Display > Crosshair

Display the crosshairs by selecting **Display > Crosshair** from the menu. This toggles the display of the crosshairs . If there is a check mark next to this command, the crosshairs are on; if there is no check mark, the crosshairs are off.

See Also:

Cursor (see page 113)

Cursor Position (see page 113)

Graticule

Display > Graticule

Display the graticule by selecting **Display > Graticule** from the menu. This toggles the display of the graticule . If there is a check mark next to this command, the graticule is on; if there is no check mark, the graticule is off.

Time Scale

Display > Time Scale

Select **Display > Time Scale** to display the waveform with time as the X-axis and voltage along the Y-axis . If there is a check mark next to this command, the waveform is displayed with Time along the X-axis; if there is no check mark, Time Scale display is off.

Properties

Display > Properties

Display the waveform, cursor, and marker properties by selecting **Display > Properties** from the menu.

Menu selection	Description
Waveform Name	Select the waveform to view or change the properties.
Enable Graticule	Select this to show or hide the graticule.

Menu selection	Description
Background Color	Changes the background color of the waveform window
Waveform Properties	
Color	Select the color for the waveform.
Line Style	Select the line style for the waveform.
Line Width	Select the line width for the waveform.
Marker Color	
Marker1	Select the color for marker1.
Marker2	Select the color for marker2.
Cursor Color	
Cursor 1	Select the color for cursor 1.
Cursor 2	Select the color for cursor 2.

When more than one waveform is displayed in one wave book or window, the inactive waveform is displayed with a dashed line style and the active waveform is displayed with a solid line style.

Undo

Edit > Undo

Select this to undo the last operation performed on the waveform and restore it to its previous state. This command can be repeated to undo the last operations indefinitely.

See Also:

Redo

Edit > Redo

Select this to redo the last operation performed on the waveform.

See Also:

Cut

Edit > Cut

To cut a portion of the waveform:

1. Select the portion of the waveform that you want to cut by turning on the cursors and positioning them on the waveform. To see the cursors, select **Display > Cursors**.

2. Select **Edit > Cut** from the menu or click the icon in the toolbar. The portion of the waveform within the cursors is cut. If the cursors are hidden, the portion of the waveform that is between the cursors is cut.

See Also:

Copy

Edit > Copy

To copy a portion of the waveform:

1. Select the portion of the waveform that you want to copy by turning on the cursors and positioning them on the waveform. To see the cursors, select **Display > Cursors**. To copy the complete waveform, select **Edit > Select All**.

2. Select **Edit > Copy** from the menu or click the icon in the toolbar. The portion of the waveform within the cursors is copied to the clipboard. If the cursors are hidden, the portion of the waveform that is between the cursors is copied.

See Also:

Paste

Edit >Paste

To paste a copied portion of the waveform:

1. Select **Edit > Paste** from the menu. The following dialog box appears:
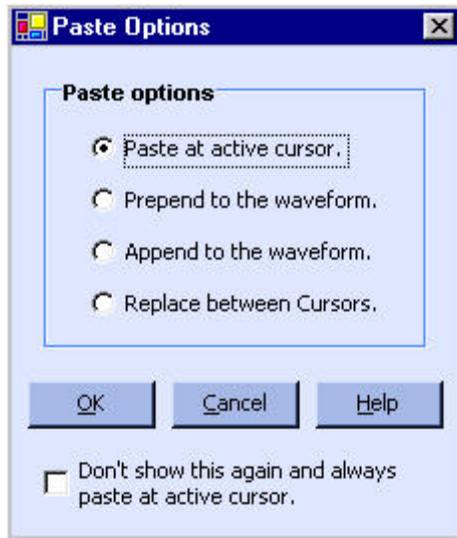
2. Select an option from the dialog box, and click **OK**.

- Select **Paste** at active cursor to paste the contents at the currently active cursor. The active cursor is indicated by a solid line style, and the inactive cursor by a dashed line type.

- Select **Prepend** to the waveform to paste the contents at the beginning of the waveform.

- Select **Append** to the waveform to paste the contents at the end of the waveform.

- Select **Replace between Cursors** to paste the contents between the cursors.

- Select **Don't show this again and always paste at active cursor** option to disable the dialog box from appearing again and always paste the contents at the currently active cursor. To turn this option off, select **Waveform > Preferences** and select **Show paste option before pasting**.

- If the cursors are hidden, the copied portion of the waveform is still pasted. You can paste the copied waveform across waveforms in any window. You can also paste the waveform into Microsoft Notepad or Microsoft Excel.

NOTE. *To display the cursors, select **Display > Cursor**.*

NOTE. *In multiple waveform display, ArbExpress pastes the contents to both waveforms to maintain the same waveform length for both.*

See Also:

Copy (see page 118)

Cut (see page 118)

Select All (see page 120)

Cursor (see page 113)

Select All

Edit > Select All

To copy the entire waveform in an active window, select **Edit > Select All** from the application menu.

See Also:

Copy (see page 118)

Paste (see page 119)

Copy to System Clipboard

Edit > Copy to System Clipboard

To copy the waveform and paste in Microsoft Excel or Microsoft Word, select **Edit > Copy to System Clipboard**. You can use these data points to generate the waveform in another application.

	A	B	C	D
1				
2	0	0	0	
3	0.062791	0	0	
4	0.125333	0	0	
5	0.187381	0	0	
6	0.24869	0	0	
7	0.309017	0	0	
8	0.368125	0	0	
9	0.425779	0	0	
10	0.481754	0	0	
11	0.535827	0	0	
12	0.587785	0	0	
13	0.637424	0	0	
14	0.684547	0	0	
15	0.728969	0	0	
16	0.770513	0	0	
17	0.809017	0	0	
18	0.844328	0	0	
19	0.876307	0	0	
20	0.904827	0	0	
21	0.929776	0	0	
22	0.951057	0	0	
23	0.968583	0	0	
24	0.982287	0	0	
25	0.992115	0	0	
26	0.998027	0	0	
27	1	0	0	
28	0.998027	0	0	
29	0.992115	0	0	
30	0.982287	0	0	
31	0.968583	0	0	
32	0.951057	0	0	
33	0.929776	0	0	

Copy as Bitmap

Edit > Copy as Bitmap

You can paste the captured image as a bitmap in Microsoft Word or Microsoft Excel.
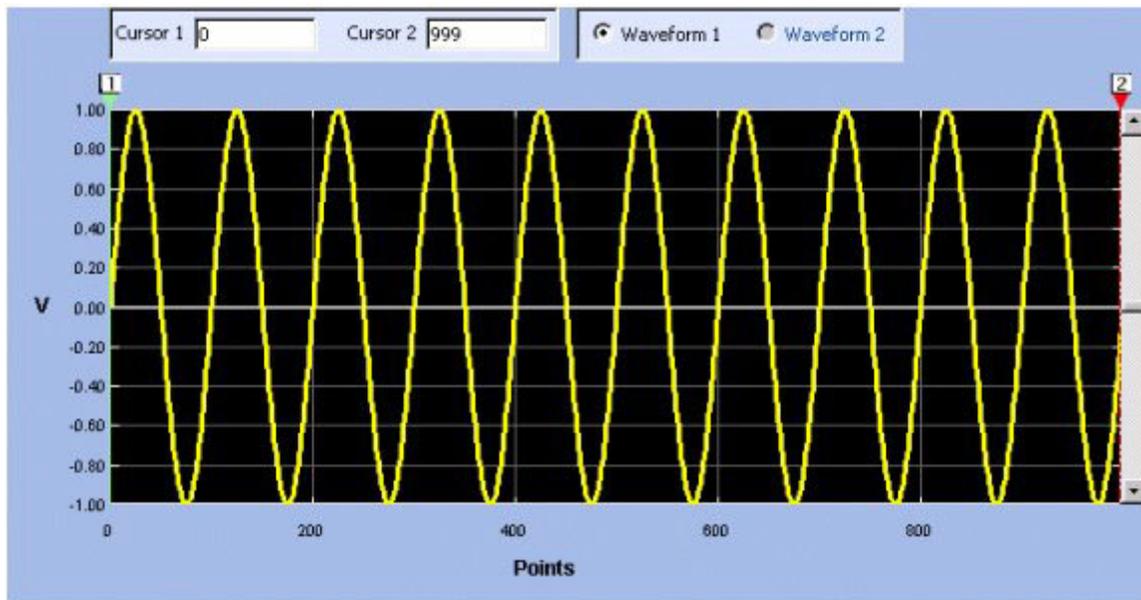
Invert

Edit > Invert

To invert a portion of the waveform:

1. Select the portion of the waveform that you want to invert by turning on the cursors and positioning them on the waveform. To see the cursors, select **Display > Cursors**.

2. Select **Edit > Invert** from the menu or click the icon in the toolbar. The portion of the waveform within the cursors is inverted along the X-axis. If the cursors are hidden, the portion of the waveform that is between the cursors is still inverted.

See Also:

Mirror

Edit > Mirror

To mirror a portion of the waveform:

1. Select the portion of the waveform that you want to mirror by turning on the cursors and positioning them on the waveform. To see the cursors, select **Display > Cursors**.

2. Select **Edit > Mirror** from the menu or click the icon in the toolbar. The portion of the waveform within the cursors is mirrored along the Y-axis . If the cursors are hidden, the portion of the waveform that is between the cursors is still mirrored.

See Also:

Invert (see page 122)

Cursor (see page 113)

Freehand

Edit > Freehand

Select **Edit > Freehand** to enable the freehand drawing mode or click the icon in the toolbar. Use this mode to draw a new waveform or to edit an existing waveform. Move the pointer to the point on the waveform that you want to edit. Click and move the selected point; it moves in the direction the pointer moves. The voltage readout in the status bar is the actual vertical height of the draw pointer.

Turn off the freehand draw mode by selecting **Edit > Freehand** or by clicking the corresponding icon.

See Also:

Horizontal Draw (see page 124)

Vertical Draw (see page 124)

Point Draw (see page 125)

Horizontal Draw

Edit > Horizontal Draw

Select **Edit > Horizontal Draw** to enable the horizontal draw mode or click the icon in the toolbar. Use this mode to draw a new waveform or to edit an existing waveform. You can move the selected point only in the horizontal direction. All vertical movement is restricted.

Move the pointer to the point on the waveform that you want to edit. Click and move the selected point; it moves only horizontally. The voltage readout in the status bar is the actual vertical height of the draw pointer.

Turn off the horizontal draw mode by selecting **Edit > Horizontal Draw** or by clicking the corresponding icon.

See Also:

Freehand (see page 123)

Vertical Draw (see page 124)

Point Draw (see page 125)

Vertical Draw

Edit > Vertical Draw

Select **Edit > Vertical Draw** to enable the vertical draw mode or click the icon in the toolbar. Use this mode to draw a new waveform or to edit an existing waveform. You can move the selected point only in the vertical direction. All horizontal movement is restricted.

Move the pointer to the point on the waveform that you want to edit. Click and move the selected point; it moves only vertically. The voltage readout in the status bar is the actual vertical height of the draw pointer.

Turn off the vertical draw mode by selecting **Edit > Vertical Draw** or by clicking the corresponding icon.

See Also:

Freehand (see page 123)

Horizontal Draw (see page 124)

Point Draw (see page 125)

Point Draw

Edit > Point Draw

Select Edit > Point Draw > Enable Point Draw to enable the point draw mode or click **Enable Point Draw** in the toolbar.

You can use the point draw feature to define points and create a waveform. Before you can enable point draw, you must have a blank or existing wave book window open. The markers disappear and the Point Draw toolbar items are enabled.

You can use the Point Draw feature in two ways to create a waveform in a new or existing window:

- Enable Point Draw and click points within the waveform window.

- Enable Point Draw and select Point Draw Table. Type the coordinates (X, Y) of the points in the Point Draw Table.

Using Point Draw

Select **Point Draw** in the toolbar. By default, Dynamic Compile mode is enabled. When Dynamic Compile mode is enabled, the application generates the waveform dynamically as you click the points. Select Interpolation mode — Smooth, Linear, or Staircase — to use when then application generates the waveform. By default, the interpolation method is Smooth.

The Shortcut Menu options are:

Menu item	Description
Disable Point Draw	Disables the point draw mode
Zoom	Has options that you can use to Zoom In, Zoom Out, Horizontal Zoom In, and Fit to Window
Set Cursor Position...	Opens the Cursor Position dialog box that you can use to set the cursor position in points or seconds
Time Scale	Changes the values on X axis into time domain
Select Previous Point	Highlights the previous point in the sequence
Select Next Point	Highlights the next point in the sequence
Edit Point Draw Table...	Opens the point draw table where you can edit the points and set the interpolation method
Delete Selected Point	Deletes the selected point
Clear All Points	Clears the display of all the points but the continues to display the waveform
Interpolation	Sets the interpolation method to use while generating the waveform. You can choose form Smooth, Linear, and Staircase

Menu item	Description
Dynamic Compile	Compiles the waveform as you click the points using the interpolation method you have chosen
Compile Draw Points	Compiles the waveform using the interpolation method you have chosen only when you click Compile

To Add a Point with Point Draw:

Click a point inside the wave book window. A mark appears at that point indicating the point. In dynamic compile mode, the point is linked to the nearest two points and the waveform points are recalculated using the selected interpolation method. If dynamic compile mode is turned off, then the points are compiled only when you click **Compile**.

To Delete a Point with Point Draw:

Use the shortcut menu or the toolbar to select a point on the waveform. Select **Delete** from the Shortcut Menu or press the Delete key to delete the point. To move to the next or previous point, use the left and right arrow keys.

To Move a Point with Point Draw:

Press **Shift** and the left or right arrow keys to move a point by 10 units along the X-axis.

Using the Point Draw Table

You can either enter points in a blank table or edit a point draw table that already has points in it. The following figure shows the Point Draw table.
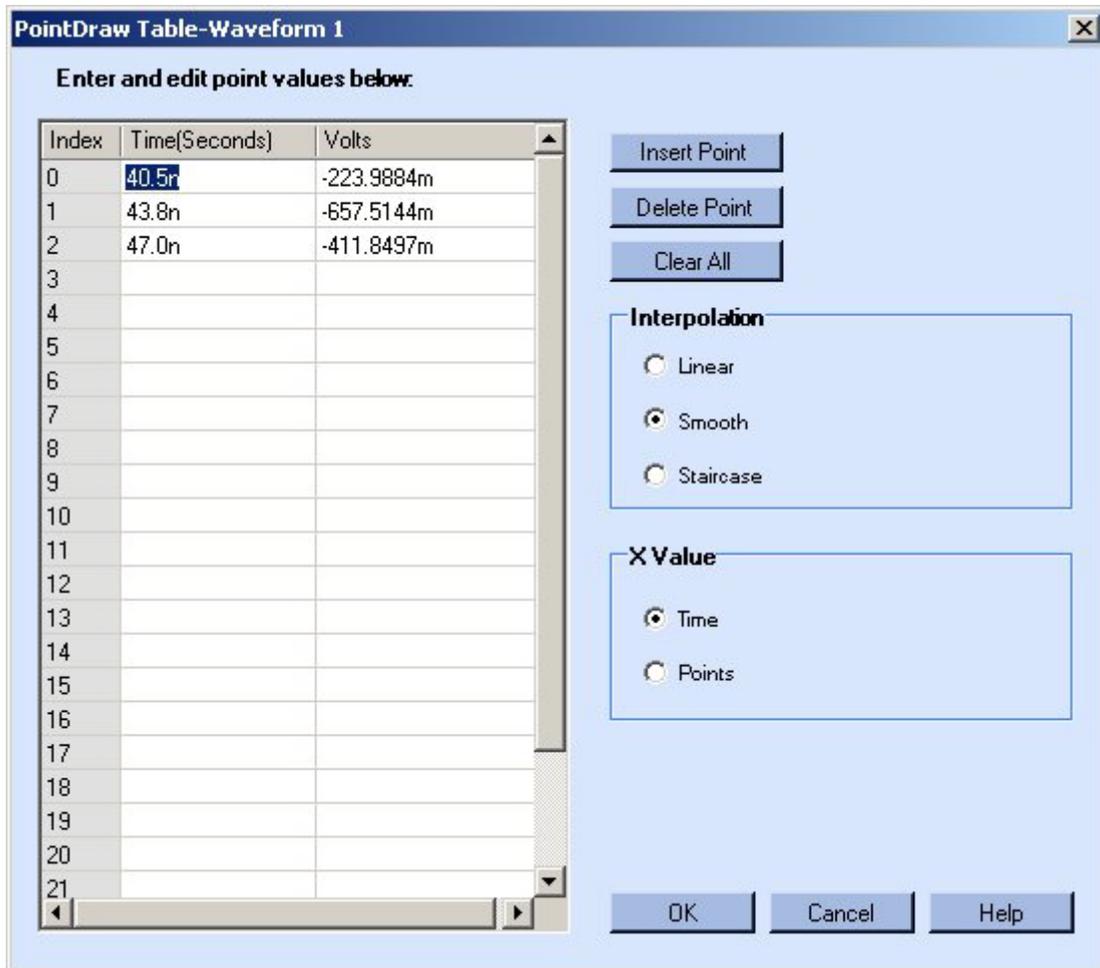
To Add a Point with the Point Draw Table:

You can insert a point in the table by positioning the cursor over a row or point and clicking Insert Point. Insert Point inserts a row above the selected row or point. Type the X,Y values of a point in the new row.

To Delete a Point with the Point Draw Table:

You can delete a point in the table by positioning the cursor over a row and clicking Delete Point. Delete Point deletes the currently selected row or point.

You can set the interpolation method to use to any one of these – Linear, Smooth, or Staircase. This setting determines the method to use while creating a waveform using the points that you defined.

You can clear all the points by clicking **Clear All**.

You can set the X value to either Time (seconds) or Points. The table refreshes to display the X-value in the selected unit. This is similar to selecting Display> Time Scale from the application's main menu.

The application checks the values you enter for the following:

- X-value (sampling point) must always be unique. If you try to repeat this value, the message "Values of the sampling index should be unique" appears.

- If you leave the amplitude (Y) blank, the applications fills it with a zero.

- If you enter a Y value but no corresponding X value, an error appears.

Click **OK** and if the application finds no errors, the Point Draw Table closes and the waveform in the Wave Book window is updated to reflect the changes that you made in the Point Draw Table.

If you change from the point draw mode to other modes like Freehand, Horizontal Draw or Vertical Draw modes, the point s are not lost. If you return to the point draw mode, the points reappear.

From the point draw mode, if you edit the waveform using Cut, Paste, Invert, Mirror, Shift/Rotate, or Math operations the following message appears: "This edit operation would flush the draw point and you might lose the current draw points. Do you want to proceed?"

See Also:

Point Draw Toolbar (see page 35)

Freehand (see page 123)

Horizontal Draw (see page 124)

Vertical Draw (see page 124)

Addition

Math > Waveform Math

Enable the math operations by selecting **Math > Waveform Math** from the menu. A Waveform Math screen is displayed.

Adding from the Waveform Library

To add a waveform to an existing waveform:

1. Select the type of waveform to add from the Waveform Library. Enter the peak-peak Amplitude, number of Cycles, and the Offset in degrees for the selected waveform.

   The original waveform, the standard waveform to add, and the resulting waveform are displayed in the Selected Waveform, Math Source, and Resultant Waveform panes.

2. Select **Add from Operation**.

Adding a Scalar Value

To add a scalar value to the waveform:

1. Select **Scalar** and type a scalar value to add to the waveform.

2. Select **Add from Operation**.

Adding a Waveform Copied to the Clipboard

To add a waveform from the clipboard:

1. Copy the waveform, or portion of it, by selecting **Edit > Copy** or **Edit > Cut**. To define the portion of the waveform to copy or cut, select **Display > Cursor Position** to position the cursors over the waveform. To copy the entire waveform, select **Edit > Select All**, and **Edit > Copy**.

2. Select **Math > Waveform Math**.

3. Click **Copy** from clipboard and from Operation, click **Add**. Click **OK**.
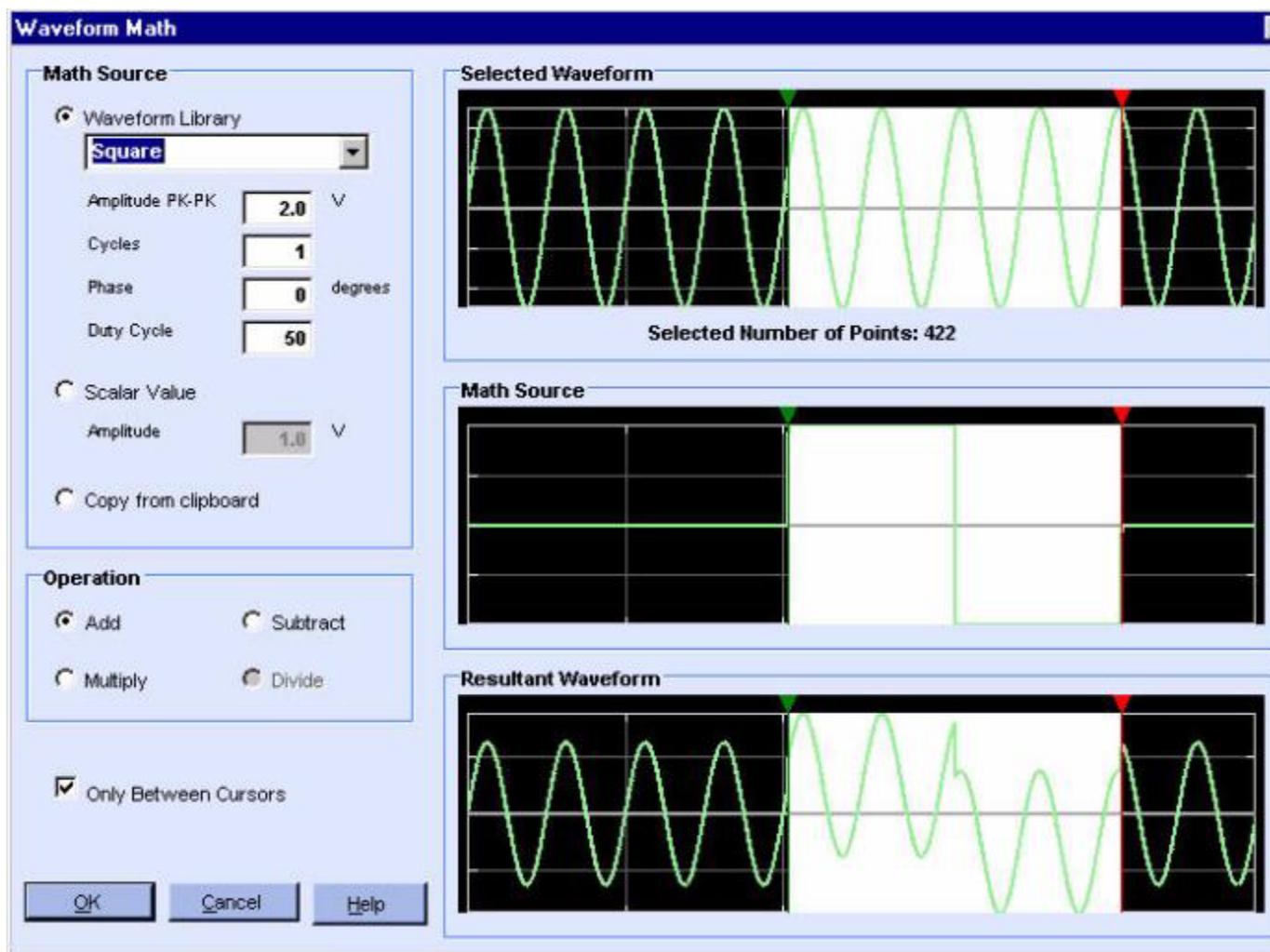
Subtraction

Math > Waveform Math

Enable the math operations by selecting **Math > Waveform Math** from the menu. A Waveform Math screen is displayed.

Subtracting from the Waveform Library

To subtract a waveform from an existing waveform:

1. From the Waveform Library, select the type of waveform to subtract. Enter the peak-peak Amplitude, number of Cycles, and the Offset in degrees for the selected waveform.

    The original waveform, the standard waveform to subtract from, and the resulting waveform are displayed in the Selected Waveform, Math Source, and Resultant Waveform panes.

2. Select **Subtract** from Operation.

Subtracting a Scalar Value

To add a scalar value to the waveform:

1. Select **Scalar** and type a scalar value to subtract from the waveform.

2. Select **Subtract** from Operation.

Subtracting a Waveform Copied to the Clipboard

To subtract a waveform that has been copied to the clipboard:

1. Copy the waveform, or portion of it, by selecting **Edit > Copy** or **Edit > Cut**. To define the portion of the waveform to copy or cut, select Display> Cursor Position to position the cursors over the waveform. To copy the entire waveform, select **Edit > Select All** and then **Edit > Copy**.

2. Select **Math > Waveform Math**.

3. Click **Copy** from clipboard and from Operation, click **Subtract**. Click **OK**.
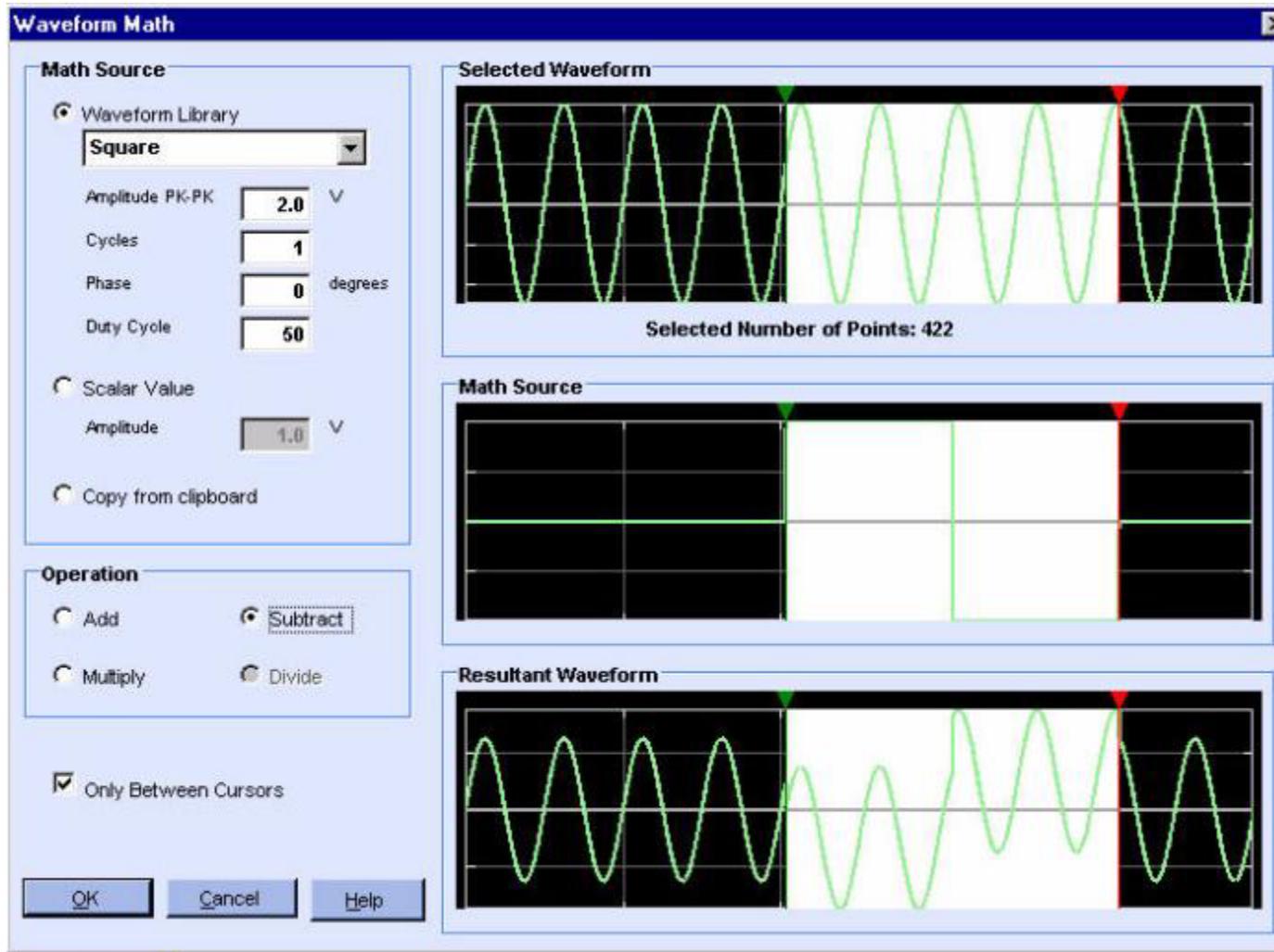
Multiplication

Math > Waveform Math

Enable the math operations by selecting **Math > Waveform Math** from the menu. A Waveform Math screen is displayed.

Multiplying from the Waveform Library

To multiply a waveform with an existing waveform:

1. Select the type of waveform with which to multiply from the Waveform Library.

The original waveform, the standard waveform to multiply with, and the resulting waveform are displayed in the Selected Waveform, Math Source, and Resultant Waveform panes.

2. Select **Multiply** from Operation.

Multiplying with a Scalar Value

To multiply the waveform with a scalar value:

1. Select **Scalar** and type a scalar value to multiply the waveform with.

2. Select **Subtract** from Operation.

Multiplying with a Waveform Copied to the Clipboard

To multiply with a waveform that has been copied to the clipboard:

1. Copy the waveform, or portion of it, by selecting **Edit > Copy** or **Edit > Cut**. To define the portion of the waveform to copy or cut, select **Display > Cursor Position** to position the cursors over the waveform. To copy the entire waveform, select **Edit > Select All**, and **Edit > Copy**.

2. Select **Math > Waveform Math**.

3. Click **Copy** from clipboard and from Operation, click **Multiply**. Click **OK**.
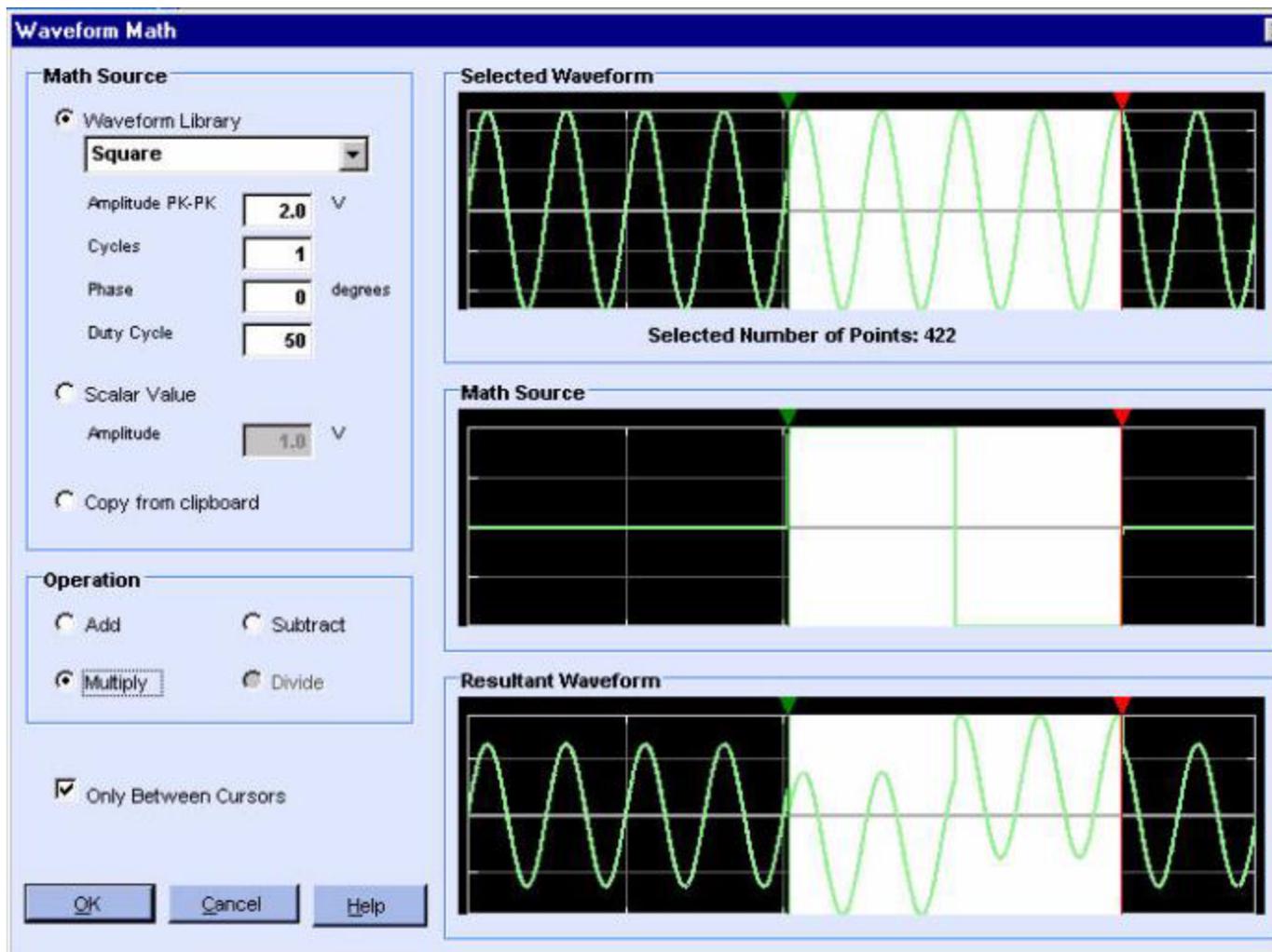
Division

Math > Waveform Math

Enable the math operations by selecting **Math > Waveform Math** from the menu. A Waveform Math screen is displayed. Waveform division is available only with scalar operations and with a waveform copied to the clipboard.

Dividing with a Scalar Value

To divide points on an existing waveform with a scalar value:

1. Select **Scalar** and type a scalar value with which to divide the waveform.

The original waveform, the standard waveform to multiply with, and the resulting waveform are displayed in the Selected Waveform, Math Source, and Resultant Waveform panes.

2. Select **Divide** from Operation.

Dividing with a Waveform Copied to the Clipboard

To divide with a waveform that has been copied to the clipboard:

1. Copy the waveform, or portion of it, by selecting **Edit > Copy** or **Edit > Cut**. To define the portion of the waveform to copy or cut, select **Display > Cursor Position** to position the cursors over the waveform. To copy the entire waveform, select **Edit > Select All**, and **Edit > Copy**.

2. Select **Math > Waveform Math**.

3. Click **Copy** from clipboard and from Operation, click **Divide**. Click **OK**.
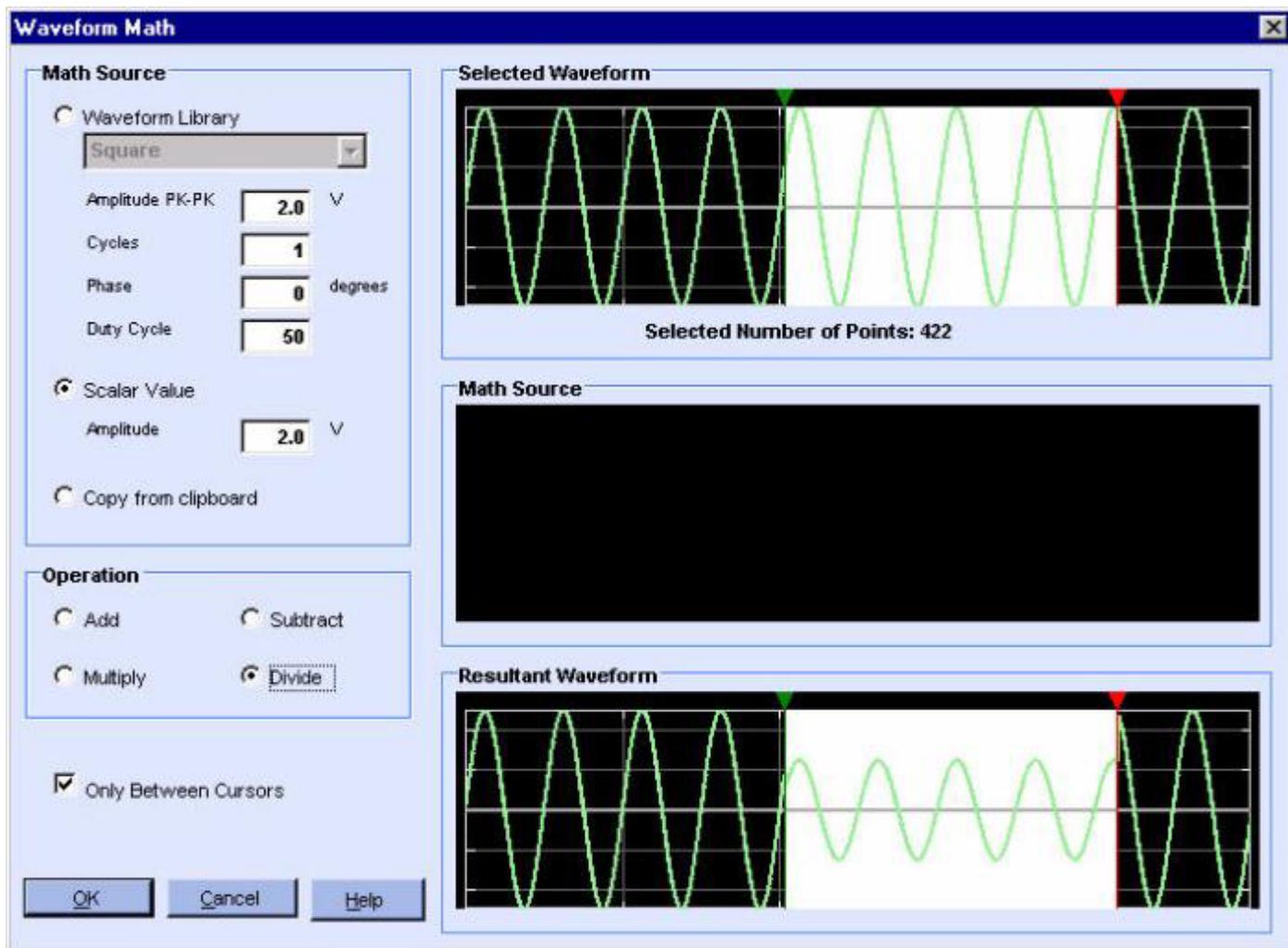
AWG/AFG File Transfer and Control

Communication > AWG/AFG File Transfer and Control

You can use ArbExpress to transfer files to and from an arbitrary waveform generator, a function generator, or an MDO3000 (with MDO3AFG option enabled) connected to the computer. From the main menu, select **Communication > AWG/AFG File Transfer and Control**.

The screen shows a toolbar and the panes — Arb List, PC Folders, PC Files, Instrument Folders, Instrument Files, and Instrument Control.
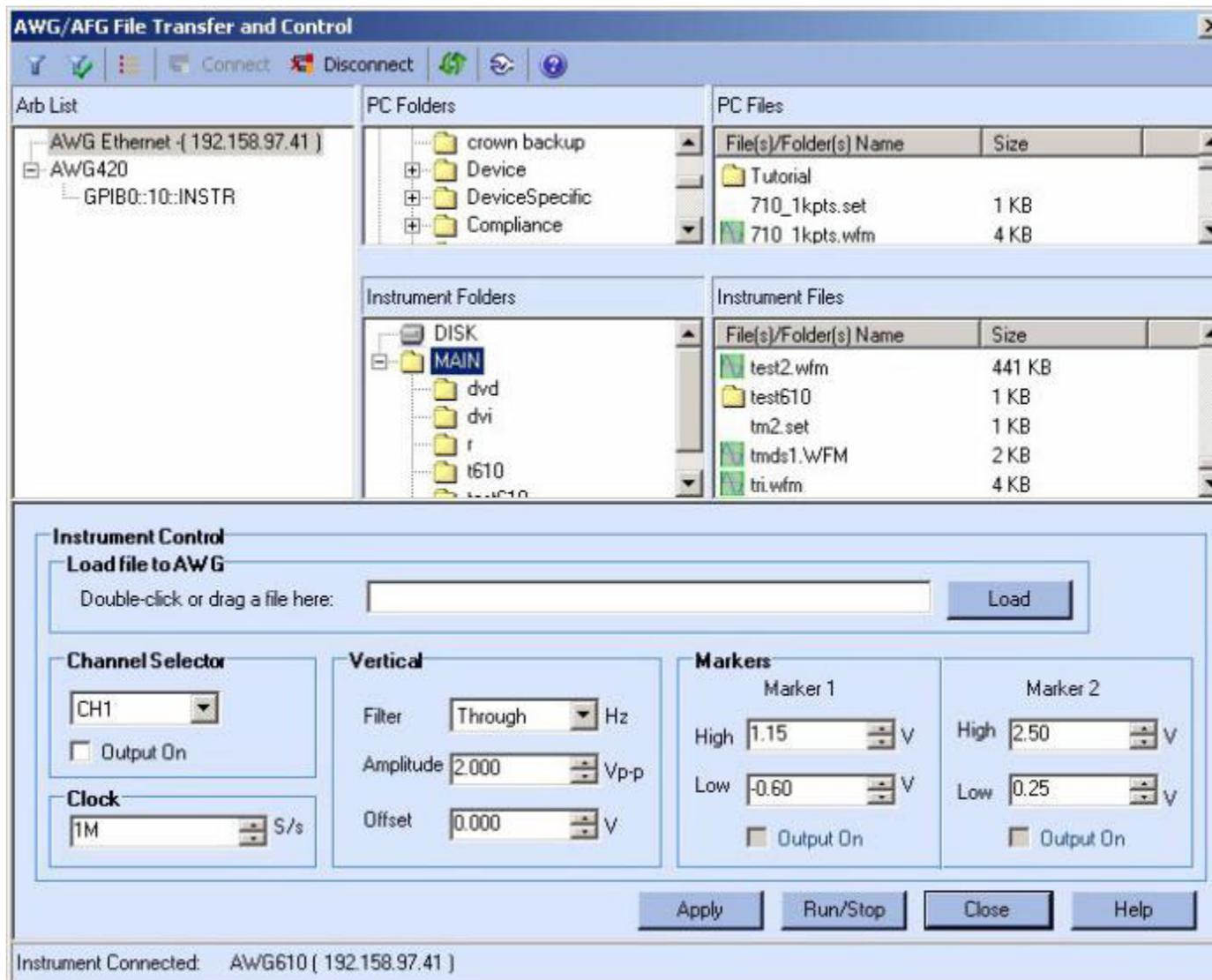
Toolbar

The toolbar contains the following buttons:
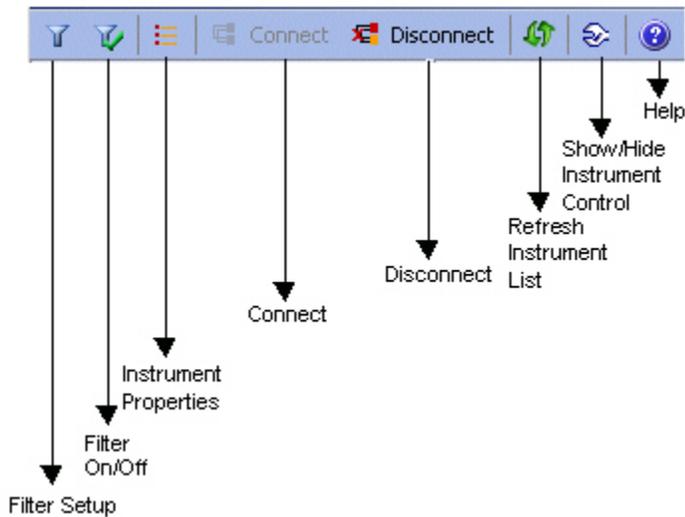
Option	Description
Filter setup	Shows the file types to select from
Filter On/Off	Toggles between the enable filter and disable filter modes
Instrument Properties	Displays properties of the instrument selected from the Arb list
Connect	Connects to a selected instrument
Disconnect	Disconnects a selected instrument if it is connected
Refresh Instrument List	Rereads the instrument file list and updates the Arb list
Show/Hide Instrument Control	Hides the instrument control panel
Help	Displays the help

Arb List

The instrument list shows a list of Tektronix waveform or function generator models that are supported by ArbExpress. When you invoke AWG/AFG File Transfer and Control, ArbExpress automatically refreshes the Arb List and disables the Refresh icon in the toolbar. Refresh is enabled once the Arb List is updated. When no instruments are available to connect to either over LAN or over GPIB, this view shows only "AWG Ethernet" and the IP address last used. Expand the list to display the Visa resource string. Select the Visa resource string and right-click to display the shortcut menu.

NOTE. *It is recommended that you refresh the TekVisa instrument list by right-clicking and selecting "Refresh" on the system tray TekVisa option to display an active list of instruments in the application Arb List.*

Shortcut Menu for the Instrument

Select an instrument and right-click. The shortcut menu displays three options — Connect, Disconnect, and Properties for GPIB resources. For resources over LAN, the shortcut menu displays four options — Connect, Disconnect, Set IP Addr, and Properties. Click Connect to connect to the instrument, click Disconnect to disconnect the instrument, and click Properties to display the properties of the instrument. The Instrument Properties displayed are Instrument Model, Bus Type (such as GPIB or LAN), Interface String (such as GPIB0::09:: INSTR — if it is a Visa resource) and connection status (connected or not connected). Set IP Addr allows you to enter a new IP address for the instrument that is connected over the LAN.

To prevent multiple connections to an instrument, the Connect button is disabled following a successful Connect command. When no instrument is connected, the Disconnect button is disabled.

File and Folder Views

The file folder view has two sections. The upper section always shows the PC folder list. This list is shown whether an instrument is connected or not. When an instrument is connected the lower section shows the files and folders on the instrument. If the instrument connected is an AFG300 series instrument, it shows the user memories and edit memories instead of files and folders.

When no instruments are connected, the remote file folder or remote memories are not visible. The instrument control pane is shown only when an instrument is connected, otherwise it is hidden.

See Also:

Transfer Files to an AWG/AFG

Communication > AWG/AFG File Transfer and Control

You can use ArbExpress to transfer files to and from an arbitrary waveform or function generator connected to the computer.

To transfer a file to an AWG or an AFG:

1. Select **Communication > AWG/AFG File Transfer and Control** from the menu.

2. Select the AWG or AFG from the Arb list and expand the tree to see the Resource ID used to connect. If no AFGs or AWGs are available, the Arb list view displays — AWG Ethernet, with the IP address used for the last connection. No instrument properties are shown.

3. Select the resource string (for example, GPIB1::01:: INSTR) and right-click to display the shortcut menu. Click **Connect** in the shortcut menu. If you connect to the instrument successfully, the instrument File and Folder views show the data files of the connected AWG or the edit and user memories of the AFG.

4. Expand the **Folder** tree to view the list of folders and files within. Select a file in the instrument File view and right-click to display the shortcut menu. Select **Copy**.

5. Select a PC folder, right-click the PC file list, and select **Paste**. A progress bar shows the percentage of task completed.

6. You can transfer the waveform using one of the following methods:

    ‒ Directly on a USB flash drive.

       Wherever a .set file is created for a waveform (.wfm or .pat) file in ArbExpress, it contains information including the name of the waveform file, the voltage, offset, and clock information. You can save the .wfm, .pat, and the .set file to a USB flash drive and transfer it manually to an AWG or an AFG.

    ‒ By dragging and dropping the .wfm file from the PC to the instrument or from the instrument to the PC. The application automatically drags and drops the .set file.

       Follow these steps to drag and drop a waveform file to the instrument:

       a. Select **Communication > AWG/AFG File Transfer and Instrument Control**.

       b. Use the shortcut menu or the toolbar to connect to the instrument.

       c. Drag and drop the required .wfm/.pat file from PC list view to instrument files view for an AWG. The application automatically transfers the .set file to instrument (not for AWG2000 series).

       d. For an AFG, drag and drop the .wfm or .pat file to the Edit memory or User memories.

          For the AFG3xx series, you can transfer the waveform files in the following directions — PC to Edit memory, PC to User memory, and Edit memory to User memory.

          For the AFG2000 and AFG3000 series, you can transfer the waveform in the following directions— PC to Edit memory, PC to User memory, Edit memory to User memory, and Edit memory to PC.

          For the MDO3000 series, you can transfer the waveform in the following directions — PC to Edit memory and Edit memory to PC.

          When you transfer a waveform from the Edit memory to the PC, the file has the name EMEM<n> in the destination folder. When you transfer a waveform from the PC to the Edit memory, the EMEM<n> waveform text box shows the waveform file name. When you drag the EMEM<n> file to User<n>, the User<n> text box shows the file name as EMEM<n>.

          When you drag a file from the PC Files list and drop it to the destination Edit or User memory, the default destination text "Drag source file and drop here" is replaced with the name of

the file transferred. When you close the dialog box or reinvoke it, the default destination text reappears.

e. In the AWG, load the .wfm or .pat file using the **Load/Restore** button.

- Directly send the waveform from a Wave book, Standard Waveform dialog, or Equation Editor dialog to the instrument.

Use the **Send to Arb** option to select a channel on the target instrument and send the waveform directly from the wave book, **Standard Waveform** dialog box, or **Equation Editor** dialog box. The application provides an option in the **Preference** tab – Channel output On after waveform transfer using "Send to Arb" – to turn the target channel on and output the waveform data. The waveform is sent to the target channel and loaded on to it. The corresponding amplitude and offset will also be set on the instrument.

In the AFG3xx, AFG2000, AFG3000, and MDO3000 series, the waveform is sent to the edit memory. A message "Are you sure you want to overwrite EMEM<n> with this file?" warns you that the instrument edit memory will be overwritten.

Follow these steps to transfer the waveform directly to the instrument from a Wave book:

a. Select **Communication > AWG/AFG File Transfer and Instrument Control** and establish connection between the instrument and the PC. Once the connection is successfully established, you can close the **File Transfer** dialog box. The connection is not lost by closing the file transfer dialog.

b. Create a waveform and from the shortcut menu, click **Send Waveform to Arb** and choose the target channel to which to transfer the waveform.

c. The voltage, offset, and other parameters that are set while creating the waveform, are set on the instrument automatically. After the file is transferred successfully the parameters are set, and if the preference **Channel Output ON after waveform transfer using "Send to Arb"** is selected, the target channel is switched on, and instrument is set in Run mode. If this preference is not selected, then the target channel is switched off.

NOTE. When you use this mode of file transfer, an associated .set file is not created. The transferred file is loaded in the instrument internal memory.

In an AFG, the transferred file is loaded in the Edit memory, and in an AWG it is loaded on the destination channel.

d. Repeat step b and step c to transfer a waveform form the **Equation Editor** or **Standard Waveform** dialog boxes.

Control an AFG

Communication > AWG/AFG File Transfer and Control

You can use ArbExpress to control an AFG or MDO3000 series (with MDO3AFG option enabled) connected to the computer. The AFG3xx series parameters can be controlled from the instrument control pane.

NOTE. *The MDO3000 series with option MDO3AFG enabled provides some, but not all, of the AFG controls described in the section. Features or functions that do not apply to the MDO3000 will be noted as such.*

To control an AFG:

1. Select an AFG from the instrument list. Even though the PC is physically connected to an AFG, the screen does not show the **Instrument Control** panel. Select an AFG, and from the shortcut menu select **Connect**. The instrument control panel appears. All the controls are updated for the selected channel.
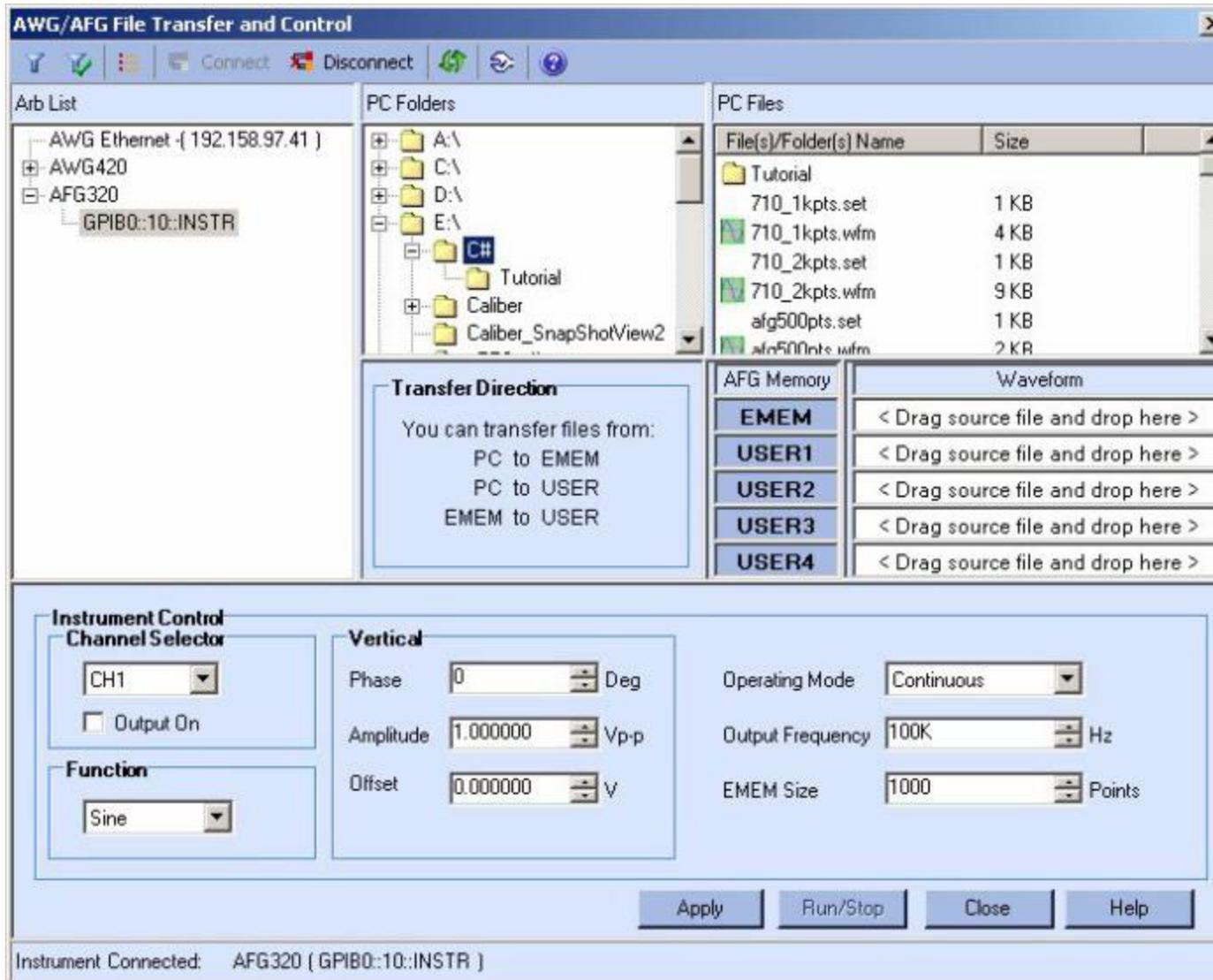
AWG/AFG File Transfer and Control screen. This screen will look slightly different if you are using an MDO3000 series instrument with option MDO3AFG.

2. Select the channel in the channel selection box to output data. The number of channels shown depends upon the number of channels of the instrument that is connected. You can select only one channel at a time. Channel 1 is the default. (The MDO3000 only has 1 channel.)

   You can set the **Function** parameter in the list by selecting the function form the function list. Click **Apply** to reflect the new selection.

   The Vertical parameters — Phase, Amplitude, and Offset values — are loaded from the file. The **Function** field displays the waveform type that is loaded.

3. Set the Operating Mode, Output Frequency in Hertz, and EMEM size in bytes, or use the default settings for the instrument.

The operating modes available for the AFG2000 and AFG3000 series are: Continuous, Sweep, Burst 1-cycle, Burst N-cycle, Burst Gated, Burst Inf cycle, Modulation AM, Modulation FM, Modulation PM, and Modulation FSK. The operating mode depends on the function that you have selected. The operating modes available for AFG3xx series are: Continuous, Trigger, and Burst.

The operating mode available for the MDO3000 is Continuous.

4. Select the **Output On** check box to generate the waveform output for the channel selected. Clear the check box to stop generating the output.

5. You can change the Phase, Amplitude, and Offset values and click **Apply** to reflect the new values in the output waveform.

NOTE. *Run/Stop is disabled for all AFGs.*

Control an AWG

Communication > AWG/AFG File Transfer and Control

You can use ArbExpress to control any AWG parameters that are displayed in the Instrument Control pane.

To control an AWG:

1. Connect an AWG from the Arb list. All the controls are updated for the selected channel.
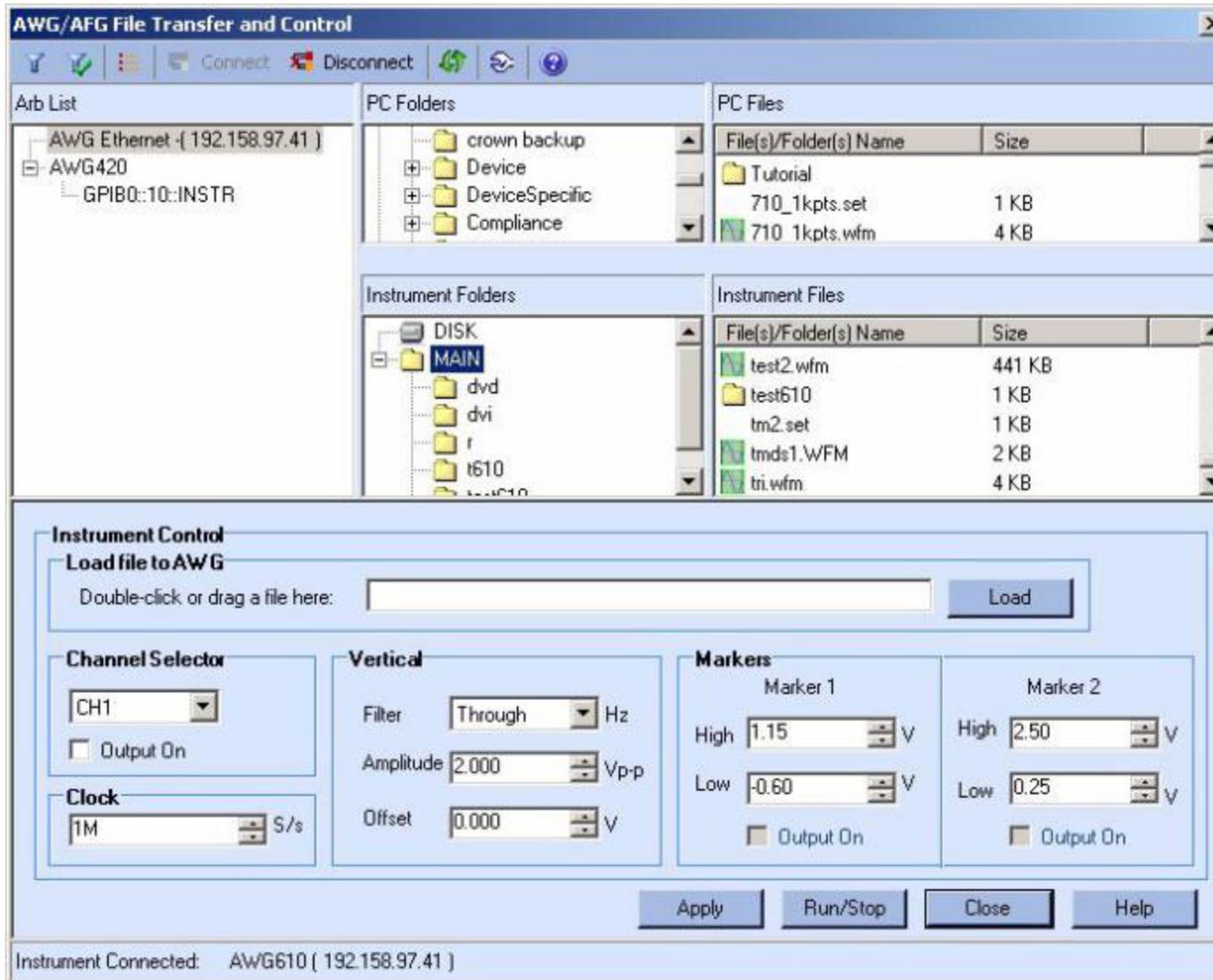
2. Select the channel in the channel selection group box. The number of channels shown depends upon the number of channels of the instrument that is connected. You can select only one channel at a time. Channel 1 is the default.

3. Select the **Output On** check box to enable the selected channel. In case of AWG2xxx, the selected channel is enabled and the waveform is output.

NOTE. It is recommended that you load a file in this channel and then enable or disable the channel.

4. Drag and drop a .wfm or .pat file from the instrument files list to the **File Name** field or type the file name and click **Load**. The Vertical parameters — Filter, Amplitude, Offset, and Clock values — are updated.

If you click once on a file in the Instrument Files view, the name of the selected file appears in the **Load File to AWG**text box. If you click twice (double click) on the file in the Instrument Files view, the name of the selected file appears in the **Load File to AWG**text box and is also loaded in the instrument.

5. Change the Clock frequency to set the output frequency for the selected channel.

6. Set the High and Low values for Marker1 and Marker2. When no file is loaded, these fields display the values for the selected channel.

7. Click **Run/Stop** to generate or stop the waveform output for the selected channel.

NOTE. *It is recommended that you load a file on the selected channel and then click Run/Stop.*

---

8. You can change the Filter, Amplitude, and Offset values and click **Apply** to reflect the new values in the output waveform.

Import from Oscilloscope

Communication > Import from Scope

You can use ArbExpress to acquire data from an oscilloscope connected to the computer.

To import from an oscilloscope:

1. Select **Communication > Import from Scope** from the menu.

2. Select the oscilloscope from the instrument list and right-click. From the shortcut menu, select **Connect**.

3. Expand the oscilloscope tree to view the channels. Select a channel and right-click to set or change the parameters.

4. Select **Import from Scope** from the shortcut menu.

5. Move to the computer file folder view and select a folder. Right-click and select **Paste**. A progress bar shows the percentage of task completed. ArbExpress automatically assigns file names in the form <Model Name>_<Channel Number>. wfm . For example, if you have acquired the waveform from Ref3 of a Tektronix TDS2024 Oscilloscope, the file name would be TDS 2024_Ref3.wfm.

The screen shows a toolbar and the panes — Scope List, PC Folders, PC Files, and Status.
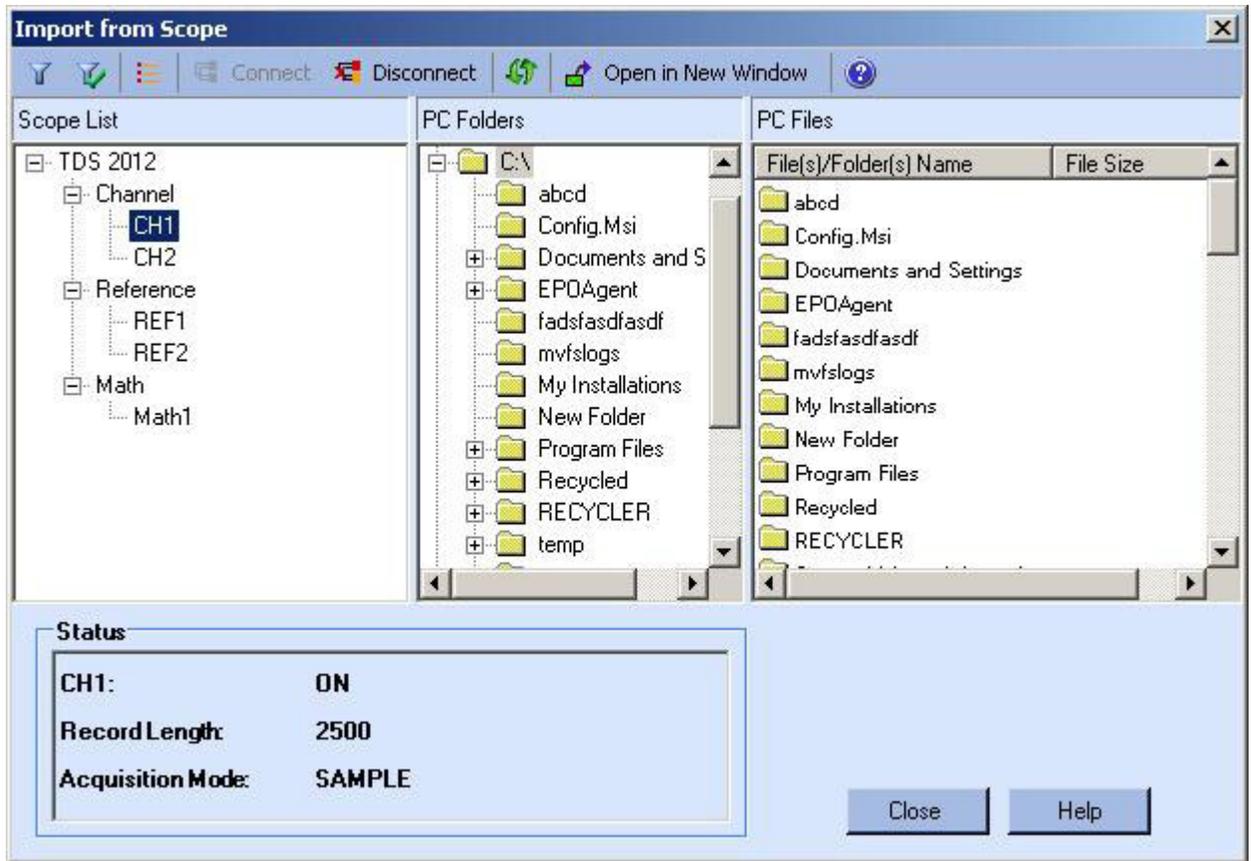
Toolbar

The toolbar contains the following buttons:
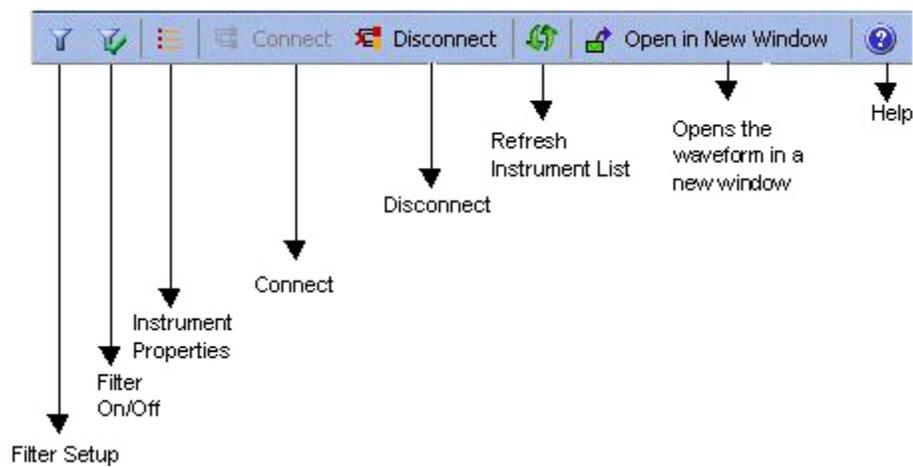
Option	Description
Filter Setup	Selects types of files available
Filter On/Off	Enables or disables filters
Instrument Properties	Displays properties of the selected oscilloscope
Connect	Connects to a selected oscilloscope
Disconnect	Disconnects a selected oscilloscope if it is connected
Refresh Instrument List	Rereads the instrument file list and updates the instrument view
Open in New Window	Acquires data from selected channel and displays it in a new window
Help	Displays the help for the dialog box

Instrument List

The instrument list shows a list of Tektronix oscilloscope models that are supported by ArbExpress. ArbExpress supports TDS1000, TPS2000, TDS2000, TDS3000, TDS5000, TDS6000, TDS7000, TBS1000, DPO2000, DPO3000, DPO4000, MSO2000, MSO3000, MSO4000, MDO3000, and MDO4000 series oscilloscopes. When the oscilloscopes are not connected, the channels are not visible. Before you acquire data, you must connect to the oscilloscope. You can do this either by selecting one of the listed oscilloscope models and clicking the **Connect** button in the toolbar or by bringing up the shortcut menu by right clicking on an oscilloscope in the instrument view. When you connect successfully to the selected oscilloscope, you will see the available Channels, Math, and Ref channels.

Assigning friendly names to listed oscilloscopes: You can associate a "Friendly name" with the oscilloscope you want to connect to. You can do this by giving the VISA resource string associated with the Oscilloscope an alias in the **TekVisa Resource Manager** dialog box. The Alias appears in the instrument list within brackets as shown in the following figure.
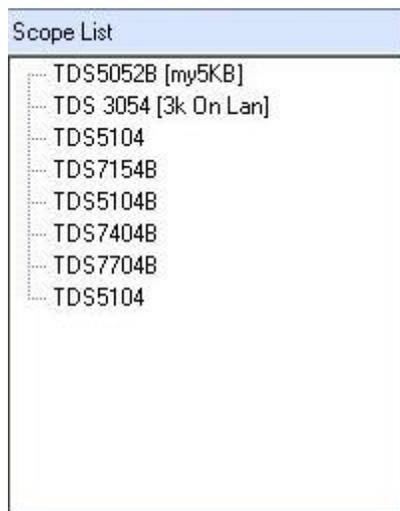
Shortcut Menu for the Oscilloscope

Select an oscilloscope and right-click. The shortcut menu displays three options — Connect, Disconnect, and Properties. Click **Connect** to connect to the oscilloscope and click **Disconnect** to disconnect the oscilloscope. Click **Properties** to show the Instrument Model, Connection Status, Interface String, and Bus Type.

Shortcut Menu for Each Channel

Select an oscilloscope channel and right-click. The shortcut menu is displayed showing the channel parameters that you can set. This shortcut menu is available only when the oscilloscope is connected.

Option	Description
Run Mode	Displays the second level of menu with item — Continuous, and Single Sequence. Continuous acquisition puts the oscilloscope in the Run mode. Single Sequence acquisition stops the acquisition as soon as the oscilloscope acquires one full waveform.
Acquisition Mode	Displays a submenu with the acquisition modes that ArbExpress supports. The mode currently selected is checked. To change the mode, select it from the drop-down list.
Record Length	Displays the available record lengths for the connected instrument. A check mark shows the currently selected record length. If you are connected to a model other than the TDS1000, TPS2000, TDS2000, or TBS1000 series, you can change the record length to any other value in the list.
Acquire	Copies the waveform into ArbExpress application buffer.

File Folder View

The File folder view displays the directory tree of the computer hard disk drive. You can navigate the files as you do with Windows Explorer. Right-click the file list to see a shortcut menu with the **Paste** command . You can copy a waveform from a Channel, Ref or Math, and paste it in the current folder. You can also select a Channel, Ref or Math from the Instrument List view and drop it into the selected folder to acquire the waveform.

Channel Status

Channel status is a list of read-only data, displayed below the PC file folder view. This shows the details of the currently selected channel.

NOTE. *An entry – Math Equation – appears only for Math channels. This entry displays the equation used for creating the math waveform.*

When no oscilloscopes are connected, this list contains no data.

See Also:

AWG/AFG File Transfer and Control (see page 135)

Scope Acquisition Wizard (see page 149)

Send Waveform to Arb

Communication > Send Waveform to Arb

Select this option to send the waveform to an AWG/AFG. If no instrument is connected, the message "No Arb is connected. Do you want to connect now?" appears. If you are connected to an AWG/AFG, then the waveform is transferred to the instrument. A progress bar displays the status of the operation. You can use the **Send to Arb** option to select a channel on the target instrument and send the waveform directly from the Wave book, **Standard Waveform** dialog box, or **Equation Editor** dialog box. Once connected, all the channels available on that instrument are displayed in the toolbar and menu.

The application provides an option in the **Preference** tab – **Channel output On after waveform transfer using "Send to Arb"**– to turn the target channel on and output the waveform data. The waveform is sent to the target channel and loaded on to it. The corresponding amplitude and offset will also be set on the instrument.

In the AFG3xx, AFG2000, AFG3000, and MDO3000 series, the waveform is sent to the edit memory. The message "Are you sure you want to overwrite EMEM<n> with this file?" warns you that the instrument edit memory will be overwritten.

Follow these steps to transfer the waveform directly to the instrument from a Wave book:

1. Select **Communication > AWG/AFG File Transfer and Instrument Control** and establish connection between the instrument and PC. Once the connection is successfully established, you can close the **File Transfer** dialog box. The connection is not lost by closing the **File Transfer** dialog box.

2. Create a waveform. In the shortcut menu, click **Send Waveform to Arb** and choose the target channel to which to transfer the waveform.

3. The voltage, offset, and other parameters that are set while creating the waveform are set on the instrument automatically. After the file is transferred successfully the parameters are set, and if the preference **Channel Output ON after waveform transfer using "Send to Arb"** is selected, the target channel is switched on, and instrument is set in Run mode. If this preference is not selected, then the target channel is switched off.

NOTE. When you use this mode of file transfer, an associated .set file is not created. The transferred file is loaded in the instrument internal memory.

In an AFG, the transferred file is loaded in the Edit memory, and in an AWG it is loaded on the destination channel.

4. Repeat steps 2 and 3 to transfer a waveform from the **Equation Editor** or **Standard Waveform** dialog boxes.

See Also:

Transferring Files to an AWG/AFG (see page 137)

Scope Acquisition Wizard (see page 149)

Valid Parameter Ranges (see page 197)

Scope Acquisition Wizard

Communication > Scope Acquisition Wizard

The wizard guides you through a series of steps to acquire data from a connected oscilloscope.

1. Select **Communication > Scope Acquisition Wizard** from the application main menu. The wizard starts with the **Welcome to the Scope Acquisition Wizard** screen.

2. Click **Next**. The wizard displays the next screen, searches and displays a list of instruments that are connected to your PC. If no instruments are found, the message "No instruments found" appears. Connect an instrument and click **Refresh** in the Wizard.
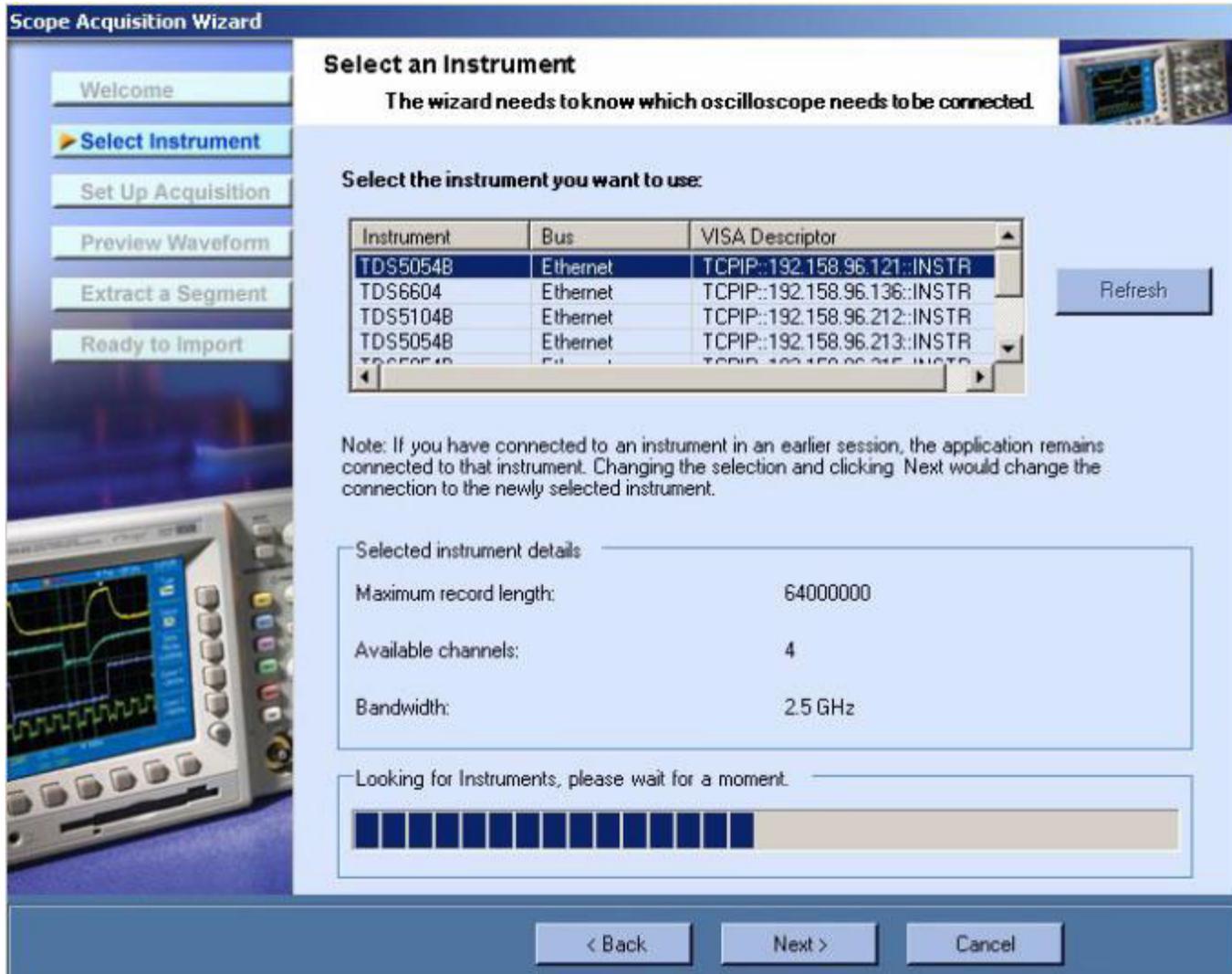
3. Select an instrument to see its details. The first instrument in the list is selected by default. To refresh the instrument list, click **Refresh**.
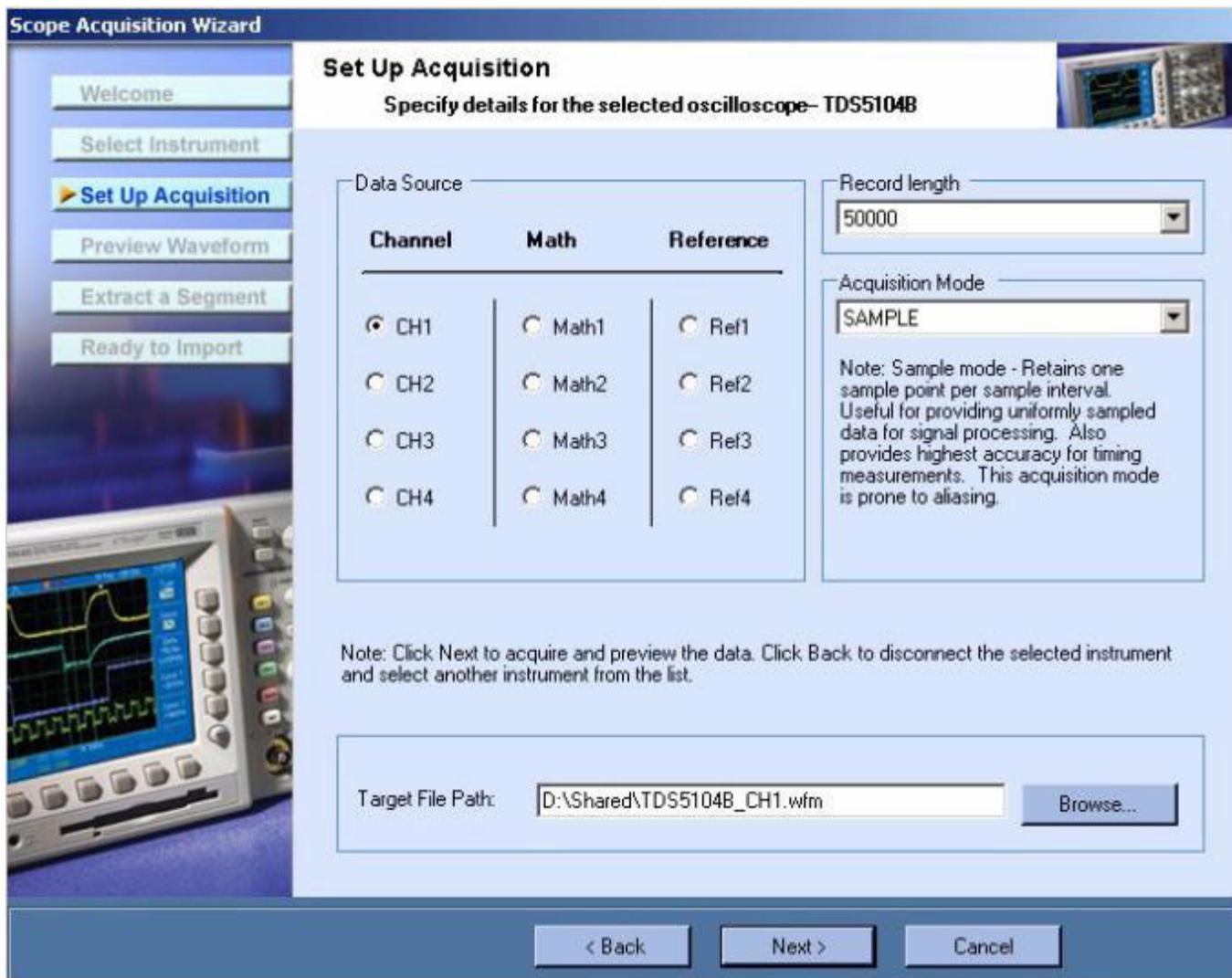
Click **Next** to connect to the selected instrument and display the **Set Up Acquisition** screen. Depending on the selected oscilloscope, the channel, math, and ref details are displayed. Select the channel, math, or ref from which to acquire data. If no math and ref are available for the selected instrument, the following text appears:

- No math channels were found.

- No reference channels were found.

In the **Select Instrument** screen, the following happens:

- If the instrument is already connected through the **Import from Scope** menu, then the connected instrument is selected in the list.

- Selecting another instrument disconnects the connected instrument.

- Scanning for instruments does not happen if it has already happened through the **Import from Scope** menu. The scanned instruments are displayed in the instrument list.

4. Select the record length from the drop-down list. Choose from the list of record lengths supported by the instrument connected.

5. Select the acquisition mode form the drop-down list. Choose from Sample, PeakDetect, Average, Hires, and Envelope.

6. Browse for the target directory to save the data in a .wfm format. The target directory defaults to the directory that you last selected. The default path and file name are – C:\AcquiredFiles\<Oscilloscope_channel>.wfm. Scope Acquisition Wizard. If you have a file with the same file name as that specified in the path, the warning message "A file already exists with this name in this folder. Do you want to overwrite?" appears. Click **Yes** to overwrite the file, and **No** to specify another file name.

7. Click **Next** to display the **Preview Waveform** screen.
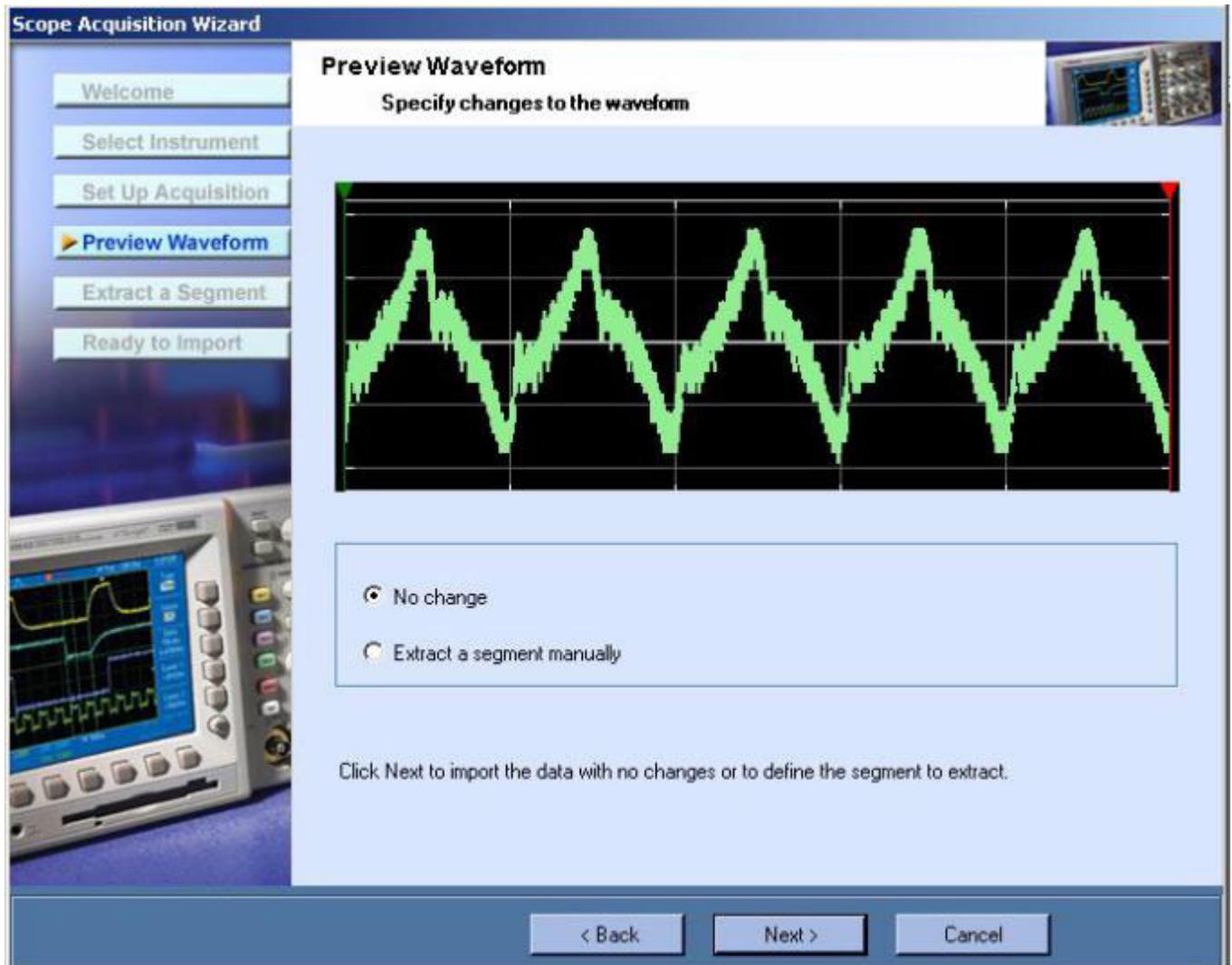
Choose one of the following:

- No changes: Make no changes to the waveform before importing.

- Extract a segment manually: Extract a part of the waveform by defining the cursor positions. The wizard opens another screen.

8. Click **Next** to import or extract a sample of the waveform.

To import a waveform:

a. Enter the number of points.

b. Select whether to rotate left or right. This would help to locate any disconnect toward the end of the waveform. The waveform will be rotated only in this view.

c. Select whether to open the waveform in a new window.

d. Click **Finish** to import the waveform.
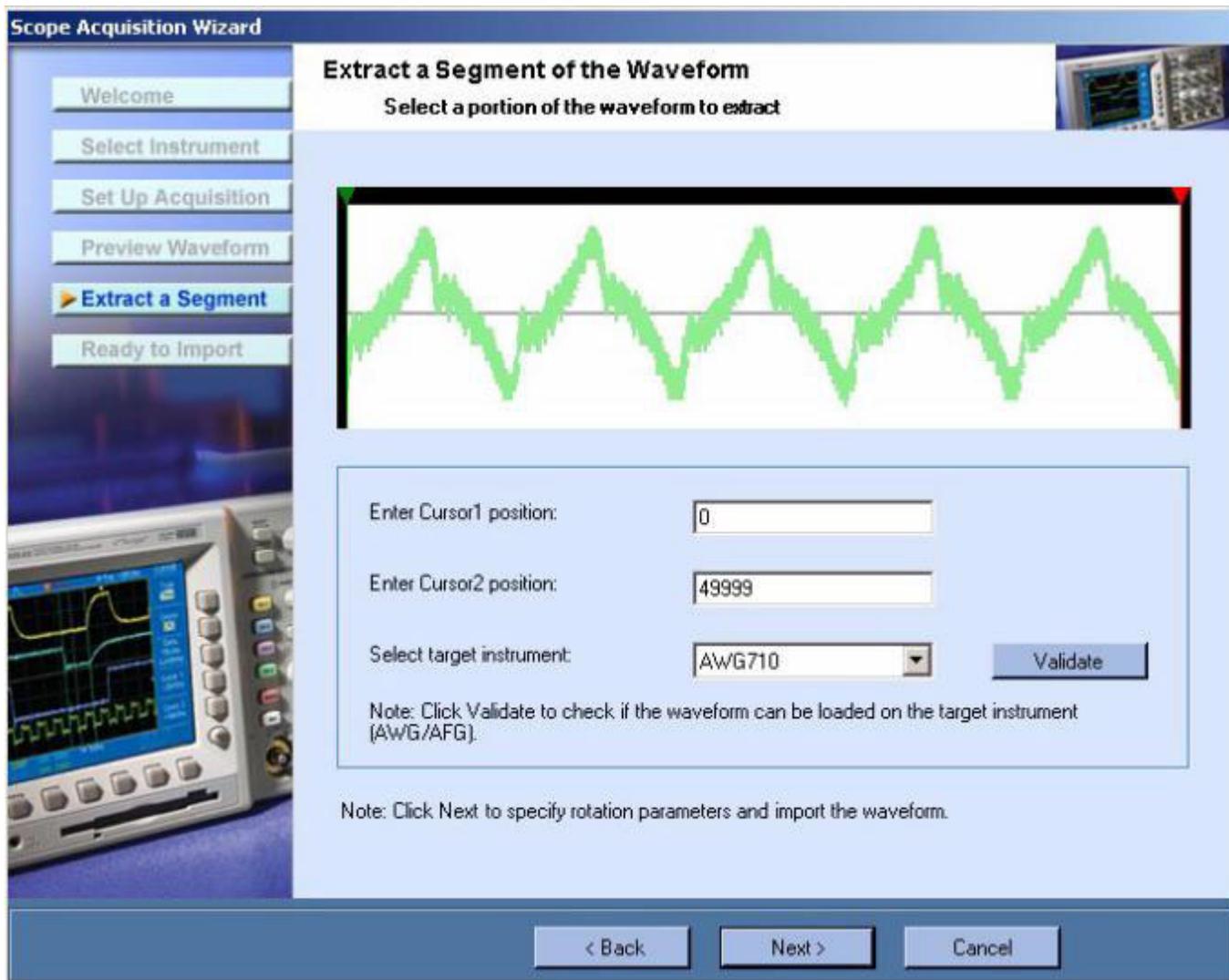
To extract a segment of the waveform:

a. Enter the position of Cursor1.

b. Enter the position of Cursor2.

c. Select the target instrument and click **Validate** to validate the waveform against the instrument. The application presents a dialog that indicates whether the currently selected instrument can accommodate the waveform. If the waveform is not valid for the selected instrument, text in the dialog indicates the waveform is not valid and provides details about the selected instrument's capability.

d. Click **Next**. The **Ready to Import Waveform** screen appears. Follow the steps as in importing a waveform with no change.

e. Click **Finish** to import the waveform.

9. The waveform acquired is opened in a new window or will be stored in the path shown.
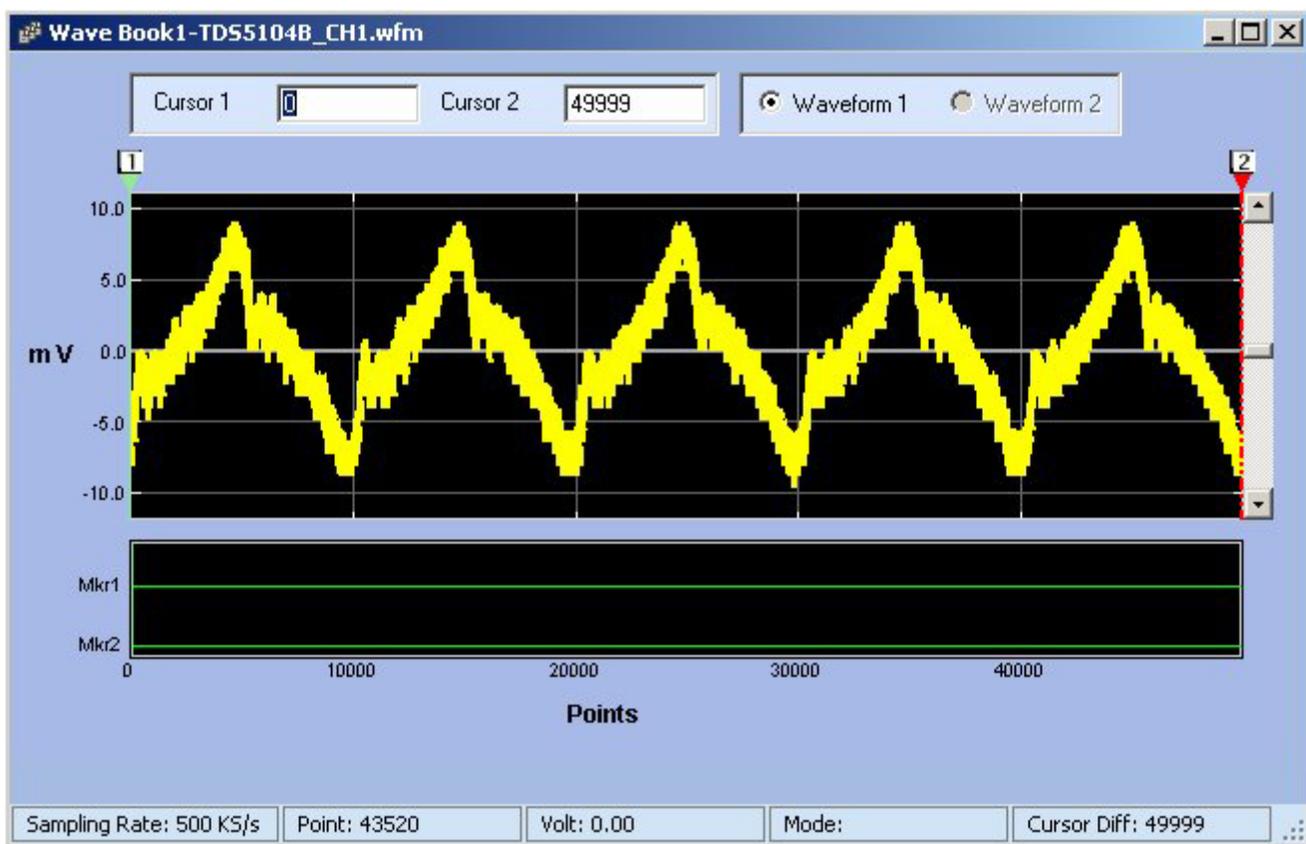
Normalize

Math > Normalize

You can normalize a waveform such that all points on it lie between +1 and – 1.

1. Select the waveform to normalize.

2. Select **Math > Normalize**.

The resulting waveform is as shown.
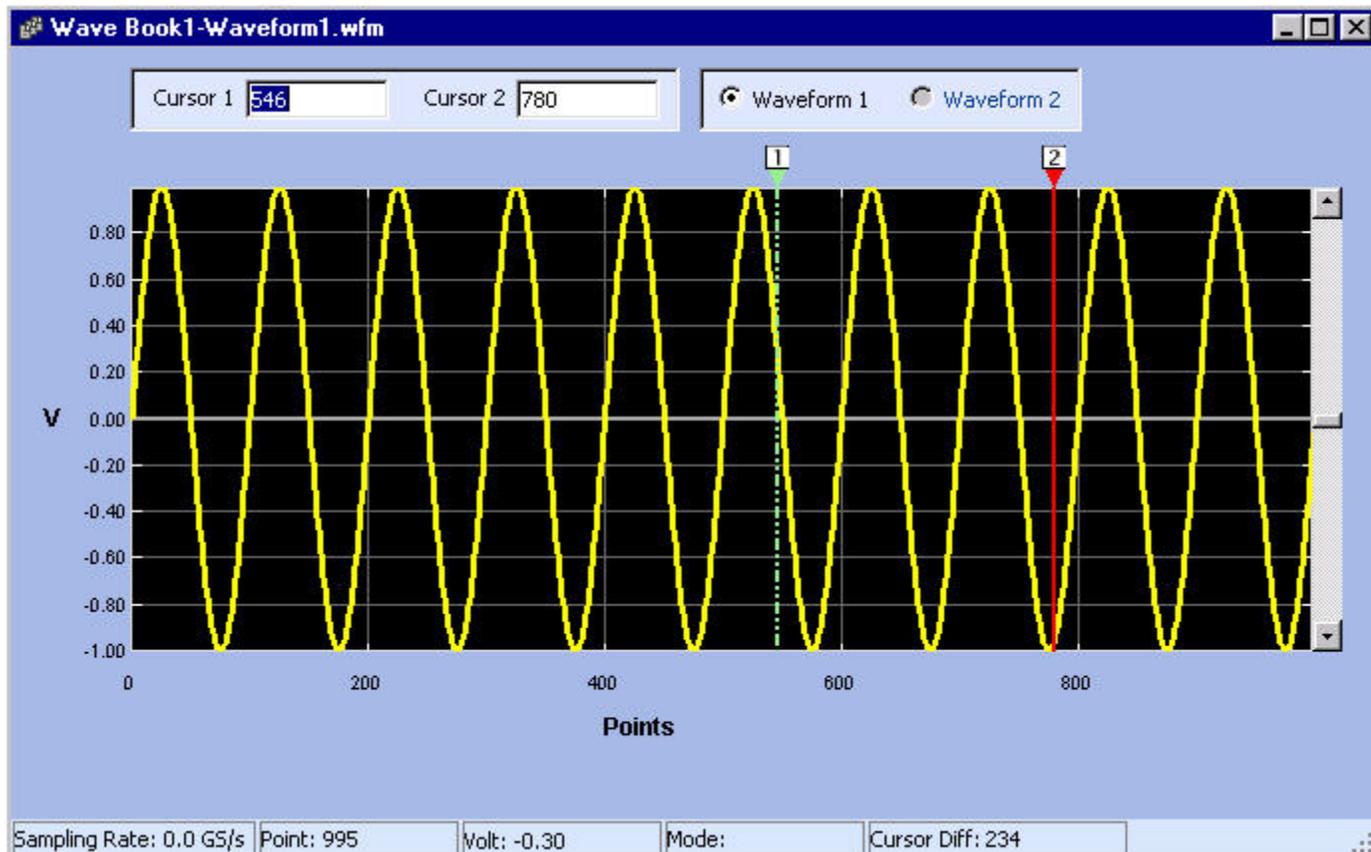
Creating Waveforms Using Matlab

This section describes how to use MATLAB software to connect to Tektronix AWGs . To use the MATLAB support, you must:

- Ensure that you have installed MATLAB version 6, release 12. The function supplied might work with lower release numbers but they are tested on MATLAB release 12.

- Ensure that you have installed TekVisa.

- Ensure that the system path includes the path where ArbEther.dll is installed. By default, this ArbEther.dll is copied to the directory where ArbExpress is installed. You need this DLL if you connect to AWGs over Ethernet.

This ArbExpress MATLAB utility is installed, by default, in the path ArbExpress\Tools\Matlab. The directory contains a ".p" file for each command and a corresponding ". m " file that has the documentation

for the command. A sample MATLAB Script, " Sample.m " is provided to show how to use the commands in a MATLAB Environment.

The MATLAB script is stored in a .m file that is created using the MATLAB built-in editor. When you compile a .m file, you get a .p file.

The following files must be present in the directory before you start using the commands documented here:

Commands

NewSession.p

CloseSession.p

query.p

read.p

write.p

LoadWfm.p

TransferWfm.p

Sample Script File

sample.m

DLL File with Gateway Routine

matarb.dll

Transferring Files from Matlab

1. Start MATLAB.

2. Go to the directory where you stored the MATLAB library files that are supplied with ArbExpress (C:\ProgramFiles\Tektronix\ArbExpress\Tools\Matlab).

3. Open a session on an AWG connected either through LAN, GPIB, or USB to your PC.

   Connecting through GPIB:

   You can connect to the AWG using the NewSession command as follows for an instrument connected through GPIB.

```
[ SessionID , StatusMsg ] = NewSession ('GPIB0::9::INSTR', 'GPIB')
```

This command works only if the GPIB resource string is found by TekVisa resource Manager. For more information, refer to the TekVisa Resource manager documentation for help on adding new instruments to the PC.

Connecting through LAN:

You can connect to the AWG using the NewSession command as follows for an instrument connected through LAN. Since TekVisa does not support connection over raw sockets, TekVisa does not list the resource name.

Connecting to an AFG2000 and AFG3000 series instrument using Visa:

```
[SessionID, StatusMsg] = NewSession ('TCPIP::10.20.30.40::INSTR', 'LAN')
```

Connecting to AFG300, AWG2000, AWG400/500/600/700 series not using Visa (support through raw sockets):

```
[SessionID, StatusMsg] = NewSession ('10.20.30.40', 'TCPIP')
```

Connecting through USB:

You can connect to the AWG using the NewSession command as follows for an instrument connected through USB.

```
[ SessionID , StatusMsg ] = NewSession
('USB0::0x0699::0x0343::JU010107::INSTR', 'USB')
```

If the command is executed successfully, the session ID is available in the SessionID variable and the StatusMsg is a null string. If the command is not successful, the SessionID contains an error code with the StatusMsg containing the text describing the failure.

4. Create a Waveform using the MATLAB mathematical functions such as Sin or Exp.

The following script for example, creates a sine waveform having a thousand points and stores it in a variable called Data. Enter the text in the MATLAB editor and save it as a .m file.

```
Frequency = 1e2;

Period = 1/Frequency;

Pts = [1:1000] * Period;

Data = sin(Pts );
```

5. Use this variable to transfer the Sine wave created to the AWG as shown:

```
[Status,StatusMsg] = SendWfm (SessionID, 'example.wfm', Data, 1000)
```

where the SessionID is the session you have opened earlier, example.wfm is the name of the waveform file, and 1000 is the number of points in the waveform.

If the file transfer is successful, you should see the waveform file with the selected name in the current directory of AWG.

NOTE. Current directory refers to the directory path returned by MMEM : CDIR command – not the directory as seen on the instrument display.

---

6. Close the session using the CloseSession command as shown:

```
CloseSession( <SessionID>)
```

where SessionID is the session you created.

Controlling the Instrument

You can control the instrument from the MATLAB environment.

1. Open a session using the NewSession command.

2. Once connected to the AWG, use the Write command to send any command that is supported by the current AWG.

3. Use the Query command to query the instrument parameters.

For example, the following command shows how to load a file and output it from channel 1 of the AWG:

```
[Status, StausMsg ] = LoadWfm(SessionID , 'example.Wfm', 1)
```

This attempts to load the file "example.Wfm" from the current directory path and output it from Channel 1 of the AWG. This command fails if the file is of a wrong format or not found in the current directory. You may not see any output if the channel number chosen is not supported by the connected instrument.

NOTE. "Current directory" here refers to the directory path returned by MMEM : CDIR command – not the directory as seen on the instrument display.

Example Program:

```
%A very preliminary sample code to show how to use MATLAB functions %to talk
to an AWG from MATLAB %Please compile this using 'PCODE <filename>' before
%running it.

%This script only with Visa resource strings %Turn off echo

   echo off

%Open a session.  If you are connecting over LAN to an AWG %the first
parameter to NewSession would be the IP address %and the second parameter
would be the string 'tcpip'

   s=NewSession('gpib0::9::instr','gpib');
```

%IDN query outputs two values: Status of the query, and the %Response from the instrument.

```
    [status,idn]=query(s, '*idn?');
```

%Writes a single command to the connected AWG. The status will %be Zero if write is successful

```
    status=Write(s,'Output1:State 1');
```

%Following script creates a sine waveform with %1000 points

```
    Frequency = 1e2;

    Period = 1/Frequency;

    Pts = [1:1000] * Period;

    Data = sin(Pts);
```

%Following command transfers the waveform in %'Data' variable to the current %directory of %AWG.

```
    TransferWfm(s, 'example.wfm', Data, 1000)
```

%Closes the connection

```
    CloseSession(s);
```

Commands

ArbExpress implements the following commands for communication with Tektronix AWGs:

Session Management

- NewSession
- CloseSession

Instrument Control and Data Transfer

- Read
- Write
- LoadWfm
- TransferWfm
- Query

See Also:

NewSession.p (see page 164)

CloseSession.p (see page 165)

query.p (see page 170)

Read.p (see page 167)

Write.p (see page 166)

LoadWfm.p (see page 168)

TransferWfm.p (see page 169)

NewSession Command

Description

This command opens a communication session with a Tektronix AWG connected to the PC using GPIB or LAN cable.

Syntax

```
[nSessionID, strErrMsg] = NewSession(strResourceID, strBusType)
```

Parameters

strResourceID — A MATLAB string containing the resource name in the standard Visa format.

strBusType — Communication bus used for connection. Supported values are "GPIB" and "TCPIP".

Return Values

nSessionID — A numeric variable that holds the session ID to be used in subsequent communication with the instrument.

strErrMsg — Contains the error description if you fail to connect to the instrument. When the connection is successful it contains a null string.

NOTE. Before trying to connect to the instrument, make sure that the instrument is accessible by TekVisa Resource manager. See the TekVisa VisaRM documentation for help on how to configure VisaRM to detect the instrument.

Example

```
[SessionID , StatusMsg] = NewSession ('GPIB0::9::INSTR', 'GPIB')

[SessionID , StatusMsg] = NewSession ('TCPIP::10.20.30.40::INSTR', 'TCPIP')

[SessionID , StatusMsg] = NewSession ('USB0::0x0699::0x0343::JU010107::INSTR', 'USB')
```

CloseSession Command

Description

This command closes the connection with instrument.

Syntax

`CloseSession(nSessionID)`

Parameters

nSessionID — A Numeric value of the session obtained when NewSession command was called.

Return Values

None.

NOTE. *You must have an active connection with an instrument before calling CloseSession.*

Example

`CloseSession( <SessionID>)`

Write Command

Description

This command sends a SCPI command to the connected instrument.

Syntax

`[nStatus, strErrMsg] = Write (nSessionID, strCmd)`

Parameters

nSessionID — Session ID obtained by NewSession command.

strCmd — SCPI command string

Return Values

nStatus — Zero if successful, error code if the operation failed.

Example

`[nStatus, strErrMsg] = Write (nSessionID, '*IDN?')`

Read Command

Description

This command reads responses from instruments. Response to the query sent in a previous call to Write command or error message if the query failed.

Syntax

```
[nStatus, strResponse] = Read(nSessionID)
```

Parameters

nSessionID — Session ID obtained from NewSession command

Return Values

nStatus — Zero if successful, error code if the operation failed.

strResponse — Response to the query sent in strQuery parameter or error message if the query failed.

NOTE. Read will return a proper response only when it is called immediately after a Write operation that wrote one of the SCPI query commands.

Example

```
Read(nSessionID)
```

LoadWfm Command

Description

This command loads a waveform into the connected AWG internal memory and outputs it from the selected channel.

Syntax

`[nStatus, strErrMsg] = LoadWfm(nSessionID, strWfmName, nCh)`

Parameters

nSessionID — Session ID obtained by calling NewSession command

strWfmName — Name of the Waveform file with or without the extension.

nCh — Channel number.

Return Value

The command always returns Zero as the return value.

NOTE. The waveform file you are trying to load must be in the current directory. If the file is in any other directory, change the path to the directory where the desired file is located by using the MMEM:CDIR command. When the load command is sent, the instrument takes time to load the file, especially if they are big files. Because the call is synchronous, the program does not return until the load operation is completed on the instrument.

If the waveform file is corrupt or in the wrong format, the instrument does not load it.

Example

`[Status, StausMsg ] = LoadWfm(SessionID , 'example.Wfm', 1)`

TransferWfm Command

Description

This command transfers a waveform from the MATLAB environment to the connected instrument mass memory.

Syntax

```
TransferWfm[nSessionID, strWfmName,double dDataPoints[], nSize)
```

Parameters

nSessionID — Session ID obtained from NewSession command

strWfmName — The name of the waveform file to be created in the instrument

dDataPoints — One-dimensional array of doubles containing data points

nSize — Number of data points in the file.

Return Values

None.

NOTE. *Use this function to transfer an array of data values into an AWG and store it in the form of a waveform file. Be cautious while using this function because if you choose a file name that already exists in the current directory of the Instrument, it will be overwritten without warning.*

Also note that this is only a transfer command and the transferred file is not loaded into the internal memory of the instrument.

Example

```
TransferWfm(SessionID, 'example.wfm', Data, 1000)
```

Query Command

Description

This command sends a query and returns the response from the instrument.

Syntax

```
[nStatus, strResponse] = Query(nSessionID, strQuery)
```

Parameters

nSessionID — Session ID obtained from NewSession Command

strQuery — Standard SCPI query

Return Values

nStatus — Zero if successful, error code otherwise

strResponse — Response to the query sent in strQuery parameter or error message if the query failed.

NOTE. This is a combination of Write and Read commands. The return value always returns the result of the read operation

Example

```
[nStatus, strResponse] = Query(nSessionID, '*IDN?')
```

Error Messages and Warnings I

Error code	Error message	Description	Possible solution
Main Application			
1001	ArbExpress instance already running	The application displays this message if you try to run ArbExpress when an instance is already open.	Close ArbExpress and try again.
1002	Do you want to overwrite?	A file with the same name is found in the currently selected folder.	Rename the file in the selected folder or select a different folder.
1003	Do you want to proceed?	This message appears when user tries to do any edit operations in point draw mode.	Choosing "Yes" would continue with edit operation but all the draw points will be flushed. Choosing "No" would abort the edit operation.
1004	Total number of points in the waveform is less than minimum points required by the instrument	This error message appears when the user tries to transfer the waveform (or when user validates the waveform manually) to a connected/selected instrument and the total points is less than the minimum points supported by the instrument.	For minimum points required by the instrument, refer to the Instrument Specifications.
1005	Total number of points exceeds maximum memory supported by the instrument	This error message appears when the user tries to transfer the waveform (or when user validates the waveform manually) to a connected/selected instrument and the total points exceeds the maximum memory limit of the instrument.	Change the total points such that it does not exceed the maximum memory limit of the instrument. For maximum memory limit of the instrument, refer to the Instrument Specifications.

Error code	Error message	Description	Possible solution
Main Application			
1006	Total number of points is not a multiple of point step supported by the instrument	This error message appears when the user tries to transfer the waveform (or when user validates the waveform manually) to a connected/selected to instrument and the total points is not a multiple of the point step.	The total points should be a multiple of point step supported by the instrument. For step size of the selected instrument, refer to the Instrument Specifications.
1007	This waveform can be loaded successfully into the instrument selected	This error message appears when user validates the waveform for the selected instrument and the waveform can successfully generated in the selected instrument.	This message indicates the waveform conforms to the specification of the selected instrument.
File Handling			
7001	Invalid file or no data points available	The file you tried to open is either corrupt or the file does not have enough data points to create a waveform.	Ensure that you are opening a valid file. If you need help to open your file or want to verify your file send the file to techsupport @tektronix.com with the description and format of the file.
7002	Error in file format	The file you opened is of the wrong format.	Ensure that the file format is one of the following — wfm, .pat, TekScope .wfm csv, .txt.
7003	Do you want to Save changes to the file <filename>?	This message appears when you try to close the waveform or application without saving.	Select Yes to save the file or No to close without saving.
7004	Unexpected file format	This error message appears when the file is not supported by ArbExpress or if it is a corrupted file.	Verify that the file is not corrupted. Verify that the file format is supported by ArbExpress. If the file is not corrupt and is valid, please contact customer support for more clarification.

Multiple Waveforms

6001	Only two waveforms can be opened or created in a Wave Book	A maximum of two waveforms can be opened in a Wave Book. You have tried to open or create more than two waveforms in a Wave Book.	Open or create the waveform in another Wave Book or a new window.
6002	You can open only files with "####" points in this Wave Book. To open the file <filename> in a new window, set Multi-Waveform Properties to New Window and select File> New or Open. You can also use the Open or New icon from the toolbar	Only waveforms with files of the same number of points in size can be opened or created in the same window.	You can: ■ Select a new window by setting the Multi-Waveform Properties to New Window. ■ Select a waveform with the same number of points as the existing waveform in the Wave Book.
6003	You can create only waveforms with #### points in this Wave Book To create a waveform in a new window, set Multi-waveform properties to New window and select File> New	Only waveforms with files of the same number of points in size can be opened or created in the same window.	You can: ■ Select a new window by setting the Multi-Waveform Properties to New Window. ■ Select a waveform with the same number of points as the existing waveform in the Wave Book.

Standard Waveform

1201	Enter a value	This message appears when no value has been entered in a field.	For more details refer to the instrument specification.
1202	Invalid value	This message appears if you have entered an invalid value in the editable fields.	The value must not cross the selected instruments specification. For more details, refer to the Instrument Specifications.
1203	Invalid amplitude. Voltage range supported is xx–xx	The value entered is not within the instrument range.	Enter a value that lies within the amplitude range supported by the instrument. For more details, refer to the Instrument Specifications.
1204	Invalid Offset, Range +x.x to –x.x	This message appears when offset crosses the range supported by the instrument.	Enter a value that lies within the range.

Standard Waveform

1205	Instrument cannot generate this frequency	This message appears when the instrument cannot generate the frequency entered because the points per cycles is less than 2 for sine and triangle and less than 10 for square and pulse.	Enter the frequency such that there are at least 2 points per cycle for Sine and Triangle and at least 10 points per cycle for Square and Pulse.
1206	Invalid Sampling Rate Range supported by the instrument is xx - xx	This message appears if the sampling rate exceeds range supported by the instrument.	Enter a value that lies within the range of the selected instrument. Refer to the instrument specifications for the range supported.
1207	Start frequency greater than end frequency	This message appears when the start frequency entered for sweep and multi-tone waveforms is greater than the end frequency.	Start frequency entered should be less than the end frequency.
1208	Points per Cycle*Cycle, exceeds the Maximum memory limit of the instrument	This message appears for sine, triangle, pulse, and square waves when Points per Cycle multiplied by Cycles exceeds the maximum memory limit of the instrument.	Enter values for points per cycle and cycle such it does not exceed the maximum memory limit of the instrument. For more details, refer to the instrument specifications.
1209	Invalid cycles, points per cycle less than 2.	This message appears if number of points per cycle for the sine and triangle waveforms is less than 2.	Increase the number of points per cycle. For sine and triangle waves, the points per cycle should be greater than two to generate a good waveform.
1210	The number of points per cycle is less than 10, change the points per cycle	This message appears if number of points per cycle for the square and pulse waves is less than 10.	Increase the number of points per cycle. For square and pulse waves, the points per cycle should be greater than two to generate a good waveform.
1211	Points per cycle = Total Points/Cycle Number of points per cycle less than 10. Change cycles or total points	This message appears when points per cycle is less than 10 for exponential rise, exponential decay, and Sinc waveforms.	Change the cycle or total points such that points per cycle is greater than 10.
1212	Points per cycle = TotalPoints/Cycles. Number of points per cycle less than 10. Change cycles or total points (Sampling Rate * Delay)	This message appears when points per cycle is less than 10 for Lorentz waveform.	Increase the points per cycle change cycle or total points (Total points = Delay * Sampling Rate). Change the total points by changing sampling rate or delay.

Standard Waveform

1213	The value exceeds the total number of points	This message appears when the value entered for Rise Time or Fall Time for Square or Pulse waveform exceeds the total number of points.	The maximum value that can be entered for Rise Time or Fall Time should be less the than total number of points. Rise Time plus Fall Time should not cross the Total number of points.
1214	Rise Time + Fall Time of the waveform should be less than the total number of points	This message appears when Rise Time + Fall Time exceeds the total number of points.	Enter values for Rise Time and Fall Time, such that Rise Time plus Fall Time do not cross the total number of points.
1215	Number of zero crossings greater than the total number of points	This message appears when the number of zero crossings entered for Sinc exceeds the total number of points.	Enter number of zero crossings that lies within the total number of points.
1216	Total Points = Duration * Sampling Rate. Total points exceeds the maximum memory limit of the instrument	This message appears for the Sweep waveform when the total points (Duration *Sampling Rate) exceeds the maximum memory limit of the instrument.	Change the sampling rate or the duration so that the total points is within the instrument specification.
1217	Total Points = Delay * Sampling Rate Total points exceeds the maximum memory limit of the instrument	This message appears for Lorentz waveform when the total points (Delay * Sampling Rate) exceeds the maximum memory limit of the instrument.	Change the sampling rate or Delay so that the total points is within the instrument specification.
1218	Total Points = Sampling Rate /Tone Spacing Total points exceeds the maximum memory limit of the instrument	This message appears for Multi Tone waveform when the total points (Delay * Sampling Rate) exceeds the maximum memory limit of the instrument.	Change the sampling rate or tone spacing so that the total points is within the instrument specification.
1219	Total Points = Duration * Sampling Rate Change duration or sampling rate	This message appears if total points is zero for sweep.	Change the duration or sampling rate so that total points is greater than zero.
1220	Total Points = Delay * Sampling Rate Change delay or sampling rate	This message appears if total points is zero for the Lorentz waveform.	Change the Delay or sampling rate so that total points is greater than zero.
1221	Total Points = Sampling Rate/Tone Spacing Change sampling rate or tone spacing	This message appears if total points is zero for multi-tone waveform.	Change the Tone Spacing or sampling rate such that total points is greater than zero.

Standard Waveform

1222	Total number of points exceeds the maximum memory limit of the instrument	This message appears when total number of points exceeds the maximum memory limit of the instrument selected.	Enter total number of points such that it does not exceed the memory limit of the instrument selected. For more details refer to the instrument specification.
1223	Total Points not a multiple of 4. Change frequency or cycles.	This message appears for the sine, triangle, square, and pulse waveforms (in the basic mode) when total points is not a multiple of four and the instrument selected is AWG710, AWG520, and AWG510.	For the sine, triangle, square, and pulse waveforms, total points = points per cycle * cycles. When total points is not a multiple of four, change the frequency so that points per cycle changes or use the advanced option to change points per cycle directly. You can also change the number of cycles.
1224	Total Points not a multiple of 4.	This message appears when the total number of points is not a multiple of 4 for waveforms other than sine, triangle, square, and pulse waveforms, when the selected instrument is AWG710, AWG710B, AWG615, AWG510, and AWG520.	Ensure that the total points are a multiple of 4.
1225	Total Points not a multiple of 8. Change frequency or cycles.	This message appears for the sine, triangle, square, and pulse waveforms (in the basic mode) when the total points is not a multiple of eight and the instrument is AWG2021.	For the sine, triangle, square, and pulse waveforms, total points = points per cycle * cycles When the total points is not a multiple of eight, change the frequency so that points per cycle changes or use the advanced option to change points per cycle directly. You can also change the number of cycles.
1226	Total Points not a multiple of 8.	This message appears when the total number of points is not a multiple of 8 for waveforms other than sine, triangle, square, and pulse waveforms, when the selected instrument is AWG2021, and AWG610.	Ensure that the total points are a multiple of 8.

Standard Waveform

1227	Delay + Pulse width + Rise Time + Fall Time should be less than total points	This message appears for pulse if the value given for delay, pulse width, rise time and fall time added together exceeds or is equal to the total points.	Enter values so that with the given parameters when the waveform is generated it is within the total points.
1228	Delay + Pulse Width exceeds total number of points	This message appears for pulse waveform if the sum of delay and pulse width exceeds total points.	Enter Delay and Pulse width so that it does not exceed total points.
1229	Rise Time + Fall Time + Duty Cycle should be less than total points	This message appears for the square waveform when the sum of rise time, fall time, and duty cycle exceeds or is equal to the total points.	Ensure that the sum of rise time, fall time, and duty cycle does not exceed total points.
1230	Value range 0 – 360 degree	This message appears when value entered for the phase in not within the range.	For phase, range is between 0–360. Enter a value within this range.
1231	Half Width exceeds Delay	For the Lorentz waveform, Half Width should not exceed delay.	For the Lorentz waveform, enter a value for Half Width so that it does not exceed the delay.
1232	Sampling rate should be at least twice than that of the highest frequency component	This message appears when the end frequency (the highest frequency component) entered for the sweep and multi-tone waveforms is less than the sampling rate.	Enter end frequency so that the sampling rate is at least twice that of the highest frequency component.
1233	Tone Spacing is greater than difference between the frequencies	This message appears for multi-tone if the tone spacing is greater than the difference between the start and end frequency.	Enter value such that tone spacing is within the difference between start and end frequency.
1234	Total Range = Total Points/Sampling Rate. Duration greater than total range	This message appears for the sweep waveform when the duration entered is greater than the total range.	Change duration so that it is within the total range. Total range = Total Points / Sampling rate
1235	End frequency should be greater than start frequency	This message appears if the end frequency is greater than start frequency for the multi-tone and sweep waveforms.	End frequency should be always greater than start frequency.

Standard Waveform

1236	Value range 1 – 99.9	This message appears for the square waveform when the duty cycle is not within the limits.	Enter a value within the range specified.
1237	Cycles exceeds the maximum limit of the instrument	This message appears when the number of cycles exceeds half the maximum memory limit.	So the maximum cycles than can be entered is half the maximum memory limit.
1238	Invalid amplitude: change voltage entered	This message appears when you enter an invalid voltage in the Max/Min mode.	There should at least two points per cycle. Enter a voltage value that lies within the voltage range supported by the instrument.
1239	Total Points = Cycles * Points per cycle .Change cycles or points per cycle	This error message appears for the sine, triangle, square, and pulse waveforms if the total points is zero.	Change points per cycle or cycles to change the total points.
1240	Frequency range supported is x mHz – x MHz	This error message appears for the AFG2000 and AFG3000 series of instruments when the value entered is not within the instrument range.	Enter a value that lies within the frequency range supported by the instrument. For more details, refer to the Instrument Specifications.
1241	Total number of points: XX. Minimum number of points required is XXX	This error message appears when the total points entered is less than the minimum number of points required by the instrument.	Increase the total points such that it meets the minimum number of points supported by the instrument.
1242	Total Points less than the minimum points required	This message appears when the total points is less than minimum points required and the user selects OK button.	Make sure total points is within the instruments specification. For any instrument selected the Min and Max memory limit is mentioned in the Notes section of the dialog box.
1243	Unable to generate this waveform	This message appears when the parameters given to generate the waveform is not valid and the user has selected OK button.	The parameters given to generate the waveform should be within the selected the instrument specification.

Standard Waveform

1244	Total Points not a multiple of 4. Change either the frequency, sampling rate points per cycle, or cycles.	This message appears for the sine, triangle, square, and pulse waveforms (in the advanced mode) when total points is not a multiple of four and the instrument selected is AWG710, AWG520, and AWG510.	For the sine, triangle, square, and pulse waveforms, total points = points per cycle * cycles. When total points is not a multiple of four, change the frequency so that points per cycle changes or change points per cycle and sampling rate directly. You can also change the number of cycles.
1245	Total Points not a multiple of 8. Change either the frequency, sampling rate points per cycle, or cycles.	This message appears for the sine, triangle, square, and pulse waveforms in advanced mode when total points is not a multiple of eight and the instrument selected is AWG2021.	For the sine, triangle, square, and pulse waveforms, total points = points per cycle * cycles. When total points is not a multiple of eight, change the frequency so that points per cycle changes or change points per cycle, sampling rate directly. You can also change the number of cycles.
1246	Invalid Amplitude Voltage range supported is Vamp ≤ 2(|Vmax|-|Voffset|)	This error message appears for the AFG310 and AFG320 when the amplitude entered is not within the range of the instrument.	The amplitude supported by the instrument is Vamp ≤ 2(|Vmax|–|Voffset|) Where Vmax is the maximum output voltage (Vmax) that the instrument can produce (±5 V) when terminated with 50 ohm. For example, if offset is zero then amplitude is 10 = 2(5– 0)
1247	Invalid Offset. Range supported is – 0.75 V to +0.75 V	This error message appears for the AFG310 and AFG320 when the offset entered is not within the range of the instrument.	The valid range for the offset voltage setting is in the range ± 0.75 V when the amplitude setting is 500 mVp-p or smaller.

Standard Waveform

1248	Invalid Offset. Range supported is |Voffset| ≤ |Vmax| - Vamp/2	This error message appears for the AFG310 and AFG320 when the offset entered is not within the range of the instrument.	The valid range for the offset voltage setting is restricted according to the following formula when the amplitude setting is 505 mVp-p or larger, for a Vmax value of ±5 V. $\|Voffset\| \leq \|Vmax\| - Vamp/2$ Example: if amplitude is 10 the offset is $0 = 5 - 10/2$.
1249	Total Points = Delay * Sampling Rate. For given delay total points exceeds maximum memory limit	This error message appears when the value entered for delay multiplied by sampling rate exceeds the maximum memory limit of the instrument	For Lorentz wave, Total points = Delay * sampling rate. The value entered for delay multiplied by sampling rate should not exceed maximum memory limit of the selected instrument.
1250	Connected instrument and selected instrument do not match. Do you want to continue?	This message appears in standard waveform and equation editor when connected instrument and selected instrument do not match.	The connected instrument and the selected instrument should match for a successful transfer. If they differ, a warning message appears. You can select Yes to proceed, however, depending on the connected instrument memory size and step size the transfer may fail.

Error Messages and Warnings II

Error code	Error message	Description	Possible solution
Waveform Math			
1301	Cursors 1 and 2 are in the same location	This message appears If both cursors 1 and 2 are at the same point.	Change the cursor locations.
1302	No waveform data in clipboard	This message appears when nothing has been copied to the clipboard.	Copy a waveform, or part of it, to the clipboard.

Import from Oscilloscope

1401	Cannot access the folder	You do not have enough permission to see the contents of this folder.	Go to folder properties on Windows Explorer and change the permissions to have enough permission.
1402	A file with this name already exists in this folder. Do you want to overwrite?	A file with the same name is found in the currently selected folder.	Rename the file in the selected folder or select a different folder.
1403	Switch on Ref# on the oscilloscope	The reference memory on the oscilloscope is switched off.	Switch on the reference memory on the oscilloscope using front panel buttons.
1404	FFT Waveforms cannot be imported. Select a Dual Math waveform	FFT waveforms are frequency domain waveforms. This version of ArbExpress does not support this type of waveforms.	NA
1405	Disconnect failed. Refresh Visa resource list and try to reconnect	Communication with the oscilloscope is lost. Therefore all commands including 'Disconnect' fail.	Check the physical connection, refresh the Visa resource and try to reconnect.
1406	Connect failed. Refresh Visa resource list, check if the instrument is properly connected and try again.	This message can appear for several reasons. ■ Physical connection between PC and oscilloscope is improper or does not exist. ■ The connected oscilloscope is not in the Visa resource list. ■ The oscilloscope is not in the Talk/Listen mode (If it is connected using GPIB cable).	Do one of the following: ■ Check the physical connection to ensure that everything is fine. ■ Refresh VisaRM if and Instrument list in the Oscilloscope Acquisition dialog. ■ Using oscilloscope front panel, select Talk/Listen mode. Refresh Visa resource and refresh the Instrument list in the Oscilloscope Acquisition dialog.
1407	Visa not found on this PC.	Visa was not found on the PC.	Install TekVisa.
1408	Error finding Visa resources.	The application cannot find Visa resources.	Refresh the VisaRM and then refresh the ArbExpress instrument list.
1409	An oscilloscope is already connected. Disconnect it before connecting a different oscilloscope.	You are trying to connect to a second oscilloscope while you are already connected to one.	Disconnect the oscilloscope currently connected, select the other and try to connect.

Import from Oscilloscope

1410	No resources are found. Refresh TekVisa Resource manager and click Refresh button again.	ArbExpress did not find any oscilloscopes that can be connected. Therefore, the Scope List is empty.	Refresh TekVisa resource manager and wait until the TekVisa Resource Manager dialog shows "Ready" state. Then, click the Refresh button on Import From Oscilloscope dialog.
1411	No Math equation is set on the Oscilloscope.	You have not set a math equation for this math source on the Oscilloscope.	Set a math equation that generates a time domain signal for this math source.

File Transfer and Control

1601	Could not connect to the instrument. Check: ■ the GPIB connection ■ the instrument mode ■ the IP Address	When the instrument is connected to the PC via the GPIB or LAN, and the user fails to connect because ■ The GPIB /LAN cable is not connected properly. ■ The instrument may be switched off. ■ The instrument is not in GPIB/LAN mode. ■ The IP Address is incorrect for the LAN connection. ■ VISA resource list is not updated.	■ Verify the GPIB (Talk/Listen)/LAN connection. Ensure there is no loose connection. ■ Refresh the Visa resource list. ■ Check that the instrument is powered on and is in GPIB/Network mode. ■ For LAN connection, ping from the instrument to the PC and vice versa. ■ Verify that instrument is ready for communication. ■ Try reconnecting to the instrument. ■ Connect only one PC connected to an instrument.
1602	Error getting instrument's file list, folder list.	The instrument is successfully connected via the GPIB bus but the user cannot get instrument folder/file list. This may happen if the connection to the instrument is lost.	■ Verify that instrument is ready for communication. ■ Try reconnecting to the instrument.

File Transfer and Control

1603	Visa32.dll not found. Install TekVisa.	This message appears when you try to access the File Transfer dialog. ■ TekVisa files not found in Windows' system folder (system32 or system folder depending on the Windows Operating System). ■ TekVisa files may be corrupt.	Do the following: **1.** Ensure that the Windows Operating System is installed on the PC. **2.** Uninstall TekVisa if already installed. Reinstall TekVisa. **3.** Ensure that the Tekvisa32.dll is placed in the Windows system folder (system or system32 folder).
1604	Error finding VISA resources	The user has set up the physical connection to this instrument via GPIB bus but is unable to get the instrument resource in the instrument list.	Start> Programs>TekVISA>TekVISA Configuration. Refresh the TekVisa resource list.

File Transfer and Control

1605	Unable to write to the instrument	The user tried to transfer a file from the PC to the instrument. The transfer failed due to: ■ lost instrument connection ■ insufficient hard disk space ■ the file that is being transferred is opened by another application The write operation failed due to: ■ Large file size. The edit memory can have a maximum of 16000 points ■ Incompatible file format ■ No communication between the application and the instrument. This message also appears while transferring a file from the PC to an AWG2000 series instrument whose file format is incompatible with the AWG2000 file format or NVRam may be full.	■ Check instrument connection ■ Check hard disk space ■ Check whether the file is being used by another application ■ Check whether the instrument file size and file format are compatible ■ Ensure that the file being transferred from the PC to the AWG2000 series instrument is compatible with the AWG2000 file format or NVRam has enough memory.
1606	Failed to get the instrument's default directory	You tried to transfer a file from the instrument's memory to the PC. The application failed to get the instrument's current default directory (MAIN) because the connection to the instrument was lost during file transfer.	Verify whether the instrument is connected and is ready to communicate.
1607	A file with this name already exists in this folder. Do you want to overwrite?	You tried to transfer a file to the destination folder in a PC or an instrument but a file with the same file name exists in this folder.	Rename the existing file and then transfer the file again. Or select Yes to overwrite the existing file.

File Transfer and Control

1608	An instrument is already connected. Disconnect it to connect to a new instrument.	The software allows one connection at a time — either through GPIB or LAN. The user tried to connect to a second instrument.	Disconnect the connected instrument and connect a new instrument.
1609	This file is empty. Cannot transfer this file.	You tried to transfer an empty file from the PC to the instrument or vice versa.	NA
1610	Unable to load the file. Check the instrument connection.	You tried to load a file by pressing the Load button in the instrument control pane. The application failed to load the file because: ■ The connection to the Instrument is lost. ■ The file format is invalid.	Do one of the following: ■ Check the instrument connection and whether the instrument is ready to communicate ■ Check if the file is a .wfm, .pat, or .set file. ■ Check if the file is present.
1611	No waveform/sequence file is loaded.	This message appears when the waveform or sequence file is not loaded in the instrument's internal memory, and user presses Run/Stop button in the instrument control pane. This also appears when the user tries to enable the AWG channel by selecting the On/Off Channel in the instrument control pane. This is applicable only to AWGs.	Load a waveform into the internal memory of the connected AWG instrument, then perform Run/Stop.
1612	Enter a value.	This message appears when no value has been entered in a field.	Enter a valid value for the field that is supported by the application.

File Transfer and Control

1613	Failed to write to the PC	This message appears when the user tries to transfer the remote file from the connected instrument to the PC file list. The application fails to do so because: ■ the instrument is not ready. ■ the destination folder in the PC has a file with same name that is being accessed by another application. ■ the destination folder in the PC may not exist. ■ Instrument connection is lost.	Check whether ■ The instrument connection is alive. ■ The instrument is ready. ■ The destination folder exists.
1614	Invalid amplitude. Voltage range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.
1615	Invalid offset. Voltage range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.
1616	Invalid marker voltage. Voltage range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.
1617	Invalid clock. Frequency range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.
1618	Invalid phase. Range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.
1619	Invalid output frequency. Frequency range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.
1620	Invalid EMEM size. Point range supported is xx – xx.	The value entered is not within the instrument range.	Enter a value that is supported by the instrument.

File Transfer and Control

1621	Insert a floppy.	This is caused when you select "DISK" on the Instrument Folder/PC folder. ■ Floppy drive may not have a disk. ■ Floppy drive or the floppy disk may be bad.	■ Ensure that the floppy disk is inserted in the disk drive and is working. ■ Instrument/PC floppy drive is working.
1622	Are you sure you want to overwrite EMEM<n> with <PC file name>?	This message appears when user transfers file from PC to the Edit memory of the instrument (AFG).	NA
1623	Are you sure you want to overwrite USER<n> with EMEM<n>?	This message appears when user transfers file from Edit memory to the User memory of the instrument (AFG).	NA
1624	Are you sure you want to overwrite USER<n> with <PC file name>?"	This message appears when user transfers file from PC to the User<n> memory of the instrument (AFG).	NA
1625	No Arb is connected. Do you want to connect now?	This message appears if the "Send To Arb" button is pressed in the application when no instrument is connected. Pressing Yes invokes the File Transfer and Control dialog.	NA
1626	Unable to load the file, format not supported.	This message is displayed when the user tries to load a .seq file in File Transfer and Instrument Control dialog box.	NA

Error Messages and Warnings III

Error code	Error message	Description	Possible solution
Scope Acquisition Wizard			
1701	No resources are found. Refresh TekVisa Resource manager and click Refresh button again.	This error message appears when the user tries to refresh or select "Select Instrument" page and when there are no instruments listed after the scan.	Refresh TekVisa.
1702	Connect failed. Refresh Visa resource list, check if the instrument is properly connected and try again.	This error message appears when the user tries to connect to a particular instrument and connection fails.	Refresh TekVisa.
1703	Switch on Ref# on the oscilloscope.	This error occurs when the user tries to acquire from Reference memory and reference is turned off.	Turn on the Reference memory.
1704	No Math equation is set on the Oscilloscope.	This error occurs when the user tries to acquire from Math data source when the equation is null.	Check whether the math equation is valid.
1705	No data points available. Please change the settings and acquire again.	This error occurs when the user tries to acquire data from a source and when no points are available.	Change the acquisition settings and acquire again.
1706	Frequency Domain Waveforms cannot be imported. Select a Dual Math waveform.	This error appears when the user tries to acquire waveform in frequency domain. For this error to happen the data source should be a MATH waveform.	Select a Dual Math waveform.
1707	Number of points match the instrument - "Selected Instrument Name."	This message appears when the user selects Validate button in the "Extract Segment" page and the number of points should match the instrument selected.	NA
1708	A file already exists with this name in this folder. Do you want to overwrite?	This message appears when the file is about to be overwritten.	NA

Point Draw

1801	Only 100 PD Points are allowed.	This message appears when PD points exceed 100.	Remove the existing PD point and then add new PD point.
1901	Enter units in right place.	This message appears when units are not entered properly for the time value. Time value can be entered when Time button is selected under XY group. The user will not be able to click the next cell until the right value is entered.	Enter the units appropriately.
1902	Please enter only digits.	This message appears when input is not correct for the time value. Time value can be entered when Time button is selected under XY group. The user will not be able to click the next cell until the right value is entered.	Enter the time value correctly.
1903	Please enter the units correctly.	This message appears when units are not entered properly for the time value. Time value can be entered when Time button is selected under XY group. The user will not be able to click the next cell until the units are entered correctly.	Enter the units appropriately.
1904	Please enter correct double value.	This message appears when the input value for Voltage is not correct. The user will not be able to click the next cell until the right voltage value is entered.	Enter the correct voltage value.
1905	The time value entered should be within maximum time range.	The maximum time value will depend on the waveform length. Time value can be entered when Time button is selected under XY group. The user will not be able to click the next cell until the right voltage value is entered.	The time value entered should be within the range.

Point Draw

1906	Sampling Index should be within Maximum Sampling value.	This message appears when the point value exceeds the waveform length. Point mode can be selecting the Points under the XY group.	Enter the point within the range.
1907	Value of the Sampling Index should be unique.	The sampling index should always be a unique value.	Enter unique sampling index.
1908	There should be minimum time difference of at least MinimumTimeDifference.	This message appears when time values in two cells have a difference of less than the MinimumTimeDifference. Time value can be entered when Time button is selected under XY group.	Entering the time value in the cell such that they have the MinimumTimeDifference between them.

Default Settings

Parameter	Selection	Default Setting
Edit> Paste	Paste at active cursor Prepend to the waveform Append to the waveform Replace between cursors.	Paste at active cursor.
	Don't show this again and always paste at active cursor.	Not selected by default.
Shift/Rotate	Points	10
	Amplitude	.5 V
	Vertical Segment: Shift Up, Shift Down	Shift Up
	Horizontal Segment: Rotate Right, Rotate Left, Shift Left, Shift Right	Rotate Right
Point Draw Table	Interpolation: Linear, Smooth, Staircase	Smooth
	X Value: Time, Points	Depends on the X axis units of the active wavebook or window
Display> Cursor Position	Points Seconds	The selection is based on the waveform. If the X-axis is Time, the setting is Seconds.
	Cursor 1	Reflects the current location, in points or seconds, of Cursor 1
	Cursor 2	Reflects the current location, in points or seconds, of Cursor 2

Parameter	Selection	Default Setting
Display> Properties	Waveform Name	Displays the name of the selected waveform
	Enable Graticule	Enabled by default
	Waveform Properties	Displays the currently selected waveform color, line style, and line width
	Marker Color	Displays the marker colors of Marker 1 and Marker 2
	Background Color	Displays the background color of the selected waveform
	Cursor Color	Displays the cursor colors of Cursor 1 and Cursor 2
Equation Editor	Instrument	AWG710
	Sampling Rate	1000000
	Number of Points	1000
	Total Range	0.001
	Equation	#Change the range according to you settings
		range (0,1ms)
		#Your equation goes here sin(w)
Waveform> Properties> Active Waveform tab	Instrument	Displays the currently selected instrument in the waveform
	Sampling Rate	Displays the sampling rate of the selected waveform
	Resampling waveform using	Shows the number of points used for resampling
	Resampling method: Sinc, Linear, Add points with zero amplitude	Sinc
	Normalize waveform before saving the file	Selected by default
Waveform> Properties> Multi-Waveform Properties tab	New Window/Existing Window	New Window
	Wave Book Selection	Displays the currently selected wave book
	Change the incoming waveform's sampling rate. Change the existing waveform's sampling rate	Change the incoming waveform sampling rate
Waveform> Properties> Preferences tab	Save .set file along with the .wfm and .pat files.	All the options are selected
	Show paste option before pasting.	When the channel is turned on or off, the complementary channels are also turned on or off
	Always enable instrument's outputs after transferring the waveform.	

Parameter	Selection	Default Setting
Math> Waveform Math	Math Source Waveform Library — Sine, Square, Triangle, DC, Noise, Pulse, Exponential Rise, Exponential Decay Scalar Copy from Clipboard	Waveform Library Amplitude 2.0, Cycles 1, Phase 0, Duty Cycle 50, Pulse Width 50, Damp Factor 50 Amplitude 1.0

	Operation
	    Add
	    Subtract
	    Multiply
	    Divide
		Add

	Only Between Cursors	Always selected

Default Settings Cont...

This table lists the default settings for the standard waveforms.

Parameter	Selection	Default Setting
Waveform> Sine	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	10
	Frequency	Maximum sampling rate / Points per cycle(100) Maximum sampling rate / Points per cycle(128) (AWG7000 series)
	Phase	0
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	100 128 (AWG7000 series)

Parameter	Selection	Default Setting
Waveform> Square	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	10
	Frequency	Maximum sampling rate / Points per cycle(100) Maximum sampling rate / Points per cycle(128) (AWG7000 series)
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	100 128 (AWG7000 series)
	Phase	0
	Duty Cycle	50
	Rise Time / Fall Time	0
	Rise Time / Fall Time Type	Ramp
Waveform> Triangle	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	10
	Frequency	Maximum sampling rate / Points per cycle(100) Maximum sampling rate / Points per cycle(128) (AWG7000 series)
	Phase	0
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	1000 128 (AWG7000 series)

Parameter	Selection	Default Setting
Waveform> Pulse	Amplitude Peak to peak	2
	Vertical offset	0
	Cycles	10
	Frequency	Maximum sampling rate / Points per cycle(100) Maximum sampling rate / Points per cycle(128) (AWG7000 series)
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	100
		128 (AWG7000/ series)
	Delay	0
	Pulse Width	10
	Rise Time / Fall Time	0
	Rise Time / Fall Time Type	Ramp
	Transition Pulse Direction	Positive
Waveform> DC	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Sampling Rate	Maximum sampling rate supported by the instrument
Waveform> Exponential Rise	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	1
	Phase	0
	Sampling Rate	Maximum sampling rate supported by the instrument
	Damp factor	5
Waveform> Exponential Decay	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	1
	Phase	0
	Sampling Rate	Maximum sampling rate supported by the instrument
	Damp factor	5

Parameter	Selection	Default Setting
Waveform> Noise	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Noise Type	Gaussian White Noise
	Sampling Rate	Maximum sampling rate supported by the instrument
Waveform> Sinc	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	1
	Phase	0
	Number of zero crossings	10
	Sampling Rate	Maximum sampling rate supported by the instrument
Waveform> Sweep	Amplitude Peak to peak	1000
	Vertical offset	0
	Points	Duration * Sampling Rate
	Start frequency	1 M
	End frequency	5 M
	Time Duration	1μ (AWG710 – AWG2021, AWG5000 series, and AWG7000 series)
		10μ (AWG2005 – AFG320) 1000/Maximum sampling rate (AFG2000 and AFG3000 series)
	Sampling Rate	Maximum sampling rate supported by the instrument. The default sampling rate for AWG2021 is 248.
		The default sampling rate for AWG7000 series is 3.2 G.

Parameter	Selection	Default Setting
Waveform> Multi-Tone	Amplitude Peak to peak	2
	Vertical offset	0
	Points	SamplingRate/ToneSpacing
	Start frequency	1M (AWG710 – AWG2021, AWG5000 series, AWG7000 series, AFG2000, and AFG3000 series) 1K (AWG2005 – AFG320)
	End Frequency	5M (AWG710 – AWG2021, AWG5000 series, AWG7000 series, AFG2000, and AFG3000 series) 5K (AWG2005 – AFG320)
	Tone Spacing	1M (AWG710 – AWG2021, AWG5000 series, and AWG7000 series) 1K (AWG2005 – AFG320) 1000/Maximum sampling rate (AFG2000 and AFG3000 series)
	Sampling Rate	Maximum sampling rate supported by the instrument. The default sampling rate for AWG2021 is 248. The default sampling rate for AWG7000 series is 3.2 G.

Parameter	Selection	Default Setting
Waveform> Lorentz	Amplitude Peak to peak	2
	Vertical offset	0
	Points	Delay * Sampling Rate
	Cycles	1
	Phase	0
	Delay	1µ (AWG710 – AWG2021, AWG5000, and AWG7000) 10µ (AWG2005 – AFG320) 1000/Maximum sampling rate * cycles (AFG2000 and AFG3000 series)
	Half Width	0.3 µs
	Sampling Rate	Maximum sampling rate supported by the instrument. The default sampling rate for AWG2021 is 248. The default sampling rate for AWG7000 series is 3.2 G.
Waveform Padding Options	Manually change the Horizontal settings to reach minimum number of points	Manually change the Horizontal settings to reach minimum number of points
	Add zeros to achieve minimum number of points	
	Add last vector to achieve minimum number of points	

Valid Parameter Ranges

The table below lists the filters, amplitudes, offsets, and levels supported by the AWGs and AFGs.

Output amplitude option
Memory length option
Output channel option

			Main Analog Output									Filter (MHz)				
			Amplitude			Offset			Level							
			MaxVpp	Min Vpp	Res. V	+ xx V	- xx V	Res. V	Max V	Min V	Res. V					
AWG710	STD	Normal	2.00	0.02	0.001	+ 0.5	-0.5	0.001	+1.5	-1.5	0.001	Through	20	50	100	200
		Direct	1.00	0.02	0.001	no control			+0.5	-0.5	0.001	no selection				
	option 02		1.00	0.50	0.001	no control			+0.5	-0.5	0.001	no selection				
	option 01															
AWG710B	STD	Normal	2.00	0.02	0.001	+ 0.5	-0.5	0.001	+1.5	-1.5	0.001	Through	20	50	100	200
		Direct	1.00	0.02	0.001	no control			+0.5	-0.5	0.001	no selection				
	option 02		1.00	0.50	0.001	no control			+0.5	-0.5	0.001	no selection				
	option 01															
AWG610	STD	Normal	2.00	0.02	0.001	+ 1.0	-1.0	0.001	+2.0	-2.0	0.001	Through	20	50	100	200
		Direct	1.00	0.02	0.001				+0.5	-0.5	0.001	no selection				
AWG615	STD	Normal	2.00	0.02	0.001	+ 0.5	-0.5	0.001	+1.5	-1.5	0.001	Through	20	50	100	200
		Direct	1.00	0.02	0.001	no control			+0.5	-0.5	0.001	no selection				
	option 02		1.00	0.50	0.001	no control			+0.5	-0.5	0.001	no selection				
	option 01															
AWG510	STD	Normal	2.00	0.02	0.001	+ 1.0	-1.0	0.001	+2.0	-2.0	0.001	Through	10	20	50	100
		Direct	0.5 fix	><	><	-0.27 fix	><	><	><	><	><	no selection				
AWG520	STD	Normal	2.00	0.02	0.001	+ 1.0	-1.0	0.001	+2.0	-2.0	0.001	Through	10	20	50	100
		Direct	0.5 fix	><	><	-0.27 fix	><	><	><	><	><	no selection				
AWG420	STD	Normal	2.00	0.02	0.001	+ 1.0	-1.0	0.001	+2.0	-2.0	0.001	Through	1	5	20	50
		Direct	0.50	0.02	0.001	no control			+0.25	-0.25	0.001	Through	1	5	20	50
	option 05	Normal	5.00	0.02	0.001	+ 2.5	-2.5	0.001	+5.0	-5.0	0.001	Through	1	5	20	50
		Direct	0.50	0.02	0.001	no control			+0.25	-0.25	0.001	Through	1	5	20	50
	option 01															
AWG430	STD	Normal	2.00	0.02	0.001	+ 1.0	-1.0	0.001	+2.0	-2.0	0.001	Through	1	5	20	50
		Direct	0.50	0.02	0.001	no control			+0.25	-0.25	0.001	Through	1	5	20	50
	option 05	Normal	5.00	0.02	0.001	+ 2.5	-2.5	0.001	+5.0	-5.0	0.001	Through	1	5	20	50
		Direct	0.50	0.02	0.001	no control			+0.25	-0.25	0.001	Through	1	5	20	50
	option 01															
AWG2021			5.00	0.05	0.005	+ 2.5	-2.5	0.005	+5.0	-5.0	0.005	Through	1	5	20	50
	option 02															
AWG2005			10.00	0.05	0.005	+ 5.0	-5.0	0.005	+10.0	-10.0	0.005	Through	0.5	1	2	5
	option 02															
AFG310			10.00	0.05	0.005	+ 5.0	-5.0	0.005	+10.0	-10.0	0.005					
AFG320			10.00	0.05	0.005	+ 5.0	-5.0	0.005	+10.0	-10.0	0.005					

The table below lists the output styles, number of channels, memory lengths, and marker out levels supported by the AWGs and AFGs.

		Output style	# of ch	Memory length/ch Max	Min	Restriction	Marker out Amplitude Max Vpp	Min Vpp	Res. V	Level Max V	Min V	Res. V
AWG710	STD	Differential		16,200,000	960	X 4	2.5	0.05	0.05	+3.00	-1.10	0.05
		Differential										
	option 02	Differential			960							
	option 01			32,400,000	960							
AWG710B	STD	Differential	1	32,400,000	960	X 4	1.25	0.05	0.05	+2.45	-2.00	0.05
		Differential										
	option 02	Differential			960							
	option 01			64,800,000	960							
AWG610	STD	Differential	1	8,100,032	512	X 8	2.5	0.05	0.05	+3.00	-1.10	0.05
		Differential										
AWG615	STD	Differential	1	32,400,000	960	X 4	1.25	0.05	0.05	+2.45	-2.00	0.05
		Differential										
	option 02	Differential			960							
	option 01			64,800,000	960							
AWG510	STD	Differential	1	4,194,048	256	X 4	4.0	0.05	0.05	+2.00	-2.00	0.005
		Differential										
AWG520	STD	Single-end	2	4,194,048	256	X 4	4.0	0.05	0.05	+2.00	-2.00	0.005
		Single-end										
AWG420	STD	Differential	2	4,050,000	64	X 1						
	option 05	Single-end										
	option 01			16,200,000	64							
AWG430	STD	Differential	3	4,050,000	64	X 1						
	option 05	Single-end										
	option 01			16,200,000	64							
AWG2021		Single end	1	262,144	64	X 8						
	option 02		2									
AWG2005		Single end	2	65,536	16	X 1						
	option 02		4									
AFG310		Single end	1	16,384	10	X 1						
AFG320		Single end	2	16,384	10	X 1						

The table below lists the output types and number of channels supported by the AFG2000 series of instruments.

	Main Analog Output Amplitude Max Vpp	Min Vpp	Res. V	Offset +xx V	-xx V	Res. V	Level Max V	Min V	Res. V	Output style	# of ch	Memory length/ch Max	Min	Restriction
AFG 2021	10.000	0.01	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	1	131072@250MS/s	2	X2

The table below lists the output styles and the number of channels supported by the AFG3xxx series of instruments.

	Main Analog Output Amplitude MaxVpp	Min Vpp	Res. V	Offset + xx V	- xxV	Res. V	Level Max V	Min V	Res. V	Output style	# of ch	Memory length/ch Max	Min	Restriction
AFG3021	10.000	0.01	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	1	65536 @250MS/s	2	X2
AFG3021B	10.000	0.01	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	1	131072 @250MS/s	2	X2
AFG3011	20.000	0.02	0.0001	+10.000	-10.000	0.001	+10.000	-10.000	0.001	Single end	1	131072 @250MS/s	2	X2
AFG3022	10.000	0.01	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	2	65536@250MS/s	2	X2
AFG3022B	10.000	0.01	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	2	131072 @250MS/s	2	X2
AFG3101	10.000	0.02	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	1	16384 @1000MS/s, 131072@250MHz	2	X2
AFG3102	10.000	0.02	0.0001	+5.000	-5.000	0.001	+5.000	-5.000	0.001	Single end	2	16384 @1000MS/s, 131072@250MHz	2	X2
AFG3251	5.000	0.05	0.0001	+2.500	-2.500	0.001	+5.000	-5.000	0.001	Single end	1	16384 @2000MS/s, 131072@250MHz	2	X2
AFG3252	5.000	0.05	0.0001	+2.500	-2.500	0.001	+5.000	-5.000	0.001	Single end	2	16384 @2000MS/s, 131072@250MHz	2	X2

The table below lists the output styles and the number of channels supported by the MDO3000 series of oscilloscope. The oscilloscope AFG is a 50 Ω source. The levels described in this table apply when the output load impedance is set to 50 Ω.

| | Main analog output | | | | | | | | Output style | # of CH | Memory length/CH | | |
| | Amplitude | | | Offset | | Level | | | | | | | |
	Max V$_{p-p}$	Min Vp-p	Res V	+xxV	-xxV	Max V	Min V	Res V			Max	Min	Restriction
MDO3012													
MDO3014													
MDO3022													
MDO3024													
MDO3032	2.5	0.01	0.0005	+1.25	-1.25	+2.5	-2.5	0.001	Single end	1	131072 @250 MHz	2	X2
MDO3034													
MDO3052													
MDO3054													
MDO3102													
MDO3104													

The table below lists the output styles and the number of channels supported by the AWG7xxx and AWG5xxx series of instruments.

| | Main Analog Output | | | | | | | | | Output style | # of ch | Memory length/ch | | |
| | Amplitude | | | Offset | | | Level | | | | | | | |
	MaxVpp	Min Vpp	Res. V	+ xx V	- xxV	Res. V	Max V	Min V	Res. V			Max	Min	Restriction
AWG7101	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	1	129600000	960	64
AWG7102	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	2	129600000	960	64
AWG7051	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	1	129600000	960	64
AWG7052	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	2	129600000	960	64
AWG7121B	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	1	129600000	960	4
AWG7122B	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	2	129600000	960	4
AWG7122C	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	2	129600000	960	4
AWG7061B	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	1	129600000	960	4
AWG7062B	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	2	129600000	960	4
AWG7082C	2.000	0.05	0.001	0.500	-0.5	0.001	1.50	-1.5	0.001	Differential	2	129600000	960	4
AWG5012	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	2	32000000	250	1
AWG5014	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	4	32000000	250	1
AWG5002	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	2	32000000	250	1
AWG5002C	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	2	32000000	250	1
AWG5004	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	4	32000000	250	1
AWG5002B	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	2	32000000	250	1
AWG5004B	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	4	32000000	250	1
AWG5012B	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	2	32000000	250	1
AWG5012C	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	2	32000000	250	1
AWG5014B	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	4	32000000	250	1
AWG5014C	4.500	0.02	0.001	2.25	-2.25	0.001	4.50	-4.5	0.001	Differential	4	32000000	250	1

Equation Editor Reference I

Use the equation editor to edit files with the extension of .equ, .eqa, or *.*. The default selection is *.eqa. Equation file data takes the form of mathematical equations. An equation program file can have up to 100 lines. An equation file is compiled to create a waveform file and to output the waveform.

Sin(	Cos(	exp(	log(	int(	pi	(	)
ln(	Sqrt(	Max(	Min(	x	e	+	-
range(	rnd(	mark(	diff(	v	k	*	/
norm(	round(	abs(	integ(	t	w	^	=

The component menu contains the items used to set the time range as well as functions, operators, variables, constants, syntax items and characters. You can use these items to create equations and enter comments.

Component	Symbol	Meaning	Example
Syntax Items	( )	These are parentheses — (and) — for specifying the order of operations. Each opening (left) parenthesis must be paired with a closing (right) parenthesis. When there are two arguments – for example, range, max, min – they are separated with a , (comma).	NA
Variables. Here are the variables that can be used in an equation.	t x v	Time from the head of that range() statement Variable taking on a value from 0.0 to 1.0 within that range ( ) Variable showing the current value of the waveform data at that position statement	NA

Component	Symbol	Meaning	Example
Operators	+, −, *, /	These add, subtract, multiply, or divide the components. The priorities are the same as usual for these four operators – * and / have priority over + and −.	NA
	^	Expresses exponents. Only integers can be raised to a higher power. ^ has the same priority as * and /. Therefore, parentheses are required to give priority to multiplication.	Example: pi * (2^3) * x where 2^3 = two raised to the third power.
Comment	#	Comments are preceded by a number sign (#). When a number sign is entered, all characters after that until the end of the line are treated as a comment. All of the items in the component menu can be used in a comment.	NA
Characters	a–z, %, $, &, @, A, _	The characters available in the component menu are the letters of the alphabet (a–z) and several symbols (%, $, &, @, A and _). These are used in comments.	NA
Other items	pi, e, k, =, ↵		NA

Component	Symbol	Meaning	Example
	pi	The circumferential ratio.	NA
	e	Exponent (for an implied 10). The range for numbers expressed in this scientific notation is from |5.9e–39| to |3.4e38|.	Examples: 1e6=1,000,000, 1e–3=0.001
	k	The k0–k9 can be specified; these are constants that may be used in equations. Specifying a new value for the same k# replaces the old value with the new one. If no constant is defined for k, this value will be automatically set to 0.	NA
	=	Equals sign. = is used with k constants.	Example: k0=2*pi
	↵	Ends the line for the range or equation; inserting a return (↵) in the middle of the line partitions it.	NA

Component	Symbol	Meaning	Example
Functions	sin(, cos(	The arguments for these trigonometric functions are in radians.	Example: range(0,100 s)cos(2*pi*x) Example: range(0,100 s)sin(2*pi*1e4*t)
	exp(, log(, ln(	Exponential function, common log function, natural log function. The log and ln arguments must be positive.	Example: range(0,50 _s) 1–exp(–5*x) range(50 _s,100 _s) exp(–5*x) Example: range(0,100 _s) log(10*(x+0.1)) Example: range(0,100 _s) ln(2*(x+0.2))
	sqrt(	The square root; the argument must be a positive value.	Example: range(0,100 _s) sqrt(sin(pi*x))
	abs(	The absolute value.	Example: range(0,100 _s) abs(sin(2*pi*x))
	int(	Truncates the fraction to obtain the integer.	Example: range(0,100 _s) int(5*sin(2*pi*x))/5
	round(	Rounds off the fraction to obtain the integer.	Example: range(0,100 _s) round(5*sin(2*pi*x))/5
	norm(	Normalizes the range specified with range() and scales the amplitude values so that the maximum absolute value is 1.0 (that is, a value of +1.0 or –1.0). The norm() statement comprises an entire line.	Example: range(0,100 _s) sin(2*pi*x)+rnd()/10 norm()
	max(min(	Takes the larger of two values. Takes the smaller of two values.	Example: range(0,100 _s) sin(2*pi*x) range(0,50 _s) min(v,0.5) range(50 _s,100 _s) max(v,–0.5)
	range(	The equation must specify the time domain. If the time domain is not defined, this is an error. The time domain is specified with range(). When making a new equation file, range(0, is input in the first line of equation. Next, the time is specified. This setting is valid until the next range(item is specified. With the first range() specification, any number of lines of equation can be input. Text written after the range() on the same line is invalid. Here is the format for the range(item: range(Equation starting time, Equation ending time)	range(0,1ms) Time range sin(2*pi*x) Equation

Equation Editor Reference II

Use the equation editor Units menu to specify the units for the parameters or variables used in the equation.

m	u	n	p
s	,	K	M

The following table lists the units that you can use and their descriptions.

Unit	Meaning
m	milli (e^{-3})
u	micro (e^{-6})
n	nano (e^{-9})
p	pico (e^{-12})
s	second
,	comma separator
K	Kilo (e^3)
M	Mega (e^6)

Use the selection menu to confirm, backspace, or clear the equation.

Enter	BKSP	CLR

The following table lists the units that you can use and their descriptions.

Button	Meaning
Enter	Confirms the selection and moves to the next line of the equation
BKSP	Backspaces over the last character. Works like the backspace key on the keyboard
CLR	Clears the entire equation

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