2400C Series Microwave Signal Generator

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CE
Certified Product

ISO 9001
Certified Process
Registrar: BSI, Certification FM 34226

Operation Manual

Giga-tronics

Operation Manual, Part Number 34802, Aug. 12, 2009

All technical data and specifications in this publication are subject to change without prior notice and do not represent a commitment on the part of Giga-tronics, Incorporated.

Warranty

Giga-tronics 2400C Series instruments are warranted against defective materials and workmanship for one year 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.

CONTACT INFORMATION

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Operation Manual, Part Number 34802, Aug. 12, 2009

Regulatory compliance information

This product complies with the essential requirements of the following applicable European Directives, and carries the CE mark accordingly.

Low Voltage Directive	73/23/EEC, amended by 93/68/EEC
EMC Directive	89/336/EEC, amended by 93/68/EEC
Electrical Safety	EN61010-1 (1993)
EMC – Emissions and Immunity	EN61326-1 (1997)

Manufacturer's Name:
Giga-tronics, Incorporated

Manufacturer's Address
4650 Norris Canyon Road
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U.S.A.

Type of Equipment:
Microwave Signal Generator

Model Series Number
2400C Series

Model Numbers:
2408C, 2420C, 2426C, 2440C

Declaration of Conformity on file. Contact Giga-tronics at the following;

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Record of changes to this Manual

Use the table below to maintain a permanent record of changes to this document. Replacement pages are issued as a TPCI (Technical Publication Change Instruction), and must be inserted at the front of the manual's binder. Remove the corresponding old pages, insert the new pages, and record the changes here. Do the same thing with TCPI pages that are issued after you have received this manual.

TPCI Number	TPCI Issue Date	Date Entered	Comments

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Table of Contents, Continued

Chapter 1. Safety and Manual Conventions

1.1 Unsafe Operating Conditions

If you notice any of the following conditions while operating electronics equipment, IMMEDIATELY de-energize the equipment.

- The instrument fails to operate normally, or operates erratically.
- The power cable, receptacle, or plug on the instrument is damaged
- The instrument causes electrical shock or operates at abnormally high temperature.
- A liquid or foreign substance falls into the instrument
- The instrument generates an abnormal sound, smell, smoke, or sparking light.

If any of the above conditions occurs, contact Giga-tronics to get the instrument repaired.

WARNING ***Continuing to operate the instrument with any of the above conditions could cause death or serious damage to the instrument and any equipment connected to it.***

1.2 Safety and Manual Conventions

This manual contains conventions regarding safety and equipment usage as described below.

1.3 Personal Safety Alert

WARNING **WARNING:** Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

1.4 Equipment Safety Alert

CAUTION **CAUTION:** Indicates a situation which can damage or adversely affect the 2400C or associated equipment.

1.5 Notes

Notes are denoted and used as follows:

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

Continued next page

1.6 Graphic Symbols for Front Panel Buttons

(Refer to Figure 3 on page 11)

Softkeys are adjacent to menu items that appear in the right-side area of the display. Pressing a softkey selects a menu item, which makes the menu item modifiable, or opens a submenu.

The menu items next to the softkeys are different for different menus, thus changing the function of the softkeys.

In this manual, softkeys are shown as: Soft Button followed by the name of the softkey. For example: Soft Button Frequency.

Menu Buttons are shown as: Menu Name For example, the System Menu button is: System

Other front panel buttons are shown graphically as: RF ON, Local, Preset.

Step Up/Step Down buttons: △ ▽

Rotary knob: ⊙

Chapter 2. Introduction

2.1 Overview

This chapter describes the controls, inputs/outputs, indicators, and display of the 2400C.

NOTE: In this manual, the term "2400C" is used to refer to all models in the 2400C series. A specific model of 2400C is referred to when necessary.

2.2 Giga-tronics 2400C Microwave Signal Generator Summary

The Giga-tronics 2400C series of microwave signal generators are high-performance, flexible frequency synthesizers ideal for research and development (R and D) and manufacturing environments.

Among the characteristics that make the 2400C series an excellent choice for a wide variety of applications are:

- Frequency range from 10 MHz to 40 GHz (depending on model in series)
- Low phase noise
- High output power
- Fast switching of both frequency and power
- Fast switching in both list mode and remote control
- Full suite of analog modulation
- All 2400C signal generators comply with MIL-PRF-28800F, Class 3

In addition, the following are standard features on all models in the 2400C series:

- High stability time-base
- 10 MHz and 100 MHz reference input/output
- External ALC, ramp frequency and power sweep
- Pulse burst capability
- Automation Xpress Interface software

NOTE: Complete descriptions of all options for the 2400C series is located on page 139.

2.3 Configuration Information

Specific information regarding each 2400C is included on the serial number label on the rear of the instrument. The information on this label is described below.

Table 1 2400C Serial Number Label	
Descriptor	**Type of Information**
Code	This is a two-digit manufacturing code
Model	This is a four-number code formatted as 24XXC. There are four models, each with a different frequency range. See below.
Serial	This is a seven-digit serial number, and provides a unique identifier for each 2400C.
Opt	When options have been included in the 2400C, one or more two-digit numbers are listed on this line of the label. For more information about options, refer to page 139.
Model	**Frequency Range**
2408C	2 GHz to 8 GHz
2420C	2 GHz to 20 GHz
2426C	2 GHz to 26.5 GHz
2440C	2 GHz to 40 GHz
NOTE: The models shown above can be ordered with Option 18, which extends the frequency range down to 10 MHz.	

2.3.1 Special Configurations

When the 2400C has been configured for user-specific application(s), supplemental pages are inserted in the front of the binder for this manual. 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 a 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.

Information about standard options is on page 139.

2.4 Receiving and Inspection

Follow the procedure in Table 2 for receiving and inspecting the 2400C.

Table 2 Receiving and Inspection of the 2400C

Step	Action
1.	Before opening the shipping container, inspect it for any signs of damage. **If THERE IS evidence of damage**; record the location and extent of the damage and contact the shipper immediately to report the damage. **If there is NO EVIDENCE of damage**; continue to the next step.
2.	Open the shipping container and inspect the contents for evidence of damage. The contents should include any external, loose options and accessories, and the following: • Operation Manual • USB 2.0 Type A Male to Type B Male cable ***NOTE:*** This cable can be used to connect a computer to the 2400C for remote control and firmware upgrades. • Power cord, 6 feet • Automation Express CD-ROM ***NOTE:*** for complete information about Automation Xpress, refer to the 2400C Programming Manual, Part Number 34808. If any of the contents are damaged or missing, contact Giga-tronics immediately. Refer to the Contact Information on the inside of the front cover of this manual.
End of procedure	

2.5 Prepare the 2400C for Use

2.5.1 Cooling Considerations

The 2400C has an internal cooling fan. The air intake is located on the rear panel of the instrument. When placing or installing the instrument for use, ensure there are no obstructions to the flow of air into the instrument, nor obstruction for exhaust air flow at either side of the instrument.

2.5.2 AC Power Requirements

Table 3 below describes the power requirements and internal fuse specifications for the 2400C.

AC Line Cord: All 2400C microwave signal generators are supplied with a 6-foot, three-wire power cord with three-terminal polarized plug with a safety ground. If a different power cord is used, it must not exceed 3 meters (9 feet) in order to meet safety requirements.

Table 3 2400C AC Power and Fuse Specifications

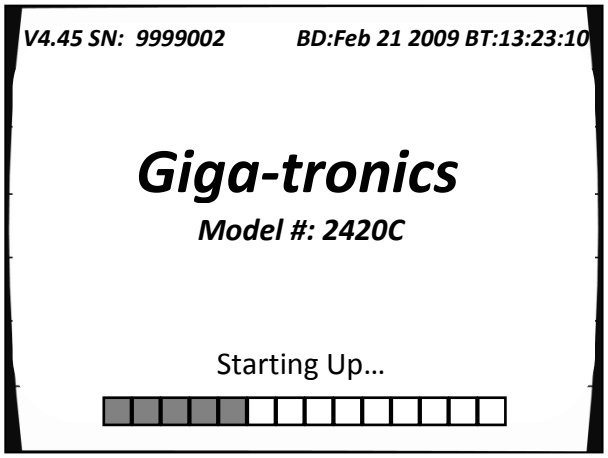
Parameter	Specification
AC line voltage	90 to 253 Volts. ***NOTE:*** The 2400C automatically adjusts to operate at any voltage within the voltage range shown above. No adjustments are necessary.
AC line frequency	47 to 440 Hz
Internal fuse (in rear of 2400C)	3 A, Slow-Blow, 250V, Type T ***NOTE:*** The procedure for replacing the fuse is in Table 6 on page 9.

Continued on next page

2.5.3 Start-up the 2400C

Table 4 below describes how to start-up the 2400C.

Table 4 Start-Up the 2400C

Step	Action
1.	Place the 2400C in the location where it will be used, observing the recommendations in on page 6.
2.	Plug the 2400C power cord into a suitable source of electrical power (see Table 3 on the previous page for electrical power specifications).
3.	Press the power switch on the front panel of the 2400C. The 2400C displays the following sequence of screens: • "Initializing" momentarily appears on the display. • The screen shown in Figure 1 appears. The following information is displayed on the start-up screen: • The firmware version • The serial number of the 2400C • The Build Date (BD) or the firmware version • The Build Time (BT) of the firmware version • A progress bar at the bottom of the screen **Figure 1. 2400C Start Up** 
4.	Upon the successful conclusion of start-up, the CW Menu is displayed. **If error messages occur during start-up:** Refer to page 141.
End of Procedure	

2.5.4 Reset the 2400C to Factory-Default Values

The 2400C uses non-volatile memory (NVRAM), which is preserved with a battery for storing the instrument's current state, saved setups, and lists. If you want to return these saved settings in NVRAM to the default values they were set to at the factory, perform the procedure below.

Table 5 Reset the 2400C to Default Values

Step	Action
1.	Press the power switch on the front of the 2400C to de-energize the instrument. Wait 5 seconds, then go to the next step.
2.	Push the power switch in to energize the unit. While the message "INTIALIZING" is displayed, press and hold the Preset button.
3.	When the "Resetting Memory..." screen is displayed, release the PRESET button.
4.	The system continues to power up normally. All information stored in the memory locations is cleared, and the system resets to factory default settings.
End of Procedure	

2.5.5 Replace the AC Line Fuse

If the AC line fuse in the 2400C continues to blow, it's usually an indication of internal problems. If this occurs, contact Giga-tronics for help (see Table 7 on page 10). Table 6 below describes how to replace the fuse in the 2400C.

Table 6 Replace the 2400C Line Fuse

Step	Action
1.	Use the power switch on the front of the 2400C to switch the unit into STANDBY.
2.	On the rear of the 2400C, disconnect the AC line cord. The fuse compartment is located to the left of the AC line cord socket.
3.	Remove the fuse as follows (see Figure 2): **A)** Use a small flat-blade screwdriver to pry open the fuse compartment. **B)** Pull out the white fuse holder. **C)** You can now remove the fuse from the fuse holder. **Figure 2. 2400C Fuse Holder** A B C 
4.	Replace the fuse with a new fuse (3 A, Slow-Blow, 250V, Type T). • Push the fuse holder in, and close the fuse compartment door.
5.	Plug the AC line cord into the rear of the 2400C and return the instrument to operation. ***NOTE:*** If the 2400C continues to blow fuses, contact your local Giga-tronics sales representative or the Giga-tronics factory. See the contact information on the inside of the front cover of this manual.
End of Procedure	

2.6 Shipping, Repair, and Calibration

2.6.1 Shipping the 2400C

If it is necessary to ship the 2400C, observe the following:

- Use the best packaging materials available. If possible, reuse the original shipping container.
- If the original shipping container is not available, use a strong carton (350 lbs./sq.in. bursting strength) or a wooden box.
- Wrap the instrument in electro-static dissipative material 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 clearly, and in bold type, as follows:

FRAGILE — DELICATE INSTRUMENT

2.6.2 Repairs

The Giga-tronics 2400C microwave signal generator is a robust instrument that has been designed and built for years of trouble-free service. However, if you experience problems with the instrument, do the following:

1. Contact your local Giga-tronics sales office, or the factory, and be prepared to provide the model, serial number, and any included options of your instrument, and a description of the problem. To contact the factory directly, use the following information:

Table 7 Contacting Giga-tronics Customer Service

Email	repairs@gigatronics.com
Telephone (within the United States)	800.726.4442
Telephone	925.328.4669
Fax	925.328.4702

2. If it is has been determined that you must ship the 2400C to the factory or a service center for repair, you will be issued a ***Return Materials Authorization (RMA)*** number. Use the RMA number in all correspondence regarding the repair.
3. Pack the 2400C for shipment as described in the previous section, and enclose all relevant information regarding the problem.
4. Ship the 2400C to the address provided by Giga-tronics Customer Service.

2.6.3 Calibration

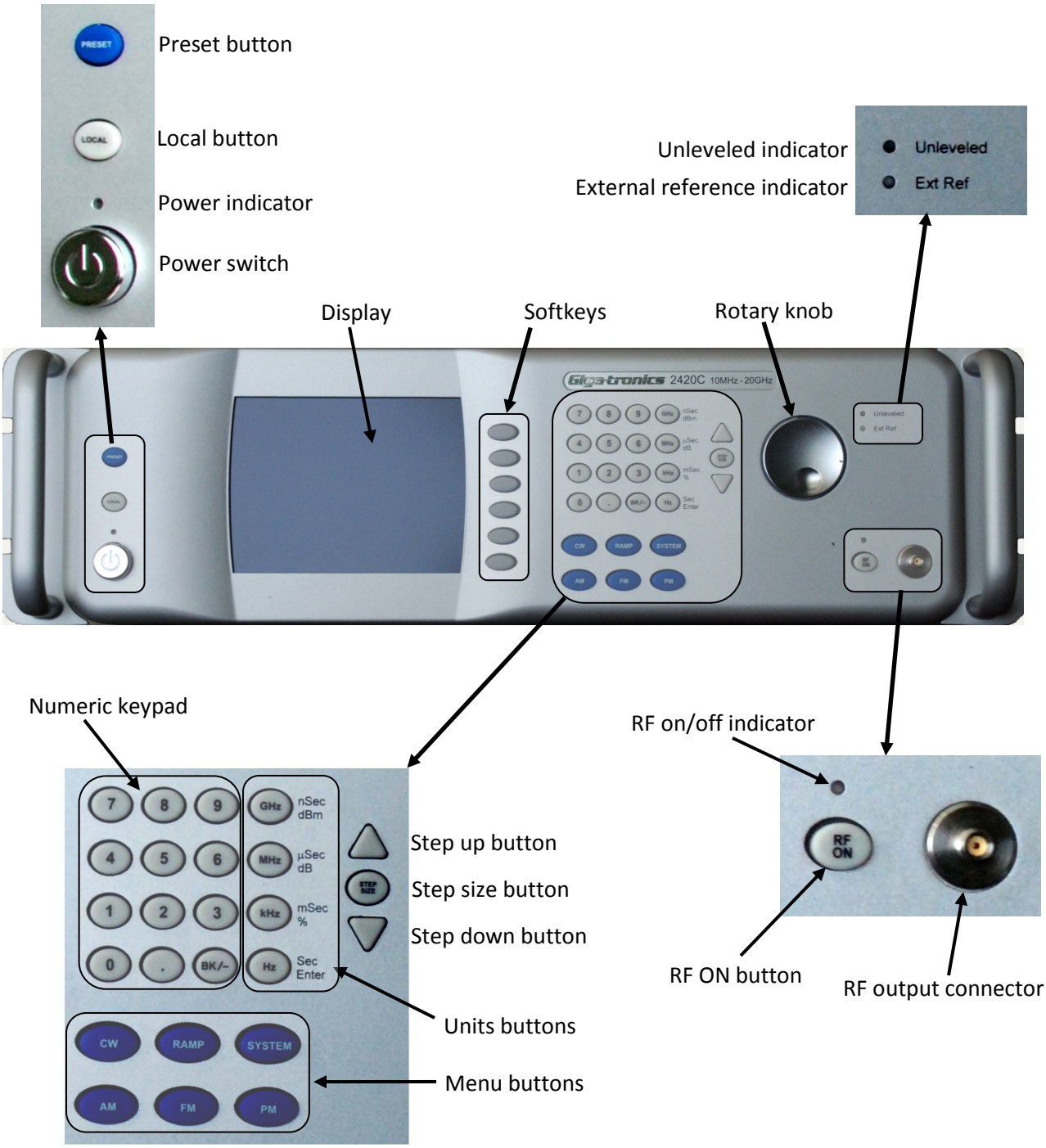
Giga-tronics recommends that the 2400C be calibrated every two years. For more information regarding calibration of your instrument, contact Giga-tronics (see the inside of the front page of this manual).

2.7 2400C Front Panel

Figure 3, below, describes the main features of the front panel of the 2400C. Refer to the tables on the following pages for detailed descriptions of the parts of the front panel.

NOTE: A 2420C is shown in Figure 3. The 2420C front panel is representative of the entire 2400C series.

Figure 3. 2400C Front Panel



2.7 2400C Front Panel, Continued

Table 8 2400C Front Panel	
Name	**Description**
POWER button	Puts the 2400C into one of two states: • STANDBY; power is applied to the internal timebase oscillator. This is to maintain timebase stability when the 2400C is not in use. • ON; all functions of the 2400C are available for use. ***NOTE:*** To ensure specified performance, allow the 2400C to remain ON or in STANDBY for at least 30 minutes prior to using the instrument.
POWER indicator	• BLUE indicates the instrument is ON and all functions are available. • AMBER indicates the instrument is in STANDBY mode.
LOCAL button	• If in REMOTE mode, pressing this button puts the instrument into LOCAL mode. • If the unit is in LOCAL mode: pressing this button displays menus that allow you to choose the remote command language used during remote operation.
PRESET button	• 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.
Display	• Displays current instrument settings, and menus for modifying the settings. • The *active display* is the group of instrument settings and associated menu items that are currently displayed.
Softkeys	Selects the menu items adjacent to them in the display for modification.
Numeric Keypad	Use for entering numeric settings for 2400C functions.
STEP SIZE button	Selects and allows editing of the step size by the Step Up/Step Down buttons, rotary knob, or numeric keypad. To change a step size, see Table 13 on page 18.
RF ON button	Activates RF power output from the 2400C.
	Continued on next page

2.7 2400C Front Panel, Continued

Table 9 2400C Front Panel, Continued	
Name	**Description**
Step up/down buttons	Increases or decreases the selected parameter in the display by the amount specified by the step size.
Rotary knob	Adjusts the parameter that is selected in the display. When a maximum or minimum limit is reached, a message appears at the bottom of the display.
Unleveled indicator	When this indicator illuminates, it means that the power output cannot be increased any further, even though the power output displayed on the front panel may show an increase. The unleveled point varies with frequency.
External Reference (Ext Ref) Indicator	Illuminated when the 2400C is operating with an external reference applied.
RF On/Off Indicator	This indicator has two states: • BLUE indicates the 2400C RF output is active. • NOT illuminated indicates the RF output is not active.
RF Output	The connector type and location of the RF Output is determined by the model and options. Standard models have the following connectors: • 2408C: N-female • 2420C and 2426C: SMA-female • 2440C: K-female ***NOTE:*** On some options, the RF output is on the rear panel. Refer to page 139 for information about all options.
Menu buttons	
CW Button	Press this button to display the CW Menu. Shows parameters related to the CW functions and the Cable Correction functions and their associated menu items.
RAMP Button	Press this button to display either the Ramp Freq or Ramp Power Menus.
SYSTEM Button	Press this button to display either the System 1 or System 2 menu. Shows parameters related to certain system-level functions.
AM Button	Press this button to display the Amplitude Modulation (AM) menus.
FM Button (Includes phase modulation menus)	Press this button to display the Frequency Modulation (FM) and Phase Modulation (ΦM) menus.
PM Button	Press this button to display the Pulse Modulation (PM) menu. Shows parameters related to the pulse modulation functions of the instrument.

2.7.1 Menus

Menus appear on the front panel display of the 2400C. Figure 4 shows the CW menu to illustrate the common areas of all menus.

Figure 4. Functional Areas of the 2400C Display

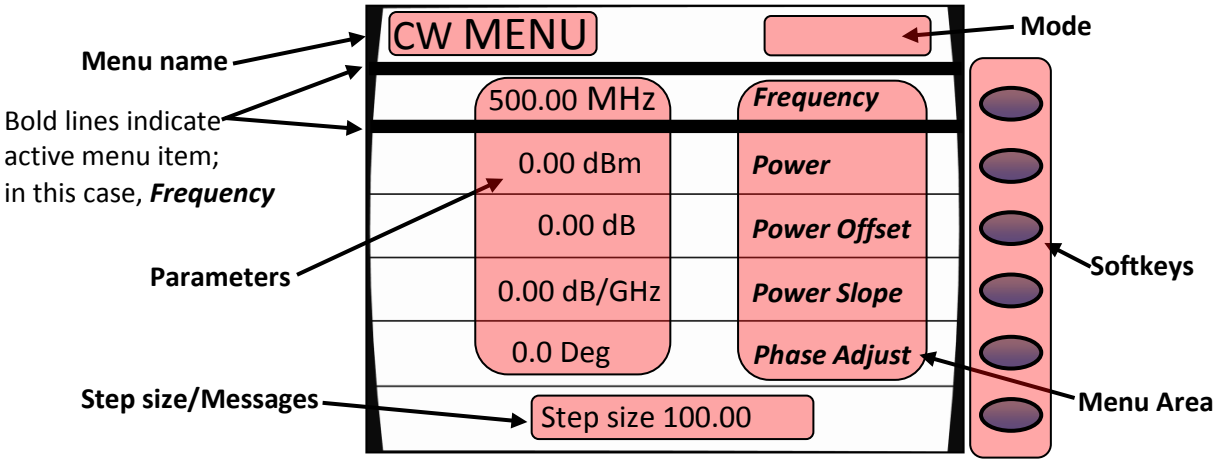


Table 10 2400C Display Description	
Area of Display	**Description**
Menu Name	Name of the menu that is displayed. This is called the *active menu*.
Parameters	Displays the current values of the instrument settings associated with the active menu. Parameters can be modified by the rotary knob or Step Up/Down buttons.
Step Size/Messages	The step size is the minimum increment by which a parameter can be modified. The step size can be adjusted. Non-error user messages can also appear in this area.

Menu Area	Displays one of the following:
	• Submenus
	• Menu items that can be modified in the active menu.
	  • Menu items are selected (made active) by pressing the adjacent softkey.
	  • The row containing the active parameter has a bold border around it.

Softkeys	Each softkey makes a submenu selectable, or parameter active for modification.
Continued next page	

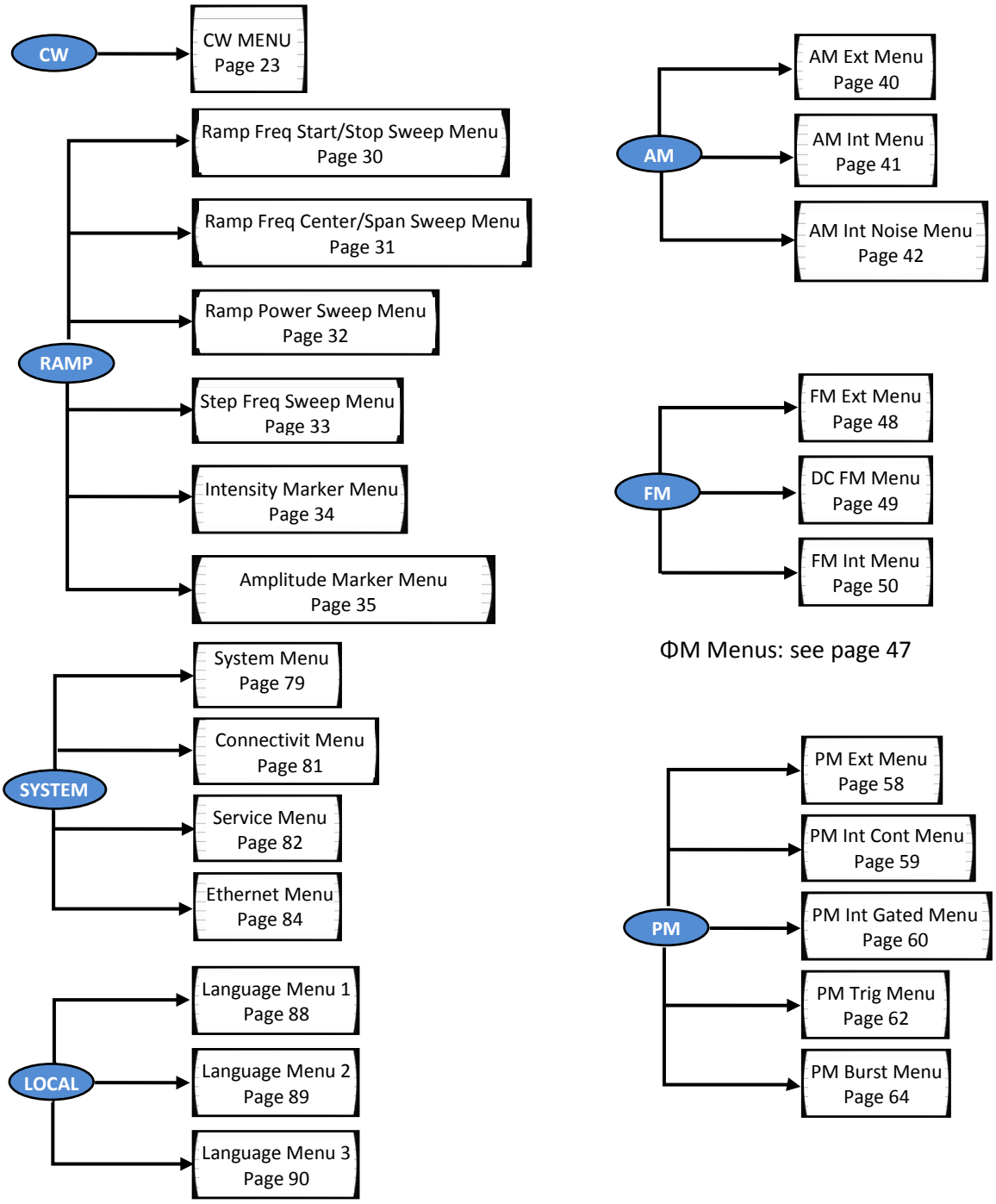
2.7.1 Menus, Continued

Table 11 2400C Display Description, Continued	
Area of Display	**Description**
Mode	This area may contain one of the following codes: • ***OFS*** appears if a power offset greater than 0 dB is set in the CW menu. • ***SLP*** appears if a power slope greater than 0 dB/GHz is set in the CW menu. • ***AM*** appears if internal or external amplitude modulation is enabled • ***FM*** appears if internal or external frequency modulation is enabled • ***ΦM*** appears if internal or external phase modulation is enabled • ***PM*** appears if internal or external pulse modulation is enabled • ***EXT LEVEL*** appears if ALC is set to external • ***UNLK*** appears if the Phase Lock Loop is unlocked • ***OVEN COLD*** appears if the internal temperature of the 2400C has not reached operational temperature. It is not recommended to use the 2400C while this indicator is active.

2.7.2 Menu Structure

Figure 5 below shows the structure of the menus of the 2400C. To access the menus, you must first press one of the blue Menu buttons (see Figure 3 on page 11).

Figure 5. Structure of the 2400C Menus



2.7.3 Access the Menus

- In local operation, the 2400C menus are accessed via the Menu buttons or Local button on the front panel (see Figure 3 on page 11). Pressing a Menu button causes the menu for that button to appear on the display. The Menu buttons are:
  - CW
  - Ramp
  - System
  - AM
  - FM; includes phase modulation (ΦM) menus
  - PM
- The LOCAL button allows you to access and modify communication functions during remote operation of the 2400C (see Figure 3 on page 11).

2.7.4 Softkeys

Use the softkeys (see Figure 4 on the previous page) to select a submenu or parameter shown to the left of the softkey, in the display.

- Pressing a softkey next to a submenu displays the submenu and makes its parameters available for viewing and modification.
- Pressing a softkey next to a parameter makes it active for modification.

2.7.5 Modify Menu Parameters

Parameters in the Menu Area of the display (see Figure 4 on the previous page) can be modified using either the rotary knob, Step Up/Down keys, or the numeric keypad (see Figure 3 on page 11), except where otherwise noted. Table 12 below describes how to modify a menu parameter.

Table 12 Modify a Menu Parameter

Step	Action
1.	Press the softkey adjacent to the parameter you want to modify. Note that the parameter becomes enclosed in a bold outline box when it is selected.
2.	Modify the value of the parameter by using △ ▽, ◎, or the numeric keypad (except where otherwise noted).
End of Procedure	

2.7.6 Modify the Step Size

The step size for a parameter can be modified as described below.

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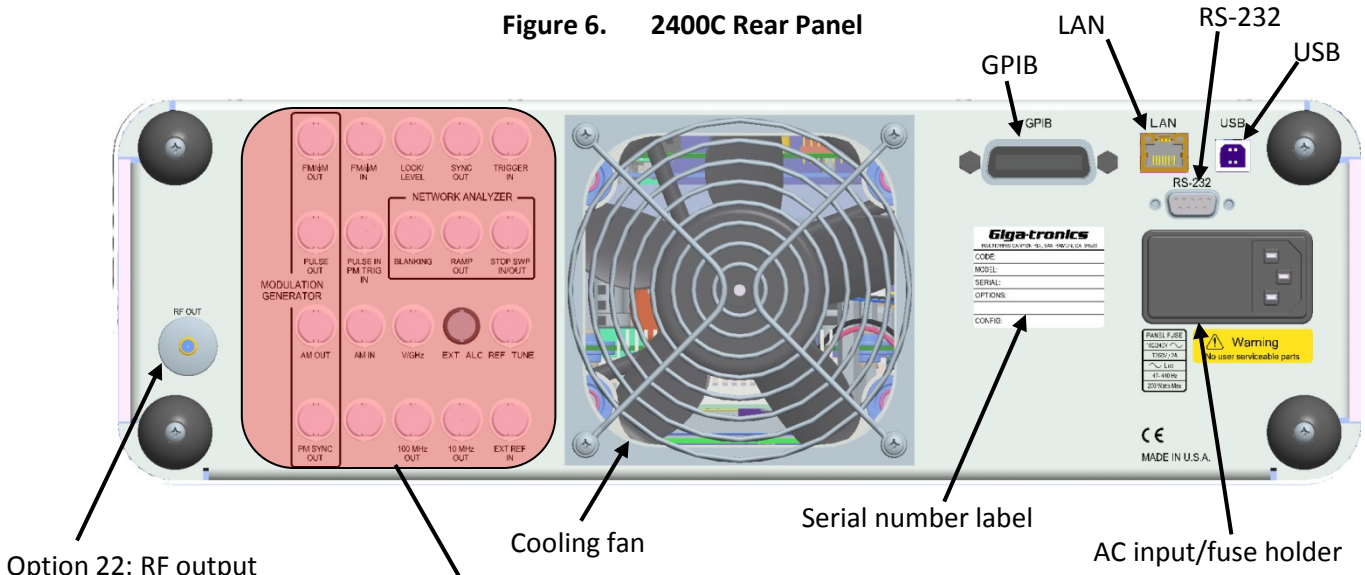
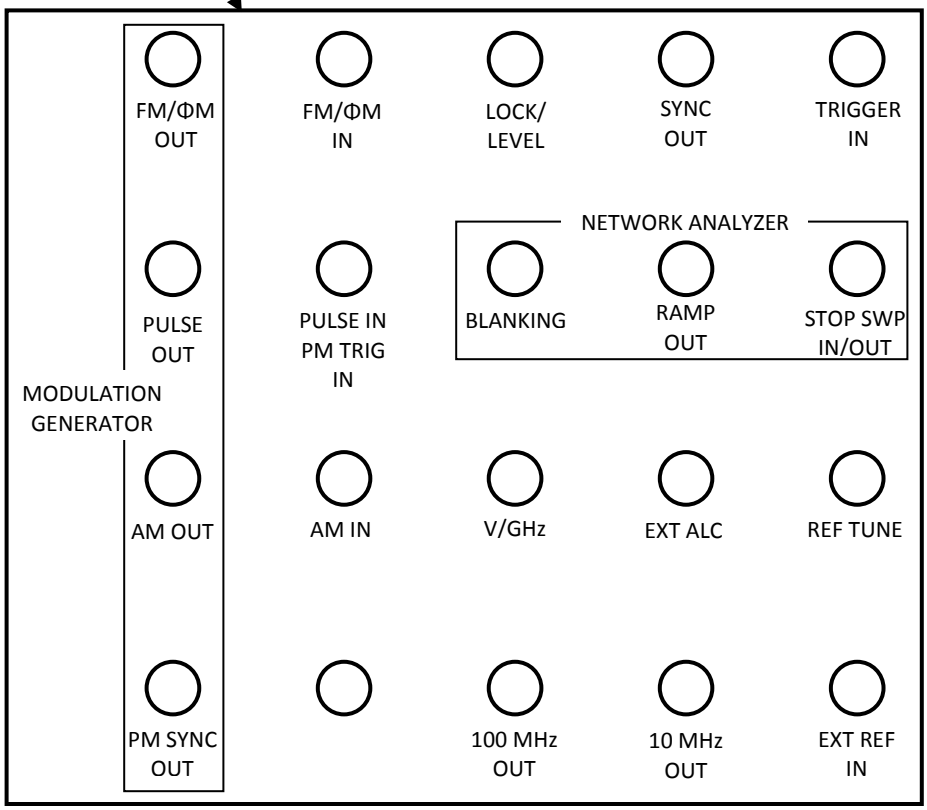
Table 13 Change the Step Size of a Parameter	
Step	**Action**
1.	Use a softkey to select a parameter. For example, in the CW menu, select Frequency.
2.	Press the Step Size button (see Figure 3 on page 11).
3.	Enter a new step size using the numeric keypad.
4.	Press the appropriate Units button (see Figure 3 on page 11).
5.	Press the Step Size button to save the new step size. Now, when you change the CW frequency using the Step Up/Step Down buttons or the rotary knob, the frequency changes according to the new Step Size.
End of Procedure	

2.8 2400C Rear Panel

Figure 6 below shows the locations of the components on the 2400C rear panel. Descriptions of the rear panel components are on the following pages.

Figure 6. 2400C Rear Panel





2.8 2400C Rear Panel, Continued

Table 14 2400C Rear Panel

NOTE: All rear panel I/O connectors (except the GPIB, RS-232, LAN, USB, and AC power connections) are type BNC unless otherwise stated. Some connectors may be inactive due to installed options.

Name	Description
EXT ALC	In external leveling, the RF output of the 2400C 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 2400C, which is used to compensate for standing wave effects or cable and component losses at the input of the device under test.
MODULATION GENERATOR	
FM/ϕM OUT	The internal modulation generator output; 2 Vpp into 10 kΩ.
PULSE OUT	A +4V video representation of the pulsed RF output signal.
AM OUT	The internal modulation generator output; 2 Vp-p into 10 kΩ.
PM SYNC OUT	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. Limits of delay: ≥ 50 ns, ≤ 10 ms.
FM/ϕM IN	• A 50 Ω input for an external FM or ϕM modulating signal. The input signal can be any waveform compatible with bandwidth considerations. A 1-V peak input produces maximum deviation. See Table 80 on page 99 for DC FM specifications. Maximum input is ± 1 V p-p. • An externally supplied DC signal can be applied to this input to modulate the frequency of the CW output.
AM IN	A 600 Ω input for an external AM signal. The input signal can be any waveform compatible with bandwidth considerations. Maximum input is ± 1 V p-p.
PULSE IN PM TRIG IN	A Pulse Modulation Input for external Pulse In. The input parameters are: TTL, polarity selectable, 50 Ω 2 kΩ pull-up.
LOCK/LEVEL	+5 Volt output, active high when the 2400C is phase locked and output leveled. The Lock and Level indicator is valid for CW and List mode.
REF TUNE	A 0 to +10 Volts, high-impedance input for tuning the internal reference in order to adjust the output frequency approximately +5 ppm. Do not exceed +15 Volts or apply a negative voltage greater than -1 Volt.

Continued on next page

2.8 2400C Rear Panel, Continued

Table 15 2400C Rear Panel, Continued	
Name	**Description**
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 RF output can be delayed from the start of the list point up to a maximum of 10 ms. The pulse width of the SYNC OUT signal is determined as follows: Pulse width = Step Time - Sync Delay - 10 µs. In Ramp operation, the pulse occurs at the start of each ramp sweep. In either case, the output pulse is +5 Volts.
TRIGGER IN	Triggers a List. Accepts a TTL level signal of > 50 ns width.
NETWORK ANALYZER	
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 kΩ, active-low signal that temporarily interrupts the instrument's frequency or power ramp sweep. This feature is only available with 2400C models with option 55A or 55B.
V/GHz	An output voltage that is directly proportional to output frequency. The output is 0.5 Volts per GHz.
100 MHz OUT	> +5 dBm, AC coupled, 100 MHz low-noise reference output signal into 50 Ω.
10 MHz OUT	10 MHz TTL 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. ***NOTE:*** If the external frequency reference has excessive noise or drift, this will degrade the performance of the 2400C.
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.
USB	A USB connector for control of the instrument during remote operation using USB 2.0 (full speed) communications
Ethernet	An Ethernet connector for control of the instrument during remote operation using LAN interface communications.
AC Power Input	90 to 253 V ac, auto-sensing, 47 Hz to 440 Hz.

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Chapter 3. CW Operation

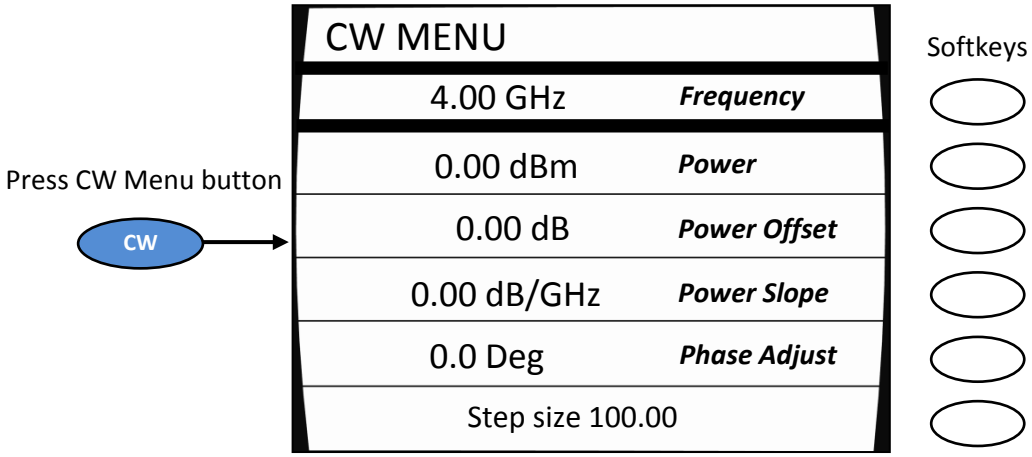
This section describes the CW Menu of the 2400C, and includes an example procedure for generating a CW signal.

The CW specifications of the 2400C start on page 91.

3.1 CW Menu Description

Table 16 CW Menu

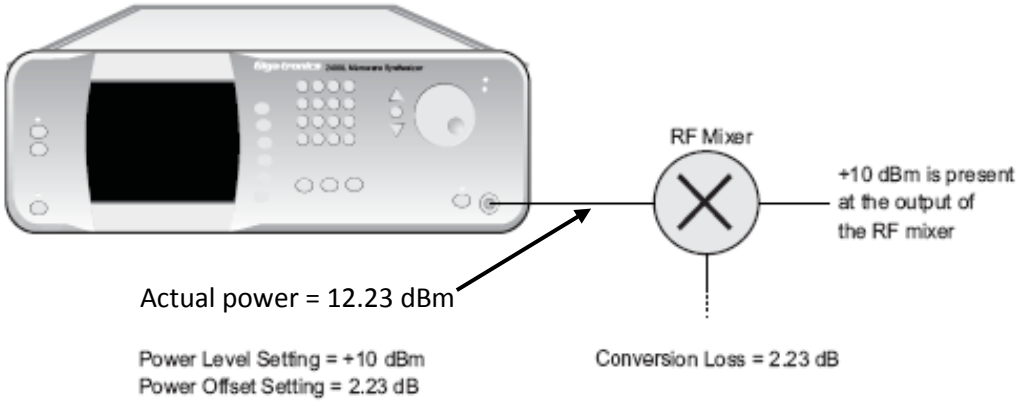
Figure 7. CW Menu



Parameter See Figure 7	**Description**
Frequency	The instrument's CW frequency. The range of the CW frequency is dependent on the model number and options of the instrument.
Power	The output power level of the selected frequency. The range of the output power level also depends on the Power Offset and Power Slope settings in the CW menu, as well as other settings of the instrument.
	Continued next page

3.1 CW Menu Description, Continued

Table 17 CW Menu, Continued

Parameter See Figure 7 on page 23.	**Description**
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 is shown in Figure 8. **Figure 8. 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	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 the power slope is greater than 0.00 dB/GHz.
	Continued next page

3.1 CW Menu Description, Continued

Table 18 CW Menu, Continued	
Parameter See Figure 7 on page 23.	**Description**
Phase Adjust	This menu item displays and allows you to modify the phase of the output signal. Note the following: • 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.

3.2 Generate a CW Signal

This procedure describes how to setup the 2400C to generate a CW signal with the following characteristics:

- Frequency: 1.250 GHz
- Power: 1 dBm
- Power offset: adjust as necessary to compensate for losses in test setup
- Power slope: adjust as necessary to compensate for losses that vary linearly with frequency
- Phase adjust: adjust as necessary

NOTE: The example procedure below uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Use this setup where a single, un-modulated frequency is needed, and where losses and frequency response are not significant in the cables and fixtures connecting to the DUT.

This procedure describes how to set up the 2400C to generate a continuous wave (CW) signal at a specified output power level. This procedure is also used to configure the carrier signal when modulation is used.

Table 19 Generate a CW Signal

Step	Action
1.	Press [ ].
2.	Select [Softkey] Frequency. Enter the 1.250 GHz using the numeric keypad, △ ▽, or ◎. ***NOTE:*** Whenever the frequency of the instrument is changed, the Phase Adjust setting resets to 0 degrees. The Phase Adjust range is 500 MHz to the maximum frequency of the instrument.
3.	**If the step attenuator option IS INSTALLED in the unit**: Go to the Step 4. **If the step attenuator option IS NOT installed in the unit**: Go to Step 5.
	Continued next page

3.2 Generate a CW Signal, Continued

Table 20 Generate a CW Signal, Continued

Step	Action
4.	The step attenuator, if installed, can be set to one 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; 1. Press System. 2. Select Softkey System Menu. 3. Select Softkey Attenuation. 4. Use △ ▽ or Softkey Attenuation 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 1. Press System. 2. Select Softkey System Menu. 3. Select Softkey Attenuation. 4. Use △ ▽, or Softkey Attenuation to select the level of attenuation.
5.	Return to the main CW menu if necessary by pressing CW.
6.	Select Softkey Power, and enter 1.00 dBm: 1. On the numeric keypad (see Figure 3 on page 11), enter 1.00. 2. Press the GHz/nSec/dBm units button ***NOTE:*** You can also change the value by using the △ ▽ keys, or ◎.
NEXT STEP*:* The insertion/conversion loss compensation features of the 2400C includes the: • Power Offset feature, which is used to compensate for a fixed level of insertion or conversion loss; • Power Slope feature, which is used to compensate for insertion or conversion loss that linearly varies with frequency.	
7.	**If YOU WANT to use the insertion/conversion loss compensation features of the 2400C:** Perform either, or both, Step 8 and Step 9 as necessary. **If you DO NOT want to use the insertion/conversion loss compensation features of the 2400C:** Go to Step 10.
	Continued next page

3.2 Generate a CW Signal, Continued

Table 21 Generate a CW Signal, Continued	
8.	***To compensate for a fixed level of loss***; 1. Select Softkey Power Offset. 2. Enter the desired loss correction using the numeric keypad, △ ▽, or ⊙. Note that when a correction factor is entered, **OFS** appears in the upper right corner of the display.
9.	***To compensate for a loss that varies linearly with frequency***; 1. Select Softkey Power Slope. 2. Enter the desired correction factor using the numeric keypad, △ ▽ keys, or ⊙. Note that when this correction factor is entered, **SLP** appears in the upper right corner of the display.
10.	***To adjust the phase of the output***; select Softkey Phase Adjust, and enter the desired phase shift using the numeric keypad, △ ▽ keys, or ⊙.
11.	If the RF ON indicator is not lit, press the RF ON button to enable the RF output.
12.	Verify that the Unleveled indicator is not lit.
13.	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.
End of Procedure	

Chapter 4. Ramp Operation

This chapter describes in detail the menus and parameters in the Ramp Menus. This chapter includes example procedures for using the 2400C front panel controls to setup ramps.

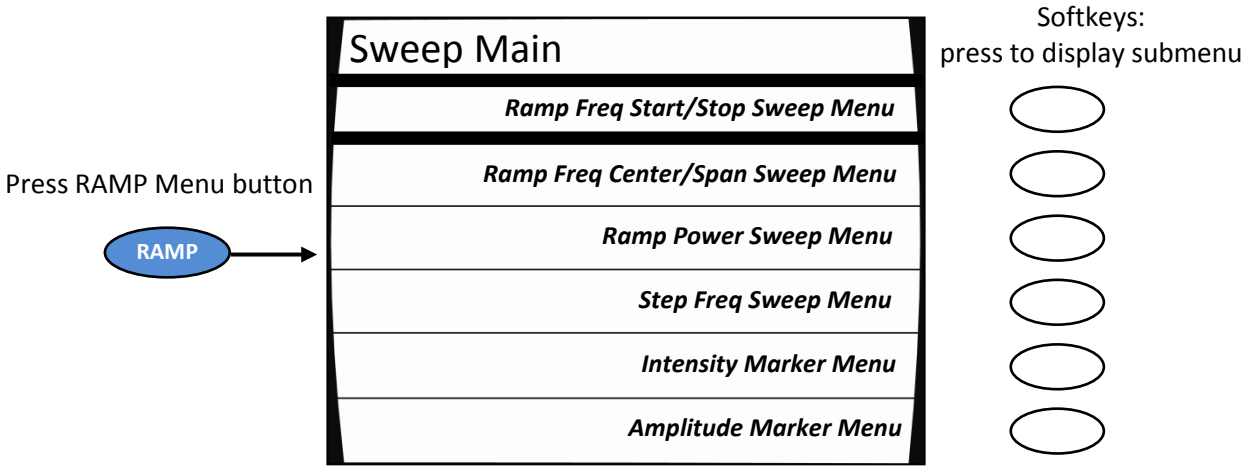
4.1 Ramp Menu Description

The Ramp Menu provides a powerful, flexible suite of functions to meet the most demanding test requirements. Figure 9 below shows the Ramp Main Menu.

Ramps can be set up for frequency or power. When a ramp is created, one parameter is swept (either frequency or power), and the other parameter is held constant.

For example, if a frequency ramp is created, the power is held constant over the range of ramp frequencies. Conversely, if a power ramp is created, the frequency is held constant over the range of power.

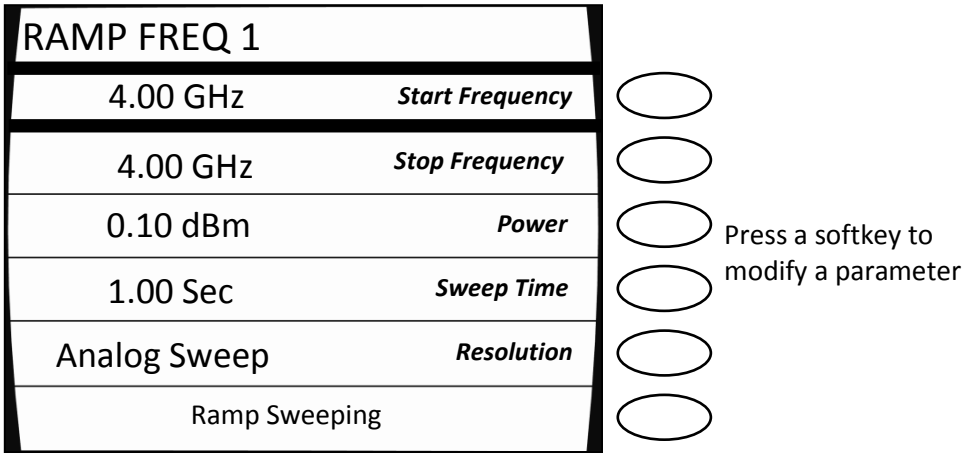
Figure 9. Ramp Main Menu



4.1 Ramp Menu Description, Continued

Table 22 Ramp Menus

Figure 10. Ramp Freq Start/Stop Sweep Menu



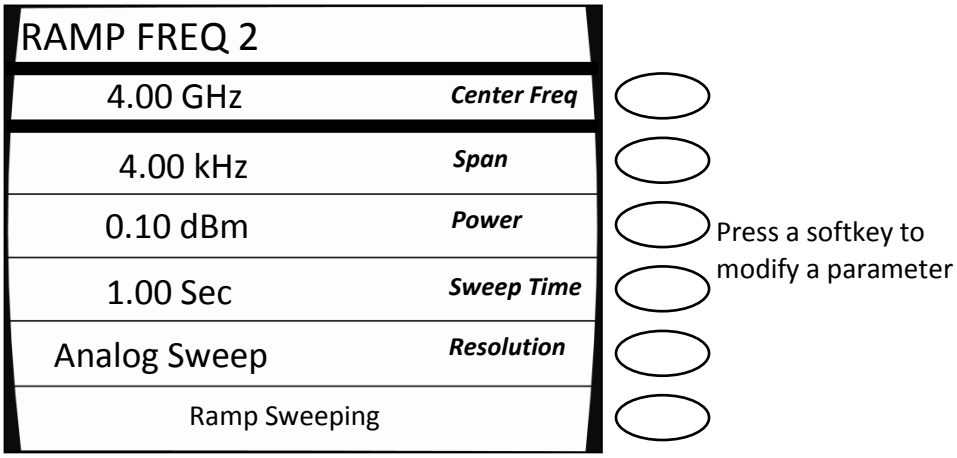
Submenu	Parameter
Ramp Freq Start/Stop Sweep Menu (see Figure 10)	• **Start Frequency** This is the starting frequency of the frequency sweep. The start frequency must be less than the stop frequency. If the start frequency is set higher than the stop frequency, the stop frequency is automatically adjusted to the same value. • **Stop Frequency** This is the ending frequency of the frequency sweep. The stop frequency must be greater than the start frequency. If it is set lower than the start frequency, the start frequency is automatically set to the same value. • **Power** The output power level during the frequency sweep. The range of the power level depends on the next two menu items and other settings of the instrument. The power level is held constant during a frequency sweep. • **Sweep Time.** This is the duration of a single sweep. • **Resolution** The sweep resolution is the number of frequency steps to be included in the frequency sweep. The step resolution can be set to: • 401 • 801 • 1601. • Analog sweep (available only with Option 43) Use the step up/step down buttons or rotary knob to set the resolution; the numeric keypad cannot be used.

Continued next page

4.1 Ramp Menu Description, Continued

Table 23 Ramp Menus, Continued

Figure 11. Ramp Freq Center/Span Sweep Menu



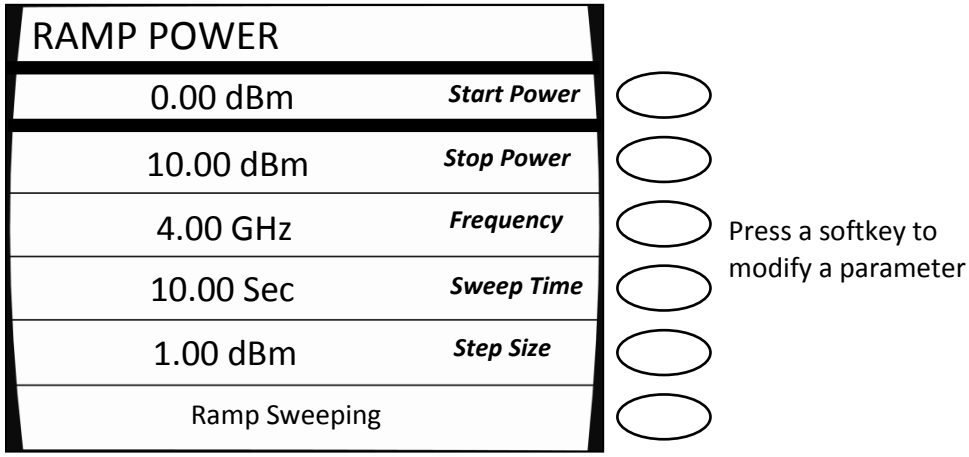
Submenu	Parameter
Ramp Freq Center/Span Sweep Menu (see Figure 11)	**Center Freq** The center frequency of the frequency span that is swept. **Span** This menu item displays and allows you to modify the frequency range of the ramp (sweep). The span is centered on the Center frequency. **Power** The output power level 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 is the duration of one cycle of a frequency sweep. **Resolution** This is the number of frequency steps in the frequency sweep. The resolution can be set to: • 401 • 801 • 1601. • Analog sweep (available only with Option 43) Use the step up/step down buttons or rotary knob to set the resolution; the numeric keypad cannot be used.

Continued next page

4.1 Ramp Menu Description, Continued

Table 24 Ramp Menus, Continued

Figure 12. Ramp Power Sweep Menu

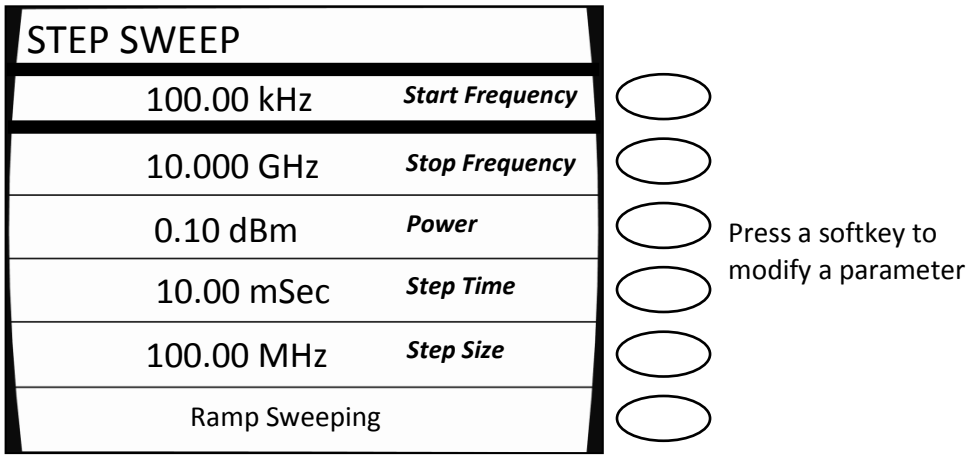


Submenu	Parameter
Ramp Power Sweep Menu (see Figure 12)	This function sweeps the RF output power level linearly from a start power level to a stop power level in a set duration, then repeats the sweep. The power level can sweep from a lower to a higher power level, or in the reverse direction. The output frequency is held constant 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 SWEEP DATA... When the calculations are complete and the output is actively sweeping, the following message is shown: RAMP SWEEPING **Start Power** This is the beginning power level of the power level sweep. • The range for the start power parameter is -20 dBm to +25 dBm if the step attenuator option is not installed in the instrument. • If the step attenuator option is installed, the start power range is from 25 dB above to 20 dB below the step attenuator setting. **Stop Power** This is the ending power level of the sweep. • If the step attenuator option is installed, the stop power range is from 25 dB above to 20 dB below the step attenuator setting chosen. • If the step attenuator option is not installed in the instrument, the range for the stop power parameter is -20 dBm to +25 dBm

Continued next page

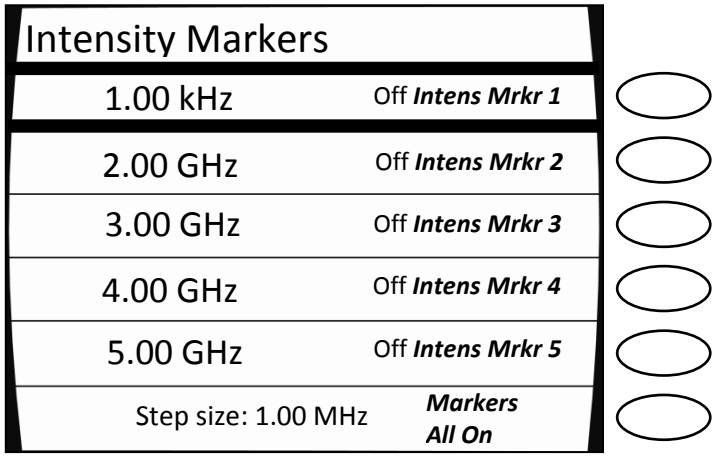
4.1 Ramp Menu Description, Continued

Table 25 Ramp Menus, Continued

Submenu	Parameter
Ramp Power Sweep Menu, Continued (see Figure 12 on the previous page)	**Frequency** This is the frequency that undergoes a power ramp. The range of adjustment of this parameter is dependent on the model number of the instrument. **Sweep Time** This is the amount of time that elapses for one cycle of a power level sweep to complete. **Step size** Power step size
Figure 13. Step Freq Sweep Menu  	
Step Freq Sweep Menu (see Figure 13)	This menu allows you to view and modify settings for the frequency sweep feature. Note the following: • When this feature is used, the frequency of the RF output sweeps linearly from a settable start frequency to a settable stop frequency, over a sweep time, then repeats the sweep. • 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 the Step Freq Sweep 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: RAMP SWEEPING
	Continued next page

4.1 Ramp Menu Description, Continued

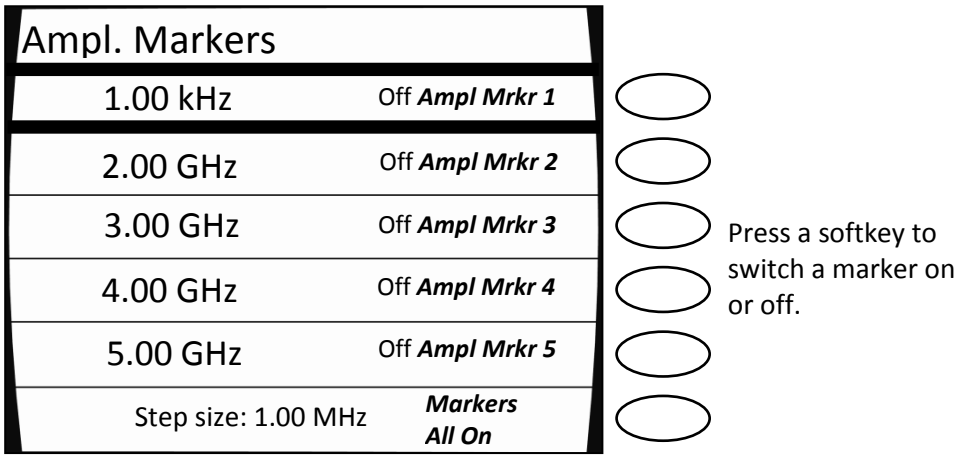
Table 26 Ramp Menus, Continued

Submenu	Parameter
Step Freq Sweep Menu, Continued (see Figure 13 on previous page)	**Start Frequency** This is the starting frequency of the frequency sweep. 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 is the ending frequency of the frequency sweep. 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** The output power level during the frequency sweep. The range of the power level depends on the following configuration and settings of the instrument: **Step Time** The duration of the step. **Step Size** Frequency step size
Figure 14. Intensity Marker Menu  	
Intensity Marker Menu (see Figure 14)	The Intensity Marker Menu allows you to view and modify settings related to the instrument's Intensity Markers used in conjunction with the frequency sweep. Five intensity markers that can be set. **Intensity Markers** These five items allow you to set the frequency of the intensity markers using the numeric key pad. The marker is activated and deactivated by pressing the marker soft key. **Markers All On/Off** This menu item allows you to toggle the states of all 5 markers in the Intensity Marker menu. Pressing the adjacent softkey toggles all marker states to be all on or all off.
Continued next page	

4.1 Ramp Menu Description, Continued

Table 27 Ramp Menus, Continued

Figure 15. Amplitude Marker Menu



Amplitude Markers Menu (see Figure 15)	The Amplitude Marker Menu allows you to view and modify settings related to the instrument's Amplitude Markers used in conjunction with the frequency sweep. Five amplitude markers can be set. **AmplMrkr1 through AmplMrkr2** These 5 items allow you to set the frequency of the amplitude markers using the numeric key pad. The marker is activated and deactivated by pressing the adjacent amplitude marker soft key. **Markers All On/Off** This menu item allows you to toggle the states of all markers in the Amplitude Marker menu. Pressing the adjacent soft key toggles all marker states to be all on or all off.

4.2 Generate a Frequency-Swept Signal

This procedure describes how to set up a signal at a constant power level that sweeps linearly from a start frequency to a stop frequency over a set duration, then repeats the sweep. The signal will be set up with the following characteristics:

- Start frequency: 1.00 GHz
- Stop frequency: 2.00 GHz
- Power level: 1.00 dBm

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Table 28 Generate a Frequency-Swept Signal

Step	Action
1.	Press [ ] to display the Sweep Main menu.
2.	Press [Softkey] RAMP FREQ Start/Stop Sweep menu.
3.	Select [Softkey] Start Frequency, and enter 1.00 GHz using the numeric keypad (and Units buttons), △ ▽, or ◎.
4.	Select [Softkey] Stop Frequency, and enter 2.00 GHz using the numeric keypad (and Units buttons), △ ▽, or ◎. ***NOTE:*** The ramp stop frequency must be set equal to or greater than the ramp start frequency.
5.	Select [Softkey] Power and enter the 1.00 dBm using the numeric keypad (and Units buttons), △ ▽, or ◎.
6.	Select [Softkey] Sweep Time, and enter 1.00 seconds using the numeric keypad (and Units buttons), △ ▽, or ◎.
7.	Select [Softkey] Resolution, and select 401 using △ ▽. ***NOTE:*** 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.
8.	If the RF ON indicator is not lit, press the RF ON button to enable the RF output. When the RF output is enabled, the RF ON indicator is illuminated blue.
End of Procedure	

4.3 Generate a Power-Swept Signal

This procedure describes how to set up the 2400C 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, and repeats the sweep. The signal will be setup with the following characteristics:

- Start power: 0.00 dBm
- Stop power: 5.00 dBm
- Frequency: 1.00 GHz
- Sweep time: 5.00 second
- Step size: 0.10 dBm

NOTE: The example procedure in this section uses specific parameters to illustrate how to set up the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Table 29 Generate a Power-Swept Signal

Step	Action
1.	Press RAMP to display the Sweep Main menu.
2.	Select Softkey Ramp Power Sweep Menu.
3.	Select Softkey Start Power, and enter 0.00 dBm using the numeric keypad (and Units buttons), △ ▽, or ◎.
4.	**If the 90 dB step attenuator IS INSTALLED in the unit**; Go to Step 5. **If the 90 dB step attenuator IS NOT installed in the unit**; Go to Step 6.
5.	Select Softkey Attenuation in the RAMP POWER menu, and use △ ▽ to select the desired step attenuator level. ***NOTE:*** The step attenuator cannot be set to auto-switch while in power sweep mode. Choose a step attenuator level so that the range of the power sweep will be within 25 dB above and 20 dB below the step attenuator level chosen.
6.	Select Softkey Stop Power, and enter 5.00 dBm using the numeric keypad (and Units buttons) , △ ▽, or ◎. ***NOTE:*** The ramp stop power level can be set equal to, greater than, or less than the ramp start power level.
	Continued next page

4.3 Generate a Power-Swept Signal, Continued

Table 30 Generate a Power-Swept Signal, Continued	
Step	**Action**
7.	Select Softkey Frequency, and enter 1.00 GHz using the numeric keypad (and Units buttons) , △ ▽, or ◎.
8.	Select Softkey Sweep Time, and enter 5.00 seconds using the numeric keypad (and Units buttons), △ ▽, or ◎.
9.	Select Softkey Step Size, and enter 0.10 dBm using the numeric keypad (and Units buttons), △ ▽, or ◎.
10.	If the RF ON indicator is not lit, press the RF ON button to enable the RF output. When the RF output is enabled, the RF ON indicator is illuminated blue.
End of Procedure	

Chapter 5. Modulation Operation

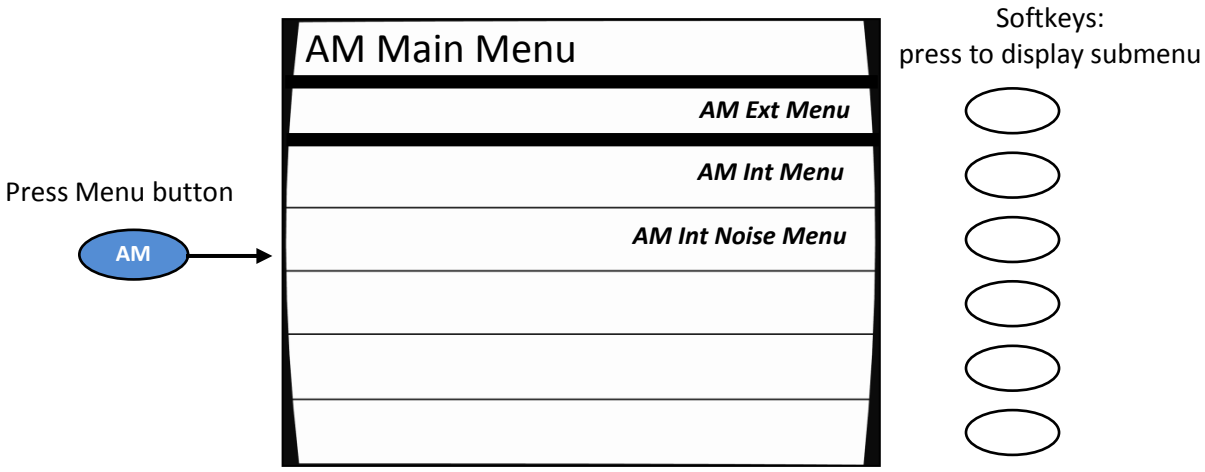
This section describes the modulation menus in the 2400C, and includes example procedures for setting up modulated test signals.

5.1 AM Menu Description

Press the AM Menu button to display the AM Main Menu. From here, you can go to one of three submenus. See Figure 16 below.

Table 31 on the next page describes the AM menus and their parameters.

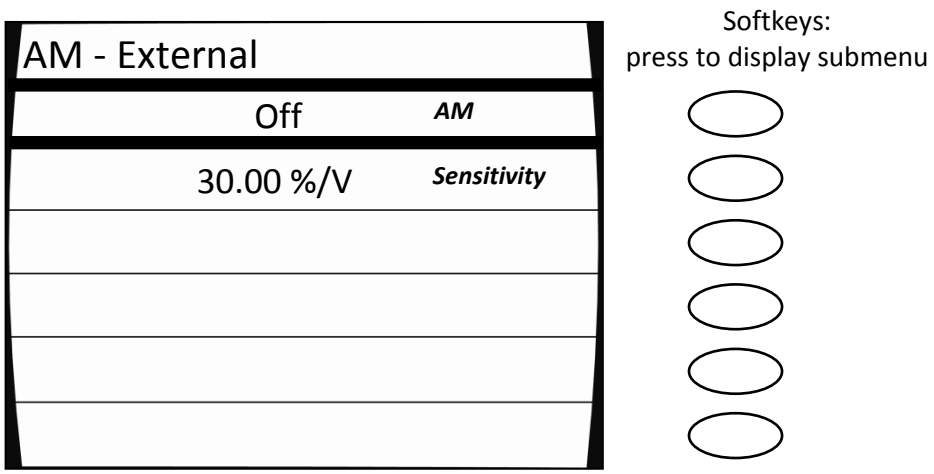
Figure 16. AM Main Menu and Submenus



5.1 AM Menu Description, Continued

Table 31 AM Menus

Figure 17. AM External Menu



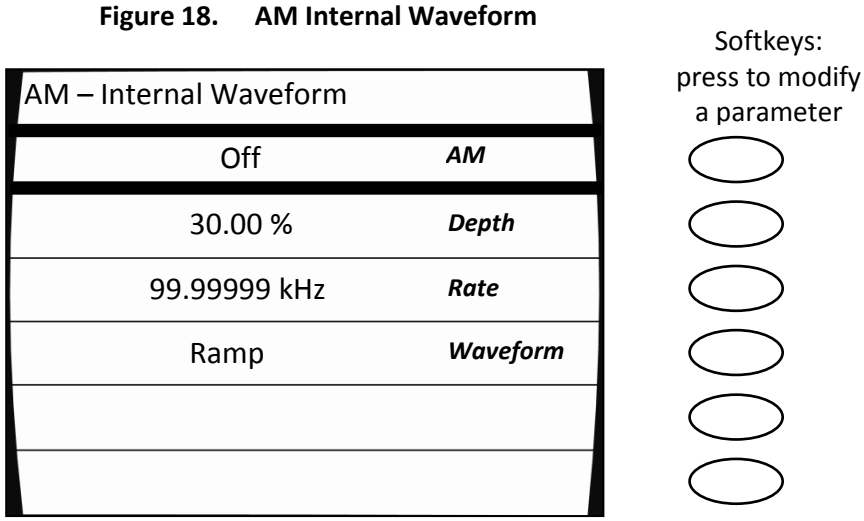
Submenu	Parameter
AM Ext Menu See Figure 17.	The AM External Menu allows you to view and modify settings for external amplitude modulation mode. In this mode, the RF output signal is modulated according to the signal that is applied to the rear panel AM IN connector. Parameters in this submenu that can be modified are: **AM** Enables or disables amplitude modulation. The active menu, that is, the menu that is currently being displayed, 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** Determines the percentage of modulation produced per Volt of input into the AM IN connector. The AM sensitivity can be modified using 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.

Continued next page

5.1 AM Menu Description, Continued

Table 32 AM Menus, Continued

Figure 18. AM Internal Waveform



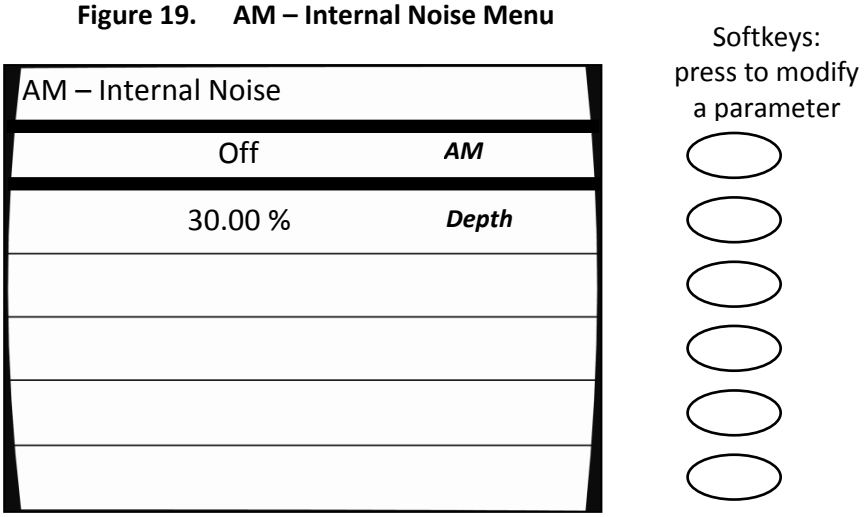
Submenu	Parameter
AM Int Menu See Figure 18	The AM Internal Waveform menu allows you to view and modify settings in which the modulating signal is an internally-generated sine, triangle, ramp, or square waveform (the signal at the AM IN connector is not used). Parameters in this submenu are: **AM** Enables or disables amplitude modulation. The active menu (the menu that is currently being displayed), determines the AM mode that is used. Pressing the adjacent softkey or the Step Up or Step Down buttons toggle the AM state. **Depth** The amount of modulation of the carrier frequency amplitude expressed as a percentage. The maximum depth adjustment available is 95 %. **Rate** The frequency (rate) of the internal modulating signal. The frequency cannot be set above 100 kHz. **Waveform** Allows you to 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).

Continued next page

5.1 AM Menu Description, Continued

Table 33 AM Menus, Continued

Figure 19. AM – Internal Noise Menu



Submenu	Parameter
AM Int Noise Menu see Figure 19.	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). **AM** Enables or disables amplitude modulation. The active menu, (the menu currently displayed), determines the AM mode that is used. Pressing the adjacent softkey or the Step Up or Step Down buttons toggles the AM state. **Depth** This menu item allows you to view and modify the AM depth setting, which is the amount of modulation of the carrier amplitude expressed as a percentage.

5.2 Generate an Internally Modulated AM Signal

The procedure below describes how to generate an AM signal with the following characteristics:

- Carrier frequency = 1.00 GHz
- Carrier power = 1.00 dBm
- Depth of AM modulation = 20 %
- Rate of AM modulation = 50 kHz
- Modulating waveform = sine wave

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Table 34 Generate an Internally Modulated AM Signal

Step	Action
1.	Verify that the RF output is NOT energized by checking the RF on/off indicator on the front of the 2400C (see Figure 3 on page 11). If the indicator is lit, press the RF ON button to de-energize the RF output.
2.	Connect the device to be tested to the RF output connector on the 2400C.
3.	Press the CW menu button (see Figure 3 on page 11).
4.	In the CW menu, select 1.00 GHz for the frequency of the AM signal: 1. Press Frequency. 2. On the numeric keypad on the front panel of the 2400C, enter 4.00. 3. Press the GHz Units button (next to the numeric keypad) to enter the new frequency. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the frequency.
5.	In the CW menu, select 1.00 dBm for the power level of the AM signal: 1. Press Power. 2. On the numeric keypad on the front panel of the 2400C, enter 1. 3. Press the GHz (nSec/dBm) Units button (next to the numeric keypad) to enter the new power level. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the power level.
6.	Press the menu button.
7.	In the AM Main Menu, press Soft Button AM Int Menu. This opens the AM — Internal Waveform submenu (see Figure 18 on page 41).
	Continued next page

5.2 Generate an Internally Modulated AM Signal, Continued

Table 35 Generate an Internally Modulated AM Signal, Continued

Step	Action
8.	In the AM — Internal Waveform submenu, set the following parameters: 1. Turn on AM modulation; press Soft Button AM. 2. Set the depth of AM modulation; press Soft Button Depth. a. Use the numeric keypad, △ ▽ keys, or ◎ to change the depth of AM modulation to 20 %. 3. Set the rate of AM modulation; press Soft Button Rate. a. Use the numeric keypad, △ ▽ keys, or ◎ to change the rate of AM modulation to 50 kHz. 4. Set the type of waveform used for AM modulation as a sine wave; press Soft Button Waveform until Sine selected.
9.	Press the RF ON button to energize the RF output of the 2400C.
End of Procedure	

5.3 Generate an Externally Modulated AM Signal

The procedure below describes how to generate an AM signal using an external modulation source. The AM signal is set up to have the following characteristics:

- Carrier frequency = 1.00 GHz
- Carrier power = 1.00 dBm
- Depth of AM modulation = 50 %
- Rate of AM modulation = 50 kHz
- Modulating waveform = sine wave

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Equipment and Materials

- External AM modulation source (see specifications in Table 79 page 99)
- Cables and connectors for connecting the AM modulation source to the 2400C
- Cables and connectors for connecting device to be tested to the 2400C RF Output

Table 36 Generate an Externally Modulated AM Signal

Step	Action
1.	Verify that the RF output is NOT energized by checking the RF on/off indicator on the front of the 2400C (see Figure 3 on page 11). If the indicator is lit, press the RF ON button to de-energize the RF output.
2.	Connect the device to be tested to the RF output connector on the 2400C.
3.	On the rear of the 2400C, locate the AM IN connector (see Figure 6 on page 19).
4.	Connect the external AM modulation source to the AM IN connector (see Table 80 on page 99 for specifications for the external FM signal).
5.	Press the menu button.
6.	In the CW menu, select 1.00 GHz for the frequency of the AM signal: 4. Press Soft Button Frequency. 5. On the numeric keypad on the front panel of the 2400C, enter 1. 6. Press the GHz Units button (next to the numeric keypad) to enter the new frequency. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the frequency.
	Continued next page

5.3 Generate an Externally Modulated AM Signal, Continued

Table 37 Generate an Externally Modulated AM Signal, Continued	
Step	**Action**
7.	In the CW menu, select 1 dBm for the power level of the AM signal: 4. Press Soft Button Power. 5. On the numeric keypad on the front panel of the 2400C, enter 1. 6. Press the GHz (nSec/dBm) Units button (next to the numeric keypad) to enter the new power level. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the power level.
8.	Press AM to display the AM Main Menu (see Figure 16 on page 39).
9.	Press Soft Button AM Ext Menu.
10.	Press Soft Button AM to switch AM mode ON.
11.	Press Soft Button Sensitivity.
12.	Adjust the sensitivity to 50 %/Volt: 1. On the numeric keypad, enter 50. 2. Press the kHz/mSec/% Units button (see Figure 3 on page 11). ***NOTE:*** You can also set the sensitivity by the using the △ ▽ keys and ◎.
13.	Set the external AM modulation source for the following output: • Frequency: 50 kHz • Amplitude: 1 V peak-to-peak • Output waveform: sine wave
14.	Energize the output of the external AM modulation source.
15.	Energize the RF output of the 2400C.
End of Procedure	

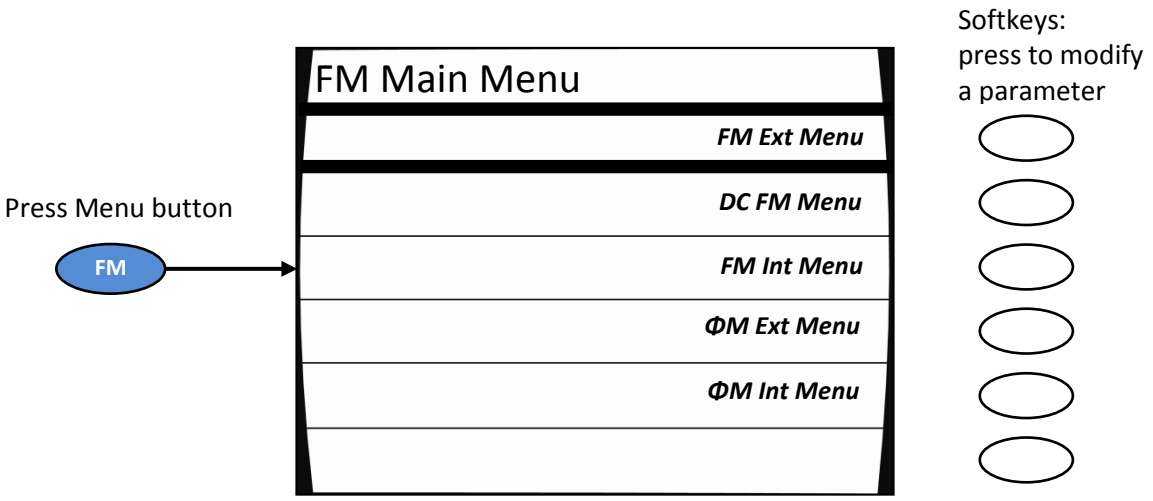
5.4 FM Menu Description

Pressing the FM menu button displays the FM Main Menu. From here, you can choose from among five submenus for modifying parameters for frequency modulation. See Figure 20.

Table 38 on the next page describes the FM menu and submenus in detail.

NOTE: The FM menu includes phase modulation modes

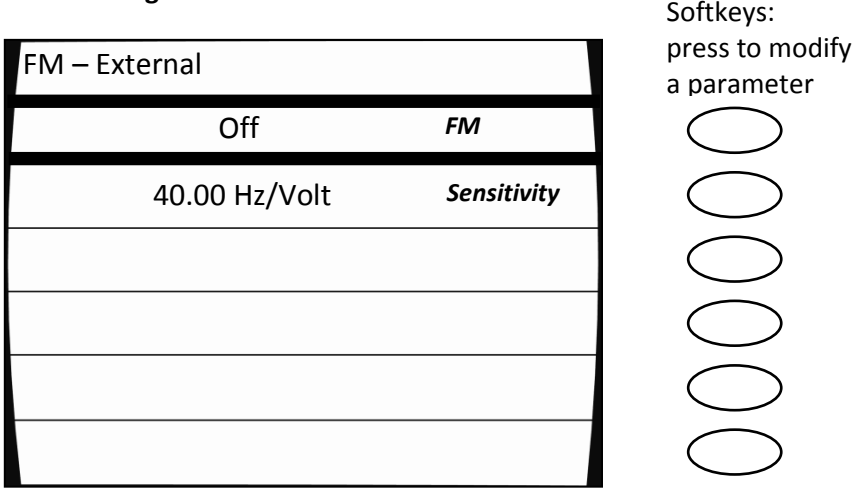
Figure 20. FM Main Menu and Submenus



5.4 FM Menu Description, Continued

Table 38 FM Menus

Figure 21. FM External Menu



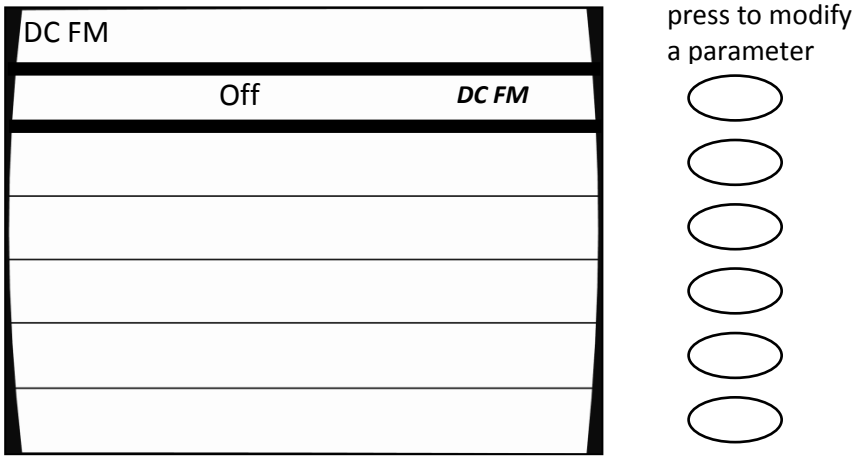
Submenu	Parameter
FM Ext Menu See Figure 21.	The FM External menu allows you to view and modify settings for external frequency modulation mode, which is used when the modulating signal is provided externally. In external FM mode, the RF output signal is modulated by the signal that is applied to the rear panel FM/ΦM IN connector. Items in this submenu that can be modified are: **FM** Enables or disables frequency modulation. The active menu, (the menu currently displayed), determines the FM mode that is used. Pressing the adjacent soft key or the Step Up or Step Down buttons toggles the FM state. **Sensitivity** Determines how much the RF output deviates in frequency per Volt of signal at the rear panel FM/ΦM IN connector.

Continued next page

5.4 FM Menu Description, Continued

Table 39 FM Menus, Continued

Figure 22. DC FM Menu



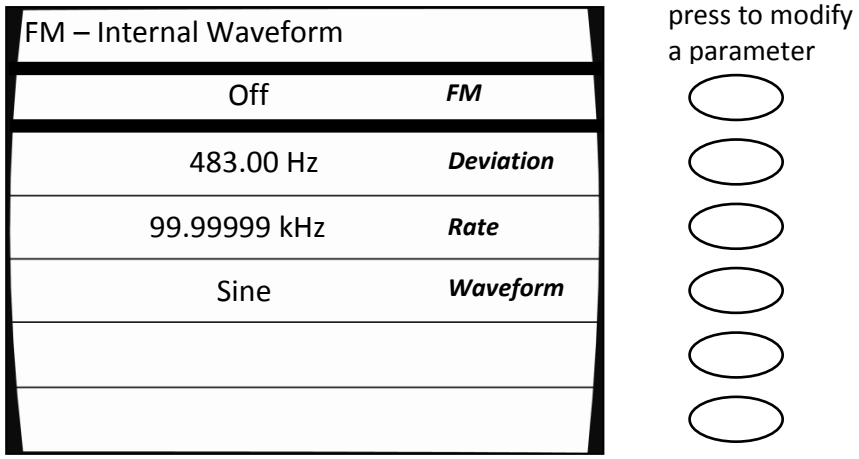
DC FM Menu See Figure 22.	In DC FM mode, the RF output signal is modulated by an external signal that is applied to the rear panel FM/ϕM IN connector. Note the following: • DC FM is available on all models including models with option 17A. • Frequency range for DC FM operation is 500 MHz to the maximum frequency of the instrument with a fixed maximum deviation of 125 kHz. • DC FM operation is available for frequencies above 500 MHz; however, maximum deviation is limited to the frequency band maximum deviation of the output frequency. There is one settable item in this submenu: **DC FM** Enables or disables DC frequency modulation. The active menu, (the menu currently displayed), determines the FM mode that is used. Pressing the adjacent soft key or the Step Up or Step Down buttons toggle the FM state.

Continued next page

5.4 FM Menu Description, Continued

Table 40 FM Menus, Continued

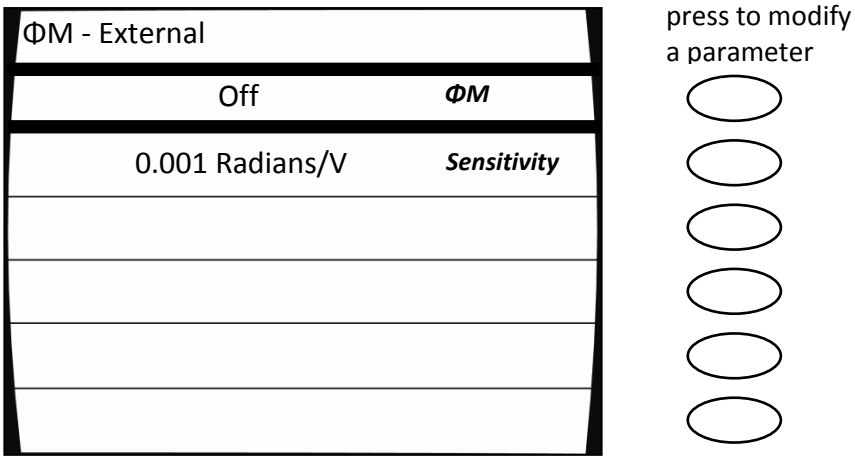
Figure 23. FM Internal Menu



Submenu	Parameter
FM Int Menu See Figure 23.	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). Settable menu items are: **FM** Switches FM Internal on and off. FM Internal is an internally driven modulation. FM - Internal can only be activated or deactivated using the step up/step down buttons. **Deviation** Determines how much (in Hertz) the RF output deviates in frequency when modulated by the internal source. **Rate** The rate (frequency) of the internal modulating signal. **Waveform** 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).

5.4 FM Menu Description, Continued

Figure 24. ΦM External Menu

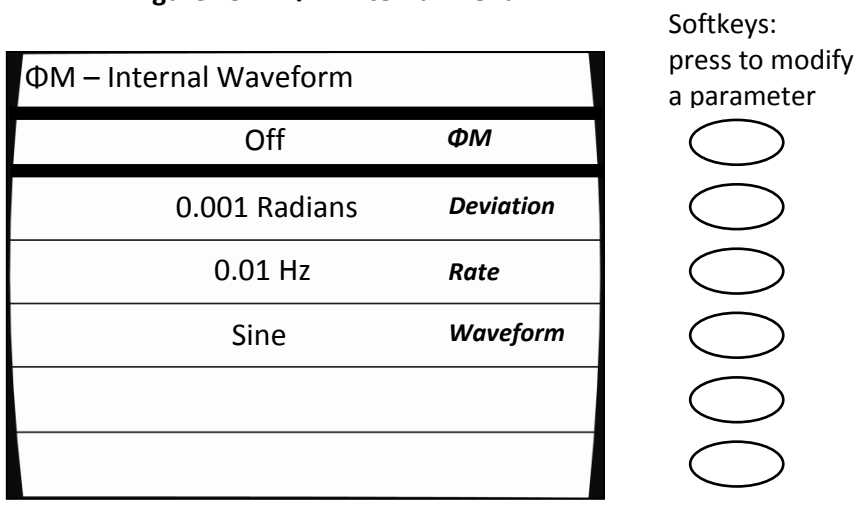


ΦM Ext Menu See Figure 24.	The ΦM External menu allows you to view and modify settings for external phase modulation mode, which is used when the modulating signal is provided externally. In external ΦM mode, the RF output signal is modulated by a signal that is applied to the rear panel FM/ϕM IN connector. Items in this submenu that can be modified are: **ΦM** Enables or disables modulation. The active menu, (the menu that is currently displayed), determines the ΦM mode that is used. Pressing either the adjacent softkey or the Step Up or Step Down buttons toggle the ΦM state. **Sensitivity** Use to view and modify the external ΦM sensitivity setting, which determines how much the RF output phase deviates in radians per Volt of signal at the rear panel FM/ϕM IN connector.

Continued next page

5.4 FM Menu Description, Continued

Figure 25. ΦM Internal Menu



Submenu	Parameter
ΦM Int Menu See Figure 25.	The ΦM -Internal menu allows you to view and modify settings related to an internal phase modulation mode in which the modulating signal is an internally-generated sine, triangle, ramp, or square wave-form (the signal at the FM/ϕM IN connector is not used). Items in this submenu that can be modified are: **ΦM** This menu item enables or disables internally-generated phase modulation. ΦM - Internal can only be activated or deactivated using the Step Up/Step Down buttons. **Deviation** Determines how much the RF output deviates in phase when modulated by the internal source. **Rate** The 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).

5.5 Generate an Internally Modulated FM Signal

The procedure below describes how to generate an internally-modulated FM signal with the following characteristics:

- Carrier frequency = 1.00 GHz
- Carrier power = 1.00 dBm
- Deviation = 200 Hz
- Rate of FM modulation = 50 kHz
- Modulating waveform = sine wave

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Equipment and Materials

- Cables and connectors for connecting device to be tested to the 2400C RF Output

Table 41 Generate an Internally Modulated FM Signal

Step	Action
1.	Verify that the RF output is NOT energized by checking the RF on/off indicator on the front of the 2400C (see Figure 3 on page 11). If the indicator is lit, press the RF ON button to de-energize the RF output.
2.	Connect the device to be tested to the RF output connector on the 2400C.
3.	Press the CW menu button.
4.	In the CW menu, select 1.00 GHz for the frequency of the FM signal: 7. Press Frequency. 8. On the numeric keypad on the front panel of the 2400C, enter 1. 9. Press the GHz Units button (next to the numeric keypad) to enter the new frequency. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the frequency.
5.	In the CW menu, select 1.00 dBm for the power level of the FM signal: 1. Press Power. 2. On the numeric keypad on the front panel of the 2400C, enter 1. 3. Press the GHz (nSec/dBm) Units button (next to the numeric keypad) to enter the new power level. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the power level.

Continued next page

5.5 Generate an Internally Modulated FM Signal, Continued

Table 42 Generate an Internally Modulated FM Signal, Continued	
Step	**Action**
6.	Press the FM Menu button. The FM Main Menu opens in the display.
7.	In the FM Main Menu, press Soft Button FM Int Menu. The FM — Internal Waveform menu opens (see Figure 23 on page 50).
8.	Press FM to switch FM on.
9.	Press Soft Button Deviation.
10.	Set the FM deviation to 200 Hz: 1. On the numeric keypad on the front panel of the 2400C, enter 200. 2. Press the Hz Units button (next to the numeric keypad) to enter the new frequency. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the frequency.
11.	Press Rate.
12.	Set the FM rate (frequency of the modulating signal) 50.00 kHz: 1. On the numeric keypad on the front panel of the 2400C, enter 50. 2. Press the kHz Units button (next to the numeric keypad) to enter the new frequency. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the frequency.
13.	Repeatedly press Waveform until Sine is displayed.
14.	Press the button to energize the RF output of the 2400C.
End of Procedure	

5.6 Generate an Externally Modulated FM Signal

The procedure below describes how to generate an FM signal that uses an external FM modulation source connected to the 2400C. An FM signal is created with the following characteristics:

- Carrier frequency = 1.00 GHz
- Carrier power = 1.00 dBm
- Deviation = 1.00 kHz
- Rate of FM modulation = 50 kHz
- Modulating waveform = sine wave

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Equipment and Materials

- External FM modulation source (see specifications in Table 80 page 99)
- Cables and connectors for connecting the FM modulation source to the 2400C
- Cables and connectors for connecting device to be tested to the 2400C RF Output

Table 43 Generate an Externally Modulated FM Signal

Step	Action
1.	Verify that the RF output is NOT energized by checking the RF on/off indicator on the front of the 2400C (see Figure 3 on page 11). If the indicator is lit, press the RF ON button to de-energize the RF output.
2.	Connect the device to be tested to the RF output connector on the 2400C.
3.	On the rear of the 2400C, locate the FM/ΦM IN connector (see Figure 6 on page 19).
4.	Connect the external FM modulation source to the FM/ΦM IN connector (see Table 80 on page 99 for specifications for the external FM signal).
5.	Press the menu button.
6.	In the CW menu, select 1.00 GHz for the frequency of the FM signal: 1. Press Soft Button Frequency. 2. On the numeric keypad on the front panel of the 2400C, enter 1. 3. Press the GHz Units button (next to the numeric keypad) to enter the new frequency. ***NOTE:*** You can also use the △ ▽ keys and ◯ to change the frequency.
	Continued next page

5.6 Generate an Externally Modulated FM Signal, Continued

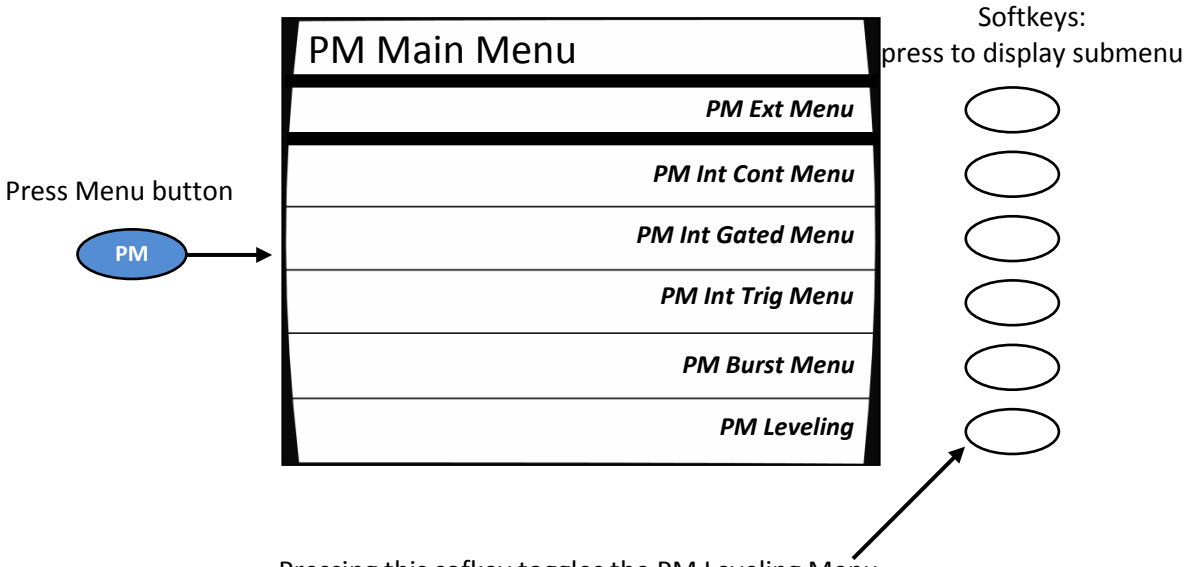
Table 44 Generate an Externally Modulated FM Signal	
Step	**Action**
7.	In the CW menu, select 1.00 dBm for the power level of the FM signal: 1. Press Soft Button Power. 2. On the numeric keypad on the front panel of the 2400C, enter 1. 3. Press the GHz (nSec/dBm) Units button (next to the numeric keypad) to enter the new power level. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the power level.
8.	Press the Menu button. The FM Main Menu opens in the display.
9.	In the FM Main Menu, press Soft Button FM Ext Menu. The FM — External Waveform menu opens (see Figure 21 on page 48).
10.	Press Soft Button FM to switch FM on.
11.	Press Soft Button Sensitivity. Set the Sensitivity to 1.00 kHz per Volt as follows: 1. On the numeric keypad on the front panel of the 2400C, enter 1. 2. Press the kHz Units button (next to the numeric keypad) to enter the new power level. ***NOTE:*** You can also use the △ ▽ keys and ◎ to change the power level.
12.	Setup the external FM modulation source as follows: • Frequency: 50 kHz • Amplitude: 1.00 V p-p
13.	Press the RF ON button to energize the RF output of the 2400C.
End of Procedure	

5.7 Pulse Modulation (PM) Menu Description

Pressing the PM menu button provides access to the internal and external pulse modulation features of the instrument. Figure 26 illustrates the PM Main menu and five submenus.

The following pages describe the PM submenus in detail.

Figure 26. PM Main Menu and Submenus



Pressing this sofkey toggles the PM Leveling Menu between two states:

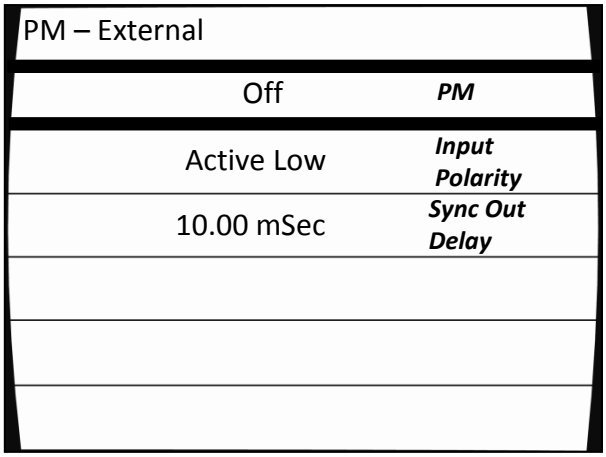
1) Always ON
2) Off for pulse widths < 1 µs
   (causes 1 ms cal pulse)

Continued next page

5.7 PM Menu Description, Continued

Table 45 PM Menus

Figure 27. PM External Menu



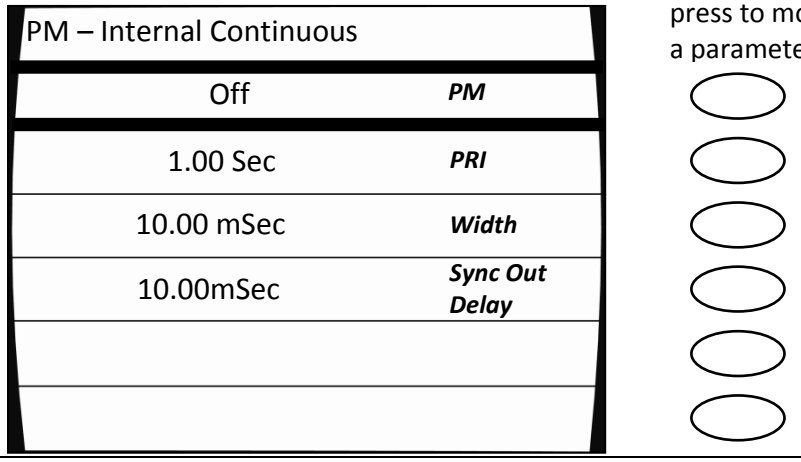
Submenu	Parameter
PM Ext Menu See Figure 27.	The PM External menu allows you to view and modify settings for external pulse modulation mode, which is used when the modulating signal is provided externally. In external PM mode, the RF output signal is pulsed by the signal that is applied to the rear panel 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. Items in this submenu that can be modified are: **PM** Turns pulse modulation on and off. Press 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** 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

Continued next page

5.7 PM Menu Description, Continued

Table 46 PM Menus, Continued

Figure 28. PM Internal Continuous Menu



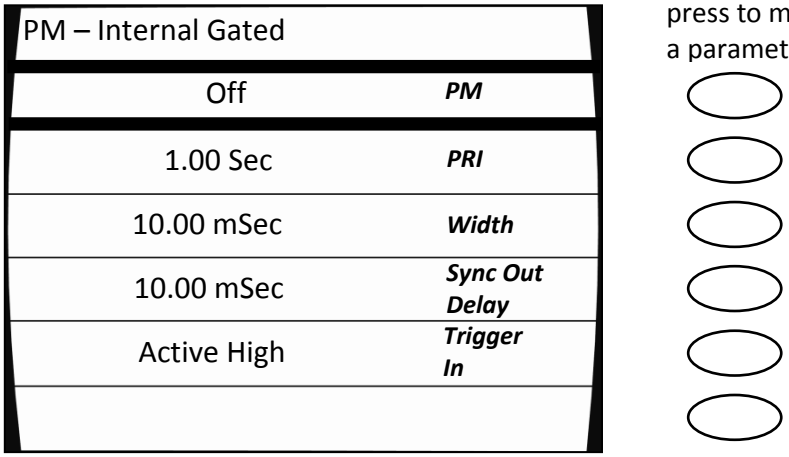
Submenu	Parameter
PM Int Cont Menu See Figure 28. ***NOTE:*** This menu is not available for models with Option 17B.	The PM Internal Continuous menu produces a continuous pulse-modulated RF output with pulse characteristics determined by an internally-generated pulse signal (any signal at the PULSE IN/PM TRIG IN connector is ignored). Items in this submenu that can be modified are: **PM** Turns pulse modulation on and off. Press 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** The pulse repetition interval (PRI) of the internal pulse modulating signal. PRI sets the duration between similar edges of the modulating signal, and thus, the RF output's pulse repetition interval. The frequency of the pulses is the reciprocal of the PRI; frequency = 1/PRI. ***NOTE:*** This parameter setting is used for the internal continuous and internal gated pulse modulation modes; it is not set and stored separately for those modes. **Width** The width of the internal pulse modulating signal. Sets the duration of the high state of the internal modulating signal, and thus, the RF output's pulse width. ***NOTE:*** This parameter setting is 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** Sets 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:*** This parameter setting is used for all three internal pulse modulation modes (continuous, triggered, and gated); it is not set and stored separately for each of those modes.

Continued next page

5.7 PM Menu Description, Continued

Table 47 PM Menus, Continued

Figure 29. PM Internal Gated Menu



Submenu	Parameter
PM Int Gated Menu See Figure 29.	The PM Internal Gated menu allows you to view and modify 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. **PM** Turns pulse modulation on and off. Pressing the adjacent soft key or the Step Up or Step Down buttons toggles the PM state. The PM indicator is displayed in the upper right-hand corner of the display when pulse modulation is turned on **PRI** The pulse repetition interval (PRI) of the instrument's internal pulse modulating signal. The PRI parameter sets the duration between similar edges of the modulating signal, and thus, the pulse repetition interval (frequency) of the pulsed RF output. ***NOTE:*** This parameter setting is used for the internal continuous and internal gated pulse modulation modes; it is not set and stored separately for those modes. **Width** Sets the duration of the high state of the modulating signal pulses, 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 20 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.

Continued on next page

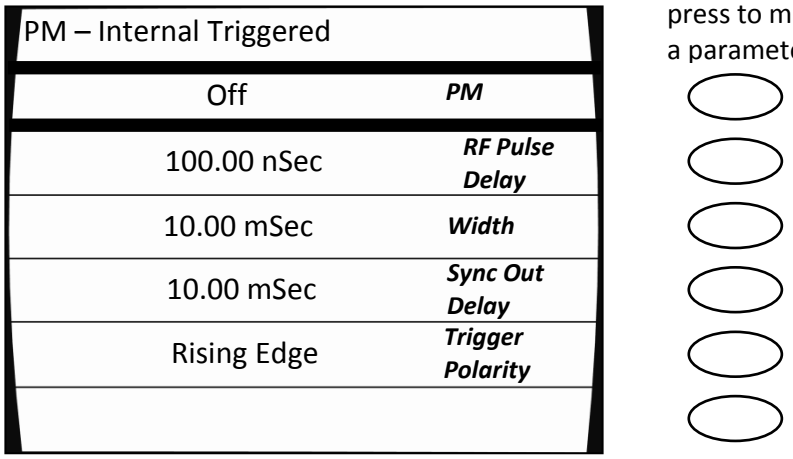
5.7 PM Menu Description, Continued

Table 48 PM Menus, Continued	
Item	**Description**
PM Int Gated Menu, continued See Figure 29 on the previous page.	**Synch Out Delay** 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** Determines whether a high or low TTL level at the PULSE IN/PM TRIG IN connector is the active gating condition for a pulse modulated RF output. The available selections are as follows: • Active High • Active Low

5.7 PM Menu Description, Continued

Table 49 PM Menus, Continued

Figure 30. PM Internal Triggered Menu



Submenu	Parameter
PM Int Trig Menu See Figure 30.	The PM Internal Triggered menu allows you to view and modify settings for 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. Settable items in this submenu are: **PM** This menu item turns pulse modulation on and off. Pressing either the adjacent softkey 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** 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 the numeric keypad, the step up/step down buttons, or the rotary knob.

Continued next page

5.7 PM Menu Description, Continued

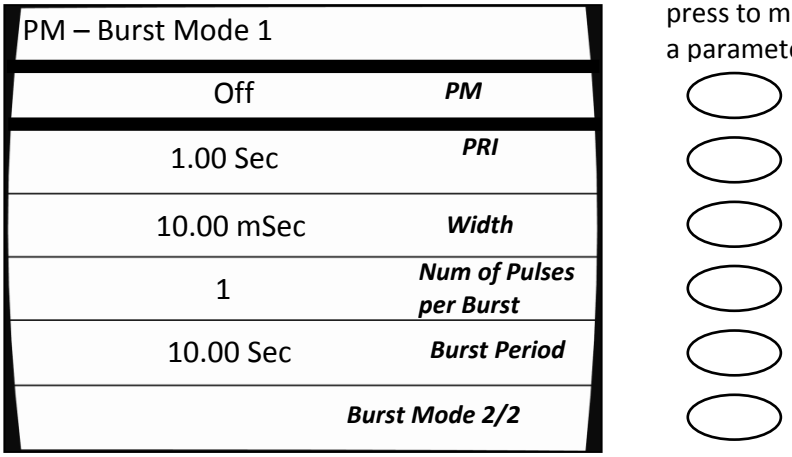
Table 50 PM Menus, Continued

Submenu	Parameter
PM Int Trig Menu, Continued See Figure 30 on previous page.	**Width** This menu item allows you to view and modify the width of the pulse that appears at the RF out-put 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** 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** 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 connector. 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: • Rising Edge • Falling Edge
	Continued next page

5.7 PM Menu Description, Continued

Table 51 PM Menus, Continued

Figure 31. PM Burst Mode Menu



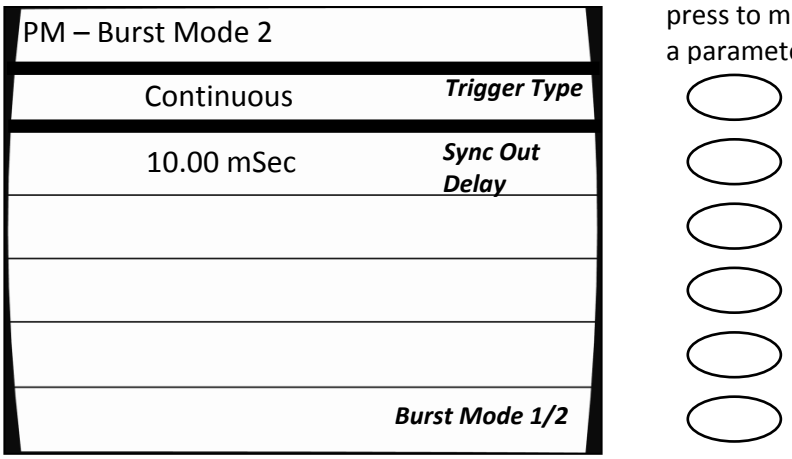
Submenu	Parameter
PM Burst Menu See Figure 31.	**PM** This menu item turns pulse modulation on and off. Pressing the adjacent softkey or the Step Up or Step Down buttons toggles the PM state. The PM indicator appears in the upper right-hand corner of the display when pulse modulation is turned on. **PRI** The pulse repetition interval (PRI) of the instrument's internal pulse modulating signal. The PRI parameter sets the duration between similar edges of the modulating signal, and thus, the pulse repetition interval of the individual pulses within the pulse burst RF output. Range is 200 ns to 1 s. Each pulse in the pulse burst will have the same PRI. Note that the PRI must be equal or greater than the pulse width plus 20 ns. **Width** The width of each pulse in a burst. Range is 10 ns to 10 ms. Each pulse in the pulse burst will have the same pulse width. **Num of Pulses per Burst** Number of pulses in a burst. Range is 1 to 300. **Burst Period** The duration of a burst, or the repetition interval of the pulse burst. Range is 200 ns to 10 s. Note that the burst period must be equal or greater than the PRI times the number of pulse in the pulse burst. **Burst Mode 2/2** Pressing this softkey displays the second menu screen.

Continued next page

5.7 PM Menu Description, Continued

Table 52 PM Menus, Continued

Figure 32. PM Burst Mode Menu 2



Submenu	Parameter
PM Burst Menu 2 See Figure 32.	**Trigger Type** You can choose from three different trigger types by using the softkey, or the Step Up or Step Down keys. The three trigger types are: • Continuous • Triggered: This selection has two parameters: o Trigger Polarity: Can select a rising edge or falling edge as the trigger using the softkey or Step Up/Step Down keys o RF Pulse Delay: Use the rotary knob, Step Up/Step Down keys, or the numeric keypad to adjust the amount of delay before the start of the pulse burst. Limits: ≥ 100 ns to 1 s. • Gated; This selection has a single parameter; o Trigger In: Can be set to Active High or Active Low using the rotary knob, Step Up/Step Down keys, or adjacent softkey. **Sync Out Delay** Sets the amount of delay for the signal at the PM SYNC OUT connector on the rear of the 2400C (see Figure 6 on page 19).

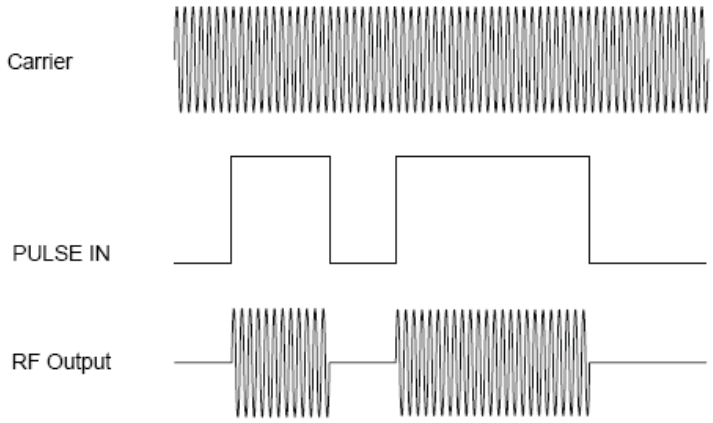
5.8 Generate an External Pulse-Modulated Signal

This procedure describes how to set up the 2400C to generate a signal that is pulse modulated by an external 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 33 shows an example of this with the input polarity of the PULSE IN/PM TRIG IN signal set to active high.

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

Figure 33. Pulse Modulation Using an External Modulation Source



In this procedure, a PM signal is generated with the following characteristics:

- Carrier frequency = 2.00 GHz
- Carrier power = 1.00 dBm
- External modulating signal pulse width = 1 ms
- External modulating signal pulse repetition interval (PRI) = 2 ms
-

Equipment and Materials

- External PM modulation source (see specifications in Table 80 page 99)
- Cables and connectors for connecting the PM modulation source to the 2400C
- Cables and connectors for connecting device to be tested to the 2400C RF Output

Continued next page

5.8 Generate an External Pulse-Modulated Signal, Continued

Table 53 Generate an Externally Pulse-Modulated Signal	
Step	**Action**
1.	Perform steps 1 through 10 of the procedure 3.2 Generate a CW Signal on page 26 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 of the instrument, and set it for the desired modulating characteristics.
3.	Press [ ] to display the PM Main menu, then press [Softkey] PM Ext Menu.
4.	Select [Softkey] PM, and use △ ▽ or press [Softkey] PM again to set PM to On (as indicated on the display).
5.	Select [Softkey] Input Polarity, and choose the appropriate polarity setting using △ ▽. ***NOTE:*** • With an Active High setting, a TTL high level at the PULSE IN/PM TRIG IN connector turns on the carrier at the RF output. • With an Active Low setting, a TTL high level at the PULSE IN/PM TRIG IN connector turns off the carrier at the RF output.
6.	***If you want to delay the signal at the PM SYNC OUT connector on the rear of the 2400C:*** Select [Softkey] Sync Out Delay, and enter the desired sync pulse delay setting using the numeric keypad, △ ▽, or ◎. ***Limits of delay:*** ≥ 50 ns; ≤ 10 ms
7.	If the RF ON indicator is not lit, press the RF ON button to enable the RF output (see Figure 3 on page 11). ***NOTE:*** When the RF output is enabled, the RF ON indicator is blue.
8.	Verify that the Unleveled indicator is not illuminated. ***NOTE:*** 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.
End of Procedure	

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Chapter 6. Special Modes

The 2400C has special modes that accommodate a wide variety of test configurations. These modes are:

- Cable Correction; Creates a power level correction versus frequency table to change the power output of the 2400C. The cable correction table is created based on a power measurement procedure performed prior to normal testing. If the normal test setup is changed, the power measurement procedure must be performed again in order to re-create the cable correction table.
  See page 70.

- External ALC; Uses a constant feedback loop to measure the power level externally, typically at the DUT. If the power level at the DUT changes. External ALC allows automatic adjustment of the RF power output of the 2400C to maintain a constant, known power level at the DUT.
  See page 74.

- External frequency reference: Uses an external 10 MHz or 100 MHz source as the frequency reference for the 2400C.
  See page 77.

6.1 Use Cable Correction

Cable Correction allows you to adjust the output power of the 2400C to compensate for losses created by connecting devices such as RF cables, connectors and other RF devices. The maximum correction is less than 10 dB, and depends on the absolute power output level. The power correction cannot exceed the maximum or minimum power output within a given setting of the step attenuator.

This function creates a user correction table of 1001 points for the frequency range of the unit. The power output for frequencies between the correction points is determined using a linear algorithm for the first frequency points above and below the selected frequency.

NOTE: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

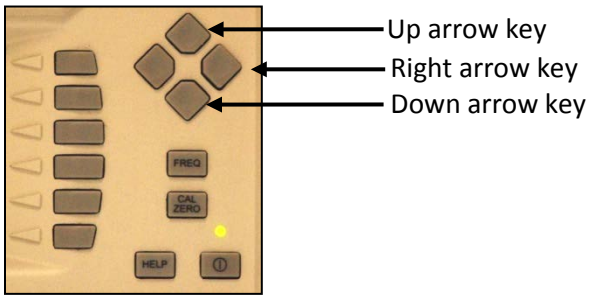
Required Equipment

- Model 2400C series Microwave Signal Generator with firmware version 4.09 or higher
- Giga-tronics 8560A series Universal Power Meter
- Giga-tronics 803XXA series CW Power Sensor, or other sensor appropriate to the frequency range and signal type to be calibrated, with power sensor cable.
- BNC Male to Male Coaxial Cable
- RS-232 Null Modem Cable, Male to Male, DB9

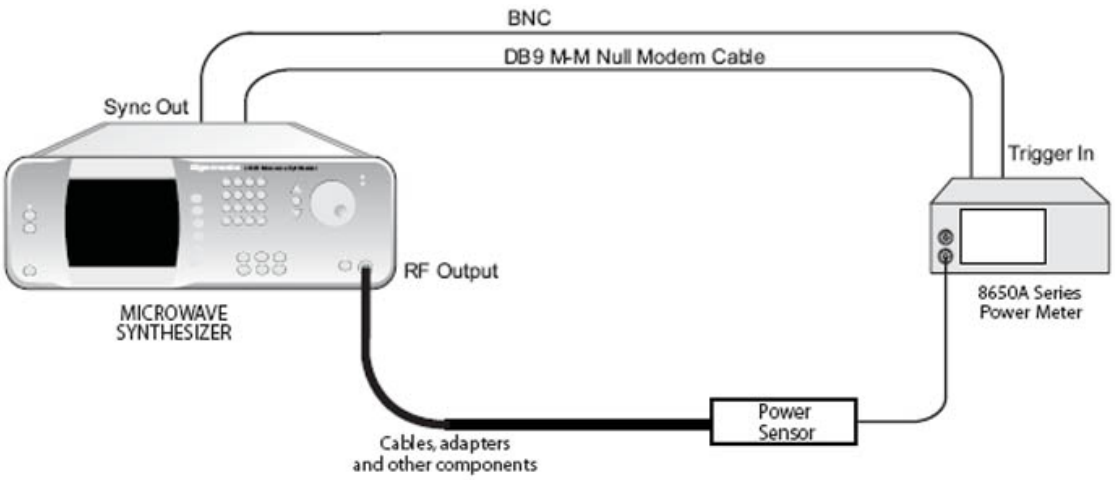
Continued next page

6.1 Use Cable Correction, Continued

Table 54 Use Cable Correction

Step	Action
Configure the 8650A series Universal Power Meter	
1.	On the front of the 8650A, select the following: 1. Softkey Meter Setup 2. Softkey Config
2.	On the front of the 8650A, press the right arrow key to select RS-232; see Figure 34. **Figure 34. 8650A series Universal Power Meter; Front Panel Controls** 
3.	Select Softkey Config.
4.	On the 8650A, set the RS-232 parameters as shown below. Use the Up/Down Arrow keys to change the values of the parameters (see Figure 34). • Baud Rate; 38400 • Data Bits; 8 • Parity; None • Stop Bits; 1
5.	Press Softkey OK twice to return to the power meter main menu.
	Continued next page

6.1 Use Cable Correction, Continued

Table 55 Use Cable Correction, Continued	
Step	**Action**
Setup the Equipment	
6.	Refer to Figure 35 for the following steps. **Figure 35. Cable Correction Setup** 
7.	Connect the null modem cable between the RS-232 ports on the rear of the 2400C and 8650A.
8.	Connect the BNC cable to these two points: • SYNC OUT connector on the rear of the 2400C • Gate/Trig Input on the rear of the 8650A
9.	Connect the power sensor into the RF path to be characterized. Connect the sensor to be as close as possible to the point where you need the most control over the power level.
10.	On the front of the 2400C, press System.
11.	Select Softkey Cable Cal Menu.
	Continued on next page

6.1 Use Cable Correction, Continued

Table 56 Use Cable Correction, Continued	
Step	**Action**
12.	Select Softkey Device Name, and select the Giga-tronics 8650A using △ ▽ or ◎.
13.	Select Softkey Interface.
14.	Press Softkey Cable Cal to begin the swept frequency characterization.
15.	After the frequency sweep is completed, a cable correction table will be generated and automatically applied to the output of the 2400C. The first line in the Cable Cal menu will change to Cable Cal Stored. The cable calibration will apply to the output of the 2400C until the **Clear Cable Cal** button in the Cable Cal menu is pressed.
End of Procedure	

6.2 Use External ALC

One application of this procedure would be a test setup where cables and fixtures connecting to the DUT incur significant losses, and you want to deliver a precise, known power level to the DUT under dynamic conditions.

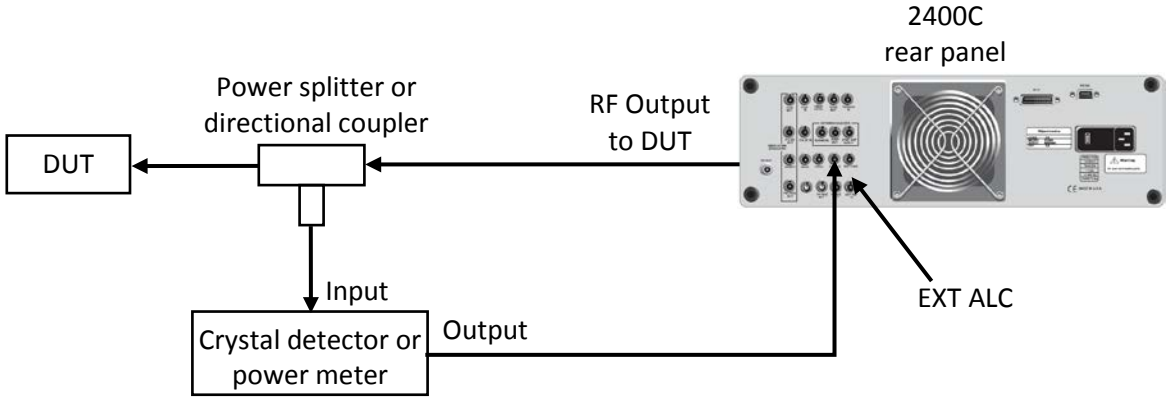
With External Automatic Level Control (ALC), the power level close to the DUT is sampled by a power meter or crystal detector, and the sample is used to generate a signal that is connected to the 2400C. This signal is used to automatically adjust the RF output power of the 2400C to compensate for the power lost in the cables and fixture. See Figure 36 below.

NOTE: The example procedures in this section use specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

This section describes two methods for using External ALC:

- ***Use External ALC with a crystal (diode) detector***; see Table 57 on page 75.
- ***Use External ALC with a Power meter***; see Table 58 on page 76.

Figure 36. Setup for External ALC



Note the following about using external ALC:

- ALC can be used in CW, Ramp, and Pulse modes only.
- The output of the 2400C is typically sampled through a directional coupler or power splitter. The signal is measured using a positive or negative crystal (diode) 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 crystal detector output with a power reference standard.

Continued next page

6.2 Use External ALC, Continued

Table 57 External ALC Using a Crystal (Diode) Detector	
Step	**Action**
1.	Connect the RF output of the 2400C to a power splitter or directional coupler that is placed as close to the DUT as possible. See Figure 36 on the previous page.
2.	Connect the input of the crystal detector to the appropriate port of the power splitter or directional coupler.
3.	Connect the output of the crystal detector to the EXT ALC connector on the rear panel using an appropriate cable.
4.	Press [ ], then press [Softkey] System Menu.
5.	Select [Softkey] ALC Leveling.
6.	Use [Softkey] ALC Leveling or △ ▽ to select Positive Diode or Negative Diode. The choice depends on the type of detector used.
7.	Press [CW].
8.	Select [Softkey] Frequency, and enter the desired CW frequency using the keypad, △ ▽, or ⊙.
9.	Select [ ] Power and enter the output level using the keypad, △ ▽, or ⊙. ***NOTE:*** When entering a new level setting using the keypad, use the dBm or dB Units buttons. Units are assumed to be in dBV.
10.	If the RF ON indicator is not lit, press the RF ON button to enable the RF output. The RF ON indicator is illuminated blue when the RF Output is enabled.
End of Procedure	

6.2 Use External ALC, Continued

Table 58 External ALC Using a Power Meter	
Step	**Action**
1.	Connect the sensor of the power meter to the appropriate port of the power splitter or directional coupler. See Figure 36 on page 74.
2.	Connect the Analog Out output of the power meter to the EXT ALC connector on the rear panel of the 2400C.
3.	Adjust the Analog Out range of the power meter from 0.0005 to 2 Volts.
4.	Press , then select Softkey System Menu.
5.	Select Softkey ALC Leveling.
6.	Select the Power Meter setting using △ ▽ or by repeatedly pressing Softkey ALC Leveling.
7.	Press System .
8.	Select Frequency, and enter the desired CW frequency using the numeric keypad, △ ▽, or ◎.
9.	Select Level and enter the desired output level using the numeric keypad, △ ▽, or ◎. ***NOTE:*** 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) for a 50 Ohm system.
10.	If the RF ON indicator is not lit, press the RF ON button to enable the RF Output. When the RF Output is enabled, the RF ON indicator is illuminated blue.
End of Procedure	

6.3 Use the External Reference Input

Internally, the 2400C generates a 100 MHz reference signal for the instrument. This reference signal is normally phase-locked to a high-stability internal 10 MHz signal.

However, if an external 10 MHz or 100 MHz signal is connected to the rear EXT REF IN connector, the internal 100 MHz reference signal phase-locks to this external signal. When an external signal is connected to the EXT REF IN connector, the instrument detects and automatically routes it through the instrument.

Required Equipment

- External signal reference (see **Error! Reference source not found.** on page 93 for reference specifications)
- Cables and connectors to connect the equipment

NOTE 1: The example procedure in this section uses specific parameters to illustrate how to setup the 2400C. You can use this procedure for real-life situations by simply changing the parameters to fit your needs.

NOTE 2: If the external reference has excessive noise or drift, this will degrade the performance of the 2400C.

The procedure below describes how to use the EXT REF IN connector on the rear of the 2400C.

Table 59 Use an External Frequency Reference

Step	Action
1.	Verify that the RF output is NOT energized by checking the RF on/off indicator on the front of the 2400C (see Figure 3 on page 11). If the indicator is lit, press the RF ON button to de-energize the RF output.
2.	Energize the external frequency reference and let it warm up according to the manufacturer's recommendations. ***NOTE 4:*** Observe Notes 1 and 2 above regarding the integrity and specifications of the reference signal.
3.	On the rear of the 2400C, locate the EXT REF IN connector (see Figure 6 on page 19).
4.	Connect the external frequency reference to the EXT REF IN connector on the rear of the 2400C. ***NOTE:*** The Ext Ref indicator on the front panel (see Figure 3 on page 11) illuminates when an energized, appropriate external frequency reference is connected to the EXT REF IN connector.
5.	Proceed to use the 2400C as you normally would.
End of Procedure	

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Chapter 7. System Menus

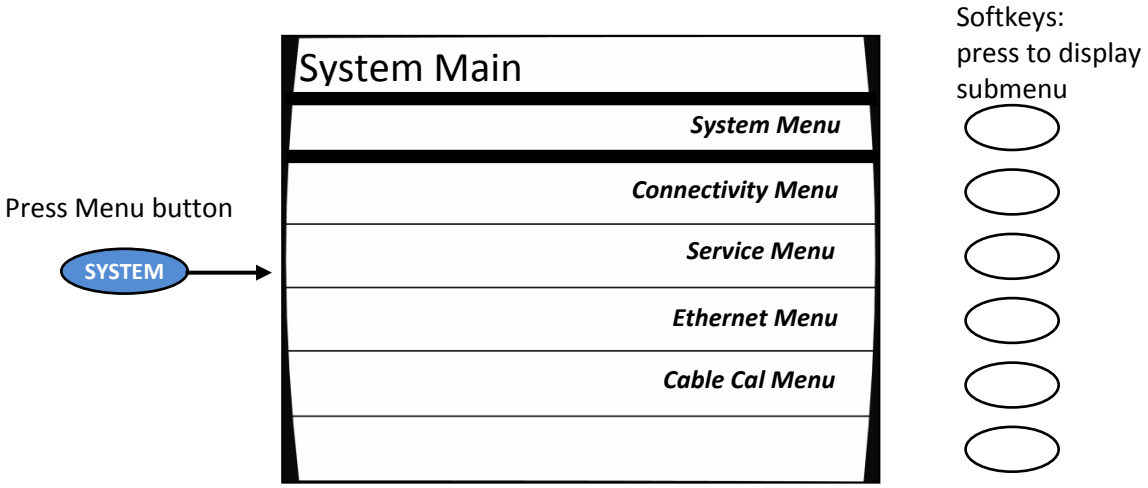
7.1 System Menus Description

The System menus gives you 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.

Pressing the System menu button opens the main System menu, which consists of four submenus as shown in Figure 37. Any submenu can be opened by pressing the softkey next to the submenu's name. All parameters shown in the System menus can be modified once selected by their adjacent softkey.

Table 60 on the next page describes the menu items of the System menus.

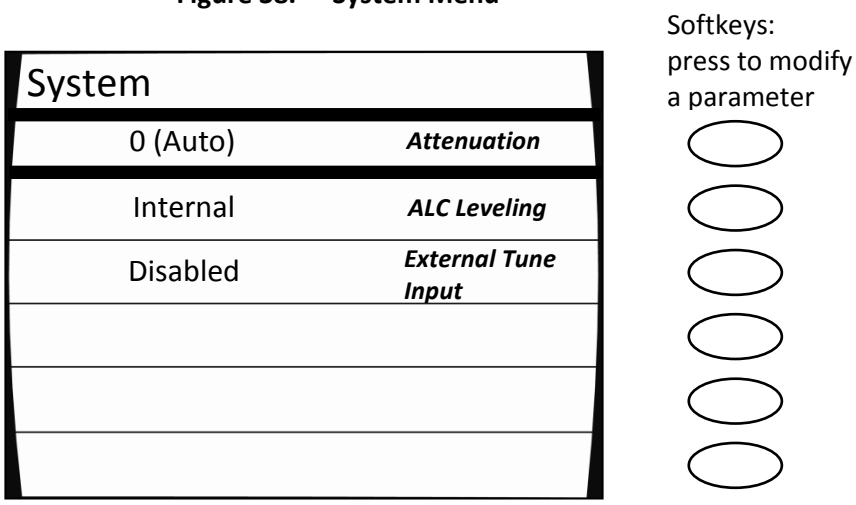
Figure 37. System Main Menu and Sub Menus



7.1 System Menu Description, Continued

Table 60 System Menus

Figure 38. System Menu



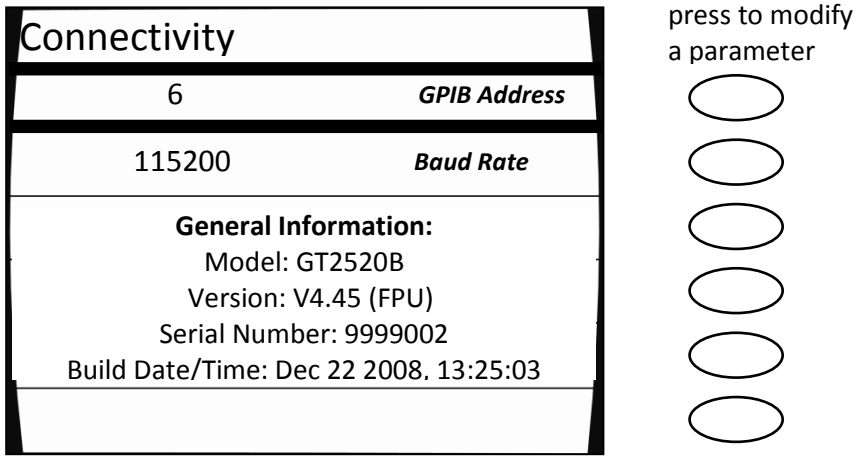
Submenu	Action or Parameter
System Menu (see Figure 38)	**Attenuation** Provides control of the step attenuator option if it is installed in the instrument. • The step attenuator can insert up to 90 dBm of attenuation into the RF output path of the instrument. • It is switchable in 10 dB steps • Can 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. ***For more information on attenuators:*** See the specifications for the mechanical and electronic attenuators in section 0 starting on page 91. **ALC Leveling** This menu item allows you to set the instrument's ALC input. The ALC input settings are; • Internal • Positive Detector • Negative Detector • Power Meter. External ALC enables the instrument to compensate for device transmission losses without user intervention. **External Tune Input** This function allows you to tune the output frequency of the 2400C over a range of approximately 20 ppm using an analog tuning voltage of 0 to +10 Volts applied to the Ref Tune input on the rear panel. Pressing this softkey enables and disables this feature.

Continued next page

7.1 System Menu Description, Continued

Table 61 System Menus, Continued

Figure 39. Connectivity Menu



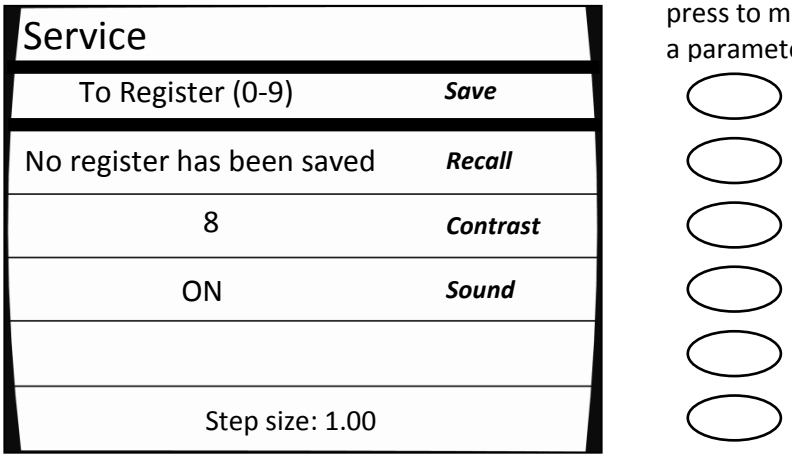
Connectivity Menu (see Figure 39)	**GPIB Address** Allows you to set the instrument's General-Purpose Interface Bus (GPIB) address. The GPIB address range is 1 to 30. **Baud Rate** Sets the data transfer rate over the RS-232 port on the rear panel of the 2400C. This menu item lets you can select from the following rates : • 1200 • 2400 • 4800 • 9600 • 19200 • 38400 • 115200

Continued next page

7.1 System Menu Description, Continued

Table 62 System Menus, Continued

Figure 40. Service Menu



Submenu	Action or Parameter
Service Menu (see Figure 40)	**Save** Allows you to save the current state of the instrument to non-volatile memory, so that the saved state can subsequently be restored. The 2400C contains ten registers, numbered 0 through 9, in 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; 1. Select the Save menu item 2. Use the numeric keypad to enter the number of the register into which you wish to save the configuration (the step up/step down buttons and rotary knob cannot be used for this). 3. Press any Units button.

Continued next page

7.1 System Menu Description, Continued

Table 63 System Menus, Continued

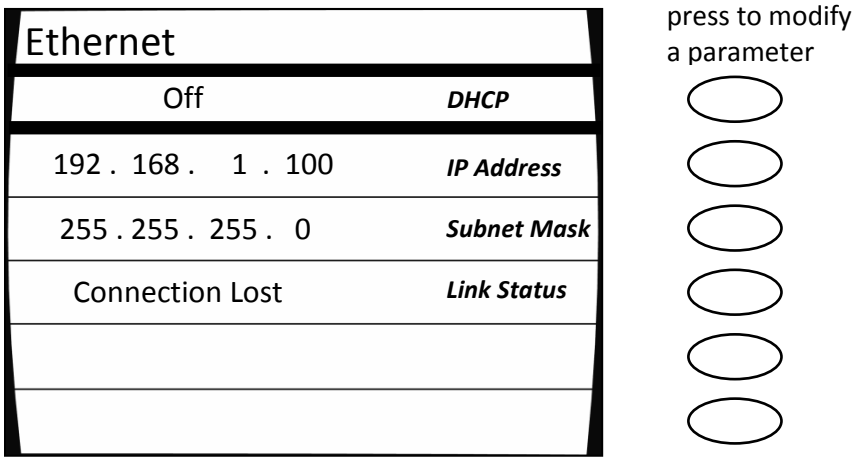
Submenu	Action or Parameter
Service Menu, Continued (see Figure 40 on previous page)	**Recall** This menu item allows you to recall a previously saved instrument state from any of the ten storage registers contained in the instrument's non-volatile memory. The parameter area in the display shows the 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, and 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.

Continued next page

7.1 System Menu Description, Continued

Table 64 System Menus, Continued

Figure 41. Ethernet Menu



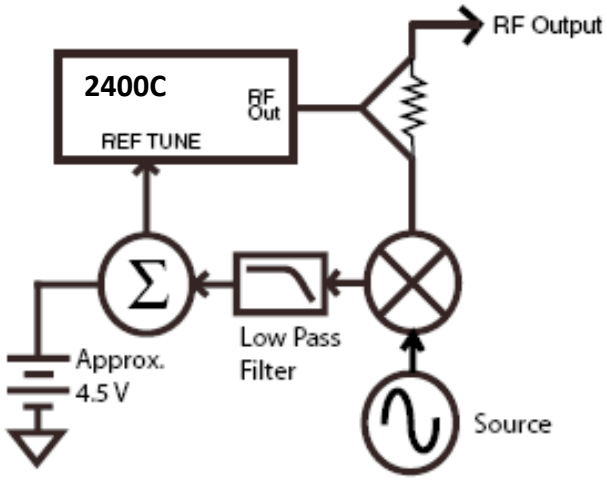
Submenu	Action or Parameter
Ethernet Menu See Figure 41.	The Ethernet Menu allows you to set up the 2400C for remote operations using the LAN connection. Settable menu items: **DCHP** Allows you to configure the 2400C Dynamic Host Configuration Protocol to be set manually or allow a DHCP server to obtain the IP and Subnet Mask. When the DHCP is set to Off, the previously stored static IP address will be displayed. **IP Address** Allows you to set the instrument's IP (Internet Protocol) address. The range for each of the sections is 0 to 255. **Subnet Mask** Allows you to set the instrument's Subnet Mask. The range for each of the sections is 0 to 255. **Link Status** Indicates whether the 2400C Ethernet connection is established or disconnected.

7.2 Use the Ref Tune Function

Why use this procedure: Use this function when you want to phase-lock the output frequency of the 2400C to a stable, external source of 0 to +10 Vdc. See Figure 42 below.

The Reference Tune (Ref Tune) function allows you to adjust the output frequency of the 2400C over a range of approximately 20 ppm when the phase-lock loop with external source applies a 0 to +10 V control voltage to the REF TUNE input on the rear panel.

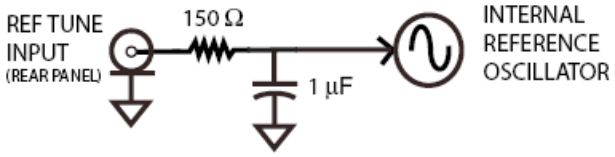
Figure 42. Reference Tune Setup



Note the following about the Ref Tune function:

- It is expected that the unlock (UNLK) message will appear in the upper right-side of the display when the Ref Tune function is enabled. The 2400C is “unlocked”. The user must determine the appropriate parameters necessary to lock the 2400C to the external frequency source.
- The tuning voltage must not exceed +15 Volts and must not go more negative than -1 Volt.
- The instrument's phase noise performance may be degraded when Ref Tune is enabled.
- The Ref Tune input is a high impedance input and has a 3 dB bandwidth at approximately 1 kHz which is set by a pole consisting of 150 Ω and 1 uF as shown in the Figure 43.

Figure 43. 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 2 ppm/Volt but should be carefully characterized for the specific DC voltage range being applied. A nominal tuning voltage of 4.5 Volts corresponds to the instrument's nominal frequency setting.

7.2 Use the Ref Tune Function, Continued

Table 65 Use the Ref Tune Feature	
Step	**Action**
1.	Connect a cable with a BNC connector between the REF TUNE connector on the rear panel of the 2400C and the controlling source.
2.	On the 2400C front panel, press System.
3.	Select Softkey System Menu. External Tune Input will appear as one of the softkeys.
4.	Enable and disable the Reference Tune input by: • Toggling External Tune Input • Pressing △ ▽.
End of Procedure	

Chapter 8. Language Menus

There are three Language menus that allow you to choose the language to be used by the instrument during remote operation.

NOTE: Complete information for remotely programming the 2400C via a host computer is available in the 2400C Programming Manual, Part Number 34783.

Displaying the Language Menus

- ***In Local mode*** (front panel operation), access the Language menus at any time by pressing the LOCAL button.

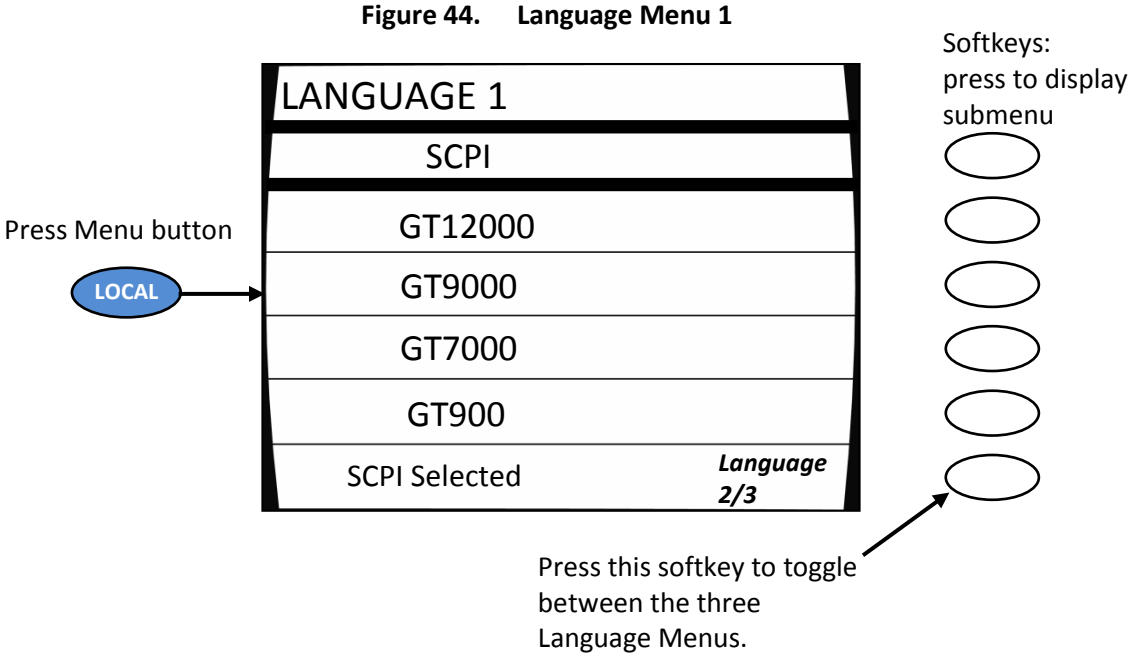
NOTE: Pressing the LOCAL button when the instrument is in the remote operating mode returns it to local operating mode.

- You can leave the Language menus at any time by pressing any of the Menu buttons on the front panel, or by going in to Remote mode.
- You can navigate between the three Language menus by pressing the bottom softkey on the front panel. See Figure 44.

8.1 Language Menu Description

Figure 44 shows Language Menu 1. The following pages describe the settable items in the three Language menus.

Figure 44. Language Menu 1



Continued next page

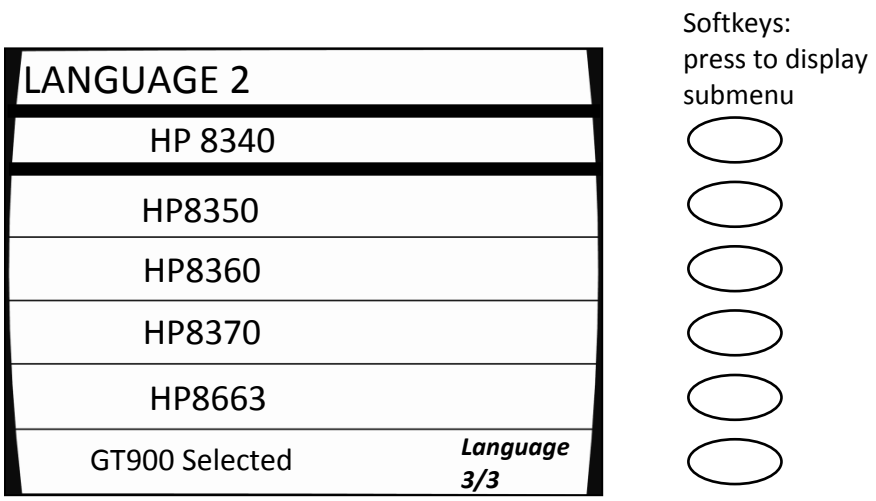
8.1 Language Menu Description, Continued

Table 66 Language Menus	
Menu	**Parameter**
Press LOCAL on the front panel of the 2400C to display: **Language Menu 1** See Figure 44 on the previous page.	Language Menu 1 and Language Menu 2 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 is used by the instrument corresponds to the Language menu item that is currently selected. Settable items in Language Menu 1 are: **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 2/3** Pressing this softkey invokes Language Menu 2 in the display. Language Menu 2 is described on the next page.
	Continued next page

8.1 Language Menu Description, Continued

Table 67 Language Menus, Continued

Figure 45. Language Menu 2



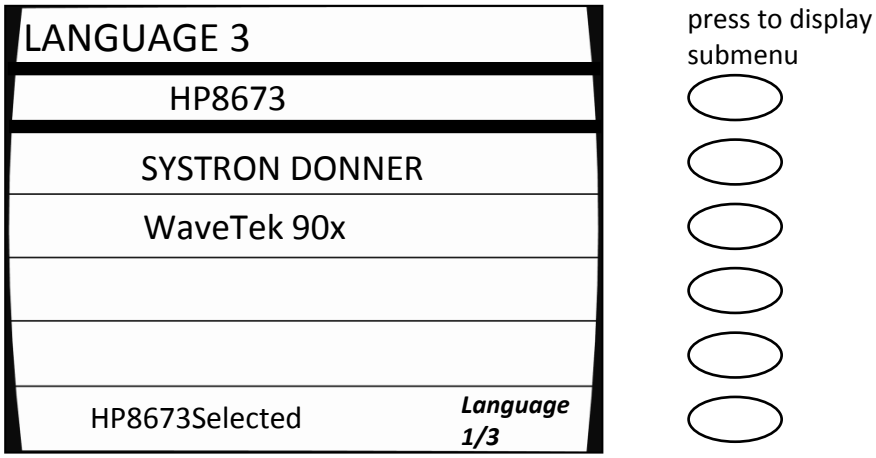
Menu	Parameter
Press softkey *Language 2/3* to display: **Language Menu 2** See Figure 45.	**HP8340** This menu item allows you to select HP 8340 command emulation as the language to be used by the instrument during remote operations. The HP8340 language option must be installed in order to access this 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 3/3** Pressing this softkey displays Language Menu 3. Language Menu 3 is described on the next page.

Continued next page

8.1 Language Menu Description, Continued

Table 68 Language Menus, Continued

Figure 46. Language Menu 3



Menu	Parameter
Press softkey *Language 3/*3 to display: **Language Menu 3** See Figure 46.	Language Menu 3 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. Settable items in this menu are: **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.

Chapter 9. Performance Verification

This section is comprised of two sub-sections:

- Specifications; contains the operating specifications of the 2400C
- Verification; contains the procedures for verifying that the 2400C is operating within its design specifications

9.1 Specifications

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

Table 69 General Specifications

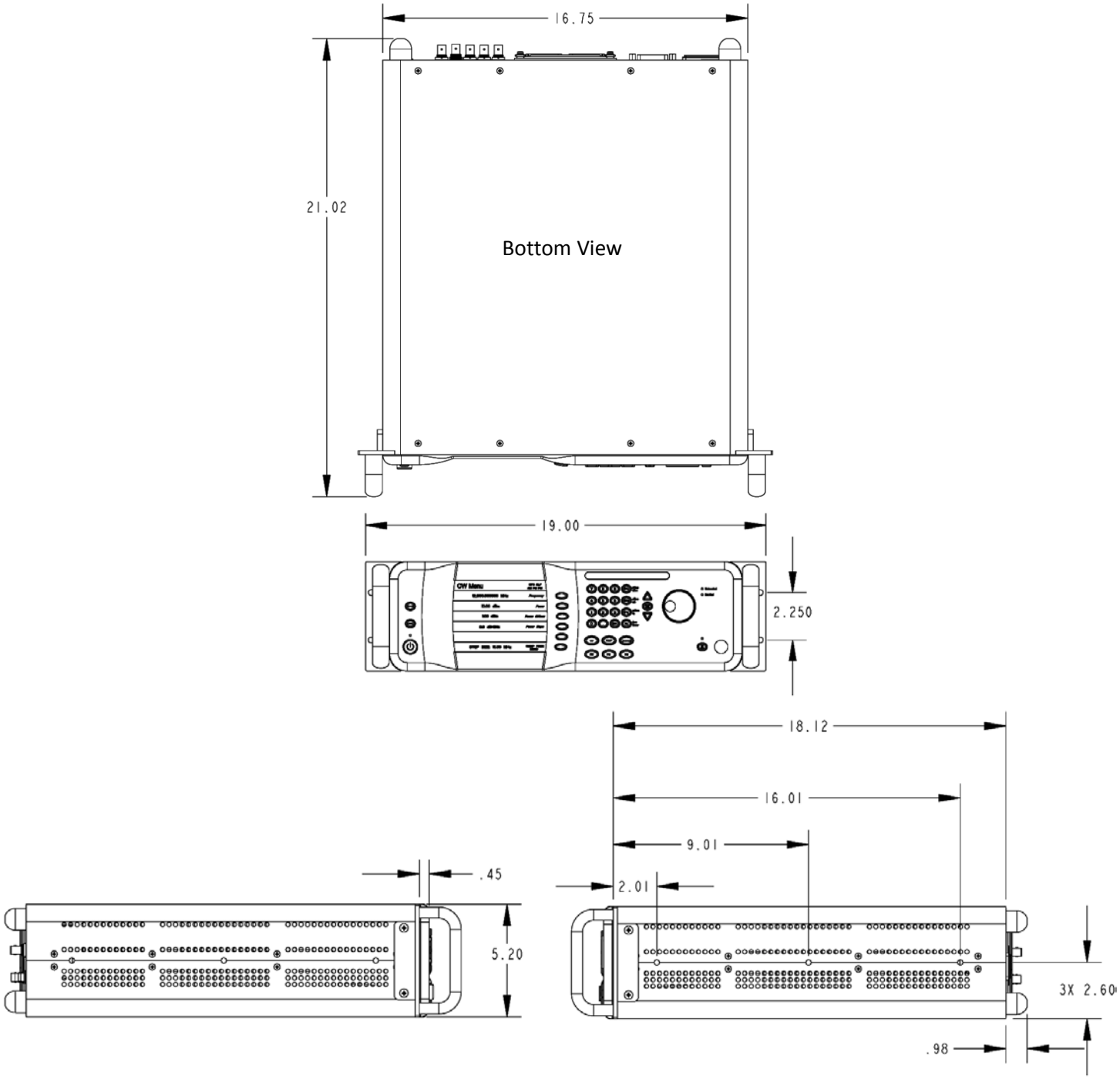
Parameter	Specification
Operating Temperature	0 °C to 55 °C
Environmental	Conforms to MIL-PRF-28800F, Class 3
Safety	EN61010
Emissions	EN61326
Approvals	CE Marked
Power	90 to 253 VAC, 47 to 440 Hz, 300 watts typical, 350 watts max
Fuse Rating	3 A Slow-Blow (SB)
Width[1, 2]	16.75 inches (425.5 mm)
Depth[1]	21 inches (533.4 mm)
Height[1]	3U (5.25 inches, 133.4 mm)
Weight	Less than 35 lbs. (15.9 kg)

[1] See the next page for drawings with dimensions of the 2400C.

[2] Width with rack handles = 19 inches (482.6 mm)

9.1 Specifications, Continued

Figure 47. 2400C Mechanical Specifications



NOTE: These drawings show the 2400C with the rack-mounting hardware installed.

9.1 Specifications, Continued

Table 70 2400C Series Model Frequency Ranges[1]		
Model Number	**Frequency Range**	**RF Output Connector**
2408C	2 GHz to 8 GHz	Type-N (F)
2420C	2 GHz to 20 GHz	SMA (F)
2426C	2 GHz to 26.5 GHz	SMA (F)
2440C	2 GHz to 40 GHz	2.92 mm (F)
[1] Option 18 extends the frequency range down to 10 MHz.		

Table 71 Frequency Specifications		
Parameter	**Specification**	
Frequency Accuracy	Same as time base	
Frequency Resolution	0.001 Hz	
Power Slope	Adjustable up to 0.5 dB/GHz	
Internal Reference Output	10 MHz	TTL level into 50 Ω
	100 MHz	> +5 dBm into 50 Ω
Aging Rate[1]	< 5 x 10^{-10}/day	
Temperature Stability[2]	< ± 2.5 x 10^{-8}	
External Reference Frequency Input	Frequency	10 MHz or 100 MHz
	Frequency Deviation	± 1 ppm
	Recommended Input Level	> -5 dBm into 50 Ω for 10 MHz
		> +5 dBm to < +8 dBm into 50 Ω for 100 MHz
Reference Tuning	Voltage Range	0 to 10V
	Sensitivity	2 ppm/V nominal
Lock/Level Indicator (CW Mode Only)	Sync Out = +5 V (TTL High)	
[1] After 30 days [2] Temperature stability over operating range of 0°C to +55°C after 30 days		

9.1 Specifications, Continued

Table 72 Frequency Bands		
Band	**Frequency**	**N (band index)**
1	≥ 10 to ≤ 15.625 MHz	512
2	> 15.625 to ≤ 31 MHz	256
3	> 31 to ≤ 63 MHz	128
4	> 63 to ≤ 125 MHz	64
5	> 125 to ≤ 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 ≤ 8 GHz	1
11	> 8 to ≤ 16 GHz	1/2
12	> 16 to ≤ 32 GHz	1/4
13	> 32 to ≤ 40 GHz	1/8

9.1 Specifications, Continued

Table 73 Spectral Purity		
Harmonics	Maximum leveled output power or +6 dBm, whichever is lower. Specification for harmonics above instrument frequency range are typical.	
	10 MHz to 2 GHz	-50 dBc
	> 2 GHz to 20.2GHz	-50 dBc
	> 20.2 GHz to 40 GHz	-50 dBc
Sub-Harmonics	Maximum leveled output power or +6 dBm, whichever is lower. Specification for Sub-harmonics above instrument frequency range are typical	
	10 MHz to 2 GHz	-80 dBc
	> 2 GHz to 20.2GHz	-50 dBc
	> 20.2 GHz to 40 GHz	-50 dBc
Spurious	Specification is for offsets > 300 Hz. Specification is -45 dBc + 20 log(1/N) dBc typical for offsets < 300 Hz	
	10 MHz to 8 GHz	-56 dBc, -58 dBc nominal
	> 8 to 16 GHz	-50 dBc, -52 dBc nominal
	> 16 to 32 GHz	-44 dBc, -46 dBc nominal
	> 32 to 40 GHz	-38 dBc, -40 dBc nominal
Residual FM (typical)	50 Hz to 15 kHz Bandwidth	
	10 MHz to 16 GHz	< 40 Hz
	> 16 to 32 GHz	< 80 Hz
	> 32 to 40 GHz	< 120 Hz
AM Noise (typical)	Offset > 5 MHz at maximum leveled power	
	10 MHz to 2 GHz	-130 dBm/Hz
	> 2 to 20.2 GHz	-145 dBm/Hz
	> 20.2 to 40 GHz	-132 dBm/Hz

9.1 Specifications, Continued

Table 74 Single Side Band (SSB) Phase Noise						
Carrier Frequency (GHz)	**Offset from Carrier (dBc/Hz)**					
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
1.0	-65	-88	-111	-101	-108	-147
4.0	-52	-82	-94	-89	-94	-140
10.0	-51	-74	-88	-84	-88	-125
20.0	-45	-68	-85	-84	-89	-113
30.0	-45	-64	-81	-80	-85	-123

Table 75 Maximum Leveled Power in dBm[1]					
Model	**Frequency Range (in GHz)**				
	0.01 to 2	2 to 8	8 to 20	20 to 26.5	26.5 to 40
2408C	14 (13)	14 (13)	N/A	N/A	N/A
2420C	14 (13)	14 (13)	14 (12)	N/A	N/A
2426C	14 (13)	12 (11)	12 (10)	10 (8)	N/A
2440C	14 (13)	12 (11)	12 (10)	10 (8)	10 (7.5)
2408C with Opt 27	7	7	N/A	N/A	N/A
NOTE 1: Applies over 0 °C to 35 °C range, and degrades < 2 dB from to 35 °C to 55 °C ***NOTE 2:*** Number in ( ) is for units with mechanical step attenuator ***NOTE 3:*** Power Output 1 dB less for rear panel option up to 26.5 GHz, and 1.25 dB to 40 GHz					

9.1 Specifications, Continued

Table 76 Minimum Leveled Power in dBm[1]					
Model	**Frequency Range in GHz**				
	0.01 to 2	2 to 8	8 to 20	20 to 26.5	26.5 to 40
2408C	-10 (-100)	-10 (-100)	N/A	N/A	N/A
2420C	-10 (-100)	-10 (-100)	-17 (-100)	N/A	N/A
2426C	-10 (-100)	-10 (-100)	-17 (-100)	-10 (-100)	N/A
2440C	-10 (-100)	-10 (-100)	-17 (-100)	-10 (-100)	-10 (-100)
2408C with Option 27	(-120)	(-120)	N/A	N/A	N/A
NOTE 1: Applies over 0 °C to 35 °C range, and degrades < 2 dB from to 35 °C to 55 °C ***NOTE 2:*** Number in ( ) is for units with a mechanical step attenuator					

Table 77 RF Power Level Accuracy			
Frequency Range	**Power Range**		
	> +5 dBm	**+5 to > -10 dBm**	**-10 to -90 dBm[1]**
10 MHz to 20.0 GHz	± 0.85 dB	± 0.7 dB	± 1.2 dB
> 20.0 to 40.0 GHz	± 1.05 dB	± 0.9 dB	± 1.5 dB
10 MHz to 8 GHz with option 27	± 1.05 dB	± 0.9 dB	± 1.5 dB
[1] Specification does not apply without a step attenuator. Level accuracy at minimum-leveled power is typically less than ± 1.5 dB without a step attenuator.			

9.1 Specifications, Continued

Table 78 Frequency and Power Sweep, General Power Specifications	
Parameter	**Specification**
Ramp Frequency Sweep	Full Frequency Coverage
Frequency Sweep Modes	Start/Stop of Center/Span
Frequency Sweep Resolution	401, 801 or 1601 points
Option 43 Analog Sweep	Option 43 provides very high resolution sweep
Ramp Power Sweep	0 to 25 dB
Power Slope (CW Mode, List Mode)	0 to 0.5 dB/GHz
Ramp Output	0 to 10 V and 0.5 V/GHz (2408C, 2420C) or 0.25 V/GHz (2426C, 2440C)
Z-Axis Blanking	+5 V
Sweep Time	100 ms to 200 s
Markers	5 intensity markers and 5 amplitude markers
Power Offset (CW Mode)	0 to 10 dB
Power Resolution	0.05 dB
Temperature Stability	0.025 dB/°C
Output Source Match (ALC on)	< 2.0:1 to 40 GHz < 1.5:1 typical, 2 GHz to 20 GHz, +5 dBm to -10 dBm

9.1 Specifications, Continued

Table 79 Amplitude Modulation[1] (Specifications apply to frequencies above 10 MHz)		
Parameter	**Specification**	
Depth	0 to 90 % at 0 dBm	
Rate (3dB bandwidth, at a carrier level of 0 dBm)	DC to 100 kHz (depth = 50 %)	
Sensitivity	0 to 95 % /V selectable	
Accuracy	± 10 % of setting at 1 kHz rate	
Input	Range	± 1V
	Impedance	600 Ω
[1] Modulation peaks must be less than maximum available power.		

Table 80 Frequency Modulation[1] (Specifications apply to frequencies above 10 MHz)		
	Parameter	**Specification**
Low Rate	Modulation Index	Deviation Limited
	Rate (3 dB bandwidth)	DC to 750 kHz
	Peak Deviation	1.5 MHz/N
	Accuracy	± 5 % at 5 kHz rate with 1.0 V peak input, 12.024 kHz/V sensitivity
	Input Range	± 1V
	Input Impedance	50 Ω
High Rate	Modulation Index	< 25/N
	Rate (3 dB bandwidth)	750 kHz to 5 MHz
	Peak Deviation	15 MHz/N
	Accuracy	± 5 % at 1 MHz rate with 1.0 V peak input , 2.4048 MHz/V sensitivity
	Input Range	± 1V
	Input Impedance	50 Ω
[1] Settling time not specified with FM turned on		

9.1 Specifications, Continued

Table 81 Phase Modulation (Specifications apply to frequencies above 10 MHz)	
Parameter	**Specification**
Rate (3 dB Bandwidth)	100 Hz to 100 kHz
Peak Deviation	10 rad-pk/N
Accuracy	± 5 % at 1 kHz rate with 1.0 V peak input, 3.83 rad/Vpk sensitivity

Table 82 Pulse Modulation (Specifications apply to frequencies above 500 MHz)		
Parameter	**Specification**	
Standard Operating Modes	Internal, External	
On/Off Ratio	> 80 dB	
Rise/Fall Times	0.5 to 20 GHz	< 10 ns max, 3 ns typical
	20 to 40 GHz	< 25 ns max, 10 ns typical
Minimum Leveled Pulse Width	Internal / External	350 ns
Minimum Unleveled Pulse Width	Open-Loop Calibrated	25 ns
Level Accuracy[1]	Pulse Width > 350 ns	± 0.5 dB
	Pulse Width > 100 to 350 ns	+1.5 / -0.5 dB
	Pulse Width > 25 to 100 ns	+2.5 / -0.5 dB
PRF (50% Duty Cycle)	Leveled	< 3 MHz
	Open-Loop Calibrated	< 10 MHz
Pulse Fidelity	Video Feed Through	0.5 to 2 GHz: < 5 %
		2 to 40 GHz: < 1 %
	Compression	< ± 5 ns
	RF Delay	< 75 ns
Input	Sensitivity	TTL levels (polarity selectable)
[1] Duty Cycle must be > 0.01 %		

9.1 Specifications, Continued

Table 83 List Mode		
Parameter	**Specification**	
Number of List Points	4000	
Frequency Settling[1]	< 550 µsec for $\Delta F_0 \leq$ 500 MHz	
Amplitude Settling[2]	< 500 µs	
Digital Sweep	Trigger Modes	External, GPIB GET, Software
	Sweep Modes	Continuous, Single Step, Single Sweep
Step Time	Standard	150 µs to 1 s
	Option 31	2 ms to 1 s
Sync Out Delay[3]	50 µs to 10 ms	
[1] Time for frequency to settle within 50 kHz of final value after a frequency switch. [2] Time for amplitude to settle within 0.1 dB of final value after an amplitude switch. [3] Delay is specified from edge of trigger pulse.		

Table 84 External ALC	
Parameter	**Specification**
Polarity:	Positive or negative diode detector or positive power meter (selectable)
Input Impedance:	1 M Ω, typical
Power Meter Leveling Rate:	0.7 Hz, typical
CW Mode	
Range	-80 dBV (100 µV) to +6 dBV (2.0 V)
Accuracy	-40 dBV to +6 dBV within 1.5 %
	-60 dBV to -40 dBV within 2 %
	-80 dBV to -60 dBV within 5 %
Pulse Mode	
Range	-80 dBV (100 µV) to +6 dBV (2.0 V)
PM Width	5 µs, minimum
PRF	< 200 kHz
Accuracy	± 0.5 dB (typical) for pulse widths ≥ 5 µs

9.1 Specifications, Continued

Table 85 Internal Function Generator	
Parameter	**Specification**
AM Modulation Source	
Waveforms	Sine, Square, Triangle, Ramp, Gaussian Noise
Rate	0.01 Hz to 100 kHz for all waveforms
Resolution	0.01 Hz
Accuracy	Same as time base
AM output	2 Vp-p into 10k Ω load
Frequency and Phase Modulation Source	
Waveforms	Sine, Square, Triangle, Ramp
Rate	0.01 Hz to 1 MHz for all waveforms
Resolution	0.01 Hz
Accuracy	Same as time base
FM output	2 Vp-p into 10k Ω load
Pulse Modulation Source	
Modes	Continuous, Gated, Triggered, Pulse Burst (up to 300 pulses)
Pulse Width	10 ns to 10 ms
Pulse Repetition Interval[1]	0.2 µs to 1 sec
Sync. Out Delay	0 to 10 ms
Resolution	10 ns
Accuracy	± 2 % of setting or ± 15 ns, whichever is greater. ± 0.08 % nom.
PM output	2 Volts into 50 Ω
[1] Note that in the pulse burst mode, the pulse burst period range is 200 ns to 10 s. The burst period must be equal or greater than the PRI times the number of pulses, and the PRI must be equal or greater than the pulse width plus 20 ns.	

9.1 Specifications, Continued

Table 86 Remote Programming			
Hardware Interface	• IEEE 488.2 • RS-232 • USB 2.0 (full speed, not high speed) • Ethernet		
Software Interface	• SCPI • GT12000 • GT9000 • GT900 • GT7000 • GT6000 • Automation Xpress Interface (Standard)		
Execution Speed (IEEE 488.2)		AXI	SCPI
	CW Switching (typ)	2.5 ms	28 ms
	4000 Point List Download (typ)	20 sec	28 sec
Automation Xpress	20 MB Disk Space		
Remote Interface	GPIB (IEEE 488.2, 1987), RS-232, USB 2.0, Ethernet		

9.2 Performance Verification Procedures

This section contains procedures and information for verifying that the 2400C is operating within its specifications. The specifications for the 2400C start on page 91. Compare the results of the performance verification tests to the appropriate sections in the Specifications chapter to verify that the 2400C is operating within specifications.

Note the following about performance verification:

- Performance verification is recommended at least every two years, or more often when required to ensure proper operation of the instrument.
- Each piece of test equipment must be warmed up according to its specifications prior to testing.
- The minimum warm-up time before testing the 2400C is 30 minutes unless otherwise specified.
- The following procedures refer to the instrument under test as the 2400C. Unless otherwise noted, all of the procedures apply to all models of 2400C.

9.2.1 List of Performance Verification Procedures

Table 87 below is a list of the Performance Verification procedures in this section, with page numbers.

Table 87 List of Performance Verification Procedures

9.2.2 Data Sheets

Data sheets are included after each performance verification test. Record all test data on the data sheets.

9.2.3 Test Equipment

Table 88 below lists the required test equipment for all of the procedures in this chapter. Specific equipment required for each procedure is listed at the beginning of each procedure. An assortment of coaxial cables for interconnecting the equipment is needed as well.

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.

Table 88 Equipment for 2400C Performance Verification

Type of Equipment	Model
Oscilloscope	Tektronix TDS3052B (500 MHz) or Equivalent
Universal Power Meter	Giga-tronics Series 8650A or Equivalent The Power Meter must have a video bandwidth capability > 100 kHz
Power Sensors, CW and Peak Power	Giga-tronics 803XXA series CW Power Sensor and Peak Power Sensor or Equivalents, as appropriate for the frequency range of the 2400C under test. The Peak Power Sensor must have a video bandwidth > 100 kHz.
Microwave Spectrum Analyzer	Agilent 8564EC or Equivalent, as appropriate for the frequency range of the 2400C under test. The Microwave Spectrum Analyzer must have “zero span” capability.
Function Generator	Agilent 33220A with option 001, external frequency reference, or Equivalent
Digital Volt Meter (Digital Multi-Meter)	Agilent 3458A or Equivalent
Pulse Generator	Minimum requirements: • Pulse width = 5 ms • Pulse interval = 10 ms • Output = 5 V into 50 Ω
Crystal (Diode) Detector	Krytar Model 703S or Equivalent (< 10 ns rise time, output capacitance ≤ 3 pF, frequency range equal to frequency range of model of 2400C under test)
Cables, Connectors, and Adapters	As Required

9.2 Performance Verification Procedures

9.2.4 Frequency Range, Resolution, and Accuracy

In this test, the RF output of the 2400C is connected to the input of a spectrum analyzer, and the 2400C's output frequency is tested at various points within its frequency range. The internal timebase of the spectrum analyzer is used as a reference for the 2400C to eliminate timebase errors.

Equipment and Materials

- Microwave spectrum analyzer
- Cables and adapters for connecting the 2400C to the frequency counter
- Data Sheet Table 91 on page 107

Figure 48. Setup; Frequency Range, Resolution, and Accuracy

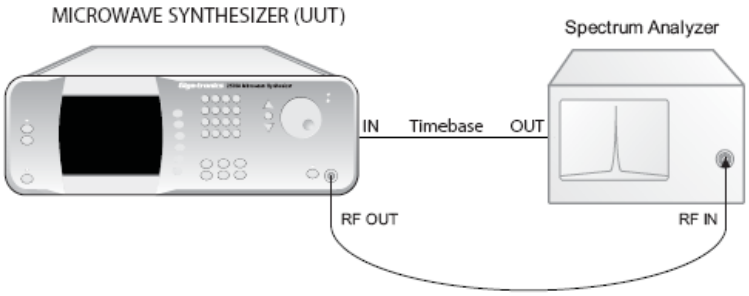


Table 89 Frequency Range, Resolution, and Accuracy	
Step	**Action**
1.	Connect the equipment as shown in Figure 48; • Connect the timebase output from the spectrum analyzer to the EXT REF IN connector on the rear of the 2400C. See Figure 6 on page 19 for the location of the connector and the electrical specifications of the external timebase. • Connect the 2400C RF Output to the low frequency input.
2.	Allow the equipment to warm up for at least 30 minutes.
3.	Set the 2400C to the lowest frequency applicable to the model 2400C you are testing (see Data Sheet 1 on page 107), and set the RF output level to 0 dBm.
4.	Press RF ON to activate the 2400C RF output. The RF on/off indicator illuminates blue when the RF output is active.
5.	Use the 2400C front panel controls to set the 2400C to each frequency listed in Data Sheet 1 that is within the range of the 2400C model you are testing. Record on the data sheet each frequency as displayed on the spectrum analyzer.
	Continued next page

9.2.4 Frequency Range, Resolution, and Accuracy, Continued

Table 90 Frequency Range, Resolution, and Accuracy, Continued	
Step	**Action**
6.	For each frequency listed in the remaining rows of the Datasheet, the counter should read the entered frequency ±1 Hz, plus or minus the counter resolution. For the specifications, refer to: • Table 70 on page 93 • Table 71 on page 93
End of Procedure	

NOTE: In Data Sheet 1 below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 91 Data Sheet: Frequency Range, Resolution, and Accuracy	
Test Frequency	**Measured Frequency**
100 MHz[1]	
200 MHz[1]	
400 MHz[1]	
750 MHz[1]	
1.5 GHz	
3 GHz	
7 GHz	
10 GHz	
15 GHz	
20 GHz	
26 GHz	
36 GHz	
40 GHz	
Model type of 2400C series (for example, 2440C):	
Serial number:	
Tested by:	Date:
[1] 2400C models with Option 18 are adjustable down to 10 MHz.	

9.2.5 Spectral Purity

In this test, the output of the 2400C 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.

Equipment and Materials

- Microwave spectrum analyzer
- Cables and adapters for connecting the 2400C to the spectrum analyzer
- Data Sheet Table 94 on page 110

Figure 49. Spectral Purity Test Setup

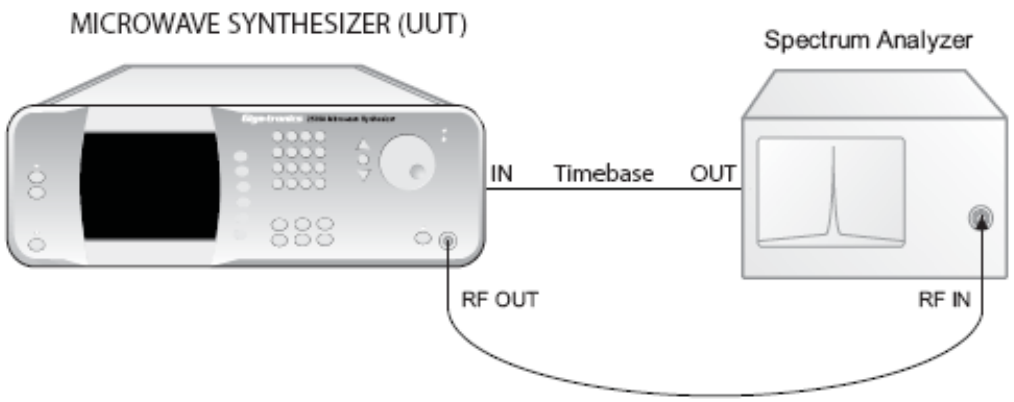


Table 92 Spectral Purity	
Step	**Action**
1.	Connect the equipment as shown in Figure 49; • Connect the timebase output from the spectrum analyzer to the EXT REF IN connector on the rear of the 2400C. See Figure 6 on page 19 for the location of the connector and the electrical specifications of the external timebase. • Connect the 2400C RF Output to the RF input using coaxial cabling and adapters as necessary.
2.	Allow the equipment to warm up for at least 30 minutes.
	Continued next page

9.2.5 Spectral Purity, Continued

Table 93 Spectral Purity	
Step	**Action**
3.	Set the 2400C to the lowest frequency that applies to the unit you are testing (see Data Sheet 2 on page 110), and set the RF amplitude to +10 dBm or maximum leveled output (whichever is lower). ***NOTE:*** The maximum leveled output is the 2400C output power just before the UNLEVELED indicator on the front panel lights.
4.	Press RF ON to turn on the RF output. The RF on/off indicator illuminates blue when the RF output is active.
5.	Set the spectrum analyzer to view the 2400C output signal. Adjust the analyzer reference level so that the peak of the displayed signal is at the top graticule line.
6.	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. Note the following; • Use appropriate resolution and video bandwidths to allow sufficient dynamic range. • Adjust the center frequency of the spectrum analyzer to the harmonic and sub-harmonic frequencies of the test frequency.
7.	Record the levels of the worst case harmonic, non-harmonic or spurious signals in the appropriate columns of the Datasheet.
8.	Repeat steps 5 through 7 for the other frequencies listed in the Datasheet that are within the operating range of the instrument. For frequencies that are outside the range of the model of 2400C you are testing, enter “N/A” in the Data Sheet.
9.	Compare the test results with the specifications shown in Table 73 on page 95.[1]
End of Procedure	
1 Read the spectrum analyzer phase noise performance specification to ensure that noise floor of analyzer does not limit analyzer range.	

Continued next page

9.2.5 Spectral Purity, Continued

Use the data sheet below to record the results of the spectral purity test. .

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 94 Data Sheet: Spectral Purity

Test Frequency	Measured Power Level		
	Harmonics	Sub-harmonics	Non-harmonics
100 MHz[1]			
200 MHz[1]			
400 MHz[1]			
750 MHz[1]			
1.5 GHz			
3 GHz			
7 GHz			
10 GHz			
15 GHz			
20 GHz			
26 GHz			
36 GHz			
40 GHz			
Model type of 2400C series (for example, 2440C):			
Serial number:			
Tested by:		Date:	
[1] 2400C models with Option 18 are adjustable down to 10 MHz.			

9.2.6 Maximum Leveled Power

This test measures the maximum power levels at different frequencies where the 2400C maintains power leveling.

NOTE: When measuring the flatness and accuracy of the 2400C, 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 linearity.

Equipment and Materials

- Universal Power Meter
- Power Sensors for the frequency ranges of the model 2400C under test
- Cables and adapters for connecting the test setup
- Data Sheet Table 96 on page 113

Figure 50. Power Specifications Test Setup

Continued next page

9.2.6 Maximum Leveled Power, Continued

Table 95 Maximum Leveled Power	
Step	**Action**
1.	Connect the equipment as shown in Figure 50 on the previous page.
2.	Allow the equipment to warm up for at least 30 minutes.
3.	Set the 2400C to the lowest frequency that applies to the 2400C you are testing in Datasheet 3, and press RF ON.
4.	Increase the output power of the 2400C until the UNLEVELED indicator lights.
5.	Reduce the output power setting until the UNLEVELED indicator turns off.
6.	Record the measured maximum leveled output power in the Datasheet for the test frequency.
7.	Repeat steps 3 through 6 for the remaining frequencies in the Datasheet that are within the operating range of the instrument.
8.	After entering all of the test results into the Datasheet, compare the results with the following to verify compliance of the 2400C: • Table 75 on page 96.
End of Procedure	

Continued next page

9.2.6 Maximum Leveled Power, Continued

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 96 Data Sheet: Maximum Leveled Power	
Test Frequency	**Measured Maximum Leveled Power (dBm)**
100 MHz[1]	
200 MHz[1]	
400 MHz[1]	
750 MHz[1]	
1.5 GHz	
3 GHz	
7 GHz	
10 GHz	
15 GHz	
20 GHz	
26 GHz	
36 GHz	
40 GHz	
Model type of 2400C series (for example, 2440C):	
Serial number:	
Tested by:	Date:
[1] 2400C models with Option 18 are adjustable down to 10 MHz.	

9.2.7 Level Accuracy

This test measures the accuracy of the power output of the 2400C at different frequencies.

NOTE: When measuring the flatness and accuracy of the 2400C, consider the various measurement uncertainties in the test system. These include, but are not limited to, VSWR, Cal Factor uncertainty, and linearity.

Equipment and Materials

- Universal Power Meter
- Power Sensors covering the frequency ranges of the model 2400C under test
- Cables and adapters for connecting the test setup
- Data Sheet Table 98 on page 115

Table 97 Level Accuracy

Step	Action
1.	Connect the equipment as shown in Figure 50 on page 111.
2.	Allow the equipment to warm up for at least 30 minutes.
3.	Set the output level of the 2400C to 0 dBm.
4.	Set the 2400C to the lowest frequency that applies to the unit you are testing in the Datasheet.
5.	Press RF ON, and record the measured output power in the “Level = 0dBm” column.
6.	Repeat steps 4 and 5 for the remaining test frequencies shown in the Datasheet that are within the operating range of the instrument.
7.	Set the output level of the 2400C to -9.99 dBm.
8.	Set the 2400C to the lowest frequency that applies to the unit you are testing in the Datasheet.
9.	Record the measured output power in the “Level = -9.99 dBm.....” column.
10.	Repeat steps 8 and 9 for the remaining test frequencies shown in the Datasheet that are within the operating range of the instrument.
11.	After entering all of the test results into the Datasheet, compare the results with the following to verify compliance of the 2400C: • Table 77 on page 97
End of Procedure	

Continued next page

9.2.7 Level Accuracy, Continued

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 98 Data Sheet: Level Accuracy

Test Frequency	Measured Output Power	
	Output set at 0 dB	Output set at -9.99 dB
100 MHz[1]		
200 MHz[1]		
400 MHz[1]		
750 MHz[1]		
1.5 GHz		
3 GHz		
7 GHz		
10 GHz		
15 GHz		
20 GHz		
26 GHz		
36 GHz		
40 GHz		
Model type of 2400C series (for example, 2440C):		
Serial number:		
Tested by:		Date:
[1] 2400C models with Option 18 are adjustable down to 10 MHz.		

9.3.8 Step Attenuator Level Accuracy

This procedure tests the accuracy of the RF power output of the 2400C when the step attenuator option is included.

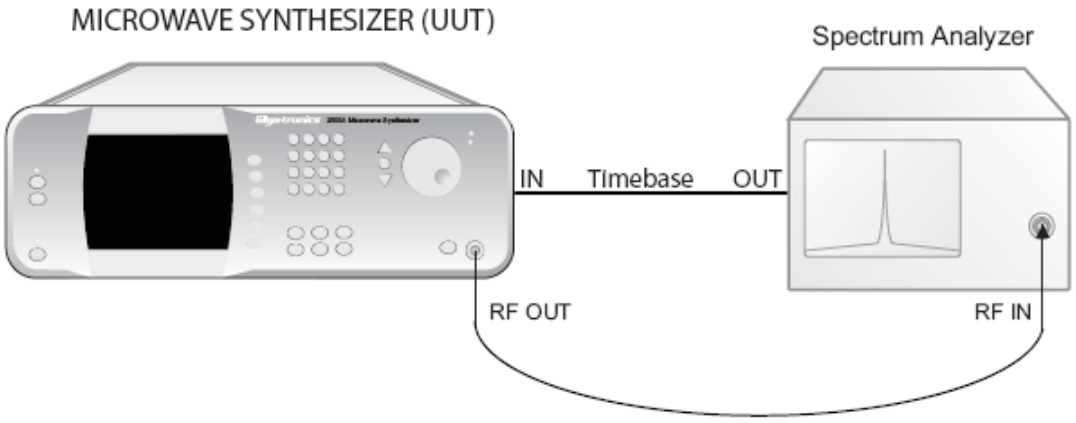
NOTE: When measuring the flatness and accuracy of the 2400C, consider the various measurement uncertainties in the test system. These include, but are not limited to, VSWR, cable loss, and linearity.

NOTE: Verify that the amplitude accuracy specification for the specific spectrum analyzer used has adequate performance capability for this test.

Equipment and Materials

- Microwave spectrum analyzer
- Cables and adapters for connecting the test setup
- Data Sheet Table 100 on page 118

Figure 51. Step Attenuator Level Accuracy Test Setup



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9.2.8 Step Attenuator Level Accuracy, Continued

Table 99 Step Attenuator Level Accuracy	
Step	**Action**
1.	Connect the equipment as shown in Figure 51 on the previous page.
2.	Allow the equipment to warm up for at least 30 minutes.
3.	Set the spectrum analyzer to the following settings: • Frequency: lowest output frequency the 2400C is capable of (see Table 100 on page 118) • Reference Level: 0 dBm • Span: 5 kHz • Sweep Time: AUTO • Resolution Bandwidth: 30 Hz • Video Bandwidth: 30 Hz
4.	Set the 2400C output power level to 0 dBm.
5.	Set the 2400C frequency to the lowest frequency the unit is capable of (see Table 100 on page 118), and press RF ON.
6.	Press the Peak Search button on the spectrum analyzer.
7.	Press the Step Size button on the 2400C and set the step size to 10 dB.
8.	Reduce the RF output level of the 2400C in 10 dB increments by pressing ▽ while observing the measurement on the spectrum analyzer.
9.	Record each level measured by the spectrum analyzer into the appropriate column of Datasheet 5 for the frequency being tested.
10.	Repeat steps 4 through 10 for the remaining test frequencies in the Datasheet, recording the measured levels in the appropriate columns of the Datasheet.
11.	After you have entered the test results onto the Datasheet, compare the results with the following to verify compliance of the 2400C: • Table 77 on page 97
End of Procedure	

Continued next page

9.2.8 Step Attenuator Level Accuracy, Continued

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 100 Data Sheet: Step Attenuator Level Accuracy

Test Frequency	Measured Output Power								
	-10 dB	-20 dB	-30 dB	-40 dB	-50 dB	-60 dB	-70 dB	-80 dB	-90 dB
100 MHz[1]									
200 MHz[1]									
400 MHz[1]									
750 MHz[1]									
1.5 GHz									
3 GHz									
7 GHz									
10 GHz									
15 GHz									
20 GHz									
26 GHz									
36 GHz									
40 GHz									
Model type of 2400C series (for example, 2440C):									
Serial number:									
Tested by:							Date:		
[1] 2400C models with Option 18 are adjustable down to 10 MHz.									

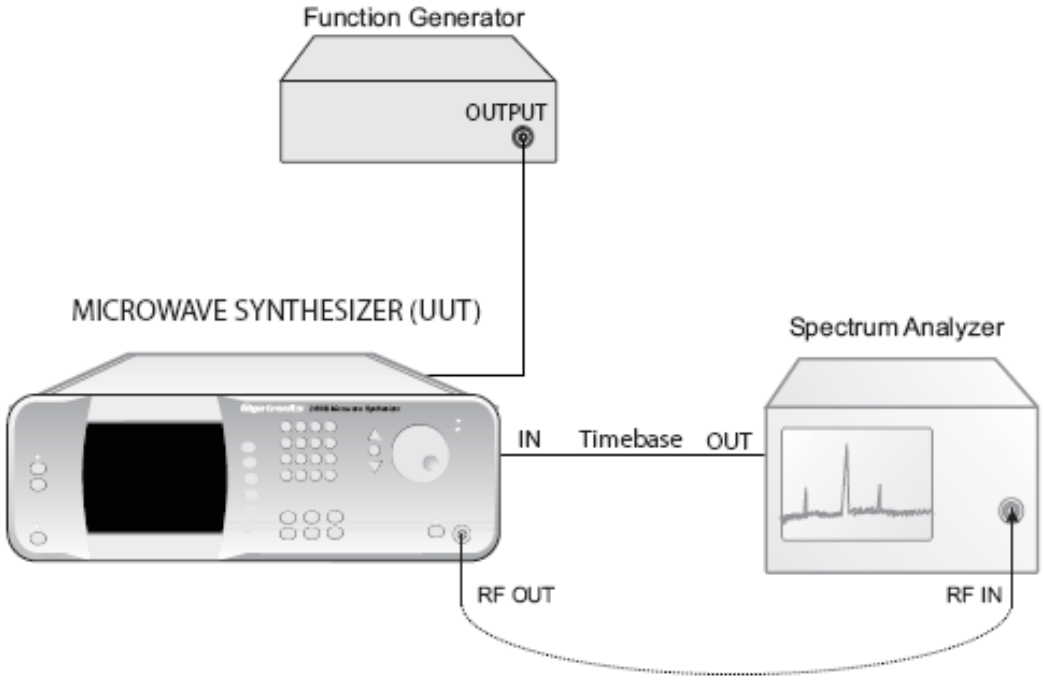
9.2.9 Amplitude Modulation Accuracy

The following procedure tests the amplitude modulation accuracy at frequencies within each band.

Equipment and Materials

- Microwave spectrum analyzer
- Function generator
- Digital Voltmeter
- Cables and adapters for connecting the test setup
- Data Sheet Table 103 on page 122

Figure 52. Amplitude Modulation Accuracy and Bandwidth Test Setup



NOTE: Set the output amplitude (into 50 Ohms) of the function generator accurately using a precision digital voltmeter.

NOTE: The external frequency reference (timebase) should be “Tee” connected from the 2400C to both the spectrum analyzer and the function generator.

Continued next page

9.2.9 Amplitude Modulation Accuracy, Continued

Table 101 Amplitude Modulation Accuracy	
Step	**Action**
1.	Connect the equipment as shown in Figure 52 on the previous page. • Connect the function generator output to the EXT AM IN connector on the rear of the 2400C. • Connect the spectrum analyzer timebase output to EXT REF IN on the rear of the 2400C.
2.	Allow the equipment to warm up for at least 30 minutes.
3.	Set the 2400C for the following settings: • External AM State: On • Sensitivity: 30 %/V • Level: 0 dBm • CW frequency: 10 MHz
4.	Set the spectrum analyzer to the following settings: • Reference Level: +5 dBm • Span: 5 kHz • Sweep time: AUTO • Resolution Bandwidth: 30 Hz • Video Bandwidth: 30 Hz
5.	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 Digital Volt Meter to ensure that its output is 2.00 Vp-p. This must be as exact as possible.
6.	Set the spectrum analyzer to the test frequency (output frequency of the 2400C). Center the signal using Peak Search and Marker to Center Frequency functions.
7.	Activate the Delta Marker function and press the Next Peak function or move the marker to the next peak.
	Continued next page

9.2.9 Amplitude Modulation Accuracy, Continued

Table 102 Amplitude Modulation Accuracy, Continued	
Step	**Action**
8.	Measure and record the AM Depth in the appropriate column in the Datasheet: • If this is the first time through the test, record the AM Depth in the "30 %/V" column. • If this is the second time through the test, record the AM Depth in the "50 %/V" column. • If this is the third time through the test, record the AM Depth in the "75 %/V" column.
9.	Measure the difference in dB of one sideband and the carrier. Use the following formula to determine the AM depth in percentage: AM 30 % = -16.5 dB AM 50 % = -12 dB AM 75 % = -8.5 dB The measurement should be with a 10 % range of the AM sensitivity setting.
10.	Deactivate the AM function of the 2400C, and repeat steps 6 through 9 for the remaining 2400C output test frequencies in the Datasheet, recording the AM depth for each in the appropriate column.
11.	Set the AM Sensitivity of the UUT to 50 % and repeat steps 8 through 9 for each of the test frequencies in the Datasheet, recording the AM depth for each measurement in the appropriate column.
12.	Set the AM Sensitivity of the UUT to 75 % and repeat steps 9 and 10 for each of the test frequencies in the Datasheet, recording the AM depth for each measurement in the appropriate column.
13.	After you have entered all of the test results onto the Datasheet, compare the test results with the following to verify compliance of the 2400C: • Table 79 on page 99
End of Procedure	

Continued next page

9.2.9 Amplitude Modulation Accuracy, Continued

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 103 Data Sheet: Amplitude Modulation Accuracy

Test Frequency	Sensitivity		
	30 %/V	50 %/V	75 %/V
10 MHz[1]			
100 MHz[1]			
200 MHz[1]			
400 MHz[1]			
750 MHz[1]			
1500 MHz			
3 GHz			
6 GHz			
12 GHz			
26 GHz			
36 GHz			
40 GHz			
Model type of 2400C series (for example, 2440C):			
Serial number:			
Tested by:		Date:	
[1] 2400C models with Option 18 are adjustable down to 10 MHz.			

9.2.10 Amplitude Modulation Bandwidth

This procedure tests the amplitude modulation bandwidth at frequencies within each band.

Equipment and Materials

- Microwave spectrum analyzer
- Oscilloscope
- Function generator
- Digital Voltmeter
- Cables and adapters for connecting the test setup
- Data Sheet Table 106 on page 125

Table 104 Amplitude Modulation Bandwidth

Step	Action
1.	Allow the equipment to warm up for at least 30 minutes.
2.	Connect the equipment as shown in Figure 52 on page 119. • Connect the function generator output to the EXT AM IN connector on the rear of the 2400C. • Connect the spectrum analyzer timebase output to EXT REF IN on the rear of the 2400C.
3.	Set the 2400C for the following settings: • Level: 0 dBm • Frequency: 10 MHz • AM Sensitivity: 30 %/V • External AM State: On
4.	Set the spectrum analyzer to the following settings: • Reference Level: 5 dBm • Span: 5 kHz • Sweep time: AUTO • Resolution Bandwidth: 30 Hz • Video Bandwidth: 30 Hz
5.	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 Digital Voltmeter to ensure that its output is 2.00 Vp-p. Setting the function generator amplitude exactly is required for this test. This must be repeated at each test frequency.
	Continued next page

9.2.10 Amplitude Modulation Bandwidth, Continued

Table 105 Amplitude Modulation Bandwidth, Continued	
Step	**Action**
6.	Set the spectrum analyzer to the output frequency of the 2400C. Center the signal using Peak Search and Marker to Center Frequency functions.
7.	Measure and record the difference, in dB, between the carrier amplitude and one sideband amplitude in the first column of the Datasheet.
8.	Vary the rate of the function generator within the specified rate range for the AM specification (see Table 79 on page 99). Identify the lowest sideband amplitude. Record the value in the second column of the Datasheet.
9.	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.
10.	Repeat steps 6 through 9 for the remaining test frequencies in the Datasheet.
11.	After you have entered all of the test results onto the Datasheet, compare the test results with the following to verify compliance of the 2400C: • Table 79 on page 99
End of Procedure	

Continued next page

9.2.10 Amplitude Modulation Bandwidth, Continued

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Table 106 Data Sheet: Amplitude Modulation Bandwidth

Test Frequency	Results		
	Carrier Amplitude	Sideband Amplitude	Δ (specification < 3 dB)
10 MHz[1]			
100 MHz[1]			
200 MHz[1]			
400 MHz[1]			
750 MHz[1]			
1.5 GHz			
3 GHz			
6 GHz			
10 GHz			
12 GHz			
26 GHz			
36 GHz			
40 GHz			
Model type of 2400C series (for example, 2440C):			
Serial number:			
Tested by:		Date:	
[1] 2400C models with Option 18 are adjustable down to 10 MHz.			

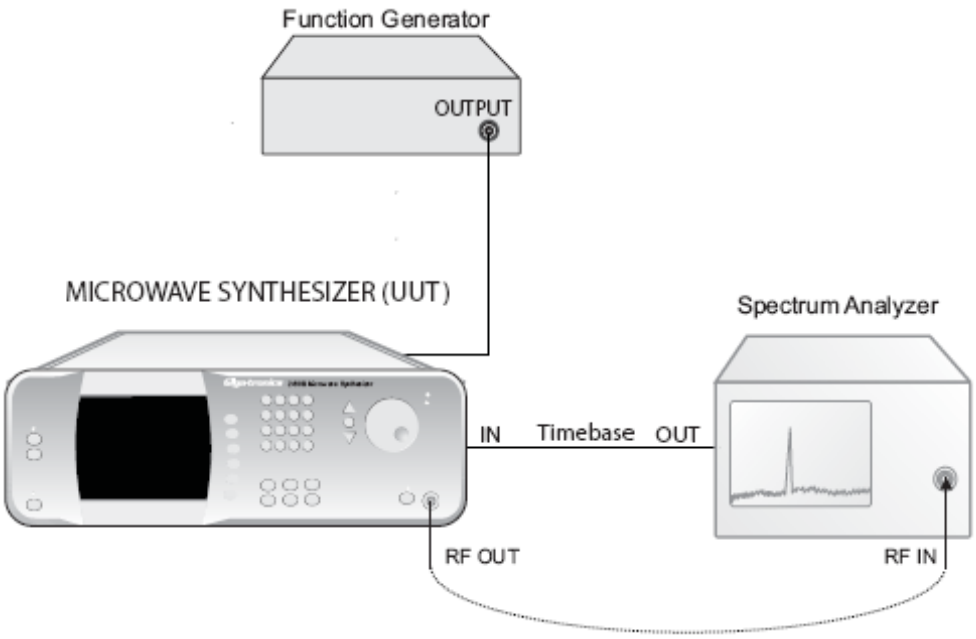
9.2.11 Frequency Modulation Accuracy — Low Rate

This procedure tests the frequency modulation accuracy of the 2400C in low rate.

Equipment and Materials

- Spectrum analyzer
- Function generator
- Digital Voltmeter
- Cables and adapters for connecting the test setup
- Data Sheet Table 108 on page 128

Figure 53. Frequency Modulation Accuracy and Deviation Bandwidth Test Setup



NOTE: Set the output amplitude (into 50 Ohms) of the function generator accurately using a precision digital voltmeter.

NOTE: The external frequency reference (timebase) should be “Tee” connected from the 2400C to both the spectrum analyzer and the function generator.

Continued next page

9.2.11 Frequency Modulation Accuracy — Low Rate, Continued

Table 107 FM Accuracy — Low Rate	
Step	**Action**
1.	Allow the equipment to warm up for at least 30 minutes.
2.	Connect the equipment as shown in Figure 53 on the previous page. • Connect the function generator to FM/ϕM IN on the rear of the 2400C • Connect the spectrum analyzer timebase output to EXT REF IN on the rear of the 2400C.
3.	Set the function generator to the following settings: • Waveform: Sine wave • Rate: 5 kHz • Output: 2 Vp-p into 50 Ω. This must be set as accurately as possible.
4.	Set the output level of the 2400C to 0 dBm, press RF ON, and set the external FM settings to the following: • FM State: Off • Sensitivity: 12.024 kHz/Volt
5.	Set the output of the 2400C to the first frequency in the Datasheet and adjust the spectrum analyzer frequency to match the test frequency. Adjust the reference level of the spectrum analyzer until the peak is on the top graticule of the display.
6.	Set the FM State to On.
7.	Adjust the rate of the function generator ± X kHz until the FM carrier is reduced at least 50 dB (Bessel Null) from the un-modulated signal reference on the spectrum analyzer.
8.	Using the following formula, determine the FM deviation error of the 2400C. Record the result in the Datasheet. Measured Deviation = 2.4048 * Rate (Function Generator Frequency) +5 %= 12.625 kHz, -5 % = 11.423 kHz
9.	Repeat steps 5 through 8 for the remaining frequency test points.
10.	After you have entered all of the test results onto the Datasheet, compare the test results with the following to verify compliance of the 2400C: • Table 80 on page 99
End of Procedure	

Continued next page

9.2.11 Frequency Modulation Accuracy — Low Rate, Continued

Table 108 Data Sheet: FM Accuracy — Low Rate			
Test Frequency (GHz)	**Results**		
	Rate	**Deviation**	**Pass/Fail +/- 5 %**
4.5			
5.0			
6.0			
7.0			
8.0			
9.0			
10.0			
Model type of 2400C series (for example, 2440C):			
Serial number:			
Tested by:		Date:	

9.2.12 Frequency Modulation Accuracy — High Rate

This procedure tests the frequency modulation accuracy of the 2400C for high-rate modulation.

Equipment and Materials

- Microwave Spectrum analyzer
- Function generator
- Cables and adapters for connecting the test setup
- Data Sheet Table 110 on page 130

Table 109 FM Accuracy — High Rate

Step	Action
1.	Allow the equipment to warm up for at least 30 minutes.
2.	Connect the equipment as shown in Figure 53 on page 126. • Connect the function generator to FM/ϕM IN on the rear of the 2400C. • Connect the spectrum analyzer timebase output to EXT REF IN on the rear of the 2400C.
3.	Set the function generator to the following settings: • Waveform: Sine wave • Rate: 830.055 kHz • Output: 2.00 Vp-p into 50 Ω. This must be set as accurately as possible.
4.	Set the output level of the 2400C to 0 dBm, press RF ON, and set the external FM settings of the 2400C to the following: • FM State: Off • Sensitivity: 15 MHz/Volt
5.	Set the output of the 2400C to the first frequency in datasheet 8 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 ± X kHz until the FM carrier is reduced at least 50 dB (Bessel Null) from the un-modulated signal reference on the spectrum analyzer.
8.	Using the following formula, determine the FM Deviation error of the 2400C. Record the result in the Datasheet. Measured Deviation = 18.0711 * Rate (Function Generator Frequency) +5 %= 15.75 MHz, -5 % = 14.25 MHz
9.	Repeat steps 5 through 8 for the remaining frequency test points.
10.	After you have entered all of the test results onto the Datasheet, compare the test results with the following to verify compliance of the 2400C: • Table 80 on page 99
End of Procedure	

9.2.12 Frequency Modulation Accuracy — High Rate, Continued

Table 110 Data Sheet: FM Accuracy — High Rate			
Test Frequency (GHz)	**Results**		
	Rate	**Deviation**	**Pass/Fail +/- 5%**
4.5			
5.0			
6.0			
7.0			
8.0			
9.0			
10.0			
Model type of 2400C series (for example, 2440C):			
Serial number:			
Tested by:		Date:	

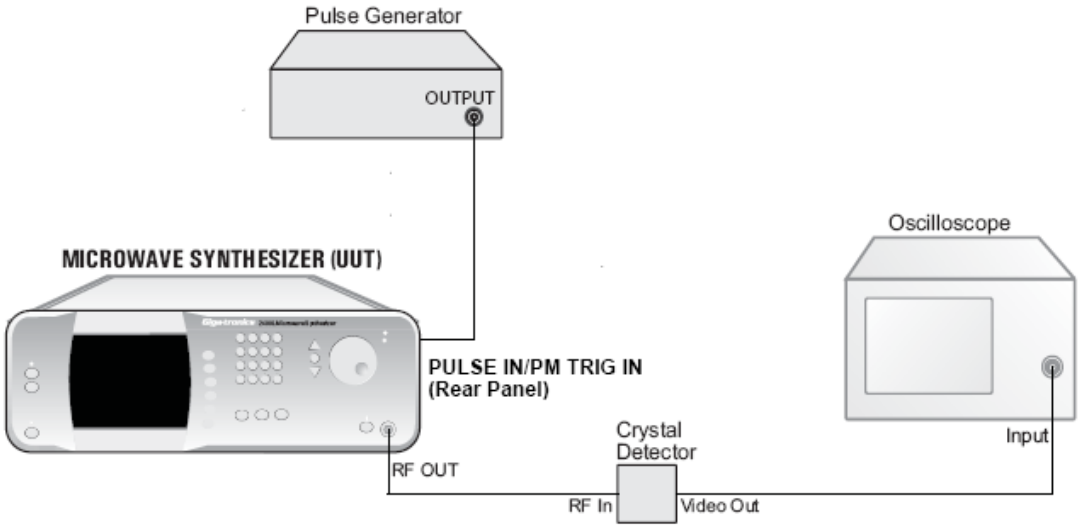
9.2.13 Pulse Modulation: Rise and Fall Time

This test measures the rise and fall times of pulse modulation.

Equipment and Materials

- Oscilloscope, > 500 MHz bandwidth recommended
- Pulse generator
- Crystal (diode) detector, < 10 ns rise time, ≤ 3 pF output capacitance, frequency range equal to or greater than the test frequency range
- Cables and adapters for connecting the test setup
- Data Sheet Table 112 on page 133

Figure 54. Pulse Modulation Rise and Fall Time Test



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9.2.13 Pulse Modulation: Rise and Fall Time, Continued

Table 111 Pulse Modulation: Rise and Fall Time	
Step	**Action**
1.	Allow the equipment to warm up for at least 30 minutes.
2.	Connect the equipment as shown in Figure 54 on the previous page.
3.	Set the pulse generator to the following settings: • Pulse Width: 5 µs • Pulse Interval: 10 µs • Output: > 2.4 Volts into 50 Ω
4.	Set the trigger of the oscilloscope according to the type of crystal detector being used (either positive or negative).
5.	Set the 2400C to the following settings: • Power Level: 0 dBm • External PM state: ON • Trigger Polarity: Active high • RF Output state: On
6.	Set the 2400C to the lowest frequency output for your model of 2400C shown in the Datasheet.
7.	Measure the rise and fall times on the oscilloscope, and record them in the appropriate columns of the Datasheet.
8.	Repeat Step 7 for each of the remaining test frequencies shown in the Datasheet.
9.	After you have entered all of the test results onto the Datasheet, compare the test results with the following to verify compliance of the 2400C: • Table 82 on page 100
End of Procedure	

Continued next page

9.2.13 Pulse Modulation: Rise and Fall Time, Continued

NOTE: In the Data Sheet below, test the 2400C only at the frequencies within the range of your specific model of 2400C. For frequencies not within your instrument's range, enter "N/A" in the test results column(s) of the data sheet.

Note: Rise Time and Fall Time are not guaranteed specifications. However, they may indicate issues with overall performance if significantly beyond nominal specification values.

Table 112 Data Sheet: Pulse Modulation Rise and Fall Time

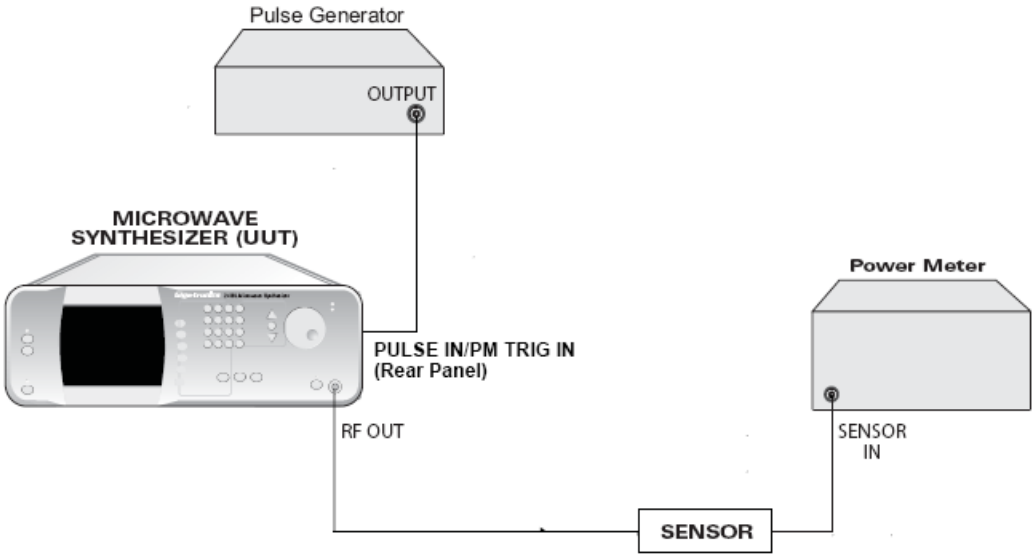
Test Frequency	Results					
	Rise Time	Fall Time	Level Accuracy			On/Off Ratio (dB)
			CW	Pulse	Delta	
750 MHz[1]						
1.5 GHz						
3 GHz						
6 GHz						
10 GHz						
12 GHz						
18 GHz						
26 GHz						
36 GHz						
40 GHz						
Model type of 2400C series (for example, 2440C):						
Serial number:						
Tested by:				Date:		
[1] 2400C models with Option 18 are adjustable down to 10 MHz.						

9.2.14 Pulse Modulation: Pulse Power Level Accuracy

Equipment and Materials

- Pulse generator
- Universal Power meter
- Peak power sensor, video bandwidth > 100 kHz
- Cables and adapters for connecting the test setup
- Data Sheet Table 112 on page 133

Figure 55. Pulse Modulation Level Accuracy Test Setup



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9.2.14 Pulse Modulation: Pulse Level Accuracy, Continued

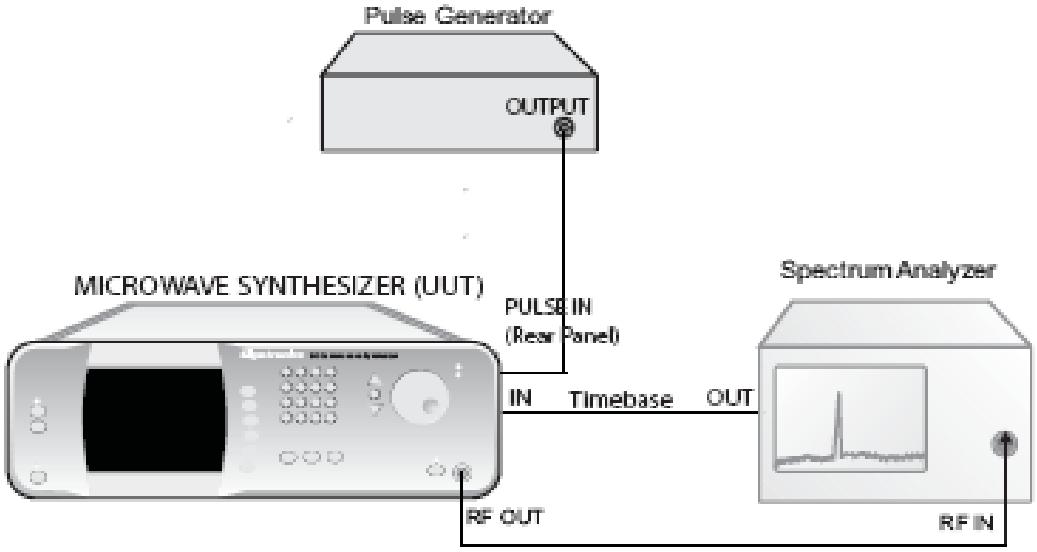
Table 113 Pulse Modulation: Pulse Level Accuracy	
Step	**Action**
1.	Allow the equipment to warm up for at least 30 minutes.
2.	Connect the equipment as shown in Figure 55 on the previous page.
3.	Set the pulse generator to the following settings: • Pulse Width: 5 µs • Pulse Interval: 10 µs • Output: > 2.4 Volts into 50 Ω
4.	Set the 2400C to the following settings: • Power Level: 0 dBm • External PM state: Off • Trigger Polarity: Active high • RF Output: On
5.	Set the power meter's sensor mode to "CW".
6.	Measure and record the CW level for each of the frequencies listed in Datasheet Table 112 on page 133 in the "Level Accuracy - CW" column.
7.	Set the External PM state of the 2400C to On.
8.	Set the power meter's sensor mode to "Peak," and adjust the sample delay to 500 ns.
9.	Measure and record the peak level for each of the frequencies listed in the Datasheet in the "Level Accuracy - Pulse" column.
10.	Compare the CW levels to the peak (Pulse) levels in the Datasheet, and record the difference in the "Level Accuracy - Delta" column.
11.	After you have entered all of the test results onto the Datasheet, compare the test results with the following to verify compliance of the 2400C: • Table 82 on page 100
End of Procedure	

9.2.15 Pulse Modulation: Pulse On/Off Ratio

Equipment and Materials

- Pulse generator
- Microwave spectrum analyzer
- Cables and adapters for connecting the test setup
- Data Sheet Table 112 on page 133

Figure 56. Pulse Modulation On/Off Ratio Test Setup



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9.2.15 Pulse Modulation: On/Off Ratio, Continued

Table 114 Pulse Modulation: On/Off Ratio	
Step	**Action**
1.	Allow the equipment to warm up for at least 30 minutes.
2.	Connect the equipment as shown in Figure 56 on the previous page.
3.	Set the pulse generator to the following settings: • Pulse Width: 5 ms • Pulse Interval: 10 ms • Output: > 2.4 Volts into 50 Ω
4.	Set the 2400C to the following settings: • Power Level: 0 dBm • External PM state: On • Trigger Polarity: Active high • RF Output state: On
5.	Set the 2400C to the lowest frequency in Datasheet Table 112 on page 133 that the unit is capable of.
6.	Set the spectrum analyzer to the following settings: • Frequency: Same as the frequency set at the UUT • Span: 0 Hz (Zero Span mode) • Sweep Rate: 20 ms • Vertical Scale: 10 dB/div • Resolution Bandwidth: 3 kHz • Video Bandwidth: 3 kHz • Video Averaging: 10 • Trigger type: Video, adjust until triggered at 50 % of the rising/falling edge
7.	Adjust the spectrum analyzer reference level so that the peak level of the pulse is at the top of the display.
8.	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 the Datasheet .
9.	Repeat steps 6 through 8 for the remaining frequencies in Datasheet Table 112 on page 133.
10.	After you have entered all of the test results onto Datasheet 8, compare the test results with the following to verify compliance of the 2400C: • Table 82 on page 100
End of Procedure	

Appendix A. Accessories and Options

List of Accessories and Options

Giga-tronics offers many add-on options and accessories for extending the capabilities and enhancing the performance of the base model 2400C. These options and accessories are an economical way to maximize the flexibility and range of the 2400C. All accessories and options available for the 2400C are described in this section.

The label on the rear of the 2400C lists the accessories and options that were provided with the instrument at the factory.

A 2400C without any options can generate a CW signal only, without any modulation.

Table 115 2400C Add-on Accessories and Options

Accessory/Option Number	Description
A011	Ruggedized carrying case
EWS20	Add 3-year warranty (2-year extended warranty)
EWS40	Add 5-year warranty (4-year extended warranty)
17A	Add Internal and External Modulation Suite
17B	Add External Modulation Suite
18	Add 10 MHz to 2 GHz Frequency Range Extension
22	Add Rear Panel RF Output Connector
23	Add Type-N RF connector (2420C only)
26A	Add 90 dB Mechanical Step Attenuator, for 2408C and 2420C
26B	Add 90 dB Step Attenuator, for 2426C
26C	Add 90 dB Step Attenuator, for 2440C
27	Add 110 dB Electronic Step Attenuator, for 2408C

Continued next page

List of Accessories and Options, Continued

Table 116 2400C Add-on Accessories and Options, Continued	
Accessory/Option Number	**Description**
31	Add: • Switching speed > 2 ms • Pulse width > 100 ns
43	Add Analog Sweep. Provides very fine resolution sweep.
44	Replace standard front panel with blank front panel (requires option #22)
46	Add Rack Slide Kit
55X – described below	Add emulation command set
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

Appendix B. Error Messages

This appendix lists error and other messages that might be encountered during operation of the instrument. In some cases, you can correct the errors; 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.

B1 Start-up Error Messages

If there are 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 occur. The message that is displayed has the following format:

Error code: *xxxxxxxxxxxxxxxxxxxx*

Startup Failure, see manual

xxxxxxxxxxxxxxxxxxxx is a 20-digit binary number representing the errors. The right most digit corresponds to Error #1 in Table 117 on the next page, and the left most 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 in Table 117 (on the next page) have been detected.

1 TIMEBASE_SET_ERROR

2 NVRAM_BATT_FAIL

3 CPU_FPGA_LOAD_FAIL

Continued next page

B1 Start-up Error Messages, Continued

Table 117 Start-up Error Messages	
Error Number	**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*

B2 NV RAM 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.

B2.1 NV RAM 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.

B2.2 NV RAM Reset Due to Battery Failure

The 2400C circuitry contains a battery to maintain the contents of NVRAM when the instrument is not connected to a 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.

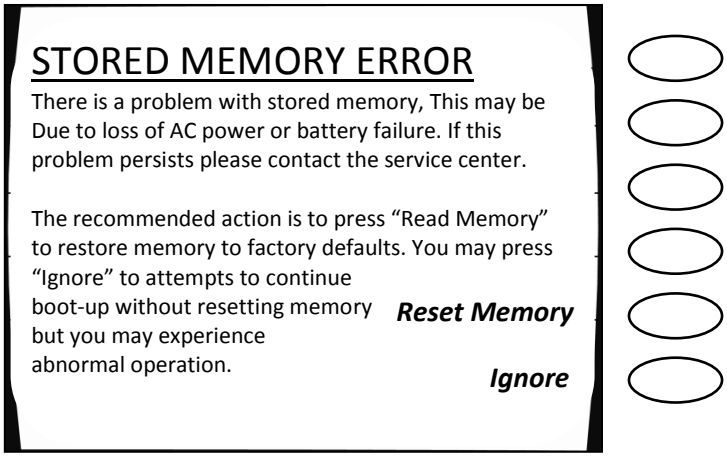
B2.3 NV RAM Reset Due to a Checksum Failure

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 57 might appear:

Figure 57. Checksum Test Failure Screen



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B2 NV RAM Messages, Continued

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.

B3 Remote Error Messages

Commands including SCPI, GPIB, or register commands issued to 2400C 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 2400C will queue the errors to an internal event buffer. When using the GPIB interface, a 2400C 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 2400C for the error condition. A user can also query the 2400C using the ERR? query (GT12000 language mode) or SYStem:ERR? (SCPI language mode).

The message structure is {error #, 2400C error message}.

The following table describes the 2400C remote error messages.

Table 118 2400C Remote Error Messages

Error Number	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.

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B3 Remote Error Messages, Continued

Table 119 2400C Remote Error Messages, Continued	
Error Number	**Error Message**
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.
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.
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B3 Remote Error Messages, Continued

Table 120 2400C Remote Error Messages, Continued	
Error Number	**Error Message**
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.
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.
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B3 Remote Error Messages, Continued

Table 121 2400C Remote Error Messages, Continued	
Error Number	**Error Message**
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.
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.
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B3 Remote Error Messages, Continued

Table 122 2400C Remote Error Messages, Continued	
Error Number	**Error Message**
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.

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