Keysight Technologies
Bluetooth Audio Measurement with the U8903B Performance Audio Analyzer

Application Note

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Importance of *Bluetooth*® Audio Analysis

The application of *Bluetooth* audio can be found everywhere in our normal daily lives. We use *Bluetooth* hands-free headsets with our cell phones to talk and to listen to music. *Bluetooth* audio is also available in the car infotainment system, allowing us to stream music from our cell phones to the car audio system. Hence there is need to have *Bluetooth* audio measurement and analysis on these devices as part of the product development, qualification and manufacturing test. *Bluetooth* audio is also part of the whole audio measurement and analysis ecosystem interface, which includes analog audio and digital audio (Figure 1). This article will focus on the *Bluetooth* audio measurement applications of the U8903B performance audio analyzer.

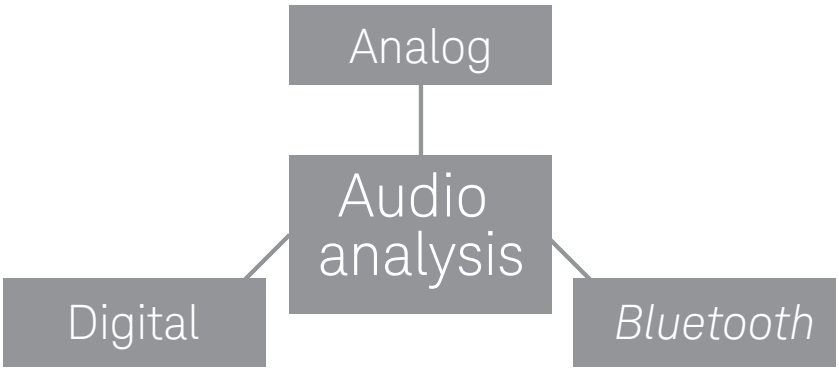


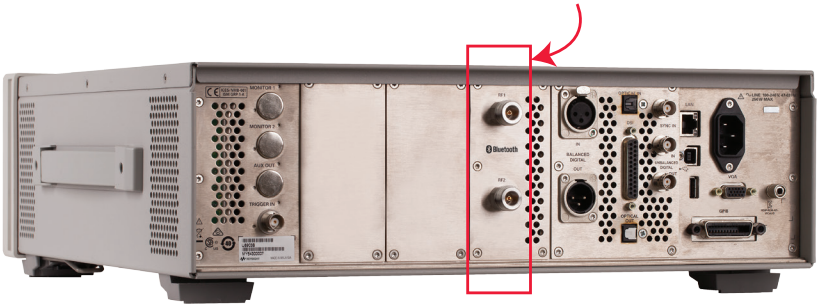
Figure 1. Audio analysis interface

The *Bluetooth* option in U8903B Performance Audio Analyzer

The *Bluetooth* (card) option for U8903B performance audio analyzer is shown in Figure 2. It consists of two N-type female connectors which can be connected to two *Bluetooth* audio device-under-tests (DUTs). The objective of this *Bluetooth* option is to establish a *Bluetooth* link between the U8903B and the DUT either via over-the-air (OTA) or physical cable connection. Once the connection has been made, the U8903B is ready to perform *Bluetooth* audio analysis measurements such as AC level, frequency measurement, distortion (THD), THD+N and so on. The U8903B *Bluetooth* option comes with *Bluetooth* generator (BG) and *Bluetooth* analyzer (BA). The *Bluetooth* option does not perform the RF signals analysis and the *Bluetooth* protocols analysis. Hence, if there is a failure in establishing the *Bluetooth* link, the U8903B will not able to perform the audio analysis of the DUT.

Front panel (no change)

Bluetooth option
(N-type connector interface)



Rear panel

Figure 2. U8903B *Bluetooth* Option

Supported Audio *Bluetooth* Profiles

The U8903B *Bluetooth* option supports Hands-Free Profile (HFP), Advanced Audio Distribution Profile (A2DP) and Audio Video Remote Control Profile (AVRCP).

Hands-Free Profile (HFP) was originally used to control a mobile phone from a hands-free headset. In the HFP setting, the Audio Gateway (AG) is the device that is the gateway of the audio, both for input and output. Devices that typically act as Audio Gateways include mobile phones and personal computer. The Headset (HS) is the device acting as the Audio Gateway's remote audio input and output mechanism. The AG and HS is illustrated in Figure 3. HFP is a duplex communication whereby both AG and HS can communicate back and forth.

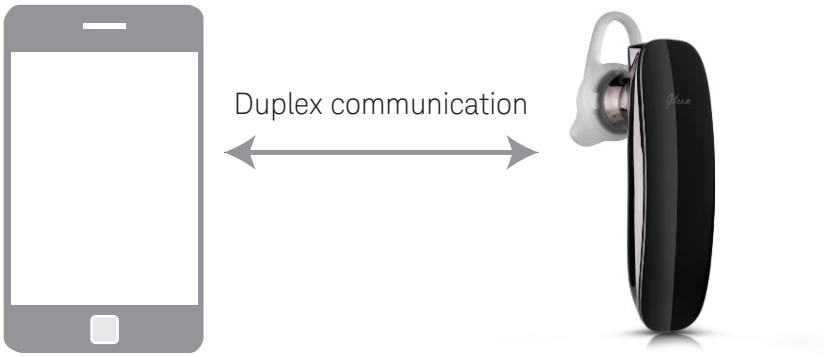


Figure 3. AG and HS in Hands-Free Profile

Advanced Audio Distribution Profile (A2DP) allows the transmission of stereo (Left and Right channels) audio signals with much better quality than the mono encoding used for HFP. An example of A2DP application is when we stream our favorite music from a mobile phone to a *Bluetooth* speaker. There are two roles of an audio device defined in A2DP: Source and Sink. Source is the device which acts as a source of a digital audio stream that is delivered to the Sink device, as illustrated in Figure 4.

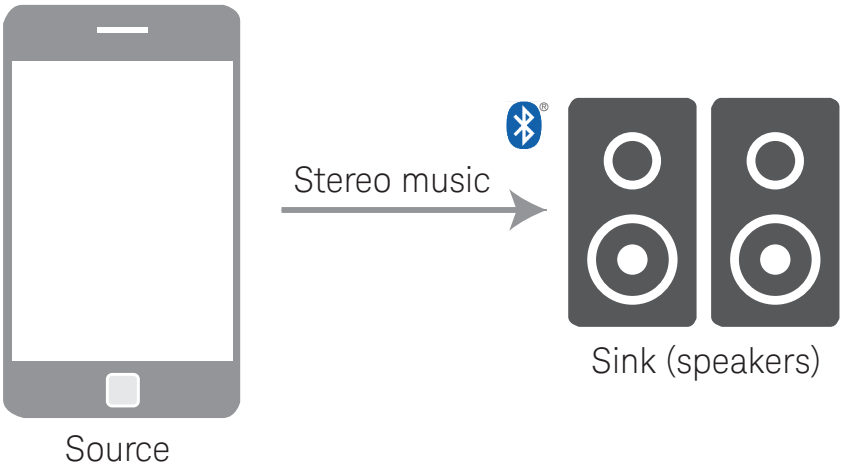


Figure 4. Source and Sink in A2DP

Audio Video Remote Control Profile (AVRCP) is used to remotely control the media playback on other devices. For example, a remote *Bluetooth* headset uses AVRCP commands to skip, forward, pause, play, and increase or decrease the volume on a mobile phone. Most *Bluetooth* audio devices often come with both AVRCP and A2DP. There are two roles defined in AVRCP. One is the controller (e.g. stereo headset) and the other is the target device (e.g. mobile phone).

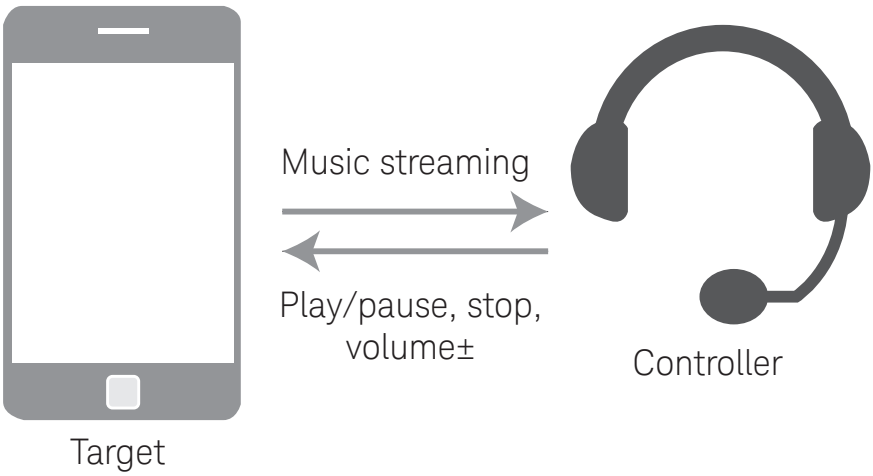


Figure 5. Controller and Target for AVRCP

Example of How to Analyze a *Bluetooth* Audio Receiver

This is an example of how the U8903B *Bluetooth* option can be used to test a *Bluetooth* audio receiver's performance. The DUT is a *Bluetooth* audio receiver with analog audio output. It receives a *Bluetooth* audio signal from a source and then converts it to analog audio. The measurement setup is shown in Figure 6. The U8903B will generate a *Bluetooth* audio test tone to the DUT and analyze the analog audio quality that it receives from the DUT.

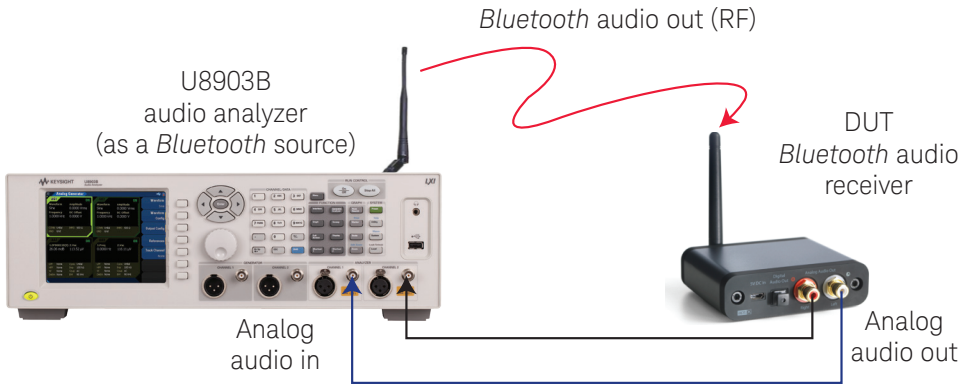


Figure 6. Measurement setup to analyze a *Bluetooth* audio receiver's performance

Step-by-step procedure

Here's a simple step-by-step guide on how to operate the U8903B's *Bluetooth* option.

1. Configure the *Bluetooth* audio generator channel 1 (BG1) to generate a 300 mFFS, 1 kHz tone as shown in Figure 7.
   - Highlight the upper window by pressing the [▼] button
   - Press [Interface] to change from Analog Generator (AG1) to the *Bluetooth* Generator (BG1)
   - Select {Waveform Config} → {Amplitude} → press [300] then select {mFFS}. Press {Return}
   - Select {Frequency} → press [1] then select [kHz]. Press {Return}

Figure 7. Setting the *Bluetooth* Generator

Step-by-step procedure, continued:

2. Setting up the *Bluetooth* link between the U8903B and the DUT
   - Select {Link Config} → {Device Scan} → {Device Search}
     The U8903B will begin searching for any surrounding *Bluetooth* devices. It may find more than one devices. Once the searching process is completed, the U8903B will display a list of detected *Bluetooth* devices. Use the arrow key to select the intended DUT as shown in Figure 8.

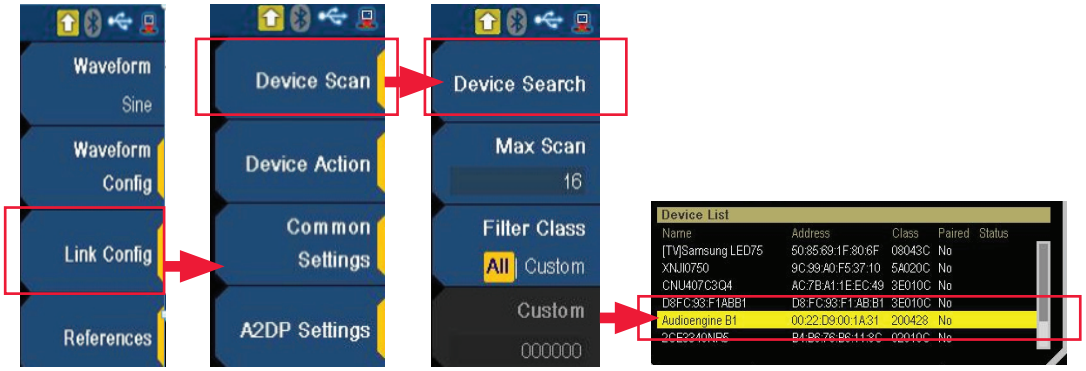


Figure 8. Scan and Search for *Bluetooth* Devices

3. Pair and Connect the A2DP profile of the DUT
   - Select {Device Action} → {Pair Device}
   - Select {Profile Connection} → use the [▲▼] key to select {Connect A2DP} → [Enter]. Once the A2DP profile is successfully connected, A2DP will be highlighted in the "Connection Info" display as shown in Figure 9.

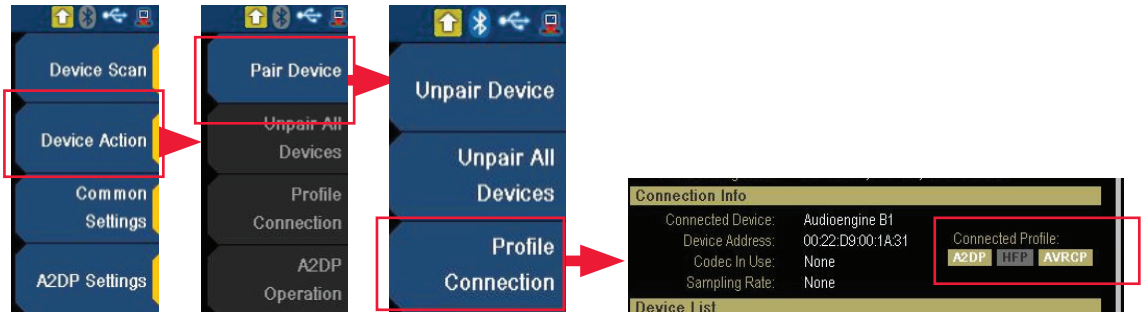


Figure 9. Pair and Connect A2DP Profile

4. Open Media (A2DP) on the DUT
   - Select {A2DP Operation} → Use the [▲▼] key to select {Open Media Connection} → [Enter]
     Once the Open Media action is successful, the Codec in Use and Sampling rate will be displayed in the Connection Info box (Figure 10).

Step-by-step procedure, continued:

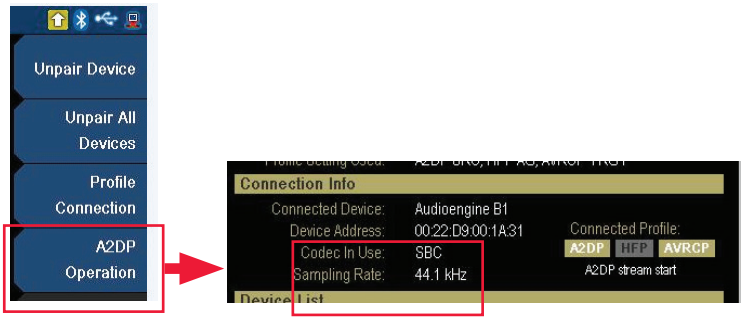
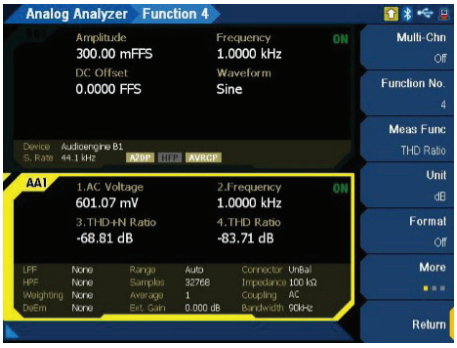
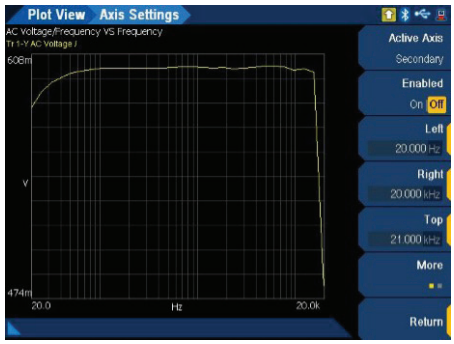


Figure 10. Open Media for A2DP

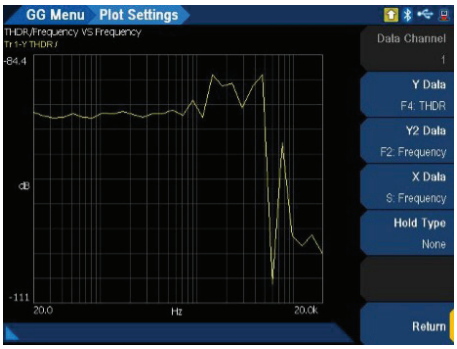
5. The *Bluetooth* link configuration is now completed. The DUT is ready to receive a *Bluetooth* test tone (300 mFFS, 1 kHz) from the U8903B. Next, go back to the *Bluetooth* Generator (BG1) window and turn on BG1. To measure and analyze the analog audio from the DUT on the U8903B, turn on the Analog Analyzer channels (AA1 and AA2) and set up the required measurement functions. An example of the measurement results is shown in Figure 11.



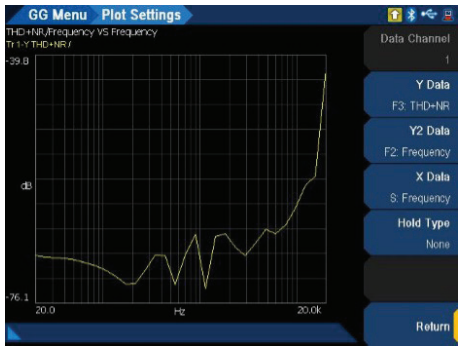
Analog audio measurements



AC level versus frequency response



THD versus frequency response



THD+N versus frequency response

Figure 11. Examples of measurements and frequency responses

Conclusion

The *Bluetooth* option on the U8903B performance audio analyzer is a great solution to measure the audio performance of *Bluetooth* devices. The *Bluetooth* link setup for the A2DP profile requires four simple steps, which consists of Search, Pair, Connect and Open Media. The *Bluetooth* option can be pre-configured during order.

For more information on the U8903B performance audio analyzer and the new *Bluetooth* option, visit:
www.keysight.com/find/audioanalyzer

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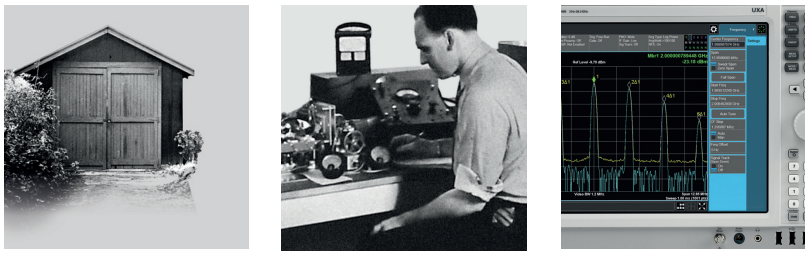

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