

# ***TekTMS AWE***

## ***WaveWriter™***

*ANALOG WAVEFORM EDITOR*

*Version 2.0*  
*S3FT400*

*Please Check for  
CHANGE INFORMATION  
at the Rear of this Manual*

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Tektronix, Inc.  
P.O. Box 500  
Beaverton, OR 97077

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# Section I OVERVIEW

## What This Program Does

Provides a method for easily creating waveforms needed by advanced signal generating and signal processing instruments. Tektronix instruments, such as arbitrary waveform generators and oscilloscopes that have the "save-on-delta" feature, are enhanced by a software program that greatly assists a user in producing waveforms. With **WaveWriter**,™ you can use these advanced instruments with a minimum of effort.

With the **WaveWriter** package, you can create original waveforms or edit waveforms that have been acquired from various instrument sources. **WaveWriter** gives you interactive control of the waveform generating process. You communicate with **WaveWriter** through the Microsoft **Windows**™ environment.

## Menus

**WaveWriter** menu operations include:

### ■ File

- Start a new waveform
- Open and save waveforms
- Print a hardcopy of the current display
- Exit **WaveWriter**

### Edit

- Modify an existing waveform
- Flip waveforms horizontally and vertically
- Change horizontal and vertical resolution

### Display

- Set waveform and screen display characteristics

### ■ Draw

- Modify an existing waveform or envelope

- Create
  - Generate a sine, triangle, square, and pulse
  - Generate a waveform from an equation
  - Create an envelope
  - Generate a waveform using a sequence of waveforms
- SigProc (Signal Processing)
  - Add, subtract, multiply, divide, and scale waveforms
- Transfer
  - Select target instrument
  - Setup/configure** communication parameters
  - Move data from instruments to **WaveWriter**
  - Move data from **WaveWriter** to instruments

**WaveWriter** also provides help screens to aid use of the program.

---

## What You Get With This Program

The Package consists of:

- Two 5<sup>1</sup>/<sub>4</sub>" high density diskettes
- Two 3<sup>1</sup>/<sub>2</sub>" diskettes
- a** The **WaveWriter** User Guide
- The **WaveWriter** Quick Reference
- a** A registration card for future updates.  
Be sure to send it in.

## What You Need to Run This Software

*WaveWriter* is designed to run only in a Microsoft Windows environment. Microsoft Windows must be installed on your system before running *WaveWriter*. See the Microsoft Windows User's Guide for installation instructions.

### The Computer

The recommended **minimum** configuration for your system is:

- IBM PC/AT or compatible (however, a system with an 80386 processor runs noticeably faster — particularly when multi-tasking)
- 640 kbytes of memory
- A hard disk
- m A graphics monitor interface, preferably an **EGA** or **VGA** adapter. A CGA adapter will run in high resolution mode, but displays in monochrome. A monochrome graphics adapter (Hercules or compatible) will run with Windows, but a color adapter is recommended for the sake of clearly separating screen information.
- A National Instruments GPIB adapter.
- Microsoft Windows 3.0

### Optional Equipment

*WaveWriter* will run without a math coprocessor, but performance will suffer. Although *WaveWriter* (and Windows) can be run from the keyboard, a mouse is highly recommended.

### Supported Instruments

Currently, the following Tektronix instruments are supported by *WaveWriter*, Version 2.0:

- 11K and DSA Series Digital Storage Oscilloscopes
- 2200 Series Digital Storage Oscilloscopes
- 2400 Series Digital Storage Oscilloscopes
- AFG 5101/5501 Arbitrary Function Generator
- VX5260 VXI Digitizer
- VX5790 VXI Arbitrary Waveform Generator

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# About This Manual

## Organization

It is our intent to present information to you in the order in which you need it from the the time you unpack everything until you store away a waveform you've created. Briefly, this manual contains:

- Introduction    Section 1 — Overview. This program and its environment.
- Section 2 — Getting Started  
                            Installing **WaveWriter** on your **PC** system  
                            Starting the program  
                            Setting up the hardware environment
- Section 3 — Using **WaveWriter**  
                            Using the Microsoft *Windows* environment  
                            Basic operation of the **WaveWriter** program
- Section 4 — A **WaveWriter** Tutorial
- How to...        A more detailed description of each of the main menu operations in **WaveWriter** is found in Sections 5 through 11.
- Section 5 — How to use **FILE** operations
- Section 6 — How to **EDIT** waveforms
- Section 7 — How to **DISPLAY** waveforms
- Section 8 — How to **DRAW** waveforms
- Section 9 — How to **CREATE** waveforms, Envelopes, and Sequences
- Section 10 — How to **PROCESS** waveforms arithmetically (SigProc)
- Section 11 — How to **TRANSFER** waveforms
- References     Appendix A — Menu map
- Appendix B — Quick reference
- Appendix C — File structures
- Appendix D — Error messages
- Appendix E — Index



## Conventions

Here is a description of the terms and notations used in this manual.

### Keynames

The names of keys ( `[ESCAPE]`, `[CONTROL]`, `[ENTER]`, `[BACKSPACE]` ) are spelled out, even though they may be abbreviated or replaced with a symbol on your keyboard.

### Key Combinations and Sequences

When two or more keys are to be pressed at the same time, they are separated with a plus sign (such as `[SHIFT] + [F3]` or `[CONTROL] + [ALT] + [DELETE]` ).

When keys are to be pressed one after the other, the keys (in sequence) are shown separated with commas. For example, "Press `[ESCAPE]`, `[F5]`" means to press `[ESCAPE]` and release it, then press `[F5]` and release it.

### Direction Keys

The direction keys are the four arrow keys on your keypad or the separate arrow keys on an enhanced keyboard. The name used in text refers to the direction the arrow points ( `[LEFT]`, `[RIGHT]`, `[UP]`, or `[DOWN]` ).

### Entering Data from the Keyboard

When in DOS, examples of communication between you and your computer are shown in this manner:

```
C:\ >testprog
```

```
Enter text file name: a:\directory \test.txt
```

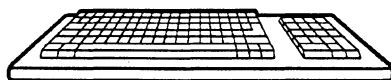
In the example, **roman** text is displayed by the operating system or the application program. *Italic* text is text that you are to enter verbatim. **Bold** text is a placeholder that you are to replace with specific information appropriate to the situation — for instance, in the example, **directory** should be replaced with the correct path name to access the file `test.txt`. In examples, such as this, it is assumed that the `[ENTER]` key is pressed at the end of a line in which you enter data.

### CAUTION

*In the Windows environment, the `[ENTER]` key is not used to terminate a text string. `[ENTER]` is used to initiate a series of actions based on a group of selections made in a dialog box. Therefore, its use may result in more taking place than you expected. See Section 3, Using **WaveWriter**, for more information.*

**Keyboard versus Mouse**

All of the selection operations used with this program can be done with either a mouse or with a sequence of keystrokes. Wherever you can make this choice, instructions are shown both ways. At the top of keyboard instructions is a picture of a keyboard, and a picture of a mouse tops mouse instructions:



These are instructions for selecting operations with keyboard keystroke sequences.



These are instructions for selecting operations with a mouse.

**Mouse Terms**

**Move** With the mouse on a flat surface, and without pressing any of its buttons, changing the position of the mouse will cause a corresponding change in position of the mouse cursor on the monitor display.

**Drag** To "drag" something on the screen means to move the mouse cursor arrow to the item to be moved. Press and HOLD the LEFT mouse button, and move the mouse to reposition the item. When the selected item is located where you want it, release the mouse button.

**Point** Move the mouse to place the end of the arrow cursor on an object, command, or filename.

**Click** Press and release the LEFT mouse button.

**Double-click** Press and release the LEFT mouse button twice in rapid succession.

**NOTE** *Microsoft Windows only uses the LEFT button on a mouse. However, the **WaveWriter** program also uses the RIGHT mouse button for certain functions.*

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## Technical Support

**WaveWriter** In North America, for technical support, first contact your local sales office; or call the Tektronix national marketing center

**(800) 426-2200**, extension **3911**.

between 8:00 a.m. and 5:00 p.m., Pacific Time.

Outside of North America, call your local Tektronix sales office or distributor.

**Microsoft Windows** For technical support for Microsoft *Windows*, contact your Microsoft support center.



# Section 2

## GETTING STARTED

### Software Installation

#### Programs and Files

The *WaveWriter* program comes to you on both 5¼" (1.2 Mbyte) and 3½" (1.44 Mbyte) diskettes. Either of the two diskette sizes can be used to install *WaveWriter* on your system. Use the one that matches your system configuration or preference.

#### Making a Backup Copy

Magnetic diskettes are subject to physical damage and the data on them is easily destroyed by inadvertant stray magnetic fields. A backup copy is inexpensive insurance against loss of data.

Before proceeding, you should make a copy of each of the diskettes in the *WaveWriter* package. Use the copies for installing programs and files, and store the original diskettes in a safe place.

Consult your DOS or Windows 3.0 manual for instructions on making copies of the diskettes.

## **Installing Files on a Hard Disk**

Insert the **WaveWriter** Setup and Program diskette (Disk 1) in drive A:

If you are not in Windows type **WIN a:\install**

If you are in Windows with the Program Manager active

Click on the **E**lle command. The file menu should appear.

Click on the **B**un command. The **Bun** dialog box should appear.

In the Command Line edit box type **a:\install** and click on **OK**.

At this point follow the instructions in each dialog box that appears until installation is complete. If you have a question or a problem occurs, click on **Help** in the dialog box.

## **Aborting the Installation**

If, at any time, you need to terminate the installation procedure, Click on **Exit** in the dialog box.

---

## **Starting WaveWriter**

To start WaveWriter double click on the WaveWriter icon

---

## Hardware Setup

### Configuring GPIB

To avoid conflicts between option cards and the GPIB card, you will need to ensure the **DMA** and interrupt channels are not the same as those of other devices in your PC. Consult the user's guide for your GPIB interface card to determine any hardware installation and setup that may be necessary. For example, if another interface card uses **DMA** channel 1, you need to set your GPIB card to a different **DMA** channel. Seldom, if ever, can two or more devices share the same **DMA** channel.

### Note to WaveWriter 1.0 Users

The `SET GPIB0` command is no longer needed in the `AUTOEXEC.BAT` file.





# Section 3

## USING WAVEWRITER

### Introduction

This section covers some basic **WaveWriter** concepts, shows you the basics of how to use this product, and gives you some background on the Microsoft *Windows* environment.

### The Target Instrument

Fundamental to **WaveWriter** is the concept of the target instrument. The target instrument is the instrument for which you are creating waveforms. The selected target instrument defines instrument specific parameters and limits, such as clock rate and vertical display ranges. When you bring in a waveform (from a different instrument or from a file) and the parameters do not match, you are informed of any discrepancies. The waveform may be altered to conform to the target instrument limits.

Before you begin creating or editing waveforms, you should select the appropriate target instrument (see **Configure/Change Instrument** in the **Transfer** menu). This insures that the waveform you are creating is suitable for the target instrument.

### Acquisition Only Instrument

This is an instrument driver that only acquires waveforms for **WaveWriter**. It does not have the capability of receiving a waveform and, therefore, can never become the target instrument. Acquisition Only instruments appear in the instrument list box when the **Transfer Acquire** menu item is selected. Communication parameters are set in the **Transfer Configure** dialog as explained in the **Transferring Waveforms** section.

### Clock Rate

Another fundamental concept in **WaveWriter** is that all waveforms in memory have the same clock rate (time/point). If you need to create waveforms of different clock rates, you must change the clock rate (see **Change Clock Rate** in the **Display** menu). Changing the clock rate reassigns the time/point for all waveforms in memory. It does not expand or compress the waveform to maintain the timing relationship, although that function is provided in **WaveWriter** (see **Horizontal Resolution** in the **Edit** menu). To create waveforms of different clock rates, we suggest you set the clock rate appropriately, create the waveform, save the waveform on disk, delete the waveform from **WaveWriter** memory, and then repeat the process for other waveforms.

**Offset**      Offset is handled in two ways within **WaveWriter**. The offset may be externally associated with a waveform, or it may be part of the waveform data values.

When acquiring or reading a waveform from an instrument or file, any offset externally associated with the waveform is remembered by **WaveWriter**.

For example, if acquiring from a 2400 Series DSO, offset is the equivalent of the vertical position control. If acquiring from the AFG 510115501, this is the OFFSET parameter. If you attempt to send that waveform to an instrument or write it to a file, you can modify the offset and store it with the waveform. If you modify the offset previously defined for that waveform, the changed value is remembered by **WaveWriter**. This offset is displayed with each entry in the *Waveform List* (described later in this section).

It is also possible to include an offset value in the waveform data values themselves. This is in addition to any offset externally defined. Add Scalar offsets waveform data values. The functions which create waveforms (Sine, Triangle, Pulse, Square, and Equation) also build the offset directly into the waveform data. For these cases, the waveform is no longer centered around 0 Volts on the display. Unless an external offset was already defined for the waveform, the external offset would be 0 Volts.

**Display / Bit range**      The horizontal axis represents time and is displayed in either *points* or *seconds*. The vertical axis displays the voltage and is always symmetrical around 0 Volts. The maximum peak-to-peak display amplitude can never exceed the maximum peak-to-peak amplitude of the target instrument. Although the waveform amplitude may exceed this limit, the data is clipped on the display, and clipped if sent to the target instrument or saved in an instrument-specific file.

The vertical axis amplitude represents the full bit range of the target instrument. That is, if the vertical axis range is set from + 5 Volts to - 5 Volts, and the target instrument has 12-bit resolution, 5 Volts would represent level 2047, and -5 Volts would represent -2047.

To use the maximum resolution of the instrument, we suggest you set the vertical scale to the full amplitude of the waveform (see Set Axis Ranges or Autoscale Current Waveform in Section 7 How to Display Waveforms). In addition, the waveform data needs to be centered around zero Volts. For example, if the waveform data values are offset so that they only lie in the upper half of the *Waveform Display Area*, only half the resolution is being used. You can use the Add Scalar function to add or subtract necessary offset so the waveform is symmetrical around 0 Volts, and then assign this scalar amount as an external offset when you save or send the waveform.

**Markers** Markers delimit segments of the waveform. For many menu selections, you have the option of using the entire waveform, or only the portion of the waveform between and including the markers. The distance between the markers can never exceed the maximum record length for the target instrument. If the *Start* or *Stop* marker is dragged past this length, the corresponding marker will be moved with it. (See *Markers* later in this section for more information.)

---

## **Why Use Windows?**

Microsoft *Windows* is a control program that provides a common interface between DOS, application programs, and you. With *Windows*, you can start several programs and switch between them, as needed, with a few keystrokes or a point and click with a mouse. Since you can leave a task without shutting it down, it is quickly resumed without having to restart — you can pick up where you left off.

*Windows* is a memory manager that lets several programs "set up shop" and arbitrates the demands these different tasks have on the system.

If you are already an experienced *Windows* user, proceed to *Setting Characteristics*, later in this section. If not, read on for some information on using *Windows*.

This section is not meant to be an exhaustive tutorial on *Windows*. Our purpose is to familiarize you with the conventions used by this and other programs designed to work with *Windows*. For more information, read the Microsoft *Windows* User's Guide (published by the Microsoft Corporation) or one of several other books on the subject.

## Consistent Command Style

*Windows* defines the display area of each task with a rectangular border. Many of these rectangular "windows" can be displayed on your monitor screen at the same time — each one representing an activated program. Each window generally has these common elements (also shown in Figure 3-1):

**Border** — defines the display area for a task.

**Title Bar** — shows the name of the program running in this window. May also show the name of a file associated with the program. A highlighted title bar indicates the currently active window. The *WaveWriter* title bar also displays the currently selected *target instrument* and the name of the current waveform (if any).

**Control-Menu Box** — when selected, displays the Control-menu.

**Control-Menu** — has commands that control the size and placement of the selected window.

**Minimize Box** — replaces a running program window with an *icon*. The program is still running, but the symbol (icon) representing the program only takes up a small space on the display screen.

**Maximize Box** — enlarges a window to fill the entire display screen. No other windows or icons are visible when the current window is maximized. Some applications that need the full screen may not have a border and can't be resized. Also, these applications may not have a maximize box.

**Menu Bar** — selectable groups or categories of commands are listed in the menu bar.

**Work Area** — the space where your application program displays text and graphics, and where you enter information for the program. The work area may be split into two or more smaller windows within the border. If your work is larger than can be displayed in the work area, some application programs add scroll bars to one or two borders of the work area (see *Scrolling*, below).

In addition, the MS-DOS Executive window has:

**Disk-drive Icons** — pictorial representations of the disk drives in your system configuration. The icon of the currently active drive is highlighted.

**Listing of the current directory** — the highlighted entry in the list is the one currently under consideration by MS-DOS for the next operation, whatever that may be.

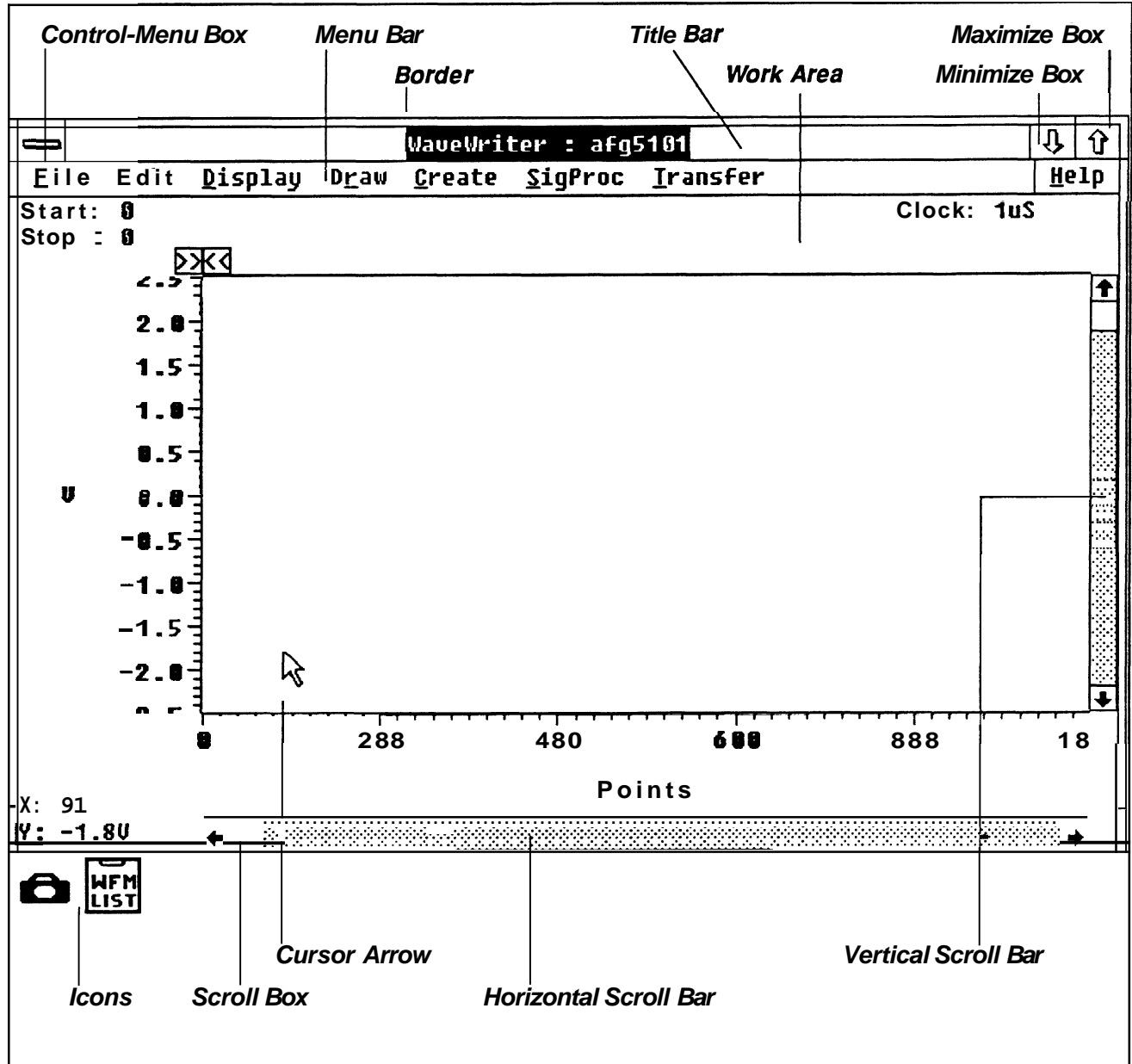
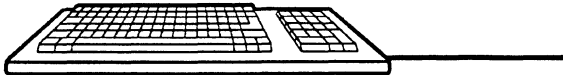


Figure 3-1. Window Display Elements.

### Scrolling

If there is too much information to fit in a window (such as a long directory listing), a scroll bar may appear at the side of the window frame. A window may have a vertical scroll bar, a horizontal scroll bar, or both. Scroll bars let you scan the window (work area) to access parts of your workspace beyond what's visible on the screen.

When you've reached the work area border, to scroll the screen:



Press **LEFT**, **RIGHT**, **UP**, or **DOWN** (as appropriate) to move the display further. For example, if you've reached the far right of the work area, press **RIGHT** repeatedly to advance the window to the right. The display in the work area moves to the left as you do so, exposing more and more of the right side of your work.

Some applications let you scroll a screenful at a time:

**PAGE UP** moves window UP or LEFT one screen.

**PAGE DOWN** moves window DOWN or RIGHT one screen.



The length of a scroll bar represents the length of the workspace in the dimension controlled by the scroll bar.

To see a part of the workspace that is currently *invisible*, drag the scroll box to the approximate location desired (toward the beginning, middle, or end of the scroll bar).

To scroll ONE LINE or ONE COLUMN at a time, move the mouse cursor (arrow) to a scroll arrow (pointing in the desired direction) and click the LEFT mouse button.

To scroll larger chunks at a time, move the mouse cursor to the scroll bar at either side of the scroll box and click the LEFT mouse button.

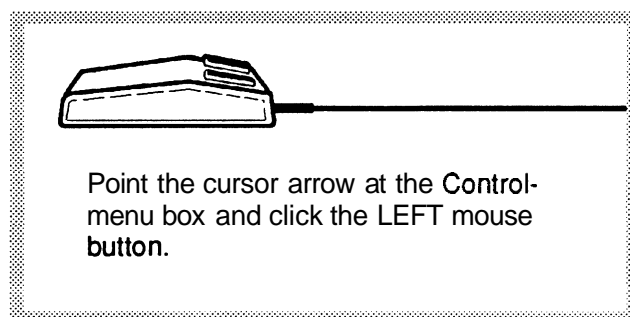
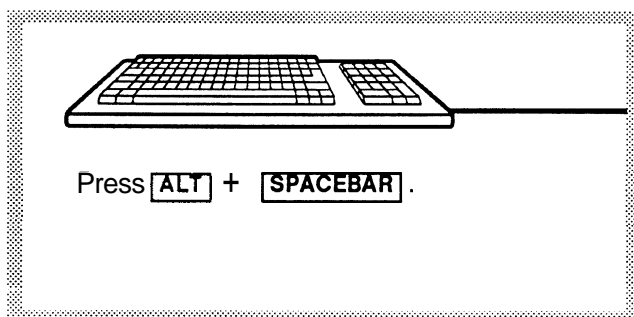
## Menu

There are two kinds of menu used with a window: the **control-menu** and **application menu**. Application menus contain commands that are specific to an application program. This section deals with the control-menu and menu commands that are features of *WaveWriter*.

### Control-menu

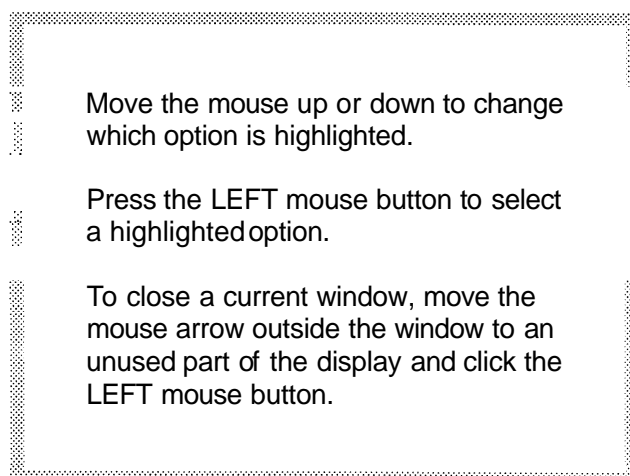
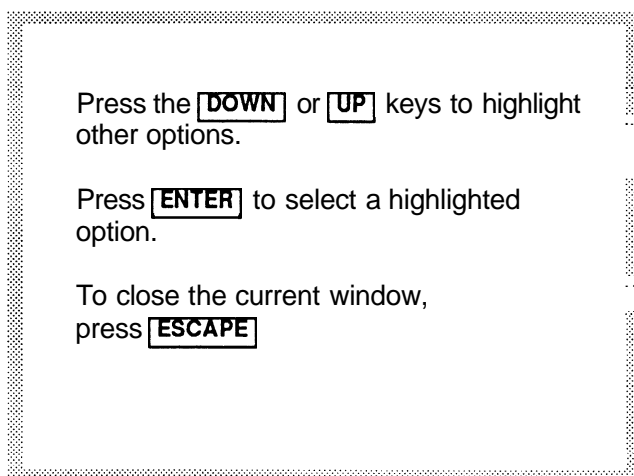
The Control-menu has commands that change a window's size, reposition it, restore it to its previous size or location, or close the window. The Control-menu commands Minimize and Maximize do the same thing as the Minimize and Maximize boxes.

**To access the control-menu:**



When the pull-down Control-menu appears, the Restore command is highlighted. If the window has not been resized, the Restore command is also shown in gray letters. This means that the Restore command is not an available option at this time. This is typical of all pull-down menu commands — a grayed-out option can not be selected.

**To access other command options:**



## Underlined Letters

Underlined letters provide keyboard access to commands. They are found in menu bars, pull-down menus, and dialog boxes (see *Dialog Boxes*, *Keyboard Direct Access* for more information).

### Menu Bars

Each command option in a menu bar has an underlined letter. This letter can be used in combination with the **ALT** key as a keyboard shortcut to select a menu bar option and pull down its menu.

### Pull-down Menus

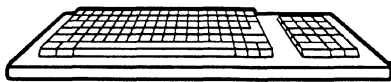
In pull-down menus, pressing the underlined letter in the desired command selects that option.

## Alternate Menu Bar Selections

After a menu bar option has been pulled-down, you can use the **LEFT** and **RIGHT** keys to pull down adjacent menu bar options. That is, when a menu is displayed, press **LEFT** and the menu is replaced by the menu to its left. If you press **RIGHT**, the menu is replaced by the menu to its right. When you reach either end of the menu bar, an additional key press takes you to the other end of the menu bar.

## Making a Selection

To select a highlighted menu item:



Press **ENTER**.



Press the LEFT mouse button.

Some commands in a menu list may need more information from you before proceeding, and display a dialog box to prompt you for further data. These commands are marked in the menu list with three dots (an ellipsis) following the command name.

Command selections displayed in gray are not available under the current conditions.



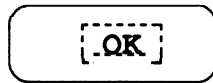
## Dialog Boxes

When you select a menu command that requires you to enter text or to inspect or modify a program parameter setting, a dialog box pops up in the middle of the display. Dialog boxes can be very simple or quite complicated, depending on how much information the program needs to do the job you requested it to do.

### Controls

Dialog boxes have several classes of *controls* (Figures 3-2A and 3-2B) that handle data differently:

**Edit box** — a space for you to enter or modify text.



**List box** — a list of names related to the current operation (see Figure 3-2B).



**Push button** — a rectangular button internally labeled with the action taken when it is selected.



**Radio button** — a captioned round button that selects **only one** of several optional features or conditions.

**Check box** — a captioned square box used where **several** options can be selected at the same time.

### Group Boxes

A group of related controls may be enclosed in a border with a descriptive heading — this is called a **group box**.

### The TAB key

The **TAB** key can be used to move between areas of a dialog box when selecting options. The caption of the control to which you've moved is enclosed in a dotted line. In the case of option buttons, the caption of the currently selected button is enclosed.

### Keyboard Direct Access

If a letter in the name of a control or group box heading is underlined, you can access the control or group box directly: press and hold **ALT**, press and release the underlined letter, then release **ALT**.

Figure 3-2A.  
Dialog Box Areas.

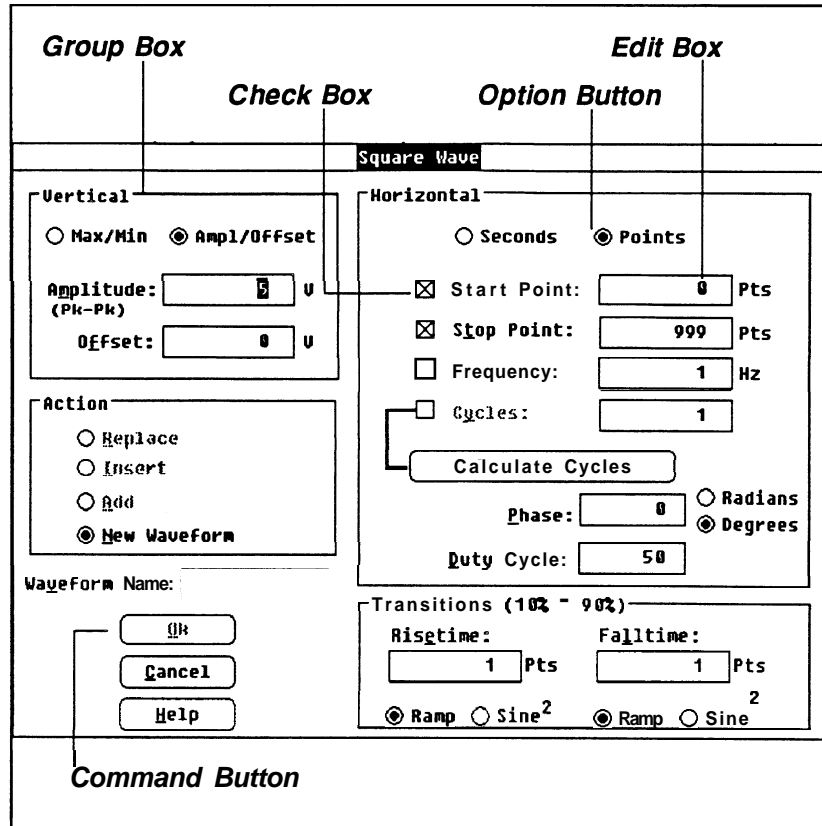
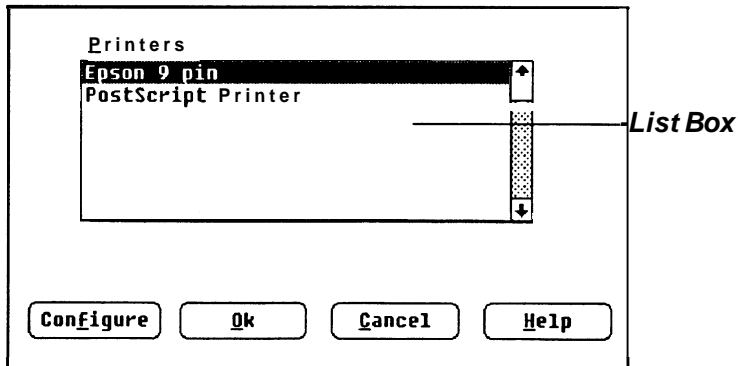


Figure 3-28.  
Dialog Box Areas.



### Data Already Entered

A dialog box may pop up with information already in place. This data is typically default or previous conditions; but the program can also display parameter values suggested by the present circumstances. In any case, you are free to make changes if the feature is not displayed in gray.

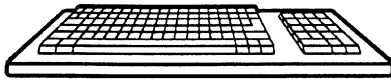
### Grayed Display

Grayed commands or options can not be accessed under the conditions in effect at the time the dialog box is displayed.

## Edit Boxes

In an edit box, a flashing vertical cursor marks the insertion point. Highlighted text is replaced when a key is pressed. When you press a displayable key, the character is displayed at the insertion point. Any existing text at the right of the insertion point is moved to the right.

To edit existing text:



Move the insertion point to the desired place in the text line with the **LEFT** or **RIGHT** key. Add characters as needed, or use either the **BACKSPACE** or **DELETE** key to remove unwanted text.

**HOME** moves the insertion point to the beginning of the line. **END** moves the insertion point to the end of the line.

Press **TAB** to move to the next area.



Point the mouse cursor at the desired insertion point and click the LEFT mouse button.

Enter or remove the desired characters from the keyboard as shown at left.

## List Boxes

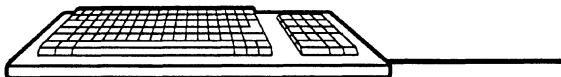
A list box is a column of names that you can choose from. These might be disk drive, file, and/or directory names, but can be a list of almost anything pertinent to a given function. If there are more names than can fit in the display, the list box has one or more scroll bars. Some names are enclosed in brackets:

[SUBDIR] — Text enclosed in brackets is a subdirectory name.

[. . .] — The parent directory, one level up, is indicated with two periods enclosed in brackets.

[-A-] — A letter enclosed in hyphens and brackets is a disk drive designation.

### To select a list box item:



Use the **UP** and **DOWN** keys to highlight the desired selection.

If the list is longer than can be displayed in the list box, use **PAGE UP** and **PAGE DOWN** to scroll the list.

**HOME** moves to the beginning of the list.  
**END** moves to the end of the list.

To select a highlighted item, press **SPACEBAR** or **ENTER**.



Point the cursor arrow at the desired item and click the LEFT mouse button. (In some cases, a double click is necessary — more later.)

If the desired item isn't visible, use the scroll bar to find it.

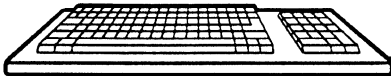
**Push Buttons**

Push buttons start an action process for a given dialog box. The default push button, if any, has a bolder outline than other push buttons in the same dialog box.

If you press **ENTER**, the default push button and any other dialog box selections (default or otherwise) are automatically chosen.

**Radio Buttons**

To select an radio button:



After moving to a radio button control with the **TAB** key, you can move *within* the control area with direction keys. Moving to an item within the control area selects that item. When you **TAB** to another control, the selected item stays selected.



To select an radio button, point to the desired button and click the **LEFT mouse button**.

**Check Boxes**

To select a check box:

After moving to a check box with the **TAB** key, select or deselect the box with the **SPACEBAR** key.

Point to the check box you want to alter and click the **LEFT mouse button**.

**The ESCAPE Key**

You can always cancel a dialog box with the **ESCAPE** key.

## Setting Characteristics

Waveform characteristics are defined by setting or modifying parameters in dialog boxes that appear when some menus are selected.

### Units of Measure

Wherever it's appropriate, units of measure are appended to an edit box at its right side. Modifiers to those units are included as part of the data within the edit box. For example, a value of 230 milliseconds is displayed as:

s

The modifiers that are recognized by **WaveWriter** are these *Systeme Internationale* (SI) characters. Case is significant.

G = giga	u = micro
M = mega	n = nano
K = kilo	p = pico
m = milli	

Non-integer numeric values can be expressed in *scientific* or *exponential notation*. Scientific notation uses a *mantissa* (a decimal number) followed by an *exponent*. The form for this type of number is:

$n.nn E- n$

The signs can be omitted for positive values.

The earlier 230 millisecond example could also be entered as any of the following:

<input type="text" value="0.23"/>	s
<input type="text" value="0.23E0"/>	s
<input type="text" value="2.3E-1"/>	s
<input type="text" value="230,000u"/>	s

### Choice of Units

Some parameters can be expressed in different units of measure. Horizontal units can be either *Seconds* or *Points*. Phase angle can be *Degrees* or *Radians*. (Vertical units are always Volts.)

Units of measure are selected with option buttons. When a different unit of measure is chosen, the current edit box value is converted to the new units.

## Waveform List

The *Waveform List* area of the display lists the waveforms currently loaded in memory. You can pick from this list to select a different **waveform** as the current **waveform**. To change waveforms, point to the desired waveform in the list and click the LEFT mouse button or, using the keyboard cursor keys, highlight the desired waveform in the list and press **[SPACEBAR]** or **[ENTER]**.

Each waveform name in the list is displayed in the color defined for that waveform, except white is displayed as black. The current waveform is highlighted. If there are more names than can fit in the *Waveform List* box, scroll bars are added to the display.

Also, on each entry line, the *Waveform List* shows the waveform's saved offset value, length, and waveform type. The length is the number of data points in the waveform. The waveform type is either "Wfm" for waveforms, or "Env" for envelopes. (See *Offset* earlier in this section.)

**NOTE** *Select colors with care. If the waveform color is the same as the background color, it won't be visible. If this happens, correct one or both colors with the **Set Colors & Line Styles** command in the **Display** menu.*

The *Waveform List* can be moved, resized vertically, or changed to an icon. When **WaveWriter** starts, the *Waveform List* is displayed as an icon. Any user activity (keyboard or mouse) also reduces the *Waveform List* to an icon at the bottom of the screen automatically. At any time, while **WaveWriter** is active, the *Waveform List* icon can be expanded to a window for viewing filenames and selecting loaded waveforms. You can do this by either pointing to the *Waveform List* icon and double-clicking the mouse, or by using the **[TAB]** key to move to the icon and selecting it with the **[SPACEBAR]** or **[ENTER]** key. If the **WaveWriter** window is maximized, use the **Change Current Waveform** command in the Display menu.

Waveform Name	Offset	Length	Type	
MODULSIN.ADF	0V	2.56mS	Wfm	↑
REF1ENV.ADF	-100mV	1.31mS	Env	
SQUARE.ADF	0V	1.31mS	Wfm	
PULSE.ADF	0V	1.28mS	Wfm	
INTERMOD.ADF	0V	2.56mS	Wfm	

Figure 3-3  
Waveform List.

## The WaveWriter Window

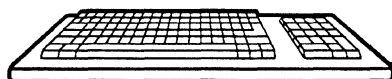
### Markers

In the horizontal axis, portions of the displayed waveform can be bounded by the *Start Marker* and the *Stop Marker*. These markers are used to define a narrower region to be acted on by various **WaveWriter** command tools.

Each marker has a “flag” attached to it at the top of the waveform display area. The *Start Marker* flag is marked with the symbol “>>” and the *Stop Marker* flag is marked with “<<”.

The precise location of the markers is displayed in the upper left corner of the window. The distance between the markers can't exceed the maximum record length of the target instrument. If the *Stop Marker* is dragged past this length, it will pull the *Start Marker* with it. The same is true in the other direction; the *Start Marker* will also pull the *Stop Marker*. The readout is either in Points or Seconds, to match the waveform display. (See **Set Axis Ranges** in the **Display** menu.)

**To adjust the markers:**



**TAB** to a *Start* or *Stop Marker*. The selected marker flashes one time. Press **SPACEBAR** or **ENTER** to activate the marker. Use the **LEFT** and **RIGHT** cursor keys to position the marker. Press **SPACEBAR** or **ENTER** to set the marker.



Click and **HOLD** the **LEFT** mouse button on the marker you wish to move. Drag the marker horizontally to the desired position. When you release the mouse button, the marker is set.

### Title Bar

The Title Bar lists 3 items separated with colons: The name “**WaveWriter**,” the target instrument, and the name of the current waveform.

### Coordinates

The precise location of the pointer or the crosshair cursors (whichever is selected), is displayed in the lower left corner of the window. The X readout is either in *Points* or *Seconds*, to match the waveform display. The Y readout is always in Volts.



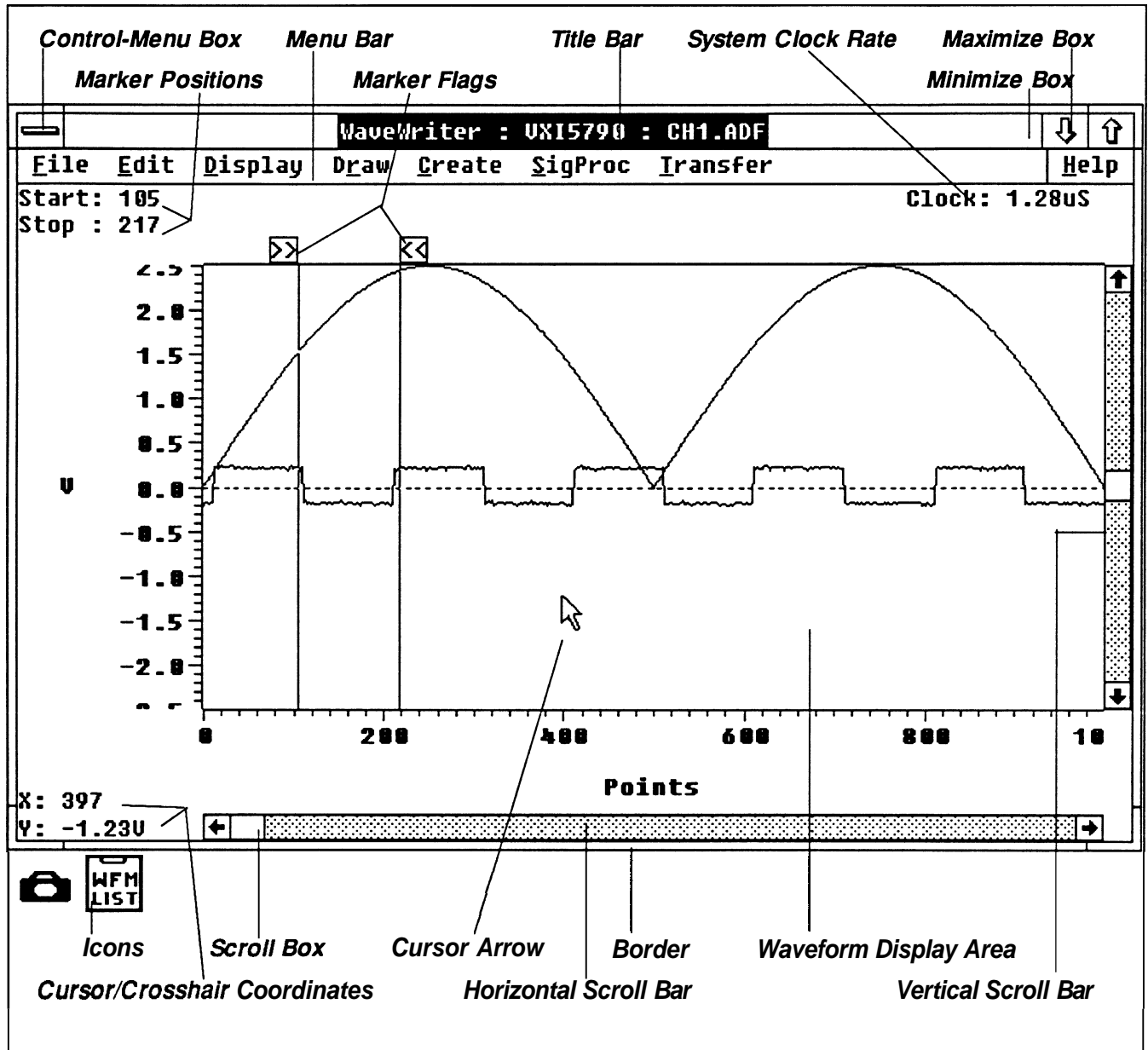


Figure 3-4. WaveWriter Window Display Elements.

## Waveform Display Area

This area of the screen displays the waveforms that have been acquired, created, or modified. When a waveform is created (or acquired), even if a longer length is valid for an instrument, the range that can be displayed in **WaveWriter** is 0 ~ 32766 points. The *Waveform Display Area* can scroll throughout this range.

**Clock** The readout in the upper right corner of the window is the clock rate of the waveforms in the *Waveform List*. All waveforms in memory have the same clock rate. See *Change Clock Rate* in Section 7. The clock rate is used in frequency and equation calculations.

**Menu Bar** The *Menu Bar* just below the *Title Bar* displays the menus available to you. Select a menu with a point and click of the mouse or press and hold **ALT**, press and release the underlined letter, then release **ALT**.

**Help** The menu item at the far right of the *Menu Bar* is the Help command. You can select the Help command to provide you with a brief explanation of the workings of various **WaveWriter** commands. When Help is selected from the main menu bar (with no dialog box displayed on the screen), a Help Topics dialog box (Figure 3-5) appears with a list box of available help text messages.

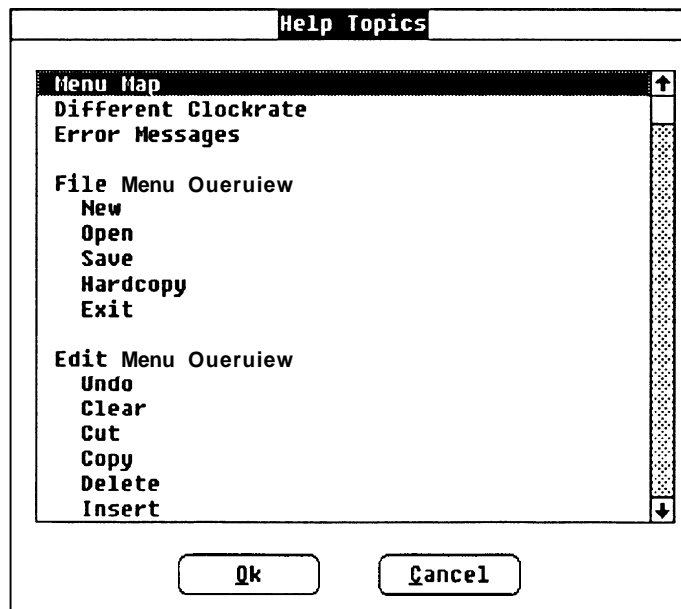


Figure 3-5.  
The Help Dialog Box.

**OK** — displays help for this highlighted topic. Return from the help message display by selecting the Control-menu box and then selecting Close from the Control-menu or double-clicking the Control-menu box.

**Cancel** — returns to the main screen display.

# Section 4 TUTORIAL

## What This Tutorial Covers

In this section we **will** cover the essentials of using **WaveWriter**. This includes the user interface (commands, controls, and displays). The tutorial is broken into five lessons:

- System fundamentals.

- Creating and modifying waveforms.

- Working with an AFG 510115501 Arbitrary Function Generator.

- Working with a 2400 Series Digital Oscilloscope and envelope waveforms.

- Working with a VX5790 VXI Arbitrary Waveform Generator and the Sequence Editor.

Each lesson can be followed independently of the others. We recommend, however, that you go through lesson 1 first, and then on to the lesson suited to the instrument you'll be using. The lessons use waveforms and other files that are distributed with **Wave Writer** and are loaded when you install the software. The last three lessons require that the instrument be available for some parts of the lesson.

In each lesson, you are asked to clear waveforms from memory before beginning. If there are waveforms in memory which have not been altered, you will be prompted to save them first. If you want to save the data, select **Yes**. Otherwise, select **No**.

In some lessons, you save files that you create. Therefore, if you go through the same tutorial more than once, the file you are creating will already be on disk. If so, you will be warned and asked if you want to overwrite it. Select **Yes** to overwrite it.

Whenever you see a phrase like,

Enter "1.24u" in the *Start* edit box.

it means to place the cursor in the *Start* edit box (by clicking on it with the mouse, tabbing to it, or using the accelerator key) and

inputting the characters 1.24u. It does not mean to Press the **ENTER** key too. For dialog boxes, the **ENTER** key is usually the equivalent of selecting OK.

We are assuming that you are already familiar with the Microsoft Windows interface. If not, please refer to the appropriate Microsoft Windows manuals and possibly their tutorial on learning Windows.

We are also assuming that you are using a mouse. We feel that this is the best way to use WaveWriter, although it can be used without a mouse. If you do not have a mouse, refer to either your Microsoft Windows manuals, or Section 3 of this user guide, for information about how the Microsoft Windows interface works without a mouse.

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## Lesson 1: System Fundamentals

### Overview

The objective of this lesson is to familiarize you with the basic operation of **WaveWriter**. We will address the important concepts of the target instrument, clock rate, and offset. We will describe the **WaveWriter** display including how to set up the horizontal and vertical axis scales, how to move the markers, and how to use the cursor coordinates. We will tell you how to display help screens.

### Step 1: Starting **WaveWriter**

If you have not installed **WaveWriter**, please do so before you continue.

For this example, we are assuming that you have installed **WaveWriter** on directory C:\WW. If not, please substitute for C:\WW the drive and directory where you have installed **WaveWriter**.

- a) Enter CD C:\WW to make the **WaveWriter** directory the default directory.
- b) If you have *Windows/286*, enter WIN WAVE.
- c) If you have *Windows/386*, enter WIN386WAVE.

WaveWriter is loaded and the copyright screen is displayed. Note that the **WaveWriter** title bar includes the name WaveWriter and the target instrument. Below that is the main menu bar. Below the File menu selection are the Start and Stop marker locations. Below the Help menu selection is the system clock rate. The *Waveform Display Area* is below that. To the lower left of the *Waveform Display Area* is the cursor coordinates display. If you move the mouse cursor around in the *Waveform Display Area*, you will notice that the coordinates display is updated.

**Note** *If you are using a monochrome monitor, you may want to use the **Display** menu function **Set Colors & Line Styles** to use only the colors black and white. For example, either set the current waveform, background waveforms, and labels & units colors to black and the background and graph background to white, or vice versa. Otherwise, the waveforms may not be visible in the default colors.*

**Step 2:**  
Using the Help **function**

Help information is available to you when you use **WaveWriter**. The help screens that are displayed are very similar to information that is found in the **WaveWriter** User Guide.

There are two ways that you can display help screens within **WaveWriter**. The Help function in the main menu will display a list of all help topics available. In addition, each dialog box in **WaveWriter** has a Help command button. If you select the Help command button, you will get information pertinent to the dialog box (menu selection).

- a) Select the Help function from the main menu.  
The Help Topics dialog box is displayed. It lists all help topics which are available.
- b) Double-click on the **WaveWriter** Overview topic.  
The Overview help screen is then displayed. This discusses the concepts of target instrument, clock rate, offset, **display/bit** range, markers, and acquisition only instruments.
- c) Point to the vertical scroll box, click the LEFT mouse button, and drag it to the bottom to view the entire help window.
- d) To close the help window, double-click on the Control-menu box at the upper left corner of the help window.  
This returns you to the Help Topics dialog box.
- e) Point to the vertical scroll down arrow, click and hold the LEFT mouse button, to scroll through the entire help topics list.
- f) Select Cancel when you are done viewing the help topics to exit the Help function.

### Step 3: Selecting the target instrument

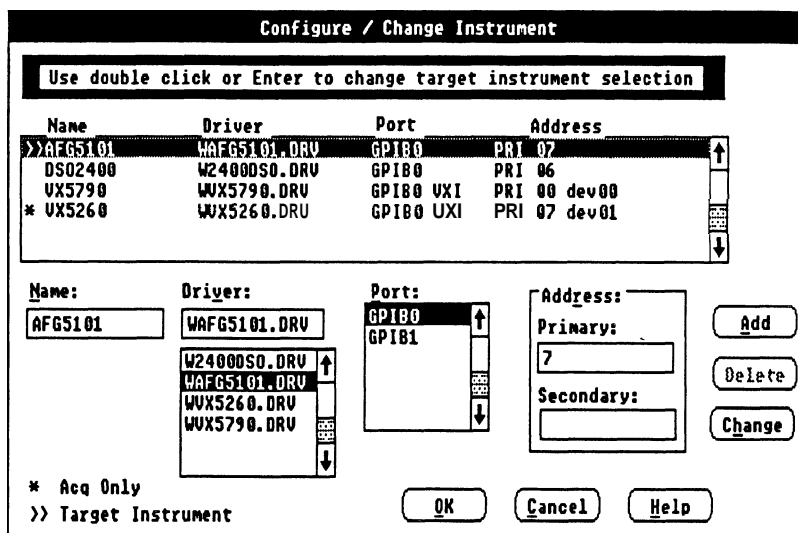
The selected target instrument defines instrument specific parameters and limits such as clock rate, *Start* and *Stop* marker limits, and vertical resolution and display range. The target instrument is the only instrument that you can send waveform data to until you select a different target instrument.

If you will always use **WaveWriter** with one target instrument, you simply set it once and it will be remembered from then on. If you will be building waveforms for more than one instrument, you will need to set the appropriate target instrument before you begin creating the waveform to insure that it is acceptable for that instrument.

- a) Select the **Transfer** menu function **Configure/Change Instrument**.

The Configure/Change Instrument dialog box is displayed, as shown in Figure 4-1.

Figure 4-1.  
Configure/Change  
Instrument Dialog Box.



This dialog box is used to change the target instrument. It is also used to add, change or delete instruments which are configured.

The line in the *Configurations* list box with the >> indicates the instrument which is selected as the target instrument.

Lines marked with an asterisk (\*) are acquisition only instruments and cannot be selected as the target instrument.

- b) Double-click on the AFG 5101 driver in the *Configurations* list box, if it is not already the target instrument.

- c) Select the **Help** command button.

The **Configure/Change** Instrument help window is displayed. Read through the text to learn about how this selection is used to configure new instruments.

- d) Double-click on the **Control-menu** box to close the help window.

- e) Select **OK**

- f) If the system clock rate is not valid for the newly selected target instrument, you are warned and offered the chance to change it to the nearest valid rate for the new target instrument. Accept the value offered. Select **Yes**.

- g) You may also be warned that the display amplitude is too large for the new target instrument. It will automatically be adjusted to the maximum allowed by the target instrument.

The target instrument is now set to the AFG 510115501 and the **WaveWriter** title bar displays AFG 5101, the configured name. If the system clock rate was changed, its display is updated as well.

#### Step 4: Setting the clock rate

All waveforms in memory have the same clock rate, therefore changing the clock rate affects the frequency content of all waveforms in memory. The waveform shape or size (number of points) is not changed by this command, only the time per point is changed.

- a) Select the **Display** menu function **Change Clock Rate**.

Since the AFG 5101/5501 is the target instrument, the AFG 5101/5501 Clock Rate dialog box is displayed (see Figure 4-2). You have the option of entering the clock rate in either *Time per Point* or *Frequency*.

- b) Enter **2u** in the *Time per Point* edit box.

**Note** *This can be done several ways. The Time per Point entry could be entered as 2E-6, 2u, or .000002. If you enter the clock rate in Frequency, you could have entered the clock rate as either 500K, 500000, or 5E5.*

- c) To see the equivalent frequency, press **TAB**.

The *Frequency* edit box is updated to 500 K, as shown in Figure 4-2.

Figure 4-2.  
AFG 5101/5501 Change  
Clock Rate Dialog Box.

AFG 5101/5501 Clock Rate

Time per Point:  S  
(or)  
Frequency:  Hz

- d) Select **OK** to confirm the clock rate selection.

The clock rate display is updated to show the new clock rate. If the horizontal axis is displayed in seconds, the labels are updated to reflect the new clock rate.

**Step 5:**  
**Setting the axis ranges**

**Set Axis Ranges** sets the ranges for the vertical and horizontal axis scales of the waveform display. This selects a portion of the overall waveform to be displayed. Parts of waveforms outside the *Waveform Display Area* are clipped, not lost, and can be restored by setting a wider range again in the Set Axis Ranges dialog box.

- a) Select the **Display** menu function **Set Axis Ranges**.

The Set Axis Ranges dialog box is displayed (see Figure 4-3).

- b) Enter "2.5" in the Amplitude edit box.

This will set the vertical axis from 1.25 Volts to -1.25 Volts.

- c) Select the Seconds option button.

Note that the units next to the *Start* and *Stop* edit boxes are changed to *Sec*. The selection of this option not only affects the way you enter the Start and Stop point, but also indicates the units used for the horizontal axis, the *Start* and *Stop* marker readouts, and the X coordinate readout.

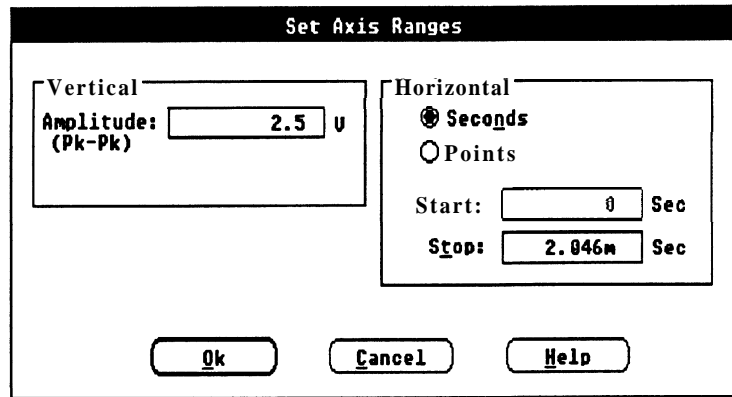
- d) Enter "0" in the Start edit box.

- e) Enter "2.046m" in the Stop edit box.

The dialog box should now appear as shown in Figure 4-3.



**Figure 4-3.**  
**Set Axis Ranges Dialog Box.**



- f) Select **OK**.

The *Waveform Display Area* is then changed to reflect the new axis selection. The horizontal axis, *Start* and *Stop* markers, and X coordinate are displayed in seconds.

**Step 6:**  
**Read a waveform from disk**

Not all waveforms that are loaded or acquired have the appropriate clock rate. **WaveWriter** can manipulate a waveform so that it can conform to the required clock rate. The following procedure will illustrate this capability.

- a) Select the **File** menu selection **Open**.

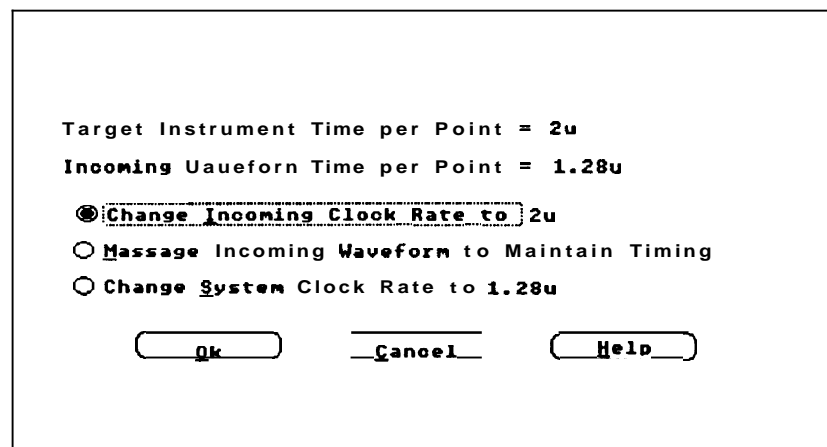
The Open dialog box is displayed.

- b) Select the ULTRASON.ADF file from the Files In list box.

- c) Select **OK**.

At this time a dialog box is displayed warning you that the clock rate of the waveform does not match the target instrument clock rate. You are offered three choices on how to resolve the differences, as shown in Figure 4-4.

**Figure 4-4.**  
**Different Clock Rate Dialog Box.**



The first selection, will change the clock rate of the incoming waveform to the system clock rate. It simply reassigns the **time/point** of the waveform without changing any data.

The second selection will either lengthen or shorten the waveform to maintain the timing relationship. In other words, one second in the incoming waveform will equal one second at the current clockrate.

The third selection will change the system clock to the rate of the incoming waveform. If there were other waveforms in memory, their clock rate would be reassigned as well.

- d) Select the *Change the Incoming Clock Rate* option button.
- e) Select **OK** to confirm the selection.

The waveform is then loaded, and the time per point reassigned from 1.28uS to 2uS. The waveform becomes the current waveform, as noted in the title bar.

Now we will load the file again, but this time we will choose the second option to maintain timing so as to compare results.

- f) Select the **File** menu selection **Open**. Double-click on the ULTRASON.ADF entry in the *Files In* list box.

You are warned that the file already exists and given the option to replace the waveform or create a new waveform.

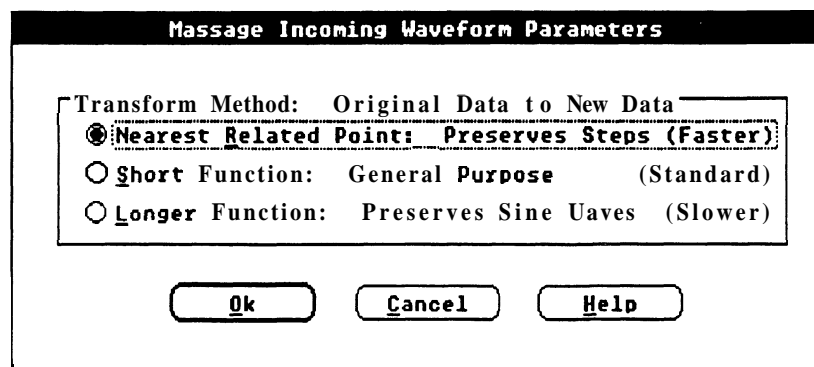
- g) Select the *Create New Waveform* option button. Enter ULTRA2 in the *New Waveform Name* edit box. Select **OK**.

The dialog box warning you of the different clock rates is then displayed.

- h) Select the *Message Incoming Waveform to Maintain Timing* option button and select **OK**.

You are then asked to choose between three transform methods, as shown in Figure 4-5.

**Figure 4-5.**  
**Transform Methods Dialog Box.**



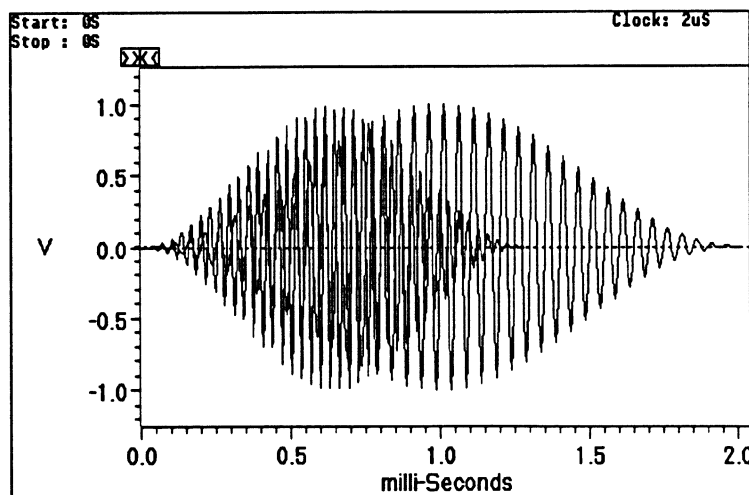
Selection of the nearest related point option replicates a single data level to calculate the needed data points and is the fastest method. Selection of short function option uses linear interpolation to calculate the needed data and is slightly slower than the preceding option. This selection is best suited when working on mixed signals such as pulse and sinusoidal waveforms within the same waveform. Selection of the long function option uses a spline interpolation algorithm to calculate the required data. This selection requires the longest amount of time and is best suited for sinusoidal type waveforms. It also produces the highest degree of accuracy.

- i) Select the ShortFunctionoption button.
- j) Select **OK** to confirm the selection.

The waveform is then decimated to conform to the system clock rate. Notice the differences in the waveforms. The new waveform becomes the current waveform, as noted by the change in the title bar, and the change of waveform colors.

The *WaveformDisplay Area* should now appear as shown in Figure 4-6.

**Figure 4-6.**  
**Waveform Display Area.**



- k) Load two **more** waveforms from disk using the following steps:

Select the **File** menu selection **Open**.

Double-click on the **SAMPLE.ADF** entry in the Files In list box.

This time, since the clock rate conforms to the system clock rate, the waveform is loaded automatically and becomes the current waveform.

Select the **File** menu selection **Open**.

Double-click on the DECA.Y.ADF entry in the Files In list box.

The waveform is brought into **WaveWriter** memory and becomes the current waveform.

**Step 7:**  
**Autoscaling the Current Waveform**

The **Autoscale Current Waveform** function is used to automatically change the axis scales to best fit the current waveform. The last two waveforms that were read into **WaveWriter** exceeded the vertical axis previously established in **Set Axis Ranges**.

- a) Select the **Display** menu function **Autoscale Current Waveform**

The vertical and horizontal axis scales are automatically changed based on the maximum and minimum Volts and record length of the current waveform.

Note that the waveform data was still there, even though the display clipped it.

**Step 8:**  
**Zooming In to see the waveform**

To magnify a region of the *Waveform Display Area*, use the **Zoom In** menu selection. This allows you to specify a region to be enlarged. This is useful for viewing and drawing.

- a) Select the **Display** menu function **Zoom In**.

The left hand corner of the zoom box appears. We will magnify the **second** cycle of DECA.Y.ADF.

- b) Using the coordinate readouts, place the corner at approximately x: 378uS, y: 3.53V. Press the LEFT mouse button and drag to approximately x: 766uS, y: 300mV. Release the mouse button.

The region within the box is now magnified.

- c) Select the **Display** menu function **Zoom Out** to return to the original display.

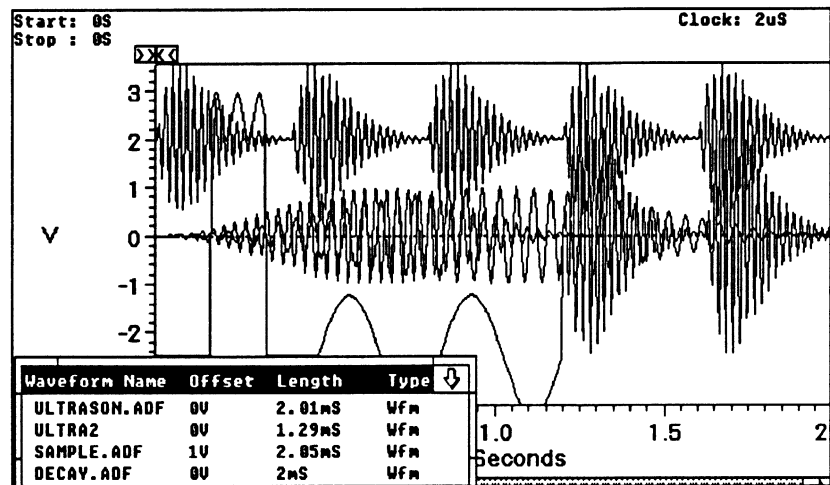
**Step 9:**  
**Selecting the current waveform**

Many **WaveWriter** functions operate on the current waveform. Many also establish the current waveform. For example, when you loaded a new waveform from disk, it automatically became the current waveform. To designate another waveform as the current waveform, you use the *WaveformList*. The *WaveformList* can be displayed either by selecting the **Display** menu function **Change Current Waveform**, or by double-clicking on the *WaveformList* icon at the bottom of the display. The *WaveformList* displays a list of waveforms currently in memory. The offset remembered for each waveform, the length, and the waveform type is also displayed. Waveform type is either waveform (WFM) or envelope (ENV).

- a) Double-click on the WaveformList icon.

The list shown in Figure 4-7 would be displayed. The rectangle indicates that DECAV.ADF is the current waveform.

Figure 4-7.  
WaveformList.



- b) Click on SAMPLE.ADF to make it the current waveform.

Note that the **WaveWriter** title bar is changed to reflect your choice. **SAMPLE.ADF** is now displayed in the current waveform color.

Note that the **WaveformList** will become an icon again as soon as you click outside the Waveform List Window.

### Step 10: Using offset

Offset is handled in two ways within **WaveWriter**. The offset may be externally associated with the waveform, or it may be part of the waveform data values.

When acquiring or reading a waveform from an instrument or file, any offset **externally** associated with the waveform will be remembered by **WaveWriter**. For example, if you read in a waveform file which has an offset stored with it, it will be remembered by **WaveWriter** and displayed in the WaveformList, but will not be used when displaying the data. If you send the waveform to an AFG 5101/5501, or VX5790 AWG, the offset will be sent with the waveform (e.g. OFFSET parameter). If you send it to a 2400 Series DSO, the vertical position control will be set to the offset value.

It is also possible to add offset into the waveform data values themselves. This would be in addition to any offset externally defined. **Add Scalar** will offset the waveform data values. Also, the functions which create waveforms (Sine, Triangle, Pulse, Square, and Equation) build the offset directly into the waveform data. For these

cases, the waveform will no longer be centered around 0 Volts on the display. Unless an external offset was already defined for the waveform, the external offset would be 0 Volts.

- a) If the *Waveform List* is not still displayed, double-click on the *WaveformList* icon.

Note that file **SAMPLE.ADF** has an external offset associated with it. The rest do not.

Look at the *Waveform Display Area*. *WaveformDECAY.ADF* has offset built into the data, i.e., there is no external offset assigned, but the waveform is not centered around 0 Volts on the display.

It is possible to have both an external offset, and to build some offset into the data itself.

**Step 11:  
Using the markers**

Markers delimit segments of the waveform in the horizontal axis. For many menu selections, you have the option of using the entire waveform, or only the portion of the waveform between and including the markers. The distance between the markers can never exceed the maximum record length for the target instrument. If the *Start* or *Stop* marker is dragged past this length, the corresponding marker will be moved with it.

Each marker has a flag attached to it at the top of the waveform display area. The *Start* marker flag is marked with the symbol >> and the *Stop Marker* with << .

The precise location of the markers is displayed in the upper left corner of the window.

- a) To move the *Start Marker*, click and drag on the box with the >>. As you drag the marker to the right, the *Stop Marker* will move with it automatically. As you then move the *Start Marker* back to the left, the *Stop Marker* will no longer move with it. Note that as you move the markers, the marker readouts are updated as well.
- b) To move the *Stop Marker*, click and drag on the box with the <<.

**Note** *Due to screen resolution, it is sometimes difficult to move a marker a point at a time. If this is a problem, use the Zoom In function to enlarge the region, move the markers as desired, and select Zoom Out.*

## Lesson 2: Creating and Saving a Television Signal Waveform

### Overview

This lesson steps you through the creation of a television signal waveform using various **WaveWriter** menu selections. You will learn to use:

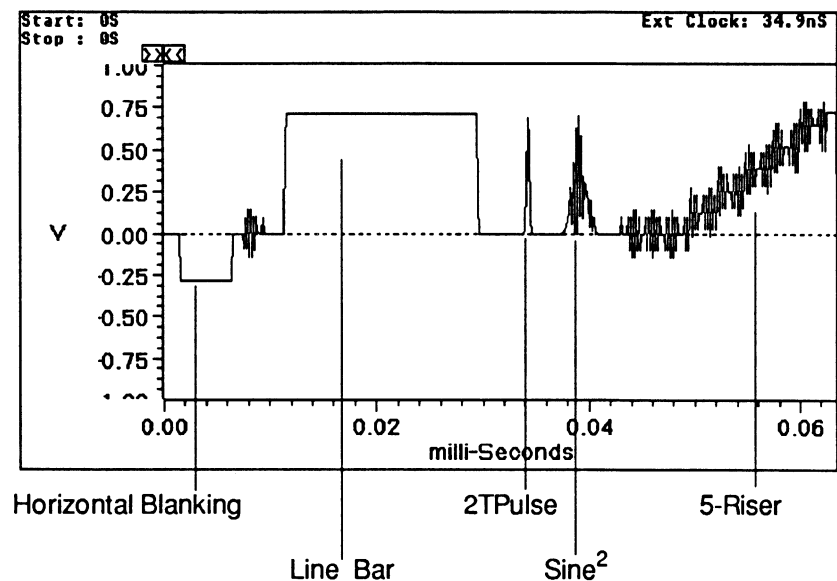
- Create functions (Equation, Sine, and Pulse)
- Draw functions (Autoline and Horizontal)
- Edit functions (Copy Between Markers and Replace Between Markers)
- SigProc** functions (Add Scaler, Multiply by Scaler and Multiply Waveforms).

The waveform you will create is a NTC-7 composite test signal. It consists of 5 parts:

- Horizontal Blanking Pulse
- Line Bar
- 2TPulse
- ModulatedSine-SquaredPulse
- Modulated5-riser staircase

Figure 4-8 is a picture of the waveform you will be creating.

**Figure 4-8.**  
**NTC-7 Composite Test Signal.**



**Step 1:**  
**Clear all waveforms from  
WaveWriter memory, if any exist**

- a) Select the **Edit** menu function **Clear Waveform(s)**

The Clear Waveform(s) dialog box appears.

- b) Select the All **Waveforms** command button.

**Note**

*Clear Waveform(s) is grayed and unavailable if there are no waveforms in memory. If there are waveforms in memory which have been altered and not saved, you are given the option to save them before deleting them.*

**Step 2:**  
**Change the target instrument  
to the VX5790**

- a) Select the **Transfer** menu function **Configure/Change Instrument**.

The Configure/Change Instrument dialog box appears.

- b) Double-click on the *Configuration list* box entry for WVX5790.DRV.

Note that the >> indicator is now with the VX5790 entry.

- c) Select **OK**.

- d) If you are warned that the current system clock rate is invalid for the newly selected target instrument, select **OK** to accept the clock rate offered.

Note that the **WaveWriter** title bar displays VX5790 as the target instrument.

**Step 3:**  
**Change the system clock rate  
to 34.9 nanoseconds**

- a) Select the **Display** menu function **Change Clock Rate**.

The Change Clock Rate dialog box for the VX5790 AWG appears (see below).

- b) Select the *External* option button.

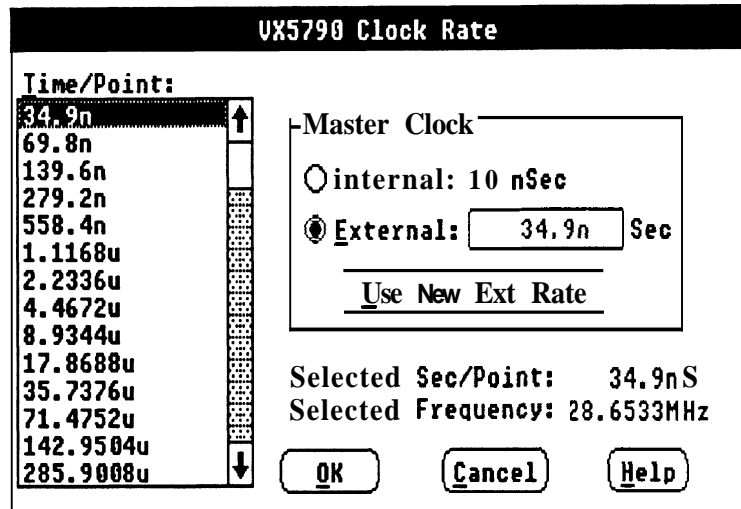
- c) Enter 34.9n in the *External* edit box.



- d) Select the **Use New Ext Rate** command button.  
Note that the *Time/Point* list box is updated.
- e) Select **34.9** nanoseconds from the *Time/Point* list box.

The dialog box should now appear as follows:

**Figure 4-9.**  
**VX5790 Change Clock Rate**  
**Dialog Box.**



- f) Select **OK**

The clock rate display just below the menu bar at the far right is updated to show the new system clock rate.

#### Step 4: Create a new waveform

- a) Select the **File** menu function **New**.  
The New dialog box appears.
- b) Enter "lesson2" in the New *Waveform Name* edit box.
- c) Select the Seconds option button.
- d) Enter 63.6576u in the Record Length edit box.
- e) Select the Normal Waveform option button.
- f) Select **OK**.

A new waveform is created at 0 Volts. This waveform becomes the current waveform, as noted in the **WaveWriter** title bar.

**Step 5:**  
Set up the axis to display  
the desired amplitude and  
record length

- a) Select the Display menu function Set **Axis** Ranges.

The Set Axis Ranges dialog box appears.

- b) Enter "2" in the Amplitude edit box.
- c) Select the Seconds option button.
- d) Enter " 0 in the *Start* edit box.
- e) Enter **63.6227u** in the Stop edit box.
- f) Select **OK**.

The vertical and horizontal axis ranges are updated to reflect your responses. The horizontal axis, markers and X coordinate readouts are in seconds.

**Step 6:**  
Create the horizontal  
blanking pulse

- a) Select the Display menu function Zoom In.

The left hand corner of the zoom box appears.

- b) Using the coordinate readouts, place the corner at approximately x: **0S**, y: **350mV**. Press the LEFT mouse button and drag to approximately x: **9uS**, y: **-720mV**. Release the mouse button.

The region within the box is now magnified.

- c) Select the Draw menu function Horizontal.
- d) Position the cursor at x: **1.54uS**, y: **-285.7mV (+/- 10mV)**. Click the LEFT mouse button and drag to x: **6.42uS**. (Note that as you drag the mouse, the horizontal line always stays at the original voltage selected.) Release the LEFT mouse button to end the line segment. Press the RIGHT mouse button to redraw the display.

**Note** If you have difficulty positioning to the initial location using the mouse, use the mouse to get close to it, and then use the direction keys to move to the exact location.

- e) Select the **Display** menu function **Zoom Out**.
- f) Select the **Create** menu function **Sine**.  
The Sine dialog box appears (see below).
- g) Select the *Ampl/Offset* option button in the *Verticalgroup* box.
- h) Enter "285.7m" in the *Amplitude* edit box.
- i) Enter "0" in the *Offset* edit box.
- j) Select the *Seconds* option button in the *Horizontalgroup* box.
- k) Click on the *Cycles* check box if it isn't empty.

Note that the **Calculate** command button is changed to say Calculate Cycles. This is the parameter which will be calculated, based on the *Start Point*, *Stop Point*, *Frequency*, and system clock rate.

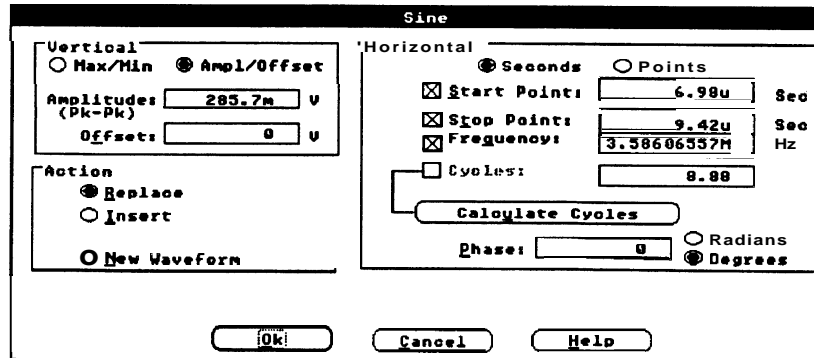
- l) Enter "6.98u" in the *Start Point* edit box.
- m) Enter "9.42u" in the *Stop Point* edit box.
- n) Enter "3.58606557M" in the *Frequency* edit box.
- o) Select the **CalculateCycles** command button.

*Cycles* is updated based on the parameters entered. The value should be 8.88.

- p) Enter "0" in the *Phase* edit box.
- q) Select the *Replace* option button in the *Action* group box.

The Sine dialog box should now appear as shown in Figure 4-10.

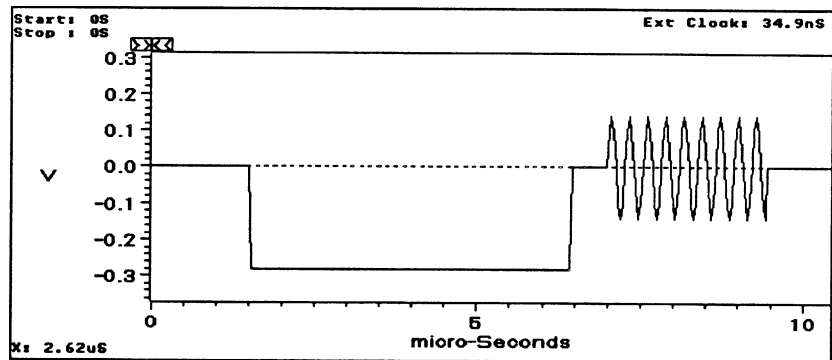
Figure 4-10.  
Sine Dialog Box.



- r) Select **OK**.
- s) Select the **Display** menu function **Zoom In** to magnify the region just created.

The display should be similar to that shown in Figure 4-11.

Figure 4-11.  
Horizontal Blanking Pulse.



- t) Select the **Display** menu function **Zoom Out** to return to the original display.

**Step 7:  
Create line bar**

- a) Select the **Create** menu function **Pulse**.

The Pulse dialog **box** appears.

- b) Fill out the Pulse dialog **box** as shown in Figure 4-12.

**Figure 4-12.**  
**Pulse Wave Dialog Box to**  
**Create Line Bar.**

**Pulse Wave**

**Vertical**

Maximum:  U

Minimum:  U

**Action**

Replace

Insert

Add

New Waveform

**Horizontal**  Seconds  Points

Start Point:  Sec

Stop Point:  Sec

Period:  Sec

Cycles:

Delay:  Sec

Pulse Width (50%):  Sec

**Transitions (10% - 90%)**

Pulse Direction:  Pos  Neg

Risetime:  Sec

Falltime:  Sec

Ramp  Sine<sup>2</sup>  Ramp  Sine<sup>2</sup>

c) Select **OK**.

**Step 8:**  
**Create 2T pulse**

a) Select the **Create** menu function **Equation**.

The Equation dialog box now appears (see below).

b) Select the **Library** command button.

The Equation Library dialog box is displayed.

c) Select the 2T pulse entry by double-clicking on it.

The Equation dialog box is redisplayed with the selected 2T pulse equation in the Equationedit box.

d) Select the Seconds option button.

e) Enter "33.923u" in the StartPointedit box.

f) Enter '34.551u" in the StopPoint edit box.

g) Select the Replace option button.

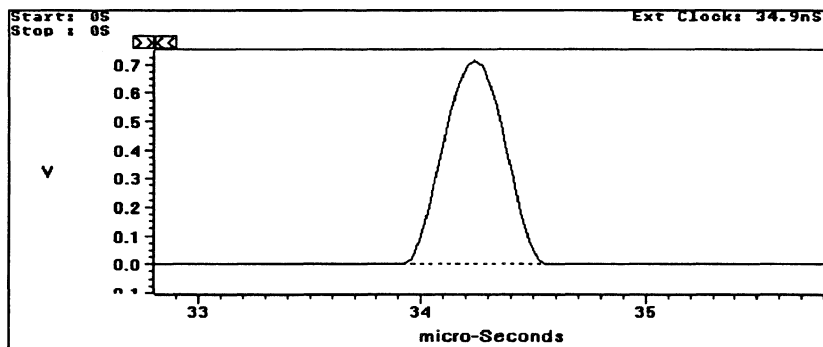
The dialog box should appear as shown in Figure 4-13.

Figure 4-13.  
Equation Dialog Box for 2T Pulse.

- h) Select **OK**.
- i) Select the **Display** menu function **Zoom In** to magnify the region just created.

The 2T Pulse is displayed in Figure 4-14.

Figure 4-14.  
2T Pulse Display.



- j) Select the **Display** menu function **Zoom Out** to return to the original display.

### Step 9: Create the modulated sine squared pulse

We will build the modulated sine squared pulse by creating two individual waveforms, multiplying them together, and then copying the result into the lesson 2 waveform we are creating.

Steps a through e could be done all in one step using the modsin2 equation in step a instead of the sin2 equation, but we wanted to show you how to use the **SigProc** and **Edit** functions.

- a) Select the Create menu function Equation.  
Select the Library command button.  
The Equation Library dialog box is displayed.  
Select the sin<sup>2</sup> entry by double-clicking on it.  
The Equation dialog box is redisplayed with the selected sin<sup>2</sup> equation in the *Equation* edit box.  
Enter "0" in the *Start Point* edit box.  
Enter "3.385u" in the *Stop Point* edit box.  
Select the *New Waveform option* button.  
Enter "sin<sup>2</sup>" in the *WaveformName* edit box.  
Select **OK**.  
The sine squared waveform is then created starting at time 0.
- b) Select the Create menu function Equation.  
Select the Library command button.  
The Equation Library dialog box is displayed.  
Select the carrier entry by double-clicking on it.  
The Equation dialog box is redisplayed with the selected carrier equation in the *Equation* edit box.  
Select the *New Waveform* option button.  
Enter "carrier" in the *WaveformName* edit box.  
Select **OK**.  
Notice that the *Start* and *Stop* Points remain the same as the previous step.  
The carrier waveform is then created starting at time 0.
- c) Now we will offset the carrier and scale it back to 1 Volt.  
Select the SigProc function **Add Scalar**.  
Enter 1 in the *Add Scalar* edit box.  
Select the *Entire Waveform* option button.  
Select **OK**.  
Select the **SigProc** function **Multiply by Scalar**.  
Enter .5 in the *Multiply by Scalar* edit box.  
Select the *Entire Waveform* option button.  
Select **OK**.

- d) Select the **SigProc** function Multiply Waveforms.

Double-click on the carrier entry in the *Displayed Waveforms* list box.

Note that the black rectangle is now around the *Wfm2* entry indicating that it is the edit box which will receive the input.

Double-click on the sin2 entry in the *Displayed Waveforms* list box.

Click on the *Wfm3* edit box and enter "modsine2" to put the product in a new waveform named modsine2.

Select **OK**.

modsine2 is now the current waveform.

- e) Select the **SigProc** function Multiply by Scalar.  
Enter .7143 in the *Multiply by Scalar* edit box.  
Select **OK**.
- f) Select the Display menu function Zoom In to magnify the region between approximately x: 0S, y: 700mV and x: 4.26uS, y: -100mV. .  
  
Move the *Start Marker* to 0S.  
Move the *Stop Marker* to 3.385 uS (the end of modsine2 waveform).
- g) Select the Edit menu function Copy Between Markers.  
  
This copies the data in modsine2, the current waveform, into the edit buffer.
- h) Select the Edit menu function Clear **Waveform(s)** to remove from memory the three waveforms we just created.  
Click on the sin2 entry.  
Press and hold the **SHIFT** key.  
Click on the carrier entry.  
Click on the modsine2 entry.  
Select **OK**.

For each waveform selected, you are warned that you haven't saved the waveform and given the opportunity to save it before it is deleted. Select No for each option since we don't need these waveforms any longer.



- i) Select the **Display** menu function **Zoom In** to magnify the region between approximately x: 36uS, y: 750mV and x: 42uS, y: -100mV.

Move the *Start Marker* to 37.413uS.

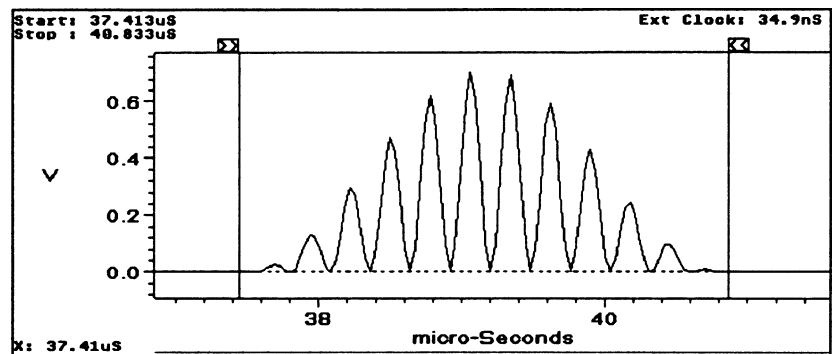
Move the *Stop Marker* to 40.833uS.

Select the **Edit** menu function **Replace Between Markers**.

This takes a copy of the edit buffer, which contains the modulated sine squared pulse, and puts it into the current waveform between the markers.

It should appear as shown in Figure 4-15.

**Figure 4-15.**  
**Modulated Sine Squared Pulse.**



- j) Select the **Display** menu function **Zoom Out** to return to the original display.

**Step 10:**  
**Create the modulated 5-Riser  
staircase test signal**

- a) Select the **Create** menu function **Sine** to create the first sine wave.

The Sine dialog box is displayed. Note that the values you entered last time are remembered. You only need to modify the entries which are different.

- b) Fill out the dialog box as shown in Figure 4-16.

**Figure 4-16.**  
**Sine Dialog Box for First**  
**Portion of 5-Riser Staircase.**

The dialog box is titled "Sine Dialog Box for First Portion of 5-Riser Staircase". It is divided into two main sections: "Vertical" and "Horizontal".

**Vertical Section:**

- Radio buttons:  Max/Min,  Ampl/Offset
- Amplitude:  U (Pk-Pk)
- Offset:  U

**Horizontal Section:**

- Radio buttons:  Seconds,  Points
- Start Point:  Sec
- Stop Point:  Sec
- Cycles:  Hz
- Phase:   Radians  Degrees
- Buttons:

**Action Section:**

- Radio buttons:  Replace,  Insert,  Add,  New Waveform

**Bottom Buttons:**

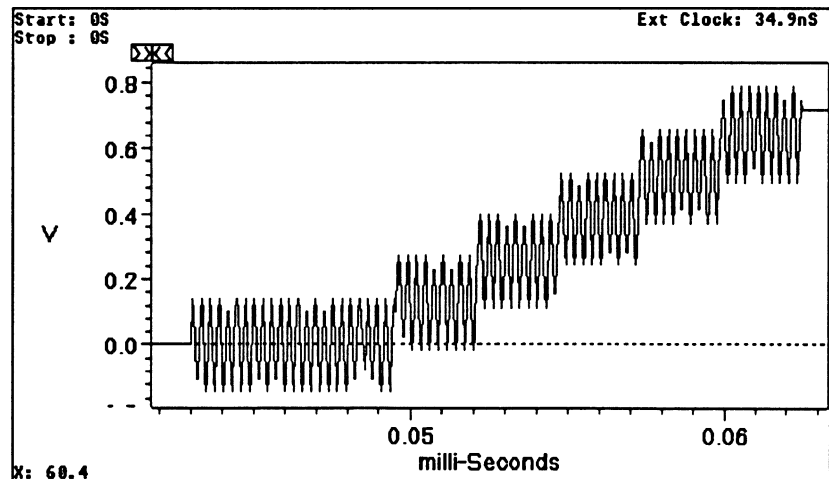
- c) Select **OK**.
- d) Select the **Create** menu function **Sine** to create the next sine wave on the stairstep.  
 Enter "128.6m" in the Offset edit box.  
 Deselect the StopPoint check box so that StopPoint is calculated.  
 Enter "49.523u" in the StartPoint edit box.  
 Enter "9.125" in the Cycles edit box.  
 Select the **Calculate Stop Point** command button to see the resulting StopPoint.  
 Select **OK**.
- e) Select the **Create** menu function **Sine** to create the next sine wave on the stairstep.  
 Enter "257.1m" in the Offset edit box.  
 Enter "52.07u" in the StartPoint edit box.  
 Select **OK**.
- f) Select the **Create** menu function **Sine** to create the next sine wave on the stairstep.  
 Enter "385.7m" in the Offset edit box.  
 Enter "54.617u" in the StartPoint edit box.  
 Select **OK**.
- g) Select the **Create** menu function **Sine** to create the next sine wave on the stairstep.  
 Enter "514.3m" in the Offset edit box.  
 Enter "57.164u" in the StartPoint edit box.  
 Select **OK**.
- h) Select the **Create** menu function **Sine** to create the last sine wave on the stairstep.  
 Enter "642.9m" in the Offset edit box.

Enter "59.714u" in the StartPoint edit box.  
Select OK.

- i) Select the Display menu function Zoom In to magnify the region between approximately x: 60uS, y: 800mV and x: 63.65uS, y: -100mV.
- j) Select the Draw menu function Autolinet to draw the final line of the waveform.
- k) Position the cursor at x: 62.26uS, y: 714.3mV (+/- 10mV).  
Click the LEFT mouse button and let up.  
Move the cursor to x: 63.45uS, y: 714.3mV.  
Press the LEFT mouse button to end the line segment.  
Press the RIGHT mouse button to redraw the screen.
- l) Select the Display menu function Zoom Out.
- m) Select the Display menu function Zoom In to magnify the 5-Riser staircase region just created (from approximately x: 42uS, y: 800mV, to x: 63uS, y: -200mV).

It should appear as shown in Figure 4-17.

**Figure 4-17.**  
**5-Riser Staircase.**



- n) Select the Display menu function Zoom Out to return to the original display.

Step 11:  
Save the waveform as an **ADIF** file

- a) Select the File menu function Save.

The Save dialog box appears.

Note that the name you entered, *lesson2*, shows up as the default for the Save File *Name* edit box.

- b) Select the *ADIFFile* check box.  
Use the **default** extension of ADF.  
Deselect the Instrument Specific File check box.  
Deselect the Make Backup check box.  
Use the default *Offset* of 0.  
Select OK.

File LESSON2.ADF is now saved.

Step 12:  
Load file **NTC-7.ADF** and  
compare results

- a) Select the File menu function Open.
- b) Double-click on the NTC-7.ADF entry in the Files In list box.

The waveform is loaded into **WaveWriter** memory and becomes the current waveform. This waveform is our solution to the above steps and should closely match yours, if you've followed all the steps correctly.

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### Lesson 3: Working with an AFG 5101/5501 Arbitrary Function Generator

#### Overview

This lesson illustrates the Acquire and Send functions for the AFG 5101/5501. You will load a waveform from disk, change the clock rate, and send the waveform to Bank 1 of the AFG. You will then acquire the same waveform back to show you that it got there correctly.

Step 1:  
Clear all waveforms from  
**WaveWriter** memory, if any exist

- a) Select the Edit menu function Clear **Waveform(s)**

The Clear **Waveform(s)** dialogbox appears.

- b) Select the All Waveforms command button.

**Note** *Clear Waveform(s) is grayed and unavailable if there are no waveforms in memory. If there are waveforms in memory which have been altered and not saved, you are given the option to save them before deleting them.*

Step 2:  
Change the target instrument  
to the AFG 510115501

- a) Select the Transfer menu function **Configure/Change** Instrument.

The **Configure/Change** Instrument dialog box appears.

- b) Double-click on the *Configuration list* box entry for **WAFG5101.DRV**.
- c) Select **OK**.
- d) If you are warned that the current system clock rate is invalid for the newly selected target instrument, select YES to accept the clock rate offered.

Note that the **WaveWriter** title bar displays AFG5101 as the target instrument.

Step 3:  
Change the clock rate to **2uS**

- a) Select the Display menu function Change Clock Rate.

The Change Clock Rate dialog box for the AFG 510115501 is displayed.

- b) Enter "2u" in the *Time per Point* edit box.
- c) Select **OK**.

The clock rate display just below the menu bar at the far right is updated to show the new system clock rate.

**Step 4:**  
Open file **SAMPLE.ADF**

- a) Select the **File** menu function **Open**.

The Open dialog **box** is displayed.

- b) Select the **SAMPLE.ADF** entry from the *Files In* list box by double-clicking on it.

The waveform is loaded from disk into **WaveWriter** memory and becomes the current waveform, as noted in the title bar.

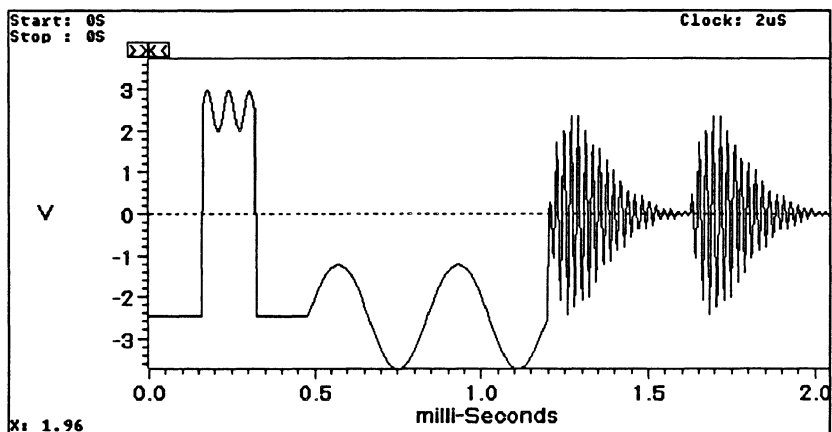
**Step 5:**  
Scale the waveform to utilize the maximum bit resolution based on the waveform amplitude

- a) Select the **Display** menu function **Autoscale Current Waveform**.

Note the change in the vertical and horizontal axis scales.

The waveform should appear as shown in Figure 4-18.

Figure 4-18.  
**SAMPLE.ADF** Display



**Step 6:**  
Send the waveform to the  
**AFG 510115501**

- a) Select the **Transfer** menu function **Send**.

The Send AFG **510115501** dialogbox appears, as shown in Figure 4-19. The instrument was first polled to get the current bank number and beginning address as defaults. The **WaveWriter** system clock rate, axis amplitude, and remembered offset are also displayed as defaults.

**Note:** *If the AFG 5105 is not at the GPIB address shown in the configuration dialog box, a warning stating that the AFG 5105 was not found is displayed. Select the "Search" option to have WaveWriter search all addresses for the AFG 5105.*

**Figure 4-19.**  
Send AFG 5101/5501 Dialog Box.

**Send AFG 5101/5501**

**Send Waveform**

**Send Waveform Between Markers**

Bank Number:

Begin BOOR:

Filter:

Output Amplitude:  V (50 Ohms)

Offset:  V

Time per Point:  s

- b) Select **OK** to accept the defaults shown.

The waveform is sent to the selected bank number, beginning at the address specified.

**Step 7:**  
Acquire the same waveform back  
from the AFG 5101/5501

- a) Select the **Transfer** menu function **Acquire**.

The Acquire dialog box appears with a list box of all instruments previously configured.

- b) Select the AFG 5101 by double-clicking on it.

The Acquire AFG 5101/5501 dialog box now appears. The Begin ADDR and Bank Number selected in the Send dialog box appear as the defaults.

- c) Select the CreateNew Waveform option button.

- d) Enter lesson3 in the *WaveformName* edit box.

The dialog box should now appear as shown in Figure 4-20.

Figure 4-20.  
Acquire AFG 5101/5501 Dialog Box.

Acquire AFG 5101/5501

Begin Addr: 0

End Addr: 1023

Bank Number: 1

Replace Current Waveform

Create New Waveform

Waveform Name: lesson3

Ok Cancel Help

e) Select **OK**.

The waveform is then acquired from the selected bank and becomes the current waveform. Note that the waveforms are identical in the *Waveform Display Area*.

---

## Lesson 4: Working with a 2400 Series Digital Storage Oscilloscope

### Overview

This lesson shows how to create an envelope waveform by tolerancing a non-envelope waveform. The newly created envelope and the original normal waveform are then sent to reference memory in the scope.

**Step 1:**  
Clear all waveforms from  
*WaveWriter* memory, if any exist

a) Select the **Edit** menu function **Clear Waveform(s)**.

The Clear Waveform(s) dialog box appears.



- b) Select the **All Waveforms** command button.

**Note** *Clear Waveform(s) is grayed and unavailable if there are no waveforms in memory. If there are waveforms in memory which have been altered and not saved, you are given the option to save them before deleting them.*

**Step 2:**  
Change the target instrument to  
the 2400 Series DSO

- a) Select the **Transfer** menu function **Configure/Change Instrument**

The **Configure/Change Instrument** dialog box appears.

- b) Double-click on the *Configuration* list box entry for **W2400DSO.DRV**.
- c) Select **OK**.
- d) If you are warned that the current system clock rate is invalid for the newly selected target instrument, select **OK** to accept the clock rate offered.

The **WaveWriter** title bar displays DSO2400 as the target instrument.

**Step 3:**  
Change the clock rate to 2mS/div

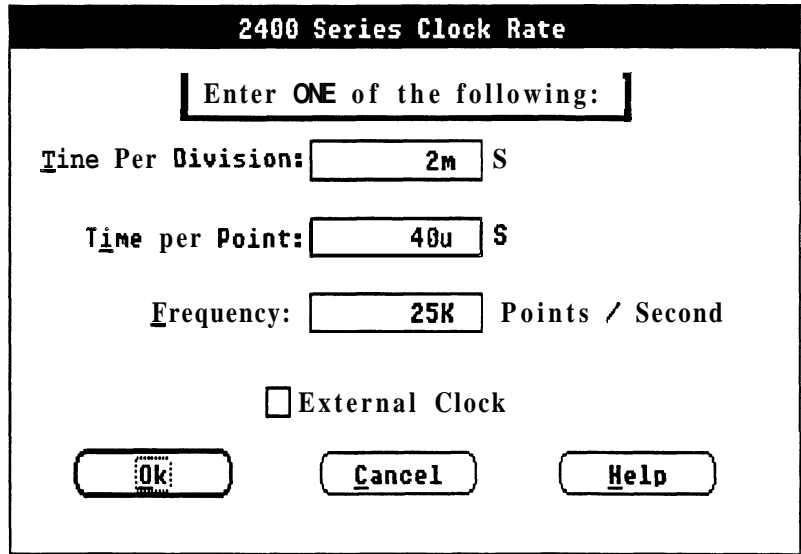
- a) Select the **Display** menu function **Change Clock Rate** .

The Change Clock Rate dialog box for the 2400 DSO is displayed.

- b) Enter "2m" in the *Time per Division* edit box.
- c) To see the corresponding *Time Per Point and Frequency* values, enter either **ENTER** or **TAB** . These edit boxes will be updated with the equivalent values.
- d) If the *External Clock* check box is selected, then deselect.

The dialog box should now appear as shown in Figure 4-21.

**Figure 4-21.**  
**2400 Series DSO Change Clock**  
**Rate Dialog Box.**



- e) Select **OK**.

The clock rate display just below the menu bar at the far right is updated to show the new system clock rate. It shows the clock rate in both time/point and time/div.

**Step 4:**  
**Set up the axis to display**  
**the desired amplitude and**  
**record length**

- a) Select the **Display** menu function **Set Axis Ranges**.

The Set Axis Ranges dialog box appears.

- b) Enter "1" in the Amplitude edit box.
- c) Select the Points option button.
- d) Enter "0" in the Start edit box.
- e) Enter "1023" in the Stop edit box.
- f) Select **OK**.

The vertical and horizontal axis scales are updated to reflect your responses. The horizontal axis, markers and coordinates readouts are in points.

**Step 5:**  
Open file **SQUARE.ADF**

- a) Select the **File** menu function **Open**.

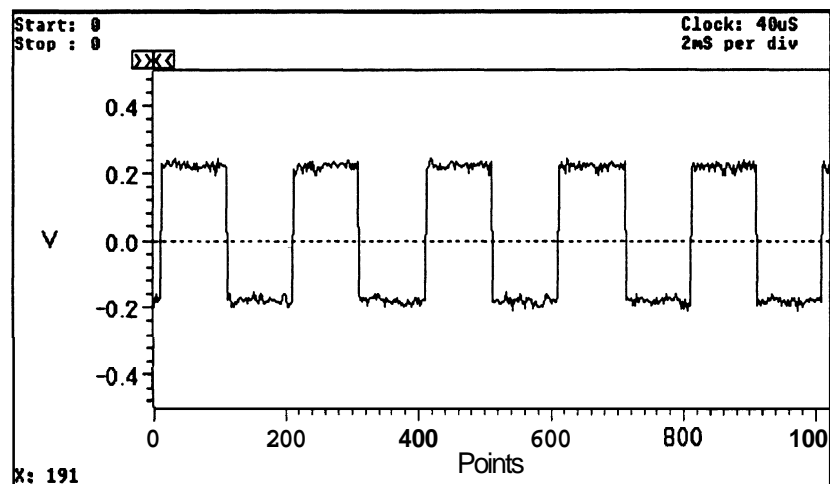
The Open dialog **box** is displayed.

- b) Double-click on the **SQUARE.ADF** entry in the Files In list **box**.

The waveform is loaded from disk into **WaveWriter** memory and becomes the current waveform, as noted in the title bar.

The **WaveformDisplay Area** should now appear as shown in Figure 4-22.

Figure 4-22.  
**SQUARE.ADF** Display.

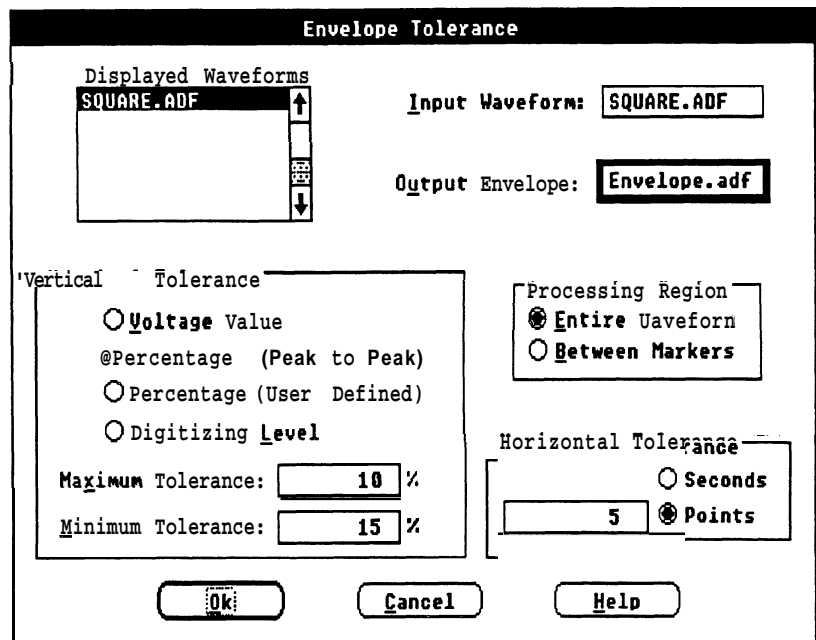


**Step 6:**  
Create an envelope waveform  
using **SQUARE.ADF** as the base

- a) Select the **Create** menu function **EnvelopeTolerance**.

Fill out the dialog **box** as shown in Figure 4-23.

Envelope  
Figure 4-23.  
nce & Box.

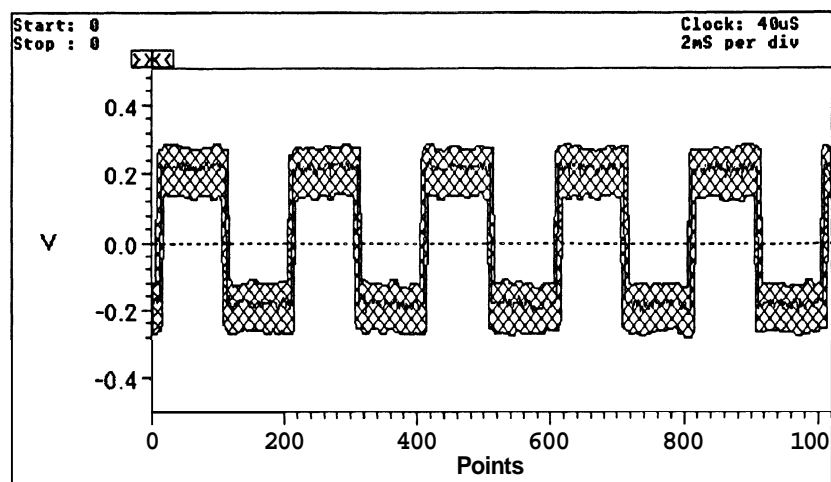


b) Select OK.

**WaveWriter** computes the waveform maximum and minimum values and then creates the upper limit of the waveform using a 10% vertical tolerance, and the lower limit using a 15% vertical tolerance. For the horizontal tolerance, each waveform point will be shifted left and right by 5 points, creating a band 10 points wide. ENVELOPE.ADF becomes the current waveform.

The *Waveform Display Area* should now appear as shown in Figure 4-24.

Figure 4-24.  
SQUARE.ADF and  
ENVELOPE.ADF



Step 7:  
Send the envelope to  
reference memory 1

- a) Select the Transfer menu function Send.

The Send 2400 Series DSO dialog box is displayed.

- b) Fill out the dialog box as shown in Figure 4-25.

**Figure 4-25.**  
**Send 2400 Series Dialog Box.**

**Send 2400 Series**

Send Waveform  
 Send Waveform Between Markers

**Location**

REF1     REF3  
 REF2     REF4

**Vertical Position**

Set WaveWriter Screen 0.0 volts to  
Oscilloscope center graticule.

Enter vertical position of ground reference:   Volts  
 Divisions

- c) Select OK.

The envelope waveform is then sent to referencememory location 1.

Step 8:  
Send the original waveform to  
reference memory 2

- a) Bring up the *Waveform List* by double-clicking on the *WaveformList* icon at the bottom of the screen.
- b) Select SQUARE.ADF as the current waveform by clicking on it.

- c) Select the **Transfer** menu function **Send**.

The Send 2400 Series DSO dialogbox appears.

- d) Select the **REF2** option button.
- e) Select **OK**.

The original waveform is sent to reference memory location 2.

---

## **Lesson 5: Working with the VX5790 Arbitrary Waveform Generator**

### **Overview**

This lesson familiarizes you with the Sequence Editor. You will load and send three waveforms from disk and build and send a sequence using them. You will then modify the sequence, save it, and send it to the VX5790 AWG.

### **Step 1:**

**Clear all waveforms from WaveWriter memory, if any exist**

- a) Select the **Edit** menu function **Clear Waveform(s)**.

The Clear Waveform(s) dialogbox appears.

- b) Select the **All Waveforms** command button.

### **Note**

*Clear Waveform(s) is grayed and unavailable if there are no waveforms in memory. If there are waveforms in memory which have been altered and not saved, you are given the option to save them before deleting them.*

### **Step 2:**

**Change the target instrument to the VXI VX5790 AWG**

- a) Select the **Transfer** menu function **Configure/Change Instrument**.

The *Configure/Change* Instrument dialog box appears.

- b) Double-click on the *Configuration* list box entry for W VX5790.DRV.

- c) Select **OK**.
- d) If you are warned that the current system clock rate is invalid for the newly selected target instrument, select **OK** to accept the clock rate offered.

The **WaveWriter** title bar displays VX5790 as the target instrument.

**Step 3:**  
Change the clock rate to 1.28uS

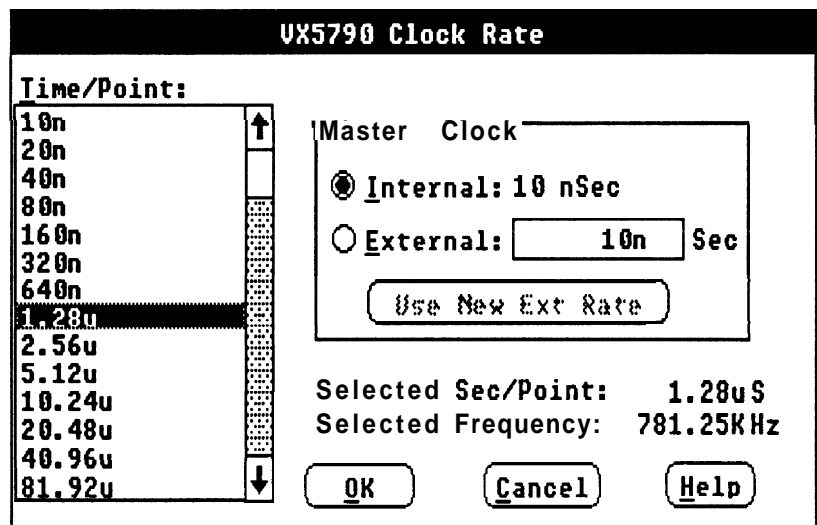
- a) Select the **Display** menu function **Change Clock Rate**.

The Change Clock Rate dialog box for the VX5790 AWG is displayed.

- b) Click on the 1.28u entry in the *Time/Point* list box.

The dialog box should now appear as shown in Figure 4-26.

Figure 4-26.  
VX5790 Change Clock Rate  
Dialog Box.



- c) Select **OK**.

The clock rate display just below the menu bar at the far right is updated to show the new system clock rate.

**Step 4:**  
Set the horizontal and  
vertical axis scales

- a) Select the **Display** menu function **Set Axis Ranges**.

The Set Axis Ranges dialog box is displayed.

- b) Enter "10" in the *Amplitude* edit box.
- c) Select the *Points* option button.
- d) Enter "0" in the *Start* edit box.
- e) Enter "999" in the *Stop* edit box.
- f) Select **OK**.

**Step 5:**  
**Open files PULSE.ADF, SINE.ADF,**  
**and TRIANGLE.ADF**

- a) Select the **File** menu function **Open**.

The Open dialog box is displayed.

- b) Enter PULSE.ADF in the *Open File Name* edit box.
- c) Select **OK**.

The pulse waveform is loaded, displayed, and becomes the current waveform.

- d) To load the second file, select **File - Open**, and double-click on file SINE.ADF.

The sine waveform is loaded, displayed, and becomes the current waveform.

- e) To load the third file, select **File - Open**, and double-click on file TRIANGLE.ADF.

You are warned that the clock rate of file TRIANGLE.ADF does not match the system clock rate. The VX5790 AWG requires all waveforms to have the same clock rate. We will modify the waveform to decimate data points so that it will conform to the system clock rate.

- f) Select the *Message Incoming Waveform to Maintain Timing* option button and select **OK**.

You are prompted for the transform method to use. The default option of nearest related point works well for this triangle wave.

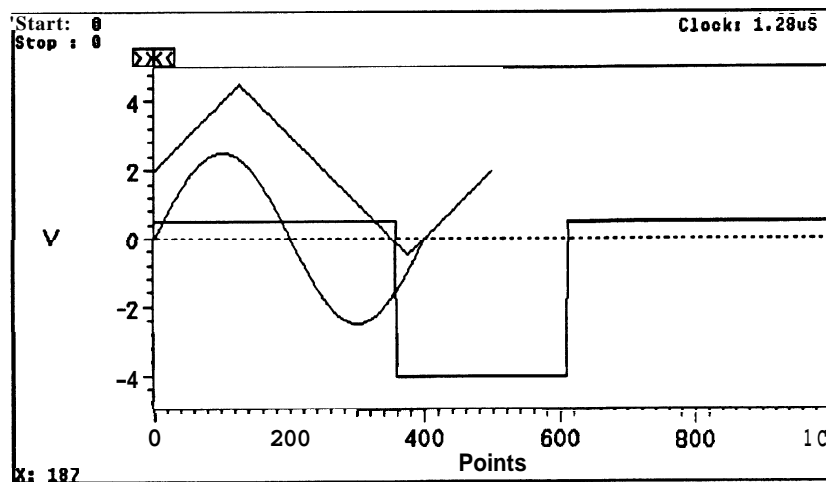
- g) Select the *Nearest Related Point* option button and select **OK**.

The waveform is then decimated to maintain the same timing relationship.



The *Waveform Display Area* should now appear as shown in Figure 4-27.

**Figure 4-27.**  
**Sine, Pulse, and Triangle**  
**Waveforms.**



**Step 6:**  
**Save the massaged triangle wave**  
**so that it can be used with the**  
**SequenceEditor**

- a) Select the **File** menu function **Save**.

The Save dialog box appears.

Note that the current waveform name, Triangle, shows up as the default for the *Save File Name* edit box.

- b) Enter TRI in the *Save File Name* edit box.  
Select the *ADIFFile* check box.  
Use the default extension of ADF.  
Deselect the *Instrument Specific File* check box, if it's checked.  
Deselect the *Make Backup* check box, if it's checked.  
Use the default *Offset* of 0.  
Select **OK**.

File TRI.ADF is now saved.

- c) Select the **Edit** menu function **Clear Waveform(s)**.  
Select TRIANGLE.ADF from the list box.  
Select **OK**.

File TRIANGLE.ADF is now cleared from **WaveWriter** memory.

**Step 7:**  
**Send the waveforms to the**  
**VXI VX5790 AWG**

- d) Select the **File** menu selection **Open**.  
Double-click on TRI.ADF to open it.

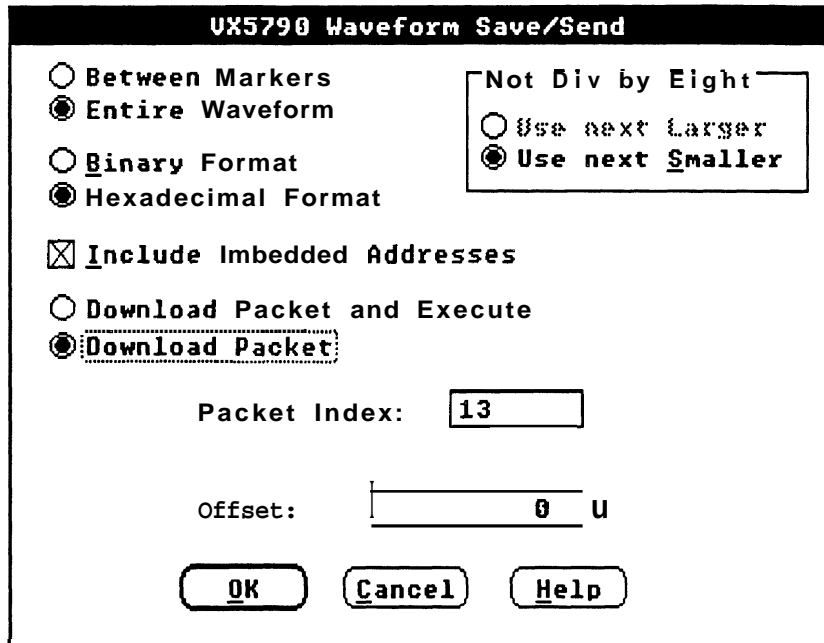
Note that this time you are not warned that the clock rate is different since we changed it.

This step is not necessary, but it does show you how to send a single waveform to the VX5790. If you wish you may skip to step 8.

- a) Select the **Transfer** menu function **Send**.

The VX5790 Waveform Save/Send dialog box is displayed, as shown in Figure 4-28.

**Figure 4-28.**  
**VX5790 Waveform Save/Send**  
**Dialog Box**



Select "Download Packet" radio button.

Accept the defaults to send the entire waveform in hexadecimal format with imbedded addresses included to the next available packet index. The *Not Div by Eight* group box is displayed because the waveform is not divisible by eight (a VX5790 hardware requirement). *Use next Smaller* is the only option since you are sending the entire waveform. The last few points of the waveform will not be sent.

- b) Select **OK**.

**Note:** "Include Imbedded Addresses" is hidden if you are running **Wave Writer** on a VX5530/35 or VX4530/35.

**Step 8:**  
**Build the sequence of waveforms**

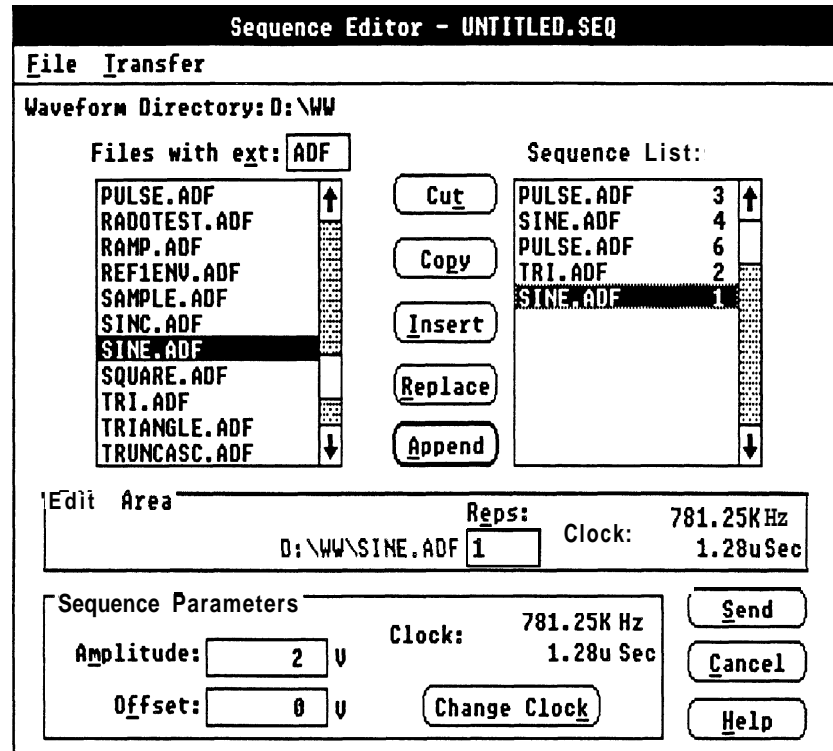
- a) Select the **Create** menu function **Sequence**.  
The Sequence dialog box is displayed (see below).
- b) Double-click on PULSE.ADF in the *WaveformFiles* list box.  
This brings the waveform name into the *Edit Area* with a **default** repetition count of 1. The clock rate for the waveform is also displayed in the *Edit Wfm Clock* group box.
- c) Enter "3" in the *Reps* edit box to change the repetition count to 3.
- d) Select the **Append** command button to append the information in the *Edit Area* into the *Sequence List*.
- e) To make the next entry in the *Sequence List* box:  
Double-click on SINE.ADF in the *Waveform Files list* box.  
Enter " 4" in the *Reps* edit box.  
Select the **Append** command button.
- f) To make the next entry in the *Sequence List* box:  
Double-click on PULSE.ADF in the *WaveformFiles list* box.  
Enter "6" in the *Reps* edit box.  
Select the **Append** command button.
- g) To make the next entry in the *Sequence List* box:  
Double-click on TRI.ADF in the *WaveformFiles list* box.  
Enter 2 in the *Reps* edit box.  
Select the **Append** command button.

Note that you are selecting TRI.ADF and not TRIANGLE.ADF because all waveforms specified in the sequence must have the same clock rate. Otherwise you would be warned when you tried to save or send the sequence that one or more file had different clock rates.

- h) To make the next entry in the *Sequence Listbox*:  
 Double-click on SINE.ADF in the *Waveform Files list box*.  
 Select the **Append** command button.

The dialog box should now appear as shown in Figure 4-29.

Figure 4-29.  
Sequence Editor Dialog Box.



**Step 9:**  
Save the sequence you created  
and send it to the instrument

- a) Select the sequence editor **File** menu function **Save**.

The Save dialog appears.

- b) Enter "lesson5" in the *Save File Name* edit box.

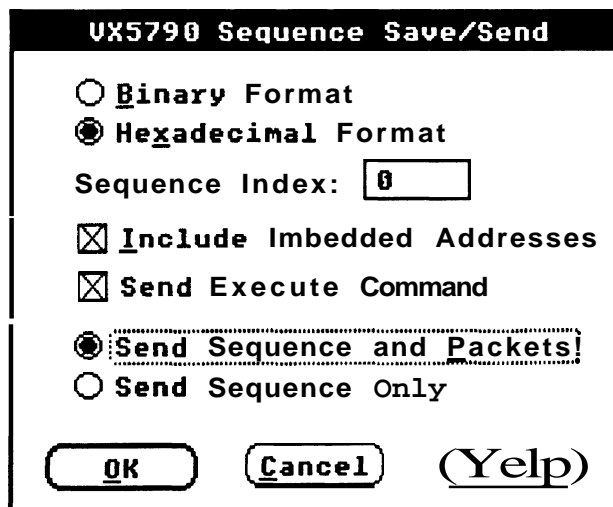
- c) Select the check box for **WaveWriter Format**.  
 Deselect the check box for *Instrument Specific File*.  
 Deselect the check box for *Make Backup*.  
 Select **OK**.

The sequence file is then saved.

- d) Select **Send**.

The VX5790 Sequence Save/Send dialog box is displayed,  
as shown in Figure 4-30.

**Figure 4-30.**  
**VX5790 Sequence Save/Send**  
**Dialog Box.**



- e) Select "Send Sequence and Packets" —Select OK.

Each packet is read from the disk and sent to the AWG.

The sequence is then sent to the default sequence index location and the sequence is executed. If you have the AWG connected to a scope, you will see the resulting waveform.

Step 10:  
 Modify the sequence  
 previously created

- a) Move TRI.ADF to the top of the *Sequence List* and change the repetition count to 3 using the following steps:

Click on TRI.ADF in the *Sequence List*.  
 Select the Cut command button.

This brings TRI.ADF into the *Edit Area* and removes it from the *Sequence List*.

Enter "3" in the *Reps* edit box.  
 Click on PULSE.ADF at the top of the *Sequence List*.  
 Select the Insert command button.

- b) Change the repetition count for the first PULSE.ADF in the *Sequence List* to 2.

Click on the first PULSE.ADF in the *Sequence List*.  
 Select the **Copy** command button.

This copies the PULSE.ADF entry into the *Edit Area*.

Enter "2" in the *Reps* edit box.  
 Select the **Replace** command button.

This replaces the PULSE.ADF entry with the new information in the *Edit Area*.

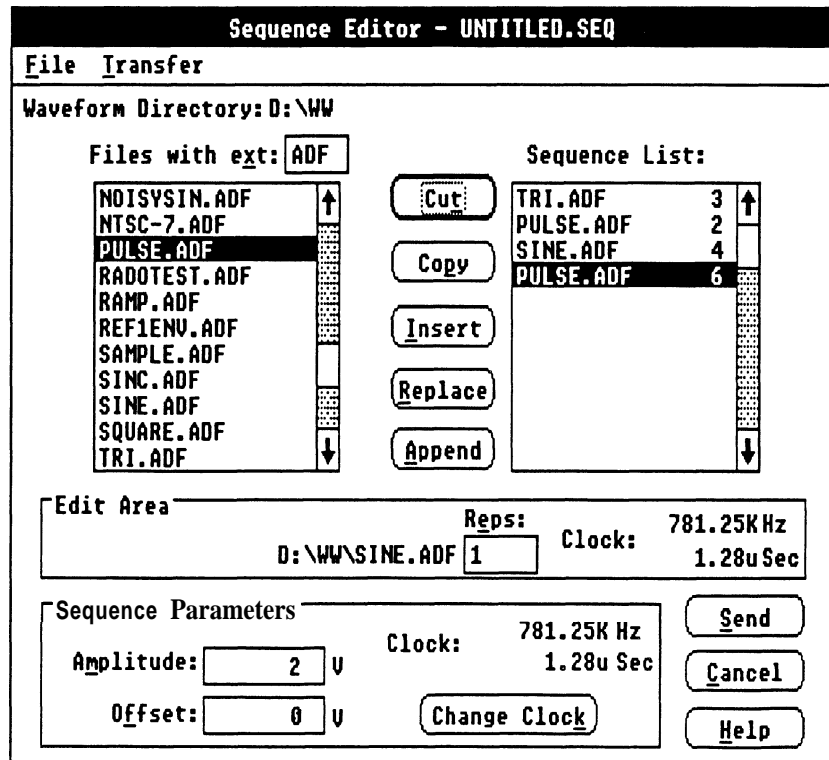
- c) Remove the last entry in the *Sequence List*.

Click on the bottom SINE.ADF.  
 Select the **Cut** command button.

This removes the entry from the *Sequence List*.

The Sequence Editor dialog box should now appear as shown in Figure 4-31.

**Figure 4-31.**  
*Sequence Editor Dialog Box.*



**Step 11:**  
**Save the new sequence and  
send it to the instrument**

- a) Select the sequence editor **File** menu function **Save**.

The Save dialog appears.

- b) Enter "lesson5b" in the *SaveFileName* edit box.

- c) Accept the previous defaults and select **OK**.

The sequence file is then saved.

- d) Select **Send**.

The VX5790 Sequence Save/Send dialog box is displayed.

- e) Enter "1" in the *Sequence Index* edit box..

- f) Select "Send Sequence Only" and select **OK**.

The sequence is then sent to sequence index 1 and the sequence is executed. Notice the difference in the waveform generated.

**Note:** *The packets have already been send to the AWG and don't have to be sent again.*

- g) Select **CANCEL** to exit the Sequence Editor.





# Section 5

## *How to use FILE OPERATIONS*

### **What the File Menu Does**

The **File** menu accesses commands that:

Create and open waveform files in memory: **New** and **Open**.

■ Store waveform files on disk: **Save**.

■ Output the current waveform display to a printing device: **Hardcopy**.

■ End the *WaveWriter* session: **Exit**.

Identify the installed version of *WaveWriter*: **About**.

**New** New is used when you need to design a waveform or envelope using the drawing tools in the Draw menu. When New is selected the dialog box in Figure 5-1 appears.

Figure 5-1.  
New  
Dialog Box.

**Waveform Name** In this edit box, enter a name for the waveform about to be created. The 8 character filename and a 3 character extension can be any combination of characters that is acceptable to the DOS system. A file name extension is not necessary, since it will be automatically appended when the waveform is saved to a disk file. If you choose to add a file name extension at this time, there are some things to consider. Although you are free to use any three DOS-acceptable characters for the extension, there are some combinations (see Save for descriptions) that we recommend be used.

**Record Length** In this edit box, enter the length of the waveform. You can specify either *Points* or *Seconds*. The minimum length is two points, and the maximum length is dependent on available memory, however, **Wave Writer** can display only up to 32767 points. If *Seconds* is selected, the number of points is based on the current system clock rate.

**Type** This group box lets you select the basic file type to create. You can create a Normal waveform or an Envelope waveform.

**Normal Waveform** A "normal" waveform, as far as **WaveWriter** is concerned, is any non-envelope waveform.

**Envelope Waveform** An envelope waveform is a waveform that simultaneously defines the upper and lower limits that another waveform needs to adhere to in both the vertical and horizontal direction.

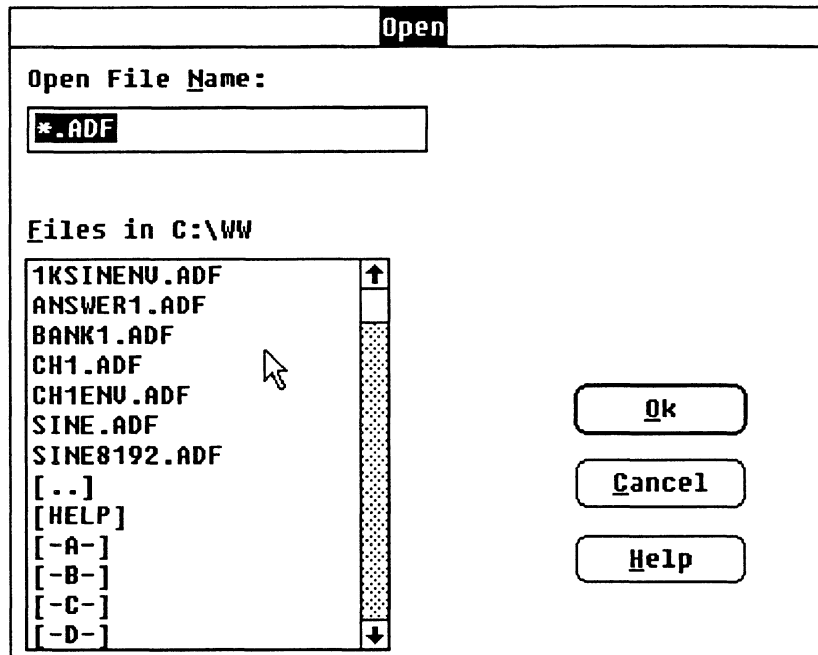
**OK** Select the **OK** command button to create the new waveform which becomes the current waveform. For normal waveforms, all the points of the new waveform are initialized at zero. For envelope waveforms, the maximum (upper limit) waveform is set to the maximum value of the *Waveform Display Area*; the minimum (lower limit) waveform is set to the minimum value of the work area. Envelopes are filled with a crosshatch pattern.

**Cancel** Select the **Cancel** command button to abort this function and return you to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **New** dialog box, select the **Control-menu** box and then select *Close*.

**Open** The **Open** command retrieves an existing waveform disk file and loads it as the current waveform. You can open a file that was created by **WaveWriter**— either in ADIF or instrument-specific format. You can also open files created by other systems that use a compatible version (.99) of the ADIF format. When **Open** is selected, the dialog box in Figure 5-2 is displayed.

Figure 5-2.  
Open  
Dialog Box.



**File Name** In this edit box, enter the name of the stored waveform to be read. You can also use this edit box to specify a subdirectory name and thereby change the directory. If you want to limit the size of the list that appears in the *Files In* list box, you can use a "wild card" entry to specify a particular group of files. For example, to list only files having a ".WAV" extension, enter:

\*.WAV

To list only files in the "C:\WAV" subdirectory that start with "Q" and have an extension that ends in "R", enter:

C:\WAV\ Q\*.\*R

A carriage return accepts your entry and modifies the list box accordingly.

**Files In [path]** This list box displays the files in the current directory, or a modified list if you have specified a narrower range by using the *File Name* edit box. Highlight the desired file (or drive or subdirectory) in the list. Select the **OK** command button to implement your selection.

**OK** The **OK** command button loads the selected waveform file as the current waveform or updates the list box if a wild card entry was made. If, in the *File Name* edit box, you have specified a non-existent file, you are warned and returned to the *File Name* edit box. If the specified filename is the same as a filename already in **WaveWriter** memory, you are given the option of replacing the file in memory or creating a file with a different name.

**Data Non-conformance** If the parameters of the waveform you are attempting to load don't match the target instrument, several things may occur:

**Vertical** — If the waveform amplitude exceeds the current axis amplitude, the waveform display will be clipped. However, no data is lost — use the **Autoscale Current** Waveform command in the Display menu to **rescale** the display. If the waveform amplitude also exceeds the range of the target instrument, **Autoscale Current** Waveform will set the vertical axis to the maximum instrument range and the portion of the waveform beyond that will be shown clipped.

**Horizontal** — If the time per point of the incoming waveform doesn't match the system clock rate, you are warned that the clock rates don't match and you can choose one of the following solutions:

- Change the clock rate of the incoming waveform to the system clock rate.

Message (expand or compress) the incoming waveform to maintain a timing match. (See *Horizontal Resolution*, Section 6.)

- Change the system clock rate to match the incoming waveform. Note, however, that if there are other waveforms loaded (displayed), their clock rates will be changed, as well (see *Change Clock Rate*, Section 7). If the incoming clock rate is not valid for the selected target instrument, this option is grayed and unavailable.
- Cancel the Open command.

## Save

**Offset** Offset values externally associated with a waveform are displayed with the waveform filename in the *WaveformList*, but are not used when displaying the waveform in the *Waveform Display Area*. Displayed waveforms are referenced to zero Volts.

**Cancel** Select the Cancel command button to abort the Open function and return to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **New** dialog box, select the Control-menu box and then select *Close*.

---

**Save** The Save command stores the current waveform to the disk file. The Save command also gives you the means to save the current waveform as a different file.

When Save is selected, the dialog box in Figure 5-3 is displayed.

**Figure 5-3.**  
Save  
Dialog Box.

The dialog box is titled "Save". It contains the following elements:

- Save File Name:** A text field containing "c:\wave30" and another text field containing "tt".
- Extension:** Two buttons: "ADF" (selected) and "ISF".
- Format:** Two radio buttons: "ADIF 0.99" and "ADIF 1.0" (selected).
- Make Backup:** An unchecked checkbox.
- Offset:** A text field containing "0" followed by a "V" for Volts.
- Buttons:** "Ok", "Cancel", and "Help" buttons at the bottom.

**File Name** In this edit box, enter a new or existing name for the waveform. The eight-character filename can be any combination of characters that is acceptable to the DOS system. A filename extension is not allowed here, since an extension will be automatically appended when the waveform is saved to a disk file. (See *Extension*). If you include a directory path as part of the filename, the path will be remembered the next time **Save** is selected.

**File Formats** You can choose either or both of two file formats when saving waveforms — *ADIF* and/or *Instrument Specific File*. Select one or both of the two check boxes.

**ADIF File** The *Analog Data Interchange Format* (ADIF) is a signal definition format that is under development at Tektronix. It is intended to provide a common signal storage format that can be read and used by various Tektronix instruments. This format will be supported by future Tektronix software products and microprocessor controlled instruments.

**ADIF Format** Select either the older ADIF format 0.99 or the newer format 1.0

TekTMS/IPG version 2.0 requires 0.99

**Instrument Specific File** This selection saves data in a form that can be read directly by a specified instrument. The actual file format varies according to the target instrument selected in the **Transfer, Configure/Change Instrument** menu.

See *Appendix C* for file format descriptions.

**Extension** The default extension for the indicated file type is displayed in an edit box. The initial **WaveWriter** defaults for these extensions are:

- .ADF is appended to files written in the ADIF format.
- .ISF is appended to files written in Instrument Specific Format.

If you choose to enter your own filename extension, it will be accepted. However, you should note that any implied significance to a set of characters is ignored. The format of a file is determined by the check box selected, not the extension you append to the *File Name*. For example, you could add the extension “.ADF” to a filename (and override a “.ISF” default) — but, if the waveform was saved with the *Instrument Specific File* check box selected, the file will be formatted in instrument specific format.

When you change extension characters, they become the default for that file type until you choose to change them again. If you create waveforms for different instruments, it would be wise to store them in different subdirectories or use different extensions for each instrument.

**Make Backup** With this check box, you choose if backup files are to be kept when a waveform is saved (see OK, below). If it is a new waveform, this option is grayed.

**Offset** Enter the offset value you want to be used externally with this waveform. The offset parameter is only used when saving or sending data, and doesn't affect the *WaveformDisplayArea*. The offset you specify will be added to the saved file in each of the **selected** formats:

**ADIF Files** — The offset parameter is included in the parameter list.

**Instrument Specific Files** — Data saved to a file is the same data as would be sent to an instrument with the **Send** command in the **Transfer** menu.

Remember, offset values externally associated with a waveform are displayed with the waveform filename in the *WaveformList*, but are not used when displaying the waveform in the *WaveformDisplayArea*. Displayed waveforms are referenced to zero Volts.

**OK** When the **OK** command button is selected, the file specified in the *File Name* edit box is created, written in the format(s) specified by check box selection. If the specified *File Name* already exists, and the *Make Backup* check box is **not** selected, you are prompted to choose if you want to overwrite the existing file(s).

If the *Make Backup* check box **is** selected, existing files are retained, with a change to the file name extension. The first character of the filename extension becomes the *tilde* (-) character. The tilde is followed by the first two characters of the old extension. The current waveform is then written using the specified *File Name*. For example, the backup file for a file "WAVE2.ADF" is "WAVE2.~AD".



**VX5790 Save** If a VX5790 is the target instrument and the Instrument Specific File is selected, another dialog box (Figure 5-4) is displayed when OK is selected.

Figure 5-4.  
VX5790 Waveform Save/Send  
Dialog Box.

**Processing Region** — Select how much of the length of the waveform is to be saved:

Only the portion of the waveform between and including the markers

■ The entire waveform.

If the number of points saved is 2048 or less, data is saved with the VXI SHAPE command. Otherwise, the CURVE command is used. Only waveforms less than or equal to 2048 points may be used in a sequence.

**Transfer Format** — Select whether the waveform is to be saved in *Binary* or Hexadecimal format. Binary data is more compact, but is not directly viewable.

**Not Divisible by Eight** — This group box is only displayed when the number of data points to be saved is not a number divisible by eight (this is a VX5790 hardware requirement).

■ If *Between Markers* has been selected, you can choose *Use Next Larger* to save the next larger size waveform that is divisible by eight — or you can choose *Use Next Smaller* to save the next smaller size waveform divisible by eight.

■ If *Entire Waveform* has been selected, *Use Next Smaller* is your only option — *Use Next Larger* is grayed and can't be selected.

**Include Imbedded Addresses** — When saving a waveform for a VX5790 using a VXI resource manager that understands imbedded addressing (such as the Tektronix VX5520), select this check box and the logical address defined in the **Configure/Change Instrument** command is included in the parameters saved. If this check box is not selected, the waveform is saved without specifying the logical address.

**Packet Index** — This edit box displays the packet index taken from the cross reference file. If you wish to override this default, enter a different value.

**Sequence Index** — This edit box is normally hidden, but is displayed when the waveform size is larger than the maximum packet size (**2048** for the VX5790). These waveforms are partitioned into acceptable packet sizes and a sequence is automatically created that includes the packets used when the waveform was partitioned.

Packets start at the specified *Packet Index* and the sequence is built at the specified *Sequence Index*.

**OK** — When OK is selected, the VX5790 waveform data is saved.

**Cancel** — Select the **Cancel** command button to exit the **Save** command and return to the main menu.

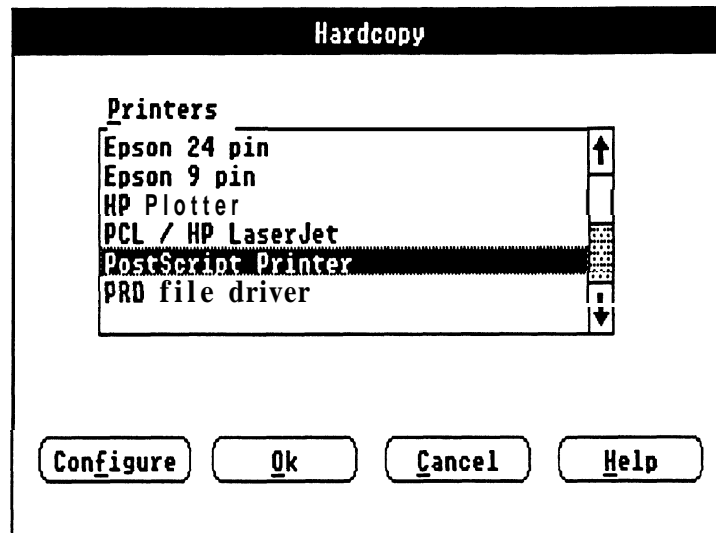
**Help** — Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Save** dialog box, select the **Control-menu** box and then select *Close*.

**Cancel** Select the **Cancel** command button to exit the **Save** command and return to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Save** dialog box, select the **Control-menu** box and then select *Close*.

**Hardcopy** The Hardcopy command sends the current *Waveform Display Area* to a selected printer or plotter. When Hardcopy is selected, the dialog box in Figure 5-5 is displayed.

Figure 5-5.  
Hardcopy  
Dialog Box.



**Printers** This list box displays the currently installed output device drivers. Highlight and select an output device from this list. To install additional printers, see the *Windows User Guide*.

**Configure** When this command button is selected, the *Windows Control Panel* window is displayed. This window contains a Setup menu which permits selecting the printer and printer configuration. See your *Microsoft Windows Users* manual for more detailed information.

**OK** When the **OK** command button is selected, the current *Waveform Display Area* is sent to the selected printer or plotter. While the data is being sent, a Cancel Print dialog box appears to let you terminate the print or plot before it is completed, if necessary.

**Cancel** Select the Cancel command to abort the Hardcopy function and return to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scrollbar, if present, to read the entire help text. To return to the Hardcopy dialog box, select the Control-menu box and then select *Close*.

**Exit** The **Exit** command ends the **WaveWriter** session and returns you to the **Windows MS-DOSExecutive** screen display. If any data has been altered, you are prompted to save it before exiting. The current **Wave** Writer configuration is saved.

**About** The **About** command displays a dialog box (Figure 5-6) that lists:

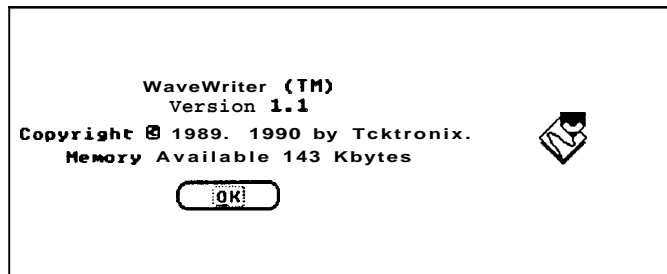
The name of this program, WaveWriter

- Version number.
- Tektronix copyright.

Available memory.

When the **About** dialog box **OK** command is selected, you are returned to the main menu.

*Figure 5-6.  
About  
Dialog Box.*



# Section 6

## How to *EDIT* WAVEFORMS

### What the Edit Menu Does

When you need to make changes to the current waveform, you can often use **Draw** menu functions to alter the shape of a waveform. However, there are features of the **Edit** menu that can **modify** the content of a waveform without redrawing:

- **Undo** — cancel the most recent change to the current waveform made by any of the menus.
- **Clear Waveform(s)** — delete all or selected waveforms from memory and the *WaveformList*.
- **Cut Between Markers** — remove part of the current waveform; save the segment in the edit buffer.
- **Copy Between Markers** — copy part of the current waveform; save the segment in the edit buffer.
- **Delete Between Markers** — delete part of the current waveform; *do not* save the segment.
- **Insert at Start Marker** — insert a copy of the edit buffer into the current waveform.
- **Replace Between Markers** — delete a part of the current waveform and insert a copy of the edit buffer in its place.
- **Append to End of Waveform** — insert a copy of the edit buffer at the end of the current waveform.
- **Flip Horizontal Between Markers** — reverse current waveform time sequence.
- **Flip Vertical Between Markers** — invert the current waveform with zero as the center.
- **Horizontal Resolution** — expand or compress the current waveform horizontally.
- **Vertical Resolution** — modify waveform data to simulate a lower vertical resolution.

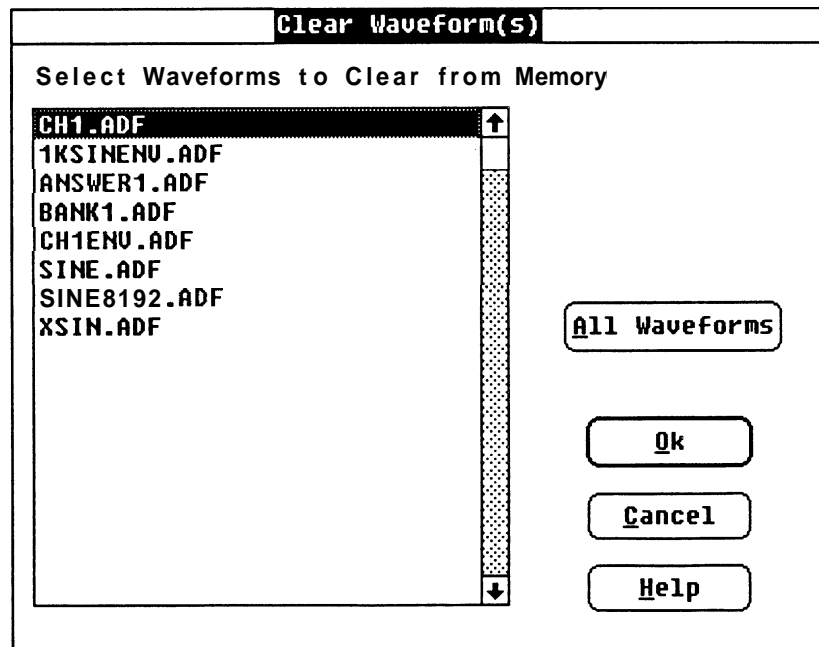
## Undo

The **Undo** function cancels the most recent change to the current waveform. The change could have been made by any of the other menus (**Edit, Draw, Create, Acquire**, etc.). If the current waveform has not been changed, the **Undo** command option is grayed in the menu. **Undo** toggles — you can undo an undo.

## Clear Waveform(s)

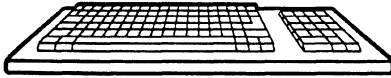
The **Clear Waveform(s)** command removes specified waveforms from memory. This deletes unwanted waveforms from the display — either those that are no longer needed, or to unclutter a display that has too many background waveforms. When **Clear Waveform(s)** is selected, the dialog box in Figure 6-1 is displayed.

Figure 6-1.  
Clear Waveform(s)  
Dialog Box.



**Select Waveforms to Clear from Memory** This list box displays **all** the currently loaded waveforms.  
**To clear one or more waveforms from the display:**

**CAUTION:** *Cleared waveforms cannot be undone. Be sure to save changes you wish to keep before clearing.*



Press **UP** or **DOWN** to highlight a waveform to be cleared. Press **ENTER** to clear the waveform from memory.

If you want to clear more than one waveform, press and **hold** the **SHIFT** key while pressing **UP** or **DOWN** to highlight additional waveforms. Press the **SPACEBAR** to unselect (or reselect) each additional waveform.

Press **ENTER** to clear the selected waveforms from memory.



Move the cursor to the name of the waveform to be cleared. Press the **LEFT** mouse button to select the entry.

If you want to clear one or more additional waveforms, move the cursor to additional entries and press and **hold** the **SHIFT** key while pressing the **LEFT** mouse button to accept each additional waveform without unselecting previous choices.

Click the **OK** button to clear selected waveforms.

Double clicking the **LEFT** mouse button while selecting a waveform name is the same as following the selection with the **OK** command button.

**All Waveforms** When **All Waveforms** is selected, all waveforms are removed from the display and cleared from memory. If any altered waveforms have not been saved, you are given the option to save them and the **Save** dialog box is displayed.

**OK** When the **OK** command button is selected, highlighted waveforms are removed from the display and cleared from memory. If any altered waveforms have not been saved, you are given the option to save them and the **Save** dialog box is displayed.

**Cancel** Select the **Cancel** command button to abort the **Clear Waveform(s)** function and return to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Clear Waveform(s)** dialog box, select the **Control-menu** box and then select Close.

---

**Cut Between Markers** When **Cut Between Markers** is selected, the region of the current waveform between and including the *Start* and *Stop* markers is removed and stored in the edit buffer. The *Stop* Marker, and the data to its right, is shifted to the left to align with the *Start* Marker position.

**The Edit Buffer** Information in the edit buffer can be pasted into another waveform by selecting a different current waveform and using **Insert at Start Marker**, **Replace Between Markers**, or **Append to End of Waveform**. The edit buffer data is available for multiple insert, replace, and append operations, but is replaced when another cut or copy command is selected.

---

**Copy Between Markers** When **Copy Between Markers** is selected, the region of the current waveform between and including the *Start* and *Stop* markers is copied to the edit buffer for later use. The current waveform is not changed.

---

**Delete Between Markers** When **Delete Between Markers** is selected, the region of the current waveform between and including the *Start* and *Stop* markers is removed. The deleted waveform segment is not saved in the edit buffer. The *Stop* Marker, and the data to its right, is shifted to the left to align with the *Start* Marker position.

---

**Insert at Start Marker** When **Insert at Start Marker** is selected, a copy of the waveform data in the edit buffer is inserted into the current waveform at the *Start* Marker location. Waveform data at the *Start* Marker, and to the right, is moved to align with the end of the inserted data. This may extend the current waveform beyond its originally defined length.



The distance between the markers can't exceed the maximum record length of the target instrument. If the length of the edit buffer being inserted would cause the *Stop Marker* to go beyond this limit, the *Stop Marker* is moved only to the maximum distance allowed.

---

## **Replace Between Markers**

When **Replace Between Markers** is selected, a copy of the waveform data in the edit buffer replaces the current waveform between and including the *Start* and *Stop* markers. If the edit buffer data is longer than the segment being replaced, the current waveform will extend beyond its originally defined length. If the edit buffer data is shorter than the segment being replaced, the current waveform is shortened.

The distance between the markers can't exceed the maximum record length of the target instrument. If the length of the edit buffer would cause the *Stop Marker* to go beyond this limit, the *Stop Marker* is moved only to the maximum distance allowed.

---

## **Append to End of Waveform**

When **Append to End of Waveform** is selected, a copy of the waveform data in the edit buffer is appended to the end of the current waveform after the last data point. This extends the current waveform beyond its originally defined length.

---

## **Flip Horizontal Between Markers**

When **Flip Horizontal Between Markers** is selected, the timing of the current waveform between and including the *Start* and *Stop* markers is reversed. What was the start of the waveform segment is now the end, and what was the end is now the beginning.

---

## **Flip Vertical Between Markers**

When **Flip Vertical Between Markers** is selected, the polarity of the current waveform between and including the *Start* and *Stop* markers is inverted around zero Volts.

## Horizontal Resolution

The portion of the current waveform in the processing region can be expanded or compressed along the horizontal axis. When **Horizontal Resolution** is selected, the dialog box in Figure 6-2 appears.

Figure 6-2.  
Horizontal Resolution  
Dialog Box.

**Horizontal Resolution**

Processing Region

Entire Wfm  Between Markers

Interval Between Markers: Stop - Start = 300s 300

New Interval:   Seconds  Points

Transform Method: Original Data to New Data

Nearest Related Point: Preserves Steps (Faster)

Short Function: General Purpose (Standard)

Longer Function: Preserves Sine Waves (Slower)

Use Data Beyond Markers for New Data Calculation

Yes (Where Available)

No

Ok Cancel Help

### Processing Region

In this group box, you select how much of the length of the waveform is to be affected by the horizontal resolution change:

The entire waveform.

Only the portion of the waveform between and including the markers.

### Current Length of Waveform

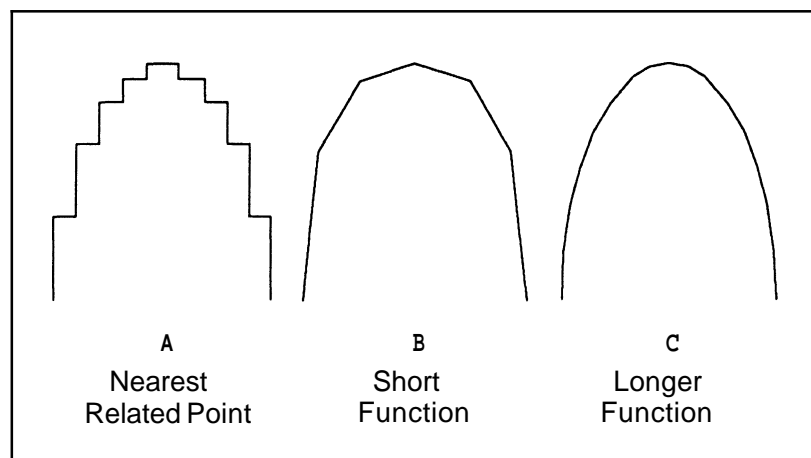
When *EntireWaveform* is selected, the *Current Length of Waveform* display shows, in points and seconds, the total length of the current waveform.

**Current Interval Between Markers** When *Between Markers* is selected, the *Current Interval Between Markers* display shows, in points and seconds, the length of the current waveform segment between and including the markers.

**New Interval** In this edit **box**, enter the new length you need either the entire waveform or the marked segment to be. Select either *Points* or *Seconds*.

**Transform Method** There are three methods to choose from when you redefine the horizontal interval — *Nearest Related Point*, *Short Function*, and *Longer Function*. Figure 6-3 approximates what happens when a **sinewave** is transformed with each of these methods.

**Figure 6-3.**  
**Three Results of a**  
**Sinewave Transformation.**



**Nearest Related Point** This is the fastest method of redefining the horizontal interval. Each newly assigned point is given the value of the original point that was closest to it horizontally. This method preserves steps in the original waveform. Figure 6-3A shows where data points may be selected from using this transform method.

**Short Function** This is the standard speed, general-purpose method. The Short Function calculates each new point using a weighted average of original points to either side. The weighting function shape is triangular, linearly decreasing as you move away from the new point location. When a waveform interval is increased (i.e., more points) the Short Function translates to linear (straight line) interpolation. In other words, the new point is located on a straight line between two original points (as shown in Figure 6-38). When the new interval is decreased, or decimated, (i.e., fewer points) the triangular weighted average spans four or more original points to calculate each new point. Greater decimation ratios require wider averaging functions.

## Horizontal Resolution

**LongerFunction** This method is much slower than the other two methods, but it is the most accurate for smoother, band limited signals (i.e., sine waves). Like the Short Function, this method calculates each new point with a weighted average of original points to either side. This weighting function is up to five times as wide as the triangular Short Function. When increasing intervals (interpolating), the weighted average spans ten points, five on each side. When decreasing intervals (decimating), the point span of the average is ten times the ratio of original to new interval lengths. The weighting function shape sinc function  $(\sin(x)/x)^a$  has been windowed<sup>b</sup> to limit its length. Sine waves with at least four points per cycle can be accurately interpolated using the Longer Function (as shown in Figure 6-3C), with errors less than 0.1%. Similarly, reducing a sine wave interval down to as few as four samples per cycle results in errors less than 0.1%.

**Use Data Beyond Markers** When LongerFunction is selected (and also ShortFunction when *compressing* a waveform) — to minimize distortion at the end points of the waveform, the transformation calculation needs data points outside the limits of the *Start* and *Stop* markers. This is allowed when you select the Yes option button. If the markers are at the ends of the waveform, extrapolated data points will be calculated. If you don't wish external data points to be used, select the No option button. This group box is grayed (not available for selection) when Nearest Related Point is selected.

**OK** When the **OK** command button is selected, the *Processing Region* is **resized** to the new length. The overall current waveform will lengthen or shorten accordingly.

**Cancel** Select Cancel to abort the **HorizontalResolution** command and return to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **HorizontalResolution** dialog box, select the Control-menu box and then select *Close*.

**NOTE** *Changing horizontal resolution does not change clock rate.*

<sup>a</sup>The sinc is the ideal interpolation function for sampled band limited (non-aliased) signals.

<sup>b</sup>A 3-term (-67dB) Blackman-Harris<sup>c</sup> window spanning the fifth zero crossing on either side of the main sinc lobe.

<sup>c</sup>Harris, F. J., *On the Use of Windows for Harmonic Analysis with the Discrete Fourier Transform*, Proceedings of the IEEE, Vol. 66, No. 1, Jan 1978.

**Vertical Resolution** The current waveform data can be adjusted to simulate a lower number bit level in the vertical axis. When **Vertical Resolution** is selected, the dialog box in Figure 6-4 appears.

*Figure 6-4.  
Vertical Resolution  
Dialog Box.*

The dialog box titled "Vertical Resolution" contains the following elements:

- Current Waueform Step Resolution:** 12 Bits
- Simulated Step Resolution:** 10 Bits (input field)
- Processing Region:**
  - Entire Waveform
  - Between Markers
  - (unlabeled)
- Buttons:** Ok, Cancel, Help

**Current Waveform Step Resolution** The *Current Waveform Step Resolution* display shows, in bits, the current waveform step resolution.

**Simulated Step Resolution** In this edit box, enter the new vertical resolution you need the current waveform data to have. This number has to be less than the bit resolution of the current waveform.

*NOTE* Once the bit level has been changed, it can't be returned to a higher level resolution. The previous waveform data can't be recovered. Always save the higher bit level waveform if the data needs to be retained.

**Processing Region** In this group box, you select how much of the length of the waveform is to be affected by the vertical resolution change:

- The entire waveform.
- Only the portion of the waveform between and including the markers.

**OK** When the **OK** command button is selected, the *Processing Region* is rescaled to the new bit levels.

**Cancel** Select **Cancel** to abort the **VerticalResolution** command and return to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **VerticalResolution** dialog box, select the **Control-menu** box and then select *Close*.

# Section 7

## How to DISPLAY WAVEFORMS

### What the Display Menu Does

You use the **Display** menu to set the attributes of the screen presentation:

- You can display waveforms in either *dot* or *vector* format.
- You can magnify a portion of the *WaveformDisplayArea* with the **Zoom In** feature.
- With the **Set Axis Ranges** command, you can control how much of the current and background waveforms is visible.
- You can **Autoscale** the *WaveformDisplayArea* to fit the current waveform.
- **Change Clock Rate.** Allows you to change the system clock rate.
- You can select a different waveform with **Change Current Waveform**
- You can select the screen cursor to be displayed as either a small *cross* or as full-screen *crosshairs*.
- You can modify various features of the screen display with the **Set Colors and Line Styles** command.

**Display Formats** Waveforms can be displayed in either *dot* or vector format.

**Redraw Dot** When **Redraw Dot** is selected, all displayed waveforms are redrawn in dot format — each dot represents a data point of the waveform.

**Redraw Vector** When **Redraw Vector** is selected, all displayed waveforms are displayed in vector format — all points are connected with the currently selected line style.

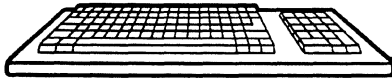
---

**The Zoom Function** A portion of the display can be magnified in the waveform workspace.

**Zoom In** allows you to define a rectangular region that will be enlarged to the full display size. You can **Zoom In** again to expand the waveform even farther. Use **Zoom Out** to return to the standard view.



**Zoom In** When **Zoom In** is selected, you can define a rectangular area that delimits the portion of the display to be magnified:



Use the direction keys to position the cursor at the upper left corner of the rectangular area to be magnified.

When the cursor is at the correct starting point, press either **SPACEBAR** or **ENTER**.

With the direction keys, position the cursor at the lower right corner of the rectangular area.

To set the dimensions and magnify the selected portion of the display, press either **SPACEBAR** or **ENTER**.



Move the cursor to the upper left corner of the rectangular area to be magnified.

Press and hold the LEFT mouse button and drag the cursor to the lower right corner of the rectangular area.

To set the dimensions and magnify the selected region, release the LEFT mouse button.

**Zoom Out** Selecting **Zoom Out** restores the display to the unmagnified waveform — the view as defined by the **Set Axis Range** command.

**Set Axis Ranges** sets the ranges for the vertical and horizontal axis scales of the waveform display. This selects a portion of the overall waveform to be displayed. Parts of waveforms outside the *Waveform Display Area* are clipped, not lost, and can be restored by setting a wider range in the Set Axis Ranges dialog box.

When Set Axis Ranges is selected, the dialog box in Figure 7-1 appears.

Figure 7-1.  
Set Axis Ranges  
Dialog Box.

**Vertical** Vertical units (amplitude) is entered in peak-to-peak Volts. For example, if you enter "5" the vertical scale will read from -2.5 Volts to +2.5 Volts. This number must be less than or equal to the maximum peak-to-peak amplitude allowed by the target instrument. This range is mapped to the full vertical resolution of the target instrument.

**Horizontal** Horizontal units can be either Seconds or Points. Figure 7-1 shows the "Points" option button selected. The *Start and Stop* edit boxes define the horizontal limits of the portion of the *Waveform Display Area* to be displayed. Since *Points* is selected in Figure 7-1, the units describing the edit boxes is "Pts". If *Seconds* was selected, "Sec" would be displayed.

The units you select with this group box (Seconds or Points) affects the horizontal axis label, the *Start and Stop* marker readouts, and the X coordinate readout.

**OK** When **OK** is selected, the vertical and horizontal axis scales are reset to the ranges you have specified.

**Cancel** Select the Cancel command button to abort the Set AxisRanges command and return to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scrollbar, if present, to read the entire help text. To return to the Set **AxisRanges** dialog box, select the Control-menu box and then select Close.

## Autoscale Current Waveform

When you select **AutoscaleCurrent** waveform, it automatically adjusts the horizontal and vertical axis scales on the *WaveformDisplay Area* to match the amplitude and the length of the current waveform. See Figures 7-2 and 7-3.

If the largest peak amplitude of the waveform exceeds the maximum amplitude of the target instrument, the vertical axis scale is set to the maximum peak-to-peak amplitude of the target instrument; waveform data will be clipped on the display, but not lost.

Figure 7-2.  
Waveform Before Autoscaling.

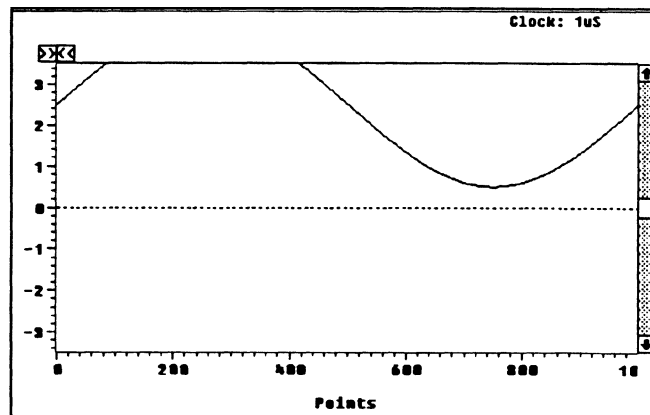
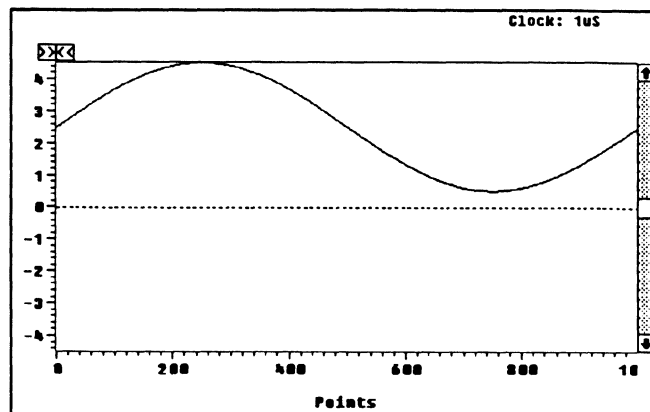


Figure 7-3.  
Waveform After Autoscaling.



**Change Clock Rate** This command is used to change the system clock rate. All waveforms in memory have the same clock rate — changing the clock rate affects all waveforms. The waveform shape or size (number of points) is not changed by this command — only the time per point and the *Waveform Display Area* axis labels are changed. The clock rate selected must be valid for the target instrument.

When **Change Clock Rate** is selected, the dialog box that appears depends on the selected target instrument. Figures 7-4 through 7-6 show the dialog boxes for the currently supported instruments.

When the new clock rate is entered and OK is selected, the *Clock* display above the *Waveform Display Area* is updated to show the new clock rate. If the horizontal axis is displayed in seconds, the labels are updated to reflect the new clock rate.

**AFG 5101/5501 Clock Rate** When **Change Clock Rate** is selected and an AFG 5101/5501 is selected as the target instrument, the dialog box in Figure 7-4 appears.

Figure 7 4  
AFG 5101/5501  
Change Clock Rate  
Dialog Box.

The dialog box is titled "AFG 5101/5501 Clock Rate". It contains two input fields: "Time per Point:" with a value of "10" and unit "s", and "Frequency:" with a value of "1M" and unit "Hz". Below the input fields are three buttons: "Ok", "Cancel", and "Help".

**Time per Point** Enter Time in seconds. The valid range is 100 nanoseconds to 999.9 seconds.

**Frequency** Enter Frequency in Hz. The valid range is 10 MHz to 1 mHz.

**OK** When the new clock rate is entered and **OK** is selected, the Clock display above the *Waveform Display Area* is updated with the new clock rate. If the horizontal axis scale is displayed in seconds, this also will be updated.

**Cancel** Select cancel to retain the previous clock rate and return to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Change Clock Rate** dialog box, select the **Control-menu** box and then select Close.

**2400 Series DSO Clock Rate** When Change Clock Rate is selected and a 2400 Series digital storage oscilloscope is selected as the target instrument, the dialog box in Figure 7-5 appears.

Figure 7-5  
2400 Series DSO  
Change Clock Rate  
Dialog Box.

2400 Series Clock Rate

Enter ONE of the following:

Time Per Division:  S

Time per point:  S

Frequency:  Points / Second

External Clock

**Time per Division** Enter time in seconds. If no external clock is present, the valid values are (in a 1, 2, 5 sequence):

2440 only: 5 seconds to 2 nanoseconds.

All other 2400 Series DSOs: 5 seconds to 5 nanoseconds.

If an external clock is present, the valid values are:

50 microseconds to 500 nanoseconds.

**Time per Point** Enter time in seconds. If no external clock is present, the valid values are (in a 1, 2, 5 sequence):

2440 only: 100 milliseconds to 40 picoseconds.

All other 2400 Series DSOs: 100 milliseconds to 100 picoseconds.

If an external clock is present, the valid values are:

1 microsecond to 10 nanoseconds.

**Frequency** Enter the number of points per second. If no external clock is present, the valid values are (in a **1, 2, 5** sequence):

**2440** only: 10 points/second to 25 gigapoints/second.

All other **2400** Series DSOs: 10 points/second to 10 gigapoints/second.

If an external clock is present, the valid values are:

1 megapoint/second to 100 megapoints/second.

**ExternalClock** In this check box, select if the scope is using an external clock.

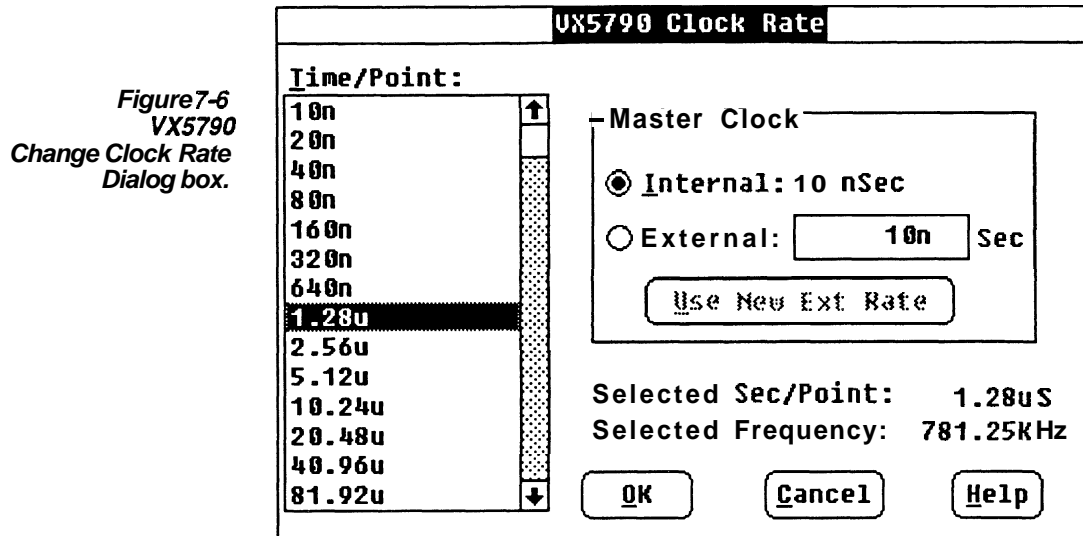
**OK** When the new clock rate has been entered and **OK** is selected, the clock rate is checked to see if it is within appropriate limits. If you are not using an external clock, and the selected clock rate is not a "1, 2, 5" sequence value, you are offered a choice between the next higher and lower valid values. When a valid value is entered, the **Clock** display is updated with the new clock rate in both **time/division** and **time/point**. If the horizontal axis scale is displayed in **seconds**, its range is updated to reflect the new clock rate.

**Cancel** Select **Cancel** to return to the main menu without changing the clock rate.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Change Clock Rate** dialog box, select the **Control-menu** box and then select *Close*.

## Change Clock Rate

**VX5790 Clock Rate** When **Change Clock Rate** is selected and a VX5790 is selected as the target instrument, the dialog box in Figure 7-6 appears.



**Time/Point** This is a list of available clock rates for the internal master system clock, either internal or external.

**Master Clock** Either the internal master clock can be selected or an external clock.  
**INTERNAL:** A fixed time per point of 10 nanoseconds.  
**EXTERNAL:** Enter the time per point of the external clock.

**Use New Ext Rate** When the external clock rate is changed, this command button is selected to recalculate the valid clock rates in the Time/Point list box. This selection is grayed if Internal is selected.

**Selected Sec/Point** Selected clock rate expressed as seconds per point.

**Selected Frequency** Selected clock rate expressed as frequency.



---

**Change Current Waveform** Displays the *WaveformList*. This is handy when the *WaveWriter* window is maximized and you can't easily get to the *WaveformList* icon. See *WaveformList*, Section 3, for more information.

---

**Show Crosshairs** The screen cursor can be displayed either as a small cross or as a full-screen crosshair. Selecting **ShowCrosshairs** alternately displays a small cross or crosshairs. In the menu display, a check mark indicates that the crosshairs are currently being displayed.

The location of the intersection of the crosshairs is shown in the coordinate readouts, the same way the small cross position is defined.

---

**Set Colors and Line Styles** When there are several waveforms displayed on the screen at the same time, it can be difficult to differentiate one waveform from another. Various elements of the display can be assigned different attributes to help you separate data items and minimize confusion on the screen:

Waveforms in memory can each be assigned a color and a line style which are used when the waveform is not current.

The current waveform can be assigned a color and a line style. This temporarily overrides any attributes assigned to an individual waveform in memory.

- A color and a line style can be assigned to all background waveforms in general. Default attributes are used until you assign specific attributes to a waveform.

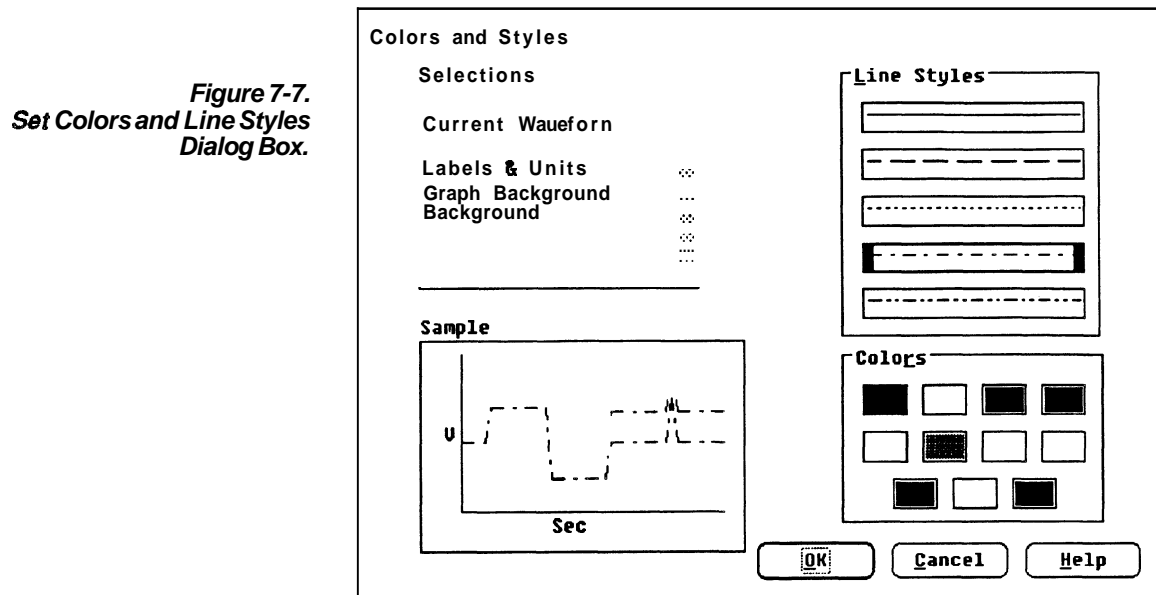
Labels and units on the waveform workspace can be assigned a color.

The graph background color can be assigned.

- The window background can be assigned a color.

*NOTE* Select colors with care. If the element or waveform color is the same as the background color, it won't be visible. If this happens, reselect one or both colors.

When **Set Colors and Line Styles** is selected, the dialog box in Figure 7-7 appears.



**Sample** The **Sample** display shows attributes as they are selected in the Line Style and Color group boxes. These changes don't take place in the selected item (from the **Selections** list box) until the **OK** command button is selected.

**Selections** The **Selections** list box displays what can currently be modified. In addition to the currently loaded waveform names, there are several other elements of the display to which you can assign attributes:

- Current Waveform
- BackgroundWaveforms
- Labels & Units (color only)
- Graph Background (color only)
- Background ( *WaveWriter* window — color only)

From the list, select a highlighted item to be modified.

**Line Styles** Select one of the displayed line styles. The selected style is indicated with a heavier black border around it. The line style may not be apparent if there isn't a large enough interval between points. Line style is only visible in vector mode.

**Colors** Select one of the displayed colors. The selected color is indicated with a heavier black border around it.

**OK** After setting the attributes of each of the entries you want to change in the Selections list **box**, select the **OK** command to make all your changes effective and to return to the main menu.

**Cancel** Select the **Cancel** command to retain your original settings and return to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scrollbar, if present, to read the entire **help** text. To return to the **Set Colors and Line Styles** dialog **box**, select the **Control-menu box** and then select Close.



# Section 8

## How to DRAW WAVEFORMS

### What the Draw Menu Does

The Draw command gives you tools to modify an existing waveform. The waveform **could** have been new, opened, acquired, or created. The tools are simple to use and can help you create precise and repeatable waveform segments. Selections in the **Draw** menu are:

**Nodraw** — the initial state.

**Freehand** — a waveform segment is defined by *all* movement of the cursor.

**Horizontal** — similar to Freehand, except that a line segment can only be defined in a horizontal direction from its start point.

**Vertical** — similar to Freehand, except that a point can only be moved in a vertical direction from its start point.

**Autoline** — a waveform segment is defined by start and stop points.

**Envelope Max Don't Care** — similar to Horizontal; defines upper limit "don't care" voltage acceptance range. (Envelope waveforms only.)

**Envelope Min Don't Care** — similar to Horizontal; defines lower limit "don't care" voltage acceptance range. (Envelope waveforms only.)

**Envelope Max** — specifies the waveform envelope upper limit to be drawn. (Envelope waveforms only.)

**Envelope Min** — specifies the waveform envelope lower limit to be drawn. (Envelope waveforms only.)

Only one of the above modes can be selected at a time except that, if you're working with a waveform envelope, either **Envelope Max** or **Envelope Min** are also specified to define the portion of the envelope to be operated on. Choosing a mode different than the current mode initiates the new selection immediately.

**Starting Out** With a waveform in memory, select the **Draw** menu.

**Drawing Segments** Except for **Nodraw**, each of the Draw modes works almost the same way. You can use either the keyboard or a mouse to draw waveform segments. If you use the keyboard — to activate a Draw mode cursor arrow, press the **TAB** key until the *Waveform List* is displayed. Then press **TAB** one more time.

To access the waveform for drawing, the cursor must be within the limits of the *Waveform Display Area*.

**CONTROL Key** When moving the cursor with direction keys, pressing the **CONTROL** + **DIRECTION** keys moves the cursor faster.

**Coordinates** Coordinates are continually updated as the cursor moves so you can accurately position the cursor. Vertical changes in cursor position show as a change in voltage. Horizontal changes in cursor position show as a change in time or in points (whichever is selected).

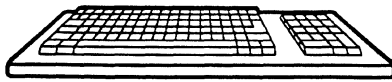
**Screen Redraw** When in a drawing mode, to redraw the screen press the RIGHT mouse button.

---

**Nodraw** **Nodraw** turns off the current drawing mode. **Nodraw** is automatically selected when you choose an operation from any other menu.

**Freehand** In this mode, while drawing is enabled, all movement of the cursor is tracked for the waveform definition.

**To draw a waveform Freehand:**



To activate a **Draw** mode cursor, press the **TAB** key until the *WaveformList* is displayed. Then press **TAB** one more time.

Use the direction keys to position the starting point for the line to be drawn.

When the cursor is in the correct starting point, press either **SPACEBAR** or **ENTER**.

Press direction keys to extend the line segment in the desired direction.

To end the line segment and disable drawing, press either **SPACEBAR** or **ENTER**.



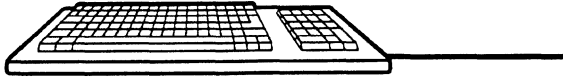
Move the cursor to the desired start point for the line segment. Press and **hold** the LEFT mouse button to enable drawing.

Move the mouse in the desired direction and a line segment follows from the start point to wherever the cursor moves.

When the cursor is at the desired end point, release the LEFT mouse button to end the line segment and disable drawing.

**Horizontal** This mode is the same as Freehand, except that while drawing is enabled, vertical movement of the mouse or direction keys is ignored.

**To draw a horizontal line:**



To activate a **Draw** mode cursor, press the **TAB** key until the *WaveformList* is displayed. Then press **TAB** one more time.

Use the direction keys to position the starting point for the line to be drawn.

When the cursor is in the correct starting point, press either **SPACEBAR** or **ENTER** to enable drawing.

Press direction keys to extend the line segment in the desired direction. The line only draws in a horizontal direction originating from the start point.

To end the line segment, press either **SPACEBAR** or **ENTER**.

Repeat for additional line segments.



Move the cursor to the desired start point for the line segment. Press and **hold** the LEFT mouse button to enable drawing.

Move the mouse in the desired direction and a horizontal line segment extends from the start point to the horizontal position of the cursor.

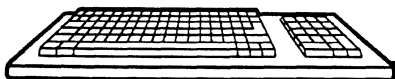
When the cursor is at the desired end point, release the LEFT mouse button to end the line segment.

Repeat for additional line segments.



**Vertical** This mode is the same as Freehand, except that while drawing is enabled, horizontal movement of the mouse or direction keys is ignored.

**To draw a vertical line:**



To activate a **Draw** mode cursor, press the **TAB** key until the *WaveformList* is displayed. Then press **TAB** one more time.

Use the direction keys to position the cursor at the point you want to change to a different level.

Press either **SPACEBAR** or **ENTER** to enable movement.

Press direction keys to move the point in the desired direction.

To fix the point in the new position, press either **SPACEBAR** or **ENTER**.



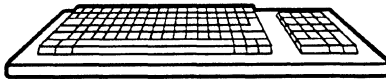
Move the cursor to the desired point to be moved. Press and **hold** the LEFT mouse button to enable movement.

Move the mouse in the desired direction and the selected point follows the cursor in a vertical **direction**.

When the cursor is at the desired location for the selected point, release the LEFT mouse button.

**Autoline** *Autoline* is a way to draw a sequence of line segments where the end point of a line is the start point of the next line to be drawn (if a continuation is desired). Line segments can be drawn at any angle.

To use Autoline:



To activate a **Draw** mode cursor, press the **TAB** key until the *WaveformList* is displayed. Then press **TAB** one more time.

Use the direction keys to position the starting point for the line to be drawn.

When the cursor is in the correct starting point, press either **SPACEBAR** or **ENTER** to enable drawing.

Press direction keys to extend the line segment in the desired direction.

At the end of a line segment, press **SPACEBAR** or **ENTER**. The end of this line is now the start point for the next line. If desired, you can create additional lines with the cursor keys and the **SPACEBAR** or **ENTER** keys.

To complete the series of line increments and disable drawing, press **ESCAPE**.



Move the cursor to the desired start point for the line. Click (but do NOT hold) the LEFT mouse button to enable drawing.

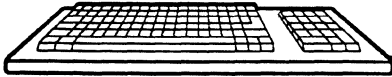
Move the mouse in the desired direction and a line extends from the start point to the cursor.

When the cursor is at the desired end point of the line, click the LEFT mouse button to end the line. The end point of this line is now the start point for the next line. If desired, move the mouse in additional directions and continue clicking the LEFT mouse button to define additional segments or increments of a waveform.

When the cursor is at the desired end point for a completed series of line segments, click the RIGHT mouse button to accept the series and disable drawing.

## Envelope Max Don't Care

This command is similar to the **Horizontal** command and allows you to draw the "don't care" acceptance range for the upper limit of the waveform envelope. The "don't care" bit level is determined by the target instrument at the time the waveform was created; it is the maximum bit level the instrument supports.



To activate a Draw mode cursor, press the **TAB** key until the *WaveformList* is displayed. Then press **TAB** one more time.

Use the direction keys to position the starting point for the line to be drawn.

When the cursor is in the correct starting point, press either **SPACEBAR** or **ENTER** to enable drawing.

Press direction keys to extend the line segment in the desired direction. The line only draws in a horizontal direction originating from the start point.

To end the line segment, press either **SPACEBAR** or **ENTER**.

Repeat for additional line segments.



Move the cursor to the desired start point for the line segment. Press and hold the LEFT mouse button to enable drawing.

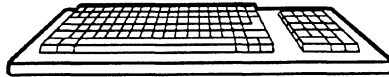
Move the mouse in the desired direction and a horizontal line segment extends from the start point to the horizontal position of the cursor.

When the cursor is at the desired end point, release the LEFT mouse button to end the line segment.

Repeat for additional line segments.

## Envelope Min Don't Care

This command is similar to the **Horizontal** command and allows you to draw the "don't care" acceptance range for the lower limit of the waveform envelope. The "don't care" bit level is determined by the target instrument at the time the waveform was created; it is the minimum bit level the instrument supports.



To activate a **Draw** mode cursor, press the [TAB] key until the *WaveformList* is displayed. Then press [TAB] one more time.

Use the direction keys to position the starting point for the line to be drawn.

When the cursor is in the correct starting point, press either **[SPACEBAR]** or **[ENTER]** to enable drawing.

Press direction keys to extend the line segment in the desired direction. The line only draws in a horizontal direction originating from the start point.

To end the line segment, press either **[SPACEBAR]** or **[ENTER]**.

Repeat for additional line segments.



Move the cursor to the desired start point for the line segment. Press and **hold** the LEFT mouse button to enable drawing.

Move the mouse in the desired direction and a horizontal line segment extends from the start point to the horizontal position of the cursor.

When the cursor is at the desired end point, release the LEFT mouse button to end the line segment.

Repeat for additional line segments.

---

**Envelope Max** When **EnvelopeMax** is selected, you can select a Draw menu command to use to modify the upper limit of the currently selected envelope. Select this option first, then select a drawing mode.

---

**Envelope Min** When **EnvelopeMin** is selected, you can select a Draw menu command to use to modify the lower limit of the currently selected envelope. Select this option first, then select a drawing mode.

*NOTE* When creating envelopes, Max values should be greater than Min values. Otherwise, the signal waveform will always fail.



# Section 9 — How to CREATE WAVEFORMS and SEQUENCES

## What the Create Menu Does

This menu selection is roughly equivalent to a multi-function signal generator. Several waveform types can be produced:

- Normal Waveforms  
Sine, triangle, pulse, and square.
- A waveform can also be defined by a mathematical expression, using the **Equation** selection.
- Envelopes  
Upper and lower waveform test limits.
- Sequences  
Specify a concatenation of waveforms.

As on a signal generator, the characteristics of a waveform can be adjusted:

- Amplitude and offset (can also be specified as Maximum and Minimum levels)
- Frequency/Period
- Cycles
- Phase
- Start and Stop points
- Rise type, fall type, risetime, falltime
- Delay, pulse width
- Duty cycle

## Setting Waveform Characteristics

Waveform characteristics are defined by setting or modifying parameters in dialog boxes that appear when a waveform type is selected from the **Create** menu.

### Units of Measure

Wherever it's appropriate, units of measure are appended to an edit box at its right side. Modifiers to those units are included as part of the data within the edit box. For example, a value of 230 milliseconds is displayed as:

s

The modifiers that are recognized by **WaveWriter** are these *Systeme Internationale* (SI) characters. Case is significant:

G = giga	u = micro
M = mega	n = nano
K = kilo	p = pico
m = milli	

Except for the Equation edit box in the Equation selection, values can be expressed in points or seconds. Non-integer numeric values can be expressed in *scientific* (exponential) *notation*. Scientific notation uses a *mantissa* (a decimal number) followed by an *exponent*. The form for this type of number is:

$-n.nn E-nn$

The signs can be omitted for positive values.

The earlier 230 millisecond example could also be entered as any of the following:

s       s  
 s  
 s

### Choice of Units

Some parameters can be expressed in different units of measure. Horizontal units can be either *Seconds* or *Points*. Phase angle can be *Degrees* or *Radians*. (Vertical units are always Volts.)

Units of measure are selected with option buttons. When a different unit of measure is chosen, the current edit box value is converted to the new units.



---

**Parameter Definitions** Most of the following definitions apply to **all** waveforms — others that are only used with a specific waveform type are identified as such.

**Amplitude** Peak-to-peak magnitude of the waveform.

**Offset** Deviation of the waveform zero-level from a reference level. Also called baseline offset. This parameter is built into the data.

**Max, Min** The highest and lowest voltage levels of a waveform. If *Max* and *Min* are entered, *Offset* is calculated as the level halfway between *Max* and *Min* and *Amplitude* is set to *Max* minus *Min*.

**Frequency/Period** Calculated based on defined points in a waveform and specified clock rate. You can also select if calculation is to be based on *Start Point*, *Stop Point*, and the number of *Cycles*.

**Pulse Width** The time interval that a pulse is at 50% or more of its peak amplitude. Calculation is based on *Start Point*, *Stop Point*, and *Cycles*. See Figure 9-1. [Pulse]

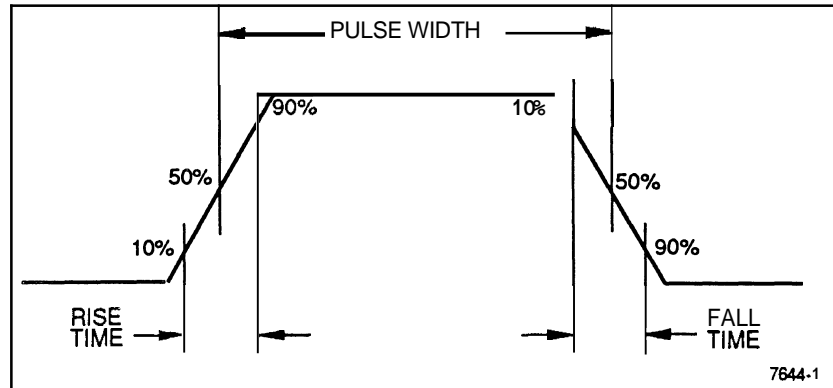
**Cycles** The number of waveform alternations. Calculation is based on *Start Point*, *Stop Point*, and *Frequency*.

**Phase** Specifies waveform starting point expressed as an angular deviation from a reference point. Can be expressed in *Degrees* or *Radians*.

**Start Point** The position, in time or points, in which the waveform starts. Calculation is based on *Stop Point*, *Frequency*, and *Cycles*. This point is different from, and doesn't necessarily coincide with the *Start Marker*.

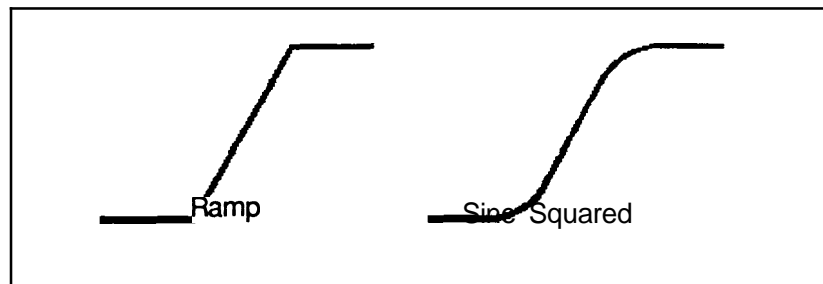
**Stop Point** The position, in time or points, in which the waveform stops. Calculation is based on *Start Point*, *Frequency*, and *Cycles*. This point is different from, and doesn't necessarily coincide with the *Stop Marker*.

Figure 9-1.  
Timing Parameters.



**Rise/Fall Type** Positive going and negative going transitions can be defined as either *Ramp* or *Sine Squared*. See Figure 9-2. If *Ramp* is selected, the complete transition time is 1.25 times the entered transition time. If *Sine Squared* is selected, the complete transition time is 2.073878 times the entered transition time. [Pulse, Square]

Figure 9-2.  
Ramp vs. Sine Squared.



**Rise/Fall Time** Transition times are defined as the period between 10 percent and 90 percent of the amplitude. See Figure 9-1. [Pulse, Square]

**Duty Cycle** The ratio of the pulse duration to the period, expressed in percent. [Square]

**Delay** The difference between the start of a waveform and the start of a pulse wave transition. Can be specified in points or time. *Delay* can't be a point or a time beyond the length of the waveform. [Pulse]

**NOTE** Some combinations of parameters may result in an "Invalid number" error message. For example, the *Start Point* can not be a negative value.

**Equation** Waveforms can be created mathematically by entering an equation that defines the characteristics of the waveform. These equations can be saved in a library (see *Add Equation to Library*) and recalled for future use (see *Library*). When **Equation** is selected, the dialog box in Figure 9-3 appears.

Figure 9-3.  
Equation Dialog Box,

**Equation** The equation edit box is where you enter a mathematical expression defining a waveform.

The following operators are supported:

( )	parenthesis	+	addition
-	subtraction	*	multiplication
/	division	A	exponentiation

The following functions are supported:

<b>sqrt</b> ( )	square root	<b>sin</b> ( ) or <b>sine</b> ( )	sine
<b>cos</b> ( )	cosine	<b>tan</b> ( )	tangent
<b>asin</b> ( )	arcsine	<b>acos</b> ( )	arccosine
<b>atan</b> ( )	arctangent	<b>sinh</b> ( )	hyperbolic sine
<b>cosh</b> ( )	hyperbolic cosine	<b>tanh</b> ( )	hyperbolic tangent
<b>abs</b> ( )	absolute value	<b>ceil</b> ( )	ceiling
<b>floor</b> ( )	floor	<b>log<sub>10</sub></b> ( )	log base 10
<b>log</b> ( )	natural log	<b>rand</b>	random noise
<b>exp</b> ( )	exponentiation, base e		

The characters "pi" can be substituted for the numeric value of the symbol  $\pi$ .

**EquationDefinitions** The following elements need to be considered and set when creating an equation:

**Start/StopPoints** — The *Start* and *Stop Points* define the range of time (t) describing the beginning and end of the waveform segment. You may enter the values in either points or seconds, but points are converted to time when the calculation is done.

**Time (t)** — Time is the running variable represented in the equation by the character t. When creating an equation, t is initially the time at the *Start Point* and, in the calculation, is incremented to the time at the *Stop Point*. This is true for all actions except 'insert'. In this case, time is initially 0 and increments to time = stop – start.

**Clock Rate** — The system clock rate.

**Frequency** — Frequency can be defined as:  
$$1 / (\text{points/cycle} * \text{clock rate})$$

**Amplitude** — The amplitude of the waveform.

**Offset** — The dc offset of the waveform.

**Horizontal** The *Start Point* and *Stop Point* for the equation can be set in either *Points* or *Seconds*. Note that the equation start and stop points are not the same as the *Start Marker* and *Stop Marker*. The values entered in these edit boxes define the range of the time variable (t) when the waveform is calculated.

**Action** Specifies where the newly defined waveform will be placed:

**Replace** Writes over the current waveform between and including the *Equation Start* and *Stop* points. It calculates the waveform at time = start to time = stop.

**Insert** Inserts the newly defined equation waveform into the current waveform starting at the *Equation Start Point*. The previously defined portion of the current waveform (after and including the *Equation Start Point*) is shifted to follow the end of the inserted waveform. It calculates the waveform at time = 0 to time = stop – start.

**Add** Arithmetically adds the newly defined equation waveform to the current waveform between and including the *Equation Start* and *Stop* points. (See Section 10.)

**New Waveform** Creates a new waveform. You are prompted to enter a new waveform name. If *Equation Start* is not defined as zero, all data points preceding *Equation Start* are set to zero Volts. *Equation Stop* defines the end of the waveform.

**Waveform Name** This edit box is only displayed if *NewWaveform* is selected. Enter a name for the new waveform.

**Equation Example** To produce a single cycle of a 1 KHz sine wave with a 2 Volt peak-to-peak amplitude and a + 1.5 Volt dc offset for the AFG 5101, enter the following parameters:

Start point = 0

Stop point = 999

Clock = 1  $\mu$ s (Use the Change Clock Rate command)

The equation shown follows the basic form for trigonometric functions, where:

A = dc offset.

B = peak amplitude.

F = desired frequency of waveform.

f = function. e.g. sin, cos, tan.

For the equation:

$$A + B * f ( 2 * \pi * F * t )$$

Calculate the signal frequency

$$[1/(\text{points/cycle} * \text{clock rate})]$$

$$F = 1/(1000 * (1 * 10^{-6})) = 1000$$

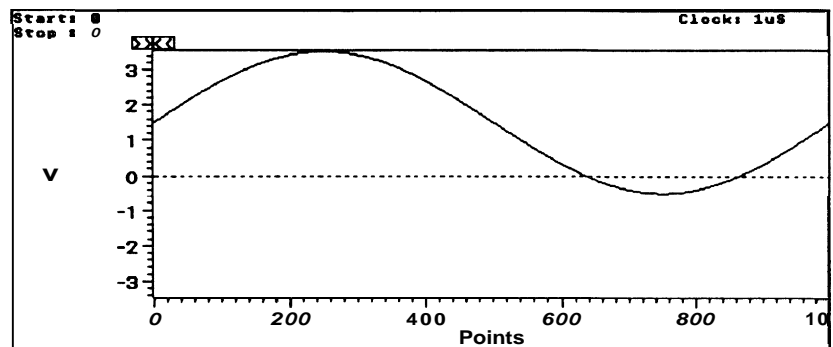
substitute the values for this example and enter in the *Equation* edit box:

$$1.5 + 2.0 * \sin ( 2 * \pi * 1000 * t )$$

When **OK** is selected, the waveform will be created. After the waveform is drawn on the screen, select **Autoscale Current** Waveform to see its full amplitude.

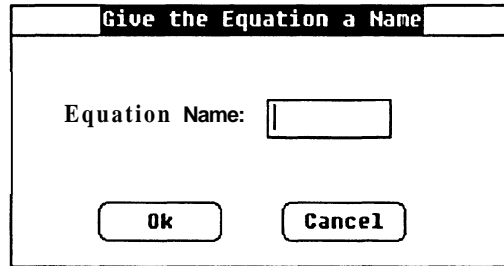
The waveform in Figure 9-4 should be displayed in the *Waveform Display Area*.

Figure 9-4.  
Equation Example.



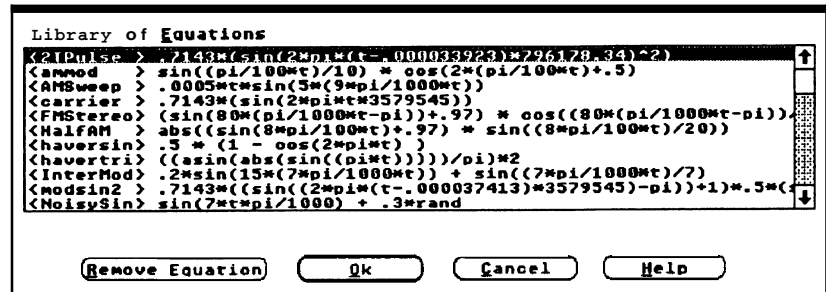
**Add Equation to Library** To add the newly created equation to the equation library, select the **Add Equation to Library** command button. You are prompted for a name to identify the waveform. The name can be any combination of up to eight ASCII alphanumeric characters. Select **OK** to accept the name. If you choose not to identify a waveform, just select **OK** without entering text. If you choose to have names that are not unique, that is also legal. Names and waveform equations are not tested for duplication.

*Figure 9-5.  
Add Equation to Library  
Dialog Box.*



**Library** When Library is selected, a dialog box such as Figure 9-6 appears. In addition to the command buttons, there is a list box that lists the equations and their identifiers. You can highlight and select an existing equation from this list.

Figure 9-6.  
Library  
Dialog Box.



**Remove Equation** Removes a highlighted equation from the library list.

**OK (Library)** Accepts deletions, if any, and returns to the Equation dialog box. The selected equation will be placed in the equation edit box.

**Cancel (Library)** Ignores deletions and returns to the Equation dialog box.

**OK (Equation)** When all parameters are set the way you want them, select the **OK** command button to initiate the selected Action

**Cancel (Equation)** Select the Cancel command button to abort the Equation function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Equation dialog box, select the Control-menu box and then select Close.

**Sample Equations** To help in using the equation feature, here are some sample equations along with a brief description. The following equations can be found in the library section of the **Equation Dialog** box. But first, the basic trig function equation format is:

$$A + B * f(2 * \pi * F * t)$$

where:

A = DC offset

B = Peak Amplitude in volts

f = trigonometric function, e.g., sin, cos, tan.

F = Frequency of waveform [1 / (points/cycle \* clock rate)]

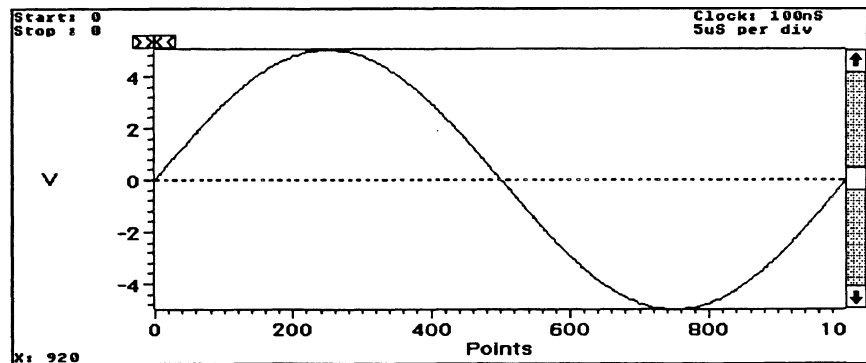
t = Time. Running variable initialized at start point and incremented to stop point.

pi = 3.14159265 (internal constant)

### Example Equations:

1. A 10KHz sine wave with a 10V peak-to-peak amplitude and no DC offset.

Figure9-6A.  
5V Sine.



Start point = 0 pts.

Stop point = 999 pts.

Clock = 100ns

Cycles = 1

In the equation:

$$5 * \sin(2 * \pi * 10^4 * t)$$

The 5 represents the peak amplitude. The sine function returns a value between 1 and -1. Multiplying by 5 adjusts the amplitude to be between 5 and -5. The frequency of the equation is calculated based on the clockrate and points/cycle of the waveform. The formula is:

$$F = 1/((\text{points/cycle}) * \text{clock}) \text{ or } 1/(1000 * 100\text{ns}) \text{ which is } 10\text{KHz} (10^4 \text{ in equation}).$$

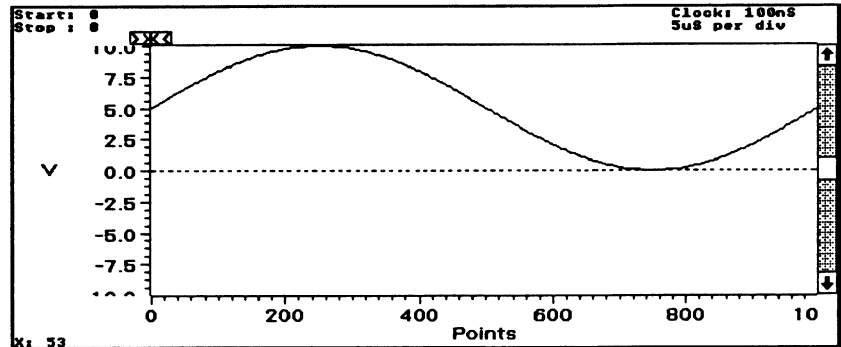


So, if you were to change the clock rate to 10ns and wanted to maintain the same number of cycles, you would have to change the frequency to  $1/(1000*10\text{ns}) = 100\text{kHz}$ . The new equation would be:

$$5 * \sin(2 * \pi * 10^5 * t)$$

2. Same sine wave as in example 1 above except with 5V dc offset.

Figure 9-6B  
5V Sine with Offset.

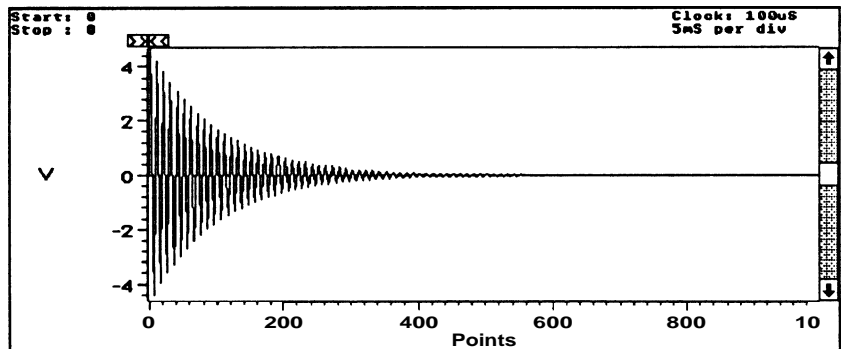


Equation:

$$5 + 5 * \sin(2 * \pi * 10^4 * t)$$

3. A 1KHz sine wave with a 10V peak-to-peak amplitude, with exponential decay with 10ms time constant.

Figure 9-6C  
Exponentially Decaying Sinewave.



Clock = 100 us

Start = 0 pts.

Stop = 999 pts.

Cycles = 100

Equation:

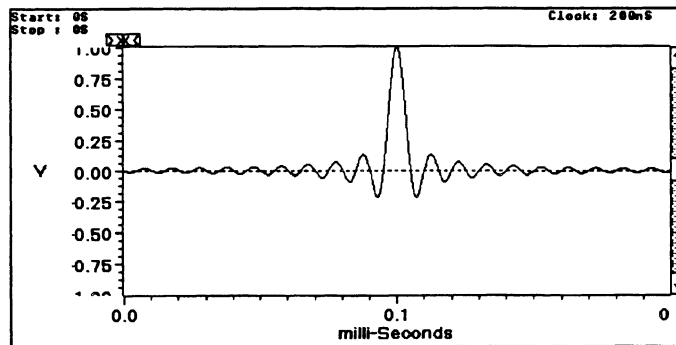
$$5 * \sin(2 * \pi * 10^3 * t) * \exp(-t / 10^{-2})$$

The 5 represents the amplitude. The frequency is calculated based on the clockrate and the points per cycle to be  $1/(1000 \text{ pts}/100 \text{ cycles} * 100\text{us}) = 1\text{kHz}$  or  $10^3$ .

The exponential function starts at 1 and decays to 0 which, when multiplied by the sine function, changes the amplitude from full scale to zero.

4. A sinc curve centered around 100uS with a frequency of 100kHz.

Figure9-60  
SincWaveform.



Clock = 200ns

Start = 0 s

Stop = 199.8 us

Cycles = 20

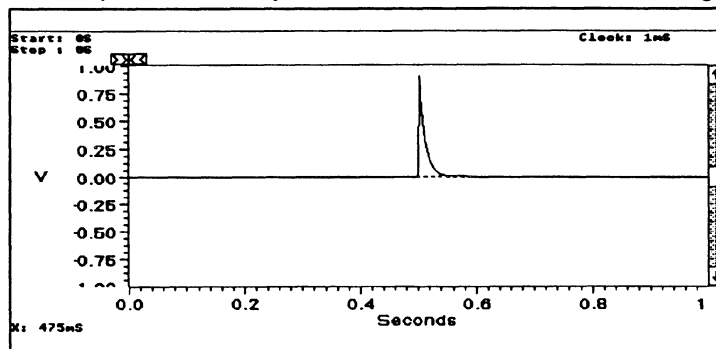
Equation:

$$(\sin(2 * \pi * 10^5 * (t - 10^{-4})) + 10^{-10}) / ((2 * \pi * 10^5 * (t - 10^{-4})) + 10^{-10})$$

The  $10^{-10}$  terms are included to eliminate divide by 0 plus provide the correct value at the singularity point  $t = 100\mu s$ . The frequency is calculated to be  $1/(1000 \text{ pts} / 20 \text{ cycles}) * 200\text{ns} = 100\text{Khz}$ . Since the time variable 't' begins at  $t = 0\text{s}$  and goes to  $t = 199.8\mu s$ , the starting time is reduced by  $100\mu s$  in the equation  $(t - 10^{-4})$  to provide the correct value at the singularity point  $t = 100\mu s$ .

5. Exponential decay with time constant of 10mS, starting at 500mS.

Figure9-6E  
Exponential Decay Waveform.



Start = Clock = 1ms

500ms

Stop = 1s (assuming 1000 point waveform)

Equation:

$$\exp(-(t - 0.5) / 10^{-2})$$

The  $(t - 0.5)$  calculates the waveform with reference to zero (start  $-500\text{ms}$ ) but it will be placed starting at  $500\text{ms}$  (Start Point) in the waveform.

6. A DSX-2 Isolated pulse template for telecommunications. The equations defining this and other telecom templates may be normalized. So, assume a normalized equation such as:

$$v(T) = 0.5(1 + \sin(\pi/2 * (1 + T/0.36)))$$

$$\text{where } 0.72 \leq T \leq 0.2$$

First translate the variable T into the variable t which starts at 0 and increases.

$$-0.72 \leq T \leq 0.2 \quad 0 \leq (T+0.72) \leq 0.92$$

$$\text{Let } t = T + 0.72. \text{ Thus } 0 \leq t \leq 0.92$$

Substitute  $t - 0.72 = T$  to get:

$$v(t-0.72) = 0.5(1 + \sin(\pi/2 * (1 + (t-0.72) / 0.36)))$$

The variable T is normalized to the period of the signal

Assume the signal of interest is 6.312 MHz, the clock frequency for a DS2 digital communications system. The period is 158.4ns. To transform the variable t into a normalized form, simply divide all occurrences of t by the signal period or 158.4ns for this example.

The final equation is:

$$v(t-0.72) = 0.5 * (1 + \sin(\pi/2 * (1 + ((t/(158.4 * 10^{-9})) - 0.72) / 0.36)))$$

This equation can now be used to generate a waveform by calculating appropriate start and stop points. Select Create Equation menu and choose the **New** Waveform action button. Then enter the following parameters:

$$\text{Start} = T = -0.72 \implies (t/158.4\text{ns}) = 0 \implies t = 0$$

$$\text{Stop} = T = 0.2 \implies (t/158.4\text{ns}) = 0.92 \implies t = 145.8\text{ns}$$

$$\text{Use clock} = 1\text{ns}$$

This will give you the first half of the maximum waveform defining the DSX-2 Pulse Template. The following equations define the rest of the template.

2nd half of the Maximum Waveform:

With the 1st half of the DSX-2 pulse template as the current waveform, Select Create Equation and choose Replace as the action. Then enter the following values:

Equation :

$$0.1 + 0.72 * \exp((-2.13 * ((t/158.4 * 10^{-9}) - 0.92)))$$

$$\text{Start} = 147\text{ns}$$

$$\text{Stop} = 350\text{ns}$$

## Equation

To generate the minimum waveform of the template a new waveform will need to be created consisting of the following two parts:

1st half of the Minimum Waveform:

Select the **Create Equation** menu item. Then, choose the **New Waveform** action button and enter in the following parameters:

Equation:

$$0.5*(1+\sin(\pi/2*(1+((t/158.4*10^{-9}))-0.72)/0.205)))$$

Start = 50ns

Stop = 150ns

Clock = 1ns

2nd half of the Minimum Waveform:

Select the **Create Equation** Dialog Box again, and choose the **Replace** action button. Then enter the following parameters:

Equation:

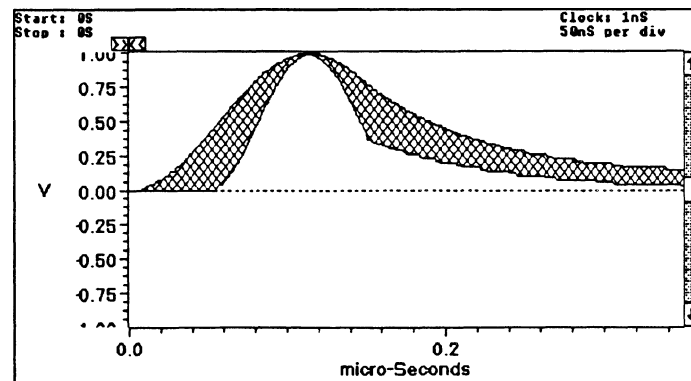
$$0.331*\exp((-1.9*((t/158.4*10^{-9})-1.02)))$$

Start = 151ns

Stop = 350ns

Now use **Envelope Couple** to combine these two waveform and create your DSX-2 Template (see Envelope Couple later in this section). These equations can be found in the equation library distributed with **WaveWriter**. See Fig. 9-6F for the resultant template.

**Figure 9-6F**  
*DSX-2 Isolated Pulse Template*



**Sine** When **Sine** is selected, the dialog box in Figure 9-7 appears.

Figure 9-7.  
Sine Dialog Box.

**Vertical** You can specify the vertical parameters in either *Max/Min* or *Amplitude/Offset* pairs.

**Max/Min** Enter the desired highest and lowest voltage levels for the waveform. Values should not be greater than allowed by the target instrument.

**Amplitude/Offset** Enter the peak-to-peak voltage in the *Amplitude* edit box. Enter the offset voltage in the *Offset* edit box. For example a waveform with 4 V peak-to-peak amplitude and a 1 V offset would vary from -1 V to 3 V.

**NOTE** *The offset value specified here is independent of the offset specified when a waveform is sent to the instrument. The offset here is a part of the data, whereas the offset specified during output is not a part of the data, but is an instrument setting that affects every waveform output from the instrument.*

**Horizontal** *Start* and *Stop Points*, *Frequency*, and *Cycles* can be specified. There is a check box associated with each of these four items. Any one value can be calculated if the other three values are known. In this dialog box a check box is unselected, rather than selected with the mouse or keyboard. One of the four check boxes is always in an unselected state (no "X" in it).

**NOTE** *Clock rate* is a fundamental parameter used in calculating waveforms. Use the **Change Clock Rate** command in the *Displaymenu* to set the system clock rate.

**Calculate** The Calculate command button is connected to the parameter to be calculated (empty check box). If you wish to preview the parameter, select the Calculate command button. However, the calculation is done automatically when the **OK** command button is selected. In Figure 9-7, *Start Point*, *Stop Point*, and *Cycles* were entered, and *Frequency* was calculated.

**Points/Seconds** Specifies the units for the *Start Point* and *Stop Point* parameters.

**Start Point** Enter (or calculate) the horizontal location where the sine wave is to start. The *Start Point* location should not be confused with the *Start Marker* position — it is not necessarily the same point.

**Stop Point** Enter (or calculate) the horizontal location where the sine wave is to stop. The *Stop Point* location should not be confused with the *Stop Marker* position — it is not necessarily the same point.

**Frequency** Enter (or calculate) the frequency of the waveform.

**Cycles** Enter (or calculate) the number of cycles to be created.

**Phase** Enter the phase for the beginning of the waveform.

**Radians/Degrees** Specifies the units of the Phase parameter.

**Action** Specifies where the newly defined waveform will be placed:

**Replace** Writes over the current waveform between and including the *Start* and *Stop Points*.

**Insert** Inserts the newly defined sine waveform into the current waveform starting at the *Start Point*. The previously defined portion of the current waveform (after and including the *Start Point*) is shifted to follow the end of the inserted waveform.

**Add** Arithmetically adds the newly defined sine waveform to the current waveform between and including the *Start* and *Stop* points. (See Section 10.)

**New Waveform** Creates a new waveform. You are prompted to enter a new waveform name. If *Start* is not defined as zero, all data points preceding *Start* are set to zero Volts. *Stop* defines the end of the waveform.

**Waveform Name** This edit box is displayed only when *NewWaveform* is selected in the *Action* group box. Enter an 8 character (or less) filename and a 3 character (or less) extension that is acceptable to the DOS system. A filename extension is not necessary, since it can be appended when the waveform is saved to a disk file.

**OK** When all parameters are set the way you want them, select the OK command button.

**Cancel** Select the Cancel command button to abort the Sine function and return to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Sine dialog box, select the Control-menu box and then select *Close*.

**Triangle** When **Triangle** is selected, the dialog box in Figure 9-8 appears.

Figure 9-8.  
Triangle Dialog Box.

**Vertical** You can specify the vertical parameters in either *Max/Min* or *Amplitude/Offset* pairs

**Max/Min** Enter the desired highest and lowest voltage levels for the waveform. Values should not be greater than allowed by the target instrument.

**Amplitude/Offset** Enter the peak-to-peak voltage in the *Amplitude* edit box. Enter the offset voltage in the *Offset* edit box. For example a waveform with 4 V peak-to-peak amplitude and a 1 V offset would vary from -1 V to 3 V.

**NOTE** *The offset value specified here is independent of the offset specified when a waveform is sent to the instrument. The offset here is a part of the data, whereas the offset specified during output is not a part of the data, but is an instrument setting that affects every waveform output from the instrument.*



**Horizontal** *Start* and *Stop Points*, *Frequency*, and *Cycles* can be specified. There is a check box associated with each of these four items. Any one value can be calculated if the other three values are known. In this dialog box a check box is unselected, rather than selected with the mouse or keyboard. One of the four check boxes is always in an unselected state (no "X" in it).

**NOTE** *Clock rate is a fundamental parameter used in calculating waveforms. Use the **Change Clock Rate** command in the **Display** menu to set the system clock rate.*

**Calculate** The Calculate command button is connected to the parameter to be calculated (empty check box). If you wish to preview the parameter, select the Calculate command button. However, the calculation is done automatically when the **OK** command button is selected. In Figure 9-8, *StartPoint*, *StopPoint*, and *Cycles* were entered, and *Frequency* was calculated.

**Points/Seconds** Specifies the units for the *StartPoint* and *StopPoint* parameters.

**StartPoint** Enter (or calculate) the horizontal location where the triangle wave is to start. The *StartPoint* location should not be confused with the *Start Marker* position — it is not necessarily the same point.

**StopPoint** Enter (or calculate) the horizontal location where the triangle wave is to stop. The *StopPoint* location should not be confused with the *Stop Marker* position — it is not necessarily the same point.

**Frequency** Enter (or calculate) the frequency of the waveform.

**Cycles** Enter (or calculate) the number of cycles to be created.

**Phase** Enter the phase for the beginning of the waveform.

**Radians/Degrees** Specifies the units of the Phase parameter.

**Action** Specifies where the newly defined waveform will be placed:

**Replace** Writes over the current waveform between and including the *Start* and *Stop Points*.

**Insert** Inserts the newly defined triangle waveform into the current waveform starting at the *Start Point*. The previously defined portion of the current waveform (after and including the *Start Point*) is shifted to follow the end of the inserted waveform.

**Add** Arithmetically adds the newly defined triangle waveform to the current waveform between and including the *Start* and *Stop* points. (See Section 10.)

**New Waveform** Creates a new waveform. You are prompted to enter a new waveform name. If *Start* is not defined as zero, all data points preceding *Start* are set to zero Volts. *Stop* defines the end of the waveform.

**Waveform Name** This edit box is displayed only when *NewWaveform* is selected in the *Action* group box. Enter an 8 character (or less) filename and a 3 character (or less) extension that is acceptable to the DOS system. A filename extension is not necessary, since it can be appended when the waveform is saved to a disk file.

**OK** When all parameters are set the way you want them, select the **OK** command button.

**Cancel** Select the Cancel command button to abort the Triangle function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Triangle dialog box, select the Control-menu box and then select *Close*.

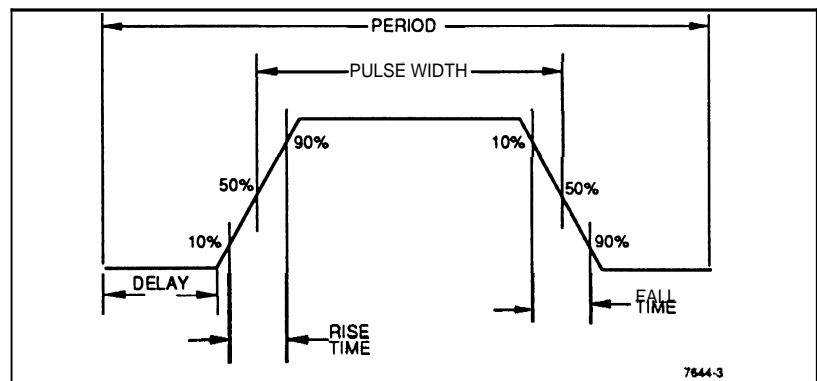
**Pulse** When Pulse is selected, the dialog box in Figure 9-9 appears,

Figure 9-9.  
Pulse Dialog Box.

**Vertical** Sets the vertical pulse parameter.

**Maximum/Minimum** Enter the desired highest and lowest voltage levels for the waveform. Values should not be greater than allowed by the target instrument.

Figure 9-10.  
Pulse Timing Parameters.



**Horizontal** *Start and Stop Points, Period, and Cycles* can be specified. There is a check box associated with each of these four items. Any one value can be calculated if the other three values are known. In this dialog box a check box is unselected, rather than selected with the mouse or keyboard. One of the four check boxes is always in an unselected state (no "X" in it).

**NOTE** *Clock rate is a fundamental parameter used in calculating waveforms. Use the **Change Clock Rate** command in the **Display** menu to set the system clock rate.*

**Calculate** The Calculate command button is connected to the parameter to be calculated (empty check box). If you wish to preview the parameter, select the Calculate command button. However, the calculation is done automatically when the **OK** command button is selected. In Figure 9-9, *StartPoint*, *StopPoint*, and *Period* were entered and *Cycles* was calculated.

**Points/Seconds** Selects the units for the *StartPoint* and *StopPoint* parameters.

**StartPoint** Enter (or calculate) the horizontal location where the pulse wave is to start. The *StartPoint* location should not be confused with the *Start Marker* position — it is not necessarily the same point.

**StopPoint** Enter (or calculate) the horizontal location where the pulse wave is to stop. The *StopPoint* location should not be confused with the *Stop Marker* position — it is not necessarily the same point.

**Period** Enter (or calculate) the period of the waveform.

**Cycles** Enter (or calculate) the number of cycles to be created.

**Delay** Enter the delay before the first transition.

**PulseWidth** Enter the width of the pulse at 50% of the peak-to-peak amplitude.

**Transitions** Enter *Risetime* and *Falltime*.

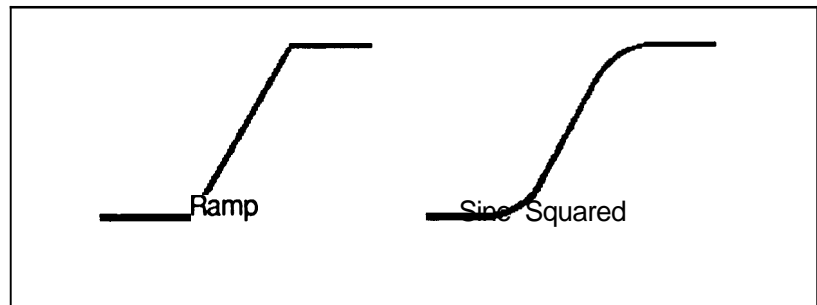
**PulseDirection** Select whether the leading edge of the pulse is *Positive* going or *Negative* going.

**Risetime** Enter the horizontal distance required for the leading edge of a pulse to go from 10% to 90% of its amplitude. (Amplitude is the difference between the *Maximum* and *Minimum* values entered.)

**Falltime** Enter the horizontal distance required for the trailing edge of a pulse to go from 90% to 10% of its amplitude. (Amplitude is the difference between the *Maximum* and *Minimum* values entered.)

**Ramp/Sine<sup>2</sup>** *Rise type* and *Fall type* can be independently set to either *Ramp* or *Sine Squared*. See Figure 9-11. If *Ramp* is selected, the contribution of the transition time to the period is 1.25 times the entered transition time. If *Sine Squared* is selected, the contribution of the transition time to the period is 2.073878 times the entered transition time.

**Figure 9-11.**  
*Ramp vs. Sine Squared.*



**Action** Specifies where the newly defined waveform will be placed:

**Replace** Writes over the current waveform between and including the *Start* and *Stop Points*.

**Insert** Inserts the newly defined pulse waveform into the current waveform starting at the *Start Point*. The previously defined portion of the current waveform (after and including the *Start Point*) is shifted to follow the end of the inserted waveform.

**Add** Arithmetically adds the newly defined pulse waveform to the current waveform between and including the *Start* and *Stop* points. (See Section 10.)

**New Waveform** Creates a new waveform. You are prompted to enter a new waveform name. If *Start* is not defined as zero, all data points preceding *Start* are set to zero Volts. *Stop* defines the end of the waveform.

**Waveform Name** This edit box is displayed only when *New Waveform* is selected in the *Action* group box. Enter an 8 character (or less) filename and a 3 character (or less) extension that is acceptable to the DOS system. A filename extension is not necessary, since it can be appended when the waveform is saved to a disk file.

**OK** When all parameters are set the way you want them, select the **OK** command button to initiate the selected Action

**Cancel** Select the Cancel command button to abort the Pulse function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Pulse dialog box, select the Control-menu box and then select *Close*.

## Square

When **Square** is selected, the dialog box in Figure 9-12 appears.

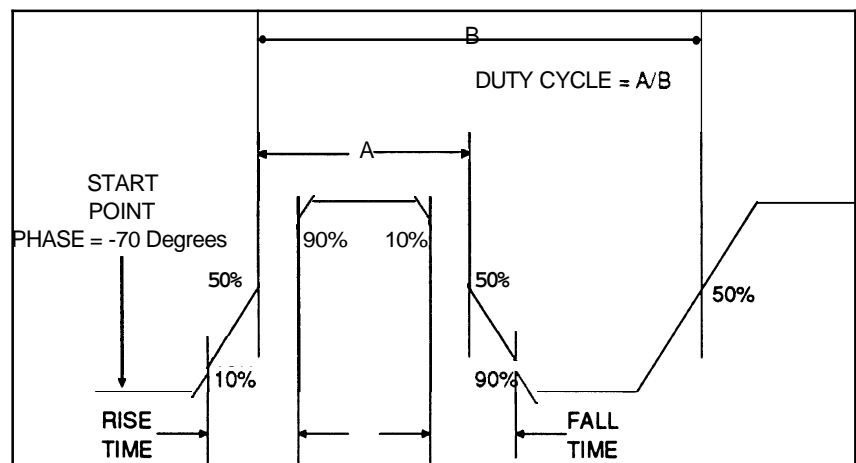
Figure 4.12.  
Square Dialog Box.

**Vertical** You can specify the vertical parameters in either *Max/Min* or *Amplitude/Offset* pairs.

**Max/Min** Enter the desired highest and lowest voltage levels for the waveform. Values should not be greater than allowed by the target instrument.

**Amplitude/Offset** Enter the peak-to-peak voltage in the *Amplitude* edit box. Enter the offset voltage in the *Offset* edit box. For example a waveform with 4 V peak-to-peak amplitude and a 1 V offset would vary from -1 V to 3 V.

Figure 4.13.  
Square Timing Parameters.



**NOTE** *The offset value specified here is independent of the offset specified when a waveform is sent to the instrument. The offset here is a part of the data, whereas the offset specified during output is not a part of the data, but is an instrument setting that affects every waveform output from the instrument.*

**Horizontal** *Start and Stop Points, Frequency, and Cycles can be specified. There is a check box associated with each of these four items. Any one value can be calculated if the other three values are known. In this dialog box a check box is unselected, rather than selected with the mouse or keyboard. One of the four check boxes is always in an unselected state (no "X" in it).*

**NOTE** *Clock rate is a fundamental parameter used in calculating waveforms. Use the Change Clock Rate command in the Display menu to set the system clock rate.*

**Calculate** *The Calculate command button is connected to the parameter to be calculated (empty check box). If you wish to preview the parameter, select the Calculate command button. However, the calculation is done automatically when the **OK** command button is selected. In Figure 9-12, *StartPoint*, *StopPoint*, and *Frequency* were entered and *Cycles* was calculated.*

**Points/Seconds** *Specifies the units for *StartPoint* and *StopPoint* parameters.*

**StartPoint** *Enter (or calculate) the horizontal location where the square wave is to start. The *StartPoint* location should not be confused with the *Start Marker* position — it is not necessarily the same point.*

**Stop Point** *Enter (or calculate) the horizontal location where the square wave is to stop. The *StopPoint* location should not be confused with the *Stop Marker* position — it is not necessarily the same point.*

**Frequency** *Enter (or calculate) the frequency of the waveform.*

**Cycles** *Enter (or calculate) the number of cycles to be created.*

**Phase** *Enter the phase for the beginning of the waveform.*

**Radians/Degrees** *Select if Phase is to be defined in *Radians* or *Degrees*.*

**Duty Cycle** *The time between 50% of the rise and 50% of the fall divided by the period (50% of the rise to 50% of the next rise). Duty cycle is expressed in percent. See Figure 9-13.*



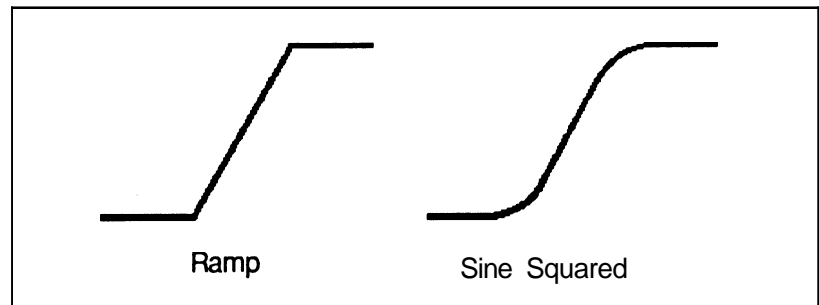
**Transitions** Enter *Rise time* and *Fall time* for the square wave.

**Risetime** Enter the horizontal distance required for the leading edge of a square wave to go from **10%** to **90%** of its amplitude or the difference between the *Maximum* and *Minimum* values entered.

**Falltime** Enter the horizontal distance required for the trailing edge of a square wave to go from **90%** to **10%** of its amplitude or the difference between the *Maximum* and *Minimum* values entered.

**Ramp/Sine Squared** *Rise type* and *Fall type* can be independently set to either *Ramp* or *Sine Squared*. See Figure 9-14. If *Ramp* is selected, the contribution of the transition time to the period is 1.25 times the entered transition time. If *Sine Squared* is selected, the contribution of the transition time to the period is **2.073878** times the entered transition time.

**Figure 9-14.**  
*Ramp vs. Sine Squared.*



**Action** Specifies where the newly defined waveform will be placed:

**Replace** Writes over the current waveform between and including the Start and StopPoints.

**Insert** Inserts the newly defined square wave waveform into the current waveform starting at the *Start Point*. The previously defined portion of the current waveform (after and including the *Start Point*) is shifted to follow the end of the inserted waveform.

**Add** Arithmetically adds the newly defined square wave waveform to the current waveform between and including the *Start* and Stoppoints. (See Section 10.)

**New Waveform** Creates a new waveform. You are prompted to enter a new waveform name. If Start is not defined as zero, all data points preceding Start are set to zero Volts. Stop defines the end of the waveform.

**Waveform Name** This edit box is displayed only when *NewWaveform* is selected in the Action group box. Enter an 8 character (or less) filename and a 3 character (or less) extension that is acceptable to the DOS system. A filename extension is not necessary, since it can be appended when the waveform is saved to a disk file.

**OK** When all parameters are set the way you want them, select the OK command button.

**Cancel** Select the **Cancel** command button to abort the **Square** function and return you to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Square** dialog box, select the **Control-menu** box and then select Close.

**Envelope Tolerance** You can define an envelope waveform by adding vertical and/or horizontal tolerances to an existing normal or envelope waveform. If you are modifying an envelope waveform, the tolerances are accumulative. When **Envelope Tolerance** is selected, the dialog box in Figure 9-15 appears.

Figure 9-15.  
Envelope Tolerance  
Dialog Box.

**NOTE** Double clicking a waveform in the *Displayed Waveforms* list will cause it to be entered into the bold edit box.

**Displayed Waveforms** A list box of available waveforms currently in memory.

**Input Waveform** Enter or select a waveform from the *Displayed Waveform* list to which apply a tolerance.

**Output Envelope** In this edit box, enter a name for the envelope waveform to be output. Any combination of ASCII alphanumeric characters can be entered for the 8 filename and 3 extension characters. Unique names should be chosen. If an existing envelope name is entered (or chosen from the *Displayed Waveforms* List), the current version will replace the previous one.

**Vertical Tolerance** The tolerance can be defined as voltages, percentages, or digitizing levels. Maximum *and* minimum tolerances must be specified. You can reduce the tolerance of an existing envelope by using a negative value.

**Voltage Value** The specified *Maximum Tolerance* in Volts is added to the waveform or the upper limit of the envelope. The specified *Minimum Tolerance* in Volts is subtracted from the waveform or the lower limit of the envelope.

**Percentage (User Defined)** To calculate percentage values, *WaveWriter* needs to know what values you consider to be 0% and 100%. When *Percentage (User Defined)* is specified and the tolerances are entered, select the **OK** command. A dialog box is displayed requesting that you enter a 0% level. Note that, for this operation, the *Waveform Display Area* cursor automatically changes to a crosshair indicator.

Move the horizontal crosshair vertically to the desired 0% level. Then, either press **[ENTER]** or press the LEFT mouse button to enter the value.

The next dialog box requests a 100% level to be entered. Use the same procedure as for the 0% level to enter the 100% level. When the 100% level is entered, the envelope is calculated and displayed.

**Percentage (Peak-to-Peak)** Calculates the maximum and minimum tolerances as percentages of the peak-to-peak amplitude of the waveform.

**Digitizing Level** The specified *Maximum Tolerance* in digitizing levels is added to the waveform or the upper limit of the envelope. The specified *Minimum Tolerance* in digitizing levels is subtracted from the waveform or the lower limit of the envelope.

**Maximum Tolerance** Maximum vertical tolerance is added to the waveform or the envelope upper limit. The value entered depends on whether *Voltage*, *Percentage*, or *Digitizing Level* was selected.

**Minimum Tolerance** Minimum vertical tolerance is subtracted from the waveform or the envelope lower limit. The value entered depends on whether *Voltage*, *Percentage*, or *Digitizing Level* was selected.

**Horizontal Tolerance** The tolerance can be specified in *Seconds* or in *Points*. Each waveform point in the *Processing Region* will be shifted left and right by this amount, creating a band twice the specified amount.

**Processing Region** Select how much of the waveform is to be affected — either the entire waveform or only the area between and including the markers.

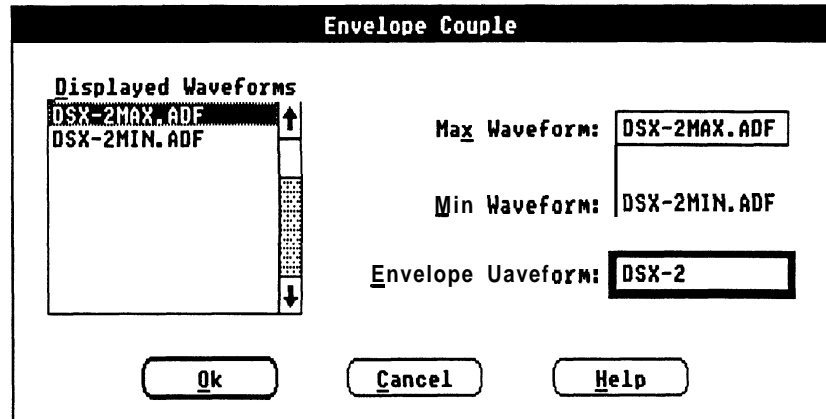
**OK** When all parameters are set the way you want them, select the **OK** command button to create the envelope waveform.

**Cancel** Select the Cancel command button to **abort** the Envelope Tolerance function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Envelope Tolerance** dialog box, select the Control-menu box and then select *Close*.

**Envelope Couple** You can use two waveforms to define the upper and lower boundaries of an envelope. When **Envelope Couple** is selected, the dialog box in Figure 9-16 appears.

Figure 9-16.  
Envelope Couple  
Dialog Box.



**Displayed Waveforms** In this list box are the waveforms currently in memory. From this list box, you can select the upper limit (*Max*) waveform, the lower limit (*Min*) waveform, and (optionally) the *EnvelopeWaveform*, which stores the envelope waveform data created by this command.

Select a waveform (by pointing at the entry and double-clicking the LEFT mouse button or by highlighting an entry with the direction keys and pressing **ENTER**). This enters the name in the bold edit box (*Max* Waveform *Min* Waveform, or Envelope Waveform). If, after entering *EnvelopeWaveform*, you want to change one of your choices, choose another waveform — the next selection will be entered in *Max* Waveform and the cycle starts over.

**Max/Min Waveforms** An input waveform (*MaxWaveform* or *Min* Waveform) **must** be one of the waveforms in the *DisplayedWaveforms* list box. You can either select an item in the list box or move the text cursor to one of the input waveform edit boxes (using **TAB** or clicking the mouse) and enter the name from the keyboard. In either case, both of the selections must be non-envelopewaveforms.

**Envelope Waveform** If you don't want to choose an existing waveform name to store the modified waveform, move the text cursor to *EnvelopeWaveform* and enter a new name from the keyboard.

The output waveform (*EnvelopeWaveform*) can be the same as one of the input waveforms — in which case, the original data is lost when the selected operation is done.

**OK** When all parameters are set the way you want them, select the **OK** command button to create the envelope waveform. The output envelope waveform is created by using the *MaxWaveform* to create the upper boundary and the *Min Waveform* to create the lower boundary. The newly created waveform becomes the current waveform.

**Cancel** Select the **Cancel** command button to abort the **Envelope Couple** function and return you to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Envelope Couple** dialog box, select the **Control-menu** box and then select *Close*.

## Envelope Decouple

An existing envelope waveform can be separated into two uncoupled waveforms — one defined by the upper boundary of the envelope, and the other defined by the lower boundary. When **EnvelopeDecouple** is selected, the dialog box in Figure 9-17 appears.

Figure 9-17.  
Envelope Decouple Dialog Box.

The dialog box titled "Envelope Decouple" contains the following elements:

- Displayed** list box: DSX-2MAX, DSX-2MIN, DSX-2
- Envelope Waveform:** DSX-2
- Max Output Waveform:** DSX-2MAX.ADF
- Min output Waveform:** NewMIN.ADF
- Buttons: Ok, Cancel, Help

### Displayed Waveforms

In this list box are all the waveforms in the Waveform List. From this list box, you can select the *EnvelopeWaveform*, from which two non-envelope waveforms will be created.

Select a waveform (by pointing at the entry and double-clicking the LEFT mouse button or by highlighting an entry with the direction keys and pressing **[ENTER]**). This enters the name in the bold edit box (*EnvelopeWaveform*, *Max Output Waveform*, or *Min Output Waveform*). If, after entering all three waveforms you want to change one of your choices, choose another waveform — the next selection will be entered in *EnvelopeWaveform*, and the cycle starts over.

### Envelope Waveform

In this edit box enter (or select from the *DisplayedWaveforms* list) the waveform to be decoupled. It must be an envelope waveform.



**Max Output Waveform** You can either select an item in the *DisplayedWaveforms* list box or move the text cursor (using **TAB** or clicking the mouse) to the *Max OutputWaveform* edit box and enter the name from the keyboard.

**Min Output Waveform** You can either select an item in the *DisplayedWaveforms* list box or move the text cursor (using **TAB** or clicking the mouse) to the *Min OutputWaveform* edit box and enter the name from the keyboard.

**OK** When all parameters are set the way you want them, select the OK command button to create the two non-envelope waveforms. The *Max OutputWaveform* is created by using the upper boundary of the envelope and the *Min OutputWaveform* is created by using the lower boundary of the envelope. The *Max OutputWaveform* becomes the current waveform.

**Note:** *The original envelope waveform is not replaced when it is decoupled.*

**Cancel** Select the Cancel command button to abort the EnvelopeDecouple function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **EnvelopeDecouple** dialog box, select the Control-menubox and then select *Close*.

# The Sequence Editor

**Introduction** Sequences are used in various instruments. For packet oriented arbitrary waveform generators, like the VX5790, sequences are an integral part of the instrument architecture. However, for waveform oriented AWGs, like the AFG 5101, sequences are a foreign concept. For this type of AWG, the sequence must be converted into a composite waveform.

**Packet Oriented AWG** The packet oriented AWG is designed to output waveforms from a series of packets in its memory. A packet is just a portion of the waveform. For example, one cycle of a 10 KHz sine wave could be stored in a packet. Each packet in the series can be repeated before outputting the next packet. For example, the packet could be repeated 100 times which would output 100 cycles of a 10 KHz sine wave, yet only one cycle is actually stored in the instrument.

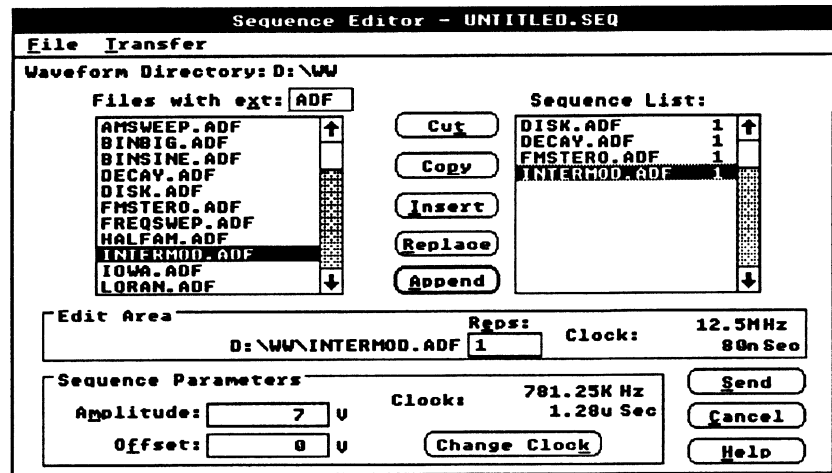
**Waveform Oriented AWG** The waveform oriented AWG must have the complete waveform that it will output in memory. Usually, its waveform memory is larger than the packet size for a packet oriented AWG. However, the total amount of memory available for packets in a packet oriented AWG is comparable to the amount of memory for a single waveform in a waveform oriented AWG.

**What is a Sequence?** A sequence is a list of waveforms that are to be output in a specified order. In addition, a repetition count is specified for each waveform. The repetition count indicates how many times its associated waveform is to be output before starting the next waveform in the sequence.

**VX5790 Filenames** When creating files for the VX5790, be aware that filename extensions are ignored. Therefore, filenames in a sequence must be unique without regard to their extensions. If not, the same packet number will be assigned to two different waveforms.

**Starting the Sequence Editor** When **Sequence** is selected from the **Create** menu, the dialog box in Figure 9-18 is displayed.

Figure 9-18.  
Sequence Editor  
Dialog Box.



**Creating New Sequences** The name of the sequence to be worked on is displayed in the title bar at the top of the dialog box. The Sequence Editor starts with “UNTITLED.SEQ” as the sequence name. This name is used as the name of a new sequence until it is saved (See **Save** in the **File** menu) at which time the name can be changed.

Select a waveform from the entries in the *WaveformFiles* list box by double-clicking with the mouse. This places the selected entry in the *Edit Area* where you enter the *Repetition* count. **Append** is selected to place the entry at the bottom of the *Sequence List* box.

All normal sequence editing features are available when creating a new sequence. For more details, see the following discussions of specific controls.

**Editing Saved Sequence Files** Sequence files are read with the **Open** command in the **File** menu. The names of the files that make up the specified sequence are displayed in the *Sequence List* box. The items can be rearranged, the repetition count changed, entries deleted, and entries added.

## Dialog Box Control Definitions

**WaveformDirectory** This area displays the current directory path. If you need to specify a directory other than the one displayed, see the following discussion.

**Files with ext** The characters in the extension edit box determine which files are shown in the list box. Only files with the extension shown are listed. Wildcard characters ("\*", "?") are permitted within the extension.

The list box shows the waveform files available on the disk. Only ADIF formatted waveforms can be used to create sequences. Attempts to use other files will cause an error. A size limit exists for waveforms included in a sequence. If the selected waveform size exceeds this limit, an error is displayed.

The list box also shows subdirectories and drives. These allows you to go to any **disk/directory** to get to your waveform directory. However, once a waveform file is entered into the *Sequence List* box, the ability to move to other drives/directories is removed. This forces all waveforms and their associated sequences must be in the same directory.

**Sequence List Box** The *Sequence List* box shows the waveforms and repetition numbers in the order they will be executed in the sequence. This is where the actual sequence is built or modified.

With the keyboard, **TAB** to the *Sequence List* box and then use the **UP** and **DOWN** cursor keys to highlight a particular entry. Or, with the mouse, point to an entry and click the LEFT mouse button.

**Edit Area** To modify a sequence, the *Sequence List* entry to be moved or modified must be placed in the *Edit Area*. The *Edit Area* is a temporary holding area in which the repetition number is added or changed for a sequence entry. The editing keys, **Cut**, **Copy**, **Insert**, **Replace**, and **Append**, use the *EditArea* for their operations.

There are four ways to get entries into the *EditArea*:

Selecting an entry in the *WaveformList* box places that waveform in the *Edit Area* and initializes the *Repetitions* count to one.

Selecting an entry in the *Sequence List* places that entry into the *Edit Area*.

Highlighting an entry in the *Sequence List* and selecting the **Copy** command places that entry in the *EditArea*.

Highlighting an entry in the *Sequence List* and selecting the **Cut** command places that entry in the *EditArea* and removes the entry from the list.

**Edit Area Clock** The *Edit Area Clock* group box shows the clock rate of the waveform in the *EditArea*. Most AWGs use the same clock rate for all waveforms in a sequence and, therefore, to accurately represent the waveforms created with *WaveWriter* on the target instrument, all waveforms in the sequence must have the same clock rate. You need to fix any discrepancy in clock rates (if the AWG uses a fixed clock rate) before attempting to use the sequence and waveforms.

**RepetitionNumber** This edit box specifies the number of times the waveform shown in the *Edit Area* is repeated before proceeding to the next waveform in the sequence. If a number is entered that exceeds the limits of the target instrument, an error message is displayed and the last digit is removed.

**SequenceParameters** This group box contains the parameters for the sequence. These parameters override any conflicting parameters in the packet files.

**Amplitude** This is the peak-to-peak amplitude setting for the sequence. This setting is used when saving instrument specific sequence files (.SIS files) and when sending the sequence to the instrument.

**Offset** This is the offset voltage for the sequence. This setting is used when saving instrument specific sequence files and when sending the sequence to the instrument.

**Clock** The clock rate that is used when saving an instrument specific sequence file and when sending a sequence. The clock rate can be changed by clicking the **Change Clock** Button.

**Change Clock** The pushbutton causes the Change Clockrate dialog box to appear (see Figure 7-6). Select the appropriate clock rate for the sequence. The **WaveWriter** clock rate is not changed.

**Copy** This command button brings a highlighted entry from the *Sequence List* box into the *Edit Area*. The current entry in the *Edit Area* is overwritten. If the *Sequence List* is empty, this control is grayed and inoperative.

**Cut** This command button removes the highlighted entry from the *Sequence List* box and places it in the *Edit Area*. The current entry in the *EditArea* is overwritten. If the *SequenceList* box is empty, this control is grayed and inoperative.

**Insert** This command button inserts the entry in the *EditArea* into the *Sequence List* **above** the highlighted entry. If the *Edit Area* is empty, this control is grayed and inoperative.

**Replace** This command button replaces a highlighted entry in the *Sequence List* box with the entry in the *Hit Area*. If the *Sequence List* is empty or the *EditArea* is empty, this control is grayed and inoperative.

**Append** This command button adds the entry in the *EditArea* to the end of the sequence. The *Sequence List* box is updated to show the result of this operation. If the *EditArea* is empty, this control is grayed and inoperative.

**Send** When all sequences are set the way you want them, select the **SEND** command button to display the Send Dialog box, see Figure 9-21.

**Cancel** The **Cancel** command button aborts the **SequenceEditor** and returns you to the main menu. Unsaved changes are abandoned.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **SequenceEditor** dialog box, select the **Control-menu** box and then select *Close*.

## Sequence Editor Menus

The **sequenceEditor** has **File** and **Transfer** menus. The commands in the **File** menu are **New**, **Open**, and **Save**. The only command in the **Transfer** menu is **Send**.

**File Menu** **File** menu functions perform disk input/output and initialize the editor when starting a new sequence.

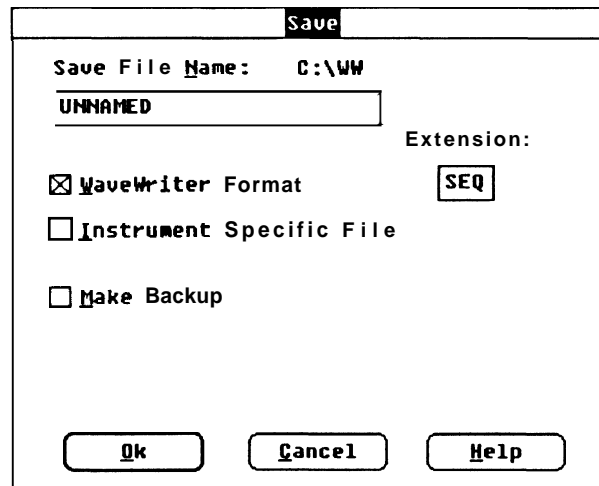
**New** This command clears any previous entries from the *Sequence List* box so a new sequence can be defined. If the old sequence has not been saved, a warning message is displayed to allow you to save the sequence.

**Open** This command reads a previously saved sequence file. A dialog box is displayed for you to pick the sequence file you want to look at or modify. Only sequence files can be opened and an error message is displayed if your selection isn't a valid sequence file. (See the **Open** command in the main **File** menu for more details.) If the old sequence has not been saved, a warning message is displayed to allow you to save the sequence.

The *Sequence List* box displays the waveforms listed in the opened file.

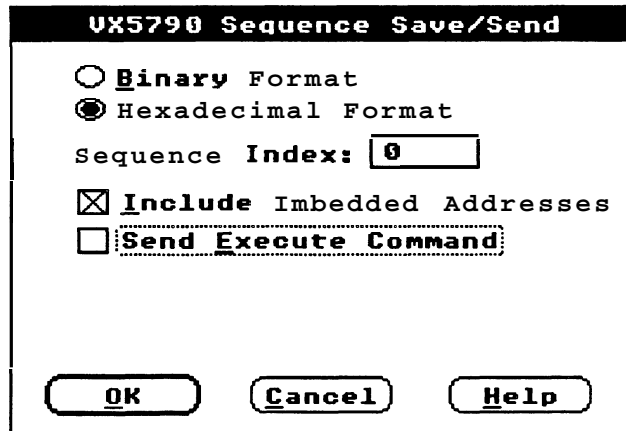
**Save** This command displays the dialog box in Figure 9-19.

Figure 9-19.  
Sequence Save  
Dialog Box.



This dialog box is like the **Save** dialog box in the main **File** menu. If **Instrument Specific File** for the VX5790 is selected then the dialog box in Figure 9-20 is displayed when **OK** is selected,

Figure 9-20.  
Sequence Save  
Dialog Box.



Format — Choose the formats in which the sequence is sent — either *Binary* or *Hexadecimal*. *Binary* is compact, *hexadecimal* is readable.

SequenceIndex — This edit box accepts the internal instrument sequence index. This must be a positive number less than 1000.

IncludeImbeddedAddresses — When sending a sequence to a **VX5790** using a **VXI** resource manager that understands imbedded addressing (such as the **Tektronix VX5520**), select this check box and the logical address defined in the **Configure/Change Instrument** command is included in the parameters sent. If this check box is not selected, the sequence is sent without specifying the logical address.

Send Execute Command — If this check box is selected, the **EXECUTE** command is appended to the end of the sequence.

Exit Select the **Exit** command to leave the **Sequence Editor** and return to the main menu.

## Transfer Menu

Send This command displays the dialog box in Figure 9-21 in which you enter instrument specific information for sending the sequence.

Format — Choose the formats in which the sequence is sent — either *Binary* or *Hexadecimal*. *Binary* is compact, *hexadecimal* is readable.

SequenceIndex — This edit box accepts the internal instrument sequence index. This must be a positive number less than 20.

IncludeImbeddedAddresses — When sending a sequence to a **VX5790** using a **VXI** resource manager that understands imbedded addressing (such as the **Tektronix VX5520**), select this check box and the logical address defined in the **Configure/Change Instrument** command is included in the parameters sent. If this check box is not selected, the sequence is sent without specifying the logical address.



Figure 9-21.  
Transfer Menu Dialog Box

**VX5790 Sequence Save/Send**

**B**inary Format

**H**exadecimal Format

Sequence Index:

**I**nclude Imbedded Addresses

**S**end Execute **C**ommand

**S**end Sequence and Packets

**S**end Sequence Only

SendExecuteCommand — If this check box is selected, the EXECUTE command is appended to the end of the sequence. This causes the generated waveform to be output on the VX5790.

Send Sequence and Packets — This will cause associated packets to be sent to the VX5790 as well as the sequence.

Send Sequence Only — This will send only the sequence information to the VX5790. It is assumed that the required packet data is already in the instrument.

See the Transfer menu, Section 11, for details on how Send works for your instrument.



# Section 10

## How to PROCESS WAVEFORMS

### Modifying Waveforms Arithmetically

Any waveform can be modified either with a constant value or with another waveform by using the SigProc (Signal Processing) menu. Your options for modifying waveforms are:

- Add a constant to each point of a waveform or multiply each point by a constant value.

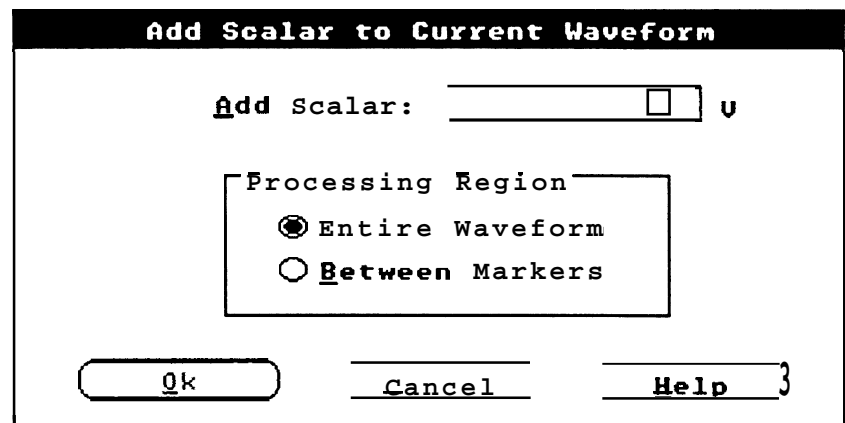
A waveform can be added to or subtracted from another waveform.

- A waveform can be multiplied by or divided by another waveform.

### Scalar values

When using a constant scalar value, each point of the current waveform in the selected *Processing Region* is modified by the scalar value. You can either add the scalar value to the current waveform, or multiply the current waveform by the scalar value. When one of the Scalar options is selected, the dialog box in Figure 10-1 appears. The dialog box is the same for either of the Scalar options, except for the title bar at the top and the **o** box label.

Figure 10-1.  
Scalar Signal Processing  
Dialog Box.



**The Scalar Value** **Add Scalar** adds a scalar value to each point of the current waveform in the *Processing Region*. The scalar value can be either positive or negative.

**Multiply by Scalar** changes the amplitude of the current waveform in the *Processing Region*. For an increase in amplitude (multiplication), enter a value greater than one. For a decrease in amplitude (division), enter a decimal value less than one.

**Processing Region** Each of the operations in this menu can be done on the entire current waveform or a selected portion.

**Entire Waveform** When this option button is selected, signal processing operations are done on the entire length of the waveform.

**Between Markers** When this option button is selected, signal processing operations are done on only the portion of the waveform(s) between and including the *Start* and *Stop* markers.

**OK** When the **OK** command button is selected, the selected factor is applied to each point of the current waveform in the *Processing Region*.

**Cancel** Select the **Cancel** command button to abort the function and return you to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the previous dialog box, select the **Control-menu** box and then select *Close*.

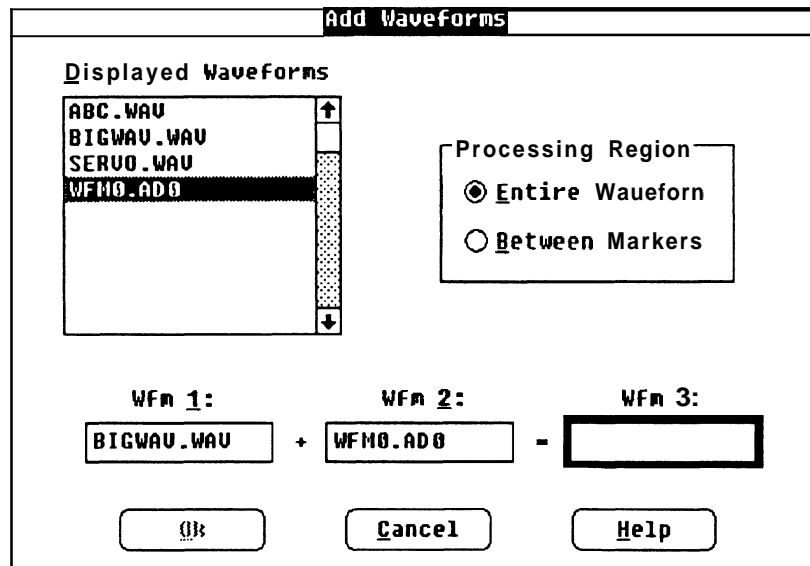
## Processing Two Waveforms

When using two waveforms to create a third waveform, each point of the first waveform is modified by the corresponding time point of the second waveform. There are several ways to do this:

- Add the second waveform to the first waveform.
- Subtract the second waveform from the first waveform.
- Multiply the first waveform by the second waveform.
- Divide the first waveform by the second waveform.

When Add, Subtract Multiply, or **Divide Waveforms** is selected, the dialog box in Figure 10-2 appears. Except for the title bar at the top of the dialog box and the arithmetic operator displayed between *Waveform1* and *Waveform2*, the display is the same for each of these menu options.

Figure 10-2.  
Add, Subtract, Multiply,  
and Divide Dialog Box.



### Displayed Waveforms

From this list box, you can select the first waveform, the second waveform, and the output waveform that stores the modified data. Select a waveform (by pointing at an entry and double-clicking the LEFT mouse button or by highlighting an entry with the direction keys and pressing **ENTER**). This enters the name in the next available text box (*Waveform1*, *Waveform2*, or *Waveform3*). After entering *Waveform3*, you may want to change one of your choices. Choose another waveform — the next selection will be entered in *Waveform1*, and the cycle starts over.

**Processing Region** Each of the operations in this menu can be done on the entire waveform or a selected portion.

**EntireWaveform** When this option button is selected, signal processing operations are done on the entire length of the waveform.

**Between Markers** When this option button is selected, signal processing operations are done on only the portion of the waveform(s) between and including the *Start* and *Stop* markers.

**Input Waveforms** An input waveform (*Waveform1* or *Waveform2*) must be one of the waveforms in the *DisplayedWaveforms* list box. You can either select an item in the list box or move the text cursor to one of the input waveform edit boxes and enter the name from the keyboard.

**Output Waveform** If you don't want to choose an existing waveform name to store the modified waveform, move the text cursor to *Waveform3* and enter a new name from the keyboard.

The output waveform (*Waveform3*) can be the same as one of the input waveforms — in which case, the original data is lost when the selected operation is done.

**OK** When the **OK** command button is selected, the operation is done at each point of the input waveforms in the *Processing Region*. The result of the operation is stored in *Waveform3*, which becomes the current waveform. If *Between Markers* was selected and *Waveform 3* is new, timing is maintained and zeros are assigned to the undefined points between the zero time reference and the *Start Marker*— the new waveform ends at the *Stop Marker*. However, if *EntireWaveform* was selected as the *Processing Region*, the output waveform is the length of the longer of the two input waveforms.

**NOTE** *If the calculation result exceeds the internal system limit, you are warned that waveform data has been clipped at this limit.*

**Cancel** Select the Cancel command button to abort the function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the previous dialog box, select the Control-menu box and then select *Close*.

# Section 11

## How to TRANSFER WAVEFORMS

### What the Transfer Menu Does

With the **Transfer** menu, you can select a target instrument. You can set up communication parameters, between your computer and the target instrument, with the **Configure/Change Instrument** option. Once the parameters are set, you use the **Acquire and Send** commands to transfer waveforms. You can **Acquire** a waveform from a specific instrument and **Send** a waveform to the target instrument.

### Configure/Change Instrument

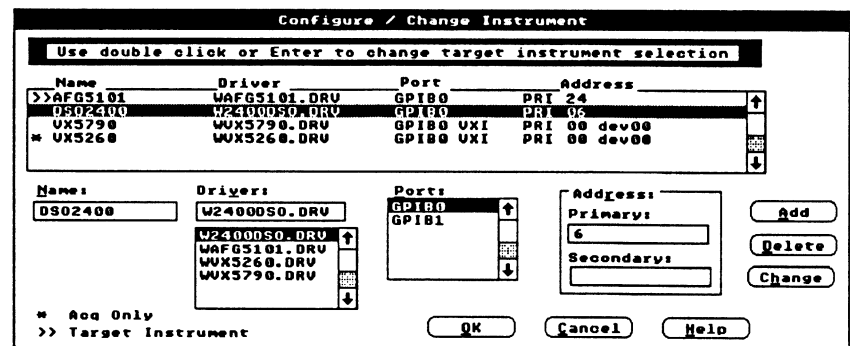
This command is used for two purposes:

To configure new instruments on the bus.

- To select the target instrument.

When **Configure/Change Instrument** is selected, the dialog box in Figure 11-1 appears.

Figure 11-1.  
Configure/Change Instrument  
Dialog Box.



**Configuration List** This list displays the current instrument configurations. It shows the name, the driver, the communication port, and the communication address assigned to each instrument.

An entry can be modified by selecting the instrument from the list. Selecting an entry highlights it and places the parameters in the appropriate edit boxes below the list box. Changes are made in these edit boxes and the "Change" button. This makes the changes a permanent part of the configuration list.

There are two special symbols that may be displayed to the left of the instrument name. The ">" symbol identifies which instrument is currently the target instrument. The "\*" symbol identifies an instrument as "acquisition-only". An "acquisition-only" instrument cannot be selected as the target instrument, and a warning is displayed if you try to do so.

**Acquisition Only Instruments** "Acquisition-only" instruments can only be used to acquire a waveform into **WaveWriter**. "Acquisition-only" instruments cannot be made the target instrument. They can be configured the same as any other instrument and will appear in the Acquire dialog box.

**Selecting a Target Instrument** To select the target instrument, either point to the entry with the mouse and double-click the left mouse button, or, with the keyboard, highlight the entry with the arrow keys and press **ENTER**. When an instrument is selected, the parameters associated with that instrument are displayed in the editing area below the Configuration List.

## **Configuration List Parameters**

**Configuration Name** This edit box is for creating or modifying names that uniquely identify each instrument and its configuration. You can enter up to 12 alphanumeric characters for each name. When an entry has been selected from the *Configuration List*, this edit box displays the configuration name — you can accept it or modify it.

**Driver Name** This list box shows the software device drivers that are available to support various instruments. Highlight an entry from this list to select a driver.

**Port Name** This list box shows the hardware ports or (busses) available for transferring data. Highlight an entry from this list to select a port.

**Device Address** This group box has edit boxes for defining different parts of a specific instrument address. The labels that define the edit box contents change, depending on the requirements for the bus selected in the Ports list box. If a GPIB Bus is selected, enter in the Primary and Secondary addresses as a number between 0-31. If a VXI bus is selected, enter in the Primary address as a number between 0-31 (GPIB VXI only), and the Logical address as defined by the resource manager (e.g. dev00).



## Action Buttons

**Add** When **Add** is selected, the configuration specified in the lower edit and list boxes is added as a new entry in the *Configuration List* box.

**Change** When **Change** is selected, the configuration specified in the lower edit and list boxes replaces the parameters of the currently highlighted entry in the *Configuration List* box.

**Delete** When **Delete** is selected, the currently highlighted entry is removed from the *Configuration List* box. Note, however, that you **can not** delete the **current** target instrument.

**OK** When the *Configuration List* is the way you want it set, select the **OK** command button. If you have just created a new configuration, or if you have modified an existing configuration, and **Add** or **Change** have not been selected, you are asked if you want to save the configuration. After your reply, you are returned to the main menu.

If the target instrument has been changed, the program checks to insure that the clock rate is valid. If it is not, you are prompted for the nearest available clock rate. If none of the options is acceptable, use the **Change Clock Rate** command in the **Display** menu to select an appropriate rate.

If the amplitude of the current waveform exceeds limits dictated by the newly selected target instrument, the vertical axis scale may be adjusted.

**Cancel** The **Cancel** command button aborts the **Configure** function and returns you to the main menu. All changes are abandoned.

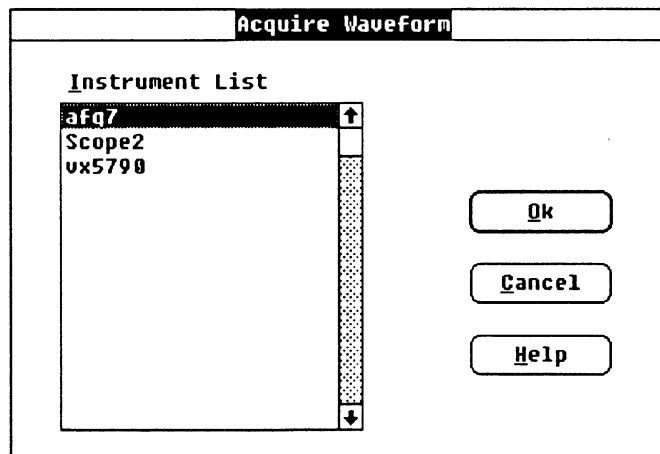
**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Configure/Change Instrument** dialog box, select the **Control-menu** box and then select *Close*.

## The Acquire Command

**Instrument List** When **Acquire** is selected, a list of configured instruments similar to the one in Figure 11-2 is displayed. Only instruments that have been configured with the **Configure/Change Instrument** option appear in this list. If only one instrument has been configured, this dialog box is bypassed and only the instrument-specific dialog box is displayed.

If the dialog box in Figure 11-2 is displayed, select an instrument from the list by highlighting the entry and selecting the **OK** command button. An instrument-specific dialog box is then displayed and you are prompted for specific instrument parameters. To see the correct dialog box for an instrument, find the instrument-specific description later in this section.

Figure 11-2.  
Acquire  
Dialog Box.



# AFG 5101/5501 Arbitrary Function Generator

**Acquire** You can acquire a waveform from either Bank 1 or Bank 2 of the AFG 5101/5501. Each bank can store a waveform of up to 8192 points. The dialog **box** shows the current settings of the instrument. When you modify parameters in the Acquiredialog **box**, those settings are changed at the instrument when **OK** is selected. When this instrument is selected, the dialog **box** in Figure 11-3 appears.

Figure 11-3.  
AFG 5101/5501  
Acquire Dialog Box.

Acquire AFG 5101/5501

Begin Addr: 0

End Addr: 8191

Bank Number:

Replace Current Uaveform

Create New Waveform

Waveform Name: untitled

Ok Cancel Help

**Begin Address** This is the beginning address of the waveform to acquire. The valid range is from 0 to 8191.

**End Address** This is the ending address of the waveform to acquire. The valid range is from 0 to 8191.

**Bank Number** You can acquire data from either Bank 1 or Bank 2.

**Destination** When the waveform is acquired, you have a choice of how to store it:

- **Replace the current waveform** — The current waveform is overwritten by the acquired waveform. The acquired waveform record length is the new current record length.
- **Create a new waveform** — You are prompted for a new waveform name. The acquired waveform becomes the current waveform. The previous current waveform is now a background waveform.

**Conformance to Target** If the acquired waveform data doesn't conform to system parameters set for the target instrument, voltage data and timing data are affected.

**Voltage** If the acquired waveform amplitude exceeds the display window limits, the waveform is clipped on the display. Data is not lost.

**Clock Rate** If the clock rate doesn't match, a warning is displayed and you are prompted to choose one of the following solutions:

Change the clock rate for the incoming waveform to match the system clock rate.

- **Message** (expand or compress) the incoming waveform to maintain a timing match. (See *Horizontal Resolution*, Section 6.)
- **Change the system clock rate** to match the incoming waveform. Note that if there are other waveforms loaded (displayed), their clock rate is changed as well. (See *Change Clock Rate*, Section 7.) If the incoming clock rate is not valid for the selected target instrument, this option is grayed and unavailable.
- **Cancel the acquisition.**

**OK** When OK is selected, the waveform is acquired, loaded in memory, and displayed as the current waveform.

**Cancel** Select **Cancel** to abort this function and return to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Acquired dialog box, select the **Control-menu** box and then select *Close*.

## 2200 Series Digital Storage Oscilloscope

**Acquire** When this instrument is selected, you are prompted to select one of the sources: ACQ or REF1 through REF4. If the **Create New Waveform** option button is selected, an edit box appears with the name of the selected source as the default. If you want a different name, edit this text.

Figure 11-4.  
2200 Series Digital  
Storage Oscilloscope  
Acquire Dialog Box.

**Location** In the **Location** group box you select which waveform in the 2200 you want to acquire. If a source in the group box is grayed it means there is no waveform in that memory location. If you select ACQ it will acquire from the acquisition memory. If you select REF1 through REF4 it will acquire from the corresponding reference memory. If your instrument only has one reference memory available, then only one Reference choice is available.

**Destination** When the waveform is acquired, you have a choice of how to store it:

**Replace the current waveform** — The current waveform is overwritten by the acquired waveform. The acquired waveform record length is the new current record length.

■ **Create a new waveform** — You are prompted for a new waveform name. The acquired waveform becomes the current waveform. The previous current waveform is now a background waveform.

**Name** Enter a valid name for the waveform to be acquired.

**Conformance to Target** If the acquired waveform data doesn't conform to system parameters set for the target instrument, voltage data and timing data are affected.

**Voltage** If the acquired waveform amplitude exceeds the display window limits, the waveform is clipped on the display. Data is not lost.

**Clock Rate** If the clock rate doesn't match, a warning is displayed and you are prompted to choose one of the following solutions:

Change the clock rate for the incoming waveform to match the system clock rate.

Message (expand or compress) the incoming waveform to maintain a timing match. (See *Horizontal Resolution*, Section 6.)

Change the system clock rate to match the incoming waveform. Note that if there are other waveforms loaded (displayed), their clock rate is changed as well. (See *Change Clock Rate*, Section 7.) If the incoming clock rate is not valid for the selected target instrument, this option is grayed and unavailable.

■ Cancel the acquisition.

**OK** When **OK** is selected, the waveform is acquired, loaded in memory, and displayed as the current waveform.

**Cancel** Select **Cancel** to abort this function and return you to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Acquired** dialog box, select the **Control**-menu box and then select *Close*.

# 2400 Series Digital Storage Oscilloscope

**Acquire** When this instrument is selected, you are prompted to select one of the sources: *CH1*, *CH2*, *ADD*, *MULT*, or *REF1* through *REF4*. If the **Create New Waveform** option button is selected, an edit box appears with the name of the selected source as the default. If you want a different name, edit this text.

Figure 11-5.  
2400 Series Digital Storage Oscilloscope Acquire Dialog Box.

**Destination** When the waveform is acquired, you have a choice of how to store it:

- **Replace the current waveform** — The current waveform is overwritten by the acquired waveform. The acquired waveform record length is the new current record length.
- **Create a new waveform** — You are prompted for a new waveform name. The acquired waveform becomes the current waveform. The previous current waveform is now a background waveform.

**Name** Enter a valid name for the waveform to be acquired.

**Adjust Amplitude to Full Scope Range** If this check box is selected (unselected is the default), the *Waveform Display Area* will be scaled to the full range of the oscilloscope display (10.12 divisions) at its current Volts/division setting.

**Conformance to Target** If the acquired waveform data doesn't conform to system parameters set for the target instrument, voltage data and timing data are affected.

**Voltage** If the acquired waveform amplitude exceeds the display window limits, the waveform is clipped on the display. Data is not lost.

**Clock Rate** If the clock rate doesn't match, a warning is displayed and you are prompted to choose one of the following solutions:

- Change the clock rate for the incoming waveform to match the system clock rate.

Message (expand or compress) the incoming waveform to maintain a timing match. (See *Horizontal Resolution*, Section 6.)

- Change the system clock rate to match the incoming waveform. Note that if there are other waveforms loaded (displayed), their clock rate is changed as well. (See *Change Clock Rate*, Section 7.) If the incoming clock rate is not valid for the selected target instrument, this option is grayed and unavailable.

- Cancel the acquisition.

**OK** When **OK** is selected, the waveform is acquired, loaded in memory, and displayed as the current waveform.

**Cancel** Select **Cancel** to abort this function and return you to the main menu.

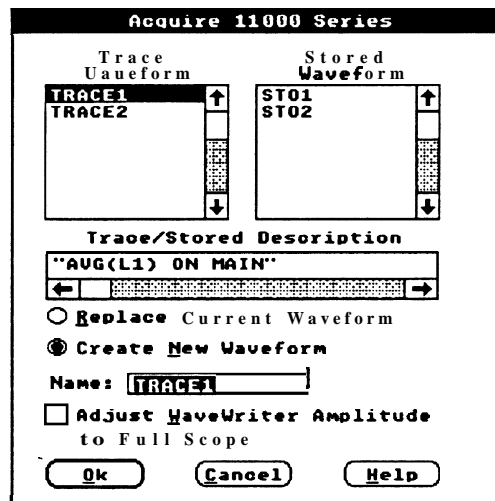
**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Acquired** dialog box, select the **Control**-menu box and then select *Close*.



# 11000 Series Oscilloscopes

**Acquire** When this instrument is selected, the following dialog box appears from which is selected the source and destination of the waveform. Two types of waveforms are available, trace waveforms and stored waveforms. The waveform description that was stored with the waveform is also displayed to help the user identify the waveform.

Figure 11-6  
11000 Series Digital  
Storage Oscilloscope  
Acquire Dialog Box



**Source** The **TraceWaveform** list box displays the active traces currently displayed on the scope. If there are no active traces available, then a message *EMPTY* is displayed in the listbox.

The **StoredWaveform** list box displays the list of stored waveforms in the scope. If there are no stored waveforms available, then a message *EMPTY* is displayed in the listbox.

When you click once on one of the entries in the listbox, its trace description appears in the **Trace/StoredDescription** scroll box and the waveform name is displayed in the Source Name Edit box. The name may be changed by editing the contents of the edit box.

Clicking on the *EMPTY* selection in the list box displays the message "No Traces Defined" in the **Trace/StoredDescription** Edit box and the **OK** button is grayed.

Double clicking on the *EMPTY* selection or the "white space" of the listbox causes an Error dialog box to appear with the message "INVALID SOURCE SELECTED".

**Note:** *If there are no Traces defined on the scope and there are no stored waveforms available in the scope then an error message is displayed with "No Valid Sources Available", and the 11000 Series Acquisition dialog box is not displayed.*

**Trace / Stored Description** This scroll box displays the waveform description that is stored with the waveform. It automatically updates when you select a source from the Trace Waveform or Stored Waveform listboxes.

**Note:** *The contents of the box may be changed, but the changes are ignored and have no effect.*

**Destination** When the waveform is acquired, you have a choice of how to store it:

- **Replace the current waveform** — The current waveform is overwritten by the acquired waveform. The acquired waveform record length becomes the new current record length.
- **Create a new waveform** — You are prompted for a new waveform name. The acquired waveform becomes the current waveform.

**Name** When the **NEW** is selected, the **SOURCE NAME** edit box appears. The name of the selected source becomes the default name, but this name may be changed to any valid MS DOS file name. If you select **OK** and that name already exists, an error message is displayed. If the name is unique and valid, a new **WaveWriter** waveform is created and the waveform list is updated with the current name.

**Adjust WaveWriter Amplitude to Full Scope Range** If this check box is selected (unselected is the default), the *Waveform Display Area* will be scaled to the full range of the oscilloscope display at its current volts/division setting.

**Conformance to Target** If the acquired waveform data doesn't conform to system parameters set for the target instrument, the data values and their timing relationship are affected.

**Data Values** If the acquired waveform amplitude exceeds the display window limits, the waveform is clipped on the display (assuming that **Adjust Amplitude to Full Scope Range** is not checked). However, the data is not lost and may be viewed by setting the **Axis Ranges** appropriately. Note however that data clipped on the scope is clipped within **WaveWriter**.

**Clock Rate** If the waveform clock rate doesn't match the system clock rate, a warning is displayed and you are prompted to choose one of the following solutions.

Change the clock rate for the incoming waveform to match the system clock rate.

- Message (expand or compress) the incoming waveform to maintain a timing match. (See *Horizontal Resolution*, Section 6)
- Change the system clock rate to match the incoming waveform. Note that if there are other waveforms loaded (displayed), their clock rate is changed as well. (See *Change Clock Rate*, Section 7) If the incoming clock rate is not valid for the selected target instrument, this option is grayed and unavailable.

Cancel the acquisition.

**OK** The OK push button is only enabled when a valid source is selected and a name has been typed into the SOURCE NAME edit box. If you double click on an invalid source, an error message is displayed: "Invalid source selected". Once a valid source has been selected, a name is placed in the SOURCE NAME edit box, and the OK button is pressed, the 11000 series waveform is transferred into **WaveWriter**

**Note:** *WaveWriter* does not control the acquisition of the 11000 Series oscilloscope. You must ensure that the waveform is completely acquired before transferring into **WaveWriter**. For example, if the selected source is a 32K envelope, it is possible to transfer an incomplete envelope into **WaveWriter**. In this case, valid data cannot be guaranteed.

**Note:** *It is a feature of the 11000 series oscilloscope to transfer only that portion of the waveform that is on the scope screen. Any data off the left end or off the right end of the scope screen is not transferred into **WaveWriter**. For example: You have acquired a 10K waveform on an 11403 and expanded the waveform to view only the falling edge of the pulse. Only that falling edge will be transferred, not the entire 10K record. This is useful if you want to perform partial waveform transfers. To transfer the entire waveform record, you must have **PAN/ZOOM OFF** or magnification 1x selected.*

**CANCEL** Selecting the **CANCEL** button will remove the dialog box from view and cancel the transfer operation. No waveform will be transferred into **WaveWriter**

**HELP** Selecting this button provides context sensitive help. A dialog will be displayed with helpful descriptions of each button in the 11000 Series Acquisition Dialog Box.

## VX5260 Digitizer

**Acquire** When the VX5260 is selected, the dialog box in Figure 11-7 appears. This dialog box allows you to enter VX5260 parameters, read a VX5260 record, and determine how the waveform is stored in **WaveWriter**. Additionally, you can display VX5260 record information and send commands to the VX5260 via a talker/listener.

Figure 11-7. VX5260 Digitizer Acquire Dialog Box

**VX5260 Parameters** These parameters allow you to select a VX5260 record, select which part of the record to transfer, display record information, and send commands to the VX5260.

- **Record Loc** — This selects which VX5260 record location to read. Enter a number in the range 1 to 128.
- **Entire Record** — This causes an entire VX5260 record to be read. If the record length is greater than the current **WaveWriter** maximum (32767 points), then the record can only be read by selecting Partial and doing multiple reads.
- **Partial** — This causes part of a VX5260 record to be read. When this control is selected, the Start and Count edit boxes appear.
 

**Start** — This selects where in the record the transfer begins. Enter a number in the range 0 to 16382 (if 16K of VX5260 acquisition memory), or 0 to 131070 (if 128K of acquisition memory).
- **Count** — This selects how many data points to transfer. Enter a number in the range 2 to 32767. A warning message will be displayed if Start + Count exceeds the VX5260 record length.

- Record Information — Displays VX5260 record information as shown in figure 11-8. If the record is empty, a warning message is displayed.
- Talker/Listener — Displays the VX5260 Talker/Listener dialog box as shown in figure 11-9. This dialog box allows you to send commands and/or queries to the VX5260.

## Destination

Replace Current Waveform — The current **WaveWriter** waveform is replaced by the new waveform. The waveform length is adjusted to fit the new waveform.

Create New Waveform — A new WaveWriter waveform is created. This waveform becomes the current waveform and the previous current waveform becomes a background waveform. The Name edit box is shown and a name must be entered before selecting **OK**.

**Name** Enter a valid MS-DOS name for the waveform. This edit box is shown when Create New Waveform is selected.

**OK** When **OK** is selected, the waveform is read, loaded in memory, and displayed as the current waveform.

**Cancel** Select Cancel to abort this function and return you to the main menu.

**Help** Select the Help button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Acquired dialog box, select the Control-Menu box and then select *Close*.

## VX5260 Record Information

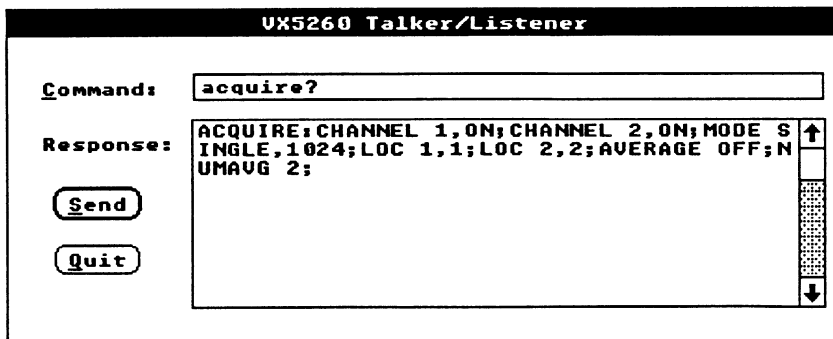
Figure 11-8. VX5260 Record Information Dialog Box

VX5260 Record # 1			
<b>Data:</b>	Normal	<b>Rate:</b>	10nS
<b>Length:</b>	1024	<b>Offset:</b>	0 U
<b>Clock:</b>	Internal	<b>Amp:</b>	10 U
<input type="button" value="OK"/>			

- **Data** —The data type (Normal, Envelope, or 16-bit).
- **Length** — The record length (Number of points).
- **Clock** —The sampling clock source (Internal or External).
- **Rate** — The sample rate in seconds (If internal clock).
- **Offset** — The waveform offset in Volts.
- **Amp** —The waveform amplitude in Volts (Not displayed for averaged waveforms).

## VX5260 Talker/Listener

Figure 11-9. VX5260 Talker/Listener Dialog Box



- **Command** — Enter the VX5260 command or query. Up to 256 characters can be entered.
- **Response** — The response to a VX5260 query command is displayed here. Up to 2200 characters can be displayed. The scrollbar can be used to display text not in the Response box. If a response is longer than 2200 characters, then only the first 2200 characters are displayed.
- **Send** — This button sends the command to the VX5260. Pressing the Enter key will also send the command to the VX5260.
- **Quit** — This button quits the dialog box. Pressing the Escape key will also quit the dialog box.



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## The Send Command

With the Send command you can transfer, to the **target** instrument, all of the current waveform or a portion of it defined by the *Start* and *Stop* markers.

When Send is selected, an instrument-specific dialog box appears. The actual dialog box displayed depends on the current target instrument (see **Configure/Change Instrument**).

# AFG 5101/5501 Arbitrary Function Generator

**Send** You can send the current waveform to either Bank 1 or Bank 2 of the AFG 5101/5501. Figure 11-10 shows the AFG 5101/5501 **Send** dialog box.

Figure 11-10.  
AFG5101/5501  
Send Dialog Box.

**Send AFG 5101/5501**

**Send Waveform**

**Send Waveform Between Markers**

Bank Number:

Begin ADDR:

Filter:

Output Amplitude:  V (50 Ohms)

Offset:  V

Time per Point:  S

**Processing Region** You can select either the entire waveform or the portion between and including the markers.

**Bank Number** You can send to either of 2 bank memories, *Bank 1* or *Bank 2*

**Beginning Address** This is the beginning address of the waveform at the selected bank. Enter an integer in the range 0 to 8191.

**Filter** The waveform to be sent can be filtered. Select one of the following:

- 0 = no filter.
- 1 = 1 MHz low-pass.
- 2 = 100 kHz low-pass.
- 3 = 11 kHz low-pass.
- 4 = 1.3 kHz low-pass

**Output Amplitude** This sets the peak-to-peak output voltage (into 50 Ohms) to the value specified. The default value is the current amplitude as displayed. Valid values are in the range of 0.01 to 9.99 Volts.

**Offset** This sets the offset voltage of the output signal. The default is the current offset value stored in the *WaveformList*, if any. The **Output Amplitude** and **Offset** must conform to the relationship:

$$\text{amplitude} / 2 + \text{offset} = \text{Absolute peak amplitude} + \text{offset} \text{ (into 50 Ohms)}$$

<b>Amplitude Range</b>	<b>Peak Amplitude + Absolute Offset into 50 Ohms</b>	<b>Resolution into 50 Ohms</b>
1–9.99V	4.99V	10 mV
0.1–0.999V	0.499V	1 mV
0.01–0.099V	0.049V	1 mV

**Time per Point** This sets the clock rate or internal trigger interval. The default is the system clock rate. Valid values are in the range of 100 nanoseconds to 999.9seconds.

**OK** When OK is selected, the current waveform is transferred, and displayed or regenerated on the target instrument.

**Cancel** Select Cancel to abort this function and return you to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Send dialog box, select the Control-menu box and then select **Close**.

## 2400 Series Digital Storage Oscilloscope

**Send** You can send the current waveform to a reference memory location in the 2400 Series DSO. When Send is selected, the dialog box in Figure 11-11 is displayed.

Figure 11-11.  
2400 Series Digital Storage Oscilloscope Send Dialog Box.

**ProcessingRegion** You can select either the entire waveform or the portion between and including the markers.

**Location** Option buttons *REF1* through *REF4* to select destination memory location.

**PartialWaveform** The next two choices only appear if *Between Markers* is selected and there are less than 1024 points in the *Processing Region* (or if the entire waveform has less than 1024 points.)

**Start At** — Edit box to align waveform at desired horizontal point on the oscilloscope screen.

**Don't Care Fill-in** — Check box sets envelope *outside* of the markers, to *Minimum* and *Maximum* levels if the check box is selected. (Envelope waveforms only)

**VerticalPosition Set WaveWriter Screen 0.0 Volts to Oscilloscope Center Graticule**  
—Aligns the *WaveformDisplay Area* 0.0 Volt level with the vertical center of the oscilloscope graticule.

**Enter Vertical Position of Ground Reference**— As an alternative to the previous choice, enter a ground reference in this edit box. Choose either *Volts* or *Divisions* with the option buttons.

**OK** When **OK** is selected, the current waveform is transferred, and displayed or regenerated on the target instrument.

**Cancel** Select **Cancel** to abort this function and return you to the main menu.

**Help** Select the **Help** command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the **Send** dialog box, select the **Control-menu** box and then select *Close*.

# VX5790 Arbitrary Waveform Generator

When this instrument is selected you can send data from *WaveWriter*. See the VXI Instruction Manual.

**Send** When **Send Sequence** is selected, the dialog box in Figure 11-12 is displayed.

Figure 11-12. VX5790 Send Dialog Box.

**Processing Region** Select how much of the length of the waveform is to be sent: If the number of points sent is 2048 or less, data is transferred with the VXI SHAPE command. Otherwise, the CURVE command is used.

- Only the portion of the waveform between and including the markers
- The entire waveform.

**Transfer Format:** Select whether the waveform is to be sent in *Binary* or *Hexadecimal* format. Binary data is more compact, but is not directly viewable.

**Not Divisible by Eight** This group box is only displayed when the number of data points to be sent is not a number divisible by eight (this is a VX5790 hardware requirement).

If *Between Markers* has been selected, you can choose *Use Next Larger* to transfer the next larger size waveform that is divisible by eight — or you can choose *Use Next Smaller* to transfer the next smaller size waveform divisible by eight.

If *Entire Waveform* has been selected, *Use Next Smaller* is your only option — *Use Next Larger* is grayed and can't be selected.

**Include Imbedded Addresses** When saving a sequence for a VX5790 using a VXI resource manager that understands imbedded addressing (such as the Tektronix VX5520), select this check box and the logical address defined in the **Configure/Change Instrument** command is included in the parameters saved. If this check box is not selected, the sequence is saved without specifying the logical address.

**Download Packet and Execute** This radio button causes the waveform data to be sent using the Curve command which automatically packetizes the data and builds a sequence. This sequence is then executed making the waveform available at the VX5790 output connector.

**Download Packet** This radio button causes only the packet data to be sent. The sequence editor must be used to build a sequence containing this packet before it will be available at the VX5790 output connector.

If the waveform length is greater than 2048, this radio button is grayed since the maximum single packet is 2048 points.

**Packet Index** This edit box displays the packet index taken from the cross reference file. If you wish to override this default, enter a different value.

**Sequence Index** This edit box appears whenever a sequence will be built, e.g., when the waveform size is larger than the maximum packet size (2048 for the VX5790), or *Download and Execute Packet* is selected.

Packets start at the specified *PacketIndex* and the sequence is referenced by the *Sequence Index*.

**Offset** Enter an external offset value associated with this waveform.

**Cross Reference File** The Cross Reference File is automatically created and maintained by the VX5790 driver. The driver converts a sequence file (containing filenames and repetitions) to a VX5790 specific file by replacing filenames with packet numbers. See Appendix C.

As long as you build all your sequences with the same cross reference file, you don't need to be concerned about two packets using the same packet index or one packet being referenced by two different packet indexes.

**OK** Select the OK command button to send the waveform data to the VX5790.

**Cancel** Select the Cancel command button to abort the Send command and return to the main menu.

**Help** Select the Help command button to display informative text relating to this operation. Use the scroll bar, if present, to read the entire help text. To return to the Send dialog box, select the Control-menu box and then select Close.



# Appendix A MENU MAP

## WaveWriter Main Menus

<b>File</b>	<b>Draw</b>	<b>Transfer</b>
New... Open... Save... Hardcopy... Exit About...	Nodraw Freehand Horizontal Vertical Autoline Envelope Max Don't Care Envelope Min Don't Care EnvelopeMax EnvelopeMin	Configure/ChangeInstrument... Acquire... Send...
		<b>Help</b>
<b>Edit</b>	<b>Create</b>	
Undo ClearWaveform(s)... Cut BetweenMarkers Copy BetweenMarkers DeleteBetweenMarkers Insert at Start Marker ReplaceBetweenMarkers Append to End of Waveform Flip HorizontalBetween Markers Flip VerticalBetweenMarkers HorizontalResolution... VerticalResolution...	Equation... Sine... Triangle... Pulse... Square... EnvelopeTolerance... EnvelopeCouple... EnvelopeDecouple... Sequence...	
<b>Display</b>	<b>SigProc</b>	
Redraw Dot Redraw Vector Zoom In Zoom Out Set Axis Ranges... Autoscale Current Waveform Change Clock Rate... Change Current Waveform Show Crosshairs Set Colors & Line Styles...	Add Scalar... Multiply by Scalar... Add Waveforms... Subtract Waveforms... Multiply Waveforms... Divide Waveforms...	

***MENU MAP***

# Appendix B

## QUICKREFERENCE

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**The File Menu** (Section 5) Disk input/output commands. Initializes *WaveWriter* when starting a new waveform.

**New** sets up for creation of normal or envelope waveform.

**New**

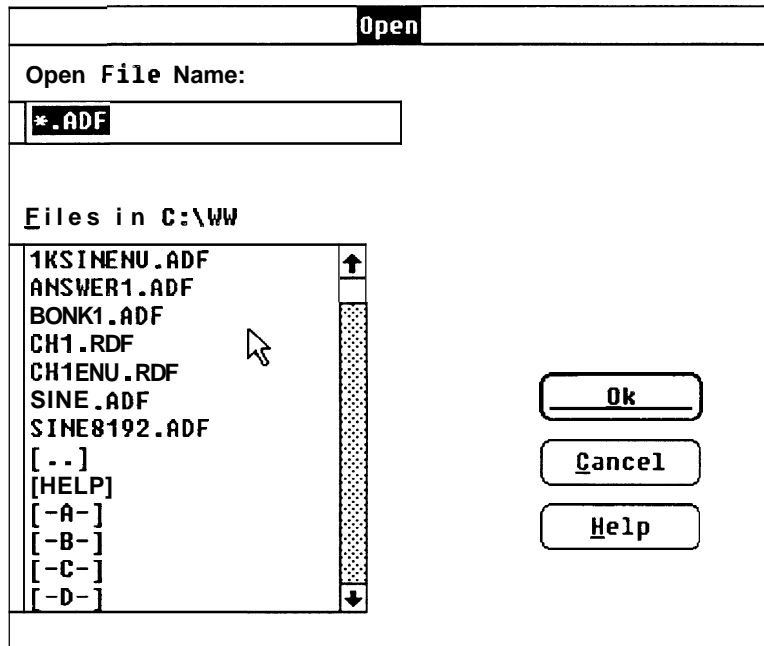
New Waveform Name:

Record Length:   Seconds  
 Points

Type

Normal Waveform  
 Envelope

**Open** Retrieves and loads an existing waveform from disk.



**Save** Stores current waveform to disk, overwriting previous version. Waveforms can be stored in *ADIF* or instrument specific format. Back-up copies may be saved.

**Save**

Save File Name: c:\wave30

Extension:       Format:  
 ADIF File       ADIF 0.99  
 Instrument Specific File        ADIF 1.0

Make Backup

Offset:  V

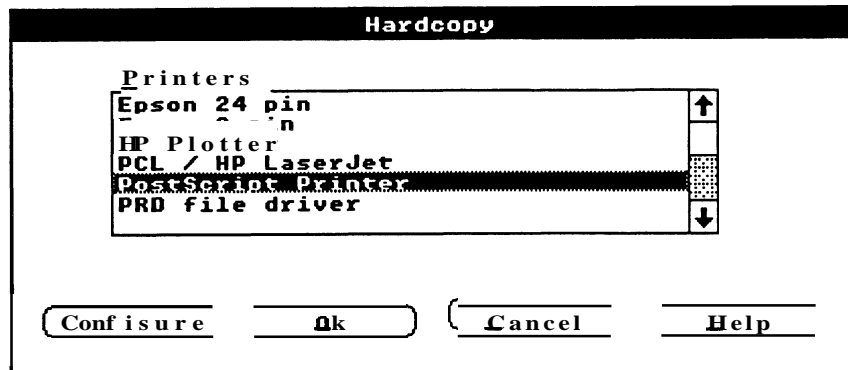
**UX5790 Waveform Save/Send**

Between Markers       Not Div by Eight  
 Entire Waveform       Use next Larger  
 Binary Format       Use next Smaller  
 Hexadecimal Format

Include Imbedded Addresses

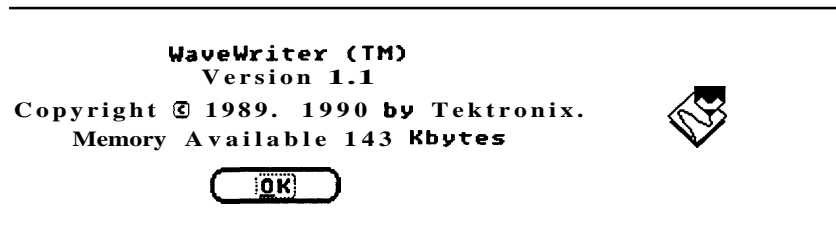
Packet Index:

**Hardcopy** Prints *Waveform Display Area* to printer or plotter.



**Exit** Exits *WaveWriter* and returns to *Windows*, prompting you to save waveforms which have been altered. Saves *WaveWriter* configuration.

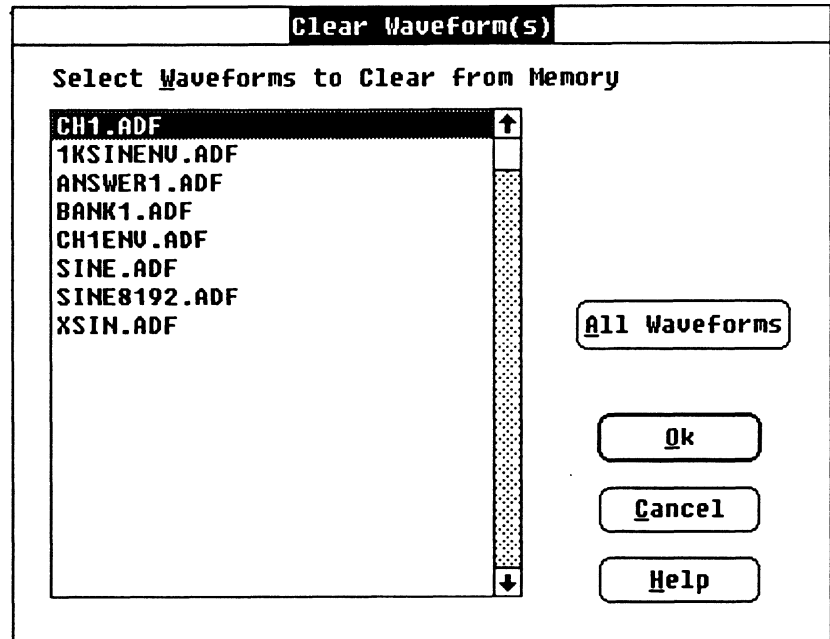
**About** Displays *WaveWriter* program information. Includes version number and available memory.



**The Edit Menu** (Section 6) Modifies a waveform without redrawing. The **Edit Buffer** is available for multiple insert, replace, and append operations. Data is replaced by another cut or copy operation.

**Undo** Cancels the most recent change to the current waveform.

**Clear Waveform(s)** Removes specified waveforms from memory.



**Cut Between Markers** Removes the region of the current waveform between and including the *Start* and *Stop* markers and stores it in the edit buffer.

**Copy Between Markers** Copies the region of the current waveform between and including the *Start* and *Stop* markers and stores it in the edit buffer. Current waveform is not changed.

**Delete Between Markers** Deletes the region of the current waveform between and including the *Start* and *Stop* markers. Deleted data is not saved in the edit buffer.

**Insert at Start Marker** Inserts a copy of the edit buffer into the current waveform before the *Start* marker.

**Replace Between Markers** Replaces the current waveform between and including the *Start* and *Stop* markers with a copy of the edit buffer.

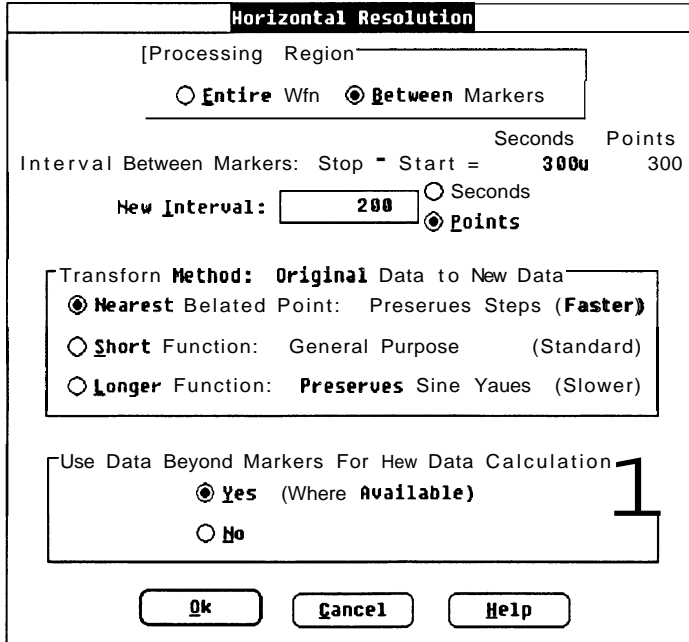
**Append to End of Waveform** Appends a copy of the edit buffer to the end of the current waveform.

**Flip Horizontal Between Markers** Reverses the timing of the current waveform between and including the *Start* and *Stop* markers.

**Flip Vertical Between Markers** Inverts the current waveform between and including the *Start* and *Stop* markers around 0 Volts.

**Horizontal Resolution** Expands or compresses all or a portion of the current waveform along the horizontal axis.

*NOTE* Changing horizontal resolution doesn't change clock rate.





**Vertical Resolution** Modifies waveform data to simulate a lower vertical resolution.

**NOTE** Once the bit level has been changed, it can't be returned to a higher resolution. The previous waveform data can't be recovered. Always save the higher bit level waveform if the data needs to be retained.

Vertical Resolution	
Current Waveform Step Resolution:	12 Bits
Simulated Step Resolution:	<input type="text" value="10"/> Bits
<b>Processing Region</b>	<input type="button" value="Ok"/>
<input checked="" type="radio"/> Entire Waueform	<input type="button" value="Cancel"/>
<input type="radio"/> Between Markers	<input type="button" value="Help"/>

## The Display Menu (Section 7) Sets the attributes of the screen presentation.

**Redraw Dot** Displays waveforms in dot format.

**Redraw Vector** Displays waveforms in vector format. Uses currently selected line styles. Line styles will not be visible unless data points are far enough apart.

**Zoom In** Magnifies a portion of the *Waveform Display Area*.

**Zoom Out** Restores the display to that set by **Set Axis Ranges**.

**Set Axis Ranges** Sets the vertical and horizontal axis scales for the *Waveform Display Area*

Set Axis Ranges

Vertical

Amplitude:  U  
(Pk-Pk)

Horizontal

Seconds  
 Points

Start:  Pts  
Stop:  Pts

Ok Cancel Help

**Autoscale Current Waveform**

Automatically adjusts the horizontal and vertical axis scales to match the current waveform within target instrument limits.

**Change Clock Rate**

Sets the system clock rate. Affects all waveforms in memory. Dialog box that appears depends on the target instrument.

**AFG 5101/5501 Clock Rate**

Time per Point:

(or)

Frequency:

**2400 Series Clock Rate**

Enter ONE of the following:

Time Per Division:  S

Time per Point:  S

Frequency:  Points / Second

External Clock

**UX5790 Clock Rate**

Time/Point:

10n	↑
20n	
40n	
80n	
...	
160n	
320n	
640n	
1.28u	
2.56u	
5.12u	
10.24u	
20.48u	
40.96u	
81.92u	↓

Master Clock

Internal: 10 nSec

External:  Sec

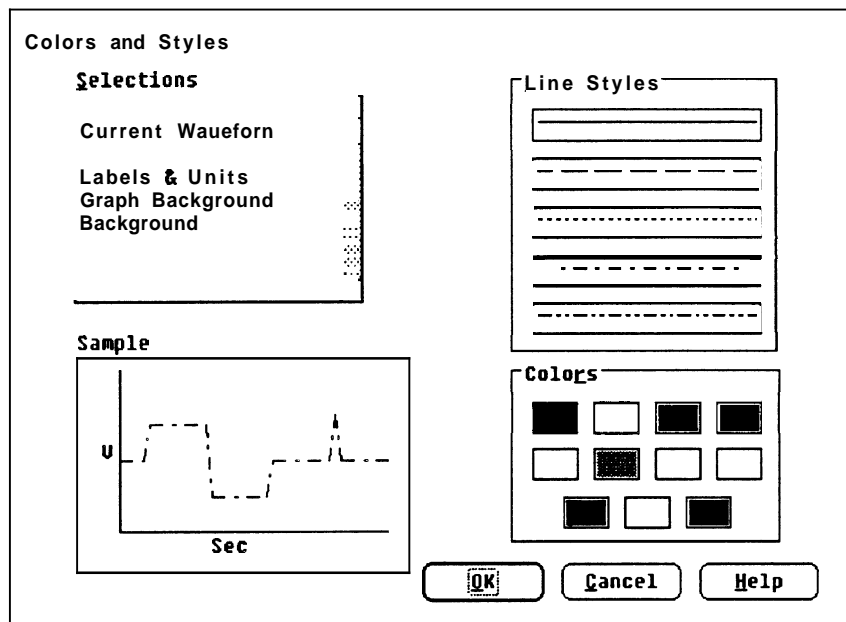
Selected Sec/Point: 1.28uS

Selected Frequency: 781.25KHz

**Change Current Waveform** Displays the *WaveformList* to change the current waveform. Double-clicking on the *WaveformList* icon also brings up the *Waveform List*.

**Show Crosshairs** Toggles between a small cross hair cursor and full-screen crosshairs. Coordinates of the cursor or crosshairs are displayed at lower left of *WaveformDisplayArea*.

**Set Colors & Line Styles** Sets the attributes of waveforms and various screen elements.



---

**The Draw Menu** (Section 8) Tools to modify an existing waveform. The **CONTROL** key is a cursor speed control. The coordinate display is continually updated with cursor movement. The right mouse button redraws the screen when in a draw mode.

**Nodraw** The initial state. Turns off the current drawing mode.

**Freehand** While drawing is enabled, all cursor movement is tracked for the waveform definition.

**Horizontal** Same as **Freehand**, except that, while drawing is enabled, vertical movement of the mouse or direction keys is ignored.

**Vertical** Same as **Freehand**, except that, while drawing is enabled, horizontal movement of the mouse or direction keys is ignored.

**Autoline** Draws a sequence of line segments where the end point of one line is the start of the next line to be drawn.

**Envelope Max Don't Care** Similar to **Horizontal** Defines the extent of the "don't care" region in the horizontal direction for the upper limit of the waveform envelope.

**Envelope Min Don't Care** Similar to **Horizontal** Defines the "don't care" voltage region in the horizontal direction for the lower limit of the waveform envelope.

**Envelope Max** Used with another drawing command to modify the upper limit of an envelope.

**Envelope Min** Used with another drawing command to modify the lower limit of an envelope.

## The Create Menu (Section 9) Creates waveforms, envelopes, and sequences.

**Equation**

Equation:

<p>Horizontal</p> <p>Start Point: <input style="width: 50px;" type="text" value="0"/> <input checked="" type="radio"/> Points</p> <p>Stop Point: <input style="width: 50px;" type="text" value="999"/> <input type="radio"/> Seconds</p>	<p>Action</p> <p><input type="radio"/> Replace</p> <p><input type="radio"/> Insert</p> <p><input type="radio"/> Add</p> <p><input checked="" type="radio"/> New Waveform</p>
--	--

Waveform Name:

Library of Equations

```

<2TPulse> .7143*(sin(2*pi*t*(-.000037413)*796178.64)-2)
<ammod > sin((pi/100*t)/10) * cos(2*(pi/100*t)+.5)
<AMSweep > .0005*t*sin(5*(9*pi/1000*t))
<carrier > .7143*(sin(2*pi*t*3579545))
<FMStereo> (sin(80*(pi/1000*t-pi))+.97) * cos((80*(pi/1000*t-pi)))
<HalfAM > abs((sin(8*pi/1000*t)+.97) * sin((8*pi/1000*t)/20))
<haversin > .5 * (1 - cos(2*pi*t))
<havertri > ((asin(abs(sin((pi*t)))))/pi)*2
<InterMod > .2*sin(15*(7*pi/1000*t)) + sin((7*pi/1000*t)/7)
<modsin2 > .7143*((sin((2*pi*(t-.000037413)*3579545)-pi))+1)*.5*(
<NoisySin > sin(7*pi/1000) + .3*rand
        
```

**Equation** Creates or modifies waveforms using an equation. Adds, retrieves, and deletes equations to and from the equation library.

**Operators:** ( ) + - \* / A

**Functions:** sqrt(x), sin(x), sine(x), cos(x), tan(x), asin(x), acos(x), atan(x), sinh(x), cosh(x), tanh(x), abs(x), ceil(x), floor(x), log(x), ln(x), rand, and exp(x).

**Definitions:** **Start** and **Stop** points define the range of time (t) describing the beginning and end of the waveform segment.

For example, to produce a single cycle of a 1 kHz sine wave with a 2 Volt peak-to-peak amplitude and a +1.5 Volt dc offset, enter the following parameters:

Start point	=	0
Stop point	=	999
Clock	=	1 $\mu$ s

(Use the **Change Clock Rate** command)

The equation shown below follows the basic form for trigonometric functions, where:

A	=	dc offset
B	=	peak-to-peak amplitude
F	=	frequency
f	=	function

For the equation:

$$A + B * f (2 * \text{pi} * F * t)$$

substitute the values for this example and enter in the *Equation* edit box:

$$1.5 * 2.0 * \sin (2 * \text{pi} * 1000 * t)$$

**Sine, Triangle, Pulse, Square** Creates a waveform by entering vertical and horizontal parameters. You can create a new waveform or modify the current waveform.

**Sine**

**Vertical**  
 Max/Min  Amplitude/Offset  
Amplitude:  U  
(Pk-Pk)  
Offset:  U

**Action**  
 Replace  
 Insert  
 Add  
 New Waveform

**Horizontal**  
 Points  Seconds  
 Start Point:  Pts  
 Stop Point:  Pts  
 Frequency:  Hz  
 Cycles:   
**Calculate Frequency**  
Phase:   Radians  Degrees

Waveform Name:

**Triangle**

**Vertical**  
 Max/Min  Amplitude/Offset  
Amplitude:  U  
(Pk-Pk)  
Offset:  U

**Action**  
 Replace  
 Insert  
 Add  
 New Waveform

**Horizontal**  
 Points  Seconds  
 Start Point:  Pts  
 Stop Point:  Pts  
 Frequency:  Hz  
 Cycles:   
**Calculate Cycles**  
Phase:   Radians  Degrees

Waveform Name:



**Pulse Wave**

**Vertical**

Maximum:  V

Minimum:  V

**Action**

Replace

Insert

Add

New Waveform

Waveform Name:

**Horizontal**

Seconds  Points

Start Point:  Pts

Stop Point:  Pts

Period:  Pts

Cycles:

Delay:  Pts

Pulse Width (50%):  Pts

**Transitions (10% - 90%)**

Pulse Direction:  Pos  Neg

Risetime:  Pts

Falltime:  Pts

Ramp  Sine<sup>2</sup>  Ramp  Sine<sup>2</sup>

**Square Wave**

**Vertical**

Max/Min  Amplitude/Offset

Amplitude:  V  
(Pk-Pk)

Offset:  V

**Action**

Replace

Insert

Add

New Waveform

Waveform Name:

**Horizontal**

Seconds  Points

Start Point:  Pts

Stop Point:  Pts

Frequency:  Hz

Cycles:

Phase:   Radians  Degrees

Duty Cycle:  %

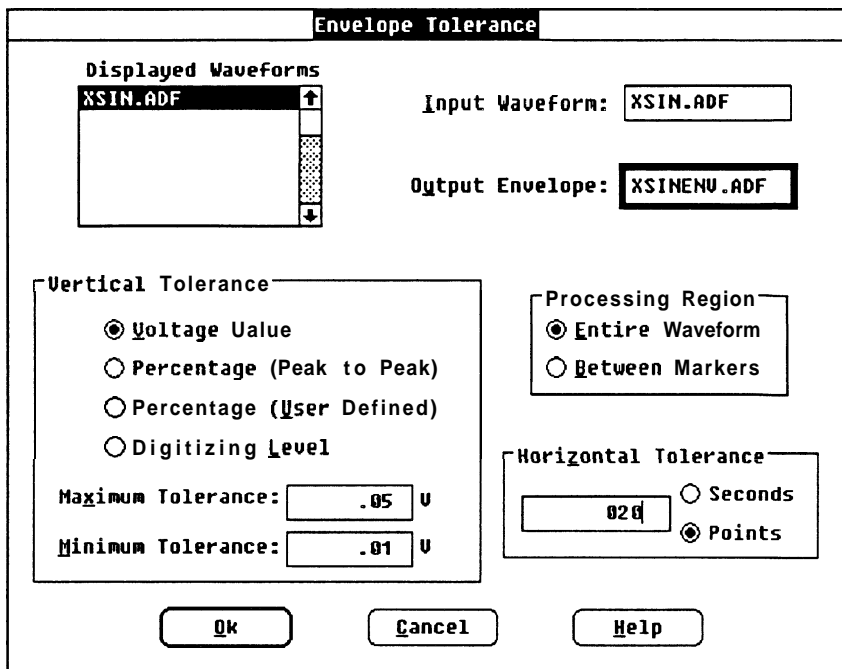
**Transitions (10% - 90%)**

Risetime:  Pts

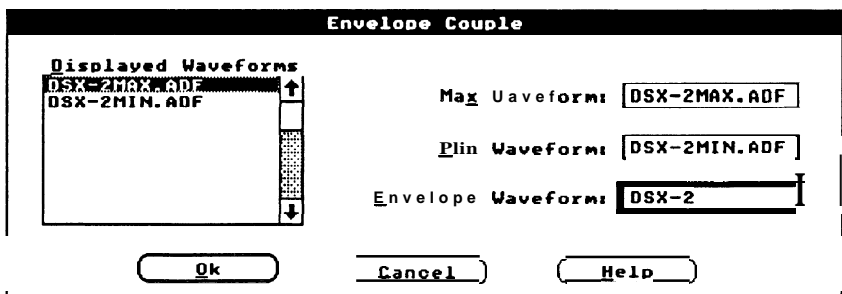
Falltime:  Pts

Ramp  Sine<sup>2</sup>  Ramp  Sine<sup>2</sup>

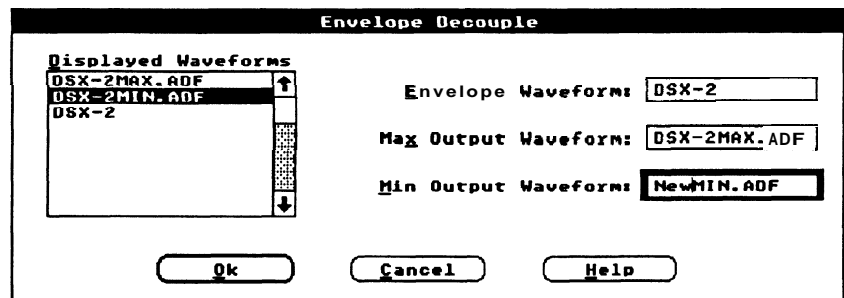
**Envelope Tolerance** Creates an envelope by adding vertical and/or horizontal tolerances to an existing normal or envelope waveform.



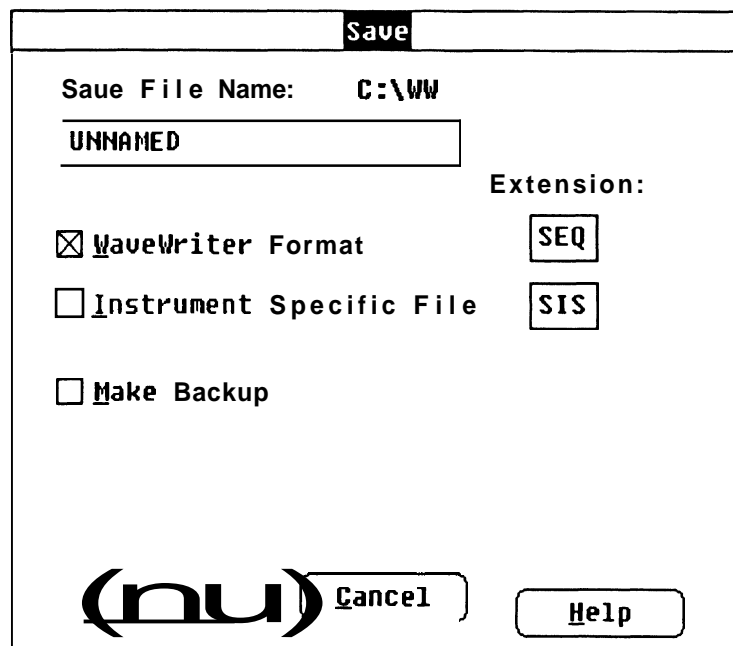
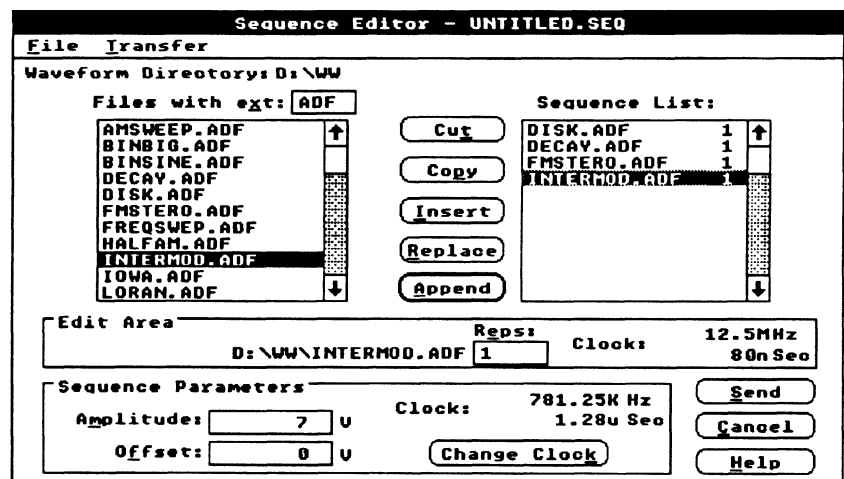
**Envelope Couple** Uses two normal waveforms to define upper and lower limits of an envelope.



**Envelope Decouple** creates two normal waveforms from an envelope waveform.

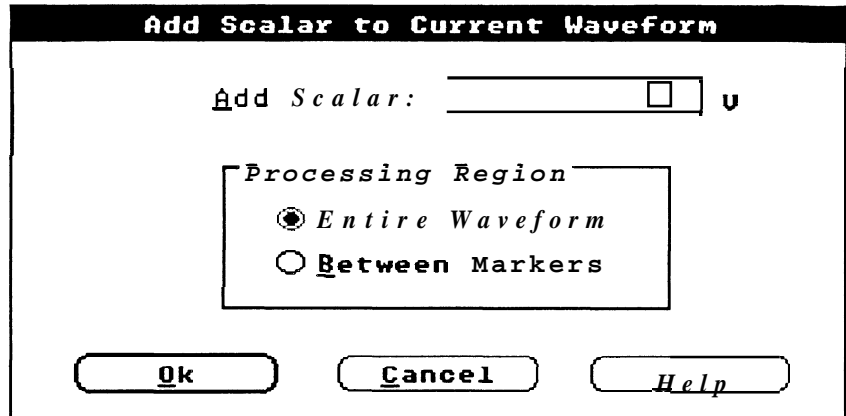


**Sequence** Creates a composite waveform by using an ordered series of waveformfiles.



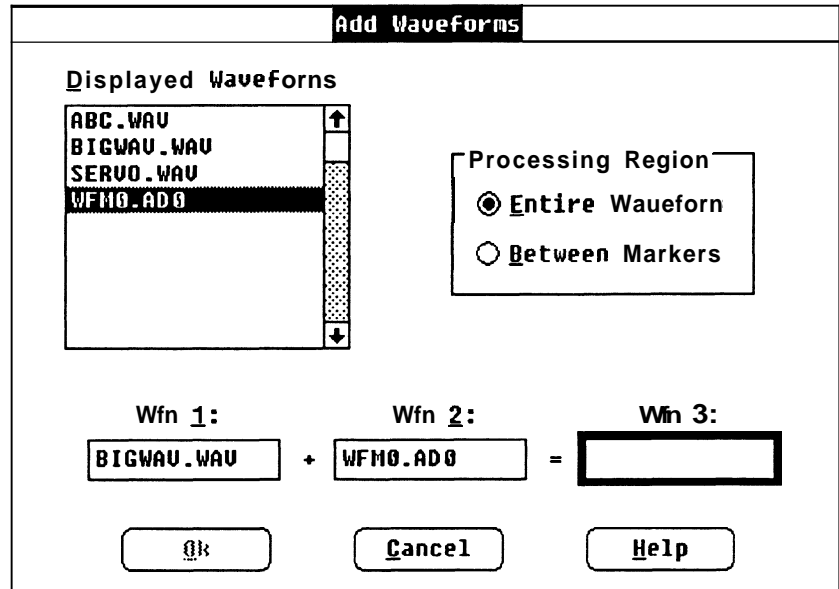
**The SigProc Menu** (Section 10) Modifies a waveform (or a selected portion of the waveform) either with a constant value or with another waveform.

**Add Scalar** Adds a constant value to the selected portion of the current waveform.



**Multiply by Scalar** Multiplies a selected portion of the current waveform by a constant value.

**Add Waveforms** Adds two waveforms together in selected processing region.



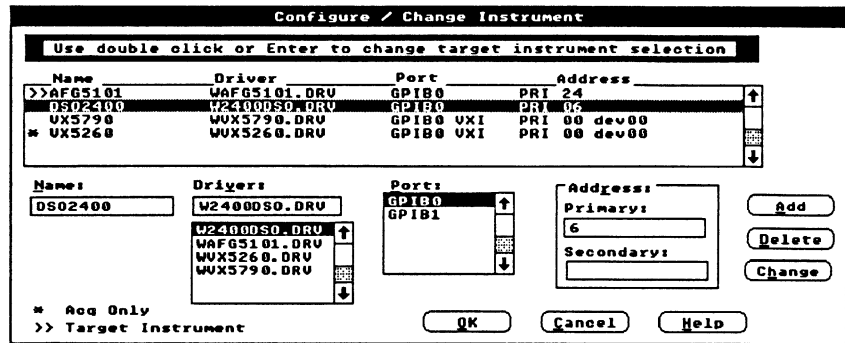
**Subtract Waveforms** Subtracts one waveform from another in selected processing region.

**Multiply Waveforms** Multiplies two waveforms together in selected processing region.

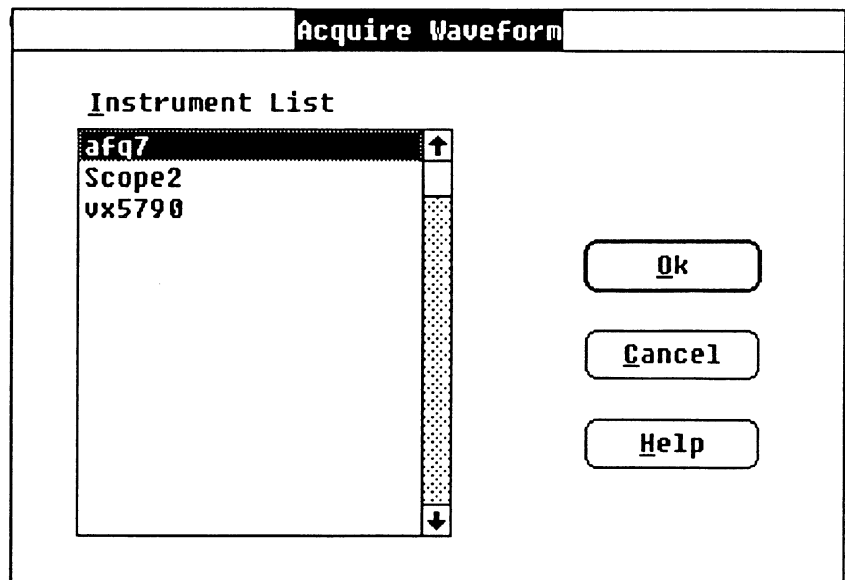
**Divide Waveforms** Divides one waveform by another in selected processing region.

**The Transfer Menu** (Section 11) Selects a target instrument. Sets up communication with the instrument. Acquires and sends waveform data.

**Configure/Change Instrument** configures new instruments. selects target instrument.



**Acquire** Acquires data from an instrument configured with the **Configure1** **ChangeInstrument** command. If the acquired data doesn't agree with system parameters set for the target instrument, voltage and timing data are affected. Dialog box that appears depends on the selected target instrument.



**Acquire AFG 5101/5501**

Begin Raddr:

End Addr:

Bank Number:

Replace Current Waveform

Create New Waveform

Waveform Name:

**Acquire 2200 Series**

Location

ACQ

REF1  REF3

REF2  REF4

Replace Current Waveform

Create New Waveform

Name:

**UX5260 Acquire**

5260 Parameters

Record Loc:

Entire Record

Partial

Record Information

Start:

Count:

Replace Current Waveform

Create New Waveform

Name:

**Acquire 11000 Series**

Trace Waveform

STORAGE1  
STORAGE2

Stored Waveform

ST01  
ST02

Trace/Stored Description

"AUG(L1) ON MAIN"

Replace Current Waveform

Create New Waveform

Name:

Adjust WaveWriter Amplitude to Full Scope

**Acquire 2400 Series**

Location

CH1  REF1

CH2  REF2

ADD  REF3

MULT  REF4

Replace Current Waveform

Create New Waveform

Name:

Adjust WaveWriter Amplitude to Full Scope Range

**Send** Transfers all or a part of the current waveform to the target instrument. Dialog box that appears depends on the selected target instrument.

**Send AFG 5101/5501**

**Send Waveform**  
 Send Waveform Between **Markers**

Bank Number:

Begin ADDR:

Filter:

Output Amplitude:  U (50 Ohms)

Offset:  U

Time per Point:  S

**Send 2400 Series**

Send **Waveform**  
 Send Waveform Between **Markers**

Location

**\_\_\_\_\_**  
 REF2  REF4 Start At:

Sec  
 **Pts**

Vertical Position

Set WaveWriter Screen 0.0 volts to Oscilloscope center graticule.

Enter vertical position of ground reference: 
 Volts  
 Divisions

**UX5790 Waveform Save/Send**

Between **Markers**  
 **Entire Waveform**  
 **Binary Format**  
 **Hexadecimal Format**

**Include Imbedded Addresses**

**Download Packet and Execute**  
 Download Packet

Packet Index:  
 Sequence Index:  
 Offset: U

**Not Div by Eight**

Use next **Larger**  
 Use next **Smaller**



---

**Help** Displays help for a list of topics.



# Appendix C

## File Structures

### The ADIF Format

**Introduction** The Analog Data Interchange Format (**ADIF**) was an evolving standard within **Tektronix**. It has been adopted by the SCPI consortium as part of the SCPI standard. Version 1.0 is compatible with the SCPI version. Version 0.99 is used by some software packages such as **TekTMS** and **SPD**. ADIF makes it easier to share waveform and other analog information between various software packages and instruments that support it. It is flexible, extendable, and can accommodate a wide range of data structures and formats.

ADIF is a data object description language that "packages" a description of the data along with the data itself. A minimum of information about the data is required, but there is a wide and rich range of information that can be optionally associated with the data. ADIF is capable of representing very complex data dimensional sets, but its block structure permits simple data sets to be represented in an easy to understand manner.

ADIF is hierarchically structured, and as such, can be subordinate to other structures. It is suitable as a file format and can be easily transmitted across **IEEE 488.1** / **IEEE 488.2**, RS-232, SCSI, Ethernet, and various other transmission media and protocols.

While ADIF can represent digital and other kinds of structured data, it is somewhat cumbersome. The **accommodation** of digital data is one of several possible extensions to **ADIF**.

What is included here is not a rigorous definition of **ADIF**. The SCPI specification is the definitive document.

**Overview** ADIF is block structured. An ADIF data set generally consists of several description blocks and a data block. A block typically contains keywords and may contain subordinate blocks. Keywords may have one or more values. Some blocks require modifiers. Modifiers allow a block to have a value as well as contain keywords and subordinate blocks. Modifiers also allow multiples of the same block type to be uniquely distinguished from one another.

Each block addresses a different aspect of data description:

**STD** Specifies the version of the ADIF standard used to create the ADIF data set, as well as any optional protocols.

**IDENTIFY** Names the data set and describes the environment in which it was generated. The environment description includes project name, test number and series, date and time, and source.

**DIMENSION** Dimension blocks specify the structure and format of data in the DATA (CURVE) blocks. Provision is made for data scaling, offset, naming, and units specification. The DIMENSION, ENCODE and ORDER blocks, taken together, completely describe the structure and physical format of the data in the DATA (CURVE) blocks.

A dimension may be either explicit or implicit. An implicit dimension is one that is represented by a function instead of actual data values. A waveform represented by voltage readings taken at a constant time interval is an example of a data set with an implicit and explicit dimension. The implicit dimension is the time dimension and is represented by a function instead of data values. The voltage dimension is explicit, with values present in the DATA (CURVE) blocks.

**ENCODE** Specifies the encoding format for data in the DATA and ENCODE blocks. Also covered are signal values for underflow, overflow, and no value, as well as the range and precision of the data.

**TRACE** Logically groups dimensions as functions, surfaces, sets, etc. TRACE blocks provide semantic information about the data and are used in the construction of VIEW blocks. They also provide a convenient and powerful mechanism for sub-setting data.

**DATA** The data. Different subordinate blocks described dimensioned data, pulse parameter measurements, sine parameter measurements, statistical measurements, and point values.

**Block and Keyword Organization** The following example listing of blocks and keywords show the ADIF hierarchical structure. Blocks are followed by a pair of parentheses. A block followed by an ellipsis is a repeat of a previous definition; If multiple occurrences of a block or keyword are permitted, it is marked with “[m]”.

The ADIF standard and revision control block:

```
STD 0
    VERSION
```

The ADIF environment description blocks:

```
IDENTIFY ()
    NAME
    DATE
    TIME
    SOURCE ()
    PACKAGES
```

The ADIF data structure and format blocks:

```
DIMENSION = <dimension label> () [m]
    NAME
    UNITS
    SCALE
    OFFSET
    SIZE
    ENCODE () ...
    NOTE
```

The ADIF blocks for semantic information:

```
TRACE = <trace label> 0 [m]
    NAME
    INDEPENDENT ()
        DIMENSION () [m]
        LABEL
        START
        STOP
    DEPENDENT ()
        DIMENSION () [m]
        LABEL
```

The ADIF data block:

```
DATA = <data label> 0 [m]
    CURVE ()
    VALUES
```

## Sequence Editor File Format

sequence files are specified with an ASCII string in the following format. In the example, text in brackets is descriptive, not literal, and is to be replaced with actual data — the brackets and the descriptive text are not included in the actual data string. The symbols **C<sub>R</sub>** and **L<sub>F</sub>** represent *carriage return* and *line-feed*, respectively. Text in parentheses is commentary and is not part of the format:

**SEQ<sup>C<sub>R</sub></sup>L<sub>F</sub>**

[Full path to the packet file] [repetition count]<sup>C<sub>R</sub></sup>L<sub>F</sub> (Packet 1)

[Full path to the packet file] [repetition count]<sup>C<sub>R</sub></sup>L<sub>F</sub> (Packet 2)

[Full path to the packet file] [Repetition count]<sup>C<sub>R</sub></sup>L<sub>F</sub> (Packet n)

The *Full path to the packet file* and the *Repetition count* fields are variable length fields separated by an ASCII blank.

## The AFG Instrument Specific Format

Data sent to the AFG 510115501 arbitrary waveform generators is formatted as follows. Text shown here in parentheses is commentary and is not part of the .ISF format. Text shown in brackets is descriptive, not literal, and is to be replaced with actual data. Although each item in the example is shown on a separate line, the data is sequential — there is no implied carriage return/line feed separator:

```

OFFSETO;      (Offset initialized; see text)
AMPL [n.nn];  (Amplitude value)
OFFSET [n.nn]; (Offset value)
RATE [n.nnEnn]; (Exponentialnotation)
ARBDATA%      (ASCII character string)
[low byte ][high byte] (Byte count)
[low byte ][high byte] (First data point)
.
[low byte ][high byte] (nth data point)
[cksm byte] (Checksum byte)

```

The first OFFSET parameter initializes the instrument to prevent an invalid amplitude/offset combination. Subsequent amplitude and offset values can be integer (0 to 4095), decimal, or exponential notation.

Binary data values range from 0 to 4095.

The byte count is twice the number of data points plus one for the checksum byte (the byte count will always be an odd integer).

**Data Conversion** To convert a low byte/high byte pair to an integer value, use the equation:

$$WfmValue = (LowByte \ll 8) | (HighByte \& 255);$$

*WfmValue* ranges from 0 to 4095. To convert *WfmValue* to its ASCII equivalent, subtract 2047.

## The 2400 DSO Instrument Specific Format

Data sent to a 2400 Series Digital Storage Oscilloscope is formatted in ASCII characters as follows. In the example, data values shown enclosed in brackets are descriptive, not literal, and are to be replaced with actual data. The brackets are not included in an actual data string:

```
WFMPRE WFI:"2400DSO",ENCD:BINA,BN.F:RI,  
XINC:[clockrate],YMULT{[Volts per level]},YOFF {[offset]},  
PT.F:[Y or envelope];  
CURVE%[high byte][low byte][data 1]...[data 1024]  
[checksum]
```

High byte and low byte are the byte count (1025) that follows.

High byte = 04 hex, low byte = 01 hex.

Each data byte value ranges from -128 to +127.



## VXI VX5790 Instrument Specific Formats

To manage waveform sequences in a manner compatible with both the DOS and VXI environments, **WaveWriter** maintains a cross-reference file that combines the information required by both environments.

### The VX5790 Cross Reference File Format

In the example, text in brackets is descriptive, not literal, and is to be replaced with actual data — the brackets and the descriptive text are not included in the actual data string. The symbols **C<sub>R</sub>** and **L<sub>F</sub>** represent *carriage return* and *line-feed*, respectively. Text in parentheses is commentary and is not part of the format:

[Packet index]:[packet filename]**C<sub>R</sub>****L<sub>F</sub>** (Packet 1)

[Packet index]:[packet filename]**C<sub>R</sub>****L<sub>F</sub>** (Packet 2)

[Packet index]:[packet filename]**C<sub>R</sub>****L<sub>F</sub>** (Packet n)

The *Packet Index* and *Packet File* fields are separated by an ASCII colon. The *Packet Index* field is a fixed length of four characters. The *Packet File* field is a variable length field. The *Packet Filename* does not include an extension — all packet filenames in the cross reference file are unique.

## The VXI VX5790 Instrument Specific File Format

In the example, text in brackets is descriptive, not literal, and is to be replaced with actual data — the brackets and the descriptive text are not included in the actual data string. Text in parentheses is commentary and is not part of the format. There are no embedded carriage-returns or line feeds in the actual data. The symbol  $S_P$  is an ASCII space character.

:dev00	(Embedded address – optional)
:inst	(Compound command header)
:off $S_P$ [offset];	(Offset)
:amp $S_P$ [amplitude];	(Amplitude)
:div $S_P$ [clock divisor];	(Defines clock rate)
:dev00	(Embedded address – optional)
:pac	(Compound command header)
:encdg $S_P$ [data type];	(Packet format – <i>hex</i> or <i>bin</i> )
:index $S_P$ [packet];	(Packet index number)
shape $S_P$	(Waveform data header)
# 3192	(Byte count. First char after “#” is the number of following characters that define the byte count. In this example, it takes 3 characters to state that 192 data bytes will follow the byte count.)

```
001900240037004d006100750089009e (192 data bytes)
00b200c600db00ef01040117012c0141
01550169017e019201a701ba01cf01e4
01f8020a021f02330248025c02700285
029902ad02c202d602ea02ff03120328
033b035003640378038d03a203b503ca
```

## Sequence Instrument Specific File Format

Below is an example of a sequence file in SIS format. This file can be sent directly to the VX5790 arbitrary waveform generator, however the sequence file should be sent after the corresponding waveform packet file are sent. In the example, a waveform should have previously been sent to packet locations 2, 4, and 17.

```
:vx5790:stop:wai;inst:amp 6.5;off 0;div 10;:vx5790:seq:encdg hex;index 0;order#218000201000406001103;
```

<b>:vx5790</b>	(Embedded address - optional)
<b>:stop;</b>	(Make sure instrument is stopped)
<b>wai;</b>	(Make for previous commands to finish)
<b>inst</b>	(Instrument group compound header)
<b>:amp 6.5;</b>	(Set amplitude to 6.5 volts)
<b>off 0;</b>	(Set offset to 0 volts)
<b>div 10;</b>	(Set clock divisor to 10; 10.24 μsec/point for internal clock)
<b>:vx5790</b>	(Embedded address - optional)
<b>:seq</b>	(Sequence group compound header)
<b>:encdg hex;</b>	(Set data encoding to hexadecimal)
<b>index 0;</b>	(Set sequence index to 0)
<b>order</b>	(Specifies that a sequence order follows)
<b># 2</b>	(Specifies that the next 2 digits are the byte count)
<b>18</b>	(Specifies that 18 bytes follow)
<b>0002</b>	(Waveformpacket location 2 is repeated 1 time, not repeated)
<b>01</b>	
<b>0004</b>	(Waveformpacket location 4 is repeated 6 times.)
<b>06</b>	
<b>0011</b>	(Waveformpacket location 17 (11 hex) is repeated 3 times)
<b>03;</b>	



# Appendix D

## Error and Warning Messages

### Introduction

Some messages are specific to an invalid edit box entry. When you select the error message box **OK** command, you will return to that edit box to correct the value.

Generally, when values are entered, they are not checked for validity until the OK command has been selected.

In the following error messages, items enclosed in square brackets ([ ]) are replaced with actual values in the error message box when it is displayed.

If you see an error message other than listed below, it is a Microsoft Windows error message. Refer to the Microsoft manual for more information.

### Error Messages

E300 — Out of memory.

Not enough memory was available to perform the selected operation. Clear unneeded waveforms or programs from memory and try again.

E301 — Window creation failed.

Not enough memory was available to create a window within **Wave Writer**. Clear unneeded waveforms or programs from memory.

E302 — Error accessing listbox.

Not enough memory was available to fill a list box in a dialog box so the list of entries may not be complete. Clear unneeded waveforms or programs from memory and try again.

E303 — Initialization failed.

When **WaveWriter** was first loaded, there was not sufficient memory to initialize the defaults. Clear unneeded programs from memory and try again.

E304 — Waveform name [name] already exists.

You attempted to create a waveform which already exists. Specify a new name to proceed with the operation.

E305 — Error reading file [filename].

An error was detected when reading the filename shown. This may be due to a disk error, or a **corrupt** file.

E306 — Error creating file [filename].

An error was detected when trying to create the filename shown. This is most likely due to a disk error.

E307 — Error closing file [filename].

An error was detected when trying to close the filename shown. This is most likely due to a disk error. It may also occur if the disk is full.

E308 — Error opening file [filename] for read.

An error was detected when trying to open the filename shown. This is most likely due to a disk error.

E309 — Error creating temporary file.

An error was detected when trying to create a temporary file.

E310 — Error removing temporary files.

An error was detected when trying to delete temporary files created by **WaveWriter**. The files may remain on disk.

E311 — Error writing to disk.

When creating or writing to an output file, an error was detected. This is most likely because the disk became full. If possible, free up more disk space by deleting unneeded files. To avoid losing data, you can minimize **WaveWriter** and use the **Windows** control panel to delete the files, and then maximize **WaveWriter** with waveforms still intact.

E312 — Premature EOF.

When the selected file was read in, the end-of file was detected before all data was read. This may have been due to a disk full error when writing the file, or the file or disk may be corrupt.

- E313 — Access denied. File cannot be overwritten, or directory full, or directory not found, or path specifies a directory.
- Executing the requested command violates the access mode of the file, subdirectory, or device involved. This can occur for the following reasons:
- **An** attempt was made to write to a file marked read-only, or read a file that is write-only.
  - An attempt was made to open a subdirectory as a file.
  - The specified directory did not exist.
- E314 — Sharing mode specified when file sharing not installed, or access-mode value invalid.
- This can occur for the following reasons:
- The given path name is a directory.
  - An attempt was made to open a read-only file for writing.
  - A sharing violation occurred (the file's sharing mode does not allow the specified operations).
- E315 — [name] — Path or file not found.
- The path or file specified does not exist. Check the name and try again.
- E316 — Too many open file handles.
- Too many files were already open to permit opening another. Close unneeded files or increase the FILES= value in the CONFIG.SYS file and reboot.
- E317 — Error creating cutlcopy buffer.  
Cut/Copy operation aborted.
- For either menu selection **Cut** or **Copy**, **WaveWriter** was not able to store the selected waveform segment on disk. This would occur if the disk was full. Eliminate unused disk files.
- E318 — Cannot open cutlcopy buffer.  
Cut/Copy operation aborted.
- For either menu selection **Cut** or **Copy**, the cut/copy buffer could not be opened. The operation is aborted.
- E319 — Problem reading cutlcopy buffer.  
Insert/Replace/Append operation aborted.
- For menu selection **Insert**, **Replace** or **Append**, the cut/copy buffer could not be read. The selected operation was aborted.

- E320 — 'Wave.cfg' corrupted. Only able to read in part of it.  
When loading **WaveWriter** the configuration file WAVE.CFG was corrupted. Default values were assigned by **WaveWriter**. When you exit **WaveWriter** a new configuration file will be saved with the currently selected defaults.
- E321 — Not enough memory. Only part of the configure file was read.  
When loading **WaveWriter** the configuration file WAVE.CFG is read to get **WaveWriter** defaults. Only part of the file was read. Default values were assigned by **WaveWriter** for portions of the file which were not found. When you exit **WaveWriter** a new configuration file will be saved with the currently selected defaults.
- E322 — [filename] is not a valid library file.  
For the Equation menu selection, the library file selected was not the proper format for equation library.
- E323 — Only 1 Help window may be opened at a time.  
You may only select one help window to be displayed at a time. To display another help window, you must first close the currently displayed help window.
- E324 — Help topic not found.  
The selected help topic is not available. This error should not occur under normal circumstances.
- E325 — Help file [filename] not found.  
The help text file for the selected help topic was not found. All help text files should be on a subdirectory HELP from the directory where the **WaveWriter** executable file resides. Perhaps the file was inadvertently deleted. Either reinstall **WaveWriter** software, or copy all .HLP files from **WaveWriter** Disk # 2 to the HELP subdirectory.
- E326 — Error reading help topics and files.  
File HLPTOPIC.HLP, which is a list of all help topics presented from the Help selection in the Main Menu, was not found or is corrupt. Either reinstall **WaveWriter** software, or copy file HLPTOPIC.HLP from **WaveWriter** Disk # 2 to the HELP subdirectory.
- E327 — Corrupted sequence file [filename].  
For menu selection Sequence, the file you selected to open is corrupted.



E328 — File [filename] cannot be read in either ADIF or instrument specific format.

For menu selection **Open**, the selected file cannot be read as either an ADIF file, or an instrument specific file for the currently selected target instrument. If the ADIF file was not created by **WaveWriter** it may not be a compatible version. If the file cannot be read in instrument specific format, it may be because the file was created for use by a different instrument. If so, use the **Change/Configure Instrument** selection to change the target instrument, and then select **Open** again to try to read the desired file.

E350 — Invalid number.

In response to an edit box, you entered an invalid number. Check the value and try again.

E351 — Must be a digit 0 — 9.

In response to an edit box, you entered a character which was not a combination of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Check the value and try again.

E352 — Invalid number. The number must be greater than [number].

In response to an edit box, you entered a number which was out of the acceptable range. The error message tells you the acceptable lower bound. Check the value and try again.

E353 — Invalid number. The number must be less than [number].

In response to an edit box, you entered a number which was out of the acceptable range. The error message tells you the acceptable upper bound. Check the value and try again.

E354 — Invalid number. The number must be between [number – number].

In response to an edit box, you entered a number which was out of the acceptable range. The error message tells you the acceptable lower and upper bounds. Check the value and try again.

E355 — Invalid number. The number must be non-negative.

In response to an edit box, you entered a number which was out of the acceptable range. Enter a number which is greater than or equal to zero.

E356 — Invalid number. Too small for instrument to handle.

For menu selection **Set Axis Ranges**, you entered a value for Amplitude which is too small for the target instrument to handle.

E357 — Waveform size exceeds repetition size of [size].

For menu selection **Sequence**, the number of repetitions exceeded the maximum amount for the target instrument. The last digit you entered was discarded.

E358 — Invalidfilename.

In response to a file name edit **box**, you entered an invalid filename.

The following characters are not allowed in filenames:

. " / \<> : | [ ] + = ; ,  
ASCII characters less than 20H

The following reserved words are not allowed for filenames:

aux, con, prn, nul, com1, com2, com3, com4,  
lpt1, lpt2, lpt3, wave

E359 — Invalid displayed waveform name.

In responses to an edit box prompt for a waveform name which must be in **WaveWriter** memory, you entered a name which does not exist. Check the spelling of the name entered, or use the Waveform List to see a list of all waveforms currently in **WaveWriter** memory.

E360 — Name already exists.

For menu selection **Change/ConfigureInstrument**, you entered a name which already exists and then selected Add to add a new entry to the instrument list. Either provide a unique name and select Add again, or select Replace if you meant to replace information for the selected instrument.

E361 — Invalid offset for current display amplitude.

For menu selection **Save**, the offset entered is not appropriate for the current display amplitude. This error is generated for instruments which require the offset to be within a certain range, based on the amplitude. See E1005 for more information.

**E362 — Parameters given require a period larger than that which is defined.**

For menu selection Pulse or Square, the values you entered to define the waveform were not appropriate. The component parameters you entered together exceed the waveform period.

For Pulse, the following relationship must be satisfied:

$$\text{Delay} + \text{Pulse Width} + \text{Rise} + \text{Fall} < \text{Period}$$

For Square, the following relationship must be satisfied:

$$\text{Rise} + \text{Fall} < (\text{Stop} - \text{Start}) / \text{Cycles}$$

The Rise and Fall in the above equations are not the Rise and Fall that you enter into the edit boxes, but rather are modified based on whether Ramp or Sine squared was selected. For Ramp, Rise and Fall will be altered by a factor of 1.25. For Sine squared, they will be altered by a factor of 2.073878. Check the entries again and correct the invalid response(s).

**E363 — Waveform length too large. The length must be less than [length].**

For menu selection Sequence, the waveform selected for the sequence was larger than the maximum allowable length. You may need to break the waveform into smaller components and save in new files before using them with the sequence editor.

**E364 — Invalid Number.  $0 < \text{Duty Cycle} < 100$ .**

For menu selection Square, the Duty Cycle you entered was invalid. The duty cycle must be greater than 0 and less than 100.

**E365 — An envelope waveform cannot be coupled.**

For menu selection **Envelope Couple**, you entered a waveform name which is an envelope waveform for one of the input waveform names. To use Envelope Couple, you supply two input waveform names which are not envelope waveforms, and another name for the output waveform, where the created envelope waveform will be stored.

**E366 — An envelope waveform must be selected to decouple.**

For menu selection **Envelope Decouple**, you entered a waveform name which is not an envelope waveform in response to the prompt for the input waveform. To use **Envelope Decouple**, you supply an input waveform name, which must already be an envelope in memory, and two output waveforms, where the component non-envelope waveforms will be stored.

**E367 — The [name] waveform is the same as the envelope waveform. They must be unique.**

For menu selection Envelope Couple, one of the input waveform names entered was the same as the envelope waveform selected for the output waveform. They must be unique.

## Error Messages

E368 — No tolerance has been entered.  
Try again or cancel.

For menu selection **EnvelopeTolerance**, no tolerance was entered. To proceed with the function, you must supply a tolerance. Otherwise select Cancel to abort.

E369 — Cannot add, subtract, multiply, or divide envelopes.

For either menu selection **AddWaveforms**, **SubtractWaveforms**, **MultiplyWaveforms**, or **DivideWaveforms**, you specified an envelope waveform name. Only normal waveforms may be used for these operations.

E370 — Could not complete horizontal resolution.

For menu selection **HorizontalResolution**, the selected operation could not be completed.

E371 — Use the file extension edit boxes to enter the extension.

For menu selection **Save**, you started to enter a file extension as part of the filename edit box. Instead, you should enter only the filename prefix in the filename edit box, and the extension in the appropriate extension box(es), depending on whether you select ADIF or instrument specific format.

E372 — Identical file extensions for both ADIF and instrument specific files not allowed.

For menu selection **Save**, the same extension was supplied for ADIF and instrument specific files. You must select different extension so that two distinct files can be created.

E373 — A file type must be selected.

For menu selection **Save**, neither the ADIF or Instrument Specific File check boxes were selected. Select one or both of these check boxes to indicate which type of file(s) you want created.

E374 — Invalid device name.

This message is only generated if the *Windows* configuration file WIN.INI is corrupt and has invalid device names specified for the printer devices. Check WIN.INI to see if it is corrupt, and if so, make a new copy using the appropriate *Windows* disk.

E375 — Printer not available.

For menu selection **Hardcopy**, the printer was not available. Please ensure the printer is available (powered on, on-line, cables firmly connected, paper loaded). If all these things are okay, check to see that the printer is configured correctly.

- E376 — Feature currently not supported for [driver].  
You selected a menu selection which is not appropriate for the currently selected target instrument. For example, you selected Acquire when the target instrument is the VX5790.
- E377 — GPIB error.  
Check all GPIB cables to ensure they are securely attached. If the **address is incorrect, use Change/Configure Instrument** to set it to the proper value, and try again.
- E378 — Illegal symbol: [symbol]  
For menu selection Equation, you entered a symbol in the equation edit **box** which is not allowed. Use 't' as a placeholder for the running variable, e.g.  $\sin(2*\pi*t)$ .
- E379 — YACC internal stack overflow.  
For menu selection Equation, the equation is too complex for the parser to handle. Try simplifying the equation.
- E380 — Syntax error.  
For menu selection Equation, a syntax error was detected in the equation edit box. Acknowledge this error and you may get more specific information about the error.
- E381 — Missing variable (t), operator, or parenthesis.  
For menu selection Equation, the equation entered was either missing the variable t, an operator, or had mismatched parenthesis. Check the equation and try again.
- E382 — Maximum and minimum waveforms cannot be the same.  
When creating envelopes, you cannot specify the same waveform to be both the maximum limit and the minimum limit.
- E383 — Invalid number for the function [function name].  
The number entered as a parameter for the particular math function is invalid. For example "sqrt (0)", is invalid.
- E384 — Acquisition-Only instrument, cannot be selected as the target instrument.  
Instruments marked with an "\*" in the **Change/Configure Instrument** dialog box are acquisition-only and cannot be made the target instrument. You are not able to send data to these instruments, you can only acquire data.

## Warning Messages

### W400 — Replace existing [filename] file?

This warning tells you that the selected output file already exists and allows you to confirm that you want to replace it. Enter 'Y' to replace the existing file and 'N' to cancel the operation.

### W401 — [filename] has changed. Do you wish to save?

For menu selection **ClearWaveform(s)**, if you choose to clear a waveform which has changed and not been saved, you are given the opportunity to save it first. Enter 'Y' to save it, or 'N' to not save it. You are also given this option when you exit **WaveWriter** and memory waveforms which have been created or altered have not been saved.

### W402 — Configuration values changed but not saved. Exit still?

This is a reminder that for the **Configure/ChangeInstrument** menu selection, you changed values for the highlighted entry, but didn't choose either Add or Replace to update them. Enter 'Y' if you don't want to change them; enter 'N' if you want to return to the dialog box to perform the desired operation.

### W403 — Sequence is not saved. Do you wish to save it?

For menu selection Sequence, you chose to exit the menu selection without having saved the information you entered. You are warned and given the opportunity to save it. Enter 'Y' to save it or 'N' to not save it.

### W404 — Unknown FORMAT type — ASCII used.

For menu selection Open, an ADIF file was read for which the FORMAT field was invalid. ASCII was assumed.

### W405 — Attempt to divide by zero.

For menu selection Divide, one or points of the divisor waveform was zero. Instead, **WaveWriter** uses the smallest nonzero adjacent data point. If all adjacent points are 0, it divides by 1.

### W406 — SYSTEM LIMITS EXCEEDED! Resultant waveform was clipped at [value].

For either menu selection **AddScalar**, **Multiply by Scalar**, **Add Waveforms**, **SubtractWaveforms**, **MultiplyWaveforms**, or **Divide Waveforms**, the resultant waveform would have had a value which exceeded the system limits. The upper/lower bound value was assigned instead.

W407 — Unable to create Undo buffer. 'Undo' will not be available.  
Select OK to continue anyway.

When attempting to preserve a copy of the waveform before altering it, insufficient disk space was available. You are asked if you still want to proceed with the operation that will change the waveform. Select OK if you wish to proceed; Cancel otherwise. To free up the necessary disk space, you may wish to delete unneeded files.

W408 — Current display amplitude is too large for selected target instrument.  
Display amplitude will be adjusted.

For menu selection **Change/ConfigureInstrument**, you changed the target instrument and the current vertical axis range now exceeds the maximum allowed for the target instrument. The vertical axis will be adjusted to the maximum allowed for the target instrument. Waveforms will be clipped on the display, but no data is lost.

W409 — Full autoscale needs a display amplitude which is too large for the target instrument. Display amplitude will be adjusted to the maximum possible.

When attempting to autoscale the current waveform, the waveform amplitude of the current waveform exceeded the maximum amplitude allowed for the target instrument. The viewport was adjusted to the maximum allowed for the target instrument. The waveform will be clipped on the display. No waveform data is lost.

W410 — One or more waveforms have a clock rate different from the sequence clock rate.

This warning appears when all waveform clock rates are not equal to the sequence clock. The clock rates should be the same when sending the sequence to the instrument. To correct the problem, use **Change Clock Rate** and then use **Save** to save the waveform with the new clock rate.

W411 — The path in [fully specified filename] will be ignored.

You entered a path with the filename in response to a filename edit box. The path was ignored. Either change the default path via the **Open** menu selection, or specify the path when you save the file.

## AFG 5101 Error Messages

E1000 — Error acquiring waveform from AFG 510115501.

An error was detected when acquiring a waveform from the AFG 510115501. Check the GPIB cables to see that they are securely attached and try again.

E1001 — Error sending waveform to AFG 510115501.

An error was detected when sending a waveform to the AFG 510115501. Check the GPIB cables to see that they are securely attached and try again.

E1002 — All addresses searched. No AFG 510115501 found.

All primary addresses were checked for the presence of an AFG 510115501 and none was found. Check the GPIB cables to see that they are securely attached and try again.

E1003 — Current clock rate is invalid for AFG 510115501.  
Accept upper limit of 999.9S?

A clock rate which is above the upper limit for the AFG 510115501 was entered. The acceptable range is: 100nS to 999.9S. You are offered the opportunity to change it to the upper limit.

E1004 — Current clock rate is invalid for AFG 510115501.  
Accept lower limit of 100nS?

A clock rate which is below the lower limit for the AFG 510115501 was entered. The acceptable range is: 100nS to 999.9S. You are offered the opportunity to change it to the lower limit.

E1005 — Invalid amplitude 1 offset pair for AFG 510115501.

The amplitude/offset combination entered when sending a waveform to the AFG 510115501 is outside of the acceptable limits. The amplitude and offset must conform to the following relationship:

$$\text{Amplitude} / 2 + \text{Offset} = \text{Absolute peak amplitude} + \text{offset into 50 Ohms}$$

<b>AmplitudeRange</b>	<b>Peak Amplitude + AbsoluteOffset into 50 Ohms</b>	<b>Resolution into 50 Ohms</b>
1V—9.99V	4.99V	10mV
0.1V—0.999V	0.499V	1mV
0.01V—0.099V	0.049V	1mV



**E1 006** — Waveform exceeds limit for AFG 51 01 15501.  
Must be less than or equal to **8192**.

When attempting to send a waveform to the AFG 5101, the waveform size was greater than the maximum record length of 8192. Use markers to segment off a section which is the appropriate size, and choose to send only the portion of the waveform between the markers.

**E1 007** — AFG 5101/5501 does not support envelope waveforms.

You attempted to either save an instrument specific file or send the waveform to the AFG 5101/5501 and the current waveform is an envelope. The instrument does not support envelopes. You may want to use **Envelope Decouple** to break the envelope into 2 components and send/save them individually.

**E1008** — Number of points to send + Beginning Address exceeds **8192**.

When attempting to send a waveform to the AFG 510115501, the Beginning Address specified plus the number of waveform points selected exceeds the maximum record length of 8192. Either change the Beginning Address to a smaller value, or move the markers to change the number of points of the waveform to send.

## 2200 DSO Error Messages

E1300 — Error acquiring waveform from 2200 DSO.

An error was detected when acquiring a waveform from a 2200 DSO. Check the GPIB cables to see that they are securely attached and try again.

E1301 — All addresses searched. No 2200 DSO found.

All primary addresses were checked for the presence of a 2200 DSO and none was found. Check the GPIB cables to see that they are securely attached and try again.

E1302 — XY Mode is not supported.

Waveform data stored in the *Vertical Mode 'XY'* cannot be read into **WaveWriter**.

E1303 — Reference memory [number] empty.

There is no waveform in the selected reference memory.

## 2400 DSO Error Messages

**E1100 — Error acquiring waveform from 2400 DSO.**

An error was detected when acquiring a waveform from a 2400 DSO. Check the GPIB cables to see that they are securely attached and try again.

**E1101 — Error sending waveform to 2400 DSO.**

An error was detected when sending a waveform to the 2400 DSO. Check the GPIB cables to see that they are securely attached and try again.

**E1102 — All addresses searched. No 2400 DSO found.**

All primary addresses were checked for the presence of a 2400 DSO and none was found. Check the GPIB cables to see that they are securely attached and try again.

**E1103 — Data has more than 1024 points.  
Too large for 2400 DSO record length.**

When attempting to send a waveform to the 2400 DSO, the waveform size was greater than the maximum record length of 1024. Use markers to segment off a section which is of the appropriate size, and choose to send only the portion of the waveform between the markers.

**E1104 — Number of points to send + Start At value exceeds 1024.**

When attempting to send a partial waveform to the 2400 DSO, the starting address specified plus the number of points between the markers exceeds the maximum record length of 1024. Either change the starting address to a smaller value, or move the markers to change the number of points of the waveform to send.

**E1105 — 2400 DSO cannot run at clock rates slower than 0.1 sec/point  
(5.0 sec/div). Is 0.1 sec/point acceptable?**

A clock rate which is too slow for the 2400 DSO was entered. For 2440's, the acceptable range is 40 pico-seconds/point to .1 seconds/point. For all other 2400 DSO's, the acceptable range is 100 pico-seconds/point to .1 seconds/point. Both clock rates must conform to a 1, 2, 5 sequence. You are offered the opportunity to change it to .1 seconds/point.

## 2400 DSO Error Messages

**El 106** — Too slow for the **2400** external clock. Accept lower limit of 1  $\mu$ S/point?

The clock rate entered is invalid for the 2400 DSO with an external clock. You are offered the opportunity to change it to the lower limit shown.

**El 107** — Too fast for the **2400** external clock. Accept upper limit of 10 nS/point?

The clock rate entered is invalid for the 2400 DSO with an external clock. You are offered the opportunity to change it to the upper limit shown.

## VX5790 Error Messages

E1200 — Error sending waveform to VX5790.

An error was detected when sending a waveform to the VX5790. Check the GPIB cables to see that they are securely attached and try again.

E1201 — No VX5790 AWG found at address [address].

When attempting to communicate with the VX5790 AWG, the instrument was not found at the shown address, i.e. the address specified in the **Change/ConfigureInstrument** menu selection.

E1202 — VX5790 does not support envelope waveforms.

You attempted to either save an instrument specific file or send the waveform to the VX5790 and the current waveform is an envelope. The instrument does not support envelopes. You may want to use **EnvelopeDecouple** to break the envelope into 2 components and send/save them individually.

E1205 — VXI communication error.

Unable to communicate over the VXI bus. Check that the logical address is correct, that the jumpers in the mainframe are properly set, and that the instrument is fully plugged into the mainframe.

W1203 — Current clock rate was not valid for the VX5790 and was changed to the nearest valid rate of [new rate].

For **Configure/ChangeInstrument**, you changed the target instrument to the VX5790, but the current clock rate is not one of the valid rates for the VX5790. The clock rate is changed to the nearest valid rate as shown in the message.

W1204 — Waveform size is greater than one packet. Multiple packets will be created. Do you wish to continue?

When the waveform size is greater than the maximum packet size, (2048), **WaveWriter** uses the VX5790 CURVE command. This command uses sequential packets to hold the waveform data and will automatically generate a sequence to execute the waveform. The specified packet index is used as the starting location for the packets, and the specified sequence index is used to hold the sequence. Existing packets in the VX5790 within the range of the CURVE command will be overwritten.

## VX5260 Error Messages

E1500 — Error acquiring waveform from VX5260 Digitizer.

An error was detected when acquiring a waveform from a VX5260 digitizer. Check the GPIB cables to see that they are securely attached and try again.

E1501 — All addresses searched. No VX5260 digitizer.

All primary addresses were checked for the presence of a VX5260 digitizer and none was found. Check the GPIB cables to see that they are securely attached and try again.

E1502 — VXI communication error.

Unable to communicate over the VXI bus. Check that the logical address is correct, that the jumpers in the mainframe are properly set, and that the instrument is fully plugged into the mainframe.

E1503 — VXI message delivery system (MDS) not loaded.

The message delivery system required for the VX5530/VX5535 has not been loaded. See the VX5530/VX5535 User's Manual for installation procedures.

W1550 — No data in the VX5260 for this record location.

W1551 — No record location specified. Please enter a number in the Record Loc edit box.

The number entered must be between 1 and 128.

W1552 — Start plus count exceeds the VX5260 record length. Need to decrease start and/or count.

W1553 — Size of data transfer greater than *WaveWriter* limit of 32767. Need to set count to 32767 or less.

W1554 — Invalid count. Please enter a number greater than 1 for count.

---

## 11000 Series DSO Error Messages

**E1 400** — All addresses searched. No 11K or DSA found.

All primary addresses were checked for the presence of an 11K DSO or DSA and none were found. Check the GPIB cable to see that they are securely attached and try again.

**E1401** — Error acquiring waveform from 11K DSO.

An error was detected when acquiring a waveform from an 11K DSO or DSA. Check the GPIB cables to see that they are securely attached and try again.

**E1 402** — Error acquiring preamble from 11K DSO.

An error was detected when acquiring the preamble from an 11K DSO or DSA. Check all GPIB connections and try again.

**E1403** — **GPIB** error: Unable to communicate with device at address [number].

Unable to communicate on the GPIB bus. Check that all cables are securely attached and try again.

**E1 404** — No valid sources available.

There are no traces defined and there are no stored waveforms. Apply an input source to the scope and try again.

**E1 405** — Invalid source selected.

The waveform selected to transfer is no longer available on the scope. Check the available sources and try again.





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Tektronix, Inc.  
Measurement Systems Division  
P.O. Box 500  
Beaverton, Oregon 97077

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