Agilent U8903A Audio Analyzer

User's Guide

Firmware 2.10.1.0 and above

Agilent Technologies

Notices

Manual Part Number

U8903-90030

Edition

Tenth Edition, June 2, 2014

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CAUTION

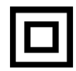
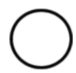
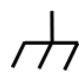
A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the likes of that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are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

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the likes of 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 may appear on the instrument and in the documentation; they 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)
	On (supply)		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		Frame or chassis terminal

Safety Considerations

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 the 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 condition	Requirement
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

NOTE

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/NMB-001:Issue 4, June 2006
- IEC 61326-1:2005/EN 61326-1:2006
- Australia/New Zealand: AS/NZS CISPR 11:2004
- USA: ANSI/UL std No. 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 conforme 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 or electronic product in domestic household waste.
C US	The CSA mark is a registered trademark of the Canadian Standards Association.
40	This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

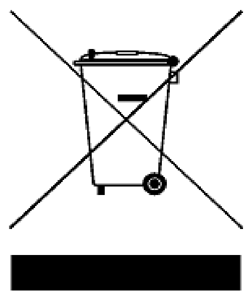
Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or 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 as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Agilent Service Center, or visit

www.agilent.com/environment/product

for more information.

Declaration of Conformity (DoC)

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

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.

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1
Getting Started

This chapter describes 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 has two channels of analog audio generator and two channels of analog audio analyzer.

The standard option for the U8903A audio analyzer is Option 200. The U8903A can be further expanded with digital audio interfaces like the AES3, SPDIF, and Digital Serial Interface (DSI). The digital audio interfaces are available with the U8903A Option 113, 114, and 115. Refer to "U8903A options" on page 6 for more information on the available U8903A options.

The U8903A is capable of performing a wide range of audio parameter measurements on both analog audio and digital audio interfaces. Measurement functions can be performed simultaneously on the analog audio and digital audio interfaces such as analog audio + AES3/SPDIF, analog audio + DSI, and AES3/SPDIF + DSI.

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.

To search for firmware updates for the U8903A, go to the Agilent U8903A firmware update Web site at www.agilent.com/find/audioanalyzer_firmware.

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 an easy- to- use instrument especially with the usage of an integrated Web browser that provides a convenient way to configure the instrument's functionality.

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 the 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 bottom at the front of the U8903A, and exhausting it through the ventilation holes on the sides and top at the rear of the U8903A. 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. Rackmount 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 rackmount 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 of the U8903A. If required, use a filler panel above the U8903A to ensure adequate space for air circulation.

Standard Shipped Items

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

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

Optional Items

The following accessories are available for purchase separately.

- Male BNC to male BNC cable, 1.2 m
- Male BNC to male RCA cable, 2 m
- Male XLR to female XLR cable, 2 m
- Male XLR to male BNC cable, 0.26 m
- Female XLR to male BNC cable, 0.26 m
- BNC accessory kit
- Rackmount kit
- Digital serial interface cable
- Digital self-test kit, 25-pin D-SUB

U8903A Digital Audio

U8903A options

U8903A Option 200

The U8903A Option 200 is the standard option with two channels of analog audio generator and analyzer.

U8903A Option 113

The U8903A Option 113 expands the audio analyzer with the AES3, SPDIF, and DSI digital audio interfaces. Refer to "Specifications" on page 263 for more information on the digital audio interfaces specifications.

U8903A Option 114

The U8903A Option 114 expands the audio analyzer with the AES3 and SPDIF digital audio interfaces. Refer to "AES3/SPDIF interface specifications" on page 272 for more information on the AES3 and SPDIF interfaces specifications.

U8903A Option 115

The U8903A Option 115 expands the audio analyzer with the DSI digital audio interface. Refer to "DSI specifications" on page 274 for more information on the DSI specifications.

Units for digital audio measurements

Table 1-1 Units for digital audio measurements

Unit	Description
FFS	Fractional of Full Scale
%FS	Percent of Full Scale
dBFS	Decibels relative to Full Scale
LSB	Least Significant Bit
FS/Vrms	Ratio between cross-domain input and output levels measurements (analog input and digital output)
Vrms/FS	Ratio between cross-domain input and output levels measurements (digital input and analog output)

Product at a Glance

Front panel outlook

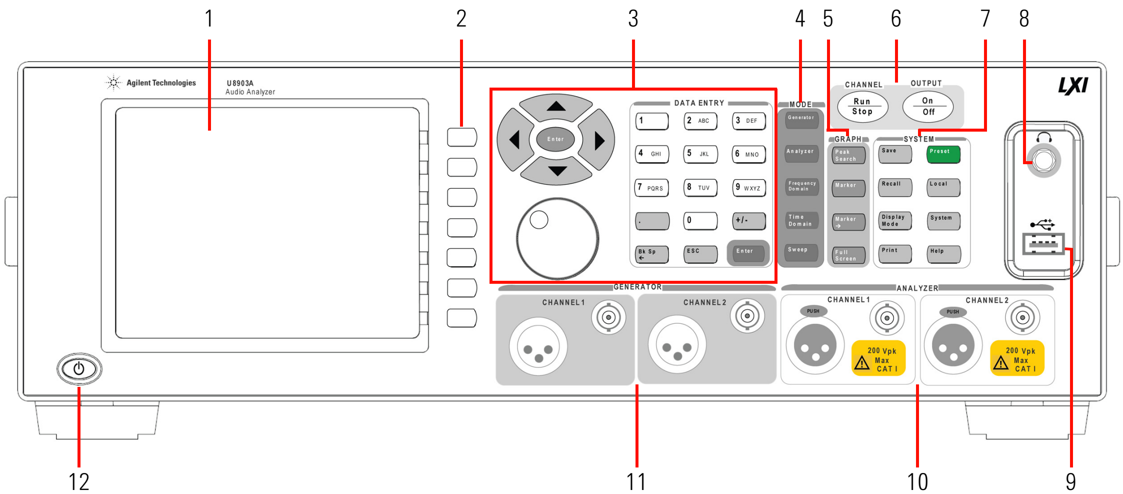

Figure 1-1 U8903A front panel

Table 1-2 U8903A front panel description

No.	Item	Description
1	LCD display	Provides information on the current function including status indicators, settings, and error messages. Refer to “LCD display layout” on page 13 for more information.
2	Softkeys 1 to 7	Activates the function as displayed on the right side of the LCD display.
3	Editing keys	The editing keys consists of the knob, Enter key, arrow keys, and data entry keys. Refer to “Editing keys” on page 33 for more information.
4	Mode	Enables access to the U8903A main functions. Refer to “Mode” on page 35 for more information.

Table 1-2 U8903A front panel description (continued)

No.	Item	Description
5	Graph	Enables access to the commonly used graph functions. Refer to "Graph" on page 99 for more information.
6	Channel/Output	Toggles 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. Refer to "Run/Stop and On/Off" on page 100 for more information.
7	System	Enables access to the U8903A system functions. Refer to "System" on page 101 for more information.
8	Headphone jack	Reserved for future expansion
9	USB port	Allows an external USB flash storage to be connected to the U8903A
10	Analog analyzer input	Receives analog audio signal using a female XLR input connector and a female BNC input connector. The input connectors are available for each channel.
11	Analog generator output	Outputs analog audio signal using a male XLR output connector and a female BNC output connector . The output connectors are available for each channel.
12	Power on/off	Turns the U8903A on or off

Rear panel outlook

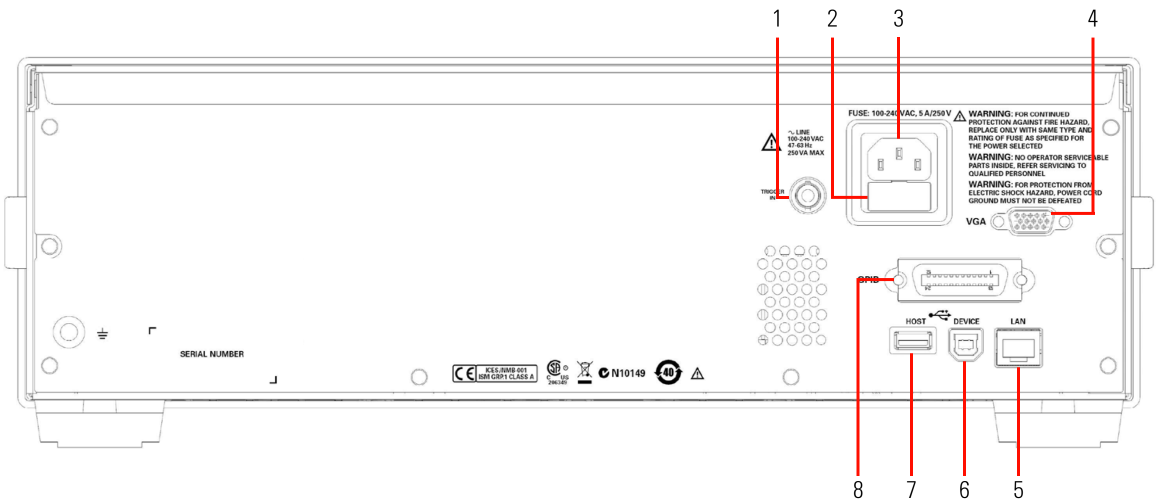

Figure 1-2 U8903A rear panel (Option 200)

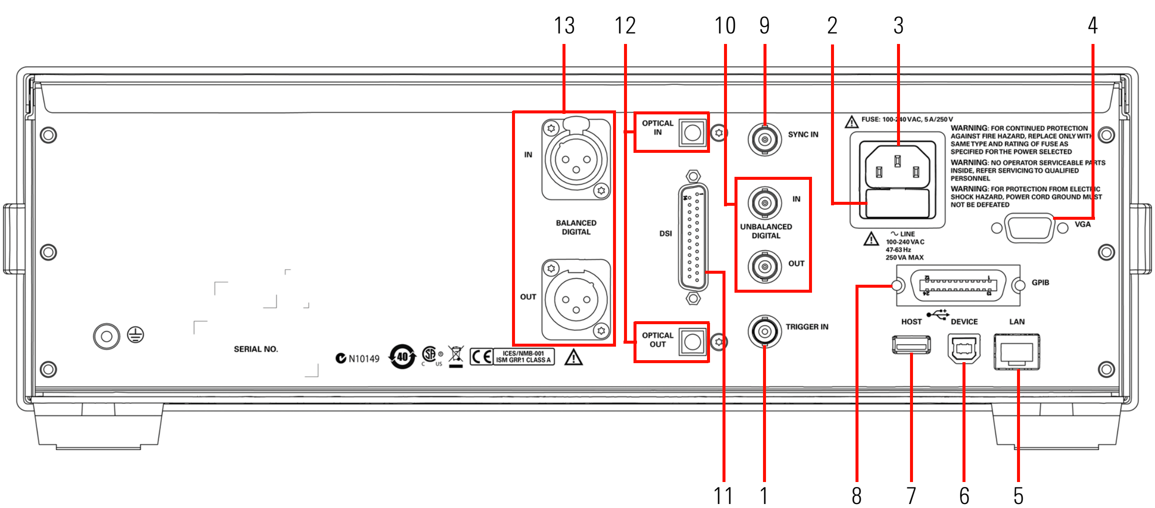

Figure 1-3 U8903A rear panel (Option 113, 114, and 115)

Table 1-3 U8903A rear panel description

No.	Item	Description
1	Trigger in	Receives an external TTL or CMOS signal using a female BNC input connector for triggering operation. Triggering can occurs on either the positive or negative edge.
2	Fuse	Fuse compartment for AC supply
3	AC power inlet	Connects to an AC line voltage
4	VGA port	Allows an external monitor to be connected to the U8903A
5	LAN port	Allows the U8903A to be controlled remotely over the LAN interface
6	USB Type-B port	Allows the U8903A to be controlled remotely over the USB interface
7	USB port	Allows an external USB flash storage to be connected to the U8903A
8	GPIB port	Allows the U8903A to be controlled remotely over the General Purpose Interface Bus (GPIB) interface
9	Sync in	Receives an external sync in clock/frame signal using a female BNC input connector (for digital audio only)
10	Digital analyzer input and output (AES3/SPDIF)	Receives and outputs digital audio signal using a female BNC input connector and a female BNC output connector respectively
11	Digital analyzer input and output (DSI)	Receives and outputs digital audio signals using a 25-pin male D-SUB connector
12	Digital analyzer input and output (SPDIF)	Receives and outputs digital audio signal using a TOSLINK input connector and a TOSLINK output connector respectively
13	Digital analyzer input and output (AES3)	Receives and outputs digital audio signal using a female XLR input connector and a male XLR output connector respectively

CAUTION

Connect the TOSLINK cable straight into the TOSLINK connector. DO NOT force the cable in or connect at an angle. Failing to do so may cause damage to the TOSLINK connector.

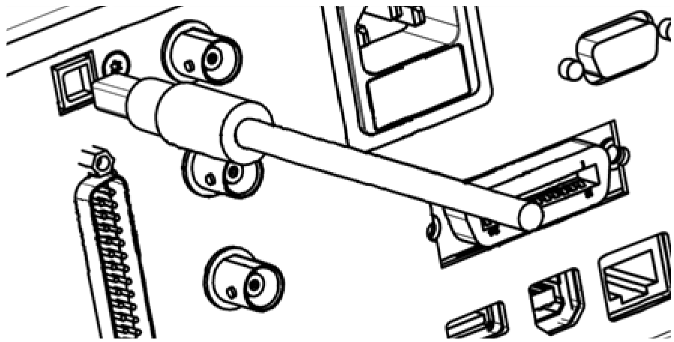

Figure 1-4 Connect the TOSLINK cable straight into the connector

LCD display layout

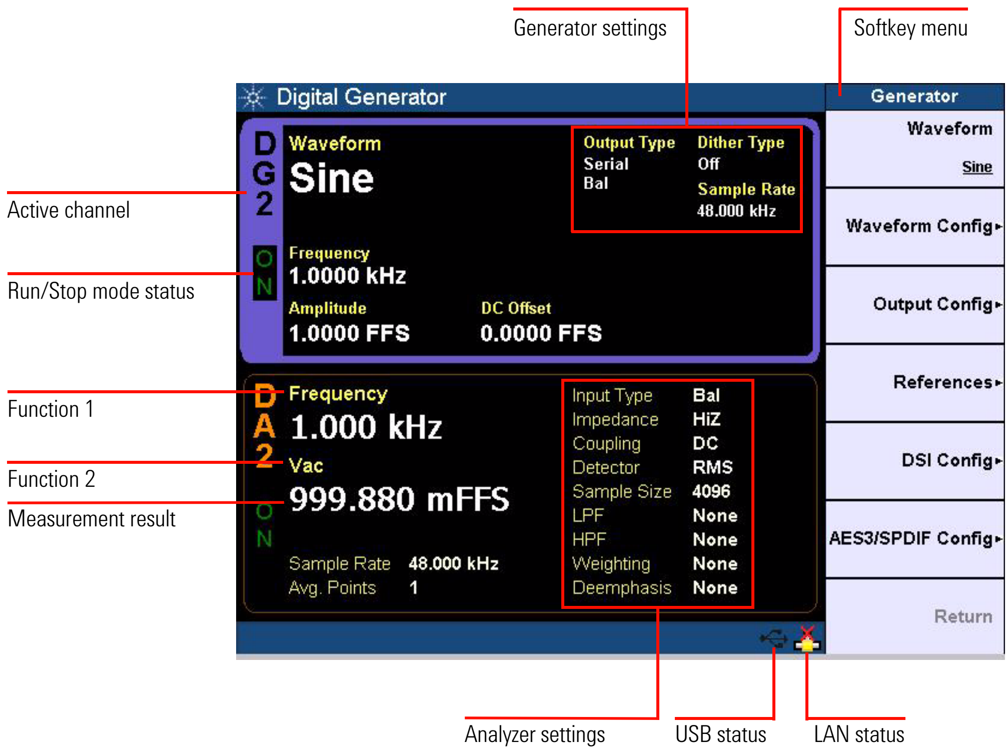

Figure 1-5 U8903A LCD display layout

Table 1-4 Active channel indicator

AG1/AG2	Analog generator channel 1 or 2
AA1/AA2	Analog analyzer channel 1 or 2
DG1/DG2	Digital generator channel 1 or 2
DA1/DA2	Digital analyzer channel 1 or 2

NOTE Refer to "Display Mode" on page 104 for more information on the U8903A display layout.

Product Dimensions

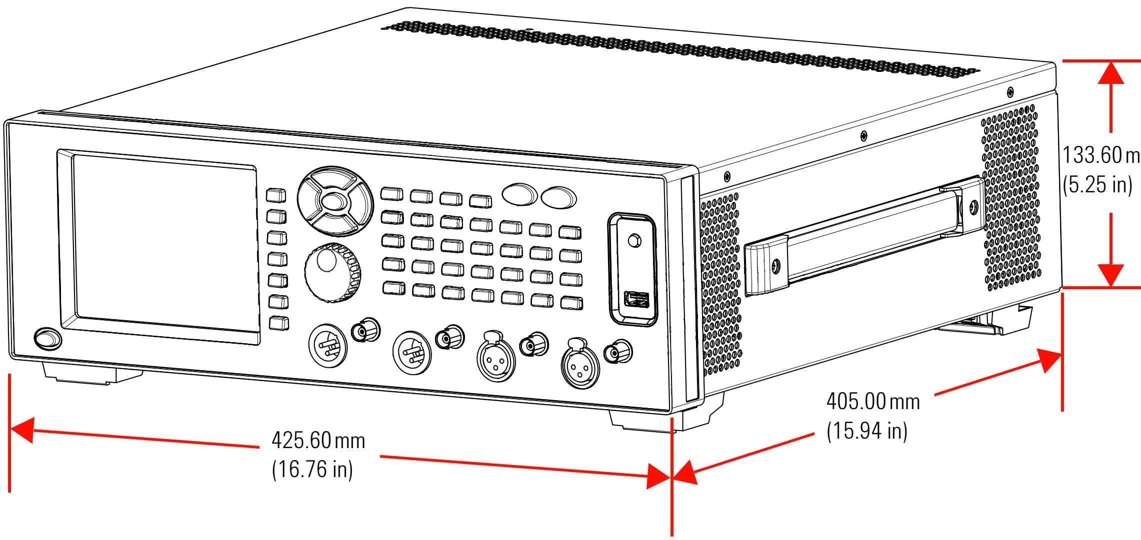

Figure 1-6 U8903A dimensions

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 fuse.
3 Remove the active fuse if it is faulty. Confirm that the backup fuse has the same rating as the active fuse.
4 Replace the active fuse with the backup fuse.

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. The U8903A will automatically adjust to the correct line voltage in the range of 100 Vac to 240 Vac.

Preset the U8903A

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 

on the System panel.

NOTE Presetting the U8903A will not reset the HP8903B configurations and the Legacy Sweep setting.

Help System

The help system provides you 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.

NOTE When Help mode is enabled, the function keys will not execute their normal functions when pressed.

An example of a help information dialog is shown in Figure 1-7.

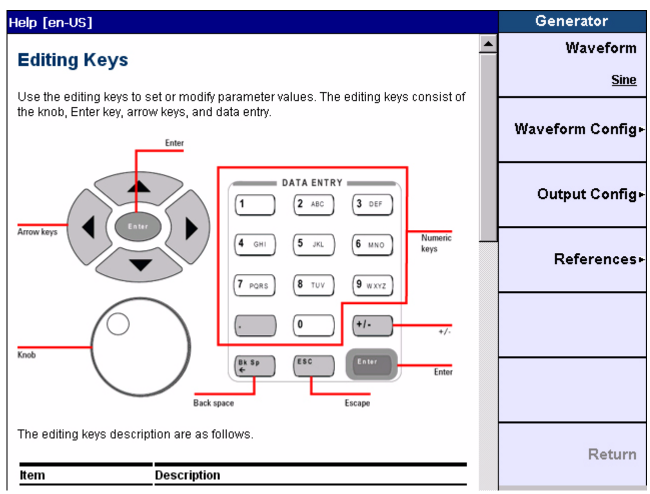

Figure 1-7 Help information dialog

System Updates

The U8903A system updates files can be obtained from the Agilent U8903A firmware update Web site at www.agilent.com/find/audioanalyzer_firmware.

U8903A software and firmware update

Perform the following procedure to update the U8903A firmware or software.

1 Press **System** from the system panel on the front panel.

2 From the system menu page, press **Update**. The Update menu is displayed as shown in Figure 1-8.

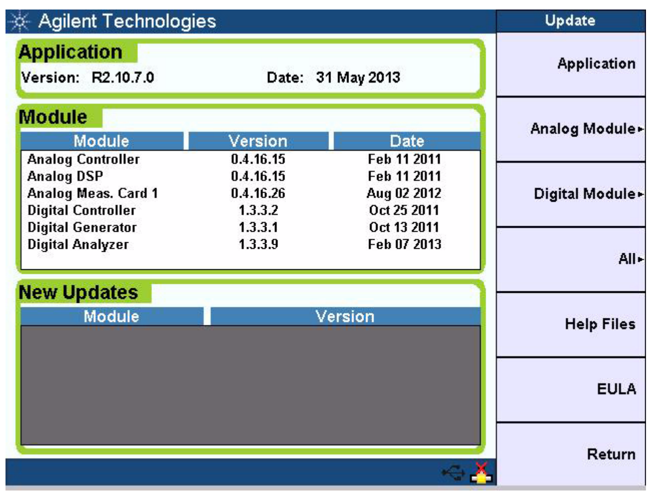

Figure 1-8 Update menu

Application

Updates the U8903A software application.

Analog Module

Selects among Analog Controller, Analog DSP, or Analog Meas. Card 1 firmware to be updated.

Digital Module

Selects among Digital Controller, Digital Generator, or Digital Analyzer firmware to be updated.

All

Updates the U8903A software application, and the analog and digital module firmware.

3 Press the respective option and the recall file manager is displayed to enable you to select the source location.
4 Select the software or firmware file to be updated, and press **Recall** as shown in Figure 1-9. Refer to “Recall” on page 103 for more information on the recall file manager.

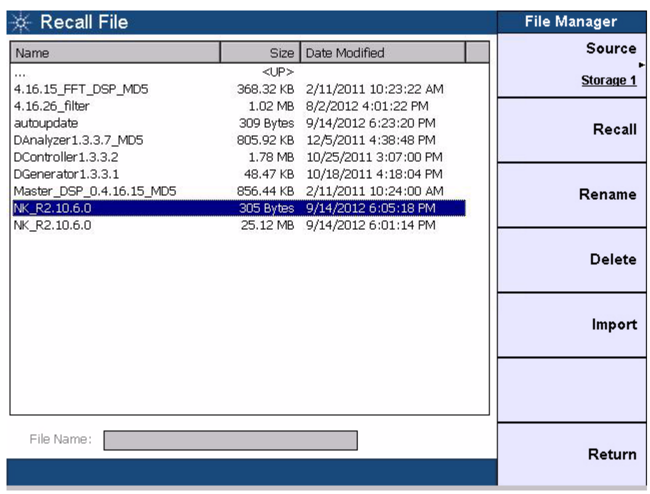

Figure 1-9 Recall file manager

U8903A help files update

Perform the following procedure to update the U8903A help files.

1 Press **System** from the system panel on the front panel.

2 From the system menu page, press **Update**. The Update menu is displayed as shown in Figure 1-10.

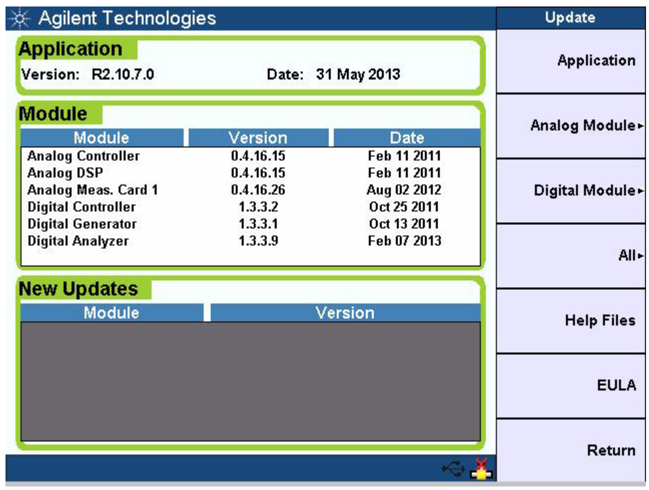

Figure 1-10 Update menu

3 Press **Help Files** and the load help files file manager is displayed to enable you to select the source location.

4 Select the .cmp file to be updated and press **Recall** as shown in Figure 1-11. Refer to “Recall” on page 103 for more information on the recall file manager.

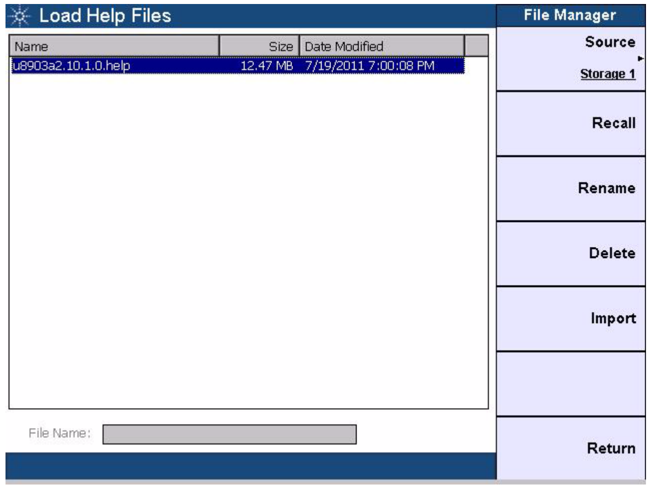

Figure 1-11 Load Help Files file manager

Self-Test

Perform the following procedure to run the U8903A self-test.

1 Press **System** from the system panel on the front panel.

2 From the system menu page, press **Service**. The Self-Test menu is displayed as shown in Figure 1-12.

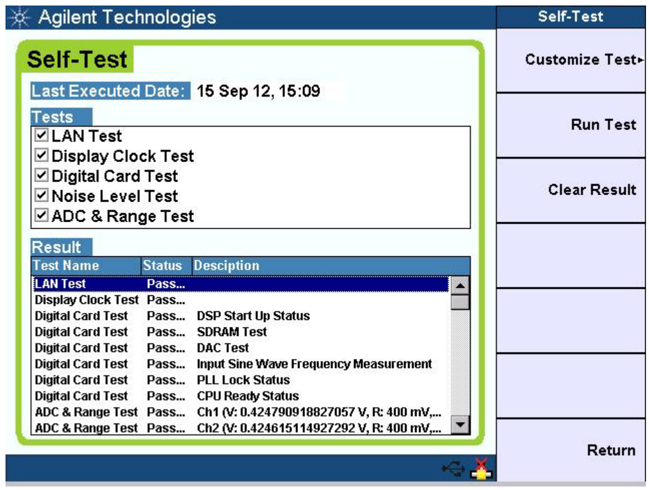

Figure 1-12 Self-Test menu

3 Press **Customize Test** to select the tests.

4 Press **Run Test** to run the selected tests.

5 Press **Clear Result** to clear the previous self-test results. The self-test results are saved in the system memory.

NOTE Self-test cannot be performed when the HP8903B mode is enabled.

LAN Test

Check on the LAN connection status, LAN hardware error, or any device-specific error.

Display Clock Test

Check on the front panel display functionality.

Digital Card Test

Check on the digital card status which consists of the following modules:

- Phase Lock Loop module (PLL lock status)
- Central Processing Unit (CPU ready status)
- Digital Signal Processing module (DSP start-up status)
- Memory module (SDRAM test)
- Digital-to-Analog Converter (DAC test)
- Analyzer and generator (Input sine wave frequency measurement)

In this test, the digital connectors need to be externally looped back. Table 1-5 shows the digital connectors that require external loop back for the digital card test.

Table 1-5 External loop back

Digital card test	25-pin male D-SUB	XLR	BNC	TOSLINK
PLL lock status				
CPU ready status	✔			
DSP start-up status	✔			
SDRAM test	✔			
DAC test	✔	✔		
Input sine wave frequency measurement[1], [2]	✔	✔	✔	

[1] External loop back is required for the 25-pin male D-SUB and the XLR or BNC connector.

[2] To externally loop back the 25-pin male D-SUB connector, solder the pins as shown in Figure 1-13.

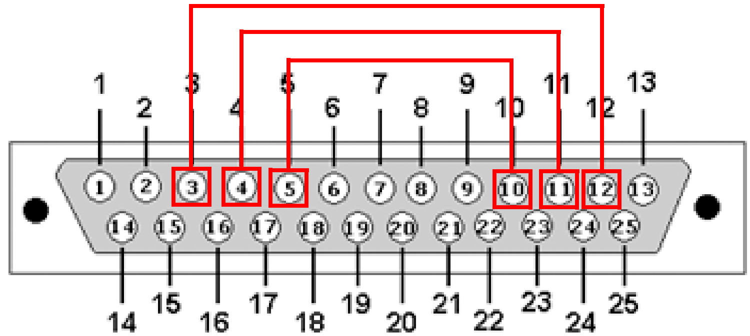

Figure 1-13 25-pin male D-SUB connector pin soldering for external loop back

In order to pass all the modules in the digital card test, the 25-pin male D-SUB connector and the XLR connector need to be externally looped back.

NOTE Agilent recommends the digital self-test kit, 25-pin D-SUB (U8903A-106).

Noise Level Test

Check on the noise level on the analog analyzer. In this test, the analog analyzer and generator are connected internally (internal loop back condition). The analog generator output is set to 0 Vp and the measured noise level on the analog analyzer input should be within the range of ±0.008 dB to pass the test.

ADC & Range Test

Check on the ADC path of the analog analyzer and the signal generation path of the analog generator. In this test, the analog analyzer and generator are connected internally (internal loop back condition).

To test the analog analyzer ADC path, the analog generator will output a 0.6 Vp sine waveform for 1 kHz, 40 kHz, and 80 kHz. For each frequency, the analog analyzer will try to measure the amplitude of the waveform at the range of 400 mV, 800 mV, 1.6 V, 3.2 V, 6.4 V, 12.8 V, 25 V, 50 V, 100 V, and 140 V.

To test the square waveform generation path of the analog generator, the analog generator will output a 1.6 Vrms square waveform with a 1 kHz frequency and the analog analyzer will measure the amplitude of the waveform at the range of 1.6 V. The amplitude measurement from the analog analyzer should be within the range of ±0.5 dB to pass the test.

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2
Operation and Features

This chapter describes the operation and features that are offered by the U8903A; they are test capabilities, key features, and front panel 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 analog generator and two channels of analog analyzer which enables the U8903A to test devices with stereo capability. The U8903A is also able to generate and analyze digital audio interfaces like AES3, SPDIF, and DSI with the available options as listed in "U8903A options" on page 6.

The U8903A analog generator has a frequency range of 5 Hz to 80 kHz, and the U8903A digital generator has a frequency range of 2 Hz to 0.45 sampling rate. The DSI digital generator has a sampling range of 6.75 kHz to 400 kHz and the AES3/SPDIF digital generator has a sampling range of 28 kHz to 192 kHz.

The audio generator features are listed as follows.

- Balanced analog or AES3/SPDIF output signals (XLR)
- Unbalanced analog or AES3/SPDIF output signals (BNC)
- DSI output signals (25-pin male D-SUB connector)
- Common mode test analog output signals (XLR)
- Selectable output impedance
- Sine waveform
- Variable phase waveform
- Dual sine waveforms which include SMPTE intermodulation distortion (SMPTE IMD) and difference frequency distortion (DFD) waveform types
- Square waveform
- Noise signal
- DC signal
- Multitone generation
- User-defined arbitrary waveform
- Digital audio test signal waveforms which include sine burst, stereo, monotonicity, constant value, walking zero, and walking one.

The U8903A analog analyzer has a frequency measurement range of 10 Hz to 100 kHz and the U8903A digital analyzer has a frequency measurement range of 5 Hz to 0.45 sampling rate. The audio analyzer features are listed as follows.

- Balanced input signals (XLR)
- Unbalanced input signals (BNC)
- DSI input signals (25-pin male D-SUB connector)
- Optical
- Frequency measurement
- AC voltage measurement
- DC voltage measurement
- THD+N Ratio measurement
- THD+N Level measurement
- THD Ratio measurement
- THD Level measurement
- Signal-to-noise ratio (SNR) measurement
- Noise level measurement
- SMPTE IMD measurement
- DFD measurement
- SINAD measurement
- Phase 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

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.

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.

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.

Filters

The U8903A has a series of filters that is implemented digitally. The filters 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. For digital analyzer, you can also have the option of using deemphasis and sample rate filters. Refer to "Appendix C: User-defined Filter File Format" on page 287 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.

- Softkeys
- Editing keys
- Mode
- Graph
- Channel and Output
- System

Editing keys

Editing keys are used to set or modify the parameter values. The editing keys group consists of the knob, Enter key, arrow keys, and data entry keys as shown in Figure 2-1.

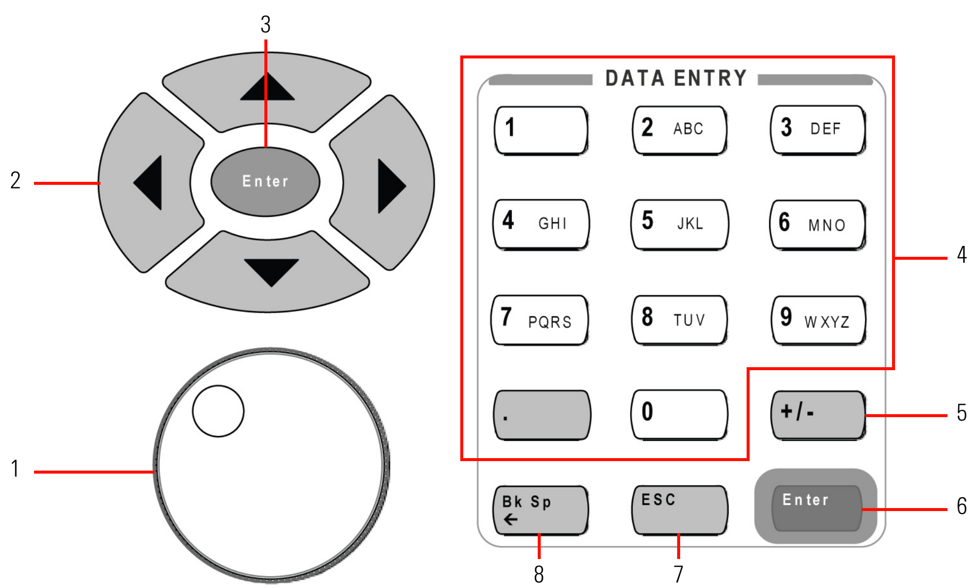


Figure 2-1 Editing keys

Table 2-1 Editing keys description

No	Item	Description
1	Knob	The usage of the knob are as follows. • Increases or decreases a numeric value • Changes a highlighted digit or character • Navigates through lists or items in a row • Moves the marker along the graph plot
2	Arrow keys	The usage of the up and down arrow keys are as follows. • Highlights the active channel • Increases or decreases a highlighted digit or value of the current measurement selection • Navigates within tables The usage of the left and right arrow keys are as follows. • Selects the channel number • Navigates the editable items on the LCD display for editing • Navigates within tables
3	Enter	Confirms an entry and then terminates data entry when the default unit is used
4	Numeric keys	Enter alphanumeric data by using the number keys and decimal point
5	+/–	Specifies a positive or negative value. For a negative value, toggle this key to enter the negative sign before a numeric value.
6	Enter	Confirms an entry
7	ESC	• Cancels a selected action • Deactivates the Help mode
8	Bk Sp	Deletes the selected data entry

Mode

The Mode panel enables access to the U8903A main functions.

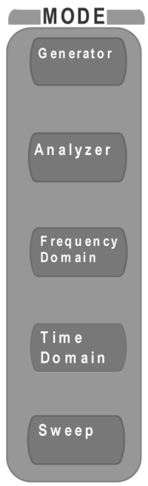


Figure 2-2 Mode panel

Table 2-2 Mode panel description

No	Item	Description
1	Generator	Selects the generator function, or toggles between analog generator or digital generator
2	Analyzer	Selects the analyzer function, or toggles between analog analyzer or digital analyzer
3	Frequency Domain	Selects the frequency domain graph analysis
4	Time Domain	Selects the time domain graph analysis
5	Sweep	Selects the sweep function

Generator

Press 

to change the display screen to the generator mode or toggle between analog generator or digital generator. On the Generator menu, you can set the waveform functions, waveform configurations, output settings, and references. For digital generator, you can also set the DSI configurations and AES3/SPDIF configurations. Use the softkey on the right side of the LCD display to navigate to the next menu level.

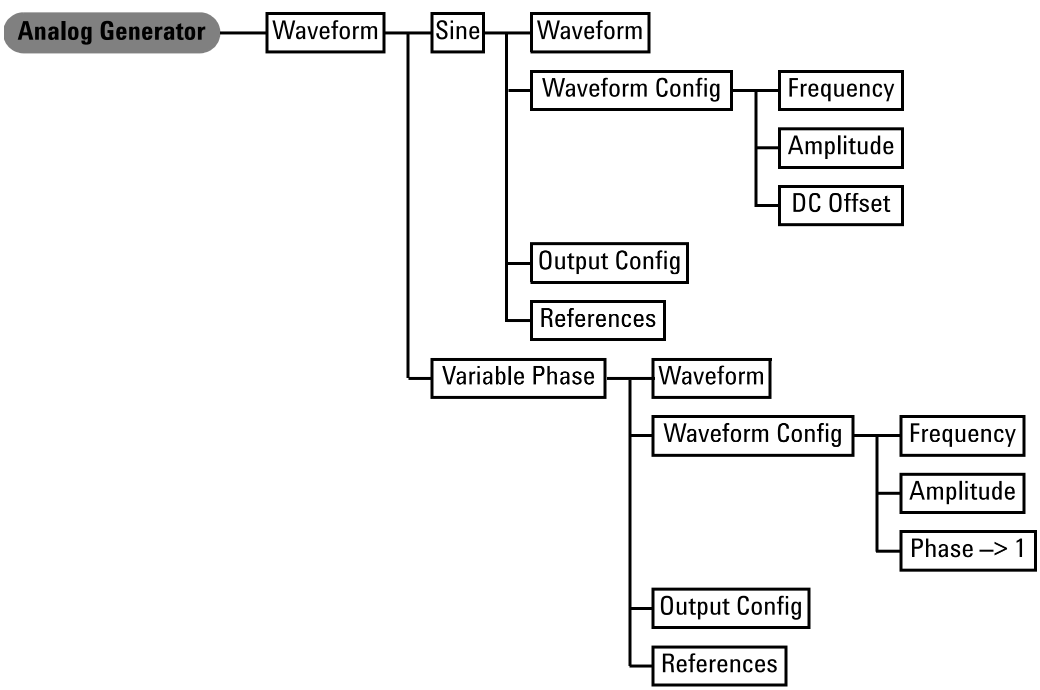


Figure 2-3 Analog generator menu tree: Waveform (Sine and Variable Phase)

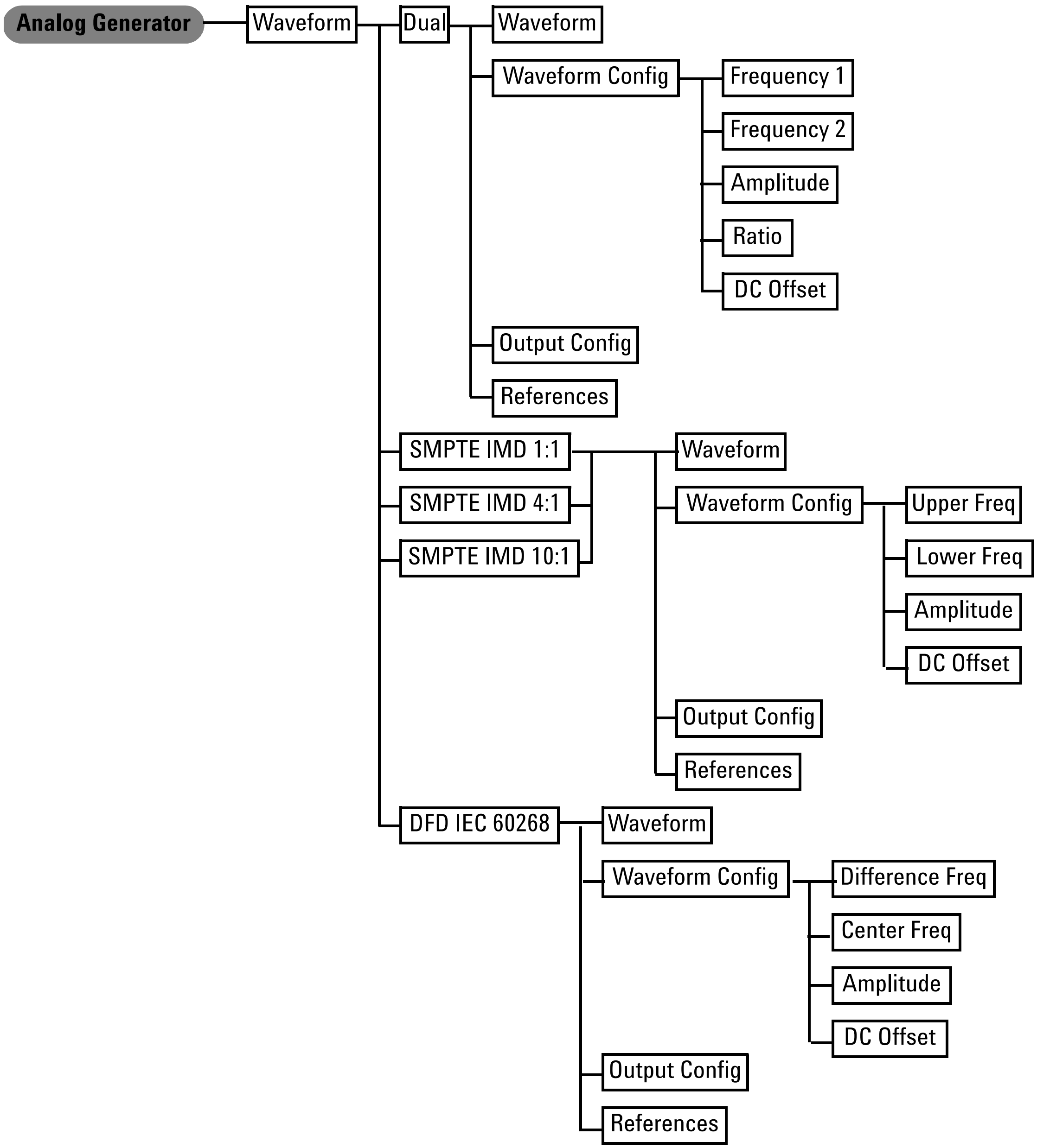


Figure 2-4 Analog generator menu tree: Waveform (Dual, SMPTE IMD 1:1 / 4:1 / 10:1, and DFD IEC 60268)

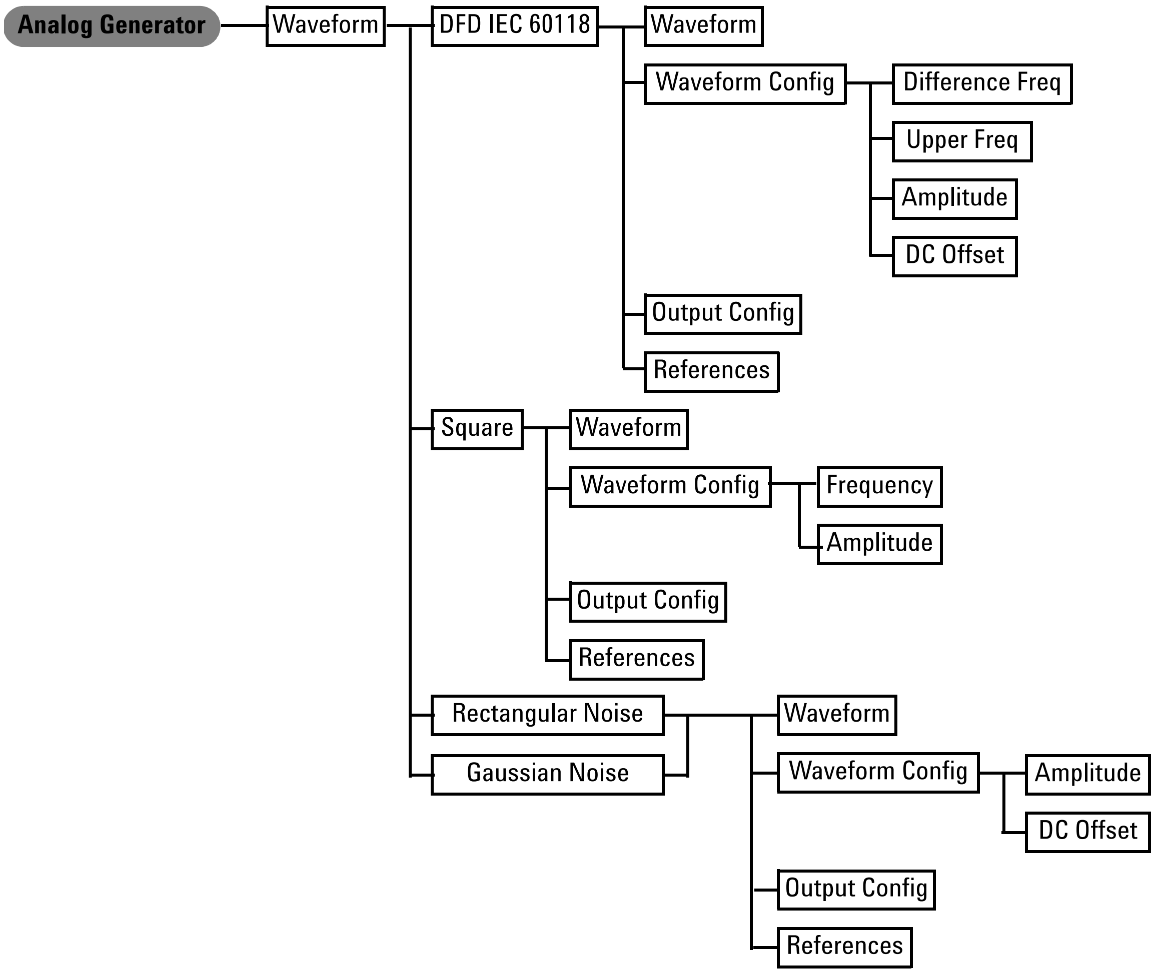


Figure 2-5 Analog generator menu tree: Waveform (DFD IEC 60118, Square, Rectangular Noise, and Gaussian noise)

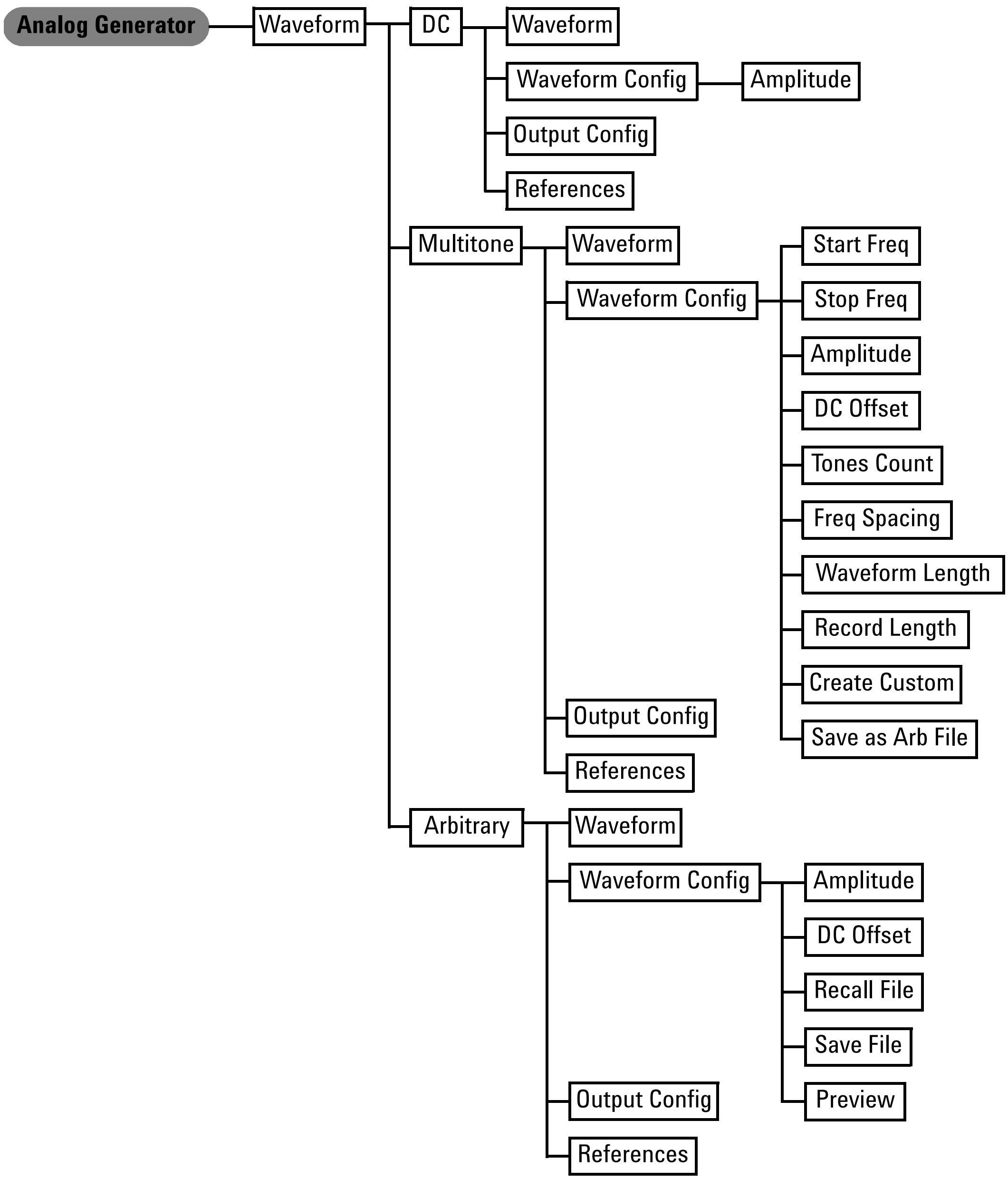


Figure 2-6 Analog generator menu tree: Waveform (DC, Multitone, and Arbitrary)

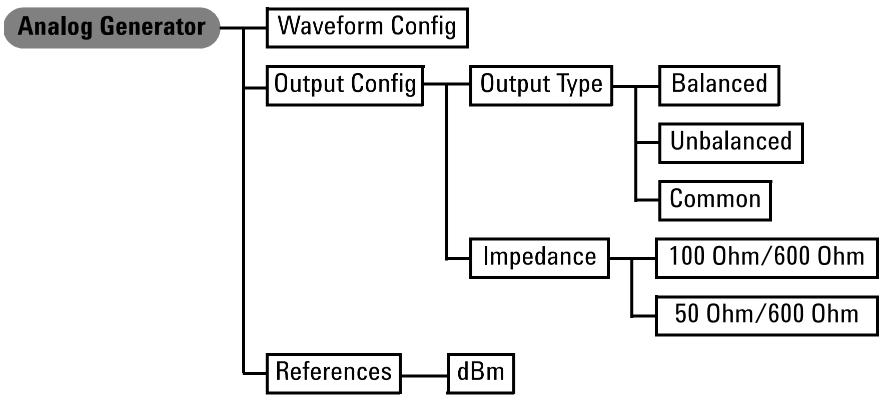


Figure 2-7 Analog generator menu tree: Waveform Config, Output Config, and References

Table 2-3 Analog generator menu tree description

Level 1	Level 2	Level 3	Level 4	Description
Waveform	Sine	Waveform		Select the signal waveform type
		Waveform Config	Frequency	Enter the signal frequency value
			Amplitude	Enter the signal amplitude value
			DC Offset	Enter the signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
	Variable Phase	Waveform		Select the signal waveform type
		Waveform Config	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
		Output Config		Refer to Output Config
		References		Refer to References

Table 2-3 Analog generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Dual	Waveform		Select the signal waveform type
		Waveform Config	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 composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
	SMPTE IMD 1:1 SMPTE IMD 4:1 SMPTE IMD 10:1	Waveform		Select the signal waveform type
		Waveform Config	Upper Freq	Enter the higher frequency sinewave component frequency value
			Lower Freq	Enter the lower frequency sinewave component frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
	DFD IEC 60268	Waveform		Select the signal waveform type
		Waveform Config	Difference Freq	Enter the difference frequency value between the first and second sinewave components

Table 2-3 Analog generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
			Center Freq	Enter the center frequency value between the first and second sinewave components
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
	DFD IEC 60118	Waveform		Select the signal waveform type
		Waveform Config	Difference Freq	Enter the difference frequency value between the first and second sinewave components
			Upper Freq	Enter the higher frequency sinewave component frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
	Square	Waveform		Select the signal waveform type
		Waveform Config	Frequency	Enter the signal frequency value
			Amplitude	Enter the signal amplitude value
		Output Config		Refer to Output Config
		References		Refer to References
	Rectangular Noise Gaussian Noise	Waveform		Select the signal waveform type

Table 2-3 Analog generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
		Waveform Config	Amplitude	Enter the signal amplitude value
			DC Offset	Enter the signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
	DC	Waveform		Select the signal waveform type
		Waveform Config	Amplitude	Enter the signal amplitude value
		Output Config		Refer to Output Config
		References		Refer to References
	Multitone	Waveform		Select the signal waveform type
		Waveform Config	Start Freq	Enter the lowest tone frequency in the signal
			Stop Freq	Enter the highest tone frequency in the signal
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the composite signal DC offset value
			Tones Count	Enter the number of tones in the signal, from 1 to 64
			Freq Spacing	Select the tones frequency relationship between linear and log
			Waveform Length	Select the number of samples used to create one iteration in the signal. NOTE: The waveform length must be less than or equal to the Record Length.
			Record Length	Select the number of samples created for one channel in the output file
			Create Custom	Create a custom multitone signal with arbitrary set of tones parameters

Table 2-3 Analog generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
			Save as Arb file	Save the multitone waveform to an output file
		Output Config		Refer to Output Config
		References		Refer to References
	Arbitrary	Waveform		Select the signal waveform type
		Waveform Config	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 Config		Refer to Output Config
		References		Refer to References
Waveform Config				Refer to individual waveform configuration
Output Config	Output Type	Balanced Unbalanced Common		Select either Balanced, Unbalanced, or Common output connection
	Impedance	100 Ohm 600 Ohm		Select the output impedance value for Balanced or Common output connection
		50 Ohm 600 Ohm		Select the output impedance value for Unbalanced output connection
References	dBm			Enter the reference impedance value

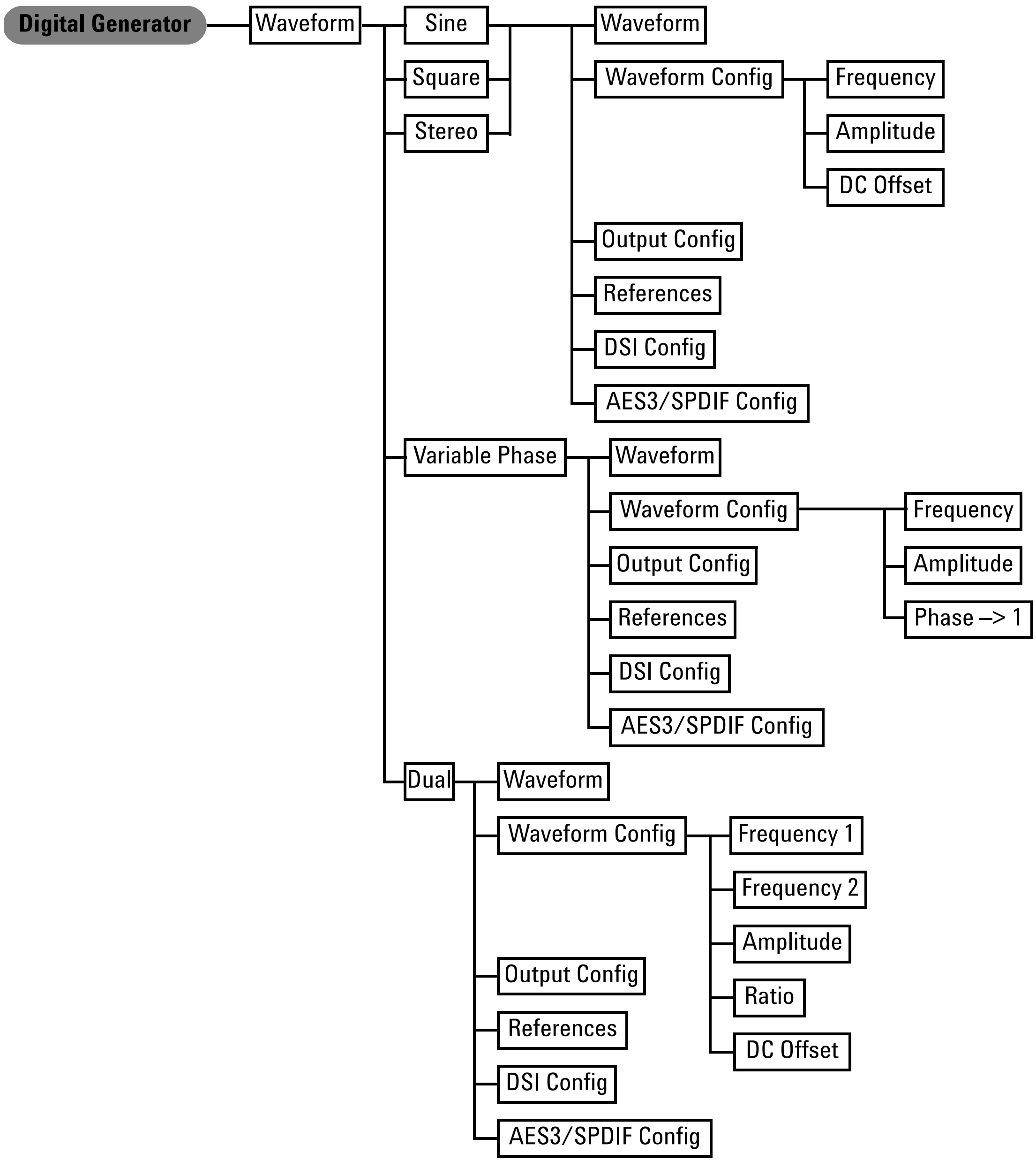


Figure 2-8 Digital generator menu tree: Waveform (Sine, Square, Stereo, Variable Phase, and Dual)

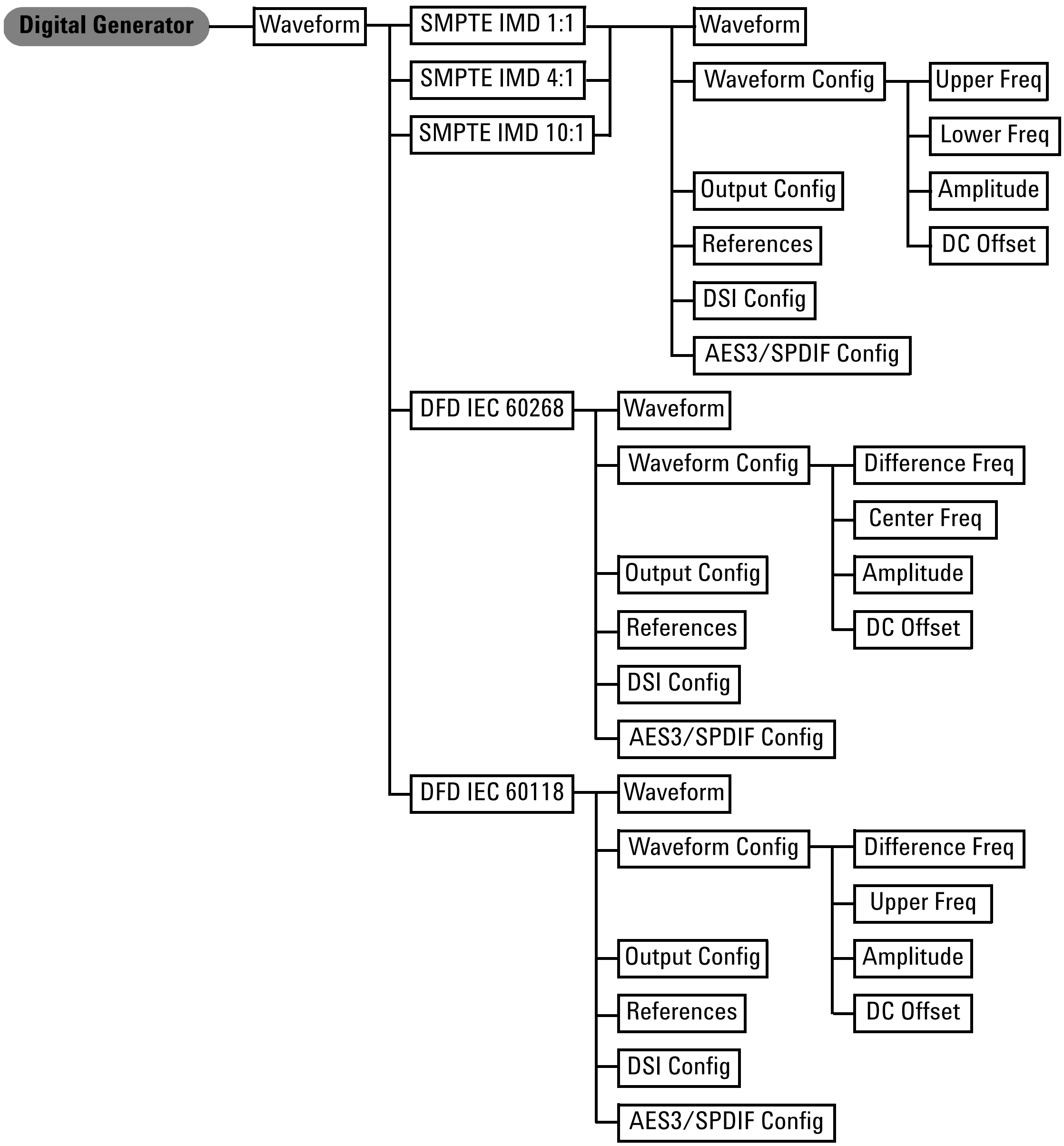


Figure 2-9 Digital generator menu tree: Waveform (SMPTE IMD1:1, SMPTE IMD 4:1, SMPTE IMD 10:1, DFD IEC 60118, and DFD IEC 60268)

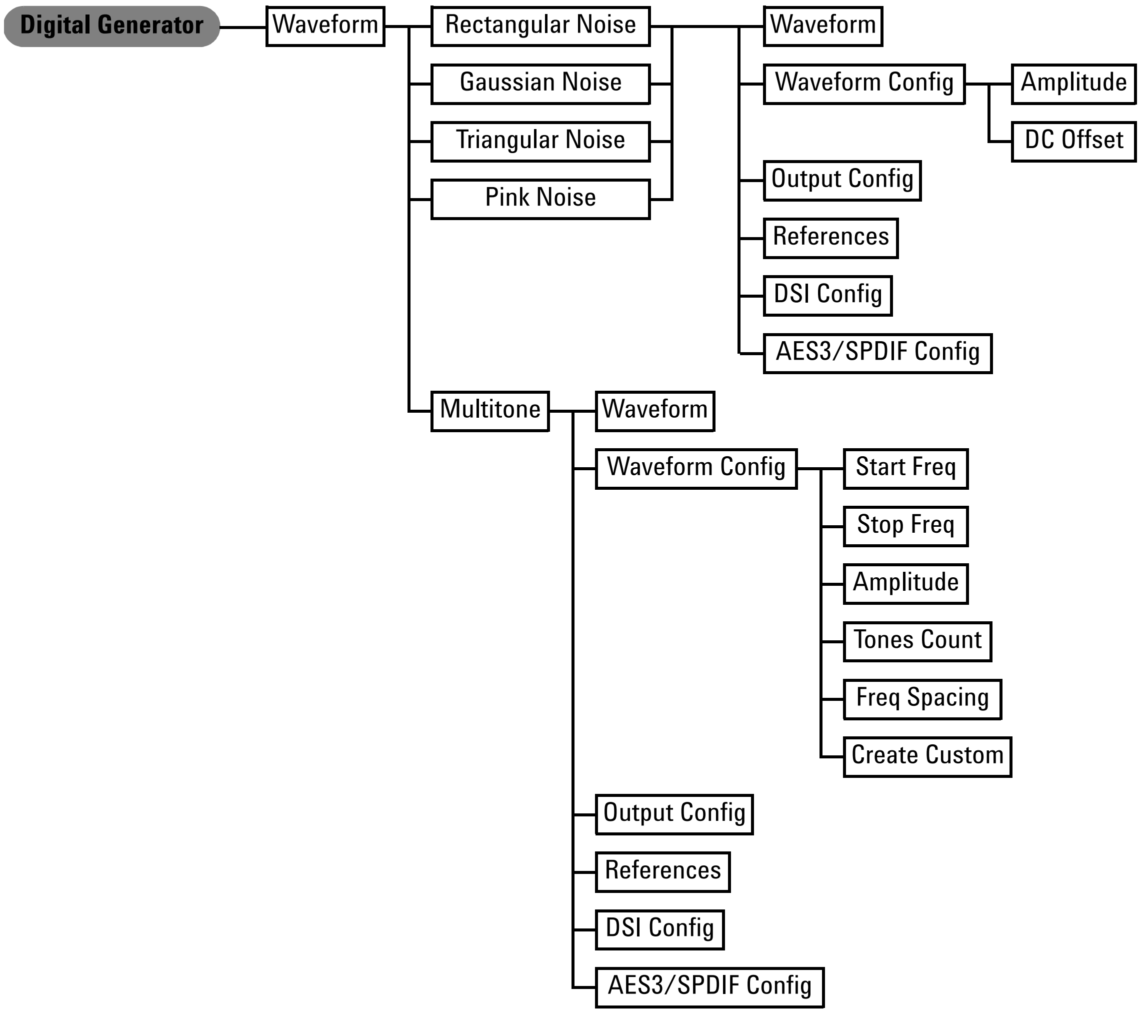


Figure 2-10 Digital generator menu tree: Waveform (Rectangular Noise, Gaussian Noise, Triangular Noise, Pink Noise, and Multitone)

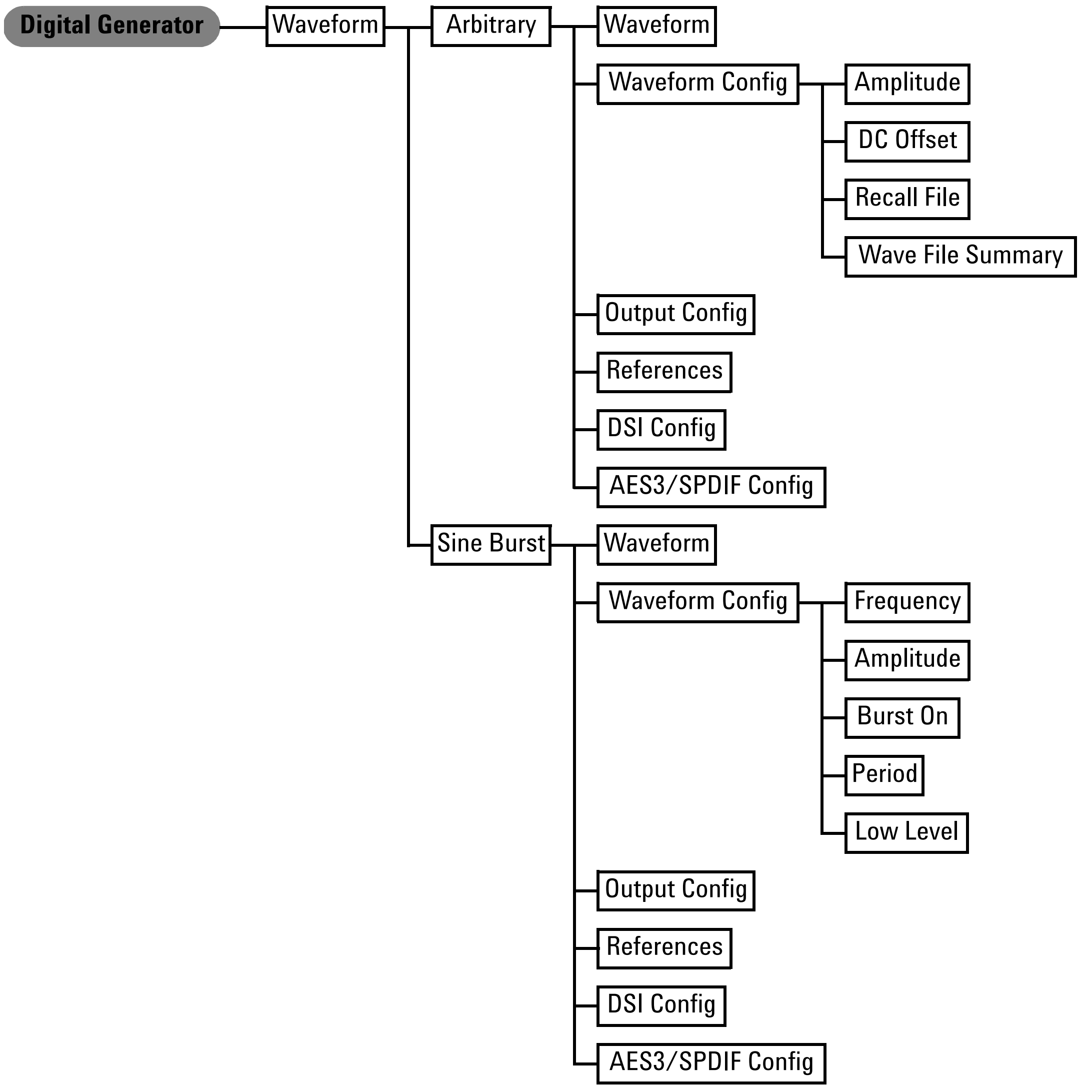


Figure 2-11 Digital generator menu tree: Waveform (Arbitrary and Sine Burst)

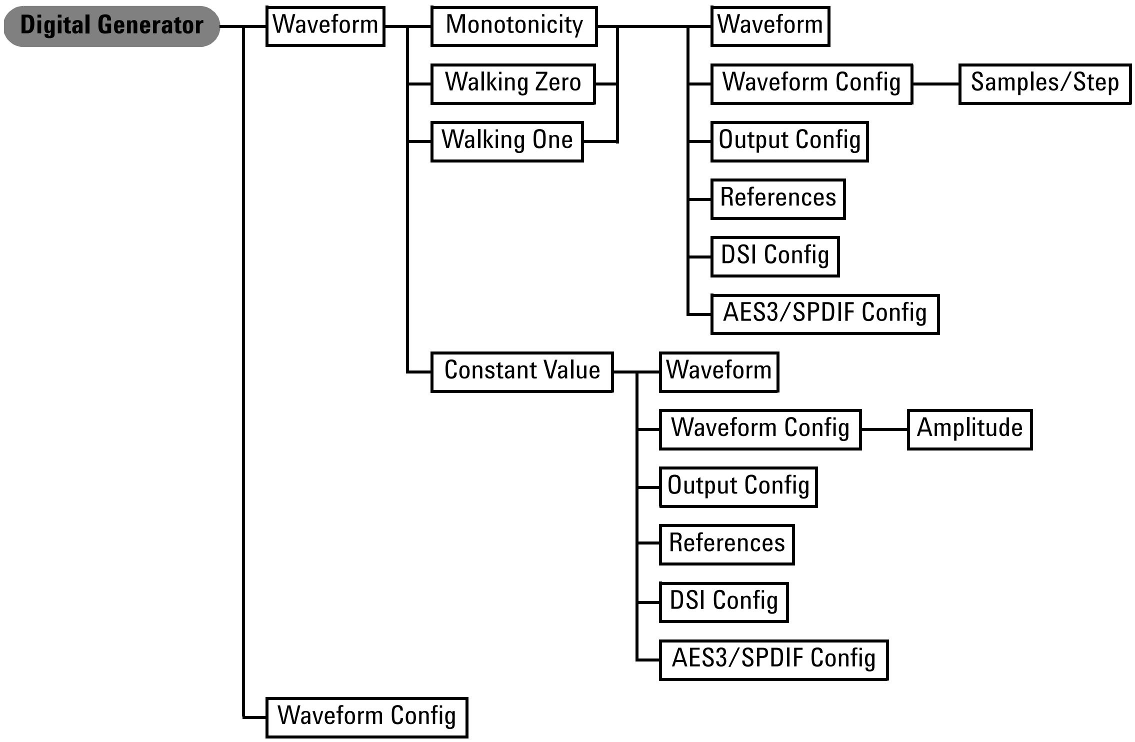


Figure 2-12 Digital generator menu tree: Waveform (Monotonicity, Walking Zero, Walking One, and Constant Value) and Waveform Config

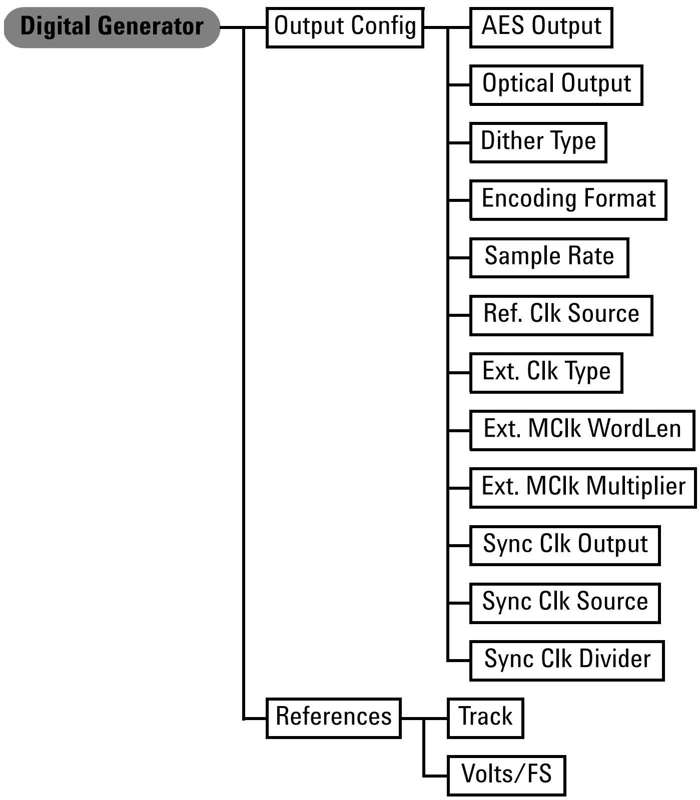


Figure 2-13 Digital generator menu tree: Output Config and References

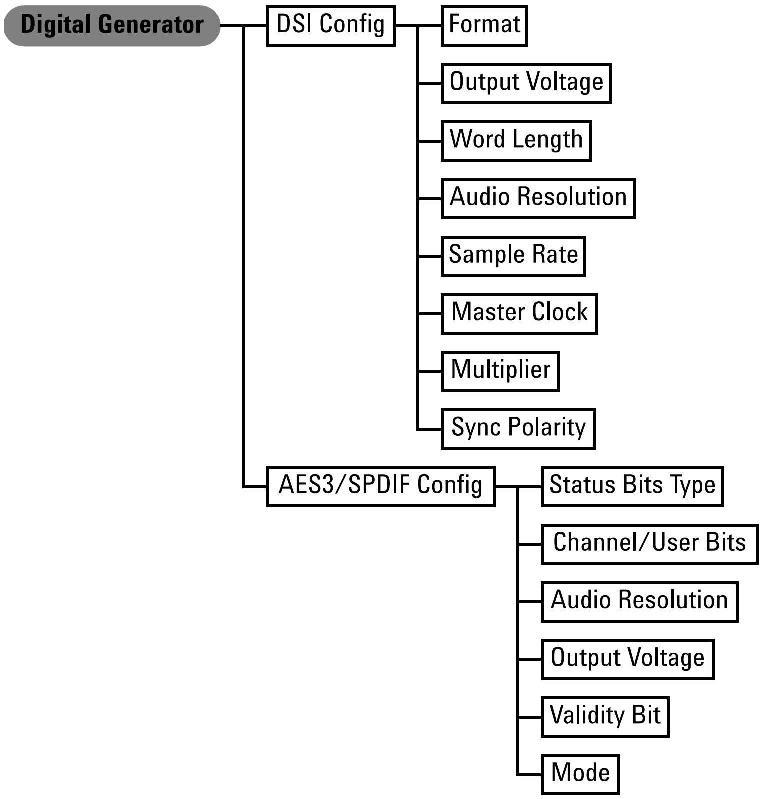


Figure 2-14 Digital generator menu tree: DSI Config, and AES3/SPDIF Config

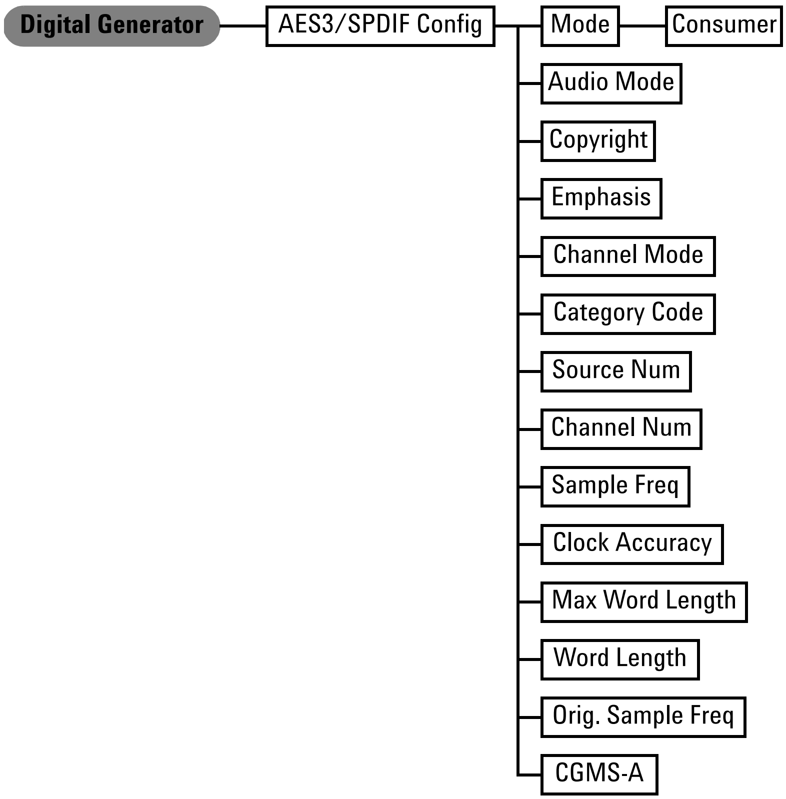


Figure 2-15 Digital generator menu tree: AES3/SPDIF Config Mode (Consumer)

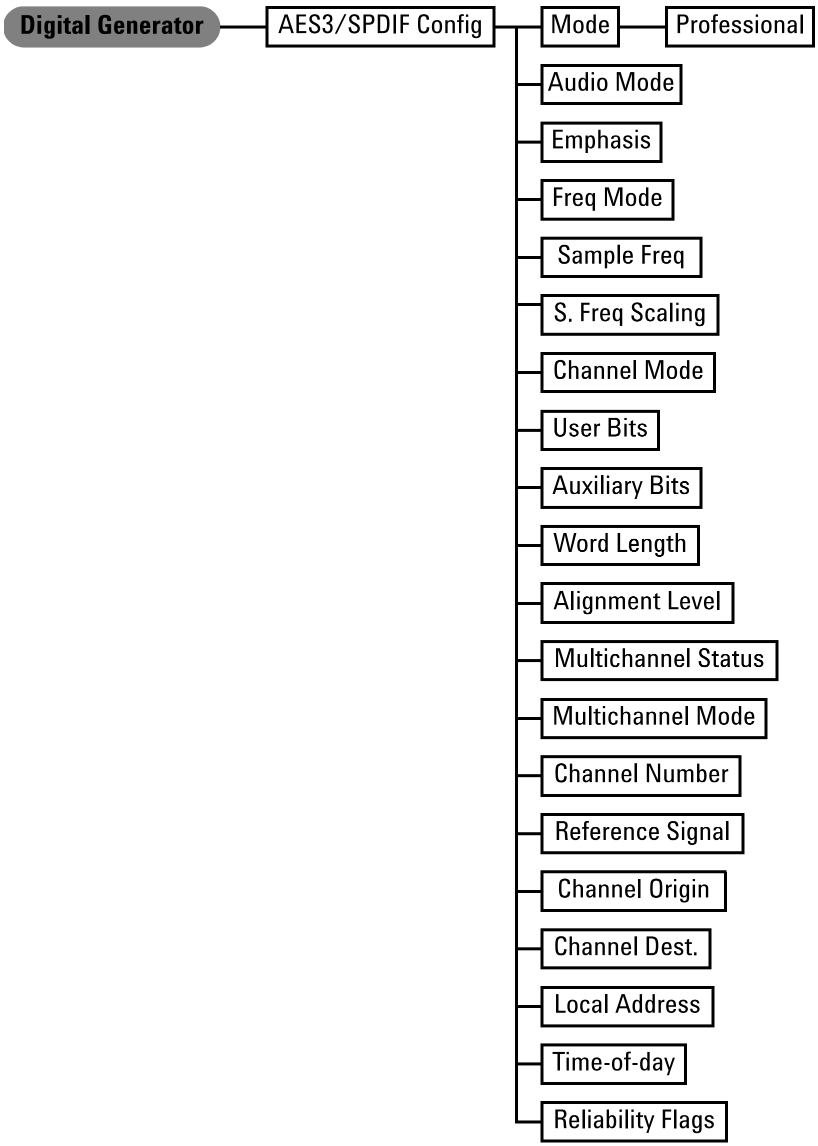


Figure 2-16 Digital generator menu tree: AES3/SPDIF Config Mode (Professional)

Table 2-4 Digital generator menu tree description

Level 1	Level 2	Level 3	Level 4	Description
Waveform	Sine Square Stereo	Waveform		Select the signal waveform type
		Waveform Config	Frequency	Enter the signal frequency value
			Amplitude	Enter the signal amplitude value
			DC Offset	Enter the signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	Variable Phase	Waveform		Select the signal waveform type
		Waveform Config	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
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	Dual	Waveform		Select the signal waveform type
		Waveform Config	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

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	SMPTE IMD 1:1 SMPTE IMD 4:1 SMPTE IMD 10:1	Waveform		Select the signal waveform type
		Waveform Config	Upper Freq	Enter the higher frequency sinewave component frequency value
			Lower Freq	Enter the lower frequency sinewave component frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	DFD IEC 60268	Waveform		Select the signal waveform type
		Waveform Config	Difference Freq	Enter the difference frequency value between the first and second sinewave components
			Center Freq	Enter the center frequency value between the first and second sinewave components
			Amplitude	Enter the composite signal amplitude value

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	DFD IEC 60118	Waveform		Select the signal waveform type
		Waveform Config	Difference Freq	Enter the difference frequency value between the first and second sinewave components
			Upper Freq	Enter the higher frequency sinewave component frequency value
			Amplitude	Enter the composite signal amplitude value
			DC Offset	Enter the composite signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	Rectangular Noise Gaussian Noise Triangular Noise Pink Noise	Waveform		Select the signal waveform type
		Waveform Config	Amplitude	Enter the signal amplitude value
			DC Offset	Enter the signal DC offset value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Multitone	Waveform		Select the signal waveform type
		Waveform Config	Start Freq	Enter the lowest tone frequency in the signal
			Stop Freq	Enter the highest tone frequency in the signal
			Amplitude	Enter the composite signal amplitude value
			Tones Count	Enter the number of tones in the signal, from 1 to 64
			Freq Spacing	Select the tones frequency relationship between linear and log
			Create Custom	Create a custom multitone signal with arbitrary set of tones parameters
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	Arbitrary	Waveform		Select the signal waveform type
		Waveform Config	Amplitude	Enter the signal amplitude value
			DC Offset	Enter the signal DC offset value
			Recall File	Import an arbitrary waveform from a file
			Wave File Summary	Display the wave file summary
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Sine Burst	Waveform		Select the signal waveform type
		Waveform Config	Frequency	Enter the signal frequency value
			Amplitude	Enter the signal amplitude value
			Burst On	Enter the number of cycles at which the signal amplitude will be at the higher level
			Period	Enter the number of cycles from the beginning of one burst to the beginning of the next burst
			Low Level	Enter the amplitude ratio of Burst On over Burst Off
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	Monotonicity Walking Zero Walking One	Waveform		Select the signal waveform type
		Waveform Config	Samples/Step	Enter the sample/step value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config
	Constant Value	Waveform		Select the signal waveform type
		Waveform Config	Amplitude	Enter the signal amplitude value
		Output Config		Refer to Output Config
		References		Refer to References
		DSI Config		Refer to DSI Config
		AES3/SPDIF Config		Refer to AES3/SPDIF Config

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
Waveform Config				Refer to individual waveform configuration
Output Config	AES Output	Off Balanced Unbalanced		Select either Off, Balanced, or Unbalanced mode output connection
	Optical Output	On Off		Enable or disable optical output
	Dither Type	Off Rectangular Triangular		Select either Off, Rectangular, or Triangular dither type
	Encoding Format	Linear PCM A-Law μ-Law		Select either Linear PCM, A-Law or μ-Law as the encoding format
	Sample Rate			Enter the sample rate
	Ref. Clk Source	Internal AES Recovered Clk External		Select either Internal, AES Recovered Clk, or External as the system reference clock source
	Ext. Clk Type	MCLK FSYNC		Select either master clock (MCLK) or sync clock (FSYNC) as the external clock type
	Ext. MClk WordLen	8 to 32		Enter the number of word length for external master clock, from 8 to 32
	Ext. MClk Multiplier			Select the external master clock multiplier. NOTE: The selection available depends on the Ext. Mclk WordLen.
	Sync. Clk Output	On Off		Enable or disable synchronous clock output
	Sync. Clk Source	Internal AES Recovered Clk External		Select either Internal, AES Recovered Clk, or External as the synchronous clock source
	Sync. Clk Divider	1 128		Select either 1 or 128 as the synchronous clock divider

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
References	Track	Channel Off		Select the reference channel where the settings of the reference channel will be tracked by the current channel
	Volts/FS			Enter the Volts/FS value
DSI Config	Format	Left Justified Right Justified I2S DSP		Select either Left Justified, Right Justified, I2S, or DSP as the DSI output format
	Output Voltage	1.2 Vpp 1.5 Vpp 1.8 Vpp 2.5 Vpp 3 Vpp 3.3 Vpp Custom		Select the DSI output voltage value
	Word Length	8 to 32		Enter the word length value, from 8 to 32. NOTE: The word length value cannot be less than the audio resolution.
	Audio Resolution	8 to 24		Enter the audio resolution value, from 8 to 24
	Sample Rate			Enter the sample rate value
	Master Clock	On Off		Enable or disable master clock output
	Multiplier			Select the multiplier value. NOTE: The selection available depends on the word length.
	Sync Polarity	Rising Falling		Select either Rising or Falling as the sync polarity
AES3/SPDIF Config	Status Bits Type	Channel User		Select either Channel or User as the status bits type

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Channel/User Bits	Edit Clear Save in Hex Save in Xml Recall		Edit, clear, save in Hex, save in xml, or recall the channel/user bits
	Audio Resolution	8 to 24		Enter the audio resolution value, from 8 to 24
	Output Voltage			Enter the AES3/SPDIF output voltage value
	Validity Bit	Set Clear		Set or clear the validity bit
	Mode	Consumer Professional		Select either Consumer or Professional as the AES3/SPDIF mode. NOTE: This setting is only applicable when the status bit type is set to Channel.
AES3/SPDIF Mode: Consumer				
AES3/SPDIF Config	Audio Mode	Non Lin. PCM Lin. PCM		Select either Non Lin. PCM or Lin. PCM as the audio mode
	Copyright	Non Copyright Copyright		Select either Non Copyright or Copyright as the copyright type
	Emphasis	No pre-emphasis 50/15 µs Reserved 1 Reserved 2		Select either No pre-emphasis, 50/15 µs, Reserved 1, or Reserved 2 as the emphasis type
	Channel Mode	0 to 3		Enter the channel mode value, from 0 to 3

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Category Code	General Laser Optical D/D Converter Magnetic Digital Broadcast 1 Digital Broadcast 2 Musical Instrument ADC Non Copyright Solid State Memory ADC Copyright Experimental Reserved 1 Reserved 2		Select the category code
	Source Num	0 to 15		Enter the source number value, from 0 to 15
	Channel Num	0 to 15		Enter the channel number value, from 0 to 15
	Sample Freq	Not indicated 22.05 kHz 24kHz 32 kHz 44.1 kHz 48 kHz 88.2 kHz 96 kHz 176.4 kHz 192 kHz 768 kHz		Select the sampling frequency value
	Clock Accuracy	Level 1 Level 2 Level 3 Reserved		Select the clock accuracy
	Max Word Length	20 bits 24 bits		Select either 20 bits or 24 bits as the maximum word length value

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Word Length	Not indicated 16 bits 17 bits 18 bits 19 bits 20 bits		Select the word length value for 20 bits Max Word Length
		Not indicated 20 bits 21 bits 22 bits 23 bits 24 bits		Select the word length value for 24 bits Max Word Length
	Orig. Sample Freq	Not indicated 8 kHz 11.025 kHz 12 kHz 16 kHz 22.05 kHz 24 kHz 32 kHz 44.1 kHz 48 kHz 88.2 kHz 96 kHz 176.4 kHz 192 kHz Reserved 1 Reserved 2		Select the original sample frequency value
	CGMS-A	Copying Permitted Condition Not Used One Generation Copy Copying Denied		Select either Copying Permitted, Condition Not Used, One Generation Copy, or Copying Denied as the CGMS-A type
AES3/SPDIF Mode: Professional				
AES3/SPDIF Config	Audio Mode	Non Lin. PCM Lin. PCM		Select either Non. Lin PCM or Lin. PCM as the audio mode

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Emphasis	Not indicated No pre-emphasis 50/15 μs CCITT J.17		Select either Not indicated, No pre-emphasis, 50/15 μs, or CCITT J.17 as the emphasis type
	Freq Mode	Locked Unlocked		Lock or unlock the frequency mode
	Sample Freq	Not indicated 22.05 kHz 24 kHz 32 kHz 44.1 kHz 48 kHz 88.2 kHz 96 kHz 176.4 kHz 192 kHz		Select the sampling frequency value
	S. Freq Scaling	Disable Enable		Enable or disable the sample frequency scaling
	Channel Mode	Not indicated 2-channel Single channel Primary-Secondary Stereo Reserved 1 Reserved 2 Mono Double Rate Left Double Rate Right Double Rate Multichannel		Select the channel mode
	User Bits	Not indicated 192-bit block Reserved for AES18 User defined Reserved for Metadata As in IEC60958-3		Select the user bits type

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Auxiliary Bits	20-bit not defined 24-bit main audio 20-bit single Reserved		Select either 20-bit not defined, 24-bit main audio, 20-bit single, or Reserved as the auxiliary bits
	Word Length	Not indicated 16 bits 17 bits 18 bits 19 bits 20 bits		Select the word length value for 20-bit not defined, 20-bit single, or Reserved Auxiliary Bits
		Not indicated 20 bits 21 bits 22 bits 23 bits 24 bits		Select the word length value for 24-bit main audio Auxiliary Bits
	Alignment Level	Not indicated -18.06 dBFS -20 dBFS Reserved		Select either Not indicated, –18.06 dBFS, –20 dBFS, or Reserved as the alignment level type
	Multichannel Status	Defined Undefined		Defined or undefined the multichannel status
	Multichannel mode	Mode 0 Mode 1 Mode 2 Mode 3 User defined		Select the multichannel mode. NOTE: This setting is only applicable when the multichannel status is set to Defined.
	Channel Number	1 to 16		Enter the channel number value for defined Multichannel Status, from 1 to 16
		1 to 128		Enter the channel number value for undefined Multichannel Status, from 1 to 128

Table 2-4 Digital generator menu tree description (continued)

Level 1	Level 2	Level 3	Level 4	Description
	Reference Signal	Not a ref. signal Grade 1 Grade 2 Reserved		Select either Not a ref. signal, Grade 1, Grade 2, or Reserved as the reference signal type
	Channel Origin			Enter the channel origin value in 4 alphanumeric digit
	Channel Dest.			Enter the channel destination value in 4 alphanumeric digit
	Local Address	0 to 2^{32}–1		Enter the local address value, from 0 to 2^{32}–1
	Time-of-day	0 to 2^{32}–1		Enter the time-of-day value, from 0 to 2^{32}–1
	Reliability Flags	0-5 6-13 14-17 18-21		Select the reliability flags range

Analyzer

Press Analyzer to change the display screen to the analyzer mode or toggle between analog analyzer or digital analyzer. On the Analyzer menu, you can set the measurement functions, measurement configurations, input configurations. For digital analyzer, you can also set the analysis mode and AES3/SPDIF configurations. Use the softkey on the right side of the LCD display to navigate to the next menu level.

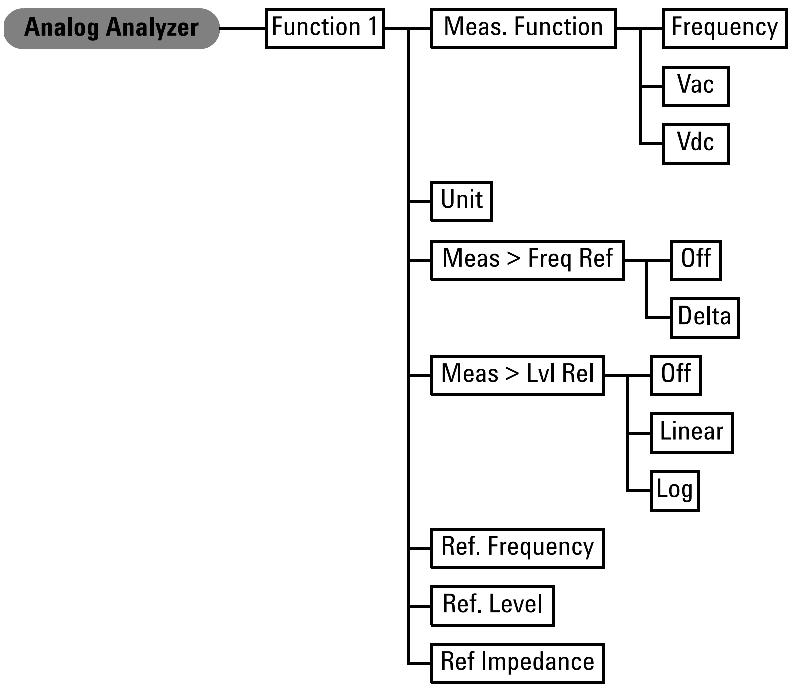


Figure 2-17 Analog analyzer menu tree: Function 1

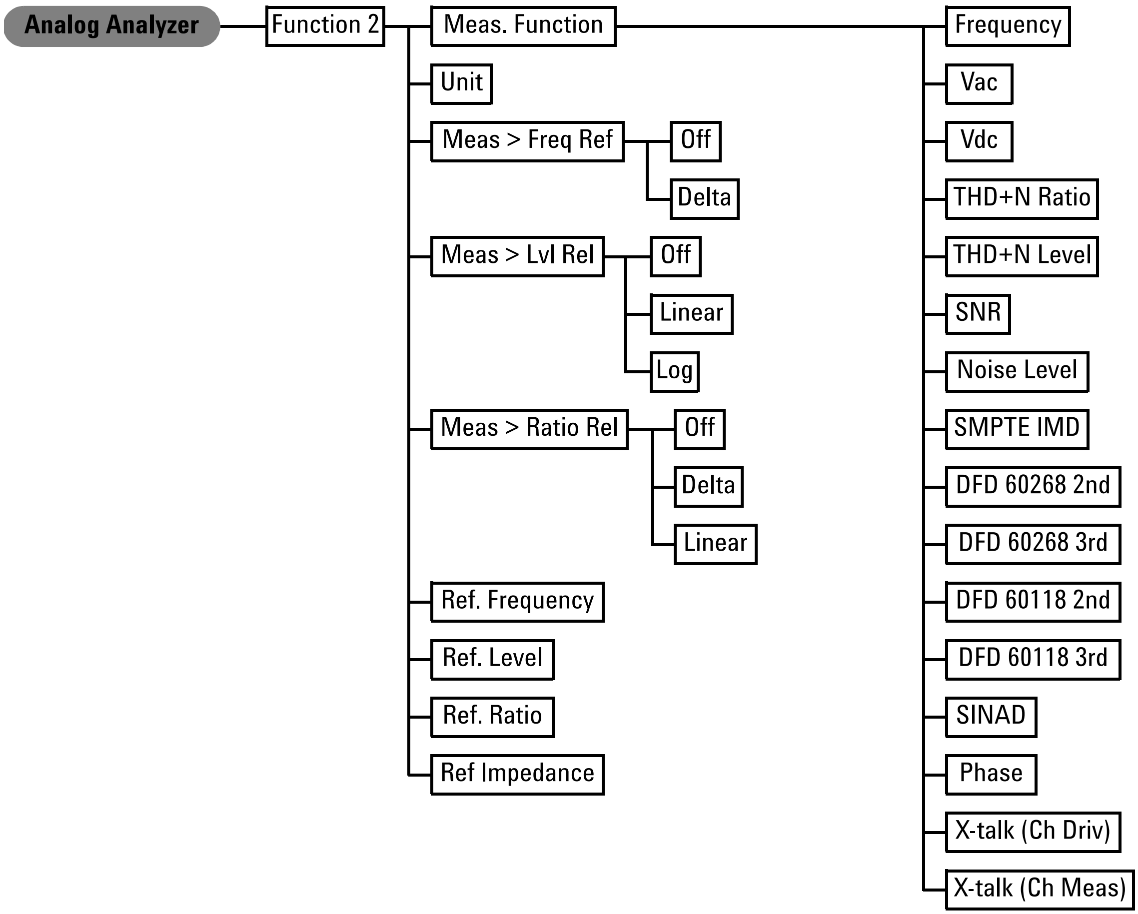


Figure 2-18 Analog analyzer menu tree: Function 2

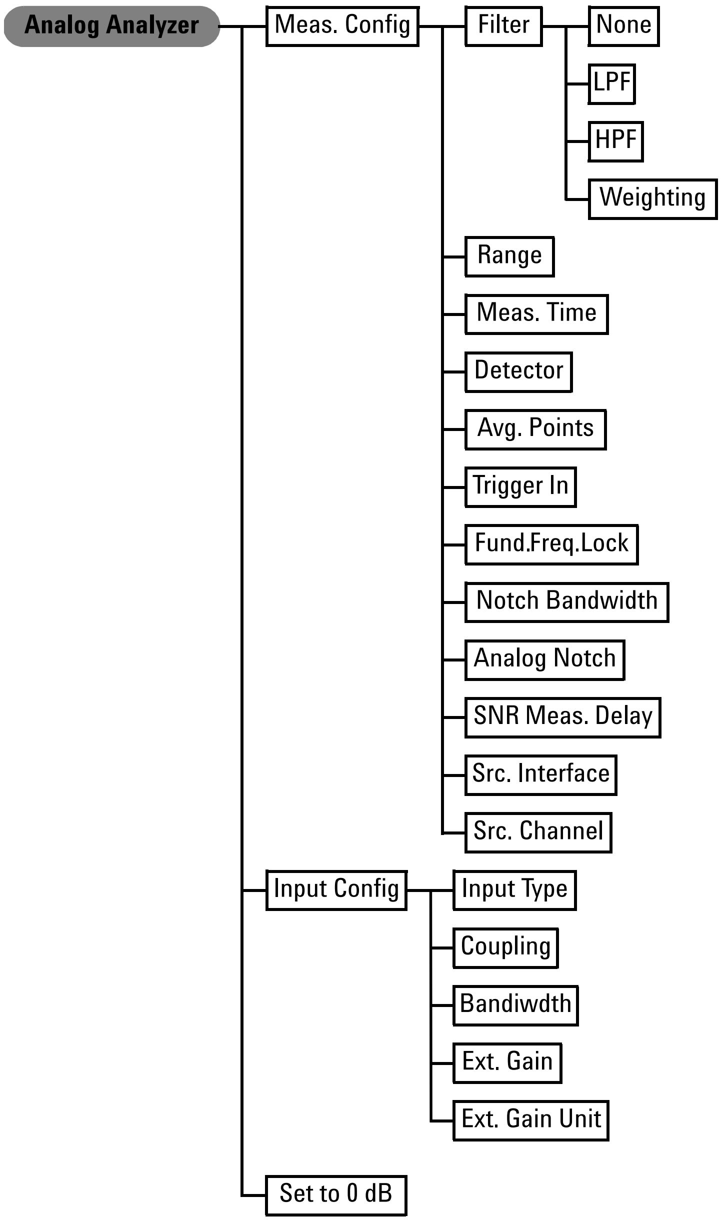


Figure 2-19 Analog analyzer menu tree: Meas. Config, Input Config, and Set to 0 dB

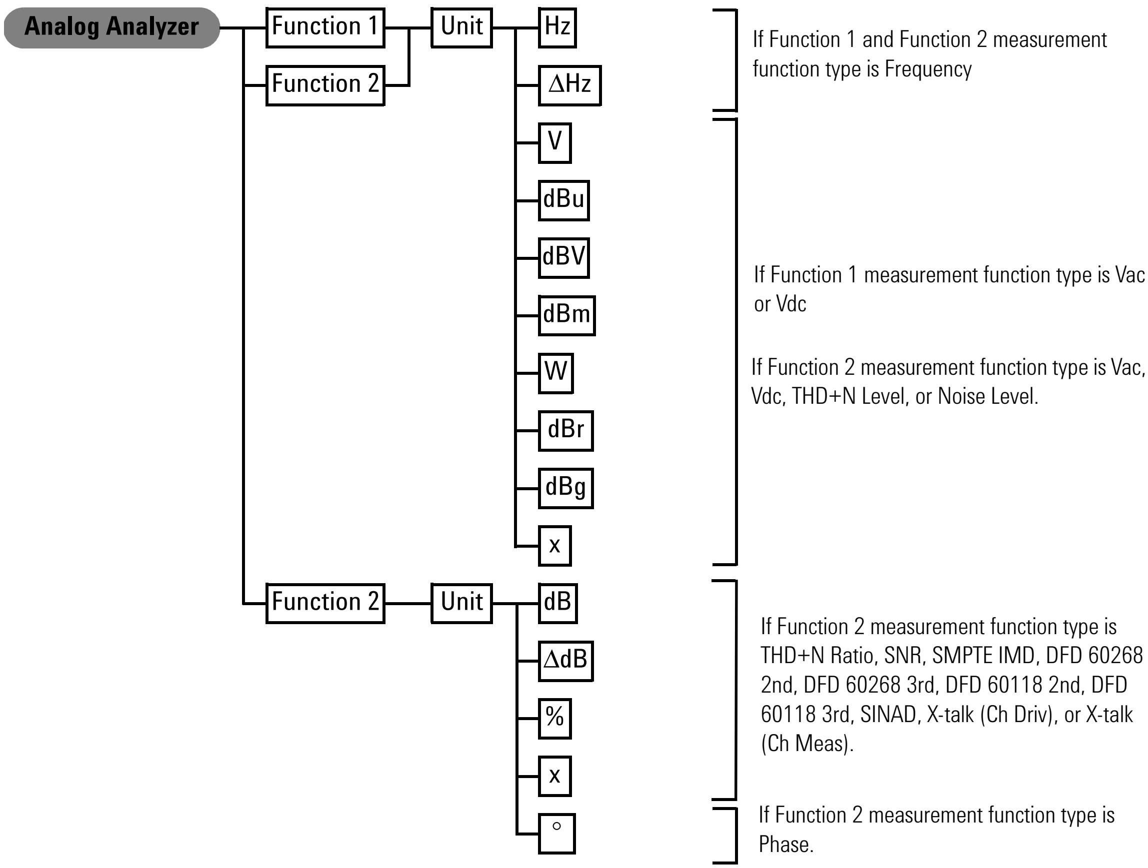


Figure 2-20 Analog analyzer menu tree: Function 1 Unit and Function 2 Unit

Table 2-5 Analog analyzer menu tree description

Level 1	Level 2	Level 3	Description
Function 1	Meas. Function	Frequency Vac Vdc	Select the first measurement parameter
	Unit	Hz ΔHz V dBu dBV dBm W dBr dBg x	Select the unit according to the measurement type
	Meas > Freq. Ref.	Off Delta	Select either Off or Delta for frequency measurement
	Meas > Lvl Rel.	Off Linear Log	Select either Off, Linear, or Log for Vac, or Vdc measurement
	Ref. Frequency		Enter the reference frequency value for frequency measurement
	Ref. Level		Enter the reference level value for Vac or Vdc measurement
	Ref. Impedance		Enter the reference impedance value for Vac or Vdc measurement

Table 2-5 Analog analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
Function 2	Meas. Function	Frequency Vac Vdc THD+N Ratio THD+N Level SNR Noise Level SMPTE IMD DFD 60268 2nd DFD 60268 3rd DFD 60118 2nd DFD 60118 3rd SINAD Phase X-talk (Ch Driv) X-talk (Ch Meas)	Select the second measurement parameter
	Unit	Hz ΔHz V dBu dBV dBm W dBr dBg dB ΔdB % x °	Select the unit according to the measurement type
	Meas > Freq. Ref.	Off Delta	Select either Off or Delta for frequency measurement
	Meas > Lvl Rel.	Off Linear Log	Select either Off, Linear, or Log for Vac, Vdc, THD+N Level, and Noise Level measurement

Table 2-5 Analog analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
	Meas > Ratio Ref	Off Delta Linear	Select either Off, Delta, or Linear for THD+N Ratio, SNR, SMPTE IMD, DFD 60268 2nd, DFD 60268 3rd, DFD 60118 2nd, DFD 60118 3rd, SINAD, X-talk (Ch Driv), and X-talk (Ch Meas) measurement
	Ref. Frequency		Enter the reference frequency value for frequency measurement
	Ref. Level		Enter the reference level value for Vac, Vdc, THD+N Level, and Noise Level measurement
	Ref. Ratio		Enter the reference ratio value for THD+N Ratio, SNR, SMPTE IMD, DFD 60268 2nd, DFD 60268 3rd, DFD 60118 2nd, DFD 60118 3rd, SINAD, X-talk (Ch Driv), and X-talk (Ch Meas) measurement
	Ref Impedance		Enter the reference impedance value
Meas. Config	Filter	None	Unselect the filter function
		LPF	Select either None, 15 kHz, 20 kHz, 30 kHz, 80 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
	Range	Auto 400 mV 800 mV 1.6 V 3.2 V 6.4 V 12.8 V 25 V 50 V 100 V 140 V	Select the input range value

Table 2-5 Analog analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
	Meas. Time	Gen Track 1/128 s 1/64 s 1/32 s 1/16 s 1/8 s 1/4 s 1/2 s 1 s	Select the measurement time value
	Detector	RMS QPK Peak-to-Peak	Select either RMS, QPK, or Peak-to-Peak detection type
	Avg. Points	1 to 50	Enter the average points, from 1 to 50
	Trigger In	Free Run External	Select either Free Run or External as the trigger in type
	Fund.Freq.Lock.	Auto Gen. Lock	Select the fundamental frequency lock method for THD+N Ratio, THD+N Level, and SINAD measurement
	Notch Bandwidth	Auto Custom(Wide)	Select either Auto or Custom(Wide) as the notch bandwidth for THD+N and SINAD measurement.
	Analog Notch	On Off	Enable or disable analog notch filter
	SNR Meas. Delay		Enter the SNR measurement delay value for SNR measurement
	Src. Interface		Select either Analog or Digital as the source inferface for SNR and Noise Level measurement
	Src. Channel		Select the source channel for SNR and Noise Level measurement

Table 2-5 Analog analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
Input Config	Input Type	Balanced Unbalanced	Select either Balanced or Unbalanced input connection
	Coupling	AC DC	Select either AC or DC coupling
	Bandwidth	High Low	Select either High or Low measurement bandwidth
	Ext. Gain		Enter the external gain value
	Ext. Gain Unit	dB x	Select either dB or x as the external gain unit
Set to 0 dB			Store the measured level or ratio of the Function 2 as the reference value and set the Function 2 reading to refer to the stored reference value. NOTE: • This feature is only applicable to level-based measurement (for example Vac and THD+N Level) or ratio-based measurement (for example THD+N ratio or SNR). • When Function 2 is set to a level-based measurement type, selecting this setting will set the Function 2 unit to dBr and the reading format to Log. • When Function 2 is set to a ratio-based measurement type, selecting this setting will set the Function 2 unit to ΔdB and the reading format to Delta.

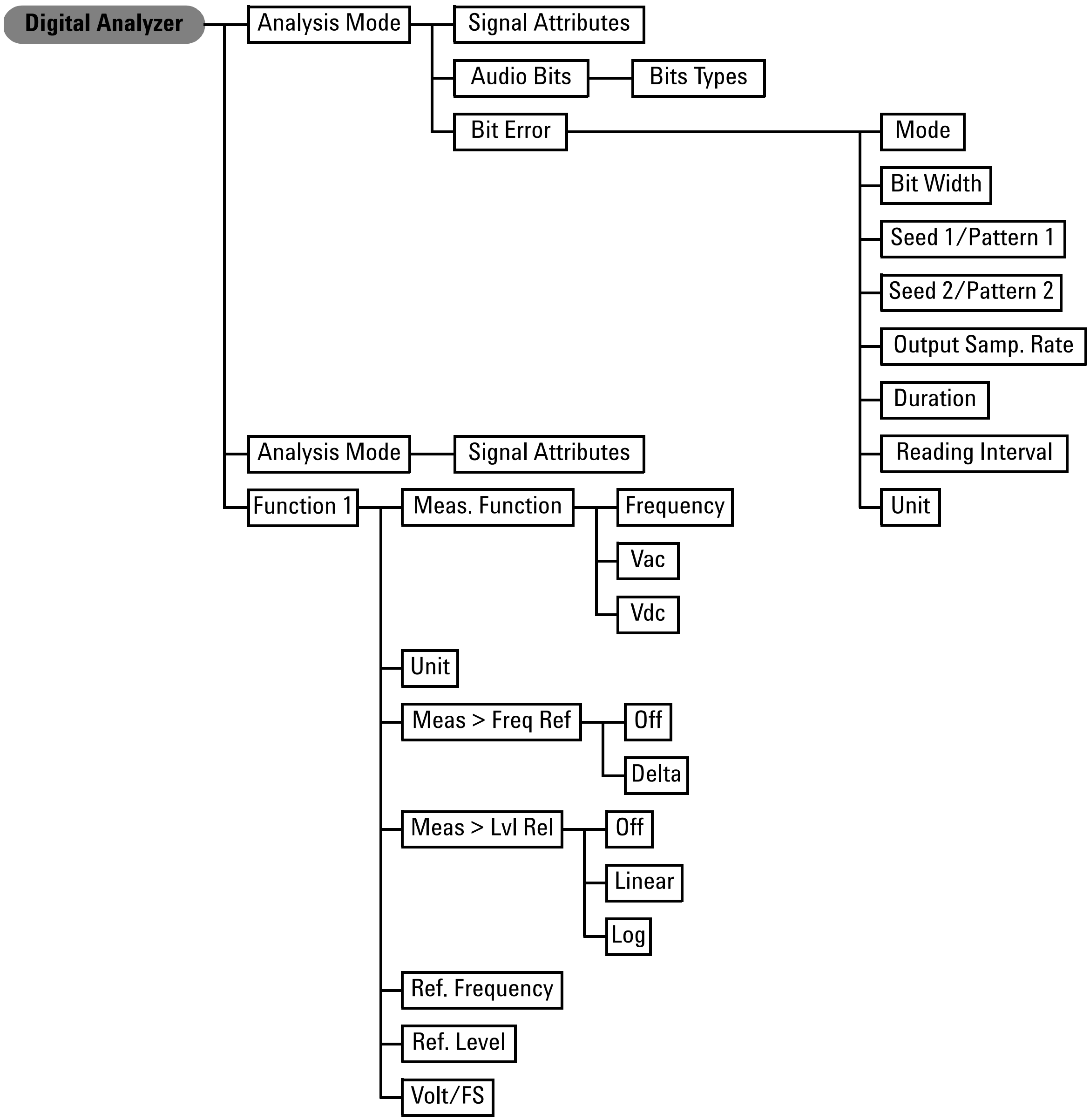


Figure 2-21 Digital analyzer menu tree: Analysis Mode and Signal Attributes (Function 1)

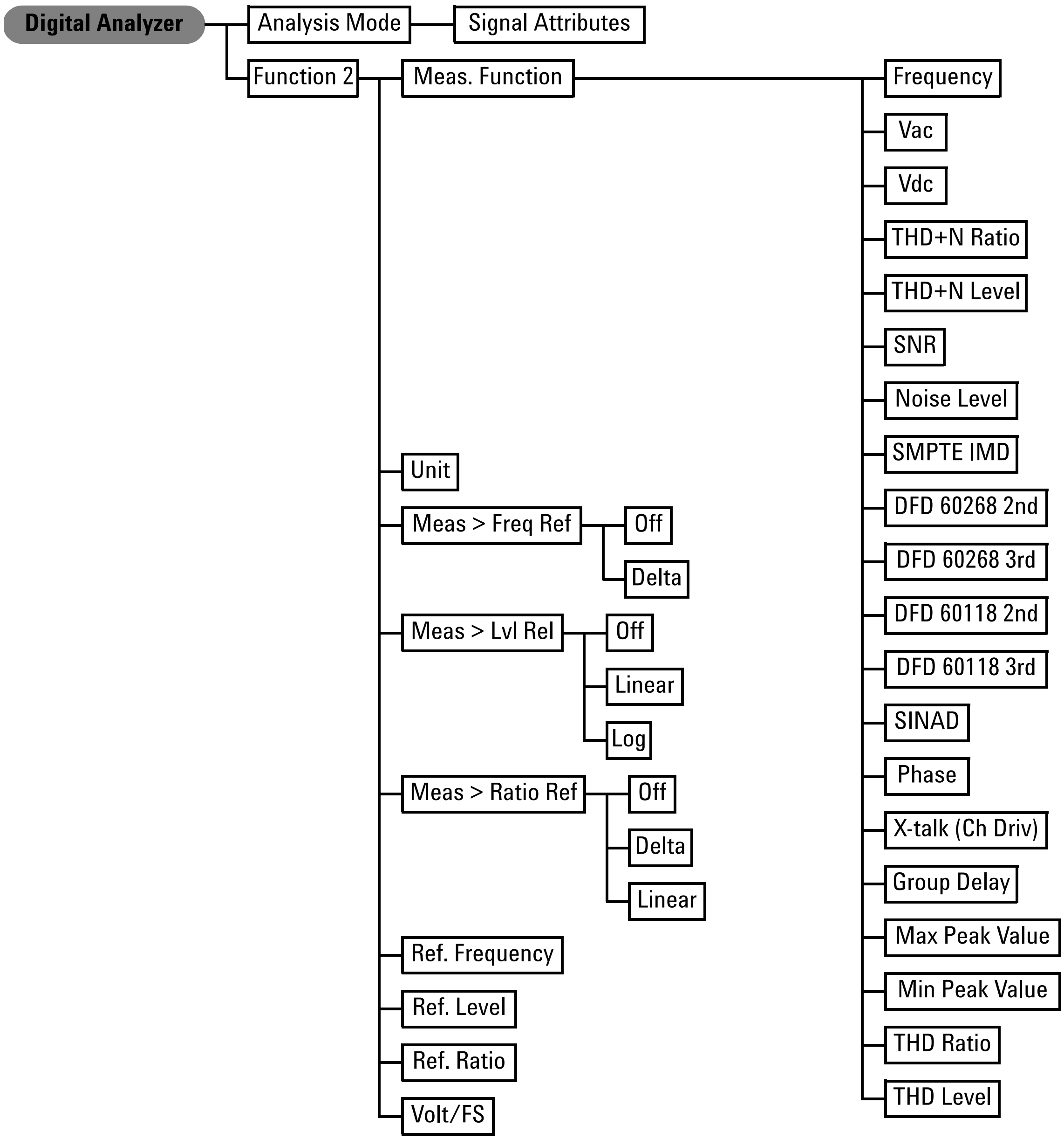


Figure 2-22 Digital analyzer menu tree: Signal Attributes (Function 2)

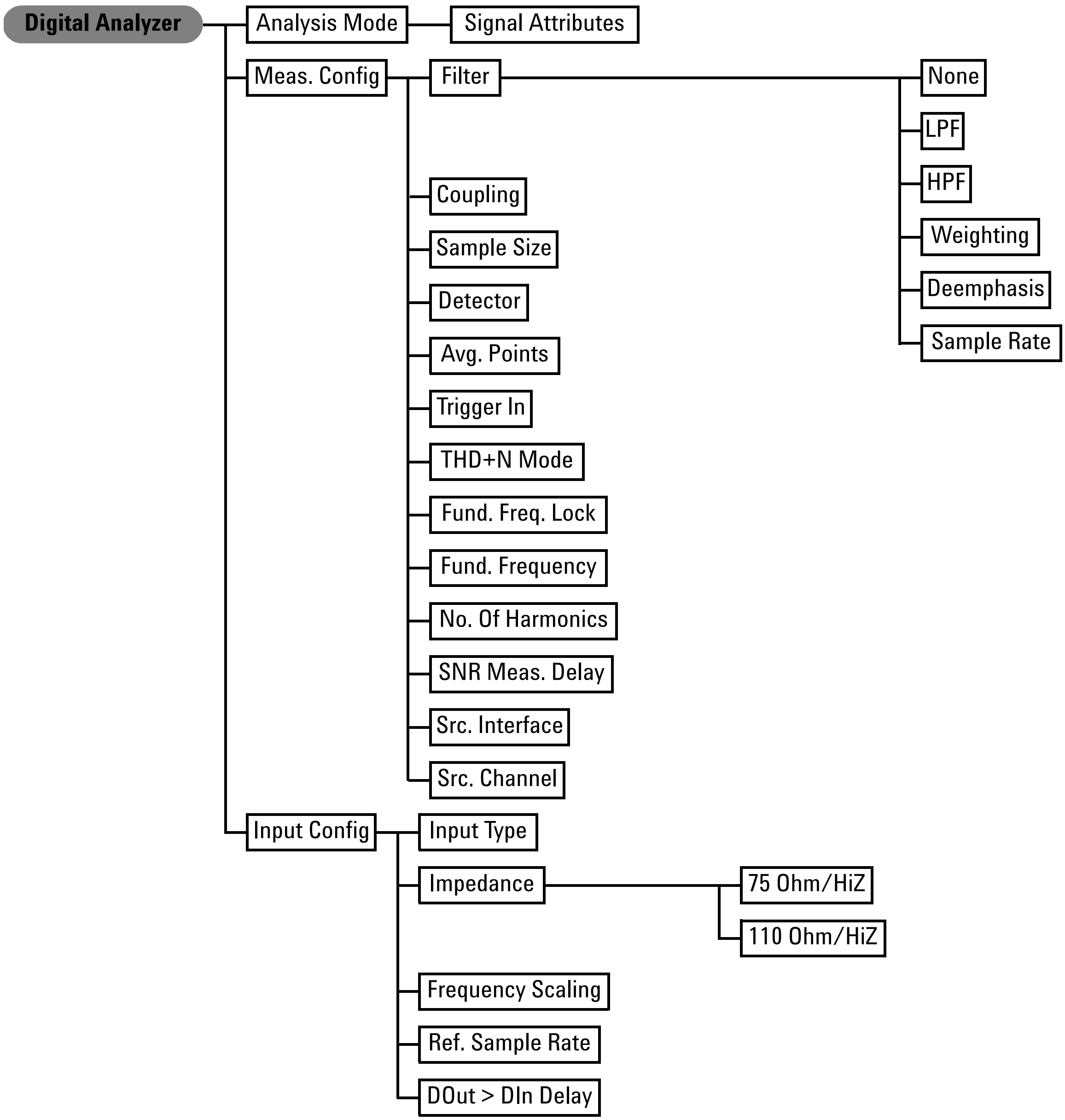


Figure 2-23 Digital analyzer menu tree: Signal Attributes (Meas. Config, and Input Config)

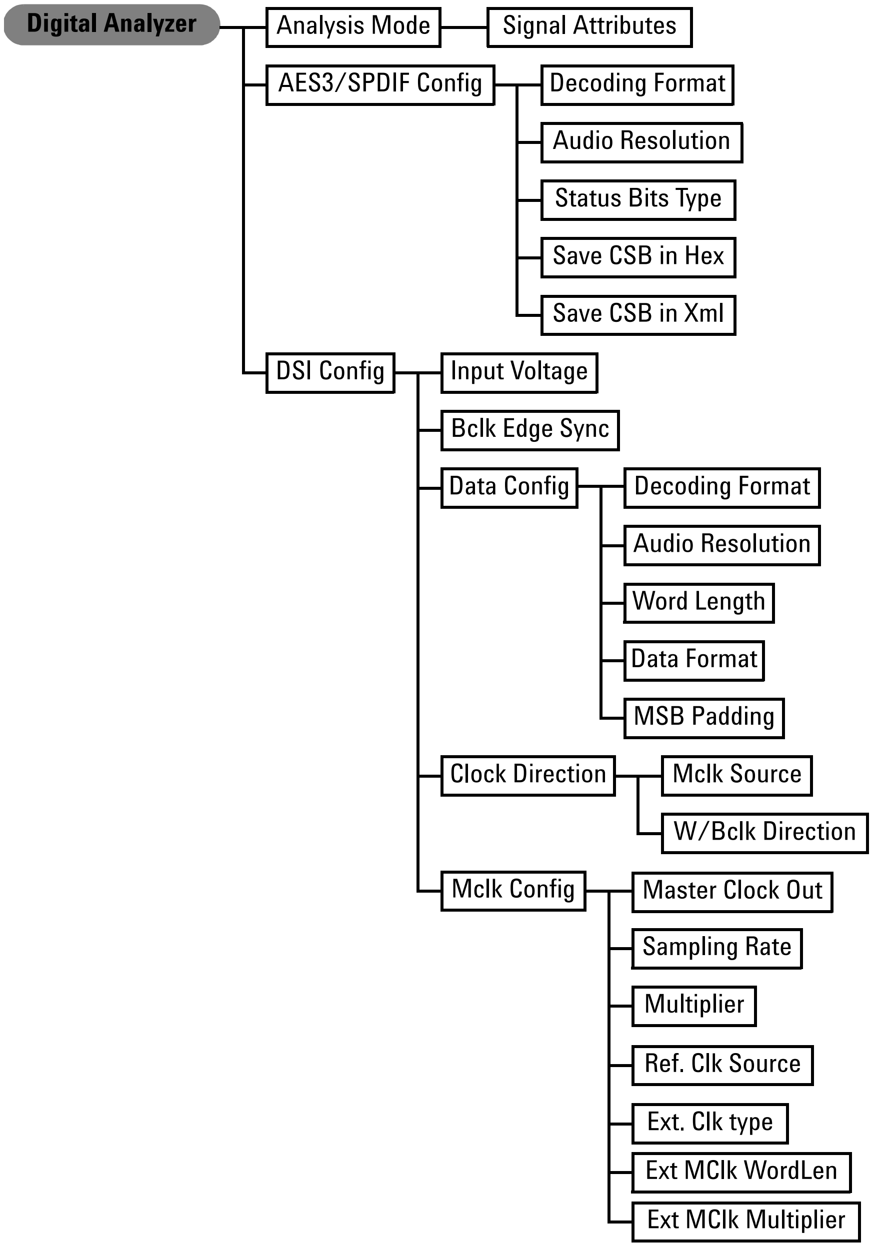


Figure 2-24 Digital analyzer menu tree: Signal Attributes (AES3/SPDIF Config and DSI Config)

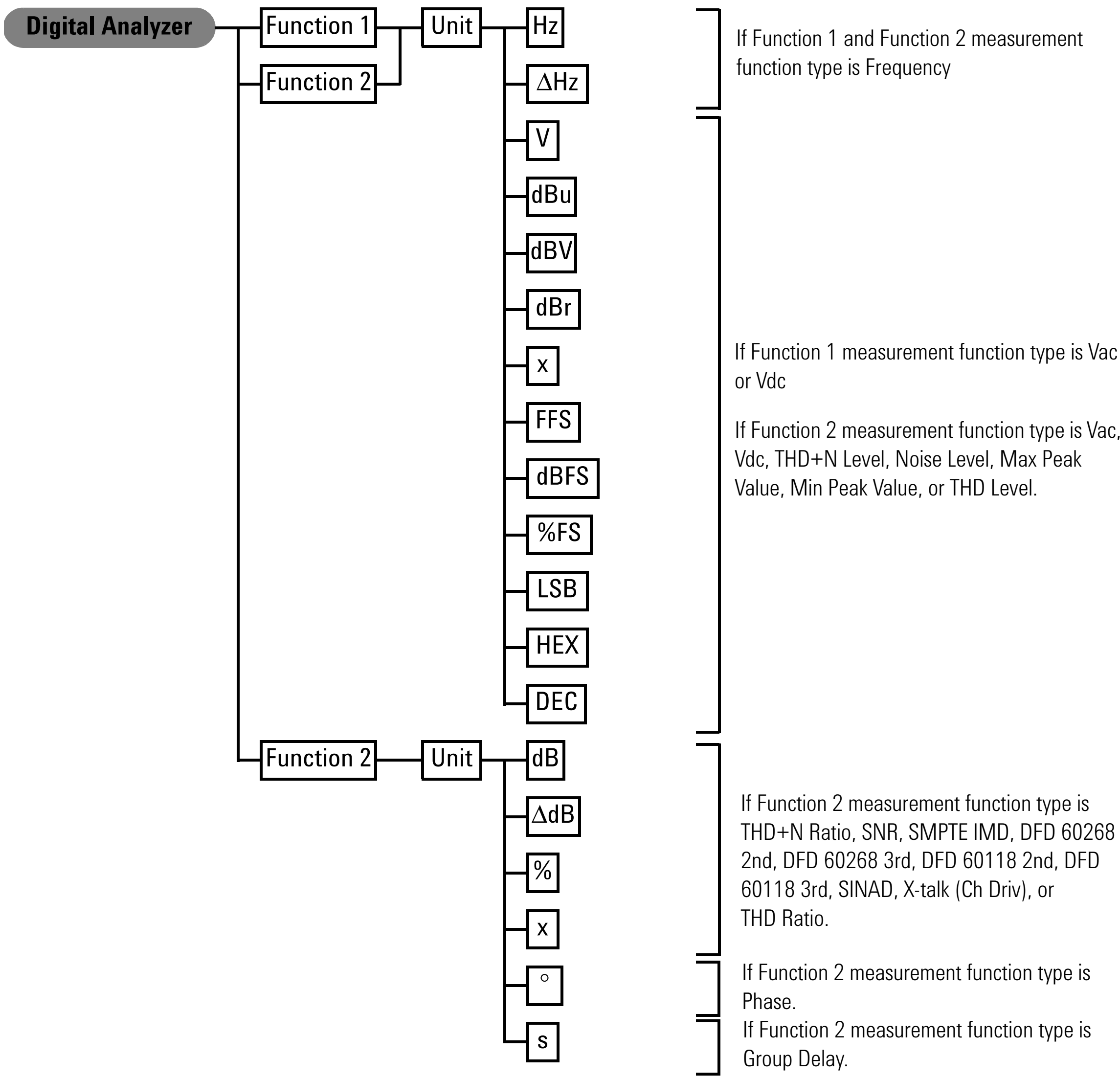


Figure 2-25 Digital analyzer menu tree: Function 1 Unit and Function 2 Unit

Table 2-6 Digital analyzer menu tree description

Level 1	Level 2	Level 3	Description
Analysis Mode	Signal Attributes Audio Bits Bit Error		Select the analysis mode
Analysis Mode: Signal Attributes			
Function 1	Meas. Function	Frequency Vac Vdc	Select the first measurement parameter
	Unit	Hz ΔHz V dBu dBV dBr FFS dBFFS %FS LSB HEX DEC	Select the unit according to the measurement type
	Meas > Freq. Ref.	Off Delta	Select either Off or Delta for frequency measurement
	Meas > Lvl Rel.	Off Linear Log	Select either Off, Linear, or Log for Vac, or Vdc measurement
	Ref. Frequency		Enter the reference frequency value for frequency measurement
	Ref. Level		Enter the reference level value for Vac or Vdc measurement
	Volt/FS		Enter the Volt/FS value for Vac or Vdc measurement. NOTE: This setting only affects readings in V, dBV, or dBu.

Table 2-6 Digital analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
Function 2	Meas. Function	Frequency Vac Vdc THD+N Ratio THD+N Level SNR Noise Level SMPTE IMD DFD 60268 2nd DFD 60268 3rd DFD 60118 2nd DFD 60118 3rd SINAD Phase X-talk (Ch Driv) Group Delay Max Peak Value Min Peak Value THD Ratio THD Level	Select the second measurement parameter
	Unit	Hz ΔHz V dBu dBV dBr FFS dBFFS %FS LSB HEX DEC dB ΔdB % x ° s	Select the unit according to the measurement type
	Meas > Freq. Ref.	Off Delta	Select either Off or Delta for frequency measurement

Table 2-6 Digital analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
	Meas > Lvl Rel.	Off Linear Log	Select either Off, Linear, or Log for Vac, Vdc, THD+N Level, Noise Level, Max Peak Value, and Min Peak Value measurement
	Meas > Ratio Ref	Off Delta Linear	Select either Off, Delta, or Linear for THD+N Ratio, SNR, SMPTE IMD, DFD 60268 2nd, DFD 60268 3rd, DFD 60118 2nd, DFD 60118 3rd, SINAD, and X-talk (Ch Driv) measurement
	Ref. Frequency		Enter the reference frequency value for frequency measurement
	Ref. Level		Enter the reference level value for Vac, Vdc, THD+N Level, Noise Level, Max Peak Value, and Min Peak Value measurement
	Ref. Ratio		Enter the reference ratio value for THD+N Ratio, SNR, SMPTE IMD, DFD 60268 2nd, DFD 60268 3rd, DFD 60118 2nd, DFD 60118 3rd, SINAD, and X-talk (Ch Driv) measurement
	Volt/FS		Enter the Volt/FS value. NOTE: This setting only affects readings in V, dBV, or dBu.
Meas. Config	Filter	None	Unselect the filter function
		LPF	Select either None, 15 kHz, 20 kHz, 30 kHz, 22 kHz, or Custom
		HPF	Select either None, 20 Hz, 100 Hz, 400 Hz, or Custom
		Weighting	Select either None, A-Weighting, CCIR 1k wtd, CCIR 2k wtd, C-Message, CCITT, or Custom
		Deemphasis	Select either None, 50 µs, 75 µs, or Custom
		Sample Rate	Select either 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, or 192 kHz
	Coupling	AC DC	Select either AC or DC coupling

Table 2-6 Digital analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
	Sample Size	2048 4096 8192 16384 32768 65536 131072	Select the sample size
	Detector	RMS 1/2 Pk-to-Pk	Select either RMS or 1/2 Pk-to-Pk detection type
	Avg. Points	1 to 50	Select the average points, from 1 to 50
	Trigger In	Free Run External	Select either Free Run or External trigger
	THD+N Mode	Normal Precision	Select either Normal or Precision as the THD+N mode. NOTE: This setting is only applicable when the Function 2 measurement function is set to the THD+N measurement.
	Fund. Freq. Lock	Auto Gen. Lock Custom	Select either Auto, Gen. Lock, or Custom as the fundamental frequency lock. NOTE: This setting is only applicable when the THD+N mode is set to Precision.
	Fund. Frequency		Set the fundamental frequency value. NOTE: This setting is only applicable when the Fund. Freq. Lock is set to Custom.
	No. Of Harmonics		Enter the number of harmonics for the THD measurement.
	SNR Meas. Delay		Enter the SNR measurement delay value for the SNR measurement.
	Src. Interface		Select either Analog or Digital as the source interface for SNR and Noise Level measurements.
	Src. Channel		Select the source channel for SNR and Noise Level measurements.

Table 2-6 Digital analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
Input Config	Input Type	Balanced Unbalanced DSI Optical	Select either Balanced, Unbalanced, DSI, or Optical input connection
	Impedance	75 Ohm HiZ	Select the input impedance for Unbalanced input connection
		110 Ohm HiZ	Select the input impedance for Balanced input connection
	Frequency Scaling	Measured ISR Custom	Select either Measure ISR or Custom as the frequency scaling type
	Ref. Sample Rate		Enter the reference sample rate. NOTE: This setting is only applicable when the frequency scaling is set to Custom.
	DOut > DIn Delay	Enable Disable	Enable or disable the digital out to digital in delay
AES3/SPDIF Config	Decoding Format	Linear PCM A-Law μ-Law	Select either Linear PCM, A-Law, or μ-Law as the decoding format
	Audio Resolution	8 to 24	Enter the audio resolution value, from 8 to 24
	Status Bits Type	Channel User	Select either Channel or User as the status bits type
	Save CSB in Hex		Save the channel status bits in Hex file
	Save CSB in XML		Save the channel status bits in XML file
DSI Config	Input Voltage	1.2 Vpp 1.5 Vpp 1.8 Vpp 2.5 Vpp 3 Vpp 3.3 Vpp Custom	Select the input voltage
	Bclk Edge Sync	Rising Falling	Select either Rising or Falling as the bit clock edge sync type

Table 2-6 Digital analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
	Data Config	Decoding Format	Select Linear PCM, A-Law, or μ-Law as the decoding format
		Audio Resolution	Enter the audio resolution
		Word Length	Enter the word length
		Data Format	Select either Left Justified, Right Justified, I2S, or DSP as the data format
		MSB Padding	Enter the MSB padding
	Clock Direction	Mclk Source	Select either External or Internal as the master clock source
		W/Bclk Direction	Select either In or Out as the word/bit clock direction
	Mclk Config	Master Clock Out	Enable or disable the master clock out
		Sampling Rate	Enter the sampling rate
		Multiplier	Enter the multiplier value
		Ref. Clk Source	Select either Internal, AES Recovered Clock, or External as the reference clock source
		Ext. Clk Type	Select either MCLK or FSYNC as the external clock type. NOTE: This setting is only applicable when the Ref. Clock Source is set to External.
		Ext MClk WordLen	Enter the master clock word length value. NOTE: This setting is only applicable when the Ref. Clock Source is set to External.
		Ext MClk Multiplier	Enter the master clock multiplier value. NOTE: This setting is only applicable when the Ref. Clock Source is set to External.
Analysis Mode: Audio Bits			
Bit Types	Data Active		Select either Data or Active as the bit type
Analysis Mode: Bit Error			
Mode	P. Random W. Const		Select either P.Random or W.Const as the bit error rate test (BERT) mode

Table 2-6 Digital analyzer menu tree description (continued)

Level 1	Level 2	Level 3	Description
Bit Width			Enter the bit width value
Seed 1/Pattern 1	Clear All Set All Walking One Walking Zero Edit Constant		Select clear all, set all, or edit constant to configure the seed 1. Select clear all, set all, walking one, walking zero, or edit constant to configure the pattern 1. NOTE: This setting name depends on the BER mode.
Seed 2/Pattern 2	Clear All Set All Walking One Walking Zero Edit Constant		Select clear all, set all, or edit constant to configure the seed 2. Select clear all, set all, walking one, walking zero, or edit constant to configure the pattern 2. NOTE: This setting name depends on the BER mode.
Output Samp. Rate			Enter the BERT output sampling rate value
Duration			Enter the BERT duration value
Reading Interval			Enter the BERT reading interval
Unit	dec hex		Select either dec or hex as the BERT unit

Graph (frequency domain or time domain)

Press Frequency Domain or Time Domain to change the display screen to the frequency domain or time domain mode respectively.

On the frequency domain menu and time domain menu, you can set the monitor settings, axis settings, hold, reference trace, running mode, input settings, and save points to file. In frequency domain menu, you can also toggle between harmonics view or graph view. Use the softkey on the right side of the LCD display to navigate to the next menu level.

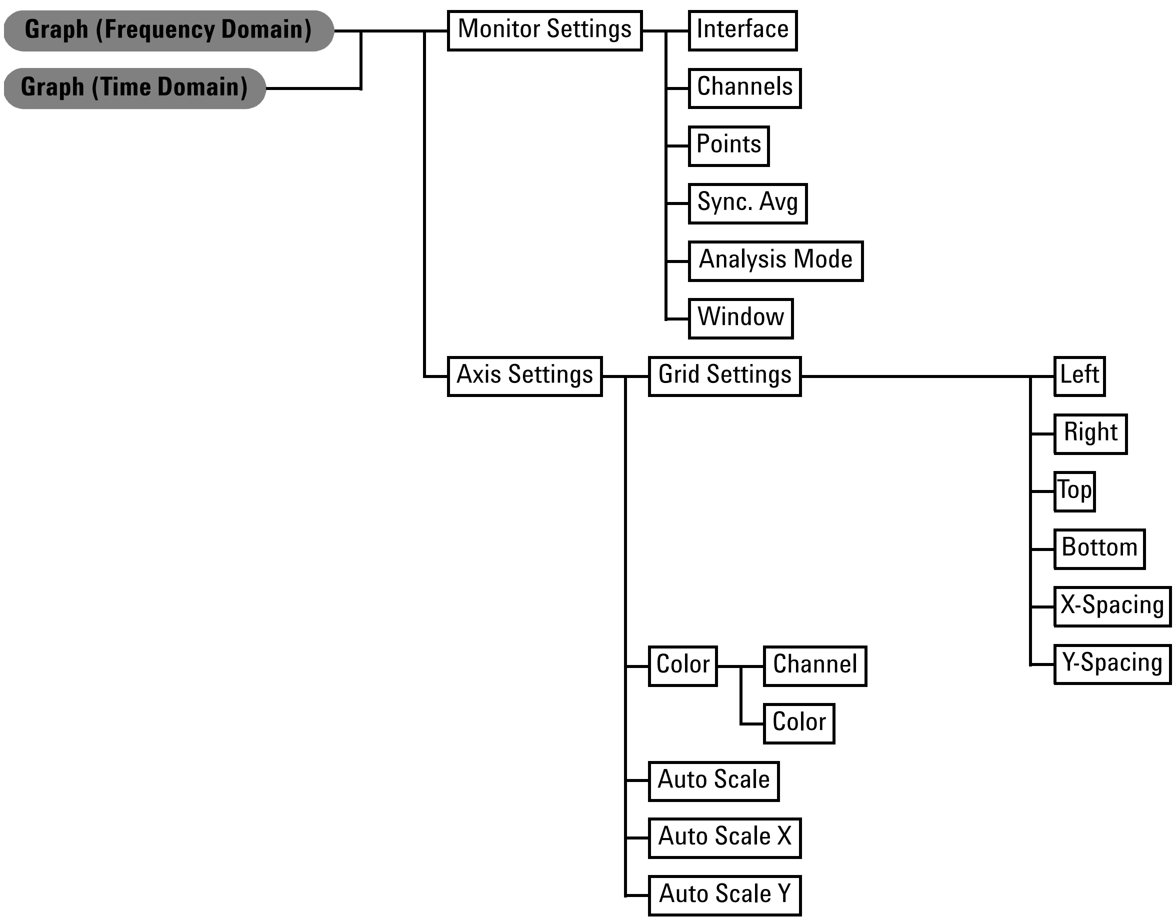


Figure 2-26 Frequency domain and time menu trees: Monitor Settings and Axis Settings

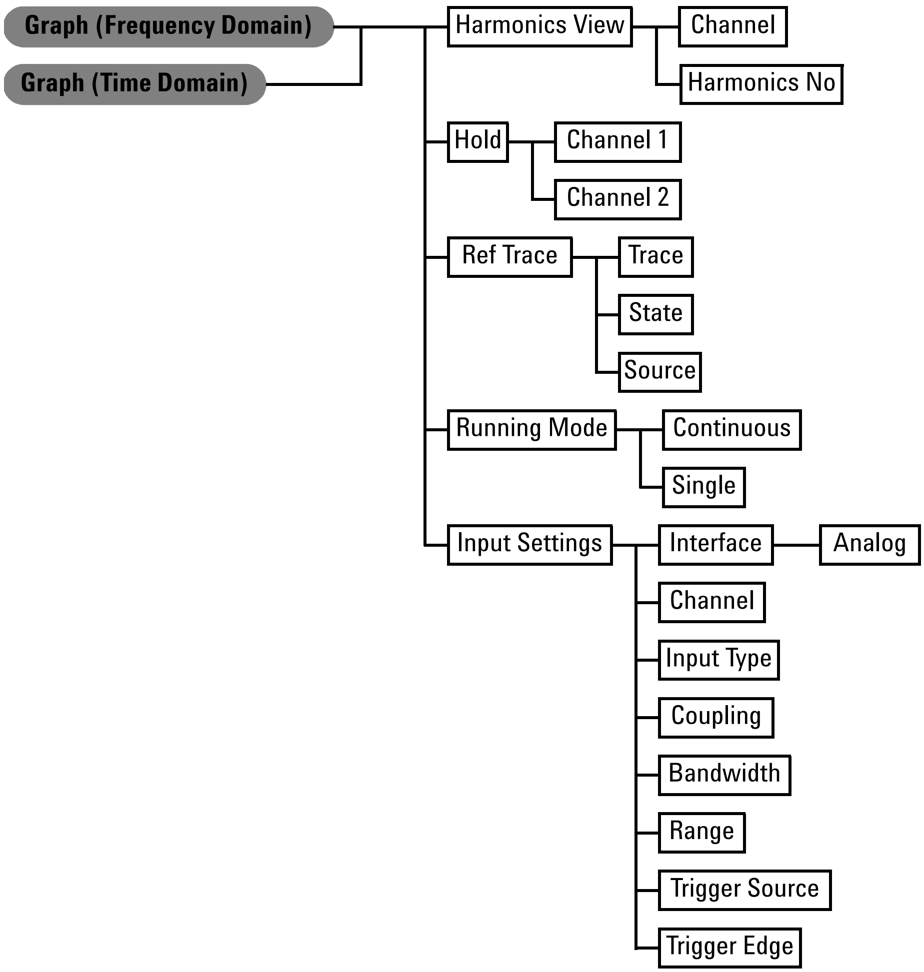


Figure 2-27 Frequency domain and time domain menu trees: Harmonics View, Hold, Ref Trace, Running Mode, and Input Settings (Analog)

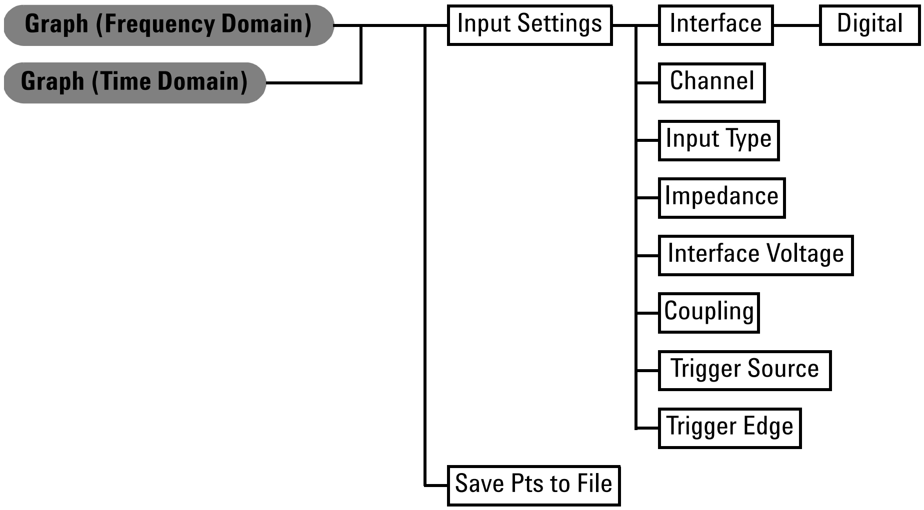


Figure 2-28 Frequency domain and time domain menu trees: Input Settings (Digital)

Table 2-7 Frequency domain and time domain menu trees

Level 1	Level 2	Level 3	Description
Monitor Settings	Interface	Analog Digital	Select either analog or digital interface
	Channels	1 2	Select either 1 or 2 as the channel number
	Points	256 512 1024 2048 4096 8192 16384 32768	Select the number of points
	Sync Avg		Enter the synchronous averaging value
	Analysis Mode	FFT Mag FFT Phase	Select either FFT Mag or FFT Phase as the analysis mode
	Window	Rectangular Hann Blackman-Harris Rife-Vincent 1 Rife-Vincent 3 Hamming Flattop	Select the window function. NOTE: This setting is only applicable in the frequency domain.
Axis Settings	Grid Settings	Left Right Top Bottom X-Spacing Y-Spacing	Enter the graph axis value and spacing type
	Color	Channel	Select the channel number
		Color	Select the channel color
	Auto Scale		Perform autoscaling
	Auto Scale X		Perform autoscaling to the X-axis
	Auto Scale Y		Perform autoscaling to the Y-axis

Table 2-7 Frequency domain and time domain menu trees (continued)

Level 1	Level 2	Level 3	Description
Harmonics View	Channel		Select the channel number. NOTE: This function is not applicable in the time domain.
	Harmonics No		Select the harmonics level number. NOTE: This function is not applicable in the time domain.
Hold	Channel 1 Channel 2	None Max Min	Select the holding mode to be used to update the graph data for channel 1and 2
Ref Trace	Trace	1 2 3	Select either 1, 2, or 3
	State	Off On	Enable or disable the reference trace state
	Source	None File Channel 1 Channel 2	Select the source from a file or channel
Running Mode	Continuous Single		Select either Continuous or Single running mode
Input Settings	Interface		Select Analog or Digital
Input Settings Interface: Analog			
	Channel	1 2	Select the channel number
	Input Type	Bal Unbal	Select the either balanced or unbalanced as the input type
	Coupling	AC DC	Select AC or DC coupling
	Bandwidth	High Low	Select high or low bandwidth

Table 2-7 Frequency domain and time domain menu trees (continued)

Level 1	Level 2	Level 3	Description
	Range	Auto 400 mV 800 mV 1.6 V 3.2 V 6.4 V 12.8 V 25 V 50 V 100 V 140 V	Select the range
	Trigger Source	Free Run 1 2 External	Select Free Run, 1, 2, or External as the trigger source
	Trigger Edge	Falling Rising	Select Falling or Rising edge
Input Settings Interface: Digital			
	Channel	1 2	Select either 1 or 2 as the channel number
	Input Type	Balanced Unbalanced DSI Optical	Select either Balanced, Unbalanced, DSI, or Optical input connection
	Impedance	75 Ohm HiZ	Select the input impedance for Unbalanced connection
		110 Ohm HiZ	Select the input impedance value for balanced connection
	Interface Voltage		Enter the interface voltage
	Coupling	AC DC	Select either AC or DC

Table 2-7 Frequency domain and time domain menu trees (continued)

Level 1	Level 2	Level 3	Description
	Trigger Source	Free Run 1 2 External	Select Free Run, 1, 2, or External
	Trigger Edge	Falling Rising	Select Falling or Rising edge
Save Pts to File			Save the points to a file

Sweep

Press Sweep to change the display screen to the sweep mode. On the Sweep menu, you can set the sweep control, sweep parameter, sweep channels, reference channel, dwell time, and graph sweep settings. You can also view the sweep function in list view, and save or recall settings. Use the softkey on the right side of the LCD display to navigate to the next menu level.

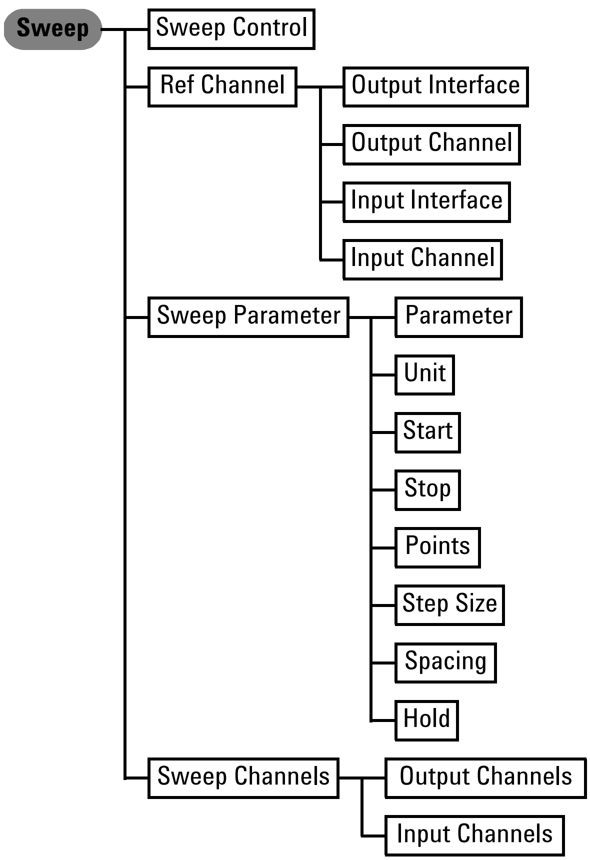


Figure 2-29 Sweep menu tree: Sweep Control, Sweep Parameter, Sweep Channels, and Ref Channel

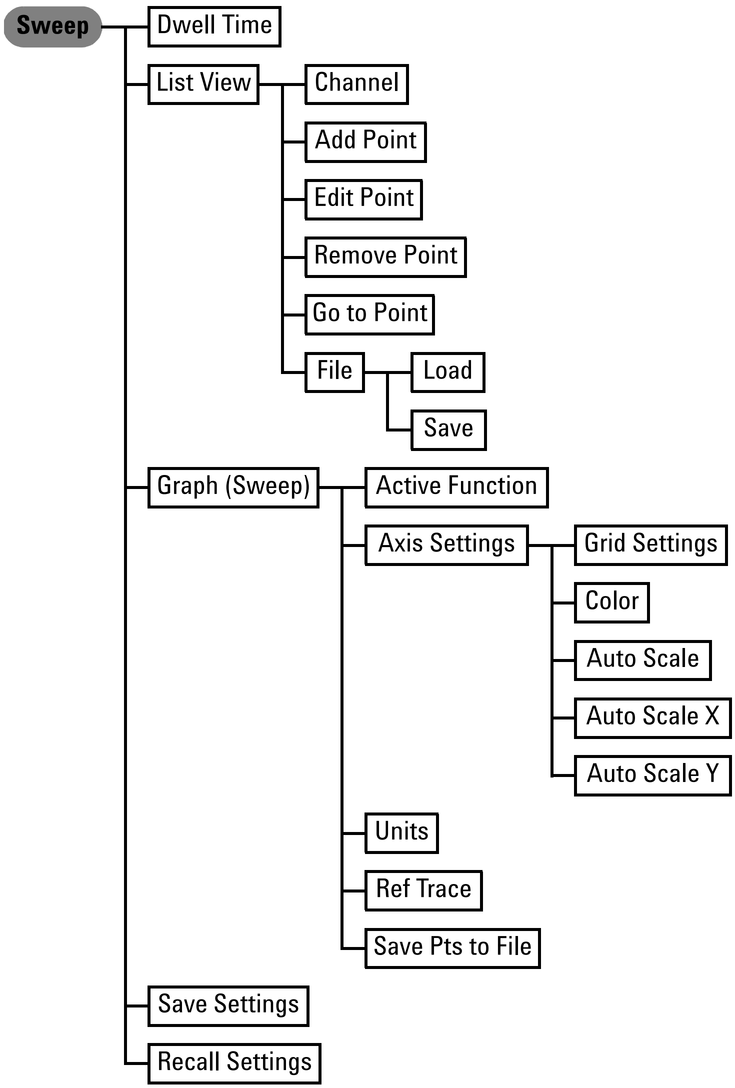


Figure 2-30 Sweep menu tree: Dwell Time, List View, Graph (Sweep), Save Settings, and Recall Settings

Table 2-8 Sweep menu tree description

Level 1	Level 2	Level 3	Description
Sweep Control	On Off		Enable or disable Sweep
Ref Channel	Output Interface	Analog Digital	Select either Analog or Digital as the output interface
	Output Channel	1 2	Select either 1 or 2 as the output channel
	Input Interface	Analog Digital	Select either Analog or Digital as the input interface
	Input Channel	1 2	Select either 1 or 2 as the input channel
Sweep parameter	Parameter	Frequency Amplitude	Enter the frequency and amplitude value. NOTE: The selection available depends on the current generated waveform in the sweep output reference channel.
	Unit		Select the sweep unit
	Start		Select the start value
	Stop		Select the stop value
	Points		Select the sweep points
	Step Size		Select the sweep step size
	Spacing	Linear Log Arbitrary	Select either Linear, Log, or Arbitrary
	Hold	None Max Min	Select None, Max, or Min
Sweep Channels	Output Channels	1 2	Select either 1 or 2 as the output channels
	Input Channels	1 2	Select either 1 or 2 as the input channels
Dwell Time			Enter the dwell time

Table 2-8 Sweep menu tree description (continued)

Level 1	Level 2	Level 3	Description
List View	Channel		Select the channel
	Add Point		Add a sweep point
	Edit Point		Edit a sweep point
	Remove Point		Remove a sweep point
	Go to Point		Go to a sweep point
	File	Load	Load data from a file to the sweep list view
		Save	Save data to a file from the sweep list view
Graph (Sweep)	Active Function	1 2	Select either 1 or 2 as the active function
	Axis Settings	Grid Settings	Select either Left, Right, Top, Bottom, X-Spacing, or Y-Spacing
		Color	Select the channel and color
		Auto Scale	Perform autoscaling
		Auto Scale X	Perform autoscaling to the X-axis
		Auto Scale Y	Perform autoscaling to the Y-axis
	Units	Function 1	Select the unit for Function 1
		Function 2	Select the unit for Function 2
	Ref Trace	Trace	Select either 1, 2, or 3 as the reference trace
		State	Enable or disable the reference trace
		Source	Select either None, file, or channel as the reference source
	Save Pts to File		Save the sweep points to a file
Save Settings			Save the current sweep settings
Recall Settings			Recall a saved sweep settings

Graph

The Graph panel enables access to the commonly used graph functions.

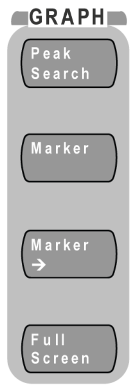


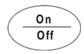
Figure 2-31 Graph panel

Table 2-9 Graph panel description

No	Item	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

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

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

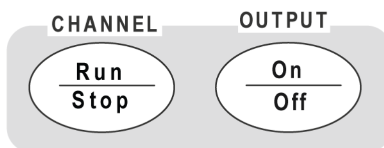


Figure 2-32 Run/Stop or On/Off

When in the Run mode, press  to stop the measurements for the selected analyzer channel. An example of a channel measurement status is shown in Figure 2-33.

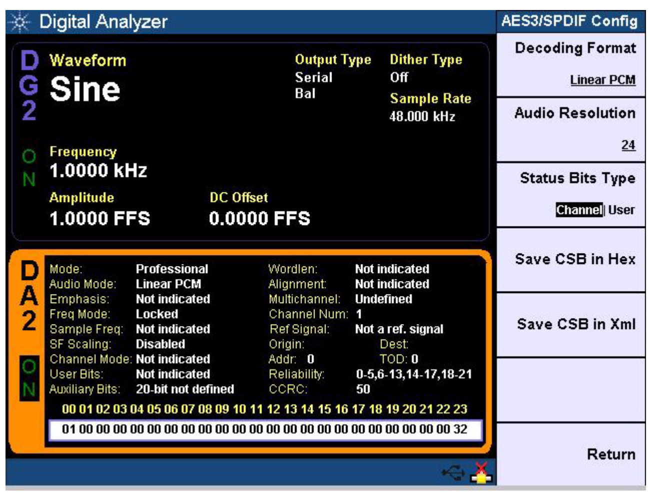


Figure 2-33 Channel measurement status

System

The System panel enables access to the U8903A system functions.

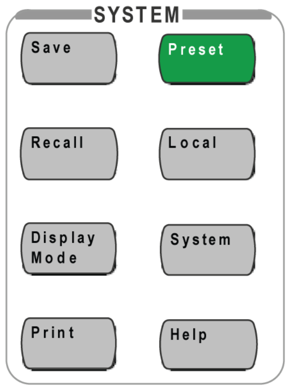
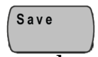


Figure 2-34 System panel

Table 2-10 System panel description

No	Item	Description
1	Save	Saves the U8903A state to a file
2	Recall	Recalls the U8903A state from a file
3	Display Mode	Toggles between 2-panel view or 4-panel view on the LCD display
4	Print	Prints the current display to a file on an external USB flash storage
5	Preset	Presets the U8903A to the 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 a single module. In analog generator, analog analyzer, or digital analyzer mode, you may select either the selected channel or whole module to save the U8903A state when 

is pressed. However, in digital generator, sweep, and 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.

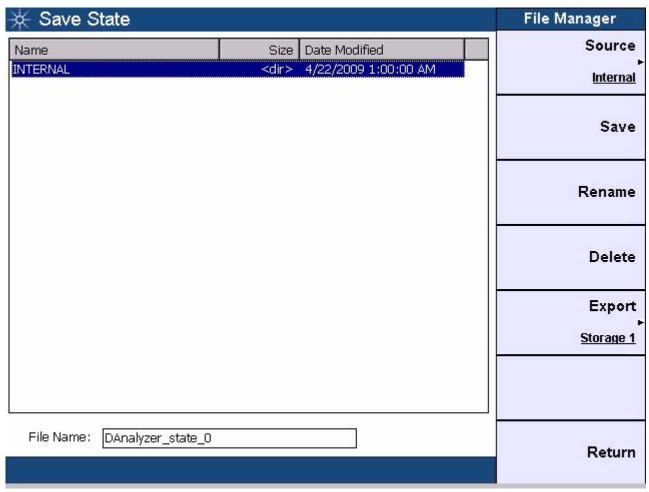


Figure 2-35 File Manager menu for saving U8903A state

You may save the current U8903A state to a file in either the U8903A internal memory or an external USB flash storage.

- **Source**

  Sets the storage location to internal memory or an external USB flash storage.

- **Save**

  Saves the current U8903A state to a file.

- **Rename**

  Renames a saved U8903A state file.

- **Delete**

  Deletes a saved U8903A state file.

- **Export**

  Exports a saved U8903A state file from the internal memory to an external USB flash storage.

Recall

This function recalls a saved U8903A state from a file saved in either the internal memory or an external USB flash storage. For single channel state file, you can select the channel(s) to recall. For module state file except digital generator, graph, and sweep mode, you can select which channel settings to be applied. As there are no multiple channel settings in the digital generator, graph, and sweep state file, channel selection is not available when recalling.

The File Manager will be launched once you pressed Recall.

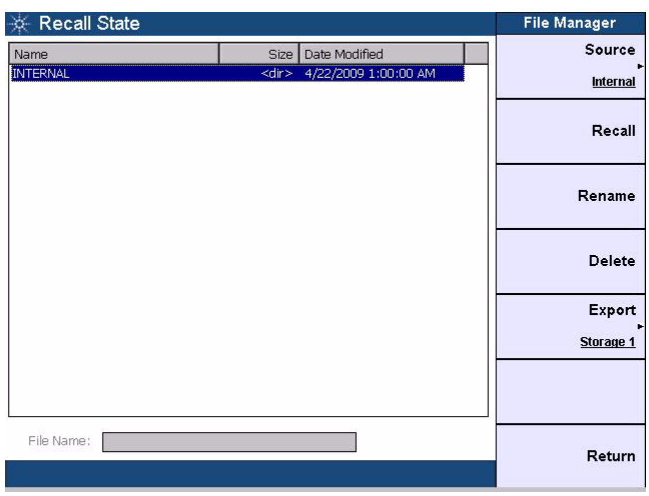


Figure 2-36 File Manager menu for recalling U8903A state

- **Source**

  Sets the storage location to internal memory or an external USB flash storage.

- **Recall**

  Recalls a saved U8903A state.

- **Rename**

  Renames a saved U8903A state file.

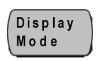
- **Delete**

  Deletes a saved U8903A state file.

- **Import**

  Imports a saved U8903A state file from an external USB flash storage to internal memory.

Display Mode

Toggle 

to display either 2-panel view or 4-panel view.

The 2-panel view display is as shown in Figure 2-37.

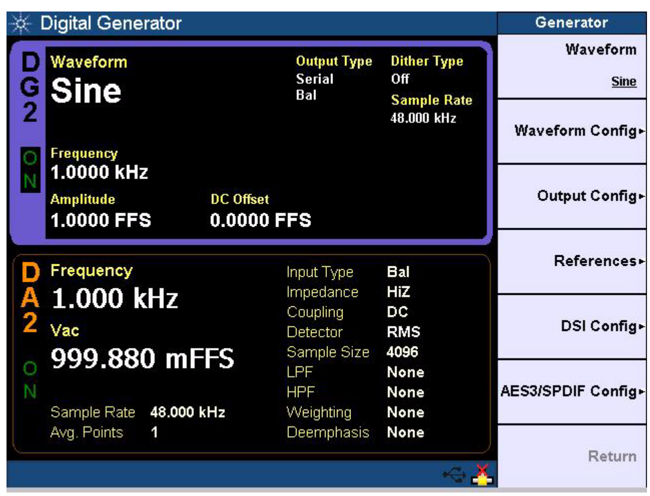


Figure 2-37 2-panel view display

The 4-panel view display is as shown in Figure 2-38.

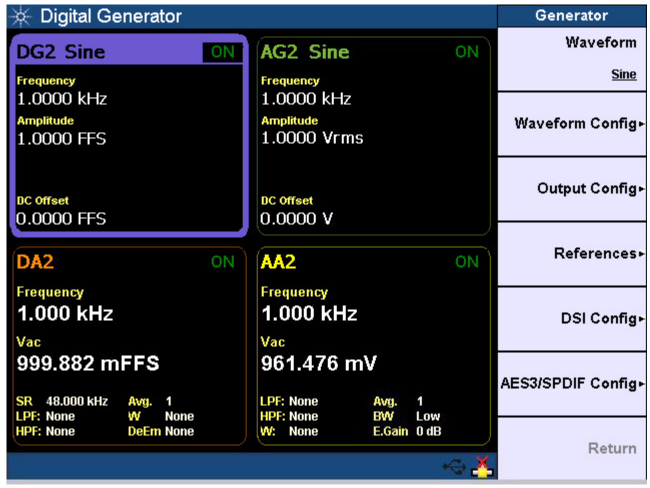


Figure 2-38 4-panel view display

Print

Press **Print** to print the current display to a file on an external USB flash storage.

Preset

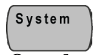
This function presets the U8903A to the factory default settings. When **Preset** is pressed in the sweep, analyzer, graph, or generator mode, you may choose to preset any of the following:

- Selected channel (only applicable for analog generator, analog analyzer, and digital analyzer mode).
- Selected module.
- All modules without deleting the user-defined files.
- Whole system including deletion of the user-defined files, refresh the GUI to default settings, and reset the system settings.

Local

This function activates the local control to switch from remote mode to front panel access.

System

Press 

to change the display screen to the system mode. On the System menu, you can access the I/O settings, U8903A update menu, service menu, utilities menu, HP8903B configurations, and Legacy sweep setting.

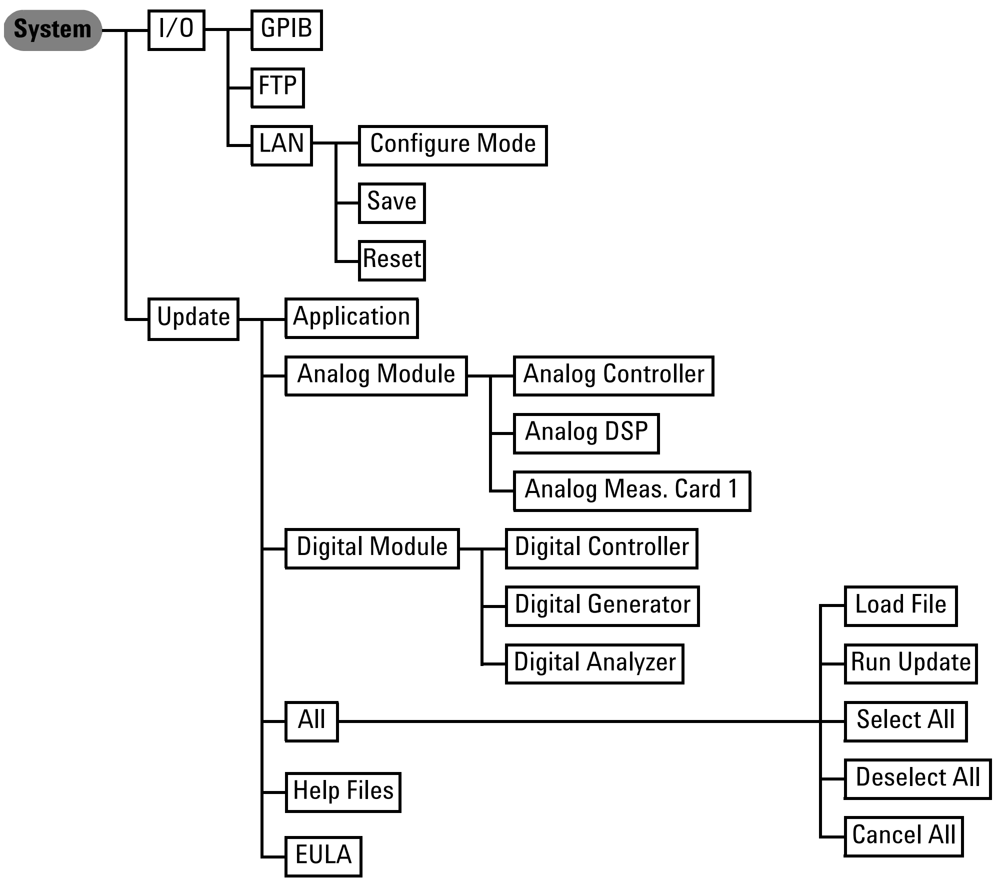


Figure 2-39 System menu tree: I/O and Update

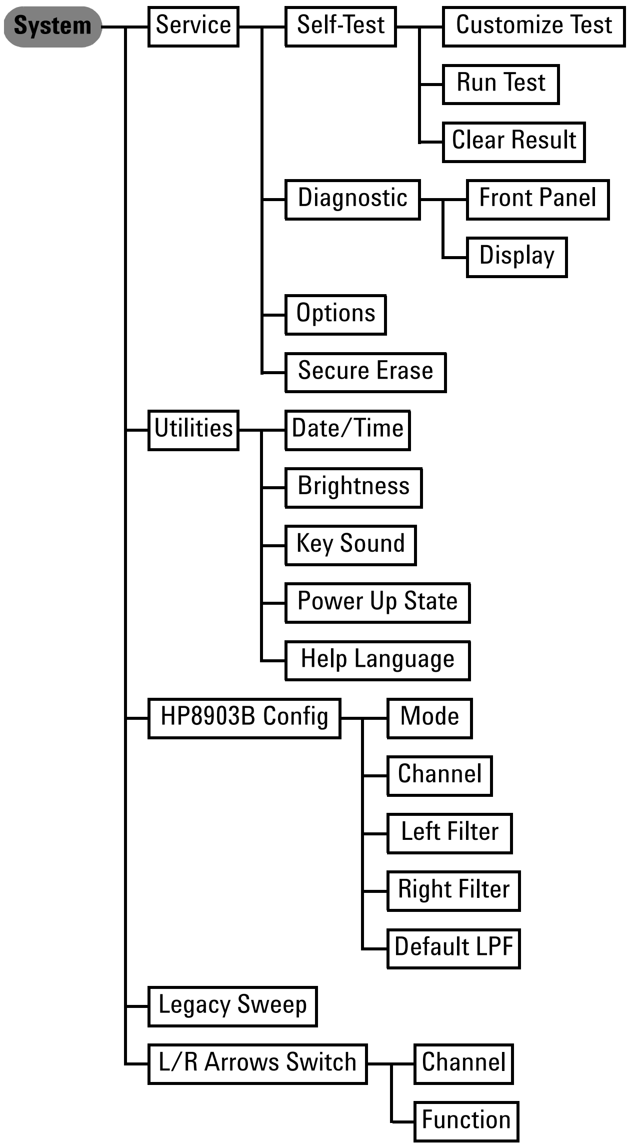


Figure 2-40 System menu tree: Service, Utilities, HP8903B Config, Legacy Sweep, and L/R Arrows Switch

Table 2-11 System menu tree description

Level 1	Level 2	Level 3	Description
I/O	GPIB	0 to 30	Enter the GPIB address value, from 0 to 30
	FTP	Enable Disable	Enable or disable the FTP control
	LAN	Configure Mode	Select either Automatic or Manual mode
		Save	Save the LAN settings
		Reset	Reset the LAN settings
Update	Application		Load a firmware file to update the U8903A application
	Analog Module	Analog Controller Analog DSP Analog Meas. Card 1	Select the respective analog module type to update
	Digital Module	Digital Controller Digital Generator Digital Analyzer	Select the respective digital module type to update
	All	Load File Run Update Select All Deselect All Cancel All	Check for new update and run the update
	Help Files		Load a .cmp file to update the U8903A help system
	EULA		Display the U8903A End User License Agreement
Service	Self-Test	Customize Test	Select All or Deselect All the test
		Run Test	Run the self-test
		Clear Result	Clear the result
	Diagnostic	Front Panel	Start the front panel diagnostics
		Display	Start the display diagnostics
	Options		Display the installed U8903A options
	Secure Erase		Eradicate stored data in the U8903A

Table 2-11 System menu tree description (continued)

Level 1	Level 2	Level 3	Description
Utilities	Date/Time	Edit Save Cancel	Enter the date and time
	Brightness	0 to 6	Adjust the brightness of the LCD display, from 0 to 6
	Key Sound	On Off	Enable or disable the key sound
	Power Up State	Default Last Settings	Select either Default or Last Settings as the power up state to be used
	Help Language	English (US) Simplified Chinese Japanese French German	Select the help system language
HP8903B Config	Mode	On Off	Enable or disable the HP8903B mode
	Channel	1 2	Select either 1 or 2 as the active channel
	Left Filter	None A-Weighting CCIR 1k wtd CCIR 2k wtd C-Message CCITT 400 Hz	Select the left filter type
	Right Filter	None A-Weighting CCIR 1k wtd CCIR 2k wtd C-Message CCITT 400 Hz	Select the right filter type
	Default LPF	30 kHz 80 kHz	Select either 30 kHz or 80 kHz as the default LPF

Table 2-11 System menu tree description (continued)

Level 1	Level 2	Level 3	Description
Legacy Sweep	On Off		Enable or disable the Legacy Sweep. When the Legacy Sweep is enabled, the reference channel change is applied to both input and output, the input/output interfaces are limited to analog only. The legacy sweep feature supports the older SCPI commands for U8903A with firmware version below 2.10.1.0. Refer to Table 2-12 for the supported SCPI commands when the Legacy Sweep is enabled or disabled.
L/R Arrows Switch	Channel		The left and right arrow keys will increase or decrease the channel number of the active panel respectively
	Function		The left and right arrow keys will behave differently on the analog generator and analog analyzer panels. • In the analog generator panel, the left and right arrow keys will select the frequency and amplitude fields respectively. • In the analog analyzer panel, there will be a maximum of four changes cached for function 2 measurement. The left and right arrow keys will switch between the cached changes.

Table 2-12 Legacy Sweep SCPI commands comparison

Legacy sweep is set to On	Legacy sweep is set to Off
INITiate:SWEep	INITiate:SWEep
SOURce:SWEep:NEXT	SOURce:SWEep:NEXT
SOURce:SWEep:VALues? (@<channel>)	SOURce:SWEep:VALues? (@<channel>)
SOURce:SWEep:MODE <mode>, (@<channel>)	SOURce:SWEep:MODE <mode>
SOURce:SWEep:CHANnel <channel>	SOURce:SWEep:CHANnel <channel>
SOURce:SWEep:PARameter <sweep parameter>, (@<channel>)	SOURce:SWEep:PARameter <sweep parameter>
SOURce:SWEep:SPACing <spacing>, (@<channel>)	SOURce:SWEep:SPACing <spacing>
SOURce:SWEep:POINts <points>, (@<channel>)	SOURce:SWEep:POINts <points>
SOURce:SWEep:DWELl <delay>, (@<channel>)	SOURce:SWEep:DWELl <delay>
SOURce:SWEep:STEP <step>, (@<channel>)	SOURce:SWEep:STEP <step>
SOURce:SWEep:STARt <start>, (@<channel>)	SOURce:SWEep:STARt <start>
SOURce:SWEep:STOP <stop>, (@<channel>)	SOURce:SWEep:STOP <stop>
FETCh:SWEep?	FETCh:SWEep? <function> (@<channel>)
MMEMory:STORe SWEEP, <filename>	MMEMory:STORe:SWEep <channel>, <function>, <filename>
	SOURce:SWEep:INTerface <interface>
	SOURce:SWEep:REFerence:CHANnel <channel>
	SOURce:SWEep:CHANnel <channel>
	SENSe:SWEep:INTerface <interface>
	SENSe:SWEep:REFerence:CHANnel <channel>
	SENSe:SWEep:CHANnel <channel>

NOTE

In default setting, the HP8903B mode is disabled.

There are some limitations when the HP8903B mode is enabled.

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

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” for more information.

3
Instrument Configuration

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

U8903A Block Diagram

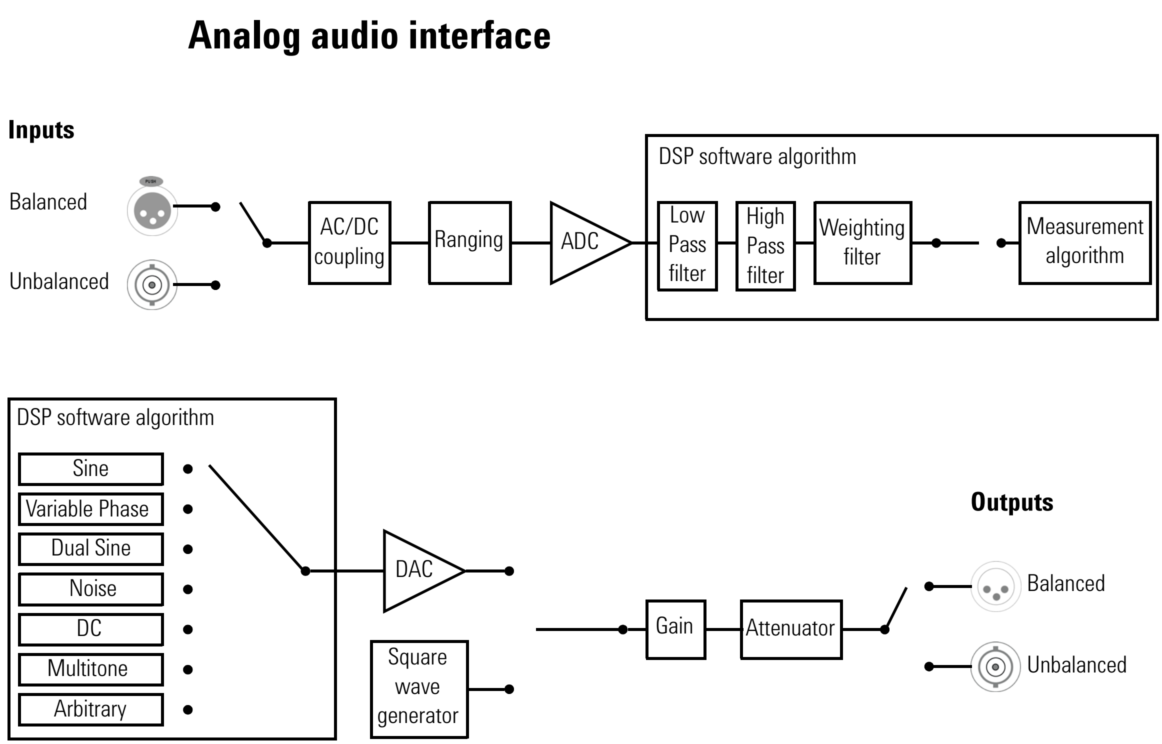


Figure 3-1 U8903A analog audio interface block diagram

Measurement

An analog audio signal can enter the analog 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 as possible to the full scale of the analog-to-digital converter (ADC), 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 can be optionally passed 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 device-under-test (DUT).

Digital audio interface

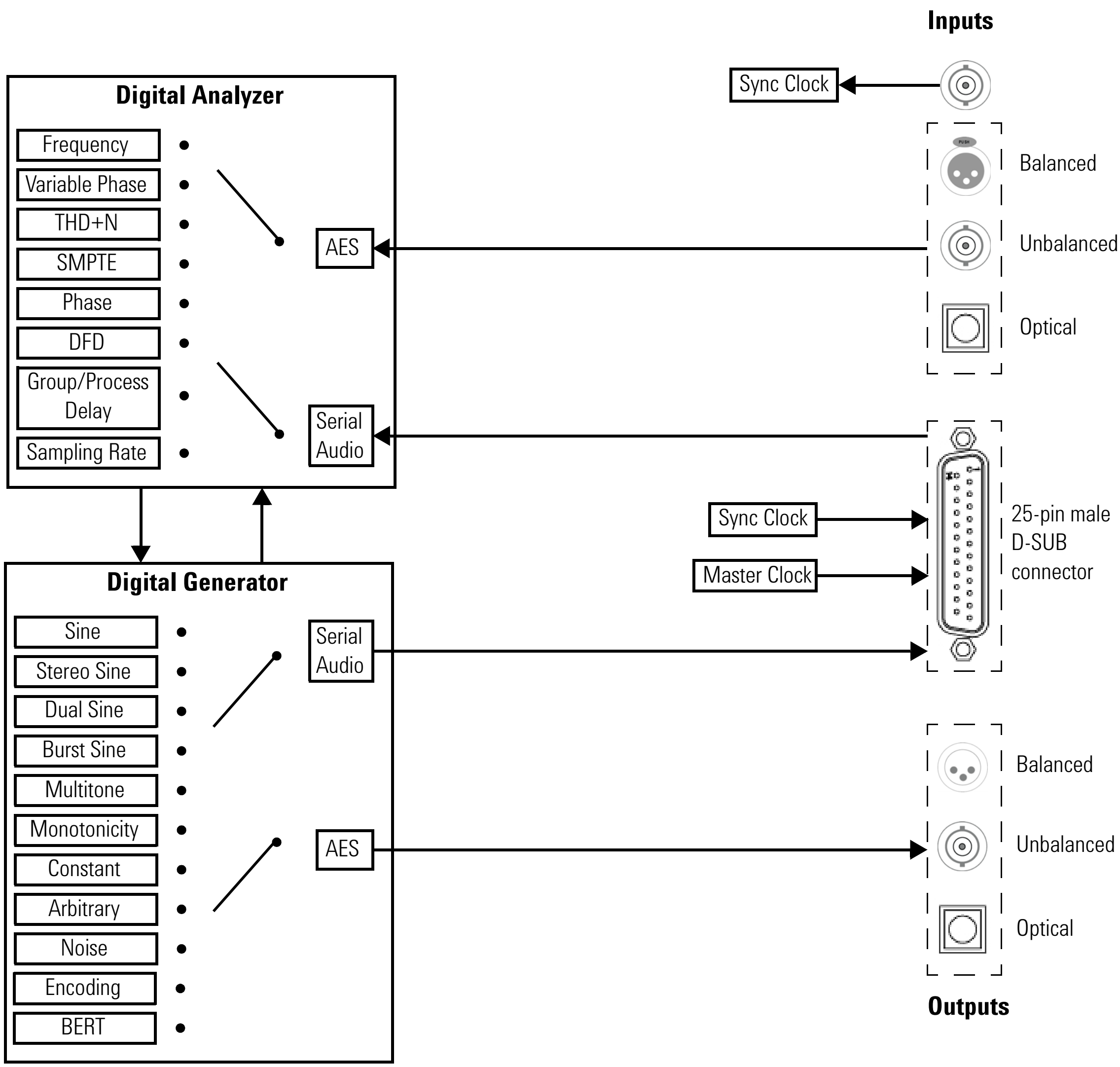


Figure 3-2 U8903A digital audio interface block diagram

Measurement

A digital audio signal can enter the digital analyzer through the Balanced (XLR), Unbalanced (BNC), optical (TOSLINK), or digital serial interface (DSI) input signal connector. For balanced, unbalanced, and optical input, the audio signal then passes through the AES receiver. For DSI input, the audio signal then passes through serial audio receiver.

The audio signal is sent to the digital analyzer. Inside the digital analyzer, the digital signal can be optionally passed through a combination of up to five digital filters, one each from the low pass, high pass, weighting, deemphasis, and sample rate filter groups before sending it to the measurement section.

Signal generation

The digital generator generates all the required waveforms digitally. The digital waveform data is then streamed to the serial audio transmitter for the DSI output, or to the AES transmitter for the balanced, unbalanced, and optical output. Finally, the waveform is routed through the Balanced (XLR), Unbalanced (BNC), Optical (TOSLINK), or digital serial interface (DSI) output signal connectors to the DUT.

Analog Generator Output Configuration

The U8903A analog generator output settings can be configured with the output type and output impedance as shown in Figure 3-3.

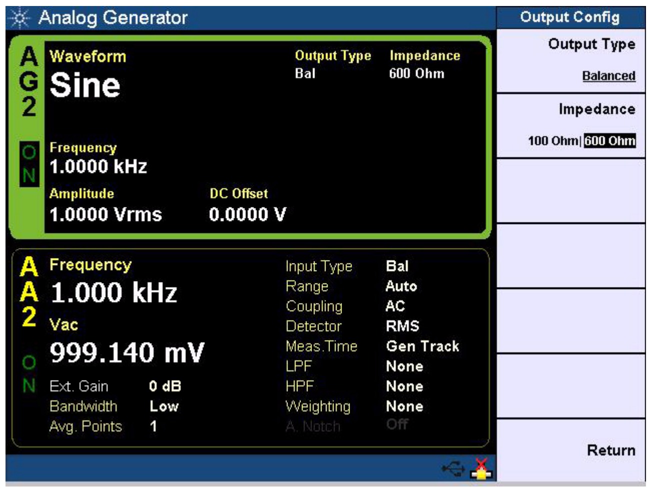


Figure 3-3 Analog generator Output Config

Output Type

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

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

Impedance

The output impedance can be selected as follows.

- *Balanced* and *Common* mode: 100 Ohm or 600 Ohm
- *Unbalanced* mode: 50 Ohm or 600 Ohm

Reference impedance

The analog generator reference impedance can be set as shown in Figure 3-4. The reference impedance is used for conversion of the output amplitude in dBm.

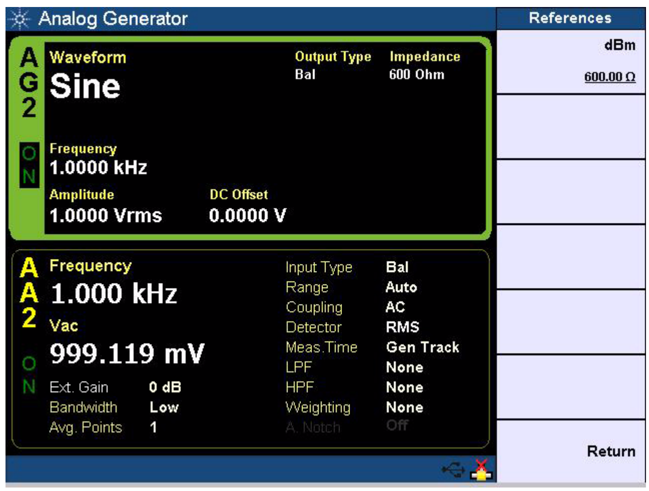


Figure 3-4 Analog generator reference impedance

Analog Analyzer Measurement Configuration

The analog analyzer measurement settings can be configured with the digital filter type, range, measurement time, detector type, average points, trigger in, and fundamental frequency lock as shown in Figure 3-5.

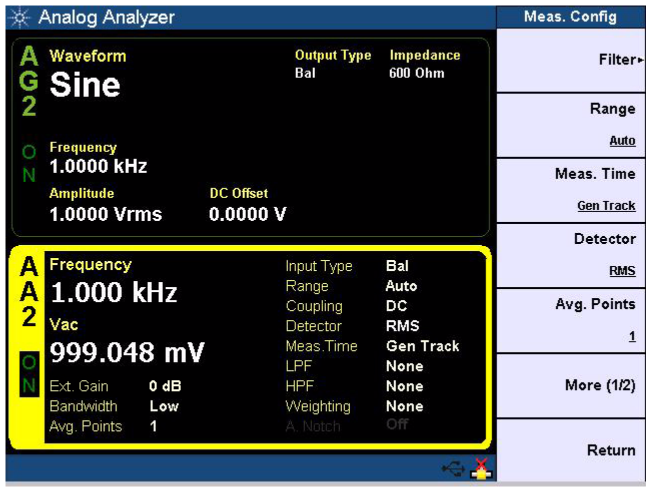


Figure 3-5 Analog analyzer Meas. Config

Filter

The filter type can be configured with None, LPF, HPF, or Weighting. Filters are used to bandwidth limit the input signals before applying a measurement function. The three types of filters can be applied to the signal simultaneously. The U8903A also allows custom filters to be uploaded through the specific filter menu. Refer to "Appendix C: User-defined Filter File Format" on page 287 for more information on the user-defined filter file format.

- *Low pass filter (LPF)* can be set to 15 kHz, 20 kHz, 30 kHz, 80 kHz, or a custom filter.
- *High pass filter (HPF)* can be set to 22 Hz, 100 Hz, 400 Hz, or a custom filter.

- *Weighting* filter can be set to A-Weighting, CCIR 1k wtd, CCIR 2k wtd, C-Message, CCITT, or a custom filter.

Range

The analog analyzer input range can be set to Auto, 400 mV, 800 mV, 1.6 V, 3.2 V, 6.4 V, 12.8 V, 25 V, 50 V, 100 V, or 140 V. The default input range is Auto, where the analog analyzer sets the optimum input range based on the input signal amplitude.

Meas. Time

The measurement time can be set to Gen Track, 1/128 s, 1/64 s, 1/32 s, 1/16 s, 1/8 s, 1/4 s, 1/2 s, or 1 s. When the measurement time is set to Gen Track, the analog 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. This setting applies to channel 1 and 2 of the analog analyzer.

Detector

The analog analyzer detection type can be set to RMS, Quasi Peak (QPK), or Peak-to-Peak.

Avg. Points

The average points can be set according to your desired value in a range of 1 to 50 points. The default average point is 1. Higher number of average points should be used when the analyzed data is noisy. This setting applies to channel 1 and 2 of the analog analyzer.

Trigger In

The analog analyzer trigger in can be set to Free Run or External. The default trigger in is Free Run, where the analyzer triggers immediately after the previous data is acquired. If External trigger in is set, the analyzer waits for a trigger pulse on the Trigger In connector at the rear panel before acquiring the measurement data. This setting applies to channel 1 and 2 of the analog analyzer.

Fund.Freq.Lock

The fundamental frequency lock method can be set to Auto or Gen. Lock. This setting is only applicable when the Function 2 measurement function is set to the THD+N Ratio, THD+N Level, or SINAD measurement. If Function 2 measurement function is set to SINAD, the default fundamental frequency lock is Gen. Lock, whereas for THD+N Ratio and THD+N Level, the default fundamental frequency lock is Auto.

The Auto frequency lock method automatically determines the fundamental frequency from the input signal. The fundamental frequency for the Gen. Lock method will be determined by the frequency value set at the corresponding generator channel.

Notch Bandwidth

The Notch filter is used to remove fundamental components of the input signal. The notch filter bandwidth can be set to Auto or Custom(Wide). The Custom(Wide) notch bandwidth is set to 500 Hz. This setting is only applicable when the Function 2 measurement function is set to the THD+N Ratio or SINAD measurement.

Analog Notch

The analog notch filter can be enabled or disabled. This setting is only applicable when the Function 2 measurement function is set to the THD+N Ratio or SINAD measurement. This filter is used to emulate the analog notch filter used in the HP8903B.

To emulate the HP8903B behavior, use the following steps.

1 Enable the analog notch filter.
2 Set the measurement time to 1/4 s.
3 Set the average points to a range of 3 to 5 points.
4 Set the analog analyzer measurement bandwidth to the low bandwidth. If the high bandwidth is used, set the filter type to the 30 kHz low pass filter.

SNR Meas. Delay

In the SNR measurement, the DUT output level and DUT residual noise are measured. The input stimulus tone to the DUT will alternate between signal and no signal to perform the SNR measurement. A DUT typically requires time to stabilize after the onset or change of an input stimulus tone. The SNR measurement delay is the time delay between the stimulus tone change and the start of the analyzer measurement.

The SNR measurement delay can be set according to your desired value in a range of 0 s to 2000 ms. This setting is only applicable when the Function 2 measurement function is set to the SNR measurement.

Src. Interface

The interface of the analog analyzer signal source can be set to the analog generator or digital generator. This setting is only applicable when the Function 2 measurement function is set to the SNR or noise level measurement.

Src. Channel

The generator source channel used in the analog analyzer can be set according to your desired generator channel. This setting is only applicable when the Function 2 measurement function is set to the SNR or noise level measurement.

Analog Analyzer Input Configuration

The analog analyzer input settings can be configured with the input type, coupling type, and measurement bandwidth as shown in Figure 3-6.

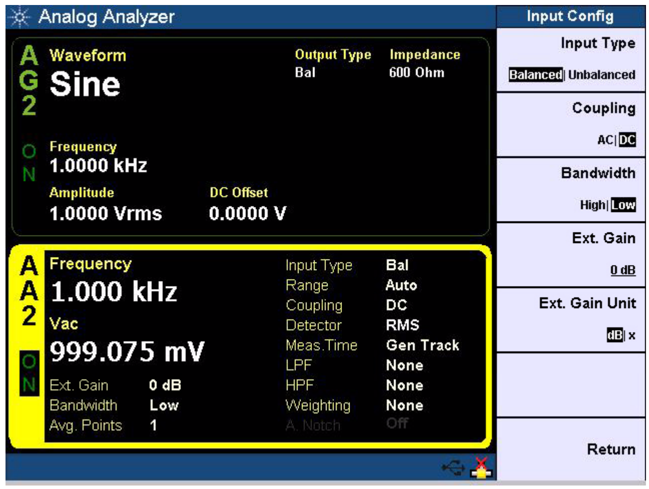


Figure 3-6 Analog analyzer Input Config

Input Type

The analog analyzer input connection can be set to Balanced or Unbalanced mode.

- *Balanced* mode routes the signal from the XLR input connectors in the front panel to the analog analyzer. The signals on the positive and negative pins of the XLR connector enter a differential amplifier where they are subtracted before passing on to the detector.
- *Unbalanced* mode routes the signal from the BNC input connector. The signal in the inner conductor of the coaxial connector is referenced to ground for measurement.

Coupling

The analog analyzer coupling type can be set to AC or DC.

- *AC* coupling blocks the DC component of the analog input signal by switching a capacitor in series to the input path. This setting should be selected when you need to measure only the AC component of a signal. for example, when you are making RMS or peak-to-peak voltage measurement.
- *DC* coupling allows both AC and DC analog input signals to pass through to the analog analyzer and to be measured down to 0 Hz. This setting should be selected when making DC voltage measurements.

Bandwidth

The analog analyzer measurement bandwidth mode can be set to high bandwidth or low bandwidth mode. The default measurement bandwidth mode is low bandwidth for better residual noise and distortion performance. This setting applies to channel 1 and 2 of the analog analyzer.

- *High* bandwidth mode can measure signals with frequencies up to 100 kHz.
- *Low* bandwidth mode can measure signals with frequencies up to 30 kHz.

Ext. Gain

The external gain can be set in the range of –60 dB to 60 dB. The default external gain is 0 dB. External gain is used to correct the effects of any external gain or loss that may be part of a measurement setup. For example, if an amplifier is part of a measurement setup, this external gain value is used to remove the effects of its gain. However, if an external attenuator is used in a high voltage measurement, this external gain value is used to correct the loss. The instrument will then report the levels being measured and not simply the levels being presented to the instrument.

Ext. Gain Unit

The external gain unit can be set to dB or x.

Digital Generator Output Configuration

The U8903A digital generator output settings can be configured with the AES output, optical output, dither type, encoding format, sample rate, reference clock source, external clock type, external master clock word length, external master clock multiplier, synchronous clock output, synchronous clock source, and synchronous clock divider as shown in Figure 3-7.

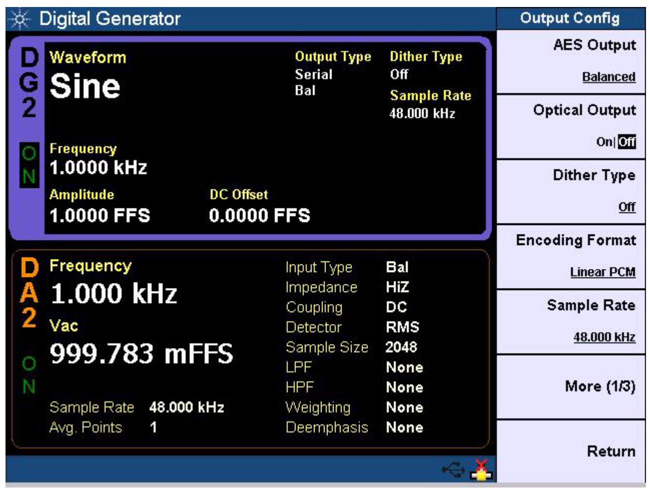


Figure 3-7 Digital generator Output Config

AES Output

The AES output can be set to Balanced or Unbalanced mode. You can also set the AES output to Off.

- *Balanced* mode outputs a digital signal on the XLR output connector at the U8903A rear panel.
- *Unbalanced* mode outputs a digital signal on the BNC output connector at the U8903A rear panel.

Optical Output

The optical output can be enabled or disabled. When enabled, the U8903A outputs a digital signal through the optical output connector at the U8903A rear panel.

Dither Type

The dither type can be set to Off, Rectangular, or Triangular. Dither is a noise component that can be superimposed on a signal.

Encoding Format

The encoding format can be set to Linear PCM, A-Law, or µ-Law.

Sample Rate

The sample rate can be set according to your desired value. The default sample rate is 48 kHz.

Ref. Clk Source

The reference clock source can be set to Internal, AES Recovered Clk, or External. Refer to "Appendix E: Digital System Clock Distribution Block Diagram" on page 292 for more information on the system clock.

Ext. Clk Type

The external clock type can be set to master clock (MCLK) or sync clock (FSYNC). Refer to "Appendix E: Digital System Clock Distribution Block Diagram" on page 292 for more information on the system clock.

Ext. MClk WordLen

The external master clock word length can be set to your desired value in a range of 8 to 32.

Ext. MClk Multiplier

The selection available in the external master clock multiplier depends on the external master clock word length.

Sync. Clk Output

The synchronous clock output can be enabled or disabled.

Sync. Clk Source

The synchronous clock source can be set to Internal, AES Recovered Clk, or External. Refer to “Appendix E: Digital System Clock Distribution Block Diagram” on page 292 for more information on the system clock.

Sync. Clk Divider

The synchronous clock divider value can be set to 1 or 128. When the synchronous clock divider is set to 1, the synchronous clock is locked to 128 × sampling rate (bi-phase clock). When the synchronous clock divider is set to 128, the synchronous clock is divided by 128 which is equal to the sampling rate set at the U8903A.

Output references

The digital generator output references can be configured with the track and volts/FS as shown in Figure 3-8.

The output reference track channel selection is used to synchronize the settings between the digital channels. For example, setting the output reference track to Channel 1 in the digital generator Channel 2 will allow the current and future settings on Channel 1 to be applied to Channel 2.

The Volts/FS can be set according to your desired value. The volts/FS reference represents the analog output voltage (in Volts) of the DAC used when converted to digital full scale (1 FS). This is useful in DAC tests for the conversion of digital units to analog units. The default volts/FS value is 1 V/FS.

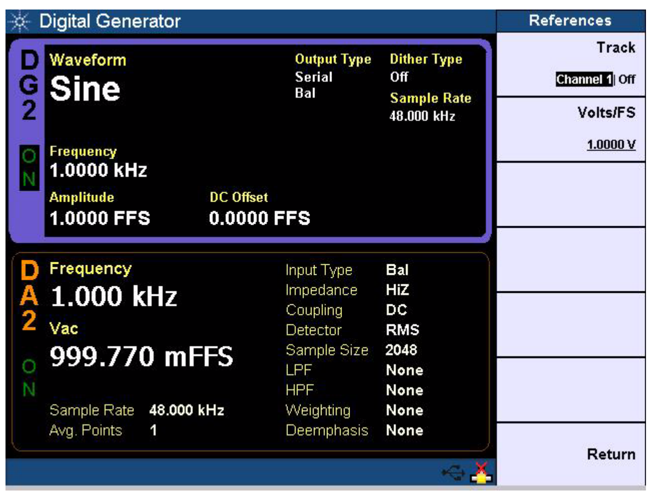


Figure 3-8 Digital generator References

DSI Output Configuration

The DSI output settings can be configured with the format, output voltage, word length, audio resolution, sample rate, master clock, multiplier, and sync polarity as shown in Figure 3-9.

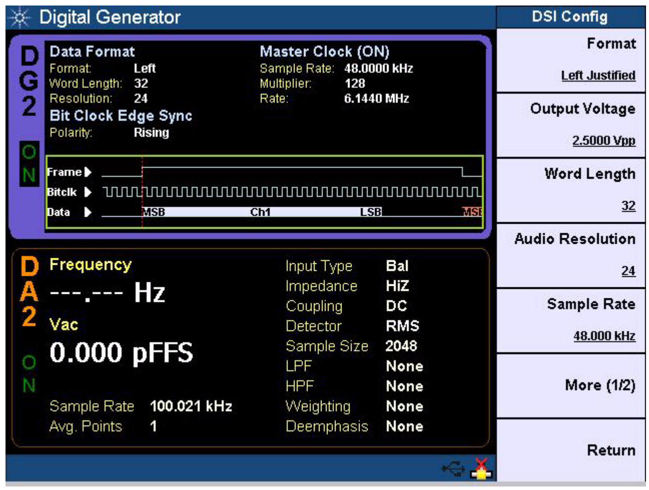


Figure 3-9 Digital generator DSI Config

Format

The DSI output format can be set to Left Justified, Right Justified, I2S, or DSP format.

Output Voltage

The output voltage can be set to 1.2 Vpp, 1.5 Vpp, 1.8 Vpp, 2.5 Vpp, 3 Vpp, 3.3 Vpp, or a custom voltage value. The default output voltage is 2.5 Vpp.

Word Length

The word length can be set according to your desired value in the range of 8 to 32. The word length cannot be less than the audio resolution.

Audio Resolution

The audio resolution can be set according to your desired value in a range of 8 to 24.

Sample Rate

The sample rate can be set according to your desired value. The default sample rate is 48 kHz.

Master Clock

The master clock output can be enabled or disabled.

Multiplier

The multiplier selection depends on the word length value.

Sync Polarity

The sync polarity can be set to the Rising or Falling as the edge synchronization to the leading edge of the frame clock.

AES3/SPDIF Output Configuration

The general AES3/SPDIF output settings can be configured with the status bits type, channel/user bits, audio resolution, and output voltage as shown in Figure 3-10. When the status bits type is set to Channel, the AES3/SPDIF output settings can be further configured with the output mode.

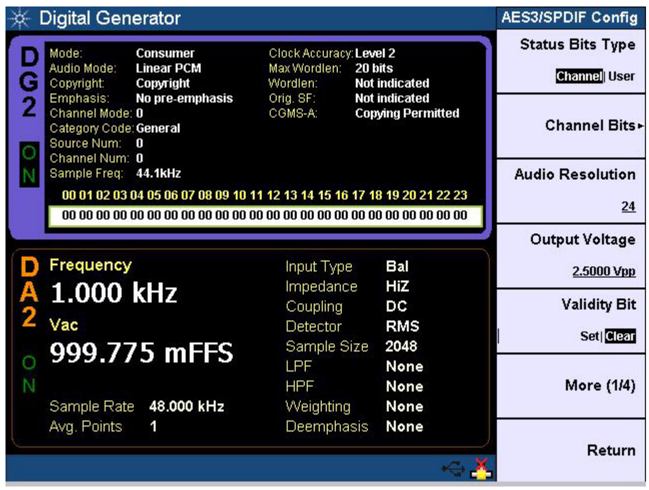


Figure 3-10 Digital generator general AES3/SPDIF Config

Status Bits Type

The status bits type can be set to Channel or User.

Channel/User Bits

You can edit, clear, save in Hex, save in Xml, and recall the channel/user bits. The name for this setting depends on the status bits type selection.

Audio Resolution

The audio resolution can be set according to your desired value in a range of 8 to 24.

Output Voltage

The output voltage can be set according to your desired value. The default output voltage is 2.5 Vpp.

Validity Bit

The validity bit can be set to Set or Clear.

Mode

The AES3/SPDIF mode can be set to Consumer or Professional mode. This setting is only applicable when the status bit type is set to Channel.

Consumer

When the AES3/SPDIF output mode is set to Consumer, the output settings can be further configured with the audio mode, copyright, emphasis, channel mode, category code, source number, channel number, sample frequency, clock accuracy, maximum word length, word length, original sample frequency, and CGMS-A as shown in Figure 3-11.

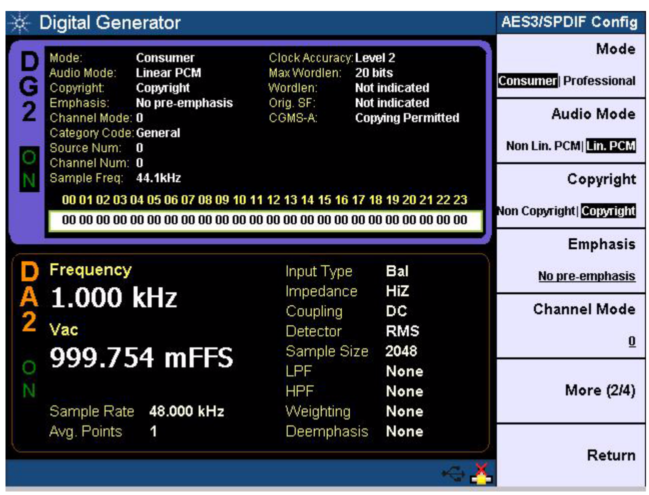


Figure 3-11 Digital generator AES3/SPDIF Config Consumer mode

Audio Mode

The audio mode can be set to Non Lin. PCM or Lin. PCM mode.

Copyright

The copyright option can be set to Non Copyright or Copyright.

Emphasis

The emphasis can be set to No pre-emphasis, 50/15 µs, Reserved 1, or Reserved 2.

Channel Mode

The channel mode value can be set to a range of 0 to 3.

Category Code

There are 13 different category code types to be set in the Consumer mode. The available category modes are as follows.

- General
- Laser Optical
- D/D Converter
- Magnetic
- Digital Broadcast 1
- Digital Broadcast 2
- Musical Instrument
- ADC Non Copyright
- Solid State Memory
- ADC Copyright
- Experimental
- Reserved 1
- Reserved 2

Source Num

The source number can be set to your desired source number in a range of 0 to 15.

Channel Num

The channel number can be set to your desired channel number in a range of 0 to 15.

Sample Freq

The sample frequency can be set to a range of 22.05 kHz to 768 kHz or Not Indicated. The available selections are 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, 192 kHz, and 768 kHz.

Clock Accuracy

The clock accuracy can be set to Level 1, Level 2, Level 3, or Reserved.

Max Word Length

The maximum word length can be set to 20 bits or 24 bits.

Word Length

The word length can be selected as follows.

- *20 bits Max Word Length*: Not indicated, 16 bits, 17 bits, 18 bits, 19 bits, or 20 bits
- *24 bits Max Word Length*: Not indicated, 20 bits, 21 bits, 22 bits, 23 bits, or 24 bits

Orig. Sample Freq

The original sample frequency can be set to a range of 8 kHz to 192 kHz or Not Indicated. The available selections are 8 kHz, 11.025 kHz, 12 kHz, 16 kHz, 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, 192 kHz, Reserved 1, and Reserved 2.

CGMS-A

The CGMS-A can be set to Copying Permitted, Condition Not Used, One Generation Copy, or Copying Denied.

Table 3-1 AES3/SPDIF Consumer mode bit description

Bits	Label	Description
0	Application mode	0: Consumer 1: Professional
1	Non-audio	0: Audio data is linear PCM samples 1: Other than linear PCM samples
2	Copyright	0: Asserted 1: Not asserted
3 – 5	Emphasis	000: Emphasis not indicated 100: CD-type emphasis
6 – 7	Channel status mode	00: Mode zero Other values reserved
8 – 15	Category code	Bit 8 is LSB
16 – 19	Source number	Bit 16 is LSB
20 – 23	Channel number	Bit 20 is LSB
24 – 27	Sampling frequency	0000: 44.1 kHz 0100: 48 kHz 1100: 32 kHz
28 – 29	Clock accuracy	10: Level I, ±50 ppm 00: Level II, ±1000 ppm 01: Level III, variable pitch shifted
30 – 31	Reserved	
32	Word length (field size)	0: Maximum length 20 bits 1: Maximum length 24 bits

Table 3-1 AES3/SPDIF Consumer mode bit description (continued)

Bits	Label	Description		
33 – 35	Word length		If bit 32 = 1	If bit 32 = 0
		000	Not indicated	Not indicated
		101	24 bits	20 bits
		001	23 bits	19 bits
		010	22 bits	18 bits
		011	21 bits	17 bits
		100	20 bits	16 bits
36 – 39	Original sampling frequency	1111: 44.1 kHz 1110: 88.2 kHz 1101: 22.05 kHz 1100: 176.4 kHz 1011: 48 kHz 1010: 96 kHz 1001: 24 kHz 1000: 192 kHz 0111: Reserved 0110: 8 kHz 0101: 11.025 kHz 0100: 12 kHz 0011: 32 kHz 0010: Reserved 0001: 16 kHz 0000: Not indicated		
40 – 41	CGMS-A	00: Copying permitted 01: Condition not used 10: One generation copy 11: Copying denied		
42 – 192	Reserved			

Professional

When the AES3/SPDIF mode is set to Professional, the output settings can be further configured with the audio mode, emphasis, frequency mode, sample frequency, sample frequency scaling, channel mode, user bits, auxiliary bits, word length, alignment level, multichannel status, multichannel mode, channel number, reference signal, channel origin, channel destination, local address, time-of-day, and reliability flags as shown in Figure 3-12.

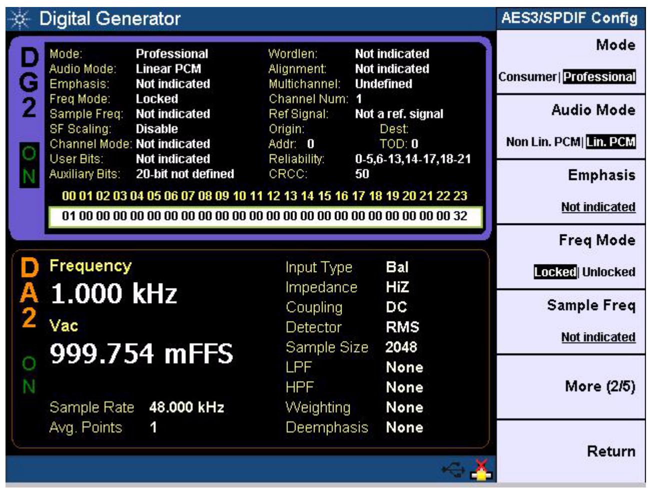


Figure 3-12 Digital generator AES3/SPDIF Config Professional mode

Audio Mode

The audio mode can be set to Non Lin. PCM or Lin. PCM mode.

Emphasis

The emphasis can be set to Not indicated, No pre-emphasis, 50/15 µs, or CCITT J.17.

Freq mode

The frequency mode can be set to Locked or Unlocked mode.

Sample Freq

The sample frequency can be set to a range of 22.05 kHz to 192 kHz or Not indicated. The available selections are 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, and 192 kHz.

S. Freq Scaling

The sample frequency scaling can be enabled or disabled.

Channel Mode

There are 11 different channel modes to be set in the Professional mode. The available channel modes are as follows.

- Not indicated
- 2-channel
- Single channel
- Primary-Secondary
- Stereo
- Reserved 1
- Reserved 2
- Mono Double Rate
- Left Double Rate
- Right Double Rate
- Multichannel

User Bits

The user bits can be set to Not indicated, 192-bit block, Reserved for AES18, User defined, Reserved for Metadata, or As in IEC60958-3.

Auxiliary Bits

The auxiliary bits can be set to 20-bit not defined, 24-bit main audio, 20-bit single, or Reserved.

Word Length

The word length can be selected as follows.

- *20-bit not defined, 20-bit single, or Reserved auxiliary bits*: Not indicated, 16 bits, 17 bits, 18 bits, 19 bits, or 20 bits
- *24-bit main audio auxiliary bits*: Not indicated, 20 bits, 21 bits, 22 bits, 23 bits, or 24 bits

Alignment Level

The alignment level can be set to Not Indicated, –18.06 dBFS, –20 dBFS, or Reserved.

Multichannel Status

The multichannel status can be set to Defined or Undefined.

Multichannel Mode

The multichannel status can be set to Mode 0, Mode 1, Mode 2, Mode 3, or user defined. The multichannel mode is only applicable when the multichannel status is set to Defined.

Channel Number

The channel number can be set to a range of 1 to 128.

- *Defined Multichannel Status*: 1 to 16
- *Undefined Multichannel Status*: 1 to 128

Reference Signal

The reference signal can be set to Not a ref. signal, Grade 1, Grade 2, or Reserved.

Channel Origin

The channel origin can be set according to your desired value in 4 alphanumeric digit.

Channel Dest.

The channel destination can be set according to your desired value in 4 alphanumeric digit.

Local Address

The local address can be set according to your desired value in a range of 0 to $2^{32}-1$.

Time-of-day

The time-of-day can be set according to your desired value in a range of 0 to $2^{32}-1$.

Reliability Flags

The reliability flags can be set to a range of 0 to 21. The available selection are as follows.

- 0-5
- 6-13
- 14-17
- 18-21

Table 3-2 AES3/SPDIF Professional mode bit description

Bits	Label	Description
0	Application mode	0: Consumer 1: Professional
1	Non-audio	0: Audio data is linear PCM samples 1: Other than linear PCM samples

Table 3-2 AES3/SPDIF Professional mode bit description (continued)

Bits	Label	Description
2 – 4	Emphasis	000: Not indicated 100: No emphasis 110: CD-type emphasis 111: J-17 emphasis
5	Lock	0: Not indicated 1: Unlocked
6 – 7	Sampling frequency	00: Not indicated (or see byte 4) 10: 48 kHz 01: 44.1 kHz 11: 32 kHz
8 – 11	Channel mode	0000: Not indicated (default to 2 channels) 0001: 2 channels 0010: 1 channel (monophonic) 0011: Primary/secondary 0100: Stereo 0101: Reserved for user application 0110: Reserved for user application 0111: SCDSR (see byte 3 for ID) 1000: SCDSR (stereo left) 1001: SCDSR (stereo right) 1111: Multichannel (see byte 3 for ID) Single Channel Double Sample Rate (SCDSR)
12 – 15	User bit management	0000: Not indicated 0001: 192-bit block as in channel status 0010: As defined in AES18 0011: User-defined 0100: As in IEC60958-3 (consumer)

Table 3-2 AES3/SPDIF Professional mode bit description (continued)

<table>
<tr><th>Bits</th><th>Label</th><th colspan="3">Description</th></tr>
<tr><td>16 – 18</td><td>Use of AUX sample word</td><td colspan="3">0000: Not defined, audio maximum 20 bits
0001: Used for main audio, maximum 24 bits
0010: Used for coordination signal, audio maximum 20 bits
0011: User-defined</td></tr>
<tr><td rowspan="7">19 – 21</td><td rowspan="7">Source word length</td><td></td><td>If maximum = 24 bits</td><td>If maximum = 20 bits</td></tr>
<tr><td>000:</td><td>Not indicated</td><td>Not indicated</td></tr>
<tr><td>001:</td><td>23 bits</td><td>19 bits</td></tr>
<tr><td>010:</td><td>22 bits</td><td>18 bits</td></tr>
<tr><td>011:</td><td>21 bits</td><td>17 bits</td></tr>
<tr><td>100:</td><td>20 bits</td><td>16 bits</td></tr>
<tr><td>101:</td><td>24 bits</td><td>20 bits</td></tr>
<tr><td>22 – 23</td><td>Alignment level</td><td colspan="3">00: Not indicated
01: –20 dBFS
10: –18.06 dBFS</td></tr>
<tr><td>24 – 31</td><td>Channel identification</td><td colspan="3">If bit 31 = 0, then channel number is 1 plus the numeric value of bits 24 - 30.
If bit 31 = 1, then bits 4 - 6 define a multichannel mode and bits 0 - 3 give the channel number within that mode.</td></tr>
<tr><td>32 – 33</td><td>Digital Audio Reference Signal (DARS)</td><td colspan="3">00: Not a DARS
01: DARS grade 1 (±1 ppm)
10: DARS grade 2 (±10 ppm)</td></tr>
<tr><td>35 – 38</td><td>Sampling frequency</td><td colspan="3">0000: Not indicated
1000: 24 kHz
0100: 96 kHz
1001: 22.05 kHz
0101: 88.2 kHz
1101: 176.4 kHz
1111: User defined</td></tr>
<tr><td>39</td><td>Sampling frequency scaling</td><td colspan="3">0: No scaling
1: Apply factor of 1/1.001 to value</td></tr>
</table>

Table 3-2 AES3/SPDIF Professional mode bit description (continued)

Bits	Label	Description
48 – 79	Alphanumeric channel origin	Four-character label using 7-bit ASCII with no parity. Bit 55, 63, 71, 79 = 0
80 – 111	Alphanumeric channel destination	Four-character label using 7-bit ASCII with no parity. Bit 87, 95, 103, 111 = 0
112 – 143	Local sample address code	32-bit binary number representing the sample count of the first sample of the channel status block
144 – 175	Time of day code	32-bit binary number representing tiem source encoding in samples since midnight
176 – 183	Reliability flags	0: Data in byte range is reliable 1: Data in byte range is unreliable
184 – 191	CRCC	00000000: Not implemented nnnnnnnn: Error check code for bits 0 - 183

Digital Analyzer Analysis Mode

The digital analyzer analysis mode can be set to Signal Attributes, Audio bits, or Bit Error mode as shown in Figure 3-13.

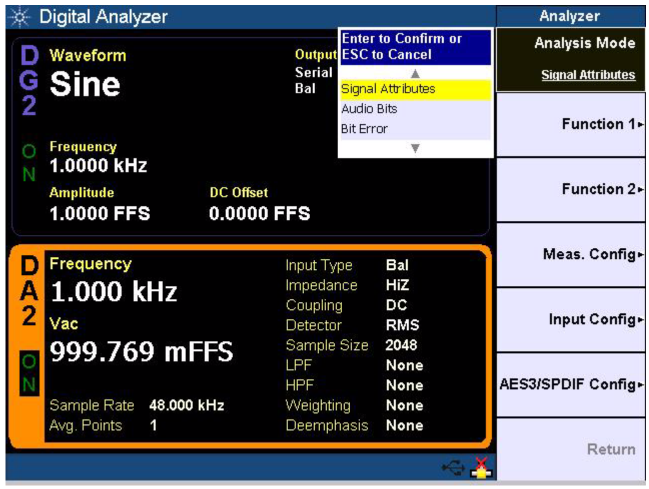


Figure 3-13 Digital analyzer analysis mode selection

Signal attributes

Signal attributes is the default and standard mode for the digital analyzer. The signal attributes mode allows you to measure the digital audio signal characteristics, and set the input, measurement, and interface configurations.

Audio bits

The audio bits mode allows you to view the data of every single bit in each word of the embedded audio data in the digital signal. When the digital analyzer analysis mode is set to audio bits, the audio bits mode setting can be configured with the audio bits type as shown in Figure 3-14.

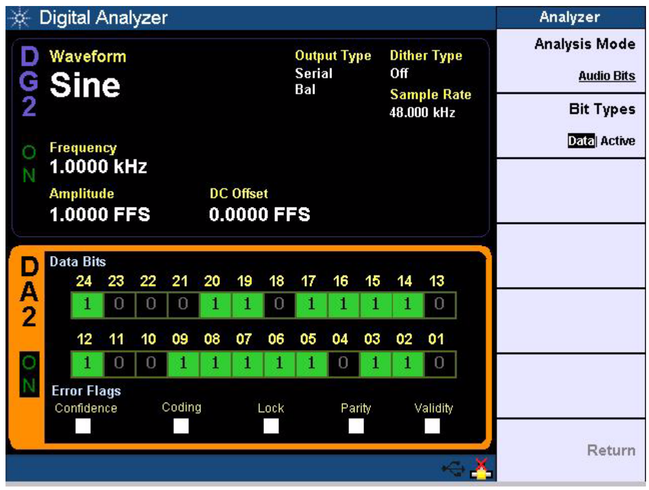


Figure 3-14 Digital analyzer audio bits mode

Bit Types

The audio bits type can be set to Data or Active bits.

Data bits represents the data in a word of the embedded audio data of the digital signal at the time of the measurement. "1" indicates that the data is 1 at the particular bit and "0" indicates that the data is 0 at the particular bit.

Active bits indicates bits that have changed state during the measurement period. "1" indicates bit has changed state, and "0" indicates no change.

Bit error

The bit error mode allows you to configure the Bit Error Rate Test (BERT) settings. When the digital analyzer analysis mode is set to bit error, the BERT settings can be configured with the mode, bit width, seed 1, seed 2, output sampling rate, duration, reading interval, and unit as shown in Figure 3-15.

The BERT measurement will provide the total errors, total bits run, and bit error rate. This test will only be meaningful if the selected output and input connectors are the same type.

NOTE When the digital analyzer analysis mode is set to Bit Error, you are not allowed to perform any other types of measurements.

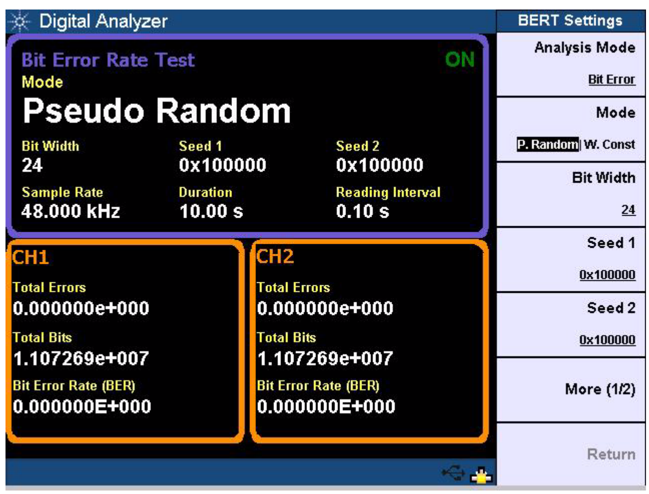


Figure 3-15 Digital analyzer bit error mode

Mode

The BERT mode can be set to P. Random (pseudorandom) or W. Const (walking constant).

Bit Width

The BERT bit width can be set according to your desired value.

Seed/Pattern 1 and 2

The BERT seed 1 and 2 can be configured with Clear All, Set All, and Edit Constant. The BERT pattern 1 and 2 can be configured with Clear All, Set All, Walking One, Walking Zero, and Edit Constant. The name for this setting depends on the BERT mode selection. The seed value is needed if pseudorandom is selected as the BERT mode while the pattern value is needed if walking constant is selected.

The Seed value is a number used to set the starting point of the pseudorandom number generator. The Seed 1 value is used for the generator channel 1 while the Seed 2 value is used for the generator channel 2.

The typical patterns used are Walking One (h'800000) and Walking Zero(h'7FFFFF). Pattern 1 value is used for generator channel 1 while Pattern 2 value is used for generator channel 2.

Output Samp. Rate

The BERT output sampling rate can be set according to your desired value.

Duration

The BERT duration can be set according to your desired value.

Reading Interval

The BERT reading interval can be set according to your desired value.

Unit

The BERT unit can be set to dec or hex.

Digital Analyzer Measurement Configuration

The digital analyzer measurement settings can be configured with the digital filter type, coupling type, sample size, measurement time, detector type, average points, trigger in, SNR measurement delay, THD+N mode, fundamental frequency lock, and fundamental frequency as shown in Figure 3-16.

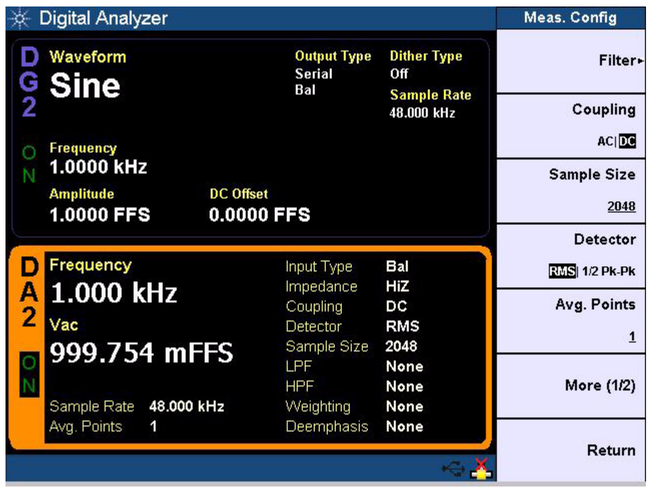


Figure 3-16 Digital analyzer Meas. Config

Filter

The filter type can be configured with None, LPF, HPF, Weighting, and Deemphasis. Sample Rate is used to normalized a particular filter cut-off frequency. For example, if the sample rate is set to 96 kHz and a 15 kHz low pass filter is selected, it will only fulfill the filter frequency response when operated at 96 kHz.

Digital filters are used to bandwidth limit the input signals before applying a measurement function. The four types of filters can be applied to the signal simultaneously. The U8903A also allows custom filters to be uploaded in through the specific filter menu. Refer to "Appendix C: User-defined Filter File Format" on page 287 for more information on the user-defined filter file format.

- *Low pass filter (LPF)* can be set to None, 15 kHz, 20 kHz, 30 kHz, 22 kHz, or a custom filter.
- *High pass filter (HPF)* can be set to None, 20 Hz, 100 Hz, 400 Hz, or a custom filter.
- *Weighting* filter can be set to None, A-Weighting, CCIR 1k wtd, CCIR 2k wtd, C-Message, CCITT, or a custom filter.
- *Deemphasis* filter can be set to None, 50 µs, 75 µs, or a custom filter.
- *Sample Rate* can be set to 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, or 192 kHz.

Coupling

The digital analyzer coupling type can be set to AC or DC.

- *AC* coupling blocks the DC component of the input signal. This setting should be selected when you need to measure only the AC component of a signal. for example, when you are making RMS or peak-to-peak voltage measurement.
- *DC* coupling allows both AC and DC input signals to pass through to the digital analyzer and to be measured down to 0 Hz. This setting should be selected when making DC voltage measurements.

Sample Size

The digital analyzer sample size can be set to 2048, 4096, 8192, 16384, 32768, 65536, or 131072. The sample size is the number of data points acquired for the measurement. The higher the sample size, the higher the accuracy of the measurement result.

Detector

The digital analyzer detection type can be set to RMS or 1/2 Pk-to-Pk. This setting is only applicable when the Function 1 or Function 2 measurement function is set to the Vac measurement.

Avg. Points

The average points can be set according to your desired value in a range of 1 to 50 points. The default average point is 1. Higher number of average points should be used when the analyzed data is noisy.

Trigger In

The digital analyzer trigger in can be set to Free Run or External. The default trigger in is Free Run, where the analyzer triggers immediately after the previous data is acquired. If External trigger in is set, the analyzer waits for a trigger pulse on the Trigger In connector at the rear panel before acquiring the measurement data.

THD+N Mode[1]

The THD+N mode can be set to Normal or Precision. This setting is only applicable when the Function 2 measurement function is set to the THD+N measurement.

Fund. Freq. Lock

The fundamental frequency lock can be set to Auto, Gen. Lock, or Custom. This setting is only applicable when the THD+N mode is set to Precision.

Fund. Frequency

The fundamental frequency can be set according to your desired value. This setting is only applicable when the Func. Freq. Lock is set to Custom.

[1] To obtain a more accurate measurement, ensure that a suitable sample size is used with different sample rate and fundamental frequency accordingly.

No. Of Harmonics

The number of harmonics for THD measurement can be set according to your desired value in a range of 2 to 20 harmonics. This setting is only applicable when the Function 2 measurement function is set to the THD measurement.

SNR Meas. Delay

In the SNR measurement, the DUT output level and DUT residual noise are measured. The input stimulus tone to the DUT will alternate between signal and no signal to perform the SNR measurement. A DUT typically requires time to stabilize after the onset or change of an input stimulus tone. The SNR measurement delay is the time delay between the stimulus tone change and the start of the analyzer measurement.

The SNR measurement delay can be set in the range of 0 s to 2000 ms. This setting is only applicable when the Function 2 measurement function is set to the SNR measurement.

Src. Interface

The interface of the digital analyzer signal source can be set to the analog generator or digital generator. This setting is only applicable when the Function 2 measurement function is set to the SNR or noise level measurement.

Src. Channel

The generator source channel used in the digital analyzer can be set according to your desired generator channel. This setting is only applicable when the Function 2 measurement function is set to the SNR or noise level measurement.

Digital Analyzer Input Configuration

The digital analyzer input settings can be configured with the input type, input impedance, frequency scaling, reference sample rate, and digital in to digital out delay as shown in Figure 3-17.

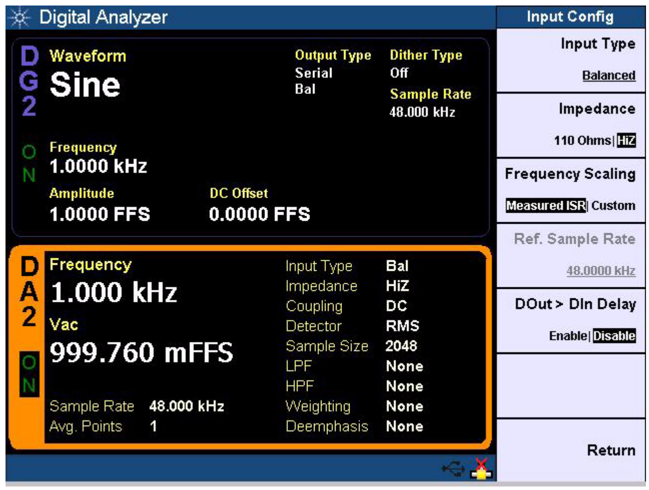


Figure 3-17 Digital analyzer Input Config

Input Type

The digital analyzer input connection can be set to Balanced, Unbalanced, DSI, or Optical mode.

- *Balanced* mode routes the digital signal from the XLR input connectors in the rear panel to the digital analyzer.
- *Unbalanced* mode routes the digital signal from the BNC input connector at the rear panel to the digital analyzer.
- *DSI* mode routes the digital signal from the 25-pin male D-SUB connector at the rear panel to the digital analyzer.
- *Optical* mode routes the digital signal from the TOSLINK input connector at the rear panel to the digital analyzer.

Impedance

The input impedance can be selected as follows.

- *Balanced mode*: 110 Ohm or HiZ
- *Unbalanced mode*: 75 Ohm or HiZ

Frequency Scaling

The frequency scaling of an embedded audio signal can be set to a measured input sampling rate (ISR) or a custom input sampling rate.

If measured ISR is selected, the frequency will track the incoming Word Clock and recover the audio at its original frequency. If custom frequency scaling is selected, the audio signal frequency will be translated according to the sample rate value set in the Ref. Sample Rate. For example, a 1 kHz audio signal with a 48 kHz sample rate will be translated to a 500 Hz audio signal when the reference sample rate is set to 24 kHz.

Ref. Sample Rate

The reference sample rate can be set according to your desired value. This setting is only applicable when the frequency scaling is set to Custom.

DOut > DIn Delay

The digital out to digital in delay can be enabled or disabled. Digital out to digital in delay is the time delay between the digital output signal and the digital input signal into the U8903A. The digital signals must be in the same digital interface. This feature is only applicable for balanced, unbalanced, and optical input type. An example of a digital out to digital in delay is shown in Figure 3-18.

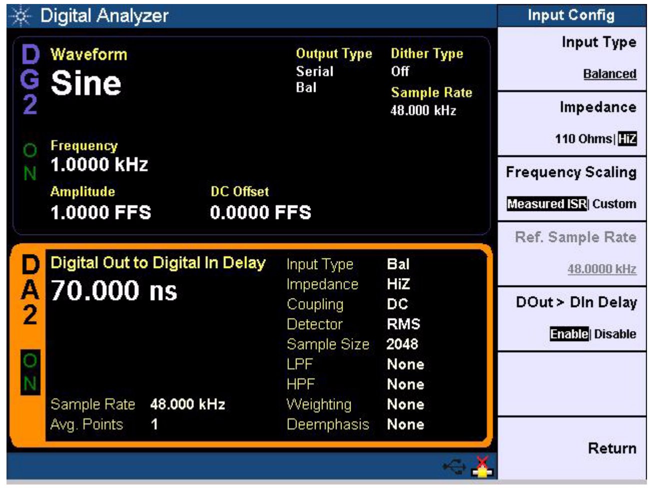


Figure 3-18 Digital out to digital in delay

AES3/SPDIF Input Configuration

The AES3/SPDIF input settings can be configured with the decoding format, audio resolution, status bits type, Save CSB in Hex, and Save CSB in XML as shown in Figure 3-19. This configuration is only applicable when the digital analyzer input connection is set to Balanced, Unbalanced, or Optical mode.

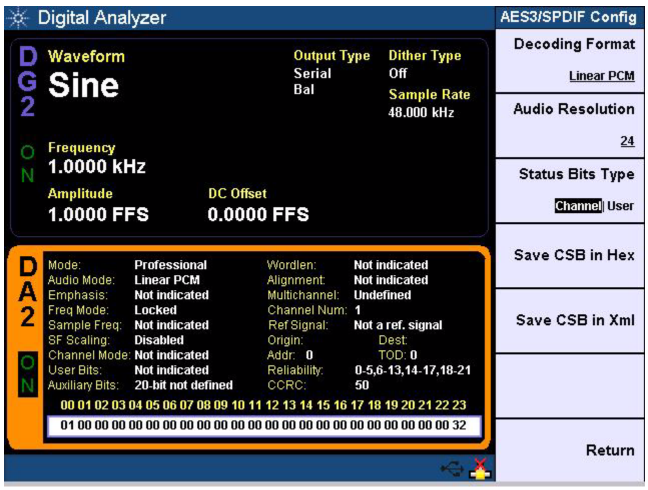


Figure 3-19 AES3/SPDIF Config

Decoding Format

The AES3/SPDIF decoding format can be set to Linear PCM, A-Law, or µ-Law.

Audio Resolution

The AES3/SPDIF audio resolution can be set according to your desired value in a range of 8 to 24.

Status Bits Type

The AES3/SPDIF status bits type can be set to Channel or User.

Save CSB in HEX or XML

The AES3/SPDIF channel status bits can be saved in HEX file or XML file.

DSI Input Configuration

The DSI input settings can be configured with the input voltage, bit clock edge sync type, data configuration, clock direction, and master clock configuration as shown in Figure 3-20. This configuration is only applicable when the digital analyzer input connection is set to DSI mode.

NOTE Refer to "Appendix F: Typical DSI Test Configurations" on page 293 for typical DSI test configurations.

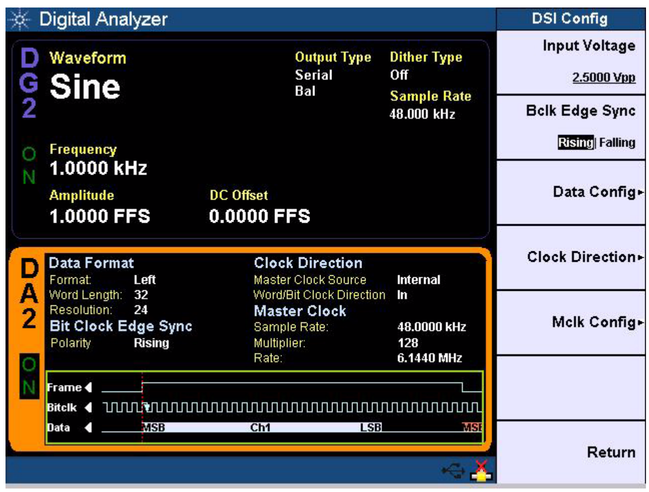


Figure 3-20 DSI Config

CAUTION Setting the input voltage level is critical. The DSI input may be permanently destroyed if the applied input voltage is 10% higher than the DSI output voltage.

Input Voltage

The DSI input voltage can be set to 1.2 Vpp, 1.5 Vpp, 1.8 Vpp, 2.5 Vpp, 3 Vpp, 3.3 Vpp, or custom.

Bclk Edge Sync

The bit clock edge sync type can be set to the Rising or Falling edge. This will set the leading edge of the data to be synchronized to the rising edge or falling edge of the bit clock.

Data Config

The data configuration can be configured with the Decoding Format, Audio Resolution, Word Length, and Data Format.

- *Decoding Format* can be set to Linear PCM, A-Law, or µ-Law.
- *Audio Resolution* can be set according to your desired value in a range of 8 to 24.
- *Word Length* can be set according to your desired value in a range of 8 to 32. The word length value must be greater than or equal to the audio resolution.
- *Data Format* can be set to Left Justified, Right Justified, I2S, or DSP.
- *MSB Padding* can be set according to your desired value.

Clock Direction

The clock direction can be configured with the Mclk Source and W/Bclk Direction.

- *Mclk Source* (master clock source) can be set to External or Internal.
- *W/Bclk Direction* (word/bit clock direction) can be set to In or Out.

Mclk Config

The master clock configuration can be configured with master clock out, sampling rate, multiplier, reference clock source, external clock type, external master clock word length, and external master clock multiplier.

- *Master Clock Out* can be enabled or disabled.
- *Sampling rate* can be set according to your desired value.
- *Multiplier* can be set according to your desired value.
- *Ref. Clock Source* can be set to Internal, AES Recovered Clk, or External. Refer to "Appendix E: Digital System Clock Distribution Block Diagram" on page 292 for more information on the system clock.
- *Ext. Clk Type* can be set to master clock (MCLK) or sync clock (FSYNC). This setting is only applicable when the Ref. Clock Source is set to External. Refer to "Appendix E: Digital System Clock Distribution Block Diagram" on page 292 for more information on the system clock.
- Ext. MClk WordLen can be set to your desired value in a range of 8 to 32. This setting is only applicable when the Ref. Clock Source is set to External.
- Ext. MClk Multiplier setting is only applicable when the Ref. Clock Source is set to External. The selection available in the external master clock multiplier depends on the external master clock word length.

4
Audio Generator Functions

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

Audio Generator

Press 

on the Mode panel to change the selected display screen to the generator mode or toggle between analog generator or digital generator.

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

Press the softkey to view the list for the generator waveform type. The available generator waveform type are listed as follows.

- Sine
- Variable phase
- Dual
- SMPTE IMD 1:1
- SMPTE IMD 4:1
- SMPTE IMD 10:1
- DFD IEC 60118
- DFD IEC 60268
- Square
- Rectangular noise
- Gaussian noise
- Triangular noise (digital generator only)
- Pink noise (digital generator only)
- DC (analog generator only)
- Multitone
- Arbitrary
- Sine burst (digital generator only)
- Stereo (digital generator only)
- Monotonicity (digital generator only)
- Constant value (digital generator only)
- Walking zero (digital generator only)
- Walking one (digital generator only)

The waveform selection list is shown in Figure 4-1 and Figure 4-2 for analog generator and digital generator respectively.

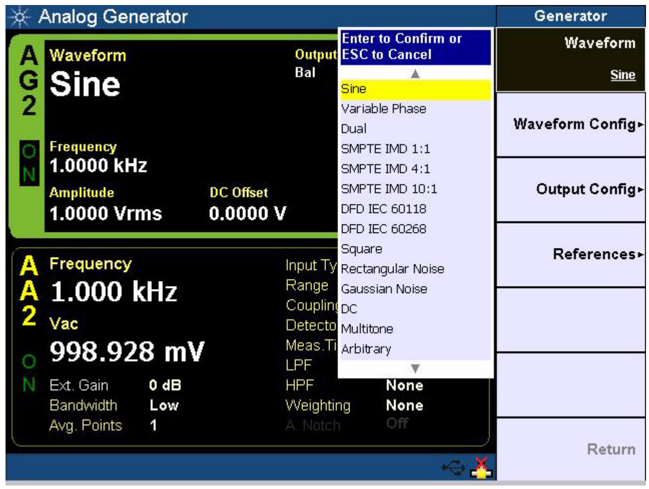


Figure 4-1 Analog generator waveform type selection

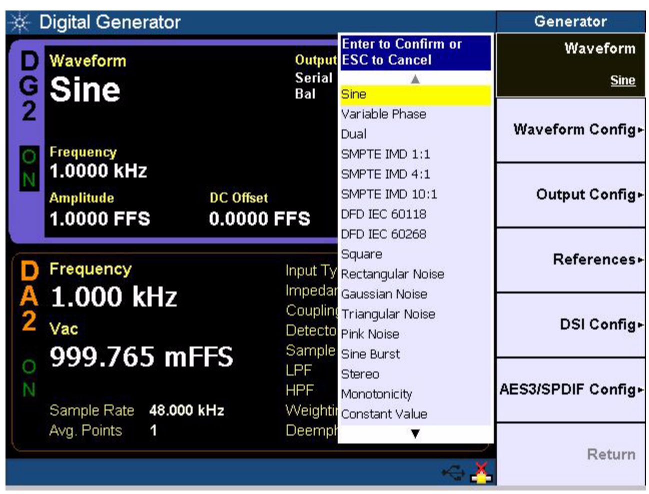


Figure 4-2 Digital generator waveform type selection

Sine waveform

Sine waveform mode is applicable for both analog and digital generator. The sine waveform is the most basic and commonly used waveform in audio analysis.

To select the sine waveform mode, press the **Waveform** softkey and select **Sine** from the drop-down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

The sine waveform can be configured with Frequency, Amplitude, and DC offset as shown in Figure 4-3 and Figure 4-4 for both the analog and digital generator respectively.

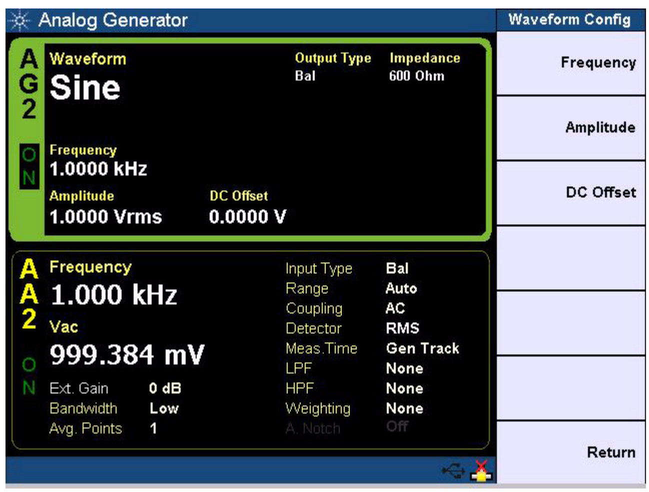


Figure 4-3 Analog generator sine waveform configuration

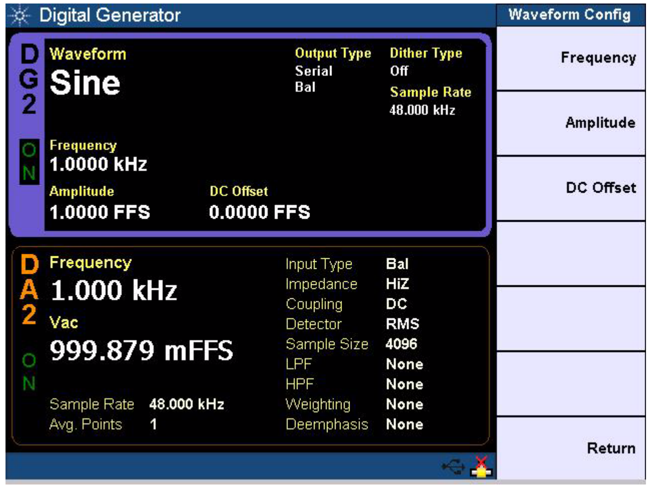


Figure 4-4 Digital generator sine waveform configuration

Frequency

Frequency is the reciprocal of the period of the signal.

Amplitude

Amplitude can be expressed as Vrms, Vpeak, Vpp, dBV, or dBu for analog generator, and FFS, dBFS, or %FS for digital generator. For a perfect sine waveform without any DC offset, Vpp is twice Vpeak, while Vrms is equivalent to Vpeak/$\sqrt{2}$.

DC offset

DC offset refers to the DC component of the waveform.

Variable phase waveform

Variable phase waveform mode is applicable for both analog and digital generator. The variable phase waveform 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 mode, press the **Waveform** softkey and select **Variable Phase** from the drop-down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

The variable phase waveform can be configured with Frequency, Amplitude, and Phase –> 1 as shown in Figure 4-5 and Figure 4-6 for both the analog and digital generator respectively. Phase –> 1 is only applicable when the generator is in channel 2.

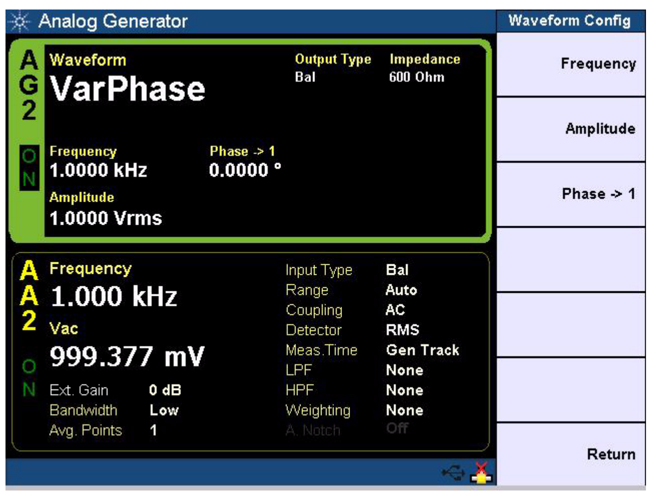


Figure 4-5 Analog generator variable phase waveform configuration

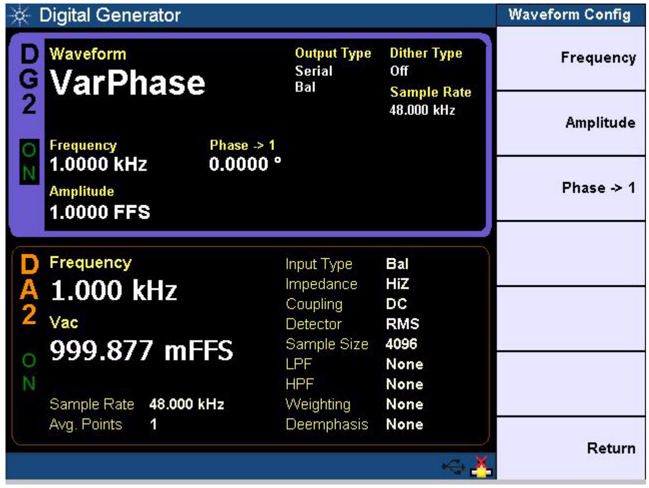


Figure 4-6 Digital generator variable phase waveform configuration

Phase

Phase –> 1 refers to the phase of the selected channel with reference to channel 1.

Dual waveform

Dual waveform mode is applicable for both analog and digital generator. The dual waveform mode 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 the dual waveform mode, press the **Waveform** softkey and select **Dual** from the drop-down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

The dual waveform can be configured with Frequency 1, Frequency 2, Amplitude, Ratio, and DC Offset as shown in Figure 4-7 and Figure 4-8 for both the analog and digital generator respectively.

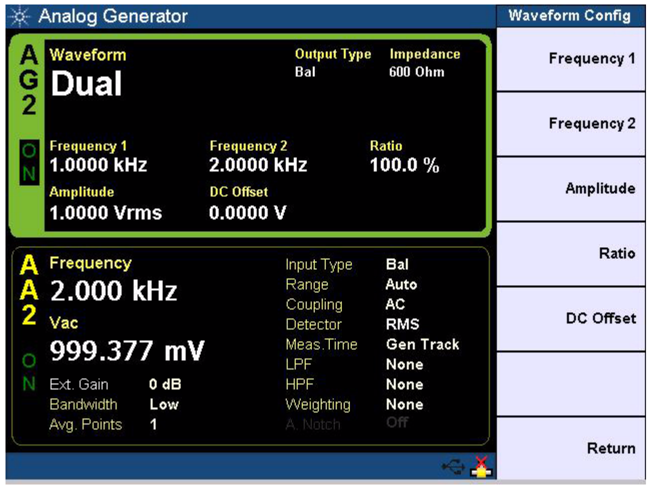


Figure 4-7 Analog generator dual waveform configuration

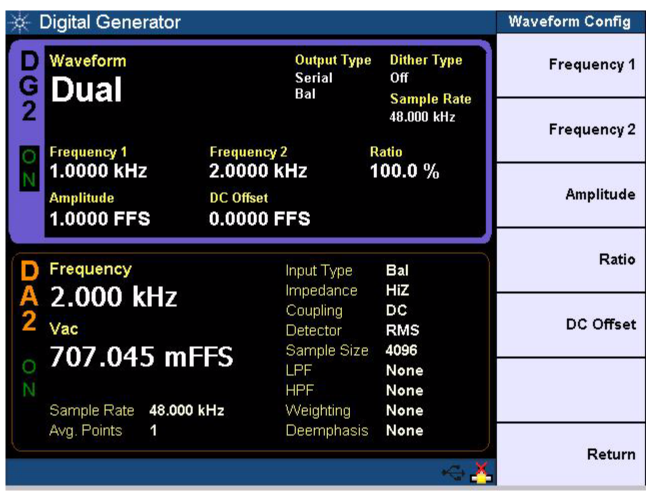


Figure 4-8 Digital generator dual waveform configuration

Frequency 1

Frequency 1 is the frequency for the first sine component.

Frequency 2

Frequency 2 is the frequency for the second sine component.

Amplitude

Amplitude refers to the amplitude of the composite signal.

Ratio

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

SMPTE IMD waveform

SMPTE IMD waveform mode is applicable for both analog and digital generator. There are three predefined SMPTE IMD dual sine waveforms comprising SMPTE IMD 1:1, SMPTE IMD 4:1, and SMPTE IMD 10:1. The SMPTE IMD waveforms conform to the SMPTE standard RP120-1983 for testing intermodulation distortion.

To select the SMPTE IMD waveform mode, press the **Waveform** softkey and select **SMPTE IMD 1:1**, **SMPTE IMD 4:1**, or **SMPTE IMD 10:1** from the drop-down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

The SMPTE IMD waveform can be configured with Upper Frequency, Lower Frequency, Amplitude, and DC Offset. The default upper frequency and the lower frequency is 7 kHz and 60 Hz respectively. They are differentiated by the amplitude ratio between the lower and upper frequencies. The SMPTE IMD 1:1 waveform configuration is shown in Figure 4-9 and Figure 4-10 for both the analog and digital generator respectively.

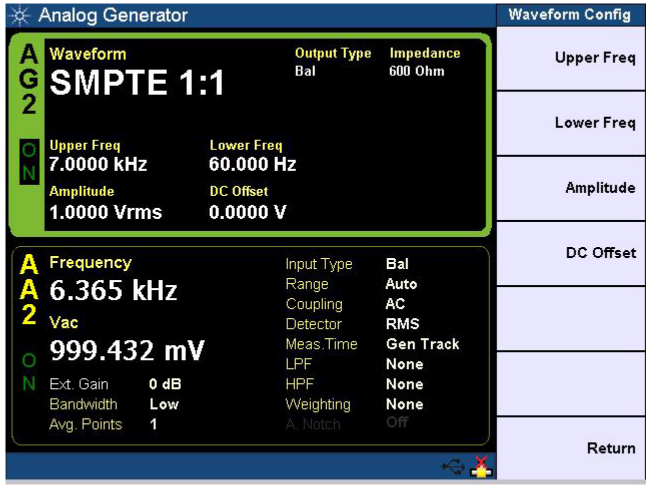


Figure 4-9 Analog generator SMPTE IMD 1:1 waveform configuration

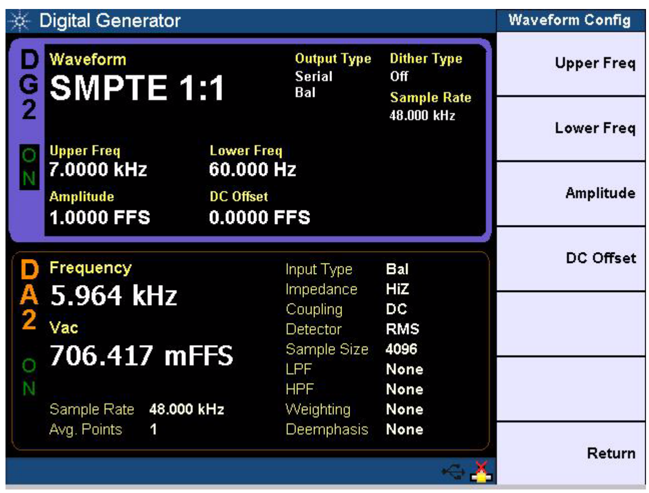


Figure 4-10 Digital generator SMPTE IMD 1:1 waveform configuration

DFD waveform

DFD waveform mode is applicable for both analog and digital generator. There are two predefined DFD dual tones waveforms comprising DFD IEC 60268 and DFD IEC 60118. The DFD waveforms are similar to SMPTE IMD, except that the two tones have equal amplitude and are spaced closer together.

To select the DFD waveform mode, press the **Waveform** softkey and select **DFD IEC 60268** or **DFD IEC 60118** from the drop-down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

The DFD IEC 60268 waveforms can be configured with Difference Frequency, Center Frequency, Amplitude, and DC Offset. The DFD IEC 60268 waveform configuration is shown in Figure 4-11 and Figure 4-12 for both the analog and digital generator respectively.

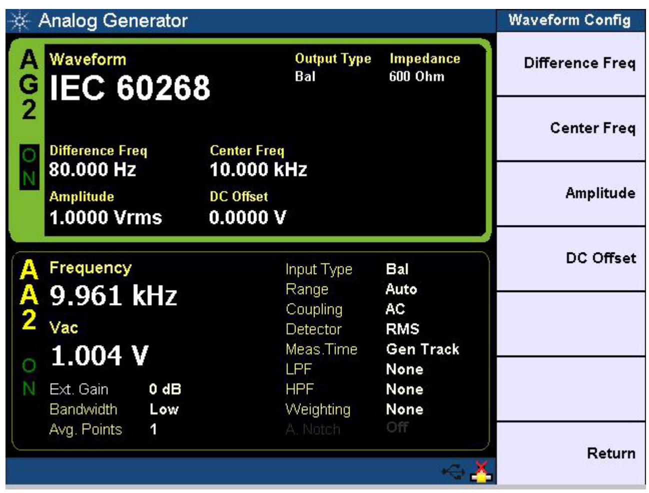


Figure 4-11 Analog generator DFD IEC 60268 waveform configuration

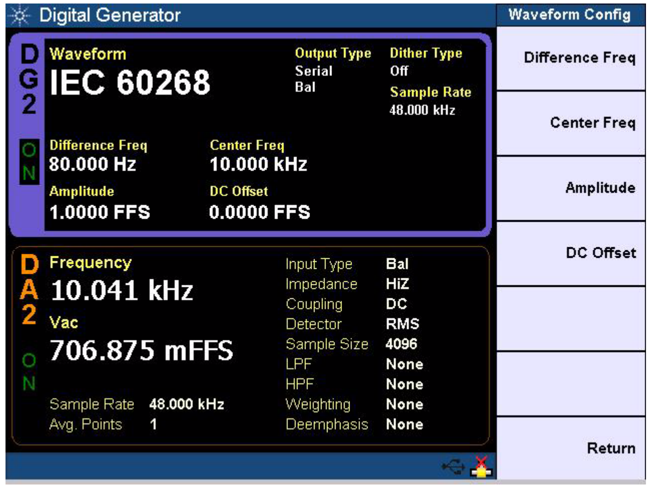


Figure 4-12 Digital generator DFD IEC 60268 waveform configuration

The DFD IEC 60118 waveform can be configured with Difference Frequency, Upper Frequency, Amplitude, and DC Offset as shown in Figure 4-13 and Figure 4-14 for both the analog and digital generator respectively.

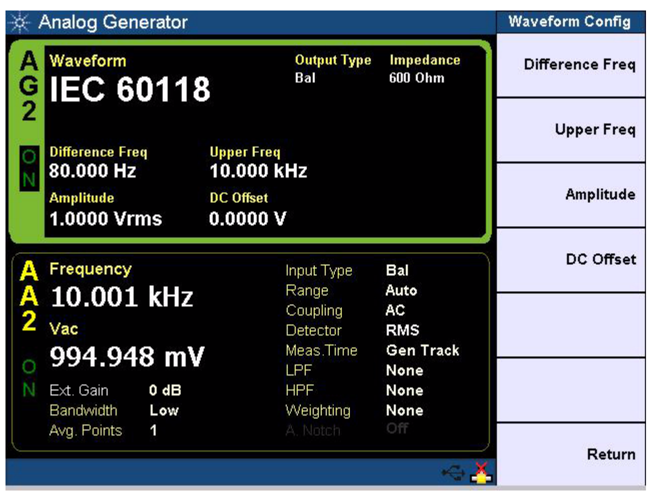


Figure 4-13 Analog generator DFD IEC 60118 waveform configuration

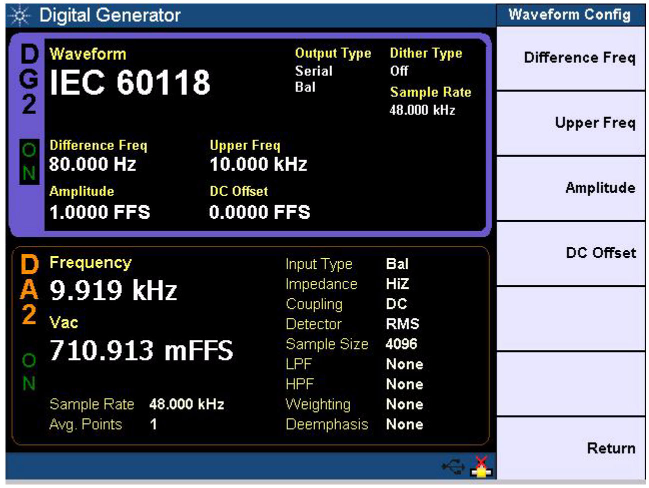


Figure 4-14 Digital generator DFD IEC 60118 waveform configuration

Square waveform

Square waveform mode is applicable for both analog and digital generator. A square waveform is used in applications such as power amplifier test.

To select the square waveform mode, press the **Waveform** softkey and select **Square** from the drop down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

For analog generator, the square waveform can be configured with Frequency and Amplitude as shown in Figure 4-15.

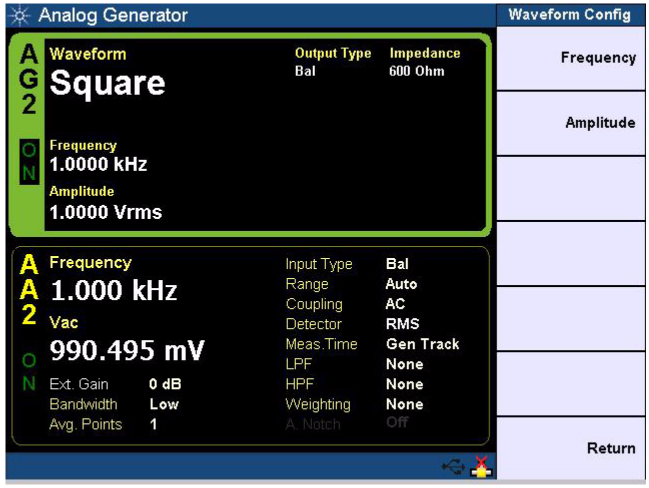


Figure 4-15 Analog generator square waveform configuration

For digital generator, the square waveform can be configured with Frequency, Amplitude, and DC Offset as shown in Figure 4-16.

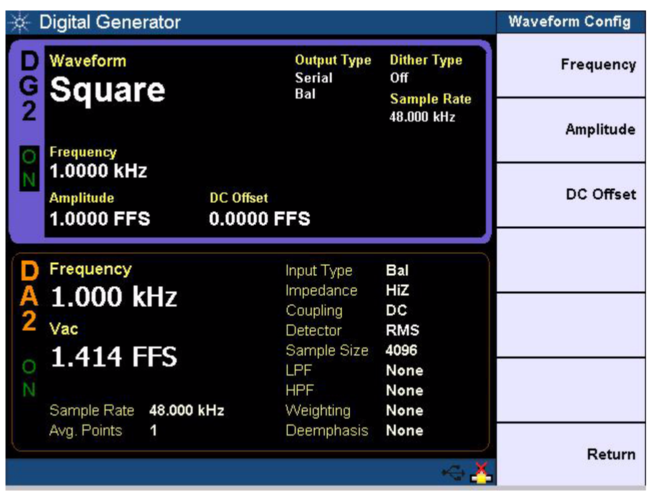


Figure 4-16 Digital generator square waveform configuration

Rectangular/Gaussian/Triangular/Pink noise

Rectangular and Gaussian noise mode is applicable for both analog and digital generator. Triangular and pink noise mode is only applicable for digital generator.

To select the rectangular, Gaussian, triangular, or pink waveform mode, press the **Waveform** softkey and select **Rectangular Noise**, **Gaussian Noise**, **Triangular Noise,** or **Pink Noise** from the drop down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

The rectangular, Gaussian, triangular, and pink noise can be configured with Amplitude and DC Offset. The Rectangular noise configuration is shown in Figure 4-17 and Figure 4-18 for both the analog and digital generator respectively.

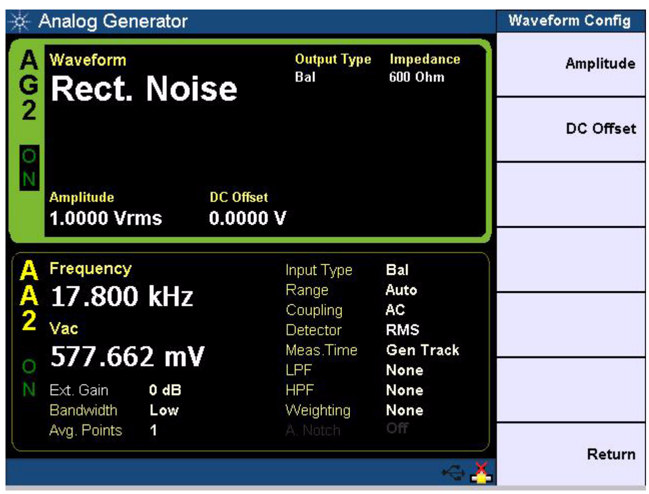


Figure 4-17 Analog generator rectangular noise configuration

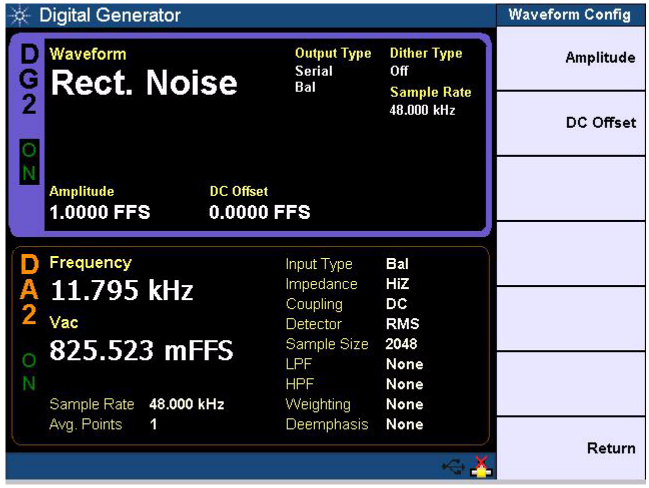


Figure 4-18 Digital generator rectangular noise configuration

DC signal

DC signal mode is applicable for analog audio generator only. A DC voltage signal is used when performing amplifier linearity measurements.

To select the DC signal mode for analog generator, press the **Waveform** softkey and select **DC** from the drop down list as shown in Figure 4-1.

The DC signal can be configured with Amplitude as shown in Figure 4-19 for the analog generator.

Figure 4-19 Analog generator DC signal configuration

Multitone waveform

Multitone waveform mode is applicable for both analog and digital audio generator.

To select the multitone waveform mode, press the **Waveform** softkey and select **Multitone** from the drop down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

For analog generator, the multitone waveform can be configured with Start Frequency, Stop Frequency, Amplitude, DC Offset, Tones Count, Frequency Spacing, Waveform Length, and Record Length. You can customize a new multitone waveform by pressing the **Create Custom** softkey, and save the waveform to an Arb file by pressing the **Save as Arb file** softkey as shown in Figure 4-20.

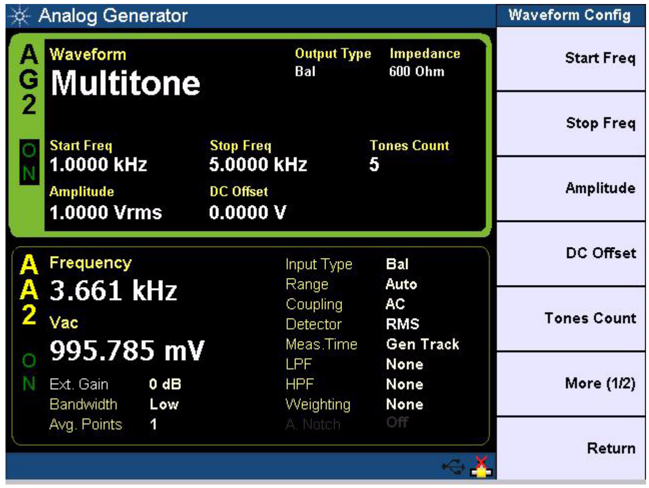


Figure 4-20 Analog generator multitone waveform configuration

Start frequency

Start frequency refers to the lowest frequency in the multitone waveform which is usually the frequency for the first tone.

Stop frequency

Stop frequency refers to the highest frequency in the multitone waveform which is usually the frequency for the last tone.

Tones count

Tones count refer to the number of signal frequency components.

Frequency spacing

Frequency spacing refers to the frequency spacing between the tones. You can select Linear or Log as the frequency spacing.

Waveform length

The waveform length determines the number of samples used to create one iteration of the multitone waveform. Longer waveform length provides higher frequency resolution but will take more time to generate and process. The waveform length can be set to 256, 512, 1024, 2048, 4096, 8192, 16384, or 32768. The waveform length must be the same or less than the record length.

Record length

The record length determines the number of samples created for one channel in the Arb file. The output file may contain multiple iterations of the multitone waveform. Record length is normally set to the same value as the waveform length. The record length can be set to 256, 512, 1024, 2048, 4096, 8192, 16384, or 32768.

Create custom

You can create your own custom waveform.

Save as Arb file

You can save the waveform to an Arb file.

For digital generator, the multitone waveform can be configured with Start Frequency, Stop Frequency, Amplitude, Tone Count, and Frequency Spacing. You can customize a new multitone waveform by pressing the **Create Custom** softkey as shown in Figure 4-21.

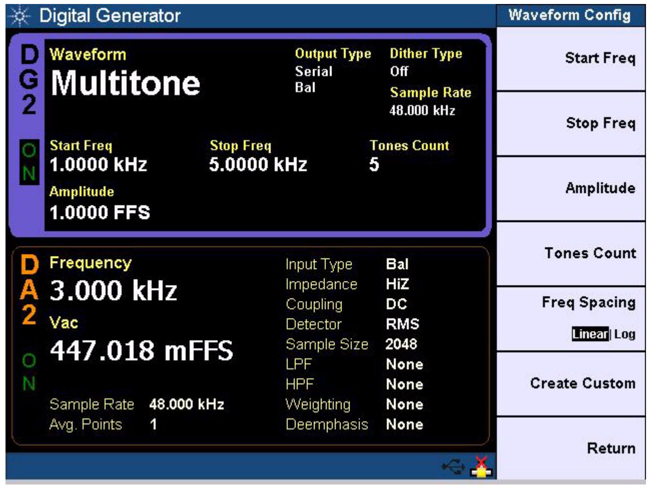


Figure 4-21 Digital generator multitone waveform configuration

Arbitrary waveform

Arbitrary waveform mode is applicable for both analog and digital audio generator. For analog generator you can load a 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 the arbitrary waveform mode, press the **Waveform** softkey and select **Arbitrary** from the drop down list as shown in Figure 4-1 and Figure 4-2 for both the analog and digital generator respectively.

For digital generator, you will need to load a Microsoft compatible wave file into the U8903A. Waveform information like audio sampling rate, sample size, bits per sample, and stereo or mono are stated in the .wav file header. The maximum file size for the wave file is 5 MB.

For more information on the arbitrary file format, refer to "Appendix B: Arbitrary File Format" on page 284.

For analog generator, the arbitrary waveform can be configured with Amplitude and DC Offset. You can recall or save the arbitrary file by pressing the **Recall File** or **Save File** softkey as shown in Figure 4-22.

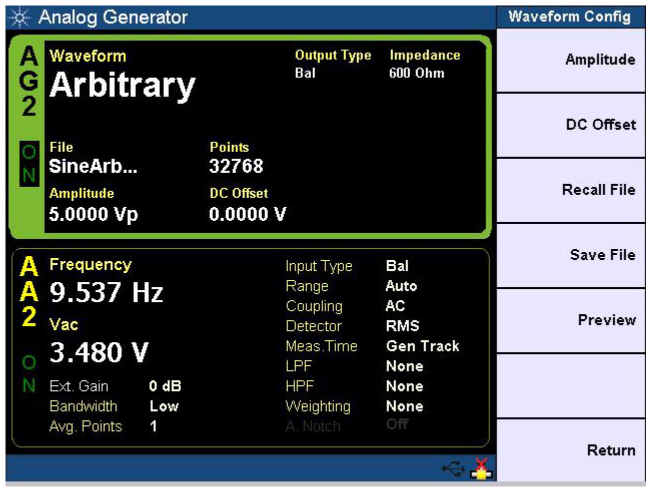


Figure 4-22 Analog generator arbitrary waveform configuration

You can also preview the arbitrary waveform in the time domain graph by pressing the **Preview** softkey.

For digital generator, the arbitrary waveform can be configured with Amplitude or DC Offset. You can recall the wave file by pressing the **Recall File** softkey, and view the wave file information by pressing the **Wave File Summary** softkey as shown in Figure 4-23.

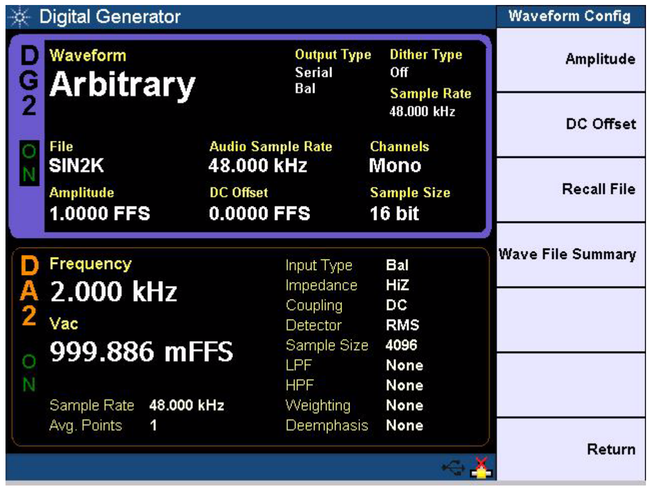


Figure 4-23 Digital generator arbitrary waveform configuration

Sine burst waveform

Sine burst waveform mode is applicable for digital audio generator only.

To select the sine burst waveform mode for digital generator, press the **Waveform** softkey and select **Sine Burst** from the drop down list as shown in Figure 4-2.

The sine burst waveform can be configured with Frequency, Amplitude, Burst On, Period, and Low Level as shown in Figure 4-24.

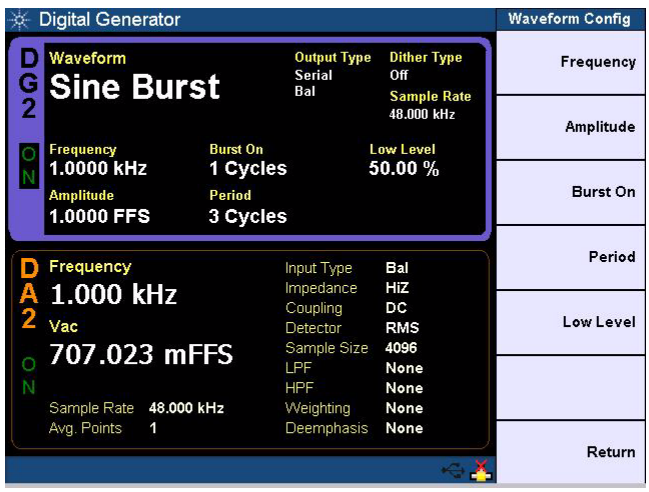


Figure 4-24 Digital generator sine burst waveform configuration

Stereo

Stereo waveform mode is applicable for digital audio generator only. For analog generator, stereo waveform can be generated with sinewave at two different channel.

To select the stereo waveform mode for digital generator, press the **Waveform** softkey and select **Stereo** from the drop down list as shown in Figure 4-2.

The stereo waveform can be configured with Frequency, Amplitude, and DC Offset as shown in Figure 4-25.

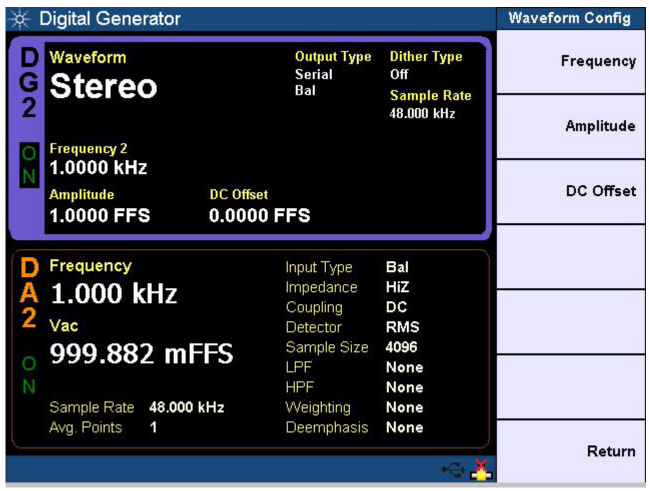


Figure 4-25 Digital generator stereo waveform configuration

Monotonicity

Monotonicity waveform mode is applicable for digital audio generator only. The Monotonicity waveform consists of a repeating square wave staircase signal. The duration for each half cycle of the square wave is determined by the Samples/Step parameter.

To select the monotonicity waveform mode for digital generator, press the **Waveform** softkey and select **Monotonicity** from the drop down list as shown in Figure 4-2.

The monotonicity waveform can be configured with Samples/Step as shown in Figure 4-26.

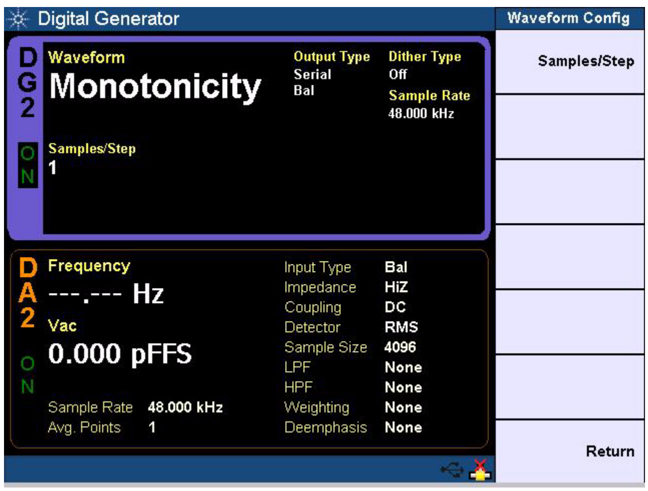


Figure 4-26 Digital generator monotonicity waveform configuration

Constant value

Constant value waveform mode is applicable for digital audio generator only. The constant value mode outputs a continuous stream of data samples at the same fixed value. This mode helps in the investigation of data-dependent errors in digital systems. In order to repeat a specific error, a fix value must be used.

To select the constant value waveform mode for digital generator, press the **Waveform** softkey and select **Constant Value** from the drop down list as shown in Figure 4-2.

The constant value waveform can be configured with Amplitude as shown in Figure 4-27.

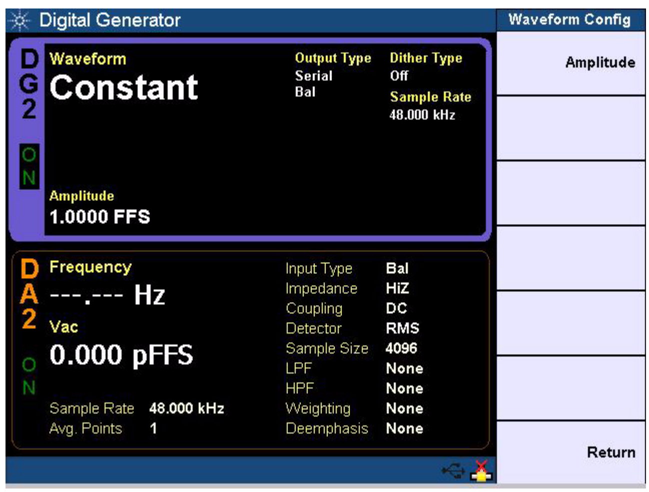


Figure 4-27 Digital generator constant value waveform configuration

Walking zero

Walking zero waveform mode is applicable for digital audio generator only. In walking zero waveform mode, one bit is set to 0 and the rest of the bits are set to 1. The bit 0 is continuously incremented from the least significant bit (LSB) to the most significant bit (MSB) and loops back to the LSB.

To select the walking zero waveform mode for digital generator, press the **Waveform** softkey and select **Walking Zero** from the drop down list as shown in Figure 4-2.

The walking zero waveform can be configured with Samples/Step as shown in Figure 4-28. The samples/step value will determine the speed the single bit 0 is incremented.

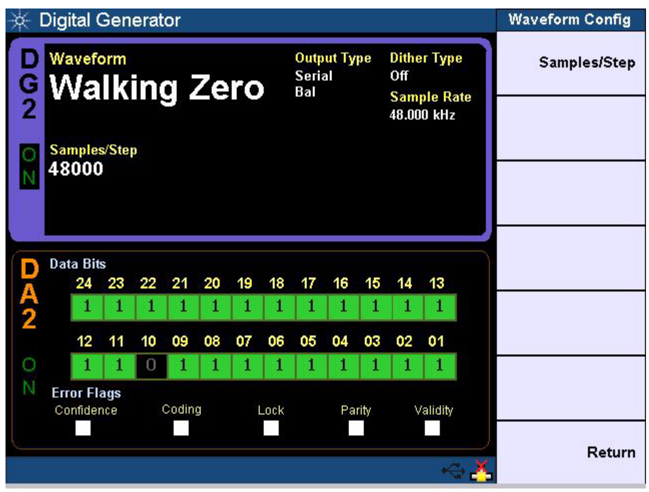


Figure 4-28 Digital generator walking zero waveform configuration

Walking one

Walking one waveform mode is applicable for digital audio generator only. In walking one waveform mode, one bit is set to 1 and the rest of the bits are set to 0. The bit 1 is continuously incremented from the least significant bit (LSB) to the most significant bit (MSB) and loops back to the LSB.

To select the walking one waveform mode for digital generator, press the **Waveform** softkey and select **Walking One** from the drop down list as shown in Figure 4-2.

The walking one waveform can be configured with Samples/Step as shown in Figure 4-29. The samples/step value will determine the speed the single bit 1 is incremented.

Figure 4-29 Digital generator walking one waveform configuration

5
Audio Analyzer Measurement Functions

This chapter describes the configuration of the U8903A for measuring the common audio analyzer measurement functions. Refer to "Appendix A: Units of the Measurement Function Returned Values" on page 280 for more information on the measurement unit.

Audio Analyzer

Press 

on the Mode panel to change the selected display screen to the analyzer mode or toggle between analog analyzer or digital analyzer.

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

Press **Function 1** or **Function 2** softkey to configure the measurement settings for each function.

The analog analyzer main menu is shown below.

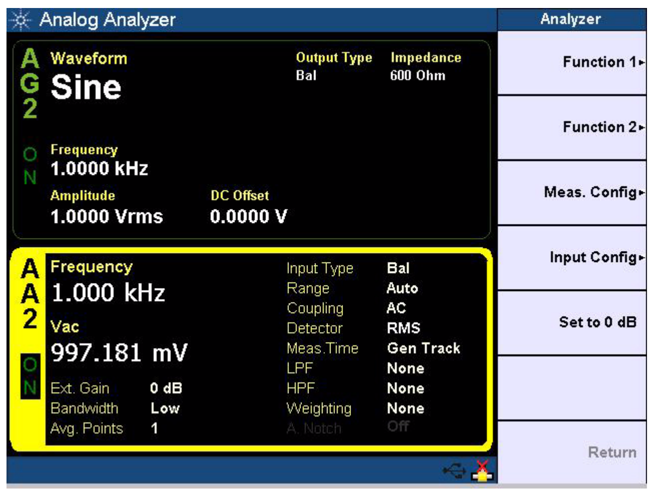


Figure 5-1 Analog Analyzer

For digital analyzer, you have the option to configure the analysis mode to be set to Signal Attributes, Audio bits, or Bit Error mode as shown in Figure 5-2.

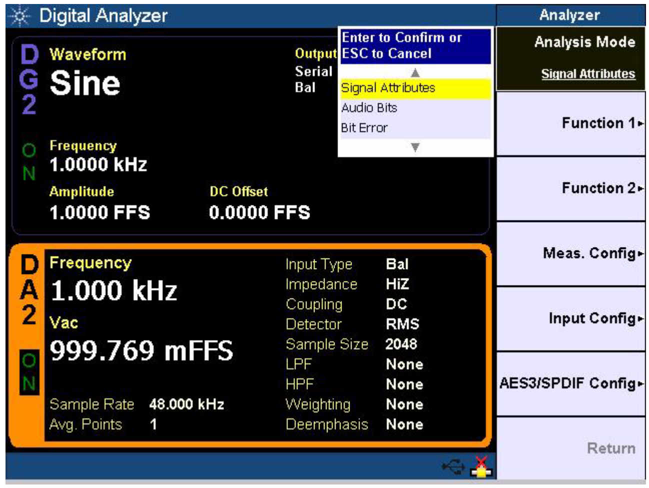


Figure 5-2 Digital analyzer analysis mode selection

In Function 1, you can configure the measurement function, measurement unit, measurement reference type, and reference value. The available measurement function type in Function 1 are listed as follows.

- Frequency
- AC voltage
- DC voltage

The Function 1 measurement function selection list is shown in Figure 5-3 and Figure 5-4 for analog analyzer and digital analyzer respectively.

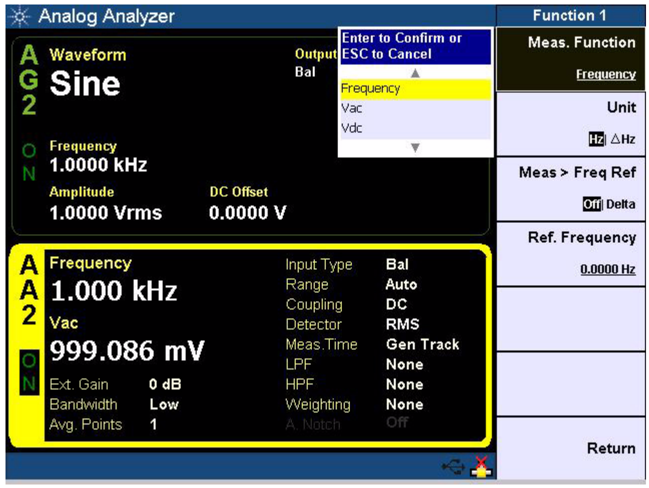


Figure 5-3 Analog analyzer Function 1 measurement function selection

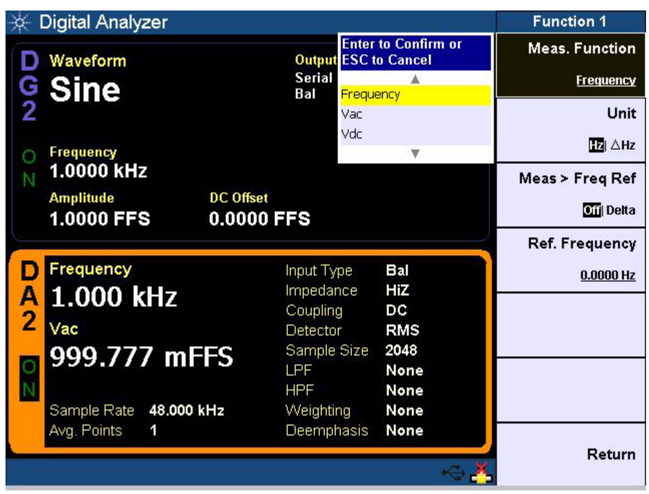


Figure 5-4 Digital analyzer Function 1 measurement function selection

In Function 2, you can configure the measurement function, measurement unit, measurement reference type, and reference value. The available measurement function type in Function 2 are listed as follows.

- Frequency
- AC voltage
- DC voltage
- THD+N ratio
- THD+N level
- SNR
- Noise level
- SMPTE IMD
- DFD 60268 2nd
- DFD 60268 3rd
- DFD 60118 2nd
- DFD 60118 3rd
- SINAD
- Phase
- Crosstalk (channel driven)
- Crosstalk (channel measured) (analog analyzer only)
- Group delay (digital analyzer only)
- Max peak value (digital analyzer only)
- Min peak value (digital analyzer only)
- THD ratio (digital analyzer only)
- THD level (digital analyzer only)

The Function 2 measurement function selection list is shown in Figure 5-5 and Figure 5-6 for analog analyzer and digital analyzer respectively.

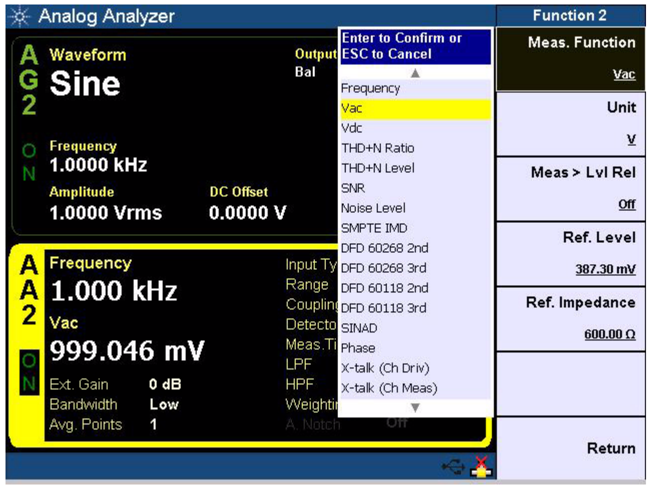


Figure 5-5 Analog analyzer Function 2 measurement function selection

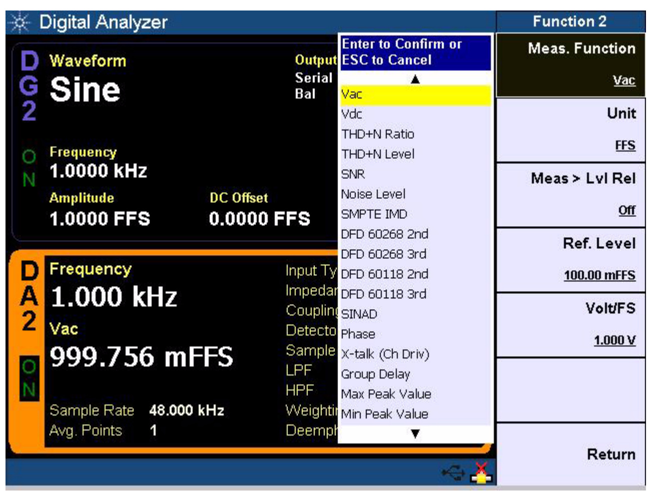


Figure 5-6 Digital analyzer Function 2 measurement function selection

Frequency

Frequency measurement function mode is applicable for both analog and digital analyzer.

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.

To select the frequency measurement function mode, press the **Meas. Function** softkey and select **Frequency** from the drop down list as shown in Figure 5-3, Figure 5-4, Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The frequency measurement function can be configured with the measurement unit, frequency reference type, and reference frequency for both Function 1 and Function 2.

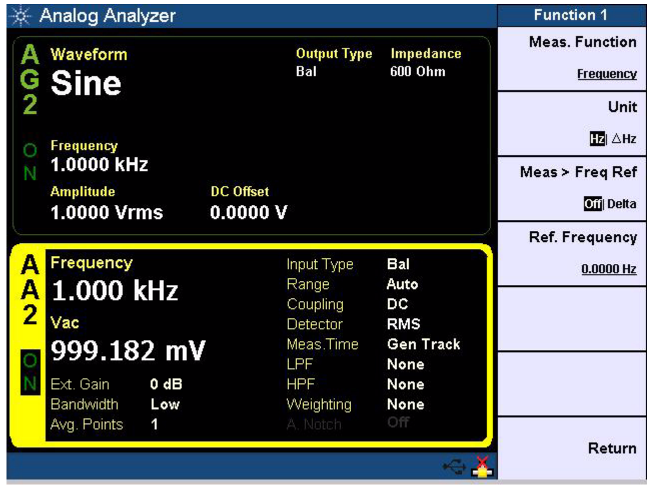


Figure 5-7 Analog analyzer Function 1 frequency measurement

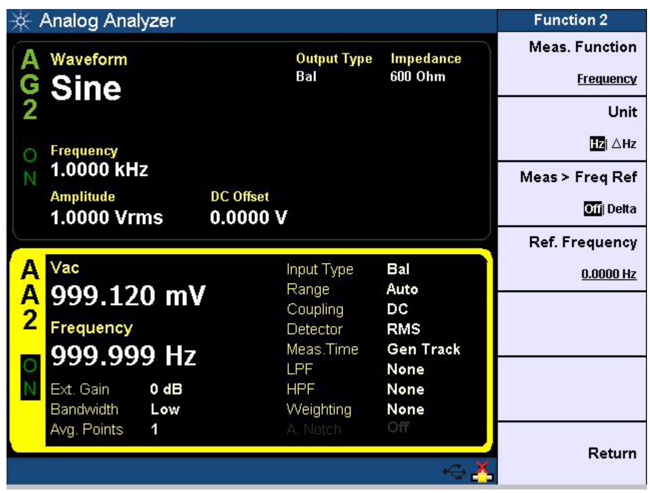


Figure 5-8 Analog analyzer Function 2 frequency measurement

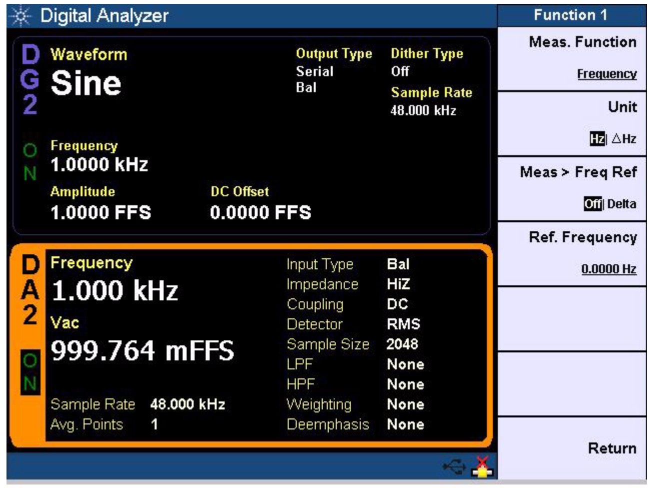


Figure 5-9 Digital analyzer Function 1 frequency measurement

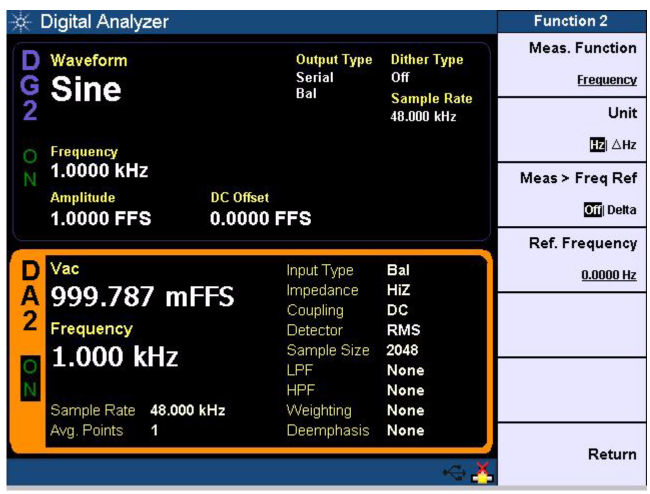


Figure 5-10 Digital analyzer Function 2 frequency measurement

AC voltage level (AC)

AC voltage level measurement function mode is applicable for both analog and digital analyzer.

AC voltage level measurement is the most common measurement function of an AC signal. The U8903A provides three types of AC level detection consisting of RMS, Quasi Peak, and Peak-to-Peak. Refer to "Analog Analyzer Measurement Configuration" on page 120 and "Digital Analyzer Measurement Configuration" on page 149 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.

To select the AC voltage level measurement function mode, press the **Meas. Function** softkey and select **Vac** from the drop down list as shown in Figure 5-3, Figure 5-4, Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The AC voltage level measurement function can be configured with the measurement unit, relative level type, and reference level for both Function 1 and Function 2. This measurement can be further configured with the reference impedance for analog analyzer, and Volt/FS for digital analyzer.

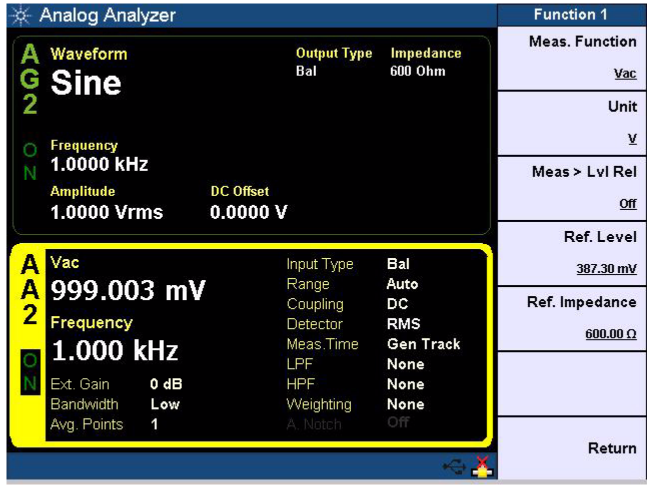


Figure 5-11 Analog analyzer Function 1 AC voltage level measurement

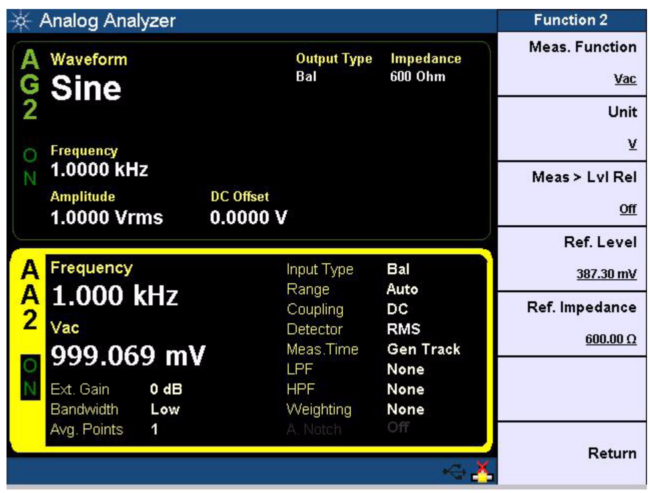


Figure 5-12 Analog analyzer Function 2 AC voltage level measurement

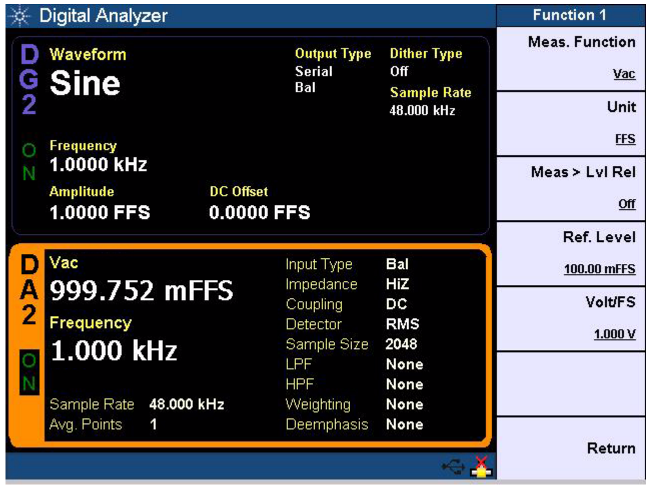


Figure 5-13 Digital analyzer Function 1 AC voltage level measurement

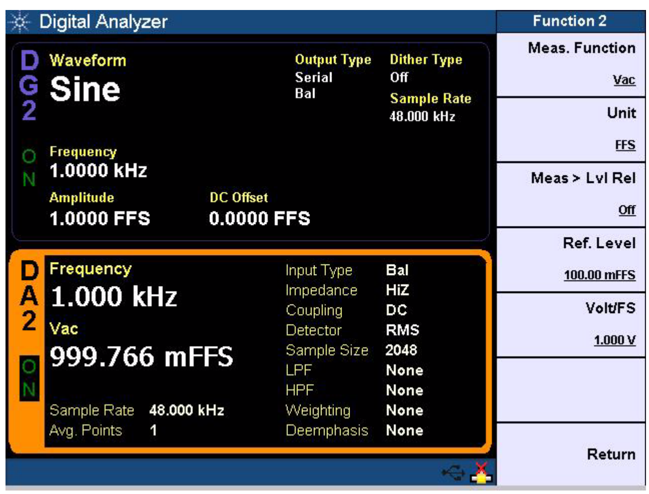


Figure 5-14 Digital analyzer Function 2 AC voltage level measurement

DC voltage level (DC)

DC voltage level measurement function mode is applicable for both analog and digital analyzer.

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).

The input coupling must be set to DC for DC voltage level measurement. Refer to "Analog Analyzer Input Configuration" on page 124 and "Digital Analyzer Measurement Configuration" on page 149 for more information.

To select the DC voltage level measurement function mode, press the **Meas. Function** softkey and select **Vdc** from the drop down list as shown in Figure 5-3, Figure 5-4, Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The DC voltage level measurement function can be configured with the measurement unit, relative level type, and reference level for both Function 1 and Function 2.

NOTE

The reference impedance and Volt/FS settings are not applicable for DC voltage level measurement in analog analyzer and digital analyzer respectively. The values set in the reference impedance and Volt/FS do not affect the DC voltage level measurement results.

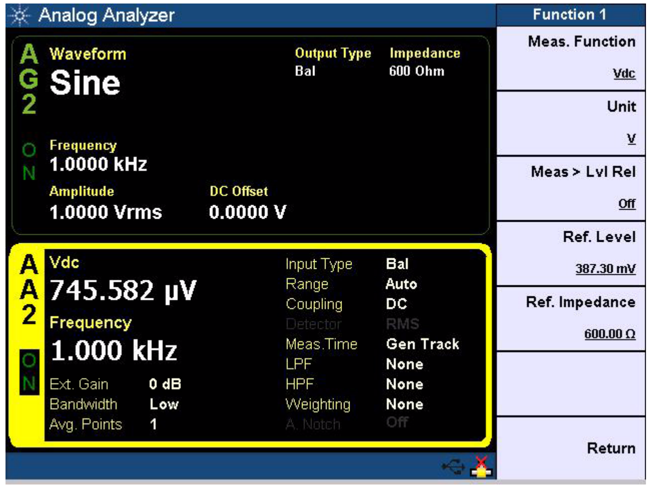


Figure 5-15 Analog analyzer Function 1 DC voltage level measurement

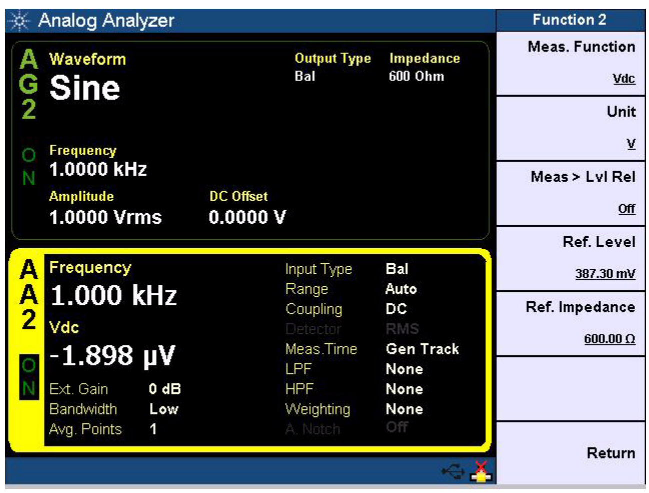


Figure 5-16 Analog analyzer Function 2 DC voltage level measurement

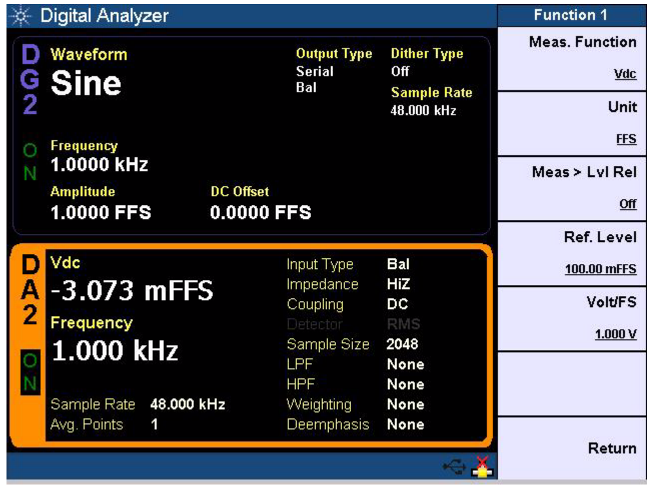


Figure 5-17 Digital analyzer Function 1 DC voltage level measurement

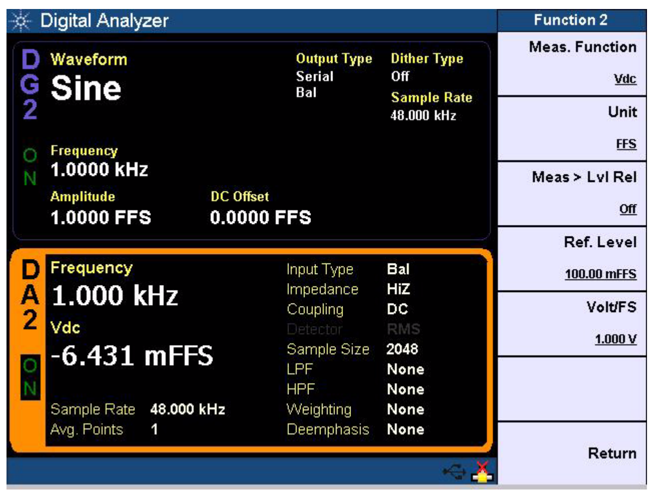


Figure 5-18 Digital analyzer Function 2 DC voltage level measurement

THD+N Ratio and THD+N Level

THD+N Ratio and THD+N Level measurement function mode is applicable for both analog and digital analyzer Function 2 measurement.

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.

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.

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

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

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

To select the THD+N Ratio or THD+N Level measurement function mode, press the **Meas. Function** softkey and select **THD+N Ratio** or **THD+N Level** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The THD+N Ratio measurement function can be configured with the measurement unit, reference ratio type, and reference ratio. The THD+N Level measurement function can be configured with the measurement unit, relative level type, and reference level.

NOTE The reference impedance and Volt/FS settings are not applicable for THD+N Ratio measurement in analog analyzer and digital analyzer respectively. The values set in the reference impedance and Volt/FS do not affect the THD+N Ratio measurement results.

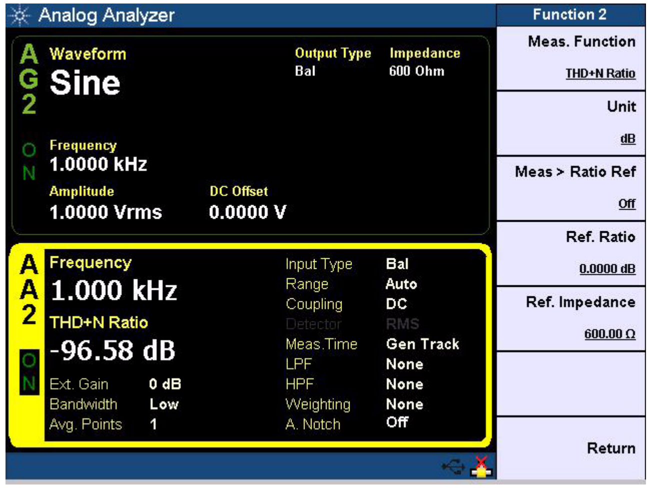


Figure 5-19 Analog analyzer Function 2 THD+N Ratio measurement

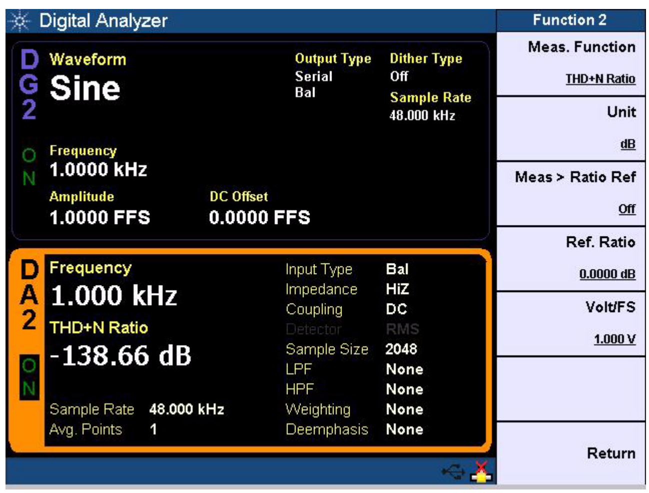


Figure 5-20 Digital analyzer Function 2 THD+N Ratio measurement

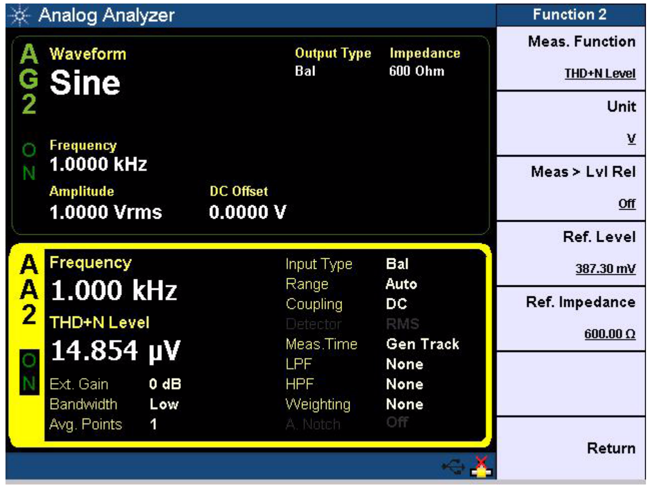


Figure 5-21 Analog analyzer Function 2 THD+N Level measurement

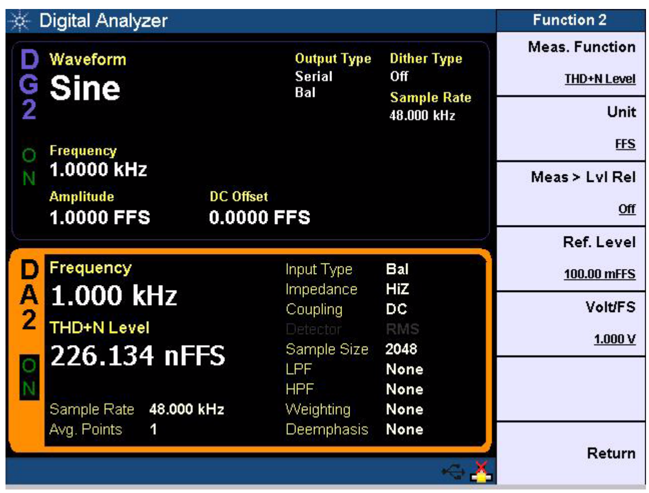


Figure 5-22 Digital analyzer Function 2 THD+N Level measurement

SNR and Noise Level

SNR and Noise Level measurement function mode is applicable for both analog and digital analyzer Function 2 measurement.

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. For example, channel 1 of the analog generator will be used for measurement on the analog 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 “Analog Analyzer Input Configuration” on page 124 and “Digital Analyzer Measurement Configuration” on page 149 for more information.

The SNR measurement is accomplished by alternatively switching the U8903A generator output, which connects to the DUT input, with a proper termination when the generator is disabled. The DUT output is connected to the U8903A input. The analyzer will measure the DUT output signal amplitude when the generator is routed to the input. The noise level is measured when the generator output which connects to the DUT input is disabled. 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.

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

To select the SNR or Noise Level measurement function mode, press the **Meas. Function** softkey and select **SNR** or **Noise Level** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The SNR measurement function can be configured with the measurement unit, reference ratio type, and reference ratio. The Noise Level measurement function can be configured with the measurement unit, relative level type, and reference level. Both the SNR and Noise Level measurements can be further configured with the reference impedance for analog analyzer and Volt/FS for digital analyzer.

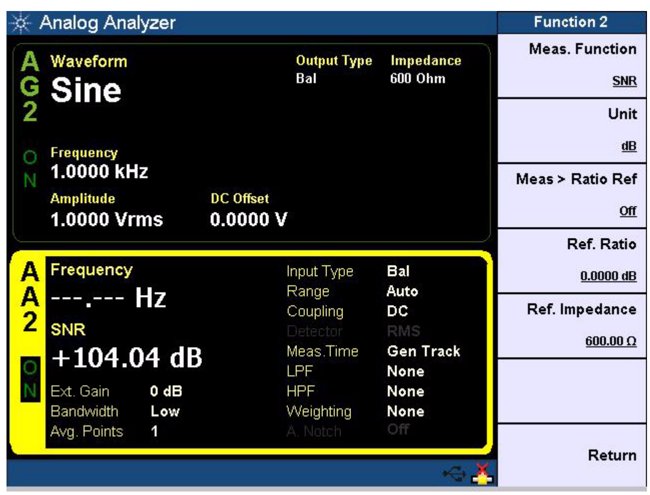


Figure 5-23 Analog analyzer Function 2 SNR measurement

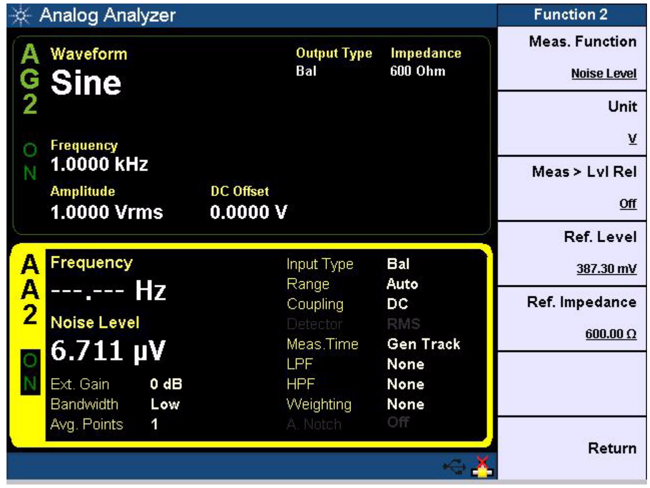


Figure 5-24 Analog analyzer Function 2 noise level measurement

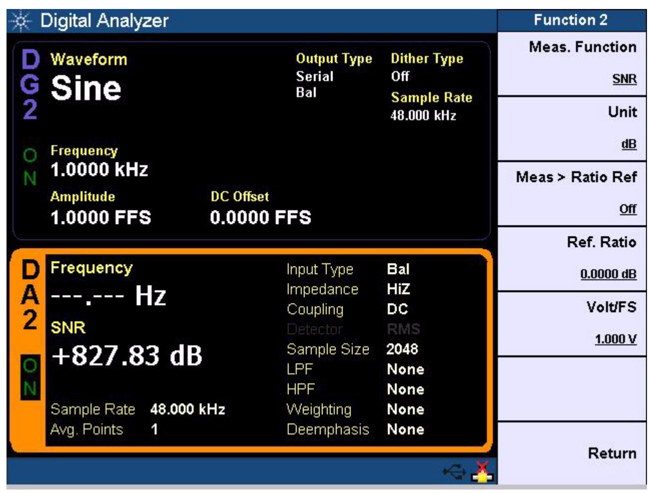


Figure 5-25 Digital analyzer Function 2 SNR measurement

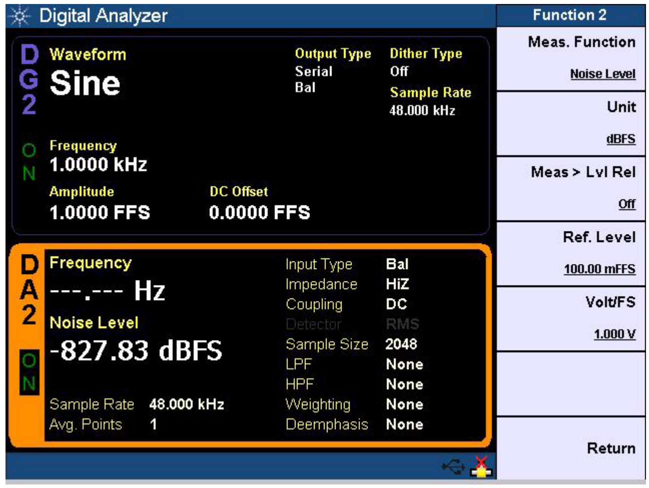


Figure 5-26 Digital analyzer Function 2 noise level measurement

SMPTE intermodulation distortion (SMPTE IMD)

SMPTE IMD measurement function mode is applicable for both analog and digital analyzer Function 2 measurement.

The SMPTE IMD function provides a measure of the second and third order intermodulation distortion introduced by the DUT 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 DUT. 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 “Dual waveform” on page 167 for more information on generating dual tones for this measurement.

To select the SMPTE IMD measurement function mode, press the **Meas. Function** softkey and select **SMPTE IMD** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The SMPTE IMD measurement function can be configured with the measurement unit, reference ratio type, and reference ratio.

NOTE

The reference impedance and Volt/FS settings are not applicable for SMPTE IMD measurement in analog analyzer and digital analyzer respectively. The values set in the reference impedance and Volt/FS do not affect the SMPTE IMD measurement results.

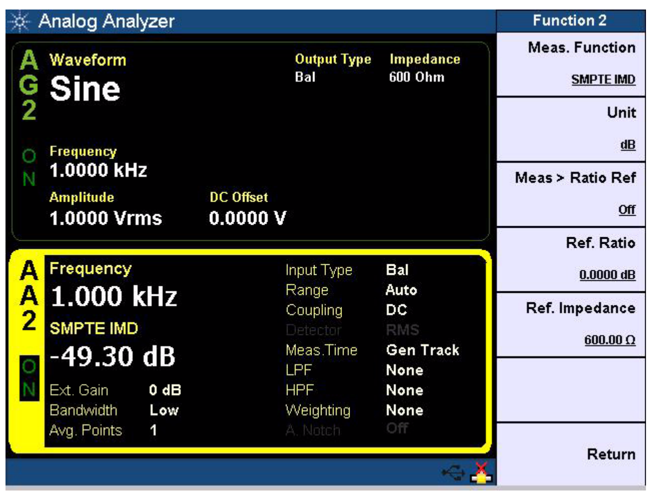


Figure 5-27 Analog analyzer Function 2 SMPTE IMD measurement

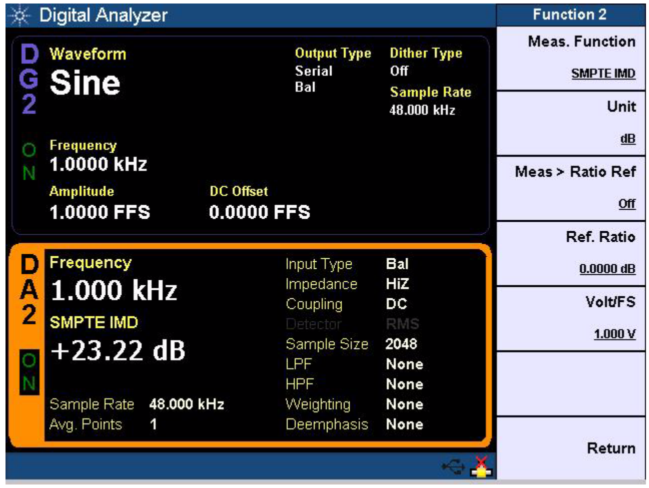


Figure 5-28 Digital analyzer Function 2 SMPTE IMD measurement

Difference frequency distortion (DFD)

DFD measurement function mode is applicable for both analog and digital audio analyzer Function 2 measurement.

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.

To select the DFD measurement function mode, press the **Meas. Function** softkey and select **DFD 60268 2nd**, **DFD 60268 3rd**, **DFD 60118 2nd**, or **DFD 60118 3rd** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The DFD measurement function can be configured with the measurement unit, reference ratio type, and reference ratio.

NOTE

The reference impedance and Volt/FS settings are not applicable for DFD measurement in analog analyzer and digital analyzer respectively. The values set in the reference impedance and Volt/FS do not affect the DFD measurement results.

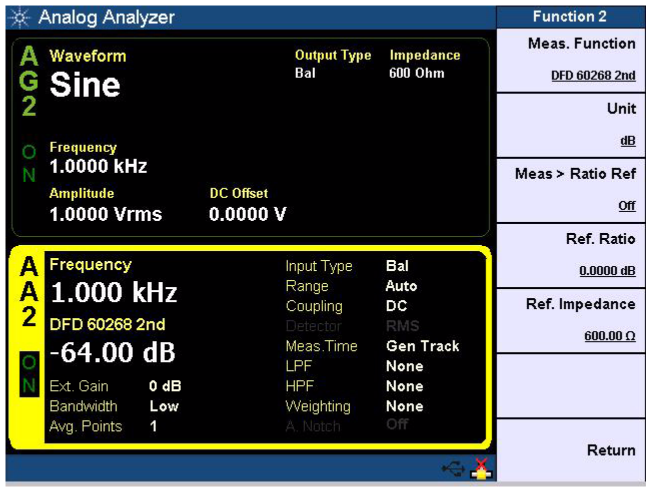


Figure 5-29 Analog analyzer Function 2 DFD 60268 2nd measurement

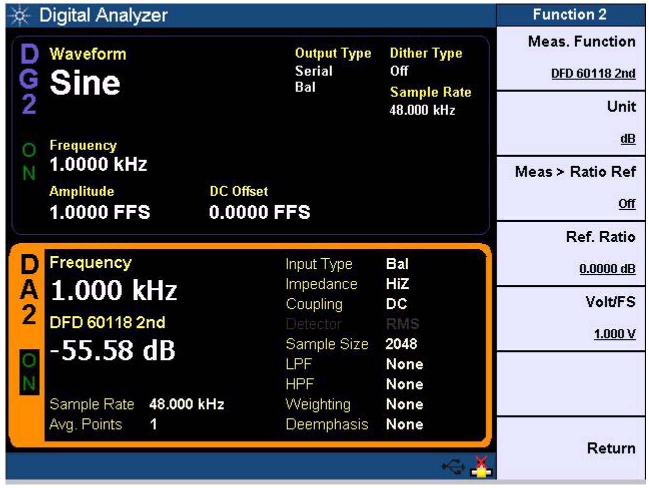


Figure 5-30 Digital analyzer Function 2 DFD 60118 2nd measurement

SINAD

SINAD measurement function mode is applicable for both analog and digital audio analyzer Function 2 measurement.

Signal, noise, and distortion ratio (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.

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

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

To select the SINAD measurement function mode, press the **Meas. Function** softkey and select **SINAD** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The SINAD measurement function can be configured with the measurement unit, reference ratio type, and reference ratio.

NOTE

The reference impedance and Volt/FS settings are not applicable for SINAD measurement in analog analyzer and digital analyzer respectively. The values set in the reference impedance and Volt/FS do not affect the SINAD measurement results.

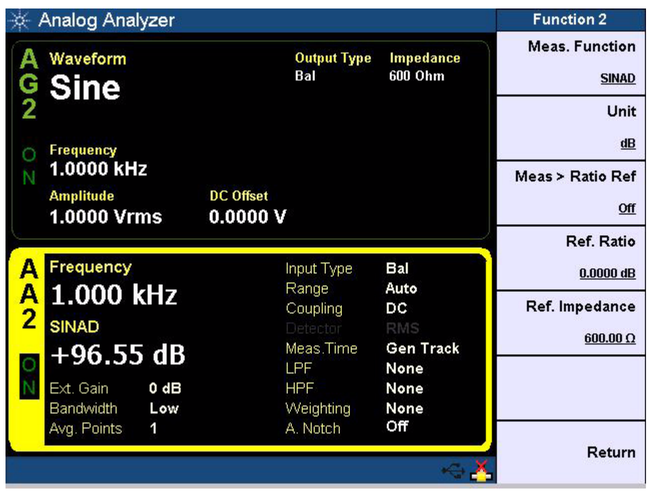


Figure 5-31 Analog analyzer Function 2 SINAD measurement

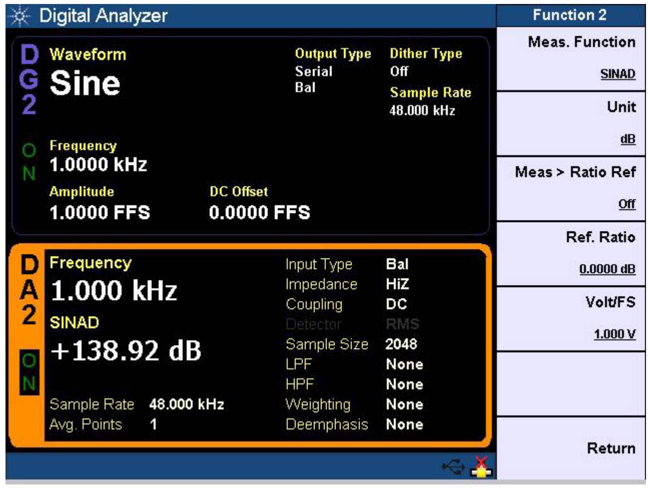


Figure 5-32 Digital analyzer Function 2 SINAD measurement

Phase

Phase measurement function mode is applicable for both analog and digital audio analyzer Function 2 measurement.

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 analog generator channel. The output of one channel is connected to the analog analyzer channel 1 while the other is connected to channel 2. Set the analog 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 DUT to the phase of the signal at its input. For example, a simple way to make this measurement is to use the analog analyzer channel 1 to measure the input, and the analog analyzer channel 2 to measure the output.

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

To select the Phase measurement function mode, press the **Meas. Function** softkey and select **Phase** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The Phase measurement function can be configured with the measurement unit.

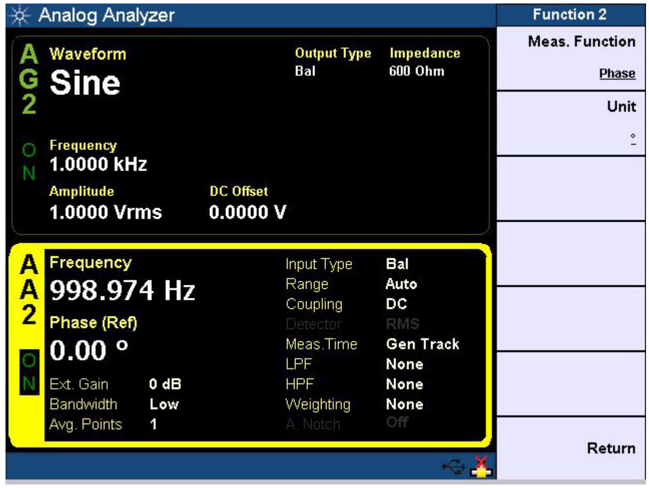


Figure 5-33 Analog analyzer Function 2 phase measurement

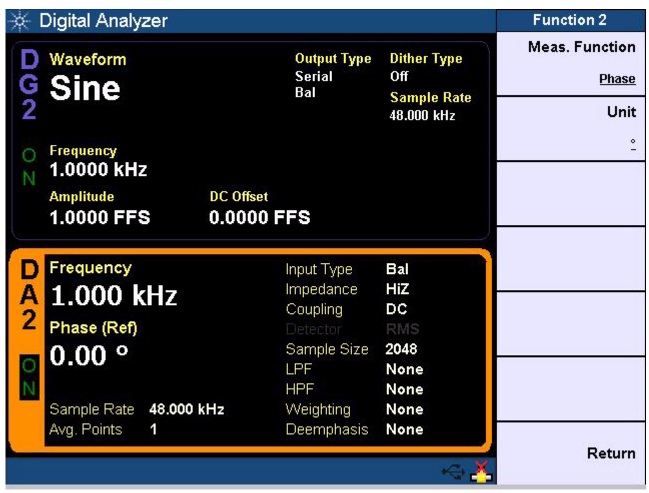


Figure 5-34 Digital analyzer Function 2 phase measurement

Crosstalk (channel-driven and channel-measured)

Crosstalk (channel-driven) measurement function mode is applicable for both analog and digital audio analyzer Function 2 measurement. Crosstalk (channel-measured) measurement function mode is only applicable for analog analyzer Function 2 measurement.

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.

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

In the Crosstalk (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.

In the Crosstalk (channel-measured) mode, 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.

To select the Crosstalk (channel-driven) or Crosstalk (channel-measured) measurement function mode, press the **Meas. Function** softkey and select **X-talk (Ch Driv)** or **X-talk (Ch Meas)** from the drop down list as shown in Figure 5-5, and Figure 5-6 for both the analog and digital analyzer respectively.

The Crosstalk (channel-driven) or Crosstalk (channel-measured) measurement function can be configured with the measurement unit, reference ratio type, and reference ratio.

NOTE

The reference impedance and Volt/FS settings are not applicable for Crosstalk measurement in analog analyzer and digital analyzer respectively. The values set in the reference impedance and Volt/FS do not affect the Crosstalk measurement results.

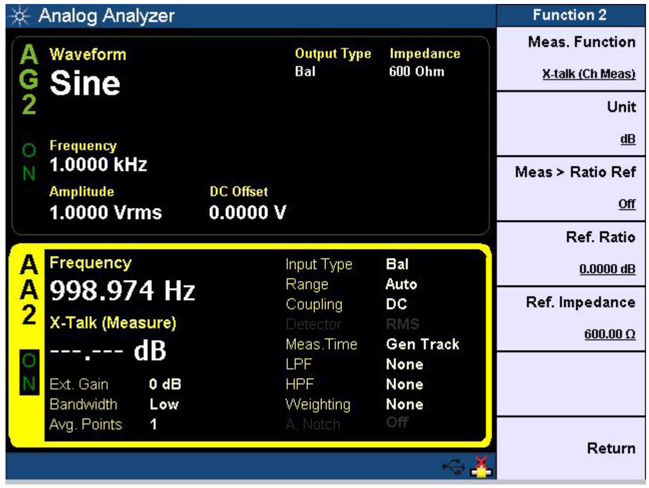


Figure 5-35 Analog analyzer Function 2 crosstalk (channel measured) measurement

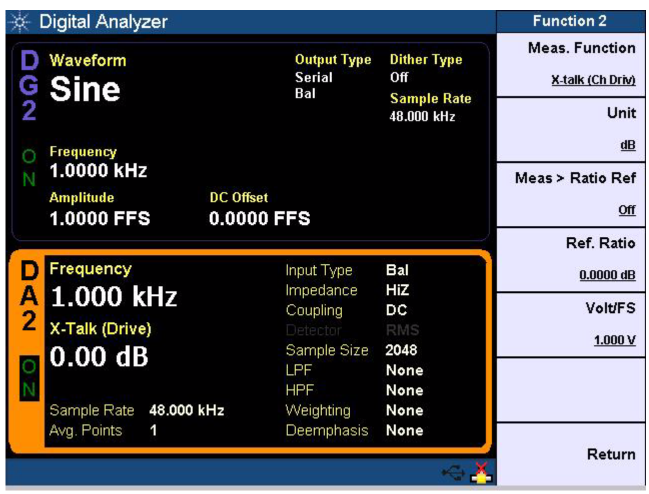


Figure 5-36 Digital analyzer Function 2 crosstalk (channel-driven) measurement

Group Delay

Group Delay measurement function mode is only applicable for digital analyzer Function 2 measurement.

Group delay is a measurement of the transit time of a signal through a DUT versus frequency. All signals are delayed when transiting through a device such as a filter, an amplifier, or a processor. This small delay is usually not a problem, but if the delay is different for different frequencies, and the signal is built up by more than one frequency, then the shape of the signal is distorted. The difference in delay for different frequencies is group delay.

Group delay is a useful measure of phase distortion. The variations in a group delay cause signal distortion, just as deviations from linear phase cause distortion. Group delay is calculated by differentiating the insertion phase response of the DUT versus frequency. Group delay is only meaningful when performing sweep.

To select the Group Delay measurement function mode, press the **Meas. Function** softkey and select **Group Delay** from the drop down list as shown in Figure 5-6.

The Group Delay measurement function can be configured with the measurement unit.

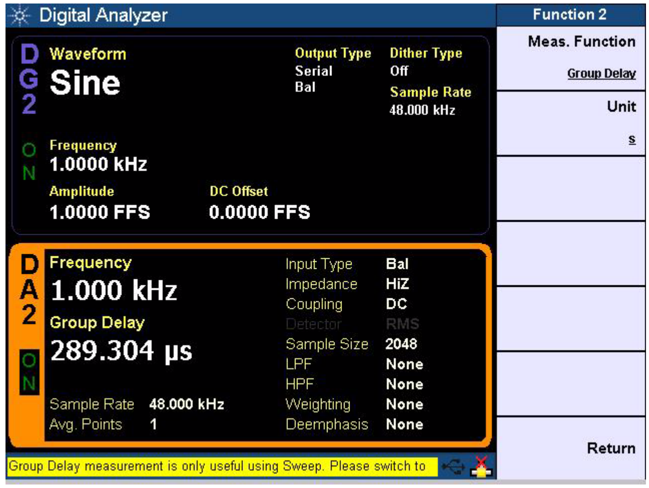


Figure 5-37 Digital analyzer Function 2 group delay measurement

Maximum and minimum peak value

Maximum and minimum peak value measurement function mode is only applicable for digital analyzer Function 2 measurement.

Maximum peak value is a measurement of the greatest positive voltage level.

Minimum peak value is a measurement of the greatest negative voltage level.

To select the maximum or minimum peak value measurement function mode, press the **Meas. Function** softkey and select **Max Peak Value** or **Min Peak Value** from the drop down list as shown in Figure 5-6.

The maximum and minimum peak measurement function can be configured with the measurement unit, relative level type, reference level, and Volt/FS.

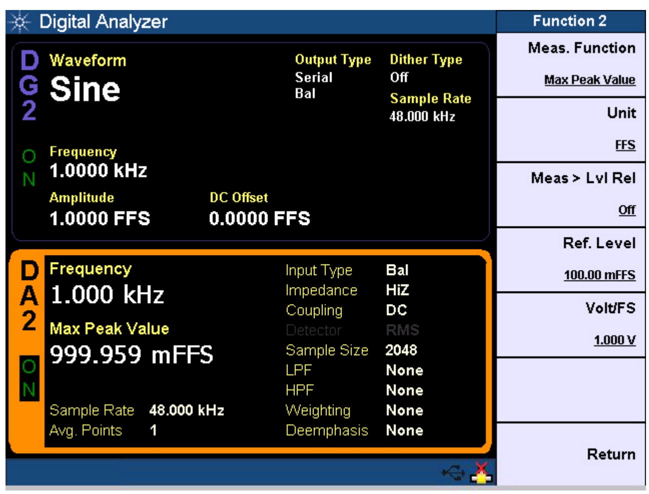


Figure 5-38 Digital analyzer Function 2 maximum peak value measurement

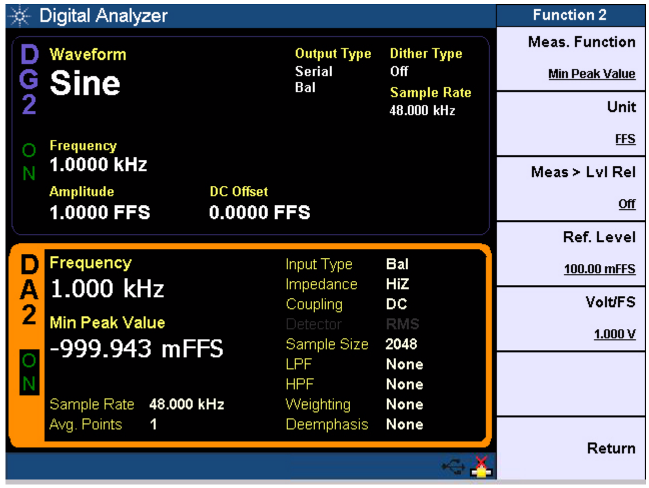


Figure 5-39 Digital analyzer Function 2 minimum peak value measurement

THD Ratio and THD Level

THD Ratio and THD Level measurement function mode is only applicable for digital analyzer Function 2 measurement.

Total Harmonic Distortion (THD) measurement is the level of distortion present in an audio signal. A low THD value indicates a low distortion. Theoretically, when a pure sine wave signal is passed through an audio system, there will not be any distortion present in the signal. However, nonlinearities in an audio system will generate distortion.

THD Level is defined as the square root of the sum of the squares of all the signal harmonic components, and is expressed in FFS. The THD Level can be computed as follows.

$$\text{THD Level} = \text{rms value of distortion}$$

THD Ratio is defined as the ratio of the THD Level relative to the fundamental signal amplitude, and is expressed in dB (default) or as a percentage. The THD Ratio can be computed as follows.

$$\text{THD Ratio} = 20\ \text{Log}\left(\frac{\text{rms value of distortion}}{\text{rms value of signal, and distortion}}\right)$$

To select the THD Ratio or THD Level measurement function mode, press the **Meas. Function** softkey and select **THD Ratio** or **THD Level** from the drop down list as shown in Figure 5-6.

The THD Ratio measurement function can be configured with the measurement unit, reference ratio type, and reference ratio. The THD Level measurement function can be configured with the measurement unit, relative level type, and reference level.

NOTE The Volt/FS setting is not applicable for THD Ratio measurement in digital analyzer. The value set in the Volt/FS does not affect the THD Ratio measurement results.

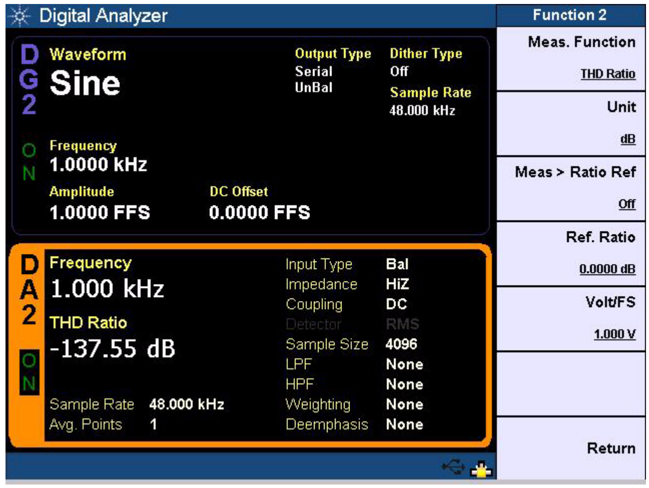


Figure 5-40 Digital analyzer Function 2 THD Ratio measurement

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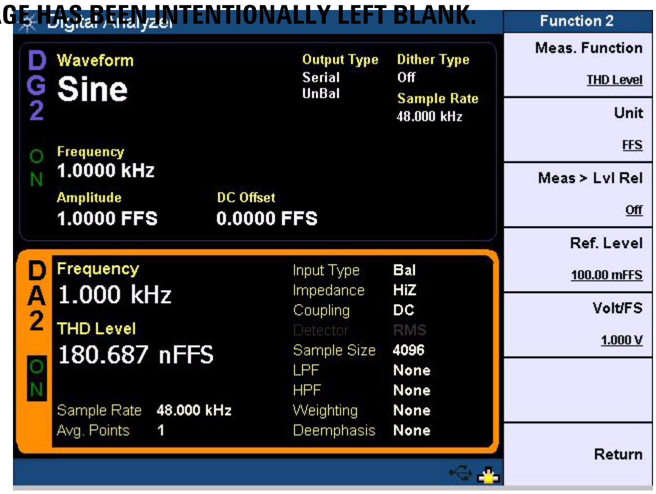


Figure 5-41 Digital analyzer Function 2 THD Level measurement

6
Frequency and Time Domain Analysis

This chapter describes 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 frequency domain or time domain.

Press Frequency Domain or Time Domain to change the display screen to the frequency domain or time domain mode respectively.

The available graph settings are listed as follows.

- Monitor settings
- Axis settings
- Harmonics view
- Hold
- Reference trace
- Running mode
- Input settings
- Save points to a file

Once you have configured the settings, press Run/Stop on the U8903A front panel to generate the graph.

The U8903A allows you to run the graph in a continuous or single mode. Press the **Running Mode** softkey to toggle between **Continuous** and **Single**. In single running mode, you can perform a single acquisition of the graph data when Run/Stop is pressed.

You also have the option to save the graph points to a file. Press the **Save Pts to File** softkey to launch the File Manager menu to save the graph points. Refer to "Save" on page 102 for more information.

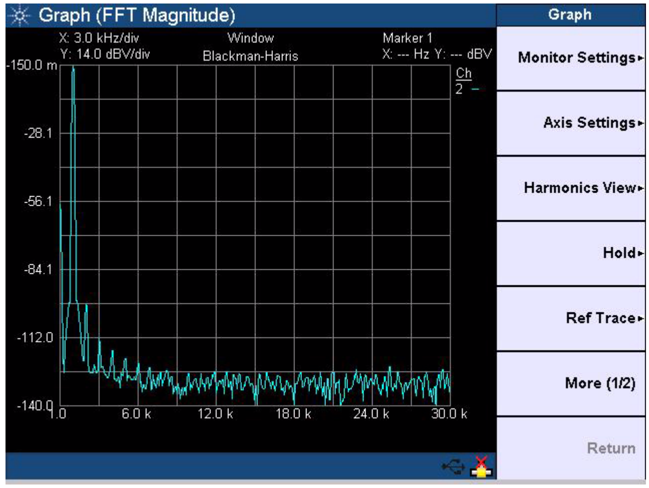


Figure 6-1 Frequency domain mode

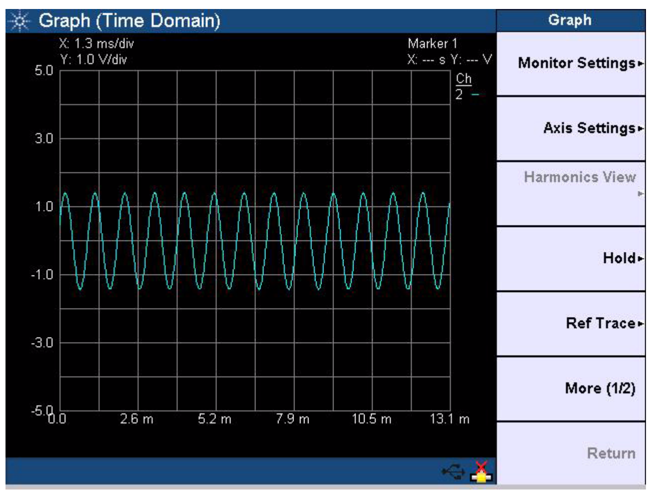


Figure 6-2 Time domain mode

Monitor settings

The graph monitor settings can be configured with the audio interface, channels, acquisition points, synchronous averaging, analysis mode, and window type as shown in Figure 6-3.

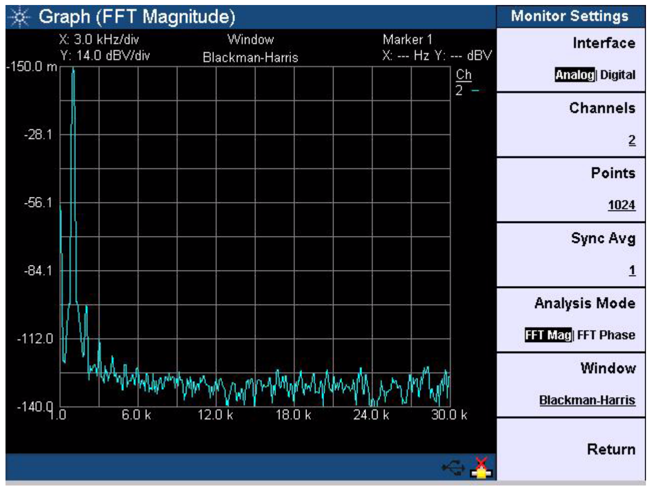


Figure 6-3 Monitor settings

Interface

The interface can be set to analog or digital interface for the graph analysis.

Channels

Press the **Channel** softkey to view the channel list. Select the desired channel and press **Enter**. The list of channels available are active channels.

Points

The points can be set to 256, 512, 1024, 2048, 4096, 8192, 16384, or 32768.

Synchronous averaging

The synchronous averaging can be set according to your desired value. 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. Synchronous averaging is only available if the trigger source is set to 1 or 2.

Analysis mode

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

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 function type are listed as follows.

- Rectangular
- Hann
- Blackman-Harris
- Rife-Vincent 1
- Rife-Vincent 3
- Hamming
- Flattop

These window function are only available in the frequency domain and will not affect the time domain analysis.

Small amplitude errors may be observed with reference to the FFT size, sample rate, and window function type. This behavior is caused by scalloping loss. Window functions with low amplitude errors will experience a worse sidelobe rejection. It is recommended that the correct type of window function is used for the given application. The worst case scalloping loss for the different window functions are shown in Table 6-1.

Table 6-1 Worst case scalloping loss

Window type	Worst case scalloping loss (dB)
Rectangular	3.92
Hann	1.42
Blackman-Harris	0.83
Rife-Vincent 1 and 3	0.48
Hamming	1.78
Flattop	0.02

- **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**

  The Hann 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 analysis.

- **Blackman-Harris**

  The Blackman-Harris 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**

  The Rife-Vincent 1 and 3 windows have smooth, monotonically-falling responses with no sidelobes.

- **Hamming**

  The Hamming 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.

- **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.

Axis settings

The axis settings can be configured with the grid settings, color, autoscale, autoscale to the X-axis, and autoscale to the Y-axis as shown in Figure 6-4.

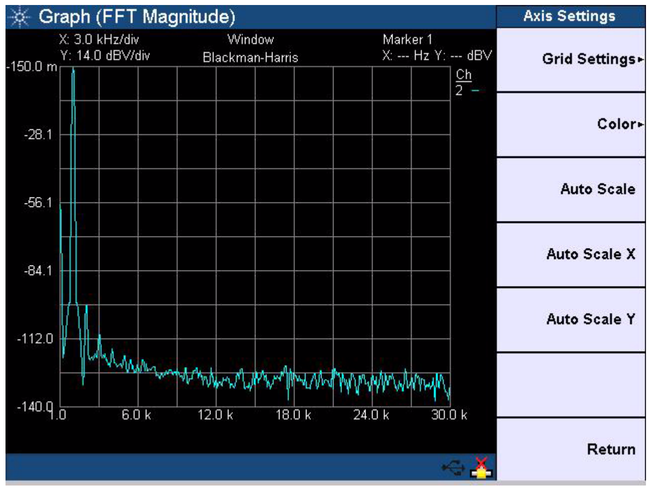


Figure 6-4 Axis settings

Grid settings

The Grid Settings allows you to set the maximum and minimum values for the X-axis and Y-axis, as well as select between linear or log scale for the spacing type.

Color

The color setting allows you to select a channel and apply a color for the selected channel graph display.

Autoscale

Select **Auto Scale** to automatically scale the display according to the signal, or select **Auto Scale X** or **Auto Scale Y** to autoscale to the X-axis or Y-axis respectively.

Harmonics view

The harmonics view is only applicable for frequency domain mode. This view enables you to display the level of each signal harmonic component of the frequency domain analysis.

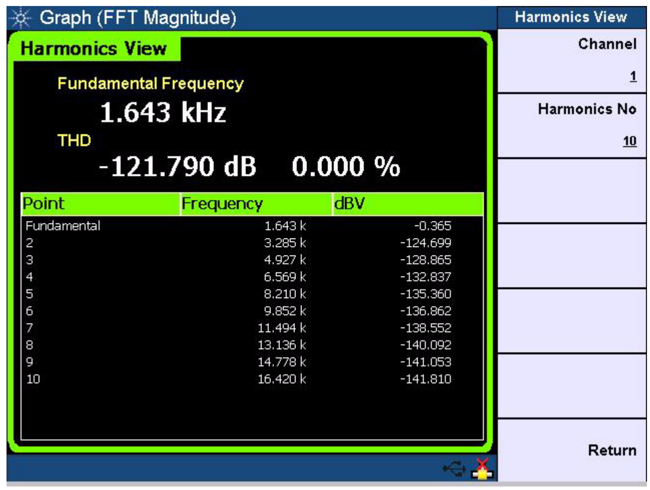


Figure 6-5 Frequency domain mode Harmonics view

The signal harmonic components data will be listed in the table. You can select the channel and set the number of harmonics component levels to be displayed from the harmonics view menu.

Hold

The hold function allows you to select the holding function to be used to update the graph trace data for channel 1 and 2. The holding function can be set to none, maximum, or minimum.

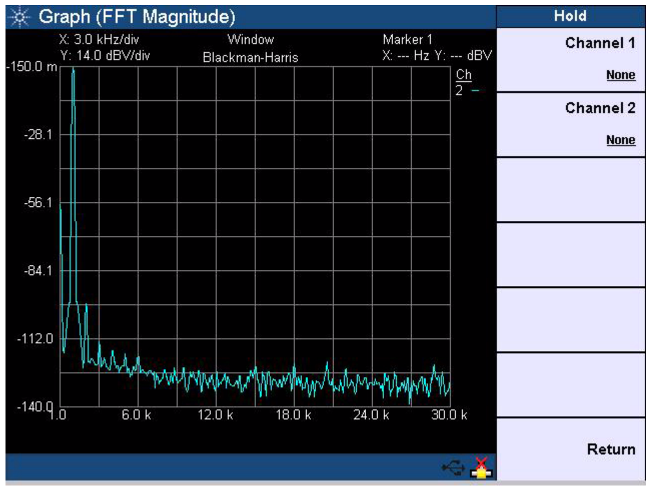


Figure 6-6 Hold function

Reference trace

The reference trace can be used for analysis or comparison purposes. The reference trace can be configured with the reference trace number, reference trace state, and reference trace source as shown in Figure 6-7.

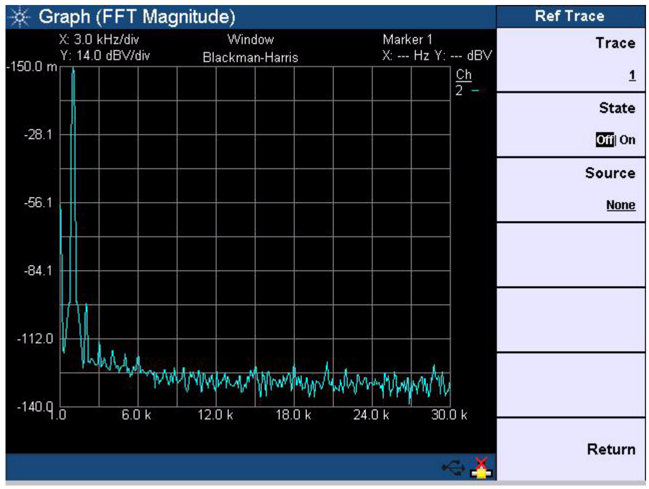


Figure 6-7 Reference trace

Trace

The reference trace can be set to 1, 2, or 3. The traces appear as R1, R2, or R3 respectively.

State

The reference trace function can be enabled or disabled.

Source

The reference trace source can be set to none, channel 1, channel 2, or a file.

Input settings

The input settings can be set to analog or digital audio interface.

For analog audio interface, the input settings can be configured with the input channel, input type, coupling type, bandwidth, input range, trigger source, and trigger edge as shown in Figure 6-8.

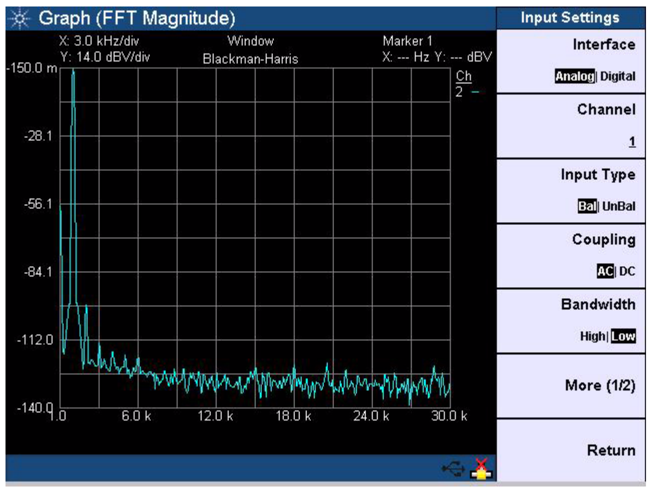


Figure 6-8 Analog audio interface input settings

Channel

Press the **Channel** softkey to view the channel list. Select the desired channel and press **Enter**. The selected channel refers to the channel for the input settings.

Input Type

The input type can be set to balanced or unbalanced.

Coupling

The input coupling type can be set to AC or DC coupling.

Bandwidth

The bandwidth can be set to high or low bandwidth.

Range

The input range can be set to Auto, 400 mV, 800 mV, 1.6 V, 3.2 V, 6.4 V, 12.8 V, 25 V, 50 V, 100 V, or 140 V. The default input range is Auto.

Trigger Source

The trigger source can be set to Free Run, 1, 2, or External.

Trigger Edge

The trigger edge can be set to the falling or rising edge. The trigger edge is only available if the trigger source is set to 1 or 2.

For digital audio interface, the input settings can be configured with the input channel, input type, input impedance, interface voltage, coupling type, trigger source, and trigger edge as shown in Figure 6-9.

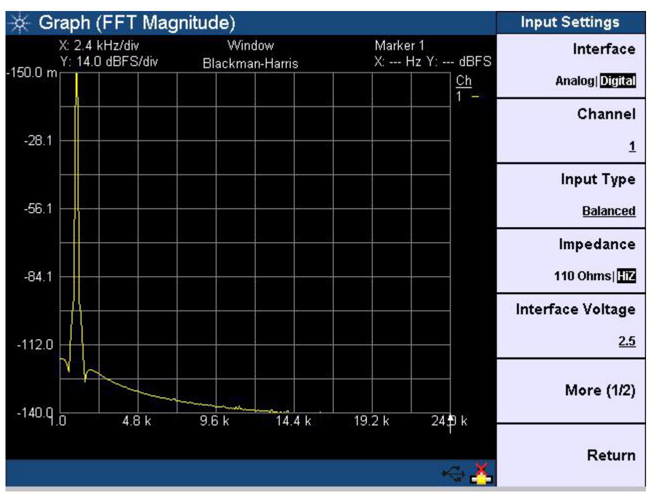


Figure 6-9 Digital audio interface input settings

Channel

Press the **Channel** softkey to view the channel list. Select the desired channel, and press **Enter**.

Input Type

The input type can be set to Balanced, Unbalanced, DSI, or Optical.

Impedance

The input impedance can be selected as follows.

- *Balanced mode*: 110 Ohm or HiZ
- *Unbalanced mode*: 75 Ohm or HiZ

Interface Voltage

The interface voltage can be set according to your desired value.

Coupling

The input coupling type can be set to AC or DC coupling.

Trigger Source

The trigger source can be set to Free Run, 1, 2, or External.

Trigger Edge

The trigger edge can be set to falling or rising edge.

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 as shown in Figure 6-10.

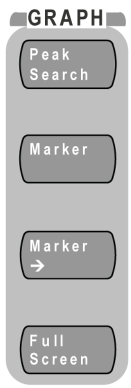


Figure 6-10 Graph panel

Peak search

Press  on the Graph panel to access the peak search function as shown in Figure 6-11.

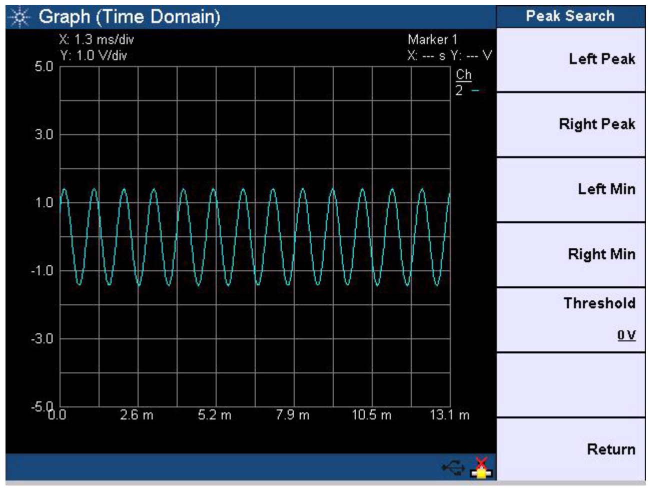


Figure 6-11 Peak search

The peak search 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.

Marker

Press Marker on the Graph panel to access the marker settings as shown in Figure 6-12.

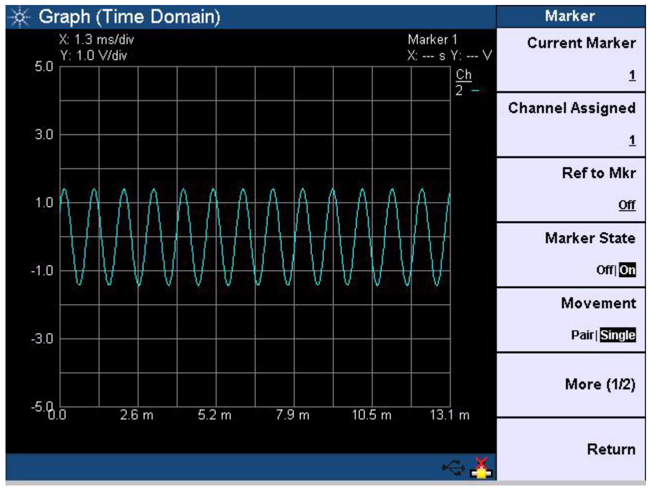


Figure 6-12 Marker

You can 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 editing keys.

You can also have the option of displaying the measurement data of the selected marker(s) in a table as shown in Figure 6-13.

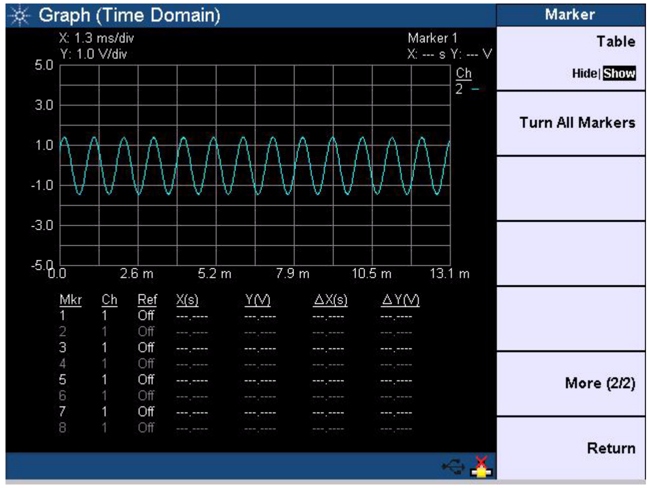


Figure 6-13 Marker measurement data display

Marker –>

Press 

on the Graph panel to display the section of the graph based on the selected marker position as shown in Figure 6-14.

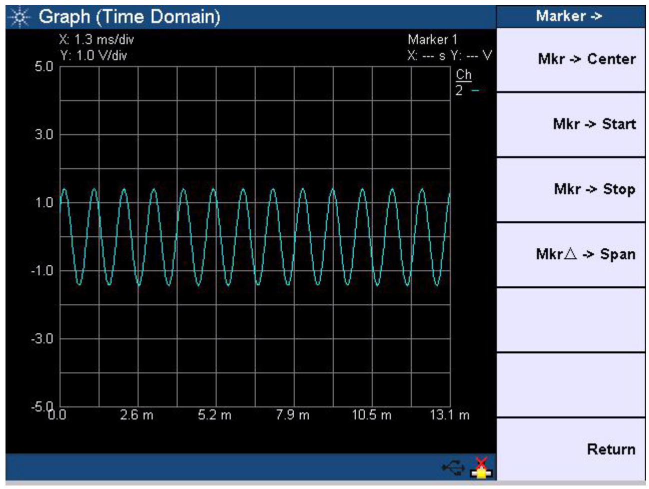


Figure 6-14 Marker –>

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.

Full screen

Press Full Screen on the Graph panel to maximize the graph view to the full display size as shown in Figure 6-15. To exit from the full screen mode, press any key on the U8903A front panel.

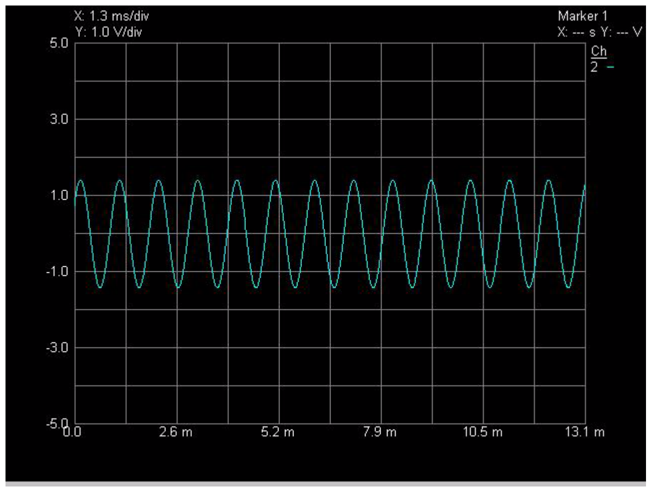


Figure 6-15 Full screen

7
Sweep Function

This chapter describes the U8903A sweep functions for performing sweep.

Sweep

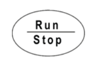
The U8903A sweep mode allows you to perform sweeps and display the results in the graph or list form.

Press 

to change the display screen to the sweep mode.

The available sweep settings are listed as follows.

- Sweep control
- Reference channel
- Sweep parameter
- Sweep channels
- Dwell time
- List view
- Graph (sweep)
- Save settings
- Recall settings

Once you have configured the settings, press 

on the U8903A front panel to start the sweep.

You can also start or stop the sweep by toggling the **Sweep Control** softkey. The sweep dwell time which represents the delay for each measurement to be taken during the sweep, can be set according to your desired value.

The U8903A allows you to save and recall the sweep settings. Press the **Save Settings** or **Recall Settings** softkey to save or recall sweep settings respectively. Refer to "Save" on page 102 and "Recall" on page 103 for more information.

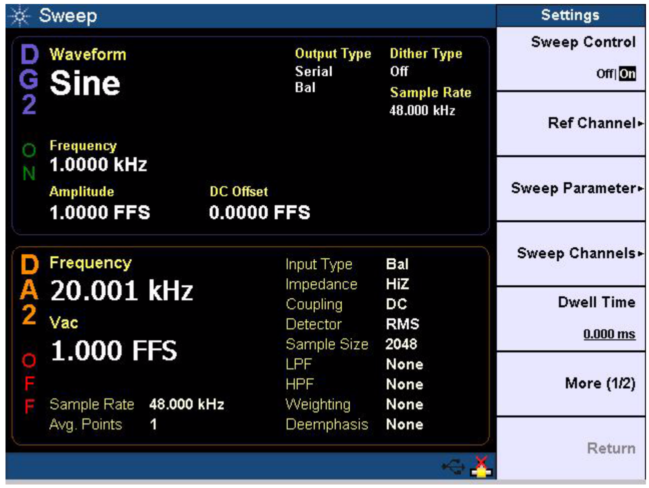


Figure 7-1 Sweep settings first page

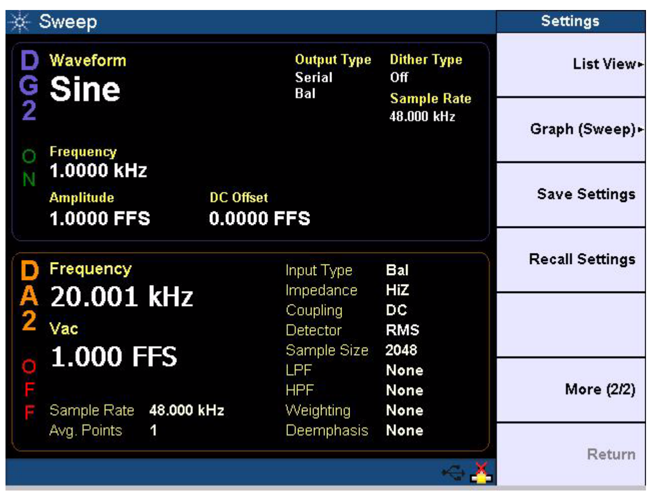


Figure 7-2 Sweep settings second page

Reference channel

The reference channels can be configured with the output interface, output channel, input interface, and input channel as shown in Figure 7-3.

NOTE The settings in the selected reference channel will be applied on all the sweep channels.

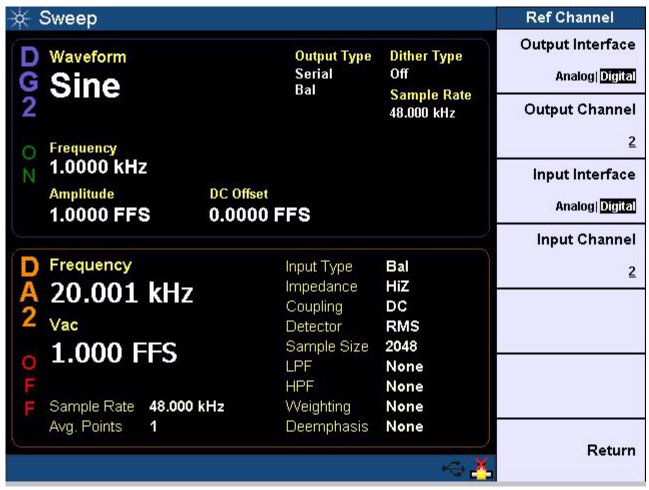


Figure 7-3 Reference Channel

Output Interface and Output Channel

The output interface can be set to Analog or Digital, and the output channel can be selected according to the output interface.

Input Interface and Input Channel

The input interface can be set to Analog or Digital, and the input channel can be selected according to the input interface.

Sweep parameter

The sweep parameter can be configured with the sweep parameter, sweep unit, start, stop, points, step size, spacing, and hold as shown in Figure 7-4.

NOTE When sweeping amplitude, the DC offset is set to zero even though it is set in the generator.

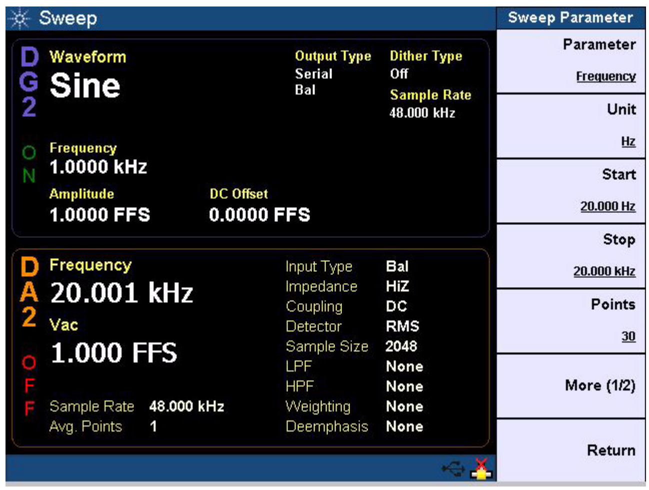


Figure 7-4 Sweep parameter

Parameter

The sweep parameter can be selected according to the current generated waveform in the sweep output reference channel.

Unit

Select the unit for sweep.

Start and Stop

The sweep start and stop points can be set according to your desired value. These points will define the limit bounds of the sweep.

Points

The sweep points can be set according to your desired value.

Step Size

The sweep step size can be set according to your desired value.

Spacing

The sweep spacing can be set to Linear, Log, or Arbitrary.

Hold

The sweep hold function can be set to None, Max, or Min. This function sets the sweep hold configuration type to be used to update the graph data.

Sweep channels

The sweep channels can be configured with the output channels and input channels as shown in Figure 7-5.

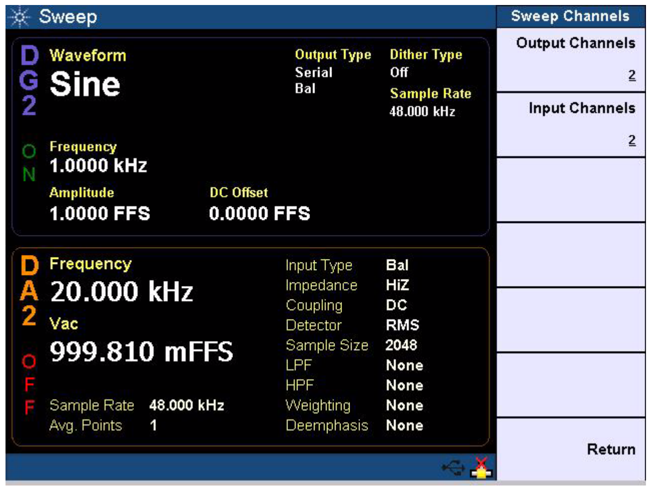


Figure 7-5 Sweep channels

List View

The list view displays the sweep results in a list form.

The list view can be configured with the channel selection, add point, edit point, remove point, go to point, and load from a file as shown in Figure 7-6.

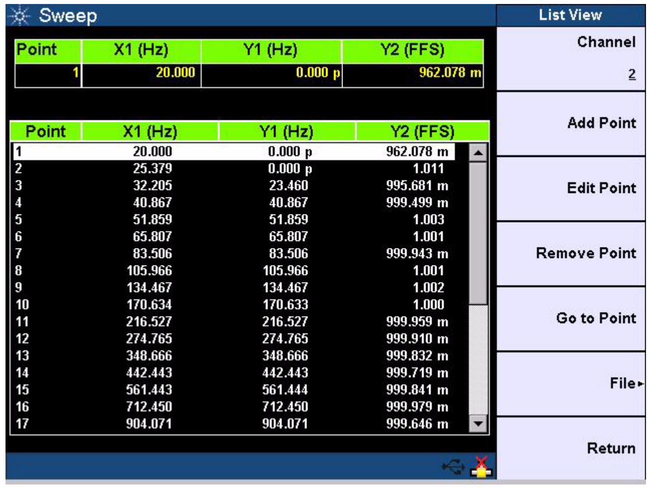


Figure 7-6 List view

Channel

You can select the channel to be displayed in a list form.

Sweep Point

The list view allows you to add sweep point, edit sweep point value, remove a sweep point, or go to sweep point.

File

You can load data from a file to the sweep list view, or save data to a file from the sweep list view.

Graph (Sweep)

The graph (sweep) displays the sweep results in a graph form.

The graph (sweep) can be configured with the active function, axis settings, units, reference trace, and save points to file as shown in Figure 7-7.

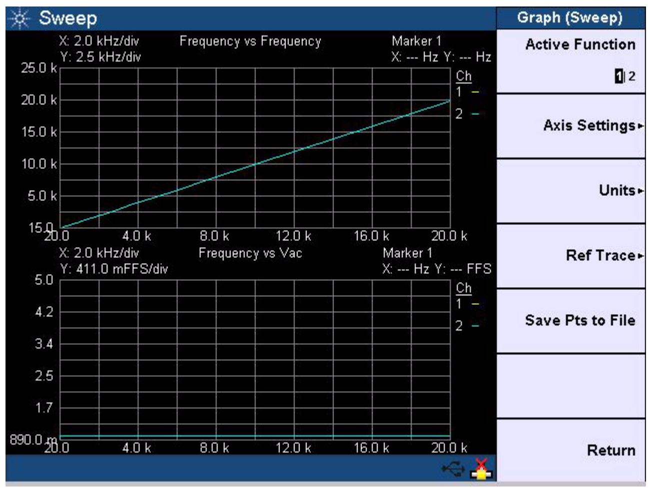


Figure 7-7 Graph (Sweep)

Active Function

The active function can be set to 1 or 2.

Axis Settings

The axis settings can be configured with the grid settings, color, and autoscale as shown in Figure 7-8.

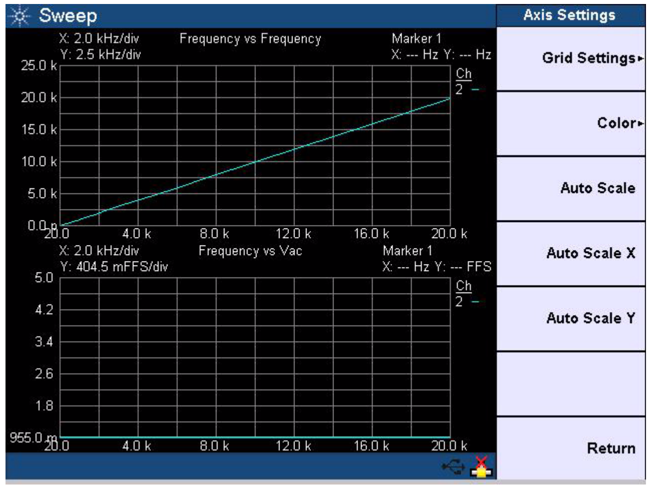


Figure 7-8 Graph (sweep) axis settings

- **Grid settings**

  The Grid Settings allows you to set the maximum and minimum values for the X-axis and Y-axis, as well as select between linear or log scale for the spacing type.

- **Color**

  The color setting allows you to set the color for the graph display.

- **Autoscale**

  Select Auto Scale to automatically scale the display according to the signal, or to autoscale to the X-axis or Y-axis.

Units

Select the unit for Function 1 and Function 2.

Ref Trace

The reference trace can be used for analysis or comparison purposes. The reference trace can be configured with the reference trace number, reference trace state, and reference trace source.

- **Trace**

  The reference trace number can be set to 1, 2, or 3. The traces appear as R1, R2, or R3 respectively.

- **State**

  The reference trace function can be enabled or disabled.

- **Source**

  The reference trace source can be set to channel 1, channel 2, or a file.

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8
Characteristics and Specifications

This chapter displays the U8903A characteristics and specifications.

Product 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 (non-condensing)
- 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 std No. 61010-1:2004

EMC COMPLIANCE

- IEC 61326-1:2005/EN 61326-1:2006
- Canada: ICES/NMB-001: Issue 4, June 2006
- Australia/New Zealand: AS/NZS CISPR 11:2004

U8903A INSTRUMENT DIMENSIONS (W × D × H)

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

DIGITAL INTERFACE BOARD DIMENSIONS (W × D × H)

110.00 mm (4.33 in) × 303.60 mm (11.95 in) × 29.90 mm (1.18 in)

WEIGHT

- 8.5 kg (without digital interface board)
- 8.747 kg (with digital interface board)

WARRANTY

- 3 years for product
- 3 months for product accessories

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.

Analog generator specifications

OUTPUT SPECIFICATIONS	
Connector 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
Generated waveforms	Sine, Dual sine, Variable Phase, Square, Noise (Gaussian and Rectangular), Arbitrary, DC, Multitone, SMPTE IMD (1:1, 4:1, and 10:1), and 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 to 16 Vrms
Range (Unbalanced/Common)	0 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	≤–95 dB (at 23 °C ±5 °C)
20 Hz to 20 kHz bandwidth	≤–92 dB (from 0 °C to 55 °C)
Dual sine ratio range	0% to 100%
Phase	–180 ° to 179.99 °
Sweep	Frequency, amplitude, and phase
SQUARE	
Frequency range	5 Hz to 30 kHz
Output	
Range (Balanced)	0 to 45.2 Vpp
Range (Unbalanced/Common)	0 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 to 16 Vrms
Range (Unbalanced/Common)	0 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, and 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 to 16 Vrms
Range (Unbalanced/Common)	0 to 8 Vrms
Inherent distortion (20 Hz to 20 kHz)	≤–101 dB
Sweep	Upper frequency, center frequency, and amplitude
NOISE	
Type	Rectangular and Gaussian
Output	
Range (Balanced)	0 to 7.2 Vrms (Gaussian), 0 to 10 Vrms (Rectangular)
Range (Unbalanced/Common)	0 to 3.6 Vrms (Gaussian), 0 to 5 Vrms (Rectangular)
ARBITRARY	
Signal	Determined by the user selected file
Sample rate	312.5 kHz
Length	32 to 32768 points/channel
Maximum number of tones	(Length/2) – 1
MULTITONE	
Signal	Determined by the user specified frequency, amplitude, and phase data
Sample rate	312.5 kHz

Length	256 to 32768 points/channel
Maximum number of tones	64
DC	
Output	
Range (Balanced)	–22.6 V to 22.6 V
Range (Unbalanced/Common)	–11.3 V to 11.3 V
Amplitude accuracy[1]	±1.5% (±250 mV to ±11.3 V)
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]	±1.5% (±250 mV to ±11.3 V)

[1] DC output and DC offset output are functional from 0 to ±250 mV. The amplitude accuracy for this range is not warranted.

Analog analyzer specifications

INPUT SPECIFICATIONS	
Connector 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	<1 µV[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
THD+N[6] AND SINAD	
Fundamental frequency range[7]	20 Hz to 100 kHz
Display range	–999.999 dB to 0 dB
Accuracy	
<20 kHz	±0.5 dB
<100 kHz	±0.7 dB
Input voltage range	<1 µV to 140 Vrms
Residual distortion (at 1 kHz, 1 Vrms 20 Hz to 20 kHz bandwidth)	≤–101 dB
3 dB measurement bandwidth[8]	>130 kHz
Detection	RMS
Display resolution	% up to 3 decimal places (dB up to 2 decimal places)
SNR	
Fundamental frequency range	10 Hz to 100 kHz
Display range	0 dB to 999.999 dB

Accuracy	
<20 kHz	±0.5 dB
<100 kHz	±0.7 dB
Input voltage range	<1 µV to 140 Vrms
Residual distortion (at 1 kHz, 1 Vrms 20 Hz to 20 kHz bandwidth)	≤–101 dB
TRIGGERING	
Type	Free Run or 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 V 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, or 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 “Range” on page 121.

[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.

[6] There will be a minor difference in the THD+N results between the U8903A and the HP8903B when the fundamental frequency is greater than 65 kHz. This is due to the different measurement bandwidths between the U8903A and the HP8903B.

[7] No harmonic is measured for any input signals when the fundamental frequency is greater than 65 kHz.

[8] Measurement bandwidth for THD+N.

Digital generator specifications[1]

DITHER	
Distribution	None, Triangular, or Rectangular
Level	0.5 LSB
SINE, DUAL SINE, AND VARIABLE PHASE	
Frequency	
Range	5 Hz to 0.45 sampling rate (Fs)
Accuracy	±10 ppm
Flatness	±0.001 dB
Residual THD+N	≤–140 dB
SQUARE	
Frequency range	5 Hz to 0.45 Fs

[1] Digital generator specifications refer to 24 bits FFS.

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, or 0.45 Fs (whichever is lower)
Mixed ratio (LF:HF)	10:1, 4:1, or 1:1
Sweep	Upper frequency, lower frequency, and amplitude
DFD (IEC 60118/IEC 60268)	
Frequency	
Difference frequency	80 Hz to 2 kHz
Upper frequency	3 kHz to 80 kHz, or 0.45 Fs (whichever is lower)
Center frequency	3 kHz to 79 kHz, or 0.45 Fs (whichever is lower)
Sweep	Upper frequency, center frequency, and amplitude
NOISE	
Type	Rectangular, Gaussian, Triangular, and Pink
Amplitude	0 to 1 FFS
ARBITRARY	
Signal	Determined by the user selected file
File format	WAVE (.wav)
Maximum file size	5.0 MB
File resolution	8, 16, or 24 bits
Frequency range	2 Hz to 0.45 Fs
MULTITONE	
Signal	Determined by the user specified frequency, amplitude, and phase data
Frequency range	2 Hz to 0.45 Fs
Maximum number of tones	64
SINE BURST	
Period	2 cycles to 65535 cycles
Burst on	1 cycles to (65534 or period – 1, whichever is lower)

Burst on to burst off ratio	0 to 100%
MONOTONICITY	
Samples/Step	1 to 32768
WALKING ONE AND WALKING ZERO	
Samples/Step	1 to 65535
CONSTANT VALUE	
Amplitude	–1 FFS to 1 FFS
DC OFFSET	
DC offset	–1 FFS to 1 FFS

Digital analyzer specifications

AC/DC	
AC level range	<–120 dBFS to 0 dBFS
DC level range	±1 FFS
AC Accuracy	±0.001 dB (at 1 kHz)
DC Accuracy	±0.001 dB
AC Flatness	±0.001 dB (10 Hz to 0.45 Fs)
Unit (reference)	FFS, %FS, V, dBFS, LSB, dBr, dBu, dBV, Hex, Dec, and x
FREQUENCY	
Range	5 Hz to 0.45 Fs
Accuracy	±5 ppm (10 Hz to 0.45 Fs)
PHASE	
Accuracy	±0.005 °
Resolution	±0.001 °

THD+N	
Range	10 Hz to 0.45 Fs
Accuracy	±0.3 dB
Residual distortion	≤–140 dB
IMD	
SMPTE IMD	1:1/4:1/10:1
High frequency	2 kHz to 60 kHz, or 0.45 Fs (whichever is lower)
Low frequency	40 Hz to 500 Hz
Accuracy	±0.5 dB
DFD	
Frequency difference	80 Hz to 2 kHz
Center frequency	3 kHz to 79 kHz, or 0.45 Fs (whichever is lower)
Accuracy	±0.5 dB

AES3/SPDIF interface specifications

INPUT/OUTPUT SPECIFICATIONS	
Input connector type	
Balanced	XLR (transformer coupling)
Unbalanced	BNC (grounded)
Optical	TOSLINK connector
Output connector type	
Balanced	XLR (transformer coupling)
Unbalanced	BNC (grounded)
Optical	TOSLINK connector
Input impedance	
Balanced	110 Ω or high impedance (>2 kΩ)
Unbalanced	75 Ω or high impedance (20 kΩ typical)

Output impedance	
Balanced	110 Ω
Unbalanced	75 Ω
Input level	
Balanced	0.3 Vpp to 5.1 Vpp
Unbalanced	0.3 Vpp to 2.5 Vpp
Output level	
Balanced	0.3 Vpp to 5.1 Vpp
Unbalanced	0.3 Vpp to 2.5 Vpp
Sampling rate	
Input	28 kHz to 192 kHz
Output	28 kHz to 192 kHz
Output level accuracy	±1 dB (typical), ±1.5 dB
Audio bit	8 bits to 24 bits
Sampling rate accuracy	±5 ppm
Inherent jitter (typical)	
Balanced	≤1.5 ns
Unbalanced	≤1.5 ns
Optical	≤5 ns
CLOCK AND SYNC	
Internal master clock	
Maximum clock rate	192 kHz
Accuracy	±5 ppm
Inherent jitter	≤1 ns
Sync clock input	
Connector type	BNC (SYNC IN on the rear panel)
Impedance	10 kΩ
Input level	3.3 V (non-adjustable, LVCMOS IO standard)
Polarity	Normal or Invert

Sync clock output	
Connector type	25-pin male D-SUB connector pin-1
Impedance	50 Ω
Output level	3.3 V (non-adjustable, LVCMOS IO standard)
Polarity	Normal or Invert
Output type	Bit clock (128 Fs)
PROTOCOL	
Channel status bits	Professional or Consumer (all applicable bits are editable for advanced settings)
Format	Professional or Consumer
User bits	Set or Cleared
Validity flag	Set or Cleared

DSI specifications

INPUT/OUTPUT SPECIFICATIONS	
Connector type	
Input	25-pin male D-SUB connector
	25-pin female D-SUB to BNC connector (optional accessories)
Output	25-pin male D-SUB connector
	25-pin female D-SUB to BNC connector (optional accessories)
Impedance	
Input	≥10 kΩ
Output	50 Ω
Logic level	
Input	1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, or user-defined (LVCMOS standard)
Output	1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, or user-defined (LVCMOS standard)
Sampling frequency range	
Input	6.75 kHz to 400 kHz
Output	6.75 kHz to 400 kHz

Master-clock	
Multiplier	64 to 1024 (depends on the Word Length)
Maximum frequency	51.2 MHz
Maximum bit clock	51.2 MHz
Maximum sampling rate	400 kHz
Data format	Left Justified, Right Justified, I2S, or DSP
Word length	8 bits to 32 bits per channel
Audio bit	8 bits to 24 bits (step by 1 bit)
Sampling rate accuracy	±5 ppm
Word clock rate	6.75 kHz to 400 kHz
CLOCK AND SYNC	
Internal master clock	
Maximum clock rate	10 MHz
Stability	±5 ppm
Inherent jitter	≤1 ns
Clock source setting (analyzer and generator)	• Incoming bit clock from DUT • Internal clock • External clock from external sync clock input
DSI clock input	
Impedance	10 kΩ typical
Input level	1.2 Vpp to 3.3 Vpp
Polarity	Normal or Invert
DSI clock output	
Impedance	10 kΩ typical
Output level	1.2 Vpp to 3.3 Vpp
Polarity	Normal or Invert
Word clock polarity	Leading edge or falling edge (with respect to bit clock)

Analog audio filters

Low pass filter	• 15 kHz low pass • 20 kHz low pass • 30 kHz low pass • 80 kHz low pass • User-defined[1]
High pass filter	• 22 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.

Digital audio filters

Low pass filter	• 15 kHz low pass • 20 kHz low pass • 22 kHz low pass • 30 kHz low pass • User-defined[1][2]
High pass filter	• 20 Hz high pass • 100 Hz high pass • 400 Hz high pass • User-defined[1][2]
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][2]
De-emphasis	50 µs, 75 µs, and user-defined[1][2]
Sample rate support	32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, 192 kHz (subject to filter cut-off)

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

[2] User-defined filter with coefficients limit of up to 252.

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 I	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.

Appendixes

Appendix A: Units of the Measurement Function Returned Values

Analog analyzer

Table A-1 Analog analyzer measurement functions unit

Measurement function	<unit>	Default unit
Frequency	Hz ΔHz	Hz
AC voltage DC voltage THD+N Level Noise level	V dBu dBV dBm W dBr dBg x	V
THD+N Ratio SINAD SNR SMPTE IMD DFD IEC 60118 2nd order DFD IEC 60118 3rd order DFD IEC 60268 2nd order DFD IEC 60268 3rd order Crosstalk (channel driven) Crosstalk (channel measured)	dB ΔdB % x	dB
Phase	°	°

Digital analyzer

Table A-2 Digital analyzer measurement functions unit

Measurement function	<unit>	Default unit
Frequency	Hz ΔHz	Hz
AC voltage DC voltage THD+N Level Noise level Max peak value Min peak value	V dBu dBV dBr x FFS %FS dBFS LSB Hex Dec	V FFS (AC voltage) dBFS (Noise level)
THD+N Ratio SINAD SNR SMPTE IMD DFD IEC 60118 2nd order DFD IEC 60118 3rd order DFD IEC 60268 2nd order DFD IEC 60268 3rd order Crosstalk (channel driven)	dB ΔdB % x	dB
Phase	°	°
Group Delay	s	s

The units can be computed using the following formulas:

Table A-3 Measurement units formula

<unit>	Formula	Description
ΔHz	$f - f_{ref}$	f_{ref} = reference frequency
dB	$20 \times \log_{10}$ (ratio)	
ΔdB	(ratio) – R_{ref}	R_{ref} = reference ratio
dBu[1]	$20 \times \log_{10}\left(\frac{V}{\sqrt{0.6}}\right)$	
dBV[1]	$20 \times \log_{10}(V)$	
dBm	$10 \times \log_{10}\left(\frac{1000\,V^2}{Zref}\right)$	Z_{ref} = reference impedance[2]
dBr[1]	$20 \times \log_{10}\left(\frac{V}{Vref}\right)$	V_{ref} = reference level[3]
dBg	$20 \times \log_{10}\left(\frac{V}{Vgen}\right)$	V_{gen} = amplitude of the generator signal for a corresponding channel
W	$\frac{V^2}{Zref}$	Z_{ref} = reference impedance[2]
x	$\frac{V}{Vref}$ or $\frac{Ratio\ (\text{in }\%)}{R_{ref}\ (\text{in }\%)}$	V_{ref} = reference level[3] R_{ref} = reference ratio
%	$100 \times$ (ratio)	

Table A-3 Measurement units formula

<unit>	Formula	Description
dBFS	$20 \times \log_{10}$ (FFS)	
%FS	$100 \times$ FFS	
LSB	FFS x $2^{(r-1)}$	r = audio resolution
Hex	(FFS x $2^{(r-1)}$) – 1	r = audio resolution The value calculated is represented in hexadecimal (base 16)
Dec	(FFS x $2^{(r-1)}$) – 1	r = audio resolution The value calculated is represented in decimal (base 10)

[1] For digital analyzer, the dBu, dBV, and dBr calculations are derived using the reference value set at Volt/FS. (V = FFS $\times$ Volt/FS)

[2] When the Vrms measurement unit is changed to Watt or dBm, the reference impedance setting will be used for the power level calculation. The reference impedance refers to the circuitry impedance or load impedance connected to the analyzer when calculating power level. Note that in a loop back test with no load impedance, the measured voltage value will be twice the expected value as there is no voltage divider present. This will return a power measurement greater than 6.02 dB if a load is present.

[3] Reference level is defined as a user-entered or a captured value from the current reading as a relative level for the subsequent measurement reading. It can be set to delta, linear, or log scale.

Appendix B: Arbitrary File Format

To load an arbitrary file for the analog arbitrary waveform, press **Waveform Config > Recall File**. The File Manager will be launched to allow you to select the file to be loaded. Once you recall an arbitrary file, the arbitrary waveform preview page will appear as shown in the Figure A-1 for analog generator.

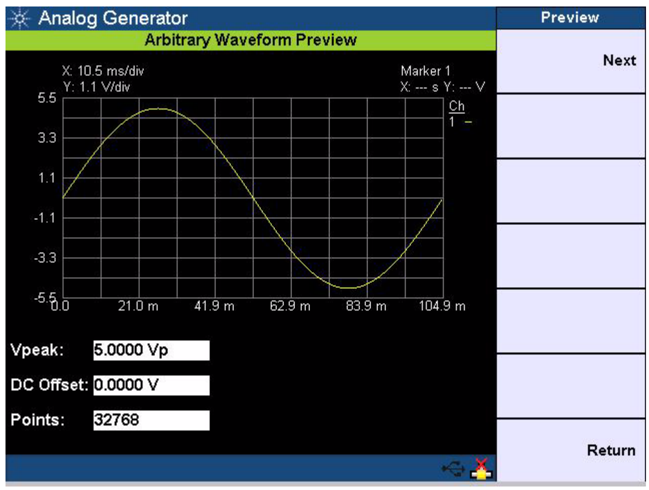

Figure A-1 Arbitrary waveform preview

Press **Next** or **Return** to display the arbitrary waveform menu.

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
.
.
.
```

Table A-4 shows the allowable range of values for each arbitrary file parameter.

Table A-4 Allowable range for arbitrary file parameters

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 using 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: 250

#Coefficients:

0.00023394
-1.69E-05
-1.61E-05
-1.57E-05
.
.
.
```

The coefficients of the FIR filter are described as follows.

0.00023394	//A[0]
–1.69E–05	//A[1]
–1.61E–05	//A[2]
–1.57E–05	//A[3]

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: 250

#Sections:

0.02188812
1
-1.852219
0.9397715
1
2
1

0.02067037
1
-1.749171
0.8318526
1
2
1
.
.
.
```

The coefficients of the IIR filter are described as follows.

0.02188812	//Section 1: $Gain_1$
1	//Section 1: $A_1[0]$
–1.852219	//Section 1: $A_1[1]$
0.9397715	//Section 1: $A_1[2]$
1	//Section 1: $B_1[0]$
2	//Section 1: $B_1[1]$
1	//Section 1: $B_1[2]$
[0.02067037	//Section 2: $Gain_2$
1	//Section 2: $A_2[0]$

–1.749171	//Section 2: $A_2[1]$
0.8318526	//Section 2: $A_2[2]$
1	//Section 2: $B_2[0]$
2	//Section 2: $B_2[1]$
1	//Section 2: $B_2[2]$

where Ax = Denominator and Bx = 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

You may set up to 256 coefficients (analog interface) and 252 coefficients (digital interface) 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.

Appendix D: DSI Input and Output Interface

The DSI input and output interface uses the 25-pin male D-SUB connector. The pins assignment for the connector are shown in Figure A-2 and Table A-5.

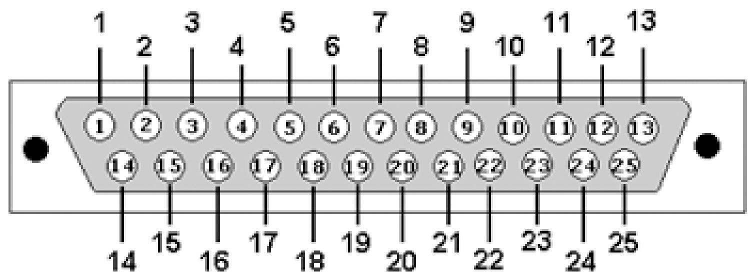

Figure A-2 25-pin male D-SUB connector

Table A-5 25-pin male D-SUB connector pins assignment

Pin no.	Label	Direction	Description
1	Sync Clk Output	Out	Sync clock output for AES3/SPDIF and DSI
2	–	–	Unused
3	DSI Data-In	In	DSI data input
4	DSI FS-InOut	In/Out	DSI frame synchronization (word clock) bidirectional pin
5	DSI CLK-InOut	In/Out	DSI bit clock bidirectional pin
6	–	–	Unused
7	+5.0 V	–	+5.0 V supply with over-current protection
8	+3.3 V	–	+3.3 V supply with over-current protection
9	–	–	Unused
10	DSI CLK-Out	Out	DSI bit clock output pin
11	DSI FS-Out	Out	DSI frame synchronization (word clock) output pin

Table A-5 25-pin male D-SUB connector pins assignment (continued)

Pin no.	Label	Direction	Description
12	DSI Data-Out	Out	DSI data output
13	Master Clk-Out	Out	Master clock out for digital audio
14 – 15	GND	–	Digital ground

Appendix E: Digital System Clock Distribution Block Diagram

The digital system clock distribution block diagram is shown in Figure A-3.

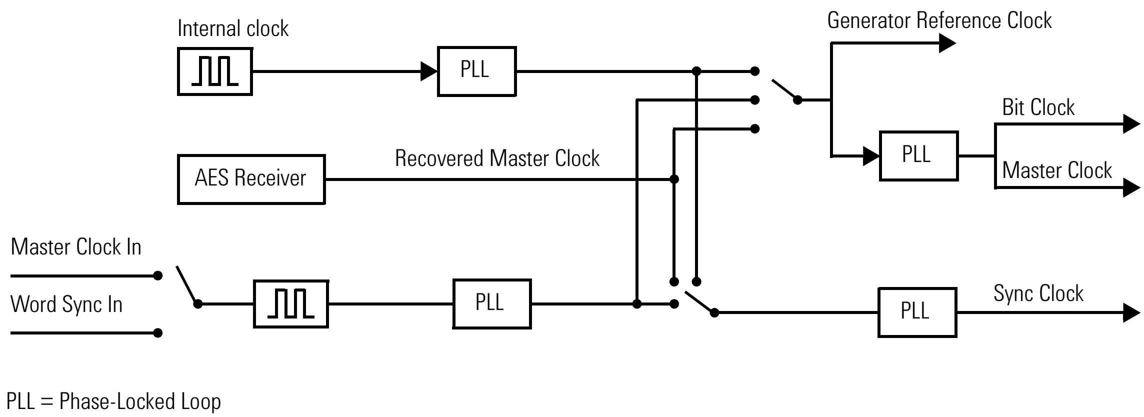

Figure A-3 Digital system clock distribution block diagram

Appendix F: Typical DSI Test Configurations

The following sections describe the possible serial audio input and output configurations.

NOTE

Refer to "Appendix D: DSI Input and Output Interface" on page 290 for more information on the pins assignment.

Configuration 1

In this configuration, the DUT uses the U8903A internal reference clock source as the reference clock. The DUT receives the clock references and data from the U8903A.

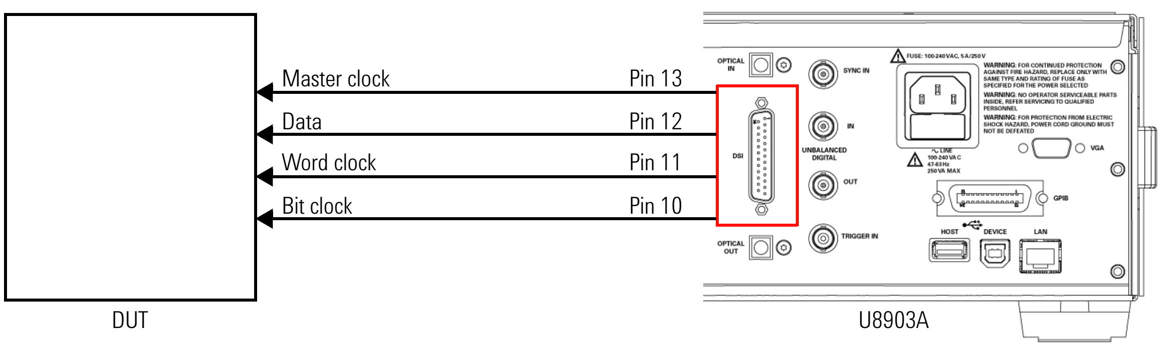

Figure A-4 DSI test configuration 1

1 Press **Generator** on the Mode panel to change the selected display screen to the generator mode or toggle to digital generator.

2 Press **DSI Config > Master Clock**, and select **On** to enable the master clock.

3 Press **DSI Config > Sample Rate**, and set the sample rate.

4 Press **DSI Config > Word Length**, and set the word length. The bit clock rate is determined by the multiplication of the sample rate, word length, and number of channels.

5 Press **DSI Config > Multiplier**, and select the multiplier. The master clock rate is determined by the multiplication of the sample rate and multiplier.

6 Press **DSI Config > Sync Polarity**, and select either **Rising** or **Falling** as the edge synchronization to the leading edge of the frame clock.

Configuration 2

In this configuration, the DUT uses an external master clock as the reference clock. The U8903A receives the data, word clock, and bit clock from the DUT. A typical application for this configuration is analog to digital converter (ADC) evaluation.

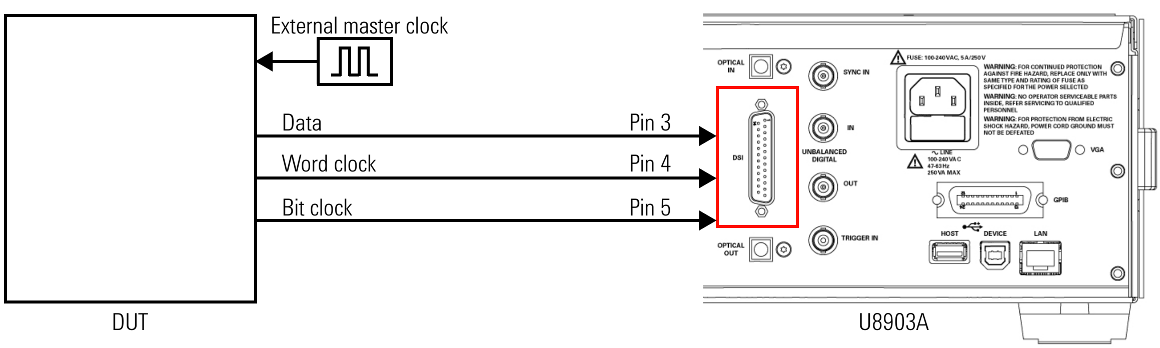

Figure A-5 DSI test configuration 2

1 Press **Analyzer** on the Mode panel to change the selected display screen to the analyzer mode or toggle to digital analyzer.

2 Press **Input Config > Input Type**, and select **DSI** as the digital analyzer input type.

3 Press **DSI Config > Clock Direction > Mclk Source**, and select **External** as the master clock source.

4 Press **DSI Config > Clock Direction > W/Bclk Direction**, and select **In** as the word and bit clock direction.

Configuration 3

In this configuration, an external master clock is used to synchronize the DUT and U8903A. A phase-locked loop (PLL) is used in the U8903A to lock the incoming master clock and regenerate the word clock and bit clock. Data will be clocked in on each bit clock.

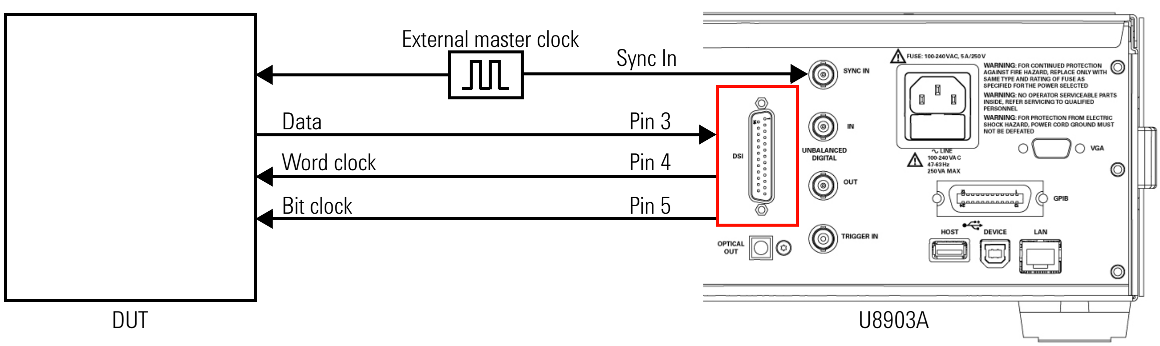

Figure A-6 DSI test configuration 3

1 Press Analyzer on the Mode panel to change the selected display screen to the analyzer mode or toggle to digital analyzer.

2 Press **Input Config > Input Type**, and select **DSI** as the digital analyzer input type.

3 Press **DSI Config > Clock Direction > Mclk Source**, and select **External** as the master clock source.

4 Press **DSI Config > Clock Direction > W/Bclk Direction**, and select **Out** as the word and bit clock direction.

5 Press **DSI Config > Mclk Config > Multiplier**, and set the multiplier to determine the sampling rate.

Configuration 4

This configuration is similar to configuration 2, except that the DUT uses the U8903A internal reference clock source as the reference clock.

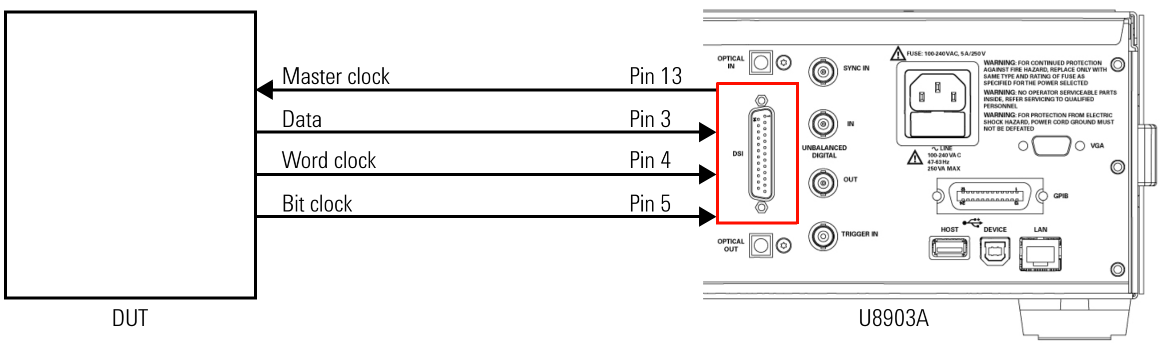

Figure A-7 DSI test configuration 4

1 Press 

on the Mode panel to change the selected display screen to the analyzer mode or toggle to digital analyzer.

2 Press **Input Config > Input Type**, and select **DSI** as the digital analyzer input type.

3 Press **DSI Config > Clock Direction > Mclk Source**, and select **Internal** as the master clock source.

4 Press **DSI Config > Clock Direction > W/Bclk Direction**, and select **In** as the word and bit clock direction.

5 Press **DSI Config > Mclk Config > Sampling Rate**, and set the sampling rate.

6 Press **DSI Config > Mclk Config > Multiplier**, and set the multiplier to determine the master clock rate.

Configuration 5

This configuration is similar to configuration 3, except that the DUT uses the U8903A internal reference clock source as the reference clock.

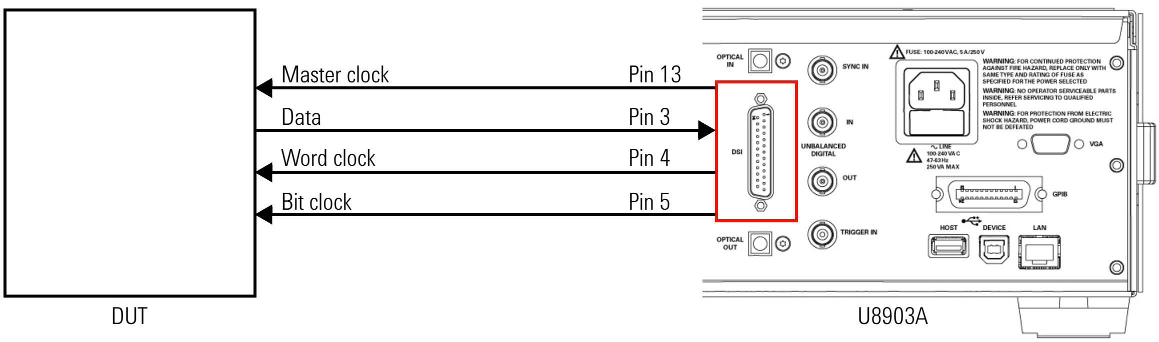

Figure A-8 DSI test configuration 5

1 Press Analyzer on the Mode panel to change the selected display screen to the analyzer mode or toggle to digital analyzer.

2 Press **Input Config > Input Type**, and select **DSI** as the digital analyzer input type.

3 Press **DSI Config > Clock Direction > Mclk Source**, and select **Internal** as the master clock source.

4 Press **DSI Config > Clock Direction > W/Bclk Direction**, and select **Out** as the word and bit clock direction.

5 Press **DSI Config > Mclk Config > Master Clock Out**, and select **On** to enable the master clock out.

6 Press **DSI Config > Mclk Config > Sampling Rate**, and set the sampling rate.

7 Press **DSI Config > Mclk Config > Multiplier**, and set the multiplier.

Appendix G: U8903A Configuration Examples

Example 1: Generating a sine waveform with the digital generator and measuring its voltage with the digital analyzer

In this example, you will learn how to generate a simple sine waveform from the U8903A digital generator and measure its voltage using the U8903A digital analyzer.

To generate a sine waveform from the digital unbalanced output with a frequency of 1 kHz and amplitude of 1 FFS, perform the following steps.

1. Connect the digital generator unbalanced output to the digital analyzer unbalanced input channel in the rear panel using a BNC cable.
2. Press Generator on the Mode panel to change the selected display screen to the generator mode or toggle to digital generator.
3. Press **Waveform**, and select **Sine** as the waveform type.
4. Press **Output Config > AES Output**, and select **Unbalanced** as the digital generator output type.
5. Press **Waveform Config > Frequency**, and set the frequency to 1 kHz.
6. Press **Waveform Config > Amplitude**, and set the amplitude to 1 FFS.
7. Press Run Stop to start the signal generation on the digital generator channel 1.

After you have completed the steps above, the U8903A display should look as follows.

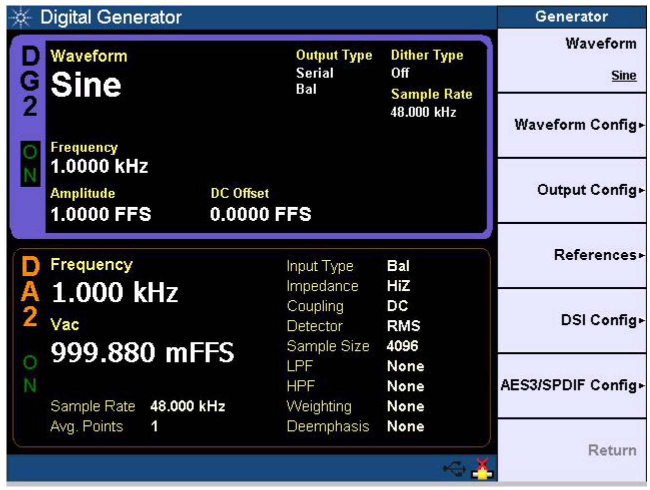

Figure A-9 Digital generator sine waveform generation

To measure the voltage of the sine waveform, perform the following steps.

1 Press Analyzer on the Mode panel to change the selected display screen to the analyzer mode or toggle to digital analyzer.

2 Press **Analysis Mode**, and select **Signal Attributes** as the digital analyzer analysis mode.

3 Press **Input Config > Input Type**, and select **Unbalanced** as the digital analyzer input type.

4 Press **Function 1 > Meas. Function**, and select **Frequency** as the first measurement function.

5 Press **Function 2 > Meas. Function**, and select **Vac** as the second measurement function.

6 Press Run Stop to start the signal measurement on the digital analyzer channel 1.

You should now obtain an AC voltage reading of 1 FFS for the generated sine waveform, within the tolerance as stated in “Specifications” on page 263. The U8903A display should look as follows.

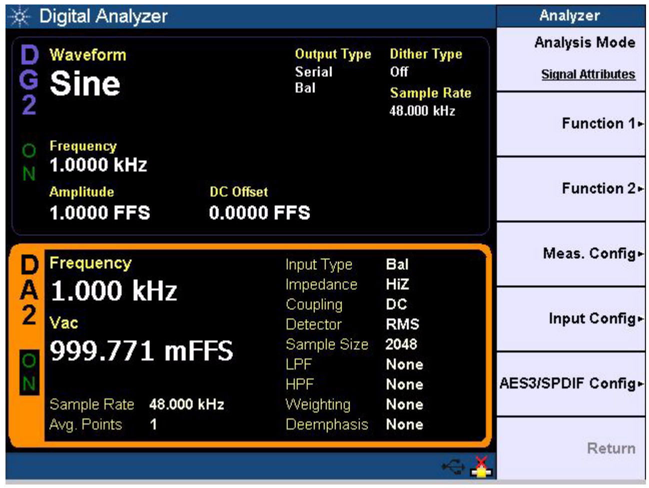

Figure A-10 Digital analyzer voltage measurement

Example 2: Configuring the System Clock Reference Settings

In this example, you will learn how to configure the U8903A system clock reference settings.

To configure the system clock reference source to external Master clock in with word length of 24 and multiplier of 192, perform the following steps.

1 Connect the external Master clock signal to the Sync In connector in the rear panel using a BNC cable.
2 Press  on the Mode panel to change the selected display screen to the generator mode or toggle to digital generator.
3 Press **Output Config > Ref. Clk Source**, and select **External** as the reference clock source.
4 Press **Output Config > Ext. Clk Type**, and select **MCLK** to set the external clock source type as Master clock.
5 Press **Output Config > Ext. MClK WordLen**, and set the Master clock word length to **24**.[1][2]
6 Press **Output Config > Ext. MClk Multiplier**, and set the Master clock multiplier to **192**.[3]

[1] Sampling rate constrains the master clock in word length values. Refer to "Appendix J: Word Length, Sampling Rate, and Multiplier for Master Clock In" on page 313 for the range of word length that can be set with different sampling rate.

[2] When setting the word length, the error message, **–221,"Settings conflict..."** may be generated. This error message can be ignored as this is to notify that the word length or multiplier is auto adjusted to the nearest allowable value due to the settings conflict.

[3] Sampling rate and word length constrain the multiplier values. Refer to "Appendix J: Word Length, Sampling Rate, and Multiplier for Master Clock In" on page 313 for the range of multiplier that can be set with different master clock in word length and sampling rate.

Example 3: Configuring the Digital Generator DSI Output Settings

In this example, you will learn how to configure the U8903A digital generator DSI output settings.

To configure the digital generator DSI output settings to DSP format, sampling rate of 192 kHz, word length of 24, and multiplier of 192, perform the following steps.

1 Press Generator on the Mode panel to change the selected display screen to the generator mode or toggle to digital generator.

2 Press **DSI Config**, to change the selected display screen to DSI output configuration page.

3 Press **DSI Config > Format**, and select **DSP** as the DSI output format.

4 Press **DSI Config > Sample Rate**, and set the sampling rate to **192 kHz**.

5 Press **DSI Config > Word Length**, and set the DSI word length to **24**.[1][2]

6 Press **DSI Config > Multiplier**, and set the DSI multiplier to **192**.[3]

[1] Sampling rate constrains the DSI word length values. Refer to “Appendix I: Word Length, Sampling Rate, and Multiplier for DSI” on page 305 for the range of word length that can be set with different sampling rate.

[2] When setting the word length, the error message, **–221,"Settings conflict..."** may be generated. This error message can be ignored as this is to notify that the word length or multiplier is auto adjusted to the nearest allowable value due to the settings conflict.

[3] Sampling rate and word length constrain the multiplier values. Refer to “Appendix I: Word Length, Sampling Rate, and Multiplier for DSI” on page 305 for the range of multiplier that can be set with different DSI word length and sampling rate.

Appendix H: Relationship between Digital Waveform Parameters and Channels

Table A-6 Relationship between digital waveform parameters and channels

Waveform	Parameter	Channel
Sine	Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 can be different
	DC Offset	Channel 1 and Channel 2 are the same
Stereo	Frequency	Channel 1 and Channel 2 can be different
	Amplitude	Channel 1 and Channel 2 can be different
	DC Offset	Channel 1 and Channel 2 are the same
Square	Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 can be different
	DC Offset	Channel 1 and Channel 2 are the same
Sine burst	Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 can be different
	Burst On	Channel 1 and Channel 2 are the same
	Period	Channel 1 and Channel 2 are the same
	Low Level	Channel 1 and Channel 2 are the same
Variable phase	Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 can be different
	Phase ⟶ 1	Channel 1 and Channel 2 are the same
Dual	Frequency 1	Channel 1 and Channel 2 are the same
	Frequency 2	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 are the same
	Ratio	Channel 1 and Channel 2 are the same
	DC Offset	Channel 1 and Channel 2 are the same
SMPTE IMD 1:1/ 4:1/ 10:1	Lower Frequency	Channel 1 and Channel 2 are the same
	Upper Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 are the same
	DC Offset	Channel 1 and Channel 2 are the same

Table A-6 Relationship between digital waveform parameters and channels (continued)

Waveform	Parameter	Channel
DFD IEC 60118	Difference Frequency	Channel 1 and Channel 2 are the same
	Upper Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 are the same
	DC Offset	Channel 1 and Channel 2 are the same
DFD IEC 60268	Difference Frequency	Channel 1 and Channel 2 are the same
	Center Frequency	Channel 1 and Channel 2 are the same
	Amplitude	Channel 1 and Channel 2 are the same
	DC Offset	Channel 1 and Channel 2 are the same
Gaussian/ Rectangular/ Triangular/Pink	Amplitude	Channel 1 and Channel 2 can be different
	DC Offset	Channel 1 and Channel 2 are the same
Constant	Amplitude	Channel 1 and Channel 2 are the same
Multitone	Amplitude	Channel 1 and Channel 2 can be different
	Start Frequency	Channel 1 and Channel 2 can be different
	Stop Frequency	Channel 1 and Channel 2 can be different
	Frequency Spacing	Channel 1 and Channel 2 can be different
	Count	Channel 1 and Channel 2 can be different
	Crest Factor	Channel 1 and Channel 2 can be different
	Clear All Tones	Channel 1 and Channel 2 can be different
	Add Tone	Channel 1 and Channel 2 can be different
	Delete Tone	Channel 1 and Channel 2 can be different
	Tone Frequency	Channel 1 and Channel 2 can be different
	Tone Amplitude	Channel 1 and Channel 2 can be different
	Tone Phase	Channel 1 and Channel 2 can be different
	Randomize Tone Phase	Channel 1 and Channel 2 can be different
Arbitrary	Amplitude	Channel 1 and Channel 2 can be different
	DC Offset	Channel 1 and Channel 2 are the same

Appendix I: Word Length, Sampling Rate, and Multiplier for DSI

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI

≤ Sampling rate (kHz)[1]	Word length	Multiplier
400	8	128
400	9	72, 144
400	10	80, 160
400	11	88, 176
400	12	96, 192
400	13	104, 208
400	14	112, 224
400	15	120, 240
400	16	64, 128
400	17	68, 136
400	18	72, 144
400	19	76, 152
400	20	80, 160
400	21	84, 168
400	22	88, 176
400	23	92, 184
400	24	96, 192
400	25	100, 200
400	26	104, 208
400	27	108, 216
400	28	112, 224
400	29	116, 232
400	30	120, 240

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
400	31	124, 248
400	32	128
200	8	128, 256
200	9	72, 144, 288
200	10	80, 160, 320
200	11	88, 176, 352
200	12	96, 192, 384
200	13	104, 208, 416
200	14	112, 224, 448
200	15	120, 240, 480
200	16	64, 128, 256
200	17	68, 136, 272
200	18	72, 144, 288
200	19	76, 152, 304
200	20	80, 160, 320
200	21	84, 168, 336
200	22	88, 176, 352
200	23	92, 184, 368
200	24	96, 192, 384
200	25	100, 200, 400
200	26	104, 208, 416
200	27	108, 216, 432
200	28	112, 224, 448
200	29	116, 232, 464
200	30	120, 240, 480

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
200	31	124, 248, 496
200	32	128, 256
100	8	128, 256, 512
100	9	72, 144, 288, 576
100	10	80, 160, 320, 640
100	11	88, 176, 352, 704
100	12	96, 192, 384, 768
100	13	104, 208, 416, 832
100	14	112, 224, 448, 896
100	15	120, 240, 480, 960
100	16	64, 128, 256, 512
100	17	68, 136, 272, 544
100	18	72, 144, 288, 576
100	19	76, 152, 304, 608
100	20	80, 160, 320, 640
100	21	84, 168, 336, 672
100	22	88, 176, 352, 704
100	23	92, 184, 368, 736
100	24	96, 192, 384, 768
100	25	100, 200, 400, 800
100	26	104, 208, 416, 832
100	27	108, 216, 432, 864
100	28	112, 224, 448, 896
100	29	116, 232, 464, 928
100	30	120, 240, 480, 960

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
100	31	124, 248, 496, 992
100	32	128, 256, 512
50	8	128, 256, 512, 1024
50	9	72, 144, 288, 576
50	10	80, 160, 320, 640
50	11	88, 176, 352, 704
50	12	96, 192, 384, 768
50	13	104, 208, 416, 832
50	14	112, 224, 448, 896
50	15	120, 240, 480, 960
50	16	64, 128, 256, 512
50	17	68, 136, 272, 544
50	18	72, 144, 288, 576
50	19	76, 152, 304, 608
50	20	80, 160, 320, 640
50	21	84, 168, 336, 672
50	22	88, 176, 352, 704
50	23	92, 184, 368, 736
50	24	96, 192, 384, 768
50	25	100, 200, 400, 800
50	26	104, 208, 416, 832
50	27	108, 216, 432, 864
50	28	112, 224, 448, 896
50	29	116, 232, 464, 928
50	30	120, 240, 480, 960

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
50	31	124, 248, 496, 992
50	32	128, 256, 512, 1024
25	8	128, 256, 512, 1024
25	9	72, 144, 288, 576
25	10	80, 160, 320, 640
25	11	88, 176, 352, 704
25	12	96, 192, 384, 768
25	13	104, 208, 416, 832
25	14	112, 224, 448, 896
25	15	120, 240, 480, 960
25	16	64, 128, 256, 512
25	17	68, 136, 272, 544
25	18	72, 144, 288, 576
25	19	76, 152, 304, 608
25	20	80, 160, 320, 640
25	21	84, 168, 336, 672
25	22	88, 176, 352, 704
25	23	92, 184, 368, 736
25	24	96, 192, 384, 768
25	25	100, 200, 400, 800
25	26	104, 208, 416, 832
25	27	108, 216, 432, 864
25	28	112, 224, 448, 896
25	29	116, 232, 464, 928
25	30	120, 240, 480, 960

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
25	31	124, 248, 496, 992
25	32	128, 256, 512, 1024
12.5	8	128, 256, 512, 1024
12.5	9	72, 144, 288, 576
12.5	10	80, 160, 320, 640
12.5	11	88, 176, 352, 704
12.5	12	96, 192, 384, 768
12.5	13	104, 208, 416, 832
12.5	14	112, 224, 448, 896
12.5	15	120, 240, 480, 960
12.5	16	64, 128, 256, 512
12.5	17	68, 136, 272, 544
12.5	18	72, 144, 288, 576
12.5	19	76, 152, 304, 608
12.5	20	80, 160, 320, 640
12.5	21	84, 168, 336, 672
12.5	22	88, 176, 352, 704
12.5	23	92, 184, 368, 736
12.5	24	96, 192, 384, 768
12.5	25	100, 200, 400, 800
12.5	26	104, 208, 416, 832
12.5	27	108, 216, 432, 864
12.5	28	112, 224, 448, 896
12.5	29	116, 232, 464, 928
12.5	30	120, 240, 480, 960

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
12.5	31	124, 248, 496, 992
12.5	32	128, 256, 512, 1024
6.75	8	128, 256, 512, 1024
6.75	9	72, 144, 288, 576
6.75	10	80, 160, 320, 640
6.75	11	88, 176, 352, 704
6.75	12	96, 192, 384, 768
6.75	13	104, 208, 416, 832
6.75	14	112, 224, 448, 896
6.75	15	120, 240, 480, 960
6.75	16	128, 256, 512
6.75	17	136, 272, 544
6.75	18	144, 288, 576
6.75	19	152, 304, 608
6.75	20	160, 320, 640
6.75	21	168, 336, 672
6.75	22	176, 352, 704
6.75	23	184, 368, 736
6.75	24	192, 384, 768
6.75	25	200, 400, 800
6.75	26	208, 416, 832
6.75	27	216, 432, 864
6.75	28	224, 448, 896
6.75	29	116, 232, 464, 928
6.75	30	120, 240, 480, 960

Table A-7 Word Length, Sampling Rate, and Multiplier for DSI (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
6.75	31	124, 248, 496, 992
6.75	32	128, 256, 512, 1024

[1] For sampling rate less than or equal to.

Appendix J: Word Length, Sampling Rate, and Multiplier for Master Clock In

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In

≤ Sampling rate (kHz)[1]	Word length	Multiplier
400	8	64, 128
400	9	72, 144
400	10	80, 160
400	11	88
400	12	96
400	13	104
400	14	112
400	15	120
400	16	64, 128
400	17	68, 136
400	18	72, 144
400	19	76
400	20	80
400	21	84
400	22	88
400	23	92
400	24	96, 192
400	25	100
400	26	104
400	27	108
400	28	112

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
400	29	116
400	30	120
400	31	124
400	32	128
200	8	64, 128, 256
200	9	72, 144, 288
200	10	80, 160
200	11	88, 176
200	12	96, 192
200	13	104, 208
200	14	112, 224
200	15	120, 240
200	16	64, 128, 256
200	17	68, 136, 272
200	18	72, 144, 288
200	19	76, 152
200	20	80, 160
200	21	84, 168
200	22	88, 176
200	23	92, 184
200	24	96, 192
200	25	100, 200
200	26	104, 208
200	27	108, 216

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
200	28	112, 224
200	29	116, 232
200	30	120, 240
200	31	124, 248
200	32	128, 256
100	8	64, 128, 256, 512
100	9	72, 144, 288, 576
100	10	80, 160, 320
100	11	88, 176, 352
100	12	96, 192, 384
100	13	104, 208, 416
100	14	112, 224, 448
100	15	120, 240, 480
100	16	64, 128, 256, 512
100	17	68, 136, 272, 544
100	18	72, 144, 288, 576
100	19	76, 152, 304
100	20	80, 160, 320
100	21	84, 168, 336
100	22	88, 176, 352
100	23	92, 184, 368
100	24	96, 192, 384
100	25	100, 200, 400
100	26	104, 208, 416

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
100	27	108, 216, 432
100	28	112, 224, 448
100	29	116, 232, 464
100	30	120, 240, 480
100	31	124, 248, 496
100	32	128, 256, 512
50	8	64, 128, 256, 512
50	9	72, 144, 288, 576
50	10	80, 160, 320, 640
50	11	88, 176, 352, 704
50	12	95, 192, 384, 768
50	13	104, 208, 416, 832
50	14	112, 224, 448, 896
50	15	120, 240, 480, 960
50	16	64, 128, 256, 512
50	17	68, 136, 272, 544
50	18	72, 144, 288, 576
50	19	76, 152, 304, 608
50	20	80, 160, 320, 640
50	21	84, 168, 336, 672
50	22	88, 176, 352, 704
50	23	92, 184, 368, 736
50	24	96, 192, 384, 768
50	25	100, 200, 400, 800

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
50	26	104, 208, 416, 832
50	27	108, 216, 432, 864
50	28	112, 224, 448, 896
50	29	116, 232, 464, 928
50	30	120, 240, 480, 960
50	31	124, 248, 496, 992
50	32	128, 256, 512
25	8	64, 128, 256, 512
25	9	72, 144, 288, 576
25	10	80, 160, 320, 640
25	11	88, 176, 352, 704
25	12	96, 192, 384, 768
25	13	104, 208, 416, 832
25	14	112, 224, 448, 896
25	15	120, 240, 480, 960
25	16	64, 128, 256, 512
25	17	136, 272, 544
25	18	72, 144, 288, 576
25	19	152, 304, 608
25	20	80, 160, 320, 640
25	21	168, 336, 672
25	22	88, 176, 352, 704
25	23	184, 368, 736
25	24	96, 192, 384, 768

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
25	25	200, 400, 800
25	26	104, 208, 416, 832
25	27	216, 432, 864
25	28	112, 224, 448, 896
25	29	232, 464, 928
25	30	120, 240, 480, 960
25	31	248, 496, 992
25	32	128, 256, 512
12.5	8	64, 128, 256, 512
12.5	9	144, 288, 576
12.5	10	80, 160, 320, 640
12.5	11	176, 352, 704
12.5	12	96, 192, 384, 768
12.5	13	208, 416, 832
12.5	14	112, 224, 448, 896
12.5	15	240, 480, 960
12.5	16	64, 128, 256, 512
12.5	17	272, 544
12.5	18	144, 288, 576
12.5	19	304, 608
12.5	20	160, 320, 640
12.5	21	336, 672
12.5	22	176, 352, 704
12.5	23	368, 736

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
12.5	24	192, 384, 768
12.5	25	400, 800
12.5	26	208, 416, 832
12.5	27	432, 864
12.5	28	224, 448, 896
12.5	29	464, 928
12.5	30	240, 480, 960
12.5	31	496, 992
12.5	32	128, 256, 512
6.75	8	64, 128, 256, 512
6.75	9	288, 576
6.75	10	160, 320, 640
6.75	11	352, 704
6.75	12	192, 384, 768
6.75	13	416, 832
6.75	14	224, 448, 896
6.75	15	480, 960
6.75	16	64, 128, 256, 512
6.75	17	544
6.75	18	288, 576
6.75	19	608
6.75	20	320, 640
6.75	21	672
6.75	22	352, 704

Table A-8 Word Length, Sampling Rate, and Multiplier for Master Clock In (continued)

≤ Sampling rate (kHz)[1]	Word length	Multiplier
6.75	23	736
6.75	24	384, 768
6.75	25	800
6.75	26	416, 832
6.75	27	864
6.75	28	448, 896
6.75	29	928
6.75	30	480, 960
6.75	31	992
6.75	32	128, 256, 512

[1] For sampling rate less than or equal to.

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Tenth Edition, June 2, 2014
U8903-90030

Agilent Technologies