

WaveMaker User Guide

GIGA-TRONICS 2400 SERIES WAVEMAKER SOFTWARE



Preface

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Giga-tronics **WaveMaker** User Guide for Windows 2000, Windows XP

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About This Book

The **WaveMaker** User Guide is for users of Giga-tronics **WaveMaker** software and the 2400 Series Microwave Synthesizer. Part I, you'll learn the basic windows, menus, and tools of the **WaveMaker** software.. Part I also provides the requirements for installing and properly configuring the software with your 2400 Synthesizer. Part II, provides information on the **WaveMaker** Service menu and also provides detailed information for programmers, such as the **WaveMaker** Auto-Programming feature for SCPI and Native.

Introduction

Welcome to **WaveMaker**-- the complete remote operating system for Giga-tronics 2400 Series Microwave Synthesizer. **WaveMaker** is a powerful, yet easy to use software application designed for remote operation and enhanced user interface of your new 2400 Microwave Synthesizer. **WaveMaker** gives you unparalleled ease of use with a feature set and intuitive interface to perform quick measurements and advanced capabilities.

WaveMaker works by establishing connections with your 2400 Series Synthesizer. **WaveMaker** is simple to operate. With just a few clicks of the mouse, you can download lists, and set up and modify parameters. There's no need for extensive product training because **WaveMaker** leverages industry-leading software applications and familiar Windows drop-down menus and other functions to perform tasks. Using any Windows-based application, such as Microsoft™ Excel or Notepad, you can create, manage and download complex lists in a matter of seconds-right from the comfort of your desktop PC. And integration is a snap. **WaveMaker** uses an RS232/USB interface to quickly align with existing desktop PC applications.

WaveMaker provides many features such as CW operation, List mode support, Auto-Programming, and remote command traffic monitor.

Understanding WaveMaker's Interfaces

WaveMaker delivers a comprehensive programming and control environment for 2400 Microwave Synthesizer users. Combining multiple interface features, **WaveMaker** ensures increased productivity and reduced integration time. **WaveMaker's** interfaces include a soft front panel and a remote command interface using SCPI and Giga-tronics Native command syntax.

Package Contents & System Requirements

The **WaveMaker** software package includes the following software and documentation:

- **WaveMaker** CD-ROM
- USB Port Adapter and USB driver software (included in **WaveMaker** CD).
- **WaveMaker** User Guide (Part #33216)

The **WaveMaker** CD contains everything you need to install and run the **WaveMaker** application, such as the **WaveMaker** Installer, the USB device, and the help document files.

For information about the software and hardware you need to use **WaveMaker**, see the Install ReadMe file on the CD.

To install and run **WaveMaker** software and use the USB Port adapter, you must have the following hardware and software:

- An IBM-compatible PC
- Microsoft Windows 2000, or Window XP
- CD-ROM drive, 4X or better
- USB V.1.1 compliant port
- At least 20MB of disk space
- 128 MB RAM or greater recommended
- National 2400s IEEE-488.2 GPIB Interface Card

Installation and Uninstallation

To install WaveMaker software, follow the steps below:

- 1 Insert the **WaveMaker** CD into the **CD/DVD** drive.
- 2 Click on My Computer and select the drive with the **WaveMaker** CD.
- 3 Double click the **WaveMakerInstall_XXX.exe** file.

The Welcome Screen Appears:



- 4 Click **NEXT**.
 - 5 The **WaveMaker** installation process will begin.
 - 6 The Setup program begins installing the **WaveMaker** software.
 - 7 In the **Choose WaveMaker destination location dialog**, select the location where you want the **WaveMaker** software to be installed.
 - 8 Click **NEXT** to accept the default location (recommended)
- OR
- 9 Enter the directory location where you want the **WaveMaker** software to install and then click **NEXT**.
 - 10 In the **Setup Type** dialog box, select the type of installation you would like to perform and then click **NEXT**.
 - **Full Setup Type** installs all the required **WaveMaker** files (recommended).
 - **Custom Setup Type** allows you to choose which components you would like to install.
 - 11 When the **WaveMaker** Installation is complete, the **Setup Complete** dialog box appears. Click **FINISH**.
 - 12 After **WaveMaker** has successfully installed onto your PC, you can click **FINISH** or continue with the USB Driver installation.

Installing the USB Device and Drivers:

The USB to Serial Cable Port Adapter provides you the simplest way to attach your Notebook or Desktop computer to the 2400 Series Microwave Synthesizer. This ultra portable expansion cable directly connects to your computer via a Universal Serial Bus (USB) port. This section of the WaveMaker user's guide describes how to connect the adapter to your computer, install software and hardware drivers, and attach and configure devices.

To use the USB Port Adapter, you must first install the USB Port Adapter driver software onto your computer. Then, you can connect it to your computer and install the hardware drivers for the adapter's port(s).

WARNING: YOU MUST INSTALL THE DRIVER SOFTWARE BEFORE CONNECTING THE ADAPTER TO YOUR COMPUTER. OTHERWISE, THE ADAPTER WILL NOT WORK PROPERLY.

Installing the USB Driver with WaveMaker Installation

- After WaveMaker has installed, click Install USB
- Follow the instructions for the next screens

You must restart your computer for the USB Adapter driver to function. You can restart your PC immediately or at a later time.

USB Driver Installation from the WaveMaker Directory

If the USB Adapter driver was not installed at the time of the WaveMaker installation, it can be installed from the WaveMaker directory.

- Using the Windows Explorer, locate the WaveMaker directory
- Select the USB Driver folder and open
- Double click on the Setup.exe file and begin the USB driver installation

Starting WaveMaker

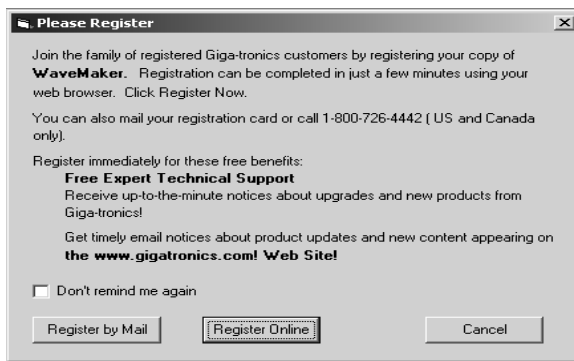
You start **WaveMaker** just as you would any software application.

To start **WaveMaker** in Windows: Choose **START > PROGRAMS > Giga-tronics > WaveMaker**. The **WaveMaker** registration window will appear.

Registering WaveMaker

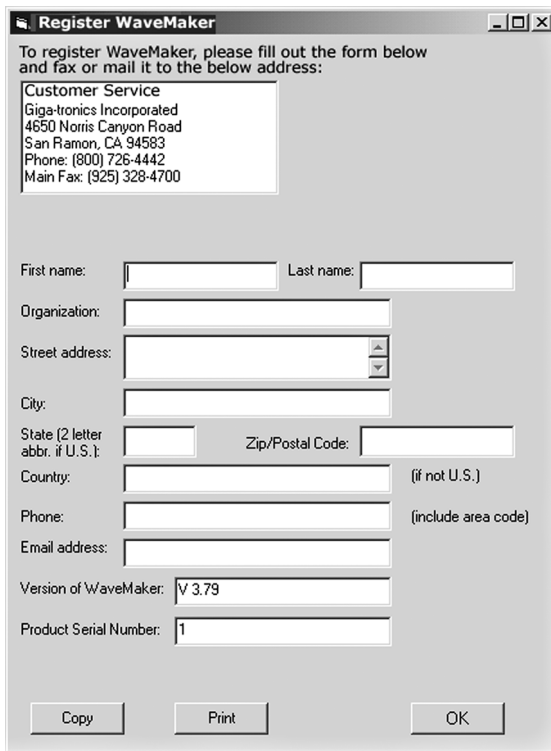
Registering your software helps Giga-tronics offer technical support and inform you about new software developments. You can register quickly by using the registration screen that appears when you first start **WaveMaker**. In addition, you can choose to register at any time by choosing **HELP > REGISTER WAVE-MAKER**. This registration requires that you be connected to the Internet, as it opens the Giga-tronics registration Web page. You can also register by phone, mail or email. Please refer to Preface, “Contacting Giga-tronics”.

- Click **REGISTER ONLINE**, to register your **WaveMaker** software online
- OR
- Click **REGISTER BY MAIL**, to register your **WaveMaker** software by mail.
- Register your software to receive notification of product updates and to be eligible for technical support.
- When finished registration, click **CONTINUE**.



Registering by mail or Fax:

- Open **HELP> REGISTER BY MAIL**. The **WaveMaker** registration by mail dialog box appears.
- Enter your name, address, phone, and fax in the edit boxes provided, and click **OK** when finished to return to the
- Click the **PRINT REGISTRATION FORM** button. **WaveMaker** prints out a copy of your completed registration form.
- Fax the form to Giga-tronics at the number that appears on the form, or mail it to the Giga-tronics address that appears on the form.



The image shows a Windows-style dialog box titled "Register WaveMaker". It contains a text area with contact information for Giga-tronics, several input fields for user information, and three buttons at the bottom.

Register WaveMaker

To register WaveMaker, please fill out the form below and fax or mail it to the below address:

Customer Service
Giga-tronics Incorporated
4650 Norris Canyon Road
San Ramon, CA 94583
Phone: (800) 726-4442
Main Fax: (925) 328-4700

First name: Last name:

Organization:

Street address:

City:

State (2 letter abbr. if U.S.): Zip/Postal Code:

Country: (if not U.S.)

Phone: (include area code)

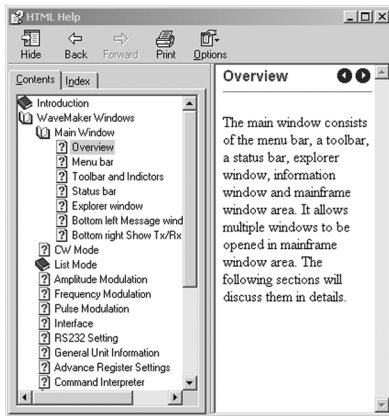
Email address:

Version of WaveMaker:

Product Serial Number:

Getting Help

WaveMaker includes complete documentation in the Help section located on the menu bar under Help, including all the information in this user guide, plus tutorials.



To get Help about WaveMaker:

- 1 On the **WaveMaker Main** window, click the **HELP** drop down menu.
- 2 The list of Help topics appear.
- 3 You can use the **CONTENTS** tab in **HELP** to find topics grouped by subject, or use the **INDEX** tab or **FIND** tab to search for information by typing in a subject, title, or specific word or phrase.
- 4 To return to the list of topics after reading about a specific topic, click **HELP TOPICS**.

Removing the USB Driver

Conflicts with other USB/RS-232 drivers can occur if a similar driver is already installed or is going to be installed. It is recommended that the same Make and Manufacturer USB adapter be used on your PC only. To remove the USB Adapter driver, perform the following:

- Using Windows Explorer, locate the **WaveMaker** directory.
- Select the USB Driver folder and open.
- Double click on the **Setup.exe** file and begin the USB driver installation

The installation utility will recognize that a USB adapter has previously been installed. The installation utility will ask if you want to remove the driver.

Uninstall WaveMaker

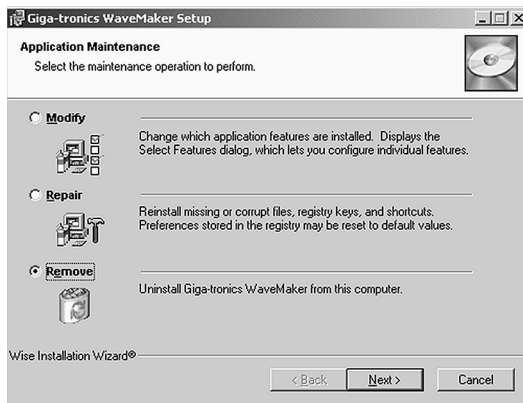
To uninstall WaveMaker from your computer, do either of the following:

Click the **WINDOWS > START** button and choose **SETTING > CONTROL PANEL**. In the control panel, click **ADD/REMOVE PROGRAMS**. In the **ADD/REMOVE PROGRAMS** properties dialog box, select **WaveMaker** and click **ADD/REMOVE**.

OR

- 1 Insert the **WaveMaker** CD into CD drive.
- 2 Double click on the **WaveMaker** Installation program.

Click on the "Uninstall Giga-tronics **WaveMaker** from this computer" selection and click **NEXT** continue.



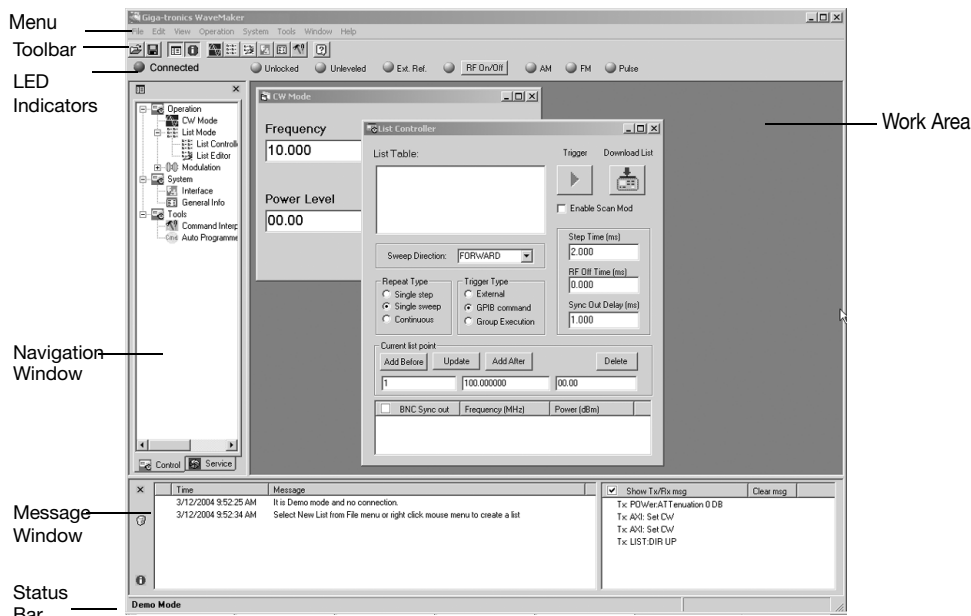
CHAPTER 2

Looking at the Work Area

This chapter introduces you to the **WaveMaker** software, familiarizes you with the software structure, and provides you with the basic procedures, menus, and windows you need to know to use **WaveMaker**.

Getting familiar with the work area

The **WaveMaker Main** window appears automatically when the software is launched. The **Main** window is easy to understand and use. The **Main** window consists of a menu bar at the top of the work area, a toolbar below the menu bar, a large work area, a navigation window, a message display window and a status bar located at the bottom. The large work area provides an area for the multiple **WaveMaker** windows to open in. The following illustration labels each area of the **WaveMaker Main** window.



Menu Bar

The Menu bar is the **WaveMaker** command center. The Menu bar contains menus and drop down submenus of all the commands available in **WaveMaker**. The menus will change depending on what window you are currently in.

File Menu

The file menu is active only when the List Controller window is open.

Open	Opens a saved file into the Main work area.
New List	Creates a list in the List Controller window.
Save List	Saves the current list in the List Controller window to a file.
Save List As	Saves the current list in the List Controller window to a new file.
Close List	Closes the current list.
Close All Lists	Closes all the lists.
Exit	Exits the WaveMaker Software program.

Edit Menu

Cut	Cuts the contents of the current selection to the clipboard.
Copy	Copies the contents of the current selection to the clipboard.
Paste	Pastes the clipboard information into the selection.

View Menu

Toolbar	Turns the WaveMaker toolbar ON/OFF.
Status Bar	Turns the WaveMaker status bar ON/OFF.
Navigation Window	Show/Hide the Navigation window.
Message Window	Show/Hide the Message window.
Web Browser	Opens the Microsoft Explorer web browser.

Operation Menu

CW Mode	Opens the CW Mode window saved file into the Main work area.
List Mode	Displays the Operations windows.
List Controller	Opens the List Controller window
List Editor	Opens the List Editor window.
Modulation	Displays the Modulation windows. (2400M Series Only)
AM Modulation	Opens the Amplitude Modulation window.
FM Modulation	Opens the Frequency Modulation window
Pulse Modulation	Opens the Pulse Modulation window.
Scan Modulation	Opens the Scan Modulation window.

System Menu

Interface	Opens the Connection Interface Window. This option is only available when navigating in the Control tab.
General Information	Opens the General Information window. This option is displayed when navigating in the Control tab.
Calibration	Opens the Calibration Window if you have purchased the Calibration option. This option is displayed when navigating in the Service tab.
Option Setting	Opens the Option Setting Window. This option is only available when navigating in the Service tab.

Tools Menu

Command Interpreter	Opens the Command interpreter window.
Auto-Programmer	Opens the Auto Programmer window.

Windows Menu

Close All	Closes all open windows.
Cascade	Arranges all windows into a stack, with each window offset slightly.
Tile Horizontal	Arranges all windows to overlap horizontally.
Tile Vertical	Arranges all windows to overlap vertically.
Arrange Icons	Lines up minimized windows along the bottom of the main WaveMaker pane.

Help Menu

Help Topics	Displays the Help Menu.
Register Online	Opens Giga-tronics web site for on-line registration.
About	Displays the WaveMaker software version and the update data information.

Toolbar

The toolbar contains buttons that operate as shortcuts to menu commands. Below is a description of each button and what the button controls. The **WaveMaker Toolbar** allows you to set up the **WaveMaker** Operations window. Common features provided in the Menu bar drop down menus, can also be selected by clicking on the appropriate icon on the **Toolbar**. The **Toolbar** also displays status LED indicators.



Icon	Name	Description
	Open Folder	Opens a list file.
	Save	Saves a list to a file.
	Navigation Window	Show/Hide the Navigation window.

	Message Display	Opens and closes the Message Display Area.
	CW Mode	Opens the CW Mode window.
	List Controller	Opens the List Controller window.
	List Editor	Opens the List Editor window.
	AM Modulation	Opens the AM Modulation window.
	FM Modulation	Opens the FM Modulation window.
	Pulse Modulation	Opens the Pulse Modulation window.
	Scan Modulation	Opens the Scan Modulation window.
	System Interface	Opens the System Interface window.
	General Info	Opens the General Information window.
	Command Interpreter	Opens the Command Interpreter window.



Help

Opens the Help Menu.

To identify a tool or control:

Position your mouse pointer over a tool or control and pause. A tool tip appears showing the name and keyboard shortcut (if any) for the item.

To select a tool:

Click its icon in the toolbar.

LED Indicators

The LED indicators ensure and deliver testing confidence. The status LED indicators displays the conditions of the communications link between the controller and the 2400, the Lock and Level condition of the current RF setting, the source of the synthesizer time base reference, and the state of the RF output.

Control of the output is also located on the **LED Indicator Toolbar**. The toggle control is used to enable or disable the generator output.

Click the **RF On/Off** button to enable and disable the RF output.



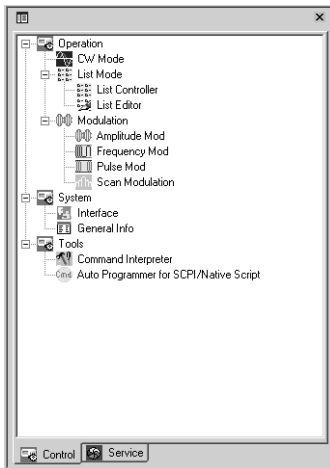
Item	Description
A. Connected LED	A green LED indicates that WaveMaker has established Communication with the 2400. A red LED indicates WaveMaker is not communicating with the 2400.
B.Unlocked LED	Displays Unlock status. A gray LED (normal mode) indicates the frequency is locked. A yellow LED (warning mode) indicates that the frequency is unlocked.
C.Unleveled LED	Displays Unlevel status. A gray LED (normal mode) indicates that the power is leveled. A yellow LED (warning mode) indicates that the power is unleveled.
D.External Reference LED	Displays the External Reference status. A blue LED (normal mode) indicates that an external reference is detected and the 2400 is locked to it. A gray LED (warning mode) indicates that there is no external reference.
E. RF ON/OFF Box	Turns RF On/Off A blue LED indicates the RF is on. A gray LED indicates the RF is off.
F. AM LED	Displays the AM status. A gray LED indicates that the amplitude modulator is off. A green LED indicates that the amplitude modulator is on.
G. FM LED	Displays the FM status. A gray LED indicates that the frequency modulator is off. A green LED indicates that the frequency modulator is on.

H. Pulse LED	Displays the Pulse status. A gray LED indicates that the pulse modulator is off. A green LED indicates that the pulse modulator is on.
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Navigation Window

The Navigation window provides a tree structure of **WaveMaker**. The Navigation window enables you to quickly navigate between the different **WaveMaker** control windows. The Navigation window consists of two separate tabbed menus, **Control** and **Service**. The control and service tabs are arranged by functionality. When an item is selected from the Navigation window, the corresponding window will open in the main work area. You can **SHOW** and **HIDE** the Navigation window at any time by selecting **VIEW>Navigation Window**.

The following sections provide a detailed description on the **Control** and **Service** Tab.



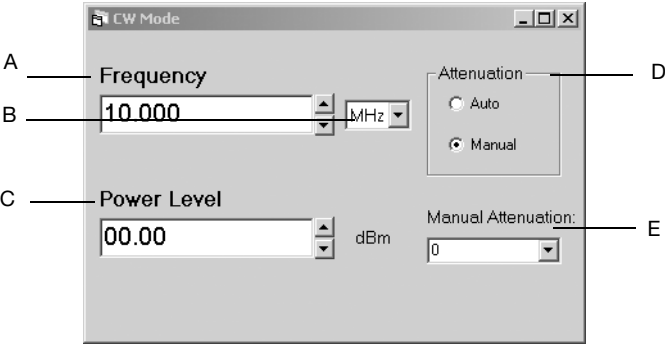
Control Tab

The **Control tab** is located on the bottom of the **Navigation window**. The **Control tab** allows you to switch between the **Navigation window** and the **Service window**. The Service window is an option based feature.

Operation Control Windows

CW Mode Window

The **CW Mode** window combined with the **List Controller** window provides a powerful combination for faster and more efficient synthesizer operation. Unlike the common front panel operation, the **CW Mode** leverages the streamlined Windows familiar environment, improving testing throughput and performance. In **CW Mode** you can set the frequency and power quickly with your mouse. Eliminate the tedious task of entering numbers individually from the front panel. With a click of your mouse, you can send commands directly to the 2400 effortlessly.



Item	Description
A. Frequency	Lets you input CW frequency directly or use the up/down arrow keys to change the value of the frequency.
B. Frequency Unit	Lets you select the units for frequency.
C. Power Level	Lets you input power directly or use the up/down arrow keys to change the value of the power.

D. Attenuation	This section controls the step attenuator state when option 26 is installed in the 2400 synthesizer. The attenuator can be set to automatically switch or to be controlled manually. The step attenuator has a 90 dB range and switches in 10 dB steps. The maximum settable range in automatic mode is -110 dBm to +25 dBm. The maximum settable range in manual mode is 40 dB.
Auto	Selecting auto attenuation causes the step attenuator to automatically switch at specific power levels for the full range of the synthesizer.
Manual	Selecting manual attenuation control prevents the step attenuator from automatically switching to a new state when a new power level is selected.
D. Manual Attenuation	Lets you select the manual attenuation value when the manual attenuation radio button is selected under Attenuation. After the manual attention radio button is selected you can then set the amount of attenuation using the Attenuation drop down box. In manual attenuation mode, the output power range will be limited to a 45 db settable range around the attenuator.

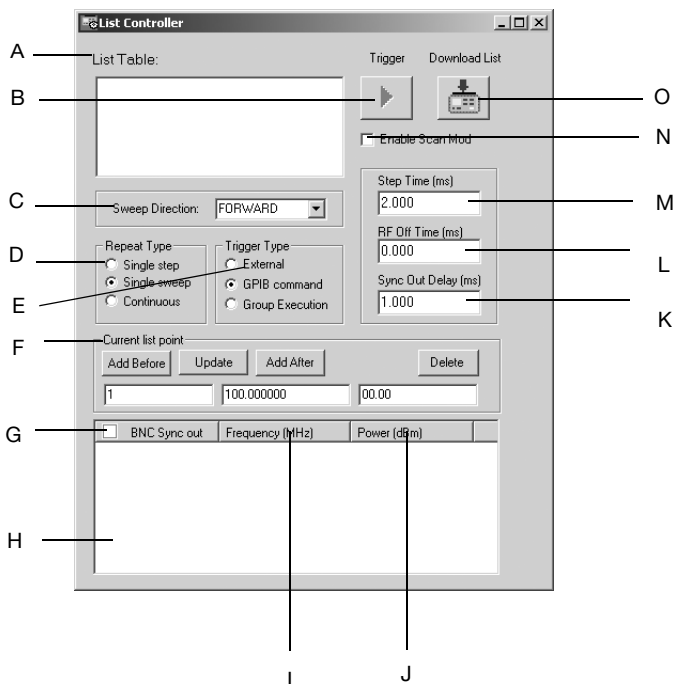
List Mode

The **List Mode** consists of two distinct list operation windows, the **List Controller** window and the **List Editor** window. Under **List Mode** you can utilize the **List Controller** window and **List Editor** window to create a new lists or load an existing list into the **WaveMaker** program. There is no limitation for the number of lists stored in **WaveMaker**, however only one list can be stored in the 2400.

List Controller Window

The **List Controller** window is used to manage and run lists. In the **List Controller** window, you can create a new list or open a file to load a list. The **List Controller** also allows you to specify how a list is executed by controlling features

such as step time, repeat mode and trigger type. The list can be edited using either this window or the **List Editor** window.



Item	Description
A. List Table	The list table displays all existing list names. Here you can select the current running list. You can also select a new list from the File Menu to add a new list file name to the box or right click your mouse button to add a new list name to the box. Select Open List from File Menu to add a list file name with the path to the box.
B. Trigger Button	Click to trigger the list. The type of trigger is defined by the trigger type.
C. Sweep Direction	Lets you set the direction of the list sweep. The list can be swept in forward or reverse direction

D. Repeat Type	Lets you set the repeat list mode parameters for the current list. This determines how a list will be executed. There are three repeat mode options to select from:
Single Step	Lets you execute the list one point at a time. Each point in the list is executed for each trigger received.
Single Sweep	Lets you execute the entire list for one trigger received.
Continuous	This option will immediately execute the current running list, repeating it indefinitely.
E. Trigger Type	Sets the type of trigger to initiate a list.
BNC	Sets the trigger type to BNC. A list will be triggered whenever a TTL signal is received at the external Trigger In BNC on the rear panel of the 2400.
GPIB Command	Sets the trigger type to GPIB. Clicking the trigger button will then issue a single 2400 trigger.
Group Execution	Sets the trigger type to Group Execution. Clicking the trigger button will trigger all 2400s on the GPIB bus.
F. Current List Points	The Current List Point field allows you to modify an individual list point in the active list.
Add Before	Lets you add a list point before the selected list item in the List Data Field.
Update	Lets you modify the frequency and power of the selected list item in the List Data Field. First, select the list point you would like to modify, then modify the frequency and power input parameters.
Add After	Click to add a list point after the selected list item in the List Data Field.
Delete	Click to delete the selected list point in the current list.
G. BNC Sync Out	BNC sync out can be set for every list point. (i.e, sync out pulse is generated in checked points).
H. List Data Field	Displays individual list point information of the active list.
I. Frequency	Lets you input a frequency value for a newly added list point. Frequency units are in MHz.

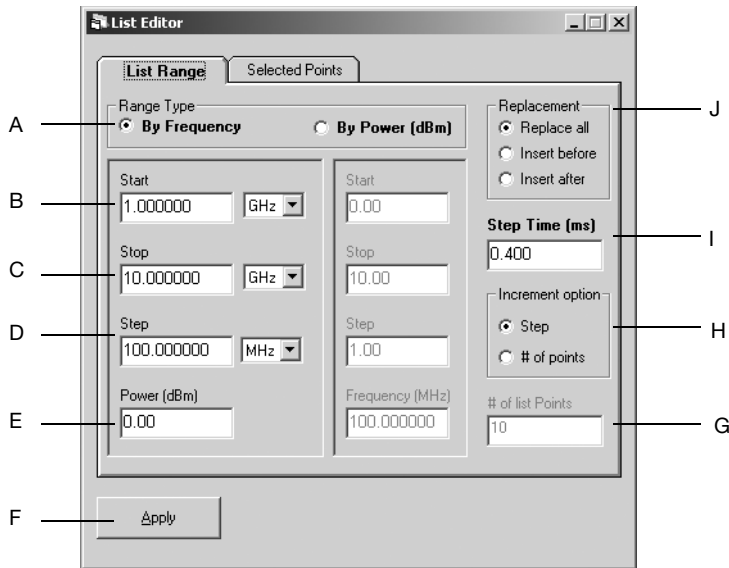
J. Power	Lets you input a power value for a newly added list point. Power units are in dBm.
K. Sync Out Delay	Sets the delay of the sync output. Units are in (ms).
L. RF Off Time (ms)	Sets the RF Off Time for each list point.
M. Step Time	Sets the step time for all list points. Units are in (ms).
N. Scan Modulation	.Checking this box extends programmable level range to greater than 40 dB.
O. Download List	Downloads the selected list to the 2400.

List Editor Window

The **List Editor** window provides a useful way to create or insert a range of list points to your current running list. The **List Editor** window contains two tabbed sets of controls: **List Range** and **Selected Points**. The **List Editor** edits the list that is currently selected in the **List Controller** window.

List Range Tab

Clicking on the **List Range** tab will open all the List Range controls. The **List Range** controls lets you add a range of points that step in value from a starting to an ending value. This range of points can be a frequency range at a specific power value or a power range at a specific frequency value. In addition, you can choose to add these points above or below or even to replace the point/s selected in the **List Controller** window.

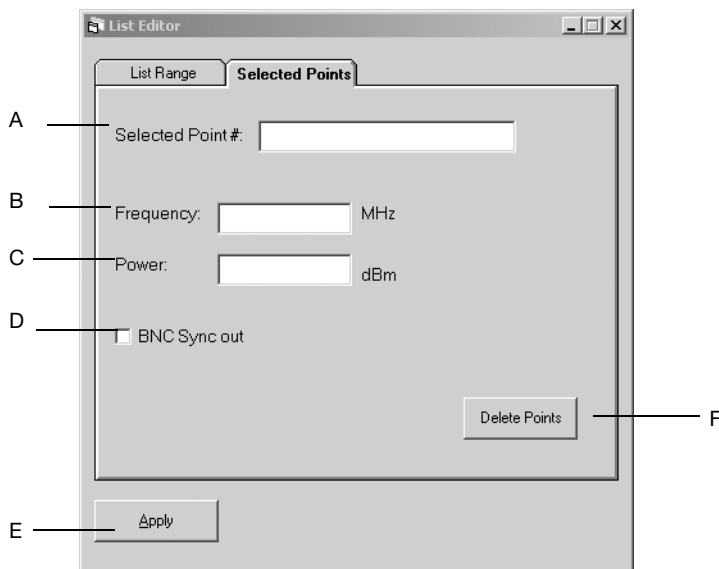


Item	Description
A. Range Type	Lets you create or insert a frequency or power list range.
B. Start Input Field	Lets you input the list range starting point.
C. Stop Input Field	Lets you input the ending list range point.
D. Step Input Field	Lets you input the step parameter for list creation.
E. Power/Frequency Input Field	Lets you set the power or frequency for all created list points.
F. Apply Button	Updates the current list with the new list range information.
I. Step Time (ms)	Sets the step time for all list points. Units are in (ms).

G. Replacement	Lets you select the replacement type for adding list Points. There are three list replacement options:
Replace	Selecting this option will replace your current running list with the newly configured list.
Insert Before	Selecting this option will insert the new range of list points before the selected list item in the List Data Field.
Insert After	Selecting this option will insert the new range of list points after the selected list item in the List Data Field.
H Step Time (ms)	Sets the step time for all list points. Units are in (ms).
I. Increment Option	Lets you insert list points by either step size or by the number of list points.
Step	Lets you specify the step size for list creation.
# of Points	Lets you specify the number of points for the list range. Wave-Maker determines the step size of the list using the following formula: $\frac{\text{STOP PARAMETER} - \text{START PARAMETER}}{\text{\# OF POINTS}}$
J. # of List Points	Lets you enter the number of list points for list range calculation.

Selected Point Tab description

Clicking on the **Selected Points** tab will display all of the Selected Point controls. The Selected Point controls enables you to alter the frequency and power values of the points selected in the **List Controller** window. You can also select or unselect BNC Sync Out for the selected points.



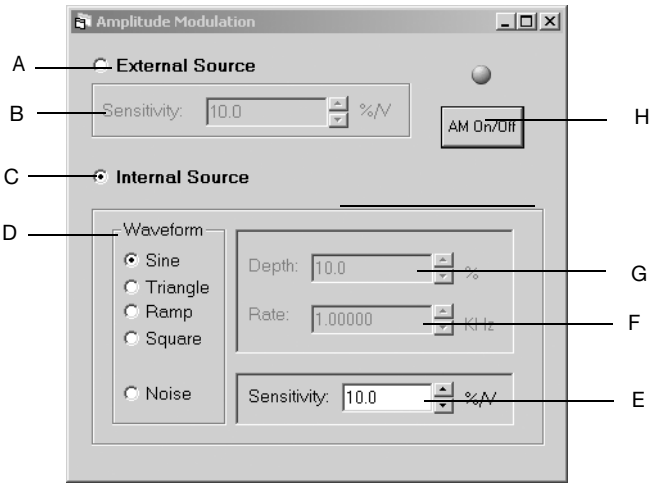
Item	Description
A. Selected Point #	Lets you select a list point(s) from the List Controller window and edit the frequency and power parameters
B. Frequency Input Field	Lets you set the frequency for the selected list point(s) in the List Controller window.
C. Power Input Field	Lets you select the power for the selected list point(s).
D. BNC Sync Out	Lets you set the BNC Sync Out for the selected point(s).
E. Apply	Applies the changes to the selected list point(s).
F. Delete Points	Deletes the selected point(s).

Modulation

Clicking on the Modulation Icon will expand the Modulation menu and display it's sub-items. An additional click will hide the Modulation sub-items.

Amplitude Modulation (AM)

Double clicking on the Amplitude Modulation icon will open the **Amplitude Modulation** window. The **Amplitude Modulation** window allows a user to enable or disable Amplitude Modulation. In addition the user can select an External or Internal Source. For an External Source the user can specify the AM Mode and the Scaling. For an Internal Source the user can specify the AM Mode, the Waveform, the Depth, and the Frequency.

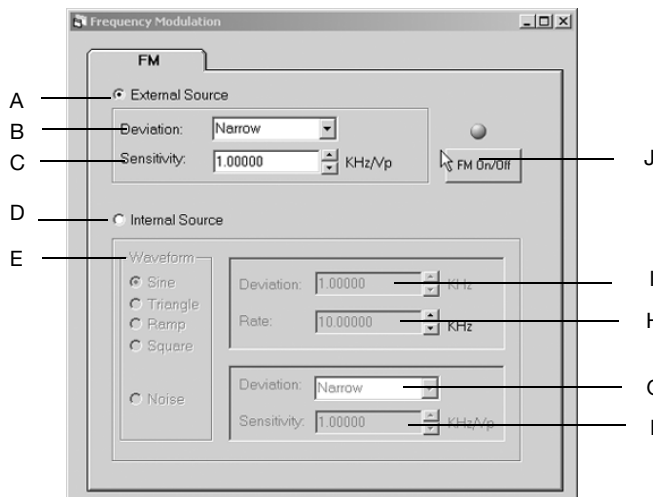


Item	Description
A. External Source	Enable external AM source. If external source is enabled, all internal related controls are gray out.
B.Sensitivity (External)	Adjust the value of external sensitivity
C. Internal Source	Enable internal AM source. If internal source is enabled, all external related controls are gray out.

D. Waveform	Select waveform option for internal AM. The available options are sine, triangle, ramp, square, and noise.
E. Sensitivity (Internal)	Adjust the value of internal sensitivity, and is only enabled when waveform is set to noise.
F. Rate	Adjust the value of internal Rate, and is only enabled when waveform is set to sine, triangle, ramp or square.
G. Depth	Adjust the value of internal depth, and is only enabled when waveform is set to sine, triangle, ramp or square.
H. AM ON/OFF	Turn AM On/Off

Frequency Modulation

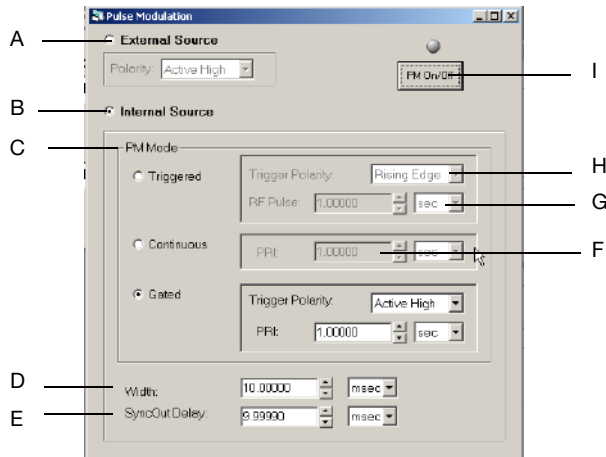
Double clicking on the Frequency Modulation icon will open the Frequency Modulation window. The Frequency Modulation window allows a user to enable or disable Frequency Modulation. In addition the user can select an External or Internal Source. For an External Source the user can specify the Deviation and the Sensitivity. For an Internal Source the user can specify the Deviation, the Waveform, the Sensitivity, and the Frequency.



Item	Description
A. External Source	Enable external FM source. If external source is enabled, all internal related controls are gray out.
B. Deviation (External)	Set external deviation to Narrow or Wide.
C. Sensitivity (External)	Adjust the value of external sensitivity
D. Internal Source	Enable internal FM source. If internal source is enabled, all external related controls are gray out.
E. Waveform	Select waveform option for internal FM. The available options are sine, triangle, ramp, square, and noise.
F. Sensitivity	Adjust the value of internal sensitivity, and is only enabled when waveform is set to noise.
G.Deviation	Adjust the value of internal deviation, and is only enabled when waveform is set to sine, triangle, ramp or square.
H. Rate	Adjust the value of internal Rate, and is only enabled when waveform is set to sine, triangle, ramp or square..
I Deviation	Set internal deviation to Narrow or Wide, and is only enabled when waveform is set to noise.
J. FM ON/OFF	Turn FM On/Off

Pulse Modulation

Double clicking on the Pulse Modulation icon will open the Pulse Modulation window. The Pulse Modulation window allows you to enable or disable Pulse Modulation. In addition, you can select an External or Internal Source. For an External Source, you can specify Polarity. For an Internal Source, you can specify the pulse width, sync out delay for Triggered, Continuous, and Gated modes. For each of these modes PRI, trigger polarity, and RF pulse can be specified depending on the mode of operation.

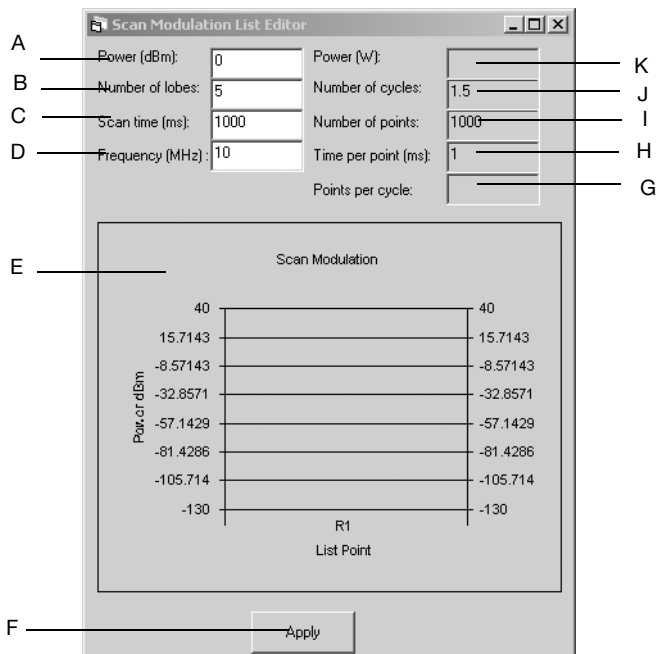


Item	Description
A. External Source	Enable external FM source. If external source is enabled, all internal related controls are gray out.
Polarity	Set external Polarity to either Active High or Low.
B. Internal Source	Enable internal PM source. If internal source is enabled, all external related controls are gray out.
C. PM Mode	Select between Triggered, Continuous, and Gated PM mode.
Triggered	Selecting this mode outputs one pulse per external trigger received following the sync delay.
Continuous	Selecting this mode outputs a continuous train of pulses specified by the PRI and pulse width parameters.
Gated	Selecting this mode outputs a burst of pulses specified by the PRI and pulse width parameters for the duration of the gating signal applied to the external trigger input.
D. Width	Adjust value of internal pulse width.
E. Syncout Delay	Adjust value of internal trigger delay.

F. PRI	Adjust value of internal trigger PRI.
G. RF Pulse	Adjust the pulse delay.
H. Trigger Polarity	Set the external trigger polarity to either Falling or Rising.
I. PM ON/OFF	Turns PM ON/OFF.

Scan Modulation

Double clicking on the Scan Modulation icon will open the Scan Modulation window. The Scan Modulation window will automatically create a Scan Modulation List. The user can specify the following items for Scan Modulation setup: Power, Number of Lobes, Scan Time, and Frequency. By clicking the Apply button a Scan Modulation List is generated, loaded into the List Controller, and displayed graphically.



Item	Description
A. Power (dBm)	.Set power in dBm.
B. Number of Lobes	Set the number of lobes in Scan.
C. Scan Time	Set the scan time.
D. Frequency (MHz)	Set frequency for the Scan.
E. Scan Modulation Graph	Display the waveform generated by the inputs
F. Apply	Apply all the input to create a list
G. Points per cycle	Display the number of points in every cycle
H. Time per point (ms)	Display the time taken for every point
I. Number of points	Display the number of list points generated in graph.
J. Number of cycles	Display the number of cycles in the graph.
K. Power (W)	Display power in W.

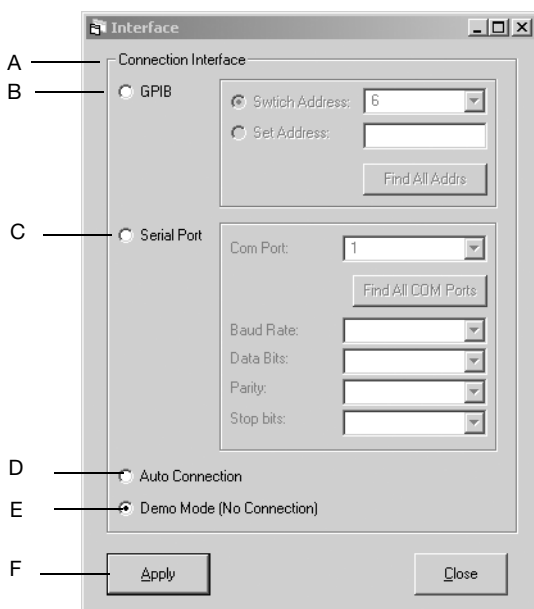
System Control Windows

Clicking the System icon in the navigation window will open the System menu with all of its icons displayed. An additional click will hide the System sub-items.

Interface Window

The **Interface** window allows you to set the communications interface between the PC and the 2400. You can choose between GPIB or RS-232/USB. You can choose a specific GPIB address or com port or you can allow **WaveMaker** to automatically detect the 2400 on any of the communication interfaces. Opening the **Interface** window can be performed two ways:

- Click on the **System** menu in the toolbar and select **Interface**.
- Click on the **System Interface** icon located on the toolbar or the **System Interface** icon located within the **Navigation** window.

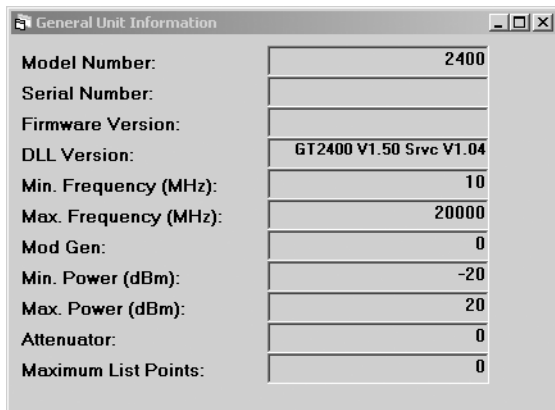


Item	Description
A. Connection Interface	Lets you select the cable connection used to connect your PC with the hardware device.
B. GPIB	Selecting the GPIB option will set the connection through the GPIB interface.
Switch Address	Lets you switch to another 2400 if it is connected to the PC via one of the communications interfaces
Set Address	Lets you change the GPIB address of the 2400 that is connected via the GPIB interface. You must click APPLY for the new address to be set.

C. Serial Port	You can select from COM 1 through 9. The COM port selection must be a valid port with a 2400 synthesizer connected to the port. The port connection can be an adapted USB/RS-232 or RS-232
COM Port	Lets you select the COM Port.
Baud Rate	Lets you select the baud rate. 115200, 38400, 19200 or 9600 baud rate can be selected. 115200 is the current default setting.
Data Bits	Lets you select the data bits. There are two options: 8 and 7. "8" is the current default setting.
Parity	Lets you select the data bits, which has three options: Odd, Even and None. "None" is the current default setting.
Stop Bits	Let's you select the data bits, which have two options: 1 and 2. "1" is the current default setting.
D. Auto Connection	This option automatically detects any 2400 synthesizer connected to the PC through the GPIB and/or RS-232. This feature can be used when the address or connection type to the 2400 is not known. This feature will take a few moments to search all available connections.
E. Demo Mode	WaveMaker will run in the demonstration mode as if a 2400 was connected to the controller. Some features such as Auto-Programming will not function because they require a 2400 to complete the communication process.
F. Apply	Clicking the apply button will apply the selected cable connection options.

General Information Window

The **General Information** window provides important information about your current 2400 Microwave Synthesizer. The **General Information** window describes your current model, serial information, current firmware version, and hardware specifications.



General Unit Information	
Model Number:	2400
Serial Number:	
Firmware Version:	
DLL Version:	GT2400 V1.50 Srvc V1.04
Min. Frequency (MHz):	10
Max. Frequency (MHz):	20000
Mod Gen:	0
Min. Power (dBm):	-20
Max. Power (dBm):	20
Attenuator:	0
Maximum List Points:	0

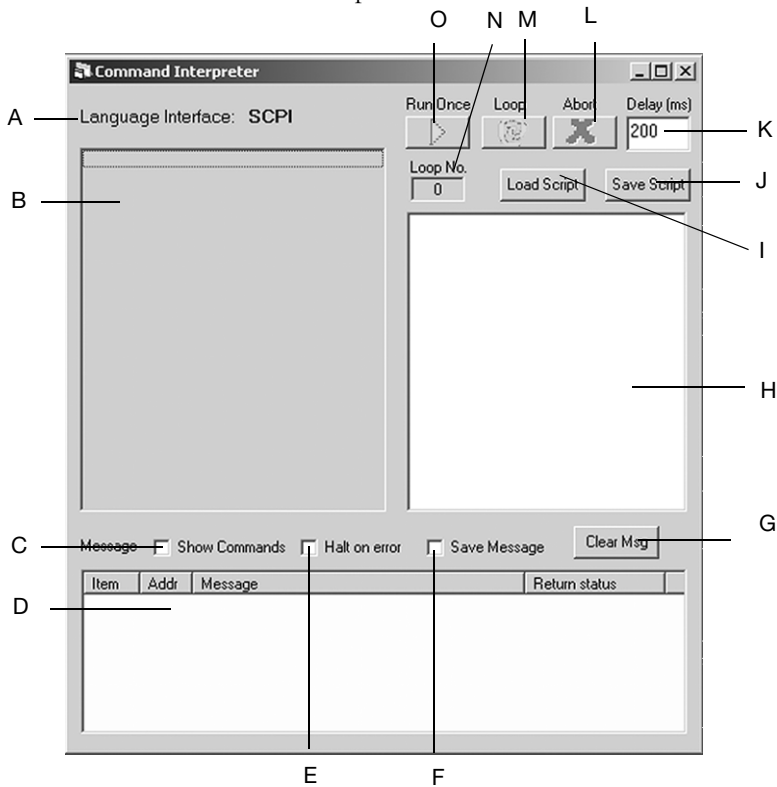
Tools Control Windows

Clicking the Tools icon in the navigation window will open the Tools menu with all of its icons displayed. An additional click will hide the Tools sub-items.

Command Interpreter Window

The **Command Interpreter** window allows you to directly input GPIB commands or load the script command(s) from a file and send the commands to the 2400. The commands in the **Command** window can be executed by double clicking on the command or by highlighting it and pressing the **ENTER** key. The commands can be executed in the order of input, starting with the command at the top of the **Com-**

mand Window. A sequence of commands in the **Command** Window can run once or in a continuous loop.

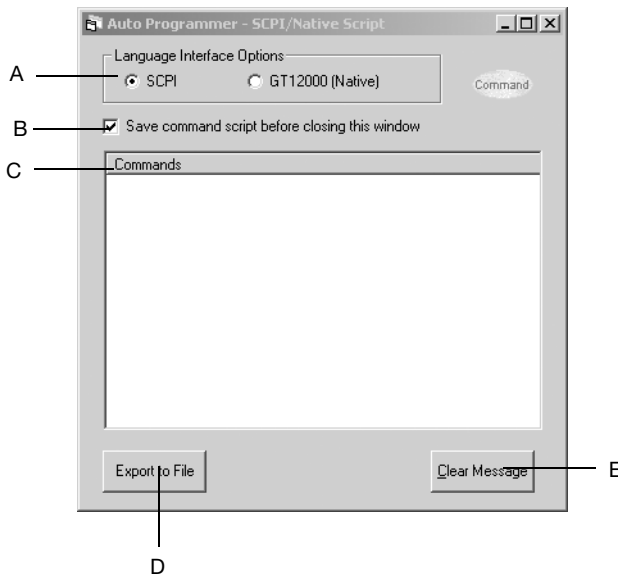


Item	Description
A. Language Interface Options	Lets you select between SCPI (Standard Commands for Programmable Instruments) or GT12000 command format.
B. Command Window	Displays function calls or commands. A double click on any of the commands in this window will send the selected command to the 2400.
C. Show Commands	Checking this box will display the sent command before the returned message.

D. Message	This window displays all the returned messages from the 2400. If the “Add Command” checkbox is checked, this feature will then display both the command and the returned message for the corresponding command.
E. Halt on Error	Checking this box will stop the execution when an error is detected.
F. Save Message	Checking this box lets you save the returned message to a file.
G. Clear Message Button	Clicking this button clears all the returned messages.
H. Command Entry	Lets you add new commands to the Command window. Text entered in this window is automatically copied to the Command window.
I. Load Script	Lets you load script(s) to the Command window from a file.
J. Save Script	Lets you save the script in the Command window to a file.
K. Delay Field	Allows you to set a delay time between commands in the Command window.
L. Abort Button	Pressing this button will abort the looping feature. Only enabled when the “Loop” button is clicked.
M. Loop	Lets you execute the sequence in the Command window continuously.
N. Loop No. Field	Displays the number of loops executed.
O. Run Once	Clicking this button executes the command sequence in the Command window, starting from the first command or from the selected command to the end.

Auto-Programmer for SCPI/Native Script

Double clicking on the **Auto Programmer for SCPI/Native Script** icon will open the **Auto Programmer** window for SCPI/Native Script. As long as the Auto Programmer for SCPI/Native Script window is open, the operations on the Control Package are recorded and translated into code at your choice. You can select between SCPI and Native Script. When you have finished, you can export the code to a file or clear the recorded actions.



Item	Description
A. Language Interface Option	Lets you generate projects or command scripts of the operations performed in WaveMaker . Code can be generated in either Visual C++ (.cpp file) or Visual Basic (.bas file)
SCPI	WaveMaker will capture the SCPI commands as they are executed.
GT12000	WaveMaker will capture the GT12000 commands as they are executed.
B. Save Command Checkbox	Lets you save the command script before exporting. The default option is checked.

C. Function/Command Capturer	Displays the executed DLL function calls or commands.
D. Export to File	Clicking this button exports the function calls or commands shown in the Function/Command Capturer window to a file.
E. Clear Message	Clicking this button will clear the function calls or commands displayed in the Function/Command Capturer window.

Service Tab

Clicking on the **Service menu** tab in the Navigation window will open the Service menu. When the Service menu displays, the Service menu icons will appear in the Navigation window.

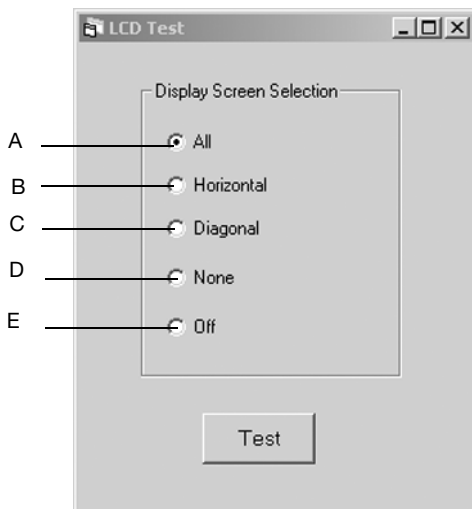
The following headings below describe the window menus that display when the **Service menu** tab is selected in the Navigation window, unless explicitly marked as descriptive only. Please refer to Chapter 4 for detailed service information.

Test

Clicking the Test icon in the navigation window will open the Test menu with all of its icons displayed. An additional click will hide the Test sub-items.

LCD Test

Double clicking the LCD Test icon will open the LCD test window. From this window you can select and run one of the following tests: All, Horizontal, Diagonal, None, and Off. Please refer to Chapter 4 for detailed service information.



Item	Description
A. All	Turns on all pixels on the GT2400 display.
B. Horizontal	Turns on pixels to form horizontal lines on the GT2400 display.
C. Diagonal	Turns on pixels to form diagonal lines on the GT2400 display.
D. None	Turns off all pixels on the GT2400 display.
E.Off	Turns all LCD tests off.

SCPI Status Reporting

Double clicking on the SCPI Status Reporting icon will open the SCPI Status Reporting window. This window allows you to select or unselect any of the following options: Enable error/event interrupt, Enable message interrupt, Operation Complete, Query Error, Execution Error, Command Error, Power On, ALC unleveled, Synth Unlocked, and No external reference. Additionally, you can choose to Restore Defaults. Please refer to Chapter 4 for detailed Service information.



System Menu

Clicking the System icon in the Navigation window will open the System menu. When the System menu opens, the various System menu icons will be displayed in the Navigation window. An additional click on the System menu icon will hide the System sub-menus

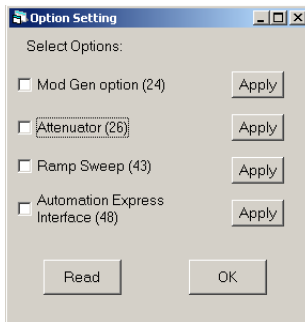
Options Setting

Double clicking on the Option Setting icon will open the **Option Setting** window. This window is used to install or remove options.

Each option setting is License ID-protected respectively.

You will need to enter a License ID provided by Giga-tronics to install or remove available options.

When you select an option to install or remove from the Option Setting window, the following screen will appear.



Item	Description
A. Attenuation (Option 26)	Lets you enable Attenuation Option. License ID required feature. Contact Giga-tronics for more information.
B. Ramp Frequency (Option 43)	Lets you enable Attenuation Option. License ID required feature. Contact Giga-tronics for more information.

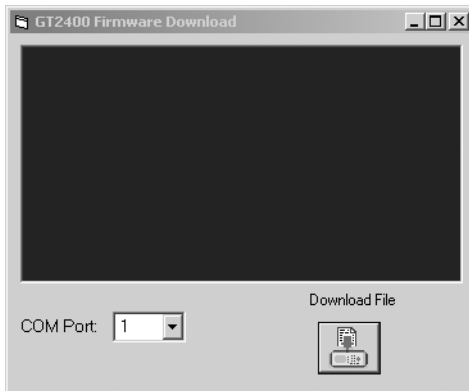
C. Automation Xpress Interface (AXI) (Option 48)	Lets you select the Automation Xpress Interface and Automation Xpress software option. License ID and registration required feature. Contact Giga-tronics for more information.
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Tools

Clicking the Tools icon in the Service Menu of the Navigation window will open the Tools menu. Opening the Tools menu will display the Tools sub-menus. An additional click will hide the Tools sub-menus.

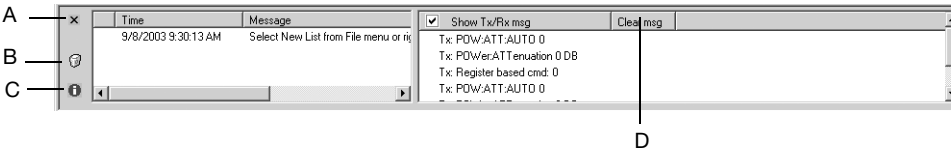
Firmware Download

Double clicking the Firmware Download icon will open the Firmware Download window. This window allows you to download files via the COM port. You must select the appropriate COM port.



Message Window

The **Message window** displays the status messages from the 2400. The **Message window** is divided into a left and right side. The left side of the **Message window** displays the system status messages and error messages. The right side of the **Message window** is referred to as the **Communication message** area. The **Communication message** area displays the Tx/Rx messages. You can clear all messages displayed in the left message window at any time by selecting the Clear Message icon (B). To clear all messages in the **Communication message** area, Click the **Tx/Rx message bar**. Click the **Tx/Rx message bar**.



Item	Description
A.	Closes the Message Display window.
B.	Click the Clear Message icon to clear all messages in the window.
C.	Show/Hide the Message Display window.
D.	Click the Clear msg button on the Tx/Rx Message bar to clear all messages in the Communication Message area.

Status Bar

The **Status bar** is used to display the current system status. Panel one of the status bar displays the connected GPIB address or a COM port number of the serial port. The Status bar also displays the DEMO MODE, if there is no connection with the 2400. Panel two of the status bar displays the language interface option such as default, SCPI, or GT12000.

G. Main Work Area

The main work area of the **WaveMaker** software provides an area for the multiple **WaveMaker** control windows to open in.

Opening and closing control windows

In general, you open and close control windows the same way you do in other programs. By default, when you run the **WaveMaker** program, it automatically opens the **CW Mode** and **Connection Selection** window.

You can open the control windows at any time by using the **Navigation** window. When you double click with your mouse on an icon in the **Navigation** window, the control window will automatically open in the **Main work** area. You can also use the **Operation** drop down menu located on the **Menu bar** to open any of the control windows.

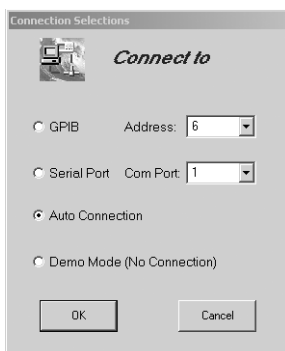
CHAPTER 3

Basic Operations

WaveMaker provides ATE support for 2400 Series functions, as well as functions not available through the 2400 Series front panel interface. The 2400 Series moves these complex functions from the synthesizer to the computer interface. **WaveMaker** combines an intuitive front panel with features that simplify integration of the 2400 synthesizer into your applications.

Configuring a Connection

After starting **WaveMaker**, the **Connection Selections** window appears. Several choices appear. After selecting the connection type, click **OK** to establish communication with the 2400 synthesizer through your PC.



The **Connection Selection** window enables you to select the type of connection you would like to establish with the 2400 Microwave Synthesizer. If a 2400 is not located on either the GPIB or the Serial COM port, the connection window will automatically select Demo Mode. The following illustrates the differences between the selection choices:

Item	Description
A. GPIB Connection	You can select from address 1 to 30. The address selection must be a valid address of a 2400 synthesizer connected to the GPIB
B. Serial Port	You can select from COM 1 through 9. The COM port selection must be a valid port with a 2400 synthesizer connected to the port. The port connection can be an adapted USB/RS-232 or RS-232
C. Auto-Connection	This feature automatically detects any 2400 synthesizer connected to the PC through the GPIB and/or RS-232. This feature can be used when the address or connection type to the 2400 is not known. This feature will take a few moments to search all available connections.
D. Demo Mode	This WaveMaker will run in the demonstration mode as if a 2400 was connected to the controller. Some features such as Auto-Programming will not function properly because they require a 2400 to complete the communication process.

Controlling multiple 2400s using GPIB

WaveMaker provides you with the ability to control multiple 2400's on the GPIB. During initial WaveMaker startup, the program performs multiple queries to determine the presence of a 2400 synthesizer. If a synthesizer is not detected, a notification will appear indicating that no synthesizers were found. When more than one 2400 is found, WaveMaker will connect to the first 2400 found on the GPIB.

Communication with multiple 2400's are performed serially. Only one 2400 can be controlled at one time. However, **Group Executable Triggers** (GET) are performed on all instruments connected to the GPIB regardless of which 2400 is connected to the WaveMaker interface. To switch to the second 2400, perform the following steps:

- 1 Open the **INTERFACE** window.
- 2 Click on the **GPIB** option in the **CABLE CONNECTIONS OPTIONS** section.
- 3 Click on the **ADDRESS LIST** selection and highlight the desired GPIB address.
- 4 Click on the **APPLY** button

Using CW Mode Operations

The **CW Mode** window controls the frequency and power level output of the 2400 synthesizer. For models with option 26, 90 dB step attenuator, you can manually control the step attenuator or let the 2400 automatically switch the attenuator.

Setting Parameters in the CW Mode Window

Editing frequency, power, and step attenuator control and settings are performed with the CW Mode window.

- 1 Double clicking on the **CW Mode** icon in the **Navigation** window opens the **CW Mode** window.
- 2 Using your mouse, highlight the field you would like to change. Either by positioning your mouse on the desired digit to adjust and using the Up/Down arrows located on the right side of the text box to increase or decrease the value. Or by directly highlight the field you would like to change and type your number directly, then press enter.
- 3 To change the step size in the text box, highlight the desired step size digit. Double-clicking on the field will select the entire value to the decimal point. To select the entire number, click and drag the mouse over the entire field. The field can also be changed using the numeric keypad on the controller keyboard. All or part of the field can be changed depending on the section of the number that is highlighted.

Pressing enter on your keyboard, changing the frequency unit, or using the up/down keys will send a command from your computer to the GT2400.

Setting Frequency Directly

The frequency can be adjusted by directly typing the desired frequency into the frequency field.

- 1 Using your mouse, highlight the displayed numbers in the frequency field.
- 2 Once the numbers are highlighted in black, use your numeric keypad to type a desired frequency number directly into the frequency field. Once you begin typing a desired frequency, the frequency field will be selected (yellow).

Setting Frequency Units

The frequency field allows you to select from several frequency units.

- 1 Click on the pull down selection and select the appropriate unit value.
- 2 Using the Up/Down selection or numeric keypad, change the frequency unit setting to the desired unit value. The new frequency setting is immediately downloaded to the 2400.

Setting Power

The power setting is always entered in dBm units.

- 1 Using the Up/Down selection or numeric keypad, change the setting to the desired value. The new power setting is immediately downloaded to the 2400.

Step Attenuator Control (Option 26)

The step attenuator is controlled manually or automatically. Under certain conditions, it is desirable not to have the step attenuator automatically switch. The first switch point is at -5 dBm. Additional switch points occur at 10 dB increments starting with -5 dBm to the minimum setting of the 2400. The **Manual Attenuation** drop down box will display the current state of the step attenuator when the **Attenuation** field is set to **Manual Mode**.

To set the Step Attenuator Mode:

- 1 Click on the **AUTO** radio button for internal control of the step attenuator.
OR
- 2 Click on the **MANUAL** radio button for manual control of the step attenuator.
The Manual Attenuation selection allows you to control the step attenuator setting starting at 0 dB. The attenuator can be adjusted from 0 to 90 dB, in 10 dB increments. Clicking on a value in the Manual Attenuation pull-down selection automatically sets the step attenuator to the newly selected setting.

Note: Manual control of the step attenuator restricts the settable range of the output. If a level setting is out of range, the manual attenuation must be set within + or - 20 dB of the desired setting.

Using List Mode Operations

You can use **WaveMaker** to control list mode operations. **WaveMaker's** list mode operation window ensures fast switching and download times.

The **List Mode Operation** consists of two list windows, the **List Controller** window and the **List Editor** Window. The **List Controller** window is used to manage and run lists. The **List Editor** window is used to create new lists, add new points to an existing list or delete one or more points in a selected list. Once a list is loaded into the **List Controller** window, individual points can be modified.

About List Operation

The GT2400 list operation is an operation that executes a series of pre-programmed instrument states (points). The list is capable of storing more than 4000 points. Each point in the list defines the GT2400 frequency, power, sync. output conditions for a fixed period of time (step time), as shown in the following figure. A remote command or external TTL trigger can be used to initiate the list. Only one list can be stored in the 2400 at any one time.

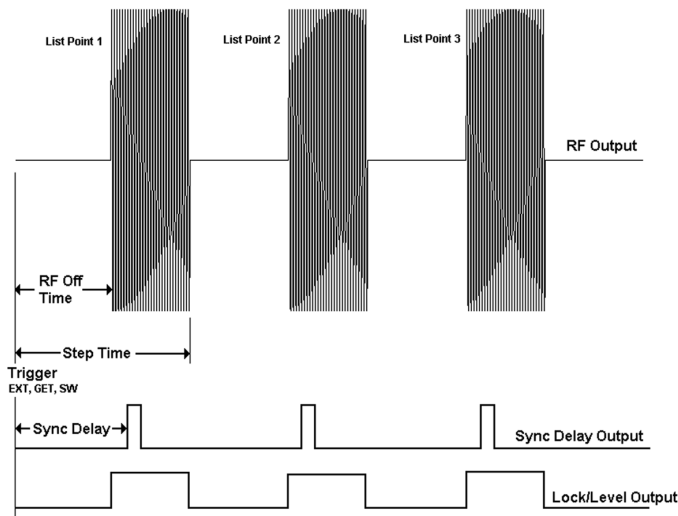


Figure 1:List Attributes

Dynamic Range and Step Attenuator Control

WaveMaker's list mode prevents the step attenuator from switching automatically. However, this restriction is not applied when programming the 2400 without **Wave-Maker** software.. Care should be taken whenever programming power lists for 2400's equipped with Option 26 Step Attenuator, 90 dB step attenuator installed. Operating a power list with the step attenuator set to automatic may cause excessive attenuator switching that can shorten the life the step attenuator. The maximum settable dynamic range with the step attenuator set to manual is 40 dB. Power levels in the list must be within a ± 20 dB range of the manual step attenuator setting. When programming a power list, the step attenuator should be set to manual and set to the middle of the power list dynamic range.

Creating a List

WaveMaker offers three distinct methods for creating lists. You can create a list by:

- 1 Creating a list using **WaveMaker's List Controller** window.
- 2 Creating a list using **WaveMaker's List Editor** window.
- 3 Importing a list you created in Microsoft Excel or a text editor program

Creating a List using the List Controller Window

The **List Controller** window provides access to the list parameters needed to operate the 2400 in list mode. In addition to operational control, the **List Controller** also maintains list files stored in memory or on a storage media such as the controller hard drive.

The **List Table** box located within the **List Controller** window displays lists you have created. You select a list from the **List Table** box to edit and to download to the 2400.

To begin creating a new list, a list name must be established first. You must have the **List Controller** window open to create a new list. If you already have a list file with a valid format, skip this section and go directly to ("Running a List" on page 60). **Wave-Maker** provides two methods for creating a new list.

Naming a List

- 1 Open the **List Controller** window by selecting the **OPERATION MENU** dropdown and select **>LIST CONTROLLER**.
- 2 Select **> FILE MENU** and select **>NEW LIST**.
- 3 The **Create a List** dialog box will appear. Type a new list name in the **List Label** field and click **>OK**.



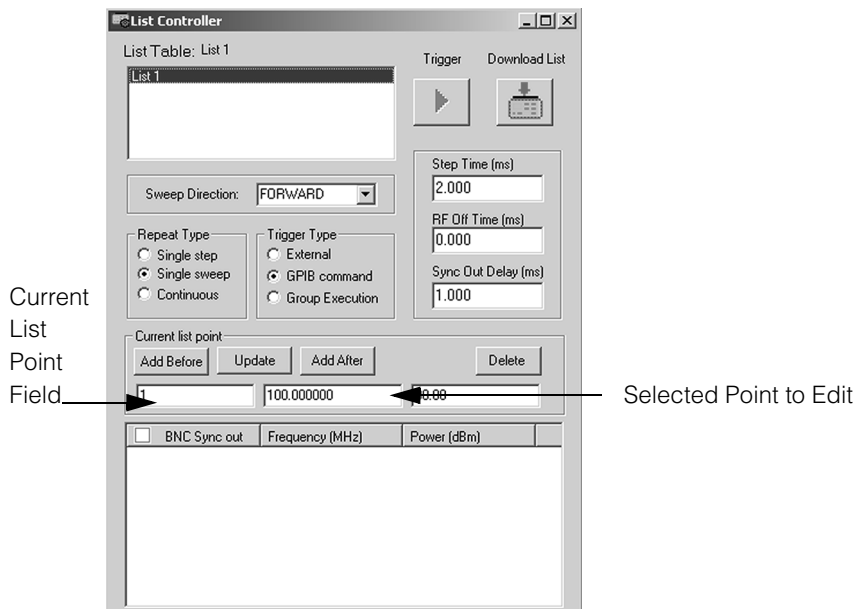
OR

- 1 Open the **List Controller** window by selecting the **OPERATION MENU** dropdown and select **>LIST CONTROLLER**.
- 2 In the **List Controller** window, place your mouse over the **List Table** box and right mouse click. Select **>NEW LIST** from the list pop up menu.
- 3 The **Create a List dialog** box will appear. Type a new list name in the **List Label** field and click **>OK**.

Once a new list name has been established, list point information can be added to the newly created list. Lists can be stored in the memory allocated by **WaveMaker** or on your computers hard drive, floppy disk or any other valid storage medium.

Editing a List Point

To edit a list point in the **List Controller** window, move your mouse over the list point and click on it. This will select and highlight the current list point to edit.



The list point information will be displayed in the **Current List Point** field. You can make changes to the current list point by typing directly into this field. When you are finished editing the list point, the grayed out **UPDATE** button will become active and you can now click the **UPDATE** button to apply the change.

New list points can be added before or after the list point in the **Current List Point** field by clicking on the **ADD BEFORE** or **ADD AFTER** buttons.

To edit the selected list point:

- 1 Click on the **UPDATE** button.

A list point can also be removed from the list by clicking on the **DELETE** button. Any time the list has been modified; it must be downloaded into the 2400. Once a list has been downloaded, the **DOWNLOAD** button will be disabled. Any change in the list editor window, triggering method, step attenuator state or delay setting will enable the **DOWNLOAD** button, indicating that a change has been made and the list must be downloaded into the 2400.

After a list is configured and editing is complete, the list must be downloaded from the **WaveMaker** program to the 2400 memory.

Creating a List in the List Controller Window Tutorial

The following example describes the creation of a simple list using the List Controller Window. The list will consist of 3 points with frequencies at 2, 8, 12 GHz. The power setting is 10 dBm for all points in the list. The first list point will also output a sync. signal.

- 1 With the mouse over the List Table box, right click and select **NEW LIST**.
- 2 Type **LIST 2** in the List Label of the Create a List input box and click **OK**.
- 3 Double click on the Frequency box in the Current List Point field and enter **2000**
- 4 Double click on the Power box in the Current List Point field and enter 10.
- 5 Click on Add After to add the first list point to the new list. Add Before can also be used
- 6 Repeat step 3 and enter **8000**.
- 7 Click on **ADD AFTER** to add the new point. Note that the power setting does not change from the last entered list point.

The power setting does not change from the previous list point. The List controller maintains all information from the previous list point to reduce list point data entry.

- 1 Click on the BNC Sync Out checkbox to disable the sync. signal for this point
- 2 Repeat step 3 and enter 12000. Click on Add After to add the new point

Creating a List Using the List Editor Window

The **List Editor** window is used to create new lists, add new points to an existing list or delete one or more points in a selected list. The **List Editor** window provides a useful way to edit a range or add points to your current running list by step frequency or step power. You can edit or add a list point(s) to your current running list by specifying the start, stop, step, dwell time, and power level.

The **List Editor** is used to quickly create simple lists where frequency and power is incremented or decremented in fixed steps. The list step is set using either a fixed step value or calculated by taking the difference between the start and stop points and then dividing the range by the number of requested points. The **List Editor** is used in con-

junction with the **List Controller**, and permits new points to be added to or replace the list in the active list window.

Configuring a frequency or level list range

Configuring a frequency or level list range in the **List Editor** window requires three basic parameters: start parameter, stop parameter, and the frequency or level setting of all points in the new list range.

- 3 Choose the list range type you wish to create by selecting between the **BY FREQUENCY** or **BY POWER (dBm)** option.
- 4 Type the value of the start parameter into the **START PARAMETER** field and select the appropriate unit. If you have selected to create a list with power as a parameter, all units displayed are measured in dBm.
- 5 Type the value of the stop parameter into the **STOP PARAMETER** field.
- 6 Enter the power level of the list range.

The list step time can be set from within the **List Editor** window or the **List Controller** window at the time of the list download to the 2400.

Setting the list step size

You can set the list step size by directly entering a value into the **Step Parameter** field. The total number of points will be determined by the size of the step. The list size can also be set to a fixed number of points. The **Increment Option** field provides you with a choice of either method to set the list step size.

- 1 From the **INCREMENT OPTION** field> click on the **STEP** option radio button. Selecting the **STEP** option will activate the **STEP PARAMETER** field of the List Range. When the **STEP** option is selected, the list will include the start and stop values plus the maximum allowable frequencies determined by the step size. The spacing between sequential list points will be equal with the exception of the last two list points if difference between the start and stop parameter is not evenly divided by the step parameter.
- 2 From the **INCREMENT OPTION** field> click on the **# OF POINTS** option. Selecting the **# OF POINTS** option will activate the **NUMBER OF LIST POINTS** field. The list is created with a fixed number of points specified in the **Number of Points** field. The size of the step is determined by difference of the start and stop parameter divided by the number of points. The spacing between sequential list points will be equal.

Setting the Replacement Type

An existing list can replace or be inserted into the active list. The **Replacement** field provides you with the option to replace the entire list or insert the new list information before or after a selected list point in the active list. When you want to insert a new list point(s) into the active list, select the desired list point in the active list window of the **List Controller** by clicking on the list point.

- 1 Click **REPLACE ALL** to replace all list points with the new list information.
- 2 Click **INSERT BEFORE** to insert the new list point(s) before the selected list point in the active list window of the **List Controller**.
- 3 Click **INSERT AFTER** to insert the new list point(s) after the selected list point in the active list window of the **List Controller**.

Creating a List Example

The following is a short example for creating a list using the **List Editor** window. The list will switch frequency starting at 2.0 GHz and stopping at 8 GHz. The frequency step size is 100 MHz, power level is set to +5 dBm and the step time is set to 1 msec.

Create a new list name by either selecting the file menu or right mouse click with the mouse in the **List Table** window of the **List Controller** window.

- 1 Click on the **BY FREQUENCY** selection.
- 2 Click on the **REPLACE ALL** selection.
- 3 Click on the **STEP** selection

Enter the following information:

Entry Field	Value
Start	2.0
Stop	8.0
Step	100
Power (dBm)	5.0

The Units selections should be set to factory defaults. If not, use the GHz units for the start and stop fields. Use the MHz units for the step field.

- 1 Enter 1.0 into the **STEP TIME** field.
- 2 Click on the **APPLY** button

Creating a List Using Microsoft Excel or a Text Editor

WaveMaker list files are text-based files that conform to a very simple format. This enables you to generate list files using a text editor or spreadsheet software. All that is required is that the program must be capable of saving to a text file (.txt).

Complex lists can be created using any spreadsheet program, such as Microsoft Excel or a text editor program. The only limitation is that the program must be capable of saving the file to a text based (.txt) format. The file format must use a space, comma, or tab delimiter. The first row specifies the list step time and the sync. pulse delay time. The following rows correspond to the list points in the list. List point one starts at row two of the text file. Each row defines the sync. pulse state, the frequency and level.

- Step time and sync. pulse delay are in milliseconds.
- Sync. pulse state is a 1 or 0. 1 is enabled, 0 is disabled.
- Frequency is in MHz. Power is in dBm.

List File Format

A list file must be constructed to a format that WaveMaker will recognize. If a list file is improperly structured, the list will not load into WaveMaker. The file format is simple. The first line in the list file specifies the list step time, the sync pulse delay time and the RF Off time. The following rows correspond to the list points in the list. The first list point begins on row two of the text file. Each row defines the Sync Signal state, frequency and level settings. The parameters in the text file are separated with a comma, space, semi-colon or tab. A line feed (Enter key) is used to terminate each row in the list file. The following describes the list parameters in the text file.

<Step time> <Sync Delay> <RF Off Time>
<Sync State> <Frequency> <Level>

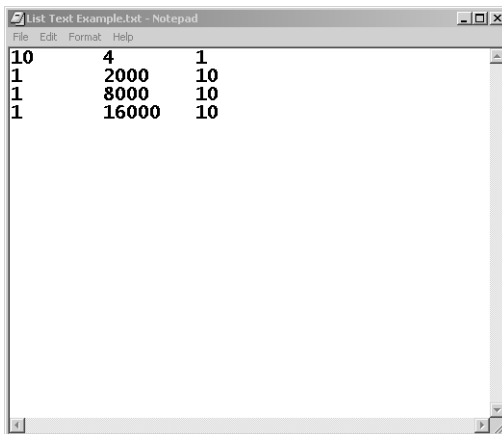
Units are not included in the list file. The following table identifies the parameter unit type and range.

Parameter	Units	Range
Step Time	milliseconds	0.15 - 1000
Sync Delay	milliseconds	0, 0.1 - 1000

RF Off Time	milliseconds	0.1 – 1000
Sync State	1 or 0	1 or 0
Frequency	MHz	10 to max frequency
Level	dBm	10 to max level

Text file example:

The list file consists of three points. The list point step time is 10 msec., sync delay is 4 msec. and the RF Off time is 1 msec. Each list point will output a sync signal and all points will be set to a level of 10 dBm. List point 1, 2, and 3 will have frequency settings of 2, 8, 16 GHz respectively. A tab delimiter, shown as <tab>, is used to separate list parameters.

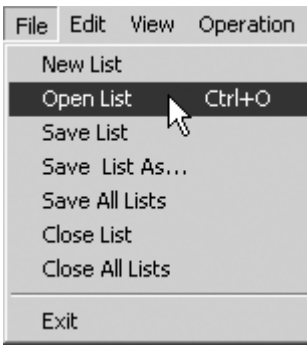


The text file can be imported by using **FILE MENU** and selecting the **OPEN FILE**. If the file is correctly structured, the list will load and a message will indicate that the list successfully loaded. The text file must be closed before it can be loaded into **Wave-Maker**.

Loading, Saving, and Closing Lists

Loading a saved list

To load a previously saved list into the **List Controller**, perform either of the first two methods to create a list and select **OPEN LIST** from the **FILE MENU** or by right clicking with your mouse in the **List Table** box. An explorer window will appear allowing you to select a list from any available file path in the controller.



Running a List

There are additional parameters that define how a list is triggered and how it will execute when a trigger is received. These parameters are set to factory default settings and can be modified to meet a wide range of applications requiring list operation. The list parameters are:

Setting the Trigger Type

Trigger type defines the source of the trigger that will execute the list

External- This selection sets the list trigger to the external Trigger Input on the rear panel of the 2400.

GPIB- This selection sets the list trigger to GPIB. The IEEE 488.2 command *TRG is sent to the 2400 via GPIB to trigger a list.

Group Execution- This selection sets the 2400 to execute a list when a Group Executable Trigger is received via the GPIB.

Setting the Repeat Type

Repeat type defines how the list will sweep. Select one of the following:

Single Step- This mode will switch one list point for every trigger received

Single Sweep- This mode will execute the entire list when a single trigger is received.

Continuous - This mode will execute the list and repeat until the list operation is aborted when a single trigger is received.

Setting the Sweep Direction

Sweep direction defines the direction of the list sweep.

Forward- This setting causes the list to execute starting with the first point in the list and progress to the last point in the list.

Reverse - This setting causes the list to execute starting with the last point in the list and progress to the first point in the list.

Downloading a List

Once a list has been loaded into **WaveMaker** and all the necessary parameters have been edited, the list must be downloaded from the PC to the 2400.

1 Click **DOWNLOAD LIST**.

Once a list has been downloaded, the **Download List button** will disable. Any parameter change in the current list or new list selection will require the new or modified list to be downloaded again.

The **WaveMaker** download operation uses a binary format to program the current list in **WaveMaker** to the 2400. Large lists will take several moments to download and compile. Using **WaveMaker**'s download provides a significant improvement

Triggering a List

After a list has been successfully downloaded, the 2400 is ready for the list to be triggered. If either the GPIB or Group Execution is selected in the **Trigger Type** field, the Trigger button with enable after a successful list download has occurred.

- 1 Click the **TRIGGER** button to initiate the list.

Step and Sync. Delay Time

Step time is a setting that determines the time for each list point. It is a single setting and applies to all points in the list. The step time setting includes the list point switching time and the dwell time at the point. List point switch time can vary according to the type of transition defined by the list point, however the list point switch time is no more than 400 usec. The settable range is 0.15 to 1000 msec.

Setting the step time and Delay Time

- 1 Enter the list step time in msec. and click the adjacent **APPLY** button. The Sync Out signal is a TTL signal that can be used to synchronize the list output with a measuring system such as a power meter or receiver. The **Sync Out Delay** is a setting that enables you to adjust the Sync Out signal with respect to a list point output. The sync. pulse occurs after the list point is executed at the specified delay setting. This is especially useful for measuring systems that use a Moving Average method in a measurement system. The Sync Out Delay has a range of 0.05 msec to 16 msec and must always be smaller than the List Step Time setting.
- 2 Enter the Sync Out Delay time in msec. and click the adjacent **APPLY** button.

List Operation Example

The following steps describe a typical list operation. A valid list file named Example1.txt is loaded into WaveMaker Memory. Repeat Type and Trigger Type and Sweep Direction are selected and the list is downloaded to the 2400. The 2400 output is activated and the list is triggered to single sweep in the reverse direction via the **List Controller** window.

From the **List Controller** window, move the mouse over the **List Table** field, right mouse click and select **OPEN LIST**.

- 1 Select **Example 1.txt** and click **OPEN**.
- 2 Click on **SINGLE SWEEP** in the **Repeat Type** field
- 3 Click on **GPIB** in the **Trigger Type** field
- 4 Click on the drop down arrow of the **SWEEP DIRECTION** and select **REVERSE**.
- 5 Click on **DOWNLOAD LIST**.
- 6 Click on **RF ON/OFF** to activate the RF output
- 7 Click on **TRIGGER**.

Storing a List

A list can be stored by selecting the **SAVE LIST** or **SAVE LIST AS** selections from the **FILE MENU**, or by right clicking with your mouse in the List Table located in the **List Controller** window. When a list is saved, the list name will be updated to include the file path where the list was saved.

Closing a List

Lists stored in the **List Table** window are maintained in the controller memory allocated by **WaveMaker**. The total number of lists allowed in this window is limited by the amount of memory available on your computer. Closing one or all lists in the **List Table** window will remove the lists from memory only. It will not delete a list stored on the hard drive.

Note: Closing a list will not automatically save the list to the hard drive nor will you be asked to save the list before closing.

Using the Command Interpreter

The Command Interpreter allows you to familiarize yourself with the 2400 series SCPI or GT 12000A native command sets. With the Command Interpreter, it is not necessary to parse the commands with the traditional GPIB write and read strings. Commands can be entered directly into the Command Entry field or loaded from a previously saved text file. The sequence of commands can then be executed using one of several methods, which are described in this section. However, using the Auto-Programmer feature in WaveMaker virtually eliminates the need to familiarize yourself with the command sets because program code generation is automatic and significantly reduces programmer code development and debug times.

Entering Commands in the Command Interpreter

The default language for the 2400 is SCPI. The Command Interpreter does not automatically control the 2400 command set interface. The command language can be change to SCPI or Native in the Command Interpreter using either the /SCPI or / Native command. There are no query commands to determine which command interface the 2400 is set to.

Manual Entry Method. Move the mouse over the Command Entry field and left click. Type the command. The text will automatically be copied in the Command Window. The Command Entry field functions like any text editor and commands can be edited using techniques such as overwrite, replace, insert.

Performing a Query. Enter "?????" (four question marks) in the Command Entry field. Instrument responses are displayed in the Message Window.

Executing Commands in the Command Window

The **Command Interpreter** enables you to execute commands as a sequence or individually. A command sequence can be executed in a single run or can be executed in a continuous loop.

- Double click on a command in the **Command Window** to execute a single command. Using this method, the commands in the **Command Window** can be executed in any order.
- Click **SINGLE RUN** to execute the commands shown in the **Command Window**. WaveMaker executes commands starting with the first command and progresses through the command list to the last command in the sequence.

- Click **LOOP** to execute the commands starting with the first command, progressing to the last command in the sequence and repeating until the action is aborted.

The Abort button will become active when the Single Run or Loop buttons are selected. Click on the **ABORT** button to terminate a command sequence operation.

The **Command Interpreter** also allows you to set a programmed delay between commands.

- Click on the **DELAY CONTROL** and enter a command delay time in milliseconds. The maximum delay setting is 9999 milliseconds.

Messages

The **Message Window** displays information regarding commands sent to the 2400 and any query information returned from the instrument. The message feature also allows you to halt a command sequence when an error or invalid remote operation has occurred. The message feature will also let you save the message history to a file.

- Click the **SHOW COMMANDS** option to display commands sent to the 2400 and any information returned from the 2400 in the form of a query.
- Click the **HALT ON ERROR** option to stop a sequence run whenever a remote operation error is encountered, such as a communications failure. This feature does not interrupt the command sequence if an invalid command is encountered.

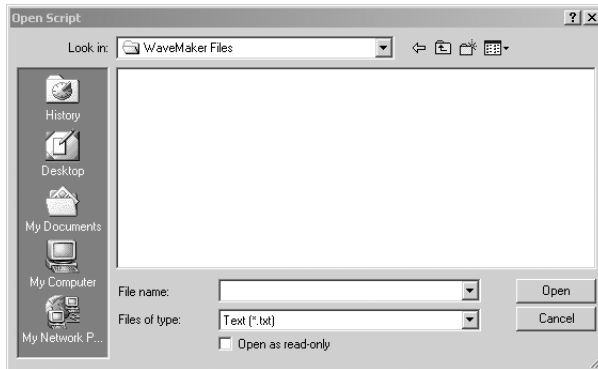
Loading, and Saving a Command Sequence

Along with directly entering a command sequence into the **Command Interpreter**, a command sequence can be loaded into the **Command Interpreter** from a text file. The only requirements to properly load a text file into the Command Interpreter, is the command(s) must be syntactically correct and each line must consist of one command and terminated with a line feed. All text editors automatically add a line termination each time the **Enter** key is pressed on the PC keyboard.

Loading a text script file into the Command Interpreter

To load a text script file into the **Command Interpreter** window, perform the following:

- 1 Click on the **Load Script** button. An **Open Script** browser window will appear and you will be prompted to select a file to load. Select the appropriate file and click on the **Open** button.



Once you have created a command sequence, you can save your script by clicking on the **Save Script** button. You will be prompted to enter a name for the file. You can also choose where you want to save the script.

Using Modulation

Using Amplitude Modulation

The Amplitude Modulation window is available when WaveMaker software is connected to a 2400M series synthesizer or in Demo mode only. Control is provided for external AM settings and internal AM settings when option 24, Internal Function Generator is installed in the 2400M.

- 1 Double click on the Modulation Icon in the Navigation window to access the Amplitude Modulation window. Double click on the AM icon to activate the Amplitude Modulation window.
- 2 For External Modulation, click on the External Source option to select the External control. Use the mouse to set the sensitivity by clicking on the up or down step functions. Highlighting any digit with the mouse sets the step size. The sensitivity can also be edited by highlighting any part or all of the sensitivity setting, enter the value directly and press the Enter key on your keyboard.
- 3 For Internal Source Modulation, click on the Internal Source option to select Internal control. Click on the desired waveform option. You can choose Sine, Triangle, Ramp Square, or Noise. Set the internal source rate and AM depth. Selecting Noise will activate the Noise sensitivity control. The Noise selection allows you to control the depth of AM only. There is no rate control for this setting.
- 4 Click on the AM On/Off button to toggle the AM modulation state of the 2400M.

Using Frequency Modulation Operations

The Frequency Modulation window is available when WaveMaker software is connected to a 2400M series synthesizer or in Demo mode only. Control is provided for external FM settings and internal FM settings when option 24, Internal Function Generator is installed in the 2400M.

- 1 Double click on the Modulation Icon in the Navigation window to access the Frequency Modulation window. Double click on the FM icon to activate the Frequency Modulation window.
- 2 For External Modulation, click on the External Source option to select the External control. Select the FM Mode for Narrow or Wide FM operation. Use the

mouse to set the sensitivity by clicking on the up or down step functions. Highlighting any digit with the mouse sets the step size. The sensitivity can also be edited by highlighting any part or all of the sensitivity setting, enter the value directly and press the Enter key on your keyboard.

- 3 For Internal Source Modulation, click on the Internal Source option to select Internal control. Click on the desired waveform option. Using the mouse and/or keyboard, edit the Deviation and Rate parameters. The Wide and Narrow mode selection is not available because the 2400M automatically adjusts the mode for best performance based on Rate and Deviation settings.
- 4 Click on the FM On/Off button to toggle the FM modulation state of the 2400M.

Using Pulse Modulation Operations

The Pulse Modulation window is available when WaveMaker software is connected to a 2400M series synthesizer or in Demo mode only. Control is provided for external Pulse settings and internal Pulse settings when option 24, Internal Function Generator is installed in the 2400M.

- 1 Double click on the Modulation Icon in the Navigation window to access the Pulse Modulation window. Double click on the Pulse Modulation icon to activate the Pulse Modulation window.
- 2 Click on the PM On/Off button to toggle the pulse modulation state On or Off.
- 3 For External Modulation, click on the External Source option to select the External control. Use the mouse to select the input trigger polarity. Pulse width and period is determined by the external drive signal supplied to the 2400M.
- 4 For Internal Modulation, click on the Internal Source option to enable the Internal Source menu.
- 5 Pulse width and sync out delay are edited using the mouse and/or keyboard. The pulse width and sync out delay entry fields are located at the bottom of the Internal Source Window.
- 6 Continuous operation allows you to adjust the period of the pulsed RF output. Note: The period must be greater than the pulse width setting. WaveMaker will automatically reset the pulse width to be lower than the period in cases where the period entered is less than the pulse width.
- 7 Triggered operation allows you to generate an RF pulse with a controllable pulse width and delay setting. The RF pulse is output after an external trigger is received and the delay time has been reached.

- 8 Gated operation allows you to generate a multiple pulse burst controlled by an external gate. This function allows you to control the pulse width, sync pulse delay, pulse repetition interval and trigger polarity of the pulse. The 2400M will output a pulse train for the duration of the gating signal. If the gate signal is terminated after a pulse has been initiated, the 2400M will complete the pulse burst specified by the pulse width.

Using Scan Modulation Operations

The Scan Modulation window is available when **WaveMaker** software is connected to a 2400M series synthesizer or in Demo mode only. Scan modulation uses list mode to generate a SinX/X waveform.

- 1 Double click on the Modulation Icon in the Navigation window to access the Scan Modulation window. Double click on the Scan Modulation icon to activate the Scan Modulation window.
- 2 Enter the power level of the scan waveform in the Power field. This power setting is the highest level in the scan waveform.
- 3 Enter the number of lobes of the SinX/X waveform. The number of lobes must be an odd integer from 1 to 49.
- 4 Enter the scan time in milliseconds. The scan time is the total sweep time of the SinX/X waveform.
- 5 Enter the frequency of the scan waveform in MHz.
- 6 Click Apply to create a list that will generate the SinX/X waveform. If the List Controller window is not already opened, or if the list window is open and no list file is active in the list window, the list file creation window request you to enter a list file name. If a list is already active in the List Controller window, this action will automatically replace the current list in the List Controller.

Using Auto-Programming

WaveMaker's Auto-Programming feature enables you to generate a sequence of commands based on the WaveMaker GUI operation when the Auto-Programmer window is active. The command syntax is properly structured and can be pasted directly in to your project.

The Auto-Programmer is configured to generate commands using either the SCPI or GT12000A command sets. Clicking on the AutoProgrammer for SCPI/Native Script icon in the Navigation Menu activates the Auto-Programmer.

Generate a text file of SCPI or GT12000A Commands

The Auto-Programmer window displays the SCPI or GT12000A commands created by the WaveMaker GUI and do not include the function call syntax needed for GPIB command calls.

Using the Export button creates a text file of the message-based commands captured when the Auto-Programmer is activated. After the text file has been created, you can cut and paste the commands into your ATE project. However, it will be necessary to create additional text to the commands to be compatible with your project's remote interface environment. For example, setting the power level of the 2400 to -21 dBm causes the following SCPI command to be created in the Auto-Programmer window:

```
POWer -2.100000E+001 DM
```

This text would not be compatible in a program environment. In the following example, editing the text to the following syntax would be acceptable in a C program environment using National Instruments GPIB.

```
int ibwrt (int ud, "POWer -2.100000E+001 DM\n", 25)
```

The following sequences demonstrate the Auto-Programmer for generating 2400 SCPI and GT12000A commands to a text file. The sequence sets up an arbitrary list which steps one list point at a time for each external trigger received by the 2400. The list information was previously stored to a text file.

SCPI Command Script Generation

Step	Description
1	Turn on the Auto-Programmer. Note: Opening the Auto-Programmer window (Tools Auto-Programmer from menu) turns on the Auto-Programmer. Operations on GUI will be recorded from this point on.
2	Select SCPI option from the radio button.
3	Load a previously created list from the hard disk to WaveMaker
4	Set repeat type to single step
5	Set trigger type to External
6	Click the download button
7	Export the command script to a file by clicking Export to a file button.
8	Ready to be executed by command interpreter.

GT12000 Command Script Generation

Step	Description
1	Turn on the Auto-Programmer. Note: Opening the Auto-Programmer window (Tools Auto-Programmer from menu) turns on the Auto-Programmer. Operations on GUI will be recorded from this point on.
2	Select GT12000 option from the radio button.
3	Load a previously created list from hard disk to WaveMaker.
4	Set repeat type to single step
5	Set trigger type to External
6	Click download button
7	Export the command script to a file by clicking Export to a file button.
8	Ready to be executed by command interpreter.

Service Features

WaveMaker offers a convenient 2400 Series service package that enables you to perform basic

Clicking on the Service Package tab in the navigation window will open the Service Package with all of its icons displayed. All headings below are menu or window items, unless explicitly marked as descriptive only

Performing a LCD Test

Double clicking the LCD Test icon will open the LCD test window. From this window you can select and run one of the following tests: All, Horizontal, Diagonal, None, and Off. When the LCD Test window is closed, any test being run is ended.

SCPI Status Reporting

Double clicking on the SCPI Status Reporting icon will open the SCPI Status Reporting window. This window allows the user to select or unselect any of the following options: Enable error/event interrupt, Enable message interrupt, Operation Complete, Query Error, Execution Error, Command Error, Power On, ALC unleveled, Synth Unlocked, and No external reference. Additionally the user can choose to Restore Defaults.

Firmware Download Tool

The Firmware Download tool allows you to upgrade your 2400 operating system. The tool walks you through a simple step-by-step process. Contact Giga-tronics, Inc. for information regarding new firmware upgrades. Firmware upgrades can only be performed using the RS-232 port of the 2400. It is recommended that you use the RS-232/USB adapter included with the 2400. If this adapter is not available, you can use a standard 9-pin RS-232 cable (non-null modem).

- 1 Double click on the Firmware Download Icon to open the Firmware Download window.
- 2 Enter the COM port setting that the Firmware Download utility will use to communicate with the 2400. If WaveMaker was initialized to a 2400 with the serial communications, the correct COM port will automatically be selected.

Note: Unless the correct COM port is already known, it is recommended that **WaveMaker** determine which COM port is used to communicate with the 2400. To perform this task, click on the Control tab at the bottom of the Navigation window and activate the Interface window. Click on Find All COM Ports.

Follow the instructions in each window.

C

Communication, multiple 2400s 48,
communications interface 33,
CW Mode
 Frequency 20,
 Power Level 20,

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