Giga-tronics

Automation Xpress™

A development tool for ATE

User Guide

Take your programming to the next level

PREFACE

Automation Xpress, an easy to use, application development tool for use with Gigatronics 2400 Series Microwave Synthesizers and Automation Xpress Interface. Automation Xpress offers fast remote operation that goes beyond just fast frequency switching.

The innovative Auto-Programming tackles the major problems facing test programmers today. Xpress Auto-Programming eliminates the complexity of having to write specific code sequences needed to control the operation of the instrument.

Automation Xpress eliminates the need for you to learn the various GPIB commands. With a click of the mouse, the Auto-Programming feature automatically records the sequence of your actions and converts those actions into program code. Auto-programming provides the option of seamlessly converting the recorded action sequence into a generated program, that can be imported into to the program environment of your choice, such as Visual C++ and Visual Basic. Auto-programming generates the same results as the action sequence created manually. The value is a reduction in test downtime, reduced programming costs, and greater profitability.

The key to reducing the cost of testing is faster frequency switching. The 2400 Series Microwave Synthesizer offers unmatched frequency and power switching in list mode, however this approach may not be suitable for some remote programming situations. Automation Xpress combined with the Automation Xpress Interface option ensures unmatched 2.5 ms CW frequency and power switching performance, providing fast and flexible data exchange rates for faster testing and more device throughput.

The AXI ensures very fast remote programming using Automation

Xpress from any ATE/TPS program to a 2400 series instrument, providing faster CW frequency switching time, faster overall download, and faster function execution times of large amounts of data. The transit and execution times for single function calls, such as changing CW frequency are 10 X faster than sending the command via standard message based commands. With Automation Xpress now sending large amounts of data, such as large lists, the transit and execution times are > 100X faster as compared to SCPI. This makes lengthy and repetitive tasks faster and more efficient, maximizing test throughput, while minimizing testing time and system downtime. Automation Xpress provides the tools necessary to successfully program the 2400 series. The Xpress Auto-programmer can virtually eliminate the need for training, providing programming scripts and sequences that are guaranteed for accuracy.

Programmers come and go, AX streamlines program development by ensuring consistent and accurate code generation. Click of the mouse code generation eliminates the chances for coding errors, resulting in increased testing confidence.

Who should read this book?

If you are new Giga-tronics Automation Xpress and the 2400 Series Microwave Synthesizer, read Getting Started to learn about the basic software Graphical User Interface and how Automation Xpress works for programming in the Automatic Test Environment.

Getting Started explains the various Automation Xpress windows, menu selections, and explains how to use the Automation Xpress Auto-Programming feature.

Contents

1

GETTING STARTED

The Automation Xpress (AX) user guides teaches you how to use and integrate Giga-tronics Automation Xpress software features into your programming environment. This user guide contains detailed information about the commands used to program the 2400 Series Microwave Synthesizer. In addition, the Automation Xpress user guide provides descriptions for the Automation Xpress GT2400 API functions and a detailed description of the AX Graphical User Interface (GUI).

You will learn step by step instructions for using the Automation Xpress Auto-Programming feature for advanced programming in Visual Basic and Visual C++.

1.1 Package Contents

The Automation Xpress software package includes the following software and documentation:

- Automation Xpress CD-ROM
- USB Port Adapter and USB driver software (included in Automation Xpress CD).
- Automation Xpress User Guide (Part #XXXXX)

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

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

To install and run Automation Xpress 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

1.2 Installation and Uninstallation

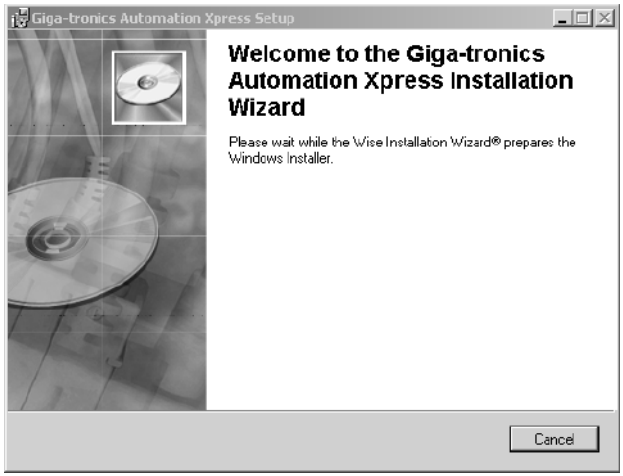
To install Automation Xpress software, follow the steps below:

1 Insert the Automation Xpress CD into the CD/DVD drive.

2 Click on My Computer and select the drive with the Automation Xpress CD.

3 Double click the Automation XpressInstall_XXX.exe file.

The following installation screen will appear:



4 Click NEXT.

5 The Automation Xpress installation process will begin.

6 The Setup program begins installing the Automation Xpress software.

7 In the Choose Automation Xpress destination location dialog, select the location where you want the Automation Xpress software to be installed.

8 Click NEXT to accept the default location (recommended)

OR

9 Enter the directory location where you want the Automation Xpress 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 Automation Xpress files (recommended).
- Custom Setup Type allows you to choose which components you would like to install.

11 When the Automation Xpress Installation is complete, the Setup Complete dialog box appears. Click FINISH.

12 After Automation Xpress has successfully installed onto your PC, you can click FINISH or continue with the USB Driver installation.

1.3 Installing the USB Device and Drivers:

The USB to Serial Cable Port Adapter provides you the simplest way to attach Notebook or Desktop computer to the 2400 Series Microwave Synthesizer. This portable expansion cable directly connects to your computer via a Universal Serial (USB) port. This section of the Automation Xpress user's guide describes how to connect 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 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 CORRECTLY.

1.3.1 Installing the USB Driver with Automation Xpress Installation

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

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

1.3.2 USB Driver Installation from the Automation Xpress Directory

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

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

1.3.3 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 Automation Xpress 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.

1.4 Uninstall Automation Xpress

To uninstall Automation Xpress from your computer, do either following:

1. Click the WINDOWS > START button and choose SETTING > CONTROL PANEL.
2. In the control panel, click ADD/REMOVE PROGRAMS.
3. From the REMOVE PROGRAMS properties dialog box, select Automation Xpress and REMOVE.

OR

1. Insert the Automation Xpress CD into CD drive.
2. Double click on the Automation Xpress Installation program.
3. Click on the "Uninstall Giga-tronics Automation Xpress from this computer" and click NEXT continue.

1.5 Starting Automation Xpress

You start Automation Xpress just as you would any software application.

To start Automation Xpress in Windows:

1 Choose START> PROGRAMS> Gigatronics> Automation Xpress. The Automation Xpress registration window will appear.

2 You will be prompted to enter the provided License ID number located on the Automation Xpress License ID label affixed to front of the Automation Xpress CD sleeve. You may also contact Giga-tronics directly to receive your License ID number.

3 After inputing the correct License ID number, Automation Xpress will launch.

1.6 Registering Automation Xpress

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 Automation Xpress. In addition, you can choose to register at any time by choosing HELP > REGISTER Automation Xpress. 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.

- Click REGISTER ONLINE, to register your Automation Xpress software online

OR

- Click REGISTER BY MAIL, to register your Automation Xpress software by mail.
- Register your software to receive notification of product updates and to be eligible for technical support.

1.6.1 Registering by mail or Fax:

- Open HELP> REGISTER BY MAIL. The Automation Xpress registration by mail dialog box appears.
- Enter your name, address, phone, and fax in the edit boxes provided, and click OK when finished.
- Click the PRINT REGISTRATION FORM button. Automation Xpress 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.

1.7 Getting Help

Automation Xpress 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 Automation Xpress:

1 On the Automation Xpress 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.

1.8 Learning Automation Xpress

A variety of resources are available to help you learn Automation Xpress, including this user manual, and a help system with tutorials you can launch from the Automation Xpress application. The Automation Xpress Help Tutorial is a series of short, lessons that focus on specific Automation Xpress features and operations, from the basics of how to create and download lists to Auto-Programming.

The Automation Xpress application contains dialog boxes and ToolTips designed to assist you in using the program. ToolTips appear when your pointer pauses over a user interface element.

1.9 Interfaces

The Series 2400 series permits data bus control in accordance with the IEEE Standard Digital Interface for Programmable Instruments, IEEE STD 488.2. Table 1, shows the IEEE 488 standard subsets that are implemented in the 2400.

1.9.1 IEEE 488 Interface

Table 1: Implemented IEEE 488 Subsets

Subset	Title	2400 Implementation
SH1	Source Handshake	Complete Capability
AH1	Acceptor Handshake	Complete Capability
T8	Talker	Basic Talker
TEO	Extended Talker	No Capability
L4	Listener	Basic Listener
LEO	Extended Listener	No Capability
SRO	Service Request	Complete Capability
RL2	Remote/Local	Complete Capability
PPO	Parallel Poll	Complete Capability
DCO	Device Clear	No Capability
DTO	Device Trigger	Complete Capability
CO	Controller	No Capability

1.9.2 Address Assignment

The remote control address is assigned from the front panel of the instrument. The available range of addresses is 1 through 30.

1.9.3 Command Interpretation

Multiple commands can be sent in a single message if a semicolon delimiter separates the individual commands. Each command will be interpreted individually. Programming in SCPI requires a colon to precede the commands following a semicolon. GT12000 command syntax only requires a semicolon to separate commands.

1.10 RS-232

1.10.1 Comport Settings

The default settings for the 2400 synthesizer are:

Parameter	Setting
Baud Rate	115200
Data Bits	8
Parity	No
Stop Bits	1
Handshake	None

There is no manual panel control for changing any of these settings. RS-232 port settings can be changed using the Automation Xpress software or via remote commands (see SYST:COMM commands in the SCPI command section for details). All remote commands must be terminated with a line feed (ASCII character 10).

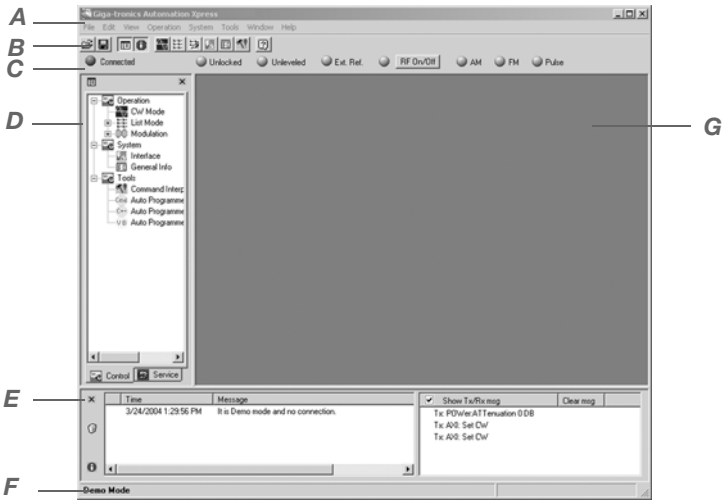
2

An Overview of AX

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

2.1 Getting familiar with the work area

The Automation Xpress 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 Automation Xpress windows to open in. The following illustration labels each area of the Automation Xpress Main window.



A. *Menu* ***B.*** *Toolbar* ***C.*** *LED Indicators* ***D.*** *Navigation Window* ***E.****Message Window* ***F.*** *Status Bar* ***G***. *Work Area*

2.1.1 Menu Bar

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

2.1.2 File Menu

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 Automation Xpress Software program.

2.1.3 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.

2.1.4 View Menu

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

2.1.5 Operation Menu

CW Mode	Opens the CW Mode window saved file into the Main work area.
List Mode	Displays the Operations windows.
List Editor	Opens the List Editor window.
List Controller	Opens the List Controller 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.

2.1.6 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.

2.1.7 Tools Menu

VC ++ Auto-Programmer	Opens the Auto Programmer window to be used with Microsoft Visual C++.
VB Auto-Programmer	Openstthe Auto Programmer window to be used with Microsoft Visual Basic.

2.1.8 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.

2.2 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 Automation Xpress Toolbar allows you to set up the Automation Xpress 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. Please see the 2 for LED information

	Opens a list file.		Opens the List Controller window.
	Saves a list to a file.		Opens the List Editor window.

	Show/Hide the Navigation window.		Opens the System Interface window.
	Opens and closes the Message Display Area.		Opens the General Information window.
	Opens the CW Mode window.		Opens the Command Interpreter window.
	Opens the Help Menu.		Opens the Frequency Modulation window.
	Opens the Aplitude Modulation window.		Opens the Pulse Mode window.
	Opens the SCAN Modulation window.		

2.2.0.1 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.

2.2.0.2 To select a tool:

Click its icon in the toolbar.

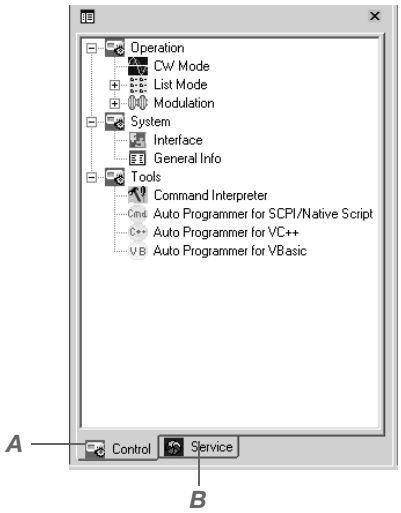
2.3 LED Indicators

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.

A. No Connection	A green LED indicates that Automation Xpress has established Communication with the 2400. A red LED indicates Automation Xpress is not communicating with the 2400.
B. Unlocked	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	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. EXT REF	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	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 the amplitude modulator is off. A green LED indicates 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 the frequency modulator is on.
H. Pulse LED	Displays the Pulse status. A gray LED indicates the pulse modulator is off. A green LED indicates the pulse modulator is on.

2.4 Navigation Window

The Navigation window provides a tree structure of Automation Xpress. The Navigation window enables you to quickly navigate between the different Automation Xpress control windows. The Navigation window consists of two seperate 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.



***A**. Control Tab **B.** Service Tab*

2.4.1 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.

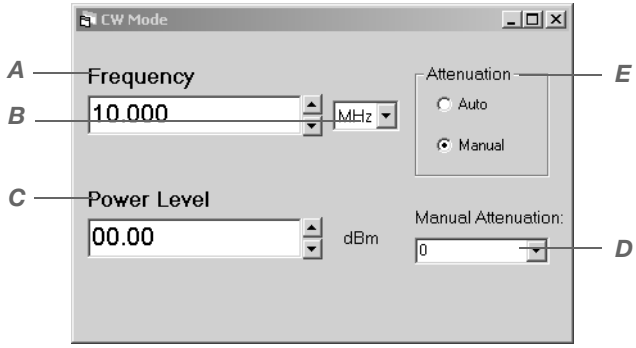
2.4.1.1 Operation Control Windows

Clicking the Operation Icon will expand the Operation menu and display it's sub-items. An additional click will hide the Operation sub-items.The CW Mode, List Mode, and Modulation windows are available from the operation menu.

2.4.1.1.1 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.



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. 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.

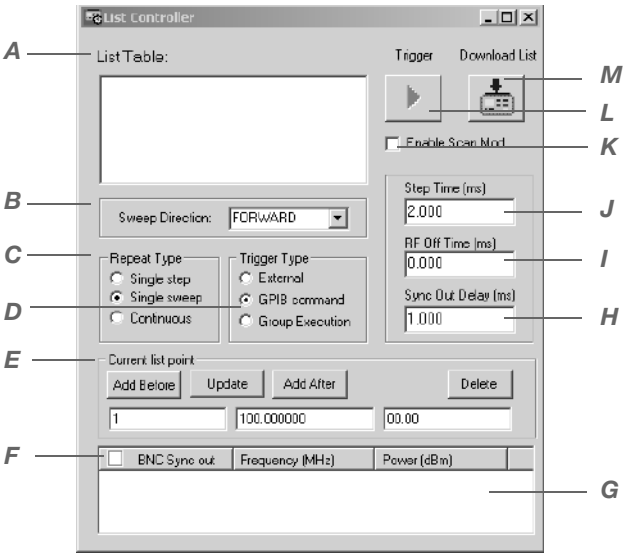
E. Attenuation	This section controls the step attenuator state when option 26 is installed in the 2400 synthesizer. The attenuator can be set to automatically switch or to be controlled manually. The step attenuator has a 90 dB range and switches in 10 dB steps. The maximum settable range in automatic 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.

2.4.1.1.2 List Mode

The List Mode consists of two distinct list operation windows, the List Controller window (see 2) and the List Editor window (see 2). 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 Automation Xpress program. There is no limitation for the number of lists stored in Automation Xpress, however only one list can be stored in the 2400.

2.4.1.1.3 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.



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. Sweep Direction	Lets you set the direction of the list sweep. The list can be swept in forward or reverse direction

C. 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.
D. 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 wil 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.
E. 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 theList 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.

F. BNC Sync Out	BNC sync out can be set for every list point. (i.e, sync out pulse is generated in checked points).
Frequency	Lets you input a frequency value for a newly added list point. Frequency units are in MHz.
Power	Lets you input a power value for a newly added list point.Power units are in dBm.
G. List Data Field	Displays individual list point information of the active list.
H. Sync Out Delay	Sets the delay of the sync output. Units are in (ms).
I. RF Off Time (ms)	
J. Step Time	Sets the step time for all list points. Units are in (ms).
K. Enable SCPI	
L. Trigger Button	Click to trigger the list. The type of trigger is defined by the trigger type.
M Download List	Downloads the selected list to the 2400.

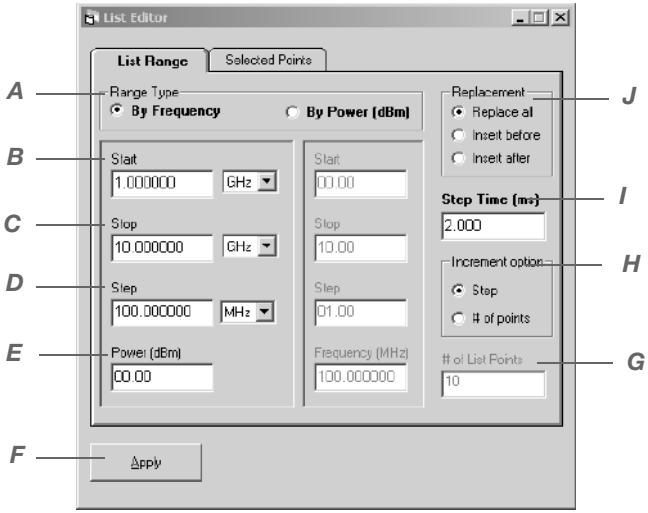
2.4.1.1.4 List Editor Window

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.

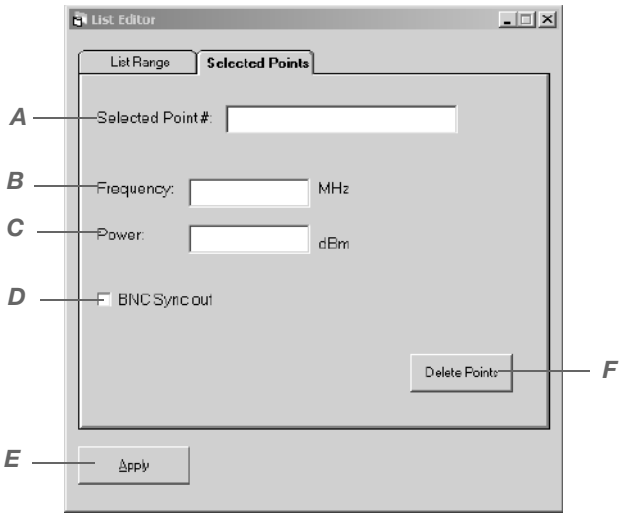


A. Range Type	Lets you create or insert a frequency or power list range.
B. Start Input Field	Lets you input the list range starting point.
C. Stop Input Field	Lets you input the ending list range point.
D. Step Input Field	Lets you input the step parameter for list creation.
E. Power/Frequency Input	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.

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. WaveMaker determines the step size of the list using the following formula: $\frac{\text{STOP PARAMETER - START PARAMETER}}{\text{\# OF POINTS}}$
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 allof 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.



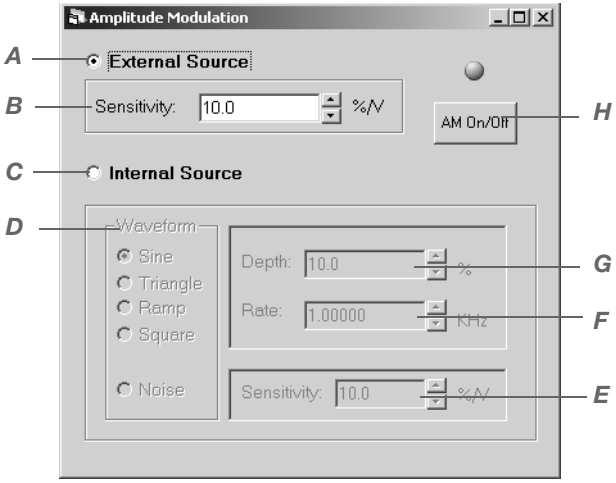
A. Selected Point #	Lets you select a list point(s) from the List Controller window and edit the frequency and power parameters
B. Frequency Input Field	Lets you set the frequency for the selected list point(s) in the List Controller window.
C. Power Input Field	Lets you select the power for the selected 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).

2.4.2 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.

2.4.2.1 Aplitude Modulation (AM)

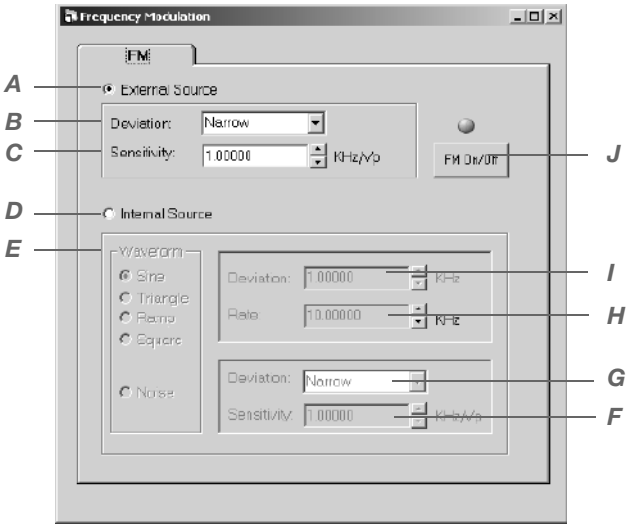
Double clicking on the Amplitude Modulation icon will open the Amplitude Modulation window. The Amplitude Modulation window allows a user to enable or disable Amplitude Modulation. In addition the user can select an External or Internal Source. For an External Source the user can specify the AM Mode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



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

2.4.2.2 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.

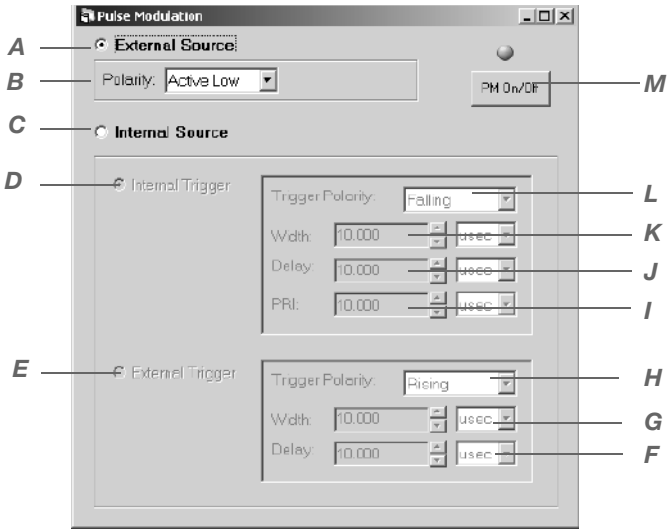


A. External Source	Enable external FM source. If external source is enabled, all internal related controls are gray out.
B. Deviation (External)	Set external deviation to Narrow or Wide.
C. Sensitivity (External)	Adjust the value of external sensitivity
D. Internal Source	Enable internal FM source. If 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

2.4.2.3 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.

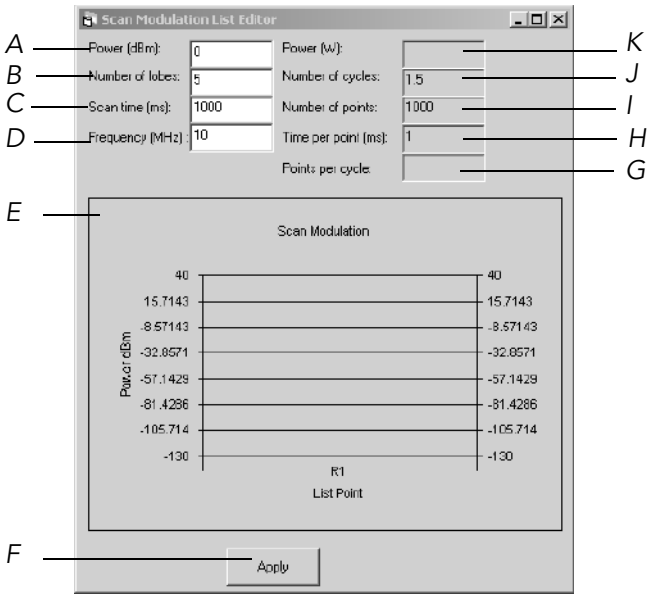


A. External Source	Enable external FM source. If external source is enabled, all internal related controls are gray out.
Polarity	Set external Poliary to either Active High or Low
B. Internal Source	Enable internal PM source. If internal source is enabled, all external related controls are gray out.

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

2.4.2.4 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.



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	Display power in W.

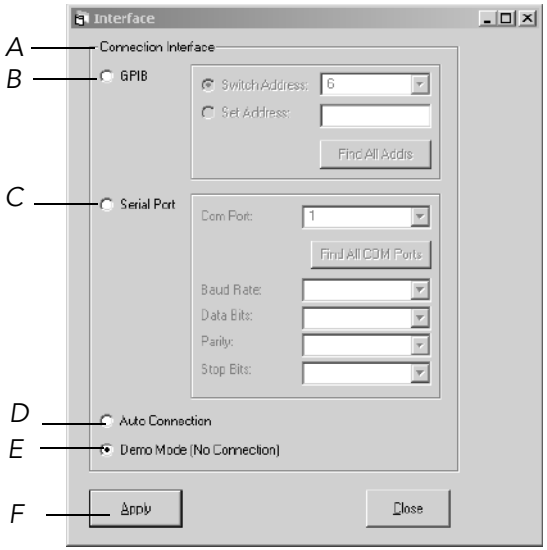
2.4.3 System Control Windows

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.

2.4.3.1 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 Automation Xpress 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.

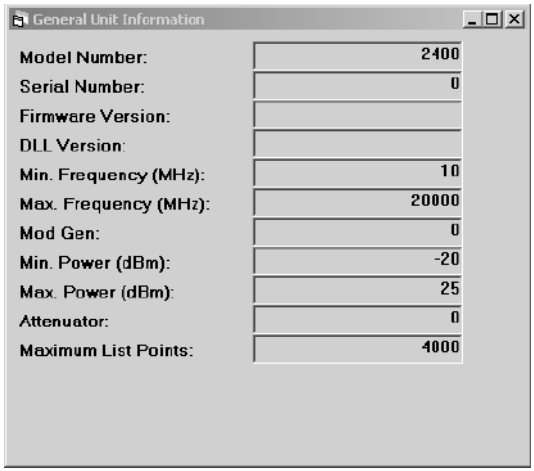


A. Connection Interface	Lets you select the cable connection used to connect your PC with the hardware device.
B. GPIB	Selecting the GPIB option will set the connection through the GPIB interface.
Switch Address	Lets you switch to another 2400 if it is connected to the PC via one of the communications 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	Automation Xpress 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 tocomplete the communication process.
F. Apply	Clicking the apply button will apply the selected cable connection options.

2.4.3.2 General Information Window

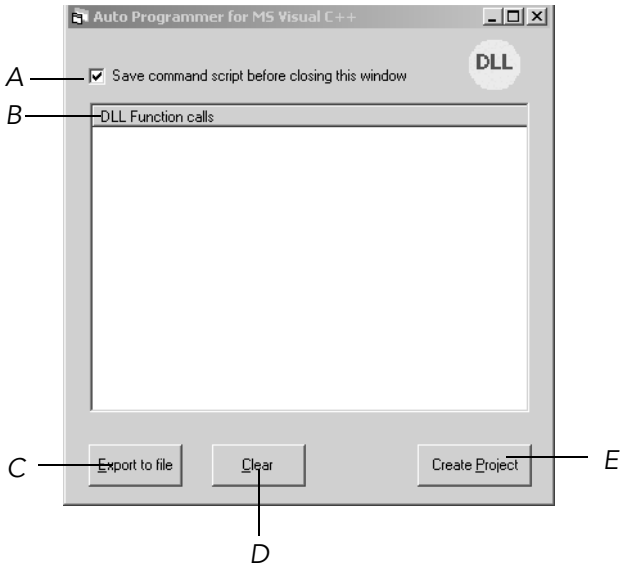
The General Information window provides important information about your current 2400 Microwave Synthesizer. The General Information window describes your current model, serial information, current firmware version, and hardware specifications.



2.4.4 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.

2.4.4.1 Auto-Programming for Visual Basic and Visual C++ Window



A. Save Command Script	Checking this box will automatically save the command script when the Auto-Programmer window is closed.
B. AX Function Calls	Displays the current AX function calls.
C. Export to File	Clicking this button exports AX function calls to a text file.

D. Clear	Clicking this button clears the AX function calls.
E. Create Project	Clicking this button will open the Create Project window for use with Microsoft Visual C++ or Visual Basic software.

2.5 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.

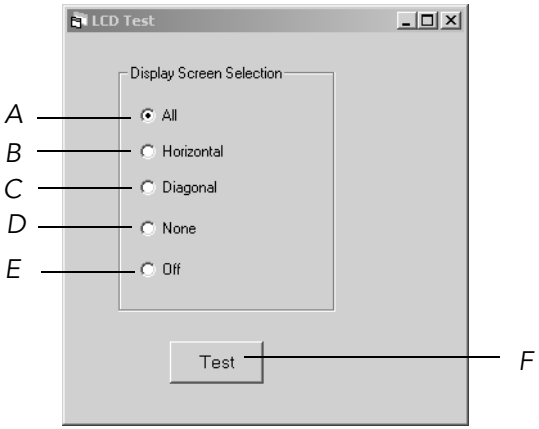
The following headings below describe the window menus that display when the Service menu tab is selected in the Navigation window, unless explicitly marked as descriptive only. Please refer to Chapter 4 for detailed service information.

2.5.1 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.

2.5.2 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.

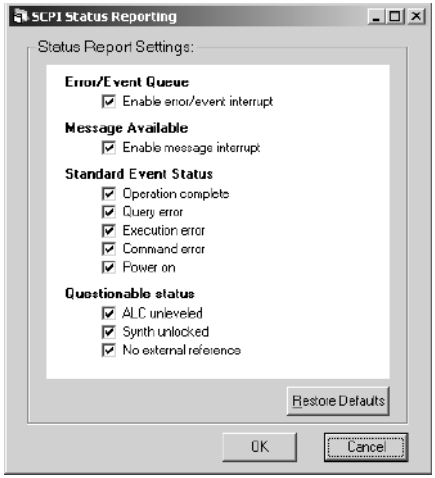


A. All	Turns on all pixels on the GT2400 display.
B. Horizontal	Turns on pixels to form horizontal lines on the GT2400 display.
C. Diagonal	Turns on pixels to form diagonal lines on the GT2400 display.

D. None	Turns off all pixels on the GT2400 display.
E. Off	Turns all LCD tests off.
F. Test	

2.5.3 Status Reporting Menu

Clicking the Status Reporting Menu icon in the Navigation window will open the Status Reporting menu.

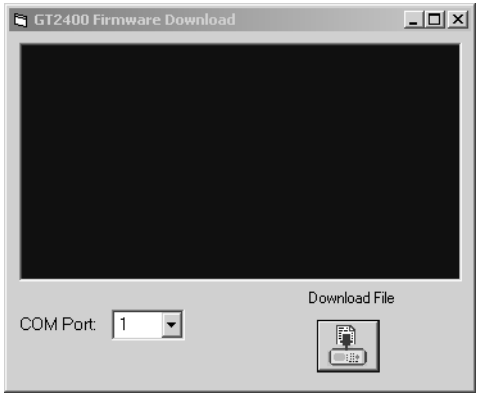


2.5.4 Tools

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.

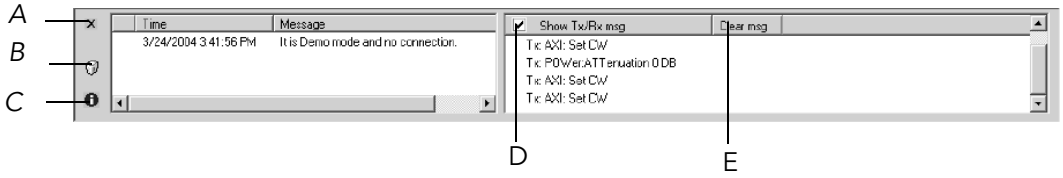
2.5.4.1 Firmware Download

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.



2.6 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.



A. Closes the Message Display window.

B. Deletes all sytem status and error messages displayed in the message window.

C. Click the Clear Message icon to clear all communication messages displayed in the communication message area of the message window.

D. Check to Show/Hide the Tx/Rx messages displayed in the communication message are of the message window.

E. Click the Clear msg button on the Tx/Rx Message bar to clear all messages the Communication Message area.

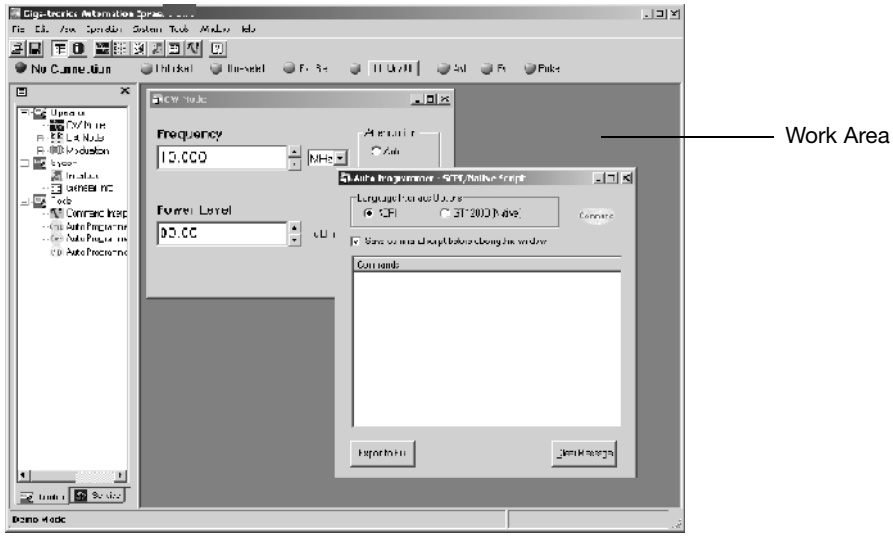
2.7 Status Bar

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.

2.8 Main Work Area

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



2.8.1 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 Automation Xpress 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.

3

AUTOMATION XPRESS INTERFACE (AXI)

Chapter Highlights

- Automation Xpres Interface (AXI) Overview
- How to use the AXI Functions
- CW Operation using V++ and Visual Basic
- List Mode Operation using V++ and Visual Basic

This chapter introduces you to the Automation Xpress Interface and explains how to generate code rapidly that you can integrate it into your ATE applications. The Automation Xpress Interface enables you to quickly program and configure your model 2400 Series synthesizer into your ATE application.

The following sections provide a step by step guide on the use of the GT2400 AXI with the Visual C++ or Visual Basic programming interface.

3.1 Automation Xpress Interface (AXI)

Automation Xpress Interface is provided in the form of a Dynamic Link Library. The following sections describe functions of the GT2400 AXI in details.

AXI Include Files:

GT2400.h	For Visual C++
DLLDeclare.bas	For Visual Basic

3.1.1 Using the GT2400 AXI

The following sections provides step-by-step instructions for integrating the AXI functions into your ATE application. Depending on your programming environment, the following two sections provide a guide on how to load the GT2400 AXI into your project.

3.1.2 C/C++ Program Interface

Step	Description
1	Create a Visual C++ project.
2	Copy GT2400.dll from C:\Program Files\Giga-tronics\Automation Xpress\bin into your project's executable folder for run time calls. (e.g. folder named "Debug")
3	Copy all files from C:\Program Files\Giga-tronics\Automation Xpress\include into your project for compilation.

Step	Description
4	Add GT2400.lib from C:\Program Files\Giga-tronics\Automation Xpress\lib into the project for compilation.
5	Add GT2400.h from C:\Program Files\Giga-tronics\Automation Xpress\include into the project.
6	Copy following line into your application C/C++ files #include "GT2400.h".
7	Make DLL function calls as needed from any .cpp files where GT2400.h file is included.
8	Build.

3.1.3 Visual Basic Program Interface

Step	Description
1	Create a Visual Basic project.
2	Copy GT2400.dll from C:\Program Files\Giga-tronics\Automation Xpress\bin into your project's executable folder for run time calls.
3	Copy DLLDeclare.bas from C:\Program Files\Giga-tronics\Automation Xpress\VBModule to the project folder.
4	Load the DLLDeclare.bas module into your project.
5	Make DLL function calls as needed from any files in the project.

Step	Description
6	Build.

3.1.4 CW Operation using Visual C++

The following example describes how to remotely configure the model 2400 for CW frequency operation in Visual Basic. The example opens a connection via GPIB to the 2400 set to address 6. The routine sets the 2400 to 20 GHz and the power level to 10 dBm. After the 2400 is configured, the RF output is activated and the connection is closed. For other frequencies and power levels, the Frequency and Power parameters can be modified to meet the individual requirements.

Note: Only bold faced code lines are unique to a specific operation mode. All other lines are supporting lines shared by both CW and List modes

Step	Description
1	Follow step 1 through step 4 of the section “3.1.2 C/C++ Program Interface” on page 54, to create a Visual C++ project.

Step	Description

2	Write following
	#include "GT2400.h"
	#include "stdio.h"
	#define SUCCESS 0
	
	//This routine sets CW frequency and power of a GT2400 synthesizer
	//at your choice through GPIB at address 6.
	void main(void)
	{
	STATUS status;
	unsigned long instrumentHandle;
	double Frequency = 1000;
	double Power = 0;
	
	status = **GT2400_OpenConnection**(0, 6, 0,&instrumentHandle);
	
	if(status < SUCCESS)
	{
	char statusText[256];
	GT2400_GetErrorMessage(status, statusText);
	printf("Status Message %s\n",statusText);
	}
	
	status = **GT2400_SetRF**(instrumentHandle, 1);
	
	printf("Frequency (MHz) =");
	scanf("%lf",&Frequency);
	printf("Power (dBm) =");
	scanf("%lf",&Power);
	
	status = **GT2400_SetCW**(instrumentHandle, Frequency, Power,
	0,0);
	
	status = **GT2400_CloseAllConnections**();
	}

Step	Description
3	Build
4	Run

3.1.5 CW operation using Visual Basic

The following example describes how to remotely configure the model 2400 for CW frequency operation in Visual Basic. The example opens a connection via GPIB to the 2400 set to address 6. The routine sets the 2400 to 20 GHz and the power level to 10 dBm. After the 2400 is configured, the RF output is activated and the connection is closed. For other frequencies and power levels, the Frequency and Power parameters can be modified to meet the individual requirements.

Step	Description
1	Follow step 1 through step 4 of section “3.1.3 Visual Basic Program Interface” on page 55, to create a Visual Basic project.

Step	Description

2	Write the following
	'This routine sets CW frequency and power of a GT2400 synthesizer
	'via GPIB at address 6.
	
	Dim status As Long
	Dim instrumentHandle As Long
	Dim Frequency As Double
	Dim Power As Double
	Dim statusText As String
	
	statusText = Space(100)
	
	status = GT2400_OpenConnection(0, 6, 0,instrumentHandle)
	
	If status < SUCCESS Then
	GT2400_GetErrorMessage(status, statusText)
	MsgBox statusText
	End If
	
	status = **GT2400_SetRF**(instrumentHandle, 1)
	
	Frequency = 20000 'MHz
	Power = 10
	status = **GT2400_SetCW**(instrumentHandle, Frequency, Power, 0,0)
	
	status = **GT2400_CloseAllConnections**()
	}

3	Build.
4	Run.

3.1.6 List operation using Visual C++

This example describes a step-by-step procedure for integrating the GT2400 AXI into your Visual Basic project, loading a list file into memory, downloading the list into the 2400 and running the list. The list file is a text-based file that can be created using Microsoft Excel, text editor or the Automation Xpress Interface. The example also provides for error checking to ensure that the data in the list file is properly structured, loaded into the DLL memory and is successfully downloaded into the 2400. When the program is executed, the program queries the user to input the list file, select the list sweep operation and trigger type.

Step	Description
1	Follow step 1 through step 5 of the section “3.1.2 C/C++ Program Interface” on page 54,to create a Visual C++ project.

Step	Description

2	Write following:
	
	#include <windows.h>
	#include <stdio.h>
	#include "gt2400.h"
	#define SUCCESS0
	
	//This routine can load any list file to GT2400 synthesizer
	//and set up repeat type and trigger type at user choice.
	void main(void)
	{
	long status;
	char listFileName[80];
	char statusText[256];
	unsigned long instrumentHandle;
	short tmp;
	
	status = GT2400_OpenConnection(0, 6, 0, &instrumentHandle);
	if(status < SUCCESS)
	{
	GT2400_GetErrorMessage(status, statusText);
	printf("Status Message %s\n",statusText);
	}
	
	printf("Please enter the file name to be loaded:\n ");
	scanf("%s",&listFileName);
	status = GT2400_LoadListFromFile(listFileName, statusText);
	if (status < SUCCESS)//Error during loading
	{
	GT2400_GetErrorMessage(status, statusText);
	printf("Status Message %s\n",statusText);
	}
	
	status = GT2400_DownloadList(instrumentHandle, listFileName);
	
	printf("Enter Repeat Type (0 = single step; 1 = single sweep; 2 = continuous) =");
	scanf("%d",&tmp);
	status = GT2400_SetRepeatType(instrumentHandle, tmp);
	
	printf("Enter Trigger Type (0 = External trigger; 1 = Software trigger or GET) =");
	scanf("%d",&tmp);

Step	Description
3	Build.
4	Run.
5	Trigger.

3.1.7 List operation using Visual Basic

This example describes a step-by-step procedure for integrating the GT2400 AXI into your Visual Basic project, loading a list file into memory, downloading the list into the 2400 and running the list. The list file is a text-based file that can be created using Microsoft Excel, text editor or the Automation Xpress interface. The example also provides for error checking to ensure that the data in the list file is properly structured, loaded into the DLL memory and is successfully downloaded into the 2400. When the program is executed, the program queries the user to input the list file, select the list sweep operation and trigger type.

Step	Description
1	Follow step 1 through step 5 of section “3.1.5 CW operation using Visual Basic” on page 58, to create a Visual Basic project.

Step	Description

2	Write following:
	'This routine will load any list file to GT2400 synthesizer
	'and set up repeat type and trigger type.
	
	Dim status As Long
	Dim listFileName As String
	Dim statusText As String
	Dim instrumentHandle As Long
	
	statusText = Space(100)
	
	status = GT2400_OpenConnection(0, 6, 0, instrumentHandle)
	If status < SUCCESS Then
	GT2400_GetErrorMessage(status, statusText)
	MsgBox statusText
	End If
	
	'Please replace C:\Temp\ListTest.txt with your list file name.
	listFileName = "C:\Temp\ListTest.txt"
	status = GT2400_LoadListFromFile(listFileName, listFileName)
	If status < SUCCESS Then
	'Error during loading
	GT2400_GetErrorMessage(status, statusText)
	MsgBox statusText
	End If
	
	status = GT2400_DownloadList(instrumentHandle, listFileName)
	
	'Repeat Type (0 = single step; 1 = single sweep; 2 = continuous) =")
	status = GT2400_SetRepeatType(instrumentHandle, 1)
	
	' Trigger Type (0 = External trigger; 1 = Software trigger or GET) =")
	status = GT2400_SetTriggerType(instrumentHandle, 0)
	
	status = GT2400_SetRF(instrumentHandle, 1)
	
	status = GT2400_CloseAllConnections()

Step	Description
3	Build.
4	Run.
5	Trigger.

4

BASIC OPERATIONS

Chapter Highlights

- How to use CW Mode Operations
- How to use List Mode Operations
- How to use Modulation Operations

The following chapter provides an overview of Automation Xpress basic operations. You will learn how to configure a list using the List Editor and List Controller window. In addition, you will learn how to run and download a list.

4.1 AX Graphical User Interface

Automation Xpress takes advantage of the familiar Windows environment, intuitive user interface, and computer graphic capabilities. The well-designed and intuitive Automation Xpress graphical interface frees you from learning complex commands and makes Automation Xpress easy to use. Automation Xpress ensures fast switching times and list downloads when using the Automation Xpress CW and List Mode feature. The GUI interface provides you the capability of remote controlling the 2400. You can use the GUI interface for CW mode control and List Mode control. The following sections will describe how to use the GUI for remote operation.

4.1.1 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.

4.1.1.1 Setting Parameters in the CW Mode Window

Editing frequency, power, and step attenautor 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.

4.1.1.2 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).

4.1.1.3 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.

4.1.1.4 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.

4.1.2 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.

4.1.2.1 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 Attentuation 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.

4.1.3 Using List Mode Operations

You can use Automation Xpress to control list mode operations. Automation Xpress'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.

4.1.3.1 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

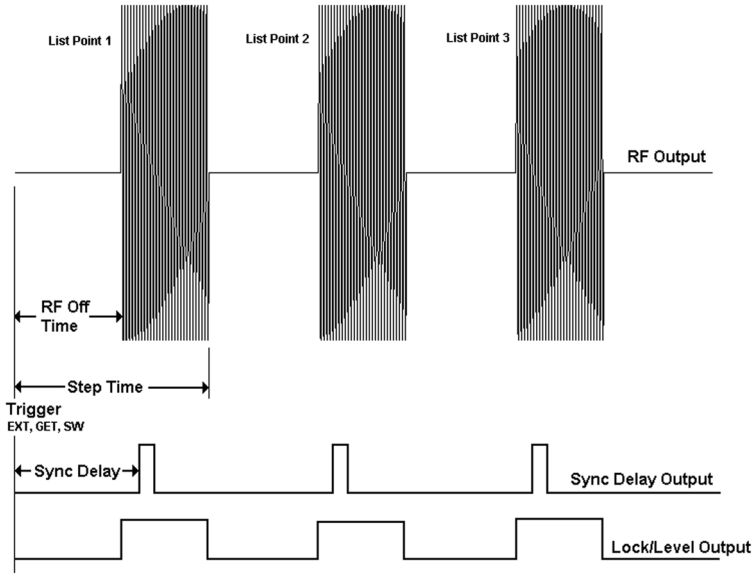


Figure 1: List Attributes

4.1.3.2 Dynamic Range and Step Attenuator Control

Automation Xpress's list mode prevents the step attenuator from switching automatically. However, this restriction is not applied when programming the 2400 without Automation Xpress 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.

4.1.3.3 Creating a List

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

1 Creating a list using Automation Xpress's List Controller window.

2 Creating a list using Automation Xpress's List Editor window.

3 Importing a list you created in Microsoft Excel or a text editor program

4.1.3.4 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 65). Automation Xpress provides two methods for creating a new list.

4.1.3.5 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.

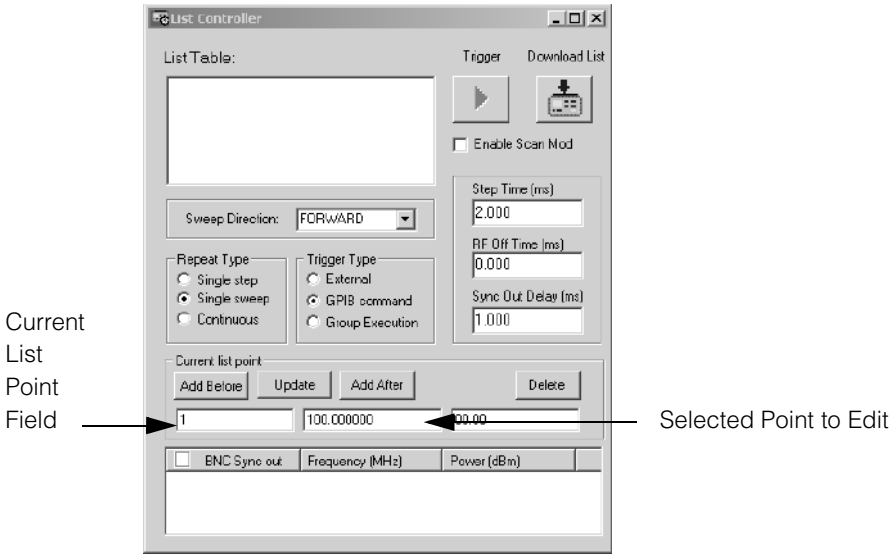
2 In the List Controller window, place your mouse over the List Table box and right mouse click. Select >NEW LIST from the list pop up menu.

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 Automation Xpress or on your computers hard drive, floppy disk or any other valid storage medium.

4.1.3.6 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 Automation Xpress program to the 2400 memory.

4.1.3.7 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

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

4.1.3.8.1 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.

Choose the list range type you wish to create by selecting between the BY FREQUENCY or BY POWER (dBm) option.

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.

Type the value of the stop parameter into the STOP PARAMETER field.

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.

4.1.3.8.2 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.

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.

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.

4.1.3.8.3 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.

4.1.3.9 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.

Click on the BY FREQUENCY selection.

Click on the REPLACE ALL selection.

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

4.1.4 Creating a List Using Microsoft Excel or a Text Editor

Automation Xpress 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.

4.1.4.1 List File Format

A list file must be constructed to a format that Automation Xpress will recognize. If a list file is improperly structured, the list will not load into Automation Xpress. 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>

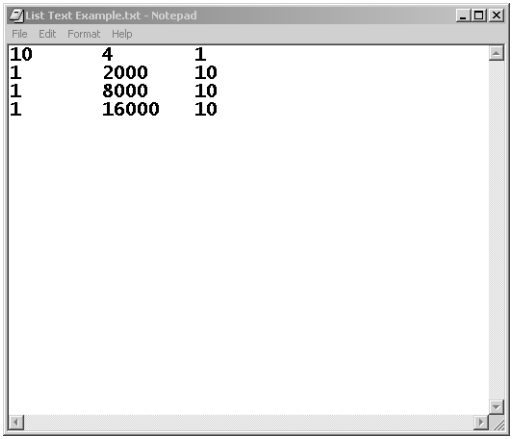
<Sync State> <Frequency> <Level>

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

4.1.4.1.1 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.

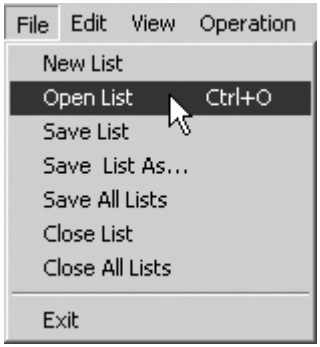


The text file can be imported by using FILE MENU and selecting the OPEN FILE. If the file is correctly structured, the list will be loade and a message will indicate that the list successfully loaded. The text file must be closed before it can be loaded into Automation Xpress.

4.1.5 Loading, Saving, and Closing Lists

4.1.5.1 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.



4.1.6 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:

4.1.6.1 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.

4.1.6.2 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.

4.1.6.3 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.

4.1.6.4 Downloading a List

Once a list has been loaded into Automation Xpress 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 Automation Xpress download operation uses a binary format to program the current list in Automation Xpress to the 2400. Large lists will take several moments to download and compile. Using Automation Xpress's download provides a significant improvement

4.1.6.5 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.

4.1.6.6 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.

4.1.6.7 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.

4.1.6.8 List Operation Example

The following steps describe a typical list operation. A valid list file named Example1.txt is loaded into Automation Xpress 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.

4.1.7 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.

4.1.8 Closing a List

Lists stored in the List Table window are maintained in the controller memory allocated by Automation Xpress. 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.

4.1.9 Using Modulation

4.1.9.1 Using Amplitude Modulation

The Amplitude Modulation window is available when Automation Xpress 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.

4.1.9.2 Using Frequency Modulation Operation

The Frequency Modulation window is available when Automation Xpress 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.

4.1.9.3 Using Pulse Modulation Operations

The Pulse Modulation window is available when Automation Xpress 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. Automation Xpress 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.

4.1.9.4 Using Scan Modulation Operations

The Scan Modulation window is available when Automation Xpress 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.Automation Xpress

5

AUTO-PROGRAMMING

Chapter Highlights

- Traditional ATE Application Development
- Principles of Automation Xpress's Auto-Programming
- Using Automation Xpress's Auto-Programming Feature

This chapter provides you with detailed information on Automation Xpress's Auto-Programming capability.

5.1 Traditional ATE Application Development

5.1.1 Programming Using AXI Functions

The Automation Xpress Interface (AXI) simplifies programmers' challenge, by grouping certain commands together to achieve specific operations. Programming using the AX functions takes advantage of the advanced internal protocols, ensuring an increase in performance. Using the SCPI command set instead of the AX functions limits the 2400 performance by drastically reducing CW and level switching speed and list download speeds.

5.2 Prinicipal of Auto-Programming

Automation Xpress's Auto-Programmer, a software feature embedded in the Automation Xpress Graphical User Interface (GUI), automatically programs ATE applications for ATE engineers. The Auto-Programmer is used in conjunction with your programming environment.

With a click of the mouse, AX's Auto-Programming feature automatically records your manual operations and the sequence of your actions, as well as provides you with the option of seamlessly converting the recorded action sequence into a generated program that you can import into to the program environment of your choice, such as Visual C++, Microsoft Visual Basic, National Instruments LabWindows or any ANSI C based programming interface. Automation Xpress's automatically generated program generates the same results as the action sequence created manually.

The Auto-Programming for the AXI requires that you purchase the Automation Xpress Interface, Option 48.

5.2.1 Auto-program using the AXI functions

The ATE programmer does not have to read detailed definitions of the AXI functions. The Auto-Programmer in Automation Xpress writes the application guided by the ATE programmer using the Graphical User Inteface (GUI).

5.3 Using the Auto-Programmer

When you open the Auto-Programmer window and perform operations in the Automation Xpress Graphical User Interface, the Auto-Programmer records these operations. The Auto-Programmer enables you to export the generated code or create projects you can run directly from your programming environment..

5.3.1 Function Call Code Generation

The Auto-Programmer can be used to produce a fully developed project in Visual C++, Visual Basic or generate a text file of function calls made by the Automation Xpress GUI when the Auto-Programmer window is active in the Automation Xpress workspace. Clicking on the AutoProgrammer for VC++ or AutoProgrammer for VBasic icon in the Navigation Menu activates the Auto-Programmer.

5.3.1.1 Generate a text file of function calls

The Auto-Programmer window displays the function calls made by the AX GUI and does not display the associated Visual C++ or Visual Basic coding.

Using the Export button creates a text file of the function calls captured when the Auto-Programmer is activated. After the text file has been created, you can cut and paste the function calls into your Visual C++ or Visual Basic project. However, it will be necessary to create additional text around the function calls to be compatible with your project environment. For example, setting the attenuation state causes the following function call to be created in the text file:

```
GT2400_SetAttenuation(instrumentHandle, 0)
```

This text would not be compatible in a C or Visual Basic program environment. Editing the text to the following syntax would be acceptable in the either program environment with exception to the semi-colon at the end of the command string. Visual Basic does not allow a semi-colon.

```
status = GT2400_SetAttenuation(instrumentHandle, 0);
```

The following sequence demonstrates the Auto-Programmer for generating AX function calls to a text file. This sequence is identical for file creation to support Visual C++ or Visual Basic. The sequence sets up an arbitrary list that steps one list point at a time for each external trigger received by the 2400.

Step	Description
1	Turn on Auto-Programmer.
2	Load a previously created list from the hard disk to Automation Xpress.

3	Set repeat type to single step
4	Set trigger type to External
5	Click the download button
6	Export the code lines to a file by clicking the Export to a file button.
7	The exported file is ready to be integrated into a project.

5.3.1.2 Generate a project in Visual C++ or Visual Basic

The Auto-Programmer can automatically generate a complete Visual C++ or Visual Basic project including all the necessary function calls made by the AX GUI after the Auto-Programmer has been activated. It is a true one-button push operation that results in an error-free project that you can immediately compile and run. Definitions for the files and variables created in the project are automatically defined in the files. The following sequence describes project creation in Visual C++ and Visual Basic. The sequence activates the Auto-Programmer (the choice of program environments is user dependent), loads a previously created list stored in a text file, sets the trigger and repeat type and downloads the list information to the 2400. Following the download, the project is created.

Step	Description
1	Turn on the Auto-Programmer. Note: Opening the Auto-Programmer window (Menu>Tools> AutoProgrammer) turns on the Auto-Programmer. Operations on the Automation Xpress GUI will be recorded from this point on.
2	Load a previously created list from the hard disk to Automation Xpress
3	Set repeat type to single step
4	Set trigger type to External
5	Click download button
6	Click "Create Project" button and select project directory. Enter the name for the new project folder and click ‘Apply’.
7	Build
8	Ready to Run

6

AXI FUNCTIONS

Chapter Highlights

- Function Summary
- Connectivity Functions
- General Synthesizer Operation Functions
- CW Control, List Control and Editing Functions
- Modulation Control Functions

The following chapter provides a function call summary and detailed information on Automation Xpress Interface programming functions that you can integrate into your ATE application. The chapter divides the individual programming functions into logical groupings that pertain to overall instrument control functions. The AXI functions are grouped by connectivity, general sythesizer operation, CW control, list control, and editing.

6.1 Function Summary

6.1.1 Instrument Connectivity Functions

Function Call	Description Summary	Section
GT2400_FindInstruments	Find all instruments connected to the GPIB or RS-232/USB	6.2.1.1
GT2400_OpenConnection	Open a connection from the PC to the instruments at the specified connection	6.2.1.2
GT2400_CloseAllConnections	Close DLL connections	6.2.1.3
GT2400_SetGPIBAddress	Set the 2400 GPIB address	6.2.1.4

6.1.2 General Synthesizer Functions

Function Call	Description Summary	Section
GT2400_ResetInstrument	Reset the instrument to factory defaults.	6.2.2.1
GT2400_GetRF	Query the instrument RF output state	6.2.2.2
GT2400_SetRF	Set the instrument RF output state	6.2.2.3
GT2400_GetAttenuation	Query the instrument Attenuation state (Option 26)	6.2.2.4
GT2400_SetAttenuation	Set the instrument Attenatution state (Option 26).	6.2.2.5

GT2400_GetErrorMessage	Query the function error status.	6.2.2.6
GT2400_GetDLLVersion	Get the DLL version number.	6.2.2.7

6.1.3 CW Operation Functions

Function Call	Description Summary	Section
GT2400_GetCW	Query the instrument frequency and power setting.	6.2.3.1
GT2400_GetCWDataLimit	Query the instrument frequency and power limits.	6.2.3.2
GT2400_SetCW	Set the instrument frequency and power setting.	6.2.3.3

6.1.4 List Control Functions

Function Call	Description Summary	Section
GT2400_DownloadList	Down load a list to the 2400.	6.2.4.3
GT2400_SetRepeatType	Set the list repeat type.	6.2.4.4
GT2400_SetTriggerType	Set the source of the list sweep trigger.	6.2.4.5
GT2400_SetListScanDirection	Set the run direction.	6.2.4.6
GT2400_SoftwareTrigger	Trigger a list via remote control	6.2.4.7

GT2400_GroupExecutionTrigger	Send a Group Execution trigger	6.2.4.8
GT2400_GetListDataLimit	Query the instrument maximum and minimum list parameters.	6.2.4.9

6.1.5 List Editing Functions

Function Call	Description Summary	Section
GT2400_LoadListFromFile	Load a list file into PC RAM for editing	6.2.5.1
GT2400_CreateNewList	Create a list in PC RAM	6.2.5.2
GT2400_SaveListToFile	Save the list in RAM to a file	6.2.5.3
GT2400_ActivateAList	Prepare the list in the instrument for operation	6.2.5.4
GT2400_GetListData	Query the active list parameters in RAM	6.2.5.5
GT2400_EditAListPoint	Edit a list point of a list stored in RAM	6.2.5.6
GT2400_EditListPoints	Edit multiple list points of a list stored in RAM	6.2.5.7
GT2400_EditFreqRangeByStepFreq	Edit a list using frequency range method	6.2.5.8
GT2400_EditPowerRangeByStepPower	Edit a list using power range method	6.2.5.9
GT2400_EditFreqRangeByNumOfPts	Creates a new list or modifies an existing list with a frequency based list array specified by a number of points	6.2.5.10
GT2400_EditPowerRangeByNumOfPts	Creates a new list or modifies an existing list with a power based list array specified by a number of points	6.2.5.11

GT2400_EditRFOffTime	Set the list point off-time of the active list in RAM	6.2.5.12
GT2400_EditStepTime	Set the list point step-time of the active list in RAM	6.2.5.13
GT2400_EditSyncOutDelay	Set the list point Sync. signal delay	6.2.5.14
GT2400_CloseAllLists	Closes all lists currently stored in RAM	6.2.5.15
GT2400_CloseAList	Closes a single list stored in RAM	6.2.5.16
GT2400_DeleteAllListPoints	Deletes all points in the active list stored in RAM	6.2.5.17
GT2400_DeleteAListPoint	Deletes a list point in the active list stored in RAM	6.2.5.18

6.1.6 Modulation Functions

Function Call	Description Summary	Section
GT2400_SetAMState	Set the amplitude modulation state.	6.3.0.1
GT2400_SetAMSource	Set the source of the amplitude modulation.	6.3.0.2
GT2400_SetAMExtSensititvity	Set external amplitude modulation sensitivity.	6.3.0.3
GT2400_SetAMIntWavefrm	Set the internal modulation generator waveform.	6.3.0.4
GT2400_SetAMIntRate	Set the rate of the internal modulation generator.	6.3.0.5
GT2400_SetAMIntDepth	Set the depth of the internal amplitude modulation	6.3.0.6
GT2400_SetFMState	Set the frequency modulation state.	6.4.0.1
GT2400_SetFMSource	Set the source of the frequency modulation.	6.4.0.2
GT2400_SetFMExtMode	Set the external frequency modulation mode.	6.4.0.3

GT2400_SetFMExtSensitivity	Set the external frequency modulation sensitivity.	6.4.0.4
GT2400_SetFMIntWavefrm	Set the internal modulation generator waveform.	6.4.0.5
GT2400_SetFMIntDev	Set the deviation of the internal frequency modulation.	6.4.0.6
GT2400_SetFMIntRate	Set internal FM generator rate	6.4.0.7
GT2400_SetPMState	Set the pulse modulation state.	6.5.0.1
GT2400_SetPMSource	Set the source of the pulse modulation.	6.5.0.2
GT2400_SetPMExtPolarity	Set the PM external input polarity.	6.5.0.3
GT2400_SetPMIntTrigSource	Set the trigger source for internal PM.	6.5.0.4
GT2400_SetPMIntTrigPolarity	Set the trigger polarity of the internal PM trigger source.	6.5.0.5
GT2400_SetPMIntWidth	Set the internal PM pulse width.	6.5.0.6
GT2400_SetPMIntDelay	Set the delay for internal pulse modulation.	6.5.0.7
GT2400_SetPMIntPRI	Set the internal pulse repetition interval	6.5.0.8

6.2 AXI Function Definitions

The functions are documented by heading, purpose, and syntax. Following the heading for each command function is a description of the purpose of the function and a syntax statement illustrating the proper syntax for the function. Parameters for each function are enclosed in parathensis( ) and are defined for C programming environment.

6.2.1 Instrument Connectivity Functions

This group of functions is used to establish a link between the controller and one or more 2400 synthesizers via the GT2400 AXI. A connection can be established using either the RS-232/USB or GPIB interface. Each of these functions does not require other function calls to complete an operation but some functions can be used together to simplify connectivity. A typical connection process determines the instruments connected to the I/O, communication sessions are established with the instruments, identification queries determine instrument I/O assignments and the communication sessions are closed. The Connectivity functions simplify this task.

6.2.1.1 GT_2400FindInstruments

Purpose

Find the addresses of instruments, either through GPIB or RS232, connected to PC.

Syntax

STATUS **GT2400_FindInstruments(const** short connectionType
short addresses[],
short *pCount)

Parameter	Description
connectionType	Input: Connection type. 0 = GPIB, 1 = RS232
addresses	Output: Array of GPIB addresses or COM port numbers of all the Giga-tronics instruments connected. (Note: In case of RS232 connection interface is selected, the first element returned in this array is the first serial port that is connected to a Giga-tronics instrument followed by the remaining serial port numbers on the PC.) Example 1: There are total of 4 COM ports on a PC, and only COM port 1 is connected to a Giga-tronics instrument, the returned result will be addresses[0] = 1 addresses[1] = 2 addresses[2] = 3 addresses[3] = 4 Example 2: There are total of 4 COM ports on a PC, and only COM port 3 is connected to a Giga-tronics instrument, the returned result will be addresses[0] = 3 addresses[1] = 4
pCount	Output: Total number of instruments connected to PC thru the specified interface

6.2.1.2 GT2400_OpenConnection

Purpose

Establish the communication between the PC and instrument with the specified connection interface and address.

Syntax

STATUS **GT2400_OpenConnection**(const short connectionType,
const short address,
const short resetDevice
unsigned long *instrumentHandle)

Parameter	Description
connectionType	Input: Connection interface. 0 = GPIB, 1 = RS232
Address	Input: GPIB address number if ConnectionType = 0 or COM port number if ConnectionType = 1.
resetDevice	Input: 1 = Reset instrument in start up, 0 = No reset
instrumentHandle	Output: The unique identification of the connected instrument. This handle can be used later to operate on multiple instruments in turn.

6.2.1.3 GT2400_CloseAllConnections

Purpose

Close all connection. You should always call this function before you close your application to avoid memory leak.

Syntax

STATUS **GT2400_CloseAllConnections**(void)

6.2.1.4 GT2400_SetGPIBAddress

Purpose

Set GPIB address.

Syntax

STATUS **GT2400_SetGPIBAddress**(const unsigned long instrumentHandle,
const short address,
unsigned long *updatedInstrumentHandle)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
address	Input: GPIB address
updatedInstrumentHandle	Output: Updated instrument handle after this function completes.

6.2.2 General Synthesizer Operation Functions

These functions provide support for general synthesizer operations. Additionally, function support for GT2400 DLL services for the DLL version and error messages are also included.

6.2.2.1 GT2400_ResetInstrument

Purpose

Reset the instrument to factory defaults.

Syntax

STATUS **GT2400_ResetInstrument**(const unsigned long instrumentHandle)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.

6.2.2.2 GT2400_GetRF

Purpose

Get state of RF output.

Syntax

STATUS **GT2400_GetRF**(const unsigned long instrumentHandle,
short *RFState)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
RFState	Output: 1= RF is on, 0 = RF is off.

6.2.2.3 GT2400_SetRF

Purpose

Set RF on or off.

Syntax

STATUS **GT2400_SetRF**(const unsigned long instrumentHandle,
const short RFState)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
RFState	Input: 1= Turn on, 0 = Turn off RF output

6.2.2.4 GT2400_GetAttenuation

Purpose

Get attenuation value.

Syntax

STATUS **GT2400_GetAttenuation**(const unsigned long instrumentHandle,

short *pAttenuation)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
pAttenuation	Output: current step attenuator setting. The range is 0 to 90 for manual attenuator control. For auto-attenuation, the returned value is -10. If no attenuator is installed the returned value is -99

6.2.2.5 GT2400_SetAttenuation

Purpose

Set attenuation.

Syntax

STATUS **GT2400_SetAttenuation**(const unsigned long instrumentHandle,
const short attenuation)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
attenuation	Input: attenuation value, e.g. if attenuation = -10, set to auto attenuation; else if attenuation >= 0, set to manual attenuation with value = attenuation attenuation = [0, 10,20,30,40,50,60,70,80,90]

6.2.2.6 GT2400_GetErrorMessage

Purpose

Returns a text description of the STATUS value returned by any AX API function.

Syntax

STATUS **GT2400_GetErrorMessage**(const long statusID, char statusText[])

Parameter	Description
errorID	STATUS of any DLL function
statusText	Text description of the STATUS

6.2.2.7 GT2400_GetDLLVersion

Purpose

Return DLL version.

Syntax

STATUS **GT2400_GetDLLVersion**(char version[])

Parameter	Description
version	DLL version

6.2.3 CW Control Functions

The function group provides control of the CW frequency settings for the 2400 series synthesizers. It also provides support for instrument queries for the current CW frequency setting and the frequency limits for the 2400. Frequency switching speeds of less than 3 milliseconds can be obtained using the GT2400 AXI.

6.2.3.1 GT2400_GetCW

Purpose

Read current CW setting (data) from the instrument.

Syntax

STATUS **GT2400_GetCWData**(const unsigned long instrumentHandle,
double *frequency,
double *power)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
frequency	Output: CW frequency (in MHz)
power	Output: CW power (in dBm)

6.2.3.2 GT2400_GetCWDataLimit

Purpose

Get CW data limits of the instrument.

Syntax

STATUS **GT2400_GetCWDataLimi**t(const unsigned long instrumentHandle ,
double *pMinFreq,
double *pMaxFreq,
double *pMinPower,
double *pMaxPower)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
pMinFreq	Output: Minimum frequency allowed (in MHz)
pMaxFreq	Output: Maximum frequency allowed (in MHz)
pMinPower	Output: Minimum power allowed (in dBm)
pMaxPower	Output: Maximum power allowed (in dBm)

6.2.3.3 GT2400_SetCW

Purpose

Set CW.

Syntax

STATUS **GT2400_SetCW**(const unsigned long instrumentHandle ,
double frequency,
double power)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
frequency	Input: CW frequency (in MHz)
power	Input: CW power (in dBm)

Example

```
//This example sets two CW frequencies in sequence, separated by a 40 second delay.

#include "GT2400.h"
#include "stdio.h"

#include "winbase.h"

void main(void)
{
```

```
long STATUS;
unsigned long instrumentHandle;

printf("f= 23.456789 MHz, Power = 5 dBm\n");

STATUS = GT2400_OpenConnection(0, 6, 0,&instrumentHandle);

STATUS = GT2400_SetRF(instrumentHandle, 1);

STATUS  = GT2400_SetCW(instrumentHandle, 23.456789, 5);

printf("Waiting for 40 seconds....\n");

Sleep(40000);

printf("f= 33.4567891 MHz, Power = 0 dBm\n");

STATUS  = GT2400_SetCW(instrumentHandle, 33.4567891, 0);

STATUS = GT2400_CloseAllConnections();
}
```

6.2.4 List Control Functions

The following functions are used to control a list operation. Lists require a number of parameters to programmed prior to the list execution.

6.2.4.1 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 is stored in the 2400 at any one time.

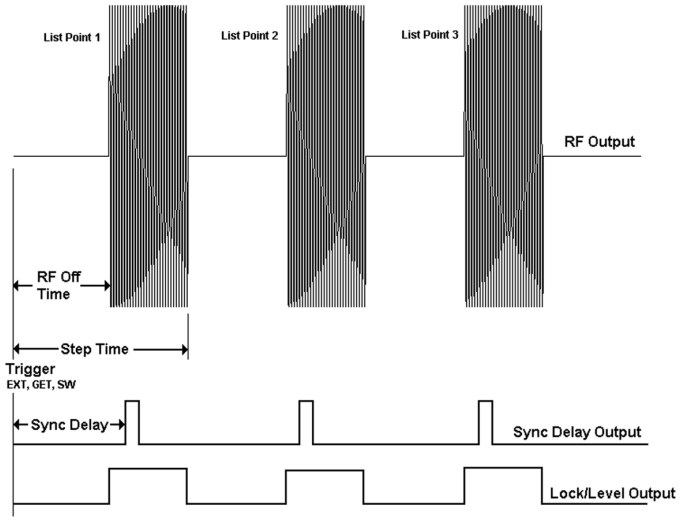


Table 1: List Mode Description

6.2.4.2 Dynamic Range and Step Attenuator Control

Care should be taken whenever programming power lists for 2400's equipped with Option 26 Step Attenuator, 90 dB step attenuator. Operating a power list with the step attenuator set to automatic may cause excessive attenuator switching that will shorten the life the step attenuator. The maximum settable 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 operating range.

6.2.4.3 GT2400_DownloadList

Purpose

Download a list to the GT2400 synthesizer. The file can be prepared beforehand by either MS Excel, or any text editor or Automation Xpress GUI or Automation Xpress DLL list editing functions.

Syntax

STATUS **GT2400_DownloadList**(const unsigned long instrumentHandle,
const char listPath[])

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
listPath	Input: Complete path (path + list name) of the list being downloaded to the unit

6.2.4.4 GT2400_SetRepeatType

Purpose

Set repeat type of the list to be triggered

Syntax

STATUS **GT2400_SetRepeatType**(const unsigned long instrumentHandle,
const short repeatType)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
repeatType	Input: 0 = single step; 1 = single sweep; 2 = continuous

6.2.4.5 GT2400_SetTriggerType

Purpose

Set trigger type to trigger the list.

Syntax

STATUS **GT2400_SetTriggerType**(const unsigned long instrumentHandle,
const short triggerType)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
triggerType	Input: 0 = External trigger; 1 = GET; 2= Software trigger

6.2.4.6 GT2400_SetListScanDirection

Purpose

Set list scan direction.

Syntax

STATUS **GT2400_SetListScanDirection**(const unsigned long instrumentHandle,
const short direction)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
direction	Input: 0 = scan from first point to last point; 1 = scan from last to first

6.2.4.7 GT2400_SoftwareTrigger

Purpose

Use software to trigger the current list.

Syntax

STATUS **GT2400_SoftwareTrigger**(const unsigned long instrumentHandle)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.

6.2.4.8 EGT2400_GroupExecutionTrigger

Purpose

Send Group Execution Trigger (G.E.T. is defined in IEEE 488) to all the instruments connected to PC via GPIB.

Syntax

STATUS **GT2400_GroupExecutionTrigger**(void)

6.2.4.9 GT2400_GetListDataLimit

Purpose

Get list data limits of the instrument.

Syntax

STATUS **GT2400_GetListDataLimit**(const unsigned long instrumentHandle,
short *pMaxListPts,
double *pMinStepTime,
double *pMaxStepTime,
double *pMinRFOffTime,
double *pMaxRFOffTime,
double *pMinSyncOutDelay,
double *pMaxSyncOutDelay)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument.
pMaxListPts	Output: Maximum number of list points allowed (in ms)
pMinStepTime	Output: Minimum list step time allowed (in ms)
pMaxStepTime	Output: Maximum list step time allowed (in ms)
pMinRFOffTime	Output: Minimum list RF off time (in ms)
pMaxRFOffTime	Output: Maximum list RF off time (in ms)
pMinSyncOutDelay	Output: Minimum list sync out delay (in ms)
pMaxSyncOutDelay	Output: Maximum list sync out delay (in ms)

6.2.5 List Editing Functions

The following functions allow the application developer to create, and edit lists in RAM. All list editor functions affect lists stored in a file or in PC RAM. Once a list has been edited, it can be loaded to the 2400 for execution using the List Control functions.

6.2.5.1 GT2400_LoadListFromFile

Purpose

Load a list from a disk file to PC RAM.

Syntax

STATUS **GT2400_LoadListFromFile**(const char filename, char errText[])

Parameter	Description
filename[]	Input: Name of the file being loaded.
errText	Output: If there is an error detected by STATUS, errText will hold the description of the problems.

6.2.5.2 GT2400_CreateNewList

Purpose

Create a new list in PC RAM.

Syntax

STATUS **GT2400_CreateNewList**(const char listPath[])

Parameter	Description
listPath	Input: Complete path (path + list name) of the list whose content is requested.

6.2.5.3 GT2400_SaveListToFile

Purpose

Save a currently active list from RAM to a disk file.

Syntax

STATUS **SaveListToFile** (const char filename,
char errText[])

Parameter	Description
filename	Input: File name of list to be saved in.
errText	Output: If there is an error detected by STATUS, errText will hold the description of the problems. If there is no error, errText is empty.

6.2.5.4 GT2400_ActivateAList

Purpose

Activate the selected list so that the list is ready to respond to a trigger

Syntax

STATUS **GT2400_ActivateAList**(const char listPath[])

Parameter	Description
listPath	Input: Complete path (path + list name) of the list to be activated.

6.2.5.5 GT2400_GetListData

Purpose

Get the contents of the selected list from DLL allocated RAM into user application.

Syntax

```
STATUS GT2400_GetListData(const char listPath[],
                          double *stepTime,
                          double *rfOffTime,
                          double *syncOutDelay,
                          short*attenSetting,
                          const char *syncInfo,
                          double *freq,
                          double *power,
                          short *pListLen)
```

Parameter	Description
listPath	Input: Complete path (path + list name) of the list whose content is requested.
stepTime	Output: Step time of all list points (in ms)
rfOffTime	Output: RF off time of all list points (in ms)
syncOutDelay	Output: Sync out delay (in ms)
syncInfo	Output: Sync out pulse information for every list pt
frequency	Output: Array of frequencies in the list (in MHz)
power	Output: Array of power in the list (in dBm)
pListLen	Output: Number of points in the list

6.2.5.6 GT2400_EditAListPoint

Purpose

Edit a selected point in a list.

Syntax

STATUS **GT2400_EditAListPoint**(const short position
const short insertType,
const char listPath[],
const unsigned char syncOutEnable,
const double frequency,
const double power)

Parameter	Description
position	Input: position in the list being edited. 0 < Position ≤current list length
insertType	Input: Insert Type: 0 = REPLACE, 1= INSERT BEFORE 2= INSERT AFTER
listPath[]	Input: Complete path (path + list name) of the list
syncOutEnable	Input: Enable/disable sync out pulse generated in the editing point
frequency	Input: Frequency of the point being updated (in MHz)
power	Input: Power of the pt being updated (in dBm)

6.2.5.7 GT2400_EditListPoints

Purpose

Edit multiple selected list points in a list with one function call.

Syntax

STATUS **GT2400_ EditListPoints** (const short position,
const short insertType,
const char listPath[],
const unsigned char *syncOutEnable,
const double * frequency,
const double * power,
const short listLen,
char errorTxt[])

Parameter	Description
position	Input: position in the list being edited. 0 < Position ≤current list length
insertType	Input: Insert Type: 0 = REPLACE, 1= INSERT BEFORE 2= INSERT AFTER (Note: if insertType = REPLACE, the existing list will be replaced with the newly created list.)
listPath[]	Input: Complete path (path + list name) of the list
syncOutEnable	Input: Byte array that enables or disables sync out pulse generated in list.

Parameter	Description
frequency	Input: Array of frequency for list points (in MHz)
power	Input: Array of power for list points (in dBm)
listLen	Input: Number of list points being edited
errText	Output: If there is an error detected by STATUS, errText will hold the description of the problems.

6.2.5.8 GT2400_EditFreqRangeByStepFreq

Purpose

Establish a list or insert a sub-list to an existing list by inputting start frequency, stop frequency, step frequency, and power.

Syntax

```
STATUS GT2400_ EditFreqRangeByStepFreq(const short position,
                                       const short insertType,
                                       const char listPath[],
                                       const double startFrequency,
                                       const double stopFrequency,
                                       const double stepFrequency,
                                       const double power)
```

Parameter	Description
position	Input: position in the list being edited. 0 < Position ≤current list length
insertType	Input: Insert Type: 0 = REPLACE, 1= INSERT BEFORE 2= INSERT AFTER (Note: if insertType = REPLACE, the existing list will be replaced with the newly created list.)
listPath	Input: Complete path (path + list name) of the list
startFrequency	Input: start frequency (in MHz)
stopFrequency	Input: stop frequency (in MHz)
stepFrequency	Input: frequency step (in MHz)
power	Input: Power for all list points (in dBm)

6.2.5.9 GT2400_EditPowerRangeByStepPower

Purpose

Establish a list or insert a sub-list to an existing list by inputting start power, stop power, step power, and frequency.

Syntax

STATUS **GT2400_ EditPowerRangeByStepPower**(const short position,
const short insertType,
const char listPath[],
const double startPower,
const double stopPower,
const double stepPower,
const double frequency)

Parameter	Description
position	Input: position in the list being edited. 0 < Position ≤current list length
insertType	Input: Insert Type: 0 = REPLACE, 1= INSERT BEFORE 2= INSERT AFTER (Note: if insertType = REPLACE, the existing list will be replaced with the newly created list.)
listPath	Input: Complete path (path + list name) of the list
startPower	Input: start power (in dBm
stopPower	Input: stop power (in dBm

Parameter	Description
stepPower	Input: step power (in dBm
Frequency	Input: Frequency for all list points (in MHz)

6.2.5.10 GT2400_EditFreqRangeByNumOfPts

Purpose

Establish a long list or insert a sub-list to an existing list by inputting start frequency, stop frequency, power, and number of list points.

Syntax

STATUS **GT2400_EdittFreqRangeByNumOfPts**(const short position,
const short insertType,
const char listPath[],
const double startFreq,
const double stopFreq,
const double Power,
const short numOfPts)

Parameter	Description
position	Input: position in the list being edited. 0 < Position ≤current list length
insertType	Input: Insert Type: 0 = REPLACE, 1= INSERT BEFORE 2= INSERT AFTER (Note: if insertType = REPLACE, the existing list will be replaced with the newly created list.)

Parameter	Description
listPath	Input: Complete path (path + list name) of the list
startFreq	Input: start frequency for range insertion (in MHz)
stopFreq	Input: stop frequency for range insertion (in MHz)
power	Input: Power for all list points (in dBm)
numOfPts	Input: Number of list points being created

6.2.5.11 GT2400_EditPowerRangeByNumOfPts

Purpose

Establish a long list or insert a sub-list to an existing list by inputting start power, stop power, frequency, and number of list points.

Syntax

```
STATUS GT2400_EditPowerRangeByNumOfPts(const short position,
                                       const short insertType,
                                       const char listPath[],
                                       const double startPower,
                                       const double stopPower,
                                       const double frequency,
                                       const short numOfPts)
```

Parameter	Description
position	Input: position in the list being edited. 0 < Position ≤current list length
insertType	Input: Insert Type: 0 = REPLACE, 1= INSERT BEFORE 2= INSERT AFTER (Note: if insertType = REPLACE, the existing list will be replaced with the newly created list.)
listPath[]	Input: Complete path (path + list name) of the list
startPower	Input: start power (in dBm)
stopPower	Input: stop power (in dBm)
frequency	Input: Frequency for all list points (in MHz)
numOfPts	Input: Number of list points being created

6.2.5.12 GT2400_EditRFOffTime

Purpose

Set RF off time of a current list in PC RAM.

Syntax

STATUS **GT2400_EditRFOffTime**(const double RFOffTime)

Parameter	Description
RFOffTime	Input: RF off time for all list points (in ms) 0.1ms ≤RFOffTime ≤1000ms

6.2.5.13 GT2400_EditStepTime

Purpose

Set the step time of a current list in PC RAM.

Syntax

STATUS **GT2400_EditStepTime**(const double stepTime)

Parameter	Description
double stepTime	Input: Step time of the active list (in ms) 0.15ms ≤stepTime ≤1000ms

6.2.5.14 EGT2400_EditSyncOutDelay

Purpose

Set the delay time for the sync out pulse generated

Syntax

STATUS **GT2400_EditSyncOutDelay**(const double syncOutDelay)

Parameter	Description
syncOutDelay	Input: Delay time of sync out pulse(in ms) 0.1ms ≤syncOutDelay ≤1000ms

6.2.5.15 GT2400_CloseAllLists

Purpose

Remove all existing lists from PC RAM.

Syntax

STATUS **GT2400_CloseAllLists**(void)

6.2.5.16 GT2400_CloseAList

Purpose

Remove the selected list from PC RAM.

Syntax

STATUS **GT2400_CloseAList**(const char listPath[])

Parameter	Description
listPath	Input: Complete path (path + list name) of the list being removed.

6.2.5.17 GT2400_DeleteAllListPoints

Purpose

Delete all points of a selected list. The contents of the memory are cleared but the memory is still reserved for this list until the list is closed.

Syntax

STATUS **GT2400_DeleteAllListPoints**(const char listPath[])

Parameter	Description
listPath	Input: Complete path (path + list name) of a list.

6.2.5.18 GT2400_DeleteAListPoint

Purpose

Delete a point of a selected list from PC RAM.

Syntax

STATUS **GT2400_ DeleteAListPoint**(const char listPath[],
const short listPointIndex)

Parameter	Description
listPath	Input: Complete path (path + list name) of the list whose point is deleted

Parameter	Description
listPointIndex	Input: Index of the list point being deleted

6.3 Amplitude Modulation

6.3.0.1 GT2400_SetAMState

Purpose

Set AM on/off.

Syntax

STATUS GT2400_SetAMState(const unsigned long instrumentHandle,
const unsigned short AMState)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
AMState	Input: 1= AM is on, 0 = AM is off.

6.3.0.2 GT2400_SetAMSource

Purpose

Set AM source to external/internal

Syntax

STATUS GT2400_SetAMSource(const unsigned long instrumentHandle,
const short AMSource)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
AMSource	Output: 1= External source, 0 = Internal source.

6.3.0.3 GT2400_SetAMExtSensitivity

Purpose

Set AM sensitivity when AM source is external

Syntax

STATUS GT2400_SetAMExtSensitivity(const unsigned long instrumentHandle,
double AMExtSensitivity)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument

Parameter	Description
AMExtSensitivity	Input: AM sensitivity 0.0 < AMExtSensitivity < 95.0 (%/V)

6.3.0.4 GT2400_SetAMIntWavefrm

Purpose

Set AM internal waveform

Syntax

STATUS GT2400_SetAMIntWavefrm(const unsigned long instrumentHandle, const short AMIntWaveform)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
AMIntWaveform	Input: AM internal waveform 1 = SINE 2 = SQUARE 3 = TRIANGLE 4 = RAMP 5 = NOISE

6.3.0.5 GT2400_SetAMIntRate

Purpose

Set AM internal rate

Syntax

STATUS GT2400_SetAMIntRate(const unsigned long instrumentHandle,
const double AMIntRate)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
AMIntRate	Input: AM internal rate (in Hz) 0.01 Hz <= AMIntRate <= 1 MHz

6.3.0.6 GT2400_SetAMIntDepth

Purpose

Set AM internal depth

Syntax

STATUS GT2400_SetAMIntDepth(const unsigned long instrumentHandle,
const double AMIntDepth)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
AMIntDepth	Input: AM internal depth 0.0 <= AMIntDepth <= 95.0

6.4 Frequency Modulation

6.4.0.1 GT2400_SetFMState

Purpose

Set FM on/off

Syntax

STATUS GT2400_SetFMState(const unsigned long instrumentHandle,
unsigned short FMState)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMState	Input: 1 = FM is on, 0 = FM is off

6.4.0.2 GT2400_SetFMSource

Purpose

Set FM source to external/internal

Syntax

STATUS GT2400_SetFMSource(const unsigned long instrumentHandle,
const short FMSource)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMSource	Input: 1 = External source, 0 = Internal source

6.4.0.3 GT2400_SetFMExtMode

Purpose

Set external FM mode to wide or Auto (narrow).

Syntax

STATUS GT2400_SetFMExtMode(const unsigned long instrumentHandle, const short FMExtMode)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMExtMode	Input: 1 = WIDE, 0 = NARROW

6.4.0.4 GT2400_SetFMExtSensitivity

Purpose

Set FM external sensitivity

Syntax

STATUS GT2400_SetFMExtSensitivity(const unsigned long instrumentHandle, const double FMExtSensitivity, const double freq)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMExtMode	Input: FM sensitivity(in Hz) (Please refer to FM sensitivity/deviation range table in Appendix E)
freq	Input: CW frequency (in Hz)

6.4.0.5 GT2400_SetFMIntWavefrm

Purpose

Set FM internal waveform

Syntax

STATUS GT2400_SetFMIntWavefrm(const unsigned long instrumentHandle, const short FMIntWaveform)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMIntWaveform	Input: FM internal waveform 1 = SINE 2 = SQUARE 3 = TRIANGLE 4 = RAMP

6.4.0.6 GT2400_SetFMIntDev

Purpose

Set FM internal deviation

Syntax

STATUS GT2400_SetFMIntDev(const unsigned long instrumentHandle, const double FMIntDeviation, const double freq)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMIntWaveform	Input: FM deviation(in Hz) (Please refer to FM sensitivity/deviation range table in Appendix E)
freq	Input: CW frequency (in Hz)

6.4.0.7 GT2400_SetFMIntRate

Purpose

Set FM internal rateSyntax

Syntax

STATUS GT2400_SetFMIntRate(cont unsigned long instrumentHandle

double FMIntRate)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
FMIntWaveform	Input: FM internal rate (in Hz) from 0.1 Hz to1 MHz

6.5 Pulse Modulation

6.5.0.1 GT2400_SetPMState

Purpose

Set PM on/off

Syntax

STATUS GT2400_SetPMState(const unsigned long instrumentHandle,
const unsigned short PMState

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMState	Input: 1 = PM is on, 0 = PM is off

6.5.0.2 GT2400_SetPMSource

Purpose

Set PM state to internal or external

Syntax

STATUS GT2400_SetPMSource(const unsigned long instrumentHandle,
const short PMSource)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMSource	Input: 1 = external source, 0 = internal source

6.5.0.3 GT2400_SetPMExtPolarity

Purpose

Set the polarity for the external Pulse mode.

Syntax

STATUS GT2400_SetPMExtPolarity (const unsigned long instrumentHandle, const short PMExtPolarity)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMExtPolarity	Input: 1 = active low, 0 = active high

6.5.0.4 GT2400_SetPMIntTrigSource

Purpose

Set PM trigger source for internal source

Syntax

STATUS GT2400_SetPMIntTrigSource(const unsigned long instrumentHandle,
const short PMIntSource)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMIntSource	Input: PM trigger source for internal source 1 = external trigger source 0 = internal trigger source

6.5.0.5 GT2400_SetPMIntTrigPolarity

Purpose

Set PM trigger polarity for internal source

Syntax

STATUS GT2400_SetPMIntTrigPolarity(const unsigned long instrumentHandle,
const short PMIntPolarity)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMIntPolarity	Input: PM trigger polarity for internal source 1 = falling 0 = rising

6.5.0.6 GT2400_SetPMIntWidth

Purpose

Set pulse width for internal source.

Syntax

STATUS GT2400_SetPMIntWidth(const unsigned long instrumentHandle,
const double PMIntWidth)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMIntWidth	Input: PM pulse width (in usec) 50 usec <= PMIntWidth <= 1 sec

6.5.0.7 GT2400_SetPMIntDelay

Purpose

Set PM delay for internal source.

Syntax

STATUS GT2400_SetPMIntDelay(const unsigned long instrumentHandle,
const double PMIntDelay)

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMIntDelay	Input: PM delay (in usec) 30 usec <= PMIntDelay <= 1.6777215 sec

6.5.0.8 GT2400_SetPMIntPRI

Purpose

Set PM internal trigger PRI (Pulse Repetition Interval) for internal source.

Syntax

STATUS GT2400_SetPMIntTrigPRI(const unsigned long instrumentHandle,
const double PMIntPRI);

Parameter	Description
instrumentHandle	Input: The unique identification of the instrument
PMIntPRI	Input: PM PRI (in usec) 30 usec <= PMIntPRI <= 1.6777215 sec

APPENDIX A

Automation Xpress API Error Definitions for STATUS

Error Code	Values	Definition
ERROR_NO_CONNECTION	-1001	Connection cannot be established between PC and the instrument.
ERROR_INVALID_INSTR_HANDLE	-1002	The input instrument handle is invalid.
ERROR_INVALID_ADDR	-1003	The input GPIB address is invalid or the specified GPIB address has been opened.
ERROR_GPIB_ADDR_OUT_RANGE	-1004	The input GPIB address is out of valid range (1 to 30)
ERROR_INVALID_COMPORT	-1005	The input COM port number is invalid.
ERROR_FAIL_SAVE_REG	-1006	Failure to save data into Windows registry.
ERROR_FAIL_OPEN_REG	-1007	Failure to load data from Windows registry.

Error Code	Values	Definition
ERROR_NO_MEMORY	-1008	Failure to load data from Windows registry.
ERROR_ATTEN_OUT_RANGE	-1009	Attenuation is out of valid range.
ERROR_ATTEN_NOT_INSTALLED	-1010	Attenuator is not installed in the instrument.
ERROR_SYNC_DELAY_OVER_RANGE	-1011	Sync out delay is out of valid range.
ERROR_RF_OFF_TIME_OVER_RANGE	-1012	RF off time is out of valid range.
ERROR_RF_OFF_OVER_STEP_TIME	-1013	RF off time exceeds list step time.
ERROR_LIST_NOT_EXIST	-1014	The input list path does not exist.
ERROR_SOURCELIST_NOT_EXIST	-1015	The source list does not exist.
ERROR_DESTLIST_NOT_EXIST	-1016	The destination list does not exist.
ERROR_FREQ_OUT_RANGE	-1017	Input frequency is out of valid range.
ERROR_BAD_FREQ_INPUT	-1018	Start frequency is greater than stop frequency in list range insertion.
ERROR_STEP_OUT_RANGE	-1019	Step frequency is out of valid range in list range insertion.
ERROR_STEPTIME_OUT_RANGE	-1020	List step time is out of valid range.
ERROR_POWER_OUT_RANGE	-1021	Input power is out of valid range.
ERROR_UNKNOWN_INSERT_TYPE	-1022	List insertion type is not valid.

Error Code	Values	Definition
ERROR_INVALID_IN_POSITION	-1023	List insertion position for new list points are not valid.
ERROR_LISTPT_EXCEED_LIMIT	-1024	Total number of list points exceeds the limit.
ERROR_INVALID_FILE_NAME	-1025	Input file name is invalid.
ERROR_READ_FILE	-1026	Unable to read the input file.
ERROR_INVALID_FILE	-1027	Input file is invalid. It may be caused by incorrect file format.
ERROR_WAIT_EV_TIMEOUT	-1028	Time out before operation completed
ERROR_BAD_POWER_INPUT	-1029	Input power is invalid.
ERROR_INVALID_COMMAND	-1030	Input command is invalid.
ERROR_INVALID_EVENT	-1031	Input event is invalid
ERROR_NULL_PTR	-1032	Function-call failure caused by passing a null pointer.
ERROR_POW_OFFSET_OUT_RANGE	-1033	Power offset is out of valid range.
ERROR_POW_SLOPE_OUT_RANGE	-1034	Power slope is out of range
ERROR_INVALID_INPUT	-1035	Input data is invalid.
ERROR_DB_SYNCHRONIZATION	-1036	Unable to synchronize the instrument database in PC.

Error Code	Values	Definition
ERROR_BAD_READING	-1037	Invalid data is returned from the instrument.
ERROR_FUNC_STACK_OVERFLOW	-1038	Stack buffer for function calls is overflow.
ERROR_EMPTY_STACK_BUFFER	-1039	No data is stored in function-call buffer.
ERROR_CMD_STACK_OVERFLOW	-1040	Stack buffer for commands is overflow.
ERROR_EMPTY_COMMAND_BUFFER	-1041	No data is stored in command buffer.
ERROR_INVALID_AUTO_PATH	-1042	Failed to find Auto Programmer directory.

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