Agilent U8903A
Audio Analyzer

User's Guide

Agilent Technologies

Notices

Manual Part Number

U8903-90002

Edition

Fourth Edition, February 1, 2011

Agilent Technologies, Inc.
5301 Stevens Creek Blvd.
Santa Clara, CA 95051 USA

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

	Direct current (DC)		Equipment protected throughout by double insulation or reinforced insulation
	Alternating current (AC)		Off (supply)
	Both direct and alternating current		On (supply)
	Three-phase alternating current		Caution, risk of electric shock
	Earth (ground) terminal		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	Protective conductor terminal		Caution, hot surface
	Frame or chassis terminal		Out position of a bi-stable push control
	Equipotentiality		In position of a bi-stable push control

General Safety Information

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies, Inc. assumes no liability for the customer's failure to comply with these requirements.

WARNING

- **Ground the equipment.**
  For Safety Class 1 equipment (equipment having a protective earth terminal), an uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.
- **DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.**
  For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. DO NOT use repaired fuses or short-circuited fuse holders.
- **Keep away from live circuits.**
  Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electric shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.
- **DO NOT operate damaged equipment.**
  If the built-in safety protection features have been impaired through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use product until safe operation is verified by service-trained personnel. If necessary, return the product to Agilent for service and repair to ensure that the safety features are maintained.
- **DO NOT service or adjust alone.**
  Do not attempt any internal service or adjustment unless a person capable of rendering first aid and resuscitation is present.
- **DO NOT substitute parts or modify equipment.**
  To avoid the occurrence of additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to Agilent for service or repair to ensure that the safety features are maintained.

WARNING

- **This equipment is under CAT 1 measurement category, do not connect the cable to MAIN.**

CAT 1
Maximum Working Voltage: 200 Vp for altitude up to 3000 m
Maximum Transient Voltage: 1210 V

- **Do not measure more than the rated voltage (as marked on the equipment).**

CAUTION

- Use the device with the cables provided.
- Repair or service that is not covered in this manual should only be performed by qualified personnels.
- Observe all markings on the device before establishing any connection.
- Always use dry cloth to clean the device. Do not use ethyl alcohol or any other volatile liquid to clean the device.
- Do not permit any blockage of the ventilation holes of the device.

Environmental Conditions

This instrument is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental conditions	Requirements
Operating temperature	0 °C to 55 °C
Operating humidity	20% to 80% RH noncondensing at 40 °C
Storage temperature	–40 °C to 70 °C
Storage humidity	20% to 80% RH noncondensing at 65 °C

CAUTION

The U8903A Audio Analyzer complies with the following safety and EMC requirements.

- IEC 61010-1:2001/EN 61010-1:2001 (2nd Edition)
- Canada: CAN/CSA-C22.2 No. 61010-1-04
- Canada: ICES-001:2004
- IEC 61326-1:2005/EN 61326-1:2006
- Australia/New Zealand: AS/NZS CISPR11:2004
- USA: ANSI/UL 61010-1:2004

Regulatory Markings

CE ISM 1-A	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.	N10149	The C-tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.
ICES/NMB-001	ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est confomre a la norme NMB-001 du Canada.		This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.
C SA US	The CSA mark is a registered trademark of the Canadian Standards Association.		

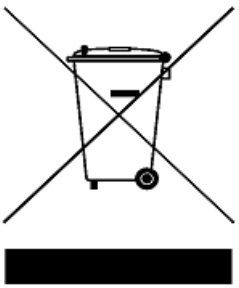
Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a "Monitoring and Control Instrument" product.

The affixed product label is shown as below.



Do not dispose in domestic household waste

To return this unwanted instrument, contact your nearest Agilent Technologies, or visit:

www.agilent.com/environment/product

for more information.

In This Guide...

1 Getting Started

This chapter provides an overview of the U8903A, which includes the product outlook, dimensions, and layout. This chapter also contains instructions on how to install and configure the U8903A.

2 Operation and Features

This chapter describes the operation and features that are offered by the U8903A, such as test capabilities, key features, and front panel menu operation.

3 Instrument Configuration

This chapter guides you through the configuration of the U8903A input and output settings for optimum measurement results.

4 Audio Generator Functions

This chapter provides you the information on the audio generator functions and settings of the U8903A.

5 Audio Analyzer Measurement Functions

This chapter describes the audio analyzer measurement functions and settings of the U8903A.

6 Frequency and Time Domain Analysis

This chapter describes the U8903A graph configuration for the frequency and time domain analysis.

7 Sweep Function

This chapter explains the sweep operation of the U8903A.

8 Specifications

This chapter lists the specifications and characteristics of the U8903A.

Appendixes

Declaration of Conformity (DoC)

The Declaration of Conformity (DoC) for this instrument is available on the Web site. You can search the DoC by its product model or description.

http://regulations.corporate.agilent.com/DoC/search.htm

NOTE If you are unable to search for the respective DoC, please contact your local Agilent representative.

Contents

1 Getting Started 1

Introduction 2

LXI Class-C Compliant Audio Analyzer 4

Product at a Glance 5

- Product outlook 5

Front Panel LCD Display 9

Product Dimensions 10

Standard Accessories 11

Optional Accessories 11

Installation and Configuration 12

- Initial inspection 12
- Ventilation 12
- Rack mounting 12

Maintenance 13

- Fuse removal/replacement 13

Power On the U8903A 14

Preset 15

Help System 16

2 Operation and Features 17

Test Capabilities 18

Key Features 20

- Remote interface 20
- Sweep function 20
- Frequency domain analysis 20
- Digital filters 21

Front Panel Operation 22
Mode 22
Graph functions 39
Run/Stop and On/Off 40
System 42
Editing Keys 51

3 Instrument Configuration 53

U8903A Block Diagram 54

Input Settings 56
AC/DC coupling 57
AC level detection 58
Digital filters 59
Input configuration 60
Input ranging 61
Frequency Lock 62

Common Settings 63
Measurement bandwidth 63
Measurement time 64
Trigger 66
Average Points 67

Ref/Rel 68

Output Settings 70
Output type 70
Output impedance 71
Reference impedance 71

4 Audio Generator Functions 73

Audio Generator 74
Sine waveform 76
Variable phase waveform 77

Dual sine waveform 78
Noise signals 84
DC signal 85
Multitone waveform 86
Square waveform 88
Arbitrary waveform 88

5 Audio Analyzer Measurement Functions 91

Audio Analyzer 92

Measurement Functions 97
Frequency 97
AC voltage level (Vac) 97
DC voltage level (Vdc) 98
THD + N Ratio and THD + N Level 98
SINAD 100
SNR and Noise Level 101
SMPTE intermodulation distortion (SMPTE IMD) 103
Difference frequency distortion (DFD) 104
Phase 105
Crosstalk (channel driven and channel measured) 107

6 Frequency and Time Domain Analysis 109

Frequency Domain and Time Domain 110
Monitor settings 112
Axis settings 115
Input settings 115
Harmonics display 116
Hold 117

Graph Functions 118
Peak search 118
Marker 119
Marker –> 120

Full screen 121

7 Sweep Function 123

Sweep 124
Sweep settings 126
Axis settings 127
Hold 128
Sweep mode 129
List view 130
I/O settings 131

8 Specifications 133

Characteristics 134

Specifications 135
Audio generator 135
Audio analyzer 138
139
Graph mode 140
Audio filters 140
Sweep capability 141

Measurement Category 143
Measurement category definitions 143

Index 145

Appendixes 147

Appendix A: SMPTE IMD and DFD Default Settings 148

Appendix B: Arbitrary File Format 149

Appendix C: User-defined Filter File Format 152

Appendix D: User-defined Sweep Points File Format 155

Appendix E: Spot Parameters 156

List of Figures

Figure 1-1 U8903A front panel 5
Figure 1-2 U8903A rear panel 7
Figure 1-3 Power-up display 9
Figure 1-4 Help dialog information example 16
Figure 2-1 Mode panel 22
Figure 2-2 Generator: Waveform (Sine, Variable Phase, and Dual Sine) menu tree 24
Figure 2-3 Generator: Waveform (Noise, DC, Multitone, Square, and Arbitrary) menu tree 25
Figure 2-4 Generator: Output Settings, Frequency, Amplitude, and DC Offset menu tree 26
Figure 2-5 Analyzer function menu tree 30
Figure 2-6 Analyzer: Units menu tree 31
Figure 2-7 Analyzer: Ref/Rel menu tree 32
Figure 2-8 Frequency and time domain menu trees 36
Figure 2-9 Sweep function menu tree 38
Figure 2-10 Graph panel 39
Figure 2-11 Run/Stop or On/Off option 40
Figure 2-12 Channel selection and status 41
Figure 2-13 System panel 42
Figure 2-14 File Manager menu for saving the U8903A state 43
Figure 2-15 File Manager menu for recalling the U8903A state 44
Figure 2-16 Analyzer-generator display 45
Figure 2-17 Analyzer 8-channel display 46
Figure 2-18 System function menu tree 47
Figure 2-19 Editing function keys 51
Figure 3-1 U8903A block diagram 54
Figure 3-2 Analyzer input settings 56
Figure 3-3 AC/DC coupling selection 57
Figure 3-4 AC level detector selection 58
Figure 3-5 Digital filter selection 59

Figure 3-6 Input signal connector configuration 60
Figure 3-7 Frequency lock 62
Figure 3-8 Common settings 63
Figure 3-9 Measurement bandwidth selection 64
Figure 3-10 Measurement time selection first page 65
Figure 3-11 Measurement time selection second page 65
Figure 3-12 Trigger settings selection 66
Figure 3-13 Average points selection 67
Figure 3-14 Reference Level 68
Figure 3-15 Reference Frequency 69
Figure 3-16 Reference Ratio 69
Figure 3-17 Output settings 70
Figure 3-18 Reference impedance 71
Figure 4-1 Generator waveform selection 75
Figure 4-2 More generator waveform selection 75
Figure 4-3 Sine waveform menu 76
Figure 4-4 Typical sine waveform and parameters 77
Figure 4-5 Variable phase waveform menu 78
Figure 4-6 Dual sine waveform selection 79
Figure 4-7 Dual waveform menu 79
Figure 4-8 More dual sine waveform parameters 80
Figure 4-9 SMPTE IMD waveform menu 81
Figure 4-10 DFD IEC 60118 waveform menu 82
Figure 4-11 DFD IEC 60268 waveform menu 83
Figure 4-12 Noise signal selection 84
Figure 4-13 Gaussian noise signal menu 84
Figure 4-14 DC signal menu 85
Figure 4-15 Multitone waveform menu 86
Figure 4-16 More multitone waveform parameters 86
Figure 4-17 Multitone waveform preview 87
Figure 4-18 Square waveform menu 88
Figure 4-19 Arbitrary waveform menu 89
Figure 4-20 More arbitrary waveform parameters 89

Figure 4-21 Arbitrary waveform preview 90
Figure 5-1 Analyzer menu functions 92
Figure 5-2 Function 1 selection 93
Figure 5-3 Function 2 selection first page 95
Figure 5-4 Function 2 selection second page 95
Figure 5-5 Function 2 selection third page 95
Figure 5-6 Function 2 selection fourth page 96
Figure 5-7 THD + N Level measurement 99
Figure 5-8 THD + N Ratio measurement 100
Figure 5-9 SINAD measurement 101
Figure 5-10 SNR measurement 102
Figure 5-11 Noise level measurement 103
Figure 5-12 SMPTE IMD measurement 104
Figure 5-13 DFD measurement 105
Figure 5-14 Phase measurement 106
Figure 5-15 Crosstalk: Channel driven mode 108
Figure 5-16 Crosstalk: Channel measured mode 108
Figure 6-1 Frequency domain mode 110
Figure 6-2 Time domain mode 111
Figure 6-3 Monitor settings page 112
Figure 6-4 Axis settings page 115
Figure 6-5 Input settings page 116
Figure 6-6 Harmonics display 116
Figure 6-7 Hold page 117
Figure 6-8 Hold configuration type 117
Figure 6-9 Peak Search menu 118
Figure 6-10 Marker menu 119
Figure 6-11 Marker measurement data display 120
Figure 6-12 Marker –> menu 121
Figure 6-13 Full screen 121
Figure 7-1 Sweep menu first page 124
Figure 7-2 Sweep menu second page 125
Figure 7-3 Sweep settings page 126

Figure 7-4 Axis settings page 127
Figure 7-5 Hold page 128
Figure 7-6 Sweep mode selection 129
Figure 7-7 List View 130
Figure 7-8 I/O settings page 131

List of Tables

Table 1-1 U8903A front panel description 5
Table 1-2 U8903A rear panel description 8
Table 1-3 Power cord types 14
Table 2-1 Mode panel key description 23
Table 2-2 Generator menu description 27
Table 2-3 Analyzer menu description 33
Table 2-4 Graph (frequency/time domain) menu description 37
Table 2-5 Sweep menu description 38
Table 2-6 Graph panel key description 40
Table 2-7 System panel key description 42
Table 2-8 System menu description 48
Table 2-9 Editing key/control description 52
Table 3-1 Filter selection 59

1 Getting Started

Introduction 2
LXI Class-C Compliant Audio Analyzer 4
Product at a Glance 5
    Product outlook 5
Front Panel LCD Display 9
Product Dimensions 10
Standard Accessories 11
Optional Accessories 11
Installation and Configuration 12
    Initial inspection 12
    Ventilation 12
    Rack mounting 12
Maintenance 13
    Fuse removal/replacement 13
Power On the U8903A 14
Preset 15
Help System 16

This chapter provides an overview of the outlook and installation of the U8903A audio analyzer.

Introduction

The U8903A is a digital signal processing (DSP)-based audio measurement system, with a frequency measurement range of 10 Hz to 100 kHz. The U8903A basic configuration consists of two channels of audio generator and analyzer. The U8903A can be configured for up to eight channels, however this feature is only applicable in future releases.

The U8903A is provided with a set of features as listed below which allows you to perform a wide range of audio parameter measurements. The U8903A also supports industrial standard instrument connectivity such as GPIB, USB, and LAN. In addition, the U8903A is equipped with frequency and time domain graph functions, as well as sweep capability for frequency, amplitude, and phase.

The U8903A audio generator has a frequency range of 5 Hz to 80 kHz. Its sine waveform amplitude range is from 0 Vrms to 8 Vrms (11.3 Vp) for the Unbalanced or Common mode test output configuration, and 0 Vrms to 16 Vrms (22.6 Vp) for the Balanced output configuration.

The audio generator features are listed as follows.

- Balanced output signals (XLR)
- Unbalanced output signals (BNC)
- Common mode test output signals (XLR)
- Selectable output impedance
- Sine waveform
- Square waveform
- Variable phase waveform
- Noise signal
- DC signal
- Dual sine waveforms which include SMPTE intermodulation distortion (SMPTE IMD) and difference frequency distortion (DFD) waveform types
- Multitone generation
- User-defined arbitrary waveform

The U8903A audio analyzer has a frequency measurement range of 10 Hz to 100 kHz, as well as an amplitude measurement range of microvolts to 200 Vp (140 Vrms).

Below is the list of the audio analyzer features.

- Balanced input signals (XLR)
- Unbalanced input signals (BNC)
- Frequency measurement
- AC voltage measurement
- DC voltage measurement
- Phase measurement
- THD + N Ratio measurement
- THD + N Level measurement
- SINAD measurement
- Signal-to-noise ratio (SNR) measurement
- Noise Level measurement
- SMPTE IMD measurement
- DFD measurement
- Crosstalk measurement
- RMS, Peak-to-Peak, Quasi Peak type detectors
- AC/DC coupling
- Digital filters such as low pass, high pass, and weighting filters
- Input autoranging
- Selectable measurement bandwidth
- Selectable measurement time
- Free Run or External trigger mode

To search for software/firmware updates for your product, go to the Agilent Technical Support website at www.agilent.com/find/TechSupport.

LXI Class-C Compliant Audio Analyzer

The U8903A audio analyzer is an **LXI Class C** compliant instrument, developed using LXI Technology. LXI, an acronym for LAN eXtension for Instrumentation, is an instrument standard for devices that use the Ethernet (LAN) as their primary communication interface.

Hence, it is easy-to-use instrument expecially with the usage of an integrated Web browser that provides a convenient way to configure the instrument's functionality.

Product at a Glance

Product outlook

Front panel

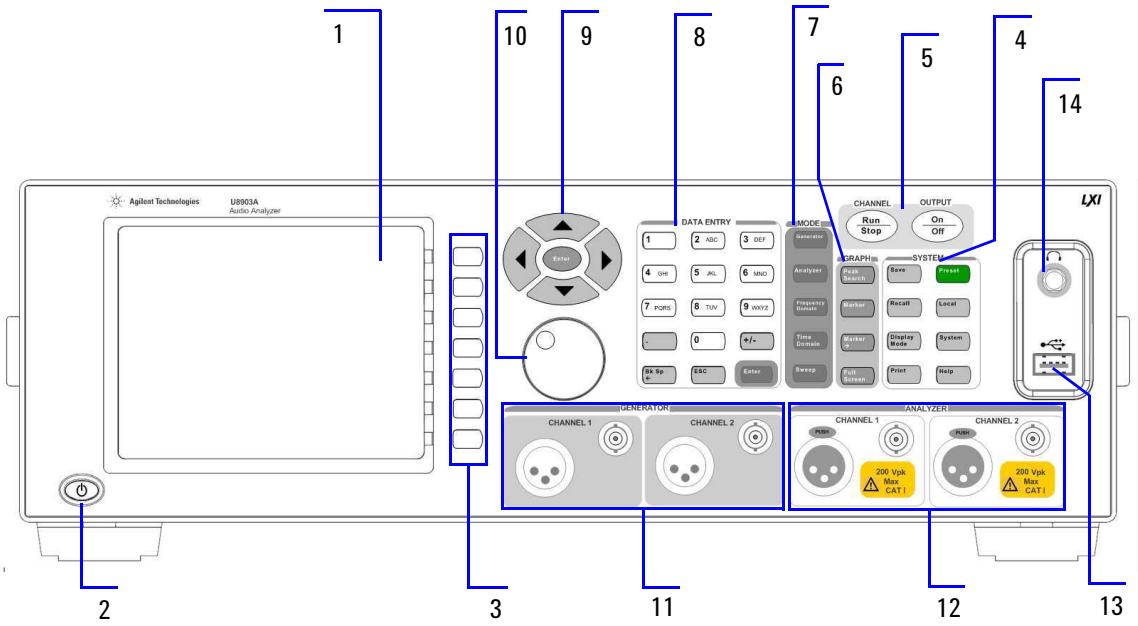


Figure 1-1 U8903A front panel

Table 1-1 U8903A front panel description

Item	Display	Description
1	LCD display	Provides information on the current function including status indicators, settings, and error messages
Item	**Key**	**Description**
2	Power on/off	Turns the U8903A on or off

Item	Key	Description
3	Softkeys 1 to 7	Activates the function as displayed on the right side of the LCD display
4	System	Controls system-wide functions consisting of: • instrument configuration information and I/O setup • screen capture function, which prints the display to a file on a USB external flash storage • display mode, which toggles between the number of channels to show on the LCD display • save and recall • local key, which switches from remote mode to front panel access • instrument preset and help function
5	Channel/Output	Toggle the Run/Stop key to start or stop signal generation or measurements for the selected generator or analyzer channel respectively. The On/Off key toggles on or off the generator output for all active channels.
6	Graph	Enables access to the graph functions including peak navigation and marker function. You can also use the Full Screen function to maximize the display area.
7	Mode	Enables access to the U8903A core functions
8	Data Entry	Contains alphanumeric and editing keys to enter values or text, or modify the values or data and confirm an entry
9	Enter and arrow keys	The Enter key confirms and then terminates data entry when the default unit is used. The usage of the arrow keys are as follows. • Selection of individual channel • Increases or decreases a highlighted digit or value of the current measurement selection • Navigation of Help topics • Navigates within forms used for setting up measurements • Navigates within tables

Item	Control	Description
10	Knob	Rotating the knob increases or decreases a numeric value, changes a highlighted digit or character, steps through a list, or moves the markers along the graph plot

Item	Connector	Description
11	Generator output	Outputs an audio signal to the unit-under-test (UUT). A XLR male output connector and a BNC female output connector are provided for each channel.
12	Analyzer input	Accepts an audio signal from the UUT. A XLR female input connector and a BNC female input connector are provided for each channel.
13	USB host	Used to connect a USB external flash storage for data transfer. You can connect or disconnect the USB external flash storage without shutting down or restarting the U8903A.
14	Headphone jack	The headphone jack will only be applicable in future releases

Rear panel

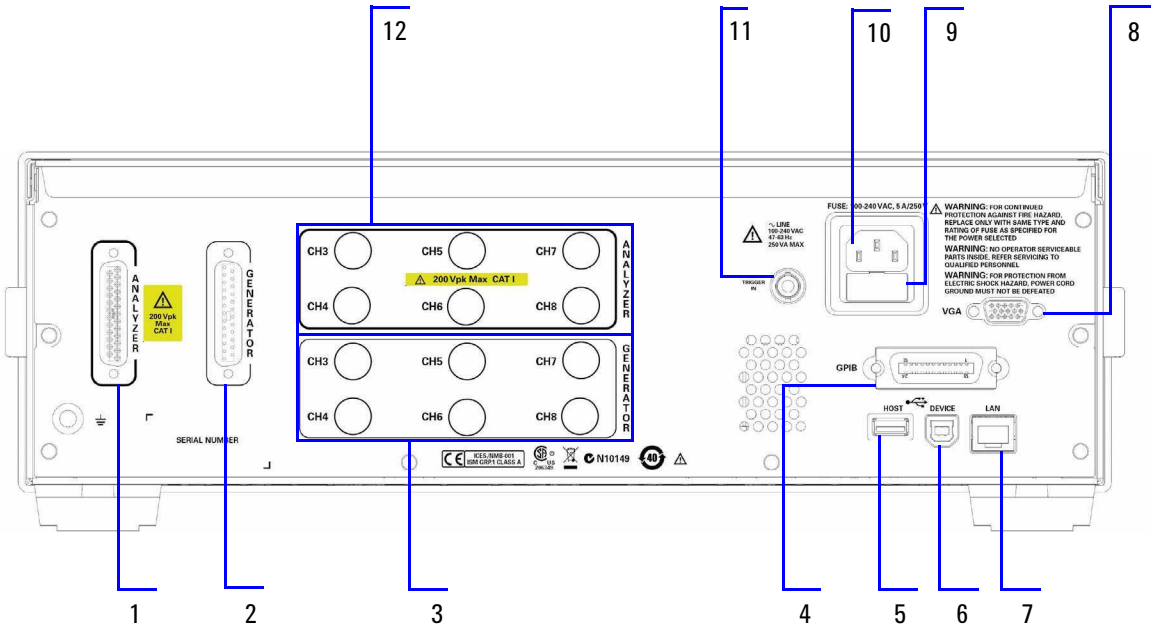


Figure 1-2 U8903A rear panel

Table 1-2 U8903A rear panel description

Item	Connector	Description
1	DSub analyzer input	25-pin Balanced input signal connectors for channels 3 to 8. Only available in future releases.
2	DSub generator output	25-pin Balanced output signal connectors for channels 3 to 8. Only available in future releases.
3	BNC output	Unbalanced output signal connectors for channels 3 to 8. Only available in future releases.
4	GPIB interface	General Purpose Interface Bus (IEEE-488) standard interface
5	USB host	Used to connect a USB external flash storage
6	USB device	Allows communication with the PC via a USB cable
7	LAN interface	Allows Ethernet LAN communication through a 10/100 Base-T LAN cable.
8	VGA interface	Allows the U8903A to be connected to an external monitor
9	Fuse	Fuse compartment for AC supply
10	AC power	Receptacle for AC line voltage connection
11	Trigger in	A BNC connector to receive an external TTL or CMOS signal for triggering operation. Triggering can occur on either the positive or negative edge.
12	BNC input	Unbalanced input signal connectors for channels 3 to 8. Only available in future releases.

Front Panel LCD Display

The U8903A displays the analyzer view upon power-up, as shown in the following figure.

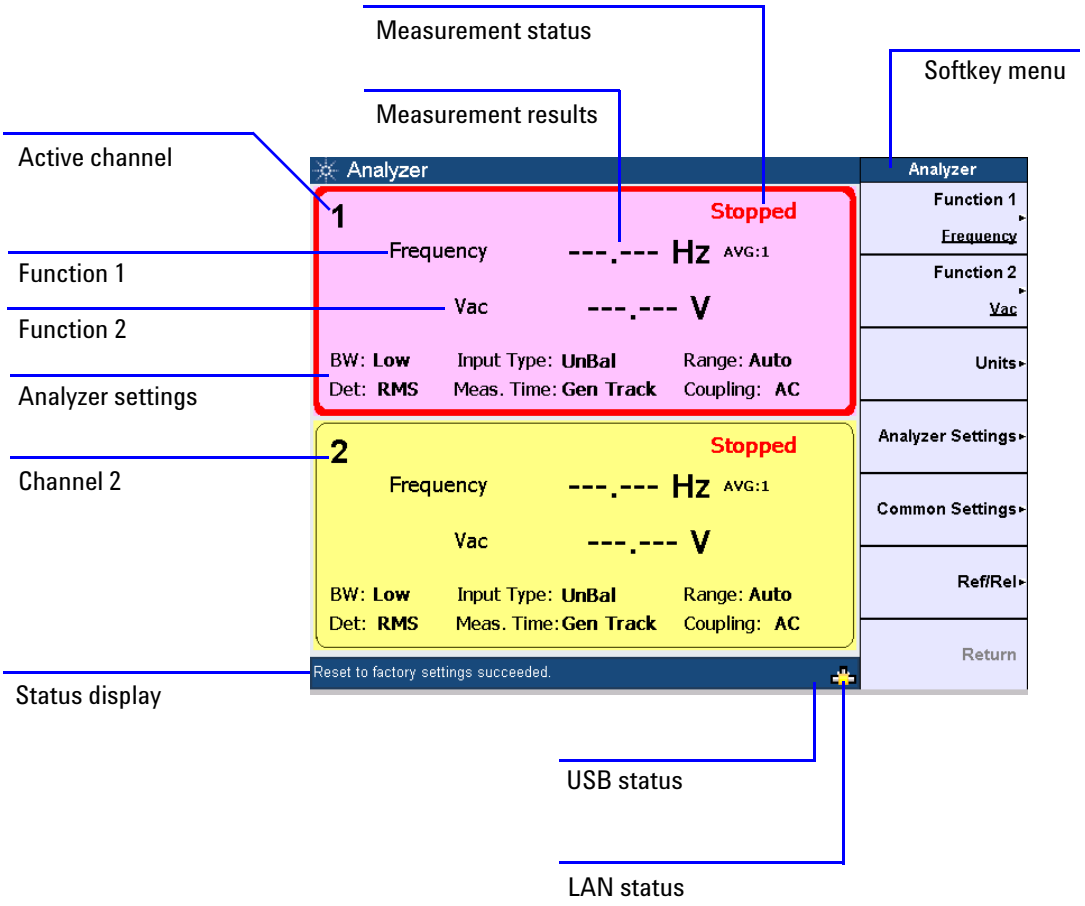
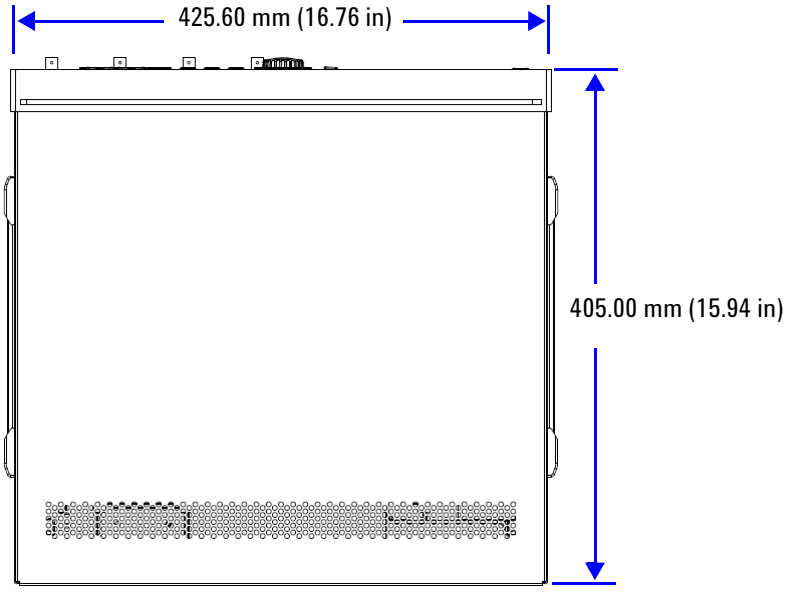


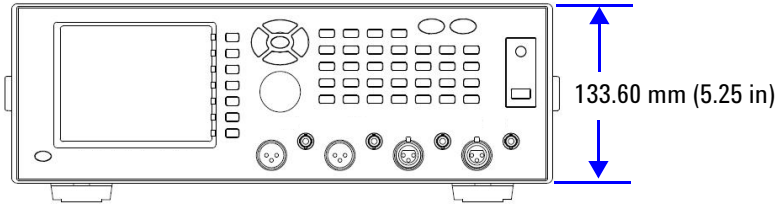
Figure 1-3 Power-up display

Product Dimensions

Top view



Front view



Standard Accessories

Verify that you have received the following items with your U8903A. If anything is missing or damaged, please contact the nearest Agilent Sales Office.

- Power cord
- LAN cable
- USB cable
- USB flash storage device
- Agilent U8903A Audio Analyzer Quick Start Guide
- Agilent U8903A Audio Analyzer Product Reference CD-ROM
- Certificate of Calibration

Optional Accessories

The following accessories are available for purchase separately.

- BNC male to BNC male cable, 1.2 m, jade gray
- BNC male to RCA male cable, 2 m, black
- XLR male to XLR female cable, 2 m, black
- Rack mount kit
- BNC cable for trigger connection

Installation and Configuration

Initial inspection

When you receive your U8903A, inspect the unit for any obvious damage such as broken terminals or cracks, dents, and scratches on the chassis that may occur during shipment. If any damage is found, notify the nearest Agilent Sales Office immediately.

Keep the original packaging in case the U8903A has to be returned to Agilent in future. If you return the U8903A for service, attach a tag identifying the owner and model number. Also include a brief description of the problem.

Ventilation

The U8903A can operate within the temperature range of 0 °C to 55 °C. The U8903A is cooled by drawing air through the sides and rear and exhausting it through the ventilation holes on the top, sides, and rear. The U8903A must be installed in a location that allows sufficient space at the top, sides, and rear for adequate air circulation.

Rack mounting

The U8903A can be mounted in a standard 19-inch rack. Rack mount kits are available as Option 908. Support rails are also required for rack mounting. These are normally supplied with the rack and are not included with the rack mount options.

If you are installing an instrument on top of the U8903A, ensure that the instrument does not obstruct the ventilation holes at the top side of the U8903A. If required, use a filler panel above the U8903A to ensure adequate space for air circulation.

Maintenance

Fuse removal/replacement

This section contains the information for replacing the U8903A rear panel AC line fuse.

NOTE Ensure that you are using the quick-acting, low-breaking capacity 5 A/250 V fuse.

Perform the following procedure to replace the fuse.

1. Use a tweezer to remove the fuse holder.
2. You will be able to see two fuses. The active fuse is the one on the right while the other is the backup.
3. Remove the active fuse and replace it with the one of the correct rating and type for your selected input AC line voltage.

WARNING **Ensure that you use the correct fuse rating for the selected AC line voltage. Do not use repaired fuses or short-circuited fuse holders to avoid any unexpected hazards.**

Power On the U8903A

Connect one end of the power cord to the U8903A rear panel AC power inlet, and the other end to an AC voltage source. Ensure that the provided power cord matches the country of origin as shown in the table below. The U8903A will automatically adjust to the correct line voltage in the range of 100 Vac to 240 Vac.

To turn on the U8903A, press  located on the lower left corner of the front panel. Press  again to turn off the U8903A.

WARNING **Always use a grounded power cord.**

Table 1-3 Power cord types

Plug type	Cable part number	Plug type	Cable part number
Opt 900 (U.K.) 	8120-1703	Opt 918 (Japan) 	8120-4754
Opt 901 (Australia) 	8120-0696	Opt 919 (Israel) 	8120-6799
Opt 902 (Europe) 	8120-1692	Opt 920 (Argentina) 	8120-6871
Opt 903 (U.S.A.) 	8120-1521	Opt 921 (Chile) 	8120-6979

Table 1-3 Power cord types (continued)

Plug type	Cable part number	Plug type	Cable part number
Opt 906 (Switzerland) 	8120-2296	Opt 922 (China) 	8120-8377
Opt 912 (Denmark) 	8120-2957	Opt 927 (Thailand) 	8120-8871
Opt 917 (South Africa) 	8120-4600		

Preset

A preset does not erase the flash memory, state memory, or I/O configuration. A preset will delete all customized settings on the U8903A.

To preset the U8903A, you can perform either one of the following steps.

- Send the `*RST`, `SYSTem:PRESet`, `SYSTem:RESet[:MODE]`, or `SYSTem:RESet:CHANnel` SCPI commands from the PC via the USB, GPIB, or LAN interface.
- Press Preset on the System panel.

Help System

The help system provides you a quick access to the operating information you require.

The Help key displays the description of all the front panel keys and current softkeys.

To activate the help mode, press Help. To deactivate, press ESC.

When Help is enabled, the function keys will not execute their normal functions when pressed. An example of a help dialog information is shown as follows.

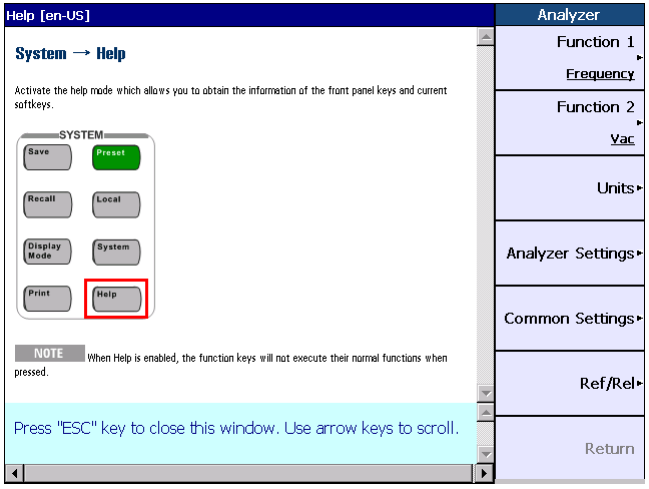


Figure 1-4 Help dialog information example

2
Operation and Features

Test Capabilities 18
Key Features 20
- Remote interface 20
- Sweep function 20
- Frequency domain analysis 20
- Digital filters 21

Front Panel Operation 22
- Mode 22
- Graph functions 39
- Run/Stop and On/Off 40
- System 42

Editing Keys 51

This chapter describes the operation and features that are offered by the U8903A, such as test capabilities, key features, and front panel menu operation.

Test Capabilities

The U8903A is capable of testing a broad range of audio-related devices and components for research and development, manufacturing, and quality assurance applications. Examples of the products that can be tested are listed below.

- Multichannel home theater systems
- Audio amplifiers, as a complete product or at the component level
- Portable audio playback devices such as MP3 players
- Speakers (require third party accessories such as microphones and power amplifiers)
- PC audio cards
- Audio components

The U8903A performs the following two basic functions.

- Audio signal generation
- Audio signal analysis

The U8903A basic configuration has two channels of generator functions and two channels of analyzer functions which enables the U8903A to test devices with stereo capability.

The U8903A audio generator has a frequency range of 5 Hz to 80 kHz. Its sine waveform amplitude range is from 0 Vrms to 8 Vrms (11.3 Vp) for the Unbalanced or Common mode test output configuration, and 0 Vrms to 16 Vrms (22.6 Vp) for the Balanced output configuration.

The audio generator features are listed as follows.

- Balanced output signals (XLR)
- Unbalanced output signals (BNC)
- Common mode test output signals (XLR)
- Selectable output impedance
- Sine waveform
- Square waveform
- Variable phase waveform

- Noise signal
- DC signal
- Dual sine waveforms which include SMPTE intermodulation distortion (SMPTE IMD) and difference frequency distortion (DFD) waveform types
- Multitone generation
- User-defined arbitrary waveform

The U8903A audio analyzer has a frequency measurement range of 10 Hz to 100 kHz, as well as an amplitude measurement range of microvolts to 200 Vp (140 Vrms).

Below is the list of the audio analyzer features.

- Balanced input signals (XLR)
- Unbalanced input signals (BNC)
- Frequency measurement
- AC voltage measurement
- DC voltage measurement
- Phase measurement
- THD + N Ratio measurement
- THD + N Level measurement
- SINAD measurement
- Signal-to-noise ratio (SNR) measurement
- Noise Level measurement
- SMPTE IMD measurement
- DFD measurement
- Crosstalk measurement
- RMS, Peak-to-Peak, Quasi Peak type detectors
- AC/DC coupling
- Digital filters such as low pass, high pass, and weighting filters
- Input autoranging
- Selectable measurement bandwidth
- Selectable measurement time
- Free Run or External trigger mode

Key Features

The key features of the U8903A are described as follows.

Remote interface

The U8903A supports three types of industry standard interfaces for measurement automation as follows.

- GPIB
- LAN
- USB

These three interfaces make the U8903A a highly flexible instrument. Furthermore, the LAN interface also enables you to view and modify the U8903A LAN configuration via a Web page.

Sweep function

The U8903A can perform sweeps and the results are displayed on the LCD display. The sweep function offers you flexible sweep configurations to cater to the various waveform types and parameters. The available main settings include the sweep mode, sweep parameter, measurement parameter, sweep interval, and also the dwell time. Data obtained from the sweep may be read from a list.

Frequency domain analysis

The Fast Fourier Transform (FFT) is one of the many advanced features of the U8903A. FFT allows a waveform to be analyzed in the frequency domain. Various parameters can be configured such as acquisition length, window function, averaging, as well as the input and axis settings.

Digital filters

The U8903A has a series of filters that are implemented digitally. They consist of low pass, high pass, and weighting filters such as CCITT, CCIR, C-Message, and A-Weighting.

The U8903A also allows user-defined filters to be uploaded to the device. You need to specify the filter parameters comprising filter type, group delay, and coefficients/sections. The filter parameters will be saved in a file and then uploaded to the U8903A. Refer to "Appendix C: User-defined Filter File Format" on page 152 for more information on the user-defined filter file format.

Front Panel Operation

The front panel keys are organized in groups based on their functions as follows.

- Mode
- Graph
- System
- Softkeys
- Controls
- Data Entry
- Navigation keys
- Knob

Mode

This group provides quick access to the main functions.

Figure 2-1 Mode panel

The description for each key on the Mode panel is shown in the table below.

Table 2-1 Mode panel key description

Item	Key	Description
1	Generator	Selects the generator function
2	Analyzer	Selects the analyzer function
3	Frequency Domain	Selects the frequency domain analysis
4	Time Domain	Selects the time domain analysis
5	Sweep	Selects the sweep function

Generator

Pressing 

changes the display screen to the generator screen. On the Generator menu, you can set various settings for audio signal generation, with waveform type, frequency, amplitude, DC offset, and output as the main settings. The generator function menu tree is divided into three parts as shown in the following pages. The first section of the menu tree shows the waveform functions consisting of Sine, Variable Phase, and Dual Sine while the second section shows the other waveform functions comprising Noise, DC, Multitone, Square, and Arbitrary. The third section of the menu tree displays the Output Settings, Frequency, Amplitude, and DC Offset functions. Use the softkey on the right side of the LCD display to navigate to the next menu level.

The generator function menu tree for waveforms consisting of Sine, Variable Phase, and Dual Sine is shown below.

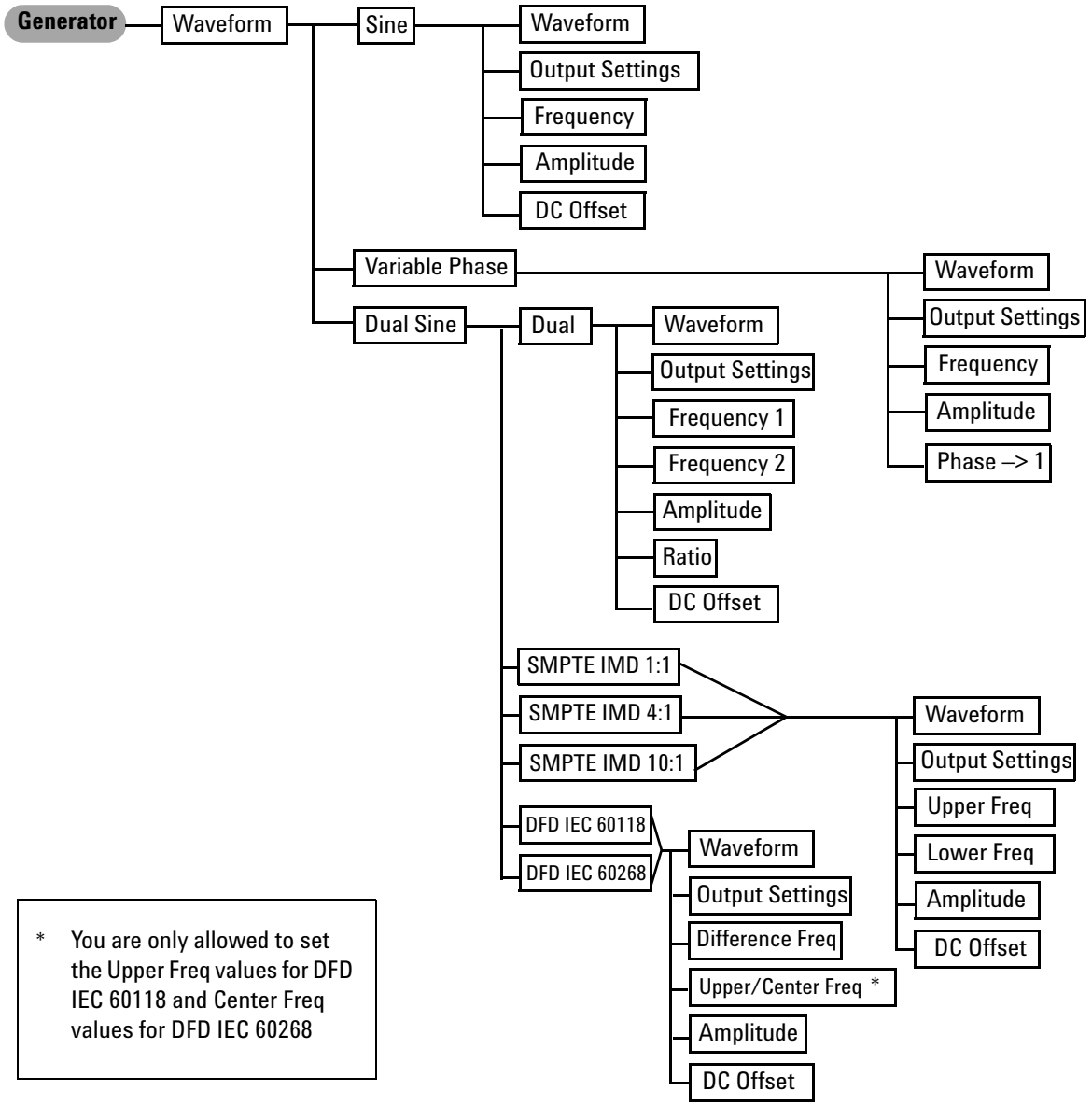


Figure 2-2 Generator: Waveform (Sine, Variable Phase, and Dual Sine) menu tree

The following figure shows the generator function menu tree for waveforms consisting of Noise, DC, Multitone, Square, and Arbitrary.

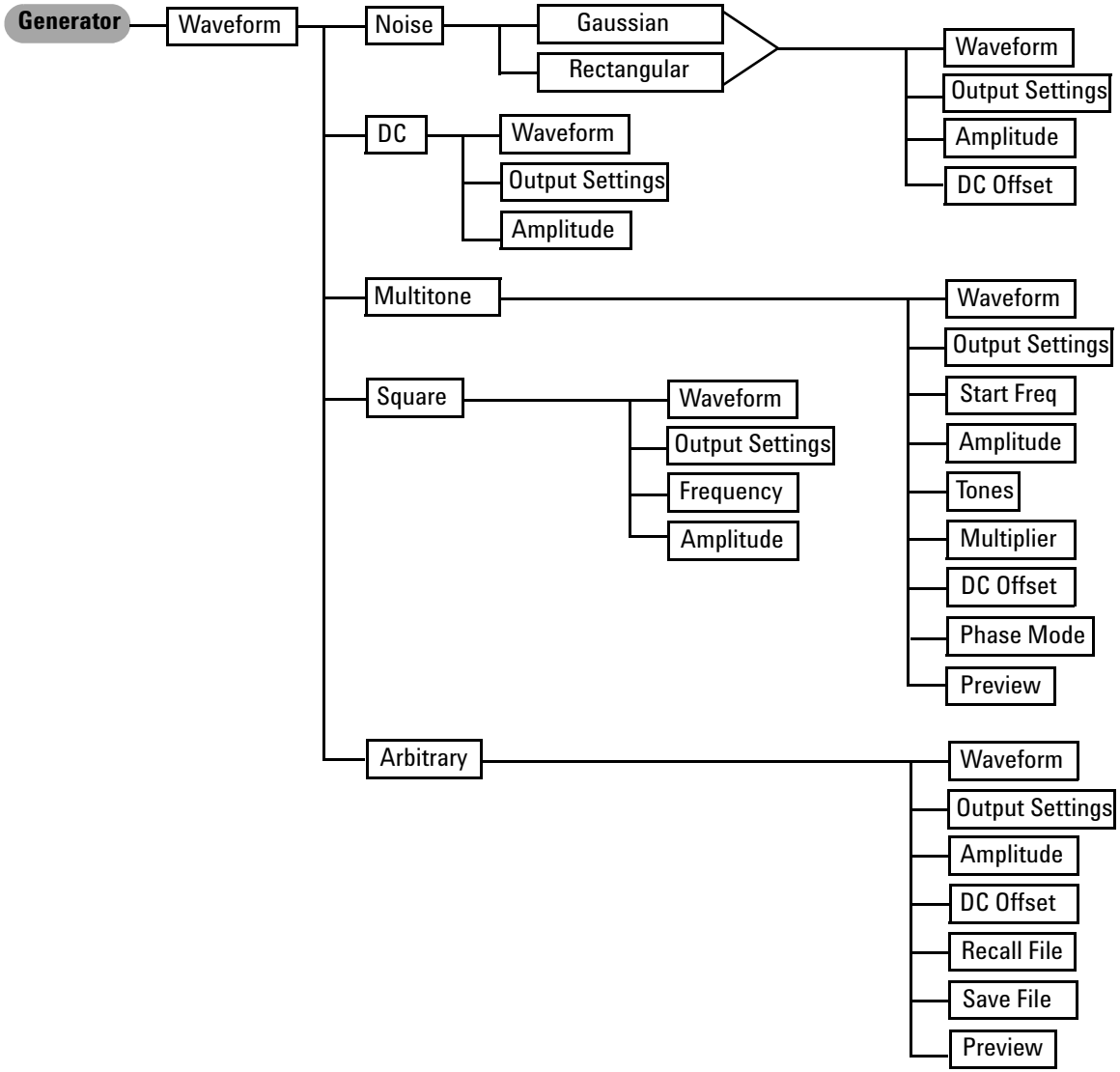


Figure 2-3 Generator: Waveform (Noise, DC, Multitone, Square, and Arbitrary) menu tree

The generator function menu tree for Output Settings, Frequency, Amplitude, and DC Offset is shown as follows.

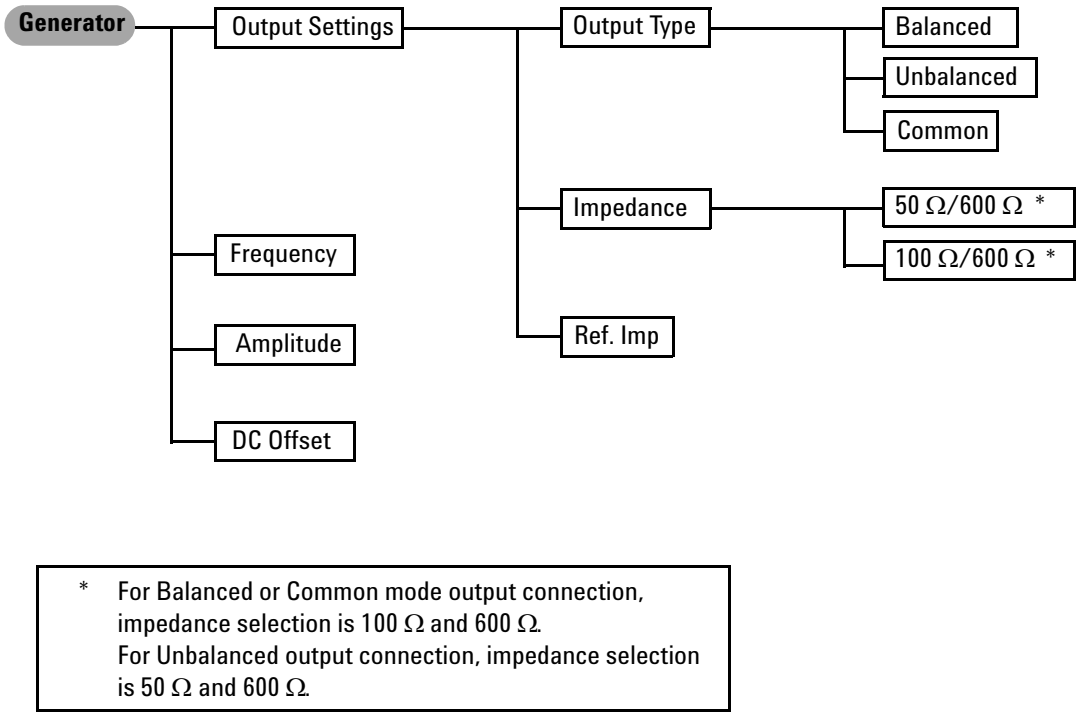


Figure 2-4 Generator: Output Settings, Frequency, Amplitude, and DC Offset menu tree

Table 2-2 Generator menu description

Level 1	Level 2	Level 3	Level 4	Description
Waveform	Sine	Waveform		Select the signal waveform type
		Output Settings		Refer to Output Settings
		Frequency		Enter the signal frequency value
		Amplitude		Enter the signal amplitude value
		DC Offset		Enter the signal DC offset value
	Variable Phase	Waveform		Select the signal waveform type
		Output Settings		Refer to Output Settings
		Frequency		Enter the signal frequency value
		Amplitude		Enter the signal amplitude value
		Phase → 1		Enter the phase of the selected channel with reference to channel 1
	Dual Sine	Dual	Waveform	Select the signal waveform type
			Output Settings	Refer to Output Settings
			Frequency 1	Enter the first sinewave component frequency value
			Frequency 2	Enter the second sinewave component frequency value
			Amplitude	Enter the composite signal amplitude value
			Ratio	Enter the ratio of the amplitude of the second sinewave component over the first sinewave component
			DC Offset	Enter the signal DC offset value
		SMPTE IMD 1:1 SMPTE IMD 4:1 SMPTE IMD 10:1	Waveform	Select the signal waveform type
			Output Settings	Refer to Output Settings
			Upper Freq	Enter the upper frequency value
			Lower Freq	Enter the lower frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the signal DC offset value

Table 2-2 Generator menu description (continued)

Level 1	Level 2	Level 3	Level 4	Description
		DFD IEC 60118	Waveform	Select the signal waveform type
			Output Settings	Refer to Output Settings
			Difference Freq	Enter the signal frequency difference value
			Upper Freq	Enter the signal upper frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the signal DC offset value
		DFD IEC 60268	Waveform	Select the signal waveform type
			Output Settings	Refer to Output Settings
			Difference Freq	Enter the signal frequency difference value
			Center Freq	Enter the signal center frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the signal DC offset value
	Noise	Gaussian Rectangular	Waveform	Select the signal waveform type
			Output Settings	Refer to Output Settings
			Amplitude	Enter the signal amplitude value
			DC Offset	Enter the signal DC offset value
	DC	Waveform		Select the signal waveform type
		Output Settings		Refer to Output Settings
		Amplitude		Enter the signal amplitude value
	Multitone	Waveform		Select the signal waveform type
		Output Settings		Refer to Output Settings
		Start Freq		Enter the signal fundamental frequency value
		Amplitude		Enter the signal amplitude value
		Tones		Enter the number of frequency components, from 2 to 60
		Multiplier		Enter the frequency multiplier
		DC Offset		Enter the signal DC offset value

Table 2-2 Generator menu description (continued)

Level 1	Level 2	Level 3	Level 4	Description
		Phase Mode		Select the phase mode
		Preview		Displays a preview of the multitone waveform in the time domain
	Square	Waveform		Select the signal waveform type
		Output Settings		Refer to Output Settings
		Frequency		Enter the signal frequency value
		Amplitude		Enter the signal amplitude value
	Arbitrary	Waveform		Select the signal waveform type
		Output Settings		Refer to Output Settings
		Amplitude		Enter the signal amplitude value
		DC Offset		Enter the signal DC offset value
		Recall File		Imports an arbitrary waveform from a file
		Save File		Saves the existing arbitrary waveform to a file
		Preview		Displays a preview of the arbitrary waveform in the time domain
Output Settings	Output Type	Balanced Unbalanced Common		Select either Balanced, Unbalanced, or Common mode output connection
	Impedance	50 Ω/600 Ω 100 Ω/600 Ω		Select the output impedance value. For Balanced or Common mode output connection, the impedance selection is 100 Ω and 600 Ω. For Unbalanced mode output connection, the impedance selection is 50 Ω and 600 Ω.
	Ref. Imp			Enter the reference impedance value
Frequency				Enter the signal frequency value
Amplitude				Enter the signal amplitude value
DC Offset				Enter the signal DC offset value

Analyzer

Pressing Analyzer changes the display screen to the analyzer screen. On the Analyzer menu, you can select the measurement functions, units, measurement settings, and set the reference values. The figure below shows the analyzer function menu tree.

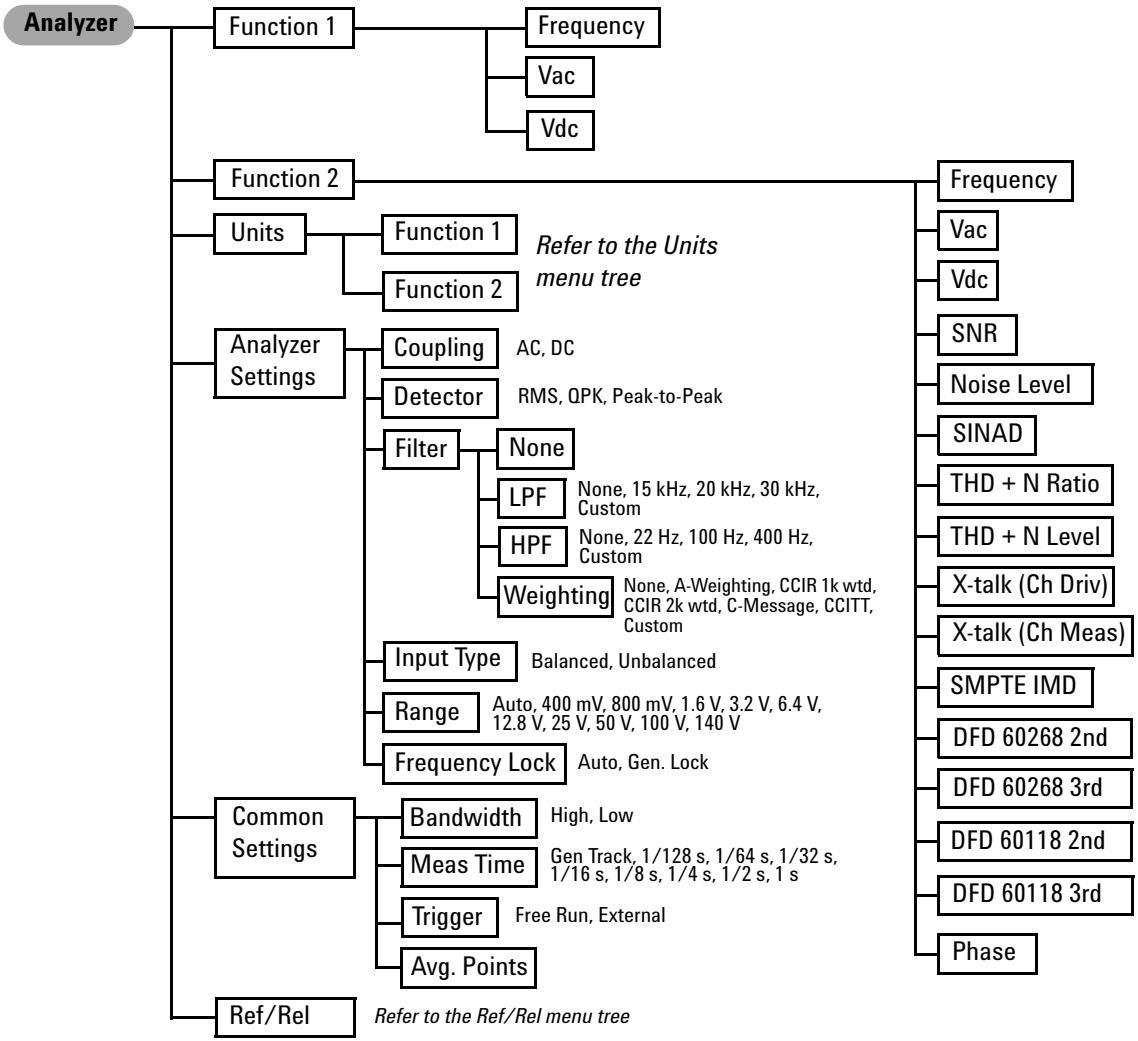


Figure 2-5 Analyzer function menu tree

The analyzer function menu tree for Units is shown as follows.

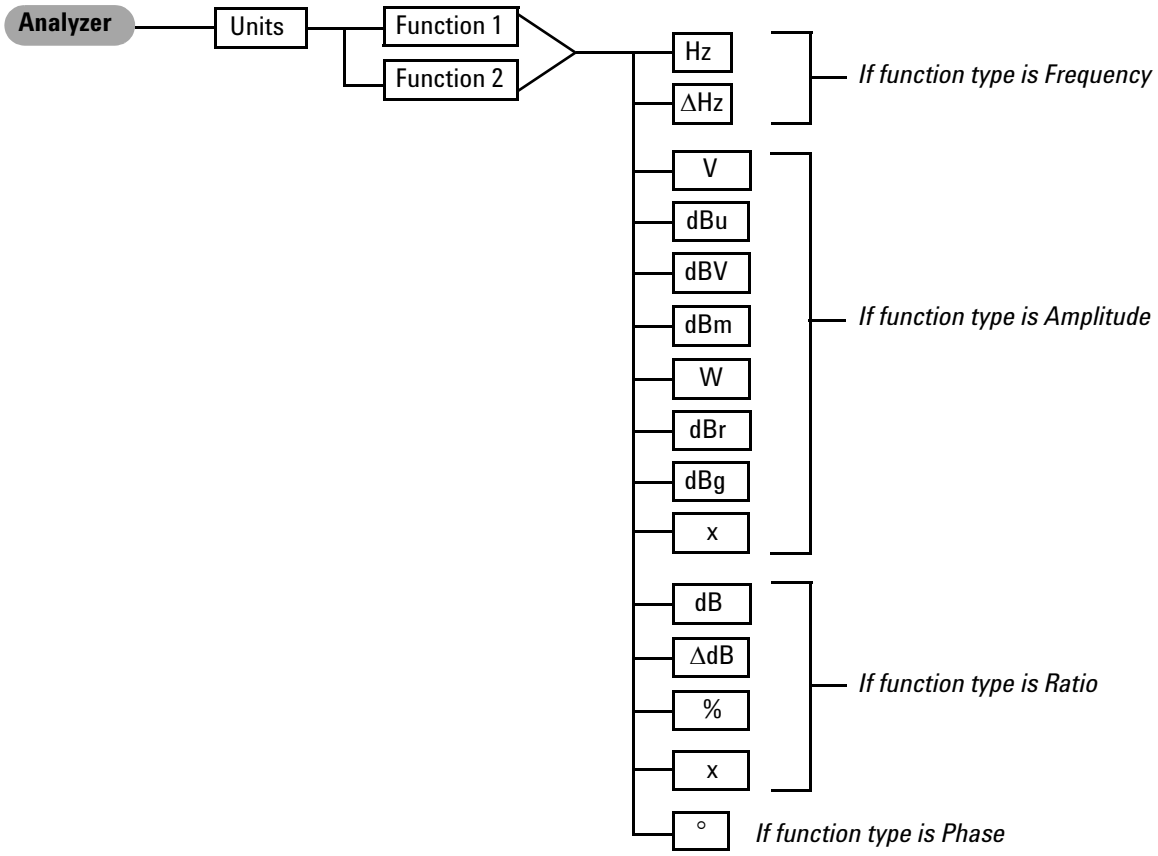


Figure 2-6 Analyzer: Units menu tree

The analyzer function menu tree for Ref/Rel is shown as follows.

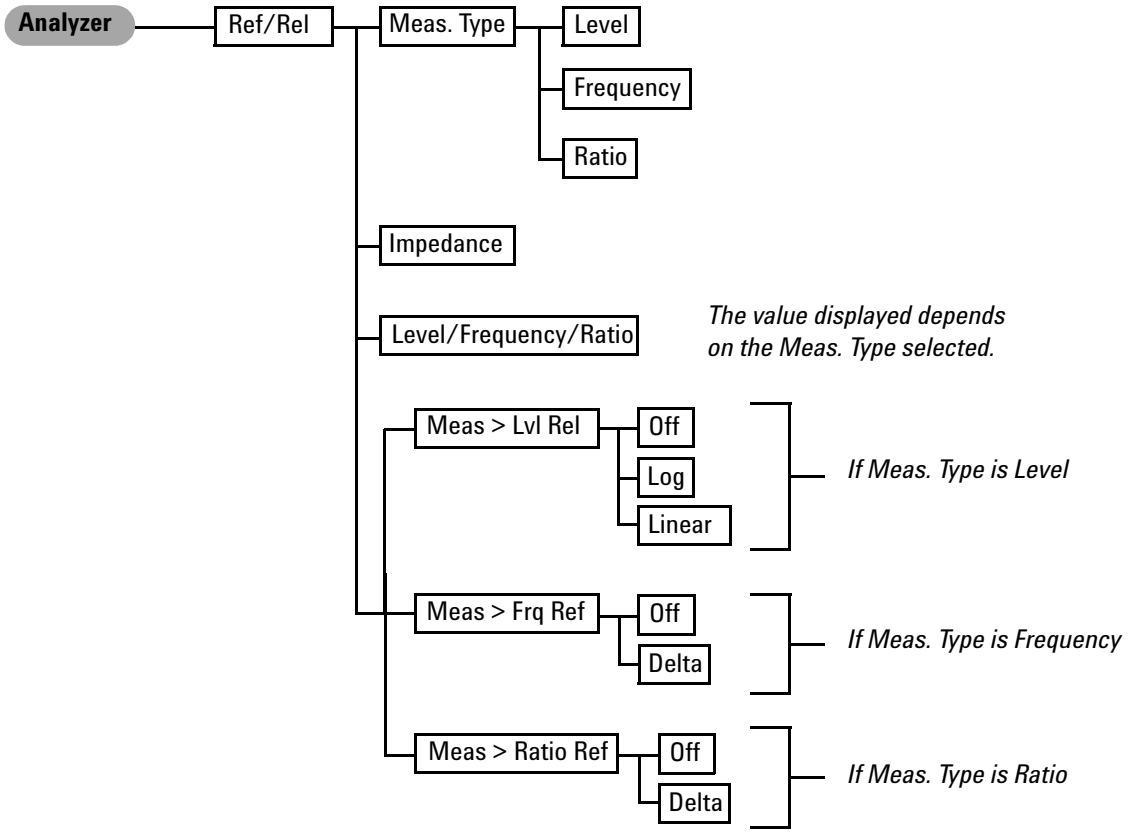


Figure 2-7 Analyzer: Ref/Rel menu tree

Table 2-3 Analyzer menu description

Level 1	Level 2	Level 3	Description
Function 1	Frequency		Select the first measurement parameter
	Vac		
	Vdc		
Function 2	Frequency		Select the second measurement parameter
	Vac		
	Vdc		
	SNR		
	Noise Level		
	SINAD		
	THD + N Ratio		
	THD + N Level		
	Crosstalk (Ch Driv)		
	Crosstalk (Ch Meas)		
	SMPTE IMD		
	DFD 60268 2nd		
	DFD 60268 3rd		
	DFD 60118 2nd		
	DFD 60118 3rd		
	Phase		

Table 2-3 Analyzer menu description (continued)

Level 1	Level 2	Level 3	Description
Units	Function 1 Function 2	Hz ΔHz V dBu dBV dBm W dBr dBg x dB ΔdB % °	Select the unit according to the function type
Analyzer Settings	Coupling	AC DC	Select either AC or DC coupling
	Detector	RMS QPK Peak-to-Peak	Select either RMS, Quasi Peak, or Peak-to-Peak detection type
	Filter	None	Unselect the filter function
		LPF	Select either None, 15 kHz, 20 kHz, 30 kHz, or Custom
		HPF	Select either None, 22 Hz, 100 Hz, 400 Hz, or Custom
		Weighting	Select either None, A-Weighting, CCIR 1k wtd, CCIR 2k wtd, C-Message, CCITT, or Custom
	Input Type	Balanced Unbalanced	Select either Balanced or Unbalanced input connection
	Range	Auto 400 mV to 140 V	Select the input range
	Frequency Lock	Auto Gen. Lock	Select the fundamental frequency lock method for SINAD, THD Level, and THD Ratio measurement

Table 2-3 Analyzer menu description (continued)

Level 1	Level 2	Level 3	Description
Common Settings	Bandwidth	High Low	Select either High or Low measurement bandwidth
	Meas Time	Gen Track 1/128 s to 1 s	Select the measurement time
	Trigger	Free Run External	Select either Free Run or External trigger
	Avg. Points		Select the average points, from 1 to 50
Ref/Rel	Meas. Type	Level Frequency Ratio	Select either Level, Frequency, or Ratio measurement type
	Impedance		Set the reference impedance value
	Level		Set the voltage reference value
	Frequency		Set the frequency reference value
	Ratio		Set the ratio reference value
	Meas > Lvl Rel	Off Log Linear	Select either Off, Log, or Linear
	Meas > Frq Ref	Off Delta	Select either Off or Delta
	Meas > Ratio Ref	Off Delta	Select either Off or Delta

Graph (Frequency domain and Time domain)

Pressing Frequency Domain or Time Domain changes the display screen to the frequency domain or time domain display respectively. In the frequency domain mode, you can select the settings related to the frequency domain graph display. On the other hand, the time domain mode allows you to access the settings for the time domain graph display. The figure below shows the frequency and time domain menu trees.

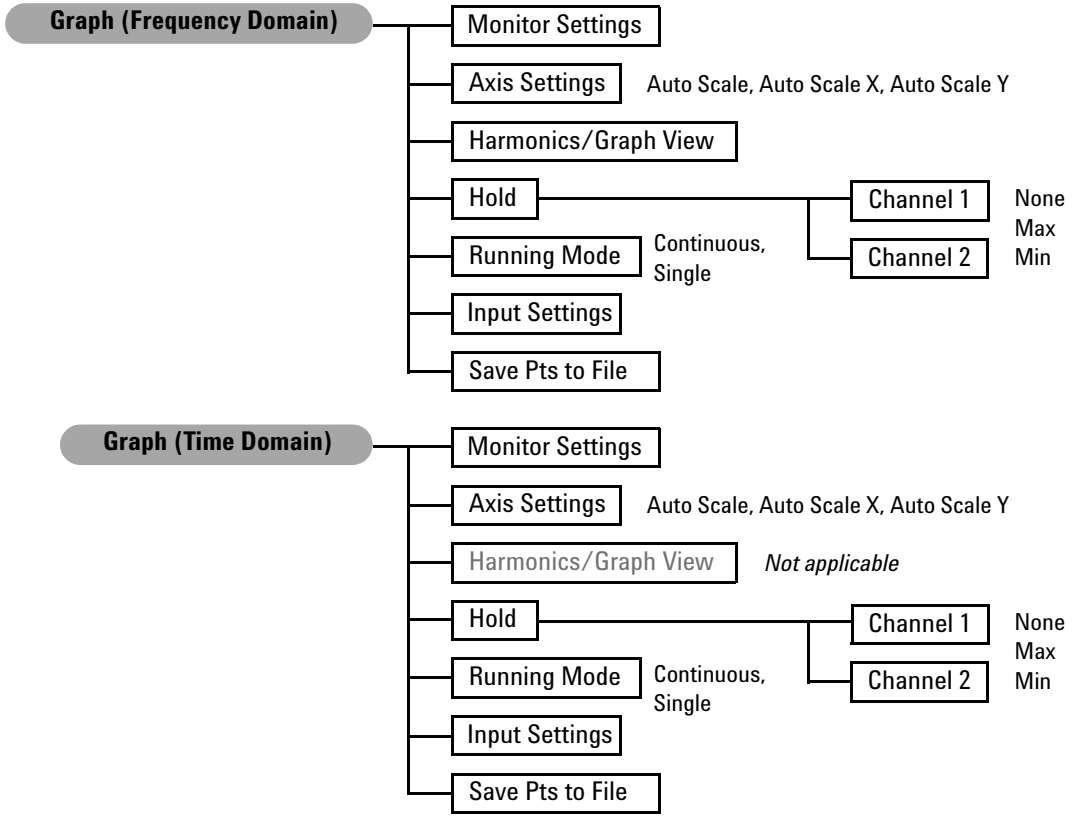


Figure 2-8 Frequency and time domain menu trees

Table 2-4 Graph (frequency/time domain) menu description

Level 1	Level 2	Level 3	Description
Monitor Settings			Select which channel(s) to display, analysis mode, window function, number of points, and synchronous averaging.
Axis Settings	Auto Scale Auto Scale X Auto Scale Y		Enter the graph axis values and spacing type. You can also choose to perform autoscaling.
Harmonics/Graph View			Displays the level of each signal harmonic component. This function is not applicable in the time domain mode.
Hold	Channel 1 Channel 2	None Max Min	Select the holding mode to be used to update the graph data for channel 1 and 2.
Running Mode	Continuous Single		Select either **Continuous** to allow the graph to run continuous measurements, or **Single** to stop the measurements.
Input Settings			Select the channel, measurement bandwidth, input connection, input range, AC/DC coupling, and trigger settings.
Save Pts to File			Saves the graph points to a file.

Sweep

Pressing Sweep changes the display screen to the sweep mode. On the Sweep menu, you can select the settings related to the sweep display. The figure below shows the sweep function menu tree.

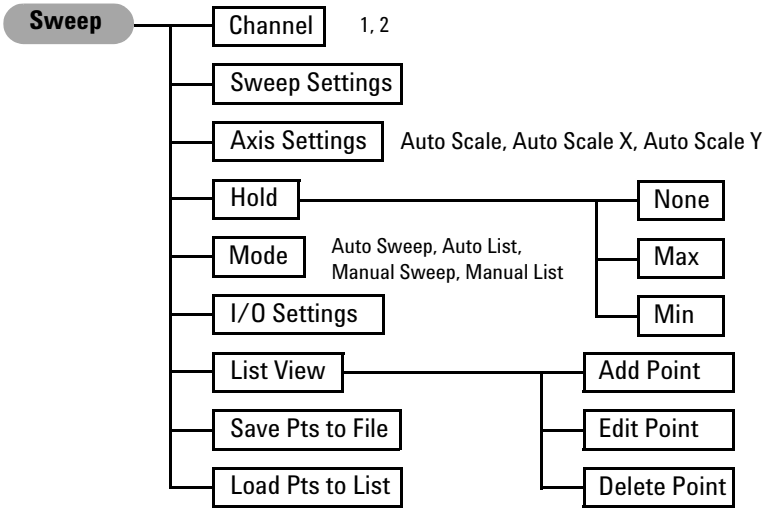


Figure 2-9 Sweep function menu tree

Table 2-5 Sweep menu description

Level 1	Level 2	Description
Channel	1 or 2	Select the channel to perform sweep.
Sweep Settings		Select the waveform type, generator sweep parameter, sweep interval, and analyzer measurement function, as well as configure the sweep points, spot values, and dwell time.
Axis Settings	Auto Scale Auto Scale X Auto Scale Y	Enter the graph axis values and spacing type. You can also choose to perform autoscaling.

Table 2-5 Sweep menu description (continued)

Level 1	Level 2	Description
Hold	None Max Min	Select the holding mode to be used to update the graph data.
Mode	Auto Sweep Auto List Manual Sweep Manual List	Select the sweep and list modes.
I/O Settings		Configure the input and output settings.
List View	Add Point Edit Point Delete Point	Displays the sweep results in list form. You may add sweep points, edit the sweep parameter value of a selected point, or delete points.
Save Pts to File		Saves the sweep points to a file.
Load Pts to List		Loads the sweep points from a file

Graph functions

This group provides quick access to the commonly used graph functions.

Figure 2-10 Graph panel

The description for each key on the Graph panel is shown in the table below.

Table 2-6 Graph panel key description

Item	Key	Description
1	Peak Search	Places a marker on either the peak or minimum of the graph
2	Marker	Accesses the marker softkeys that select the current and reference markers and turns them on and off. You may also move the markers and display the marker measurement data.
3	Marker →	Accesses the marker softkeys that display the section of the graph based on the selected marker position
4	Full Screen	Maximizes the graph view to the full display size

Run/Stop and On/Off

For generator or analyzer, you can select a channel by pressing the arrow keys  on the U8903A front panel.

Toggling 

on the front panel will start or stop signal generation on a generator channel or measurements on an analyzer channel.

Toggling 

on the front panel will turn on or off the generator output for all active channels.

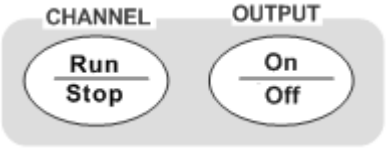


Figure 2-11 Run/Stop or On/Off option

The following figure shows an example of individual channel selection and measurement status on the analyzer channel.

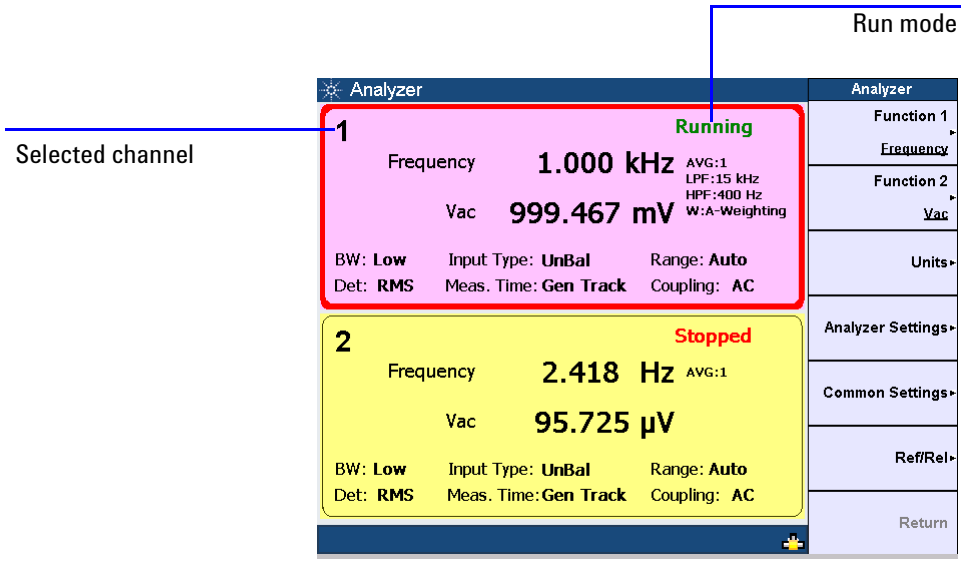


Figure 2-12 Channel selection and status

When the selected analyzer channel is in Run mode, the U8903A will take continuous readings as fast as possible based on the specified measurement time.

Pressing Run Stop while in the Run mode will stop the measurements for the selected analyzer channel.

System

The U8903A provides access to some useful system functions located on the System panel as shown in the following figure.

Figure 2-13 System panel

The description for each key on the System panel is shown in the following table.

Table 2-7 System panel key description

Item	Key	Description
1	Save	Saves the U8903A state to a file
2	Recall	Recalls the U8903A state from a file
3	Display Mode	Toggles between the number of channels to show on the LCD display
4	Print	Prints the display to a file on a USB external flash storage
5	Preset	Presets the U8903A to its factory default settings
6	Local	Activates local control to switch from remote mode to front panel access
7	System	Loads the System menu
8	Help	Activates the help function

Save

This function saves the current U8903A state to a file. You have the option to save the U8903A state for a single channel or whole module. When Save is pressed in the sweep, analyzer, or generator mode, you may select either the selected channel or whole module to save the U8903A state. When Save is pressed in the graph mode, you can only select the whole module to save the U8903A state. The File Manager will be launched once you have made your selection.

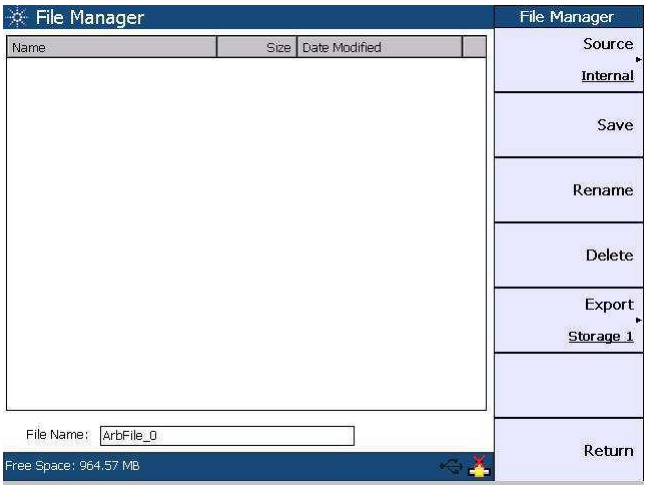


Figure 2-14 File Manager menu for saving the U8903A state

You may save the current U8903A state to a file in either the U8903A internal memory or a USB external flash storage. Set the storage location for your file by pressing **Source** and select either the U8903A internal memory or a USB external flash storage before saving.

To save the file, press **Save**. To delete a file, press **Delete**. You may change a selected file name by pressing **Rename.** To export a file from the U8903A internal memory to a USB external flash storage, press **Export** and select the desired external flash storage.

Recall

This function recalls a saved U8903A state from a file in either the U8903A internal memory or a USB external flash storage. The File Manager will be launched once Recall is pressed.

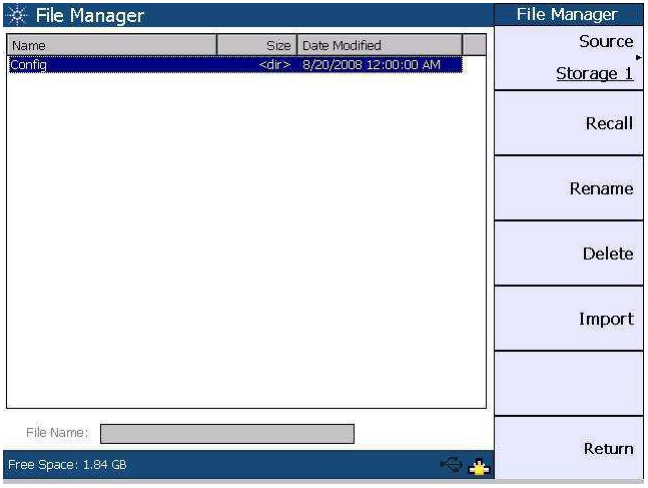


Figure 2-15 File Manager menu for recalling the U8903A state

Press **Source** to select a saved U8903A state file in either the U8903A internal memory or a USB external flash storage. When you have selected a state file, pressing **Recall** will display a Recall page. For single channel state file, the Recall page allows you to select the channel(s) to apply the settings. For module state file except graph, the Recall page allows you to select which channel settings to be applied. As there are no multiple channel settings in the graph state file, channel selection is not applicable in its Recall page. For more information, refer to the *U8903A Audio Analyzer Instrument Help File*.

To import a file from a USB external flash storage to the U8903A internal memory, press **Source** and select the external flash storage. Select the desired file and press **Import**.

Display mode

Toggling Display Mode will display either two or eight channels for the generator mode and display either two channels, analyzer-generator channels, or eight channels for the analyzer mode.

The analyzer-generator display is shown as follows. This display is only available in the analyzer mode.

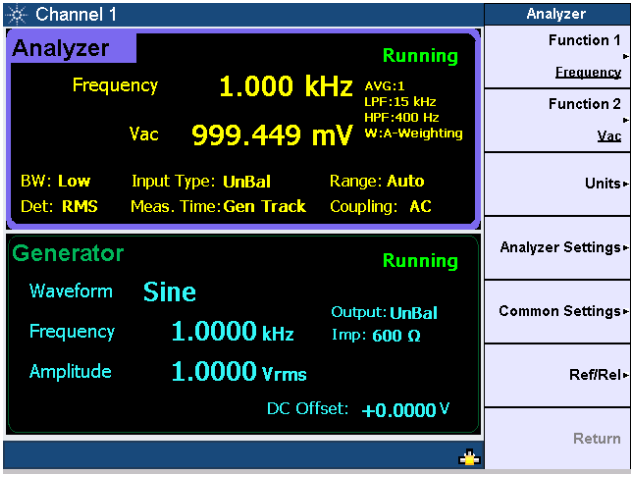


Figure 2-16 Analyzer-generator display

The analyzer 8-channel display is shown as follows. Only two channels are displayed as channels 3 to 8 are only available in future releases.

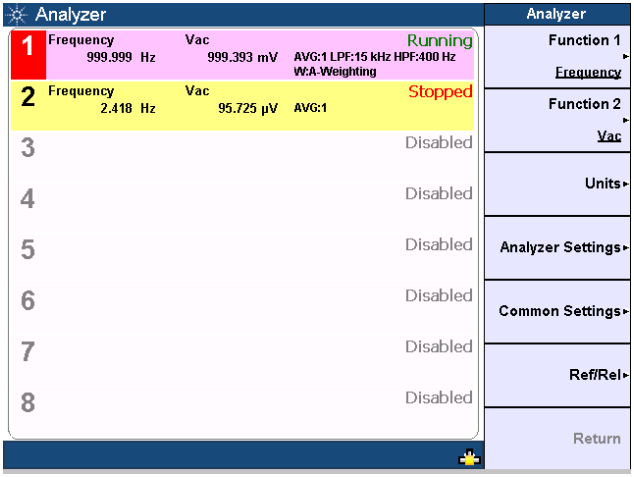


Figure 2-17 Analyzer 8-channel display

Print

This function prints the display to a file on a USB external flash storage.

Preset

This function presets the U8903A to its factory default settings. When Preset is pressed in the sweep, analyzer, graph, or generator mode, you may choose to preset any of the following:

- Selected channel (only applicable for the sweep, analyzer, or generator mode)
- Selected module
- All modules without deleting the user-defined files
- Whole system including deletion of the user-defined files.

Local

This function returns the U8903A to local operation from the remote mode.

System

The following figure shows the system function menu tree.

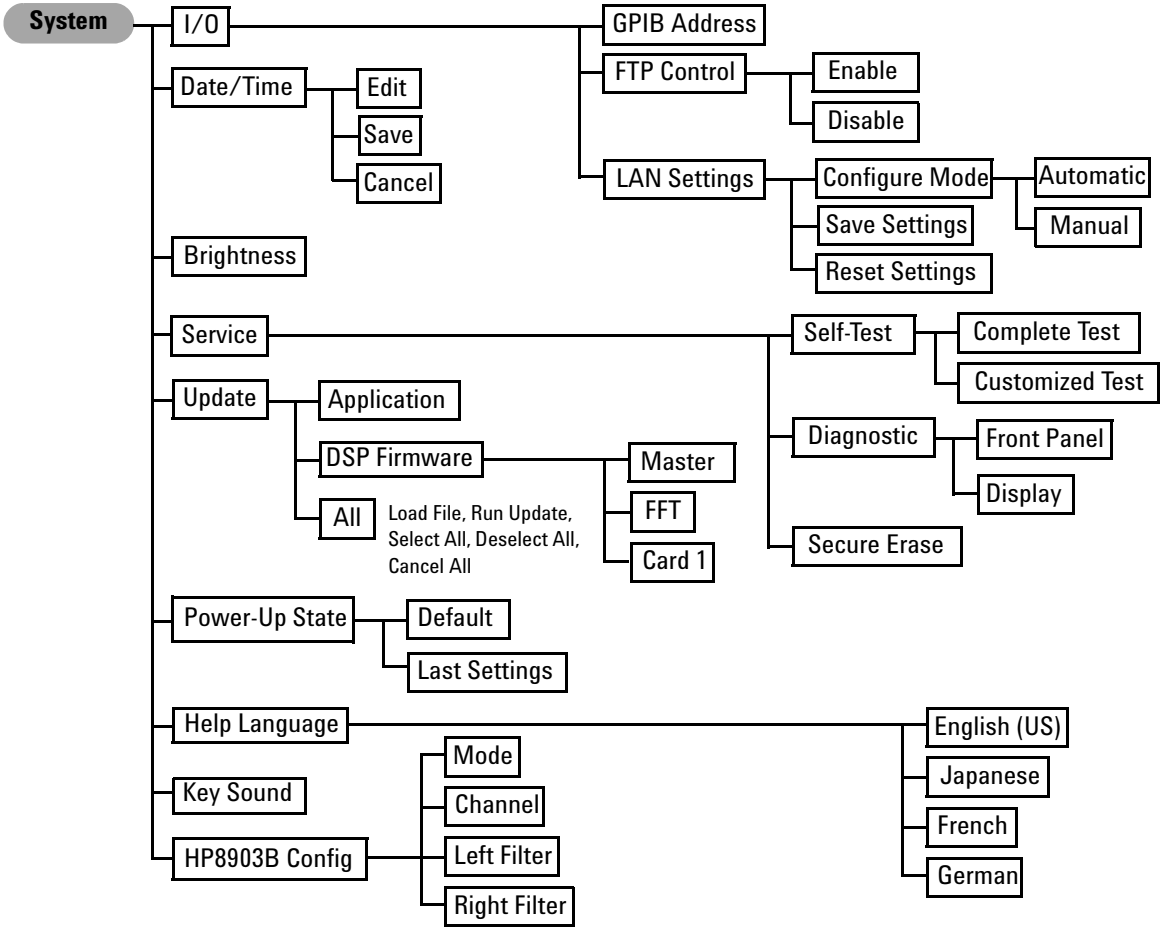


Figure 2-18 System function menu tree

Table 2-8 System menu description

Level 1	Level 2	Level 3	Level 4	Description
I/O	GPIB Address			Enter the GPIB address value
	FTP Control	Enable Disable		Enables or disables the FTP control
	LAN Settings	Configure Mode	Automatic Manual	Select the mode to enter the LAN settings
		Save Settings		Saves the LAN settings
		Reset Settings		Resets the LAN settings
Date/Time	Edit			Enter the date and time
	Save			Saves the date and time settings
	Cancel			Cancels the changes made
Brightness				Adjust the brightness of the LCD display from 0 to 6
Service	Self-Test	Complete Test		Performs a full instrument self-test
		Customized Test		Performs a self-test on a particular section of the U8903A
	Diagnostic	Front Panel		Performs a diagnostic test on the U8903A front panel. You can verify whether a key is functional by observing the change of color for the pressed key.
		Display		Performs a diagnostic test on the LCD display. Full color will be displayed to check for bad pixel.
	Secure Erase			Eradicates stored data in the U8903A

Table 2-8 System menu description (continued)

Level 1	Level 2	Level 3	Level 4	Description
Update	Application			Performs an update of the U8903A application
	DSP Firmware	Master FFT Card 1		Select the DSP firmware to update consisting of Master, FFT, and Card 1
	All	Load File Run Update Select All Deselect All Cancel All		Check for new update and run the update
Power-Up State	Default			Sets the U8903A to its default power-on state
	Last Settings			Sets the U8903A to its previous setting mode upon power up
Help Language	English (US)			Sets the language to English
	Japanese			Sets the language to Japanese
	French			Sets the language to French
	German			Sets the language to German
Key Sound				Turns on/off the keypad sound
HP8903B Config	Mode			Select to enable/disable the HP8903B mode
	Channel			Select the active channel for HP8903B mode
	Left Filter			Sets the left filter type
	Right Filter			Sets the right filter type

NOTE

In default setting, the HP8903B mode is enabled.

There are some limitations when the HP8903B mode is enabled.

- HP8903B commands are only applicable in GPIB interface.
- Large data (32K graph data or image capture using `SYST:DISP:IMAG?` command) are not able to be acquired using the GPIB interface.
- GPIB response is slower in HP8903B mode.

NOTE For more information on the system functions, refer to the *U8903A Audio Analyzer Instrument Help File*.

Help

This function activates the help mode which provides a description of each front panel key or current softkey. Refer to Chapter 1, "Help System" on page 16 for the details.

Editing Keys

The editing keys consist of the left navigation keys and right input keys as shown in the following figure.

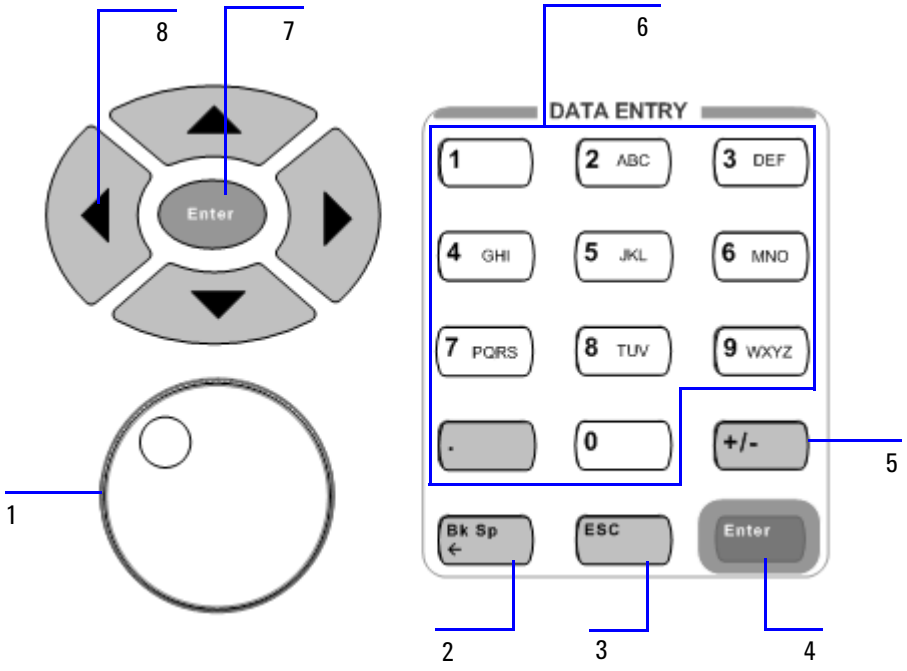


Figure 2-19 Editing function keys

The description for each editing key or control is shown in the table below.

Table 2-9 Editing key/control description

Item	Control	Description
1	Knob	Rotate the knob to increase or decrease a numeric value, change a highlighted digit or character, or step through lists or items in a row
2	Back Space	Deletes the character to the left of the cursor
3	Esc	Cancels a selected action
4	Enter	Confirms an entry
5	+/–	Specifies a positive or negative value. For a negative value, toggle this key to enter the negative sign before a numeric value.
6	Numeric keys	Enter alphanumeric data by using the number keys and decimal point, or select the channel number in analyzer mode
7	Enter	Confirms an entry
8	Arrow keys	Use the arrow keys to select a channel, and highlight or navigate the editable items on the LCD display for editing

3 Instrument Configuration

U8903A Block Diagram 54
Input Settings 56
- AC/DC coupling 57
- AC level detection 58
- Digital filters 59
- Input configuration 60
- Input ranging 61
- Frequency Lock 62

Common Settings 63
- Measurement bandwidth 63
- Measurement time 64
- Trigger 66
- Average Points 67

Ref/Rel 68
Output Settings 70
- Output type 70
- Output impedance 71
- Reference impedance 71

This chapter describes how to configure the U8903A inputs and outputs to obtain the optimum measurement results for your application.

U8903A Block Diagram

A simplified U8903A block diagram is shown as follows.

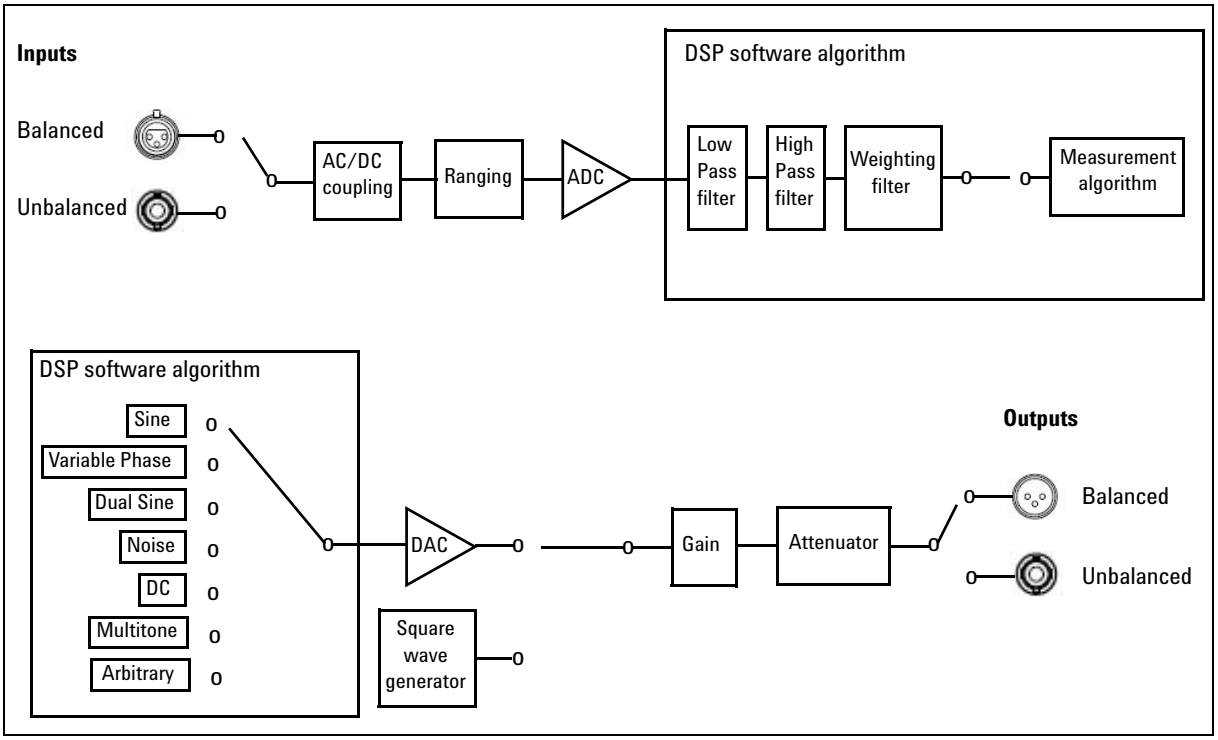


Figure 3-1 U8903A block diagram

The description for the U8903A block diagram is provided as follows.

Measurement

An audio signal can enter the analyzer through either the Balanced (XLR) or Unbalanced (BNC) input signal connector. The audio signal then passes through the AC/DC coupling circuit. If AC coupling is selected, its DC component is blocked, thus only the AC component of the signal passes through to the Ranging circuit. However, if DC coupling is selected, the entire signal passes through to the Ranging circuit.

The Ranging circuit conditions the signal to as close to the full scale of the analog-to-digital converter (ADC) as possible, optimizing the measurement dynamic range. The 24-bit ADC then converts the analog signal to its digital form and sends it to the digital signal processor (DSP). Inside the DSP, the digital signal may optionally pass through a combination of up to three digital filters, one each from the low pass, high pass, and weighting filter groups before sending it to the measurement section.

Signal generation

The DSP generates all the required waveforms, except for square wave, digitally. The digital waveform data is streamed realtime into the 24-bit digital-to-analog converter (DAC) where it is converted to voltage and sent to the output conditioning block to be amplified or attenuated to the required amplitude. Finally, the waveform is routed through either the Balanced (XLR) or Unbalanced (BNC) output signal connectors to the unit-under-test (UUT).

Input Settings

The U8903A analyzer inputs can be configured with selectable AC/DC coupling, AC level detector, digital filters, Unbalanced/Balanced input connections, and measurement ranges as shown in the following figure.

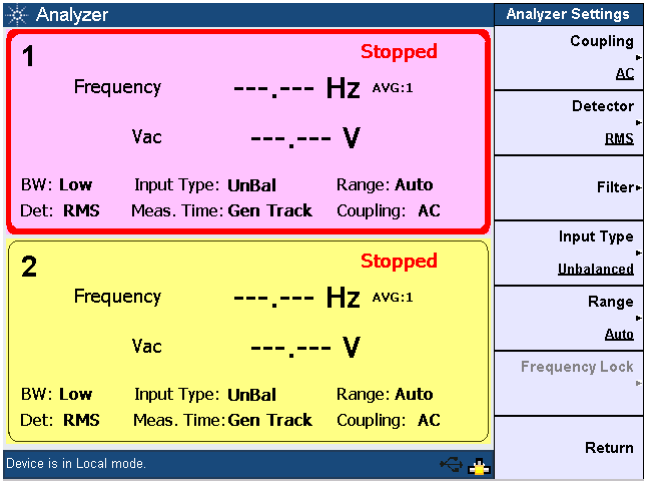


Figure 3-2 Analyzer input settings

AC/DC coupling

The DC coupled setting allows both AC and DC input signals to pass through to the measurement circuitry. The AC coupled setting blocks the DC component of the input signal by switching a capacitor in series to the input path.

The DC coupled setting allows signals to be measured down to 0 Hz. This setting should be used when making DC voltage measurements. The AC coupled setting is selected when you need to measure only the AC component of a signal, for example, when making RMS or peak-to-peak voltage measurements.

The AC/DC coupling selection is shown as follows.

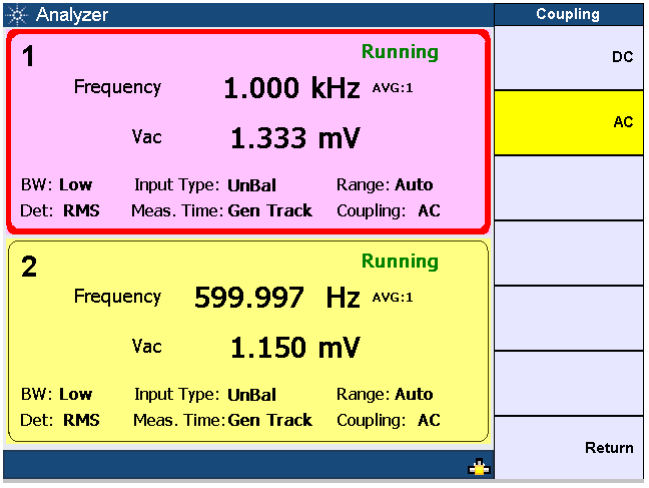


Figure 3-3 AC/DC coupling selection

AC level detection

There are three AC level detection types consisting of RMS, Peak-to-Peak, and Quasi Peak as shown in the following figure. The RMS detector performs a conventional true root-mean-square (RMS) measurement on the input signal. This RMS value includes the DC component, unless the AC coupling mode is selected. The Peak-to-Peak detector returns the peak-to-peak voltage, while the Quasi Peak detector provides a response conforming to the CCIR-468 specification for noise measurements. This detector is usually used together with the CCIR-1k weighted filter.

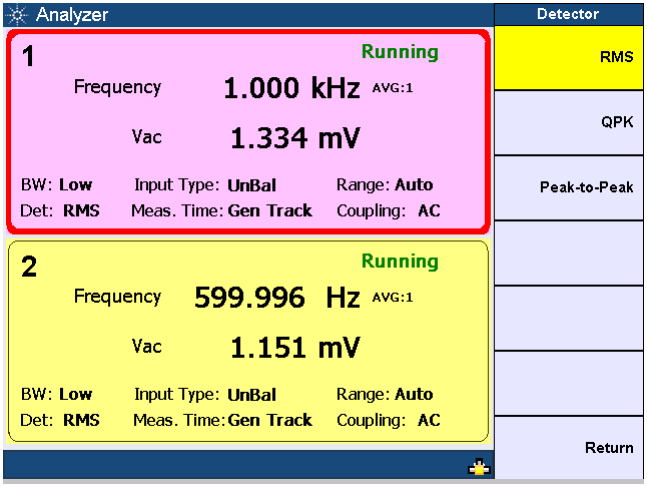


Figure 3-4 AC level detector selection

Digital filters

Digital filters are used to bandwidth limit the input signals before applying a measurement function. There are three selectable filter types consisting of low pass, high pass, and weighting as shown in the figure below. Up to three filters, one from each type, can be applied to the signal simultaneously. The U8903A also allows user-defined filters to be uploaded to the device. Refer to "Appendix C: User-defined Filter File Format" on page 152 for more information on the user-defined filter file format.

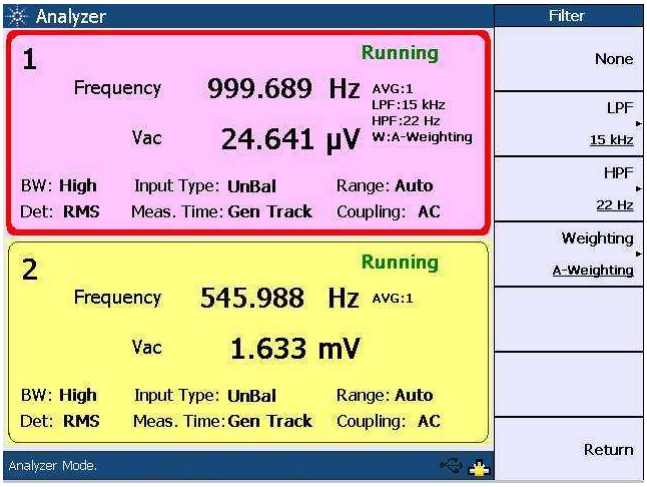


Figure 3-5 Digital filter selection

The low pass, high pass, and weighting filter selection is as follows.

Table 3-1 Filter selection

Low pass filter	High pass filter	Weighting filter
15 kHz	22 Hz	A-Weighting
20 kHz	100 Hz	CCIR-1k weighted
30 kHz	400 Hz	CCIR-2k weighted
User-defined	User-defined	C-Message
		CCITT
		User-defined

Input configuration

The input signal connectors can be configured as Balanced or Unbalanced as shown in the following figure. The Balanced configuration routes signals from the front panel XLR input connectors to the analyzer. The signals on the positive and negative XLR pins enter a differential amplifier where they are subtracted before passing on to the detector. The Unbalanced configuration selects the front panel BNC connectors as the input source. The signal in the inner conductor of the coaxial connector is referenced to ground for measurement.

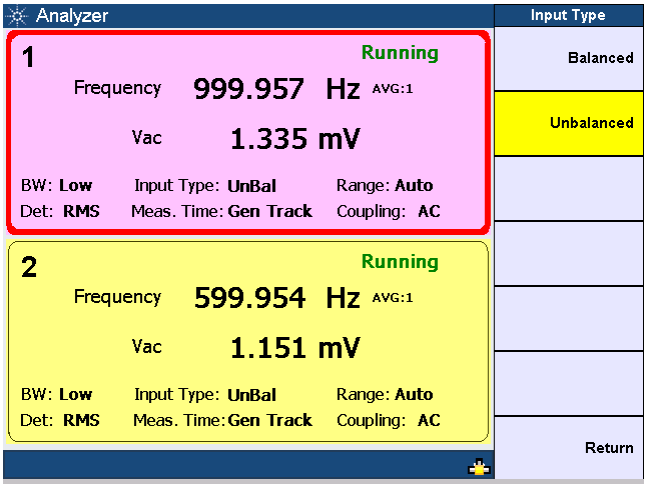


Figure 3-6 Input signal connector configuration

Input ranging

The default range setting is Auto, where the analyzer sets the optimum input range based on the input signal amplitude. The input range can also be set manually, with the values given below.

- 400 mV
- 800 mV
- 1.6 V
- 3.2 V
- 6.4 V
- 12.8 V
- 25 V
- 50 V
- 100 V
- 140 V

Frequency Lock

The fundamental frequency lock setting is only applicable when Function 2 measurement of the specified channel is set to SINAD, THD + N Ratio, or THD + N Level. If Function 2 measurement is set to SINAD, the default frequency lock type is Gen. Lock, whereas for THD + N Ratio and THD + N Level, the default frequency lock type is Auto.

When the frequency lock type is set to Auto, the fundamental frequency is determined by the measured signal frequency of the frequency measurement function. Function 1 measurement is set to Frequency if the frequency lock type is Auto.

When the frequency lock type is set to Gen. Lock, the fundamental frequency is determined by the frequency value set at the corresponding generator channel.

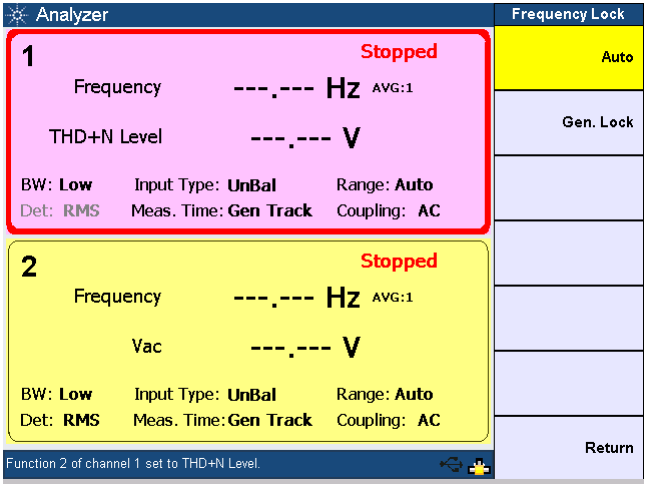


Figure 3-7 Frequency lock

Common Settings

The following figure shows the U8903A analyzer common settings.

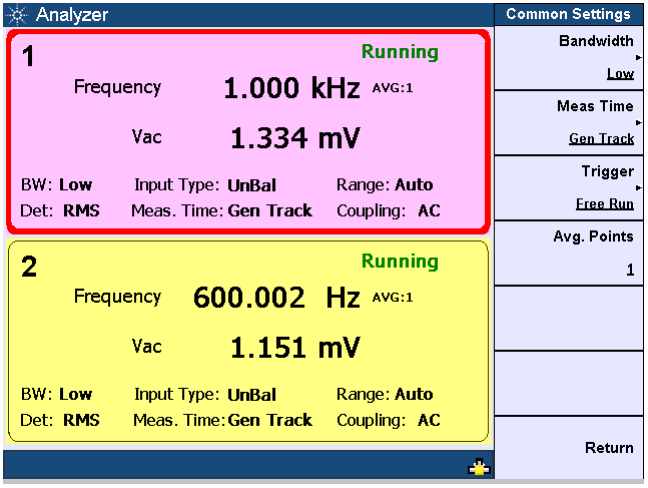


Figure 3-8 Common settings

Measurement bandwidth

The U8903A has two settings for measurement bandwidth. The low bandwidth mode has a maximum measurement bandwidth of 30 kHz, while the high bandwidth mode can measure signals with frequencies up to 100 kHz. The low bandwidth mode is the default setting with better residual noise and distortion performance.

The measurement bandwidth selection is shown as follows.

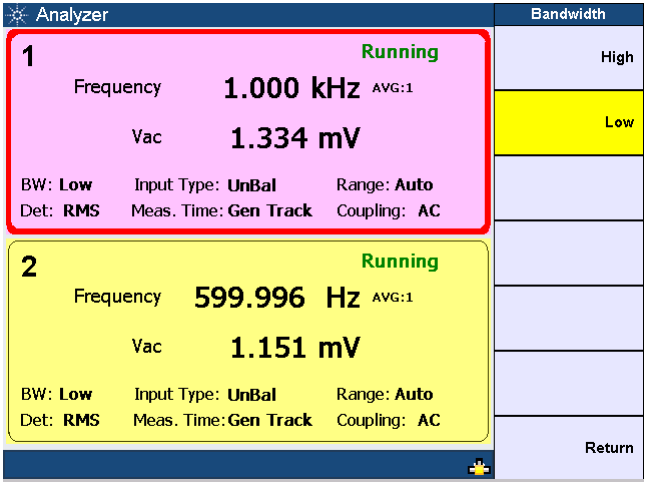


Figure 3-9 Measurement bandwidth selection

Measurement time

The measurement time can be set to Gen Track or a fixed duration ranging from 0.0078125 s (equivalent to a measurement rate of 128 readings/s) to 1 s. When the measurement time is set to Gen Track, the analyzer will vary the measurement time according to the generator frequency for the same channel. This is useful when making sweep measurements as the measurement time will be optimized for fast sweeps. However, Gen Track works only if the signal is looped back from the U8903A output to its input.

The measurement time selection is shown as follows.

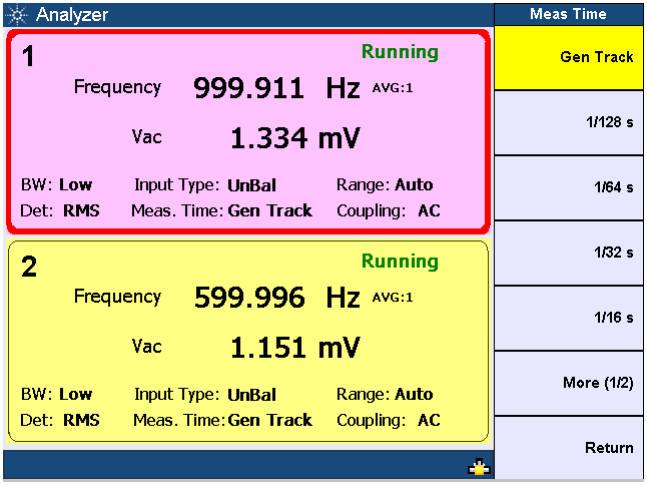


Figure 3-10 Measurement time selection first page

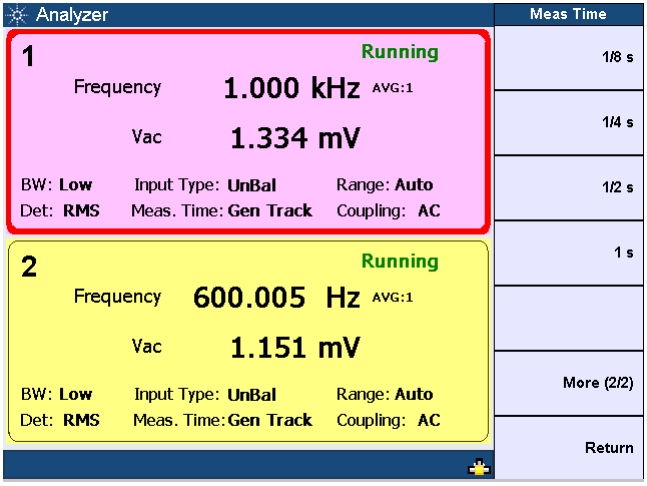


Figure 3-11 Measurement time selection second page

Trigger

The default trigger setting is Free Run, where the analyzer triggers immediately after the previous data is acquired. If External triggering is set, the analyzer waits for a trigger pulse on the Trigger In connector of the rear panel before acquiring the measurement data. The figure below shows the trigger setting selection of the analyzer.

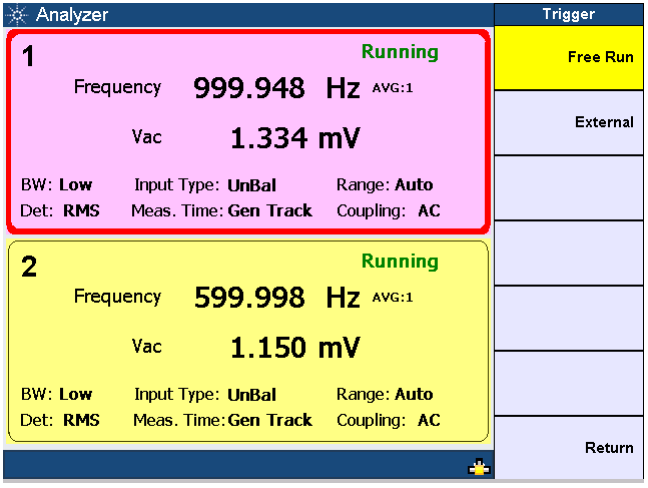


Figure 3-12 Trigger settings selection

Average Points

The default average points setting is 1. This sets the number of readings used for averaging. Higher number of average points should be used when the analyzed data is noisy. The figure below shows the average points setting selection of the analyzer.

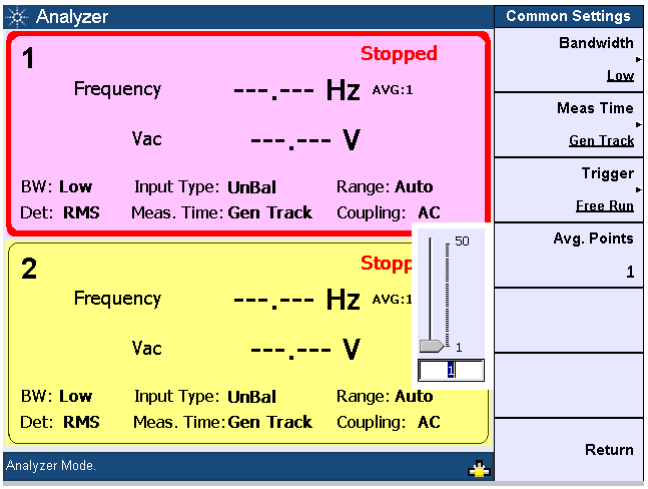


Figure 3-13 Average points selection

Ref/Rel

The Ref/Rel section sets the reference impedence, voltage, frequency, and ratio values depending on the type of reference to be set for unit conversion. There are three available types consisting of Level, Frequency, and Ratio.

For the relative level values, the level measurement can be displayed in Off mode, Log mode (dBr), or Linear mode (x).

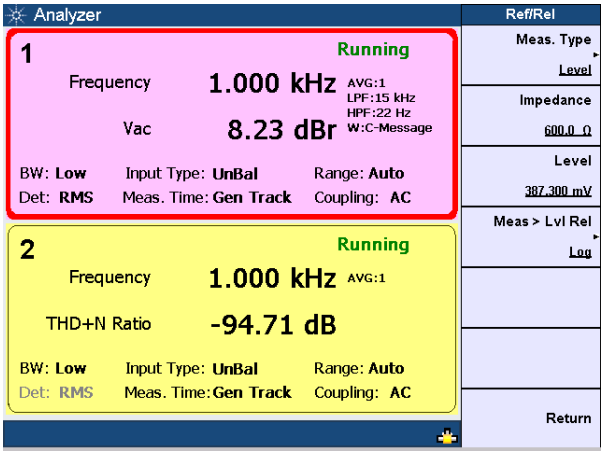


Figure 3-14 Reference Level

For the reference frequency values, the frequency measurement can be displayed in Off mode (Hz) or Delta mode (ΔHz).

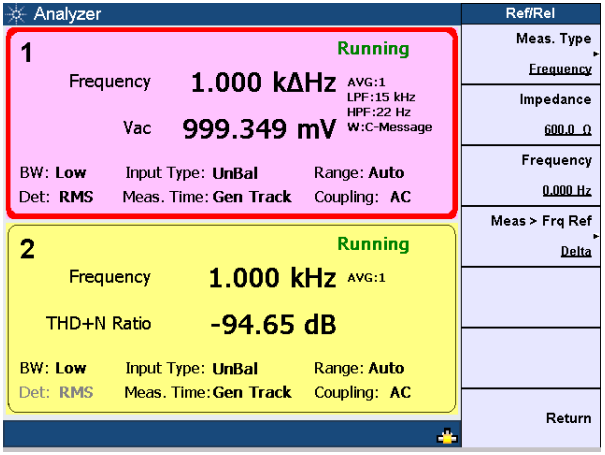


Figure 3-15 Reference Frequency

For the reference ratio values, the ratio measurement can be displayed in Off mode or Delta mode (ΔdB).

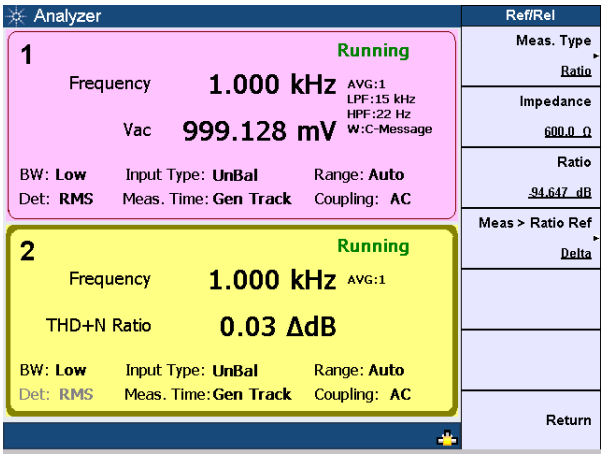


Figure 3-16 Reference Ratio

Output Settings

The U8903A generator output settings can be configured using selectable output connections, impedances, and reference impedances as shown in the figure below.

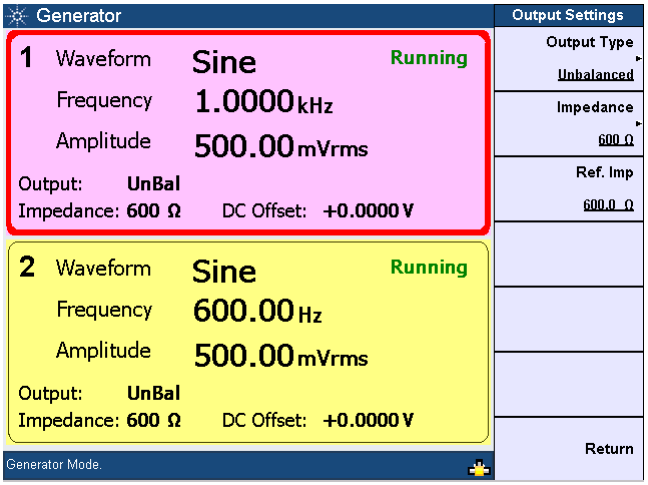


Figure 3-17 Output settings

Output type

The output connection can be set to Balanced, Unbalanced, or Common mode.

Balanced outputs a pair of differential signals which are equal in amplitude but 180 ° out of phase on the XLR positive and negative pins.

Unbalanced outputs a signal referenced to ground on the BNC output connector.

Common mode outputs a pair of equal amplitude and in-phase signals on the XLR positive and negative pins.

Output impedance

The output impedance can be selected as follows.

Balanced and Common mode: 100 Ω, 600 Ω

Unbalanced: 50 Ω, 600 Ω

Reference impedance

The reference impedance can be set as shown in the figure below. The impedance is used for conversion of the measurement result in unit W or dBm.

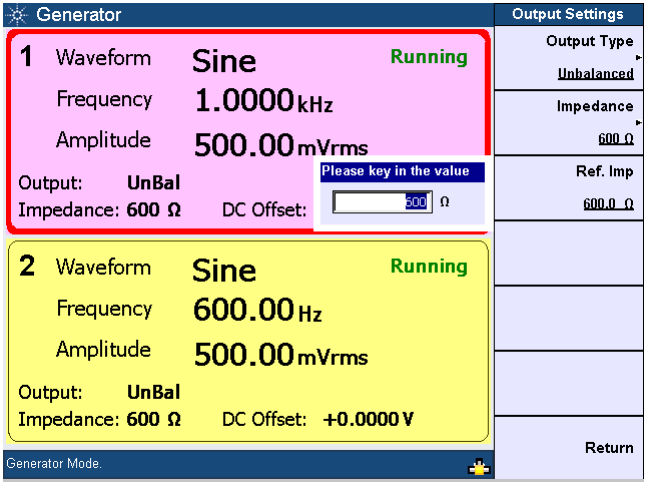


Figure 3-18 Reference impedance

4
Audio Generator Functions

Audio Generator 74
- Sine waveform 76
- Variable phase waveform 77
- Dual sine waveform 78
- Noise signals 84
- DC signal 85
- Multitone waveform 86
- Square waveform 88
- Arbitrary waveform 88

This chapter describes the procedure to generate the U8903A audio test signals.

Audio Generator

Press 

on the Mode panel to access the audio generator settings page.

Select the active channel to start configuring the channel. You can perform a channel selection by using the arrow keys.

The generator waveform functions are listed as follows. These waveform functions are accessible by pressing the corresponding softkeys.

- Sine
- Variable phase
- Dual sine
  - Dual
  - SMPTE IMD 1:1
  - SMPTE IMD 4:1
  - SMPTE IMD 10:1
  - DFD IEC 60118
  - DFD IEC 60268
- Noise
  - Gaussian
  - Rectangular
- DC
- Multitone
- Square
- Arbitrary

The generator waveform selection is shown as follows.

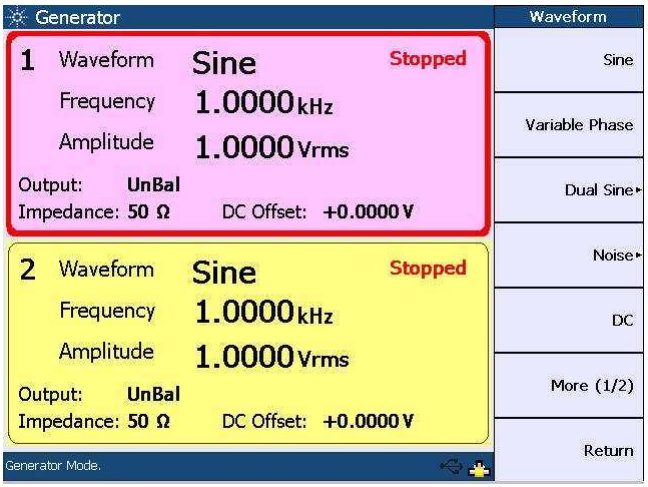


Figure 4-1 Generator waveform selection

Press **More (1/2)** to display more generator waveform selection as follows.

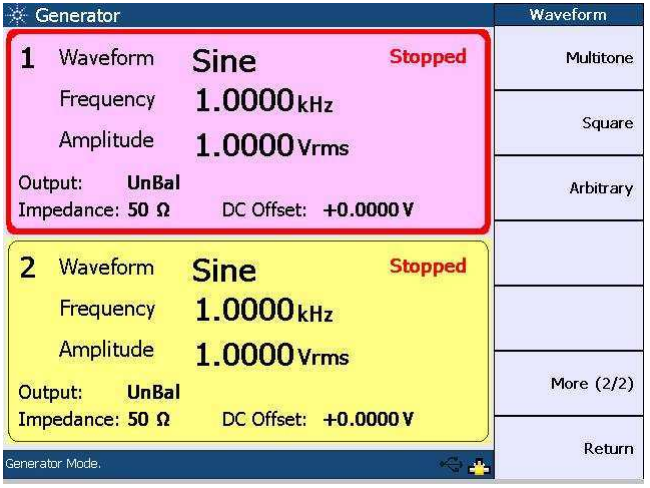


Figure 4-2 More generator waveform selection

To select the desired waveform or signal, press the corresponding softkey.

Sine waveform

The sine waveform is the most basic and commonly used stimulus in audio analysis. Press **Waveform > Sine** to select a sine waveform. The following figure shows the sine waveform menu.

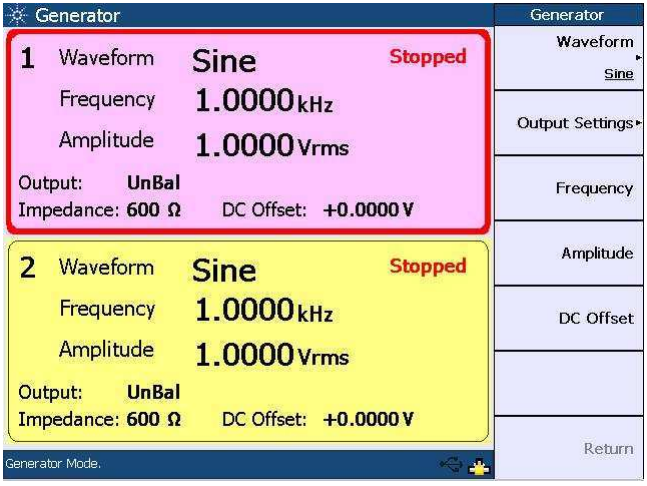


Figure 4-3 Sine waveform menu

The sine waveform may be configured with the following parameters.

- Frequency
- Amplitude
- DC Offset

Frequency is the reciprocal of the period of the signal.

Amplitude can be expressed as Vrms, Vpeak, Vpp, or dBV. For a perfect sine waveform without any DC offset, Vpp is twice Vpeak, while Vrms is equivalent to Vpeak/$\sqrt{2}$.

The DC offset refers to the DC component of the waveform.

The following figure shows a typical sine waveform and its configurable parameters.

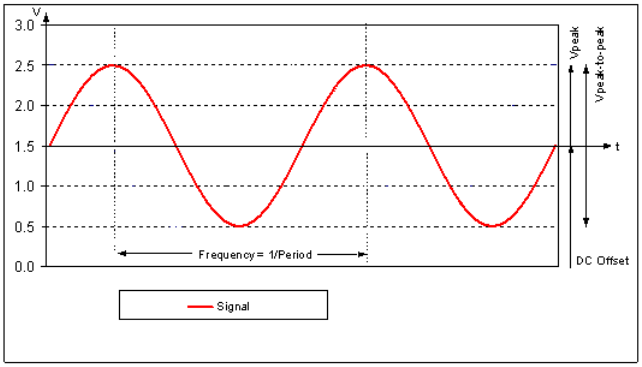


Figure 4-4 Typical sine waveform and parameters

Based on the above figure, Vpeak is equivalent to 1.0 V. Vpp is equivalent to 2 V. The DC offset has a value of 1.5 V. This value is equivalent to the average amplitude of the waveform.

Variable phase waveform

The variable phase mode outputs a sine waveform on all channels. The waveforms on all channels share the same frequency, however their phase and amplitude can differ. Variable phase waveforms are useful for measuring the phase difference or timing skew between the channels of a multiple channel audio system. To select the variable phase waveform, press **Waveform > Variable Phase**.

The variable phase waveform menu is shown as follows.

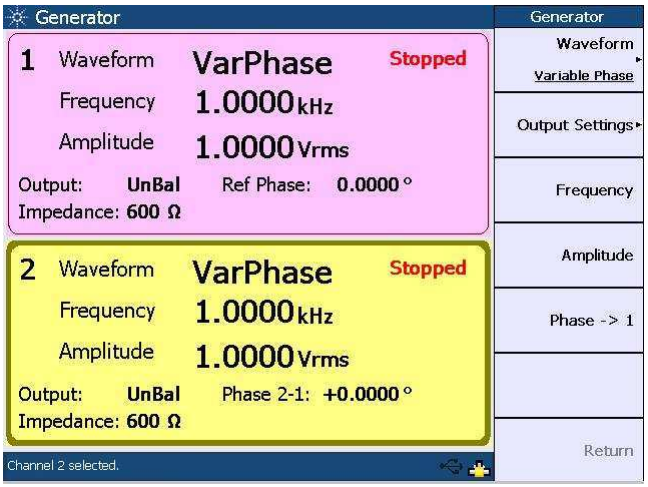


Figure 4-5 Variable phase waveform menu

The variable phase waveform may be configured with the following parameters.

- Frequency
- Amplitude
- Phase $\rightarrow$ 1

Phase $\rightarrow$ 1 refers to the phase of the selected channel with reference to channel 1.

Dual sine waveform

The dual sine waveform group allows you to generate a composite waveform that is the summation of two independent sine waveforms. Dual sine waveforms are useful in testing the intermodulation distortion characteristics of an audio system. To select a dual sine waveform, press **Waveform > Dual Sine**.

The following figure shows the dual sine waveform selection.

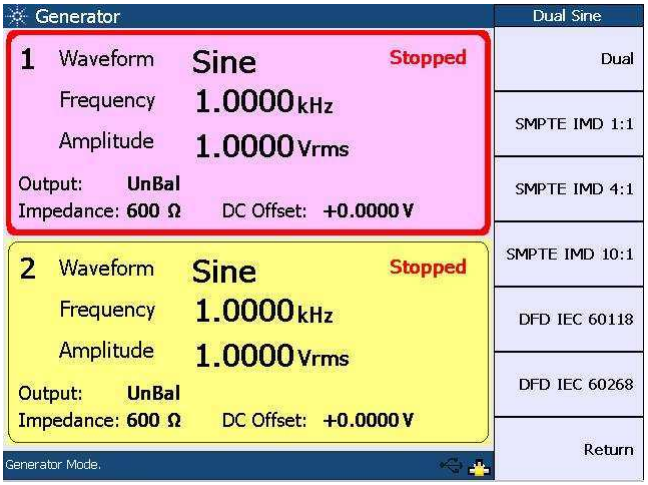


Figure 4-6 Dual sine waveform selection

Dual waveform

You can select a generic dual sine waveform as follows.

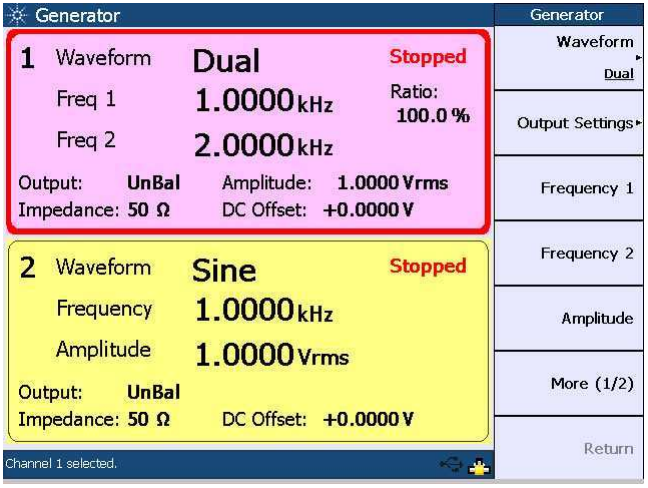


Figure 4-7 Dual waveform menu

Press **More (1/2)** to display more dual sine waveform parameters as follows.

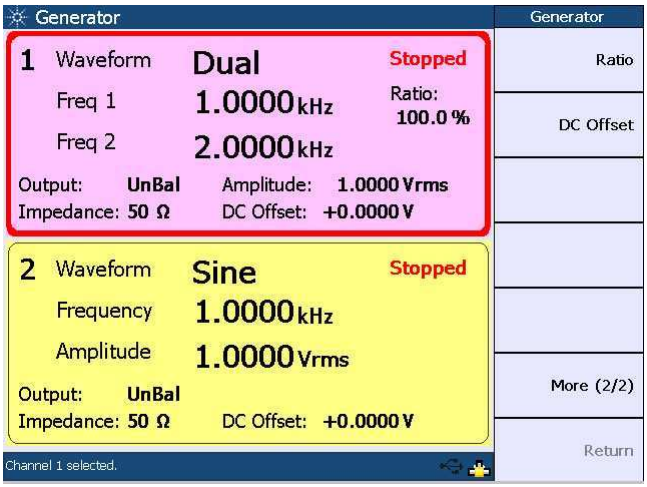


Figure 4-8 More dual sine waveform parameters

The dual sine waveform may be configured with the following parameters.

- Frequency 1
- Frequency 2
- Amplitude
- Ratio
- DC Offset

Frequency 1 is the frequency of the first sine component.

Frequency 2 is the frequency of the second sine component.

Amplitude refers to the amplitude of the composite signal.

Ratio refers to the amplitude ratio of the second component over the first component.

SMPTE IMD waveform

There are three predefined SMPTE IMD dual sine waveforms comprising SMPTE IMD 1:1, 4:1, and 10:1. They conform to the SMPTE standard RP120-1983 for testing intermodulation distortion. The SMPTE IMD waveforms consist of a lower and an upper frequency sine waveform, at default values of 60 Hz and 7 kHz respectively. They are differentiated by the amplitude ratio between the lower and upper frequencies.

The following figure shows the SMPTE IMD waveform menu.

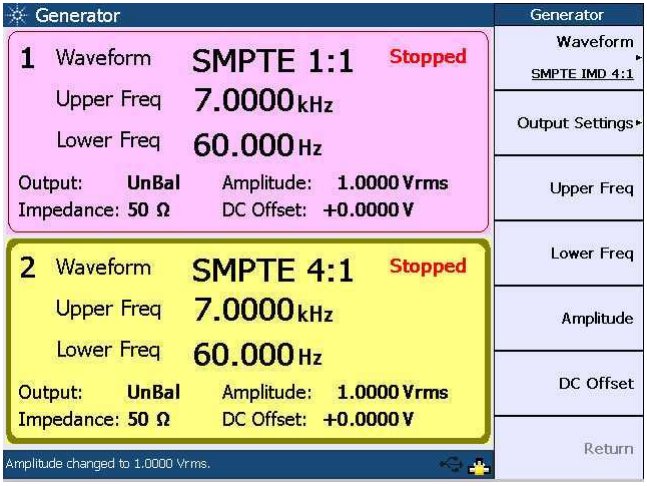


Figure 4-9 SMPTE IMD waveform menu

The SMPTE IMD waveform may be configured with the following parameters.

- Upper Frequency
- Lower Frequency
- Amplitude
- DC Offset

Amplitude refers to the amplitude of the composite signal.

DFD waveform

The DFD waveforms are similar to SMPTE IMD, except that the two tones have equal amplitude and are spaced closer together. There are two predefined DFD dual tones consisting of DFD IEC 60268 and DFD IEC 60118.

The following figure shows the DFD IEC 60118 waveform menu.

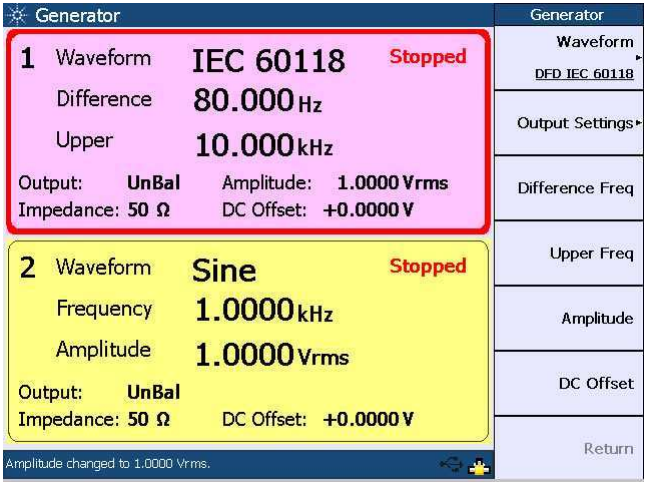


Figure 4-10 DFD IEC 60118 waveform menu

The DFD IEC 60118 waveform may be configured with the following parameters.

- Difference Frequency
- Upper Frequency
- Amplitude
- DC Offset

Amplitude refers to the amplitude of the composite signal.

The DFD IEC 60268 waveform menu is shown as follows.

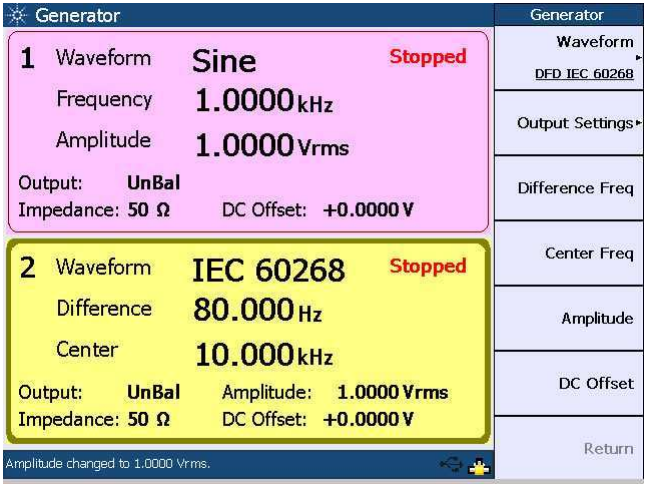


Figure 4-11 DFD IEC 60268 waveform menu

The DFD IEC 60268 waveform may be configured with the following parameters.

- Difference Frequency
- Center Frequency
- Amplitude
- DC Offset

Amplitude refers to the amplitude of the composite signal.

NOTE Refer to "Appendix A: SMPTE IMD and DFD Default Settings" on page 148 for the default settings of both SMPTE IMD and DFD waveforms.

Noise signals

To select the noise signal, press **Waveform > Noise**. You can select either a Gaussian or Rectangular noise signal as shown in the following figure.

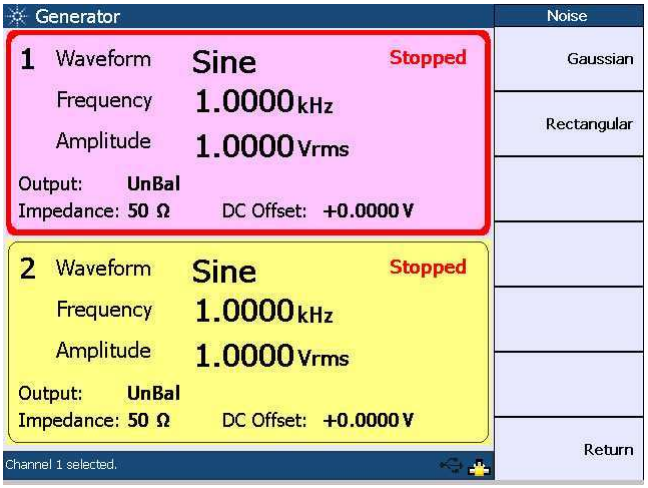


Figure 4-12 Noise signal selection

The Gaussian noise signal menu is shown as follows.

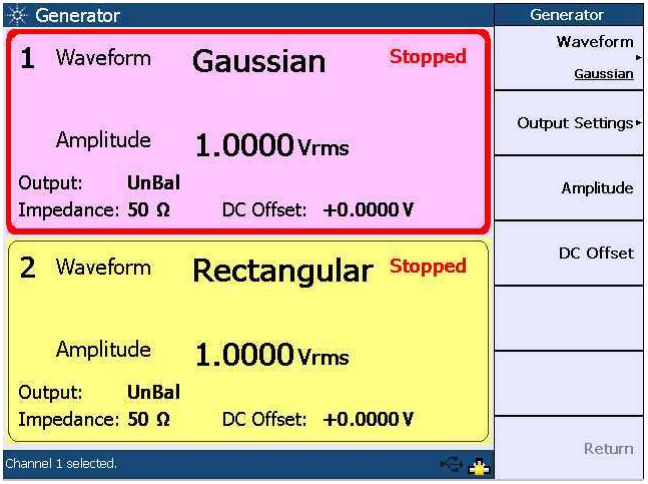


Figure 4-13 Gaussian noise signal menu

The noise signal may be configured with the following parameters.

- Amplitude
- DC Offset

DC signal

A DC voltage is used when performing amplifier linearity measurements. Press **Waveform > DC** to select the DC signal output.

The following figure shows the DC signal menu.

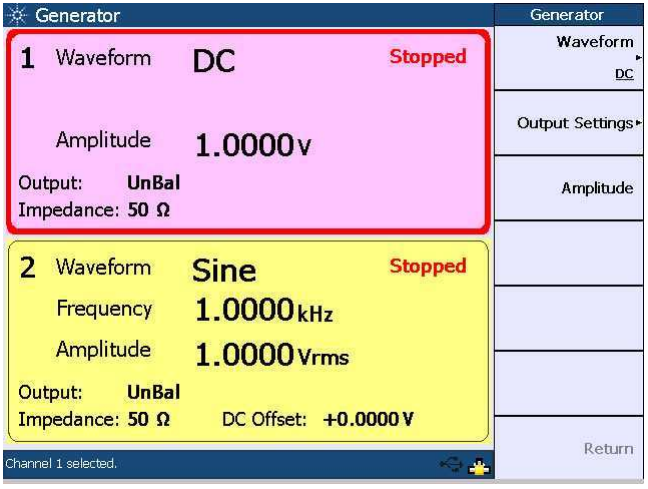


Figure 4-14 DC signal menu

The only configurable parameter for the DC signal is amplitude.

Multitone waveform

To select a multitone waveform, press **Waveform > Multitone**. The multitone waveform menu is shown as follows.

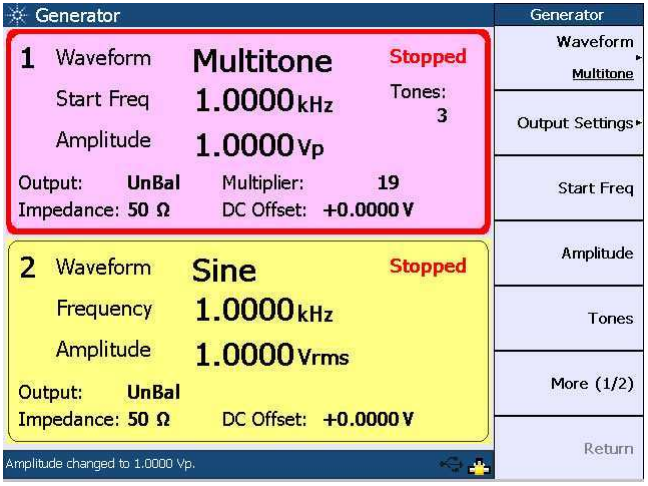


Figure 4-15 Multitone waveform menu

Press **More (1/2)** to display more multitone waveform parameters as follows.

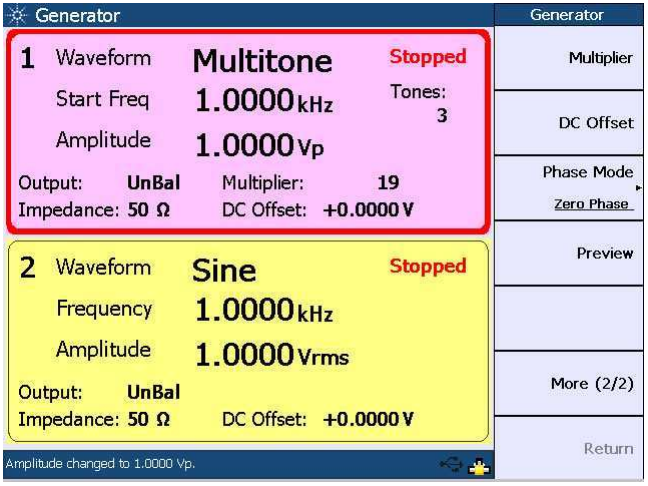


Figure 4-16 More multitone waveform parameters

The multitone waveform may be configured with the following parameters.

- Start Frequency
- Amplitude
- Tones
- Multiplier
- DC Offset
- Phase Mode

Start frequency refers to the waveform fundamental frequency.

Tones refer to the number of signal frequency components.

The multiplier is used to multiply the start frequency to determine the frequency spacing between the tones.

The phase mode consists of the Zero Phase and Random Phase mode. In the Zero Phase mode, all frequency components have the same phase where there is zero phase difference between any two tones. In the Random Phase mode, the phase difference between the tones is randomized. This has the effect of reducing the crest factor for the multitone waveform.

You may display the multitone waveform as follows.

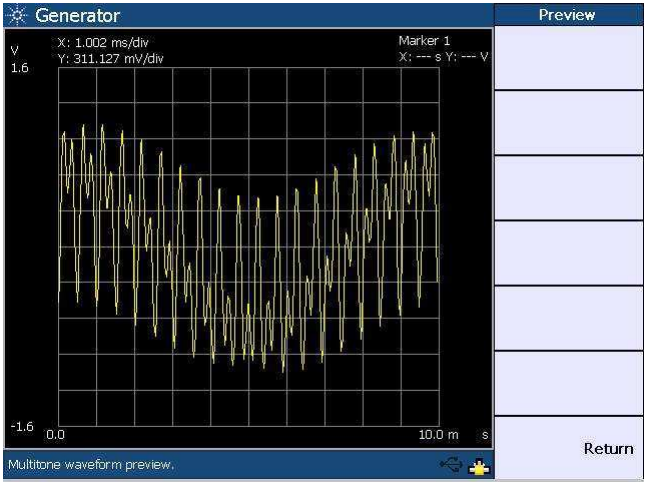


Figure 4-17 Multitone waveform preview

Square waveform

A square waveform is used in applications such as power amplifier test. To select a square waveform, press **Waveform > Square**.

The following figure shows the square waveform menu.

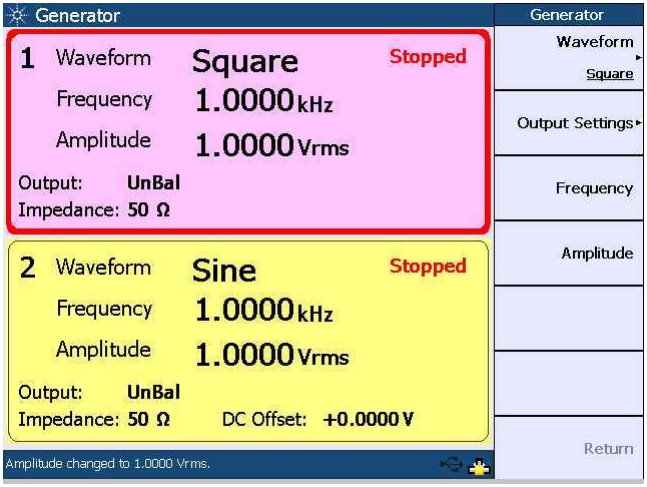


Figure 4-18 Square waveform menu

The square waveform may be configured with the following parameters.

- Frequency
- Amplitude

Arbitrary waveform

The arbitrary waveform function enables you to load a digital waveform file into the U8903A as a sequence of waveform samples, with a maximum length of 32768 points. The samples are output at a fixed sampling rate of 312.5 kHz from the generator, in a continuous sequence. To select an arbitrary waveform, press **Waveform > Arbitrary**.

The following figure shows the arbitrary waveform menu.

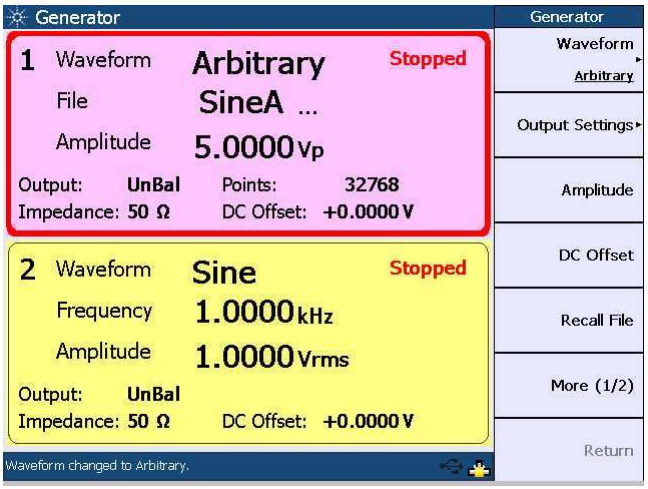


Figure 4-19 Arbitrary waveform menu

Press **More (1/2)** to display more arbitrary waveform parameters as follows.

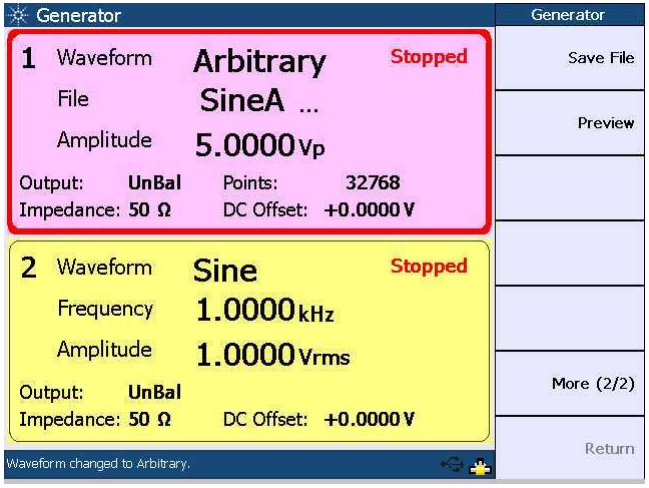


Figure 4-20 More arbitrary waveform parameters

For more information on the arbitrary file format, refer to "Appendix B: Arbitrary File Format" on page 149.

You may display the arbitrary waveform in the time domain as shown in the following figure.

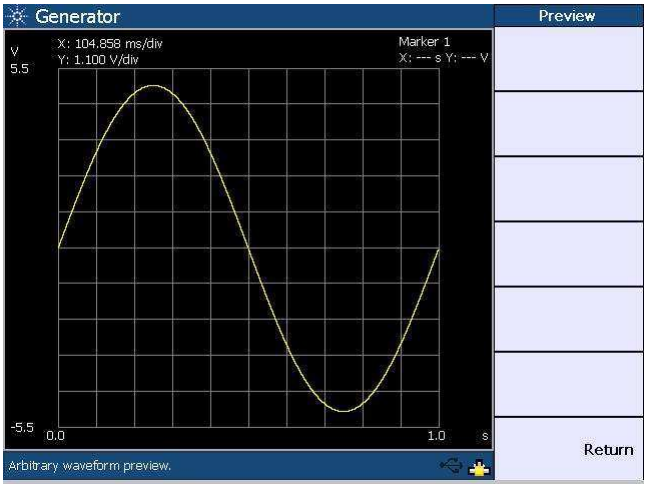


Figure 4-21 Arbitrary waveform preview

The arbitrary waveform may be configured with the following parameters.

- Amplitude
- DC Offset

You may load or save the arbitrary waveform data by pressing **Recall File** or **Save File** respectively.

5 Audio Analyzer Measurement Functions

Audio Analyzer 92
Measurement Functions 97
- Frequency 97
- AC voltage level (Vac) 97
- DC voltage level (Vdc) 98
- THD + N Ratio and THD + N Level 98
- SINAD 100
- SNR and Noise Level 101
- SMPTE intermodulation distortion (SMPTE IMD) 103
- Difference frequency distortion (DFD) 104
- Phase 105
- Crosstalk (channel driven and channel measured) 107

This chapter explains the configuration of the U8903A for measuring the common audio analyzer measurement functions.

Audio Analyzer

To access the analyzer mode, press Analyzer on the Mode panel. Each channel of the U8903A can perform two measurement functions simultaneously.

To configure the measurement functions, select the active channel using the arrow keys.

The main menu functions of the analyzer mode are as follows.

- Function 1
- Function 2
- Analyzer Settings
- Common Settings
- Ref/Rel

The analyzer menu functions are shown in the following figure.

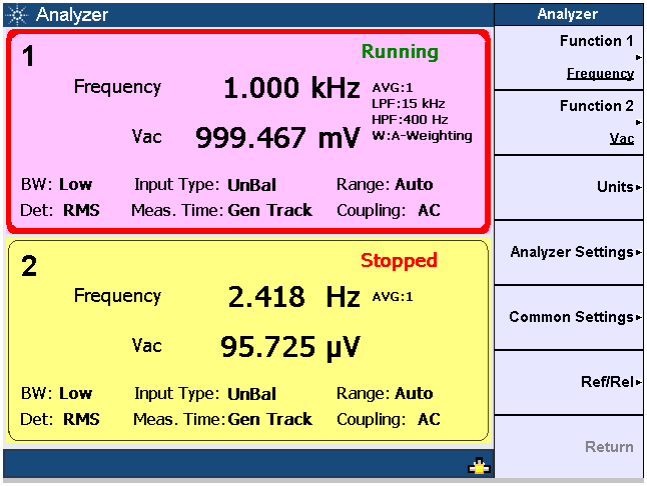


Figure 5-1 Analyzer menu functions

Use the softkeys to configure the measurement functions of the analyzer mode.

For Function 1, the following measurement functions can be selected.

- Frequency
- AC voltage
- DC voltage

The measurement functions of Function 1 are shown in the figure below.

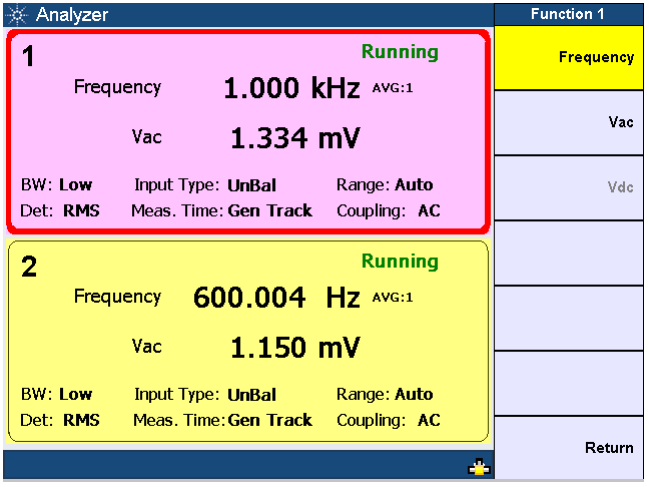


Figure 5-2 Function 1 selection

For Function 2, the following measurement functions can be selected.

- Frequency
- AC voltage
- DC voltage
- SNR
- Noise Level
- SINAD
- THD + N Ratio
- THD + N Level
- Crosstalk (channel driven/channel measured)
- SMPTE IMD
- DFD IEC 60268 2nd/3rd order
- DFD IEC 60118 2nd/3rd order
- Phase

With the exception of phase and crosstalk, individual channels can be configured to measure different functions.

The measurement functions of Function 2 are shown as follows.

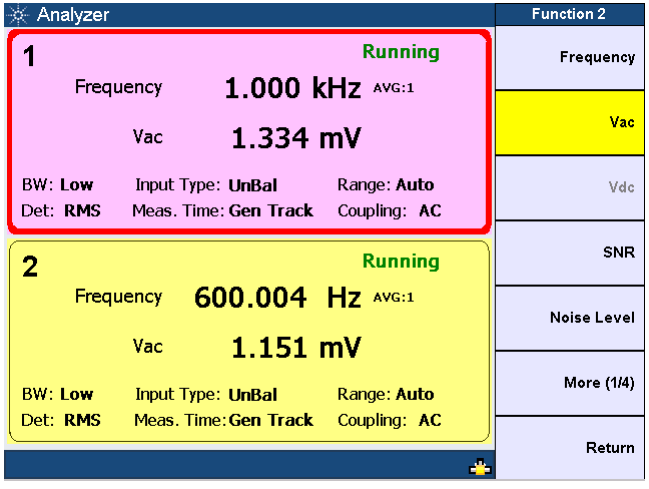


Figure 5-3 Function 2 selection first page

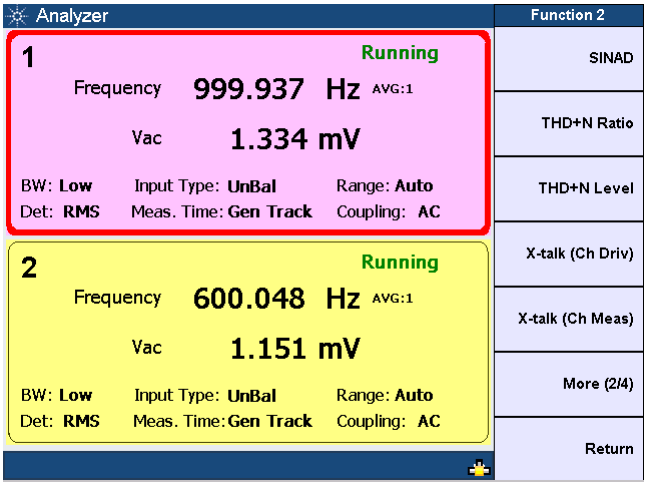


Figure 5-4 Function 2 selection second page

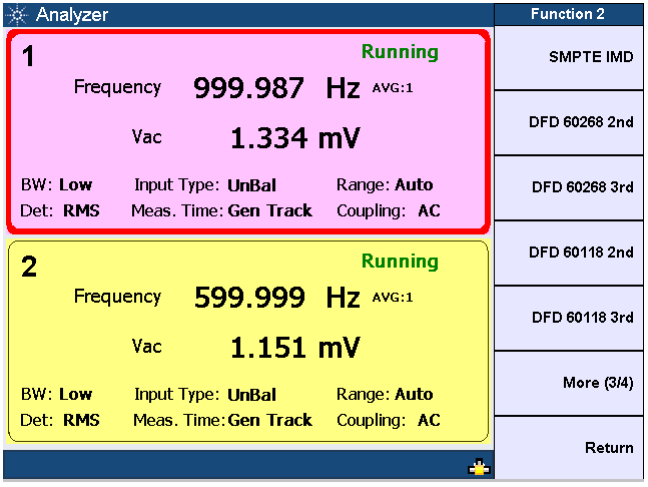


Figure 5-5 Function 2 selection third page

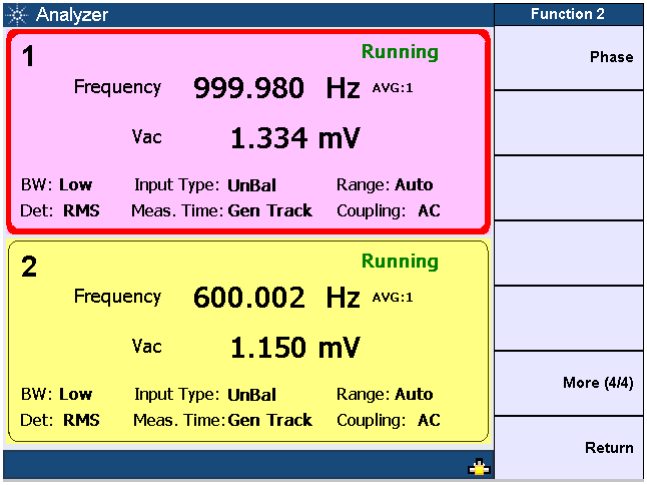


Figure 5-6 Function 2 selection fourth page

On the Analyzer Settings menu, you may select the coupling, detector type, digital filters, input connection, and measurement range before the selected measurement is performed on the incoming signal. For more information on the measurement settings, refer to Chapter 3, "Input Settings" on page 56.

On the Common Settings menu, the selectable options include the measurement bandwidth, measurement time, and trigger mode. Refer to Chapter 3, "Common Settings" on page 63 for the details.

On the Ref/Rel menu, you may set the the reference impedence, voltage, frequency, and ratio values depending on the type of reference to be set for unit conversion. For more information on the Ref/Rel settings, refer to Chapter 3, "Ref/Rel" on page 68.

Measurement Functions

This section describes the measurement functions.

Frequency

Frequency is a common and basic measurement function which is expressed in hertz (Hz). The U8903A uses software algorithm to detect the period of a repetitive waveform and the frequency is computed from the reciprocal of the period.

To obtain better accuracy and resolution, autoranging should be enabled. For low frequency signals, set a longer measurement time to get better and more stable readings. Input filters can also be activated to remove unwanted high frequency noise from the measured signal, allowing more stable readings.

AC voltage level (Vac)

This is the most common measurement function of an AC signal. The U8903A provides three types of AC level detection consisting of RMS, Peak-to-Peak, and Quasi Peak. Refer to Chapter 3, "AC level detection" on page 58 for more information. When the RMS detection method is selected, the AC voltage measurement is expressed as an RMS value. Likewise, if the Peak-to-Peak detector is selected, the result is a peak-to-peak value.

As an example, for a 1 Vrms sine input signal, the display will show 1 V if the RMS detector is selected. On the other hand, if the Peak-to-Peak detector is selected, the display will show 2.828 V (1.414 × 2).

The Quasi Peak detector is normally used with the CCIR filter per the IEC 60468 standard.

DC voltage level (Vdc)

DC voltage levels are often encountered in audio equipment although they are not part of the audio signal, for example, bias voltages and outputs from AC-to-DC converters. DC voltage is expressed in volts (V).

DC level is one of the U8903A measurement functions.

Coupling must be set to DC for DC level measurements.

THD + N Ratio and THD + N Level

Harmonic distortion on a spectrally pure signal is created by nonlinearities in the circuit through which it passes. The nonlinearities can arise in the transfer characteristics of an active device or by running the active device into saturation or cutoff. In most cases, distortion can be reduced by decreasing the signal level, applying filtering, or adding negative feedback.

In communication devices, THD + N indicates how well a signal is being reproduced at the receiver after going through the communication medium. To limit the bandwidth to the band of interest, input filters like the C-Message weighting filter can be applied. Use the appropriate input range to avoid clipping and also to make full use of the ADC dynamic range to get the most accurate results.

According to Fourier mathematics, the nonlinear terms in the circuit transfer function give rise to harmonics of the signal. Therefore, the THD + N function provides a quantitative measurement of the quality of an audio signal or in other words, the purity of a signal. THD + N Level is defined as the square root of the sum of the squares of all the signal harmonic components and noise amplitude, and is expressed in Vrms. The THD + N Level can be computed as follows.

THD + N Level = rms value of noise and distortion

The following figure shows the THD + N Level measurement.

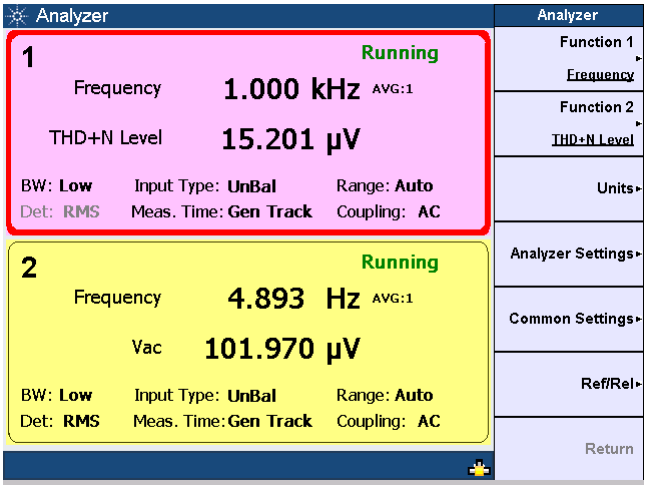


Figure 5-7 THD + N Level measurement

The THD + N Ratio is defined as the ratio of the square root of the sum of the squares of all the signal harmonic components and noise amplitude, relative to the total signal amplitude. The THD + N Ratio can be computed as follows.

$$THD + N\ Ratio = 20 \log \left(\frac{rms\ value\ of\ noise\ and\ distortion}{rms\ value\ of\ signal,\ noise,\ and\ distortion} \right)$$

The THD + N Ratio is expressed in dB (default) or as a percentage.

The THD + N Ratio measurement is shown as follows.

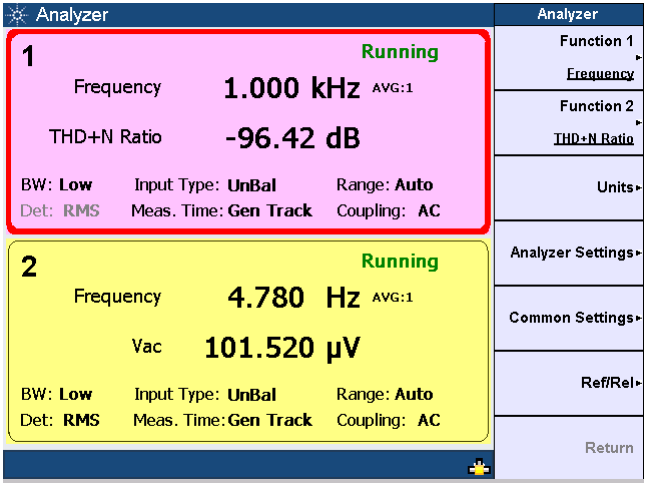


Figure 5-8 THD + N Ratio measurement

SINAD

SIgnal, Noise, And Distortion (SINAD) is equal to the reciprocal of the distortion measurement. It is mostly used to determine the sensitivity of a communications receiver. The ratio computed in the SINAD measurement is shown as follows.

$$SINAD = 20 \log \left(\frac{rms\ value\ of\ signal,\ noise,\ and\ distortion}{rms\ value\ of\ noise\ and\ distortion} \right)$$

SINAD is expressed in dB (default) or as a percentage.

The SINAD measurement is shown as follows.

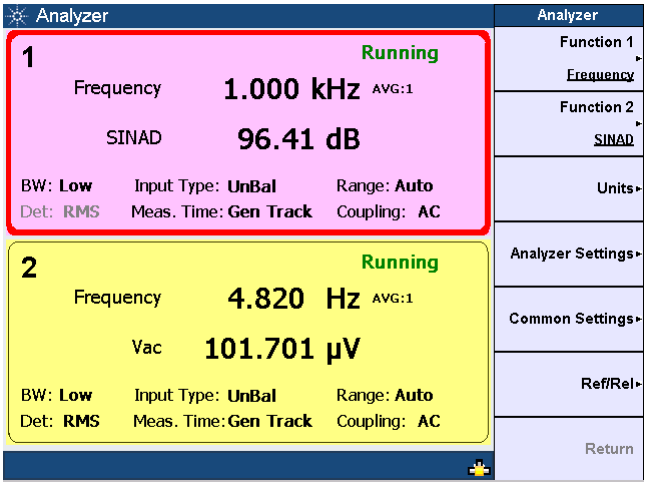


Figure 5-9 SINAD measurement

SNR and Noise Level

Signal-to-noise ratio (SNR) is defined as the ratio of the signal amplitude to noise amplitude. Both the signal and noise amplitude must be measured at the same or equivalent points in a system, and within the same system bandwidth.

The U8903A implementation of the SNR measurement is a closed loop configuration in which both the generator and the analyzer are used in the test setup. Channel 1 of the generator will be used for measurement on the analyzer channel 1.

The SNR for an audio system such as an amplifier at a specified input or output level is the ratio between the output signal power and noise level. An SNR value is further defined by the measurement bandwidth specification. The measurement bandwidth is up to 20 kHz, with or without weighting filters. Refer to Chapter 3, “Input Settings” on page 56 for the information on selecting the input settings.

The SNR measurement is accomplished by alternatively switching the input of the UUT between the U8903A generator output and a built-in 600 Ω termination. The UUT output is connected to the U8903A input. The analyzer will measure the UUT output signal amplitude when the generator is routed to the input. The noise level is measured when the input of the UUT is terminated with 600 Ω. It is expressed in Vrms. The ratio between the output signal amplitude and noise level is the SNR result which can be expressed in dB (default) or as a percentage. The SNR can be computed as follows.

$$SNR = 20 \log \left(\frac{rms\ value\ of\ signal}{rms\ value\ of\ noise} \right)$$

The figure below shows the SNR measurement.

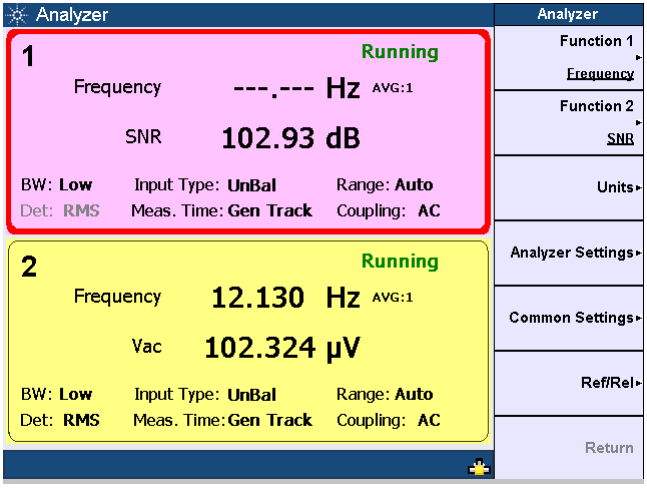


Figure 5-10 SNR measurement

The following figure shows the noise level measurement.

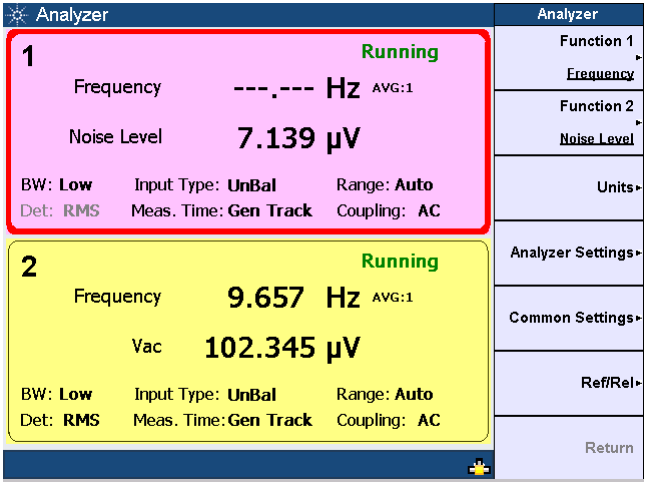


Figure 5-11 Noise level measurement

SMPTE intermodulation distortion (SMPTE IMD)

The SMPTE IMD function provides a measure of the second and third order intermodulation distortion introduced by the UUT by injecting two pure tones (tone 1 and tone 2, where tone 1 is at a much lower frequency than tone 2, for example, 60 Hz and 7 kHz respectively) into the UUT. SMPTE IMD is expressed in dB (default) or as a percentage.

If tone 1 = f1 and tone 2 = f2, the following harmonics are considered.

- f2 – f1
- f2 + f1
- f2 – 2f1
- f2 + 2f1

The SMPTE IMD value is computed as the ratio of the sum of the intermodulation harmonics amplitude to the upper frequency tone amplitude.

Refer to Chapter 4, "Dual sine waveform" on page 78 for information on generating dual tones for this test.

The SMPTE IMD measurement is shown as follows.

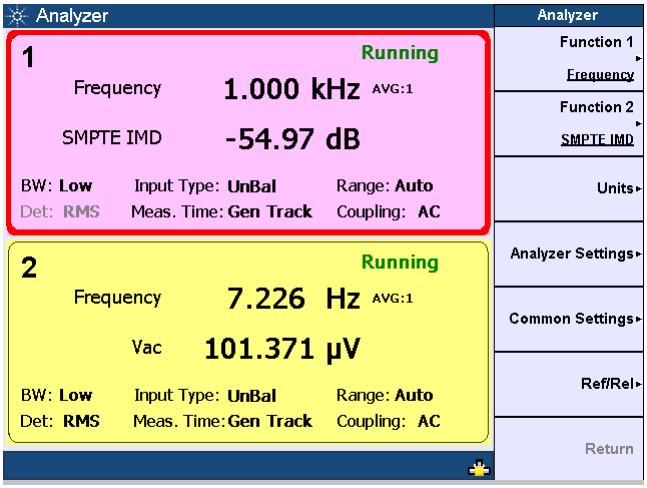


Figure 5-12 SMPTE IMD measurement

Difference frequency distortion (DFD)

The DFD measurement is similar to SMPTE IMD, except that the two tones in the stimulus signal are of equal amplitude and are spaced closer to each other (typically 19 kHz and 20 kHz). This measurement also allows you to select either the second or third order intermodulation distortion.

The figure below shows the DFD measurement.

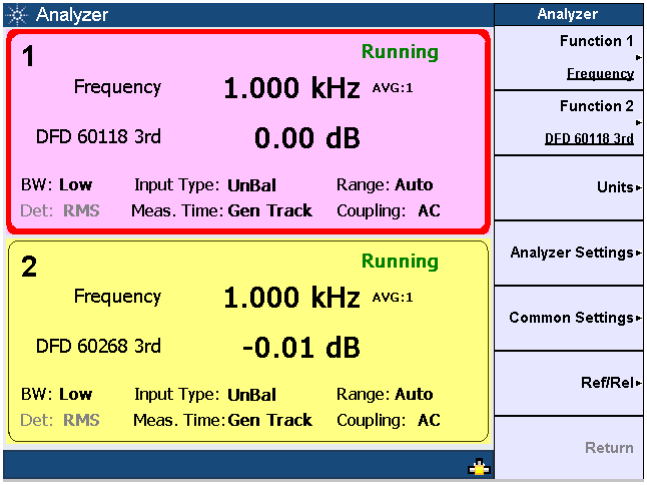


Figure 5-13 DFD measurement

Phase

Phase measurements are used to describe the positive or negative time offset in a periodic waveform cycle (such as a sine waveform), measured from a reference waveform. The reference is usually the same signal at a different point in the system, or a related signal in a different channel of the system. Phase is expressed in degrees (°).

Phase shift varies with frequency, and therefore, it is common to make phase measurements at several frequencies or to plot the phase response of a frequency sweep.

There are generally two types of phase measurements as follows.

- interchannel phase delay
- device phase response

To make an interchannel phase measurement, the signal level must be specified. Phase measurements are generally not level-sensitive, as long as the signal is well above the noise and below distortion.

For example, to test the interchannel phase delay of a stereo system, we inject a 1 Vrms, 1 kHz sine waveform using the same generator channel. The output of one channel is connected to the analyzer channel 1 while the other is connected to channel 2. Set the analyzer to measure phase. If channel 1 is set as the reference channel, the channel 2 result is the interchannel phase delay.

A phase response measurement compares the phase of the output signal of a UUT to the phase of the signal at its input. A simple way to make this measurement is to use the analyzer channel 1 to measure the input, and the analyzer channel 2 to measure the output.

The U8903A always uses channel 1 of the generator as the reference channel, while the selected analyzer channel becomes the reference channel for interchannel phase measurements.

The following figure shows the phase measurement with reference to channel 1.

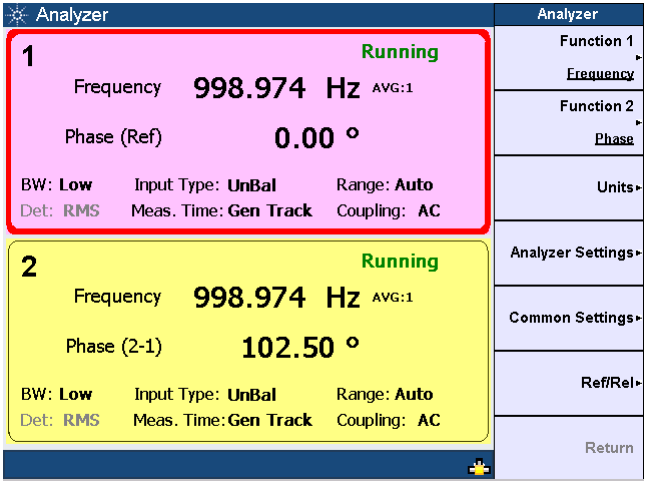


Figure 5-14 Phase measurement

Crosstalk (channel driven and channel measured)

In audio systems with more than one channel, it is common for a signal in one channel to appear at the output of another channel at a reduced level. Crosstalk refers to this signal leakage across channels and is expressed in dB (default) or as a percentage.

Crosstalk is a measurement of the ratio of the signal amplitude in an unused channel relative to that of a channel driven with a signal. The unused channels should be grounded, or set to an appropriate bias point. Crosstalk is largely due to capacitive coupling between the channel conductors in the device and generally varies with frequency.

There are two modes of crosstalk measurement comprising channel driven and channel measured. Crosstalk can be computed as follows.

$$Crosstalk = 20 \log \left(\frac{rms\ value\ of\ signal\ measured}{rms\ value\ of\ signal\ driven} \right)$$

In the channel driven mode, the designated reference channel will be injected with the stimulus. The presence of this signal in the other channel will be measured. The crosstalk result of the channel indicates the crosstalk from the reference channel to that channel. Only one reference channel can be selected at any one time.

NOTE The reference channel always displays a value of 0 dB or 100% for all crosstalk measurements.

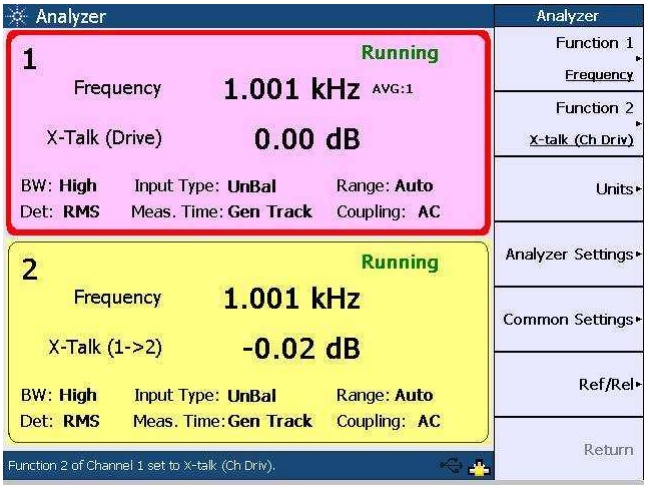


Figure 5-15 Crosstalk: Channel driven mode

In the channel measured mode as shown below, the designated reference channel is used to measure the crosstalk from the other channel to this channel. The crosstalk result of the channel indicates the crosstalk from the other channel to the reference channel.

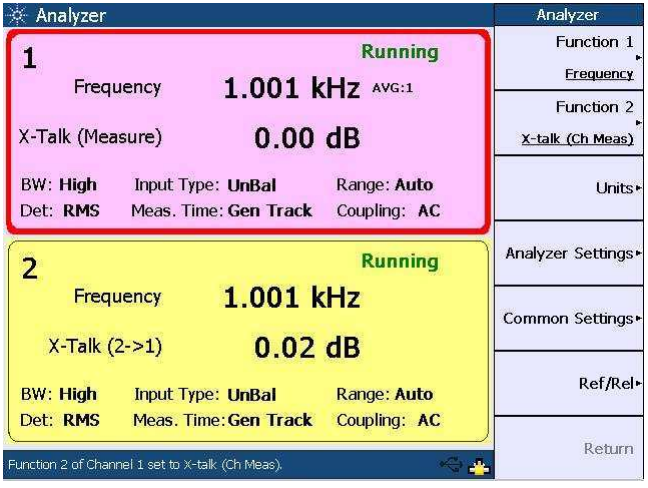


Figure 5-16 Crosstalk: Channel measured mode

6
Frequency and Time Domain Analysis

Frequency Domain and Time Domain 110
- Monitor settings 112
- Axis settings 115
- Input settings 115
- Harmonics display 116
- Hold 117

Graph Functions 118
- Peak search 118
- Marker 119
- Marker –> 120
- Full screen 121

This chapter explains how to configure the graph settings for frequency and time domain analysis.

Frequency Domain and Time Domain

The U8903A graph mode displays a 2-dimensional graph of the signal in the frequency or time domain.

To access the frequency or time domain mode, press Frequency Domain or Time Domain on the Mode panel respectively.

The settings available in both the frequency and time domain modes are as follows.

- Monitor settings
- Axis settings
- Input settings

To generate the graph once you have configured the settings, press Run Stop on the U8903A front panel.

The frequency domain mode is shown in the following figure.

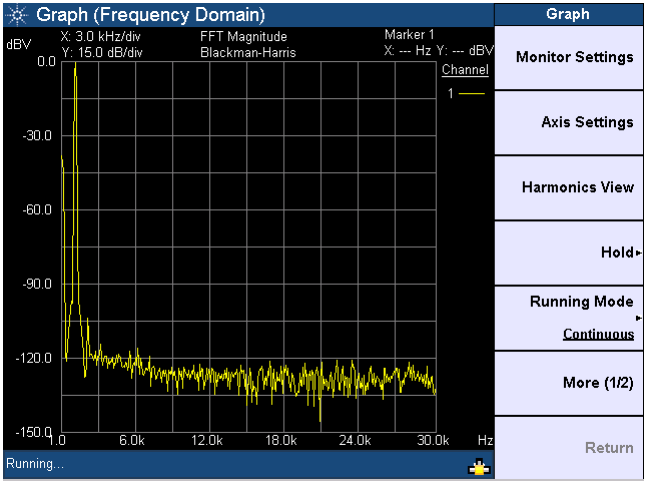


Figure 6-1 Frequency domain mode

The time domain mode is shown as follows.

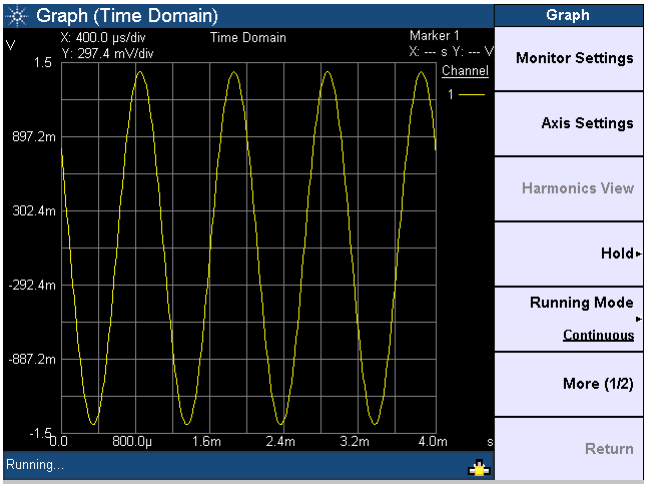


Figure 6-2 Time domain mode

You can choose to allow the graph to run continuously by pressing **Running Mode > Continuous**. The **Running Mode > Single** function enables you to perform a single acquisition of the graph data each time 

is pressed.

You also have the option to save the graph points to a file by pressing **Save Pts to File**. The File Manager menu will be launched. Refer to Chapter 2, “Save” on page 43 for more information on using the File Manager menu.

Monitor settings

The following figure shows the monitor settings page.

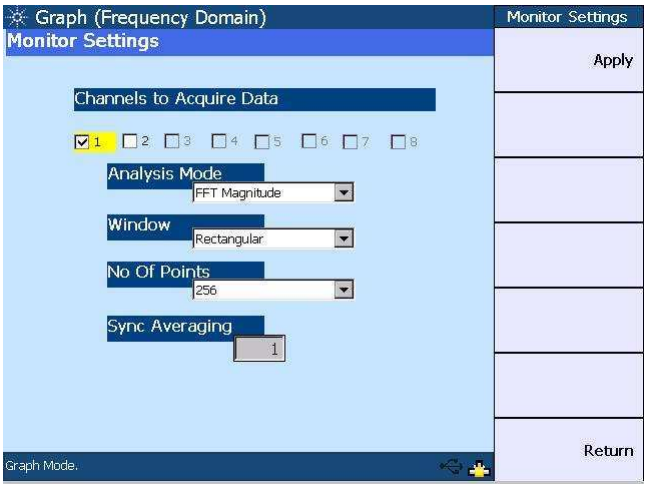


Figure 6-3 Monitor settings page

The monitor settings page enables you to select the channel(s) to acquire the graph data for display. The valid channels are channels 1 and 2, while channels 3 to 8 will only be available in future releases. The other functions of the monitor settings are listed as follows.

Analysis mode

The analysis mode allows you to set the graph display to either time domain, frequency domain (magnitude), or frequency domain (phase).

In the time domain mode, the steps involved are acquiring the data and displaying the results. On the other hand, the steps for the frequency domain mode consist of acquiring the data, performing the FFT operation, and processing the results for graphing.

Window

The available window functions are Rectangular, Hann, Hamming, Blackman-Harris, Rife-Vincent 1 and 3, and Flattop. These windows are only applicable in the frequency domain and will not affect the time domain analysis.

- **Rectangular**

  Also called a Uniform window, the Rectangular window is actually no window at all. This window provides good frequency resolution and amplitude accuracy and is best for measuring transient signals rather than continuous signals, for example, pseudorandom noise, impulses, sine bursts, and decaying sinusoids.

- **Hann**

  This window is used for making accurate frequency measurements especially when trying to resolve two frequency components that are close together. The Hann window has the best overall filter characteristic and is a good general purpose window for most signal analyses.

- **Hamming**

  This window provides better frequency resolution but less amplitude accuracy compared to the Rectangular window. The Hamming window has a slightly better frequency resolution than the Hann window, and is suitable for measuring sine, periodic, and asymmetric transients or bursts.

- **Blackman-Harris**

  This window provides the best amplitude resolution, but less frequency resolution compared to the Rectangular, Hann, and Hamming windows. This window is normally used for measuring higher order harmonics of single frequency signals.

- **Rife-Vincent 1 and 3**

  These windows have smooth, monotonically-falling responses with no sidelobes.

- **Flattop**

  The Flattop window has a flat ripple (<0.01 dB) in the passband. Thus, it is applicable mainly for calibration purposes where accurate amplitude accuracy is desired.

Acquisition Length

You can select how many points of the data record to acquire and display. The possible acquisition lengths are as follows.

- 256
- 512
- 1024
- 2048
- 4096
- 8192
- 16384
- 32768

Synchronous averaging

Synchronous averaging reduces noise levels by averaging the acquired data in the time domain. This has the effect of producing a "cleaner" waveform in the time domain, or lowering the noise floor in the frequency domain display.

NOTE Synchronous averaging is only applicable when the trigger source is set to the channel-based trigger. Refer to Input settings for the trigger settings.

Axis settings

You can manually change the X-axis and Y-axis settings, such as the minimum and maximum values, as well as select between linear or log scale. You may perform an autoscale to automatically scale the display according to the signal, or to autoscale the X-axis or Y-axis.

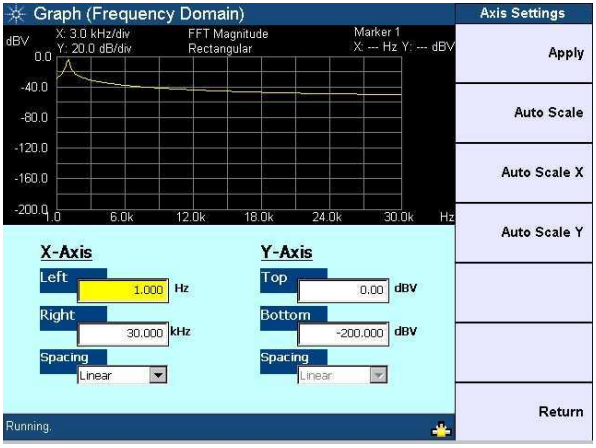


Figure 6-4 Axis settings page

Input settings

The input settings section allows you to select the channel to be configured, measurement bandwidth, input connection, input range, and coupling. You may set the trigger source and trigger edge on the trigger settings section. The trigger source selection consists of Free Run, External, Channel 1, and Channel 2.

Refer to Chapter 3, "Input Settings" on page 56 and "Common Settings" on page 63 for more information on the input settings.

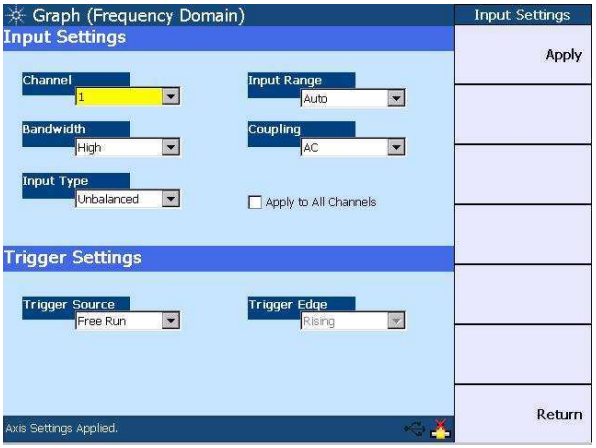


Figure 6-5 Input settings page

Harmonics display

The harmonics view page enables you to display the level of each signal harmonic component of the frequency domain analysis. You may select the channel and enter the number of harmonic component levels to be displayed. The signal harmonic components data will be listed in the table. This feature is not applicable in the time domain mode.

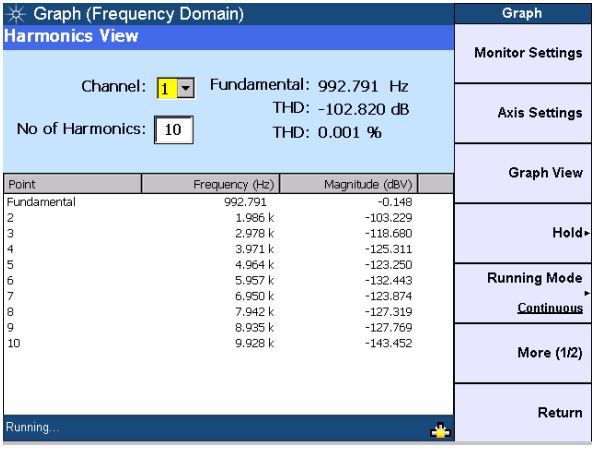


Figure 6-6 Harmonics display

Hold

The hold function sets the graph hold configuration type to be used to update the graph data for channels 1 and 2. You can set the hold configuration to none, maximum, or minimum.

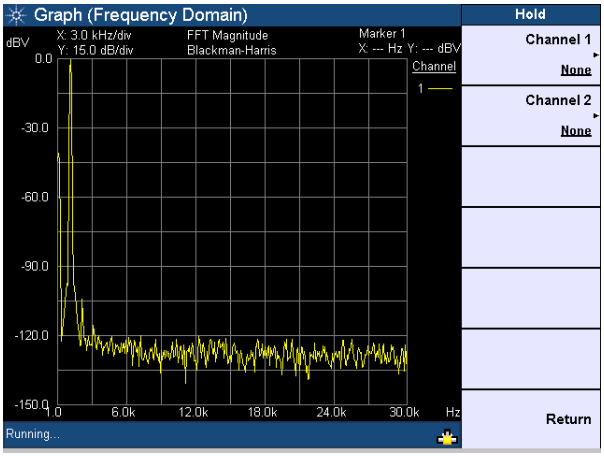


Figure 6-7 Hold page

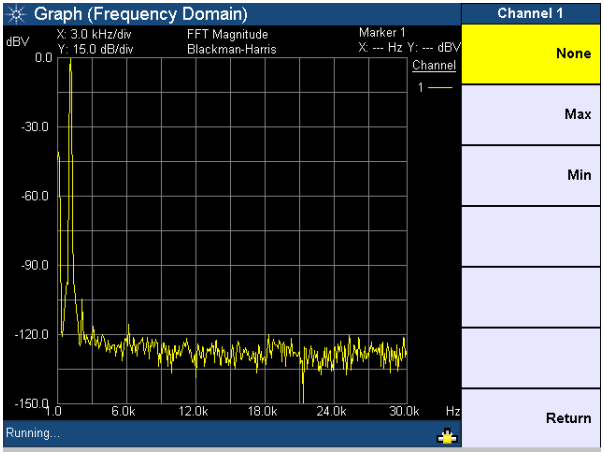


Figure 6-8 Hold configuration type

Graph Functions

This section describes the commonly used graph functions which allow you to perform peak searching, configure the markers, select the marker position on the graph, or maximize the graph view to the full display size by pressing the corresponding key on the Graph panel.

Peak search

This function enables you to place a marker on the peak or minimum of the graph. You can set the threshold level that the marker can identify as a peak or minimum on the graph. If the trace is above the threshold level, it will be identified as a peak, whereas the trace below the threshold level will be identified as a minimum. Use the knob on the U8903A front panel to move the threshold level along the plot. The X-axis and Y-axis values of the marker will be displayed at the top right of the graph when you place a marker at either the right or left peak, or right or left minimum of the graph.

To access the peak search function, press Peak Search on the Graph panel. The Peak Search menu is shown as follows.

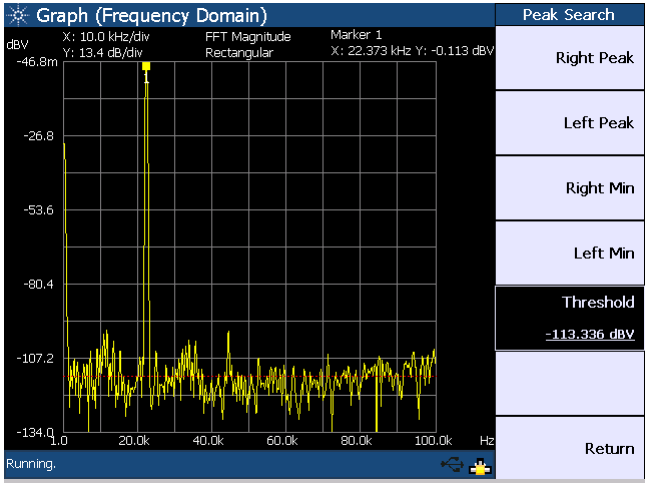


Figure 6-9 Peak Search menu

Marker

The Marker menu provides you access to the available marker functions.

To access the Marker menu, press 

on the Graph panel. The first page of the marker menu is shown as follows.

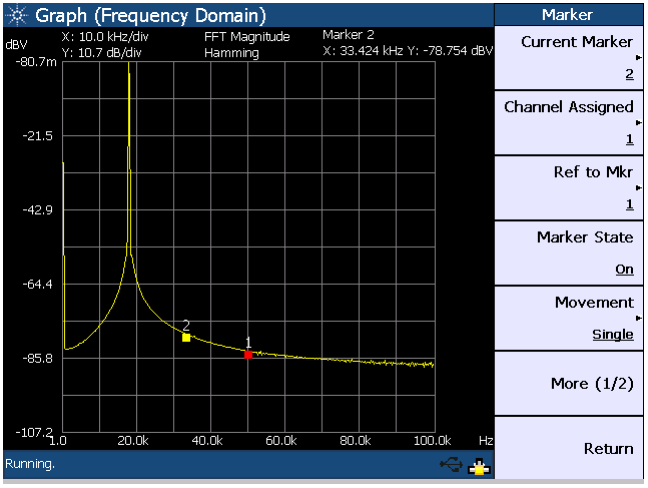


Figure 6-10 Marker menu

Using the marker functions, you may set the current and reference markers to be placed on the graph for the selected channel. The markers can be moved along the graph plot by rotating the knob on the U8903A front panel.

You also have the option to display the measurement data of the selected marker(s) in a table as shown in Figure 6-11.

NOTE For more information on the marker functions, refer to the *U8903A Audio Analyzer Instrument Help File*.

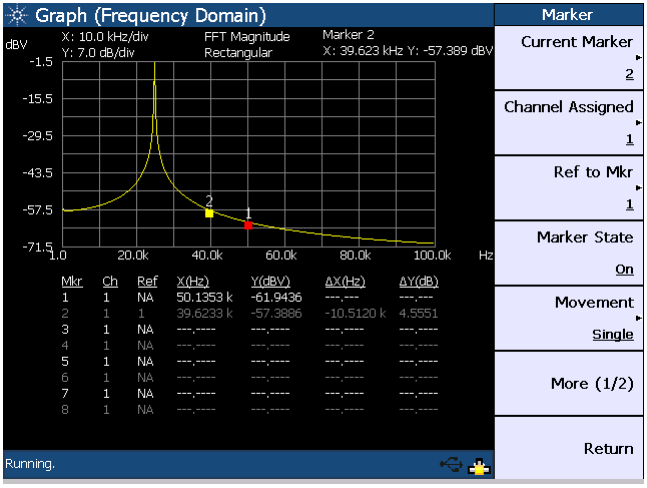


Figure 6-11 Marker measurement data display

Marker –>

This function allows you to view a section of the graph based on the selected current marker position. Using the softkeys, you may configure the graph area to be displayed by positioning the current marker at either the center, start, or stop point of the graph plot. In addition, you can also view the area between the current marker and reference marker by pressing **Marker** Δ → **Span**. To access the Marker → menu, press  on the Graph panel.

The Marker → menu is shown as follows.

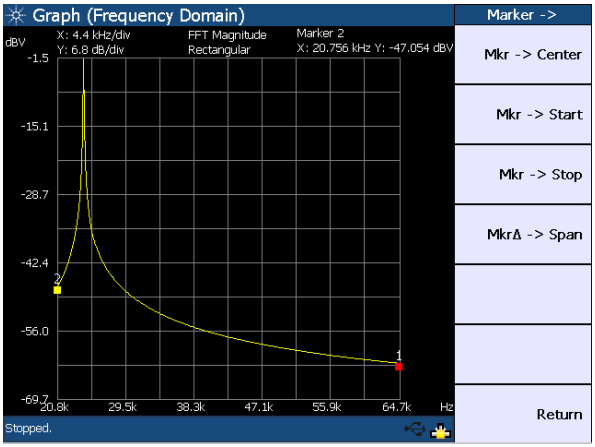


Figure 6-12 Marker –> menu

Full screen

This function enables you to maximize the graph view to the full display size by pressing Full Screen on the Graph panel. To exit the full screen mode, press any key on the U8903A front panel.

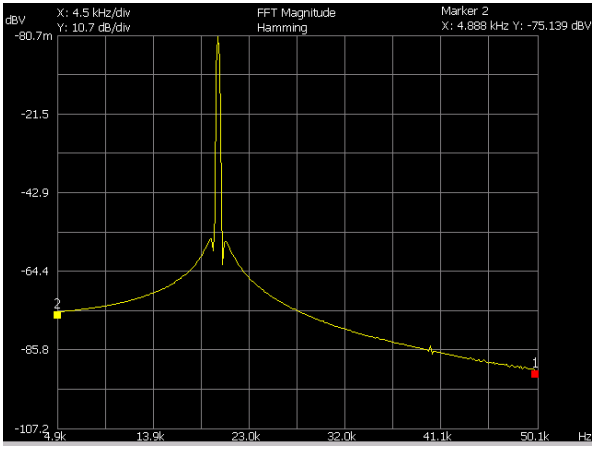


Figure 6-13 Full screen

7 Sweep Function

Sweep 124
Sweep settings 126
Axis settings 127
Hold 128
Sweep mode 129
List view 130
I/O settings 131

This chapter describes the U8903A sweep functions for performing sweep.

Sweep

The U8903A sweep mode enables you to perform sweeps and display the results in the graph or list form. To access the sweep mode, press Sweep on the Mode panel.

In the sweep mode, a generator parameter such as frequency, amplitude, or phase is varied across a certain range. At each point of the sweep, an analyzer measurement is made. The sweep mode allows you to easily collect and plot data for parameters such as frequency response, gain compression, and amplitude linearity.

To start the sweep, press Run Stop on the U8903A front panel.

The Sweep menu is shown as follows.

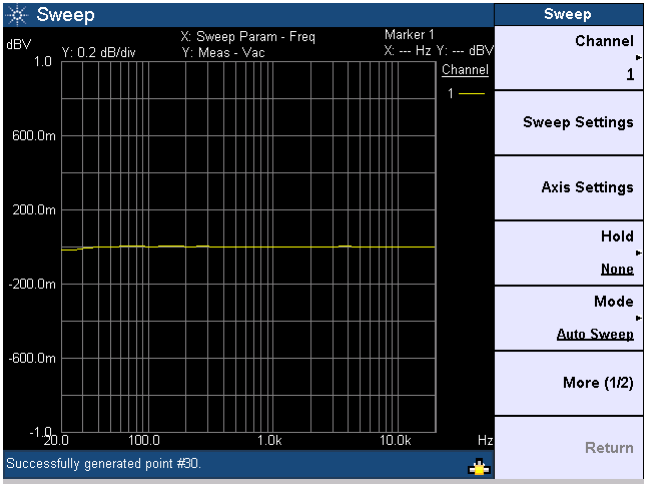


Figure 7-1 Sweep menu first page

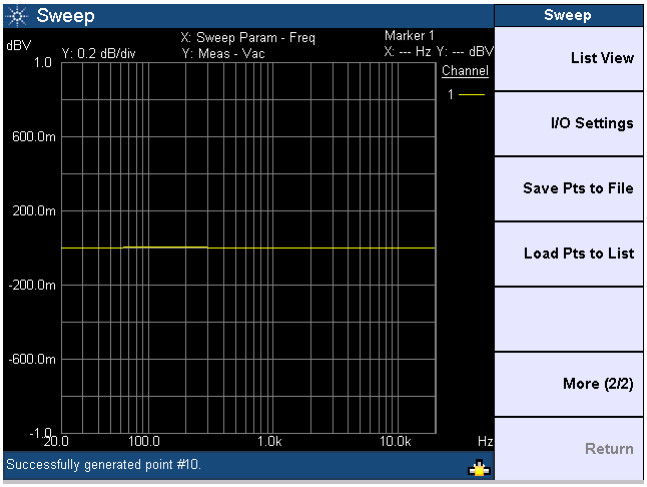


Figure 7-2 Sweep menu second page

On the sweep plot, the sweep parameter is displayed on the horizontal axis, while the sweep measurement is displayed on the vertical axis.

Using the Sweep menu, you may set the channel to perform sweep, select the sweep mode, configure the sweep, hold function, I/O and axis settings, display the sweep results in list form, as well as save or load the sweep points.

NOTE You must not select channel 1 as the sweep channel if the generator function is variable phase, as channel 1 is the reference channel for variable phase.

You can save the sweep points to a file by pressing **Save Pts to File**. To load the sweep points from a file, press **Load Pts to List**. The File Manager will be launched to allow you to save or load the sweep points. Refer to Chapter 2, "Save" on page 43 and "Recall" on page 44 for the information on using the File Manager menu. You may also perform sweep using a list of user-defined sweep points. Refer to "Appendix D: User-defined Sweep Points File Format" on page 155 for more information on the user-defined file format for the sweep points.

Sweep settings

The sweep settings page is shown as follows.

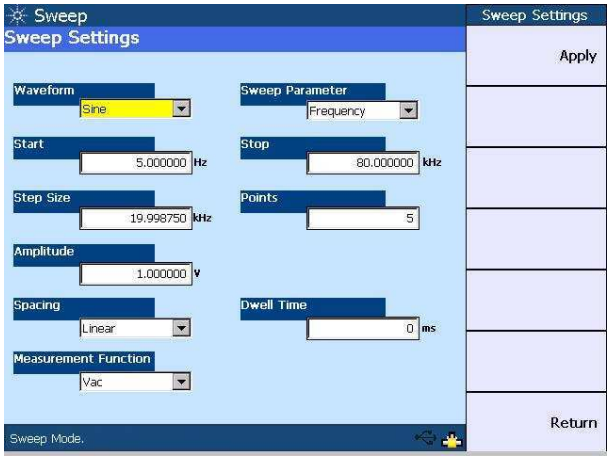


Figure 7-3 Sweep settings page

NOTE

- Multitone and arbitrary waveform functions are not applicable in the sweep mode.
- Amplitude values set on the sweep settings page are assumed to be RMS values.

The sweep parameter selection will vary according to the selected waveform type. The sweep start and stop points, as well as the step size and number of points, can only be configured if the Auto Sweep or Manual Sweep mode is selected.

The spot parameter panel will change according to the selected waveform type and sweep parameter. Refer to "Appendix E: Spot Parameters" on page 156 for the list of spot parameters.

For the sweep spacing, you may select either linear or log interval. You may also set the dwell time which represents the delay for each measurement to be taken during the sweep.

You may select an analyzer measurement function as the measurement parameter during the sweep. If phase is selected as the measurement parameter, you need to select a reference channel for the phase measurement. Noise Level is not applicable for the sweep measurement parameter selection.

Axis settings

You can manually change the X-axis and Y-axis settings, such as the minimum and maximum values, as well as select between linear or log scale. You may perform an autoscale to automatically scale the display according to the signal, or to autoscale the X-axis or Y-axis.

Figure 7-4 Axis settings page

Hold

The hold function sets the sweep hold configuration type to be used to update the graph data. You can set the hold configuration to none, maximum, or minimum.

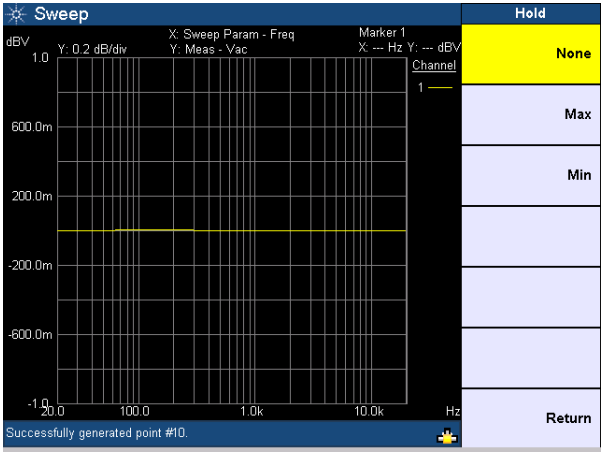


Figure 7-5 Hold page

Sweep mode

The available sweep modes are Auto Sweep, Manual Sweep, Auto List, and Manual List as shown in the following figure.

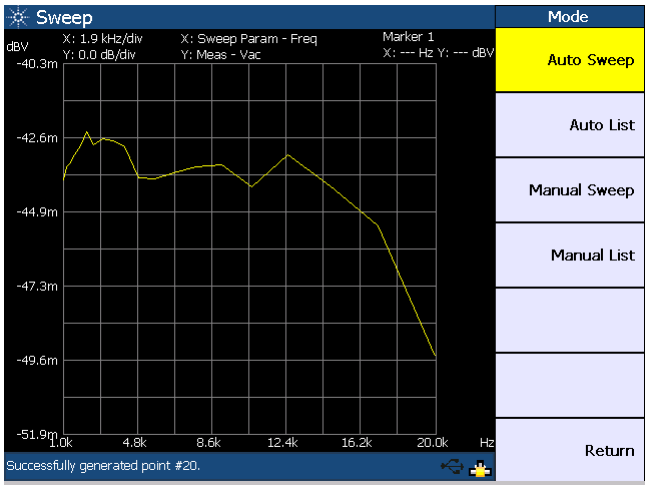


Figure 7-6 Sweep mode selection

Auto Sweep

If the sweep mode is set to Auto Sweep, pressing Run/Stop will initiate the sweep from start to end. Sweep points are based on the Start, Stop, and Step Size sweep parameter settings.

Manual Sweep

If the sweep mode is set to Manual Sweep, pressing Run/Stop will step the next point of the sweep parameter.

You need to press Run/Stop each time to increment the points until the U8903A reaches the end of the sweep. Sweep points are based on the Start, Stop, and Step Size sweep parameter settings.

Auto List/Manual List

If the sweep mode is set to Auto List or Manual List, you may load the sweep points from a file or modify the points directly in List View.

Pressing Run Stop will automatically start the sweep in the Auto List mode. For Manual List, the sweep point will increment each time Run Stop is pressed.

List view

This function allows you to display the sweep results in list form.

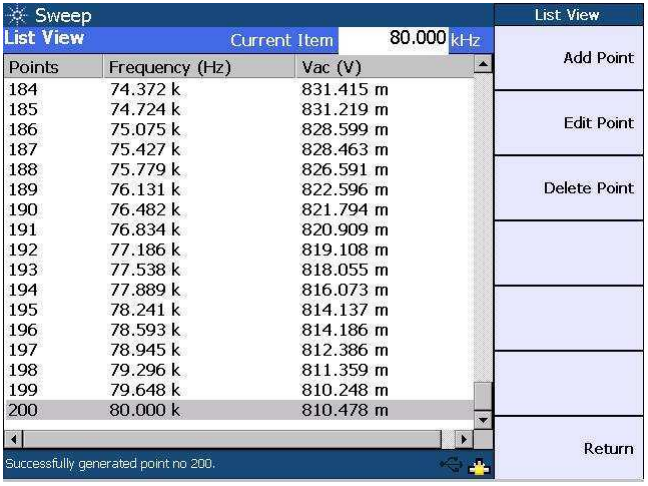


Figure 7-7 List View

Pressing **Add Point** enables you to add sweep points below the list. You may edit the sweep parameter value of a selected point by pressing **Edit Point**. To delete points, press **Delete Point**.

I/O settings

The I/O settings page enables you to configure the sweep input and output settings as shown in the following figure.

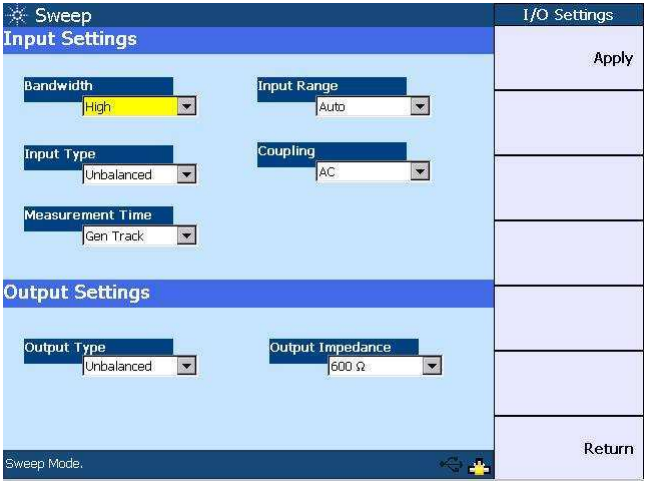


Figure 7-8 I/O settings page

Refer to Chapter 3, "Input Settings" on page 56, "Common Settings" on page 63, and "Output Settings" on page 70 for details on the measurement bandwidth, input connection and range, coupling, measurement time, as well as the output connection and impedance.

8 Specifications

Characteristics 134
Specifications 135
- Audio generator 135
- Audio analyzer 138
- Graph mode 140
- Audio filters 140
- Sweep capability 141

Measurement Category 143
- Measurement category definitions 143

This chapter displays the U8903A characteristics and specifications.

Characteristics

POWER CONSUMPTION

250 VA

POWER REQUIREMENTS

- 100 Vac to 240 Vac
- 47 Hz to 63 Hz

OPERATING ENVIRONMENT

- Operating temperature from 0 °C to 55 °C
- Relative humidity at 20% to 80% RH (noncondensing)
- Altitude up to 3000 m
- Pollution Degree 2
- Installation Category II

STORAGE COMPLIANCE

–55 °C to 75 °C

SAFETY COMPLIANCE

Certified with:

- IEC 61010-1:2001/EN61010-1:2001 (2nd Edition)
- Canada: CAN/CSA-C22.2 No. 61010-1-04
- USA: ANSI/UL 61010-1:2004

EMC COMPLIANCE

- IEC 61326-1:2005/EN 61326-1:2006
- Canada: ICES-001:2004
- Australia/New Zealand: AS/NZS CISPR11:2004

DIMENSIONS (W × D × H)

425.60 mm (16.76 in) × 405.00 mm (15.94 in) × 133.60 mm (5.25 in)

WEIGHT

8.5 kg (without cards)

WARRANTY

One year

Specifications

The following specifications are based on performance with 30 minutes warm-up time and at a temperature of 0 °C to 55 °C unless stated otherwise.

Audio generator

Generated waveform	Sine, Dual sine, Variable Phase, Square, Noise (Gaussian and Rectangular), Arbitrary, DC, Multitone, SMPTE IMD (1:1, 4:1, and 10:1), DFD (IEC 60118/IEC 60268)
SINE, DUAL SINE, AND VARIABLE PHASE	
Frequency	
Range	5 Hz to 80 kHz
Accuracy	5 ppm
Resolution	0.1 Hz
Output	
Range (Balanced)	0 V to 16 Vrms
Range (Unbalanced/Common)	0 V to 8 Vrms
Amplitude accuracy	±1%
Amplitude resolution	1 μVrms (limited to five digits of resolution)
Flatness	
20 Hz to 20 kHz	±0.01 dB
5 Hz to 80 kHz	±0.1 dB
THD + N at 1 kHz, 1 Vrms, 20 Hz to 20 kHz bandwidth	≤–95 dB (at 23 °C ± 5 °C) ≤–92 dB (from 0 °C to 55 °C)
Dual sine ratio range	0 dB to 100 dB
Phase	–180 ° to 179.99 °
Sweep	Frequency, amplitude, phase
SQUARE	
Frequency	
Range	5 Hz to 30 kHz
Output	
Range (Balanced)	0 V to 45.2 Vpp
Range (Unbalanced/Common)	0 V to 22.6 Vpp

Amplitude accuracy	±2% (for 1 kHz)
Rise time	<2 µs
SMPTE IMD (1:1/4:1/10:1)	
Frequency	
Low frequency (LF) tone	40 Hz to 500 Hz
High frequency (HF) tone	2 kHz to 60 kHz
Output	
Range (Balanced)	0 V to 16 Vrms
Range (Unbalanced/Common)	0 V to 8 Vrms
Mixed ratio (LF:HF)	10:1, 4:1, or 1:1
Residual IMD (20 Hz to 20 kHz)	≤–92 dB
Sweep	Upper frequency, lower frequency, amplitude
DFD (IEC 60118/IEC 60268)	
Frequency	
Difference frequency	80 Hz to 2 kHz
Upper frequency	3 kHz to 80 kHz
Center frequency	3 kHz to 79 kHz
Output	
Range (Balanced)	0 V to 16 Vrms
Range (Unbalanced/Common)	0 V to 8 Vrms
Inherent distortion (20 Hz to 20 kHz)	≤–101 dB
Sweep	Upper frequency, center frequency, amplitude
ARBITRARY/MULTITONE	
Sample rate	312.5 kHz
Length	32 to 32768 points/channel
Maximum number of tones	(Length/2) – 1
NOISE	
Type	Gaussian, Rectangular
Output	
Range (Balanced)	0 V to 7.2 Vrms (Gaussian), 0 V to 13.16 Vrms (Rectangular)
Range (Unbalanced/Common)	0 V to 3.6 Vrms (Gaussian), 0 V to 6.58 Vrms (Rectangular)

DC	
Output	
Range (Balanced)	–22.6 V to 22.6 V
Range (Unbalanced/Common)	–11.3 V to 11.3 V
Amplitude accuracy	±1.5%
DC OFFSET	
Applicable for all waveform types except Variable Phase, DC, and Square	
Output level	
Range	–11.3 V to 11.3 V
Amplitude accuracy	±1.5%
OUTPUT CHARACTERISTICS	
Connection type	
Balanced	XLR
Unbalanced	BNC
Common mode	XLR
Impedance	
Balanced	100 Ω, 600 Ω
Unbalanced	50 Ω, 600 Ω
Output current limit (typical)	50 mA
Maximum output power into 600 Ω	
Balanced (600 Ω)	20 dBm
Unbalanced (600 Ω)	14 dBm
Crosstalk	
20 Hz to 20 kHz	≤–101 dB (at 23 °C ± 5 °C)
	≤–99 dB (from 0 °C to 55 °C)
20 kHz to 80 kHz	≤–85 dB

Audio analyzer

INPUT CHARACTERISTICS	
Connection type	
Balanced	XLR
Unbalanced	BNC
Coupling	DC, AC
Measurement bandwidth	
Low	30 kHz
High	100 kHz
Input ranges	400 mV to 140 Vrms[1]
Measurement range	<1μV[2] to 140 Vrms
Maximum rated input	200 Vp for altitude up to 3000 m
Impedance	
Balanced	200 kΩ
Unbalanced	100 kΩ
Flatness	
20 Hz to 20 kHz	±0.01 dB[3] (at 23 °C ± 5 °C) ±0.012 dB[4] (from 0 °C to 55 °C)
20 kHz to 100 kHz	±0.1 dB (at 23 °C ± 5 °C) ±0.15 dB (from 0 °C to 55 °C)
THD + N at 1 kHz, 1 Vrms, 20 Hz to 20 kHz bandwidth	≤–101 dB
CMRR	
≤20 kHz (input range ≤6.4 V)	≥70 dB[5]
≤20 kHz (input range >6.4 V)	≥40 dB[5]
Crosstalk	
20 Hz to 20 kHz	≤–101 dB
Input protection	Overload protection for all ranges, onscreen warning message on the front panel
TRIGGERING	
Type	Free Run, External
Level	5 V
Minimum trigger high voltage	1.25 V
Maximum trigger low voltage	0.5 V
Input impedance	>50 kΩ

AMPLITUDE	
DC measurement range	0 to ±200 V
DC accuracy	±1%
AC accuracy (20 Hz to 100 kHz)	±1% (at 23 °C ± 5 °C) ±2% (from 0 °C to 55 °C)
AC level detection	RMS, Peak-to-Peak, Quasi Peak
FREQUENCY	
Range	10 Hz to 100 kHz
Minimum input	1 mV (S/N > 40 dB)
Accuracy	5 ppm
Resolution	6 digits
PHASE	
Accuracy	
<20 kHz	±2 °
<100 kHz	±4 °
Minimum input	1 mV (S/N > 40 dB)
Resolution	0.01 °
SMPTE IMD	
Residual IMD	≤0.0025% (–92 dB)

[1] For the available input ranges, refer to Chapter 3, "Input ranging" on page 61.

[2] Defined by the 24-bit measurement.

[3] ±0.01 dB – 0.001 dB/Hz below 50 Hz.

[4] ±0.012 dB – 0.001 dB/Hz below 50 Hz.

[5] When AC coupled, CMRR will deteriorate at low frequencies.

Graph mode

Size/Acquisition length	256, 512, 1024, 2048, 4096, 8192, 16384, 32768
Window	Rectangular, Hann, Hamming, Blackman-Harris, Rife-Vincent 1 and 3, Flattop
Amplitude accuracy (Flattop window)	±0.1 dB (±1.2%)
Display mode	
Time domain	Normal, Interpolate, Peak, Absolute Value
Frequency domain	Displays highest FFT bin between graph points

Audio filters

Low pass filter	• 15 kHz low pass • 20 kHz low pass • 30 kHz low pass • User-defined[1]
High pass filter	• 20 Hz high pass • 100 Hz high pass • 400 Hz high pass • User-defined[1]
Weighting filter	• A-Weighting (ANSI-IEC "A" weighted, per IEC Rec 179) • CCIR 1K weighted (CCIR Rec. 468) • CCIR 2K weighted (Dolby 2K) • C-Message (C-Message per IEEE 743) • CCITT (ITU-T Rec. O.41, ITU-T Rec. P.53) • User-defined[1]

[1] User-defined filters can be uploaded through standard I/O connections.

Sweep capability

FREQUENCY SWEEP (SINE AND DUAL SINE WAVEFORMS)	
Start point	5 Hz to 80 kHz
Stop point	5 Hz to 80 kHz
Amplitude spot value (Balanced)	0 V to 16 Vrms
Amplitude spot value (Unbalanced/Common)	0 V to 8 Vrms
FREQUENCY SWEEP (SQUARE WAVEFORM)	
Start point	5 Hz to 30 kHz
Stop point	5 Hz to 30 kHz
Amplitude spot value (Balanced)	0 V to 22.6 Vrms
Amplitude spot value (Unbalanced/Common)	0 V to 11.3 Vrms
FREQUENCY SWEEP (SMPTE IMD 1:1/4:1/10:1 WAVEFORM)	
Start point (Upper frequency)	2 kHz to 60 kHz
Start point (Lower frequency)	40 Hz to 500 Hz
Stop point (Upper frequency)	2 kHz to 60 kHz
Stop point (Lower frequency)	40 Hz to 500 Hz
Amplitude spot value (Balanced)	0 V to 16 Vrms
Amplitude spot value (Unbalanced/Common)	0 V to 8 Vrms
FREQUENCY SWEEP (DFD IEC 60118/IEC 60268 WAVEFORM)	
Start point (Upper frequency)	3 kHz to 80 kHz
Start point (Center frequency)	3 kHz to 79 kHz
Stop point (Upper frequency)	3 kHz to 80 kHz
Stop point (Center frequency)	3 kHz to 79 kHz
Amplitude spot value (Balanced)	0 V to 16 Vrms
Amplitude spot value (Unbalanced/Common)	0 V to 8 Vrms
Difference frequency spot value	80 Hz to 2 kHz

VOLTAGE SWEEP	
Start point (Balanced)	0 V to 16 Vrms[1]
Start point (Unbalanced/Common)	0 V to 8 Vrms[1]
Stop point (Balanced)	0 V to 16 Vrms[1]
Stop point (Unbalanced/Common)	0 V to 8 Vrms[1]
Frequency spot value (Sine and Dual sine waveforms)	5 Hz to 80 kHz
Frequency spot value (Square waveform)	5 Hz to 30 kHz
Frequency spot value (SMPTE IMD 1:1/4:1/10:1 waveform)	40 Hz to 500 Hz (lower frequency), 2 kHz to 60 kHz (upper frequency)
Frequency spot value (DFD IEC 60118/IEC 60268 waveform)	3 kHz to 80 kHz (upper frequency), 3 kHz to 79 kHz (center frequency), 80 Hz to 2 kHz (difference frequency)
DC SWEEP	
Start point (Balanced)	–22.6 V to 22.6 V
Start point (Unbalanced/Common)	–11.3 V to 11.3 V
Stop point (Balanced)	–22.6 V to 22.6 V
Stop point (Unbalanced/Common)	–11.3 V to 11.3 V
PHASE SWEEP	
Start point	–180 ° to 179.99 °
Stop point	–180 ° to 179.99 °

[1] This range is applicable for sine wave only.

Measurement Category

The U8903A is intended to be used for measurement under Measurement Category I, 200 Vp for altitude up to 3000 m.

Measurement category definitions

Measurement CAT 1	Measurements performed on circuits that are not directly connected to MAINS. For example, measurements on circuits that are not derived from MAINS, and specially protected (internal) mains-derived circuits.
Measurement CAT II	Measurements performed on circuits which are directly connected to the low voltage installation. For example, measurements on household appliances, portable tools, and similar equipment.
Measurement CAT III	Measurements performed in fixed building installation. For example, measurements on distribution boards, circuit breakers, wiring (including cables), bus bars, junction boxes, switches, socket outlets in fixed installation, equipment for industrial use, and stationary motors with permanent connections to fixed installation.
Measurement CAT IV	Measurements performed at the source of the low voltage installation. For example, electricity meters, measurements on primary overcurrent protection devices, and ripple control units.

Index

A

AC level detection 34, 58, 97, 139
accessories 11
acquisition length 114, 140
analysis mode 112
analyzer
  display 9, 46, 92
  features 3, 19
  menu 30, 33, 92
  settings 9, 30, 34, 56, 63, 96
  specifications 138
  units 30, 31, 32, 34
arbitrary waveform 25, 29, 88, 136, 149
autosweep/list 126, 129
averaging 37, 114

B

block diagram 54
BNC 2, 3, 7, 11, 54, 60, 70, 137, 138

C

characteristics 134
common settings 30, 35, 63, 96
coupling 3, 19, 34, 56, 57, 96, 138
crosstalk 3, 19, 33, 94, 107, 137, 138

D

DC signal 2, 19, 25, 28, 85, 135, 137
DFD 28, 33, 82, 104, 135, 136, 148
digital filters 3, 19, 21, 34, 59, 96, 152
dimensions 10, 134
display mode 6, 42, 45, 140
dual sine waveforms 2, 19, 27, 74, 78, 135

E

editing keys 6, 51

F

file maintenance 43, 44
front panel 5, 22, 48
fuse 13

G

generator
  features 2, 18
  menu 23, 27
  output settings 26, 29, 70, 137
  specifications 135
  waveforms 24, 25, 27, 74, 135
graph
  frequency/time domain 2, 36, 110, 140
  functions 39, 118
  menu 36
  mode 110
  settings 37, 110

H

harmonics 37, 116
help 6, 16, 42, 50

I

I/O 6, 39, 48, 131
input configuration 60, 138
input range 30, 34, 61, 138
inspection 12

L

list view 124, 130
local 6, 42, 46

M

manual sweep/list 39, 129
marker 40, 119
measurement
  bandwidth 35, 63, 138
  category V, 143
  functions 30, 33, 93, 94, 97
  time 35, 64
Mode 6, 22, 74, 92, 110, 124
multitone waveform 28, 86, 136

N

noise level 33, 102
noise signals 28, 84, 136

O

on/off 6, 40

P

peak search 40, 118
phase measurement 33, 105, 139
power on 5, 14, 49
preset 15, 42, 46
print 6, 42, 46

R

rack mount 11, 12
rear panel 7, 8, 14
recall 6, 42, 44
remote interface 20
run/stop 6, 40

S

save 6, 42, 43
SINAD 33, 100
sine waveform 27, 76, 135
SMPTE IMD 27, 33, 81, 103, 136, 139, 148
SNR 33, 101
square waveform 29, 88, 135
sweep
  file 39, 125, 155
  menu 38, 124
  mode 129
  settings 38, 126, 156
  specifications 141
system
  menu 42, 47, 48

T

THD + N 33, 98, 135, 138
trigger 8, 11, 35, 66, 138

V

variable phase waveform 27, 77, 135
ventilation V, 12

W

window functions 113, 140

X

XLR 2, 7, 11, 54, 60, 70, 137, 138

Appendixes

Appendix A: SMPTE IMD and DFD Default Settings 148
Appendix B: Arbitrary File Format 149
Appendix C: User-defined Filter File Format 152
Appendix D: User-defined Sweep Points File Format 155
Appendix E: Spot Parameters 156

Appendix A: SMPTE IMD and DFD Default Settings

The SMPTE IMD default settings are listed in the following table.

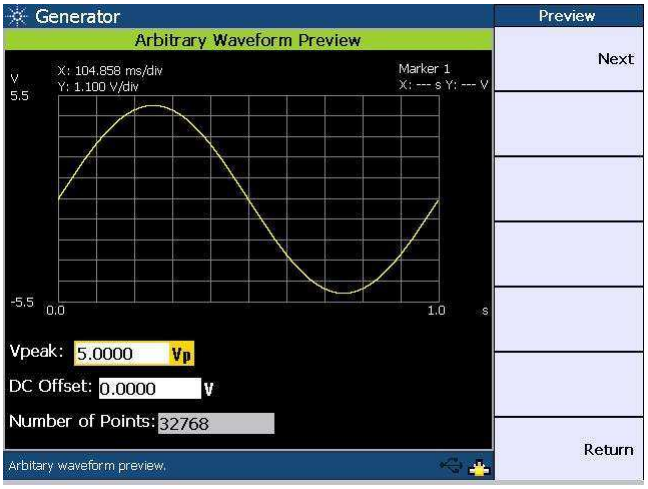
	SMPTE 1:1	SMPTE 4:1	SMPTE 10:1
Amplitude ratio of the lower frequency to upper frequency	1:1	4:1	10:1
Upper frequency	7 kHz	7 kHz	7 kHz
Lower frequency	60 Hz	60 Hz	60 Hz
Amplitude	0 Vrms	0 Vrms	0 Vrms
DC offset	0 V	0 V	0 V

The DFD default settings are shown in the following table.

	DFD IEC 60118	DFD IEC 60268
Difference frequency	80 Hz	80 Hz
Upper frequency	10 kHz	N/A
Center frequency	N/A	10 kHz
Amplitude	0 Vrms	0 Vrms
DC offset	0 V	0 V

Appendix B: Arbitrary File Format

If the arbitrary waveform is selected for a particular channel for the first time, a message will appear to prompt you to load an arbitrary file. The File Manager will be launched to allow you to select the file to be loaded. Once you recall an arbitrary file, the waveform preview page will appear as shown in the following example.



You have the option to change the Vpeak and DC offset values on the waveform preview page. Press **Next** to confirm the arbitrary waveform data. The arbitrary waveform menu will be displayed.

You may configure the arbitrary file using the format as shown in the example below. The file is saved in the *.arb format.

#Vpeak: 2

#DC offset: 0

#Points:
0
–0.2
–0.4
.
.
.

The following table shows the allowable range of values for each arbitrary file parameter.

Parameter	Range
Vpeak	• 0 to 22.6 Vp (Balanced output connection) • 0 to 11.3 Vp (Unbalanced or Common output connection)
DC offset	–11.3 V to 11.3 V
Points	32 to 32768 points

NOTE

When the DC offset and amplitude are added together, it must not exceed the maximum voltage for the current output connection type:

- For the Balanced output connection, Vpeak + |DC offset| must be within 0 V and 22.6 V.
- For the Unbalanced and Common mode output connections, Vpeak + |DC offset| must be within 0 V and 11.3 V.

The sampling rate for the arbitrary waveform is fixed at 312.5 kHz. Thus, the interval between samples is 3.2 µs (1/312.5).

For the following arbitrary file example, the highest numerical number of the sample points, which is 6, is output with the Vpeak. The other samples are level-controlled according to their ratio to the maximum.

#Vpeak: 2

#DC offset: –3

#Points:

0

–1

–1.5

–1

0

2

4

6

4

2

.
.
.

Any of the following conditions may cause an error or warning message to appear.

- Unable to load the sample points, as the points may not be a valid float.
- Summation of the Vpeak and DC offset exceeds the maximum voltage for the current output connection type.
- Invalid Vpeak and DC offset values.
- Total of sample points < 32.
- The arbitrary file does not exist.

Appendix C: User-defined Filter File Format

Pressing **Custom** in either the low pass, high pass, or weighting filters section enables you to upload a user-defined filter file via the File Manager.

The available user-defined filter types are Infinite Impulse Response (IIR) and Finite Impulse Response (FIR). You need to specify the coefficients or sections as well as group delay for the respective filter type. Use the following examples to configure the filter file format. The file is saved in the *.juf format.

Example of the FIR filter file format:

#Type: FIR

#Delay: 10

#Coefficients: [0.001, 0.002, 0.003, 0.004, 0.005]

The coefficients of the FIR filter are described as follows.

```
0.001        //A[0]
0.002        //A[1]
0.003        //A[2]
0.004        //A[3]
0.005        //A[4]
```

NOTE

The FIR filter transfer function, $H(z)$, is defined as:

$$H(z) = A[0] + A[1]z^{-1} + A[2]z^{-2} + A[3]z^{-3} + \ldots$$

where z = complex variable

Example of the IIR filter file format:

#Type: IIR

#Delay: 10

#Sections: [0.021888116917017919, 1, –1.8522189864275376, 0.93977145409560914, 1, 2, 1] [0.020670375338350408, 1, –1.7491711051903651, 0.83185260654376658, 1, 2, 1]

The coefficients of the IIR filter are described as follows.

0.021888116917017919	//Section 1: $Gain_1$
1	//Section 1: $A_1[0]$
–1.8522189864275376	//Section 1: $A_1[1]$
0.93977145409560914	//Section 1: $A_1[2]$
1	//Section 1: $B_1[0]$
2	//Section 1: $B_1[1]$
1	//Section 1: $B_1[2]$
0.020670375338350408	//Section 2: $Gain_2$
1	//Section 2: $A_2[0]$
–1.7491711051903651	//Section 2: $A_2[1]$
0.83185260654376658	//Section 2: $A_2[2]$
1	//Section 2: $B_2[0]$
2	//Section 2: $B_2[1]$
1	//Section 2: $B_2[2]$

where A_x = Denominator and B_x = Numerator

NOTE

The IIR filter transfer function, $H(z)$, is defined as:

$$H(z) = \prod_{x=1}^{N} Gain_x \left(\frac{B_x[0] + B_x[1]z^{-1} + B_x[2]z^{-2}}{A_x[0] + A_x[1]z^{-1} + A_x[2]z^{-2}} \right)$$

where z = complex variable, N = number of sections, x = section number

There will only be one set of [] if the filter type is FIR. The IIR filter contains multiple [], where each set of [] represents one section.

You may set up to 256 coefficients for the FIR filter type, and up to 36 sections for the IIR filter. The number of FIR coefficients must not be less than four, while the minimum number of sections allowed for IIR is one (seven coefficients). The delay is specified in the form of samples and within the range of 0 to 65535.

It is recommended to use commas to separate the coefficients. However, newlines can also be used as separators.

Appendix D: User-defined Sweep Points File Format

This section explains how to configure the user-defined sweep points file.

You may specify the values of the sweep points in a row or column.

For example:

100,200,300,400,500

or

100

200

300

400

500

The file is saved in the *.csv format.

NOTE The system will sort the values in ascending order after parsing the file.

Appendix E: Spot Parameters

Sweep parameter	Waveform	Spot parameter 1	Spot parameter 2
Amplitude	Sine Square	Frequency	–
	Dual	Frequency 1	Frequency 2
	SMPTE IMD (1:1, 4:1, and 10:1)	Lower Frequency	Upper Frequency
	DFD IEC 60118	Difference Frequency	Upper Frequency
	DFD IEC 60268	Difference Frequency	Center Frequency
	DC Gaussian Rectangular	–	–
Phase	Variable Phase	Frequency	Amplitude
Frequency	Sine Square	Amplitude	–
Frequency 1	Dual	Amplitude	Frequency 2
Frequency 2	Dual	Amplitude	Frequency 1
Lower Frequency	SMPTE IMD (1:1, 4:1, and 10:1)	Amplitude	Upper Frequency
Upper Frequency	SMPTE IMD (1:1, 4:1, and 10:1)	Amplitude	Lower Frequency
	DFD IEC 60118	Amplitude	Difference Frequency
Center Frequency	DFD IEC 60268	Amplitude	Difference Frequency

www.agilent.com

Contact us

To obtain service, warranty, or technical assistance, contact us at the following phone or fax numbers:

United States:
(tel) 800 829 4444 (fax) 800 829 4433
Canada:
(tel) 877 894 4414 (fax) 800 746 4866
China:
(tel) 800 810 0189 (fax) 800 820 2816
Europe:
(tel) 31 20 547 2111
Japan:
(tel) (81) 426 56 7832 (fax) (81) 426 56 7840
Korea:
(tel) (080) 769 0800 (fax) (080) 769 0900
Latin America:
(tel) (305) 269 7500
Taiwan:
(tel) 0800 047 866 (fax) 0800 286 331
Other Asia Pacific Countries:
(tel) (65) 6375 8100 (fax) (65) 6755 0042

Or visit Agilent World Wide Web at:
www.agilent.com/find/assist

Product specifications and descriptions in this document are subject to change without notice. Always refer to the Agilent web site for the latest revision.

Fourth Edition, February 1, 2011

U8903-90002

Agilent Technologies