Measurement of Maximum Sound Pressure Level of Headphones according to EN50332
Application Note

Products:

| R&S®UPV

| R&S®UPV66

| R&S®UPV-K1

| R&S®SMB

| R&S®SMB-B5

This application note explains how to use the Audio Analyzer R&S® UPV for measurements of maximum sound pressure level of headphones according to EN50332. It is possible to measure a combination of music player / FM receiver and headphones, the maximum output voltage of a player / FM receiver alone or the wideband characteristic voltage of headphones alone. An application program is available for download as installer file and as VB.NET project.

ROHDE&SCHWARZ

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1 Overview

The Audio Analyzer R&S®UPV is abbreviated to UPV for the remainder of this Application Note.
The Signal Generator R&S®SMB100A is abbreviated to SMB for the remainder of this Application Note.
The Signal Generator R&S®SML is abbreviated to SML for the remainder of this Application Note.

Portable audio equipment like MP3 players has become part of our everyday life. In particular together with headphones they make music etc. available anywhere upon command. On the other hand there is evidence that frequent exposure of the human ear to high sound pressure levels leads to irreversible damage of the inner ear. The risk of damage depends on the sound pressure level, the duration of the application and the recovery time between periods of high sound pressure.
As a response to this threat of hearing damage there have been several efforts in legislation and standardization.
One result of these efforts is the European standard EN50332. EN50332-1 defines a measurement method for determining the maximum sound pressure level of a combination of portable audio device and earphones or headphones, respectively. EN50332-2 defines measurement methods for separately offered portable audio devices and headphones.
This application note explains how to use the UPV for measurements according to EN50332. A user-friendly application program is available for download as installer file and as VB.NET project.

2 Principle of the Measurement

The described measurement can be performed on player devices like MP3 players, CD players and cassette tape players as well as on FM receivers.

A core part of the standardized test method is the so-called "program simulating noise" according to IEC 60268-1. In this standard a noise signal is defined with a spectrum which should represent an average of the signals usually present on a broadcast transmitter (speech and different music styles). The 3rd-octave spectrum of the signal is shown in Fig.1.
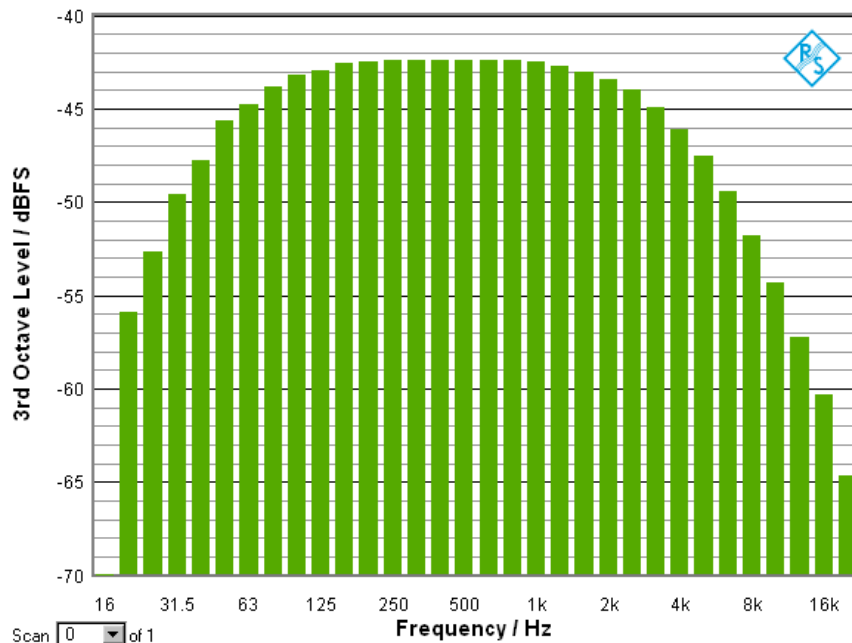

Figure 1: 3rd-octave spectrum of program-simulating noise according to IEC 60268-1.

In addition, EN 50332 provides requirements for the level and the crest factor of the signal. The crest factor (ratio between peak value and rms value) must be between 1.8 and 2.2. For a magnetic recording, the test signal level shall be at -6dB re 250 nWb/m at 315 Hz. For digital recordings the signal level shall be at -10 dBFS (decibels referenced to the RMS value of a full scale sinewave signal). For test of FM receivers, the test signal at the modulator input shall have a rms level of -6 dB related to the amplitude of a sinusoidal signal at 250 Hz which produces a peak-to-peak deviation of ±75 kHz.

In EN 50332-1 this test signal is applied to the combination of player or FM receiver device and earphones or headphones, respectively.

The result value of the standardized measurement according to EN 50332-1 is the A-weighted rms (root-mean-square) of the instantaneous sound pressure, expressed as sound pressure level relative to 20 µPa.

The sound pressure shall be picked up with a head-and-torso simulator (HATS) according to IEC 60318-7 (formerly IEC 60959) which is equipped with an artificial ear consisting of an occluded-ear simulator according to IEC 60318-4 (formerly IEC 60711) and an ear canal of 8.8 mm length and 7.5±0.02 mm diameter. Free-field equalization shall be used for the HATS. In order to keep compatibility between different implementations of the HATS, the inverse of the free field response given in IEC 60318-7 table 3 is used as equalization.

EN 50332-2 provides test specifications for player devices and headphones measured separately.

With the program simulating noise described above, the RMS output voltage of the player device is measured at the headphone jack. In contrary to the acoustic measurements the voltage is measured without frequency weighting.

For headphones the so-called wideband characteristic voltage is determined. It is the unweighted RMS input voltage to the headphones which produces an A-weighted and free field corrected level of 94 dBSPL(A) (corresponding to a sound pressure of 1 PA) in the artificial ear.

The RMS measurement is to be averaged over 30 seconds in all cases.

Although the measurement method may be used applying any limit values, EN 50332 specifies the upper limit for bundled devices to be 100 dBSPL(A), the upper limit for the maximum output voltage of players measured alone to be 150 mV and the lower limit of the wideband characteristic voltage for headphones measured alone to be 75 mV.

3 Required Equipment

3.1 Equipment from Rohde & Schwarz

Required Equipment	
From Rohde & Schwarz	
Description	**Type**
Audio Analyzer	R&S®UPV or R&S®UPV66
XLR/BNC Adapter Set	R&S®UPL-Z1
Universal Sequence Controller (optional, recommended for acoustic calibration tool)	R&S®UPV-K1
Signal Generator (Optional for test of FM tuners)	R&S®SMB100A with R&S®SMB-B5 or R&S®SML with R&S®SML-B5 or R&S®SMBV100A with R&S®SMBV-K57
Bluetooth Tester (Optional for test of Bluetooth headsets)	R&S®CBT with R&S®CBT-B41, R&S®CBT-B42 and R&S®CBT-K52

Required minimum UPV firmware version is 3.1.2.

3.2 Equipment not supplied by Rohde & Schwarz

Required Equipment		
Not supplied by Rohde & Schwarz		
Description	**Manufacturer**	**Type**
Head-and-Torso Simulator	Bruel & Kjaer or G.R.A.S or G.R.A.S.	4128C/D 45BA 45CA with RA0045 and KB0070/71/72/73
Power Supply	Bruel & Kjaer or G.R.A.S	2690A0S2 12AK
Acoustic Calibrator or Pistonphone	Bruel & Kjaer or G.R.A.S	4231 42AP with RA0157

4 Manual Execution (without Option UPV-K1)

4.1 Preparations

Extract 1GA48_files.zip and copy the files therein to directory "D:\UPV\EN50332" on the hard disk of the UPV. If the directory is not yet existing, it must be created.
If desired, a VEQ file containing an equalization curve according to the individually measured listener free field response (file "LFR_R.ADA" on the B&K calibration disk) can be prepared by copying and editing the VEQ file, and storing it to the same directory. Calculate gain factors g from the Y values of the file "LFR_R.ADA" from the B&K calibration disk according to the formula

$$g_i = 10^{(-Y_i/20)}$$

Insert the frequencies from the ADA file in the left column and the results g_i as gain factors in the right column in the VEQ file. Finally count the number of values in the file and enter it in the second line of the header before "# Datacount".

4.1.1 Tests according to EN 50332-1

If the HATS is equipped with one artificial ear, connect the output to analyzer input 1 via a power supply or microphone conditioning amplifier.
If the HATS is equipped with two artificial ears, connect the outputs to analyzer inputs 1 and 2 via a 2-channel power supply or microphone conditioning amplifier.
For testing CD players, burn an audio CD containing a track with the signal from the file "PSN-10dB.wav" and insert it into the CD player.
For testing MP3 players, copy the file "ProgSimNoise-10dB.mp3" to the memory of the MP3 player.

For testing portable FM receivers, connect generator outputs 1 and 2 to the left and right input of the SML or SMB stereo coder or connect the S/P-DIF output of the UPV-B2 to the S/P-DIF input of the stereo coder. In this case the "PSN-10dB.wav" must be copied to "D:\UPV\EN50332" as well.
Make a suitable connection from the SMB or SML RF output to the antenna input of the DUT. In most cases an antenna coupler will have to be used.
Settings of the generator SMB or SML:
Set frequency equal in generator and tuner
Set RF level depending on coupling loss, e.g. -30 dBm
Set Modulation to "Stereo"
Deviation = 80 kHz
Source: "Ext L,R" or "Ext S/P DIF", respectively
Mode: R=L
Ext L,R impedances = 100 kΩ
Set Preemphasis according to regional system, matching tuner setting (50 µs for Europe)
Pilot State: On
Pilot Deviation = 6.75 kHz
Pilot Phase = 0 deg.

Any player or FM receiver device to be tested must be set the following way:

If a noise reduction system is present, it must be turned off
The volume control must be set to maximum
If a tone control (equalizer) is present, it must be adjusted to maximize the sound pressure level.

4.1.2 Tests according to EN 50332-2

For measuring the maximum output voltage of a device, connect the headphone outputs to UPV analyzer inputs 1 and 2, using a suitable connection cable with 32 Ω termination resistors in parallel. Regarding setup for FM tuners and setting of the player device, see also the hints in chapter 4.1.1.

For determining the wideband characteristic voltage of headphones, the HATS is connected and calibrated like described above. The headphones are directly connected to UPV generator outputs 1 and 2, using an appropriate connection cable. As this measurement involves an adjustment of the generator voltage, the earbuds are measured one by one. Only the right artificial ear is used, connected to analyzer input 1. Analyzer input 2 is connected internally to the generator output for measuring the input voltage of the headphones.
It should be noted that EN 50332-2 requires the source impedance of the generator feeding the headphones to be < 2 Ω, whereas the UPV output impedance is 5 Ω. A measurement precisely to the specification requires therefore an external driver amplifier. However, a good approximation can be done by measuring the generator voltage under load condition as described below.

4.2 Calibration of the Artificial Ear

Load the setup "HATS_CAL.SET" to the UPV. Connect the output of the power supply or conditioning amplifier to which the HATS ear is connected to analyzer input 1 of the UPV. Take off the pinna of the ear according to the manual of the HATS, insert adapter part UA1546 into the B&K 4231 calibrator and hold it firmly to the IEC711 coupler in the HATS. Start the calibrator and start a single measurement on the UPV. Subtract the nominal acoustic calibration level in this setup stated by the manufacturer (97.1 dB for B&K 4128 with calibrator 4231, 113.38 dB for G.R.A.S. 45BA with calibrator 42AP) from the dBV reading on the UPV and note down the result for subsequent use.
Remove the calibrator and put back the pinna of the artificial ear.
If the second artificial ear is present in the HATS, repeat the procedure with the second artificial ear and analyzer input 2.

4.3 Performing the Measurement

4.3.1 Measuring a combination of player and headset

Load setup "EN50332.SET" on the UPV. Enter the calibration value noted above as dBV value into the reference field of the function config panel.
Place the headphones of the DUT on the HATS and start playback of the test signal.
Start a single measurement on the UPV.

After the measurement has terminated, the display(s) "RMS over FFT" show(s) the desired result. The FFT spectrum can be checked in the graph window.

4.3.2 Measuring a combination of FM tuner and headset

The modulating signal can be connected from the UPV to the RF generator (R&S® SML with R&S® SML-B5, R&S® SMB with R&S® SMB-B5, R&S® SMBV with R&S® SMBV-K57) analog or digitally.

EN 50332-1 specifies that "the test signal applied at the input of the RF generator shall be set at an RMS value of -6 dB related to the amplitude of a sinusoidal waveform at 250 Hz, producing a peak to peak deviation of ±75 kHz". The set peak deviation of 75 kHz is achieved at the SMB or SML with a peak input voltage (amplitude) of 1 V equivalent to a level of 0 dBV. As the program simulating noise provided with this application note has a crest factor which is slightly higher than 6 dB, clipping could occur on the FM modulator. To avoid this, the deviation is set to 80 kHz in the signal generator, and the input voltage to the modulation input is reduced by 20 * log (80/75) dB = 0.56 dB. Therefore the RMS value of the noise signal on the analog connection has to be set to 0 dBV – 6 dB – 0.56 dB = -6.56 dBV. As the AES17 standard defines the RMS value of a full-scale sinewave to be 0 dBFS, the playback of the "PSN-10dB.wav" file using the "Play" function produces a RMS value 13 dB below the set "Volt Peak" value. To achieve a RMS value of -6.56 dBV, "Volt Peak" has to be set to -6.56 dBV + 13 dB = +6.44 dBV. For digital connection to the generator there is a special wav file "PSN-3.56dB.wav" with a level of -10 dBFS+6.44 dB = -3.56 dBFS.

Load setup "EN50332.SET" on the UPV. Enter the calibration value noted above as dBV value into the reference field of the function config panel.

For analog connection to the generator, change "Channel" in the generator config panel to "2=1" and "Volt Peak" to +6.44 dBV. For digital connection, change the generator to "Digital Audio" in the generator config panel and load wave file "PSN-3.56dB.wav".

Tune the FM receiver to the signal from the signal generator, place the headphones of the DUT on the HATS and start a single measurement on the UPV.

After the measurement has terminated, the display(s) "RMS over FFT" show(s) the desired result. The FFT spectrum can be checked in the graph window.

4.3.3 Measuring a player alone

Load setup "EN50332_device.SET" on the UPV.

Connect the headphone outputs of the DUT to the UPV analyzer inputs with 32 Ω termination resistors in parallel and start playback of the test signal. Start a single measurement on the UPV.

After the measurement has terminated, the display(s) "RMS over FFT" show(s) the desired result. The FFT spectrum can be checked in the graph window.

4.3.4 Measuring an FM tuner alone

Load setup "EN50332.SET" on the UPV. Enter the calibration value noted above as dBV value into the reference field of the function config panel.

For analog connection to the generator, change "Channel" in the generator config panel to "2=1" and "Volt Peak" to +6.44 dBV. For digital connection, change the

generator to "Digital Audio" in the generator config panel and load wave file "PSN 3.56dB.wav".
Tune the FM receiver to the signal from the signal generator.
Connect the headphone outputs of the DUT to the UPV analyzer inputs with 32 Ω termination resistors in parallel and start a single measurement on the UPV.
After the measurement has terminated, the display(s) "RMS over FFT" show(s) the desired result(s). The FFT spectrum can be checked in the graph window.

4.3.5   Measuring a headset alone

Load setup "EN50332_device.SET" on the UPV. Place the headphones of the DUT on the HATS and start a single measurement on the UPV. The generator voltage must be adjusted such that the sound pressure level at the artificial ear (function result of channel 1) is 94 dBSPL(A). If the first measurement yields a result of x dBSPL(A), the generator voltage has to be corrected by (94-x) dB. When the generator voltage is changed, another measurement is automatically started which is used to confirm the correction. The result of the second measurement must be close to 94 dBSPL(A). If necessary, another correction followed by a third measurement is executed.
Once the result in channel 1 is close enough to 94 dBSPL(A), switch off the A weighting filter and the equalizer in the analyzer function panel and start another measurement. The function result of channel 2 then shows the actual input voltage to the heaphones.
Remember to re-activate the A weighting filter and the equalizer, or to reload the setup, before measuring the next DUT.
For a measurement using an external driver amplifier, analyzer input 2 is connected to the output of the driver amplifier, and "Ch2 Input" in the analyzer config panel is changed to "Bal".

4.3.6   Measuring a Bluetooth headset

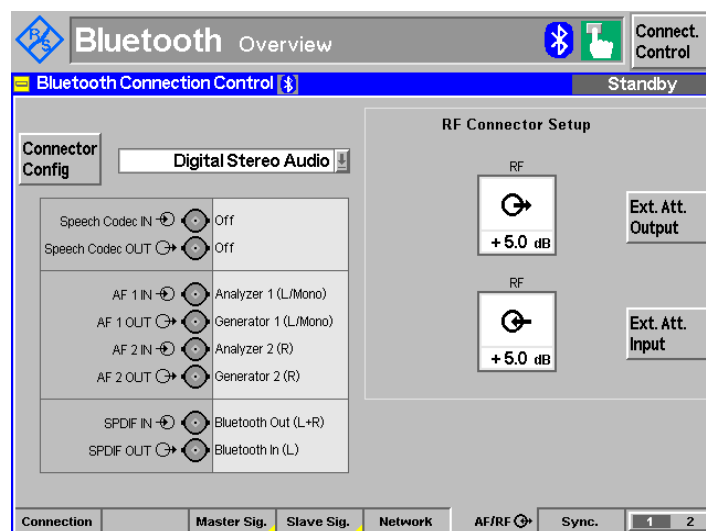#### 4.3.6.1   Settings on the R&S® Bluetooth tester CBT

Figure 2: Configuration of the audio and RF connections

The test signal is transferred from the UPV generator to the CBT via the digital S/P-DIF interface. Connect UPV unbalanced digital input to CBT SPDIF OUT. Connect UPV unbalanced digital output to CBT SPDIF IN. The clock of the CBT S/P-DIF input is synchronized to the Bluetooth system clock and does not adapt to the applied input signal. Therefore it is required to synchronize the digital output of the UPV to the internal digital audio clock of the CBT. The digital generator of the UPV is configured to synchronize to the signal from the CBT digital output at the digital analyzer input. Once the correct input of the digital analyzer is set, this synchronization works even of the analog analyzer is used during the measurement.
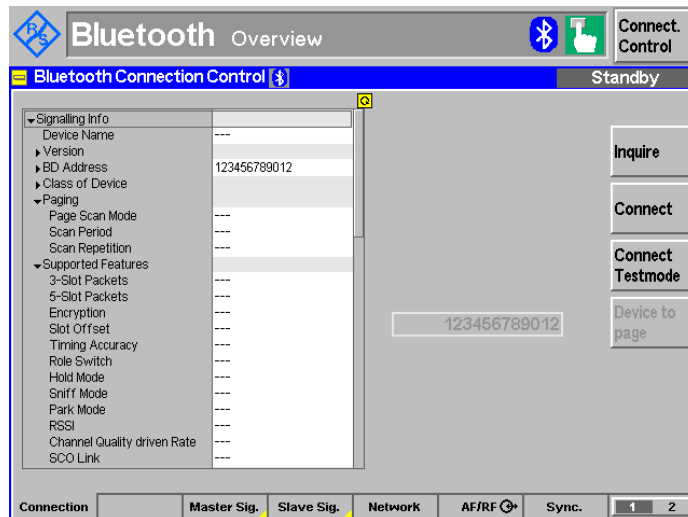

Figure 3: Connection overview

Make a suitable connection from the CBT RF output to the antenna input of the DUT. The device under test has to be set into a mode in which it can be discovered by the CBT. Then the Inquiry is started in the Connection overview page of the CBT. After successful inquiry, the identification number of the device under test is displayed in the "Devices Found" field.
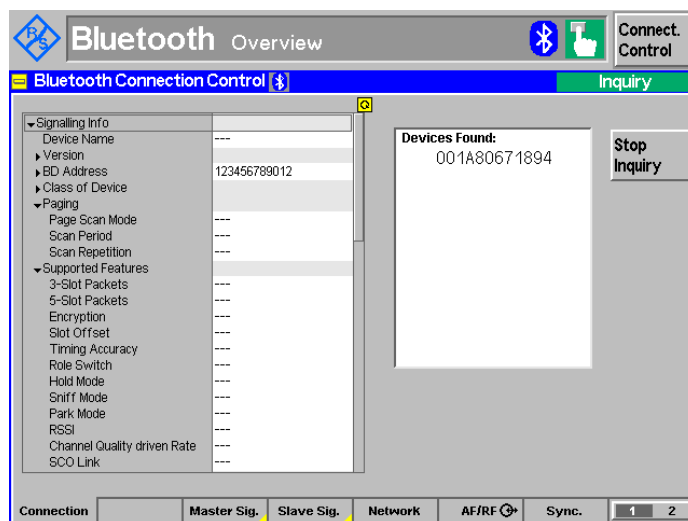

Figure 4: Inquiry

After pressing "Stop Inquiry" the device under test can be selected in the "Device to page" field.
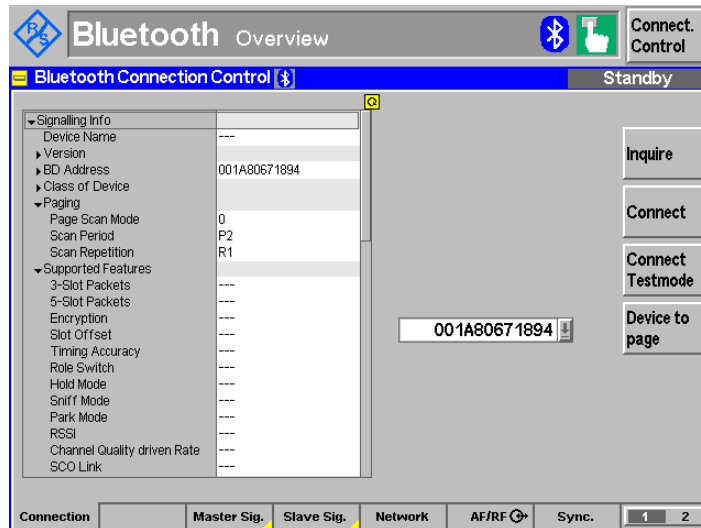

Figure 5: Connection overview with device found
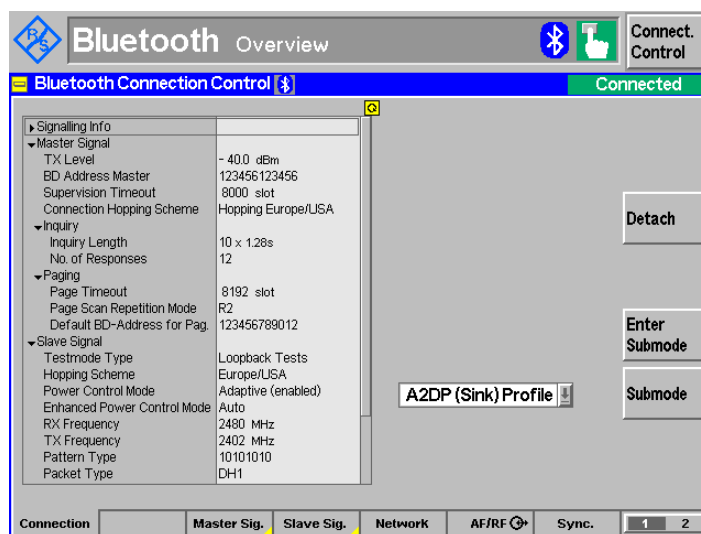
Then press the "Connect" softkey.

Figure 6: Connection overview with device attached

For operation of the DUT as stereo headset, the A2DP profile has to be used. Select submode "A2DP (Sink) Profile" and press the "Enter Submode" softkey.
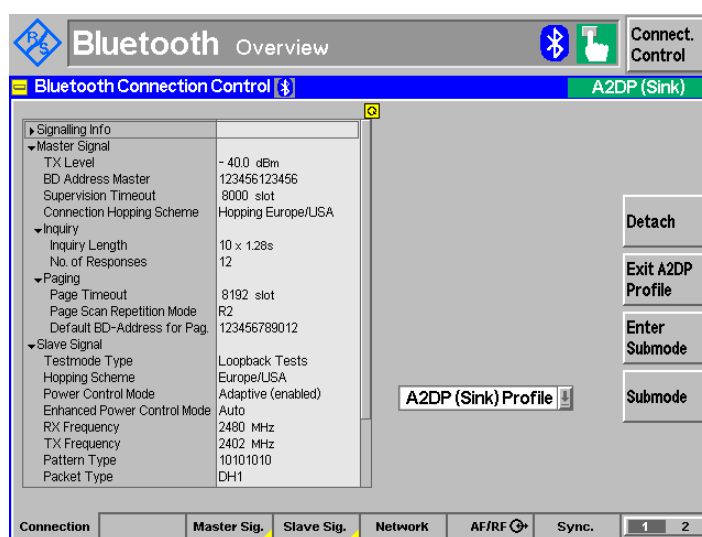
Figure 7: Connection overview with device in A2DP sink profile

4.3.6.2   UPV setup and measurement

Connect the right artificial ear to analyzer input 1. For binaural measurement, connect also the left artificial ear to analyzer input 2.
Insert the earbud(s) into pinna(s) or place the headphones on the HATS.
Set the volume control and, if available, all equalizer bands on the DUT to maximum.
Load setup "EN50332_BT.SET" on the UPV. Set "Instrument" in the analyzer config panel to "Digital Audio" to execute the digital input selection from the setup file. Then set it back to "Analog". Start a single measurement on the UPV.

5 Using the Application Program

5.1 Installation

Copy the installer 1GA48_EN50332_200.MSI to the UPV hard disk and start it. Follow the instructions on the screen. The installer creates a shortcut "EN50332 1GA48" on the desktop and in the "Programs\R&S UPV Applications" submenu.

When using the project files in the development environment of VB.NET without installer, 1GA48_files.zip has to be unzipped and the files therein have to be copied manually to folder "D:\UPV\EN50332".
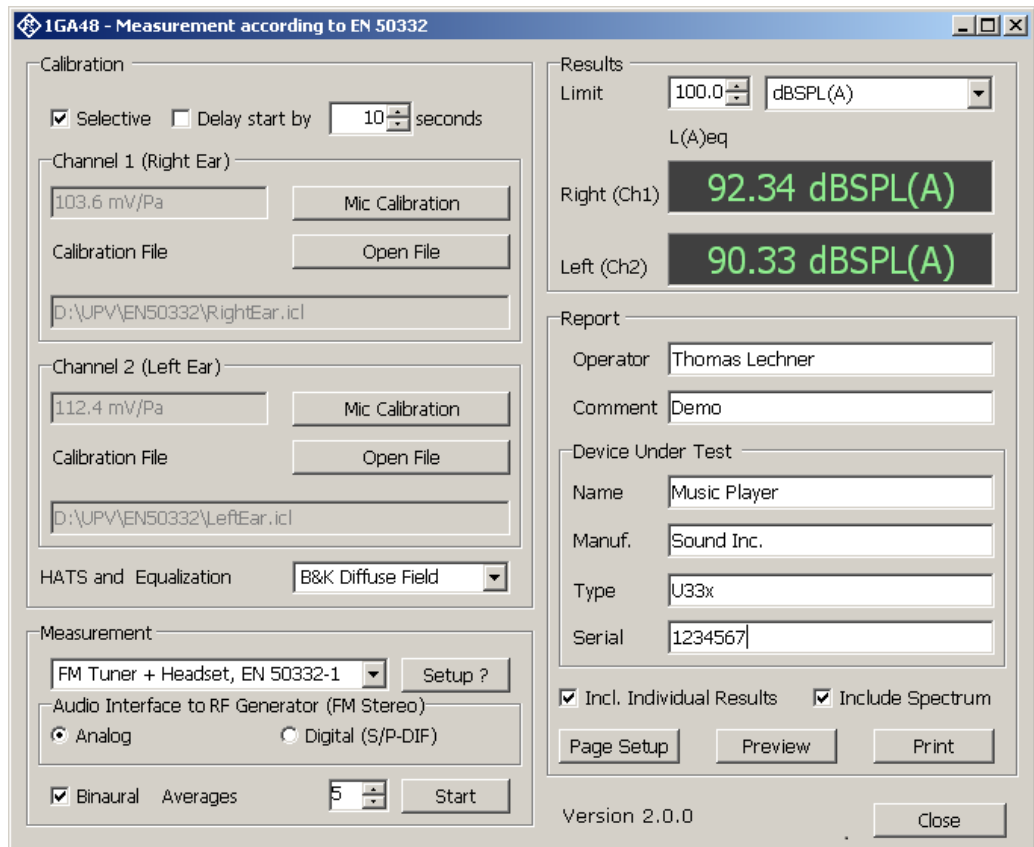
5.2 User Interface

Figure 8: User interface of the application program

5.3   Calibration of the Artificial Ears

5.3.1   Calibration Settings

If the checkbox "Selective" is activated, a band pass filter is applied to the RMS measurement of the output signal of the artificial ear. This increases the immunity of the measurement against background noise.

As the calibrator must be held manually against the artificial ear during the calibration, "Delay start by xx seconds" can be activated to have a specified delay between clicking the "Mic Calibration" button and the start of the measurement, for applying the calibrator against the ear.

After clicking the "Mic Calibration" button, a window opens which allows to enter the acoustic calibration level produced by the calibrator at the artificial ear. This sound pressure is used to calculate the ear sensitivity from the measured output voltage. It is preset to 97.1 dBSPL which is valid for the combination of HATS type 4128 C/D and calibrator 4231. For G.R.A.S. 45BA with calibrator 42AP enter 113.38 dB. For other equipment refer to the manufacturer's manual.

If "Selective" is activated, a second window queries the frequency of the calibration signal. It is preset to 1000 Hz common to most calibrators. Pistonphones mostly use a frequency of 250 Hz. Please refer to the manual of the respective device.

5.3.2   Starting a Calibration

If "Delay start by xx seconds" is not activated, the calibrator must be applied to the artificial ear according to the instructions of the HATS before the "Mic Calibration" button is clicked. Alternatively, "Delay start by xx seconds" can be activated specifying a suitable delay. In this case the calibrator must be applied while the countdown is running.

If the output level of the artificial ear is unstable, a warning is displayed and the calibration routine is aborted.

If the calibration routine is successful, a file selector opens in which a name for the file storing the calibration result has to be provided. This file can later be used to recall the calibration value to avoid a new calibration routine. The name of the file is displayed in the text box below the "Mic Calibration" button after the calibration value has been stored or loaded.

5.3.3   Loading a Calibration Value from File

The button "Open File" opens a file selector which can be used to browse to a file with extension "icl" which contains the correct calibration data for the artificial ear connected to the respective input.

5.3.4   Selecting the HATS Type and Ear Equalization

Select the appropriate entry of the combobox close to the "HATS and Equalization" label.

Note that diffuse field equalization is alternatively allowed only in EN 50332-1:2013. In the older version EN 50332-1:2000-10 free field equalization is mandatory.

5.4   Performing measurements

5.4.1   Choosing a Measurement

With the combo box in the "Measurement" group box one of the measurements explained in section 2 can be selected. Selecting a measurement also selects the associated limit value.

The "Setup ?" button displays a window with instructions how to connect the equipment and the device under test.

Note that acoustic measurements require the calibration value(s) for the artificial ear(s). If no calibration value is present for the first (right) ear, the "Start" button is deactivated.

The checkbox "Binaural" activates a two-channel measurement. Note that a binaural acoustic measurement requires two artificial ears to be present in the HATS. If no calibration value is present for the second (left) artificial ear, the checkbox is deactivated.

5.4.2   Setting the Number of Averages for Acoustic Tests

For all acoustic tests the standard suggests five measurements with the headphones removed and repositioned for each measurement.

Set the number of averages in the numeric control in the Measurement field. For measurement of the maximum output voltage of a player device or FM receiver at the headphone output the controls are hidden, and the set number of averages has no effect.

When averaging of multiple measurements is set, a message box prompts the operator to remove and reposition the headphones before each subsequent measurement. As the test signal files provided are made for a single measurement, the playback has to be restarted before the message box is acknowledged with the "Ok" button. The "Cancel" button breaks the measurement.
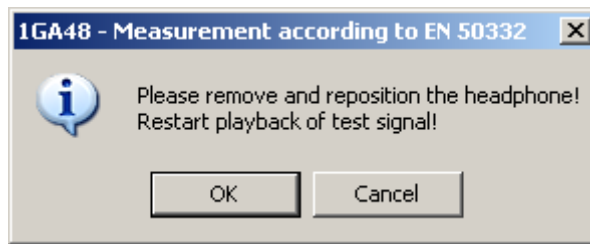
Figure 9: Message box for repositioning the headphones between subsequent measurements

5.4.3 Changing the limits

The limits can be changed in the numeric control of the "Results" group box. If the measurement type is changed, the modified limit is memorized and restored when the same measurement is selected the next time.

5.4.4 Starting a Measurement

A click on the "Start" button in the measurement group box starts the measurement selected in the combo box. A window "Measuring" is displayed while the RMS averaging is running. Measurement of headphones takes at least 90 seconds for adjusting the sound pressure level and measuring the input voltage. A binaural headphones measurement takes at least 180 seconds. All other measurements take approximately 30 seconds.

The results are displayed in the "Results" group box. A limit violation is indicated by red figures. Otherwise the result figure is green.

5.5 Generating Reports

5.5.1 Entering Data

In the text boxes of the "Report" field, information about the operator and the device under test can be entered, which appears in the report. This data is for report purpose only and has no influence on the execution of the tests itself.

If text boxes are left blank, the corresponding space in the report will be suppressed together with the respective labels.

5.5.2 Selecting Additional Information

With the respective checkboxes the measured spectrum and, in case of averaging of multiple measurements, a table with all individual results can be inserted into the report. With multiple measurements the report always shows the spectrum of the last measurement.

5.5.3   Page setup

Clicking this button opens a page setup dialog where paper size, printer and printer settings can be defined. The layout of the report can be used with A4 and letter sized paper.

5.5.4   Print Preview

Clicking this button shows a preview of the report with current data and results. Printout can be started from the preview window.

5.5.5   Print

Clicking this button prints a report with current data and results on the selected printer with the current settings.

6 Changes and Additions

6.1   Version 2.0.0

- Choice between free field and diffuse field equalization
- Frequency range of both equalizations extended up to 20 kHz according to ITU-T P.58(2013)
- Report of HATS type
- Averaging of multiple acoustic measurements
- Display of ear equalization values
- Storing of settings when the program is closing and restoring the settings at the next startup
- Support for Bluetooth headsets, requires option UPV-B2
- Possibility to abort running measurements

7 Literature

- European Standard EN50332-1(2000), "Sound system equipment: Headphones and earphones associated with portable audio equipment. Maximum sound pressure level measurement methodology and limit considerations. Part 1: General method for "one package equipment".
- European Standard EN50332-2(2003), "Sound system equipment: Headphones and earphones associated with portable audio equipment. Maximum sound pressure level measurement methodology and limit considerations. Part 2: Matching of sets with headphones if either or both are offered separately".
- Final Draft European Standard FprEN50332-1:2013, "Sound system equipment: Headphones and earphones associated with portable audio equipment. Maximum sound pressure level measurement methodology and limit considerations. Part 1: General method for "one package equipment".
- Final Draft European Standard FprEN50332-2:2013, "Sound system equipment: Headphones and earphones associated with portable audio equipment. Maximum sound pressure level measurement methodology and limit considerations. Part 2: Matching of sets with headphones if either or both are offered separately".
- IEC 60268-1(1988), "Sound general equipment; General".
- IEC60959(1990), "Head and torso simulator for acoustic measurements of airconduction hearing aids"
- IEC/TS 60318-7(2010): Electroacoustics - Simulators of human head and ear - Part 7: Head and torso simulator for acoustic measurements of air-conduction hearing aids
- ITU-T P.58(2013) "Head and Torso Simulator for Telephonometry"

8 Additional Information

Please send any comments or suggestions about this application note to TM-Applications@rsd.rohde-schwarz.com.

9 Ordering Information

Ordering Information		
Type of instrument		
Description	**Instrument type**	**Ordering number**
Audio Analyzer	R&S®UPV or R&S®UPV66	1146.2003.02 1146.2003.66
XLR/BNC Adapter Set	R&S®UPL-Z1	1078.3704.02
Universal Sequence Controller (optional, recommended for acoustic calibration tool)	R&S®UPV-K1	1401.7009.02
Optional for test of FM tuners		
Signal Generator	R&S®SMB100A	1406.6000.02
Stereo / RDS Coder	R&S®SMB-B5	1407.3205.02
Alternatively for test of FM tuners		
Vector Signal Generator	R&S®SMBV100A	1407.6004.02
FM Stereo / RDS	R&S®SMBV-K57	1415.8190.02
Optional for test of Bluetooth headsets		
Digital audio interfaces AES/EBU, S/P DIF	R&S®UPV-B2	1146.4306.02
Bluetooth® Tester	R&S®CBT	1153.9000.35
Dual-Channel Audio Generator and Analyzer	R&S®CBT-B41	1170.3406.05
Digital Audio Interface	R&S®CBT-B42	1170.3706.03
A2DP Stereo Profile and SBC Codec	R&S®CBT-K52	1170.4002.02

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

Regional contact

Europe, Africa, Middle East
+49 89 4129 12345
customersupport@rohde-schwarz.com

North America
1-888-TEST-RSA (1-888-837-8772)
customer.support@rsa.rohde-schwarz.com

Latin America
+1-410-910-7988
customersupport.la@rohde-schwarz.com

Asia/Pacific
+65 65 13 04 88
customersupport.asia@rohde-schwarz.com

China
+86-800-810-8228 /+86-400-650-5896
customersupport.china@rohde-schwarz.com

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