# 2500A Series


Registered 04 June 1996 Amended 10 September 2001

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**2500A Series Microwave Synthesizer Operations Manual**

**34172, Revision C, March 2008**

Analog, RF & Microwave

Giga-tronics

Signal Generation, Routing & Measurement

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**WARRANTY**

Giga-tronics 2500A Series instruments are warranted against defective materials and workmanship for four years from date of shipment. Giga-tronics will at its option repair or replace products that are proven defective during the warranty period. This warranty DOES NOT cover damage resulting from improper use, nor workmanship other than Giga-tronics service. There is no implied warranty of fitness for a particular purpose, nor is Giga-tronics liable for any consequential damages. Specification and price change privileges are reserved by Giga-tronics.

**MODEL NUMBERS**

The 2500A Series has model numbers for each instrument with a specific frequency range as described in Chapter 1. All models are referred to in this manual by the general term 2500A, except where it is necessary to make a distinction between the models. In these cases, the specific model number(s) will be used.

**Giga-tronics, Incorporated**
4650 Norris Canyon Road
San Ramon, California 94583

TEL: 800.726.4442
925.328.4650
FAX: 925.328.4700
www.gigatronics.com

# Declaration of Conformity

Application of Council Directive(s)

**Standard(s) to which Conformity is Declared:**

| | |
|---|---|
| 89/336/EEC and 73/23/EEC | EMC Directive and Low Voltage Directive |
| EN61010-1 (1993) | Electrical Safety |
| EN61326-1 (1997) | EMC - Emissions & Immunity |

**Manufacturer's Name:**

Giga-tronics, Incorporated

**Manufacturer's Address:**

4650 Norris Canyon Road
San Ramon, California 94583
U.S.A.

**Type of Equipment:**

Microwave Synthesizer

**Model Series Number:**

2500A Series

**Model Numbers In Series:**

2508A, 2520A, 2526A, 2540A
2508AS, 2520AS, 2526AS, 2540AS

Declaration of Conformity on file. Contact Giga-tronics, Inc.

4650 Norris Canyon Rd.
San Ramon, CA 94583

Ph: 1-925-328-4650
Fx: 1-925-328-4700

# About The Publication

## Preface

This publication provides an overview and describes local (front panel) operation, remote operation, specifications, and performance verification of the Giga-tronics 2500A family of Microwave Synthesizers. This Preface contains chapter descriptions, a record of changes made to the publication since its production, and a description of the special configurations. Changes that occur after production of this publication, and Special Configuration data will be inserted as loose bound pages in the publication binder. Please insert and/or replace the indicated pages as detailed in the Technical Publication Instructions included with new and/or replacement pages.

### Chapters:

#### 1- Introduction

This chapter contains an overview of the 2500A, basic system information, and input and output descriptions.

#### 2 - Front Panel Operation

This chapter contains information about front panel operation of the instrument. Controls, features, and menus are described, operating tasks are explained, and factory default settings are listed.

#### 3- Remote Operation

This chapter contains information about remote operation of the instrument over the General Purpose Interface Bus (GPIB) or RS-232.

#### 4- Specifications & Performance Verification

This chapter contains 2500A specifications and step-by-step procedures to verify 2500A Series Microwave Synthesizer performance.

### Appendices:

#### A- Accessories and Options

This appendix describes the accessories and options that are available for the 2500A Series Microwave Synthesizers. Each accessory and option is described under its respective heading.

#### B - Error Messages

This appendix provides a description of the various error messages and other user messages that might be encountered during instrument operation.

### Index

A subject listing of contents.

# Conventions

The following safety conventions are used in this publication. Additional conventions not included here are defined at the time of usage.

### Warning

WARNING

**The WARNING statement is encased in gray and centered in the page. This calls attention to a situation, or an operating or maintenance procedure or practice, which if not strictly corrected or observed, could result in injury or death of personnel. An example is the proximity of high voltage.**

### Caution

CAUTION

**The CAUTION statement is enclosed with single lines and centered in the page. This calls attention to a situation, or an operating or maintenance procedure, or practice, which if not strictly corrected or observed, could result in temporary or permanent damage to the equipment, or loss of effectiveness.**

### Notes

NOTE: A NOTE Highlights or amplifies an essential operating or maintenance procedure, practice, condition or statement.

# Configuration Data

## Giga-tronics: Serial, Code, Models, Option or Configuration Label

Examine the code, model number, serial number, and option/configuration label affixed to the rear panel of the 2500A Microwave Synthesizer.

### Code Number

Each instrument has a two-digit code, referred to as the Manufacturing Configuration Code.

### Model Number

Each instrument has a four-digit model number in the form 25*XX*, and one or two character suffix which designates the series:

- 25*XX*B - Benchtop model
- 25*XX*S - ATE model

The frequency range of the instrument is designated by the model number:

- 2508A - 0.1 MHz to 8 GHz
- 2520A - 0.1 MHz to 20 GHz
- 2526A - 0.1 MHz to 26.5 GHz
- 2540A - 0.1 MHz to 40 GHz

### Serial Number

Each instrument has a seven-digit serial number, shown on the label of the rear panel.

### Option Number(s)

When options are installed, one or more 2 digit numbers are listed on the "Opt." line and correspond to options installed in the instrument. Option numbers are explained in Appendix A.

### Special Configurations

When the accompanying product has been configured for user-specific application(s), supplemental pages will be inserted at the front of the publication binder. Remove the indicated page(s) and replace it (them) with the furnished Special Configuration supplemental page(s).

If the "Opt." line contains a three digit number (for example, 641), there is combination of options and/or special modifications installed in the instrument. Information relating to these special configurations is contained in supplemental pages included with the manual.

# Record of Publication Changes

This table is provided for your convenience to maintain a permanent record of publication change data. Replacement pages will be issued as a TPCI (Technical Publication Change Instruction), and will be inserted at the front of the binder. Remove the corresponding old pages, insert the new pages, and record the changes here.

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# Table of Contents

## CHAPTER 1: 2500A INTRODUCTION



## CHAPTER 2: FRONT PANEL OPERATION

# 1 2500A Introduction

## 1.1 Overview

The Giga-tronics 2500A Microwave Synthesizers deliver industry-leading performance combining outstanding low phase noise performance, high output power, and fast switching simultaneously. These features of the 2500A Synthesizer family make it an excellent test solution for a wide range of CW, modulation, swept frequency, and fast frequency switching RF and Microwave applications in both R&D and manufacturing environments. All 2500A Synthesizers comply with MIL-PRF-28800F, Class 3.

The 2500A Synthesizer family is available in two series, with four unique models within each series. Table 1-1 lists the model numbers, and the frequency ranges covered by each model.

**2500A Series.** The 2500A Series includes frequency ranges from 100 kHz to 8 GHz, 20 GHz, 26.5 GHz, and 40 GHz. In addition, external ALC, ramp frequency and power sweep, high stability timebase, 100 MHz reference output, DC-FM, AM, FM, and Pulse capability, and Automation Xpress Interface software and rack ears are all standard features.

### 1.1.1 2500A Frequency Ranges

Table 1-1 shows the various models of the 2500A Series Microwave Synthesizers, and their respective RF output frequency ranges:

**Table 1-1: 2500A Frequency Ranges**

| Models | Frequency Range |
|---|---|
| 2508A/2508AS | 100 kHz to 8 GHz |
| 2520A/2508AS | 100 kHz to 20.199 GHz |
| 2526A/2508AS | 100 kHz to 26.5 GHz |
| 2540A/2508AS | 100 kHz to 40 GHz |

## 1.1.2 2500A Options

The following briefly describes the options that are available within the various series of the 2500A. Appendix A further describes the options:

- Option 17A- Delete Modulation
- Option 17B - Delete Modulation Function Generator
- Option 18- Delete 10 MHz - 2 GHz Frequency Extension
- Option 23 - Type N Connector (2520 Models only)
- Option 26- Delete 90 dB Step Attenuator
- Option 31- Reduced Frequency Switching and Pulse Width Performance
- Option 44- Delete Display Front panel
- Option 46- Rack Slide Kit
- Option 55- Command Sets
    - 55A - HP 8370
    - 55B - HP 8340
    - 55C - HP 8673
    - 55D - HP 8662
    - 55E - Systron-Donner 1720
    - 55F - Wavetek 90X
    - 55G - HP 8350
    - 55H - HP 8360

## 1.1.3 Items Furnished

Accessories and Options are detailed in Appendix A of this publication. In addition to the options and/or accessories specifically ordered, the following items are furnished with the instrument:

- Operation Manual
- USB 1.1/RS-232 Cable Adapter
- Power Cord, 6 ft.
- Giga-tronics Automation Xpress Software Package

## 1.1.4 Items Required

No special items are required to operate the 2500A Series during local (front panel) operation. Remote operation requires some of the following items depending on the interface used:

- IEEE 488 Interface Cable
- PC with GPIB, RS-232, or USB

- Standard 9 Pin Type D Serial Cable

Test equipment required for performance verification is described in Chapter 4.

# 1.2 General Information

All instruments are shipped in operational condition. No special installation procedures are required. Each 2500A Series model must pass rigorous inspections and tests prior to shipment. Following installation, a performance verification should be performed to ensure that operation has not been impaired during shipment. The following below apply to all models:

- Unless otherwise stated, warm-up time of 30 minutes for normal operation
- Performance Verification procedures are outlined in Chapter 4

## 1.2.1 Receiving Inspection

Use care when removing the instrument from the carton and immediately inspect for physical damage, such as bent or broken connectors on the front and rear panels, dents or scratches on the panels, broken handles, etc. Check the shipping carton for evidence of physical damage and immediately report any damage to the carrier.

## 1.2.2 Cooling

A cooling fan is installed in all 2500A Series instruments. The cooling air intake is located on the rear panel. Care must be taken to avoid obstructing the flow of air into the instrument.

## 1.2.3 Cleaning

The air intake screen should be cleaned whenever a significant amount of dust has accumulated on it. Whenever the instrument covers are removed, the interior should be blown out with a dry air at a low velocity.

## 1.2.4 Power

All 2500A models contain primary and standby power with internal switching. The instrument automatically senses input line voltage in the range of 90 to 253 Vac, 47 to 440 Hz. There are no manual voltage adjustments or selection controls (the voltage select wheel within the power module is not used in the 2500A). All 2500A Series have a 3-Wire power cord with a 3-terminal polarized plug for connection to

the power source and safety ground. The power cord must not exceed 3 meters (9 feet) to meet safety requirements.

WARNING

**The safety ground is connected directly to the chassis. If a 3-to-2 wire adapter is to be used, be sure to connect the ground lead from the adapter to earth ground. Failure to do this poses a shock hazard.**

CAUTION

**DO NOT position the equipment so that it is difficult to remove the AC line cord.**

## 1.2.5 Line Fuse

All 2500A Series models have a line fuse holder on the rear panel. The power line fuse is 2A, Slow-Blow, 250V, Type T. See Figure 1-1 below for the location of the line fuse.

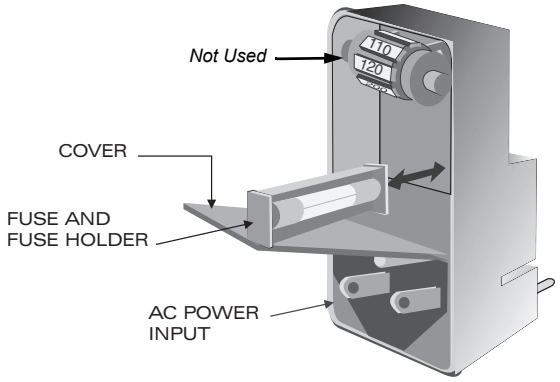


Figure 1-1: Fuse Holder

### 1.2.5.1 Line Fuse Replacement

Open the housing cover. Pull out the small drawer on the right side of the housing (marked with an arrow) and remove the old fuse. Replace with a new fuse, insert the drawer and close the housing cover, see Figure 1-1, above.

NOTE: The voltage select wheel shown in Figure 1-1, above, can be set at any position. Its position has no effect on the 2500A line voltage, as the 2500A line voltage is auto-sensing and auto-setting.

### 1.2.6 Calibration Cycle

Giga-tronics recommends a calibration cycle of two years for the 2500A.

### 1.2.7 Reshipment Preparation

If it is necessary to return the instrument to the factory, protect it during reshipment using the best packaging materials available. If possible, reuse the original shipping container. If the original shipping container is not available, use a strong carton (350lbs./ sq.in. bursting strength) or a wooden box. Wrap the instrument in heavy paper or plastic before placing it into the shipping container. Completely fill the areas on all sides of the instrument with packaging material. Take extra precaution to protect the front and rear panels. Seal the package with strong tape or metal bands. Mark the outside of the package as follows:

**FRAGILE - DELICATE INSTRUMENT**

If corresponding with the factory or local Giga-tronics sales office regarding reshipment, please provide the model and serial number. If the instrument is being returned for repair, be sure to enclose all relevant information regarding the problem that has been found.

NOTE: If returning an instrument to Giga-tronics for service, first contact Customer Service so that a return authorization number (RMA) can be assigned. Contact Giga-tronics via email (repairs@gigatronics.com) or by phone (800.726.4442). The 800 number is only valid within in the United States. Contact can also occur via our domestic line at (925.328.4640) or Fax at (925.328.4702).

## 1.3 Inputs and Outputs

The input and output connectors are shown in figures 1-2 and 1-3. Table 1-3 contains the front and rear panel I/O connector functional descriptions for all 2500A Series models.

## 1.3.1 Front Panel Connector (RF Output)

This is the instrument's RF output. It is located on the front panel of 2500B Series Synthesizer models, and on the rear panel of versions of 2500S Series models.

The type of RF connector that is supplied depends on the frequency range of the instrument. Figure 1-2 shows the general location of the front panel RF output connector on 2500B Series models, and Table 1-2 indicates by model the type of RF connector that is supplied.


Figure 1-2: Series 2500B Front Panel Output

**Table 1-2: RF Connector Types**

| Models | RF Connector Type |
|---|---|
| 2508A/2508AS | N (f) |
| 2520A/2520AS<br>2526A/2526AS | SMA (f) |
| 2540A/2540AS | K (f) |

## 1.3.2 Rear Panel Interface and I/O Connectors

This section defines the functions of the 2500A Series rear panel connectors (see Figure 1-3).

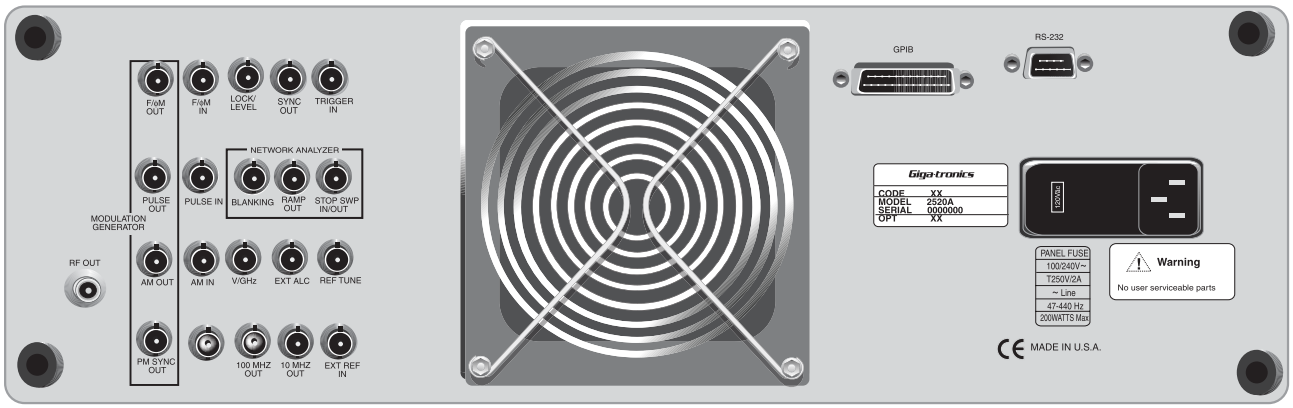

Figure 1-3: 2500A Rear Panel

All rear panel I/O connectors explained in this section are type BNC unless otherwise stated. Some connectors may not be supported because of installed options. For example, Modulation and Modulation Generator connectors are not active with Option 17A or 17B. Table 1-3 describes the 2500A rear panel I/O connectors.

**Table 1-3: 2500A Rear Panel I/O Connector Descriptions**

| Connector Label | Description |
|---|---|
| EXT ALC | In external leveling, the output of the 2500B is detected by either a positive or negative crystal detector or power meter with an analog output. The signals from these devices are connected to the ALC circuitry of the 2500B which is used to compensate for standing wave effects or cable and component losses at the input of the device under test.<br><br>See Section 4.2.8 for External ALC specifications |
| RF OUT | The RF signal output for the instrument. See Table 1-2 for RF connector types.<br><br>It is located on the front panel for all 2500B Series instruments and rear panel for all 2500S Series instruments. |
| FM OUT[1] | The internal modulation generator output;<br>2 Vp-p into 10k Ω. |
| PULSE OUT[1] | A +4V video representation of the pulsed RF output signal. |
| AM OUT[1] | The internal modulation generator output;<br>2 Vp-p into 10k Ω. |
| PM SYNC OUT[1] | A synchronization output pulse of >75 ns width, TTL level that can be delayed relative to the leading edge of the video signal at the PULSE OUT connector. |
| FM IN[2] | A 50 Ω input for an external FM signal. The input signal can be any waveform compatible within bandwidth considerations. A 1 Vp input produces maximum deviation.<br><br>An externally supplied DC signal can be applied to modulate the frequency of the CW output using this connector.<br><br>See Section 4.2.6 for DC FM specifications |
| AM IN[2] | A 600 Ω input for an external AM signal. The input signal can be any waveform compatible within bandwidth considerations. A 1 Vp-p input produces 50% AM depth. |
| PULSE IN/PM TRIG IN[2] | A Pulse Modulation Input for external pulse gating, pulse triggering or external Pulse In. The input parameters are +5 volt, 50 Ω |
| LOCK/LEVEL | +5 volt indicator, active high when the 2500A is phase locked and output leveled. The Lock and Level indicator is valid for CW mode only. |
| REF TUNE | A 0 to +10 volts, high impedance input for tuning the internal reference for adjusting the output frequency approximately ±5 ppm. Do not exceed +15 volts or apply a negative voltage greater than -1 volt. |
| SYNC OUT | In List mode, the unit can be set to generate a pulse at this output when a specified list point is reached. The output can be delayed from the start of the list point up to a maximum of 10 msec. The pulse width of the SYNC OUT signal is determined by the following parameters: pulse width = Step Time - Sync Delay - 10 usec<br><br>In Ramp operation, the pulse occurs at the start of each ramp sweep.<br><br>In either case, the output pulse is +5 volt. |

**Table 1-3: 2500A Rear Panel I/O Connector Descriptions**

| Connector Label | Description |
|---|---|
| TRIGGER IN | Used to trigger a List. Accepts a TTL level signal of > 50 ns width. |
| BLANKING | A +5 volt output signal occurring at band crossings, filter switches, and retraces for the duration of those events. |
| RAMP OUT | A 0 to 10 volt ramp output scaled to the frequency sweep. |
| STOP SWP IN/OUT | Stop Sweep I/O is a 5 volt, 2 K Ω, active low signal that temporarily interrupts an instrument frequency or power ramp sweep. This feature is only available with 2500B models with option 55 and 2500S models with options 55 and 44. |
| V/GHz | An output voltage that is directly proportional to output frequency. For 26 and 40 GHz models, the output is 0.25 volts per GHz. For 8 and 20 GHz models, the output is 0.5 volts per GHz. |
| 100 MHz OUT | A +5 dBm typical, AC coupled, 100 MHz low noise reference output signal into 50 Ω. |
| 10 MHz OUT | A 2 Vp-p 10 MHz square wave reference output signal into 50 Ω. |
| EXT REF IN | The external reference input. Can be either a 10 MHz input that is >-5.0 dBm into 50 Ω or a 100 MHz input > +5 dBm. The 100 MHz input level should not exceed +8 dBm for best performance. |
| GPIB | A 24-pin IEEE STD 488.2 connector for control of the instrument during remote operation using GPIB. |
| RS-232 | A DB-9 connector for control of the instrument during remote operation using RS-232 serial communications. |
| AC Power Input | 90-253 VAC, auto-sensing, 47 Hz to 440 Hz. |

1. Not available with Option 17A or 17B.
2. Not available with Option 17A

# 2 Front Panel Operation

## 2.1 Introduction

This chapter describes how to operate the 2500A Series from the front panel.

The information in this chapter pertains primarily to the 2500A Series of Gigatronics Microwave Synthesizers. Note, however, that while the menus, key sequences, etc., presented in this chapter pertain primarily to front panel operation, the features explained are universal for either the front panel or remote operating modes.

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***NOTE:*** Chapter 3 provides instructions on using the 2500A Series from a remote host computer over the General Purpose Interface Bus (GPIB), an RS-232 serial connection, USB or Ethernet.

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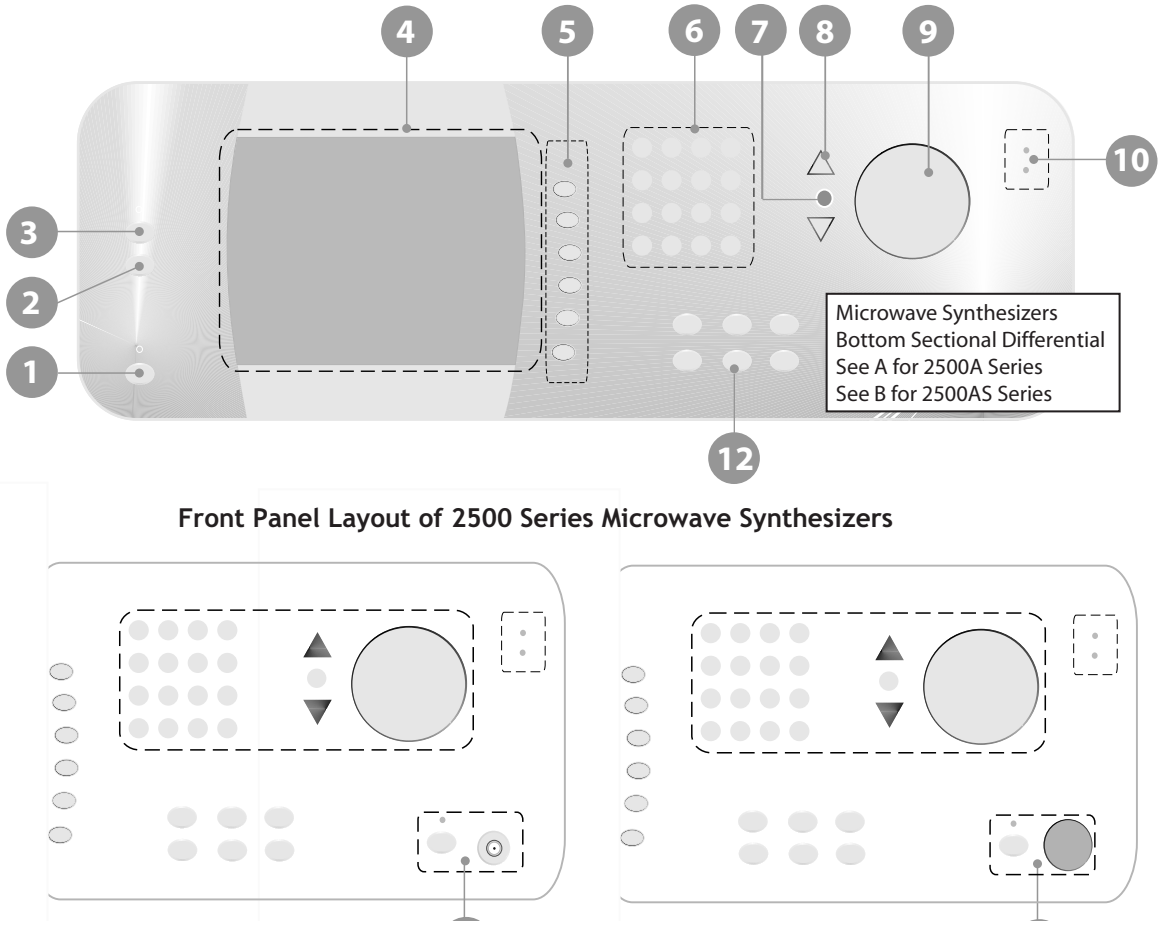
## 2.2 Front Panel At a Glance

The 2500A Series front panel contains the controls and display for local operation of the instrument. Some functions are not available from the front panel; they require use of a PC with a compatible remote interface. Front panel controls are grouped according to the functions they perform. Descriptions for the front panel controls are referenced to the numbers depicted in Figure 2-1 on the next page.




Front Panel Layout of 2500 Series Microwave Synthesizers



**Figure 2-1: 2500A Front Panel with Callouts**

## 2.2.1 Front Panel Description

### Power

The main power switch for the 2500A, which is used to set the power either to on or standby. A blue indicator indicates that main power button is blue, an amber indicator indicates that the main power is off but power is applied to the internal timebase oscillator.

### LOCAL Button

1

Allows front panel access when the unit is in remote mode. If the unit is already in local mode, pressing this button accesses menus that allow you to choose the remote command language to be used by the instrument while remote operation.

### PRESET Button

Presets the 2500A to factory defaults, or initializes NVRAM.

2

- Pressing the PRESET button momentarily presets instrument settings to factory default values, but does not affect system memory locations, display contrast, or the GPIB address.
- Pressing and holding the PRESET button while the unit is powering up initializes NVRAM, which includes presetting instrument settings to factory default values as well as initializing all ten system memory locations, the display contrast, and the GPIB address.

3

### Display

Displays current instrument settings, as well as the menus that allow you to modify the settings. The group of instrument settings and associated menu items that are currently displayed is called the *active display.*

Menus are accessed by pressing the menu buttons. The menus appear along the right-hand side of the display adjacent to the interactive softkeys. To select a particular menu item, press the adjacent interactive softkey. Modify the parameter using the data entry keypad, step-up/step-down buttons, or knob.

4

### Interactive Softkeys

Selects the menu items adjacent to them in the display for modification.

### Data Entry Keypad

A 12-button numeric keypad and adjacent Units buttons for direct entry of instrument parameters.

### STEP SIZE Button

5

Selects and allows editing of the step size used by the Step Up/Down buttons and rotary knob. To change a step size, choose a menu item, press the STEP SIZE button, enter the step size using the keypad, then press the appropriate units button.

6

### Step Up/Down Buttons

Increases or decreases the selected parameter in the display by the amount specified by the step size.

7

### Rotary Knob

Increases or decreases the parameter that is selected in the display. When a maximum or minimum limit is reached, a message will be displayed at the bottom of the display indicating that the parameter limit has been reached.

8

### Front Panel LED indicators

The front panel indicators are located in several places.

9

**Unleveled Indicator.** This indicator is lit when the 2500A output is operating in an unleveled state.

**External Reference (Ext Ref) Indicator.** This indicator is lit when the 2500A is operating with an external reference applied.

10

**RF On/Off Indicator.** This indicator, which is located above the RF ON button, is blue when the 2500A RF output is active. When the RF output is inactive, the indicator is not lit.

**Power Indicator.** This indicator, which is above the main power button, is blue when the unit is on, and amber when the unit is in standby mode.

### RF Output

This is the RF output section for 2500A Series instruments. The 2500A series connector is located on the lower left portion of the front panel.

### Menu Buttons

**CW Button.** Pressing this button displays the CW Menu, which shows parameters related to the CW functions of the instrument, and the Cable Correction functions and their associated menu items.

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**RAMP Button.** Pressing this button displays either the Ramp Freq or Ramp Power Menu, which shows parameters related to either the frequency or power ramp (sweep) functions of the instrument, and their associated menu items.

**SYSTEM Button.** Pressing this button displays either the System 1 or System 2 Menu, which shows parameters related to certain system-level functions, and their associated menu items.

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**AM Button.** Amplitude modulation is not available on the 2500A.

**FM Button.** Frequency Modulation is not available on the 2500A.

**PM Button.** Pressing this button displays the External PM Menu which shows parameters related to the pulse modulation functions of the instrument, and their associated menu items.

## 2.3 2500A Menus

This section provides a brief overview of the 2500A's display and menus, and explains each of the 2500A menus in more detail.

## 2.3.1 Menu System Overview

### 2.3.1.1 Menu Buttons

Most 2500A features and functions are accessed through a series of menus. The menus are accessed by pressing one of the *menu buttons* that are on the front panel of the instrument. As an example, to access the System menus, press the SYSTEM button:


The following menu buttons are available:

**CW, RAMP, SYSTEM, PM, LOCAL.**

The 2500A's front panel display is divided into several functional areas, as shown in Figure 2-2:

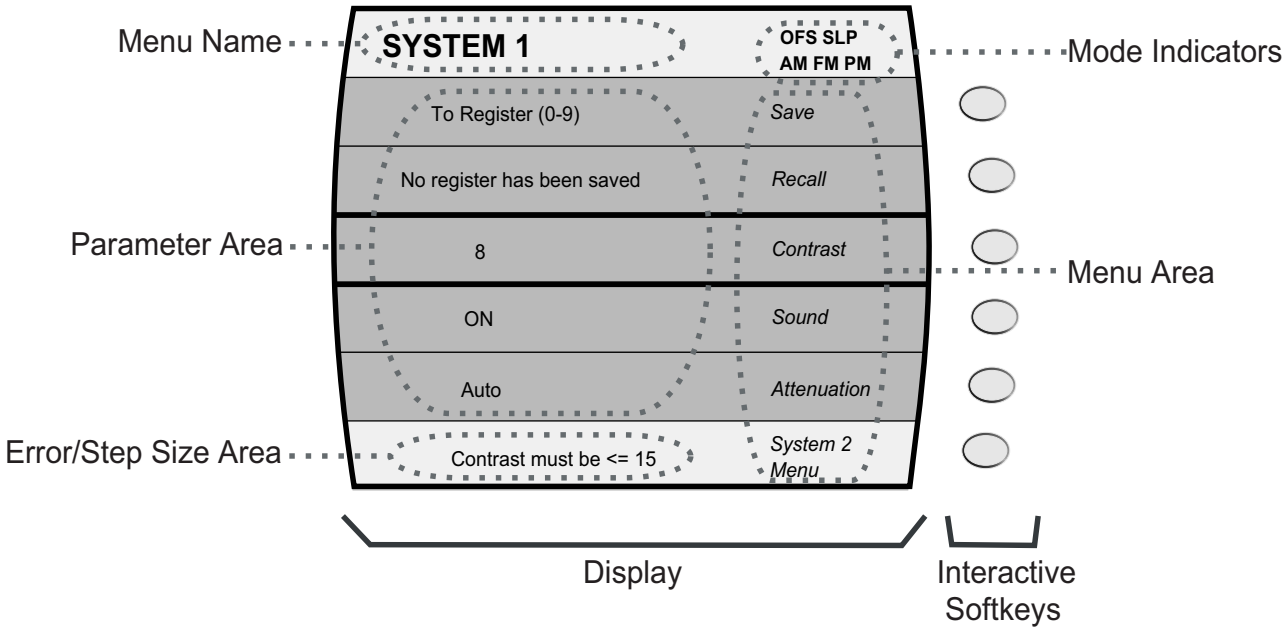



**Figure 2-2: Functional Areas of the 2500A Display**

The following explains each of the functional areas of the display shown in Figure 2-2:

**Menu Name.** This is the name of the menu that is currently shown in the front panel display. The menu that is currently shown is called the *active menu*.

**Menu Area.** This area displays the various menu choices that are available in the active menu. The row containing the menu item and parameter that is currently selected is surrounded by bold lines.

**Parameter Area.** This area displays the current values of the instrument settings that are associated with the active menu. Parameters can be modified.

**Error/Step Size Area.** If applicable, this area shows the currently set step size for the parameter that is selected for modification. Certain non-error user messages might also be displayed in this area.

**Mode Indicators.** Indicators will appear in this area of the display if the instrument is currently in any of several operating modes. If the instrument is currently in a given operating mode, its indicator will appear regardless of the menu that is currently active. The following indicators are available:

***OFS*** - Appears if a power offset of greater than 0 dB is set in the CW menu.

***SLP*** - Appears if a power slope of greater than 0 dB/GHz is set in the CW menu.

***PM*** - Appears if either internal or external pulse modulation is currently enabled.

***EXT. LEVEL*** - Appears if the ALC is set to External.

***UNLK*** - Appears if the Phase Lock Loop is unlocked.

***OVEN COLD*** - Appears if the internal temperature of the 2500A has not reached operational temperature. It is not recommended to use the 2500A while this indicator is active.

## 2.3.2 CW Menu Descriptions

The CW menus display the instrument's currently set CW (continuous wave) frequency, power level, power offset, and power slope, and allows you to make changes to those settings. The Cable Cal menu allows you to perform and a apply a cable offset correction to the CW menu power level setting. The Cable Cal feature requires a Giga-tronics 8650A series power meter or any power meter with a SCPI compatible command set. To access the CW menu, press the front panel CW menu button:


There are two menus associated with the CW menu button. Figure 2-3 shows the CW menu:

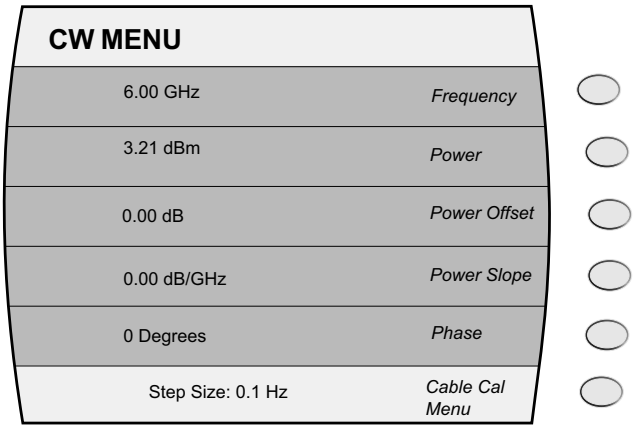



**Figure 2-3: CW Menu with Interactive Softkeys**

The following explains each item in the CW menu:

**Frequency.** This menu item displays and allows you to modify the instrument's CW frequency. The range of the CW frequency parameter is dependent on the model number of the instrument.

**Power.** This menu item displays and allows you to modify the instrument's output power level. The range of the output power level depends on the following configuration and settings of the instrument:

**Power Offset.** This menu item displays and allows you to modify the instrument's power offset. The power offset feature increases the instrument's output power by the amount of the power offset setting, without changing the power level as shown in the Display. This allows you to compensate for the insertion or conversion loss of components that are attached to the instrument's RF output. An example appears in Figure 2-4.

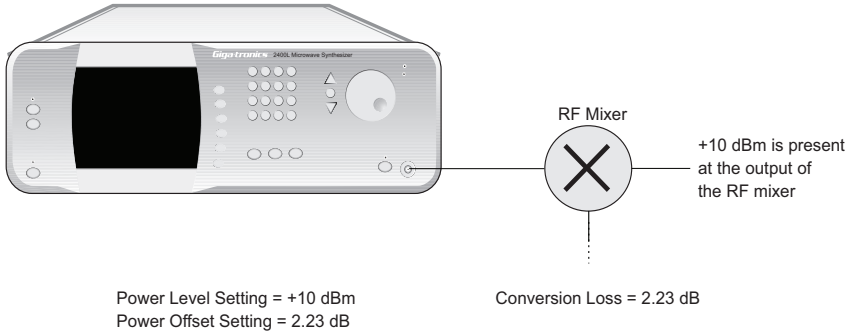



**Figure 2-4: Power Offset Example**

The Power Offset indicator (**OFS**) appears in the upper right-hand corner of the display when any power offset value greater than 0.00 dB is entered.

**Power Slope.** This menu item displays and allows you to modify the instrument's power slope. The power slope feature increases the instrument's output power linearly as a function of the output frequency. The power slope function allows you to automatically compensate for insertion/conversion losses of components attached to the instrument's RF output that exhibit a linear loss characteristic with

frequency. The Power Slope indicator (**SLP**) appears in the upper right-hand corner of the display when any power slope value greater than 0.00 dB/GHz is entered.

**Phase Adjust.** This menu item displays and allows you to modify the phase of the output signal. The phase of the signal is maintained until the phase is readjusted or whenever the instrument frequency setting is changed. When the instrument frequency setting is changed, the phase adjust setting is reset to 0 degrees. Phase Adjust is specified for a minimum frequency range of 500 MHz to the maximum frequency range of the instrument. Phase adjust is available for frequencies below 500 MHz however the output response time of the phase adjust is decreased.

Specifications:

Frequency: 500 MHz to maximum frequency
Range: ±360 degrees
Accuracy: <0.2°, typical

### 2.3.2.1 Cable Cal Menu

This menu allows you to generate an offset table for use with the power level setting in the CW menu using the pre-selected power meter and RS-232 interface. Figure 2-5 shows the Cable Cal RS-232 menu. A similar menu is displayed if an Agilent EPM power meter is selected.

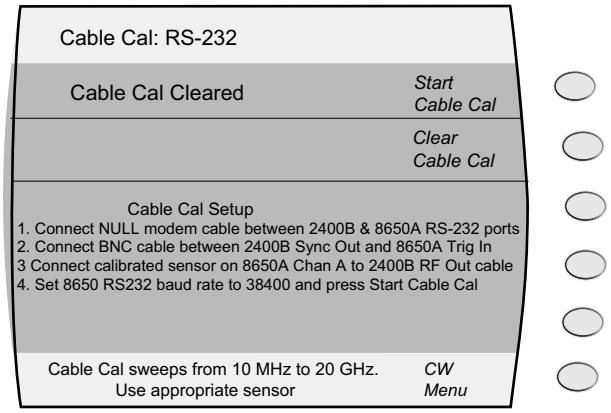



**Figure 2-5: Cable Cal RS-232 Menu**

## 2.3.3 RAMP Menu Descriptions

The RAMP menus display the instrument's currently set ramp frequency sweep and ramp power sweep settings, and allow you to make changes to those settings.


There are 7 menus associated with the RAMP menu button. There is one top level menu that alllows access to any of the 6 sweep function menus. Figure 2-6 shows the Sweep Main Menu.

**Figure 2-6: Top Level Sweep Menu**

**Ramp Freq Start/Stop Sweep Menu.** Pressing this softkey invokes the Ramp Freq Start/Stop menu in the display. See “Ramp Freq 1 Menu”, for Ramp Freq menu item descriptions.

**Ramp Freq Center/Span Sweep Menu.** Pressing this softkey invokes the Ramp Freq Center/Span menu in the display. See “Ramp Freq 2 Menu”, for Ramp Freq menu item descriptions.

**Ramp Power Sweep Menu.** Pressing this softkey invokes the Ramp Power Sweep menu in the display. See “Ramp Power Menu”, for Ramp Power menu item descriptions.

**Step Freq Sweep Menu.** Pressing this softkey invokes the Step Freq Sweep menu in the display. See “Step Sweep Freq Menu”, for Step Frequency Sweep menu item descriptions.

### 2.3.3.1 Ramp Freq 1 Menu

The Ramp Freq 1 menu will generate a frequency sweep where the start and stop frequencies are specified. The Ramp Freq 1 menu allows you to view and modify settings related to the instrument’s frequency sweep features. When this menu is used, the frequency of the RF output can be swept linearly from a predetermined start frequency to a predetermined stop frequency in a predetermined sweep time.

---

***NOTE:*** As soon as any Ramp or Step menu is chosen, the instrument calculates the sweep, then begins sweeping the output frequency. The ramp is recalculated whenever a parameter is changed. During calculations, the following message is shown at the bottom of the display:

Preparing sweeping data...

When the calculations are complete and the output is actively sweeping, the following message is shown:

Ramp sweeping

---

Figure 2-7 shows the Ramp Freq 1menu:

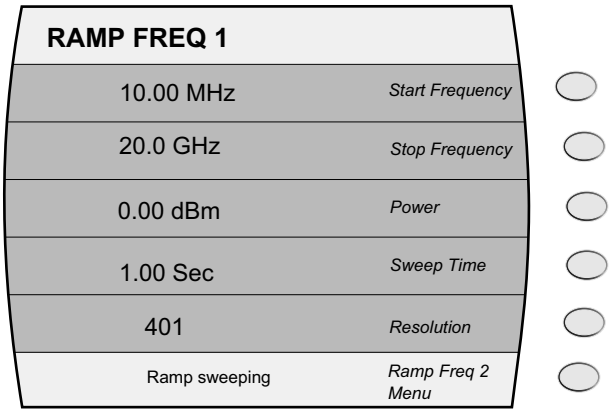


**Figure 2-7: Ramp Freq Menu with Interactive Softkeys**

The following explains each item in the Ramp Freq menu:

**Start Frequency.** This menu item displays and allows you to modify the ramp start frequency. This is the frequency that will be used as the starting frequency of the frequency sweep. Note that the start frequency must be less than the stop frequency. If the start frequency is set higher than the stop frequency, the stop frequency is automatically adjusted to the same value.

**Stop Frequency.** This menu item displays and allows you to modify the ramp stop frequency. This is the frequency that will be used as the ending frequency of the frequency sweep. Note that the stop frequency must be greater than the start frequency. If it is set lower than the start frequency, the start frequency is automatically adjusted to the same value.

**Power.** This menu item displays and allows you to modify the output power level to be used during the frequency sweep. The range of the power level depends on the following configuration and settings of the instrument:

**Sweep Time.** This menu item allows you to view and modify the sweep time. This is the amount of time that elapses for one cycle of a frequency sweep to complete.

**Resolution.** This menu item allows you to view and modify the sweep step resolution. The sweep step resolution can be set to 401, 801 and 1601 frequency steps.

**Ramp Freq 2 Menu.** Pressing this softkey invokes the Ramp Freq 2 menu (Center/Span Frequency) menu in the display.

### 2.3.3.2 Ramp Freq 2 Menu

The Ramp Freq 2 Menu will generate a ramp frequency sweep where the center frequency and sweep span paramters are specified. The menu allows you to view and modify settings related to the instrument's frequency sweep features. When this menu is used, the frequency of the RF output can be swept linearly referenced from the center frequency with a predetermined span frequency in a predetermined sweep time.

Figure 2-8 shows the Ramp Freq Start/Stop menu:

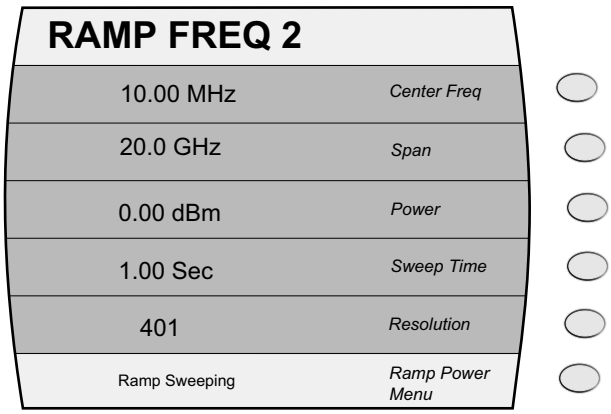



**Figure 2-8: Center/Span Ramp Freq Menu with Interactive Softkeys**

The following explains each item in the Ramp Freq Center/Span menu:

**Center Frequency.** This menu item displays and allows you to modify the ramp start frequency. This is the frequency that will be used as the starting frequency of the frequency sweep. Note that the start frequency must be less than the stop frequency. If the start frequency is set higher than the stop frequency, the stop frequency is automatically adjusted to the same value.

**Span Frequency.** This menu item displays and allows you to modify the ramp span frequency. The span determines the range of the frequency weep beginning at half the value of the span setting lower than the center frequency and ending at a frequency one half the value of the span setting higher than the center frequency.

**Power.** This menu item displays and allows you to modify the output power level to be used during the center/span frequency sweep. The range of the power level can be set to any valid power setting of the instrument.

**Sweep Time.** This menu item allows you to view and modify the sweep time. This is the amount of time that elapses for one cycle of a frequency sweep to complete.

**Resolution.** This menu item allows you to view and modify the sweep step resolution. The sweep step resolution can be set to 401, 801 and 1601 frequency steps.

**Ramp Power Menu.** Pressing this softkey invokes the Ramp Power menu in the display. See "Ramp Power Menu", below, for Ramp Power menu item descriptions.

### 2.3.3.3 Ramp Power Menu

The Ramp Power menu allows you to view and modify settings related to the instrument's power sweeping feature. When this feature is used, the power level of the RF output sweeps linearly from a predetermined start power level to a predetermined stop power level in a predetermined amount of time, then repeats. The power level can sweep from a lower to a higher power level, or vice versa. The output frequency is held at the same value during a power sweep. The maximum settable range for ramp power sweep is 45 dB.

---

***NOTE:*** As soon as the Ramp Power menu is chosen, the instrument calculates the ramp, then begins sweeping the output power. The ramp is recalculated whenever a parameter is changed. During calculations, the following message is shown at the bottom of the display:

Preparing sweeping data...

When the calculations are complete and the output is actively sweeping, the following message is shown:

Ramp sweeping

---

Figure 2-9 shows the Ramp Power menu:

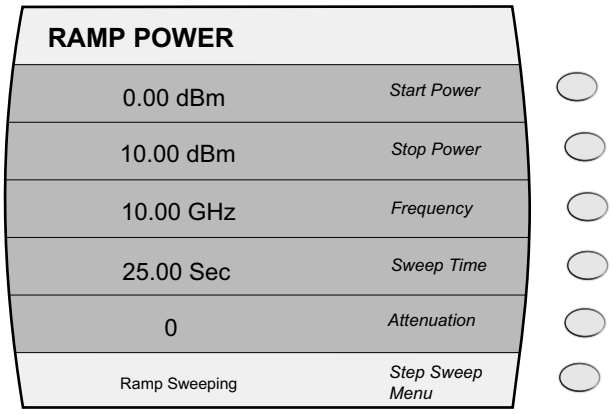



**Figure 2-9: Ramp Power Menu with Interactive Softkeys**

The following explains each item in the Ramp Power menu:

**Start Power.** This menu item displays and allows you to modify the ramp start power level. This is the power level that will be used as the beginning of the power level sweep.

The range for the start power parameter is -20 dBm to +25 dBm if the 90 dB step attenuator is not installed in the instrument. If the 90 dB step attenuator is installed, the start power range is from 25 dB above to 20 dB below the step attenuator setting chosen.

**Stop Power.** This menu item displays and allows you to modify the ramp stop power level. This is the power level that will be used as the end point of the power level sweep.

The range for the stop power parameter is -20 dBm to +25 dBm if the 90 dB step attenuator is not installed in the instrument. If the 90 dB step attenuator is installed, the stop power range is from 25 dB above to 20 dB below the step attenuator setting chosen.

**Frequency.** This menu item displays and allows you to modify the output frequency to be used during the power level sweep. The range of the frequency parameter is dependent on the model number of the instrument.

**Sweep Time.** This menu item allows you to view and modify the sweep time. This is the amount of time that elapses for one cycle of a power level sweep to complete.

**Attenuation.** This menu item allows you to select a range of the step attenuator if it is installed in the instrument. The step attenuator can insert up to 90 dB of attenuation into the RF output path of the instrument, in selectable 10 dB steps.

**Step Sweep Menu.** Pressing this softkey invokes the Ramp Freq menu in the display. See “Ramp Freq 1 Menu”, above, for Ramp Freq menu item descriptions.

### 2.3.3.4 Step Sweep Freq Menu

The Step Sweep menu allows you to view and modify settings related to the instrument’s frequency sweeping feature. When this feature is used, the frequency of the RF output sweeps linearly from a predetermined start frequency to a predetermined stop frequency in a predetermined sweep time, then

repeats. The sweep occurs in a set number of equal increments, as determined by the Resolution setting. The output power is held at the same level during a frequency sweep.

---

***NOTE:*** As soon as theStep Swep menu is chosen, the instrument calculates the ramp, then begins sweeping the output frequency. The ramp is recalculated whenever a parameter is changed. During calculations, the following message is shown at the bottom of the display:

Preparing sweeping data...

When the calculations are complete and the output is actively sweeping, the following message is shown:

Step sweeping

---

Figure 2-10 shows the Step Sweep menu:

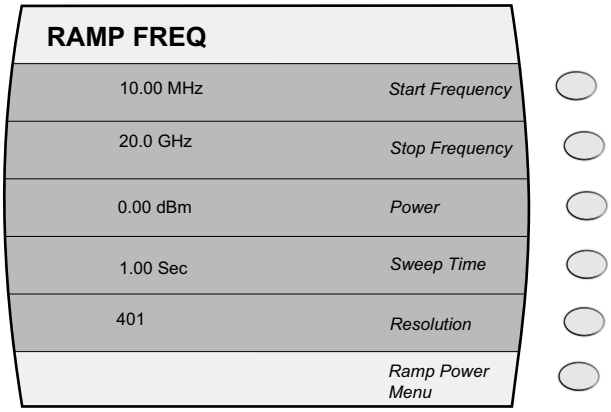



**Figure 2-10: Ramp Freq Menu with Interactive Softkeys**

The following explains each item in the Ramp Freq menu:

**Start Frequency.** This menu item displays and allows you to modify the ramp start frequency. This is the frequency that will be used as the starting frequency of the frequency sweep. Note that the start frequency must be less than the stop frequency. If the start frequency is set higher than the stop frequency, the stop frequency is automatically adjusted to the same value.

**Stop Frequency.** This menu item displays and allows you to modify the ramp stop frequency. This is the frequency that will be used as the ending frequency of the frequency sweep. Note that the stop frequency must be greater than the start frequency. If it is set lower than the start frequency, the start frequency is automatically adjusted to the same value.

**Power.** This menu item displays and allows you to modify the output power level to be used during the frequency sweep. The range of the power level depends on the following configuration and settings of the instrument:

**Step Time.** This menu item allows you to view and modify the step time. This is the amount of time that a single frequency step is executed. When the last frequency in the step sweep is executed and com-

pleted, the sweep continues with the start frequency and cycles continuously until a change in the menu made or

**Step Size.** This menu item allows you to view and modify the frequency step size. The step size can be set to the minimum frequency resolution of the synthesizer to the maximum frequency range of the synthesizer.

**Ramp Freq 1 Menu.** Pressing this softkey invokes the Ramp Freq 1 menu in the display. See "Ramp Freq 1 Menu", below, for Ramp Power menu item descriptions.

## 2.3.4 SYSTEM Menu Descriptions

The System menus provide access to system-level settings, such as memory storage locations, GPIB address configuration, display contrast, and system volume control. System information, including the model number, serial number, firmware version, etc., can also be displayed. To access the System menus, press the front panel SYSTEM menu button:


There are three menus associated with the SYSTEM menu button.

### 2.3.4.1 System 1 Menu

The System 1 menu allows you to save instrument states to non-volatile memory and subsequently recall them, and view and set the display contrast, turn system sound (audio feedback) on or off, and view and configure the step attenuator if the 90 dB step attenuator is installed.

Figure 2-11 shows the System 1 menu:

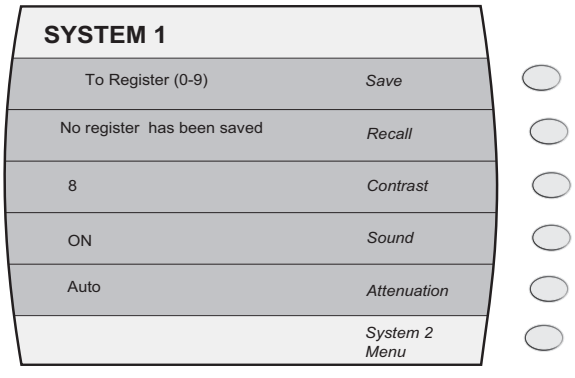



**Figure 2-11: System 1 Menu with Interactive Softkeys**

The following explains each item in the System 1 menu:

**Save.** This menu item allows you to save the current state of the instrument to non-volatile memory, so that the saved state can subsequently be restored. The 2500A contains ten registers, numbered 0 through 9, into which instrument states can be saved. Note that saving an instrument state to a given register overwrites any state that might have previously been stored in that register.

To save the current instrument configuration to a given register, select the Save menu item, enter the number of the register into which you wish to save the configuration using the numeric keypad, then press any units button.

Only the numeric keypad can be used to enter a register number; the step up/step down buttons and rotary knob cannot be used.

**Recall.** This menu item allows you to recall a previously saved instrument state from any of the ten storage registers contained in the instrument's non-volatile memory.

The parameter area in the display shows the following text:

From Register (*X*)

Where *X* is the list of registers, separated by commas, that currently have an instrument state saved in them. For example, if instrument states are currently stored in registers 1, 2, and 5, the parameter area would read as follows:

From Register (1, 2, 5)

If none of the registers have instrument states saved to them, as would be the case after the instrument's memory is cleared, the following is displayed in the parameter area:

No register has been saved

To recall a previously saved instrument configuration, press the Recall softkey, enter the number of the register from which you wish to recall the configuration using the numeric keypad, then press any units button.

Only the numeric keypad can be used to enter a register number; the step up/step down buttons and rotary knob cannot be used.

**Contrast.** This menu item allows you to set the contrast of the instrument's front panel display. The contrast range is 1 to 15, where 1 represents most contrast and results in the darkest display, and 15 represents least contrast and results in the lightest display.

**Sound.** This menu item allows you to enable or disable (mute) the system sound.

The available selections are ON and MUTE. When Sound is set to ON, the instrument provides audio feedback whenever a button is pressed or the knob is rotated, and an operational error notification is emitted when an error condition occurs, such as when an improper button sequence is pressed, a parameter limit is exceeded, etc.

**Attenuation.** This menu item provides control of the step attenuator if it is installed in the instrument.

The step attenuator can insert up to 90 dB of attenuation into the RF output path of the instrument. It is switchable in 10 dB steps, and can be set to automatically switch as the instrument's power level is varied, or it can be manually set to insert a fixed amount of attenuation.

**System 2 Menu.** Pressing this softkey invokes the System 2 Menu in the display. See "System 2 Menu", below, for System 2 Menu item descriptions.

### 2.3.4.2 System 2 Menu

The System 2 menu allows you to view and modify the instrument's GPIB address, ALC setting, and view system information.

Figure 2-12 shows the System 2 menu:

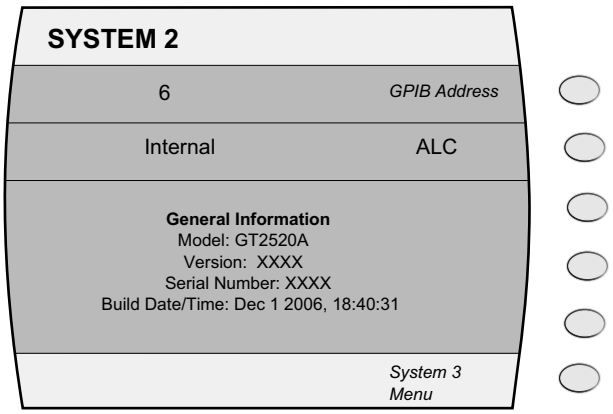



**Figure 2-12: System 2 Menu with Interactive Softkeys**

The following explains each item in the System 2 menu:

**GPIB Address.** This menu item allows you to set the instrument's General-Purpose Interface Bus (GPIB) address. The GPIB address range is 1 to 30.

**ALC.** This menu item allows you to set the instrument's ALC input. The ALC input settings are Internal, Positive Detector, Negative Detector and Power Meter. External ALC enables the instrument to compensate for device transmission losses without user intervention.

**General Information.** This field displays 2500A system information. This information is for display only; it has no associated menu choice. The following information is displayed:

- *Model* - This is the specific model number of the instrument.
- *Version* - This is the specific firmware version installed in the instrument.
- *Serial Number* - This is the instrument's serial number.
- *Build Date/Time* - This is the date and time when the firmware version was created.

**System 3 Menu** Pressing this softkey invokes the System 3 Menu in the display.

### 2.3.4.3 System Menu 3

The System 3 menu allows you to tune the output frequency over a range of 500 ppm using the REF TUNE feature.

Figure 2-13 shows the System 3 menu.

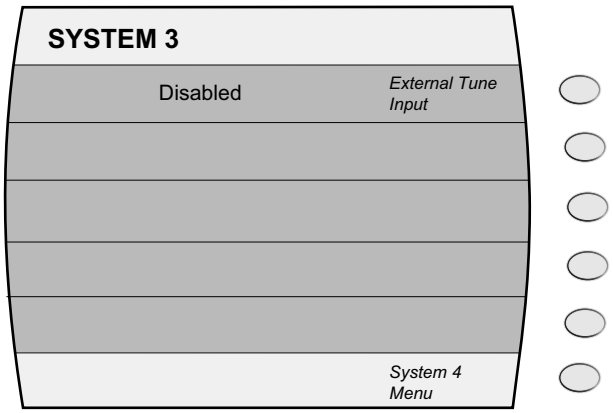



**Figure 2-13: System 3 menu with Interactive Softkeys.**

**External Tune Input.** This menu item allows you to enable or disable the instrument's Reference Tune feature.

**System 4 Menu** Pressing this softkey invokes the System 4 Menu in the display.

### 2.3.4.4 System Menu 4

The System Menu 4 allows you to set up the 2500A for remote operations using the LAN connection.

Figure 2-14 shows the System 4 menu.

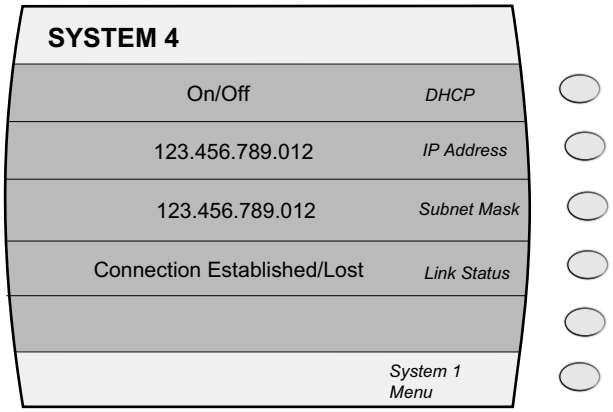



**Figure 2-14: System 4 menu with interactive Sofkeys**

**DHCP.** This menu item allows you to configure the 2500A Dynamic Host Configuration Protocol to be set manually or allow a DHCP server to obtain the IP and Subnet Mask. When the DHCP is set to Off, the previously stored static IP address will be displayed.

**IP Address.** This menu item allows you to set the instrument's IP (Internet Protocol) address. The range for each of the sections is 0 to 255.

**Subnet Mask.** This menu item allows you to set the instrument's Subnet Mask. The range for each of the sections is 0 to 255.

**Connection Established/Lost.** This menu item serves as a link status indicating whether the 2500A ethernet connection is established or disconnected.

The default port number for the 2500A series is 2550

## 2.3.5 AM Menu Descriptions

The AM menus provide access to the internal and external amplitude modulation features of the instrument. To access the main AM menus, press the front panel AM menu button:


There are three menus that can be accessed from the main AM Menu.

Figure 2-15 shows the main AM menu.

**Figure 2-15: AM Main Menu with Interactive Soft Keys**

**AM Ext Menu.** Pressing this softkey invokes the externally driven Amplitude Modulation menu in the display. See "External AM Menu", for AM Ext menu item descriptions.

**AM Int Menu.** Pressing this softkey invokes the internally driven Amplitude Modulation menu in the display. See "AM - Internal Waveform", for AM Int menu item descriptions.

**AM Int Noise Menu.** Pressing this softkey invokes the Amplitude Modulation Internal Noise menu in the display. See "AM - Internal Noise", for AM Ext menu item descriptions.

### 2.3.5.1 External AM Menu

The AM - External Menu allows you to view and modify settings related to external amplitude modulation mode, which is used when the modulating signal is to be provided externally. In external AM mode, the RF output signal is modulated according to the signal that is applied to the rear panel AM IN connector.

Figure 2-16 shows the AM External Menu:

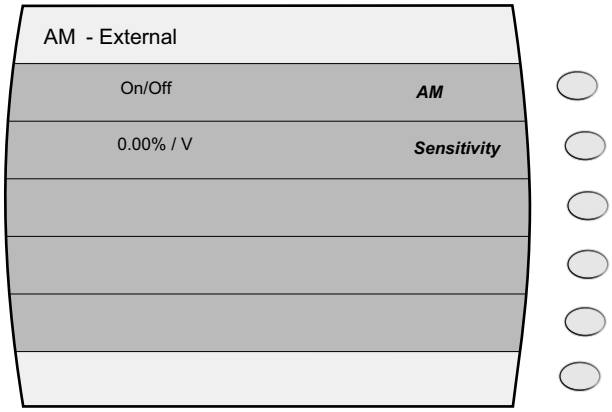



**Figure 2-16: AM - External menu with Interactive Softkeys**

The following explains each item in the AM - External menu:

**AM.** This menu item turns amplitude modulation on and off. Note that this setting only enables or disables amplitude modulation; it is the active menu, that is, the menu that is currently being displayed, that determines the AM mode that is used. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the AM state.

The **AM** indicator is displayed in the upper right-hand corner of the display when amplitude modulation is turned on.

**Sensitivity.** This menu item allows you to view and modify the AM sensitivity setting. AM sensitivity determines the percentage of modulation produced per volt of input into the AM IN connector.

The AM sensitivity can be modified using either the numeric keypad, the step up/step down buttons, or the rotary knob. The AM sensitivity range is 0 to 95%/volt, and the step size can be set in the range of 0.10 to 47.5%/volt.

### 2.3.5.2 AM - Internal Waveform

The AM - Internal Waveform menu allows you to view and modify settings related to an internal amplitude modulation mode in which the modulating signal is an internally-generated sine, triangle, ramp, or square waveform (the signal at the AM IN connector is not used).

Figure 2-17 shows the AM - Internal Waveform menu:

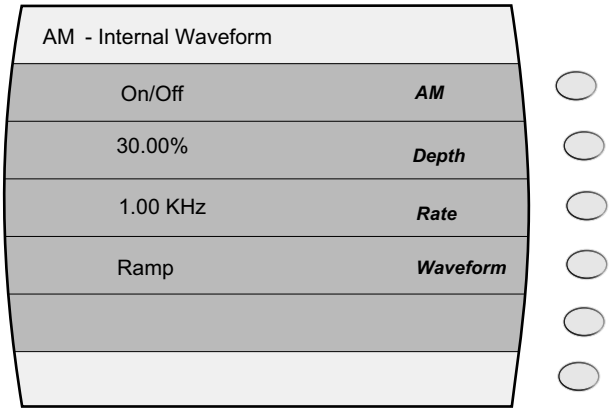



**Figure 2-17: AM - Internal Waveform with Interactive Softkeys**

The following explains each item in the AM- Internal Waveform menu:

**AM. T**This menu item turns amplitude modulation on and off. Note that this setting only enables or disables amplitude modulation; it is the active menu, that is, the menu that is currently being displayed, that determines the AM mode that is used. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the AM state.

**Depth.** This menu item allows you to view and modify the AM depth setting, which is the extent of the variation of the modulated RF output signal's amplitude expressed as a percentage.

**Rate.** This menu item allows you to view and modify the rate (frequency) of the internal modulating signal.

**Waveform.** This menu item allows you to view and choose the type of waveform used as the internal modulating signal. The available selections are Sine, Triangle (symmetrical triangle wave), Ramp (positive going ramp), or Square (50% duty cycle square wave).

### 2.3.5.3 AM - Internal Noise

The AM - Internal Noise menu allows you to view and modify settings related to an internal amplitude modulation mode in which the modulating signal is an internally-generated Gaussian noise source (the signal at the AM IN connector is not used).

Figure 2-18 shows the AM - Internal Noise menu:

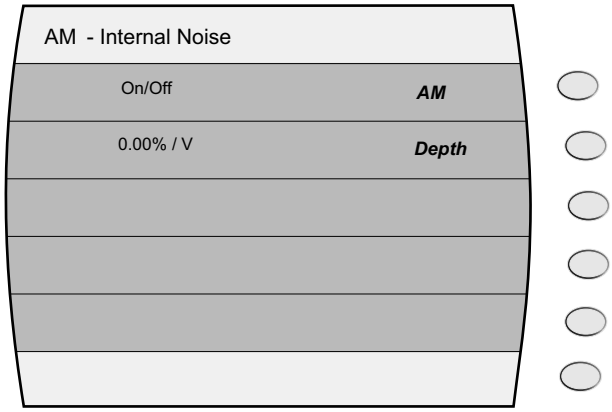
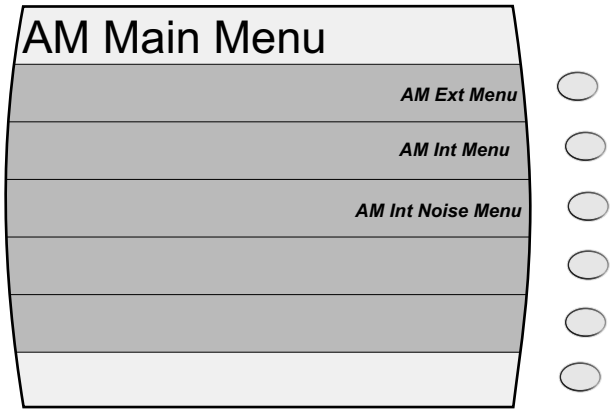



**Figure 2-18: AM - Internal Noise with Interactive Softkeys**

The following explains each item in the AM - Internal Noise menu:

**AM.** This menu item turns amplitude modulation on and off. Note that this setting only enables or disables amplitude modulation; it is the active menu, that is, the menu that is currently being displayed, that determines the AM mode that is used. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the AM state.

**Depth.** This menu item allows you to view and modify the AM depth setting, which is the extent of the variation of the modulated RF output signal's amplitude expressed as a percentage.




## 2.3.6 FM Menu Descriptions

The FM menus provide access to the internal and external frequency modulation features of the instrument. To access the FM Main menu, press the front panel FM menu button:

There are three FM that can be accessed.

### 2.3.6.1 FM - External Menu

The FM -External menu allows you to view and modify settings related to external frequency modulation mode, which is used when the modulating signal is to be provided externally. In external FM mode, the RF output signal is modulated according to the signal that is applied to the rear panel FM/ϕM IN connector.

Figure 2-19 shows the FM - External menu:

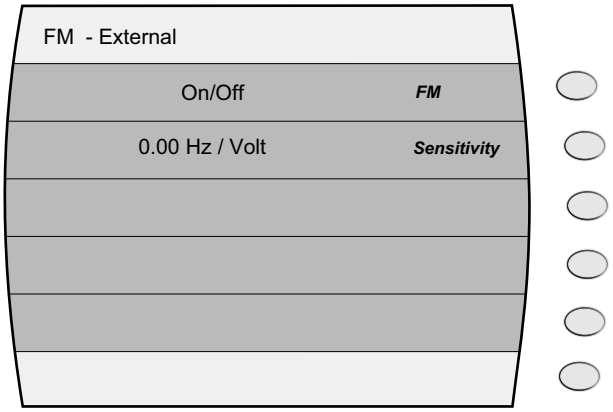



**Figure 2-19: FM - External Menu with Interactive Softkeys**

The following explains each item in the FM - External menu:

**FM.** This menu item turns frequency modulation on and off. Note that this setting only enables or disables amplitude modulation; it is the active menu, that is, the menu that is currently being displayed, that determines the FM mode that is used. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the FM state.

**Sensitivity.** This menu item allows you to view and modify the external FM sensitivity setting, which determines how much the RF output deviates in frequency per volt of signal at the rear panel FM/ϕM IN connector.

### 2.3.6.2 FM - Internal Menu

The FM - Internal menu allows you to view and modify settings related to an internal frequency modulation mode in which the modulating signal is an internally-generated sine, triangle, ramp, or square waveform (the signal at the FM/ϕM IN connector is not used).

Figure 2-20 shows the FM - Internal menu:

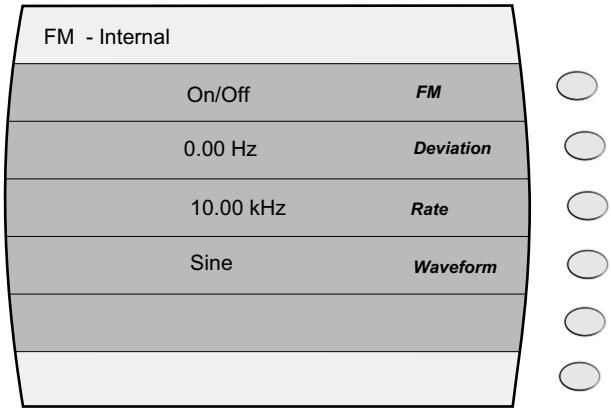



**Figure 2-20: FM - Internal with Interactive Softkeys**

The following explains each item in the FM - Internal menu:

**FM.** This menu item turns FM - Internal on and off. FM - Internal is an internally driven modulation requiring a + 1 V peak to peak input for maximum deviation. FM - Internal can only be activated or deactivated using the step up/step down buttons.

**Deviation.** This menu item allows you to view and modify the FM deviation setting, which determines how much the RF output deviates in frequency when modulated by the internal source.

**Rate.** This menu item allows you to view and modify the rate (frequency) of the internal modulating signal.

**Waveform.** This menu item allows you to view and choose the type of waveform used as the internal modulating signal. The available selections are Sine, Triangle (symmetrical triangle wave), Ramp (positive going ramp), or Square (50% duty cycle square wave).

### 2.3.6.3 DC FM Menu

The FM Menu 3 menu allows you to activate and deactivate the DC FM feature of the instrument. DC FM requires an externally provided signal to modulate the output frequency of the instrument. In DC FM mode, the RF output signal is modulated according to the signal that is applied to the rear panel FM/ϕM IN connector. DC FM is available on all models including models with option 17A, Delete Modulation Suite. Frequency range for DC FM operation is 500 MHz to the maximum frequency of the instrument with a fixed maximum deviation of 125 kHz. DC FM operation is available for frequencies below 500 MHz however maximum deviation is limited to the frequency band maximum deviation of the output frequency.

Figure 2-21 shows the FM Menu 2 menu:

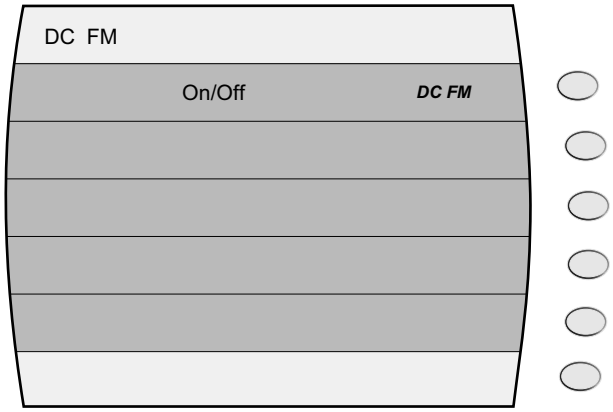



**Figure 2-21: DC FM with Interactive Softkey**

The following explains each item in the DC FM menu:

**DC FM.** This menu item turns frequency modulation on and off. Note that this setting only enables or disables amplitude modulation; it is the active menu, that is, the menu that is currently being displayed, that determines the FM mode that is used. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the FM state.

## 2.3.7 PM Menu Descriptions

The PM menus provide access to the internal and external pulse modulation features of the instrument. To access the PM Main menu, press the front panel PM menu button:


There are five menus associated with the PM menu button.

Figure 2-22 shows the PM Main menu

**Figure 2-22: PM Main Menu with Interactive Soft Keys**

**PM Ext Menu.** Pressing this softkey invokes the externally driven Pulse Modulation menu in the display. See “PM - External Source Menu”, for PM Ext menu item descriptions.

**PM Int Cont Menu.** Pressing this softkey invokes the internally driven Pulse Modulation menu in the display. See “PM Internal-Continuous Menu”, for PM Int menu item descriptions.

**PM Int Gated Menu.** Pressing this softkey invokes the gated, internally driven Pulse Modulation menu in the display. See “PM Internal-Gated Menu”, for PM Int Gated menu item descriptions.

**PM Int Trig Menu.** Pressing this softkey invokes the externally driven Amplitude Modulation menu in the display. See “PM Internal-Triggered Menu”, for PM Ext menu item descriptions.

### 2.3.7.1 PM - External Source Menu

The PM - External menu allows you to view and modify settings related to external pulse modulation mode, which is used when the modulating signal is to be provided externally. In external PM mode, the RF output signal is pulsed according to the signal that is applied to the rear panel PULSE IN/PM TRIG IN connector. When the instrument does not include the internal modulation generator, this is the only PM mode that is available.

Figure 2-23 shows the PM Menu 1 menu:

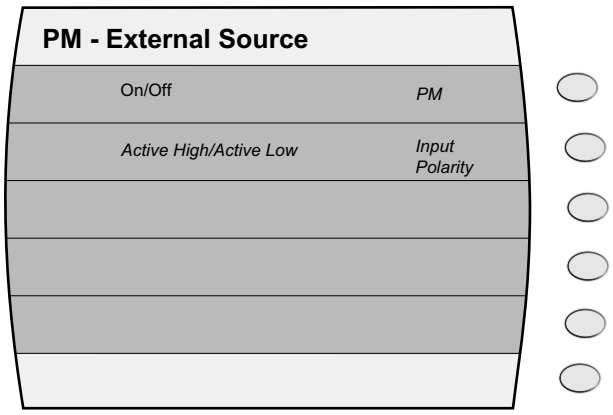



**Figure 2-23: PM Menu 1 with Interactive Softkeys**

The following explains each item in the PM Menu 1 menu:

**PM. T**This menu item turns pulse modulation on and off. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the PM state. The **PM** indicator is displayed in the upper right-hand corner of the display when pulse modulation is turned on

**Input Polarity.** This menu item allows you to view and choose the input polarity. Input polarity determines whether a high or low TTL level at the PULSE IN/PM TRIG IN connector will produce an "on" condition at the RF output. The available selections are as follows:

- *Active High*
- *Active Low*

### 2.3.7.2 PM Internal-Continuous Menu

The PM - Internal Continuous menu allows you to view and modify settings related to an internal pulse modulation mode which produces a continuous pulse modulated RF output with pulse characteristics determined by an internally-generated pulse signal (any signal at the PULSE IN/PM TRIG IN connector is ignored).

---

***NOTE:*** This menu is not available for models with Option 17B.

---

Figure 2-24 shows the PM Menu 2 menu:

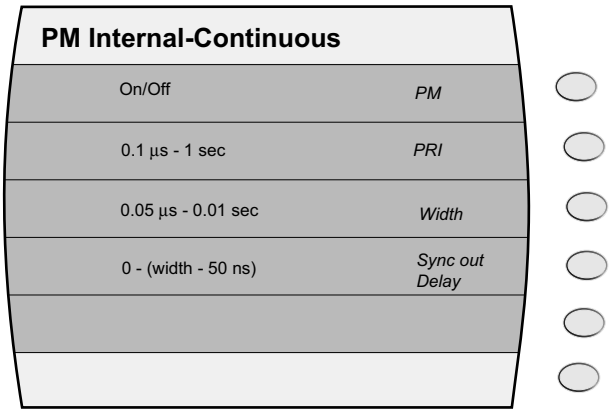



**Figure 2-24: PM Menu 2 with Interactive Softkeys**

The following explains each item in the PM Menu 2 menu:

**PM.** This menu item turns pulse modulation on and off. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the PM state. The **PM** indicator is displayed in the upper right-hand corner of the display when pulse modulation is turned on

**PRI.** This menu item allows you to view and modify the PRI (pulse repetition interval) of the internal pulse modulating signal. The PRI parameter sets the time between like edges of the modulating signal, and thus, the RF output's pulse repetition interval (frequency).

---

***NOTE:*** The same PRI parameter setting gets used for the internal continuous and internal gated pulse modulation modes; it is not set and stored separately for those modes.

---

**Width.** This menu item allows you to view and modify the width of the internal pulse modulating signal. The width parameter sets the amount of time that each pulse of the internal modulating signal is at the high state, and thus, the RF output's pulse width.

---

***NOTE:*** The same width parameter setting gets used for all three internal pulse modulation modes (continuous, triggered, and gated); it is not set and stored separately for each of those modes.

---

**Sync Out Delay.** This menu item allows you to view and modify the sync out delay setting, which determines the amount of delay that occurs between the leading edge of the video pulse at the PULSE OUT connector and the leading edge of the sync pulse at the PM SYNC OUT connector.

***NOTE:*** The same sync out delay parameter setting gets used for all three internal pulse modulation modes (continuous, triggered, and gated); it is not set and stored separately for each of those modes.

### 2.3.7.3 PM Internal-Gated Menu

The PM Internal-Gated menu allows you to view and modify settings related to the internal gated pulse modulation mode. In this mode, the instrument's CW signal is pulse modulated according to the PRI and Width settings of its internal pulse modulation generator, but appears at the RF output connector as determined by the gating signal that is applied to the rear-panel PULSE IN/PM TRIG IN connector.

Figure 2-25 shows the PM Menu 3 menu:

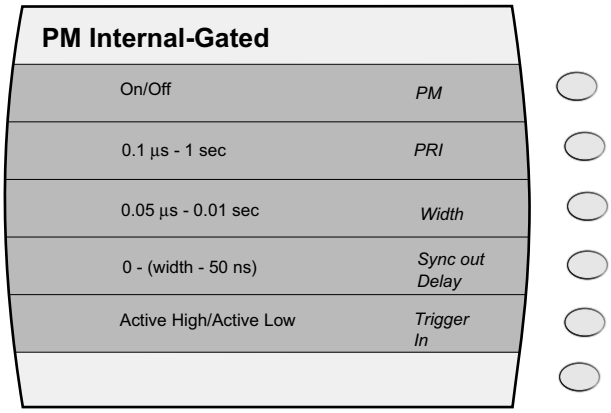



**Figure 2-25: PM Internal Gated 3 with Interactive Softkeys**

***NOTE:*** This menu is not available for models with Option 17B.

The following explains each item in the PM Menu 3 menu:

**PM.** This menu item turns pulse modulation on and off. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the PM state. The **PM** indicator is displayed in the upper right-hand corner of the display when pulse modulation is turned on

**PRI.** This menu item allows you to view and modify the PRI (pulse repetition interval) of the instrument's internal pulse modulating signal. The PRI parameter sets the time between like edges of the modulating signal, and thus, the pulse repetition interval (frequency) of the pulses that appear at the RF output connector when an appropriate gating signal is applied to the rear-panel PULSE IN/PM TRIG IN connector.

***NOTE:*** The same PRI parameter setting gets used for the internal continuous and internal gated pulse modulation modes; it is not set and stored separately for those modes.

**Width.** This menu item allows you to view and modify the width of the internal pulse modulating signal. The width parameter sets the amount of time that each pulse of the internal modulating signal is at the high state, and thus, the width of the pulses that appear at the RF output connector when an appropriate gating signal is applied to the rear-panel PULSE IN/PM TRIG IN connector.

If the width parameter is set to a value that is more than the current PRI setting, the PRI setting is automatically adjusted to be 120 ns greater than the Width setting. The step size can be set in the range of 10 ns to 5 ms.

***NOTE:*** The same width parameter setting gets used for all three internal pulse modulation modes (continuous, triggered, and gated); it is not set and stored separately for each of those modes.

**Sync Out Delay.** This menu item allows you to view and modify the sync out delay setting, which determines the amount of delay that occurs between the leading edge of the pulse video and the leading edge of the sync pulse at the PM SYNC OUT connector.

***NOTE:*** The same sync out delay parameter setting gets used for all three internal pulse modulation modes (continuous, triggered, and gated); it is not set and stored separately for each of those modes.

**Trigger In.** This menu item allows you to view and choose the active polarity of the externally applied gating signal. This setting determines whether a high or low TTL level at the PULSE IN/PM TRIG IN connector will be the active gating condition for a pulse modulated RF output. The available selections are as follows:

- *Active High*
- *Active Low*

### 2.3.7.4 PM Internal-Triggered Menu

The PM Internal-Triggered menu allows you to view and modify settings related to the internal triggered pulse modulation mode. In this mode, the instrument produces a single RF pulse at the RF output connector whenever it receives a valid trigger signal at the rear-panel PULSE IN/PM TRIG IN connector. The RF pulse thus generated has a width that is determined by the Width setting in this menu, and is delayed by the amount of delay set with the RF Pulse Delay setting in this menu.

Figure 2-26 shows the PM Menu 4 menu:

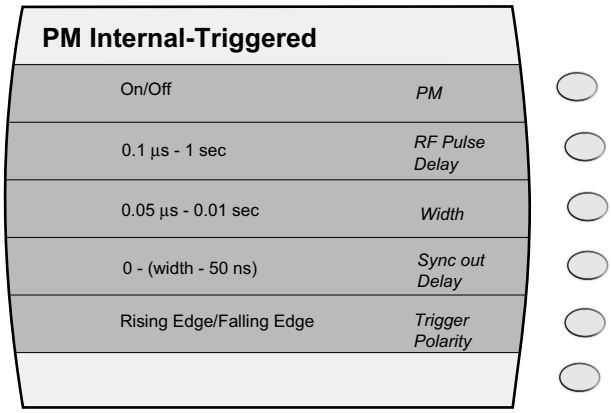



**Figure 2-26: PM Menu 4 with Interactive Softkeys**

The following explains each item in the PM Menu 4 menu:

**PM. T**This menu item turns pulse modulation on and off. Pressing either the adjacent soft key or the Step Up or Step Down buttons toggle the PM state. The **PM** indicator is displayed in the upper right-hand corner of the display when pulse modulation is turned on

**RF Pulse Delay.** This menu item allows you to view and modify the RF pulse delay setting, which determines the amount of delay that occurs between the chosen triggering edge (rising or falling) of the signal at the PULSE IN/PM TRIG IN connector and the rising edge of the video pulse at the rear-panel PULSE OUT connector.

---

***NOTE:*** The pulse that subsequently appears at the RF output connector is typically delayed by approximately 50 ns.

---

The RF pulse delay parameter can be modified using either the numeric keypad, the step up/step down buttons, or the rotary knob.

**Width.** This menu item allows you to view and modify the width of the pulse that appears at the RF output connector when an appropriate triggering signal is applied to the rear-panel PULSE IN/PM TRIG IN connector.

---

***NOTE:*** The same width parameter setting gets used for all three internal pulse modulation modes (continuous, triggered, and gated); it is not set and stored separately for each of those modes.

---

**Sync Out Delay.** This menu item allows you to view and modify the sync out delay setting, which determines the amount of delay that occurs between the leading edge of the video pulse at the PULSE OUT connector and the leading edge of the sync pulse at the PM SYNC OUT connector.

**Trigger Polarity.** This menu item allows you to view and choose the edge of the TTL pulsed input signal applied to the PULSE IN/PM TRIG IN connector that is used to trigger an RF pulse at the RF output con-

nector. This setting determines whether the rising edge or falling edge of the pulse at the PULSE IN/PM TRIG IN connector will trigger an RF pulse at the output. The available selections are as follows:

- *Rising Edge*
- *Falling Edge*

## 2.3.8 Language Menu Descriptions

The Language menus allow you to choose the language to be used by the instrument during remote operation. To access the Language menus, press the front panel LOCAL button while the instrument is in local (front panel) operating mode:


***NOTE:*** Pressing the LOCAL button while the instrument is in the remote operating mode returns it to local operating mode.

There are two Language menus associated with the LOCAL button.

### 2.3.8.1 Language Menu 1

The Language Menu 1 menu, as well as the Language Menu 2 menu, allow you to view and choose the language to be used by the instrument during remote operation. Some of the remote language choices are standard, and some are optional. The remote language that will be used by the instrument corresponds to the Language menu item that is currently selected.

Figure 2-27 shows the Language Menu 1 menu:

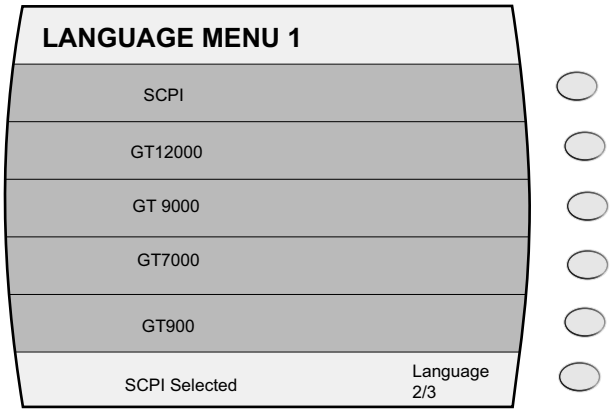



**Figure 2-27: Language Menu 1 with Interactive Softkeys**

The following explains each item in the Language Menu 1 menu:

**SCPI.** This menu item allows you to select Standard Commands for Programmable Instruments (SCPI) as the language to be used by the instrument during remote operations. SCPI is one of the standard remote language choices that are available. To choose SCPI as the remote language, select this menu item.

**GT12000.** This menu item allows you to select the Giga-tronics Series 12000A native command set as the language to be used by the instrument during remote operations.

**GT9000**. This menu item allows you to select GT 9000 command set as the remote control language to be used by the instrument using the instrument's GPIB or RS-232 port.

**GT7000**. This menu item allows you to select GT 7000 command set as the remote control language to be used by the instrument using the instrument's GPIB or RS-232 port.

**GT900.** This menu item allows you to select GT 900 command set as the remote control language to be used by the instrument using the instrument's GPIB or RS-232 port

**Language 2/2.** Pressing this softkey invokes Language Menu 2 in the display. See “Language Menu 2”, below, for Language Menu 2 menu item descriptions.

### 2.3.8.2 Language Menu 2

The Language Menu 2 menu, as well as the Language Menu 1 menu, allow you to view and choose the language to be used by the instrument during remote operation.

Figure 2-28 shows the Language Menu 2 menu:

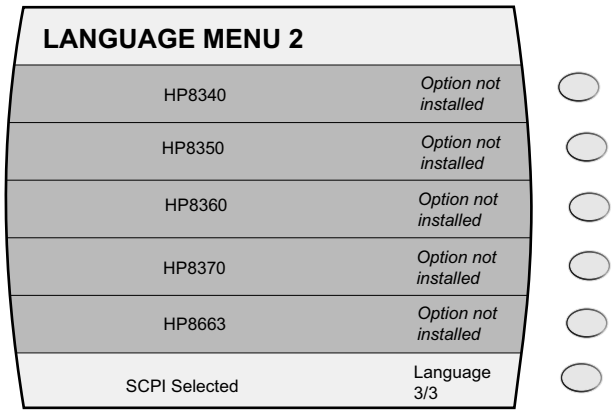



**Figure 2-28: Language Menu 2 with Interactive Softkeys**

The following explains each item in the Language Menu 2 menu:

**HP8340.** This menu item allows you to select HP 8340 command emulation as the language to be used by the instrument during remote operations.The HP8340 language option must be installed in order to access this menu item.

**HP8350.** This menu item allows you to select HP 8350 command emulation as the language to be used by the instrument during remote operations. The HP8350 language option must be installed in order to access this menu item.

**HP8360.** This menu item allows you to select HP 8360 command emulation as the language to be used by the instrument during remote operations. The HP8360 language option must be installed in order to access this menu item.

**HP8370.** This menu item allows you to select HP 8370 command emulation as the language to be used by the instrument during remote operations. The HP8370 language option must be installed in order to access this menu item.

**HP8663.** This menu item allows you to select HP 8663 command emulation as the language to be used by the instrument during remote operations. The HP8663 language option must be installed in order to access this menu item.

**Language 2/3.** Pressing this softkey invokes Language Menu 1 in the display. See "Language Menu 1", above, for Language Menu 1 menu item descriptions.

### 2.3.8.3 Language Menu 3

The Language Menu 3 menu allows you to view and choose the language to be used by the instrument during remote operation. The remote language that will be used by the instrument corresponds to the Language menu item that is currently selected.

Figure 2-29 shows the Language Menu 2 menu:

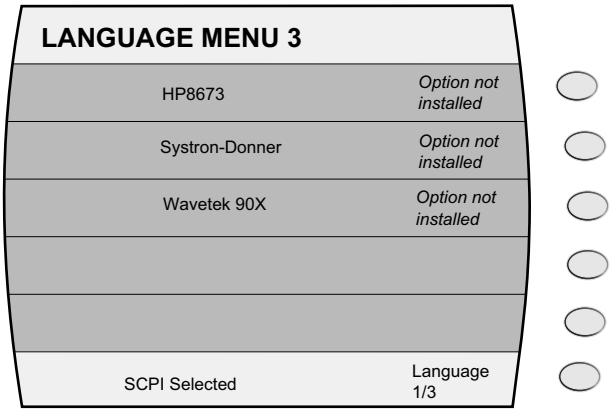



**Figure 2-29: Language Menu 3 with Interactive Softkeys**

The following explains each item in the Language Menu 3 menu:

**HP8673.** This menu item allows you to select HP 8673 command emulation as the language to be used by the instrument during remote operations. The HP8673 language option must be installed in order to access this menu item.

**Systron Donner**. This menu item allows you to select Systron Donner command set as the remote control language to be used by the instrument using the instrument's GPIB or RS-232 port. The Systron-Donner language option must be installed in order to access this menu item.

**Wavetek 90X**. This menu item allows you to select Wavetek 90X command set as the remote control language to be used by the instrument using the instrument's GPIB or RS-232 port. The Wavetek 90X language option must be installed in order to access this menu item.

# 2.4 Front Panel Operating Tasks

This section describes front panel operation of the 2500A.

This section contains the following subsections:

- “Power-Up” - This section explains the power-up sequence of the 2500A.
- “Sanitization” - This section explains how to “sanitize” the 2500A instrument memory of any instrument states that might contain instrument state information that might be classified.
- “Basic Operating Tasks” - This section explains how to perform some basic tasks, such as how to preset the instrument to factory default settings, and how to set and modify instrument parameters.
- “Signal Generation” - This section explains how to use the instrument to generate different types of output signals, with or without modulation.
- “Remote Setup” - This section explains how to set the instrument’s GPIB address and choose its remote language so that it can be used in remote operating mode.

## 2.4.1 Power-Up

When the 2500A is powered up, the system runs through a series of start-up tasks. If problems are encountered by the system during start-up, an error message is displayed after start-up is complete.

### 2.4.1.1 Normal Power-Up

After the main power switch is pressed the message “INITIALIZING GT 2500A” momentarily appears in the display, then a screen appears that is similar to Figure 2-30.

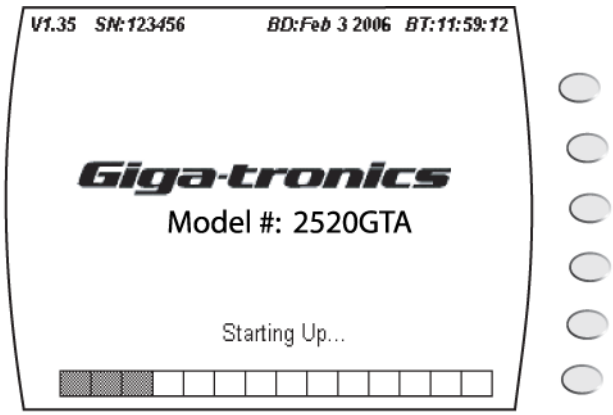



**Figure 2-30: Power-Up Screen**

The firmware version number, build date, and build time, as well as the instrument's serial number are shown along the top of the screen. The instrument's model number is shown in the center of the screen, and a start-up task progress bar is shown at the bottom of the screen.

A start-up progress bar is displayed after initialization is complete. Table 2-1 lists the start-up tasks that are performed. In the table, start-up bar number 1 corresponds to the leftmost segment, and 14 corresponds to the rightmost segment

**Table 2-1: Start-Up Tasks**

| Start-Up Bar Number | Start-Up Task |
|---|---|
| 1 | Loading DSP Boot Code |
| 2 | Loading Synth FPGA |
| 3 | Loading Synth DSP Code |
| 4 | Performing YIG calibration low |
| 5 | Performing YIG calibration high |
| 6 | Performing A1A2 Calibration |
| 7 | Loading ALC SP FPGA - TestCode |
| 8 | Loading ALC PM FPGA |
| 9 | Performing ALC Memory Tests |
| 10 | Loading ALC DSP Code |
| 11 | Re-Configuring ALC SP FPGA |
| 12 | Loading the ALC Characterization Tables |
| 13 | Loading the Frequency Correction Tables for Ramp Frequency Sweep |
| 14 | Determining ALC Detector Zero Offset |

After all start-up tasks have completed successfully, the CW menu appears in the display.

#### 2.4.1.2 Errors During Power-Up

If any problems occur during the power-up process, error codes or other user messages will be shown in the display. If the power-up process encounters problems, go to Appendix B, “Error Messages” for more information.

### 2.4.2 Basic Operating Tasks

This section explains how to perform some basic operating tasks.

#### 2.4.2.1 Resetting the System/Sanitization Procedure

The 2500A Series uses non-volatile memory (NVRAM), which is preserved with a battery for storing the Instrument’s current state, saved setups, and lists. In certain situations, it might be desirable to return the instrument to the state it was in when received from the factory. The following procedure explains how to reset the instrument.

1. Using the power switch on the front panel, turn the 2500A’s power off.
2. Power up the 2500A.
3. Press and hold the PRESET button at some point while the “INITIALIZING GT2500” screen is displayed.
4. When the “Resetting Memory...” screen is displayed, release the PRESET button.

The system will continue to power up normally. All information stored in the memory locations will be cleared, and the system will be reset to factory default settings.

#### 2.4.2.2 Entering and Modifying Parameters

Parameters in the 2500A menus can be modified using the numeric keypad, Step Up and Step Down buttons, or the rotary knob.

To select a menu item so that its associated parameter can be modified, first press one of the menu buttons (CW, RAMP, SYSTEM, AM, FM, or PM), then press the softkey that is adjacent to the menu item for the parameter you wish to modify.

The following three methods can be used to modify the parameter associated with a selected menu item.

---

***NOTE:*** Some of the parameter modification methods might not be available when modifying certain parameters. For example, all three methods are generally available to modify numeric parameters, but direct entry is not available for modifying parameters in which a state is changed.

---

#### 2.4.2.2.1 Soft Key State Toggle

To modify a parameter whose only available selections are On and Off using this method, select the menu item that is associated with the desired paramter by pressing the adjacent soft key. Pressing the soft key with the menu item selected will toggle the state of the menu item.

#### 2.4.2.2.2 Direct Entry Using Numeric Keypad

To modify a parameter using this method, select the menu item that is associated with the desired parameter, enter the new value using the numbered buttons in the numeric keypad, then press the appropriate Units button to update the parameter to the new setting.

To enter negative values, press the BK/- button before entering the first digit of the new value. After the first digit of the new entry has been entered, the BK/- button performs a backspace function, to delete previously entered digits.

#### 2.4.2.2.3 Step Up/Step Down Buttons

This method can be used to modify numeric parameters, as well as parameters that toggle between defined states (for example, the On/Off states of modulation parameters).

To modify a parameter using this method, select the menu item that is associated with the desired parameter, then press the Step Up button or Step Down button to increase or decrease the selected parameter by the specified step size.

The step size determines the resolution by which the parameter will be increased or decreased with each press of the Step Up or Step Down buttons. Refer to “Step Size”, below, for information on how to modify the step size.

#### 2.4.2.2.4 Rotary Knob

This method can be used to modify numeric parameters, as well as some parameters that toggle between defined states.

To modify a parameter using this method, select the menu item, then rotate the knob clockwise or counter clockwise to increase or decrease the value of the parameter.

The parameter will be modified according to the programmed step size.

#### 2.4.2.2.5 Step Size

The step size for a specific parameter determines the resolution by which that parameter will change when modified using either the Step Up/Down buttons or rotary knob. The step size for the selected parameter is displayed at the bottom of the display if an operator error message is not being displayed.

To modify the step size for the selected parameter, press the STEP SIZE button, enter a new step size using the numeric keypad, then press any Units button.

## 2.4.3 Signal Generation

This section explains how to use the instrument to generate different types of output signals. CW, ramp (sweep), and modulation modes are explained.

### 2.4.3.1 Generating a CW Signal

The following procedure explains how to set up the instrument to generate a continuous wave (CW) signal at a specified output power level. This procedure is also used to set up the carrier signal when modulation is used.

The procedure follows:

1. Press the CW button to invoke the CW menu in the display.

2. Select the “Frequency” menu item in the CW menu, and enter the desired CW frequency using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

3. If the 90 dB step attenuator is installed in the unit, continue with the next step, otherwise, continue with Step 4.

   The step attenuator, if installed, can be set in either of two modes:

   - *Auto Mode* - In this mode, the step attenuator automatically switches attenuation state as the instrument’s output power level setting is varied. *To set the step attenuator so that it automatically switches attenuation levels with changes in output power level*, press the SYSTEM button, select the “System 1 Menu” menu item if it appears, select the “Attenuation” menu item, and use the Step Down button to select Auto.

   - *Fixed Mode* - In this mode, the step attenuator is set to a fixed level of attenuation. The maximum and minimum settable range is +25 dB to -20 dB relative to the attenuator setting. *To set the step attenuator so that it remains fixed at a desired level of attenuation*, press the SYSTEM button, select the “System 1 Menu” menu item if it appears, select the “Attenuation” menu item, and use the Step Up or Step Down button to select the desired level of attenuation.

4. Return to the CW menu if necessary by pressing the CW button, select the “Power” menu item, and enter the desired output power level. Using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

5. If you wish to use the instrument’s insertion/conversion loss compensation features, continue with the next step, otherwise, continue with Step 8. The insertion/conversion loss compensation features include the Power Offset feature, which is used to account for a fixed level of insertion or conversion loss, and the Power Slope feature, which is used to account for insertion or conversion loss that linearly varies with frequency.

6. Perform the following loss compensation actions, as desired (both features can be used concurrently):

   - ***To compensate for a fixed level of loss***, select the “Power Offset” menu item, and enter the desired loss correction using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob. Note that when a correction factor is entered, **OFS** appears in the upper right corner of the display.

   - ***To compensate for a loss that varies linearly with frequency***, select the “Power Slope” menu item, and enter the desired correction factor using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob. Note that when this correction factor is entered, **SLP** appears in the upper right corner of the display.

7. To adjust the phase of the output, select the "Phase Adjust" menu item, and enter the desired phase shift using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

---

***NOTE:*** Whenever the frequency of the instrument is changed, the Phase Adjust setting will reset to 0 degrees. The Phase Adjust range is 500 MHz to the maximum frequency of the instrument. Phase adjust is available for frequencies below 500 MHz; however, the output response time is increased.

---

8. If the LED indicator that is above the RF ON button is not lit, press the RF ON button to enable the signal at the RF output connector.

9. Verify that the Unleveled indicator is not lit.

   If the Unleveled indicator is lit, then the combination of output power level, power offset, power slope, and step attenuator mode (if applicable) is set inappropriately, and the RF output is unleveled. Adjust the combination of settings until the Unleveled indicator turns off.

### 2.4.3.2 Generating an External ALC Leveled Signal

The following procedure describes how to set up the instrument to generate an externally level controlled signal using the External ALC feature. This procedure can be used in CW, Ramp, and Pulse modes only. The output of the instrument is typically sampled through a directional coupler or power splitter. The signal is sampled using a positive or negative crystal detector or power meter. External ALC response with the instrument configured for Pulse Modulation varies according to duty cycle of the signal being sampled. Low duty cycles result in a slower response time for the instrument to level.

Level control for External ALC operation using crystal detectors are described in dBV units. The crystal detector output may vary for power and frequency. Because of the variability of the crystal detector output, it may be necessary to characterize the output of the crystal detector output to a power standard. The external positive or negative crystal detector ALC procedure follows:

1. Connect the input of the crystal detector to the sample port of the power splitter or directional coupler.

2. Connect the output of the crystal detector to the Ext ALC In connector on the rear panel using an appropriate cable.

3. Press the System button to invoke the System menu on the display. If the System Menu 1 is displayed, press the System 2 Menu soft key to display the System Menu 2.

4. Select the ALC menu item in the System 2 menu, and select the positive or negative detector setting using the Step Up/Step Down buttons depending on the type of crystal detector used of external ALC.

5. Select the ALC menu item in the System 2 menu, and select the positive or negative detector setting using the Step Up/Step Down buttons depending on the type of crystal detector used of external ALC.

6. Press CW button to invoke the CW menu on the display. Select the "Frequency" menu item in the CW menu, and enter the desired CW frequency using the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

---

***NOTE:*** The Power Offset and Power Slope functions are no longer available.

---

7. Select the "Level" menu item in the CW menu and enter the desired output level using the keypad, Step Up/Step Down buttons, or the rotary knob.

8. When entering a new level setting using the numeric keypad, use the dBm or dB Units buttons. Units are assumed to be in dBV.

9. If the LED indicator that is above the RF ON button is not lit, press the RF ON button to enable the signal at the RF output connector.

The External Power Meter ALC procedure follows:

1. Connect the sensor of the power meter to the sample port of the power splitter or directional coupler.

2. Connect the Analog Out output of the Power Meter to the EXT ALC connector on the rear panel of the instrument.

3. Adjust the Analog Out range of the power meter from 0.0005 to 2 volts. The power range is adjusted according to the user's specific needs.

4. Press the System button to invoke the System menu on the display. If the System Menu 1 is displayed, press the System 2/2 soft key to display the System Menu 2.

5. Select the ALC menu item in the System 2 menu, and select the Power Meter setting using Step Up/Step Down buttons.

6. Press the CW button to invoke the CW menu on the display.

7. Select the "Frequency" menu item in the CW menu, and enter the desired CW frequency using the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

***NOTE:*** The Power Offset and Power Slope functions are no longer available.

8. Select the "Level" menu item in the CW menu and enter the desired output level using the keypad, Step Up/Step Down buttons, or the rotary knob.

9. When entering a new level setting using the numeric keypad, use the dBm or dB Units buttons. Units are assumed to be in dBV. Use the following formula to convert to Volts to dBV:

   $dBV = 20\log_{10}(V)$

10. If the LED indicator that is above the RF ON button is not lit, press the RF ON button to enable the signal at the RF output connector.

11. When the signal at the RF output connector is enabled, the LED indicator that is above the RF ON button is blue.

### 2.4.3.3 Using the Ref Tune Feature

Ref Tune (Reference Tune) allows tuning the instrument's output frequency over a range of approximately 500 ppm using an analog tuning voltage of 0 to +10 volts applied to the Ref Tune input on the rear panel. This is useful in applications where the instrument is be phase locked to another stable source as shown in Figure 2-31.

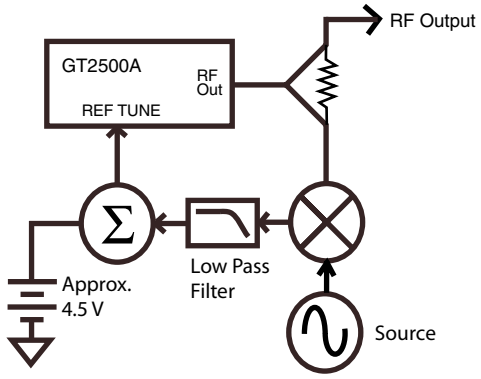



**Figure 2-31: Phase Locking the 2500A to a Second Source**

The Reference Tune input is enabled from the System 3 menu. It is normal for the instrument to show the unlock indication when the Ref Tune function is enabled.

The Ref Tune input is a high impedance input and has a 3 dB bandwidth of approximately 1 kHz which is set by a pole consisting of 150 Ω and 1 uF as shown in the Figure 2-32.

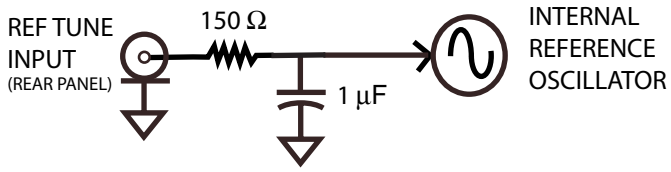



**Figure 2-32: REF TUNE Input Circuit**

Additional resistance in the driving source will lower the bandwidth accordingly. The tuning sensitivity at the instrument's output frequency is approximately 200 ppm/volt although it may vary from about a hundred ppm/volt to several hundred ppm/volt. A nominal tuning voltage of 4.5 volts corresponds to the instrument's frequency setting.

The tuning voltage must not exceed +15 volts and must not go more negative than -1 volt. It should be noted that the instrument's phase noise performance may be degraded when Ref Tune is enabled.

1. Connect a BNC cable between the REF TUNE connector on the rear panel of the 2500A and the controlling source signal.

2. Press the System button to invoke the System menu.

3. Press the System Menu soft key until the System Menu 3 is displayed

4. Press the External Tune Input soft key to activate the Reference Tune Input.

### 2.4.3.4 Cable Correction Function

The Cable Correction feature allows the user to adjust the output of the 2500A Series Microwave Synthesizer to compensate for losses created by connecting devices such as RF cables, connectors and other RF devices. The maximum correction is greater than 10 dB. The feature creates a user correction table of 1001 points for the frequency range of the unit. Level correction for frequencies between the correction points are determined using a linear algorithm for the first frequency points above and below the desired frequency. The feature requires an 8650A Series Universal Power Meter which is controlled using a Null-Modem RS-232 cable. Additionally, the 2500A should have firmware version 4.12 or higher with the cable correction function enabled.
The following steps describe the procedure for generating and applying the Cable Correction feature.

#### Required Equipment

•Model 2500A with firmware version 4.09 or higher
•8650A Series Universal Power Meter
•80303A or 80304A CW Power Sensor
•Compatible Power Sensor Cable
•BNC Male to Male Cable
•Null-Modem RS-232 Cable Male to Male

### 2.4.3.5 Configuring the 8650A Universal Power Meter

The 8650A Power Meter must be manually configured for the appropriate baud rate settings. The 2500A communicates with the 8650A with a baud rate setting of 38400.

1. Connect the sensor to the calibrator and calibrate the sensor to the power meter.

2. Press the Meter Setup, select RS-232 and press the Config soft key.

3. Set the RS-232 parameters to the following:

   •Baud Rate 38400
   •Data Bits 8
   •Parity Off
   •Stop Bits 1

4.Press the OK soft key and return to the main menu.

### 2.4.3.6 Configuring the Cable Correction Setup

Set up the 2500A and 8650A as shown in Figure 2-33.

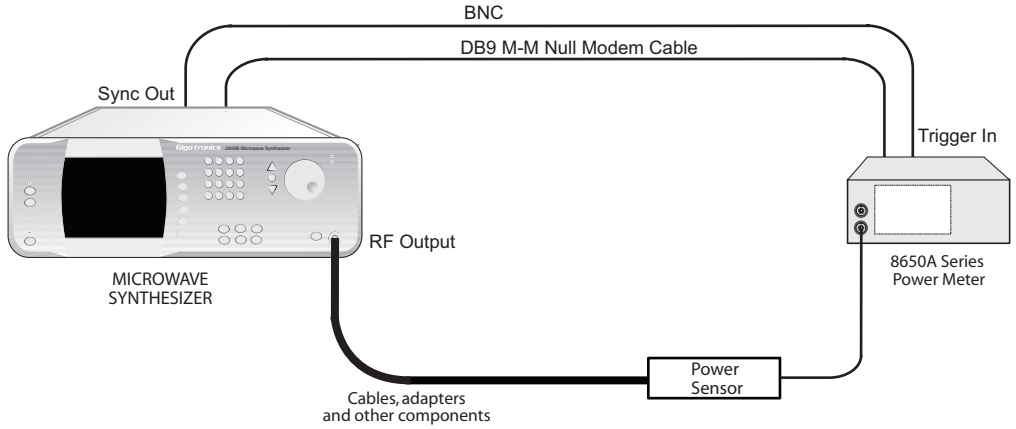



**Figure 2-33: Cable Correction Set Up**

1. Connect the Null Modem cable between the 2500A RS-232 port and the 8650A RS-232 port.

2. Connect the BNC cable from the Sync Out connector on the rear panel of the 2500A and the Trig In connector on the rear panel of the 8650A.

3. Connect sensor to the RF path to be characterized.

4. From the CW menu, press the Cable Cal softkey.
5. Press the Device Name softkey and select the Giga-tronics 8650A using the Up or Down Arrow buttons.
6. Press the RS-232 softkey to enter the Cable Cal:RS-232 menu.
7. Press the **Start Cable Cal** soft key to begin the swept frequency characterization.

After the frequency sweep is completed, a cable correction table will be generated and automatically applied to the output of the 2500A. The first line in the Cable Cal menu will change to Cable Cal Stored. The cable calibra-

tion will apply to the output of the 2500A until the **Clear Cable Cal** button in the Cable Cal menu is pressed. If an Agilent EPM power meter is used, select Agilent EPM in step 5.

### 2.4.3.7 Generating a Frequency Swept Signal

The following procedure explains how to set up the instrument to generate a signal at a constant power level that sweeps linearly from a set start frequency to a set stop frequency over a set amount of time, then repeats.

The procedure follows:

1. Press the RAMP button to invoke the Main Ramp menu, then press the RAMP FREQ Start/Stop menu. Select the "Start Frequency" menu item in the RAMP FREQ menu, and enter the desired ramp start frequency using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

2. Select the "Stop Frequency" menu item in the RAMP FREQ menu, and enter the desired ramp stop frequency using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

---

***NOTE:*** The ramp stop frequency must be set equal to or greater than the ramp start frequency.

---

3. Select the "Power" menu item in the RAMP FREQ menu, and enter the desired output power level using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

4. Select the "Sweep Time" menu item in the RAMP FREQ menu, and enter the desired ramp sweep time using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

5. Select the "Resolution" menu item in the RAMP FREQ menu, and select the desired resolution using the Step Up/Step Down buttons.

   The resolution setting determines the number of discreet frequency steps that will be included in the frequency ramp. Three resolutions are available: 401, 801, or 1601. Higher resolution settings will result in more steps and a finer resolution ramp.

6. If the LED indicator that is above the RF ON button is not lit, press the RF ON button to enable the signal at the RF output connector. When the signal at the RF output connector is enabled, the LED indicator that is above the RF ON button is blue.

### 2.4.3.8 Generating a Power Swept Signal

The following procedure explains how to set up the instrument to generate a signal at a constant frequency that sweeps linearly from a set start power level to a set stop power level over a set amount of time, then repeats.

The procedure follows:

1. Press the RAMP button to invoke the Main Ramp menu, then press the RAMP Power menu. Select the “Start Power” menu item in the RAMP Power menu, and enter the desired ramp start power using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

2. If the 90 dB step attenuator is installed in the unit, continue with the next step, otherwise, continue with Step 4.

3. *S*elect the “Attenuation” menu item in the RAMP POWER menu, and use the Step Up or Step Down button to select the desired step attenuator level.

   The step attenuator cannot be set to auto-switch while in power sweep mode. Choose an appropriate step attenuator level such that the range of the power sweep will be within 25 dB above and 20 dB below the step attenuator level chosen.

4. Select the “Start Power” menu item in the RAMP POWER menu, and enter the desired ramp start power level using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

5. Select the “Stop Power” menu item in the RAMP POWER menu, and enter the desired ramp stop power level using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

   The ramp stop power level can be set equal to, greater than, or less than the ramp start power level.

6. Select the “Frequency” menu item in the RAMP POWER menu, and enter the desired output frequency using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

7. Select the “Sweep Time” menu item in the RAMP POWER menu, and enter the desired ramp sweep time using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

8. If the LED indicator that is above the RF ON button is not lit, press the RF ON button to enable the signal at the RF output connector.

   When the signal at the RF output connector is enabled, the LED indicator that is above the RF ON button is blue.

### 2.4.3.9 Generating an Externally Pulse Modulated Signal

The following procedure explains how to set up the instrument to generate a signal that is pulse modulated using an external modulation source.

When this type of pulse modulation is used, the RF output signal is pulsed according to the signal that is applied to the rear-panel PULSE IN/PM TRIG IN connector. Figure 2-34 shows an example of this with

the input polarity of the PULSE IN/PM TRIG IN signal is set to active high.

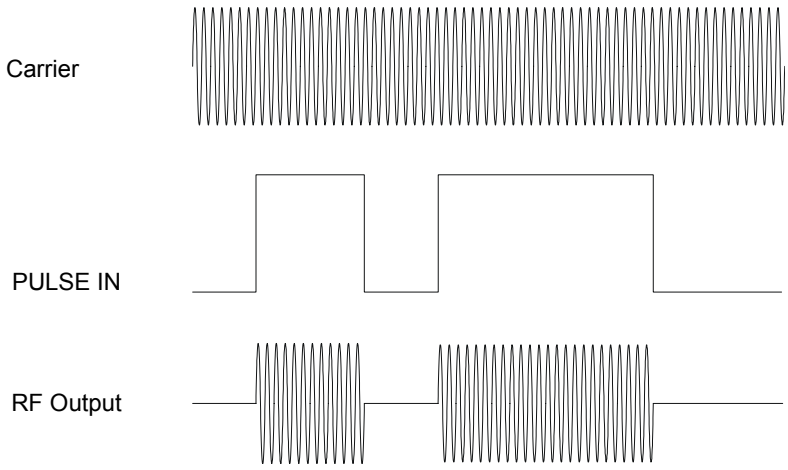



**Figure 2-34: External Pulse Modulation**

The procedure follows:

1. Perform steps 1 through 6 of the procedure entitled “Generating a CW Signal” to set the frequency and power level of the carrier.

2. Connect a TTL pulse source to the PULSE IN/PM TRIG IN connector on the rear-panel of the instrument, and set it for the desired modulating characteristics.

3. Press the PM button to invoke the PM Main menu, then press the PM Ext Menu.

4. Select the “PM” menu item in PM Menu 1, and use the Step Up or Step Down button or press the adjacent soft key again to set it to On.

5. Select the “Input Polarity” menu item in PM Menu 1, and choose the appropriate polarity setting using the Step Up/Step Down buttons.

   With a setting of Active High, a TTL high level at the PULSE IN/PM TRIG IN connector turns on the carrier at the RF output, and with a setting of Active Low, a TTL high level at the PULSE IN/PM TRIG IN connector turns off the carrier at the RF output.

6. Select the “Sync Out Delay” menu item in PM Menu 1, and enter the desired sync pulse delay setting using either the numeric keypad, Step Up/Step Down buttons, or the rotary knob.

7. If the LED indicator that is above the RF ON button is not lit, press the RF ON button to enable the signal at the RF output connector.

   When the signal at the RF output connector is enabled, the LED indicator that is above the RF ON button is blue.

8. Verify that the Unleveled indicator is not lit.

If the Unleveled indicator is lit, then the combination of output power level, power offset, power slope, and step attenuator mode (if applicable) is set inappropriately, and the RF output is unleveled. Adjust the combination of settings until the Unleveled indicator turns off.

## 2.4.4 Remote Setup

This section explains how to set the instrument's GPIB address and choose its remote language.

### 2.4.4.1 Setting the GPIB Address

The following procedure explains how to set the GPIB address of the instrument. The instrument is identified on the GPIB bus during remote operations using the GPIB address set in this procedure. Each unit on the GPIB bus must have a unique GPIB address.

1. Press the SYSTEM button to invoke the System menus, and if the SYSTEM 2 menu does not appear in the display, press the bottom-most interactive softkey until it does.

2. Enter the desired GPIB address using either the numeric keypad or Step Up/Step Down buttons.

### 2.4.4.2 Selecting the Remote Language

The instrument can communicate using one of several different languages when in remote operating mode. Every 2500A Series instrument is capable of communications using the SCPI (Standard Commands for Programmable Instruments) language or any Giga-tronics native command set, and other optional Command Sets are available.

1. If the instrument is not currently in remote operating mode, press the LOCAL button once to invoke the Language menus in the display. If the instrument currently is in remote operating mode, press the LOCAL button twice - once to take it out of remote operating mode, then again to invoke the Language menus in the display.

2. If the desired language does not appear in the parameter area of the display, press the bottom-most interactive softkey to check the next menu.

3. If the message "Option not installed" appears next to a given language in the menu area of the display, that language is optional and not currently available in the instrument. Contact Giga-tronics customer support to inquire about purchasing additional language options.

4. Once you have located the desired language, press the associated interactive softkey in the display to select it.

5.

# 3 Remote Operation

## 3.1 Introduction

The 2500A and 2500AS Series can be operated from a remote host over the General Purpose Interface Bus (GPIB) or RS-232 interface using the Automation Xpress software and Automation Xpress Interface (AXI) from Gigatronics. For further information, refer to the Automation Xpress online help system.

The instrument can also be programmed using either Standard Commands for Programmable Instruments (SCPI) or any of the available command sets.

### 3.1.1 What is Automation Xpress?

Automation Xpress is an easy to use application development tool for use with 2500A Series instruments. Automation Xpress is the preferred method of using the 2500A in remote operation.

Automation Xpress eliminates the need to learn the various GPIB or native language commands. With a click of the mouse, the Automation Xpress Auto-Programming feature automatically records the sequence of your actions performed in the Automation Xpress GUI and converts those actions into program code. Auto-programming provides the option of seamlessly converting recorded action sequences into generated programs that can be imported into the program environment of your choice, such as Visual C++ or Visual Basic.

The key to reducing the cost of testing is faster frequency switching. The 2500A Series Microwave Synthesizer offers unmatched frequency and power switching in list mode; however, the list mode approach might not be suitable for some remote programming situations. Automation Xpress combined with the Automation Xpress Interface 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 transit and execution times for single function calls, such as changing CW frequency, are ten times faster than sending the command via standard message based commands. With Automation Xpress sending large amounts of data such as large lists, the transit and execution times are greater than 100 times faster 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 also provides the tools necessary to successfully program the 2500A series. The Xpress Auto-programmer can virtually eliminate the need for training, providing programming scripts and sequences that are guaranteed for accuracy.

## 3.1.2 Computer Interfaces

The following computer interfaces are supported by the 2500A.

**GPIB.** The IEEE 488.2 interface connection (24-pin) between the 2500A Series and host computer equipment for remote operation over GPIB is located on the rear of the unit. The connector pin assignments are listed in Table 3-1 (pin assignments are the same for all 2500A Series models).

**Table 3-1: GPIB Connector Pin Assignments**

| Pin | Signal | Pin | Signal | Pin | Signal |
|---|---|---|---|---|---|
| 1 | D101 | 9 | IFC | 17 | REN |
| 2 | D102 | 10 | SRQ | 18 | GND (6) |
| 3 | D103 | 11 | ATN | 19 | GND (7) |
| 4 | D104 | 12 | Shield | 20 | GND (8) |
| 5 | E0I | 13 | D105 | 21 | GND (9) |
| 6 | DAV | 14 | D106 | 22 | GND (10) |
| 7 | NRFD | 15 | D107 | 23 | GND (11) |
| 8 | NDAC | 16 | D108 | 24 | GND Logic |

**RS-232.** This 9 pin connector interfaces communications equipment using RS-232 format. See Table 3-2 for the connector pin assignments (pin assignments are the same for all 2500A Series models). Table 3-3 contains the 2500A Series serial interface communication settings.

**Table 3-2: RS-232 Connector Pin Assignments**

| Pin | Function |
|---|---|
| 1 | Protective Ground |
| 2 | Transmitted Data |
| 3 | Received Data |
| 4 | Not Used |
| 5 | Not Used |
| 6 | Not Used |
| 7 | Not Used |
| 8 | Not Used |
| 9 | Not Used |

**Table 3-3: Communication Settings**

| | |
|---|---|
| **Baud Rate** | **115200** |
| **Data Bits** | **8** |
| **Parity** | **None** |
| **Stop Bits** | **1** |
| **Handshake** | **None** |

# 3.2 SCPI Command Set

The SCPI syntax supported by 2500A Series instruments is explained in this section.

NOTE: For information on Automation Xpress and the Automation Xpress Interface, which is the preferred method of using the 2500A in remote operation mode, refer to the paragraph entitled “What is Automation Xpress?” in this chapter.

## 3.2.1 SCPI Command Format

SCPI conformance requires adherence to a strict syntax structure. The typographic conventions employed in the tables within each of the subsystem descriptions under “SCPI Command Subsystems”, below, are summarized in this section.

**Case Sensitivity.** SCPI commands are not case-sensitive and can be entered in either uppercase or lowercase characters.

**Abbreviating Commands.** SCPI commands can be abbreviated as follows:

- Letters noted in upper case.
- If entering more than the required letters, the entire command must be entered. For example, if the command syntax is shown as INITiate, either INIT, init, INITIATE, or initiate can be used.

**Optional Commands.** If the syntax shows a portion of a SCPI command in square brackets, that portion is an implied command which can be omitted. An implied command is the default command among the commands available at its level. For example, in the case of the command INITiate:[IMMediate], the immediate mode is the default mode, therefore, entering INIT has the same effect as entering INIT:IMM.

NOTE: The square brackets themselves are not actually part of the command, hence, they should be omitted even if the optional command is entered.

**Queries.** Most SCPI commands have an accompanying query form that can be sent in order to cause the instrument to return the current state of the parameter setting. For example, the query form of the TRIGger:SOURce BUS|EXTernal command is TRIGger:SOURce?

Some SCPI commands are events that cause something to happen at a particular time but do not create a setting or value to be checked afterwards. Consequently, they have no query form.

## 3.2.2 SCPI Command Subsystems

SCPI commands are divided into subsystems. The following subsystems are used in the 2500A:

### 3.2.2.1 Output Subsystem

**Table 3-4: Output Subsystem SCPI Commands**

| Command Syntax | Description |
|---|---|
| OUTPut[:STATe] ON\|OFF\|1\|0 | Turns the signal at the RF OUT connector on and off |
| OUTPut[:STATe]? | Queries the RF OUTPUT state. The return value is as follows:<br><br>1 The signal at the RF OUT connector is currently on.<br>0 The signal at the RF OUT connector is currently off. |

### 3.2.2.2 Source Subsystem - CW Mode

All commands in the Source subsystem begin with [SOURce], however, [SOURce] is the default command, therefore it is optional.

**Table 3-5: Source Subsystem - CW Mode SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:FREQuency[:CW\|:FIXed] <freq> [HZ \| KHZ \| MHZ \| GHZ] | Sets CW frequency to the value specified by <freq>. The units are assumed to be in Hertz if no units designator is supplied. |
| [SOURce]:FREQuency[:CW\|:FIXed]? | Queries the current CW frequency. The value returned is in Hz. |
| [SOURce]:MODE CW\|FIXed\|LIST\|FSWEep\|PSWEep | Sets the operational mode of the synthesizer. CW or FIXed is used to set the source to output a non-swept signal. LIST is used to set the source to use LIST mode. FSWEep is used to set the source to frequency sweep. PSWEep is used to set the source to power sweep. |
| [SOURce]:MODE? | Queries the current operating mode of the instrument. |
| [SOURce:]PHASe:[ADJust:] n (RADians\|DEGrees) | Sets the relative phase of the output signal. The default units are in radians where the range is $-2\ pi \geq n \leq +2\ pi$. The command also accepts phase offsets in degrees where the range is $-360° \geq n \leq +360°$. Radians are the default units if no units are specified. Changing frequency automatically resets the phase offset to zero. |
| [SOURce]:POWer:ALC:SOURce INTernal\|DIODe\|PMETer\|DPOSitive | Selects the source of the feedback signal for the ALC. The DIODe parameter assumes a negative crystal detector is used. DPOSitive allows for the use of a positive crystal detector. |

**Table 3-5: Source Subsystem - CW Mode SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:POWer:ATTenuation:AUTO ON\|OFF | Sets the Attenuator to Auto (ON) or Manual (OFF). |
| [SOURce]:POWer:ATTenuation 0\|10\|20\|30\|40\|50\|60\|70\|80\|90 | Sets the Attenuator to the specified fixed (manual) value. |
| [SOURce]:POWer:ATTenuation? | Queries the Attenuator setting. |
| [SOURce]:POWer[:LEVel:][IMMediate:] [AMPLitude:] d (DM \| DBM \| dBV)\|MAXimum\|MINimum | Sets the CW power level to the value specified by <level>. The units are defined as DM, DBM, or dBV. |
| [SOURce]:POWer[:LEVel\|:IMMediate\| :AMPLitude]? | Queries the CW power level The value returned is in dBm. |
| [SOURce]:ROSCillator:SOURce? | Queries the source of the reference oscillator. The return value is as follows:<br><br>INT The internal oscillator is being used as the reference.<br>EXT A signal at the EXT REF IN connector is being used as the reference. |

### 3.2.2.3 Source Subsystem - Correction

All commands in the Source subsystem begin with [SOURce], however, [SOURce] is the default command, therefore it is optional.

**Table 3-6: Source Subsystem - Correction SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:CORRection:LOSS <offset> [DB] | Sets the power offset to the value specified by <offset>. The units are dB. |
| [SOURce]:CORRection:LOSS? | Queries the power offset. The value returned is in dB. |
| [SOURce]:CORRection:SLOPe <slope> | Sets the power slope to the value specified by <slope>. The units are dB/GHz. |
| [SOURce]:CORRection:SLOPe? | Queries the power slope. The value returned is in dB/GHz |

### 3.2.2.4 Source Subsystem - List Mode

All commands in the Source subsystem begin with [SOURce], however, [SOURce] is the default command, therefore it is optional.

**Table 3-7: Source Subsystem - List Mode SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:LIST:DIRection UP\|DOWN | Sets the direction of a list when it is run. If UP is set, the list will run from start to end. If DOWN is set, the list will run from end to start. The default is UP. |

**Table 3-7: Source Subsystem - List Mode SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:LIST:DIRection? | Queries the currently set list run direction. The return value is as follows:<br><br>UP The list is set to run from start to end.<br>DOWN The list is set to run from end to start. |
| [SOURce]:LIST:DWELl <t1>,<t2>,……,<tn> | Specifies the dwell point times (<t1>,<t2>,……,<t*n*>) of the list set, the dwell point times are delimited by commas. The 2500A list dwell setting is global for all list points. The first dwell time parameter applies to all subsequent points. Setting additional dwell times is optional. The units are seconds. |
| [SOURce]:LIST:DWELl:POINts? | Queries the number of points in the dwell time list. |
| [SOURce]:LIST:FREQuency <f1>,<f2>,<f3>,……,<fn> | Specifies the frequency points (<f1>,<f2>,<f3>,……,<f*n*>) of the list set. The frequency points are delimited by commas. |
| [SOURce]:LIST:FREQuency:POINts? | Queries the number of points currently in the frequency list. |
| [SOURce]:LIST:POWer <p1>,<p2>,<p3>,……,<pn> | Specifies the power points (<p1>,<p2>,<p3>,……,<p*n*>) of the list set. The power points are delimited by commas. |
| [SOURce]:LIST:POWer:POINts? | Returns the number of points currently in the power list |
| [SOURce]:LIST:PRECompute | Converts (pre-computes) the source data of the list saved in NVRAM into object format, which is directly readable by the hardware.<br><br>*Note:* In firmware releases less than version 2.82, the syntax for this command is `[SOURce]:LIST:PRECompute?` (the query form). |
| [SOURce]:LIST:REPeat SWEEp\|STEP\|CONTinuous | Sets the repeat mode for the current list. The choices are as follows:<br><br>SWEEp Upon triggering, the entire list is executed from the beginning, then execution stops.<br>STEP Upon triggering, the current list point is executed, then execution stops. The next trigger executes the next point in the list. The list's first point is considered to be the initial current point, and the point following the list's final point.<br>CONTinuous The entire list repeats indefinitely. |
| [SOURce]:LIST:REPeat? | Queries the repeat mode of the current list |
| [SOURce]:LIST:SEQuence <m1>,<m2>,<m3>,…..,<mn> | Defines a sequence for stepping through the existing list when [SOURce]:LIST:SEQuence:AUTO is set to OFF. The points specified in this command (<m1>,<m2>,<m3>,…..,<mn>) are indexes into a new sub-list, and only points in this sub-list will be triggered. For example, if one of the indexes defined with this command is 3, then the third point in the frequency, dwell, and power lists will be sequenced. |
| [SOURce]:LIST:SEQuence:POINts? | Queries the number of points in the sequence list |
| [SOURce]:LIST:SEQuence:AUTO ON\|OFF | Sets list sequence AUTO mode. The choices are as follows:<br><br>ON The list sequence set with the [SOURce]:LIST:SEQuence command will not take effect, so all list points will run when triggered.<br>OFF The list will run only the points set with the [SOURce]:LIST:SEQuence command.<br><br>The default is ON.<br><br>Note: This command is also used to change the 2500A mode from CW or Ramp to List mode. Example: LIST: SEQ: AUTO ON switches to List Mode |

**Table 3-7: Source Subsystem - List Mode SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:LIST:SYNC <sync> | Sets sync out option to <sync>. The sync out option determines how a pulse is emitted from the SYNC OUT connector during List operation. The choices are as follows:<br><br>0 No pulses are emitted from the SYNC OUT connector during List operation.<br>1 A pulse is emitted from the SYNC OUT connector when the first list point is executed.<br>2 A pulse is emitted from the SYNC OUT connector when the last list point is executed.<br>3 A pulse is emitted from the SYNC OUT connector when each point in the list is executed. |

### 3.2.2.5 Status Subsystem

**Table 3-8: Status Subsystem SCPI Commands**

| Command Syntax | Description |
|---|---|
| STATus:QUEStionable:CONDition? | Returns the value of the Questionable Status Condition Register. The value returned is a decimal value representing the current state of the register. |
| STATus:QUEStionable:ENABle <ques> | Sets the Questionable Status Enable Register.<br><br>Range of <ques> is 0 - 65535 |

### 3.2.2.6 System Subsystem

**Table 3-9: System Subsystem SCPI Commands**

| Command Syntax | Description |
|---|---|
| SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <address>\|MAXimum\|MINimum | Sets the instrument's GPIB address. The choices are as follows:<br><br><address> Any integer between 1 and 30.<br>MAXimum Sets the GPIB address to 30.<br>MINimum Sets the GPIB address to 1. |
| SYSTem:COMMunicate:GPIB[:SELF]:ADDRess? | Queries the instrument's GPIB address. |
| SYSTem:COMMunicate:SERial:BAUD <rate> | Sets the RS-232 interface baud rate. The supported values for <rate> are 9600, 19200, 38400, and 115200. |
| SYSTem:COMMunicate:SERial:BAUD? | Queries the current RS-232 interface baud rate. |
| SYSTem:COMMunicate:SERial:BITS <bits> | Sets the number of RS-232 interface data bits. The supported values for <bits> are 7 and 8. |
| SYSTem:COMMunicate:SERial:BITS? | Queries the number of RS-232 interface data bits. |
| SYSTem:COMMunicate:SERial:PARity [:TYPE] EVEN \| ODD \| NONE | Sets the RS-232 interface parity type. The choices are as follows:<br><br>EVEN Selects even parity.<br>ODD Selects odd parity.<br>NONE Parity is not used. |
| SYSTem:COMMunicate:SERial:PARity? | Queries the RS-232 interface parity setting. |
| SYSTem:COMMunicate:SERial:SBITS <sbits> | Sets the number of RS-232 interface stop bits. The supported values for <sbits> are 1 and 2. |

**Table 3-9: System Subsystem SCPI Commands**

| Command Syntax | Description |
|---|---|
| SYSTem:COMMunicate:SERial:SBITS? | Queries the number of RS-232 interface stop bits. |
| SYSTem:ERRor[:NEXT]? | Queries the next error in the instrument's error/event queue. If the error/event queue is empty, "0, No Error" is returned.<br><br>See the paragraph entitled "2500A Error Messages" in Appendix B for a summary of available error messages |
| SYSTem:LANGuage NATive | Switches from the SCPI command set to the native (GT12000) command set. |
| SYSTem:LANGuage:NATive <native_cmd> | Issues the native (GT12000) syntax command specified by <native_cmd> from within SCPI without leaving the SCPI syntax. |
| SYSTem:PRESet | Sets device-specific functions to a known state that is independent of the past-use history of the device. The command does not reset any part of the status reporting system. (Same as the *RST command.) |
| SYSTem:VERSion? | Queries the SCPI version to which the instrument applies. The response is in the form *YYYY.V* where *YYYY* is the year-version and *V* is the revision number within that year. |

### 3.2.2.7 Trigger Subsystem

**Table 3-10: Trigger Subsystem SCPI Commands**

| Command Syntax | Description |
|---|---|
| TRIGger[:IMMediate] | Initiates an immediate sweep cycle in List mode. If Repeat Type is set to either single step or single sweep, then the sweep returns to IDLE when complete.<br><br>(Same as a *TRG, that is a single instrument trigger, as opposed to a GroupExecuteTrigger.) |
| TRIGger:SOURce BUS\|EXTernal | Selects the trigger source for List mode. The sources are:<br><br>BUS Sets the trigger source to GPIB/GET.<br>EXTernal Sets the trigger source to BNC. (Trigger commands do not function when TRIGger:SOURce is set to EXT). |
| TRIGger:SOURce? | Queries the trigger source for List mode. The return value is as follows:<br><br>BUS The trigger source is set to GPIB/GET.<br>EXTernal The trigger source is set to BNC.<br><br>If not set, NOT IN SWEEP MODE is returned. |

### 3.2.2.8 Source Subsystem - Ramp Sweep

All commands in the Source subsystem begin with [SOURce], however, [SOURce] is the default command, therefore it is optional.

**Table 3-11: Source Subsystem - Ramp Sweep SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:FREQuency:STARt <f_start> [HZ \| KHZ \| MHZ \| GHZ] | Sets the ramp start frequency to the value specified by <f_start>. Hertz is assumed as the units if no units is specified.<br><br>The start frequency must be set less than the stop frequency. If this rule is violated, the start and stop frequencies are set to the same value. |
| [SOURce]:FREQuency:STARt? | Queries the ramp start frequency. The return value is in Hertz. |
| [SOURce]:FREQuency:STOP <f_stop> \|HZ \| KHZ \| MHZ \| GHZ] | Sets the ramp stop frequency to the value specified by <f_stop>. Hertz is assumed as the units if no units is specified.<br><br>The start frequency must be set less than the stop frequency. If this rule is violated, the start and stop frequencies are set to the same value. |
| [SOURce]:FREQuency:STOP? | Queries the ramp stop frequency. The return value is in Hertz. |
| [SOURce]:FREQuency:CENTer <f_center> [HZ \| KHZ \| MHZ \| GHZ] | Sets the center frequency of the ramp sweep mode. |
| [SOURce]:FREQuency:CENTer? | Queries the ramp center frequency. The return value is in Hertz. |
| [SOURce]:FREQuency:SPAN <f_center> [HZ \| KHZ \| MHZ \| GHZ] | Sets the span frequency of the ramp sweep mode |
| [SOURce]:FREQuency:SPAN? | Queries the ramp span frequency. The return value is in Hertz |
| [SOURce]:SWEep: TIME <time> | Sets the sweep time for ramp sweep to the value specified by <time>. The units are seconds. |
| [SOURce]:SWEep:TIME? | Queries the sweep time for ramp sweep. The return value is in seconds. |
| [SOURce]:POWer:STARt d (DM \| DBM \| dB) | Sets the ramp sweep start power level. The assumed units are defined as DM, DBM, or dBV. |
| [SOURce]:POWer:STARt? | Queries the ramp start power. The return value is in dBm. |
| [SOURce]:POWer:STOP d (DM \| DBM \| dB) | Sets the ramp sweep stop power level. The assumed units are defined as DM, DBM, or dBV. |
| [SOURce]:POWer:STOP? | Queries the ramp stop power. The return value is in dBm. |

### 3.2.2.9 Source Subsystem- Modulation

All commands in the Source subsystem begin with [SOURce], however, [SOURce] is the default command, therefore it is optional.

**Table 3-12: Source Subsystem - Modulation SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:AM:DEPTh <am_depth> | Sets the internal amplitude modulation depth to a percentage value as specified by <am_depth>. |
| [SOURce]:AM:DEPTh? | Queries the internal amplitude modulation depth. The return value is in percent. |
| [SOURce]:AM:INTernal:FREQuency <am_freq> [HZ \| KHZ \| MHZ \| GHZ] | Sets the rate of the internal amplitude modulation generator to the value specified by <am_feq> (Not available with Option 17A or 17B). Hertz is assumed if no units is specified. |
| [SOURce]:AM:INTernal:FREQuency? | Queries the rate of the internal amplitude modulation generator. The return value is in Hertz (Not available with Option 17A or 17B). |
| [SOURce]:AM:INTernal:FUNCtion:SHAPe OFF\|SINE\|SQUare\|TRIangle\|PRaMP\|NOISe | Sets the shape of the internal amplitude modulation generator waveform (Not available with Option 1A7 or 17B). The choices are as follows:<br><br>OFF Turns the internal amplitude modulation generator off.<br>SINE Sets the internal amplitude modulation generator waveform to sine wave.<br>SQUare Sets the internal amplitude modulation generator waveform to square wave.<br>TRIangle Sets the internal amplitude modulation generator waveform to triangle wave.<br>PRaMP Sets the internal amplitude modulation generator waveform to a positive-going ramp.<br>NOIse Selects the internal noise generator as the amplitude modulation generator. |
| [SOURce]:AM:INTernal:FUNCtion:SHAPe? | Queries the shape of the internal amplitude modulation generator waveform (Not available with Option 17A or 17B).<br><br>Returns: "Off", "Sine", "Square", "Triangle", "Pos Ramp", or "Noise". |
| [SOURce]:AM:SCALing <am_scaling> | Sets the external amplitude modulation scaling to a percentage per volt value as specified by <am_scaling>. |
| [SOURce]:AM:SCALing? | Queries the external amplitude modulation scaling. Return value is a percentage per volt. |
| [SOURce]:AM:SOURce INTernal\|EXTernal | Sets the amplitude modulation source. The choices are as follows:<br><br>INTernal Sets the internal AM generator as the AM source.<br>EXTernal Selects external AM. The modulation source in this case is the signal applied at the rear-panel AM IN connector. |
| [SOURce]:AM:SOURce? | Queries the amplitude modulation source. Returns "INTernal" or "EXTernal" |
| [SOURce]:AM:STATe ON\|OFF\|1\|0 | Sets amplitude modulation mode on or off. The choices are as follows:<br><br>1\|ON Sets AM mode to on.<br>0\|OFF Sets AM mode to off. |
| [SOURce]:AM:STATe? | Queries the state of amplitude modulation mode. The return value is as follows:<br><br>1 AM mode is currently on.<br>0 AM mode is currently off. |

**Table 3-12: Source Subsystem - Modulation SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:FM:BANDwidth NARRow\|WIDE | Sets the Frequency Modulation bandwidth. The choices are as follows:<br><br>NARRow Selects narrow FM bandwidth.<br>WIDE Selects wide FM bandwidth. |
| [SOURce]:FM:BANDwidth? | Queries the Frequency Modulation bandwidth. Returns "Narrow" or "Wide". |
| [SOURce]:FM[:DEViation] <fm_dev> [HZ \| KHZ \| MHZ \| GHZ] | Sets the internal Frequency Modulation deviation to the value specified by <fm_dev> (Not available with Option 17A or 17B). Hertz is assumed for the units if no units is specified. |
| [SOURce]:FM[:DEViation]? | Queries the internal Frequency Modulation deviation that is currently set. The return value is in Hertz (Not available with Option 17A or 17B). |
| [SOURce]:FM:INTernal:FREQuency <fm_freq> [HZ \| KHZ \| MHZ \| GHZ] | Sets the rate of the internal Frequency Modulation generator to the value specified by <fm_freq> . Hertz is assumed for the units if no units is specified. (Not available with Option 17A or 17B). |
| [SOURce]:FM:INTernal:FREQuency? | Queries the current rate of the internal Frequency Modulation generator. The return value is in Hertz (Not available with Option 17A or 17B). |
| [SOURce]:FM:INTernal:FUNCtion:SHAPe OFF\|SINE\|SQUare\|TRIangle\|PRaMP | Sets the shape of the internal frequency modulation generator waveform (Not available with Option 17A or 17B). The choices are as follows:<br><br>OFF Turns the internal frequency modulation generator off.<br>SINE Sets the internal frequency modulation generator waveform to sine wave.<br>SQUare Sets the internal frequency modulation generator waveform to square wave.<br>TRIangle Sets the internal frequency modulation generator waveform to triangle wave.<br>PRaMP Sets the internal frequency modulation generator waveform to a positive-going ramp. |
| [SOURce]:FM:INTernal:FUNCtion:SHAPe ? | Queries the shape of the internal frequency modulation generator waveform (Not available with Option 17A or 17B).<br><br>Returns: "Off", "Sine", "Square", "Triangle", or "Pos Ramp". |
| [SOURce]:FM:SENSitivity <fm_sens> | Sets the Frequency Modulation external sensitivity to the value specified by <fm_sens>. The value is in Hertz per volt. |
| [SOURce]:FM:SENSitivity? | Queries the Frequency Modulation external sensitivity. The return value is in Hertz per volt. |
| [SOURce]:FM:SOURce EXTernal\| INTernal\|DC | Sets the frequency modulation source. The choices are as follows:<br><br>INTernal Sets the internal FM generator as the FM source.<br>EXTernal Selects external FM. The modulation source in this case is the signal applied at the rear-panel FM/ϕM IN connector.<br>DC Maximum deviaiton for DC mode is 125 kHz for ±1 volt external input from 500 MHz to maximum frequency of the instrument. |
| [SOURce]:FM:SOURce? | Queries the frequency modulation source. Returns either "Internal" or "External". |
| [SOURce]:FM:STATe ON\|OFF\|1\|0 | Sets the frequency modulation mode on or off. The choices are as follows:<br><br>1\|ON Sets FM mode to on.<br>0\|OFF Sets FM mode to off. |

**Table 3-12: Source Subsystem - Modulation SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:FM:STATe? | Queries the frequency modulation mode. The return value is as follows:<br><br>1 FM mode is currently on.<br>0 FM mode is currently off. |
| [SOURce]:PULM:EXTernal:POLarity NORMal\|INVerted | Determines the polarity of the signal at the PULSE IN connector that produces an RF output during pulse modulation. The choices are as follows:<br><br>NORMal RF at the RF OUT connector will be on when the signal at the PULSE IN connector is at a TTL high.<br>INVerted RF at the RF OUT connector will be on when the signal at the PULSE IN connector is at a TTL low. |
| [SOURce]:PULM:EXTernal:<br><br>POLarity? | Queries the pulse modulation polarity. Returns either "NORMal" or "INVerted". |
| [SOURce]:PULM:SOURce EXTernal:INTernal | Set the pulse modulation source. The choices are as follows:<br><br>INTernal Sets the internal PM generator as the PM source.<br>EXTernal Selects external PM. The modulation source in this case is the signal applied at the rear-panel PULSE IN connector. |
| [SOURce]:PULM:SOURce? | Queries the source of pulse modulation. Returns: either "INTernal", or "EXTernal". |
| [SOURCe:]PULM:STATe ON\|OFF\|1\|0 | Sets the pulse modulation mode on or off. The choices are as follows:<br><br>1\|ON Sets Pulse mode to on.<br>0\|OFF Sets Pulse mode to off. |
| [SOURce]:PULSe:DELay <pm_delay> (S\|MS\|US) | Sets the delay of the internal pulse modulation generator waveform to the value specified by <pm_delay> (Not available with Option 17A or 17B). |
| [SOURce]:PULSe:DELay? | Queries the delay of the internal pulse modulation generator waveform (Not available with Option 17A or 17B). The return value is in seconds. |
| [SOURce]:PULSe:FREQuency <pm_freq> [HZ \| KHZ \| MHZ \| GHZ] | Sets the internal pulse modulation rate to the value specified by <pm_freq> (Not available with Option 17A or 17B). Hertz is assumed if no units is supplied. |
| [SOURce]:PULSe:FREQuency? | Queries the internal pulse modulation rate (Not available with Option 17A or 17B). The return value is in Hertz. |
| [SOURce]:PULSe:MODE OFF \| TRIGgered \| CONTinuous \| GATEd | Sets the internal pulse modulation mode (Not available with Option 17A or 17B). The choices are as follows:<br><br>OFF Turns internal pulse modulation mode off.<br>TRIGgered Sets the instrument to produce a single internally generated RF output pulse when a valid trigger signal is received at the PM TRIG IN connector.<br>CONTinuous Sets the instrument to produce an internally generated pulse modulated RF output signal continuously.<br>GATEd Sets the instrument to produce an internally generated pulse modulated RF output signal for the duration of the externally provided gate signal at the PM TRIG IN connector. |

**Table 3-12: Source Subsystem - Modulation SCPI Commands**

| Command Syntax | Description |
|---|---|
| [SOURce]:PULSe:PERiod <pm_per> | Sets the period of the internal pulse modulation generator to the value specified by <pm_per>. (Not available with Option 17A or 17B). The default units are in Hertz unless otherwise specified. |
| [SOURce]:PULSe:SYNC <pm_sync> | Sets the delay of the pulse modulation sync signal. The delay range of the Pulse Sync Output function is 100 nSec. to 10 mSec. (Not available with Option 17A or 17B) The default units are in Hertz unless otherwise specified. |
| [SOURce]:PULSe:WIDTh <pm_width> (S\|MS\|US) | Sets the internal pulse modulation width to the value specified by <pm_width> (Not available with Option 17A or 17B). |
| [SOURce]:PULSe:WIDTh? | Queries the internal pulse modulation width. The return value is in seconds. (Not available with Option 17A or 17B). |

# 3.3 IEEE 488.2 Common Commands

The commands and queries in the following table are defined by IEEE 488.2. IEEE 488.2 defines how the instrument should respond to the following common commands and queries. These commands are independent of the SCPI and GT-12000 native command sets.

**Table 3-13: IEEE 488.2 Common Commands**

| Command | Name | Description |
|---|---|---|
| *CLS | Clear Status | Clears the event registers in all status groups. It also clears the Event Status Register and the Error/Event Queue |
| *ESE <ese> | Standard Event Status Enable | Sets the Standard Event Status Enable Register. A service request is issued whenever the specified event has occurred<br><br>Range of <ese>: 0 - 255 |
| *ESE? | Standard Event Status Enable | Returns the value of the Standard Event Status Enable Register. The value returned is a decimal value representing the current state of the Standard Event Status Enable Register |
| *ESR? | Standard Event Status Register | Returns the value of the Standard Event Status Register. The value returned is a decimal value representing the current state of the Standard Event Status Register |
| *IDN? | Identification | Returns the instrument identification |
| *OPC | Operation Complete | Causes the Operation Complete bit (that is, Bit 0 of the Standard Event Status Register) to be set to 1 when all pending selected device operations have been finished. List Mode only |
| *OPC? | Operation Complete | Places an ASCII character 1 into the device's output queue when all pending selected device operations have been finished. Unlike the *OPC command, the *OPC? query does not affect the OPC Event bit in the Standard Event Status Register (ESR). |

**Table 3-13: IEEE 488.2 Common Commands**

| Command | Name | Description |
|---|---|---|
| *RST | Reset | Sets the device-specific functions to a known state that is independent of the past-use history of the device. The command does not reset any part of the status reporting system |
| *SRE <sre> | Service Request Enable | Sets and enables the value of the Service Request Enable Register<br><br>Range of <sre>: 0 to 255 |
| *SRE? | Service Request Enable | Returns the value set by the *SRE command for the Service Request Enable Register |
| *STB? | Read Status Byte | Returns the value of the current state of the Status Byte |
| *TST? | Self-Test | Self-Test Query. It returns '0' if the test succeeds, and '1' if the test fails<br><br>The test sets a predefined group of CW frequencies and power levels. After each frequency and power is set, the firmware reads the instrument's LOCK/ LEVEL status. If failing the lock/level, the test is failed. In order to avoid damage to the device the 2500A is connected to, maximum attenuation is set if it is available, or the power level is set to minimum for the duration of the test. The system will be restored to the pre-test condition upon completion |
| *WAI | Wait-to-Continue | Causes the synthesizer to complete all pending tasks before executing any additional commands |

# 3.4 2500A Specific Commands

The commands in the following table are specific to the 2500A Series of instruments, and are independent of the SCPI and GT-12000 native command sets.

**Table 3-14: 2500A Specific Commands**

| Command | Name | Description |
|---|---|---|
| *RCL <reg> | Recall Instrument State | Recalls a previously saved instrument state from memory<br><br>Range of <reg>: 0 - 9 |
| *SAV <reg> | Save Instrument State | Saves the current instrument state to memory<br><br>Range of <reg>: 0 - 9 |
| *TRG | Trigger Device | Triggers the synthesizer if BUS is the specified trigger source (see “TRIGger:SOURce BUS\|EXTernal” on page 76). |
| /SCPI | SCPI | Changes command syntax to SCPI |
| /NATive | Giga-tronics Native | Change command syntax to GT-12000 "native" |

# 3.5 Status Register System

The Status Register System provides information regarding the state of the 2500A during remote operation. Several status registers can be queried to provide specific information regarding the state of the instrument or the status of events relating to its operation. These registers can be queried directly or can be configured to initiate a service request whenever an expected condition has occurred. One or more conditions can be monitored at one time by the 2500A.

Figure 3-1 shows the interrelationship between the registers that constitute the 2500A Status Register System.

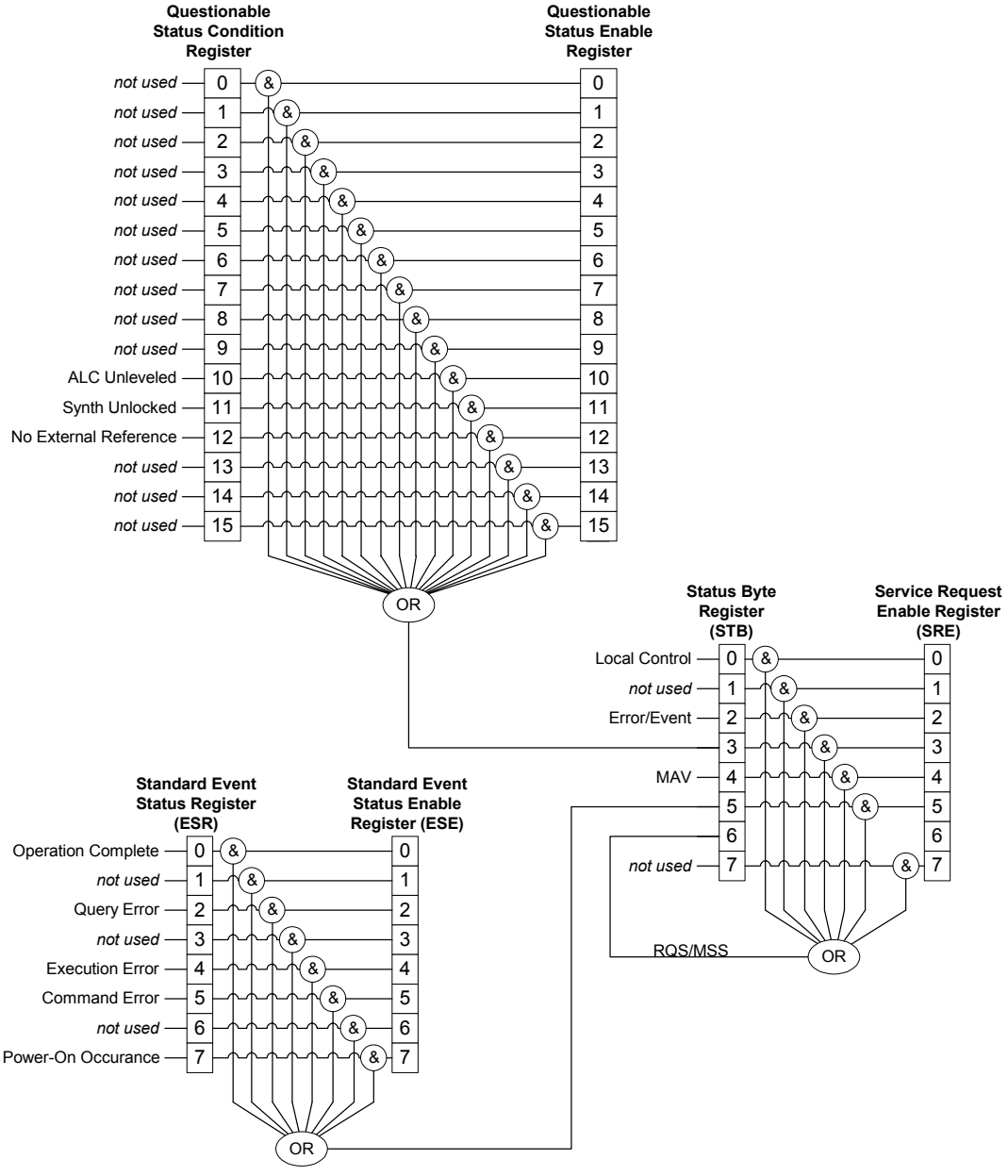



Figure 3-1: Status Register System

The following paragraphs briefly describe the registers:

## 3.5.1 Status Byte (STB) and Service Request Enable (SRE) Registers

The Status Byte Register is the primary status register. It is the top-level register used to track changes in the state of the 2500A. The summary bits of lower-level status registers become set in the Status Byte Register when certain conditions occur that are being monitored by and have been enabled in those lower-level registers. The *STB? query can be used to read the contents of the Status Byte Register.

The Service Request Enable Register controls which bits in the Status Byte Register can generate a service request. The bits in the Service Request Enable Register are logically ANDed with the equivalent bits in the Status Byte Register, and the results of those AND operations are logically ORed to produce a service request. The RQS/MSS bit (bit 6) in the Status Byte Register is set when the logic OR operation produces a service request. The *SRE command can be used to set the contents of the Service Request Enable Register, and the *SRE? query can be used to read the contents of the Service Request Enable Register.

The following describes each bit in the Status Byte Register:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **Not used** | **RQS/ MSS** | **ESB** | **MAV** | **QUES Status** | **Error/ Event** | **Not Used** | **Local Control** |

0 Local Control. This bit is set whenever the Local button is pressed while the source is in remote operation

1 Not used. Always 0.

2 Error/Event. This bit is set whenever a SCPI error has occurred.

3 QUES Status (Questionable Status). This bit is set whenever a condition defined in the questionable status register has occurred. See the section entitled “Questionable Status Condition and Enable Registers”, below, for details.

4 MAV. Message Available. This bit is set whenever a message is available.

5 ESB. Standard Event Status Register. This bit is set whenever a condition defined in the Standard Event Status Register has occurred. See the section entitled “Standard Event Status (ESR) and Standard Event Status Enable (ESE) Registers”, below, for details.

6 RQS/MSS. Interrupt Request. This bit is set whenever an event identified by the service request mask has occurred.

7 Not used. Always 0.

## 3.5.2 Standard Event Status (ESR) and Standard Event Status Enable (ESE) Registers

The Standard Event Status Register is one of the lower-level status registers. It monitors certain common instrument status conditions. When a condition occurs that is being monitored by this register, *and* that

condition has been enabled by the Standard Event Status Enable Register, bit 5 is set in the Status Byte Register. The *ESR? query can be used to read the contents of the Standard Event Status Register.

The Standard Event Status Enable Register controls which bits in the Standard Event Status Register can set bit 5 of the Status Byte Register. The bits in the Standard Event Status Enable Register are logically ANDed with the equivalent bits in the Standard Event Status Register, and the results of those AND operations are logically ORed to produce a summary bit. The ESB bit (bit 5) in the Status Byte Register is set when the logic OR operation sets the summary bit. The *ESE command can be used to set the contents of the Standard Event Status Enable Register, and the *ESE? query can be used to read the contents of the Standard Event Status Enable Register.

The following describes each bit in the Standard Event Status Register:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **Power on Occurrence** | **Not Used** | **Command Error** | **Execution Error** | **Not Used** | **Query Error** | **Not Used** | **Operation Complete** |

0 Operation Complete. This bit is set whenever all pending operations are completed (such as a list computation).

1 Not used. Always 0.

2 Query Error. This bit is set whenever a query error has occurred.

3 Not used. Always 0.

4 Execution Error. This bit is set whenever an execution error has occurred.

5 Command Error. This bit is set whenever an invalid GPIB command has been received.

6 Not used. Always 0.

7 Power On Occurrence. This bit is set whenever the instrument has been powered off and then on again during manual and remote operation.

## 3.5.3 Questionable Status Condition and Enable Registers

The Questionable Status Register is one of the lower-level status registers. It monitors certain 2500A-specific status conditions. When a condition occurs that is being monitored by this register, bit 3 is set in the Status Byte Register. The STATus:QUEStionable:CONDition? query can be used to read the contents of the Questionable Status Register.

The following describes each bit in the Questionable Status Register:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **Not Used** | **Not Used** | **Not Used** | **Not Used** | **Not Used** | **Not Used** | **Not Used** | **Not Used.** |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| **Not Used** | **Not Used** | **Not Used** | **No External Reference** | **Synth unlocked** | **ALC unleveled** | **Not Used** | **Not Used.** |

0-9 Not Used.

10 ALC Unleveled. This bit is set whenever the output power is operated in an unleveled condition.

11 Synthesizer Unlocked. This bit is set whenever the synthesizer has lost phase lock.

12 No External Reference. This bit can be monitored whenever an external reference is applied to the synthesizer for phase locking multiple synthesizers. This bit is set whenever the external reference signal is lost.

13-15 Not Used.

## 3.5.4 List Mode Operation

2500A list mode operation is not available from the front panel. In order to use list mode, remote programming must be used.

Automation Xpress and the Automation Xpress Interface (AXI) is the preferred method of using the 2500A in remote operation. For information on using Automation Xpress and the AXI, refer to the Automation Xpress online help system.

Command-based remote interface commands can also be used to program list mode operation. The remainder of this section includes some examples that explain how to program a 2500A for list mode operation using commands.

### 3.5.4.1 Example: List Mode

The following example shows the SCPI commands that are used to program the 2500A to step its output power level from 8 to 5 to 0 dBm while keeping its frequency constant at 5 GHz. The dwell time, that is, the time spent on each step, is 200 ms. In this example, software triggering is used, and the sweep mode is set to single-sweep. The last command in the sequence triggers the list.

| Sequence | Command | Description |
|---|---|---|
| **1** | **LIST:SEQ:AUTO ON** | **Activate list mode.** |

| Sequence | Command | Description |
|---|---|---|
| 2 | LIST:FREQ 5000000000.0,5000000000.0,5000000000.0 | Add 3 list points to a list with frequency 5 GHz. |
| 3 | LIST:POW 8.000,5.000,0.000 | Set the power for the 3 list points to 8, 5 and 0 dBm respectively. |
| 4 | LIST:DWEL 0.200000, 0.200000, 0.200000 | Set the dwell (step) time for the 3 list points to 0.2 seconds. |
| 5 | LIST:PRECompute | Pre-compute the created list data. |
| 6 | LIST:REPeat SWEEP | Set the list repeat type to single sweep. |
| 7 | TRIGger:SOURce BUS | Set the list trigger mode to GPIB (software) triggering. |
| 8 | OUTP ON | Turn the RF output on. |
| 9 | *TRG | Trigger the list. |

# 4 Specifications & Performance Verification

## 4.1 Models

**Table 4-1: Models[1]**

| Models | Frequency Range |
|---|---|
| 2508A/2508AS | 100 kHz to 8 GHz |
| 2520B/2520AS | 100 kHz to 20.199 GHz |
| 2526B/2526AS | 100 kHz to 26.5 GHz |
| 2540B/2540AS | 100 kHz to 40 GHz |

1. Option 18, Deletes 100 kHz to 2 GHz frequency range

## 4.2 Specifications

All specifications apply over a 0°C to +55°C range after 30 minutes of warm-up time, unless otherwise stated.

NOTE: Giga-tronics recommends a calibration cycle of two years for the 2500A.

### 4.2.1 Frequency

Accuracy: Same As Timebase (after 30 day warm-up)
Resolution: 0.001 Hz
**Internal References:**

**10 MHz**
Aging Rate: $< 5 \times 10^{-10}$/day
Temperature Stability: $< \pm 2.5 \times 10^{-8}/^{o}C$

10 MHz Reference Out:
Output: DC coupled, 2 Vp-p, sine wave reference output signal, 50Ω

100 MHz Reference Out:
Output: typ. +5 dBm AC coupled reference output signal, 50Ω

External Reference Input:
Frequency: 10 MHz or 100 MHz, ± 1 ppm
Level: ≥ -5 dBm, 50Ω

#### 4.2.1.1 Frequency Bands

**Table 4-2: Frequency Bands**

| Band | Frequency | N (Band Index) |
|---|---|---|
| 0 | 0.1 to 9.99 MHz | N/A |
| 1 | 10 to 16 MHz | 512 |
| 2 | >16 to 31 MHz | 256 |
| 3 | >31 to 63.99 MHz | 128 |
| 4 | >63 to 125 MHz | 64 |
| 5 | >125to 250 MHz | 32 |
| 6 | >250 to 500 MHz | 16 |
| 7 | >500 to 1000 MHz | 8 |
| 8 | >1 to 2 GHz | 4 |
| 9 | >2 to 4 GHz | 2 |
| 10 | >4 to 10.1 GHz | 1 |
| 11 | >10.1 to 20.2 GHz | 1/2 |
| 12 | >20.2 to 40 GHz | 1/4 |

## 4.2.2 Output Power

Specification applies over the 0°Cto 35°C range and degrades <2.0 dB above 35°C to 55°C

**Table 4-3: Maximum Output Power (dBm)[1]**

| Model | 0.1 - 10 MHz | 0.01 - 2 GHz | 2 - 8 GHz | 8 - 20 GHz | 20 - 26.5 GHz | 26.5 - 40 GHz |
|---|---|---|---|---|---|---|
| 2508 | + 10 | +14 | + 17 | | | |
| 2520 | + 10 | +14 | +17 | +20 | | |
| 2526 | + 10 | +14 | +13 | +15 | +10 | |
| 2540 | + 10 | +14 | +13 | +15 | +10 | +9 |

1. Step Attenuator reduces power by 1.5 dB to 18 GHz, 2.0 dB from 18 GHz to 26.5 GHz, and 2.5 dB and above 26.5 GHz

**Table 4-4: Minimum Settable Power**

| Model | 2508, 2520 | 2526, 2540 |
|---|---|---|
| Standard | -107 dBm | -100 dBm |
| Option 26<br>Delete Step Attenuator | -17 dBm | -10 dBm |

Resolution: 0.05 dB
Power Offset: 0 to 10 dB
Temperature Stability: 0.025 dB/°C
Source Match: <2.0:1 into 50Ω

**Table 4-5: Accuracy[1]**

| Frequency Range | ≥ +5 dBm | ≥-10 dBm | ≥-100 dBm[2] |
|---|---|---|---|
| 100 kHz - 20 GHz | ± 0.85 | ± 0.7 | ± 1.2 |
| 20 - 40 GHz | ± 1.05 | ± 0.9 | ± 1.4 |

1. Specifcation applies over the 15°C to 35°C range and degrades <0.10 dB per degree Centigrade outside this range
2. Does not apply with option 26 (delete step attenuator). Level accuracy at -20 dBm for models with option 26 is typically less than ± 1.5 dB

## 4.2.3 Spectral Purity

**Table 4-6: Harmonics[1]**

| Frequency | Harmonics |
|---|---|
| 0.1 to <10 MHz | -30 dBc |
| 10 - 100 MHz | -40 dBc |
| 0.1 - <2 GHz | -55 dBc |
| 2.0 - <20.0 GHz | -55 dBc |
| 20.0 - 40 GHz | -30 dBc |

1. At maximum leveled output or +10 dBm, whichever is lower. Harmonics above instrument range are typical.

**Table 4-7: Sub-Harmonics[1]**

| Frequency | dBc, +6 dBm Setting |
|---|---|
| 0.01 to 2 GHz | - 80 |
| >2 to 20 GHz | - 60 |
| >20 to 40 GHz | - 50 |

1. At maximum leveled output or +10 dBm, whichever is lower

**Table 4-8: Spurious (Non-Harmonic related Spurs)[1]**

| Frequency | Offsets (> 300 Hz) |
|---|---|
| 100 kHz to 10.1 GHz | - 65 dBc |
| >10.1 to 20.20 GHz | - 58 dBc |
| >20.2 to 40 GHz | -50 dBc |

1. Offsets < 300 Hz, -45 dBc typical

**Table 4-9: Residual FM (typical)**

| Frequency | Bandwidth - 50 Hz to 150 kHz |
|---|---|
| 100 kHz to 20.2 GHz | < 6 Hz |
| >20.2 to 40 GHz | < 12 Hz |

**Table 4-10: AM Noise[1]**

| Frequency | Offsets > 5 MHz |
|---|---|
| 100 kHz to 2 GHz | - 130 dBc/Hz |
| >2 to 20.2 GHz | - 145 dBc/Hz |
| >20 to 40 GHz | - 140 dBc/Hz |

1. Typical. Offset >5 MHz

**Table 4-11: SSB Phase Noise**

| Frequency | Offset from Carrier (dBc/Hz) | | | | | |
|---|---|---|---|---|---|---|
| (GHz) | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz |
| 1.0 | -70 | -96 | -116 | -128 | -126 | -149 |
| 4.0 | -58 | -84 | -103 | -115 | -114 | -144 |
| 10 | -50 | -78 | -99 | -109 | -108 | -141 |
| 15 | -46 | -73 | -94 | -105 | -105 | -139 |
| 20 | -44 | -70 | -93 | -101 | -101 | -132 |
| 30 | -40 | -67 | -88 | -99 | -99 | -133 |

## 4.2.4 List Mode

List Points: 4000
Frequency Settling Time[1]: <550 usec. for ≤ 500[2] MHz frequency switch
Amplitude Settling Time:[3] <500 usec.
Step Time: .150 msec. to 1000 msec. per point
2 msec to 1000 msec per point (Option 31)
Sync Out Delay: 0.05 msec. to 10 msec
Trigger Modes: External, Bus, GET
Sweep Modes: Continuous, Signel Step, & Single Sweep

1. See Time for freqeuncy to settle within 50 kHz of final value after a frequency switch.
2. $\Delta F_0 = | (F_{stop}*N_{stop}) - (F_{start}*N_{start}) |$ - See Frequency Bands Table 4-2 for N values.
3. Time for amplitude to settle within 0.1 dB of final value after an amplitude switch.

## 4.2.5 Amplitude Modulation

| | |
|---|---|
| Frequency: | 100 kHz to maximum frequency |
| Depth: | 0 to 90% (output = 0 dBm) |
| Rate (3 dB Bandwidth): | DC to 10 kHz (30% Depth) |
| Sensitivity: | 0 to 95%/V selectable |
| Accuracy: | ± 10% of setting @ 1 kHz rate |
| Input: | |
| Range: | ± 1 Volts Peak |
| Impedance: | 600Ω |

## 4.2.6 Frequency Modulation

| | |
|---|---|
| Frequency: | 10 MHz to maximum frequency |
| Input: | ± 1 Volts Peak |
| Impedance: | 50Ω |

DC FM

| | |
|---|---|
| Frequency Range: | 500 MHz to Maximum Frequency |
| Deviation: | 125 kHz |
| Input Range: | ±1 Vp-p |
| Accuracy: | 5% of deviation, typical |

Narrow Mode: (Modulation Index - Limited by Deviation)

| | |
|---|---|
| Rate (3 dB Bandwidth): | DC to 50 kHz |
| Peak Deviation: | 1 MHz/N where N = Band Index; see Table 4-2 |
| Accuracy: | ± 5% at 5 kHz rate, .6013 volt peak, 20 kHz/V sensitivity |

Wide Mode:

| | |
|---|---|
| Rate (3 dB Bandwidth): | 10 kHz to 5 MHz |
| Peak Deviation: | 20 MHz/N or Modulation Index of 3.7 X $F_{GHz}$, whichever is less |
| Accuracy: | ± 5% at 100 kHz rate, 0.2405 V peak input, 1 MHz/V sensitivity |

## 4.2.7 Pulse Modulation

| | |
|---|---|
| Frequency: | 500 MHz to maximum frequency |
| On/Off Ratio: | >80 dB |
| Minimum Leveled Width: | 100 nsec, Internal or External |
| Minimum Unleveled Width: | 10 nsec External |
| | 50 nsec Internal |
| PRF (50% duty cycle): | DC to 5 MHz, leveled |
| | DC to 10 MHz, unleveled |

**Table 4-12: Rise/Fall Times**

| Frequency | Rise/Fall Time |
|---|---|
| 0.5 to 20 GHz | < 10 nsec |
| > 20 to 40 GHz | < 25 nsec |

**Table 4-13: Pulse Level Accuracy [1]**

| Pulse Width | Accuracy of Setting (dB) |
|---|---|
| <100 nsec. | Not specified |
| 100 to 150 nsec. | +2.5/-0.5 |
| >150 to 250 nsec. | +1.5/-0.5 |
| >250 nsec | ±0.5 |

1. Duty Cycle > 0.01%, relative to CW

**Table 4-14: Pulse Fidelity (typical)**

| Parameter | 0.5 to 2 GHz | 2 - 40 GHz |
|---|---|---|
| Overshoot and Ringing | <15% | <15% |
| Video Feed Through | <5% | <1% |

Compression: <±5 nsec
Delay: <75 nsec
Input:
Sensitivity: TTL levels (polarity selectable)
Impedance: 50Ω

## 4.2.8 External ALC

Input Range:

Detector: -66 dBV to 6 dBV
Max Input: +10 volts

Accuracy:

+6 dBV to -40 dBV ±1 %
-40 dBV to -66 dBV ±2 %

Mode Availability:

CW
List
Pulse (5 usec. pulse width min, < 200 kHz)

Input Impedance: 1 Meg Ohm

## 4.2.9 Internal Modulation Generator

**Table 4-15: AM Modulation Source**

| Parameter | Specification |
|---|---|
| Waveforms | Sine, Square, Triangle, Ramp, Gaussian Noise |
| Rate | 0.01 Hz to 10kHz, all waveforms |
| Resolution | 0.01 Hz |
| Accuracy | Same as time base |
| AM Output | 2V, peak to peak into 10 k Ohm Load |

**Table 4-16: FM Modulation Source**

| Parameter | Specification |
|---|---|
| Waveforms | Sine, Square, Triangle, Ramp |
| Rate | 0.01 Hz to 1 MHz, all waveforms |
| Resolution | 0.01 Hz |
| Accuracy | Same as time base |
| FM Output | 2V, peak to peak into 10 k Ohm Load |

**Table 4-17: Pulse Modulation Source**

| Parameter | Specification |
|---|---|
| Pulse Repition Interval | 0.2 us to 1 sec |
| Resolution | 10 nsec. |
| Accuracy | +/-0.1% typical, worst case: ±2% of setting or ±20nS whichever is greater |
| PM Output | 2 Volts into 50Ω |

Pulse Modulation Modes

Continuous Mode
- Pulse Repetition Interval: 200 nsec. to 1 second
- Pulse Width: 50 nsec. to 10 msec.
- Sync Out Delay: 0 to 10 msec.

Gated Mode
- Pulse Repetition Interval: 200 nsec. to 1 second
- Pulse Width: 50 nsec. to 10 msec.
- Sync Out Delay: 0 to 10 msec.
- Gating Input Polarity: Active High or Active Low

Triggered Mode
- PRF Pulse Delay: 100 nsec. to 1 second
- Pulse Width: 50 nsec. to 10 msec.
- Sync Out Delay: 0 to 10 msec.
- Trigger Input Polarity: Rising or Falling Edge

## 4.2.10 General Specifications

| | |
|---|---|
| Operating Temperature: | 0 to 55°C |
| Environmental | Conforms to MIL-PRF-28800F, Class 3 |
| Safety: | EN61010 |
| Emissions: | EN61326 |
| Approvals: | CE Marked |
| Power: | 90-253 VAC, 47-64 Hz<br>200 watts typical, 300 watts maximum |
| Fuse Rating: | 2 A, SB |
| Width: | 16.75 inches, 425.5 mm |
| Depth: | 21 inches, 533.4 mm |
| Height: | 3U, 5.25 inches, 133.4 mm |
| Weight: | <35 lbs., <15.9 kg |

# 4.3 Performance Verification

This section is used to verify the electrical performance of the 2500A using the specifications described in this chapter. Performance verification is recommended at least every two years, or more often when required to ensure proper operation of the instrument.

Test equipment must be warmed up according to specifications. The minimum warm-up time before testing the instrument is 30 minutes unless otherwise specified. The following procedures refer to the instrument under test as the 2500A or UUT (Unit Under Test) for all 2500A Series Microwave Synthesizer models.

## 4.3.1 Recommended Equipment

Each performance test in this chapter includes a list of the equipment required to perform the test. This list of equipment, called “Equipment Required”, appears at the beginning of each procedure.

The “Equipment Required” sections indicate, by type, the test equipment that is required for each test. Recommended models for each type of test equipment are included in this section. Equivalent test equipment can be substituted for the recommended models, provided that the accuracies and specifications are equal to or better than those of the recommended models.

| | |
|---|---|
| • Oscilloscope | Tektronix TDS3052B or Equivalent |
| • Microwave Frequency Counter | Anritsu MF2412B Frequency Counter (2520 Models) |
| • Power Meter | Giga-tronics Series 8650A |
| • Power Sensors | Giga-tronics 80313A or Equivalent |
| • | Giga-tronics 80324A or Equivalent (2540 Models) |
| • | Giga-tronics 80334A or Equivalent |
| • | Giga-tronics 80350A or Equivalent (2520 Models) |
| • Spectrum Analyzer | Agilent 8564EC or Equivalent |
| • Function Generator | Agilent 33220A or Equivalent |
| • Universal Counter | Agilent 33121A or Equivalent |
| • Crystal Detector | Krytar Model 703S or Equivalent |

In addition, an assortment of coaxial cables should be available for interconnecting the equipment.

## 4.3.2 Performance Tests: All 2500A Series

The performance tests in this section apply to all 2500A Series instruments.

### 4.3.2.1 Frequency Range, Resolution & Accuracy

In this test, the RF output of the 2500A is connected to the input of a frequency counter, and the 2500A's output frequency is tested at various points within its frequency range. The internal timebase of the counter is used as a reference for the 2500A to eliminate timebase errors from the measurements.

#### 4.3.2.1.1 Equipment Required

- Microwave Frequency Counter

#### 4.3.2.1.2 Test Setup

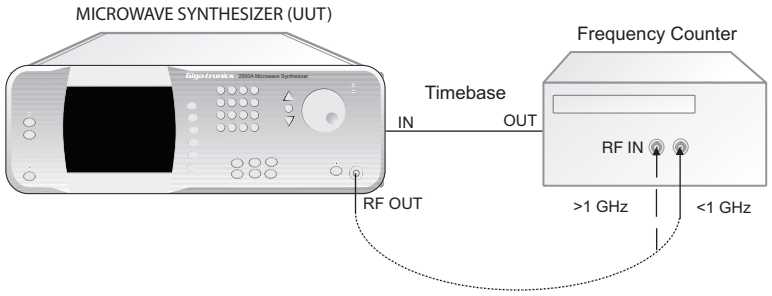



Figure 4-1: Frequency Range, Resolution & Accuracy Test Setup

#### 4.3.2.1.3 Procedure

1. Connect the equipment as shown in Figure 4-1. Connect the 2500A RF Output to the low frequency input using coaxial cabling and adapters as is necessary. Allow the equipment to warm up for at least 30 minutes. Because the 2500A and the counter use the same timebase, timebase errors are eliminated. The 2500A automatically switches to the external reference when it is connected.

2. Set the 2500A for an output frequency of 10 MHz, and set the RF output level to 0 dBm.

3. Press the [RF ON] button to activate the 2500A output.

   The indicator above the RF ON button is blue when the 2500A output is active.

4. Set the 2500A to each frequency listed in Datasheet 1, and verify that the counter reads the set frequency plus or minus the counter resolution.

5. When the test frequency exceeds the maximum frequency of the input, move the 2500A RF Output to the high frequency Input on the frequency counter.

6. For each frequency listed in the remaining rows of Datasheet 1, the counter should read the entered frequency ±1 Hz, plus or minus the counter resolution. Ignore all frequencies outside the frequency range of the unit under test.

## 4.3.2.2 Spectral Purity Tests

### 4.3.2.2.1 Description

In this test, the output of the 2500A is connected to a spectrum analyzer. Various frequencies are selected and the analyzer tuned to determine the presence of either harmonic or non-harmonic (spurious) signals.

### 4.3.2.2.2 Equipment Required

- Spectrum Analyzer

### 4.3.2.2.3 Test Setup

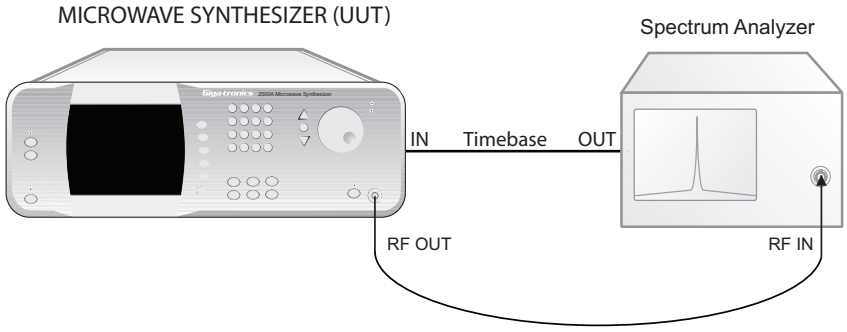



Figure 4-2: Spectral Purity Tests

### 4.3.2.2.4 Procedure

1. Connect the equipment as shown in Figure 4-2. Allow the equipment to warm up for at least 30 minutes. Set the 2500A to the first test frequency listed in Datasheet 2, and set the RF amplitude to +10 dBm or maximum leveled output (whichever is lower).

2. Press the [RF ON] button to turn on the RF output.

   The indicator above the RF ON button is blue when the 2500A output is active.

3. Set the spectrum analyzer to view the 2500A output signal. Adjust the analyzer reference level so that the peak of the displayed signal is at the top graticule line.

4. Set the spectrum analyzer span to 500 MHz with the signal centered on the screen. Gradually narrow the span, keeping the signal centered, to observe any non-harmonically-related or spurious signals. Use appropriate resolution and video bandwidths to allow sufficient dynamic range. Adjust center frequency of the spectrum analyzer to the harmonic and subharmonic frequencies of the test frequency.

5. Record the levels of the worst case harmonic, non-harmonic or spurious signals in the appropriate columns of Datasheet 2.

6. Repeat steps 3 through 5 for the other frequencies listed in Datasheet 2 that are within the operating range of the instrument.

### 4.3.2.3 RF Output Power Tests

The following procedures test output power at frequencies within each band. There are three tests: Maximum-Leveled Power, Level Accuracy, and Step Attenuator Level Accuracy.

The tests are presented in this section as manual procedures, however, for a comprehensive evaluation of the output of the 2500A, it is recommended that an automated test system be used to perform these tests.

---

NOTE: When measuring the flatness and accuracy of the 2500A, consideration must be given to the various measurement uncertainties in the test system. These include, but are not limited to, VSWR, Cal Factor uncertainty and calibration.

---

#### 4.3.2.3.1 Equipment Required

- Power Meter
- Power Sensors covering the frequency ranges being tested
- Spectrum Analyzer

#### 4.3.2.3.2 Test Setups

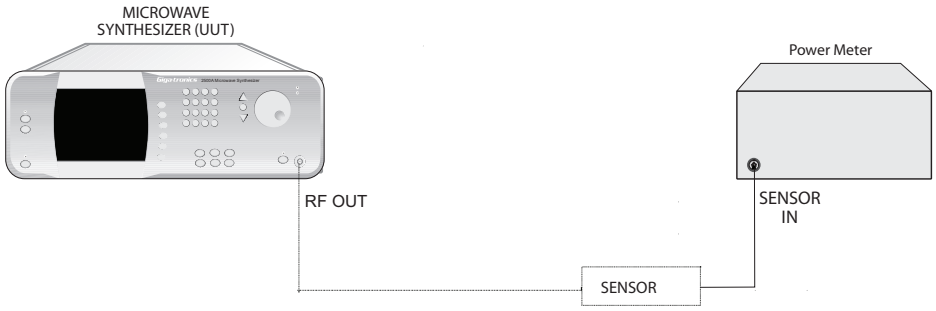



Figure 4-3: Maximum-Leveled Power and Level Accuracy Tests

#### 4.3.2.3.3 Procedure - Maximum-Leveled Power Test

1. Connect the Power Meter and Power Sensor to the RF output of the UUT as shown in Figure 4-3.
2. Set the UUT to the first frequency specified in Datasheet 3, and activate the RF output.
3. Increase the output power of the UUT until the Unleveled indicator lights.
4. Reduce the output power setting until the Unleveled indicator turns off.
5. Record the measured maximum leveled output power in Datasheet 3 for the test frequency.
6. Repeat steps 3 through 5 for the remaining frequencies in Datasheet 3 that are within the operating range of the instrument.

#### 4.3.2.3.4 Procedure - Level Accuracy Test

1. Use the test setup described in the Maximum-Leveled Power Test (Figure 4-3).
2. Set the output level of the UUT to 0 dBm.
3. Set the UUT to the first test frequency listed in Datasheet 4.
4. Record the measured output power in the “Level = 0dBm” column.
5. Repeat Step 4 for the remaining test frequencies shown in Datasheet 4 that are within the operating range of the instrument.
6. Set the output level of the UUT to +12.5 dBm. For 2540 models, set the output level to +6.5 dBm.
7. Set the UUT to the first test frequency listed in Datasheet 4.
8. Record the measured output power in the “Level = +12.5 dBm. . . . . .” column.
9. Repeat Step 8 for the remaining test frequencies shown in Datasheet 4 that are within the operating range of the instrument.

---

NOTE: When measuring the accuracy of the model 2500A, consideration must be given to the measurement uncertainties of the test system. These include, but not limited to, VSWR, Cal Factor Uncertainty, and Calibration Uncertainty.

---

#### 4.3.2.3.5 Procedure - Step Attenuator Level Accuracy Test

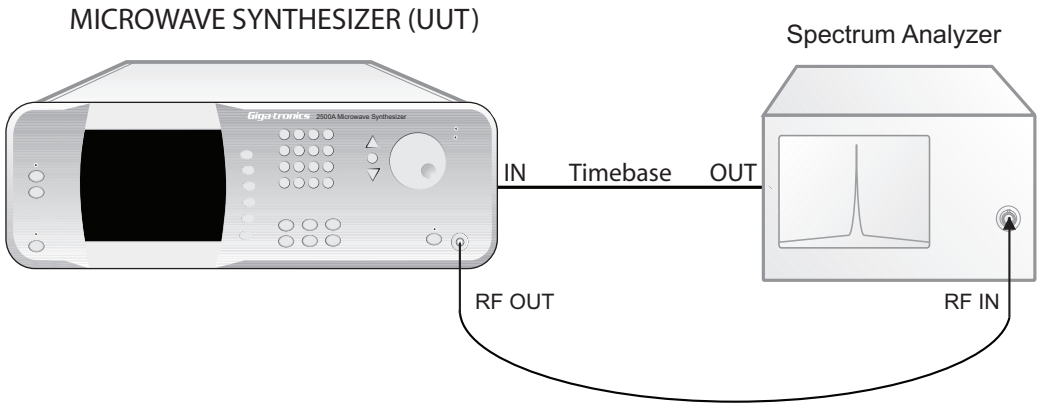



Figure 4-4: Step Attenuator Level Accuracy Test

1. Connect the test equipment and UUT as shown in Figure 4-4, connecting the UUT directly to the RF input of the Spectrum Analyzer.

2. Set the Spectrum Analyzer to the following settings:

| | |
|---|---|
| Frequency | 12 MHz |
| Reference Level | 0 dBm |
| Span | 5 kHz |
| Sweeptime | 400 msec. |
| Resolution Bandwidth: | $\leq$ 1 kHz |
| Video Bandwidth: | $\geq$ 1 MHz |

3. Set the UUT output power level to -3 dBm.

4. Set the UUT frequency to 12 MHz and activate the output.

5. Press the Peak Search button on the Spectrum Analyzer.

6. Press the Step Size button on the UUT and set the step size to 10 dB.

7. Reduce the RF output level of the UUT in 10 dB increments by pressing the Down Arrow button while observing the measurement on the Spectrum Analyzer.

8. Record each level measured of the Spectrum Analyzer into the appropriate column of Datasheet 5 for the frequency being tested.

9. Repeat steps 3 through 8 for the remaining test frequencies in Datasheet 5, recording the measured levels in the appropriate columns of Datasheet 5.

## 4.3.3 Performance Tests: 2500A Series

The performance tests in this section apply only to instruments that contain modulation capability, that is, the standard 2500B and 2500S Series instruments where Option 17A, Delete Modulation Suite, is *not* installed in the 2500A Series Synthesizer.

### 4.3.3.1 Amplitude Modulation Tests

The following procedures test Amplitude Modulation Accuracy and Bandwidth at frequencies within each band. See Table 4-2 for frequency band information.

#### 4.3.3.1.1 Equipment Required

- Spectrum Analyzer
- Function Generator

#### 4.3.3.1.2 Test Setup

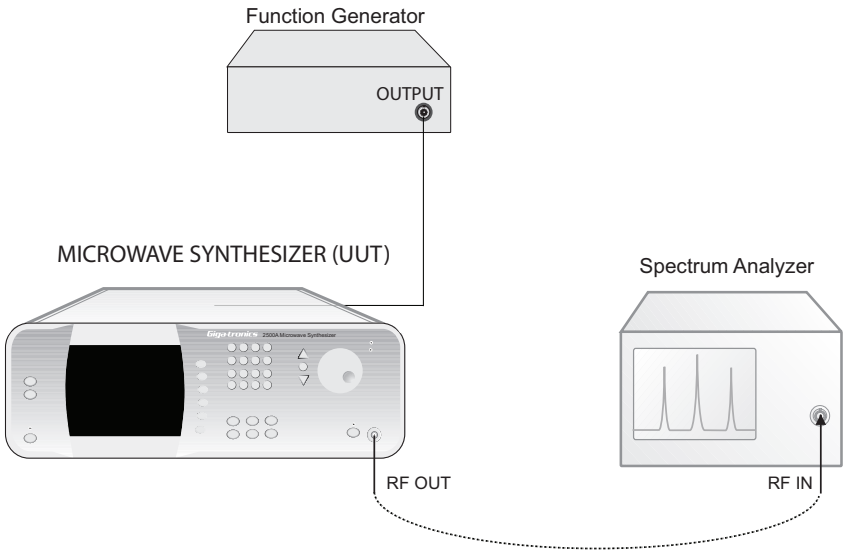



Figure 4-5: Amplitude Modulation Accuracy and Amplitude Modulation Bandwidth Tests

#### 4.3.3.1.3 Procedure - Amplitude Modulation Accuracy

1. Set the UUT for the following settings:

| | |
|---|---|
| External AM State: | On |
| AM Sensitivity: | 30% |
| Level: | 0 dBm |
| Frequency: | 12 MHz |

2. Set the Spectrum Analyzer to the following settings:

| | |
|---|---|
| Reference Level | +5 dBm |
| Span | 5 kHz |
| Sweeptime | 400 msec. |
| Resolution Bandwidth: | ≤ 100 Hz |
| Video Bandwidth: | ≥ 30 kHz |

3. Set the Function Generator for a 1 kHz Sine Wave output at 2.00 V peak-to-peak.

4. Connect the test equipment and UUT as shown in Figure 4-5, connecting the UUT directly to the RF input of the Spectrum Analyzer. Connect the Function Generator output to the AM IN BNC.

---

NOTE: Measure the output of the Function Generator using a precision meter or oscilloscope to ensure that its output is 2.00 Vp-p.

---

5. Set the Spectrum Analyzer to the test frequency. Center the signal using Peak Search and Marker to Center Frequency functions.

6. Activate the Delta Marker function and press the Next Peak function or move the marker to the next peak.

7. Measure and record the AM Depth in the appropriate column in Datasheet 6:

   - If the first time through the test, record the AM Depth in the “30%” column.
   - If the second time through the test, record the AM Depth in the “50%” column.
   - If the third time through the test, record the AM Depth in the “90%” column.

   Measure the difference in dB of one sideband and the carrier. Use the following formula to determine the AM depth in percentage:

   $AM\% = 10^{[(E_{sb} - E_c)/20]*200}$

   Example: Carrier Peak is 0 dBm and one Sideband Peak is -10 dBm

   AM% = 10^[(0 dBm -10 dBm)/20]*200
   AM% = 10^(-0.5)*200
   AM% = (.316)*200
   AM% = 63.2

   The measurement should be with a 10% range of the AM sensitivity setting.

8. Deactivate the AM function of the UUT and repeat Step 5 to Step 7 for the remaining test frequencies in Datasheet 6, recording the AM depth for each in the appropriate column.

9. Set the AM Sensitivity of the UUT to 50% and repeat Step 7 to Step 8 for each of the test frequencies in Datasheet 6, recording the AM depth for each measurement in the appropriate column.

10. Set the AM Sensitivity of the UUT to 90% and repeat Step 7 to Step 8 for each of the test frequencies in Datasheet 6, recording the AM depth for each measurement in the appropriate column.

#### 4.3.3.1.4 Procedure - Amplitude Modulation Bandwidth

1. Set the UUT for the following settings:

| | |
|---|---|
| Level: | 0 dBm |
| Frequency: | 10 MHz |
| AM Sensitivity: | 30% |
| External AM State: | On |

2. Set the Spectrum Analyzer to the following settings:

| | |
|---|---|
| Reference Level | +5 dBm |
| Span | 20 kHz |
| Sweeptime | 400 msec. |
| Resolution Bandwidth: | $\leq$ 100 Hz |
| Video Bandwidth: | $\geq$ 30 kHz |

3. Connect the test equipment and UUT as shown in Figure 4-5,

4. Set the Function Generator for a 1 kHz Sine Wave output at 2.00 V peak-to-peak.

---

NOTE: Measure the output of the Function Generator using a precision meter or oscilloscope to ensure that its output is 2.00 Vp-p.

---

5. Set the Spectrum Analyzer to the test frequency. Center the signal using Peak Search and Marker to Center Frequency functions.

6. Measure and record the difference, in dB, between the carrier amplitude and one sideband amplitude in the first column of Datasheet 7.

7. Vary the rate of the function generator within the specified rate range for the AM specification. Identify the lowest sideband amplitude. Record the value in the second column of Datasheet 7.

8. Subtract the reading in column 2 from the reading in column 1 and record the value in column 3. The difference between the two readings should be 3 dB or less.

9. Repeat steps 5 through 8 for the remaining test frequencies in Datasheet 7.

## 4.3.3.2 Frequency Modulation Tests

The following procedures test Frequency Modulation Accuracy and Maximum Deviation at frequencies within the 4 to 8 GHz band. The procedures identify a Bessel null for each of the test frequencies in both narrow and wide mode FM.

### 4.3.3.2.1 Equipment Required

- Function Generator

### 4.3.3.2.2 Test Setup

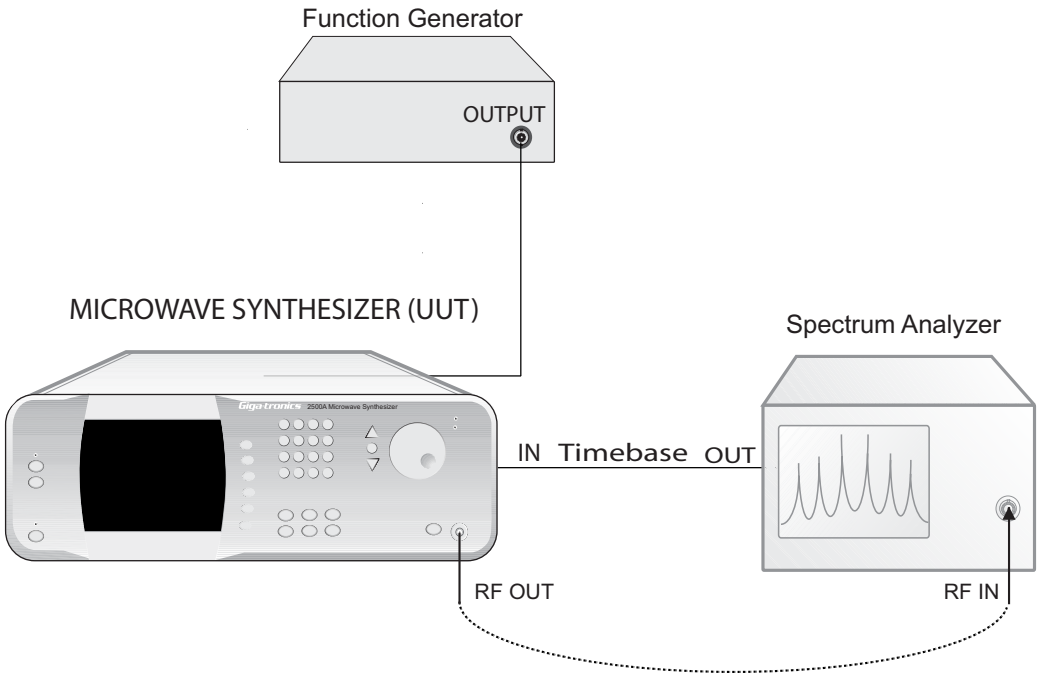



Figure 4-6: FM Deviation Bandwidth and Accuracy Setup

### 4.3.3.2.3 Procedure - Narrow Mode FM Maximum Deviation Test

1. Connect the test equipment and UUT as shown in Figure 4-6.

2. Set the Function Generator to the following settings:

| | |
|---|---|
| Waveform: | Sine wave |
| Rate: | 41.06 kHz |
| Output: | 2 Vp-p into 50Ω |

3. Set the Spectrum Analyzer to the following settings:

| | |
|---|---|
| Center Frequency | 4 GHz |
| Reference Level | +5 dBm |
| Span | 100 kHz |
| Sweeptime | 1 Sec. |
| Resolution Bandwidth: | ≤ 100 Hz |
| Video Bandwidth: | ≥ 30 kHz |

4. Set the level of the UUT to +13 dBm, activate the RF output, and set the external FM settings of the UUT to the following:

| | |
|---|---|
| FM State: | Off |
| Mode: | Narrow |
| Sensitivity: | 1 MHz/volt |

5. Set the output of the UUT to the first frequency in datasheet. (Add cross-reference to the datasheet at end of chapter) and adjust the spectrum analyzer frequency to match the test frequency. Adjust the reference level of the spectrum analyzer until the peak on the top graticule of the display.

6. Set the FM State to On. The Bessel null may shift from the center frequency as a result of a slight offset voltage associated with the function generator. The Bessel null can be moved to the center of the display by either adjusting the center frequency of the spectrum analyzer or slightly adjusting the offset voltage of the function generator.

7. Adjust the rate of the function generator ± X kHz until the FM carrier is -50 dBc or greater (Bessel Null) from the unmodulated signal reference on the spectrum analyzer.

8. Using the following formula, determine the FM Deviation of the UUT. Record the result in Datasheet #8.

$$\text{Deviation} = 24.353 * \text{Rate}_{(\text{Function Generator})}$$

24.353 is the Bessel Null 8th Order Carrier Zero

9. Repeat steps 5 through 9 for the remaining frequency test points.

#### 4.3.3.2.4 Procedure - Wide Mode FM Maximum Deviation Test

1. Connect the test equipment and UUT as shown in Figure 4-6.

2. Set the Function Generator to the following settings:

| | |
|---|---|
| Waveform: | Sine wave |
| Rate: | 4.17 MHz |
| Output: | 2.00 Vp-p into 50Ω |

3. Set the Spectrum Analyzer to the following settings:

| | |
|---|---|
| Reference Level | +5 dBm |

| | |
|---|---|
| Span | 50 MHz |
| Sweeptime | 400 msec. |
| Resolution Bandwidth: | ≤ 100 kHz |
| Video Bandwidth: | ≥ 30 kHz |

4. Set the level of the UUT to 0 dBm, activate the RF output, and set the external FM settings of the UUT to the following:

| | |
|---|---|
| FM State: | Off |
| Mode: | Wide |
| Sensitivity: | 10 MHz/volt |

5. Set the output of the UUT to the first frequency in datasheet. (Add cross-reference to the datasheet at end of chapter) and adjust the spectrum analyzer frequency to match the test frequency. Adjust the reference level of the spectrum analyzer until the peak on the top graticule of the display.

6. Set the FM State to On.

7. Adjust the rate of the function generator until the FM carrier is -50 dBc or greater (Bessel Null) from the unmodulated signal reference on the spectrum analyzer.

8. Using the following formula, determine the FM Deviation of the UUT. Record the result in Datasheet #9.

$$\text{Deviation} = 2.4 * \text{Rate}_{\text{(Function Generator)}}$$

2.4 is the Bessel Null 1st Order Carrier Zero

9. Repeat steps 5 through 8 for the remaining frequency test points.

### 4.3.3.3 Pulse Modulation Tests

The following procedures test Pulse Modulation Level Accuracy, On/Off Ratio, and Rise/Fall times at frequencies within each band. The tests require a fast crystal detector (rise time < 10 nsec).

#### 4.3.3.3.1 Equipment Required

- Oscilloscope (300 MHz bandwidth recommended)
- Crystal Detector (< 10 nSec rise-time, frequency range equivalent to test frequency range)
- Spectrum Analyzer (0 Hz span capable)
- Power Meter
- Power Sensor
- Pulse Generator

#### 4.3.3.3.2 Test Setup

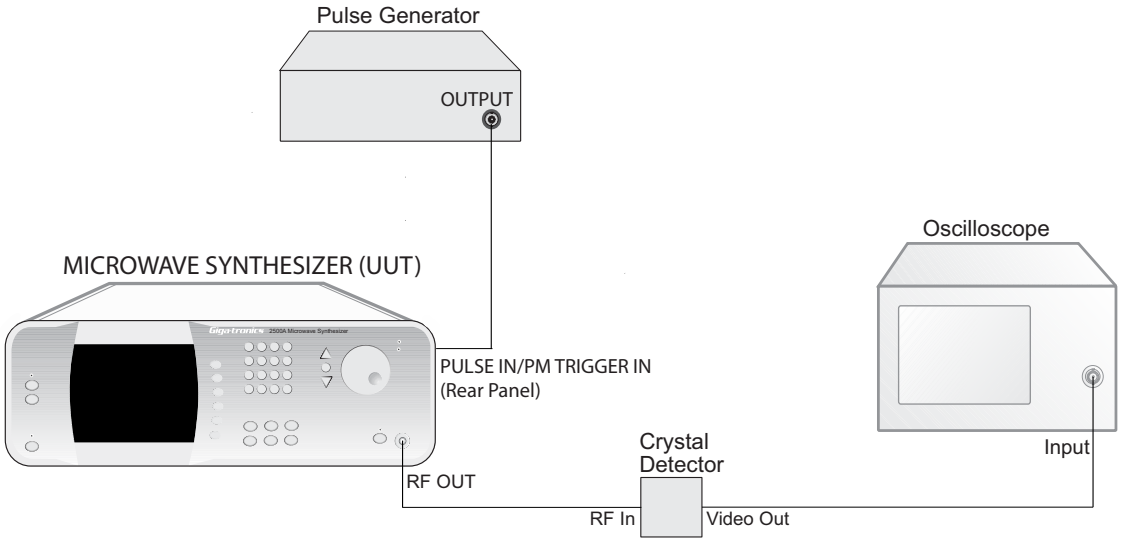



Figure 4-7: Pulse Modulation Rise and Fall Time Test

#### 4.3.3.3.3 Procedure - Rise and Fall Time Test

1. Connect the test equipment and UUT as shown in Figure 4-7.

2. Set the Pulse Generator to the following settings:

| | |
|---|---|
| Pulse Width: | 5 msec. |
| Pulse Interval: | 10 msec. |
| Output: | 5 Volts into 50Ω |

3. Set the trigger of the Oscilloscope according to the type of Crystal Detector being used (either positive or negative).

4. Set the UUT to the following settings:

| | |
|---|---|
| Power Level: | 0 dBm |
| External PM state: | ON |
| Trigger Polarity: | Active high |
| RF Output state: | On |

5. Set the UUT to the first test frequency shown in Datasheet 10.

6. Measure the rise and fall times on the oscilloscope, and record them in the appropriate columns of Datasheet 10.

7. Repeat Step 6 for each of the remaining test frequencies shown in Datasheet 10.

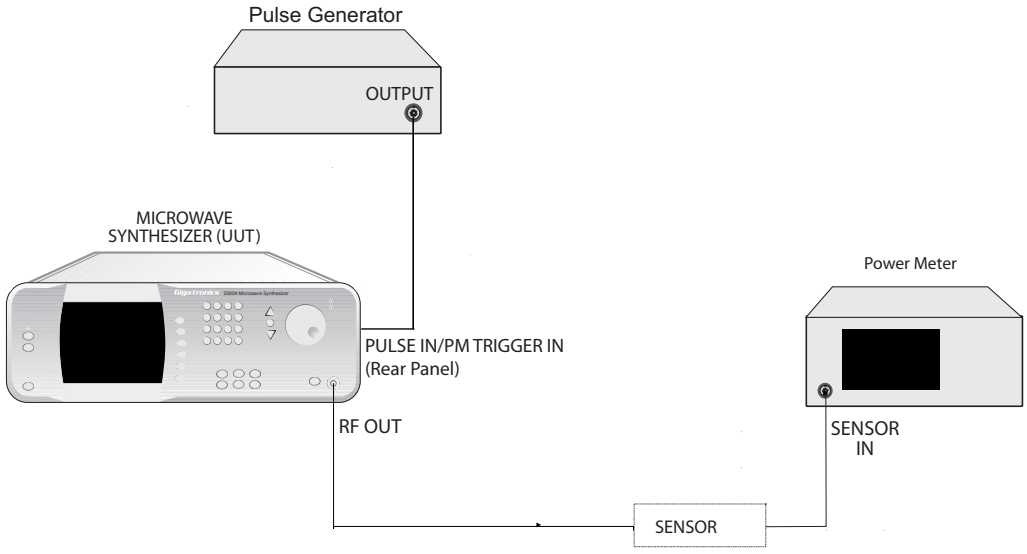



Figure 4-8: Pulse Modulation Level Accuracy Test

#### 4.3.3.3.4 Procedure - Pulse Level Accuracy Test

1. Connect the test equipment and UUT as shown in Figure 4-8.

2. Set the Pulse Generator to the following settings:

| | |
|---|---|
| Pulse Width: | 5 msec. |
| Pulse Interval: | 10 msec. |
| Output: | 5 Volts into 50Ω |

3. Set the UUT to the following settings:

| | |
|---|---|
| Power Level: | 0 dBm |
| External PM state: | Off |
| Trigger Polarity: | Active high |
| RF Output state: | On |

4. Set the power meter's sensor mode to "CW".

5. Measure and record the CW level for each of the frequencies listed in Datasheet 10 in the "Level Accuracy - CW" column of Datasheet 10.

6. Set the External PM state of the UUT to On.

7. Set the power meter's sensor mode to "Peak," and adjust the sample delay to 500 nsec.

8. Measure and record the peak level for each of the frequencies listed in Datasheet 10 in the "Level Accuracy - Pulse" column of Datasheet 10.

9. Compare the CW levels to the peak (Pulse) levels in Datasheet 10, and record the difference in the "Level Accuracy - Delta" column.

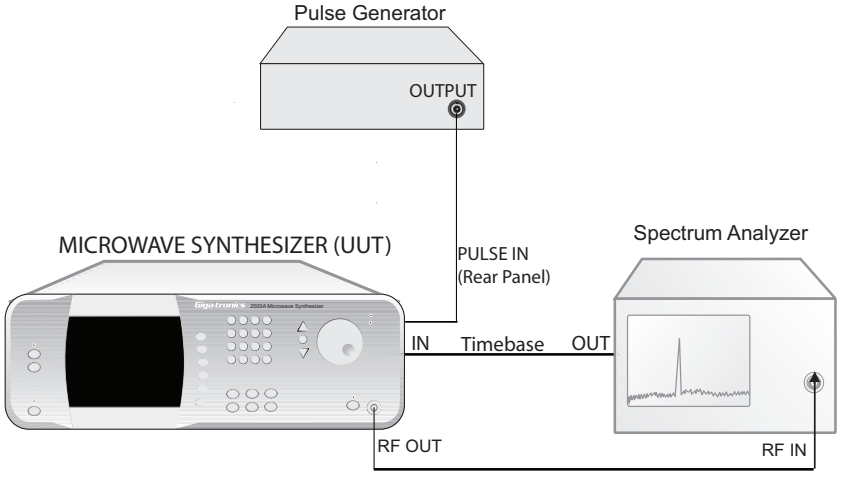



Figure 4-9: Pulse Modulation On/Off Ratio Test

#### 4.3.3.3.5 Procedure - On/Off Ratio Test

1. Connect the test equipment and UUT as shown in Figure 4-9.

2. Set the Pulse Generator to the following settings:

| | |
|---|---|
| Pulse Width: | 5 msec. |
| Pulse Interval: | 10 msec. |
| Output: | 5 Volts into 50Ω |

3. Set the UUT to the following settings:

| | |
|---|---|
| Power Level: | 0 dBm |
| External PM state: | On |
| Trigger Polarity: | Active high |
| RF Output state: | On |

4. Set the UUT to the first test frequency shown in Datasheet 10.

5. Set the Spectrum Analyzer to the following settings:

| | |
|---|---|
| Frequency: | Same as the frequency set at the UUT |
| Span: | 0 Hz |
| Sweep Rate: | Set to display two pulses (It might be necessary to adjust the resolution bandwidth) |
| Vertical Scale: | 10 dB/div |
| Resolution Bandwidth: | 3 kHz |
| Video Averaging: | 100 |
| Trigger type: | Video |

6. Adjust the Spectrum Analyzer reference level so that the peak level of the pulse is at the top of the display.

7. Measure the power difference between the on state and the off state of the displayed pulse, and record the measurement in the “ON/OFF Ratio (dB)” column of Datasheet 10.

8. Repeat steps 5 through 7 for the other frequencies in Datasheet 10.

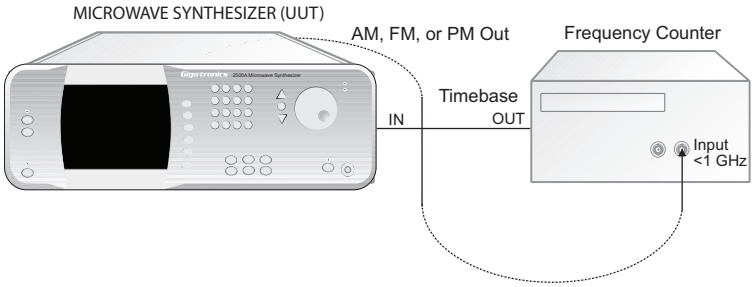



Figure 4-10: Internal Modulation Generator Tests

## 4.3.3.4 Internal Modulation Generator Tests

The following verification tests are for all models that do not have option 17.

### 4.3.3.4.1 AM Frequency Accuracy Test

1. Connect the test equipment and UUT as shown in Figure 4-10. Connect a BNC cable from the AM Out connector to the Band 1, BNC connector of the frequency counter

2. Set the CW frequency of the 2500A to 6 GHz.

3. Press the AM button to activate the AM Menu. If AM Menu 2 is not displayed, press the AM X/3 softkey until AM Menu 2 is displayed.

4. Press the AM softkey and the Step Up button to activate the Internal AM Modulation Generator. The AM indicator will appear in the upper left corner of the display.

5. Press the Rate softkey and enter the first value on Datasheet 11. Measure and record the reading of the frequency counter.

6. Repeat Step 5 for the remaining data points on the datasheet.

### 4.3.3.4.2 FM Frequency Accuracy Test

1. Connect the test equipment and UUT as shown in Figure 4-10. Connect a BNC cable from the FM Out connector to the Band 1, BNC connector of the frequency counter.

2. Set the CW frequency of the 2500A to 6 GHz.

3. Press the FM button to activate the FM Menu. If FM Menu 2 is not displayed, press the FM X/3 softkey until FM Menu 2 is displayed.

4. Press the FM softkey and the Step Up button to activate the Internal FM Modulation Generator. The FM indicator will appear in the upper left corner of the display.

5. Press the Rate softkey and enter the first value on Datasheet 12. Measure and record the reading of the frequency counter

6. Repeat Step 5 for the remaining data points on the datasheet.

#### 4.3.3.4.3 Pulse Repetition Interval Accuracy

1. Connect the test equipment and UUT as shown in Figure 4-10. Press the Display Time button on the Frequency Counter. Connect a BNC cable from the PM Out connector to the Band 1, BNC connector of the frequency counter

2. Set the CW frequency of the 2500A to 6 GHz.

3. Configure the counter to measure the period of the video pulse waveform.

4. Press the PM button to activate the PM Menu. If PM Menu 2 is not displayed, press the PM X/4 softkey until PM Menu 2 is displayed.

5. Press the PM softkey and the Step Up button to activate the Internal PM Modulation Generator. The PM indicator will appear in the upper left corner of the display.

6. Press the PRI softkey and enter the first value on Datasheet 13.

7. Press the Width softkey and enter the first pulse width value on Datasheet 13. Measure and record the reading of the frequency counter.

8. Repeat Step 5 for the remaining data points on the datasheet.

## 4.3.4 2500A Series Test Datasheets

The following test data sheets are included for entering the various readings taken during the performance tests.

| 2500A Series Test Datasheet | | |
|---|---|---|
| Serial Number | | Record measured values in the Test Result column. |
| Date | | |
| Tested By: | | |

**Datasheet 1: Frequency, Range, Accuracy Test**
(Refer to section 4.2.1 for specifications)

| Test Frequency | Measured Frequency |
|---|---|
| 100 kHz | |
| 5 MHz | |
| 8 MHz | |
| 25 MHz | |
| 50 MHz | |
| 100 MHz | |
| 200 MHz | |
| 400 MHz | |
| 750 MHz | |
| 1.5 GHz | |
| 3 GHz | |
| 7 GHz | |
| 15 GHz | |
| 23 GHz (2526,2540 series only) | |
| 40 GHz (2540 series only) | |

**Datasheet 2: Spectral Purity Tests**
(Refer to section 4.2.1 for specifications)

| Test Frequency | Measured Power Level | | |
|---|---|---|---|
| | Harmonics | Sub-Harmonics | Non-Harmonics |
| 100 kHz | | | |
| 5 MHz | | | |
| 8 MHz | | | |
| 25 MHz | | | |
| 50 MHz | | | |
| 100 MHz | | | |
| 200 MHz | | | |
| 400 MHz | | | |
| 750 MHz | | | |
| 1.5 GHz | | | |
| 3 GHz | | | |
| 7 GHz | | | |
| 15 GHz | | | |
| 23 GHz (2526,2540 series only) | | | |
| 40 GHz (2540 series only) | | | |

**Datasheet 3: Maximum-Leveled Power Test**
(Refer to section 4.2.2 for specifications)

| Test Frequency | Measured Maximum-Leveled Power (dBm) |
|---|---|
| 100 kHz | |
| 25 MHz | |
| 50 MHz | |
| 100 MHz | |
| 200 MHz | |
| 400 MHz | |
| 750 MHz | |
| 1.5 GHz | |
| 3 GHz | |
| 7 GHz | |
| 15 GHz | |
| 23 GHz (2526,2540 series only) | |
| 40 GHz (2540 series only) | |

**Datasheet 4: Level Accuracy Test**
(Refer to section 4.2.2 for specifications)

| Test Frequency | Measured Output Power | |
|---|---|---|
| | @ Level = 0dBm | ±0.65 dB, 100 kHz to 20 GHz<br>±0.85 dB, >20 to 40 GHz |
| 100 kHz | | |
| 10 MHz | | |
| 100 MHz | | |
| 200 MHz | | |
| 400 MHz | | |
| 750 MHz | | |
| 1500 MHz | | |
| 3 GHz | | |
| 6 GHz | | |
| 12 GHz | | |
| 26 GHz (2526/40 series only) | | |
| 36 GHz (2540 series only) | | |
| 40 GHz (2540 series only) | | |

**Datasheet 5: Step Attenuator Level Accuracy Test**
(Refer to section 4.2.2 for specifications)

| Test Frequency | Measured Output Power (dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | @ -13 | @ -23 | @ -33 | @ -43 | @ -53 | @ -63 | @ -73 | @ -83 | @ -93 |
| 100 kHz | | | | | | | | | |
| 10 MHz | | | | | | | | | |
| 100 MHz | | | | | | | | | |
| 200 MHz | | | | | | | | | |
| 400 MHz | | | | | | | | | |
| 750 MHz | | | | | | | | | |
| 1500 MHz | | | | | | | | | |
| 3 GHz | | | | | | | | | |
| 6 GHz | | | | | | | | | |
| 12 GHz | | | | | | | | | |
| 26 GHz[1] | | | | | | | | | |
| 36 GHz[2] | | | | | | | | | |
| 40 GHz[2] | | | | | | | | | |

1. 2526/40 series only.
2. 2540 series only.

**Datasheet 6: Amplitude Modulation Accuracy Test**
(Refer to section 4.2.2 for specifications)

| Test Frequency | Sensitivity 30% | 50% | 90% |
|---|---|---|---|
| 10 MHz | | | |
| 100 MHz | | | |
| 200 MHz | | | |
| 400 MHz | | | |
| 750 MHz | | | |
| 1500 MHz | | | |
| 3 GHz | | | |
| 6 GHz | | | |
| 12 GHz | | | |
| 26 GHz (2526/40 series only) | | | |
| 36 GHz (2540 series only) | | | |
| 40 GHz (2540 series only) | | | |

**Datasheet 7: Amplitude Modulation Bandwidth Test**
(Refer to section 4.2.5 for specifications)

| Test Frequency | CarrierAmplitude | Sideband Amplitude | Delta (Spec. < 3 dB) |
|---|---|---|---|
| 10 MHz | | | |
| 100 MHz | | | |
| 200 MHz | | | |
| 400 MHz | | | |
| 750 MHz | | | |
| 1500 MHz | | | |
| 3 GHz | | | |
| 6 GHz | | | |
| 12 GHz | | | |
| 26 GHz (2526/40 series only) | | | |
| 36 GHz (2540 series only) | | | |
| 40 GHz (2540 series only) | | | |
| 36 GHz (2540 series only) | | | |
| 40 GHz (2540 series only) | | | |

**Datasheet 8: Narrow Mode FM Maximum Deviation Test**
(Refer to section 4.3.3.2 for specifications)

| Frequency | Rate | Deviation | Pass/Fail 38.56 - 43.56 kHz |
|---|---|---|---|
| 4.0 | | | |
| 5.0 | | | |
| 6.0 | | | |
| 7.0 | | | |
| 7.99 | | | |

**Datasheet 9: Wide Mode FM Maximum Deviation Test**
(Refer to section 4.3.3.2 for specifications)

| Frequency | Rate | Deviation | Pass/Fail 2.95 - 5.88 MHz |
|---|---|---|---|
| 4.0 | | | |
| 5.0 | | | |
| 6.0 | | | |
| 7.0 | | | |
| 8.0 | | | |
| 9.0 | | | |
| 10.0 | | | |

**Datasheet 10: Pulse Modulation Test**
(Refer to section 4.2.7 for specifications)

| Test Frequency | Rise Time | Fall Time | Level Accuracy CW | Level Accuracy Pulse | Level Accuracy Delta | On/Off Ratio (dB) |
|---|---|---|---|---|---|---|
| 500 MHz | | | | | | |
| 750 MHz | | | | | | |
| 1500 MHz | | | | | | |
| 3 GHz | | | | | | |
| 6 GHz | | | | | | |
| 12 GHz | | | | | | |
| 26 GHz (2526/40 series only) | | | | | | |
| 36 GHz (2540 series only) | | | | | | |
| 40 GHz (2540 series only) | | | | | | |

**Datasheet 11: Function Generator AM Frequency Accuracy Test**
(Refer to section 4.2.9 for specifications)

| AM Rate (Hz) | Measured Rate |
|---|---|
| 100.0 | |
| 250.0 | |
| 500.0 | |
| 750.0 | |
| 1000.0 | |
| 2500A.0 | |
| 5000.0 | |
| 7500.0 | |
| 10000.0 | |

**Datasheet 12: Function Generator FM Frequency Accuracy Test**
(Refer to section 4.2.9 for specifications)

| FM Rate (Hz) | Measured Rate |
|---|---|
| 500.0 | |
| 1000.0 | |
| 5000.0 | |
| 10000.0 | |
| 500000.0 | |
| 1000000.0 | |

**Datasheet 13: Function Generator Pulse Accuracy**
(Refer to section 4.2.9 for specifications)

| Pulse Repetition Interval | Pulse Width | Measured PRI |
|---|---|---|
| 1.0E-6 | 5.0E-7 | |
| 1.0E-5 | 5.0E-6 | |
| 1.0E-4 | 5.0E-5 | |
| 1.0E-3 | 5.0E-4 | |
| 1.0E-2 | 5.0E-3 | |
| 2.0E-2 | 1.0E-2 | |

# A Accessories & Options

## A.1 Introduction

The accessories and options shown in Table A-1 are available for the 2500A Series Microwave Synthesizers. Each accessory and option is described under its respective heading in this appendix.

## A.2 List of Accessories and Options

**Table A-1: Accessories & Options**

| Accessory/Option No. | Description |
|---|---|
| A011 | Ruggedized Carrying Case |
| 17A | Delete Modulation Suite and Internal Function Generator |
| 17B | Delete Internal Function Generator |
| 18 | Delete 0.01 to 2 GHz Frequency Extension (2508, 2520) |
| 26 | Delete 90 dB Step Attenuator |
| 31 | 2 msec. Switching Speed Limit (Export Restriction) |
| 44 | Front Panel, Includes option 45 Rack Ears |
| 46 | Rack Slide Kit |
| 55 | Command Sets. Followed by corresponding letter |

**Table A-2: Option 55 Command Sets**

| Option | Command St |
|---|---|
| 55A | HP 8370 |
| 55B | HP 8340 |
| 55C | HP 8673 |
| 55D | HP 8663 |
| 55E | Systron Donner 1720 |
| 55F | Wavetek 90X |
| 55G | HP 8350 |
| 55H | HP 8360 |

# B Error Messages

This appendix lists error and other messages that might be encountered during operation of the instrument. In some cases, encountered errors will be can be remedied by the user, while in other cases, you might need to contact Giga-tronics support. This appendix consists of the following sections:

- "Start-Up Error Messages" - This section lists the messages that might be encountered during the instrument's power-up sequence.
- "NVRAM Messages" - This section lists messages that might be encountered if the system detects problems with internal non-volatile memory (NVRAM).
- "Remote Error Messages" - This section lists the messages that might be encountered during remote operation of the instrument.

## B.1 Start-Up Error Messages

If the system encounters any problems during the start-up sequence, a message is displayed after start-up is complete. Typically, you should contact Giga-tronics customer support if any start-up error messages are encountered. The message that is displayed has the following format:

Error code: *xxxxxxxxxxxxxxxxxxxx*
Startup Failure, see manual

Where *xxxxxxxxxxxxxxxxxxxx* is a 20-digit binary number representing the errors that have occurred. The rightmost digit corresponds to Error #1 in Table B-1, below, and the leftmost digit corresponds to Error #20. A "1" in a particular bit position indicates an error. For example, the following message displayed after start-up:

Error code: 00000000000000000111
Startup Failure, see manual

Indicates that Error #1, 2, and 3 shown in Table B-1 have been detected.

1 TIMEBASE_SET_ERROR
2 NVRAM_BATT_FAIL
3 CPU_FPGA_LOAD_FAIL

Table B-1 lists the start-up error messages.

**Table B-1: Start-Up Error Messages**

| Error # | Error Description |
|---|---|
| 1 | TIMEBASE_SET_ERROR |
| 2 | NVRAM_BATT_FAIL |
| 3 | CPU_FPGA_LOAD_FAIL |
| 4 | SYN_FPGA_LOAD_FAIL |
| 5 | ALC_SP_FPGA_LOAD_FAIL |
| 6 | ALC_PM_FPGA_LOAD_FAIL |
| 7 | RTOS_UTIL_ERROR |
| 8 | SYN_DSP_BOOT_LOAD_FAIL |
| 9 | ALC_DSP_BOOT_LOAD_FAIL |
| 10 | SYN_DSP_LOAD_FAIL |
| 11 | ALC_DSP_LOAD_FAIL |
| 12 | ALC_ZERO_FAIL |
| 13 | ALC_COMM_ERR |
| 14 | ALC_MEM_TEST_FAIL |
| 15 | ALC_ANALOG_TEST_FAIL |
| 16 | YIG_CAL_ERR |
| 17 | SYN_CAL_ERR |
| 18 | FPGA_CHECK_ERR |
| 19 | A1A2_CAL_ERR |
| 20 | *Bit position not currently used* |

# B.2 NVRAM Messages

The instrument uses non-volatile memory (NVRAM) to store user settings and configurations. In certain instances, user messages might be displayed that are related to NVRAM. The following paragraphs explain these instances.

## B.2.1 NVRAM Reset Due to a Firmware Upgrade

If the instrument's firmware is upgraded, the start-up process detects the difference in firmware versions the next time it runs. In this case, the system resets the NVRAM, and displays the following message once the start-up process is complete:

Memory reset due to firmware upgrade. Please refer to release notes.

## B.2.2 NVRAM Reset Due to a Battery Failure

The 2500A circuitry contains a battery to maintain the contents of NVRAM when the instrument is not connected from the mains power source. On occasion, this battery might fail, which causes NVRAM corruption. In this case, the system resets the NVRAM, and displays the following message once the start-up process is complete:

Memory reset due to battery failure. Please contact the service center.

## B.2.3 NVRAM Reset Due to a Checksum Failure

A checksum of the NVRAM is calculated as a means of ensuring the integrity of the contents of the memory. On occasion, a comparison of the current contents of NVRAM with the checksum might uncover a disparity in values, causing a checksum failure. Checksum failures might be caused by the following situations:

- A firmware defect is present (most likely)
- AC power loss occurred while the system was writing to NVRAM
- A partial battery failure has occurred

If these situations occur, the screen shown in Figure B-1 might appear:

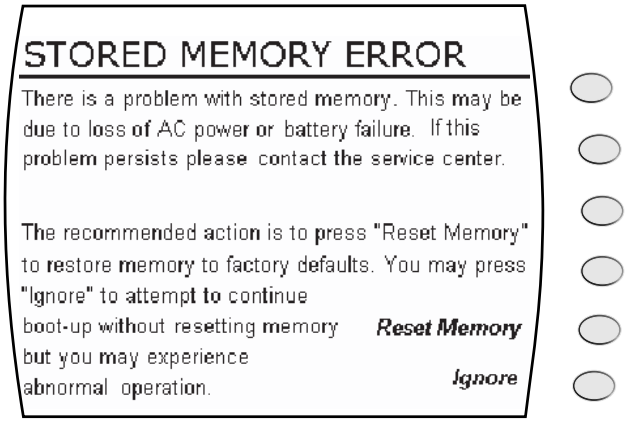



**Figure B-1: Checksum Test Failure Screen**

When a checksum error occurs, you can take either of the following actions:

- Choose the interactive softkey that is adjacent to “Reset Memory.” In this case, NVRAM is reset.
- Choose the interactive softkey that is adjacent to “Ignore.” In this case, NVRAM is not reset, but the checksum is recalculated. This allows you to continue using the instrument with the current contents of NVRAM intact, but you might encounter abnormal instrument operation.

# B.3 Remote Error Messages

Commands including SCPI, GPIB, or register commands issued to 2500A may fail to execute. There are several reasons for the failure, such as wrong command string, wrong number of parameters, invalid parameter values, or invalid operation mode. This section defines the error codes and error strings for each possible failure. When an error occurs, the 2500A will queue the errors to an internal event buffer. When using the GPIB interface, a 2500A will send a service request to the controller and the controller software is responsible for querying the status message. When using the RS232 interface, the controller software should poll the 2500A for the error condition. A user can also query the 2500A using the ERR? query (GT12000 language mode) or SYStem:ERR? (SCPI language mode).

The message structure is {error #, 2500A error message}

Table B-2 describes the 2500A remote error messages.

**Table B-2: 2500A Error Messages**

| 2500A ERROR # | 2500A ERROR MESSAGE |
|---|---|
| 1 | Command syntax error. |
| 2 | Invalid register-based command. |
| 3 | Command data checksum error. |
| 4 | Invalid RF state (0=off, 1=on) |
| 5 | Invalid *SAV/*RCL register (0 - 9 supported). |
| 6 | CW or RAMP POWER frequency is out of range. |
| 7 | CW or RAMP FREQUENCY power is out of range. |
| 8 | List range editing error, start frequency is out of range. |
| 9 | List range editing error, stop frequency is out of range. |
| 10 | List range editing error, step frequency is out of range. |
| 11 | List range editing error, Power level is out of range. |
| 12 | List range editing error, start power is out of range. |
| 13 | List range editing error, stop power is out of range. |

**Table B-2: 2500A Error Messages**

| 2500A ERROR # | 2500A ERROR MESSAGE |
|---|---|
| 14 | List range editing error, step power is out of range. |
| 15 | List range editing error, frequency is out of range. |
| 16 | List range editing error, dwell time is out of range. |
| 17 | System out of list memory. |
| 18 | Invalid list point parameter. |
| 19 | List does not exist. |
| 20 | Invalid list trigger repeat type. Single Step, Single Sweep, and Continuous are supported. |
| 21 | Invalid list trigger type. BNC, GPIB GET, GPIB Command, and Immediate are supported. |
| 22 | Immediate trigger only works with Continuous trigger repeat type. |
| 23 | RAMP option is not enabled. |
| 24 | RAMP Power span is out of range. |
| 25 | RAMP start Power is out of range. |
| 26 | RAMP stop Power is out of range. |
| 27 | RAMP Frequency span is out of range. |
| 28 | RAMP start Frequency is out of range. |
| 29 | RAMP stop Frequency is out of range. |
| 30 | RAMP time is out of range. |
| 31 | Sweep frequency is out of range. |
| 32 | Sweep power is out of range. |
| 33 | Invalid internal PM polarity. RISing or FALLing are supported. |
| 34 | Invalid External PM polarity, NORmal or INVerted are supported. |
| 35 | Invalid PM source. INTernal or EXTernal are supported. |
| 36 | Invalid PM action. 0 - deactivate, 1 - activate, 2 - activate internal PM, 3 - activate external pulse negative true, 4 - Activate internal PM, external rising edge trigger, 5 - Activate internal PM, external falling edge trigger. |
| 37 | Invalid PM waveform. 0 - waveform off, 1 - waveform single, 2 - waveform double, 3 - waveform triple, 4 - waveform quadruple. |

**Table B-2: 2500A Error Messages**

| 2500A ERROR # | 2500A ERROR MESSAGE |
|---|---|
| 38 | Modulation option is not enabled. |
| 39 | Internal modulation generator option is not enabled. |
| 40 | Scan option is not enabled. |
| 41 | Invalid AM action. 0 - Deactivate AM, 1 - Activate external AM, 2 - Activate internal AM with sine wave, 3 - Activate internal AM with square wave, 4 - Activate internal AM with triangle wave, 5 - Activate internal AM with positive ramp, 6 - Activate internal AM with negative ramp, 7 - Activate internal AM with noise, 8 - Activate internal AM, but set output to zero. |
| 42 | Invalid AM mode. LINear or LOGarithmic is supported. |
| 43 | Invalid AM source. INTernal or EXTernal is supported. |
| 44 | Invalid AM scan mode. 0 - Deactivate AM, 1 - Activate external scan modulation, 2 - Activate internal scan modulation with sine wave, 3 - Activate internal scan modulation with square wave, 4 - Activate internal scan modulation with triangle wave, 5 - Activate internal scan modulation with positive ramp, 6 - Activate internal scan modulation with negative ramp, 7 - Activate internal scan modulation with noise, 8 - Activate internal scan modulation, but set output to zero. |
| 45 | Invalid FM source. INTernal or EXTernal is supported. |
| 46 | Invalid FM mode. 1 - FM Narrow, 2 - FM Wide. |
| 47 | Invalid FM action. 0 - Deactivate FM, 1 - Activate external FM, 2 - Activate internal FM with sine wave, 3 - Activate internal FM with square wave, 4 - Activate internal FM with triangle wave, 5 - Activate internal FM with positive ramp, 6 - Activate internal FM with negative ramp, 7 - Activate internal FM with zero output. |
| 48 | Invalid boolean value is specified. 0 - OFF, 1 - ON. |
| 49 | List sync out delay is out of range. |
| 50 | Invalid list trigger direction: 0 – Forward (from first to last list point), 1 – Backward (from last to first list point). |
| 51 | Invalid list sequence number (some sequence numbers might be less than 0 or exceed available list index). |
| 52 | List has not been pre-computed before running. Pre-computing a list is required before running a list. |
| 53 | Running a list is not allowed due to an un-calibrated unit. |
| 54 | Index of the first dimension in characterization array is out of range. |
| 55 | Index of the second dimension in characterization array is out of range. |
| 56 | Index of the third dimension in characterization array is out of range. |
| 57 | Index of the fourth dimension in characterization array is out of range. |

**Table B-2: 2500A Error Messages**

| 2500A ERROR # | 2500A ERROR MESSAGE |
|---|---|
| 58 | Invalid name for characterization variables. |
| 59 | No heap space is available for storing characterization data. |
| 60 | Heap is not allocated for storing characterization data. |
| 61 | A float variable has been viewed previously. |
| 62 | Unable to erase data in flash. |
| 63 | Checksum mismatches for characterization data in flash and heap. |
| 64 | Heap allocation has been done previously. |
| 65 | List RF off time is out of range. |
| 66 | Incorrect password for setting minimum list step time. |
| 67 | Unable to update parameter block data. |
| 68 | List step time is out of range. |
| 69 | FM deviation is out of range. |
| 70 | FM sensitivity is out of range. |
| 71 | PM internal PRI is out of range. |
| 72 | PM internal width is out of range. |
| 73 | PM internal sync out delay is of out of range. |
| 74 | CW power slope is out of range. |