User Manual

Tektronix

ArbExpress AXW100 Waveform Creation and Editing Tool for Tektronix AWG/AFG Version 1.0

077-0000-00

Adapted from the Online Help

www.tektronix.com

Table of Contents

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ArbExpress AXW100 Waveform Creation and Editing Tool

Overview

About ArbExpress AXW100 Software

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

ArbExpress generates waveforms for Tektronix's signal sources 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.

ArbExpress™ Ver 1.0
The Arbitrary Waveform Editing Tool from Tektronix
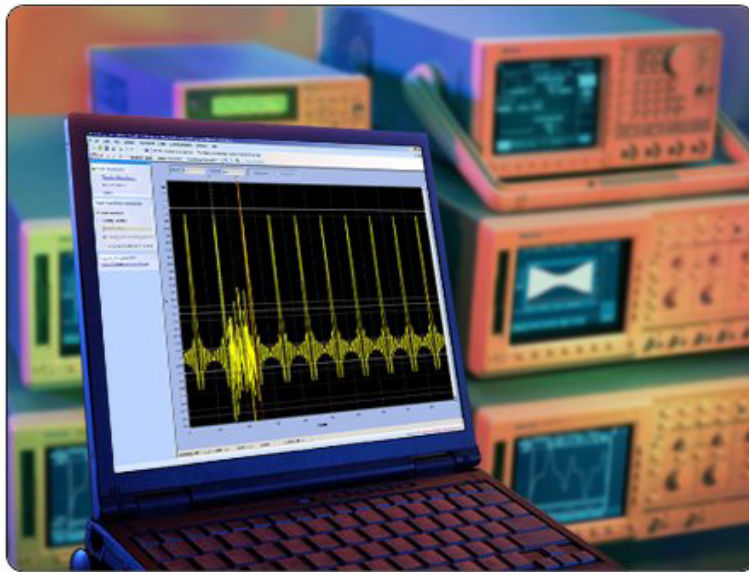
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Configuration

The minimum requirements for the ArbExpress AXW100 application are listed in Table 1-1.

Table 1–1: Minimum system requirements

OS supported	Minimum requirements
Windows XP Professional Service Pack 1	Pentium III @ 800 MHz and higher
	256 MB RAM
Windows 2000	300 MB Free Disk Space
	Microsoft Internet Explorer 5.01 and higher
Windows 98/Me	.NET Framework 1.1 Redistributable
Windows NT Service Pack 6a	

The following table lists the conditions under which ArbExpress uses TekVisa version 2.01.

Table 1–2: ArbExpress and TekVisa

	AWG/AFG	Oscilloscope
LAN	TekVisa not required*	TekVisa required
GPIB	TekVisa required	TekVisa required
RS232*	Not supported	TekVisa required

* AFG and AWG2xxx series do not support LAN

ArbExpress supports file transfer and control from MATLAB version 6.1, release 12.1. To use this feature, install TekVisa version 2.01 on the PC.

Installation

This section describes how to install the ArbExpress AXW100 application using the InstallShield Wizard. The installation program setup.exe installs the ArbExpress software. Do the following to install the ArbExpress software:

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

2. If the installation program does not automatically start, find setup.exe under the folder \ArbExpress on the CD-ROM and double-click it. The InstallShield wizard displays the Splash Screen.

3. Follow the instructions given by the InstallShield wizard.

4. The installation follows this sequence of steps: Welcome, License Agreement, Choose Destination Location, Start Copying Files, Setup Status, and View Release Notes (optional).

   - Click **Next** to continue and navigate through the InstallShield wizard.

   - Click **Back** if you want to change the settings in the previous window.

5. In the Welcome window, click **Next** to display the License Agreement window.

6. In the License Agreement window, do the following:

   - Read the License Agreement carefully.

   - Select the **I accept the terms of the License agreement** option to continue.

7. After you have selected the **I accept the terms of the License agreement** option, click **Next** to display the Choose Install Folder window.

8. In the Choose Destination Location window, do one of the following:

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

   - To change the location where you would like to install the ArbExpress software, click **Browse** and browse to the location.

9. Click **Next** to display the Start Copying Files window. This window displays the disk space available and the disk space required to install ArbExpress.

10. Click **Next** to start installation. The Setup Status window displays a progress bar. ArbExpress will be installed in the selected folder with a shortcut in the Start menu.

11. When the installation is complete, the message "ArbExpress Software Setup completed successfully" is displayed. If you do not have TekVisa version 2.01 and .NET Runtime Framework version 1.1 installed on your computer, ArbExpress detects this and displays a message to install these before running ArbExpress.

    You can install TekVisa version 2.01 from the folder \TekVisa v2.01 and .NET Runtime Framework version 1.1 from the folder \DotNet Framework available in the ArbExpress CD-ROM.

12. Click **Finish** to exit and view the release notes.

Using Online Help

Select Help on the right side of the application menu bar to bring up the online 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 bring up the appropriate help page.

Search tab—allows a text-based search. Follow these steps:

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 select the Display button.

    ▪   To print a topic, select the Print button from the Help Topics menu bar.

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

    ▪   Select the Back button 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, choose the Help Topics button 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).

Sometimes you will see the word **Note** in the topic text. This indicates 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 Contents for this help file, and then click the following book icons to display links to specific dialog boxes: Operating Basics> Dialog Boxes.

Printing from the Online Help

While using the ArbExpress online help, you can print topics and information from the Help viewer. Some online help topics have color in the examples of the displayed application. If you want to print this type of topic on a monochrome printer, some information may not print because of certain colors. Instead, you should print the topic from the PDF (portable document format) file that corresponds to the Online Help. You can find the file in the main directory on the CD-ROM disk. The figures of the application menus in the PDF file are gray scale so the relevant information will appear on the printed page.

To print a single topic:

1. Find the topic in the Contents pane.

2. Click Print from the menu.

3. Click Print the selected topic and click OK.

To print all topics in a selected TOC book:

1. Find the TOC book in the Contents pane.

2. Click Print from the menu.

3. Click Print the selected heading and all subtopics and click OK.

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

Getting Started

Basic Operations

ArbExpress AXW100 Waveform Creation and Editing Tool for Tektronix AWG/AFG is a 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 separated by ">". 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 that open with the right-click on the mouse button, 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 commonly and frequently used 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.
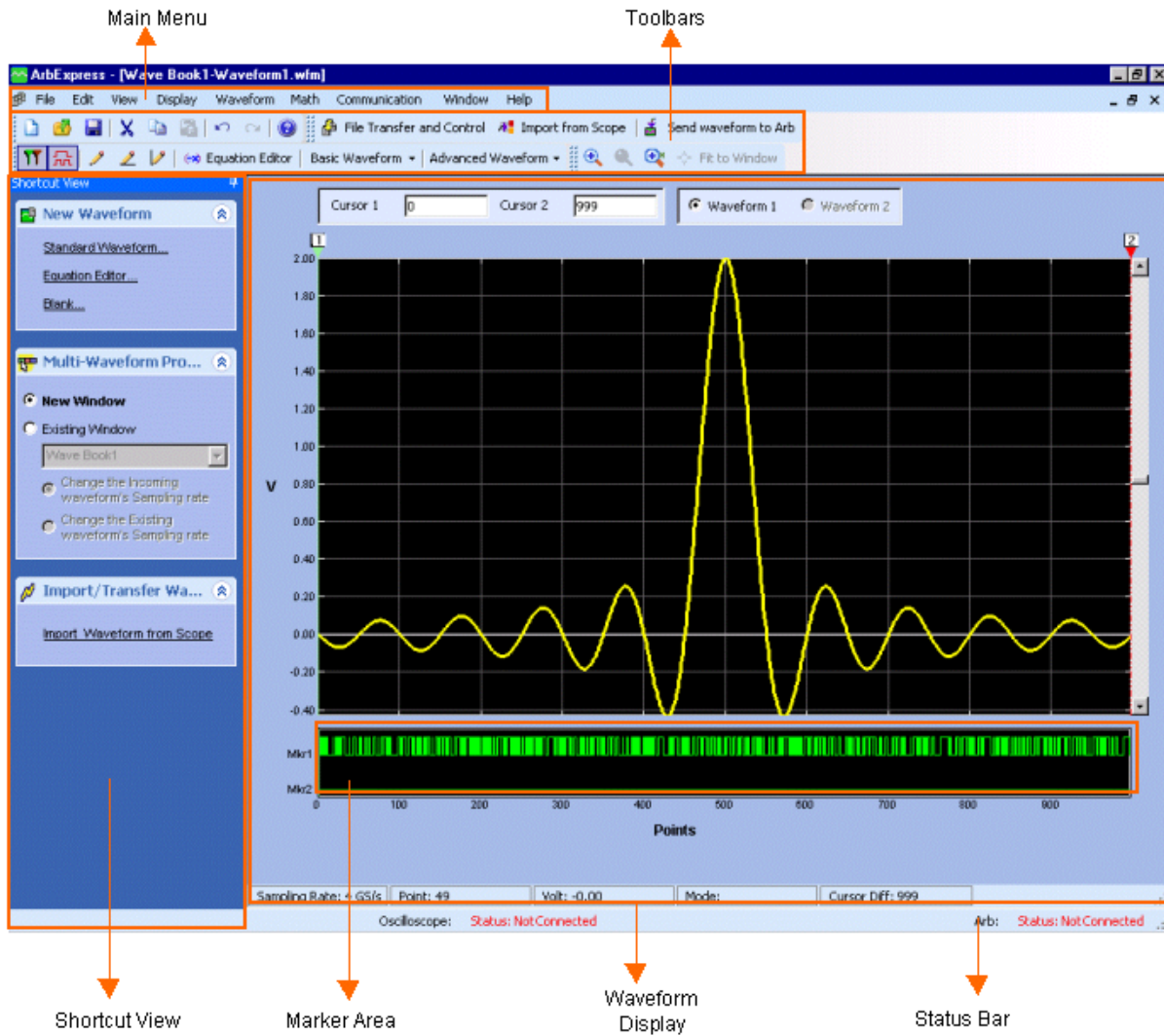
Figure 2-1: Application screen, menus, and toolbars

In the ArbExpress software, you can enter values in fields in different ways. For some fields, you have to directly type in the values, in some you have to select from a drop-down list, and in some 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, and m for milli.

File Name Extensions

The application uses these file name extensions to identify the file type. Table 2-1 lists the file name extensions.

Table 2-1: File name extensions and their descriptions

File name extensions	Description
.wfm	Oscilloscope waveform files AWG waveform files created by AWG400-700, and AWG-2000 series of waveform generators
.pat	AWG pattern format files
.csv	Comma separated variable files
.txt	Text files
.equ	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. Table 2-2 lists the default directory names.

Table 2-2: Application file names and directories

Directory	Function
C:\Program Files\Tektronix\ArbExpress\System	Stores the application files .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 (.equ)
C:\Program Files\Tektronix\ArbExpress\Samples\Tools\Matlab	Stores the sample MATLAB equation files (.m)

You can install ArbExpress in a directory of your choice.

Starting the Application

To start ArbExpress, you can

- Run the application from the Windows Start menu.
  Select Start > Programs > Tektronix ArbExpress> ArbExpress Application,
  or

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

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, .csv, and .txt,
extensions.

When more than one waveform is opened in a window, the active waveform is
displayed in a solid line type and the inactive waveform is displayed with a
dashed line type. You can select the active waveform by selecting Waveform 1 or
Waveform 2. You can set the cursor positions by entering the values in the
Cursor 1 and Cursor 2 fields.
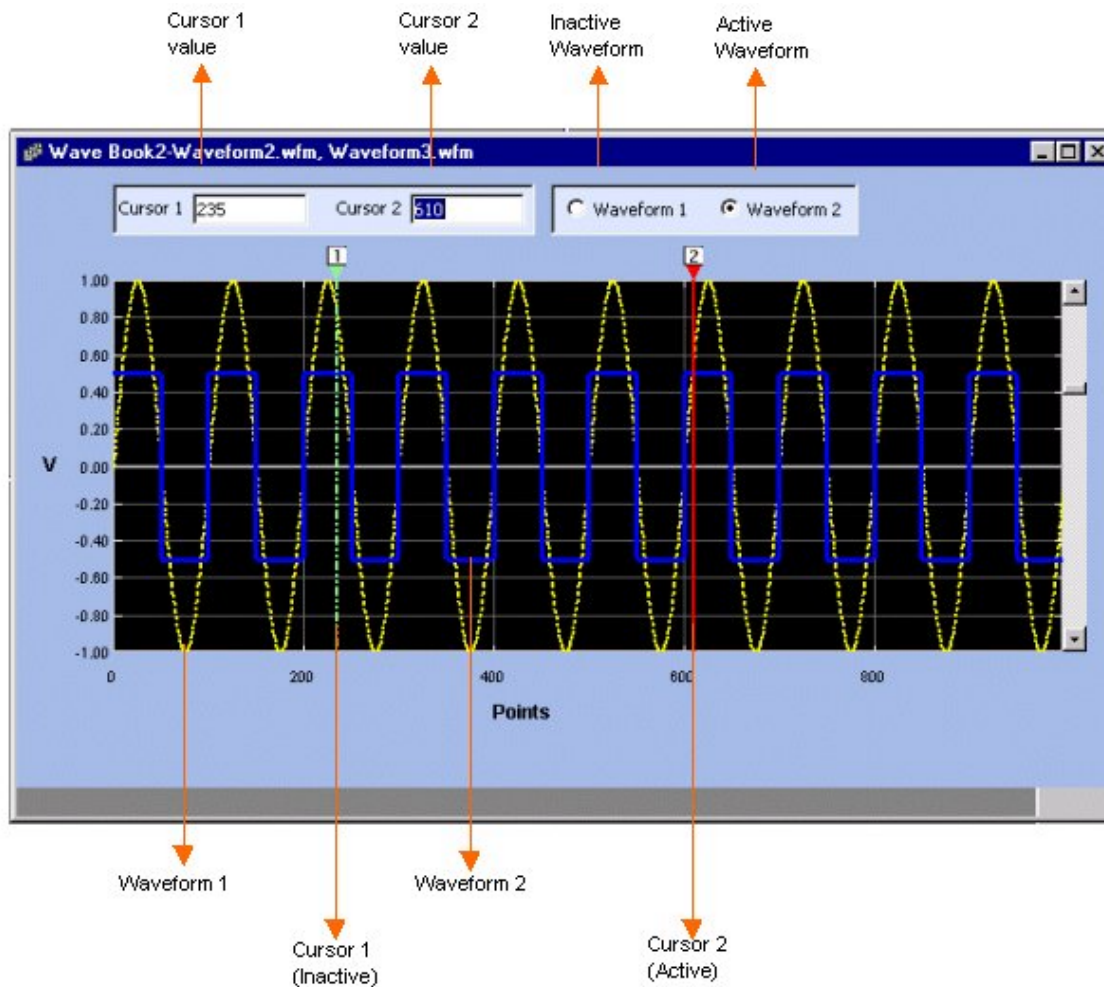
Figure 2-2: Waveform window

Creating a Waveform

File> New

To create a waveform, select File> New. You have three items to choose from:

- Blank Sheet, where you can open a blank sheet in a window

- Standard Waveform, which displays the Standard Waveform dialog box. Use the Standard Waveform to create any of the standard waveforms that are available.

- Equation Editor, which displays the Equation Editor dialog box. Use the Equation Editor to create a waveform or edit an existing waveform equation.

Saving a Waveform

File> Save/Save As

To save a waveform, select File> Save. Enter the file name in the Save dialog box to save the waveform.

To save a waveform under a different name, select File> Save As. Enter the file name in the Save As dialog box to save the waveform.

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.

Closing a Waveform

File> Close

To close a waveform, select File> Close. The application closes the current window. If the waveform is not saved, you are prompted to save the waveform. In a multiple waveform display, Close closes the active waveform.

Exiting the Application

File> Exit

Select File> Exit to exit the application. If you have not saved the waveforms, you are prompted to do so.

Shortcut Keys

You can use the following shortcut keys listed in Table 2-3 for the application commands.

Table 2–3: Shortcut keys

Menu item	Shortcut key
File> Open	Ctrl + O
File> Save	Ctrl + S
File> Exit	Ctrl + E
Edit> Undo	Ctrl + Z
Edit> Redo	Ctrl + Shift + Z
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

ArbExpress AXW100 Waveform Creation and Editing Tool

Operating Basics

Menus

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

Figure 3-1: ArbExpress main menu

When a waveform is open, the menu bar becomes:
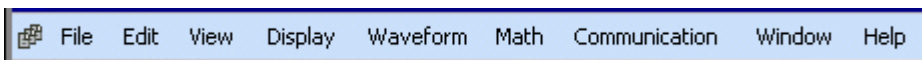
Figure 3-2: ArbExpress main menu when a waveform is open

File Menu
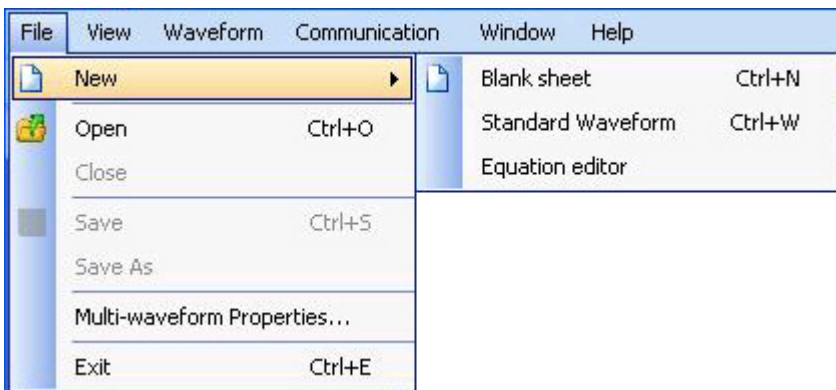
Figure 3-3: File menu

The File menu selections that are available are:

Table 3-1: File menu options and their descriptions

Menu selection	Description
New	Opens a blank waveform file (.wfm)
Open	Opens a waveform file (.wfm, .pat, .csv, .txt)
Close	Closes an open waveform file
Save	Saves changes to the currently open waveforms
Save As	Saves files to a different file name using the Save as dialog box (.wfm, .pat, .csv)
Multi-Waveform Properties...	Displays the properties of multiple waveforms

Table 3-1: File menu options and their descriptions

Menu selection	Description
Exit	Exits the application

Edit Menu

The Edit menu is visible only if a waveform window is open.

Figure 3-4: Edit menu

The Edit menu selections that are available are:

Table 3-2: Edit menu options and their descriptions

Menu selection	Description
Undo	Undoes the last operation performed on a waveform
Redo	Redoes the last operation performed on a waveform
Cut	Cuts the portion of a waveform that is between cursors
Copy	Copies the portion of a waveform that is between cursors
Paste	Displays the paste options allowing you to choose where to paste
Select All	Selects and copies the entire waveform into the memory
Copy to System Clipboard	Copies the waveform that can be pasted in Microsoft Excel or Microsoft Word
Copy as Bitmap	Copies the selected waveform window as a bitmap that can be pasted into Microsoft Word or Microsoft Excel
Invert	Inverts the portion of a waveform between the cursors
Mirror	Mirrors the portion of a waveform between the cursors
Freehand	Draws a waveform along the path you trace

Table 3-2: Edit menu options and their descriptions (Cont.)

Horizontal Draw	Allows drawing only horizontally
Vertical Draw	Allows drawing only vertically

View Menu

Figure 3-5: View menu

The View menu selections that are available are:

Table 3-3: View menu options and their descriptions

Menu selection	Description
Show/Hide Shortcut View	Displays and hides the shortcut view
Standard Toolbar	Displays and hides the standard toolbar
Waveform Toolbar	Displays and hides the waveform toolbar
Zoom Bar	Displays and hides the zoom toolbar
Instrument Bar	Displays and hides the instrument bar
Status Bar	Displays and hides the status bar

Display Menu

The Display menu is available only when a waveform is displayed in the window.
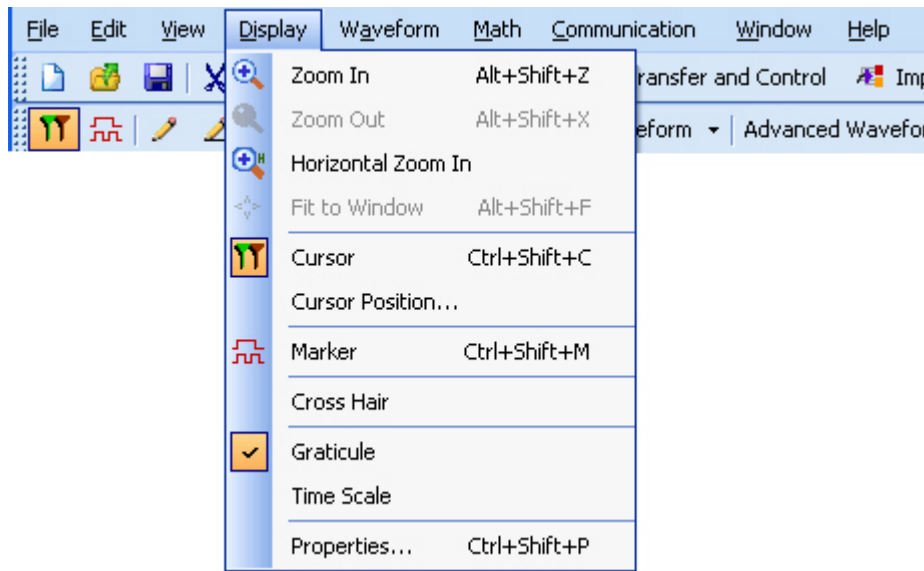
Figure 3-6: Display menu

The Display menu selections that are available are:

Table 3-4: Display menu options and their descriptions

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

Waveform Menu

Figure 3-7: Waveform menu

The Waveform menu selections that are available are:

Table 3–5: Waveform menu options and their descriptions

Menu selection	Description
Equation Editor...	Creates a waveform using the equation editor
Sine...	Creates a sine wave
Square...	Creates a square wave
Triangle...	Creates a triangular wave
Pulse...	Creates a pulse wave
Noise...	Creates a noise wave
Dc...	Creates a DC wave
Exponential Rise...	Creates a exponential rise wave
Exponential Decay...	Creates a exponential decay wave
Sinc...	Creates a sinc wave
Sweep...	Creates a sweep wave
Multi-Tone...	Creates a multi-tone wave
Lorentz...	Creates a Lorentz wav
Preferences...	Sets the waveform preferences
Waveform Properties...	Displays the waveform properties

Math Menu

The Math menu is available only when a waveform window is open.
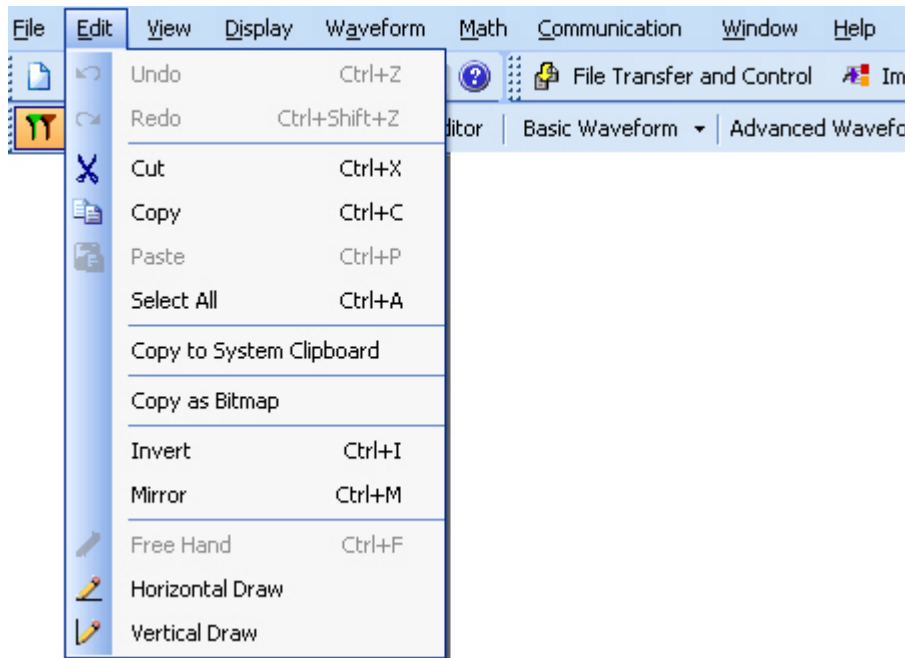

Figure 3–8: Math menu

The Math menu selections that are available are:

Table 3-6: Math menu options and their descriptions

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)
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	Scales the waveform signal value to a ±1.0 range, with 0 as the center

Communication Menu
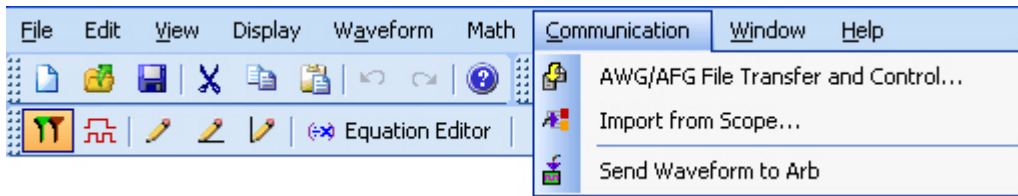
Figure 3-9: Communication menu

The Communication menu selections that are available are:

Table 3-7: Communication menu options and their descriptions

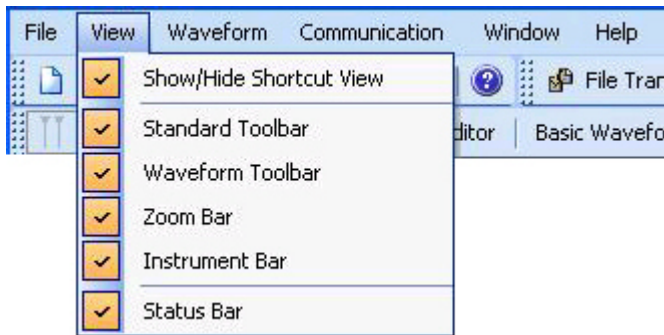| Menu selection	Description
AWG/AFG File Transfer...	Connects and transfers files to and from an arbitrary waveform or function generator and allows you to change instrument parameters like clock frequency, voltage, offset and others of the instrument connected
Import from Scope...	Connects and acquires a waveform from an oscilloscope
Send Waveform to Arb	Sends the waveform to a connected AWG/AFG

Window Menu
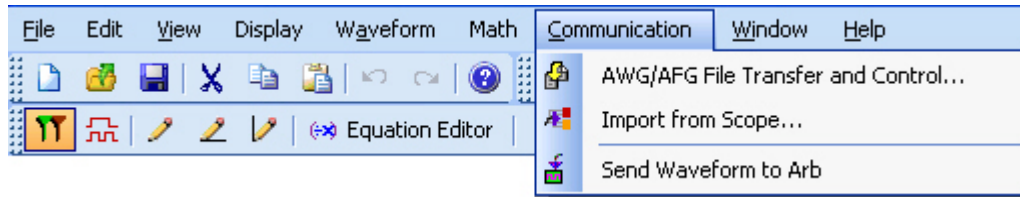
Figure 3-10: Window menu

The Window menu selections that are available are:

Table 3-8: Window menu options and their descriptions

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

Help Menu

The Help menu is always visible.
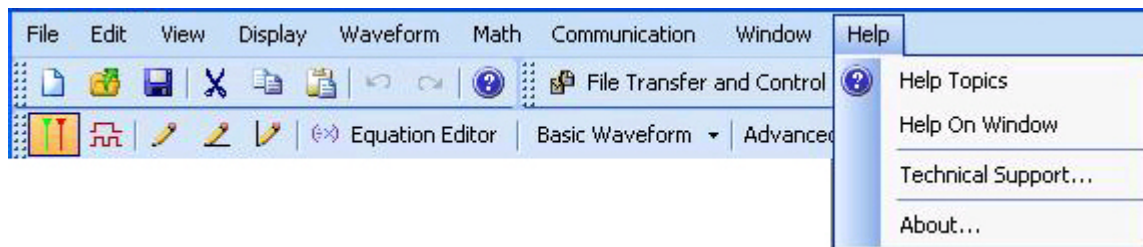
Figure 3-11: Help menu

The Help menu selections that are available are:

Table 3-9: Help menu options and their descriptions

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

Use Shortcut Menu for Waveforms

You can view the shortcut menu by a right-clicking inside an open waveform window.
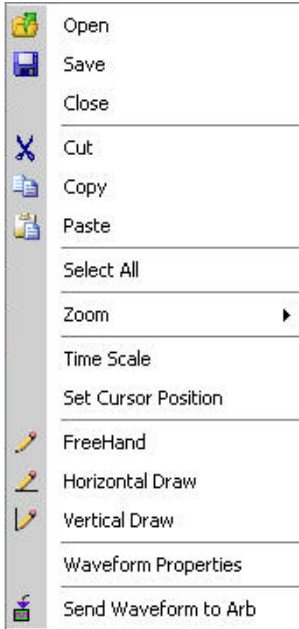
Figure 3–12: Shortcut menu

The shortcut menu has the following options:

Table 3–10: Shortcut menu options and their descriptions

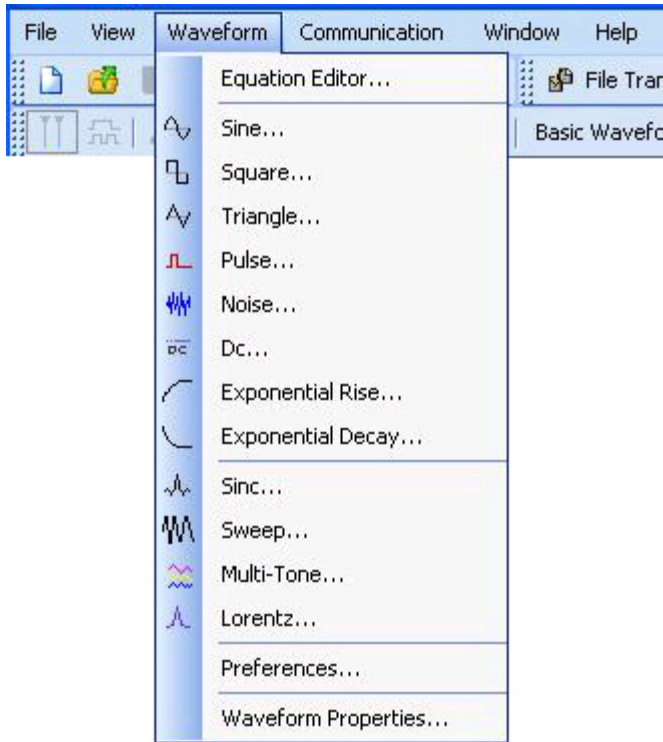| Menu selection	Description
Open	Opens a waveform file (.wfm, .pat, .csv, .txt)
Save	Saves the currently selected waveform
Close	Closes the currently selected waveform
Cut	Cuts the portion of a waveform that is between cursors
Copy	Copies the portion of a waveform that is between cursors
Paste	Displays the paste options allowing you to choose where to paste
Select All	Selects and copies the entire waveform into the memory
Zoom	Opens a submenu with options to zoom in, zoom out, and Fit to Window
Time Scale	Displays the waveform with time as the X-axis and voltage along the Y-axis
Set Cursor Position	Positions the cursor exactly at the points or time specified
Freehand	Draws a waveform along the path you trace
Horizontal Draw	Allows drawing only horizontally
Vertical Draw	Allows drawing only vertically
Waveform Properties	Displays the properties color, line style, line width, and cursor colors of the selected waveform
Send Waveform to Arb	Sends the waveform to the connected instrument

Toolbars

Standard Toolbar

View> Standard Toolbar

Enable the standard toolbar by selecting it from the View menu. The standard 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—New blank waveform, Open existing waveform, Save the waveform, Cut waveform between cursors, Copy waveform between cursors, Paste waveform, Undo, Redo, and Help.
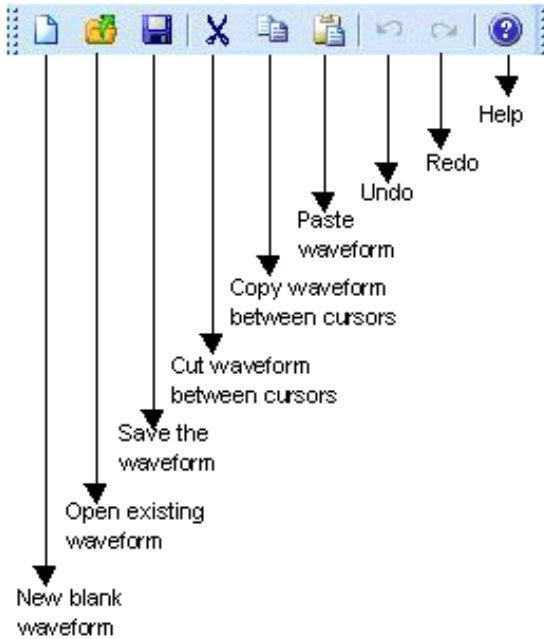
Figure 3–13: Standard toolbar

Waveform Toolbar

View> Waveform Toolbar

Enable the waveform toolbar by selecting it from the View menu.
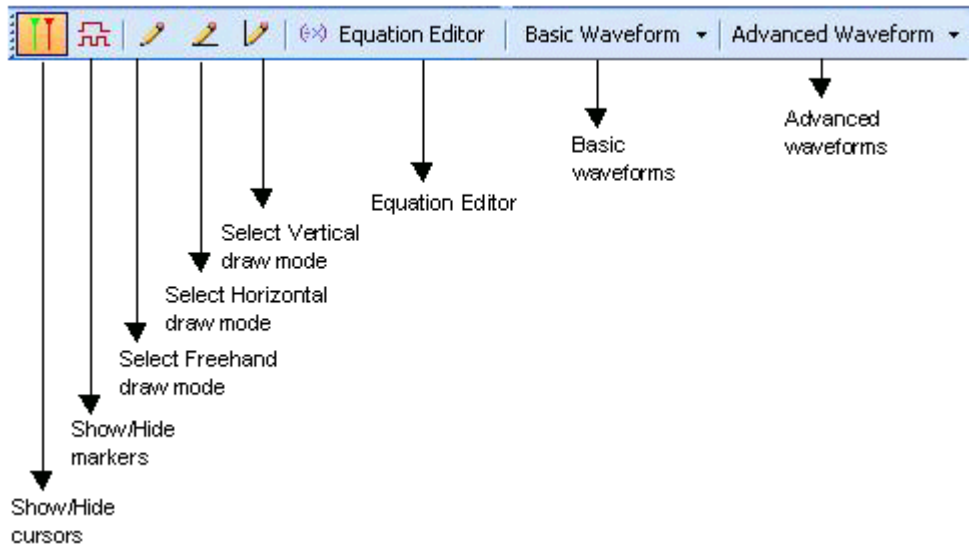
Figure 3–14: Waveform toolbar

The waveform toolbar, by default displayed 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, and Advanced Waveform.

Zoom Bar

View> Zoom Bar

Enable the zoom bar by selecting it from the View menu.
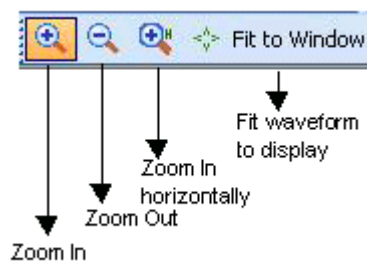
Figure 3–15: Zoom toolbar

The zoom toolbar, by default displayed 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.

Instrument Bar

View> Instrument Toolbar

Enable the instrument toolbar by selecting it from the View menu.
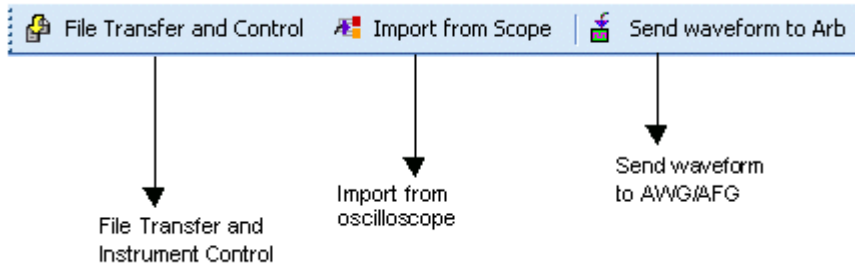
Figure 3-16: Instrument toolbar

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, Import from Scope, and Send Waveform to Arb.

Status Bar

View> Status Bar

Enable the Status Bar by selecting it from the View menu.

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.

Figure 3-17: Application status bar

The Waveform status bar displays the sampling rate, points, signal voltage, editing mode, and cursor difference. When viewing 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 the draw mode, the voltage readout is the actual vertical height of the draw pointer.
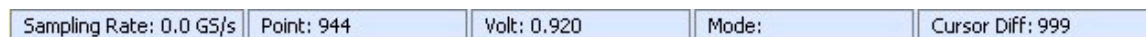
Figure 3-18: Waveform status bar

ArbExpress AXW100 Waveform Creation and Editing Tool

Shortcut View

The Shortcut View occupies the left part of the display. You can keep the shortcut view open by pushing the pin on the top right corner of the panel.
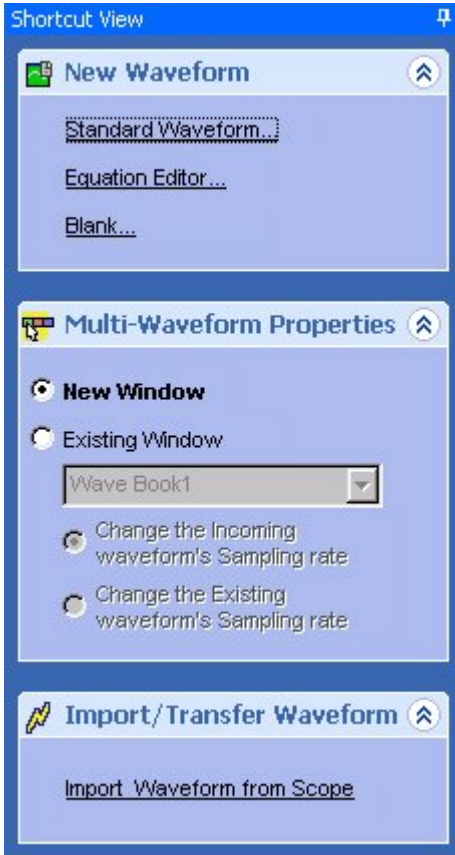
Figure 3-19: Shortcut View

The shortcut panel view shows the following selections:

Table 3-11: Shortcut View options and their descriptions

Menu selection	Description
New Waveform	Allows you to create a new or blank waveform, standard waveform, or a new equation
Multi-Waveform Properties	Allows you to create a new waveform in new window or create a new waveform in existing window. It also allows you to open a existing waveform in either a new window or an existing window
Import/Transfer Waveform	Allows you to acquire or import waveform from an oscilloscope

You can show or hide each selection in the shortcut panel by pressing the double arrow at the top right corner of each panel.

New Waveform View

View> Shortcut View

Enable the Shortcut View by selecting it from the View menu. Use the New Waveform panel in the Shortcut View to create a standard waveform, a waveform using the equation editor, or a blank waveform.

Figure 3-20: New Waveform View

You can create a standard waveform, a waveform using the equation editor, or a blank waveform. You can display a maximum of two waveforms in a single window.

Table 3-12: New Waveform View options and their descriptions

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

Multi-Waveform Properties

View> Shortcut View

Enable the Shortcut View by selecting it from the View menu. Use the Window Properties panel in the Shortcut View to select the window for opening a new or an 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 present in the panel.
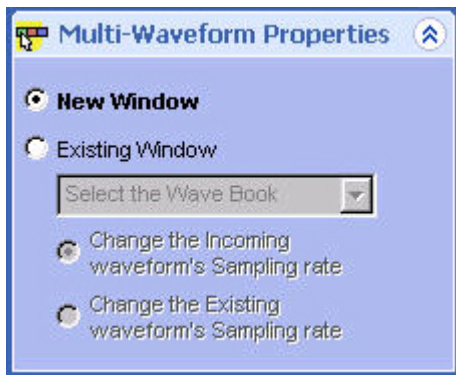
Figure 3–21: Multi-waveform Properties

If you want 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 the option Change the Incoming waveforms sampling rate, to change the sampling rate of the new waveform to match that of the existing waveform. Or, select the option 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

Enable the Shortcut View by selecting it from the View menu. Use the Import/Acquire Waveform panel in the Shortcut View to import a waveform from a file or acquire it from an oscilloscope.

Figure 3–22: Import/Transfer Waveform from Oscilloscope

Dialog Boxes

Most of the ArbExpress application dialog boxes have a help topic associated with them. To display descriptions for the dialog boxes, display the dialog box and click the Help button.

For help on specific dialog boxes, display the Contents for this help file, and then click the following book icons to display links to specific dialog boxes: Operating Basics> Dialog Boxes.

Multi-Waveform Properties Dialog Box

File> Multi-Waveform Properties

Use this dialog box to set up the window in which to display the waveforms.

Table 3–13: Multi-Waveform Properties options and their descriptions

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's clock to match the clock of the existing waveform
Change the existing waveform's clock	Changes the existing waveform's clock to match the incoming or new waveform's clock

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 Waveform 1 or Waveform 2 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 in a dotted line.

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 will be prompted with the message "Only two waveforms can be opened or created in a Wave Book".

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

Paste Option Dialog Box

Edit> Paste

Use this dialog box to paste the copied portion of the waveform. You can select any of the following Paste options.

Table 3-14: Paste options and their descriptions

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
Always paste between cursors	If checked, always pastes the copied contents the between the cursors

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.

Cursor Position Dialog Box

Display> Cursor Position

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

Table 3-15: Cursor Position options and their descriptions

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.

Table 3–16: Display Properties options and their descriptions

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 is displayed with a dashed line style and the active waveform is displayed with a solid line style.

Equation Editor Dialog Box

Waveform> Equation Editor

Use this dialog box to create a waveform using the Equation Editor. You can set the following parameters in the Equation Editor dialog box.

Table 3–17: Equation Editor options and their descriptions

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 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 that are provided. Use the other toolbar icons to perform operations like Close, Cut, Copy, and Paste.
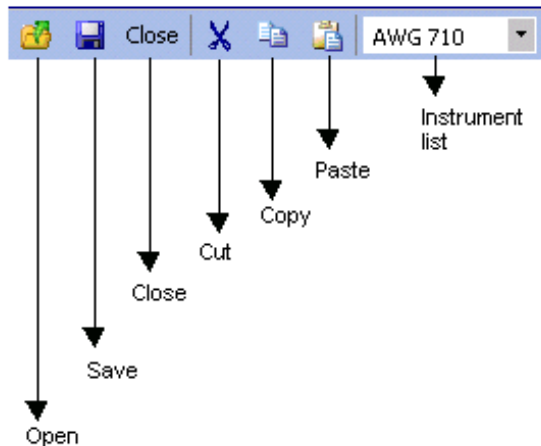
Figure 3-23: Equation Editor toolbar

You can create an equation by:

- 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) 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. Once 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.

Click the Compile button to compile the equation. 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 application supports the AWG2000 equation editor model. Equations created using the equation editor cannot be used on the AWG400 through AWG700 series waveform generators.

Sine Wave Dialog Box

File> New> Standard Waveform

Use this dialog box to create a sine waveform. You can set the following parameters in the Standard Waveform dialog box.

Table 3–18: Sine Wave options and their descriptions

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 the frequency in Hertz. 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.
Lock Frequency	You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency.

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3-19: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a square waveform. You can set the following parameters in the Standard Waveform dialog box:

Table 3-20: Square Wave options and their descriptions

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 the frequency in Hertz. 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.
Lock Frequency	You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency
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 in seconds
Ramp	Select Ramp
Sine^2	Select Sine^2

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your

current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3–21: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a triangle waveform. You can set the following parameters in the Standard Waveform dialog box:

Table 3–22: Triangle Wave options and their descriptions

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 the frequency in Hertz. 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.
Lock Frequency	You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency.

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3–23: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a pulse waveform. You can set the following parameters in the Standard Waveform dialog box:

Table 3–24: Pulse Wave options and their descriptions

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 the frequency in Hertz. 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.
Lock Frequency	You can lock the desired frequency and adjust either the Samples per Second or the Points per Cycle to achieve the frequency
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

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3–25: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a noise waveform. You can set the following parameters in the Standard Waveform dialog box. The Noise waveform does not have any advanced options.

Table 3-26: Noise Wave options and their descriptions

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

Click the Preview button to preview the waveform, the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3-27: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to the waveform to achieve the minimum number of points.

Table 3–27: Waveform padding options (Cont.)

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> New> Standard Waveform

Use this dialog box to create a DC waveform. You can set the following parameters in the Standard Waveform dialog box. The DC waveform does not have any advanced options.

Table 3–28: DC Wave options and their descriptions

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
Total Number of Points	Enter the total number of points in the waveform

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected. If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click Preview:

Table 3-29: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create an exponential rise waveform. You can set the following parameters in the Standard Waveform dialog box. The Exponential Rise waveform does not have any advanced options.

Table 3-30: Exponential Rise Wave options and their descriptions

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

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3–31: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create an exponential decay waveform. You can set the following parameters in the Standard Waveform dialog box. The Exponential Decay waveform does not have any advanced options.

Table 3–32: Exponential Decay Wave options and their descriptions

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

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3–33: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a Sinc waveform. You can set the following parameters in the Standard Waveform dialog box. The Sinc waveform does not have any advanced options.

Table 3–34: Sinc Wave options and their descriptions

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

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected. If the number of points is fewer than the number of points supported by the instrument, the following options appear when you click Preview:

Table 3–35: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to the waveform to achieve the minimum number of points.

Table 3–35: Waveform padding options (Cont)

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> New> Standard Waveform

Use this dialog box to create a Sweep waveform. You can set the following parameters in the Standard Waveform dialog box. The Sweep waveform does not have any advanced options.

Table 3–36: Sweep Wave options and their descriptions

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
Sampling Rate	Enter the sampling rate for the waveform

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3–37: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a Multi-Tone waveform. You can set the following parameters in the Standard Waveform dialog box. The Multi-Tone waveform does not have any advanced options.

Table 3–38: Multi-tone Wave options and their descriptions

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
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

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3-39: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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> New> Standard Waveform

Use this dialog box to create a Lorentz waveform. You can set the following parameters in the Standard Waveform dialog box. The Lorentz waveform does not have any advanced options.

Table 3-40: Lorentz Wave options and their descriptions

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 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
Delay	Enter the delay in seconds
Half Width	Enter the half width

Click the Preview button to preview the waveform, click the Default button to restore the default values for the waveform, click the OK button to save your current values and create the waveform, and click the Send to Arb button to send the waveform directly to an arbitrary waveform or function generator that is connected. Send to Arb is enabled only when an instrument (AWG or AFG) is connected.

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

Table 3-41: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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.

Preferences Dialog Box

Waveform> Preferences

Use this dialog box to set preferences for a waveform. You can select any of the following preferences.

Table 3-42: Preferences options and their descriptions

Option	Description
Save .set file along with .wfm and .pat files	Saves the settings file along with the waveform and pattern files. The .set file contains the voltage and offset of the waveform. Enable this before creating a waveform.
Normalize before saving the file	Normalizes the waveform before saving it. The waveform amplitude is set between −1 and +1 before the waveform is saved.
Show paste option before pasting	Displays the Paste option dialog box before pasting the contents.

Waveform Properties Dialog Box

Waveform> Waveform Properties

Use this dialog box to view and modify the properties of the selected waveform. For multiple waveform display, choose the waveform by selecting the Waveform 1 or Waveform 2 button located just above the waveform display.

Table 3-43: Waveform Properties options and their descriptions

Option	Description
Instrument	Select the instrument from the list
Number of Points	Displays the number of points of the selected waveform. You can change this to suit the requirements of the target instrument

Table 3-43: Waveform Properties options and their descriptions

Sampling Rate	Displays the sampling rate of the selected waveform. You can change this to suit the requirements of the target instrument

Save the waveform by selecting **File> Save** or **File> Save As**.

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.

Table 3-44: File Transfer and Instrument Control options and their descriptions

Option	Description
Instrument List	Lists the instruments that can be connected
Instrument Folders	Lists the folders on the instrument's hard disk drive
Instrument Files	Lists the files in the folder selected on the instrument's hard disk
PC Folders	Lists the folders on the PC's hard disk drive
PC Files	Lists the files in the folder selected on the PC's hard disk
Instrument Control	
Channel	Selects the channel that you want to control
Output ON	Turns the output on or off
Load File to AWG	Select the source folder from the instrument folder list. Enter or select the file to load. You can drag and drop the file from the Instrument's file list and the file name automatically appears here
Vertical	Control the vertical parameters
Filter	Lists the filters available that you can select from. Use this to filter frequencies greater than the value specified.
Voltage	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
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

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.

Table 3–45: Waveform Math options and their descriptions

Option	Description
Waveform Library	
Select the waveform	Select a standard waveform from the list. 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. Select one or more file type to show: .wfm, .pat, .csv, .txt, *.*. The default filter type is *.*.

Click the Default button to restore the default file type.

Click the Enable button to enable the Filter On/Off button. If the filter is set to On, then clicking the Enable button does not change anything.

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.

Instrument Properties Dialog Box

Communication> File Transfer>

Use this dialog box to view the instrument properties.

Table 3–46: Instrument Properties options and their descriptions

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 only TDS1000, TDS2000 and TDS3000 families of oscilloscopes. The following steps describe how to use this dialog.

Before connecting

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

Connecting to an Oscilloscope

The Scope list shows the list of oscilloscopes available to connect to. 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. 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's current record length is the same as the Ref waveform's record length.

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

- On/Off

- Record length (only when connected to TDS3000 family of oscilloscopes)

- Acquisition mode (supports sample, peak detect, and average modes)

- Single sequence or continuous mode

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 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.

Table 3-47: Set Pattern options and their descriptions

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	Type the pattern. Use characters 0 – 9 and A – F to create a hexadecimal pattern, and 0 and 1 to create a binary pattern.

How to ...

Create Waveforms

Using the 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.
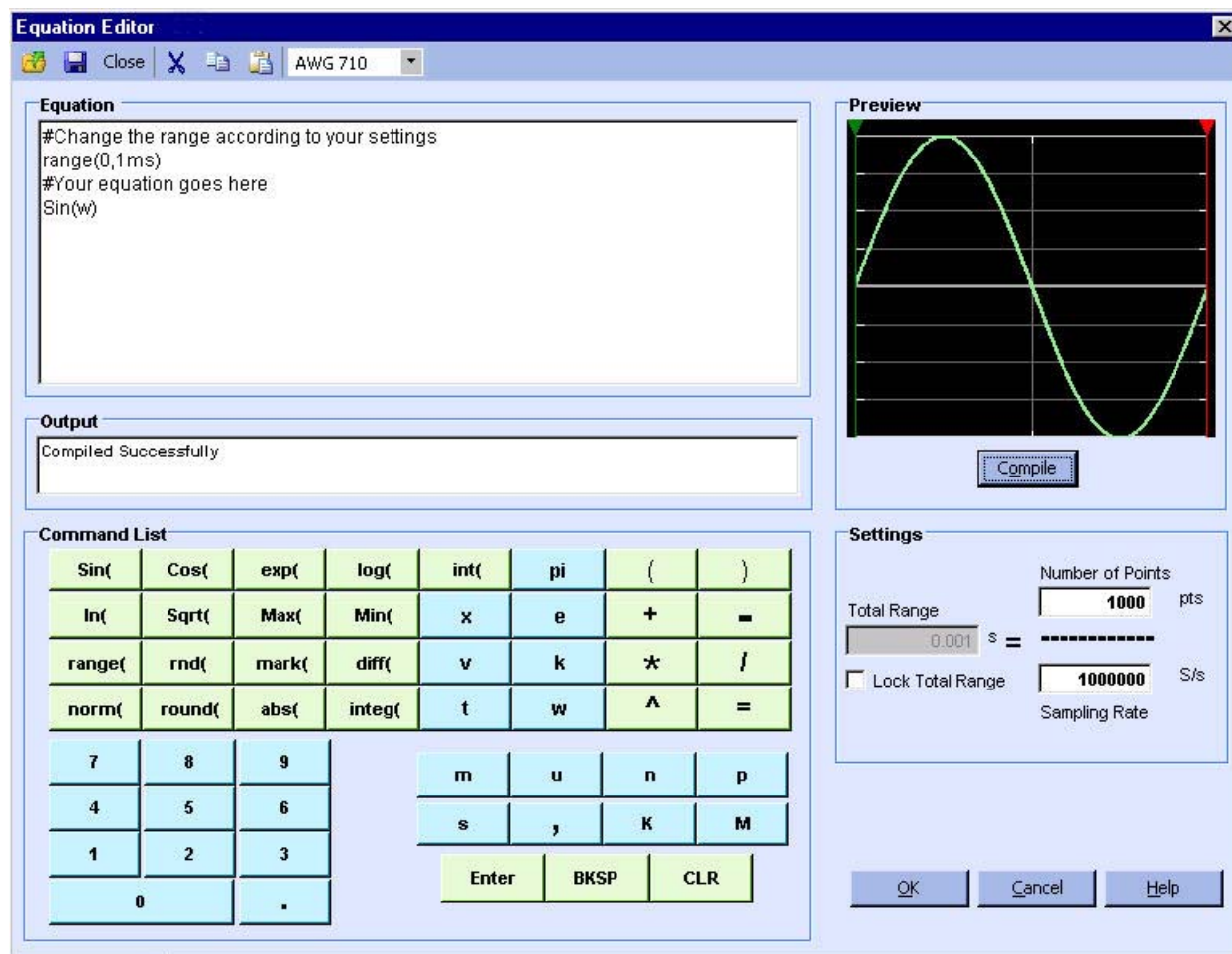

Figure 4-1: Equation Editor main screen

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
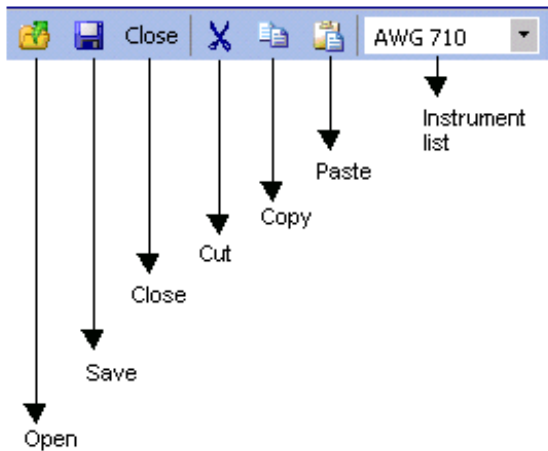
Figure 4–2: Equation Editor toolbar

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, follow these steps:

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, follow these steps:

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

ArbExpress AXW100 Waveform Creation and Editing Tool

Sampling Rate. Once you set the Total Range, you can lock it and change the Number of Points or the Sampling Rate.

If the total range defined in the equation is less than the total range in Settings, the equation will fail to compile. The output pane will display a message and the error.
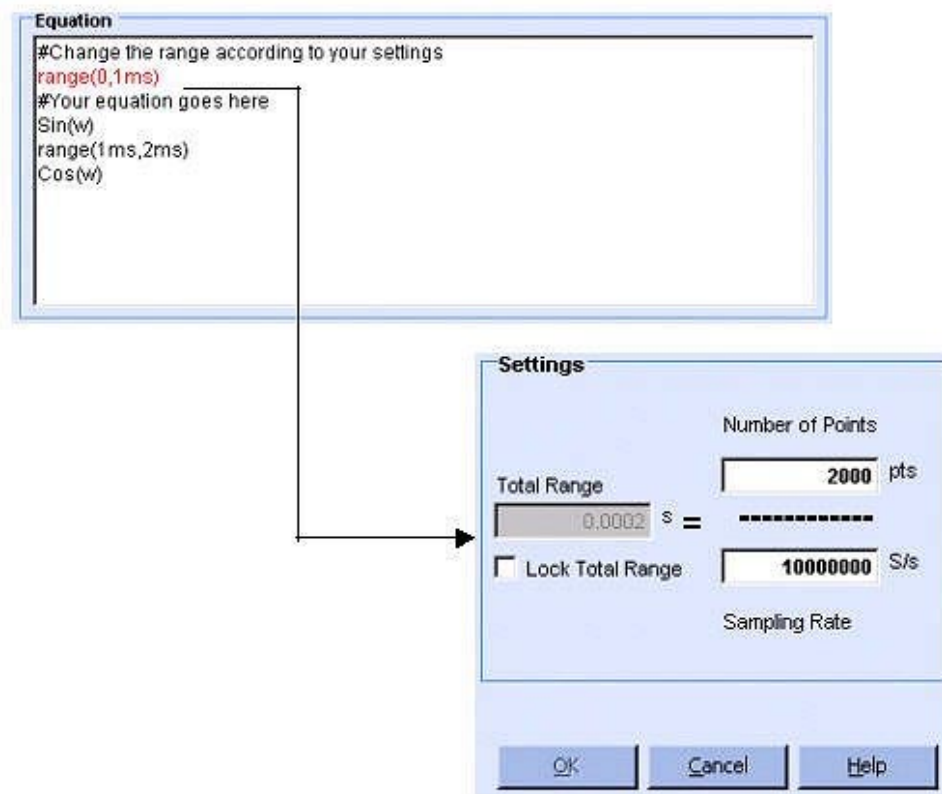
Figure 4-3: Example of error while compiling and equation

If the number of points specified in the Settings is more than the range specified in the equation, then the available extra points will have the value zero.
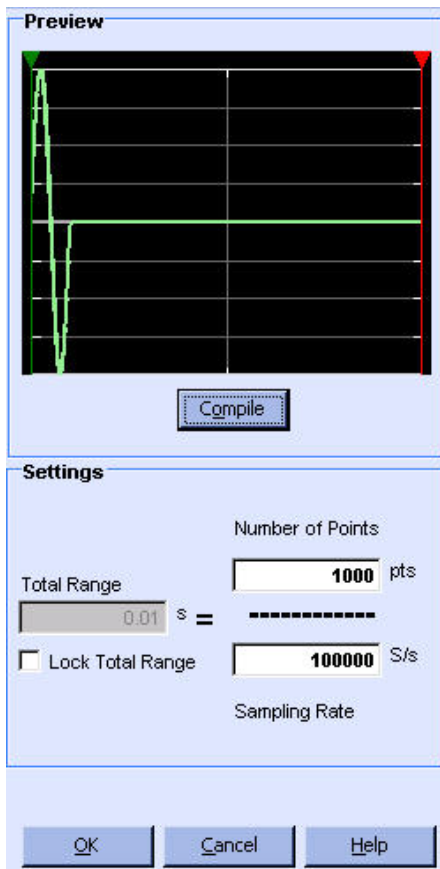
Figure 4-4: Waveform padded with zeros

5. Click Compile. The compiled equation is displayed in Preview. The compilation status and messages are displayed in Output. Only if the compilation is successful, you can click OK.

The application supports the AWG2000 equation editor model and follows the same syntax. Equations created using the equation editor cannot be used on the AWG400 through AWG700 series waveform generators.

Sine Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
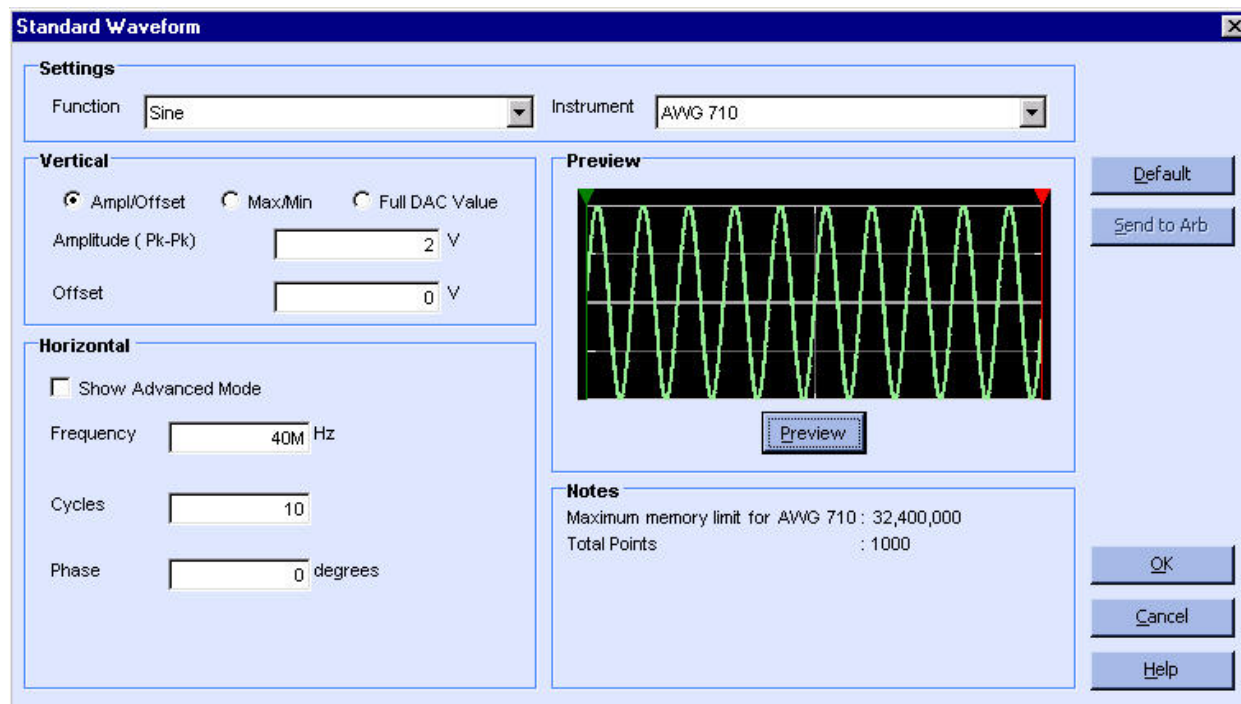
Figure 4-5: Creating a Sine wave

To create a sine wave, follow these steps:

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

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

   a. 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.

   If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

   b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

   c. 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 the Advanced option to show advanced parameter options for the sine wave.

4. If you have chosen the Advanced option, you can set the Frequency as the number of samples per second divided by the number of points per cycle. Select the Lock Frequency check box to lock the frequency and vary only the Samples per second, or the Points per Cycle.

Horizontal

☑ Show Advanced Mode

Samples/sec
4G

Frequency   40M Hz =

☐ Lock Frequency
100

Cycles   10   Points/Cycle

Phase   0 degrees
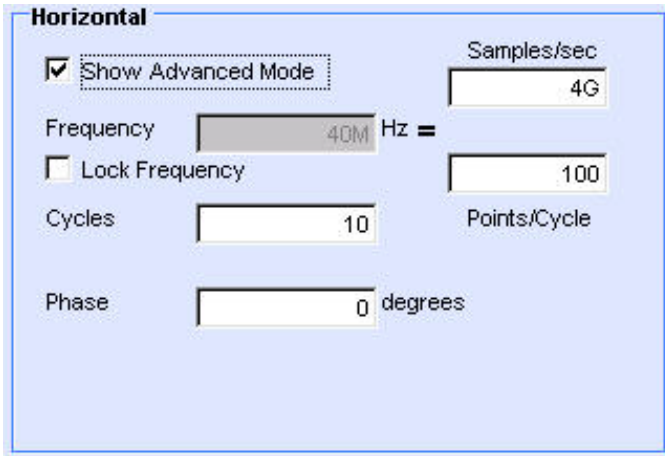
Figure 4-6: Advanced options for a Sine wave

5. Click the Preview button, under 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.

Notes

Maximum Points : 32,400,000   Minimum Points : 960
Total Points   : 100

◉ Manually change 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
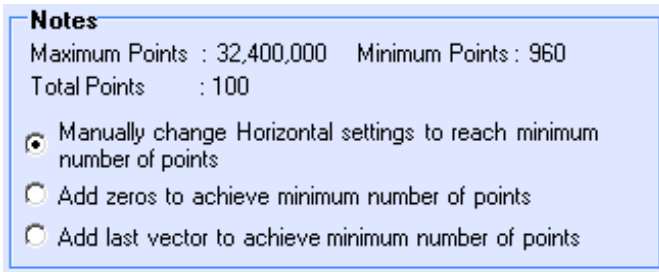
Figure 4-7: Waveform padding options

Table 4-1: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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.

To display the waveform in a new or an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Square Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
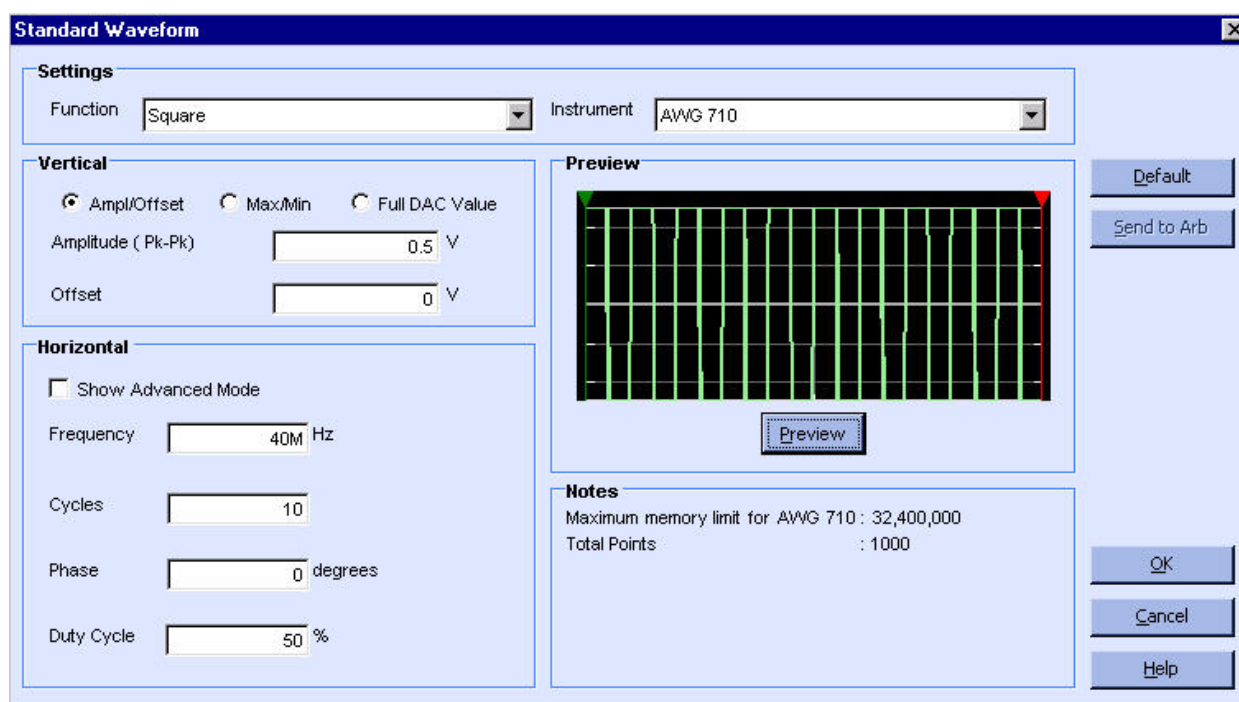
Figure 4-8: Creating a Square wave

To create a square wave, follow these steps:

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:

a. Amp/Offset to enter the Amplitude (Pk-Pk) and Offset in volts. The amplitude specifies the amplitude of the waveform (along the Y-axis)

ArbExpress AXW100 Waveform Creation and Editing Tool **67**

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.

If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

c. 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 the Advanced option to show advanced parameter options for the square wave.

4. If you have selected the Advanced option, you can set the Frequency as the number of samples per second divided by the number of points per cycle. Select the Lock Frequency check box to lock the frequency and vary only the Samples per second, or the Points per Cycle. Another pane titled Transitions (10%-90%) appears.

a. Set the number of points for Rise Time and select rise type to Ramp or $Sine^2$.

b. Set the number of points for Fall Time and the fall type to Ramp or $Sine^2$.

Figure 4-9: Advanced options for a Square wave

5. Click the Preview button, under 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.
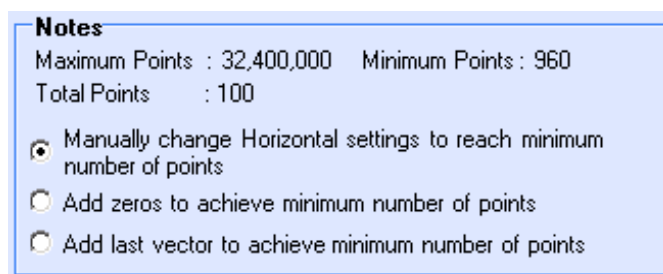
Figure 4–10: Waveform padding options

Table 4–2: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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.

To display the waveform in a new or an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Triangle Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
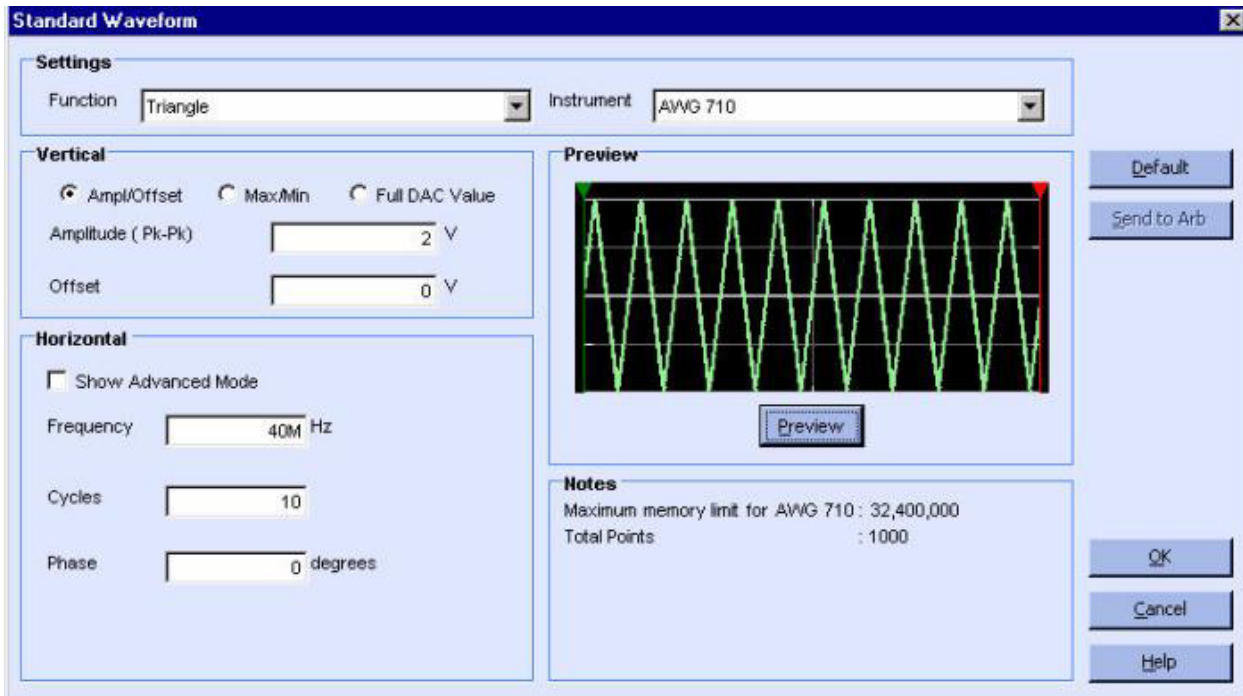
Figure 4-11: Creating a Triangle wave

To create a triangular wave, follow these steps:

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

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

    a. 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.

    If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

    b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

    c. 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 the Advanced option to show advanced parameter options for the triangle wave. Select the Lock Frequency check box to lock the frequency and vary only the Samples per second, or the Points per Cycle.
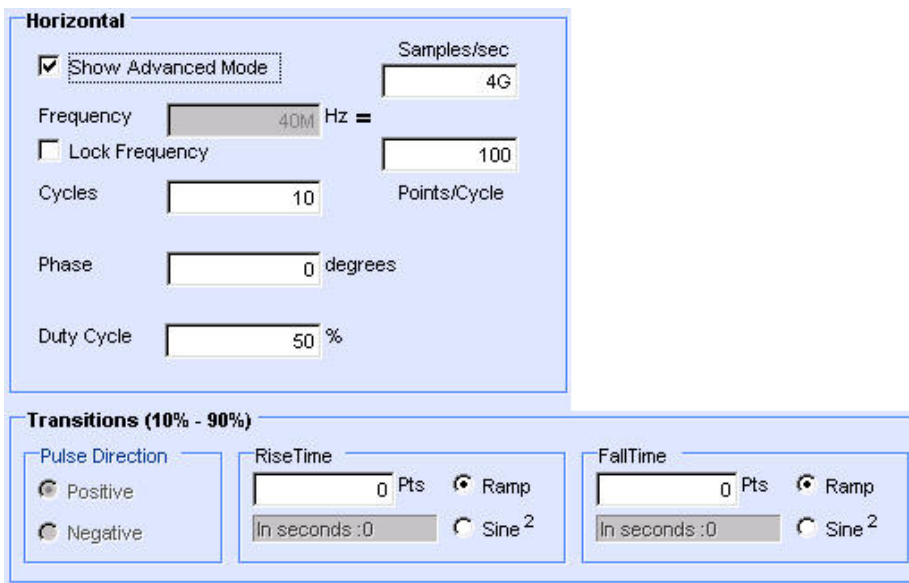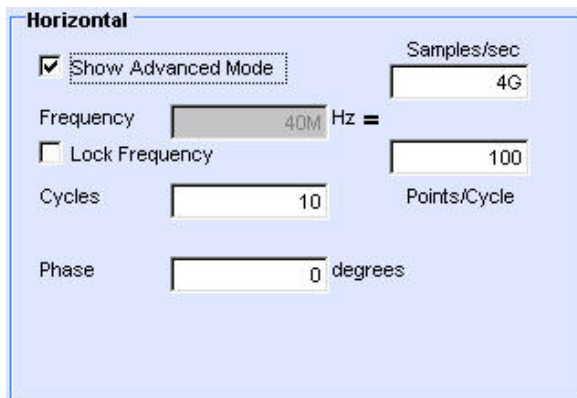
Figure 4–12: Advanced options for a Triangle wave

4. Click the Preview button, under 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.

Figure 4–13: Waveform padding options

Table 4–3: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Pulse Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
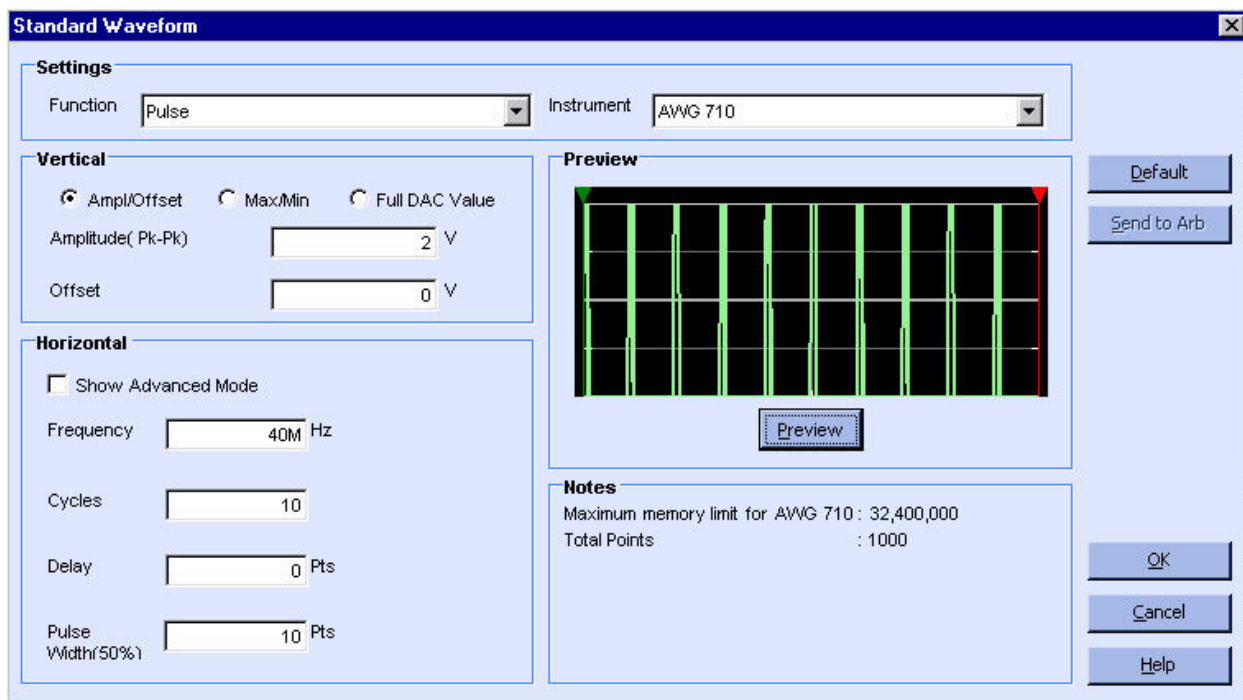
Figure 4–14: Creating a Pulse wave

To create a pulse wave, follow these steps:

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:

    a. 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.

If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

   b.   Max/Min to enter the Maximum and Minimum voltage values for the waveform.

   c.   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 the Advanced option to show advanced parameter options for the pulse wave. Select the Lock Frequency check box to lock the frequency and vary only the Samples per second, or the Points per Cycle.

**4.**   If you have chosen the Advanced option, another pane titled Transitions (10%-90%) appears.

   a.   Set the Pulse Direction to Positive or Negative.

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

   c.   Set the number of points for Fall Time and the fall type to Ramp or Sine^2.

Figure 4–15: Advanced options for a Pulse wave

5.   Click the Preview button, under 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.
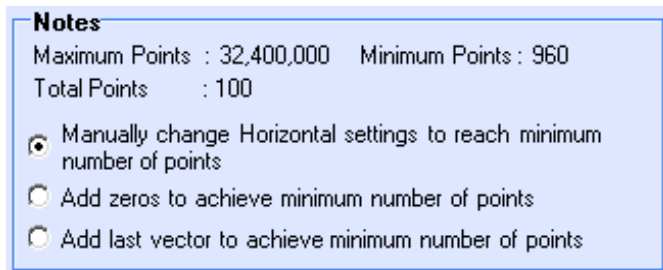
ArbExpress AXW100 Waveform Creation and Editing Tool   **73**

Figure 4-16: Waveform padding options

Table 4-4: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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.

To display the waveform in a new or an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Noise Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
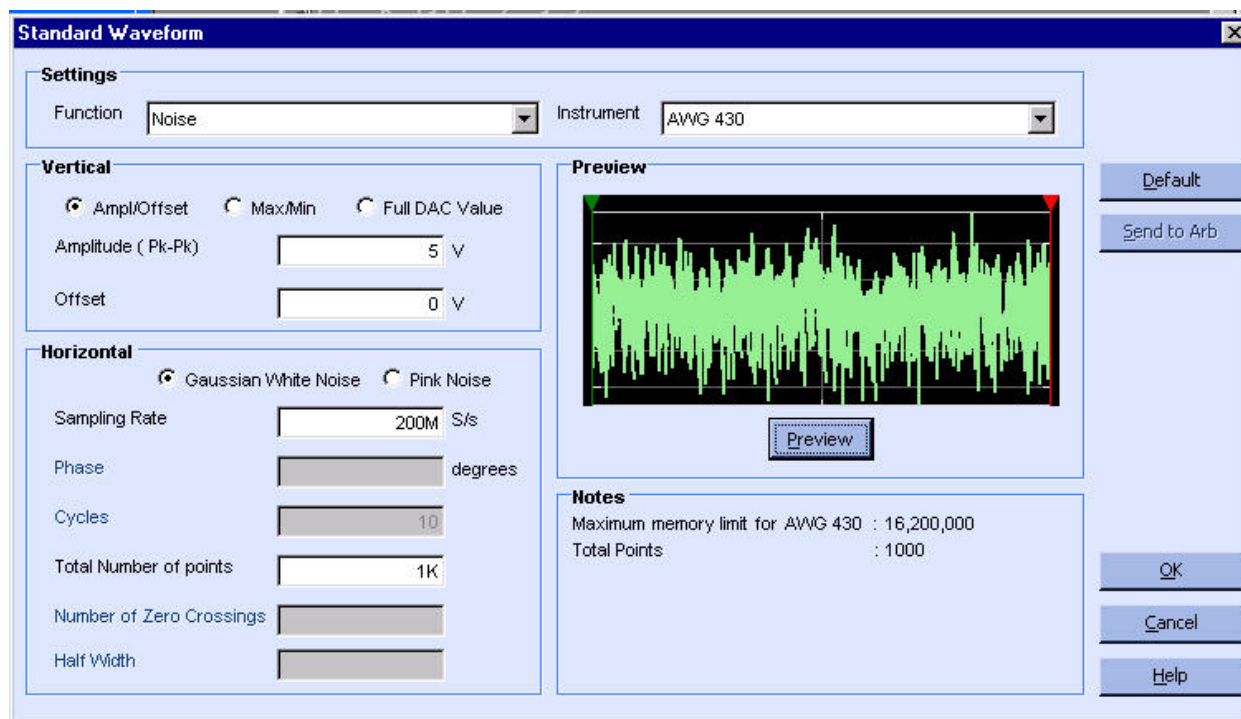
Figure 4-17: Creating a Noise wave

To create a noise wave, follow these steps:

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:

a. 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.

If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

c. 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.

4. Click the Preview button, under Preview, to view the waveform.

The following figures show a preview of the Gaussian White Noise and Pink Noise waveforms.
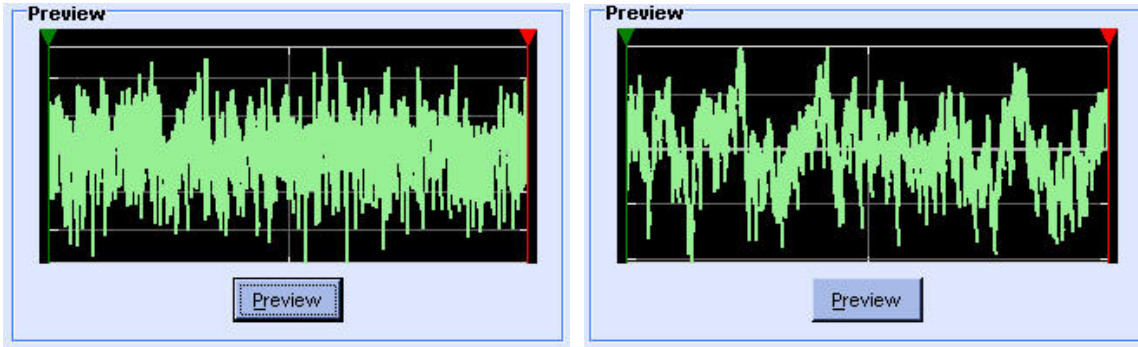
Figure 4–18: Examples of Gaussian White Noise and Pink Noise waveforms

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

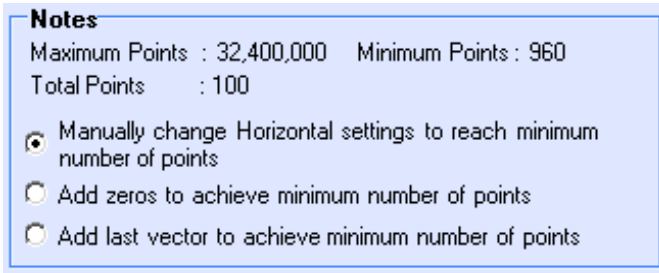**Figure 4–19: Waveform padding options**

Table 4–5: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

DC Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
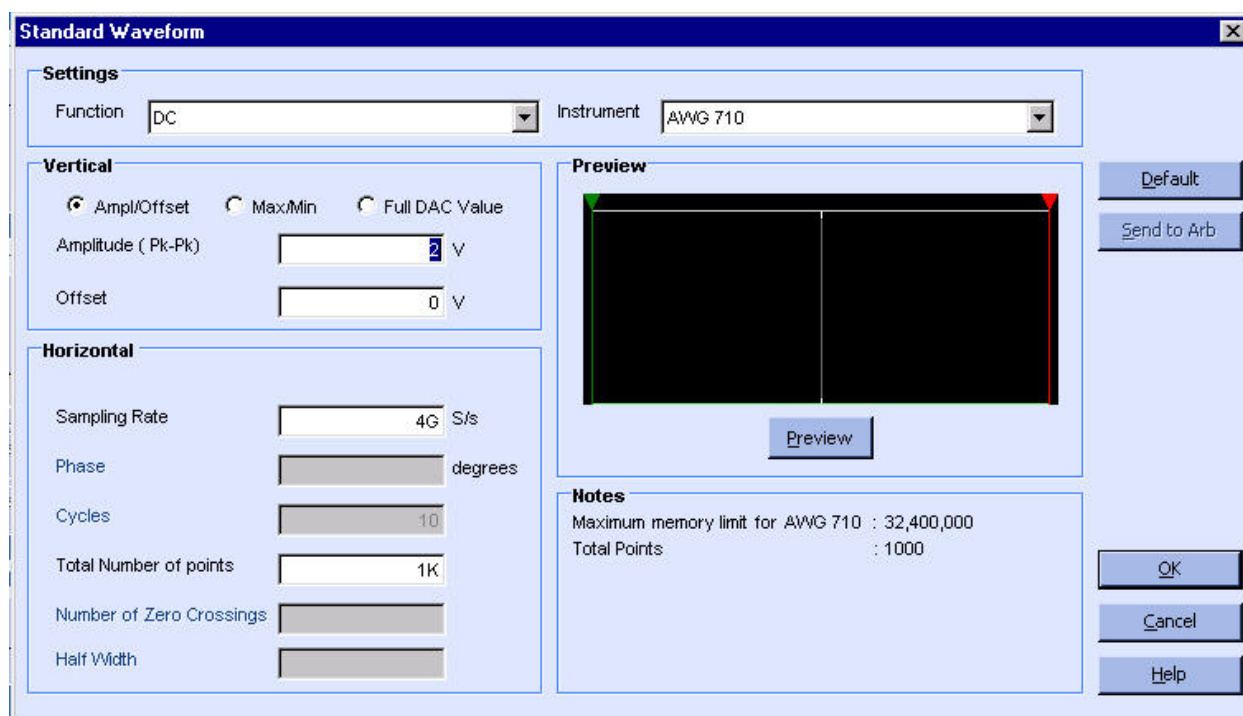
Figure 4-20: Creating a DC wave

To create a DC wave, follow these steps:

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

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

   a. Amp/Offset to enter the Amplitude (Pk-Pk) and Offset values. The amplitude specifies the amplitude of the waveform (along the Y-axis).

   If an instrument is already connected, the amplitude are automatically set on the instrument.

   b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

    c. 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.

4. Click the Preview button, under 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.

Figure 4-21: Waveform padding options

Table 4-6: Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Exponential Rise Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
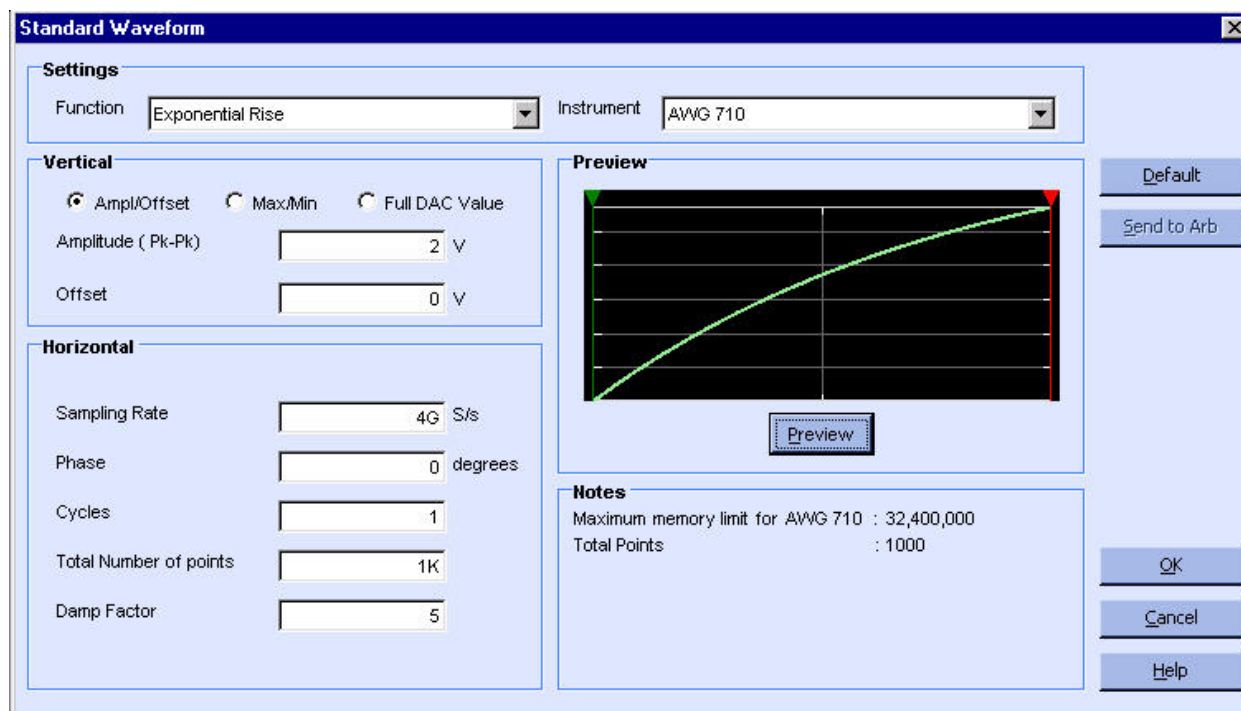
To create an exponential rise wave, follow these steps:

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

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

   a. 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.

   If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

   b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

   c. 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.

4. Click the Preview button, under 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.

Notes

Maximum Points : 32,400,000   Minimum Points : 960
Total Points   : 100

⦿ Manually change 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

Figure 4–23: Waveform padding options

Table 4–7:Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Exponential Decay Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.

Figure 4-24: Creating an Exponential Decay wave

To create an exponential decay wave, follow these steps:

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:

   a. 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.

   If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

   b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

   c. 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.

4. Click the Preview button, under 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.
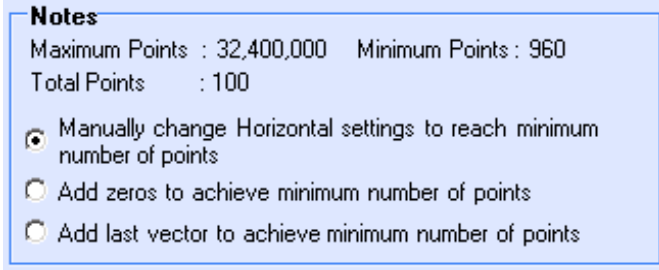

Figure 4–25: Waveform padding options

Table 4–8:Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 File> Multi-waveform Properties or in the Shortcut view.

Create Advanced Waveforms

Sinc Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.

Figure 4-26: Creating a Sinc wave

To create a sinc wave, follow these steps:

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

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

   a. 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.

   If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

   b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

     c. 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.

4. Click the Preview button, under 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.

Figure 4-27: Waveform padding options

Table 4-9:Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Sweep Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.
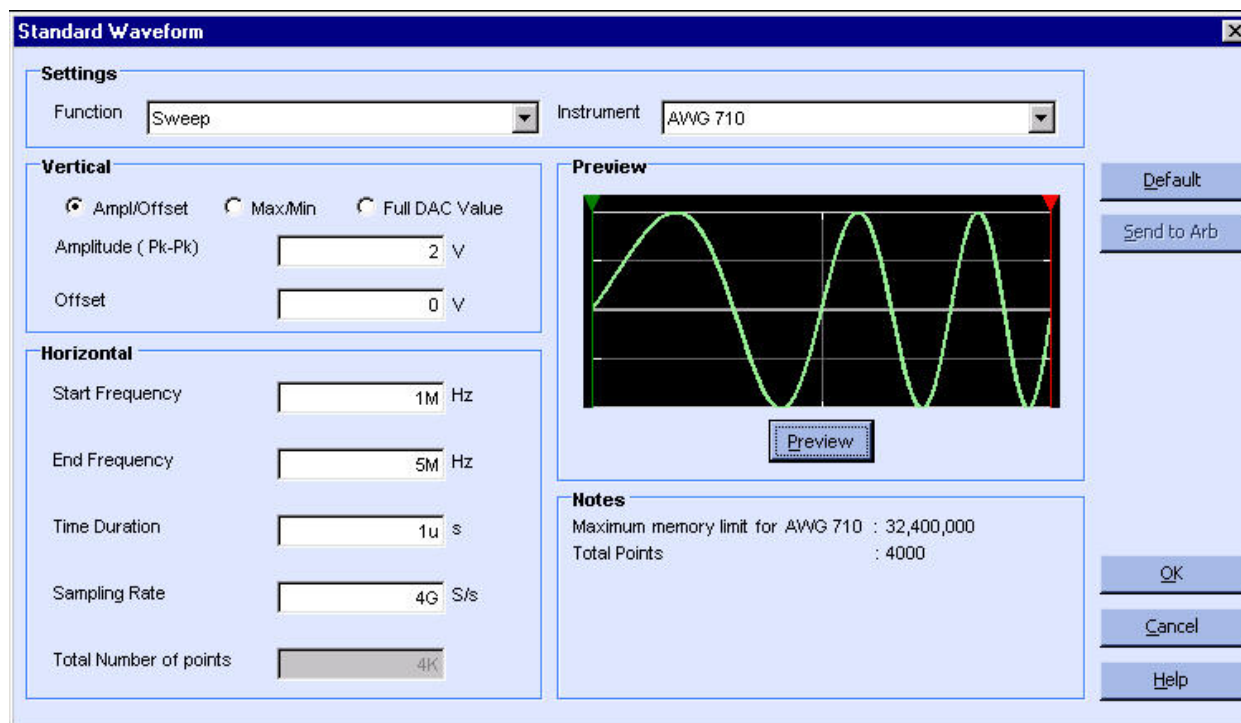
`Figure 4-28: Creating a Sweep wave`

To create a sweep wave, follow these steps:

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

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

a. 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.

If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

c. 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.

4. Click the Preview button, under 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.
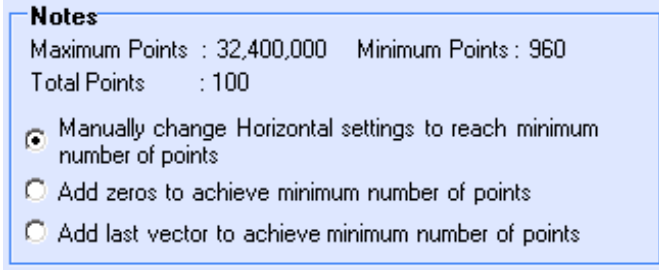
Notes
Maximum Points : 32,400,000   Minimum Points : 960
Total Points   : 100

⦿ Manually change 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

Figure 4-29: Waveform padding options

Table 4-10:Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Multi-Tone Wave

File> New> Standard Waveform

To create a standard waveform select File> New> Standard Waveform.

Figure 4-30: Creating a Multi-tone wave

To create a multi-tone wave, follow these steps:

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

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

a. 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.

If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

c. 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, Sampling Rate, and Total Number of Points.

4. Click the Preview button, under 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.

Notes
Maximum Points : 32,400,000   Minimum Points : 960
Total Points   : 100
○ Manually change 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

Figure 4-31: Waveform padding options

Table 4-11:Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Lorentz Wave

File> New> Standard Waveform

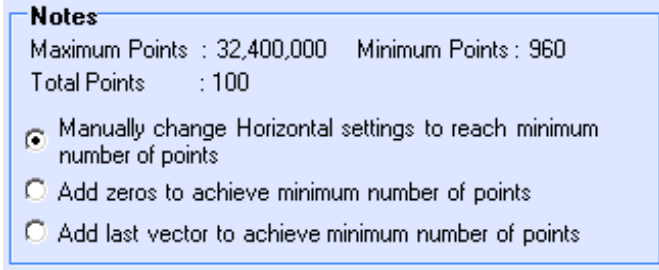To create a standard waveform select File> New> Standard Waveform.
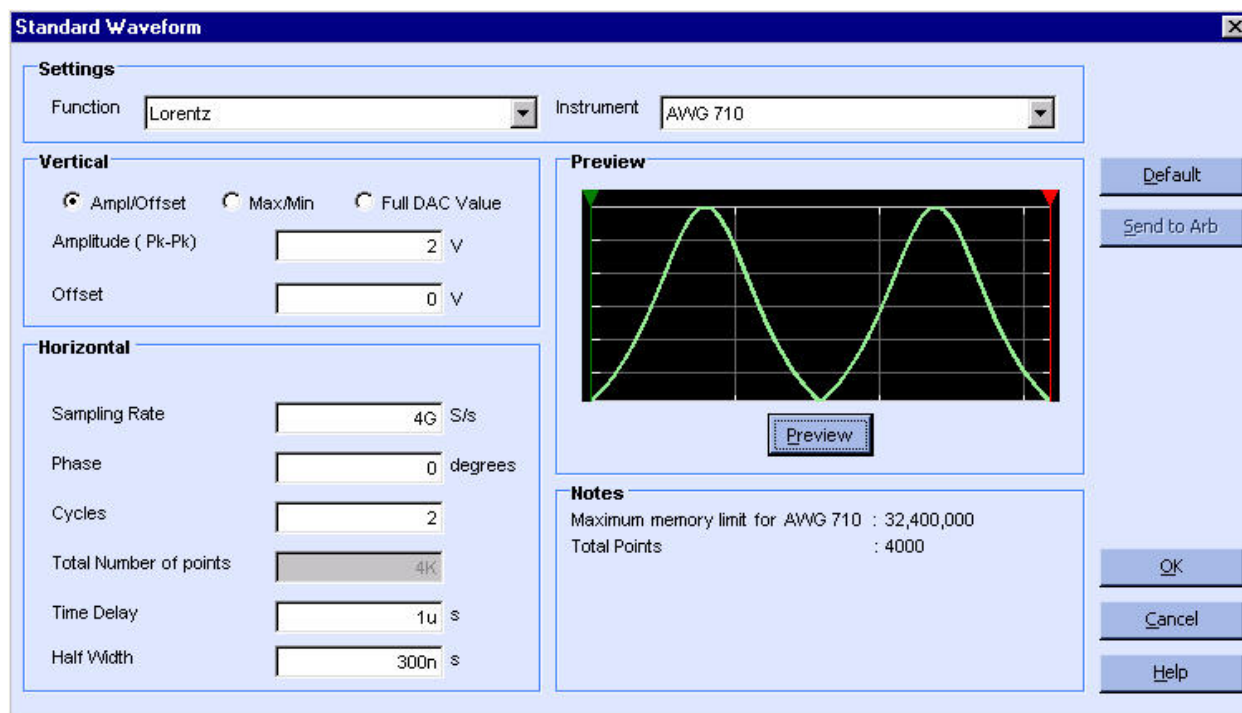
Figure 4-32: Creating a Lorentz wave

To create a Lorentz wave, follow these steps:

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

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

   a. 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.

   If an instrument is already connected, the amplitude and offset are automatically set on the instrument.

   b. Max/Min to enter the Maximum and Minimum voltage values for the waveform.

   c. 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 Half Width and Pulse Width. The Half Width specifies time until the maximum amplitude and Pulse Width the time interval between the mid-value. The application calculates the Total Number of Points as the product of Pulse Width and Sampling Rate.

4. Click the Preview button, under 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.

Figure 4-33: Waveform padding options

Table 4-12:Waveform padding options

Option	Description
Manually change the Horizontal settings to reach minimum number of points	Select this to increase the total number of points to 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 the Default button to restore the default values for the parameters.

Click the Send to Arb button to transfer the waveform to an AWG or an AFG. This button is enabled only when an instrument (AWG or AFG) is connected.

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 an existing window, select File> Multi-waveform Properties or Multi-waveform Properties in the Shortcut view.

Create Marker Patterns

Marker

Display> Marker

Display the markers by selecting Display> Marker from the menu. This 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.

Table 4-13: Marker 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
Set Pattern	Displays a dialog box where you can set the pattern type (Hexadecimal or Binary) for the markers
Clear Pattern	Clears the entire marker area
Invert Pattern	Inverts the marker area values
Make High	Sets the data values to high
Make Low	Sets the data values to low
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
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 within 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.

Display

Cursor

Display> Cursor

Display the cursors by selecting Display> Cursor from the menu. This 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.

Cursor Position

Display> Cursor Position

Display the cursor position by selecting Display> Cursor Position from the menu. This option sets the cursor position in points or in seconds.

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

Zoom In

Display> Zoom In

Select Display> Zoom In from the menu. You can zoom the area of interest by

- clicking near a point, or

- selecting an area of interest

If the markers are displayed, the corresponding marker area is also zoomed. You can zoom to four levels. If you zoom more than four times, the message "Only four levels of zoom supported" is displayed.

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.

`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 by

- clicking near a point, or

- selecting an area of interest

If the markers are displayed, the corresponding marker area is also zoomed. You can zoom to four levels. If you zoom more than four times, the message "Only four levels of zoom supported" is displayed.

`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.

`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.

`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.

Table 4–14: Display Properties options and their descriptions

Menu selection	Description
Waveform Name	Select the waveform to view or change the properties
Enable Graticule	Select this to show or hide the graticule
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	
Marker 1	Select the color for marker1
Marker 2	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.

Edit Waveforms

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.

Redo

Edit> Redo

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

`Cut`

Edit> Cut

To cut a portion of the waveform, follow these steps:

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 on the icon from 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.

`Copy`

Edit> Copy

To copy a portion of the waveform, follow these steps:

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 on the icon from 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.

`Paste`

Edit> Paste

To paste a copied portion of the waveform, follow these steps:

1. Select Edit> Paste from the menu.

The following dialog box appears.
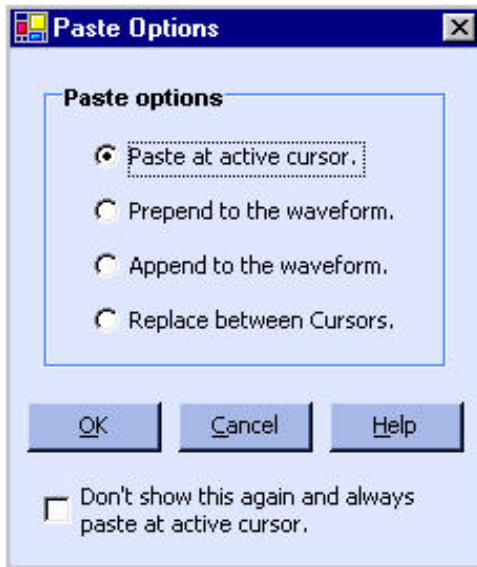
Figure 4-34: Paste options

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

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 in 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.*

Select All

Edit> Select All

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

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	

Figure 4-35: Waveform data points in Microsoft Excel

Copy as Bitmap

Edit> Copy as Bitmap

To capture the waveform in the current window, select Edit> Copy as Bitmap.
You can paste the captured image as a bitmap in Microsoft Word, or Microsoft
Excel.
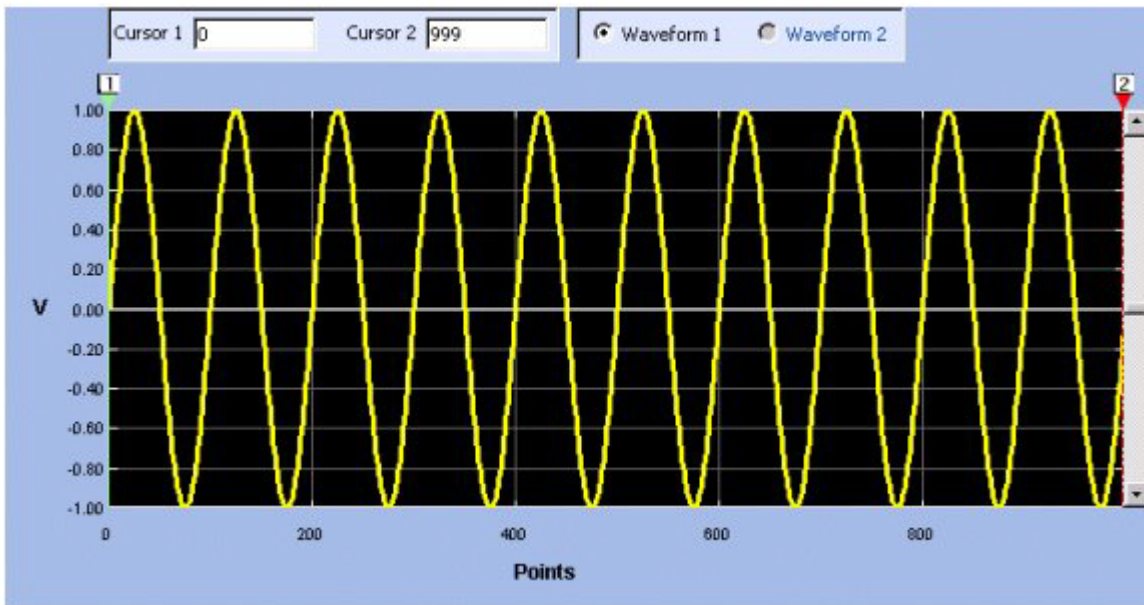
Figure 4-36: Example of a waveform as a bitmap

Invert

Edit> Invert

To invert a portion of the waveform, follow these steps:

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 on the icon from 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.

`Mirror`

Edit> Mirror

To invert a portion of the waveform, follow these steps:

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> Mirror from the menu or click on the icon from 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.

`Freehand`

Edit> Freehand

Select Edit> Freehand from the menu to enable the freehand drawing mode or click on the icon from 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.

`Horizontal Draw`

Edit> Horizontal Draw

Select Edit> Horizontal Draw from the menu to enable the horizontal draw mode or click on the icon from 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.

Vertical Draw

Edit> Vertical Draw

Select Edit> Vertical Draw from the menu to enable the vertical draw mode or click on the icon from 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.

Use Math

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

Follow these steps 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.

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

3. Select Add from Operation.

Adding a Scalar Value

Follow these steps 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

Follow these steps 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.

Figure 4–35: Adding waveforms

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

Follow these steps to subtract a waveform from an existing waveform.

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

2. 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.

3. Select Subtract from Operation.

Subtracting a Scalar Value

Follow these steps 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

Follow these steps 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 Edit> Copy.

2. Select Math> Waveform Math.

3. Click Copy from Clipboard, and from Operation, click Subtract. Click Ok.
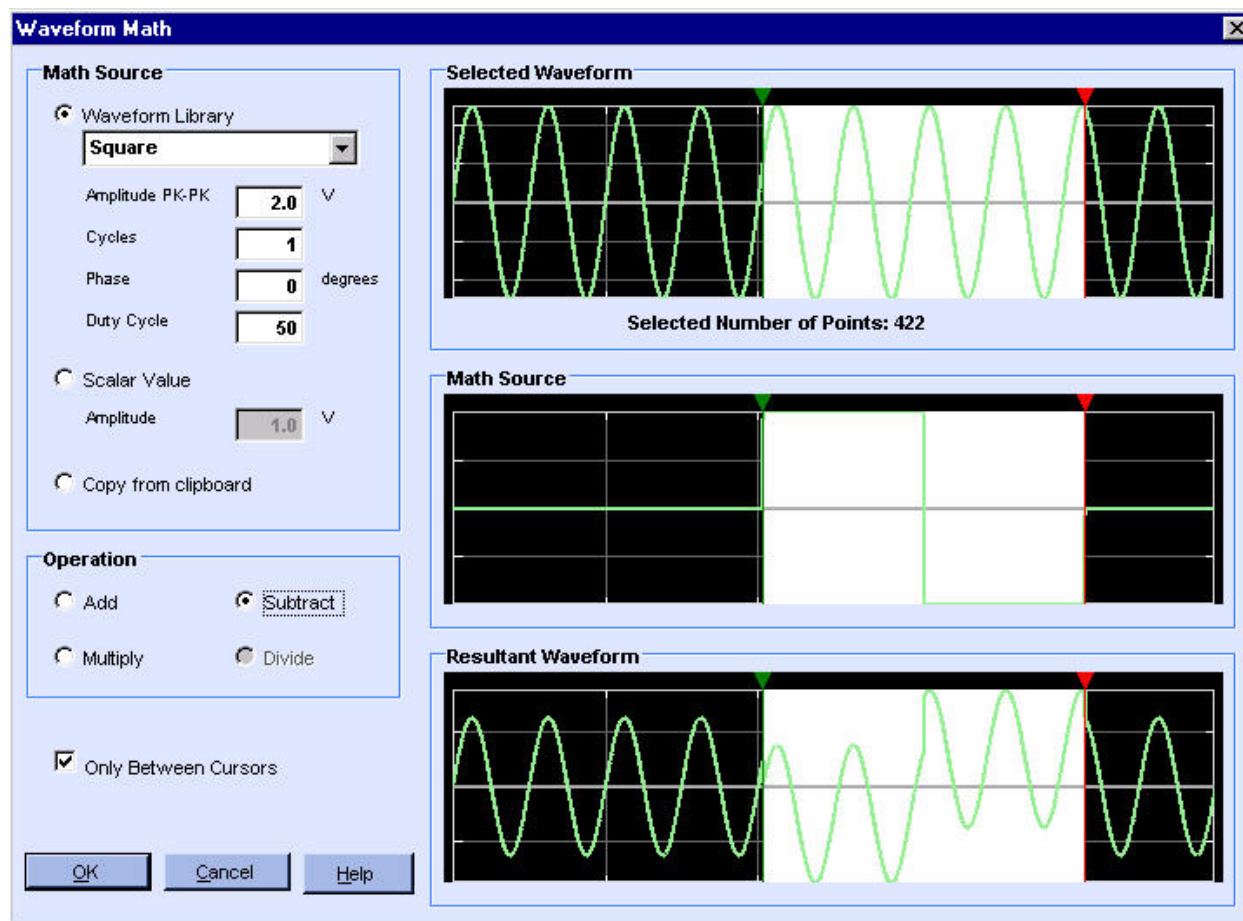
Figure 4-38: Subtracting waveforms

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

Follow these steps to multiply a waveform with an existing waveform.

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

2. 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.

3. Select Multiply from Operation.

Multiplying with a Scalar Value

Follow these steps 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

Follow these steps 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.
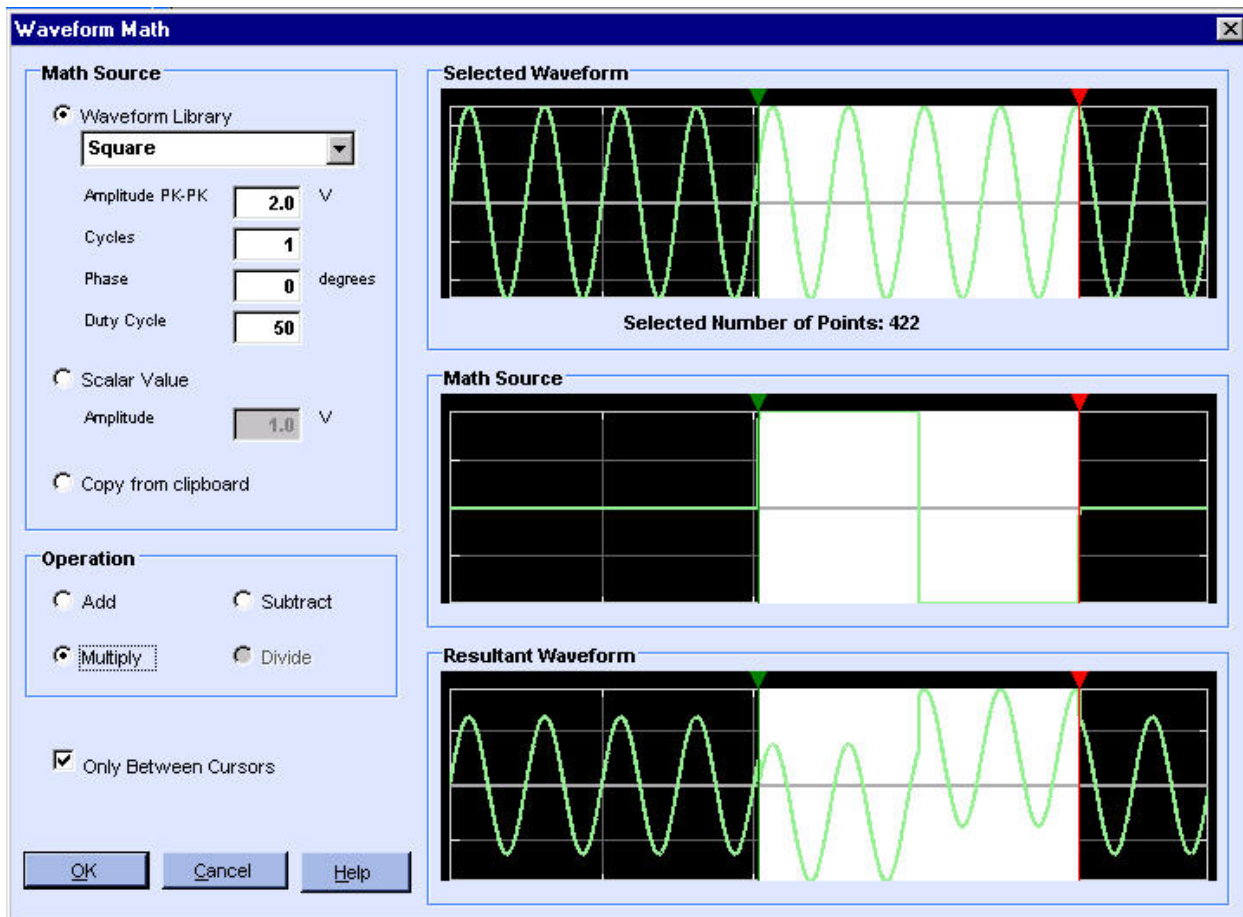
Figure 4-39: Multiplying waveforms

`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

Follow these steps 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.

2. 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.

3. Select Divide from Operation.

Dividing with a Waveform copied to the Clipboard

Follow these steps 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.
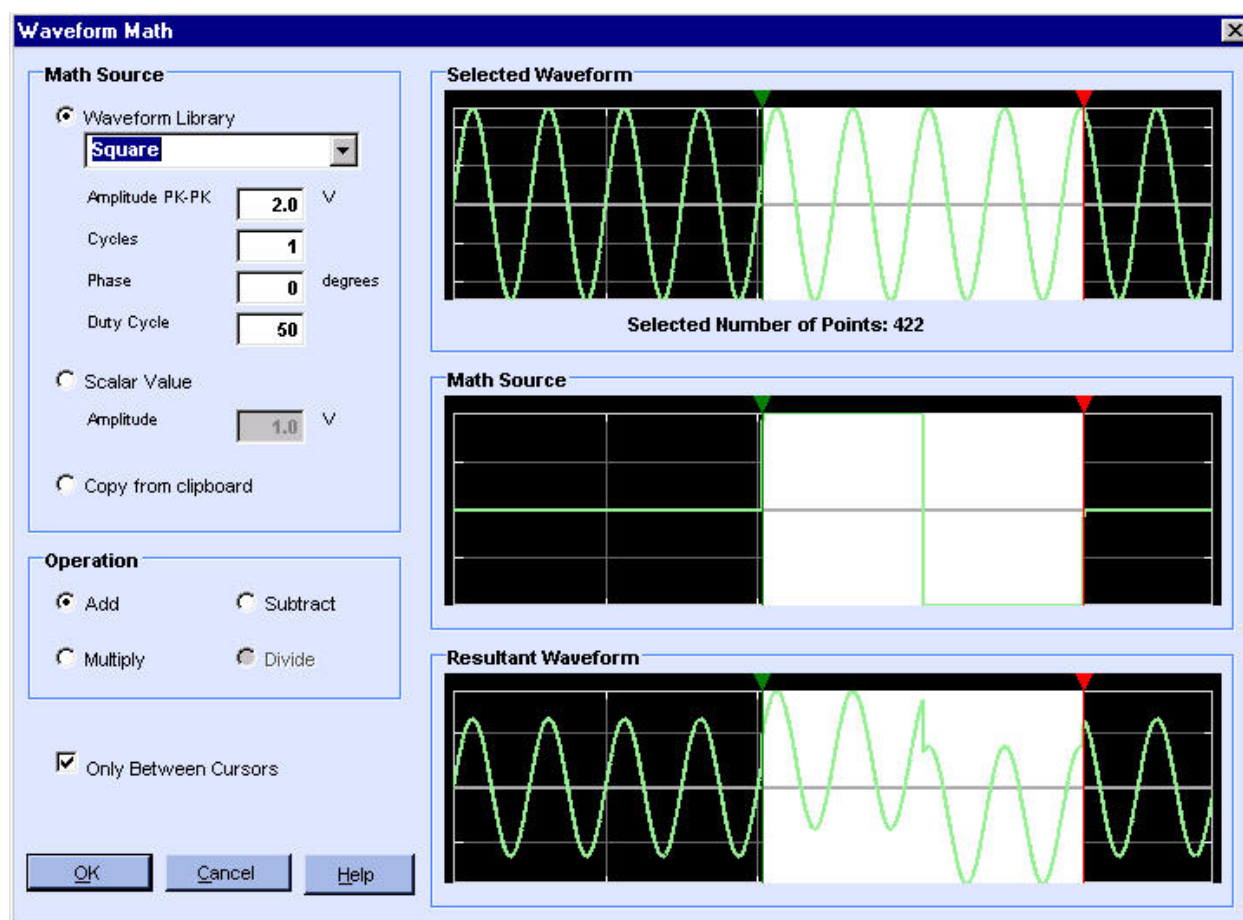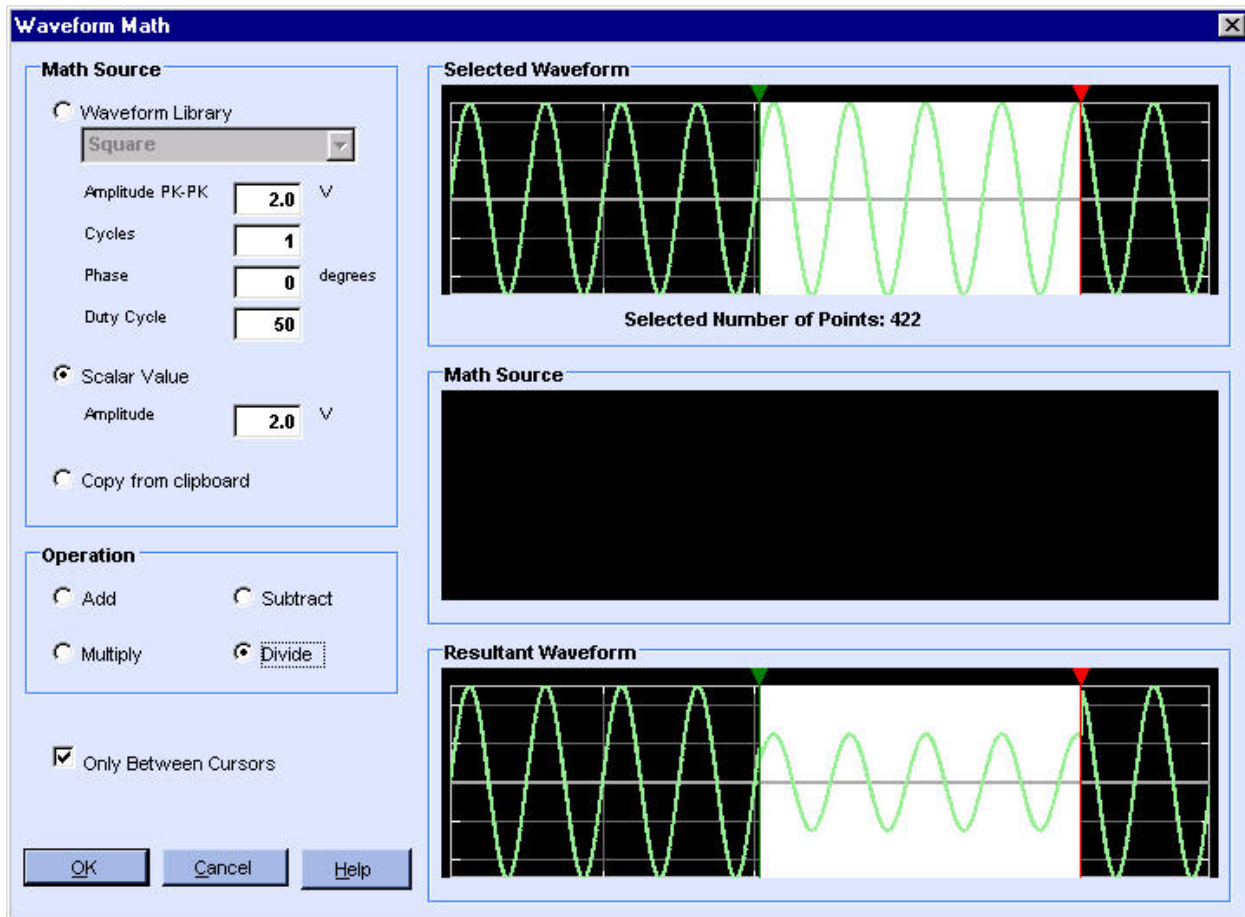

Figure 4-40: Dividing waveforms

Communicate with Other Instruments

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 or function generator connected to the computer. To transfer a file to an AWG or an AFG, follow these steps:

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 displaysAWG 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's 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's File view and right-click to display the shortcut menu. Select Copy.

5. Select a PC folder, right-click on 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 floppy

    Wherever a .set file is created for a waveform (.wfm or .pat) file in ArbExpress, it contains the name of the waveform file, the voltage, offset, marker voltage settings, and clock and channel information. You can save the .wfm, .pat, and the .set file to a floppy and transfer it to and an AWG or an AFG.

■ By dragging and dropping the .wfm file. The application automatically drags and drops the .set file.

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

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

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

3. 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).

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

5. In the instrument, load the .wfm or .pat file using the Load/Restore button.

▪ Directly from the PC to the instrument

Follow these steps to transfer the waveform directly to the instrument.

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. The connection is not lost by closing the file transfer dialog.

2. Create a waveform and from the shortcut menu, click "Send Waveform to Arb" to transfer the waveform to the instrument.

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, Channel 1 is switched on, and instrument is set in the Run mode. Note that when you use this mode of file transfer, an associated .set file is not created. The transferred file is loaded in the instrument's internal memory.

The screen shows a toolbar and the panes—Arb List, PC Folders, PC Files, Instrument Folders, Instrument Files, and Instrument Control.
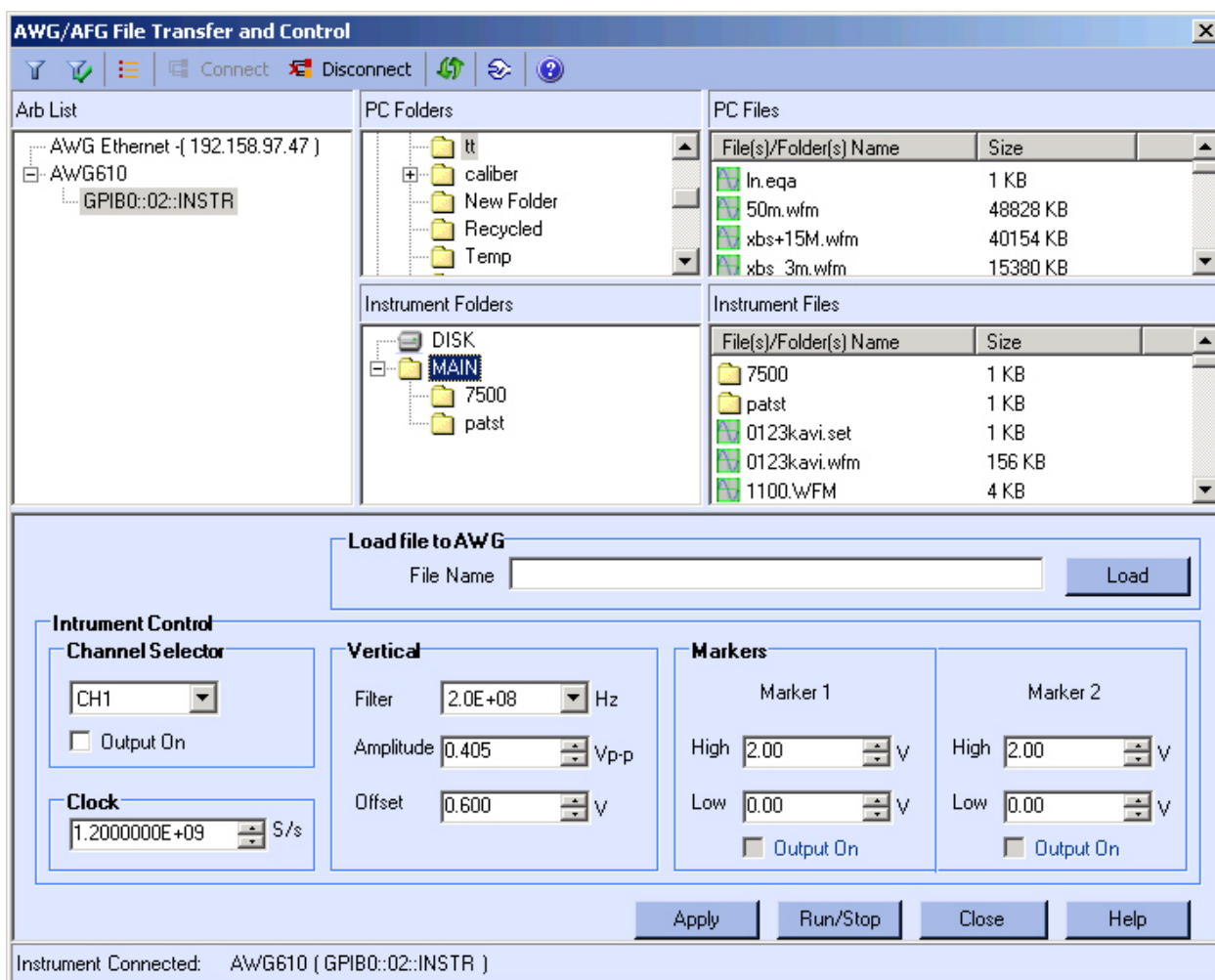
Figure 4-41: Transferring a file and controlling an Arbitrary Waveform Generator

Toolbar
The toolbar contains the following buttons:
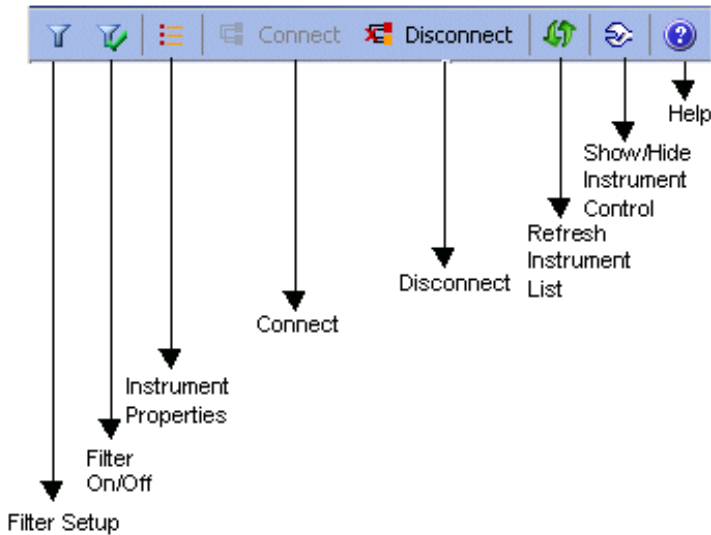
Figure 4-42: File transfer and control toolbar

Table 4-15: File Transfer and Control toolbar options and their descriptions

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	Re-reads 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 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.

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 properties displayed are instrument model, bus type (such as GPIB or LAN), connection 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.

Controlling an AWG
You can use ArbExpress to control an AWG parameters that are displayed in the Instrument Control pane. To do this, follow these steps:

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 channel.

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

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.

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.

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

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 the Run/ Stop button 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.

Controlling an AFG

You can use ArbExpress to control an AFG connected to the computer. The AFG3xx series parameters can be controlled from the instrument control pane. To do this, follow these steps:

1. Select an AFG from the instrument list and connect to it. All the controls are updated for the selected channel.

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 channel.

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.

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.

Import from Oscilloscope

Communication> Import from Scope

You can use ArbExpress to acquire data from an oscilloscope connected to the computer. To do this, follow these steps:

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's 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.
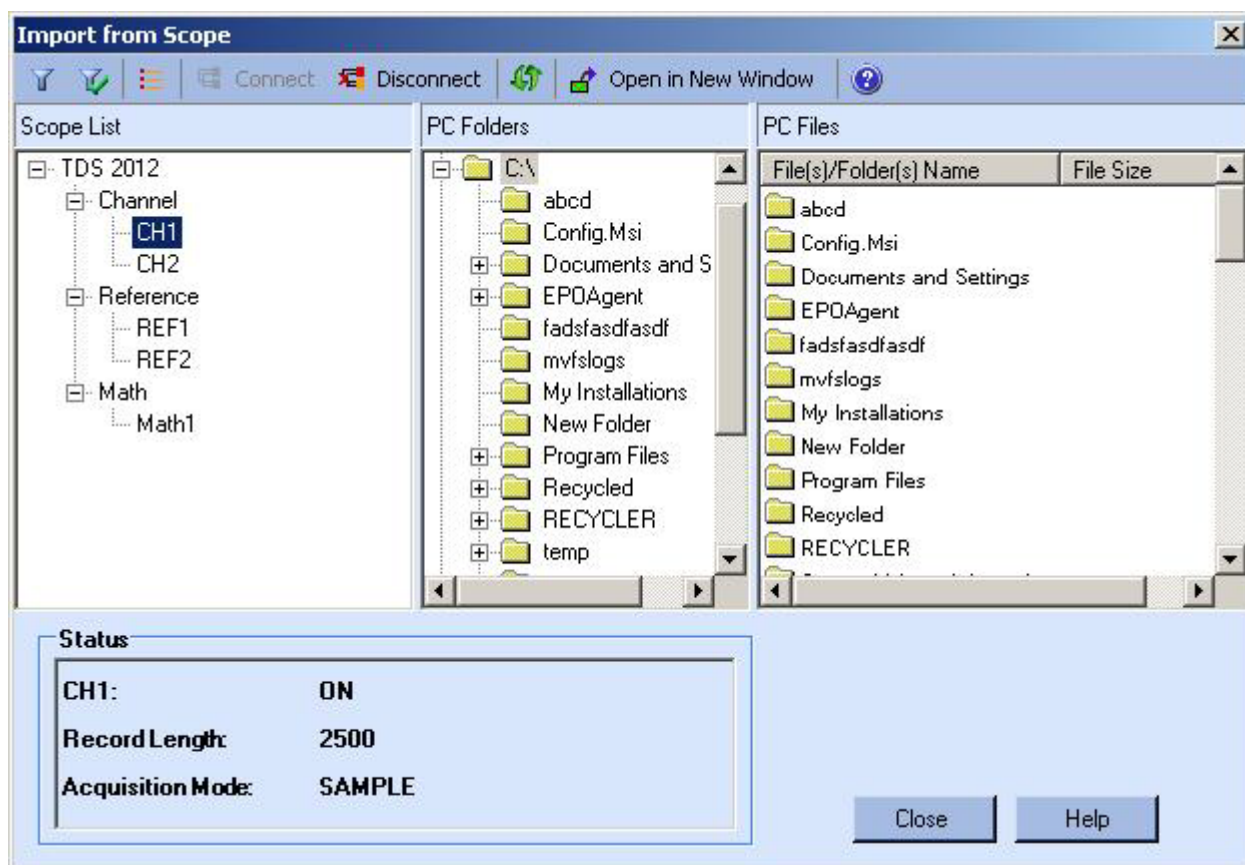
Figure 4-43: Importing a waveform from an oscilloscope

Toolbar
The toolbar contains the following buttons:
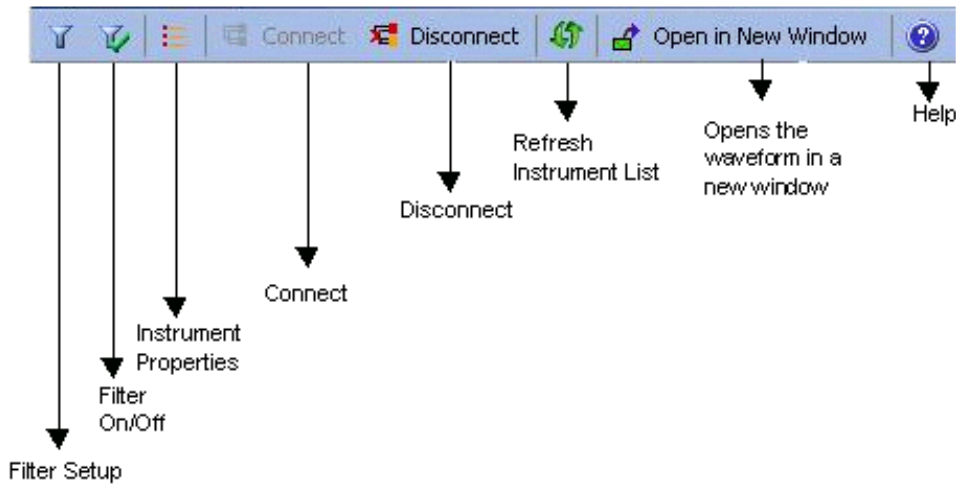
Figure 4-44: Import from Oscilloscope toolbar

Table 4-16: Import from Scope toolbar options and their descriptions

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. Currently ArbExpress supports only TDS1000, TDS2000, TDS3000 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 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.

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

114 ArbExpress AXW100 Waveform Creation and Editing Tool

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.

Table 4–17: Import from Scope shortcut menu options and their descriptions

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 or TDS2000 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's hard disk drive. You can navigate the files as you do with Windows Explorer. Right-click on the file list to see a shortcut menu with the command - Paste. 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.

Send Waveform to Arb

Communication> Send Waveform to Arb

This option is enabled only when you have a waveform in a window. Select this option to send the waveform to an AWG/AFG that is already connected. A progress bar displays the status of the operation.

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.
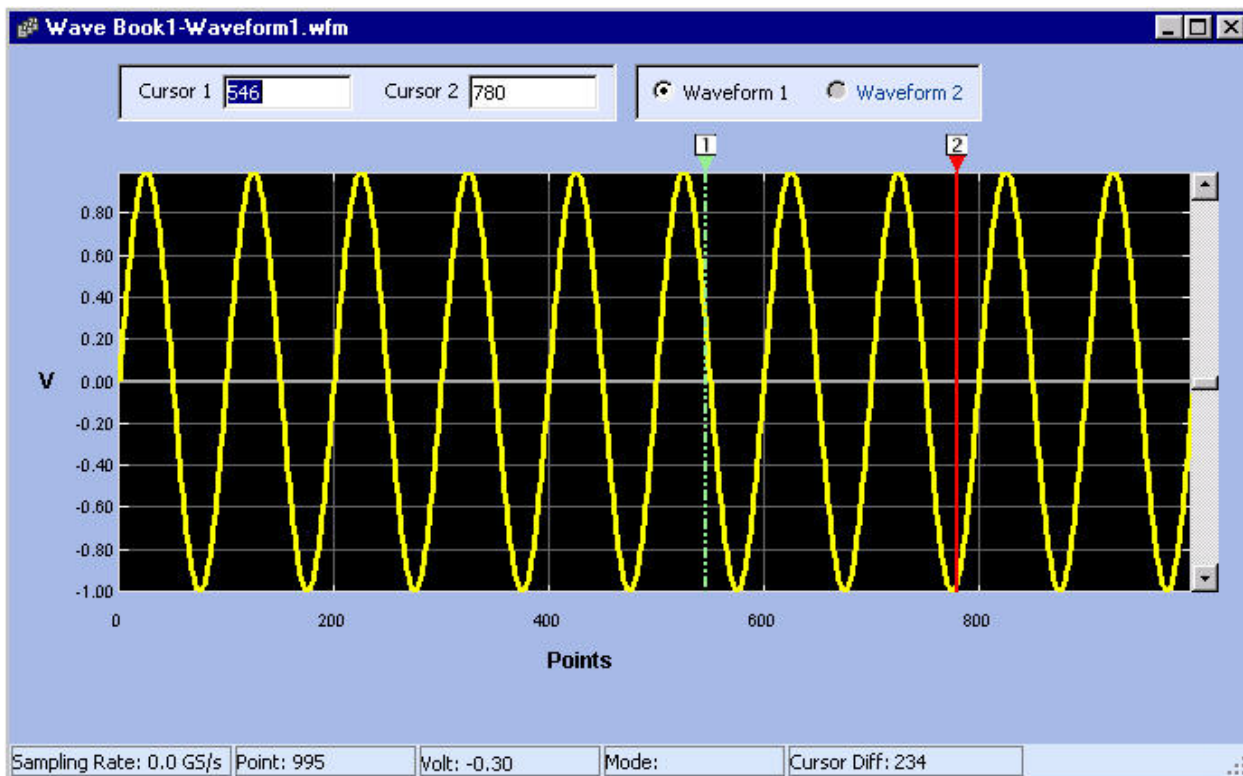
Figure 4−45: Example of a normalized waveform

Use MATLAB Support

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 version 2.01, build 97.

- Ensure that the system path includes the path where ArbEther.dll is installed. By default, this DLL is copied to the directory where ArbExpress is installed. You need this DLL if you connect to AWGs over Ethernet.

This utility is installed, by default, in the path—ArbExpress\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 following files must be present in the directory before you start using the commands documented here:

Commands

connect.p

disconnect.p

loadwfm.p

query.p

Read.p

Sendcmd.p

Sample script file:

sample.m

DLL file with gateway routine

matarb.dll

Transferring Files from MATLAB

To transfer files from MATLAB, follow these steps.

1. Start MATLAB.

2. Go to the directory where you have stored the Matlab library files that are supplied with ArbExpress.

3. Open a session to an AWG connected to your PC. You can connect to it using NewSession command as shown below:

   ```
   [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.

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 describing the failure.

4. Create a Waveform using MATLAB's mathematical functions such as Sin, Exp, and others.

5. The following script for example, creates a sine waveform having a thousand points and stores it in a variable called Data.

   ```
   Frequency = 1e2;

   Period = 1/Frequency;

   Pts = [1:1000] * Period;

   Data = sin(Pts);
   ```

6. Use this variable to transfer the Sine wave created to the AWG as shown:

   ```
   [Status,StatusMsg] = SendWfm(SessionID, Data,
   "Sample.wfm", 1000)
   ```

   where the SessionID is the session you have opened earlier, Sample.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.

7. 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. To do this, follow these steps:

1. Open a session using NewSession command.

2. Once connected, use the Write command to send any command that is supported to the connected AWG.

3. Use the Query command to query the instrument's 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,
"Sample.Wfm", 1)
```

This attempts to load the file "Sample.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.

Commands

ArbExpress implements the following commands for communication with Tektronix AWGs.

There are two commands for session management—NewSession and CloseSession, and five commands for instrument control and data transfer—Read, Write, LoadWfm, TransferWfm, and Query.

`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

strResourceIDA Matlab string containing the resource name in the standard Visa format.

strBusTypeCommunication bus used for connection. Supported values are "GPIB" and "TCPIP".

Return values

nSessionIDA 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. Refer to the documentation of TekVisa's VisaRM for help on how to configure VisaRM to detect the instrument.

`CloseSession Command`

Description

This command closes the connection with instrument.

Syntax

CloseSession(nSessionID)

Parameters

nSessionIDA 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.

SendCmd Command

Description

This command sends a SCPI command to the connected instrument.

Syntax

[nStatus, strErrMsg] = SendCmd (nSessionID, strCmd)

Parameters

nSessionIDSession ID obtained by NewSession command.

strCmdSCPI command string

Return values

nStatusZero if successful. Visa error code if the operation failed.

Read Command

Description

This command reads responses from instruments.

Syntax

[nStatus, strErrMsg] = Read(nSessionID)

Parameters

nSessionIDSession ID obtained from NewSession command

Return values

nStatusZero if successful, Visa error code if the operation 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 command.

LoadWfm Command

Description

This command loads a waveform into the connected AWG's internal memory and outputs it from the selected channel.

Syntax

Syntax 1

[nStatus, strErrMsg] = LoadWfm(nSessionID, strWfmName, nCh)

Syntax 2

[nStatus, strErrMsg] = LoadWfm(nSessionID, strWfmName)

Parameters

nSessionIDSession ID obtained by calling NewSession command

strWfmNameName of the Waveform file with or without the extension.

nChChannel 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, you should change the path to the directory where the desired file is located by using MMEM:CDIR command. When the load command is sent, the instrument takes some time to load the file especially if they are big files. Since the call is synchronous, the program will not return till the load operation is completed on the instrument.

Also note that if the waveform file is corrupt or in the wrong format, the instrument will not load it.

When you are connected to an AWG with only one channel, it is better to use Syntax 2 because it assumes that the channel number is 1. If you want to use a channel number other than 1, you must use Syntax 1.

`TransferWfm Command`

Description

This command transfers a waveform from the Matlab environment to the connected instrument's mass memory.

Syntax

TransferWfm[nSessionID, double dDataPoints[], strWfmName, nSize)

Parameters

nSessionIDSession ID obtained from NewSession command

dDataPointsOne dimensional array of doubles containing data points

strWfmNameThe name of the waveform file to be created in the instrument

nSizeNumber 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 them 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.*

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

strQueryStandard SCPI query

Return values

nStatusZero if successful, Visa error code otherwise

strResponseResponse to the query sent in strQuery parameter or error message if the query failed.

> *Note: This is a combination of SendCmd and Read commands. The return value always returns the result of the read operation.*

Reference

Error Messages and Warnings

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 one instance is already open.	Close ArbExpress and try again.
1002	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.
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 our 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.
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	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.

Error code	Error message	Description	Possible solution
	New icon from the toolbar		
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.

Error code	Error message	Description	Possible solution
Standard Waveform			
1201	Enter a value	This message appears when no value has been entered in a field.	Enter a valid value in the field for the instrument selected. For more details refer to the instrument specification.
1202	Invalid value	This message appears if you have entered a very large value in the editable fields in the standard waveform.	Enter a value with within the range. The value must not cross the selected instrument's 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's 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.
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.

Error code	Error message	Description	Possible solution
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	The number of points per cycle is less than 2, change the points per cycle	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	PointsPerCycle = 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.
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.

Error code	Error message	Description	Possible solution
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.
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.	This message appears for the sine, triangle, square, and pulse waveforms when total points is not a multiple of four when the instrument selected is 710,520,510.	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	This message appears for	For the sine, triangle, square, and pulse

Error code	Error message	Description	Possible solution
	multiple of 8. Change frequency.	the sine, triangle, square, and pulse waveforms when the total points is not a multiple of eight when the instrument is AWG2021.	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.
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 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 doesn't exceeds 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 0360 degree	This message appears when value entered for the phase in not within the range.	For phase, range is between 0360. 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	Enter value so that tone spacing is within the difference between start and end frequency.

Error code	Error message	Description	Possible solution
		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.
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.	There should at least two points per cycle. 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.	Enter a voltage value that lies within the voltage range supported by the instrument.
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.

Error Messages and Warnings Cont...

Error code	Error message	Description	Possible solution
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.	
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.

Error code	Error message	Description	Possible solution
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	• Verify the GPIB (Talk/Listen)/LAN connection. Ensure there is no loose connection. • Refresh the Visa resource list for the GPIB connection • 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 re-connecting to the instrument
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.
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	• Check instrument connection • Check hard disk space • Check whether the file is being used by another application • Check whether the instrument file size

Error code	Error message	Description	Possible solution
		• insufficient hard disk space • the file that is being transferred is opened by another application This message also appears when an AFG3xx is connected, and the user tries to drag-and-drop or copy an item from PC files list to the edit memory (EMEM) of the instrument. 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.	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.
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	Disconnect the connected instrument and connect a new instrument.

Error code	Error message	Description	Possible solution
		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.	
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 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.
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

Error code	Error message	Description	Possible solution
1614	Invalid amplitude. Voltage range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
1615	Invalid offset. Voltage range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
1616	Invalid marker voltage. Voltage range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
1617	Invalid clock. Frequency range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
1618	Invalid phase. Range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
1619	Invalid output frequency. Frequency range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
1620	Invalid EMEM size. Point range supported is xxxx.	The value entered is not within the instrument's range.	Enter a value that is supported by the instrument.
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

ArbExpress AXW100 Waveform Creation and Editing Tool **135**

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
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
Display> Properties	Waveform Name	Displays the name of the selected waveform
	Enable Graticule	Enabled by default
	Waveform Properties	Displays the currently selected waveform's 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> Preferences	Save .set file along with the .wfm and .pat files Normalize before saving the file Show paste option before pasting	All the options are selected
Waveform> Waveform Properties	Instrument	Displays the currently selected instrument in the waveform
	Number of Points	Displays the currently selected instrument in the waveform
	Sampling Rate	Displays the currently selected instrument in the waveform

Parameter	Selection	Default Setting
Multi-Waveform Properties	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's sampling rate
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 5 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)
	Phase	0
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	100
Waveform> Square	Amplitude Peak to peak	2
	Points	1000
	Vertical offset	0
	Cycles	10
	Frequency	Maximum sampling rate / Points per cycle(100)
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	100
	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)
	Phase	0
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	1000
Waveform> Pulse	Amplitude Peak to peak	2
	Vertical offset	0
	Cycles	10
	Frequency	Maximum sampling rate / Points per cycle(100)
	Sampling Rate	Maximum sampling rate supported by the instrument
	Points per cycle	100
	Delay	0
	Pulse Width	10
	Rise Time / Fall Time	0
	Rise Time / Fall Time Type	Ramp
	Transition Pulse Direction	Positive

Parameter	Selection	Default Setting
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
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	1M
	End Frequency	5 M
	Time Duration	1u (AWG710 – AWG2021) 10u (AWG2005- AFG320)
	Sampling Rate	Maximum sampling rate supported by the instrument. The default sampling rate for AWG2021 is 248.

Parameter	Selection	Default Setting
Waveform> Multi-Tone	Amplitude Peak to peak	2
	Vertical offset	0
	Points	SamplingRate/ToneSpacing
	Start frequency	1M (AWG 710–AWG2021) 1K (AWG 2005–AFG 320)
	End Frequency	5M (AWG 710–AWG2021) 5K (AWG 2005–AFG 320)
	Tone Spacing	1M (AWG 710–AWG2021) 1K (AWG 2005–AFG 320)
	Sampling Rate	Maximum sampling rate supported by the instrument. The default sampling rate for AWG2021 is 248.
Waveform> Lorentz	Amplitude Peak to peak	2
	Vertical offset	0
	Points	Delay * Sampling Rate
	Cycles	1
	Phase	0
	Delay	1u (AWG710–AWG2021) 10u (AWG2005–AFG320)
	Half Width	0.3us
	Sampling Rate	Maximum sampling rate supported by the instrument. The default sampling rate for AWG2021 is 248.
Waveform Padding Options	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	Manually change the Horizontal settings to reach minimum number of points

Valid Parameter Ranges

The table below lists the amplitudes, offsets, filters, and levels supported by the AWGs and AFGs.

AWG/AFG comparison

- Output amplitude option
- (yellow) Memory length option
- (pink) Output channel option

Device	Mode	N/D	Amplitude MaxVpp	Min Vpp	Res. V	Offset + xx V	- xxV	Res. V	Level Max V	Min V	Res. V	Filter (MHz) Through				
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
	STD	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
	STD	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.

AWG/AFG comparison

			Output style	# of ch	Memory length/ch			Marker out					
								Amplitude			Level		
					Max	Min	Restriction	Max Vpp	Min Vpp	Res. V	Max V	Min V	Res. V
AWG710	STD	200	Differential	1	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	200	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	200	Differential	1	8,100,032	512	X 8	2.5	0.05	0.05	+3.00	-1.10	0.05
			Differential										
AWG615	STD	200	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	100	Differential	1	4,194,048	256	X 4	4.0	0.05	0.05	+2.00	-2.00	0.005
			Differential										
AWG520	STD	100	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	50	Differential	2	4,050,000	64	X 1						
		50											
	option 05	50	Single-end										
		50											
	option 01				16,200,000	64							
AWG430	STD	50	Differential	3	4,050,000	64	X 1						
		50											
	option 05	50	Single-end										
		50											
	option 01				16,200,000	64							
AWG2021		50	Single end	1	262,144	64	X 8						
	option 02			2									
AWG2005		5	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						