U8903B
Performance Audio Analyzer

KEYSIGHT

SERVICE GUIDE

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CAUTION

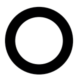
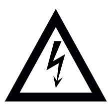
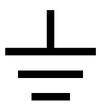
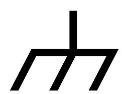
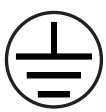
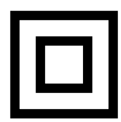
A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood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

WARNING

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

Safety Symbols

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

	Direct current (DC)		Alternating current (AC)
	Off (mains supply)		On (mains supply)
	Caution, risk of electric shock		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	Earth (ground) terminal		Frame or chassis (ground) terminal
	Protective earth (ground) terminal		Equipment protected throughout by double insulation or reinforced insulation

Safety Considerations

Read the information below before using this instrument.

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

WARNING

- Do not use the device if it is damaged. Before you use the device, inspect the casing. Look for cracks or missing plastic. Do not operate the device around explosive gas, vapor, or dust.
- Always use the device with the cables provided.
- Observe all markings on the device before establishing any connection.
- Turn off the device and application system power before connecting to the I/O terminals.
- When servicing the device, use only the specified replacement parts.
- Do not operate the device with the cover removed or loosened.
- Use only the power adapter provided by the manufacturer to avoid any unexpected hazards.
- This equipment is under measurement category as below:
  DO NOT CONNECT THE CABLE TO MAINS.

  
  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 device).

CAUTION

- If the device is used in a manner not specified by the manufacturer, the device protection may be impaired.
- Always use dry cloth to clean the device. Do not use ethyl alcohol or any other volatile liquid to clean the device.
- Clean the case with a soft, lint-free, slightly dampened cloth. Do not use detergent, volatile liquids, or chemical solvents.
- Do not permit any blockage of the ventilation holes of the device.

Environmental Conditions

The U8903B 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
Temperature	Operating condition – 0 °C to 55 °C Storage condition – –40 °C to 70 °C
Humidity	Operating condition – 95% RH up to 40 °C, decreases linearly to 45% RH at 55 °C (non-condensing)[a] Storage condition – Up to 95% RH at 40 °C (non-condensing)
Altitude	Up to 3000 m
Pollution degree	2
Installation category	II
Measurement category	CAT (none) 200 Vpk max
Overvoltage protection	II

[a] From 40 °C to 55 °C, the maximum % Relative Humidity follows the line of constant dew point.

WARNING

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE OR WET ENVIRONMENTS
Do not operate the instrument around flammable gases or fumes, vapor, or wet environments.

Regulatory Information

The U8903B complies with the following safety and Electromagnetic Compatibility (EMC) standard:

Safety compliance

- IEC 61010-1/EN 61010-1
- Canada: CAN/CSA-C22.2 No. 61010-1-12
- USA: ANSI/UL Std. No. 61010-1

EMC compliance

- IEC 61326-1/EN61326-1
- Canada: ICES/NMB-001
- Australia/New Zealand: AS/NZS CISPR11

Regulatory Markings

ICES/NMB-001 ISM GRP 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. 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.	C US	The CSA mark is a registered trademark of the Canadian Standards Association.
	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.		The RCM 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.
MSIP-REM-ATI-WCAUD8903B	This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.	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 Keysight Service Center, or visit www.keysight.com/environment/product for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/U8903B
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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1 Performance Verification Overview

This chapter provides an overview on performance verification of the U8903B. It also includes a list of recommended test equipment.

Introduction

This section provides a brief overview for verifying the performance of the U8903B. Performance verifications allow you to verify that the U8903B is operating within its published specifications.

Figure 1-1 illustrates the process flow for carrying out the self-test, performance tests, and repair.

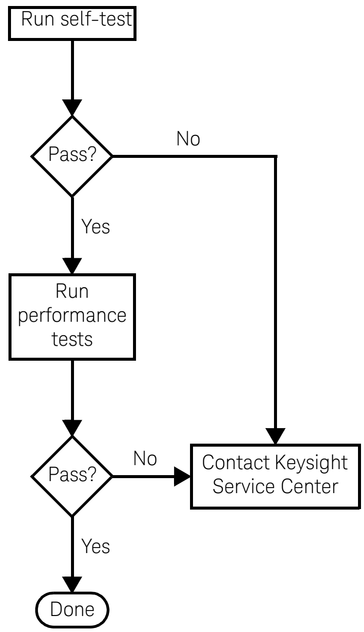

Figure 1-1 Process flow for self-test, performance tests, and repair

Self-Test

A brief power-on self-test occurs automatically whenever you turn on the U8903B. This limited test assures that the U8903B is capable of operation.

If the self-test fails, the error message can be accessed via the front panel. Alternatively, you can send the `SYSTem:ERRor?` query from the remote interface. Refer to the *U8903B Performance Audio Analyzer Programmer's Reference* for more information on the error messages.

Self-test may be initiated remotely by sending the `*TST?` query to the U8903B. Always ensure that the self-test passes before proceeding with any performance verification test.

If all tests pass, you have a high confidence that the U8903B is operational.

Keysight Calibration Services

When your U8903B is due for calibration, contact your local Keysight Service Center for a low-cost recalibration. The U8903B is supported on automated calibration and adjustment systems, which allow Keysight to provide this service at competitive prices.

Calibration Interval

A one-year interval is adequate for most applications. Accuracy specifications are warranted only if calibration is made at regular calibration intervals. Accuracy specifications are not warranted beyond the one-year calibration interval. Keysight does not recommend extending calibration interval beyond the recommended calibration interval for any application.

Recommended Test Equipment

The recommended test equipment for performance verification tests is listed below. If the exact equipment is not available, substitute the calibration standards of equivalent requirement(s).

Table 1-1 Recommended equipment for performance verification tests

Equipment	Recommended model	Critical specification
Digital multimeter	Keysight 3458A	– DC voltage range of 0 V to 10 V or higher – AC voltage range of 0 Vrms to 10 Vrms or higher – 8.5-digit resolution or higher – DC voltage accuracy of 0.3% or higher – AC voltage accuracy of 0.02% or higher
Calibrator	Fluke 5720A	– DC voltage range of 0 V to 150 V or higher – AC voltage range of 0 Vrms to 150 Vrms or higher – Frequency range of 20 Hz to 100 kHz or higher – DC voltage accuracy of 0.2% or higher – AC voltage accuracy of 0.02% or higher
Frequency counter	Keysight 53132A Option 010 Keysight 53220A Option 010	– Frequency range of 50 Hz to 80 kHz – Accuracy of 1 ppm or higher
Oscilloscope	Keysight DSO8064A Keysight DSO8104A	–
50 Ω terminator	–	–
Shorting cap (BNC)	–	–
Computer	–	GPIB/USB/LAN and APIB connections
BNC cable	Keysight U8903B-101	1.2 m
XLR cable	Keysight U8903B-102	2 m
BNC-to-banana jack adapter	–	–
BNC-T adapter	–	–

Test Consideration

For optimum performance, all procedures should comply with the following recommendations:

- Ensure that the calibration ambient temperature is stable and between 18 °C and 28 °C.
- Ensure the ambient relative humidity is less than 80%.
- Allow at least 30 minutes of warm-up period upon power on.
- Use shielded cables only. Keep the cables that connect the test setup as short as possible.
- In the event of a test failure, it is recommended to repeat the test to ensure that procedural error was not made.
- The verification and adjustment procedures are based on the assumption that the recommended test equipment is being used. Substituting with an alternative test equipment may require modification of some procedures.

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2 Performance Verification for Analog Generator

The performance verification procedures described in this chapter verify that the U8903B analog generator is operating within its published specifications.

Introduction

This section lists the procedures to test the electrical performance of the U8903B analog generator using the published specifications given in the *U8903B Performance Audio Analyzer User's Guide (U8903-90045)* as the performance standards.

If the analog generator fails any of the tests or if any abnormal test results are obtained, adjustment will need to be carried out accordingly.

NOTE

– Refer to "**Recommended Test Equipment**" on page 20 for the list of recommended test equipment to be used in the performance tests.

– Use the test records given in "**Appendix A**" on page 83 to tabulate the results of the performance tests.

Performance Verification

DC accuracy verification

This test verifies the accuracy of the DC signal generated by the U8903B over a range of amplitudes using two digital multimeters to ensure that it is within the published specification.

Table 2-1 DC accuracy specification

DC accuracy specification	Equipment used
±1.0%	2 × Digital multimeter

1 Connect the U8903B Unbalanced output channel 1 to the first digital multimeter and Unbalanced output channel 2 to the second digital multimeter as shown in **Figure 2-1**. The BNC-to-banana jack adapter is used for this connection. Preset both the U8903B and digital multimeters.

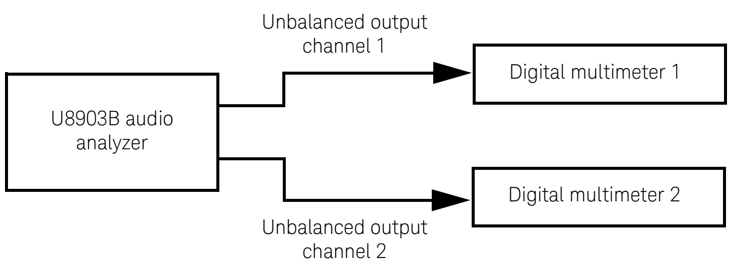

Figure 2-1 U8903B to digital multimeter connections for DC accuracy verification

2 Configure the digital multimeter as follows:

- Measurement function: DC voltage
- Level filter: Enabled
- NPLC: 10
- Number readings: 1 (with auto sample event)
- Trigger arming: Hold (suspend)
- Trigger mode: Auto
- Range: Refer to "**Test record for DC accuracy verification**" on page 84

3 Configure the U8903B output channels to be tested as follows:

- Connection type: Unbalanced
- Output impedance: 600 Ω

- Output grounding configuration: Floating ground
- Waveform: DC
- Output state: ON

4 Set both the U8903B output channel 1 and channel 2 to be tested to produce DC voltage with amplitude of V_{DUT} as given in the "**Test record for DC accuracy verification**" on page 84.

5 Set both the digital multimeters' range as given in the "**Test record for DC accuracy verification**" on page 84.

6 Enable the U8903B output channels.

7 Record the DC voltage measurement on both the digital multimeters, V_{DMM} in the "**Test record for DC accuracy verification**" on page 84.

8 Compute the DC accuracy using the following equation:

$$DC\ accuracy = (V_{DMM} - V_{DUT}) / V_{DUT} \times 100$$

9 Repeat **step 4** to **step 8** for the rest of the V_{DUT} values to complete the verification of the U8903B output channels to be tested.

10 Compare the recorded DC accuracy values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Sine wave amplitude accuracy and flatness verification

This test verifies the accuracy of the sine wave voltage amplitude generated by the U8903B over a range of amplitudes and flatness swept over a set of frequencies using two digital multimeters to ensure that it is within the published specification.

Table 2-2 Sine wave amplitude accuracy and flatness specifications

AC accuracy specification	Flatness specification	Equipment used
±1.0% (1 kHz)	– ±0.008 dB (from 5 Hz to 20 kHz) – ±0.08 dB (from 20 kHz to 80 kHz)	2 × Digital multimeter

NOTE Power up the U8903B for at least 30 minutes before performing the sine wave amplitude accuracy and flatness verification.

1 Connect the U8903B generator Unbalanced output channel 1 to the first digital multimeter and Unbalanced output channel 2 to the second digital multimeter as shown in **Figure 2-2**. Coaxial cables with BNC connectors are used for this connection. Preset both the U8903B and digital multimeters.

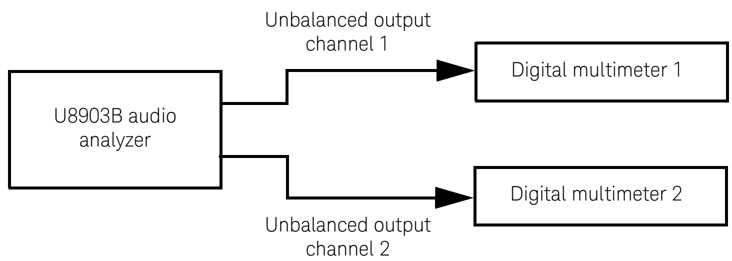

Figure 2-2 U8903B to digital multimeter connections for sine wave amplitude accuracy and flatness verification

2 Configure the digital multimeter as follows:
   - Measurement function: AC voltage
   - Level filter: Enabled
   - NPLC: 10
   - Number readings: 1 (with auto sample event)
   - Trigger arming: Hold (suspend)
   - Trigger mode: Auto
   - ACV mode: Synchronous sub-sampled
   - Range: Refer to “**Test record for sine wave amplitude accuracy verification**” on page 86
3 Configure the U8903B generator output channels to be tested as follows:
   - Connection type: Unbalanced
   - Output impedance: 600 Ω
   - Output grounding configuration: Floating ground
   - Waveform: Sine
   - Output state: ON
4 Set both the U8903B output channel 1 and channel 2 to be tested to output a frequency of 1000 Hz.
5 Set both the U8903B output channel 1 and channel 2 to be tested to output an amplitude of V_{DUT} as given in the “**Test record for sine wave amplitude accuracy verification**” on page 86.
6 Set both the digital multimeters’ range as given in the “**Test record for sine wave amplitude accuracy verification**” on page 86.
7 Enable the U8903B output channels.

8 Trigger AC voltage measurements on both the digital multimeters and record the readings as V_{DMM} in the "**Test record for sine wave amplitude accuracy verification**" on page 86.

9 Compute the AC voltage error percentage for both measurement readings using the following equation:

$$AC\ voltage\ error\ (\%) = (V_{DMM} - V_{DUT}) / V_{DUT} \times 100$$

10 Repeat **step 5** to **step 9** for the rest of the V_{DUT} to complete the verification of the U8903B output channel to be tested.

11 Disable the output of U8903B.

12 Set both the U8903B output channel 1 and channel 2 to be tested to output an amplitude of 1 V.

13 Set both the U8903B output channel 1 and channel 2 to be tested to output a frequency of 1000 Hz (first frequency point in "**Test record for flatness verification**" on page 87).

14 Set both the digital multimeters' range to 1 V.

15 Enable the U8903B output channels.

16 Trigger AC voltage measurements on both the digital multimeters and record the readings as V_{REF}.

17 Set both the U8903B output channel 1 and channel 2 to be tested to output the subsequent frequencies as given in "**Test record for flatness verification**" on page 87.

18 Trigger and record the AC voltage measurements on both the digital multimeters as V_{DMM}.

19 Compute the flatness using the following equation:

$$Flatness\ (dB) = 20 \times \log_{10} (V_{DMM} / V_{REF})$$

20 Repeat **step 17** to **step 19** for the rest of the frequencies to complete the verification of the U8903B output channel to be tested.

21 Compare the recorded AC accuracy and flatness values to the specifications. If the test fails, adjustment will need to be carried out accordingly.

Sine wave frequency accuracy verification

This test verifies the sine wave frequency accuracy of the signal generated by the U8903B using a frequency counter to ensure that it is within the published specification.

Table 2-3 Frequency accuracy specifications

Frequency accuracy specification	Equipment used
± (2 ppm + 100 μHz)	Frequency counter

1 Connect the U8903B Unbalanced output channel 1 to the frequency counter channel 1 and Unbalanced output channel 2 to the frequency counter channel 2 as shown in **Figure 2-3**. Preset both the U8903B and the frequency counter.

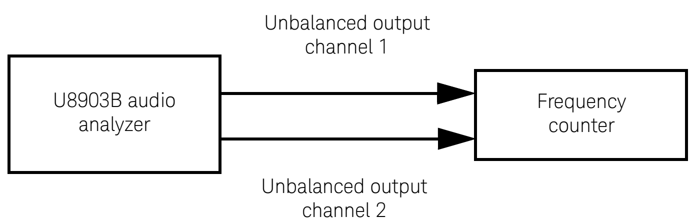

Figure 2-3 U8903B to frequency counter connections for frequency accuracy verification

2 Configure the frequency counter input channels as follows:

- If frequency counter model is 53220A, set SCPI language mode: 53132A
- Impedance: 1 MΩ
- Low pass filter: ON
- Input coupling: DC
- Level at center of hysteresis window: 0 V
- Trigger level percentage of signal peak-to-peak range: 50%
- Reference timebase: Internal reference
- Measurement function: Channel 1 frequency
- Frequency measurement start arm mode: Immediate
- Frequency measurement stop arm mode: Timer

3 Configure the U8903B output channels to be tested as follows:

- Connection type: Unbalanced
- Output impedance: 600 Ω
- Output grounding configuration: Floating ground

- Waveform: Sine
- Output amplitude: 1 Vrms
- Output state: ON

4 Set both the U8903B output channel 1 and channel 2 to be tested to produce a sine wave with amplitude of 1 Vrms and frequency of f_{DUT} as given in the "**Test record for frequency accuracy verification**" on page 88.

5 Set the frequency counter gate time to the appropriate setting as given in the "**Test record for frequency accuracy verification**" on page 88.

6 Enable the U8903B output channel 1 and record the frequency measurement on the frequency counter, f_{FC} channel 1 in the "**Test record for frequency accuracy verification**" on page 88.

7 Enable the U8903B output channel 2 and record the frequency measurement on the frequency counter, f_{FC} channel 2 in the "**Test record for frequency accuracy verification**" on page 88.

8 Compute the frequency accuracy using the following equation:

$$Frequency\ accuracy = (f_{FC} - f_{DUT} / f_{DUT}) \times 1000000$$

9 Repeat **step 4** to **step 8** for the rest of the f_{DUT} values to complete the verification of the U8903B output channel to be tested.

10 Compare the recorded frequency accuracy values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Crosstalk verification

This test measures the leakage caused by stray capacitance and inductance coupling between the generator output channels of the U8903B using an external loopback connection.

Table 2-4 Crosstalk specification

Crosstalk specification	Equipment used
≤–130 dB + 0.1 µV (from 20 Hz to 20 kHz)	U8903B (external loopback)

1 Connect the U8903B Unbalanced output channel 1 and channel 2 to its own Unbalanced input channel 1 and channel 2 as shown in **Figure 2-4**. Preset the U8903B audio analyzer.

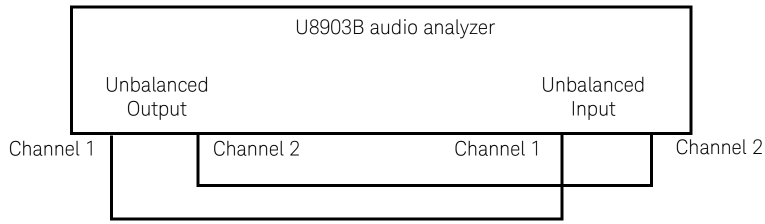

Figure 2-4 U8903B audio analyzer connections for crosstalk verification

2 Configure the U8903B generator output channels as follows:

- Connection type: Unbalanced
- Output impedance: 600 Ω
- Output grounding configuration: Floating ground
- Waveform: Sine
- Output state: OFF

3 Configure the U8903B analyzer input channels as follows:

- Connection type: Unbalanced
- Input bandwidth: 90 kHz
- Input coupling: DC
- Voltage detector type: RMS
- Trigger source: Immediate
- Multi-channel function: Crosstalk
- Sample size: 131072

4 The first test will measure the generator crosstalk from channel 1 to channel 2 in which the Driving channel is channel 1 and the Measured channel is channel 2.

5 Set the U8903B analyzer Driving channel as the reference channel and the analyzer input range of Vrms as given in the "**Test record for crosstalk verification**" on page 88.

6 Set the U8903B analyzer Measured channel input impedance to 300 Ω and analyzer input range to 0.32 Vrms.

7 On the U8903B generator, set the Driving channel output amplitude of Vrms as given in the "**Test record for crosstalk verification**" on page 88 and the Measured channel output amplitude to 0 Vrms.

8 Set the U8903B generator Driving and Measured channel frequency of f_{DUT} as given in the "**Test record for crosstalk verification**" on page 88.

9 Set the Driving channel output state to ON and the Measured channel output state to OFF.

10 On the U8903B analyzer, enable the output for both the Driving and Measured channels.

11 Record the crosstalk measurement obtained from the Measured channel in the “**Test record for crosstalk verification**” on page 88.

12 Repeat **step 5** to **step 11** for the rest of the frequency, analyzer input range, and generator output amplitude combinations to complete the verification of the U8903B output channels to be tested.

13 Repeat **step 4** to **step 12** to measure the generator crosstalk from channel 2 to channel 1 in which the Driving channel is channel 2 and the Measured channel is channel 1.

14 Compare the recorded crosstalk measurement values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Square wave rise time verification

In this test, the U8903B generates a square wave swept over a set of frequencies, and the rise time is measured using a Keysight DSO8064A/8104A digital oscilloscope to ensure that it is within the published specification.

Table 2-5 Square wave rise time specification

Rise time specification	Equipment used
<2 µs	Keysight DSO8064A/8104A digital oscilloscope

1 Connect the U8903B Unbalanced output channel 1 to the digital oscilloscope channel 1 and Unbalanced output channel 2 to the digital oscilloscope channel 2 as shown in **Figure 2-5**. Preset both the U8903B and the digital oscilloscope.

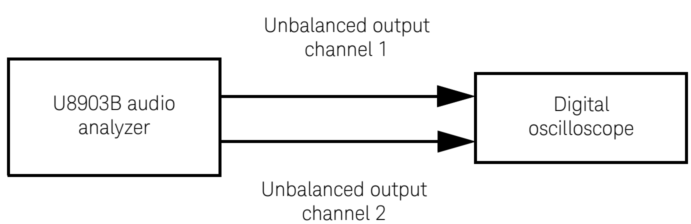

Figure 2-5 U8903B to oscilloscope connections for square wave rise time verification

2 Configure the digital oscilloscope as follows:

– Trigger mode: Edge

– Edge trigger slope: Positive

– Channel 1 offset: 0

- Channel 1 vertical axis unit: Volt
- Channel 2 offset: 0
- Channel 2 vertical axis unit: Volt

3 Configure the U8903B output channels to be tested as follows:

- Connection type: Unbalanced
- Output impedance: 600 Ω
- Output grounding configuration: Floating ground
- Waveform: Square
- Output state: ON

4 Set the U8903B output channel 1 and 2 to be tested to produce a square wave with amplitude of $V_{p\text{-}p}$ as given in the "**Test record for square wave rise time verification**" on page 89.

5 Set the U8903B output channel 1 and 2 with the frequency of f_{DUT} as given in the "**Test record for square wave rise time verification**" on page 89.

6 Configure the digital oscilloscope for measurement channel 1 as follows:

- Adjacent channel display (channel 2): OFF
- Measurement channel display (channel 1): ON
- Edge trigger source: Measurement channel (channel 1)
- Source for measurement: Measurement channel (channel 1)
- Time scale (time per division): Refer to "**Test record for square wave rise time verification**" on page 89
- Measured channel vertical scale (volts per division): Refer to "**Test record for square wave rise time verification**" on page 89

7 Enable the U8903B output channel 1.

8 Record the rise time measurement on the digital oscilloscope, t_{rise} for channel 1 in the "**Test record for square wave rise time verification**" on page 89.

9 Repeat **step 6** to **step 8** for the output channel 2.

10 Repeat **step 5** to **step 9** for the rest of the frequency f_{DUT} values.

11 Repeat **step 4** to **step 10** for the rest of the amplitude V_{DUT} values to complete the verification of the U8903B output channel to be tested.

12 Compare the recorded rise time measurement values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Square wave amplitude accuracy verification

This test verifies the amplitude accuracy of the square wave signal generated by the U8903B over a range of amplitudes using two digital multimeters to ensure that it is within the published specification.

Table 2-6 Square wave amplitude accuracy specification

Amplitude accuracy specification	Equipment used
±1% (for 1 kHz)	2 × Digital multimeter

1 Connect the U8903B Unbalanced output channel 1 to the first digital multimeter and Unbalanced output channel 2 to the second digital multimeter as shown in **Figure 2-6**. Preset both the U8903B and digital multimeters.

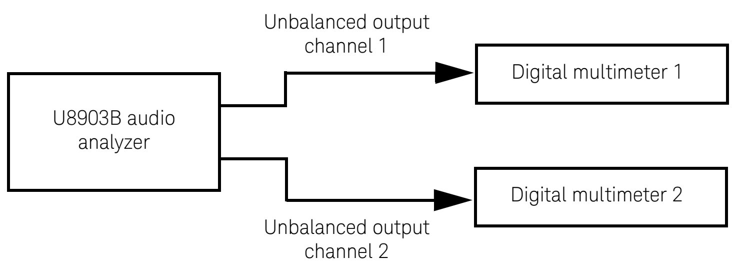

Figure 2-6 U8903B to digital multimeter connections for square wave amplitude accuracy verification

2 Configure the digital multimeters as follows:
   - Measurement function: AC voltage
   - Level filter: Enabled
   - NPLC: 10
   - Number readings: 1 (with auto sample event)
   - Trigger arming: Hold (suspend)
   - Trigger mode: Auto
   - ACV Mode: Synchronous Sub-sampled
   - Range: Refer to “**Test record for square wave amplitude accuracy verification**” on page 90

3 Configure the U8903B output channels to be tested as follows:
   - Connection type: Unbalanced
   - Output impedance: 600 Ω
   - Output grounding configuration: Floating ground

– Waveform: Square
– Output state: ON

4 Set both the U8903B output channels to be tested to produce a square wave with amplitude of V_{DUT} and frequency of 1 kHz as given in the “**Test record for square wave amplitude accuracy verification**” on page 90.

5 Set both the digital multimeter range as given in the “**Test record for square wave amplitude accuracy verification**” on page 90.

6 Enable the U8903B output channels.

7 Record the sine wave amplitude voltage measurement on the digital multimeters, V_{DMM} in the “**Test record for square wave amplitude accuracy verification**” on page 90.

8 Compute the square wave amplitude accuracy using the following equation:

$$\textit{Sine wave amplitude accuracy} = (V_{DMM} - V_{DUT}) / V_{DUT} \times 100$$

9 Repeat **step 4** to **step 8** for the rest of the V_{DUT} to complete the verification of the U8903B output channel to be tested.

10 Compare the recorded amplitude measurement values to the specification. If the test fails, adjustment will need to be carried out accordingly.

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3 Performance Verification for Analog Analyzer

The performance verification procedures described in this chapter verify that the U8903B analog analyzer is operating within its published specifications.

Introduction

This section lists the procedures to test the electrical performance of the U8903B analog analyzer using the published specifications given in the *U8903B Performance Audio Analyzer User's Guide (U8903-90045)* as the performance standards.

If the analog analyzer fails any of the tests or if any abnormal test results are obtained, adjustment will need to be carried out accordingly.

NOTE

– Refer to "**Recommended Test Equipment**" on page 20 for the list of recommended test equipment to be used in the performance tests.

– Use the test records given in "**Appendix A**" on page 83 to tabulate the results of the performance tests.

Performance Verification

DC accuracy verification

This test verifies the DC accuracy of the U8903B analyzer by measuring a range of DC voltage amplitudes supplied by a calibrator to ensure that it is within the published specification.

Table 3-1 DC accuracy specification

DC accuracy specification	Equipment used
±1%	Calibrator

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Connect the calibrator to the U8903B input channel to be tested via the Unbalanced connection as shown in **Figure 3-1**. The BNC-to-banana jack adapter and the BNC male-to-female T splitter is used for this connection. Preset both the U8903B and calibrator.

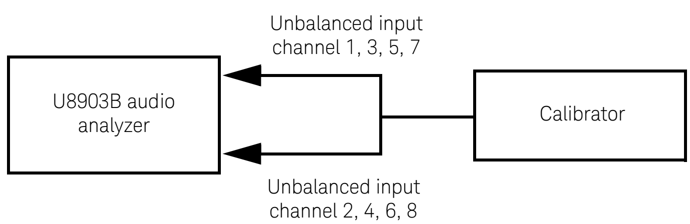

Figure 3-1 Calibrator to U8903B connection for DC accuracy verification

2 Configure the calibrator as follows:
   - Output state: Standby

3 Configure the U8903B input channels, channel 1 (3, 5, or 7) and channel 2 (4, 6, or 8) as shown in **Figure 3-1** to be tested as follows:
   - Connection type: Unbalanced
   - Input bandwidth: 90 kHz
   - Input coupling: DC
   - Voltage detector type: RMS

- Trigger source: Immediate
- Function 2: DC Voltage
- Sample size: 131072
- Input range: Refer to "**Test record for DC accuracy verification**" on page 91

4 Set the calibrator to produce DC voltage with amplitude of V_{IN} as given in the "**Test record for DC accuracy verification**" on page 91.

5 Enable the calibrator output by setting the calibrator output state to Operate.

6 Record the DC voltage measurement on the U8903B, V_{DUT} in the "**Test record for DC accuracy verification**" on page 91.

7 Compute the DC accuracy using the following equation:

$$DC\ accuracy = (V_{DUT} - V_{IN}) / V_{IN} \times 100$$

8 Repeat **step 4** to **step 7** for the rest of the V_{IN} values to complete the verification of the U8903B input channels to be tested.

9 Repeat **step 2** to **step 8** to complete the verification of the remaining U8903B input channels.

10 Compare the recorded DC accuracy values to the specification. If the test fails, adjustment will need to be carried out accordingly.

AC accuracy and flatness verification

This test verifies the AC accuracy and flatness of the U8903B analyzer by measuring a range of amplitudes swept over a set of frequencies supplied by a calibrator, to ensure that it is within the published specification.

Table 3-2 AC accuracy and flatness specifications

AC accuracy specification	Flatness specification	Equipment used
±0.03 dB (1 kHz)	±0.008 dB (for 20 Hz to 20 kHz) ±0.08 dB (for 20 kHz to 80 kHz) ±0.1 dB (for ≤96 kHz)	Calibrator

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Connect the calibrator to the U8903B input channels to be tested via the Unbalanced connection as shown in **Figure 3-2**. The BNC-to-banana jack adapter and the BNC male-to-female T splitter are used for this connection. Preset both the U8903B and calibrator.

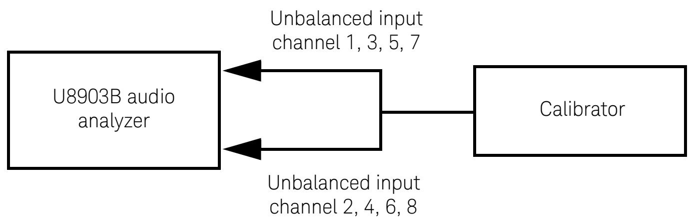

Figure 3-2 Calibrator to U8903B connection for AC accuracy and flatness verification

2 Configure the calibrator as follows:
   - Output state: Standby

3 Configure the U8903B input channels, channel 1 (3, 5, or 7) and channel 2 (4, 6, or 8) as shown in **Figure 3-2** to be tested as follows:
   - Connection type: Unbalanced
   - Input bandwidth: 90 kHz
   - Input coupling: DC
   - Voltage detector type: RMS
   - Trigger source: Immediate
   - Function 2: AC Voltage
   - Sample size: 262144 for 50 Hz and below, and 65536 for 50 Hz and above
   - Input range: Refer to “**Test record for AC accuracy and flatness verification**” on page 92

4 Set the calibrator to produce a sine wave voltage with amplitude of V_{IN} and frequency of f_{IN} as given in the “**Test record for AC accuracy and flatness verification**” on page 92.

5 Enable the calibrator output by setting the calibrator output state to Operate.

6 Record the sine wave voltage measurement on both the U8903B measured channels, V_{DUT} in the “**Test record for AC accuracy and flatness verification**” on page 92.

7 Compute the sine wave accuracy *at 1 kHz* using the following equation:

$$Sine\ wave\ accuracy\ (dB) = 20 \times \log_{10} (V_{DUT} / V_{IN})$$

8 Using the voltage measured at 1 kHz as reference, compute the flatness using the following equation. The frequency response is relative to the amplitude at 1 kHz.

Flatness (dB) = 20 $\times$ *log*$_{10}$ *(*V_{DUT} *at that particular* f_{IN} */* V_{DUT} *at 1 kHz)*

9 Repeat **step 4** to **step 8** for the rest of the frequency f_{IN}.

10 Repeat **step 3** to **step 9** for the rest of V_{IN} to complete the verification of the U8903B input channels to be tested.

11 Compare the recorded AC accuracy and flatness values to the specifications. If the test fails, adjustment will need to be carried out accordingly.

Frequency accuracy verification

This test verifies the frequency accuracy of the U8903B analyzer by using the function generator as a source and the frequency counter as a reference, to ensure that it is within the published specification.

Table 3-3 Frequency accuracy specifications

Frequency accuracy specification	Equipment used
±(2 ppm + 100 µHz) ≤50 kHz ±5 ppm >50 kHz	– Function generator – Frequency counter

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Use three BNC male-to-female T splitters to create a 4-way connection from the function generator output to the U8903B and frequency counter inputs.

2 Connect the function generator outputs to the frequency counter input channel 1 and 2, and to the U8903B unbalanced input channel 1 and 2 as shown in **Figure 3-3**. Preset the U8903B, function generator, and frequency counter.

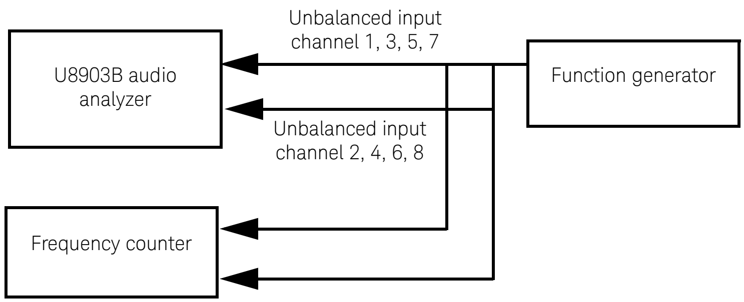

Figure 3-3 Function generator to frequency counter and U8903B connection for frequency accuracy verification

3 Configure the function generator output channel as follows:

- Output load: High-Z load
- Output polarity: Normal
- Waveform function: Sine wave
- Amplitude unit = Vrms
- Amplitude offset = 0 V

4 Configure the frequency counter input channels as follows:

- If frequency counter model is 53220A, set SCPI language mode: 53132A
- Impedance: 1 MΩ
- Low pass filter: ON
- Input coupling: DC
- Level at center of hysteresis window: 0 V
- Trigger level percentage of signal peak-to-peak range: 50%
- Reference timebase: Internal reference
- Measurement function: Channel 1 frequency
- Frequency measurement start arm mode: Immediate
- Frequency measurement stop arm mode: Timer

5 Configure the U8903B input channels to be tested as follows:

- Connection type: Unbalanced
- Input bandwidth: 90 kHz
- Input coupling: DC
- Voltage detector type: RMS
- Trigger source: Immediate

- Function 2: AC Voltage
- Sample size: 262144 for 50 Hz and below, and 131072 for 50 Hz and above

6 Set the function generator to produce a sine wave with amplitude of 1 Vrms and frequency of f_{DUT} as given in the "**Test record for frequency accuracy verification**" on page 97.

7 Set the U8903B input channels sample size as given in the "**Test record for frequency accuracy verification**" on page 97.

8 Set the frequency counter gate time as given in the "**Test record for frequency accuracy verification**" on page 97.

9 Enable the function generator output.

10 Using the `FETC? FUNC1,(@1)` SCPI command for the U8903B, record the frequency measurement on the frequency counter, f_{FC} and the U8903B, f_{Meas} in the "**Test record for frequency accuracy verification**" on page 97.

11 Compute the frequency accuracy of the U8903B using the following equation:

$$Frequency\ accuracy = (f_{Meas} - f_{FC} / f_{FC}) \times 1000000$$

12 Repeat **step 6** to **step 11** for the rest of the f_{DUT} values to complete the verification of the U8903B input channel to be tested.

13 Repeat **step 1** to **step 12** to complete the verification of the other U8903B input channels.

14 Compare the recorded frequency accuracy values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Phase accuracy verification

This test verifies the phase accuracy of the U8903B analyzer by measuring the phase difference of a sine wave generated by a function generator to the input channels of the U8903B.

Table 3-4 Phase accuracy specification

Phase accuracy specification	Equipment used
±2° (for <20 kHz) ±4° (for >20 kHz)	Function generator

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Connect the function generator to the U8903B input channel 1 (3, 5, or 7) and 2 (4, 6, or 8) via the Unbalanced connection as shown in **Figure 3-4**. The BNC-to-banana jack adapter and the BNC male-to-female T splitter is used for this connection. Preset both the U8903B and function generator.

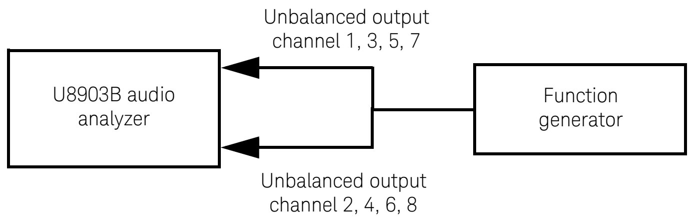

Figure 3-4 Function generator to U8903B connection for phase accuracy verification

2 Configure the function generator as follows:
   - Output Load: High-Z load
   - Output polarity: Normal
   - Waveform function: Sine wave
   - Amplitude unit = Vrms
   - Amplitude offset = 0 V

3 Configure the U8903B input channel 1 (3, 5, or 7) and 2 (4, 6, or 8) as follows:
   - Connection type: Unbalanced
   - Input bandwidth: 90 kHz
   - Input coupling: AC
   - Voltage detector type: RMS
   - Trigger source: Immediate
   - Reference channel: Channel 1 (3, 5, or 7)
   - Multi-channel function: Phase
   - Input Range:1 V
   - Sample size: 131072

4 Set the function generator to produce a sine wave with amplitude of 1 Vrms and frequency of f_{IN} as given in the "**Test record for phase accuracy verification**" on page 97.

5 Enable the function generator output.

6 Record the phase measurement on the U8903B input channel 2 (4, 6, or 8) in the "**Test record for phase accuracy verification**" on page 97.

7 Repeat **step 4** to **step 6** for the rest of the f_{IN} values to complete the verification of the U8903B input channel 2 (4, 6, or 8).

8 Repeat **step 1** to **step 7** to complete the verification of the other U8903B input channels.

9 Compare the recorded phase accuracy values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Crosstalk verification

This test measures the leakage caused by stray capacitance and inductance coupling between the U8903B input channels, to ensure that it is within the published specification. A calibrator is used to generate a sine wave to the U8903B for the crosstalk measurement.

Table 3-5 Crosstalk specification

Crosstalk specification	Equipment used
≤–140 dB (+0.1 µV ≤20 kHz)	– Calibrator – 50 Ω terminator

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Connect the calibrator output to the U8903B input channel to be tested via the Unbalanced connection as shown in **Figure 3-5**. The BNC-to-banana jack adapter is used for this connection. Terminate the adjacent U8903B input channel with a 50 Ω terminator. Preset both the U8903B and calibrator.

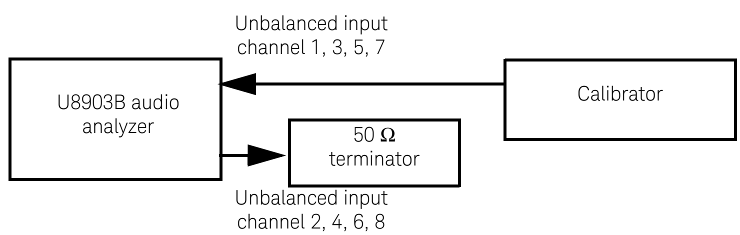

Figure 3-5 Audio generator to U8903B with terminator connection for crosstalk verification

2 Configure the calibrator as follows:

– Output state: Standby

3 Configure the U8903B input channels to be tested as follows:
   - Connection type: Unbalanced
   - Input bandwidth: 90 kHz
   - Input coupling: AC
   - Voltage detector type: RMS
   - Trigger source: Immediate
   - Multi-channel function: Crosstalk
   - Sample size: 131072
4 The first test will measure the analyzer crosstalk from channel 1 (3, 5, or 7) to channel 2 (4, 6, or 8) in which the Driving channel is channel 1 (3, 5, or 7) and the Measured channel is channel 2 (4, 6, or 8).
5 Set the U8903B analyzer Driving channel as the reference channel and the analyzer input range of V as given in the "**Test record for crosstalk verification**" on page 98.
6 Set the U8903B analyzer Measured channel input range to 0.32 V.
7 Set the calibrator to produce a sine wave with amplitude of V_{IN} and frequency of f_{IN} as given in the "**Test record for crosstalk verification**" on page 98.
8 Enable the calibrator output.
9 On the U8903B analyzer, enable both the Driving and Measured channels.
10 Record the crosstalk measurement obtained from the Measured channel in the "**Test record for crosstalk verification**" on page 98.
11 Repeat **step 5** to **step 10** for the rest of the frequency, analyzer input range, and V_{IN} combinations to complete the verification of the U8903B input channels to be tested.
12 Repeat **step 4** to **step 11** to measure the analyzer crosstalk from channel 2 (4, 6, or 8) to channel 1 (3, 5, or 7) in which the Driving channel is channel 2 (4, 6, or 8) and the Measured channel is channel 1 (3, 5, or 7).
13 Repeat **step 1** to **step 12** to complete the verification of the other U8903B input channels.
14 Compare the recorded crosstalk measurement values to the specification. If the test fails, adjustment will need to be carried out accordingly.

CMRR verification

Common Mode Rejection Ratio (CMRR) is the ability of the Balanced U8903B input channel to reject in-phase noise.

This test verifies the CMRR performance of the U8903B analyzer by using a calibrator to generate a sine wave to the U8903B for the CMRR measurement to ensure that it is within the published specification.

Table 3-6 CMRR specification

CMRR specification	Equipment used
≥80 dB (input range ≤3.2 V) ≥50 dB (input range >3.2 V)	Calibrator

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 The BNC male-to-female T splitter and modified BNC coaxial cables with one end a BNC connector (male) and the other end a XLR connector (male) with pin 2 and 3 shorted to carry the same signal is used for this connection. Refer to "**Modify a Cable for the U8903B CMRR test**" on page 148.

2 Connect the calibrator to the U8903B input channels to be tested via the Balanced connection as shown in **Figure 3-6**. Preset both the U8903B and calibrator.

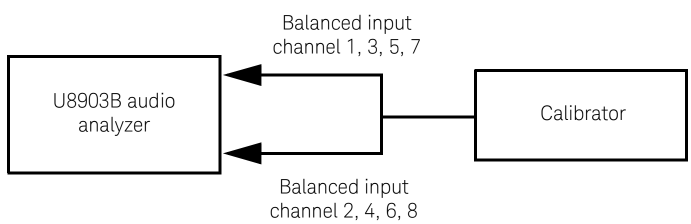

Figure 3-6 Audio generator to U8903B connection for CMRR verification

3 Configure the calibrator as follows:
   - Output state: Standby

4 Configure the U8903B input channel 1 (3, 5, or 7) and channel 2 (4, 6, or 8) to be tested as follows:
   - Connection type: Balanced
   - Input bandwidth: 90 kHz
   - Input coupling: DC

- Function 2: VAC
- Voltage detector type: RMS
- Trigger source: Immediate
- Display view: Graph view
- Graph analysis mode: Magnitude
- FFT windowing: Blackman Harris
- Sample size: 65536
- Graph X-axis spacing: Linear
- Graph trace 1 (3, 5, or 7) State: ON
- Graph trace 2 (4, 6, or 8) State: ON
- Graph Y-axis top limit: -50 dBV
- Graph Y-axis bottom limit: -160 dBV
- Graph marker threshold state: ON
- Graph marker threshold level: -130 dBV

5. On the U8903B analyzer, set the input range as given in the "**Test record for CMRR verification**" on page 99.
6. On the calibrator, set the amplitude to 1 V and the frequency of f_{IN} as given in the "**Test record for CMRR verification**" on page 99.
7. On the U8903B graph analysis mode, set the graph X-axis left and right edge as given in the "**Test record for CMRR verification**" on page 99.
8. On the U8903B graph analysis mode, set the graph Marker 1 state to ON and assign it to Trace 1 (3, 5, or 7). Set the graph Marker 2 state to ON and assign it to Trace 2 (4, 6, or 8).
9. Enable the calibrator output.
10. Using the graph Marker 1 search function, place Marker 1 at the highest amplitude acquired from the graph measurement.
11. Record the Marker 1's X-value measurement as F_{CMRR}, multiply Marker 1's Y-value measurement with –1 and record as CMRR on the U8903B in the "**Test record for CMRR verification**" on page 99.
12. Repeat **step 10** to **step 11** for the Marker 2 measurement.
13. Repeat **step 6** to **step 12** for the rest of the frequency of f_{IN}.
14. Repeat **step 5** to **step 13** for the rest of the U8903B analyzer input range.
15. Repeat **step 1** to **step 14** to complete the verification of the other U8903B input channels.

16 Compare the recorded CMRR values to the specification. If the test fails, adjustment will need to be carried out accordingly.

Distortion (THD+N) verification

This test verifies if the residual THD+N of the U8903B is within the published specification using an internal loopback connection to test the THD+N performance.

Table 3-7 Distortion specification

Distortion specification (at 1 kHz, 1 Vrms)	Equipment used
≤–108 dB (for 20 Hz to 20 kHz bandwidth, 23 °C ±5 °C) ≤–100 dB (for 20 Hz to 20 kHz bandwidth, 0 °C to 55 °C)	U8903B (internal loopback)

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Preset the U8903B audio analyzer. Configure the U8903B generator output channel 1 and 2 to connect to all of its own analyzer input channels (up to 8 channels concurrently) through internal loopback.

2 Configure the U8903B generator output channels as follows:
   - Connection type: Unbalanced
   - Output impedance: 600 Ω
   - Output grounding configuration: Floating ground
   - Waveform: Sine
   - Output frequency: 1 kHz
   - Output amplitude: 1 Vrms
   - Output state: ON

3 Configure the U8903B analyzer input channels to be tested as follows:
   - Connection type: Loopback
   - Input bandwidth: 90 kHz
   - Input coupling: DC
   - Input range:1 V
   - Voltage detector type: RMS
   - Trigger source: Immediate
   - Measurement function1: Frequency
   - Measurement function2: THD+N Ratio

- Measurement function3: THD Ratio
- Measurement function4: AC Voltage
- Sample size: 131072
- High pass filter: 20 Hz
- Low pass filter: 20 kHz

4 Enable the U8903B analyzer input channels to be tested.

5 Record the THD+N ratio measurement on the audio analyzer for each tested channel in the “**Test record for distortion verification**” on page 100.

6 Compare the recorded THD+N ratio measurement value to the specification. If the test fails, adjustment will need to be carried out accordingly.

SMTPE IMD verification

This test verifies the SMTPE IMD performance of the U8903B analyzer by using an internal loopback connection to ensure that it is within the published specification.

Table 3-8 SMTPE IMD specification

SMTPE IMD specification (at 1 Vrms)	Equipment used
≤–95 dB	U8903B (internal loopback)

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Preset the U8903B audio analyzer. Configure the U8903B generator output channel 1 and 2 to connect to all of its own analyzer input channels (up to 8 channels concurrently) through internal loopback.

2 Configure the U8903B generator output channels as follows:

- Connection type: Unbalanced
- Output impedance: 600 Ω
- Output grounding configuration: Floating ground
- Waveform: SMPTE 1 to 1
- Output state: ON

3 Configure the U8903B analyzer input channels to be tested as follows:

- Connection type: Loopback

- Input bandwidth: 90 kHz
- Input coupling: DC
- Input range:1 V
- Voltage detector type: RMS
- Trigger source: Immediate
- Measurement function2: SMPTE IMD
- Sample size: 131072
- Input Auto Range: ON
- IMD Frequency Detection Mode: Generator frequency lock

4 On the U8903B generator, set the waveform to the first SMPTE function as given in the "**Test record for SMPTE IMD verification**" on page 101.

5 On the U8903B generator, set the upper frequency to 7 kHz. Set the lower frequency and the amplitude of Vrms as given in the "**Test record for SMPTE IMD verification**" on page 101.

6 On the U8903B analyzer, set the input channels lower frequency to be tested as given in the "**Test record for SMPTE IMD verification**" on page 101.

7 Enable the U8903B analyzer input channels to be tested.

8 Record the SMPTE IMD measurement on the U8903B input channels to be tested in the "**Test record for SMPTE IMD verification**" on page 101.

9 This measurement will be the SMPTE IMD of the U8903B analyzer in dB.

10 Repeat **step 5** to **step 8** for the rest of the amplitudes and lower frequencies.

11 Repeat **step 4** to **step 10** for the rest of the SMPTE functions to complete the verification of the U8903B input channel to be tested

12 Compare the recorded SMPTE IMD measurement values to the specification. If the test fails, adjustment will need to be carried out accordingly.

DFD verification

This test verifies the DFD performance of the U8903B is within the published specification using an internal loopback connection.

Table 3-9 DFD specification

DFD specification (at 1 Vrms)	Equipment used
≤–106 dB	U8903B (internal loopback)

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1. Preset the U8903B audio analyzer. Configure the U8903B generator output channel 1 and 2 to connect to all of its own analyzer input channels (up to 8 channels concurrently) through internal loopback.
2. Configure the U8903B generator output channels as follows:
   - Connection type: Unbalanced
   - Output impedance: 600 Ω
   - Output grounding configuration: Floating ground
   - Waveform: DFD IEC268
   - Level summation: Linear
   - Output state: ON
3. Configure the U8903B analyzer input channels to be tested as follows:
   - Connection type: Loopback
   - Input bandwidth: 90 kHz
   - Input coupling: DC
   - Voltage detector type: RMS
   - Trigger source: Immediate
   - Measurement function2: DFD IEC 60268 2nd order
   - Sample size: 131072
4. On the U8903B generator output channels, set the difference frequency to 80 Hz. Set the center frequency of f_{DUT} and the amplitude of Vrms as given in "**Test record for DFD verification**" on page 102.
5. On the U8903B analyzer input channels, set the input range as given in "**Test record for DFD verification**" on page 102.

6 Enable the U8903B analyzer input channels to be tested.

7 Set the U8903B analyzer measurement function2 to DFD IEC 60268 2nd order and record the tested channels as DFD_{2nd} in "**Test record for DFD verification**" on page 102.

8 Set the U8903B analyzer measurement function2 to DFD IEC 60268 3rd order and record the tested channels as DFD_{3rd} in "**Test record for DFD verification**" on page 102.

9 Repeat **step 4** to **step 8** for the rest of the input range, Vrms, and f_{DUT} values to complete the verification of the U8903B input channels to be tested.

10 Compare the recorded wideband DFD measurement value to the specification. If the test fails, adjustment will need to be carried out accordingly.

Residual noise verification

This test verifies if the residual noise of the U8903B is within the published specification by using shorting connectors to terminate the U8903B input channels and measuring its own residual noise.

Table 3-10 Residual noise specification

Residual noise specification	Equipment used
≤1.3 µVrms (for 20 Hz to 20 kHz bandwidth)	U8903B

NOTE Ensure that all the other verification procedures for the U8903B are completed and passed before performing the residual noise verification.

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Connect the shorting connectors (BNC) to all the U8903B input channels to be tested. Preset the U8903B DUT.

2 Configure the U8903B analyzer input channels to be tested as follows:
   - Connection type: Unbalanced
   - Input bandwidth: 90 kHz
   - Input coupling: DC
   - Voltage detector type: RMS
   - Trigger source: Immediate

- Measurement function2: AC Voltage
- Sample size: 131072
- Low pass filter: 20 kHz
- High pass filter: 20 Hz
- Input voltage range: 0.32 V

3 Enable the U8903B analyzer input channels to be tested.

4 Record 10 measurements on the audio analyzer for each tested channel. Compute the average of the 10 measurements for each tested channel as $Noise_{avg}$ in the "**Test record for residual noise verification**" on page 103.

5 Compare the recorded $Noise_{avg}$ measurement value to the specification. If the test fails, adjustment will need to be carried out accordingly.

Wideband AC flatness verification

This test verifies the wideband sine wave flatness of the U8903B analyzer by using the function generator as a source and the digital multimeter as a reference, to ensure that it is within the published specification.

Table 3-11 Wideband sine wave flatness specifications

Wideband sine wave flatness specification	Equipment used
±0.1 dB (≤200 kHz) ±0.5 dB (≤1 MHz) ±1 dB (≤1.5 MHz)	Function generator Digital multimeter

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Connect the function generator to the U8903B Unbalanced input channel 1 to be tested and to the digital multimeter via the connection as shown in **Figure 3-7**. The BNC-to-banana jack adapter and the BNC male-to-female T splitter is used for this connection. Preset the U8903B, digital multimeter, and function generator.

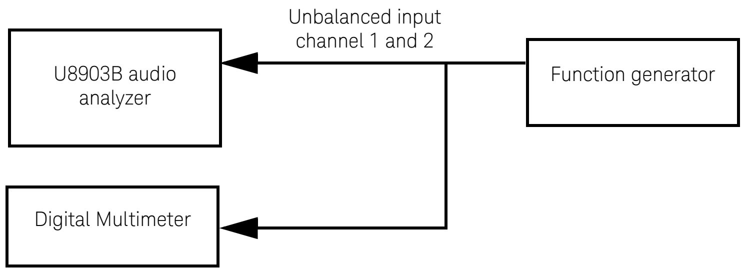

Figure 3-7 Function generator to U8903B and digital multimeter for wideband sine wave flatness verification

2 Configure the digital multimeter as follows:

- Measurement function: AC voltage
- Level Filter: Enable
- NPLC: 10
- Number readings: 1 (with auto sample event)
- Trigger arming: Hold (suspend)
- Trigger mode: Auto
- ACV mode: Synchronous sub-sampled
- Input Range: Refer to "**Test record for wideband sine wave flatness verification**" on page 103.

3 Configure the function generator as follows:

- Output load: High-Z load
- Output polarity: Normal
- Waveform function: Sine wave
- Amplitude unit: Vrms
- Amplitude offset: 0 V

4 Configure the U8903B input channel 1 to be tested as follows:

- Connection type: Unbalanced
- Input bandwidth: 1.5 MHz
- Input coupling: DC
- Voltage detector type: RMS
- Trigger source: Immediate
- Measurement function2: AC Voltage
- Sample size: 1048576 for 20 Hz / 524288 for 50 Hz / 262144 for above 50 Hz

5 Set the function generator to produce a sine wave voltage with amplitude of V_{IN} and frequency of f_{IN} as given in the "**Test record for wideband sine wave flatness verification**" on page 103.

6 On the digital multimeter, set the range as given in the "**Test record for wideband sine wave flatness verification**" on page 103.

7 On the U8903B analyzer, set the input range as given in the "**Test record for wideband sine wave flatness verification**" on page 103.

8 Enable the function generator output by setting it to ON.

9 Record the digital multimeter measurement, V_{DMM} and the U8903B analyzer channel 1 measurement, V_{DUT} in the "**Test record for wideband sine wave flatness verification**" on page 103.

10 Compute the wideband sine wave flatness using the following equation:

$$\textit{Wideband sine wave flatness (dB)} = 20 \times \log_{10} (V_{DUT} / V_{DMM})$$

11 Repeat **step 4** to **step 10** for the rest of the frequency f_{IN} and amplitude V_{IN}.

12 Repeat **step 1** to **step 11** for the U8903B Unbalanced input channel 2 to complete the verification of the U8903B input channels to be tested.

13 Compare the recorded wideband sine wave flatness to the specifications. If the test fails, adjustment will need to be carried out accordingly.

Wideband frequency accuracy verification

This test verifies the wideband frequency accuracy of the U8903B analyzer by using the function generator as a source and the frequency counter as a reference, to ensure that it is within the published specification.

Table 3-12 Wideband frequency accuracy specifications

Wideband frequency accuracy specification	Equipment used
±2 ppm (>50 kHz)	– Function generator – Frequency counter

NOTE Power on the U8903B audio analyzer for at least 30 minutes before performing the performance verification.

1 Use three BNC male-to-female T splitters to create a 4-way connection from the function generator output to the U8903B and frequency counter inputs.

2 Connect the function generator outputs to the frequency counter input channel 1 and 2, and to the U8903B unbalanced input channel 1 and 2 as shown in **Figure 3-8**. Preset the U8903B, function generator, and frequency counter.

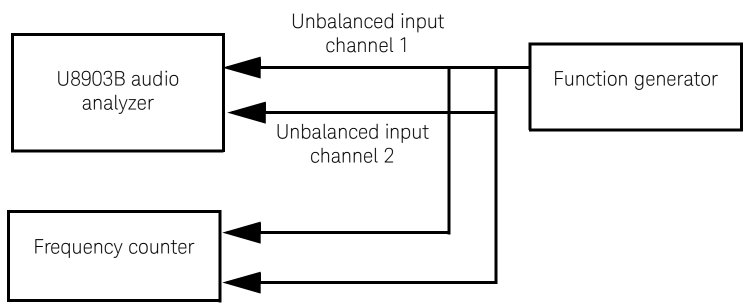

Figure 3-8 Function generator to frequency counter and U8903B connection for wideband frequency accuracy verification

3 Configure the function generator output channel as follows:

- Output load: High-Z load
- Output polarity: Normal
- Waveform function: Sine wave
- Amplitude unit = Vrms
- Amplitude offset = 0 V

4 Configure the frequency counter input channels as follows:

- If frequency counter model is 53220A, set SCPI language mode: 53132A
- Impedance: 1 MΩ
- Low pass filter: ON (for frequency <100 kHz)
- Input coupling: DC
- Level at center of hysteresis window: 0 V
- Trigger level percentage of signal peak-to-peak range: 50%
- Reference timebase: Internal reference
- Measurement function: Channel 1 frequency
- Frequency measurement start arm mode: Immediate
- Frequency measurement stop arm mode: Timer

5 Configure the U8903B input channels to be tested as follows:

- Connection type: Unbalanced
- Input bandwidth: 90 kHz

- Input coupling: AC
- Voltage detector type: RMS
- Trigger source: Immediate
- Input voltage range:1 V
- Measurement function2: AC Voltage
- Sample size: 1048576 for 20 Hz / 524288 for 50 Hz / 262144 for above 50 Hz

6. Set the function generator to produce a sine wave with amplitude of 1 Vrms and frequency of f_{DUT} as given in the "**Test record for wideband frequency accuracy verification**" on page 111.
7. Set the U8903B input channels sample size as given in the "**Test record for wideband frequency accuracy verification**" on page 111.
8. Set the frequency counter gate time as given in the "**Test record for wideband frequency accuracy verification**" on page 111.
9. Enable the function generator output.
10. Using the `FETC? FUNC1,(@1)` SCPI command for the U8903B, record the frequency measurement on the frequency counter, f_{FC} and the U8903B channel 1, f_{Meas} in the "**Test record for wideband frequency accuracy verification**" on page 111.
11. Compute the frequency accuracy of the U8903B using the following equation:

    $$\text{Wideband frequency accuracy} = ((f_{Meas} - f_{FC}) / f_{FC}) \times 1000000$$

12. Repeat **step 6** to **step 11** for the rest of the f_{DUT} values to complete the verification of the U8903B input channel 1 to be tested.
13. Repeat **step 1** to **step 12** to complete the verification for the U8903B input channel 2.
14. Compare the recorded wideband frequency accuracy values to the specification. If the test fails, adjustment will need to be carried out according

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4 Performance Verification for Digital Generator and Digital Analyzer

The performance verification procedures described in this chapter verify that the U8903B digital analyzer and digital generator is operating within its published specifications.

U8903B Options

Table 4-1 U8903B digital interface options

Option	Description
U8903B-DGT	Digital audio card.
N3434A	AES3, SPDIF, and DSI digital audio interfaces (fixed perpetual license).
N3435A	AES3 and SPDIF digital audio interfaces (fixed perpetual license).
N3436A	DSI digital audio interface (fixed perpetual license).

NOTE Refer to the U8903B Audio Analyzer User's Guide (U8903- 90045) for more information on the AES3, SPDIF, and DSI interfaces specifications.

Performance Verification

DSI master clock output frequency accuracy verification

This test measures the sampling rate accuracy on the DSI (Digital Serial Interface) master clock output of U8903B using Keysight 53132A/53220A frequency counter to ensure that it is within the published specification.

Table 4-2 DSI master clock output frequency accuracy specification

DSI master clock output frequency accuracy specification	Equipment used
±5 ppm	Frequency counter

1 Connect the Keysight 53132A/53220A frequency counter input channel 1 to the U8903B DSI MCLK output line using the DB25 to BNC cable as shown in **Figure 4-1**.

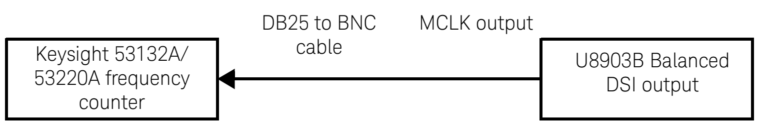

Figure 4-1 Keysight 53132A/53220A to DSI MCLK output for balanced DSI master clock output frequency accuracy verification

2 Configure the Keysight 53132A/53220A frequency counter as follows:

- Preset the equipment
- Channel 1 input impedance: 50 Ω
- Frequency measurement start arming source: Immediate
- Frequency measurement stop arming source: Timer
- Frequency arming and measurement gate time: 0.3 s

3 Configure the U8903B digital output channel to be tested as follows:

- DSI output voltage: 3.3 V
- Reference clock source: Internal
- DSI audio resolution: 24 bits
- External reference clock word length: 32
- External reference clock multiplier: 128
- DSI data format: I2S
- DSI output bit clock sync edge: FALLing
- DSI Master Clock output state: ON

- Digital output sampling rate: 48 kHz
- Digital output function: SINE waveform
- SINE waveform frequency: 1 kHz
- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Verification steps for word length at 8 bits:

a Set the DSI audio resolution to 8 bits.

b Set the DSI audio word length to 8 bits.

c Set the DSI Master Clock multiplier to 128.

d Set the digital output sampling rate to 16 kHz.

e Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

f Set the DSI audio word length to 32 bits.

g Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

h Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

i Measure the Master Clock Rate twice and average the two measurements.

j Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

k Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

$$\Delta F_{error}\, ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$$

5 Verification steps for word length at 12 bits:

a Set the DSI audio resolution to 12 bits.

b Set the DSI audio word length to 12 bits.

c Set the DSI Master Clock multiplier to 96.

d Set the digital output sampling rate to 16 kHz.

e Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

f Set the DSI audio word length to 32 bits.

g Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

h Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

i Measure the Master Clock Rate twice and average the two measurements.

j Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

k Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

$$\Delta F_{error}\ ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$$

6 Verification steps for word length at 16 bits:

a Set the DSI audio resolution to 16 bits.

b Set the DSI audio word length to 16 bits.

c Set the DSI Master Clock multiplier to 128.

d Set the digital output sampling rate to 48 kHz.

e Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

f Set the DSI audio word length to 32 bits.

g Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

h Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

i Measure the Master Clock Rate twice and average the two measurements.

j Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

k Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

$$\Delta F_{error}\ ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$$

7 Verification steps for word length at 20 bits:

a Set the DSI audio resolution to 20 bits.

b Set the DSI audio word length to 20 bits.

c Set the DSI Master Clock multiplier to 160.

- **d** Set the digital output sampling rate to 48 kHz.
- **e** Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **f** Set the DSI audio word length to 32 bits.
- **g** Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **h** Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **i** Measure the Master Clock Rate twice and average the two measurements.
- **j** Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **k** Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

  $\Delta F_{error}\ ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$

8 Verification steps for word length at 24 bits:

- **a** Set the DSI audio resolution to 24 bits.
- **b** Set the DSI audio word length to 24 bits.
- **c** Set the DSI Master Clock multiplier to 192.
- **d** Set the digital output sampling rate to 48 kHz.
- **e** Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **f** Set the DSI audio word length to 32 bits.
- **g** Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **h** Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **i** Measure the Master Clock Rate twice and average the two measurements.
- **j** Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **k** Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

  $\Delta F_{error}\ ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$

9 Verification steps for word length at 28 bits:

- **a** Set the DSI audio resolution to 24 bits.
- **b** Set the DSI audio word length to 28 bits.
- **c** Set the DSI Master Clock multiplier to 224.
- **d** Set the digital output sampling rate to 48 kHz.
- **e** Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **f** Set the DSI audio word length to 32 bits.
- **g** Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **h** Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **i** Measure the Master Clock Rate twice and average the two measurements.
- **j** Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **k** Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

  $$\Delta F_{error}\ ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$$

10 Verification steps for word length at 32 bits:

- **a** Set the DSI audio resolution to 24 bits.
- **b** Set the DSI audio word length to 32 bits.
- **c** Set the DSI Master Clock multiplier to 128.
- **d** Set the digital output sampling rate to 16 kHz.
- **e** Set the DSI audio resolution based on the Word Length as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **f** Set the DSI audio word length to 32 bits.
- **g** Set the Digital Output Sampling Rate based on the sampling rate (Hz) as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **h** Set the DSI Master Clock Multiplier based on the Master Clock Multiplier as given in "**Test record for DSI master clock output frequency accuracy verification**" on page 114.
- **i** Measure the Master Clock Rate twice and average the two measurements.

j Record the average Master Clock Rate, $F_{measure}$ in the "**Test record for DSI master clock output frequency accuracy verification**" on page 114.

k Compute the master clock error using the following equation. MCLK is the master clock rate calculated where MCLK = MUL × Sampling Rate (Hz).

$$\Delta F_{error}\ ppm = [(F_{measure} - MCLK) / MCLK] \times 1000000$$

Balanced output level accuracy verification

This test measures the balanced output level accuracy on the balanced digital audio output of the U8903B using the Keysight DSO8064A oscilloscope to ensure that it is within the published specification.

Table 4-3 Balanced output level accuracy specification

Balanced output level accuracy specification	Equipment used
±1 dB (typical), ±1.5 dB	Digital oscilloscope

1 Connect the Keysight DSO8064A oscilloscope input channel 1 and 2 to the U8903B balanced digital output channel with the 55 Ω termination using the XLR female to two BNC male AES cable with separated + and – output lines as shown in **Figure 4-2**.

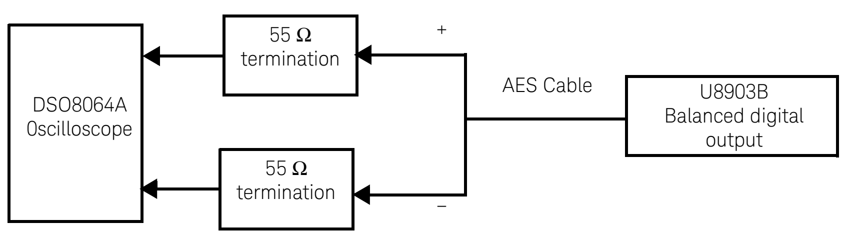

Figure 4-2 DSO8064A oscilloscope to U8903B balanced digital output for balanced output level accuracy verification

2 Configure the DSO8064A oscilloscope as follows:

- Trigger mode: Edge
- Edge trigger slope: Positive
- Channel 1 offset: 0
- Channel 1 vertical axis unit: Volt
- Channel 2 offset: 0

- Channel 2 vertical axis unit: Volt
- Input channel 1 and 2: Enable
- Function 1 to subtract channel 1 and channel 2
- Function 1: Enable
- Function 1 offset: 0

3 Configure the U8903B digital output channel to be tested as follows:

- Digital output type: Balanced
- Digital output voltage: 2.5 V
- Digital output sampling rate: 48 kHz
- Digital output AES audio resolution: 24 bits
- AES output: ON
- Digital output function: SINE waveform
- SINE waveform frequency: 1 kHz
- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Set the digital output sampling rate to F_{SR} as given in “**Test record for balanced output level accuracy verification**” on page 127.

5 Set the digital output level to V_{DUT} as given in “**Test record for balanced output level accuracy verification**” on page 127.

6 Configure the DSO8064A oscilloscope as follows:

- Time base scale: 1 / (Sampling rate × 32 × 2)
- Channel 1 and channel 2 vertical scale value: refer to **Table 4-4**
- Function 1 vertical scale range value: refer to **Table 4-4**
- Function 1 offset: 0

Table 4-4 Channel 1 and channel 2 vertical scale and vertical scale range

V_{DUT} (V)	CH1 and CH2 voltage per division (V)	Function 1 vertical scale range (V)
0.3	0.025	0.4
0.5	0.0425	0.68
0.8	0.075	1.2
1	0.085	1.36
1.2	0.1	1.6
1.3	0.125	2
1.5	0.125	2

Table 4-4 Channel 1 and channel 2 vertical scale and vertical scale range (continued)

V_{DUT} (V)	CH1 and CH2 voltage per division (V)	Function 1 vertical scale range (V)
1.8	0.15	2.4
2.0	0.175	2.8
2.3	0.195	3.12
2,.5	0.21	3.36
2.8	0.235	3.76
3	0.25	4
3.3	0.275	4.4
3.5	0.295	4.72
3.8	0.32	5.12
4	0.335	5.36
4.3	0.36	5.76
4.5	0.375	6
4.8	0.4	6.4
5.1	0.425	6.8

7 Set the DSO8064A oscilloscope to measure the amplitude of Function 1 and record the measurement as $V_{measure}$.

8 Compute the level accuracy using the following equation.

$$Level\ Accuracy\ (dB) = 20 \times Log\ (V_{measure} / V_{DUT})$$

9 Repeat **step 5** to **step 8** for the rest of the V_{DUT} as given in "**Test record for balanced output level accuracy verification**" on page 127 to complete the verification of the different voltages.

10 Repeat **step 4** to **step 9** for the rest of the F_{SR} as given in "**Test record for balanced output level accuracy verification**" on page 127 to complete the verification of the different sampling rates.

Balanced input sampling rate accuracy verification

This test measures the sampling rate accuracy on the balanced digital audio input of the U8903B using the Keysight 53132A/53220A frequency counter and its own digital audio balanced generator to ensure that it is within the published specification.

Table 4-5 Balanced input sampling rate accuracy specification

Balanced input sampling rate accuracy specification	Equipment used
±5 ppm	Frequency counter

1 Connect the Keysight 53132A/53220A frequency counter input channel 1 and 2 to the U8903B Balanced digital output channel using the XLR female to two BNC male split AES cable with separated + and – output lines as shown in **Figure 4-3**.

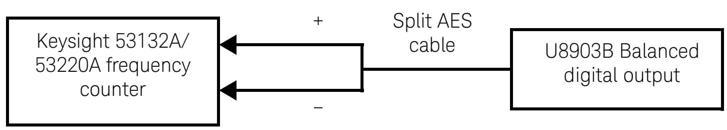

Figure 4-3 Keysight 53132A/53220A to U8903B balanced digital output for balanced input sampling rate accuracy verification

2 Configure the Keysight 53132A/53220A frequency counter as follows:

- Preset the equipment
- Channel 1 and channel 2 input impedance: 50 Ω
- Frequency measurement start arming source: Immediate
- Frequency measurement stop arming source: Timer
- Frequency arming and measurement gate time: 0.5 s

3 Configure the U8903B digital output channel to be tested as follows:

- Preset the U8903B
- Digital output type: Balanced
- Digital output voltage: 4 V
- Digital output sampling rate: 48 kHz
- Digital output AES audio resolution: 24 bits
- AES output: ON
- Optical output state: OFF
- Digital output function: SINE waveform

- SINE waveform frequency: 1 kHz
- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Configure the U8903B digital input channel to be tested as follows:

- Digital input type: Balanced
- Digital input impedance: 110 Ω
- Digital measurement sample size: 16384
- Input coupling for both channel D1 and D2: DC
- Voltage detector for both channel D1 and D2: RMS
- AES audio format: LPCM
- Channels D1 and D2 FUNCTION1 to measure frequency
- Channels D1 and D2 FUNCTION1 to measure Voltage AC

5 Set the U8903B calibration digital output mode to BCOM mode for AES/SPDIF.

NOTE

This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to BCOM.

```
CAL:DIGITAL:MODE BCOM,NORM,NORM
```

6 Set the digital output sampling rate F_{SR} as given in "**Test record for balanced input sampling rate accuracy verification**" on page 133.

7 Set the frequency counter to measure the frequency of the output signal on Channel 1 and 2 and record the measurement as $F_{measure1}$ and $F_{measure2}$ respectively.

8 Compute the average sampling rate error, F_{SRavg} using the following equation.

$$F_{SRavg} = [(F_{measure1} - F_{measure2}) / 2] / 64$$

9 Record the F_{SRavg} values in "**Test record for balanced input sampling rate accuracy verification**" on page 133.

10 Repeat **step 6** to **step 9** for the rest of the F_{SR} as given in "**Test record for balanced input sampling rate accuracy verification**" on page 133 to complete the verification of the different output sampling rates.

11 Connect the U8903B Balanced digital output to its own balanced digital input using the AES cable as shown in **Figure 4-4**.

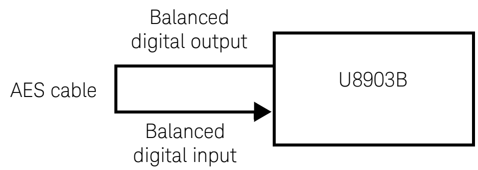

Figure 4-4 U8903B balanced digital output to its own balanced digital input for balanced input sampling rate accuracy verification

12 Set the U8903B calibration digital output mode to NORM mode for AES/SPDIF.

NOTE This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to NORM.

```
CAL:DIGITAL:MODE NORM,NORM,NORM
```

---

13 Set the digital output sampling rate F_{SR} as given in "**Test record for balanced input sampling rate accuracy verification**" on page 133.

14 Set the U8903B digital analyzer to measure the sampling rate and record the measurement reading as SR_{meas}.

15 Compute the sampling rate error using the following equation based on the previous recorded F_{SRavg} value.

$$\Delta F_{SRerror}\ ppm = [(SR_{mea} - F_{SRavg}) / F_{SR}] \times 1000000$$

16 Repeat **step 13** to **step 15** for the rest of the F_{SR} as given in "**Test record for balanced input sampling rate accuracy verification**" on page 133 to complete the verification of the different output sampling rates.

17 Repeat **step 4** to **step 16** with the digital balanced input impedance set to High impedance (Hi-Z).

Balanced output sampling rate accuracy verification

This test measures the sampling rate accuracy on the balanced digital audio output of the U8903B using the Keysight 53132A/53220A frequency counter to ensure that it is within the published specification.

Table 4-6 Balanced output sampling rate accuracy specification

Balanced output sampling rate accuracy specification	Equipment used
±5 ppm	Frequency counter

1 Connect the Keysight 53132A/53220A frequency counter input channel 1 and 2 to the U8903B balanced digital output channel using the XLR female to two BNC male split AES cable with separated + and – output lines as shown in **Figure 4-5**.

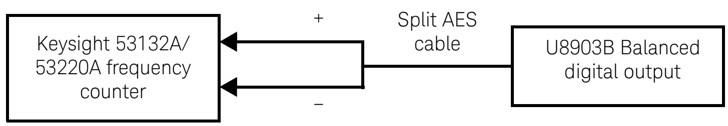

Figure 4-5 Keysight 53132A/53220A to U8903B balanced digital output for balanced output sampling rate accuracy verification

2 Configure the Keysight 53132A/53220A frequency counter as follows:

– Preset the equipment

– Channel 1 and channel 2 input impedance: 50 Ω

– Frequency measurement start arming source: Immediate

– Frequency measurement stop arming source: Timer

– Frequency arming and measurement gate time: 0.5 s

3 Configure the U8903B digital output channel to be tested as follows:

– Preset the U8903B

– Digital output type: Balanced

– Digital output voltage: 4 V

– Digital output sampling rate: 48 kHz

– Digital output AES audio resolution: 24 bits

– AES output: ON

– Digital output function: SINE waveform

– SINE waveform frequency: 1 kHz

- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Set the U8903B calibration digital output mode to BCOM mode for AES/SPDIF.

NOTE This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to BCOM.

```
CAL:DIGITAL:MODE BCOM,NORM,NORM
```

5 Set the digital output sampling rate F_{SR} as given in "**Test record for balanced output sampling rate accuracy verification**" on page 136.

6 Set the frequency counter to measure the frequency of the output signal on Channel 1 and 2 and record the measurement as $F_{measure1}$ and $F_{measure2}$ respectively.

7 Compute the sampling rate error using the following equation.

Channel 1: $\Delta F_{error1}\ ppm = [F_{measure1} - (F_{SR} \times 64)] / (F_{SR} \times 64) \times 1000000$

Channel 2: $\Delta F_{error2}\ ppm = [F_{measure2} - (F_{SR} \times 64)] / (F_{SR} \times 64) \times 1000000$

8 Repeat **step 5** to **step 7** for the rest of the F_{SR} as given in "**Test record for balanced output sampling rate accuracy verification**" on page 136 to complete the verification of the different output sampling rates.

9 Set the calibration digital output mode to back to NORM mode for AES/SPDIF.

NOTE This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to NORM.

```
CAL:DIGITAL:MODE NORM,NORM,NORM
```

Unbalanced output level accuracy verification

This test measures the level accuracy on the Unbalanced digital audio output of the U8903B using DSO8064A digital oscilloscope to ensure that it is within the published specification.

Table 4-7 Unbalanced output level accuracy specification

Unbalanced output level accuracy specification	Equipment used
±1 dB (typical), ±1.5 dB	Digital oscilloscope

1 Connect the Keysight DSO8064A oscilloscope input channel 1 to the U8903B unbalanced digital output channel with the 75 Ω termination using the SPDIF/75 Ω impedance cable as shown in **Figure 4-6**.

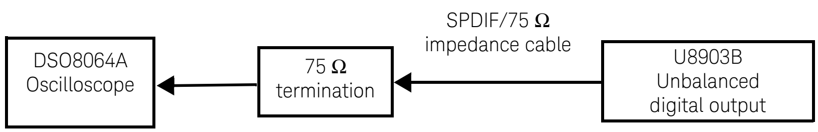

Figure 4-6 DSO8064A oscilloscope to U8903B unbalanced digital output for unbalanced output level accuracy verification

2 Configure the DSO8064A oscilloscope as follows:

- Trigger mode: Edge
- Edge trigger slope: Positive
- Channel 1 offset: 0
- Channel 1 vertical axis unit: Volt
- Function 1: Enable
- Function 1 offset: 0

3 Configure the U8903B digital output channel to be tested as follows:

- Digital output type: Unbalanced
- Digital output voltage: 2.5 V
- Digital output sampling rate: 48 kHz
- Digital output AES audio resolution: 24 bits
- AES output: ON
- Digital output function: SINE waveform
- SINE waveform frequency: 1 kHz

- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Set the digital output sampling rate to F_{SR} as given in "**Test record for unbalanced output level accuracy verification**" on page 138.

5 Set the digital output level to V_{DUT} as given in "**Test record for unbalanced output level accuracy verification**" on page 138.

6 Configure the DSO8064A oscilloscope as follows:

- Timebase scale: 1 / (Sampling rate × 32 × 2)
- Channel 1 vertical scale: Refer to **Table 4-8**

Table 4-8 Channel 1 vertical scale settings

V_{DUT} (V)	Voltage per division (V)
0.3	0.05
0.5	0.085
0.8	0.15
1	0.17
1.2	0.2
1.3	0.25
1.5	0.25
1.8	0.3
2.0	0.35
2.3	0.39
2.5	0.42

7 Set the DSO8064A oscilloscope to measure the amplitude of Channel 1 and record the measurement as $V_{measure}$.

8 Compute the level accuracy using the following equation:

$$Level\ Accuracy\ (dB) = 20 \times Log\ (V_{measure} / V_{DUT})$$

9 Repeat **step 5** to **step 8** for the rest of the V_{DUT} as given in "**Test record for unbalanced output level accuracy verification**" on page 138 to complete the verification of the different voltages.

10 Repeat **step 4** to **step 9** for the rest of the F_{SR} as given in "**Test record for unbalanced output level accuracy verification**" on page 138 to complete the verification of the different sampling rates.

Unbalanced input sampling rate accuracy verification

This test measures the sampling rate accuracy on the unbalanced digital audio input of the U8903B using the Keysight 53132A/53220A frequency counter and its own digital audio unbalanced generator to ensure that it is within the published specification.

Table 4-9 Unbalanced input sampling rate accuracy specification

Unbalanced input sampling rate accuracy specification	Equipment used
±5 ppm	Frequency counter

1 Connect 53132A/53220A Frequency Counter input channel 1 to the U8903B unbalanced digital output channel using the SPDIF or 75 Ω impedance cable as shown in **Figure 4-7**.

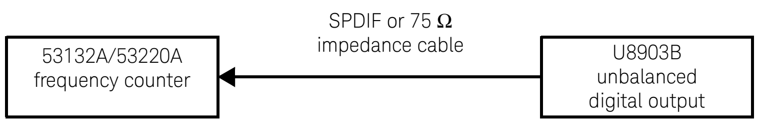

Figure 4-7 Keysight 53132A/53220A to U8903B unbalanced digital output for unbalanced input sampling rate accuracy verification

2 Configure the Keysight 53132A/53220A frequency counter as follows:
   - Preset the equipment
   - Channel 1 and channel 2 input impedance: 50 Ω
   - Frequency measurement start arming source: Immediate
   - Frequency measurement stop arming source: Timer
   - Frequency arming and measurement gate time: 0.5 s

3 Configure the U8903B digital output channel to be tested as follows:
   - Preset the U8903B
   - Digital output type: Unbalanced
   - Digital output voltage: 2.5 V
   - Digital output sampling rate: 48 kHz
   - Digital output AES audio resolution: 24 bits
   - AES output: ON
   - Optical output state: OFF
   - Digital output function: SINE waveform
   - SINE waveform frequency: 1 kHz

- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Configure the U8903B digital input channel to be tested as follows:
   - Digital input type: Unbalanced
   - Digital input impedance: 75 Ω
   - Digital measurement sample size: 16384
   - Input coupling for both channel D1 and D2: DC
   - Voltage detector for both channel D1 and D2: RMS
   - AES audio format: LPCM
   - Channels D1 and D2 FUNCTION1 to measure frequency
   - Channels D1 and D2 FUNCTION1 to measure Voltage AC

5 Set the U8903B calibration digital output mode to BCOM mode for AES/SPDIF.

NOTE This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to BCOM.

```
CAL:DIGITAL:MODE BCOM,NORM,NORM
```

6 Set the digital output sampling rate F_{SR} as given in "**Test record for unbalanced input sampling rate accuracy verification**" on page 141.

7 Set the frequency counter to measure the frequency of the output signal and record the measurement as $F_{measure}$.

8 Compute the sampling rate, F_{SR_FC} based on the frequency counter measurement value using the following equation.

   $F_{SR\_FC} = F_{measure} / 64$

9 Record the F_{SR_FC} values in "**Test record for unbalanced input sampling rate accuracy verification**" on page 141.

10 Repeat **step 6** to **step 9** for the rest of the F_{SR} as given in "**Test record for unbalanced input sampling rate accuracy verification**" on page 141 to complete the verification of the different output sampling rates.

11 Connect the U8903B unbalanced digital output to its own balanced digital input using the SPDIF or 75 Ω impedance cable as shown in **Figure 4-8**.

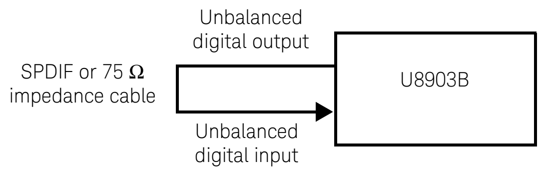

Figure 4-8 U8903B unbalanced digital output to its own unbalanced digital input for unbalanced input sampling rate accuracy verification

12 Set the U8903B calibration digital output mode to NORM mode for AES/SPDIF.

NOTE

This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to NORM.

```
CAL:DIGITAL:MODE NORM,NORM,NORM
```

---

13 Set the digital output sampling rate F_{SR} as given in "**Test record for unbalanced input sampling rate accuracy verification**" on page 141.

14 Set the U8903B digital analyzer to measure the sampling rate and record the measurement reading as SR_{meas}.

15 Compute the sampling rate error using the following equation based on the previous recorded F_{SR_FC} value.

$$\Delta F_{SRerror}\ ppm = [(SR_{meas} - F_{SR\_FC}) / F_{SR}] \times 1000000$$

16 Repeat **step 13** to **step 15** for the rest of the F_{SR} as given in "**Test record for unbalanced input sampling rate accuracy verification**" on page 141 to complete the verification of the different output sampling rates.

17 Repeat **step 4** to **step 16** with the digital unbalanced input impedance set to High impedance (Hi-Z).

Unbalanced output sampling rate accuracy verification

This test measures the sampling rate accuracy on the unbalanced digital audio output of the U8903B using the Keysight 53132A/53220A frequency counter to ensure that it is within the published specification.

Table 4-10 Unbalanced output sampling rate accuracy specification

Unbalanced output sampling rate accuracy specification	Equipment used
±5 ppm	Frequency counter

1 Connect Keysight 53132A/53220A frequency counter input channel 1 to the U8903B unbalanced digital output channel using the SPDIF or 75 Ω impedance cable.

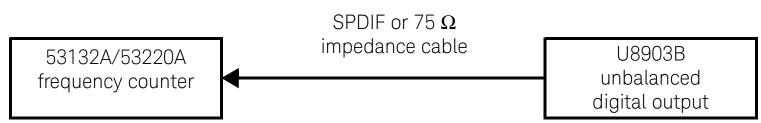

Figure 4-9 Keysight 53132A/53220A to U8903B unbalanced digital output for unbalanced output sampling rate accuracy verification

2 Configure the Keysight 53132A/53220A frequency counter as follows:

- Preset the equipment
- Channel 1 input impedance: 50 Ω
- Frequency measurement start arming source: Immediate
- Frequency measurement stop arming source: Timer
- Frequency arming and measurement gate time: 0.5 s

3 Configure the U8903B digital output channel to be tested as follows:

- Preset the U8903B
- Digital output type: Unbalanced
- Digital output voltage: 2.5 V
- Digital output sampling rate: 48 kHz
- Digital output AES audio resolution: 24 bits
- Digital output function: SINE waveform
- SINE waveform frequency: 1 kHz
- SINE waveform amplitude: 1 FFS
- Digital output state: ON

4 Set the U8903B calibration digital output mode to BCOM mode for AES/SPDIF.

NOTE

This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to BCOM.

```
CAL:DIGITAL:MODE BCOM,NORM,NORM
```

5 Set the digital output sampling rate F_{SR} as given in "**Test record for unbalanced output sampling rate accuracy verification**" on page 144.

6 Set the frequency counter to measure the frequency of the output signal on Channel 1 and record the measurement as $F_{measure}$.

7 Compute the sampling rate error using the following equation:

$$\Delta F_{error}\ ppm = [F_{measure} - (F_{SR} \times 64)] / (F_{SR} \times 64) \times 1000000$$

8 Repeat **step 5** to **step 7** for the rest of the F_{SR} as given in "**Test record for unbalanced output sampling rate accuracy verification**" on page 144 to complete the verification of the different output sampling rates.

9 Set the calibration digital output mode to back to NORM mode for AES/SPDIF.

NOTE

This mode is only supported by SCPI. Send below SCPI to the unit to configure the digital output mode to NORM.

```
CAL:DIGITAL:MODE NORM,NORM,NORM
```

Keysight U8903B
Audio Analyzer

Service Guide

Appendix A

KEYSIGHT
TECHNOLOGIES

Analog Generator Performance Verification

Test record for DC accuracy verification

Table A-1 Test record for DC accuracy verification

V_{DUT} (V)	Digital multimeter range	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	DC accuracy (%) (Channel 1)	DC accuracy (%) (Channel 2)
–10.00	100				
–9.75	10				
–9.50	10				
–9.25	10				
–9.00	10				
–8.75	10				
–8.50	10				
–8.25	10				
–8.00	10				
–7.75	10				
–7.50	10				
–7.25	10				
–7.00	10				
–6.75	10				
–6.50	10				
–6.25	10				
–6.00	10				
–5.75	10				
–5.50	10				
–5.25	10				
–5.00	10				
–4.75	10				
–4.50	10				
–4.25	10				
–4.00	10				
–3.75	10				
–3.50	10				
–3.25	10				
–3.00	10				

Table A-1 Test record for DC accuracy verification

V_{DUT} (V)	Digital multimeter range	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	DC accuracy (%) (Channel 1)	DC accuracy (%) (Channel 2)
–2.75	10				
–2.50	10				
–2.25	10				
–2.00	10				
–1.75	10				
–1.50	10				
–1.25	10				
–1.00	10				
–0.75	1				
–0.50	1				
–0.25	1				
0.25	1				
0.50	1				
0.75	1				
1.00	10				
1.25	10				
1.50	10				
1.75	10				
2.00	10				
2.25	10				
2.50	10				
2.75	10				
3.00	10				
3.25	10				
3.50	10				
3.75	10				
4.00	10				
4.25	10				
4.50	10				
4.75	10				
5.00	10				
5.25	10				
5.50	10				

Table A-1 Test record for DC accuracy verification

V_{DUT} (V)	Digital multimeter range	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	DC accuracy (%) (Channel 1)	DC accuracy (%) (Channel 2)
5.75	10				
6.00	10				
6.25	10				
6.50	10				
6.75	10				
7.00	10				
7.25	10				
7.50	10				
7.75	10				
8.00	10				
8.25	10				
8.50	10				
8.75	10				
9.00	10				
9.25	10				
9.50	10				
9.75	10				
10.00	100				

Test record for sine wave amplitude accuracy verification

Table A-2 Test record for sine wave amplitude accuracy verification

V_{DUT} (V)	Digital multimeter range	V_{DMM} (Vrms) (Channel 1)	V_{DMM} (Vrms) (Channel 2)	AC accuracy (%) (Channel 1)	AC accuracy (%) (Channel 2)
0.008	0.01				
0.01	0.01				
0.015	0.1				
0.02	0.1				
0.03	0.1				
0.04	0.1				
0.05	0.1				
0.08	0.1				

Table A-2 Test record for sine wave amplitude accuracy verification

V_{DUT} (V)	Digital multimeter range	V_{DMM} (Vrms) (Channel 1)	V_{DMM} (Vrms) (Channel 2)	AC accuracy (%) (Channel 1)	AC accuracy (%) (Channel 2)
0.1	0.1				
0.15	1				
0.2	1				
0.3	1				
0.4	1				
0.6	1				
1	1				
1.2	10				
1.8	10				
2.5	10				
3.5	10				
5	10				
8	10				

Test record for flatness verification

Table A-3 Test record for flatness verification

V_{DUT} (V)	f_{DUT} (Hz)	Digital multimeter range	V_{DMM} (Vrms) (Channel 1)	V_{DMM} (Vrms) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
1	1000	1				
1	5	1				
1	100	1				
1	500	1				
1	750	1				
1	12250	1				
1	18250	1				
1	20000	1				
1	30000	1				
1	40000	1				
1	50000	1				
1	60000	1				

Table A-3 Test record for flatness verification

V_{DUT} (V)	f_{DUT} (Hz)	Digital multimeter range	V_{DMM} (Vrms) (Channel 1)	V_{DMM} (Vrms) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
1	70000	1				
1	80000	1				

Test record for frequency accuracy verification

Table A-4 Test record for frequency accuracy verification

f_{DUT} (Hz)	Gate time (s)	f_{FC} (Hz) (Channel 1)	f_{FC} (Hz) (Channel 2)	Frequency accuracy (ppm) (Channel 1)	Frequency accuracy (ppm) (Channel 2)
10	10				
20	10				
50	5				
100	5				
500	0.5				
1000	0.5				
5000	0.5				
10000	0.5				
50000	0.5				
80000	0.5				

Test record for crosstalk verification

Table A-5 Test record for crosstalk verification

Generator output amplitude (Vrms)	Analyzer input range (V)	f_{DUT} (Hz)	Crosstalk (dB) (Channel 1 to Channel 2)	Crosstalk (dB) (Channel 2 to Channel 1)
0.32	0.32	1000		
0.32	0.32	20000		
1	1	1000		
1	1	20000		
3.2	3.2	1000		
3.2	3.2	20000		

Table A-5 Test record for crosstalk verification

Generator output amplitude (Vrms)	Analyzer input range (V)	f_{DUT} (Hz)	Crosstalk (dB) (Channel 1 to Channel 2)	Crosstalk (dB) (Channel 2 to Channel 1)
8	10	1000		
8	10	20000		

Test record for square wave rise time verification

Table A-6 Test record for square wave rise time verification

V_{p-p} (V)	Volts per division	Time per division (µs)	f_{DUT} (Hz)	t_{rise} (s) (Channel 1)	t_{rise} (s) (Channel 2)
0.5	0.5 / 6	400	500		
0.5	0.5 / 6	200	1000		
0.5	0.5 / 6	100	2000		
0.5	0.5 / 6	40	5000		
0.5	0.5 / 6	20	10000		
0.5	0.5 / 6	10	20000		
0.5	0.5 / 6	6.6667	30000		
1.0	1 / 6	400	500		
1.0	1 / 6	200	1000		
1.0	1 / 6	100	2000		
1.0	1 / 6	40	5000		
1.0	1 / 6	20	10000		
1.0	1 / 6	10	20000		
1.0	1 / 6	6.6667	30000		
4.5	4.5 / 6	400	500		
4.5	4.5 / 6	200	1000		
4.5	4.5 / 6	100	2000		
4.5	4.5 / 6	40	5000		
4.5	4.5 / 6	20	10000		
4.5	4.5 / 6	10	20000		
4.5	4.5 / 6	6.6667	30000		

Test record for square wave amplitude accuracy verification

Table A-7 Test record for square wave amplitude accuracy verification

V_{DUT} (V)	Digital multimeter range	V_{DMM} (Vrms) (Channel 1)	V_{DMM} (Vrms) (Channel 2)	Amplitude accuracy (%) (Channel 1)	Amplitude accuracy (%) (Channel 2)
0.01	0.1				
0.015	0.1				
0.02	0.1				
0.03	0.1				
0.04	0.1				
0.05	0.1				
0.08	0.1				
0.1	1				
0.15	1				
0.2	1				
0.3	1				
0.4	1				
0.6	1				
1	10				
1.2	10				
1.8	10				
2.5	10				
3.5	10				
5	10				
7.5	10				
10	100				

Analog Analyzer Performance Verification

Test record for DC accuracy verification

NOTE Use the test record below for the remaining test channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Table A-8 Test record for DC accuracy verification

V_{IN} (V)	U8903B input range (V)	V_{DUT} (V) (Channel 1)	V_{DUT} (V) (Channel 2)	DC accuracy (%) (Channel 1)	DC accuracy (%) (Channel 2)
–140	140				
–100	100				
–32	32				
–10	10				
–3.2	3.2				
–1	1				
–0.32	0.32				
0.32	0.32				
1	1				
3.2	3.2				
10	10				
32	32				
100	100				
140	140				

Test record for AC accuracy and flatness verification

NOTE Use the test record below for the remaining test channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Table A-9 Test record for AC accuracy and flatness verification

V_{IN} (Vrms)	U8903B input range (V)	f_{IN} (Hz)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
0.2	0.32	1000						
0.2	0.32	20			–	–		
0.2	0.32	100			–	–		
0.2	0.32	500			–	–		
0.2	0.32	2250			–	–		
0.2	0.32	8250			–	–		
0.2	0.32	10000			–	–		
0.2	0.32	15000			–	–		
0.2	0.32	20000			–	–		
0.2	0.32	30000			–	–		
0.2	0.32	40000			–	–		
0.2	0.32	50000			–	–		
0.2	0.32	60000			–	–		
0.2	0.32	70000			–	–		
0.2	0.32	80000			–	–		
0.2	0.32	82275			–	–		
0.2	0.32	85625			–	–		
0.2	0.32	88275			–	–		
0.2	0.32	90000			–	–		
1	1	1000						
1	1	20			–	–		
1	1	100			–	–		
1	1	500			–	–		
1	1	2250			–	–		
1	1	8250			–	–		

Table A-9 Test record for AC accuracy and flatness verification (continued)

V_{IN} (Vrms)	U8903B input range (V)	f_{IN} (Hz)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
1	1	10000			–	–		
1	1	15000			–	–		
1	1	20000			–	–		
1	1	30000			–	–		
1	1	40000			–	–		
1	1	50000			–	–		
1	1	60000			–	–		
1	1	70000			–	–		
1	1	80000			–	–		
1	1	82275			–	–		
1	1	85625			–	–		
1	1	88275			–	–		
1	1	90000			–	–		
2.4	3.2	1000						
2.4	3.2	20			–	–		
2.4	3.2	100			–	–		
2.4	3.2	500			–	–		
2.4	3.2	2250			–	–		
2.4	3.2	8250			–	–		
2.4	3.2	10000			–	–		
2.4	3.2	15000			–	–		
2.4	3.2	20000			–	–		
2.4	3.2	30000			–	–		
2.4	3.2	40000			–	–		
2.4	3.2	50000			–	–		
2.4	3.2	60000			–	–		
2.4	3.2	70000			–	–		
2.4	3.2	80000			–	–		
2.4	3.2	82275			–	–		
2.4	3.2	85625			–	–		
2.4	3.2	88275			–	–		
2.4	3.2	90000			–	–		

Table A-9 Test record for AC accuracy and flatness verification (continued)

V_{IN} (Vrms)	U8903B input range (V)	f_{IN} (Hz)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
9.6	10	1000						
9.6	10	20			–	–		
9.6	10	100			–	–		
9.6	10	500			–	–		
9.6	10	2250			–	–		
9.6	10	8250			–	–		
9.6	10	10000			–	–		
9.6	10	15000			–	–		
9.6	10	20000			–	–		
9.6	10	30000			–	–		
9.6	10	40000			–	–		
9.6	10	50000			–	–		
9.6	10	60000			–	–		
9.6	10	70000			–	–		
9.6	10	80000			–	–		
9.6	10	82275			–	–		
9.6	10	85625			–	–		
9.6	10	88275			–	–		
9.6	10	90000			–	–		
30	32	1000						
30	32	20			–	–		
30	32	100			–	–		
30	32	500			–	–		
30	32	2250			–	–		
30	32	8250			–	–		
30	32	10000			–	–		
30	32	15000			–	–		
30	32	20000			–	–		
30	32	30000			–	–		
30	32	40000			–	–		
30	32	50000			–	–		
30	32	60000			–	–		

Table A-9 Test record for AC accuracy and flatness verification (continued)

V_{IN} (Vrms)	U8903B input range (V)	f_{IN} (Hz)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
30	32	70000			–	–		
30	32	80000			–	–		
30	32	82275			–	–		
30	32	85625			–	–		
30	32	88275			–	–		
30	32	90000			–	–		
96	100	1000						
96	100	20			–	–		
96	100	100			–	–		
96	100	500			–	–		
96	100	2250			–	–		
96	100	8250			–	–		
96	100	10000			–	–		
96	100	15000			–	–		
96	100	20000			–	–		
96	100	30000			–	–		
96	100	40000			–	–		
96	100	50000			–	–		
96	100	60000			–	–		
96	100	70000			–	–		
96	100	80000			–	–		
96	100	82275			–	–		
96	100	85625			–	–		
96	100	88275			–	–		
96	100	90000			–	–		
140	140	1000						
140	140	20			–	–		
140	140	100			–	–		
140	140	500			–	–		
140	140	2250			–	–		
140	140	8250			–	–		
140	140	10000			–	–		

Table A-9 Test record for AC accuracy and flatness verification (continued)

V_{IN} (Vrms)	U8903B input range (V)	f_{IN} (Hz)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)	Flatness (dB) (Channel 1)	Flatness (dB) (Channel 2)
140	140	15000			–	–		
140	140	20000			–	–		
140	140	30000			–	–		
140	140	40000			–	–		
140	140	50000			–	–		
140	140	60000			–	–		
140	140	70000			–	–		
140	140	80000			–	–		
140	140	82275			–	–		
140	140	85625			–	–		
140	140	88275			–	–		
140	140	90000			–	–		

Test record for frequency accuracy verification

NOTE Use the test record below for the remaining test channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Table A-10 Test record for frequency accuracy verification

f_{DUT} (Hz)	Gate time (s)	U8903B Sample Size	f_{FC} (Hz) (Channel 1)	f_{Meas} (Hz) (Channel 1)	f_{FC} (Hz) (Channel 2)	f_{Meas} (Hz) (Channel 2)	Frequency accuracy (ppm) (Channel 1)	Frequency accuracy (ppm) (Channel 2)
10	10	262144						
20	10	262144						
50	5	262144						
100	5	131072						
500	0.5	131072						
1000	0.5	131072						
5000	0.5	131072						
10000	0.5	131072						
50000	0.5	131072						
80000	0.5	131072						
90000	0.5	131072						

Test record for phase accuracy verification

NOTE Use the test record below for the remaining test channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Table A-11 Test record for phase accuracy verification

f_{IN} (Hz)	Phase accuracy (°)
10	
50	
100	

Table A-11 Test record for phase accuracy verification (continued)

f_{IN} (Hz)	Phase accuracy (°)
500	
1000	
5000	
10000	
50000	
90000	

Test record for crosstalk verification

NOTE Use the test record below for the remaining test channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Table A-12 Test record for crosstalk verification

V_{IN} (V)	U8903B input range (V)	f_{DUT} (Hz)	Crosstalk (dB) (Channel 1 to Channel 2)	Crosstalk (dB) (Channel 2 to Channel 1)
0.32	0.32	1000		
0.32	0.32	20000		
1	1	1000		
1	1	20000		
3.2	3.2	1000		
3.2	3.2	20000		
10	10	1000		
10	10	20000		
32	32	1000		
32	32	20000		
100	100	1000		
100	100	20000		
140	140	1000		
140	140	20000		

Test record for CMRR verification

NOTE Use the test record below for the remaining test channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Table A-13 Test record for CMRR verification

U8903B input range (V)	f_{IN} (Hz)	Graph left edge (Hz)	Graph right edge (Hz)	F_{CMRR} (Hz) (Trace 1)	CMRR (dB) (Trace 1)	F_{CMRR} (Hz) (Trace 2)	CMRR (dB) (Trace 2)
0.32	500	300	800				
0.32	1000	800	1200				
0.32	10000	9800	10200				
0.32	20000	19800	20200				
1	500	300	800				
1	1000	800	1200				
1	10000	9800	10200				
1	20000	19800	20200				
3.2	500	300	800				
3.2	1000	800	1200				
3.2	10000	9800	10200				
3.2	20000	19800	20200				
10	500	300	800				
10	1000	800	1200				
10	10000	9800	10200				
10	20000	19800	20200				
32	500	300	800				
32	1000	800	1200				
32	10000	9800	10200				
32	20000	19800	20200				
100	500	300	800				
100	1000	800	1200				
100	10000	9800	10200				
100	20000	19800	20200				
140	500	300	800				
140	1000	800	1200				

Table A-13 Test record for CMRR verification (continued)

U8903B input range (V)	f_{IN} (Hz)	Graph left edge (Hz)	Graph right edge (Hz)	F_{CMRR} (Hz) (Trace 1)	CMRR (dB) (Trace 1)	F_{CMRR} (Hz) (Trace 2)	CMRR (dB) (Trace 2)
140	10000	9800	10200				
140	20000	19800	20200				

Test record for distortion verification

Table A-14 Test record for distortion verification

Distortion (dB) (Channel 1)	Distortion (dB) (Channel 2)

Test record for SMPTE IMD verification

Table A-15 Test record for SMPTE IMD verification

SMPTE function	SCPI command parameter	SMPTE lower frequency (Hz)	Amplitude (Vrms)	SMPTE IMD (dB) (Channel 1)	SMPTE IMD (dB) (Channel 2)
SMPTE 1 to 1	SMPTe11	60	1		
SMPTE 1 to 1	SMPTe11	60	3		
SMPTE 1 to 1	SMPTe11	60	5		
SMPTE 1 to 1	SMPTe11	60	8		
SMPTE 1 to 1	SMPTe11	170	1		
SMPTE 1 to 1	SMPTe11	170	3		
SMPTE 1 to 1	SMPTe11	170	5		
SMPTE 1 to 1	SMPTe11	170	8		
SMPTE 1 to 1	SMPTe11	300	1		
SMPTE 1 to 1	SMPTe11	300	3		
SMPTE 1 to 1	SMPTe11	300	5		
SMPTE 1 to 1	SMPTe11	300	8		
SMPTE 4 to 1	SMPTe41	60	1		
SMPTE 4 to 1	SMPTe41	60	3		
SMPTE 4 to 1	SMPTe41	60	5		
SMPTE 4 to 1	SMPTe41	60	8		
SMPTE 4 to 1	SMPTe41	170	1		
SMPTE 4 to 1	SMPTe41	170	3		
SMPTE 4 to 1	SMPTe41	170	5		
SMPTE 4 to 1	SMPTe41	170	8		
SMPTE 4 to 1	SMPTe41	300	1		
SMPTE 4 to 1	SMPTe41	300	3		
SMPTE 4 to 1	SMPTe41	300	5		
SMPTE 4 to 1	SMPTe41	300	8		
SMPTE 10 to 1	SMPTe101	60	1		
SMPTE 10 to 1	SMPTe101	60	3		
SMPTE 10 to 1	SMPTe101	60	5		
SMPTE 10 to 1	SMPTe101	60	8		
SMPTE 10 to 1	SMPTe101	170	1		
SMPTE 10 to 1	SMPTe101	170	3		

Table A-15 Test record for SMPTE IMD verification (continued)

SMPTE function	SCPI command parameter	SMPTE lower frequency (Hz)	Amplitude (Vrms)	SMPTE IMD (dB) (Channel 1)	SMPTE IMD (dB) (Channel 2)
SMPTE 10 to 1	SMPTe101	170	5		
SMPTE 10 to 1	SMPTe101	170	8		
SMPTE 10 to 1	SMPTe101	300	1		
SMPTE 10 to 1	SMPTe101	300	3		
SMPTE 10 to 1	SMPTe101	300	5		
SMPTE 10 to 1	SMPTe101	300	8		

Test record for DFD verification

Table A-16 Test record for DFD verification

Generator output amplitude (Vrms)	U8903B input range (V)	f_{DUT} (Hz)	DFD_{2ND} (Channel 1)	DFD_{3RD} (Channel 1)	DFD_{2ND} (Channel 2)	DFD_{3RD} (Channel 2)
1	1	3150				
1	1	4000				
1	1	5000				
1	1	6300				
1	1	8000				
1	1	10000				
1	1	12500				
1	1	16000				
1	1	20000				

Test record for residual noise verification

NOTE The residual noise verification applies to all channels. Use the test record below for the remaining test channels to be tested.

Table A-17 Test record for residual noise verification

$Noise_{avg}$ (dB) (Channel 1)	$Noise_{avg}$ (dB) (Channel 2)

Test record for wideband sine wave flatness verification

Table A-18 Test record for wideband sine wave flatness verification

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
0.2	0.32	1	1000						
0.2	0.32	1	20						
0.2	0.32	1	50						
0.2	0.32	1	100						
0.2	0.32	1	500						
0.2	0.32	1	2250						
0.2	0.32	1	5250						
0.2	0.32	1	10000						
0.2	0.32	1	30000						
0.2	0.32	1	50000						
0.2	0.32	1	70000						
0.2	0.32	1	90000						
0.2	0.32	1	95000						
0.2	0.32	1	100000						
0.2	0.32	1	200000						
0.2	0.32	1	300000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
0.2	0.32	1	400000						
0.2	0.32	1	500000						
0.2	0.32	1	600000						
0.2	0.32	1	700000						
0.2	0.32	1	800000						
0.2	0.32	1	900000						
0.2	0.32	1	1000000						
0.2	0.32	1	1050000						
0.2	0.32	1	1100000						
0.2	0.32	1	1150000						
0.2	0.32	1	1200000						
0.2	0.32	1	1250000						
0.2	0.32	1	1300000						
0.2	0.32	1	1350000						
0.2	0.32	1	1400000						
0.2	0.32	1	1450000						
0.2	0.32	1	1500000						
1	1	10	1000						
1	1	10	20						
1	1	10	50						
1	1	10	100						
1	1	10	500						
1	1	10	2250						
1	1	10	5250						
1	1	10	10000						
1	1	10	30000						
1	1	10	50000						
1	1	10	70000						
1	1	10	90000						
1	1	10	95000						
1	1	10	100000						
1	1	10	200000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
1	1	10	300000						
1	1	10	400000						
1	1	10	500000						
1	1	10	600000						
1	1	10	700000						
1	1	10	800000						
1	1	10	900000						
1	1	10	1000000						
1	1	10	1050000						
1	1	10	1100000						
1	1	10	1150000						
1	1	10	1200000						
1	1	10	1250000						
1	1	10	1300000						
1	1	10	1350000						
1	1	10	1400000						
1	1	10	1450000						
1	1	10	1500000						
2.4	3.2	10	1000						
2.4	3.2	10	20						
2.4	3.2	10	50						
2.4	3.2	10	100						
2.4	3.2	10	500						
2.4	3.2	10	2250						
2.4	3.2	10	5250						
2.4	3.2	10	10000						
2.4	3.2	10	30000						
2.4	3.2	10	50000						
2.4	3.2	10	70000						
2.4	3.2	10	90000						
2.4	3.2	10	95000						
2.4	3.2	10	100000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
2.4	3.2	10	200000						
2.4	3.2	10	300000						
2.4	3.2	10	400000						
2.4	3.2	10	500000						
2.4	3.2	10	600000						
2.4	3.2	10	700000						
2.4	3.2	10	800000						
2.4	3.2	10	900000						
2.4	3.2	10	1000000						
2.4	3.2	10	1050000						
2.4	3.2	10	1100000						
2.4	3.2	10	1150000						
2.4	3.2	10	1200000						
2.4	3.2	10	1250000						
2.4	3.2	10	1300000						
2.4	3.2	10	1350000						
2.4	3.2	10	1400000						
2.4	3.2	10	1450000						
2.4	3.2	10	1500000						
7	10	10	1000						
7	10	10	20						
7	10	10	50						
7	10	10	100						
7	10	10	500						
7	10	10	2250						
7	10	10	5250						
7	10	10	10000						
7	10	10	30000						
7	10	10	50000						
7	10	10	70000						
7	10	10	90000						
7	10	10	95000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
7	10	10	100000						
7	10	10	200000						
7	10	10	300000						
7	10	10	400000						
7	10	10	500000						
7	10	10	600000						
7	10	10	700000						
7	10	10	800000						
7	10	10	900000						
7	10	10	1000000						
7	10	10	1050000						
7	10	10	1100000						
7	10	10	1150000						
7	10	10	1200000						
7	10	10	1250000						
7	10	10	1300000						
7	10	10	1350000						
7	10	10	1400000						
7	10	10	1450000						
7	10	10	1500000						
7	32	10	1000						
7	32	10	20						
7	32	10	50						
7	32	10	100						
7	32	10	500						
7	32	10	2250						
7	32	10	5250						
7	32	10	10000						
7	32	10	30000						
7	32	10	50000						
7	32	10	70000						
7	32	10	90000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
7	32	10	95000						
7	32	10	100000						
7	32	10	200000						
7	32	10	300000						
7	32	10	400000						
7	32	10	500000						
7	32	10	600000						
7	32	10	700000						
7	32	10	800000						
7	32	10	900000						
7	32	10	1000000						
7	32	10	1050000						
7	32	10	1100000						
7	32	10	1150000						
7	32	10	1200000						
7	32	10	1250000						
7	32	10	1300000						
7	32	10	1350000						
7	32	10	1400000						
7	32	10	1450000						
7	32	10	1500000						
7	100	10	1000						
7	100	10	20						
7	100	10	50						
7	100	10	100						
7	100	10	500						
7	100	10	2250						
7	100	10	5250						
7	100	10	10000						
7	100	10	30000						
7	100	10	50000						
7	100	10	70000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
7	100	10	90000						
7	100	10	95000						
7	100	10	100000						
7	100	10	200000						
7	100	10	300000						
7	100	10	400000						
7	100	10	500000						
7	100	10	600000						
7	100	10	700000						
7	100	10	800000						
7	100	10	900000						
7	100	10	1000000						
7	100	10	1050000						
7	100	10	1100000						
7	100	10	1150000						
7	100	10	1200000						
7	100	10	1250000						
7	100	10	1300000						
7	100	10	1350000						
7	100	10	1400000						
7	100	10	1450000						
7	100	10	1500000						
7	140	10	1000						
7	140	10	20						
7	140	10	50						
7	140	10	100						
7	140	10	500						
7	140	10	2250						
7	140	10	5250						
7	140	10	10000						
7	140	10	30000						
7	140	10	50000						

Table A-18 Test record for wideband sine wave flatness verification (continued)

V_{IN} (V)	U8903B input range (V)	Digital multimeter range (V)	f_{IN} (Hz)	V_{DMM} (V) (Channel 1)	V_{DMM} (V) (Channel 2)	V_{DUT} (Vrms) (Channel 1)	V_{DUT} (Vrms) (Channel 2)	AC accuracy (dB) (Channel 1)	AC accuracy (dB) (Channel 2)
7	140	10	70000						
7	140	10	90000						
7	140	10	95000						
7	140	10	100000						
7	140	10	200000						
7	140	10	300000						
7	140	10	400000						
7	140	10	500000						
7	140	10	600000						
7	140	10	700000						
7	140	10	800000						
7	140	10	900000						
7	140	10	1000000						
7	140	10	1050000						
7	140	10	1100000						
7	140	10	1150000						
7	140	10	1200000						
7	140	10	1250000						
7	140	10	1300000						
7	140	10	1350000						
7	140	10	1400000						
7	140	10	1450000						
7	140	10	1500000						

Test record for wideband frequency accuracy verification

Table A-19 Test record for wideband frequency accuracy verification

f_{DUT} (Hz)	Gate time (s)	U8903B Sample Size	f_{FC} (Hz) (Channel 1)	f_{Meas} (Hz) (Channel 1)	f_{FC} (Hz) (Channel 2)	f_{Meas} (Hz) (Channel 2)	Frequency accuracy (ppm) (Channel 1)	Frequency accuracy (ppm) (Channel 2)
100000	0.5	262144						
200000	0.5	262144						
300000	0.5	262144						
400000	0.5	262144						
500000	0.5	262144						
600000	0.5	262144						
700000	0.5	262144						
800000	0.5	262144						
900000	0.5	262144						
1000000	0.5	262144						
1100000	0.5	262144						
1200000	0.5	262144						
1300000	0.5	262144						
1400000	0.5	262144						
1500000	0.5	262144						

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Keysight U8903B
Audio Analyzer

Service Guide

Appendix B

KEYSIGHT TECHNOLOGIES

Digital Generator and Digital Analyzer Performance Verification

Test record for DSI master clock output frequency accuracy verification

Table B-1 Test record for DSI master clock output frequency accuracy verification

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
8	6750	128	864000				
8	6750	256	1728000				
8	6750	512	3456000				
8	6750	1024	6912000				
8	8000	128	1024000				
8	8000	256	2048000				
8	8000	512	4096000				
8	8000	1024	8192000				
8	11030	128	1411840				
8	11030	256	2823680				
8	11030	512	5647360				
8	11030	1024	11294720				
8	12500	128	1600000				
8	12500	256	3200000				
8	12500	512	6400000				
8	12500	1024	12800000				
8	16000	128	2048000				
8	16000	256	4096000				
8	16000	512	8192000				
8	16000	1024	16384000				
8	22050	128	2822400				
8	22050	256	5644800				
8	22050	512	11289600				
8	22050	1024	22579200				
8	28800	128	3686400				
8	28800	256	7372800				
8	28800	512	14745600				
8	28800	1024	29491200				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
8	32000	128	4096000				
8	32000	256	8192000				
8	32000	512	16384000				
8	44100	128	5644800				
8	44100	256	11289600				
8	44100	512	22579200				
8	48000	128	6144000				
8	48000	256	12288000				
8	48000	512	24576000				
8	50000	128	6400000				
8	50000	256	12800000				
8	50000	512	25600000				
8	88200	128	11289600				
8	88200	256	22579200				
8	96000	128	12288000				
8	96000	256	24576000				
8	100000	128	12800000				
8	100000	256	25600000				
8	176400	128	22579200				
8	192000	128	24576000				
8	200000	128	25600000				
12	6750	96	648000				
12	6750	192	1296000				
12	6750	384	2592000				
12	6750	768	5184000				
12	8000	96	768000				
12	8000	192	1536000				
12	8000	384	3072000				
12	8000	768	6144000				
12	11030	96	1058880				
12	11030	192	2117760				
12	11030	384	4235520				
12	11030	768	8471040				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
12	12500	96	1200000				
12	12500	192	2400000				
12	12500	384	4800000				
12	12500	768	9600000				
12	13000	96	1248000				
12	13000	192	2496000				
12	13000	384	4992000				
12	13000	768	9984000				
12	16000	96	1536000				
12	16000	192	3072000				
12	16000	384	6144000				
12	16000	768	12288000				
12	22050	96	2116800				
12	22050	192	4233600				
12	22050	384	8467200				
12	22050	768	16934400				
12	28800	96	2764800				
12	28800	192	5529600				
12	28800	384	11059200				
12	28800	768	22118400				
12	32000	96	3072000				
12	32000	192	6144000				
12	32000	384	12288000				
12	32000	768	24576000				
12	44100	96	4233600				
12	44100	192	8467200				
12	44100	384	16934400				
12	44100	768	33868800				
12	48000	96	4608000				
12	48000	192	9216000				
12	48000	384	18432000				
12	48000	768	36864000				
12	50000	96	4800000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
12	50000	192	9600000				
12	50000	384	19200000				
12	88200	96	8467200				
12	88200	192	16934400				
12	88200	384	33868800				
12	96000	96	9216000				
12	96000	192	18432000				
12	96000	384	36864000				
12	100000	96	9600000				
12	100000	192	19200000				
12	100000	384	38400000				
12	176400	96	16934400				
12	176400	192	33868800				
12	192000	96	18432000				
12	192000	192	36864000				
12	200000	96	19200000				
12	200000	192	38400000				
12	250000	96	24000000				
12	384000	96	36864000				
12	400000	96	38400000				
16	6750	128	864000				
16	6750	256	1728000				
16	6750	512	3456000				
16	8000	64	512000				
16	8000	128	1024000				
16	8000	256	2048000				
16	8000	512	4096000				
16	11030	64	705920				
16	11030	128	1411840				
16	11030	256	2823680				
16	11030	512	5647360				
16	12500	64	800000				
16	12500	128	1600000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
16	12500	256	3200000				
16	12500	512	6400000				
16	16000	64	1024000				
16	16000	128	2048000				
16	16000	256	4096000				
16	16000	512	8192000				
16	22050	64	1411200				
16	22050	128	2822400				
16	22050	256	5644800				
16	22050	512	11289600				
16	25000	64	1600000				
16	28800	128	3686400				
16	28800	256	7372800				
16	28800	512	14745600				
16	32000	64	2048000				
16	32000	128	4096000				
16	32000	256	8192000				
16	32000	512	16384000				
16	44100	64	2822400				
16	44100	128	5644800				
16	44100	256	11289600				
16	44100	512	22579200				
16	48000	64	3072000				
16	48000	128	6144000				
16	48000	256	12288000				
16	48000	512	24576000				
16	50000	64	3200000				
16	50000	128	6400000				
16	50000	256	12800000				
16	50000	512	25600000				
16	88200	64	5644800				
16	88200	128	11289600				
16	88200	256	22579200				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
16	96000	64	6144000				
16	96000	128	12288000				
16	96000	256	24576000				
16	100000	64	6400000				
16	100000	128	12800000				
16	100000	256	25600000				
16	176400	64	11289600				
16	176400	128	22579200				
16	192000	64	12288000				
16	192000	128	24576000				
16	200000	64	12800000				
16	200000	128	25600000				
16	250000	64	16000000				
16	384000	64	24576000				
16	400000	64	25600000				
20	6750	160	1080000				
20	6750	320	2160000				
20	6750	640	4320000				
20	8000	80	640000				
20	8000	160	1280000				
20	8000	320	2560000				
20	8000	640	5120000				
20	11030	80	882400				
20	11030	160	1764800				
20	11030	320	3529600				
20	11030	640	7059200				
20	12500	80	1000000				
20	12500	160	2000000				
20	12500	320	4000000				
20	12500	640	8000000				
20	16000	80	1280000				
20	16000	160	2560000				
20	16000	320	5120000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
20	16000	640	10240000				
20	22050	80	1764000				
20	22050	160	3528000				
20	22050	320	7056000				
20	22050	640	14112000				
20	28800	80	2304000				
20	28800	160	4608000				
20	28800	320	9216000				
20	28800	640	18432000				
20	32000	80	2560000				
20	32000	160	5120000				
20	32000	320	10240000				
20	32000	640	20480000				
20	44100	80	3528000				
20	44100	160	7056000				
20	44100	320	14112000				
20	44100	640	28224000				
20	48000	80	3840000				
20	48000	160	7680000				
20	48000	320	15360000				
20	48000	640	30720000				
20	50000	80	4000000				
20	50000	160	8000000				
20	50000	320	16000000				
20	50000	640	32000000				
20	88200	80	7056000				
20	88200	160	14112000				
20	88200	320	28224000				
20	96000	80	7680000				
20	96000	160	15360000				
20	96000	320	30720000				
20	100000	80	8000000				
20	100000	160	16000000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
20	100000	320	32000000				
20	176400	80	14112000				
20	176400	160	28224000				
20	192000	80	15360000				
20	192000	160	30720000				
20	200000	80	16000000				
20	200000	160	32000000				
20	250000	80	20000000				
20	384000	80	30720000				
20	400000	80	32000000				
24	6750	192	1296000				
24	6750	384	2592000				
24	6750	768	5184000				
24	8000	96	768000				
24	8000	192	1536000				
24	8000	384	3072000				
24	8000	768	6144000				
24	11030	96	1058880				
24	11030	192	2117760				
24	11030	384	4235520				
24	11030	768	8471040				
24	12500	96	1200000				
24	12500	192	2400000				
24	12500	384	4800000				
24	12500	768	9600000				
24	16000	96	1536000				
24	16000	192	3072000				
24	16000	384	6144000				
24	16000	768	12288000				
24	22050	96	2116800				
24	22050	192	4233600				
24	22050	384	8467200				
24	22050	768	16934400				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
24	28800	96	2764800				
24	28800	192	5529600				
24	28800	384	11059200				
24	28800	768	22118400				
24	32000	96	3072000				
24	32000	192	6144000				
24	32000	384	12288000				
24	32000	768	24576000				
24	44100	96	4233600				
24	44100	192	8467200				
24	44100	384	16934400				
24	44100	768	33868800				
24	48000	96	4608000				
24	48000	192	9216000				
24	48000	384	18432000				
24	48000	768	36864000				
24	50000	96	4800000				
24	50000	192	9600000				
24	50000	384	19200000				
24	50000	768	38400000				
24	88200	96	8467200				
24	88200	192	16934400				
24	88200	384	33868800				
24	96000	96	9216000				
24	96000	192	18432000				
24	96000	384	36864000				
24	100000	96	9600000				
24	100000	192	19200000				
24	100000	384	38400000				
24	176400	96	16934400				
24	176400	192	33868800				
24	192000	96	18432000				
24	192000	192	36864000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
24	200000	96	19200000				
24	200000	192	38400000				
24	250000	96	24000000				
24	384000	96	36864000				
24	400000	96	38400000				
28	6750	224	1512000				
28	6750	448	3024000				
28	6750	896	6048000				
28	8000	112	896000				
28	8000	224	1792000				
28	8000	448	3584000				
28	8000	896	7168000				
28	11030	112	1235360				
28	11030	224	2470720				
28	11030	448	4941440				
28	11030	896	9882880				
28	12500	112	1400000				
28	12500	224	2800000				
28	12500	448	5600000				
28	12500	896	11200000				
28	16000	112	1792000				
28	16000	224	3584000				
28	16000	448	7168000				
28	16000	896	14336000				
28	22050	112	2469600				
28	22050	224	4939200				
28	22050	448	9878400				
28	22050	896	19756800				
28	28800	112	3225600				
28	28800	224	6451200				
28	28800	448	12902400				
28	28800	896	25804800				
28	32000	112	3584000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
28	32000	224	7168000				
28	32000	448	14336000				
28	32000	896	28672000				
28	44100	112	4939200				
28	44100	224	9878400				
28	44100	448	19756800				
28	44100	896	39513600				
28	48000	112	5376000				
28	48000	224	10752000				
28	48000	448	21504000				
28	48000	896	43008000				
28	50000	112	5600000				
28	50000	224	11200000				
28	50000	448	22400000				
28	50000	896	44800000				
28	88200	112	9878400				
28	88200	224	19756800				
28	88200	448	39513600				
28	96000	112	10752000				
28	96000	224	21504000				
28	96000	448	43008000				
28	100000	112	11200000				
28	100000	224	22400000				
28	100000	448	44800000				
28	176400	112	19756800				
28	176400	224	39513600				
28	192000	112	21504000				
28	192000	224	43008000				
28	200000	112	22400000				
28	200000	224	44800000				
28	250000	112	28000000				
28	384000	112	43008000				
28	400000	112	44800000				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
32	6750	128	864000				
32	6750	256	1728000				
32	6750	512	3456000				
32	6750	1024	6912000				
32	8000	128	1024000				
32	8000	256	2048000				
32	8000	512	4096000				
32	8000	1024	8192000				
32	11030	128	1411840				
32	11030	256	2823680				
32	11030	512	5647360				
32	11030	1024	11294720				
32	12500	128	1600000				
32	12500	256	3200000				
32	12500	512	6400000				
32	12500	1024	12800000				
32	16000	128	2048000				
32	16000	256	4096000				
32	16000	512	8192000				
32	16000	1024	16384000				
32	22050	128	2822400				
32	22050	256	5644800				
32	22050	512	11289600				
32	22050	1024	22579200				
32	28800	128	3686400				
32	28800	256	7372800				
32	28800	512	14745600				
32	28800	1024	29491200				
32	32000	128	4096000				
32	32000	256	8192000				
32	32000	512	16384000				
32	44100	128	5644800				
32	44100	256	11289600				

Table B-1 Test record for DSI master clock output frequency accuracy verification (continued)

Word length	Sampling rate (Hz)	Master clock multiplier (MUL)	Master clock rate (MCLK)	Measurement 1	Measurement 2	$F_{measure}$ (Hz)	F_{error} (ppm)
32	44100	512	22579200				
32	48000	128	6144000				
32	48000	256	12288000				
32	48000	512	24576000				
32	50000	128	6400000				
32	50000	256	12800000				
32	50000	512	25600000				
32	88200	128	11289600				
32	88200	256	22579200				
32	96000	128	12288000				
32	96000	256	24576000				
32	100000	128	12800000				
32	100000	256	25600000				
32	176400	128	22579200				
32	192000	128	24576000				
32	200000	128	25600000				

Test record for balanced output level accuracy verification

Table B-2 Test record for balanced output level accuracy verification

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
28.8	0.3		
28.8	0.5		
28.8	0.8		
28.8	1		
28.8	1.2		
28.8	1.3		
28.8	1.5		
28.8	1.8		
28.8	2		
28.8	2.3		
28.8	2.5		
28.8	2.8		
28.8	3		
28.8	3.3		
28.8	3.5		
28.8	3.8		
28.8	4		
28.8	4.3		
28.8	4.5		
28.8	4.8		
28.8	5.1		
32	0.3		
32	0.5		
32	0.8		
32	1		
32	1.2		
32	1.3		
32	1.5		
32	1.8		
32	2		
32	2.3		

Table B-2 Test record for balanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
32	2.5		
32	2.8		
32	3		
32	3.3		
32	3.5		
32	3.8		
32	4		
32	4.3		
32	4.5		
32	4.8		
32	5.1		
44.1	0.3		
44.1	0.5		
44.1	0.8		
44.1	1		
44.1	1.2		
44.1	1.3		
44.1	1.5		
44.1	1.8		
44.1	2		
44.1	2.3		
44.1	2.5		
44.1	2.8		
44.1	3		
44.1	3.3		
44.1	3.5		
44.1	3.8		
44.1	4		
44.1	4.3		
44.1	4.5		
44.1	4.8		
44.1	5.1		
48	0.3		

Table B-2 Test record for balanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
48	0.5		
48	0.8		
48	1		
48	1.2		
48	1.3		
48	1.5		
48	1.8		
48	2		
48	2.3		
48	2.5		
48	2.8		
48	3		
48	3.3		
48	3.5		
48	3.8		
48	4		
48	4.3		
48	4.5		
48	4.8		
48	5.1		
88.2	0.3		
88.2	0.5		
88.2	0.8		
88.2	1		
88.2	1.2		
88.2	1.3		
88.2	1.5		
88.2	1.8		
88.2	2		
88.2	2.3		
88.2	2.5		
88.2	2.8		
88.2	3		

Table B-2 Test record for balanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
88.2	3.3		
88.2	3.5		
88.2	3.8		
88.2	4		
88.2	4.3		
88.2	4.5		
88.2	4.8		
88.2	5.1		
96	0.3		
96	0.5		
96	0.8		
96	1		
96	1.2		
96	1.3		
96	1.5		
96	1.8		
96	2		
96	2.3		
96	2.5		
96	2.8		
96	3		
96	3.3		
96	3.5		
96	3.8		
96	4		
96	4.3		
96	4.5		
96	4.8		
96	5.1		
176.4	0.3		
176.4	0.5		
176.4	0.8		
176.4	1		

Table B-2 Test record for balanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
176.4	1.2		
176.4	1.3		
176.4	1.5		
176.4	1.8		
176.4	2		
176.4	2.3		
176.4	2.5		
176.4	2.8		
176.4	3		
176.4	3.3		
176.4	3.5		
176.4	3.8		
176.4	4		
176.4	4.3		
176.4	4.5		
176.4	4.8		
176.4	5.1		
192	0.3		
192	0.5		
192	0.8		
192	1		
192	1.2		
192	1.3		
192	1.5		
192	1.8		
192	2		
192	2.3		
192	2.5		
192	2.8		
192	3		
192	3.3		
192	3.5		
192	3.8		

Table B-2 Test record for balanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
192	4		
192	4.3		
192	4.5		
192	4.8		
192	5.1		

Test record for balanced input sampling rate accuracy verification

Table B-3 Test record for balanced input sampling rate accuracy verification

Sampling rate F_{SR} (kHz)	Impedance (W)	$F_{measure1}$ (kHz) (Channel 1)	$F_{measure2}$ (kHz) (Channel 2)	F_{SRavg} (kHz)	SR_{meas} (kHz)	$F_{SRerror}$ (ppm)
28.8	110					
30	110					
35	110					
40	110					
44.1	110					
50	110					
55	110					
60	110					
65	110					
70	110					
75	110					
80	110					
85	110					
88.2	110					
92	110					
96	110					
100	110					
105	110					
110	110					
115	110					
120	110					
125	110					
130	110					
135	110					
140	110					
145	110					
150	110					
155	110					
160	110					
165	110					

Table B-3 Test record for balanced input sampling rate accuracy verification (continued)

Sampling rate F_{SR} (kHz)	Impedance (W)	$F_{measure1}$ (kHz) (Channel 1)	$F_{measure2}$ (kHz) (Channel 2)	F_{SRavg} (kHz)	SR_{meas} (kHz)	$F_{SRerror}$ (ppm)
170	110					
176.4	110					
180	110					
185	110					
190	110					
192	110					
28.8	Hi-Z					
30	Hi-Z					
35	Hi-Z					
40	Hi-Z					
44.1	Hi-Z					
50	Hi-Z					
55	Hi-Z					
60	Hi-Z					
65	Hi-Z					
70	Hi-Z					
75	Hi-Z					
80	Hi-Z					
85	Hi-Z					
88.2	Hi-Z					
92	Hi-Z					
96	Hi-Z					
100	Hi-Z					
105	Hi-Z					
110	Hi-Z					
115	Hi-Z					
120	Hi-Z					
125	Hi-Z					
130	Hi-Z					
135	Hi-Z					
140	Hi-Z					
145	Hi-Z					
150	Hi-Z					

Table B-3 Test record for balanced input sampling rate accuracy verification (continued)

Sampling rate F_{SR} (kHz)	Impedance (W)	$F_{measure1}$ (kHz) (Channel 1)	$F_{measure2}$ (kHz) (Channel 2)	F_{SRavg} (kHz)	SR_{meas} (kHz)	$F_{SRerror}$ (ppm)
155	Hi-Z					
160	Hi-Z					
165	Hi-Z					
170	Hi-Z					
176.4	Hi-Z					
180	Hi-Z					
185	Hi-Z					
190	Hi-Z					
192	Hi-Z					

Test record for balanced output sampling rate accuracy verification

Table B-4 Test record for balanced output sampling rate accuracy verification

Sampling rate F_{SR} (kHz)	$F_{measure1}$ (kHz) (Channel 1)	$F_{measure2}$ (kHz) (Channel 2)	F_{error1} (ppm) (Channel 1)	F_{error2} (ppm) (Channel 2)
28.8				
30				
35				
40				
44.1				
50				
55				
60				
65				
70				
75				
80				
85				
88.2				
92				
96				
100				
105				
110				
115				
120				
125				
130				
135				
140				
145				
150				
155				
160				
165				

Table B-4 Test record for balanced output sampling rate accuracy verification (continued)

Sampling rate F_{SR} (kHz)	$F_{measure1}$ (kHz) (Channel 1)	$F_{measure2}$ (kHz) (Channel 2)	F_{error1} (ppm) (Channel 1)	F_{error2} (ppm) (Channel 2)
170				
176.4				
180				
185				
190				
192				

Test record for unbalanced output level accuracy verification

Table B-5 Test record for unbalanced output level accuracy verification

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
28.8	0.3		
28.8	0.5		
28.8	0.8		
28.8	1		
28.8	1.2		
28.8	1.3		
28.8	1.5		
28.8	1.8		
28.8	2		
28.8	2.3		
28.8	2.5		
32	0.3		
32	0.5		
32	0.8		
32	1		
32	1.2		
32	1.3		
32	1.5		
32	1.8		
32	2		
32	2.3		
32	2.5		
44.1	0.3		
44.1	0.5		
44.1	0.8		
44.1	1		
44.1	1.2		
44.1	1.3		
44.1	1.5		
44.1	1.8		
44.1	2		

Table B-5 Test record for unbalanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
44.1	2.3		
44.1	2.5		
48	0.3		
48	0.5		
48	0.8		
48	1		
48	1.2		
48	1.3		
48	1.5		
48	1.8		
48	2		
48	2.3		
48	2.5		
88.2	0.3		
88.2	0.5		
88.2	0.8		
88.2	1		
88.2	1.2		
88.2	1.3		
88.2	1.5		
88.2	1.8		
88.2	2		
88.2	2.3		
88.2	2.5		
96	0.3		
96	0.5		
96	0.8		
96	1		
96	1.2		
96	1.3		
96	1.5		
96	1.8		
96	2		

Table B-5 Test record for unbalanced output level accuracy verification (continued)

Sampling rate F_{SR} (kHz)	V_{DUT} (V)	$V_{measure}$ (V)	Level accuracy (dB)
96	2.3		
96	2.5		
176.4	0.3		
176.4	0.5		
176.4	0.8		
176.4	1		
176.4	1.2		
176.4	1.3		
176.4	1.5		
176.4	1.8		
176.4	2		
176.4	2.3		
176.4	2.5		
192	0.3		
192	0.5		
192	0.8		
192	1		
192	1.2		
192	1.3		
192	1.5		
192	1.8		
192	2		
192	2.3		
192	2.5		

Test record for unbalanced input sampling rate accuracy verification

Table B-6 Test record for unbalanced input sampling rate accuracy verification

Sampling rate F_{SR} (kHz)	Impedance (W)	$F_{measure}$ (kHz) (Channel 1)	F_{SR_FC} (kHz)	SR_{meas} (kHz)	$F_{SRerror}$ (ppm)
28.8	75				
30	75				
35	75				
40	75				
44.1	75				
50	75				
55	75				
60	75				
65	75				
70	75				
75	75				
80	75				
85	75				
88.2	75				
92	75				
96	75				
100	75				
105	75				
110	75				
115	75				
120	75				
125	75				
130	75				
135	75				
140	75				
145	75				
150	75				
155	75				
160	75				
165	75				

Table B-6 Test record for unbalanced input sampling rate accuracy verification (continued)

Sampling rate F_{SR} (kHz)	Impedance (W)	$F_{measure}$ (kHz) (Channel 1)	F_{SR_FC} (kHz)	SR_{meas} (kHz)	$F_{SRerror}$ (ppm)
170	75				
176.4	75				
180	75				
185	75				
190	75				
192	75				
28.8	Hi-Z				
30	Hi-Z				
35	Hi-Z				
40	Hi-Z				
44.1	Hi-Z				
50	Hi-Z				
55	Hi-Z				
60	Hi-Z				
65	Hi-Z				
70	Hi-Z				
75	Hi-Z				
80	Hi-Z				
85	Hi-Z				
88.2	Hi-Z				
92	Hi-Z				
96	Hi-Z				
100	Hi-Z				
105	Hi-Z				
110	Hi-Z				
115	Hi-Z				
120	Hi-Z				
125	Hi-Z				
130	Hi-Z				
135	Hi-Z				
140	Hi-Z				
145	Hi-Z				
150	Hi-Z				

Table B-6 Test record for unbalanced input sampling rate accuracy verification (continued)

Sampling rate F_{SR} (kHz)	Impedance (W)	$F_{measure}$ (kHz) (Channel 1)	F_{SR_FC} (kHz)	SR_{meas} (kHz)	$F_{SRerror}$ (ppm)
155	Hi-Z				
160	Hi-Z				
165	Hi-Z				
170	Hi-Z				
176.4	Hi-Z				
180	Hi-Z				
185	Hi-Z				
190	Hi-Z				
192	Hi-Z				

Test record for unbalanced output sampling rate accuracy verification

Table B-7 Test record for unbalanced output sampling rate accuracy verification

Sampling rate F_{SR} (kHz)	$F_{measure}$ (kHz)	F_{error} (ppm)
28.8		
30		
35		
40		
44.1		
50		
55		
60		
65		
70		
75		
80		
85		
88.2		
92		
96		
100		
105		
110		
115		
120		
125		
130		
135		
140		
145		
150		
155		
160		
165		
170		

Table B-7 Test record for unbalanced output sampling rate accuracy verification (continued)

Sampling rate F_{SR} (kHz)	$F_{measure}$ (kHz)	F_{error} (ppm)
176.4		
180		
185		
190		
192		

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Keysight U8903B
Audio Analyzer

Service Guide

Appendix C

KEYSIGHT
TECHNOLOGIES

Modify a Cable for the U8903B CMRR test

1 Order the following parts as material:

Table C-1 Parts to order

Part	Quantity
U8903-61301, male XLR to female XLR, 2 m, Black	1 piece
8120-1840, BNC male to straight BNC 48-in	1 piece

2 Cut one end of the 8120-1840 BNC cable shown in **Figure C-1**.

Figure C-1 8120-1840 BNC cable

3 Locate the male end of the XLR cable, then turn the black sleeve counter-clockwise to loosen it from the metal body.

Figure C-2 Male end of the XLR cable

4 Retrieve the sleeve and wire hood to uncover the soldering wire.

Figure C-3 Uncover the soldering wire

5 De-solder the wires.

Figure C-4 De-solder the wires

6 Sleeve in the 8120-1840 BNC cable into the hood. Solder the BNC cable center connector to both XLR pin 2 and 3. Solder the BNC shielding to XLR pin 1.

Figure C-5 Solder the BNC cable to the male end of the XLR cable

7 Re-install the XLR metal body.

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