Products: Audio Analyzer R&S UPV

Measurement of Play-only devices
like MP3 Players
with R&S Audio Analyzer UPV

Application Note 1GA46_0E

Play-only devices like CD- or MP3 players cannot be measured as traditional 4-pole devices. Therefore traditional transfer function measurements using the generator part of the audio analyzer are not possible. Those devices are tested with a pre-recorded test signal available as wav or MP3 file. This application note describes a fast test together with a setup and an executable which runs the test and displays the desired results. The test signal is provided as a linear coded wav file. This file can easily be coded into MP3 format using any commercially available or public domain wave editors or ripper programs. The test can also be executed by IEEE control and all results can be read out by IEEE commands.

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1   Overview

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The Audio Analyzer R&S®UPV is abbreviated to UPV for the remainder of this Application Note.

2   Principle of Operation

Play-only devices like CD- or MP3 players cannot be measured in traditional manner because the signal comes either from a disc or a file. So the only way to measure the audio characteristics of such a device is to use a test disc or a test file which contains all necessary test signals for the measurement.

Single tone measurements have the disadvantage that the beginning of the test sequence has to be synchronized with the test signal. Furthermore the test itself takes longer because a number of frequencies is tested sequentially step by step. A better solution is the use of a multitone signal which allows to measure all necessary parameters in one single measurement.

In the following application a 16 tone test signal is used which allows to measure frequency response, distortion, signal to noise ratio and crosstalk in a single measurement. The test signal is provided as a linear coded wav file. This signal can be used for creating a disc or a MP3 file using appropriate standard programs. Care has to be taken for selecting appropriate coding parameters like bit rate for the MP3 file, as they may influence the measurement results. It is recommended to use at least 256 kB/s to avoid frequency range limitations caused by the MP3 coding.

As the signal is continous, no start synchronization is needed. Just play the signal in the device under test and start the executable Player.exe at any time for the measurement.

In the analyzer the function FFT with a size of 16 k must be selected. Due to any pitch error in the device under test, the test signal is not synchronous to the FFT analysis. Therefore a FFT windowing function must be used. The Flat Top window is used here because it delivers the correct amplitude values also for nonsynchroneous signals. A pre-measurement is made in order to measure the frequency shift of the signal. This measurement delivers the pitch or frequency error of the DUT which can arise from the error of the Xtal frequency in the device. The nominal test frequencies are corrected by this pitch error for the measurement, so even with a pitch error up to 5% the measurements are correct.

At about 100 Hz and 10 kHz, the frequencies in the left channel and in the right channel are slightly different thus allowing to measure the crosstalk from left channel to the right channel and vice versa at those frequencies.

Both channels comprise a 1 kHz component in the signal. The amplitude of this 1 kHz component is used as a 0 dB reference for the frequency response display, so the graph will always cross 0 dB at 1 kHz.

The test signal is composed such that it does not contain harmonic components of 1 kHz up to the 9th harmonic Therefore the harmonics of the 1 kHz line can be measured and are shown as THD at 1 kHz.

The signal power in the spectral gaps of the multitone signal is summed up in the frequency range 20 Hz to 20 kHz, and the resulting voltage of this sum is regarded as the noise signal not directly caused by the test signal. It must be noted that the measured noise floor may be not identical to the noise floor without the multitone signal present. Due to nonlinearities in the device under test also higher order mixing products can occur anywhere in the spectrum and will thus be treated like noise. The noise voltage thus obtained is referred to the total signal level and displayed as S/N ratio.

The multitone signal used in this test contains the following frequencies (in Hz):

Left	30	70	100	230	480	710	1000	1550
	2600	4400	7100	9900	12000	15000	18000	20000
Right	30	70	130	230	480	710	1000	1550
	2600	4400	7100	10100	12000	15000	18000	20000

This signal is provided as Player.wav together with the executable Player.exe for this application.

The macro measures, calculates and displays frequency response, pitch error, total level, level at 1 kHz, total harmonic distortion, crosstalk at 100 Hz and 10 kHz, and signal-to-noise ratio.

3   Software Requirements

The Audio Analyzer UPV needs firmware version 1.4.0 resp. 2.0.0 (for Compass version 2 in the UPV) or higher installed.

4   Test Setup

The test definition is given in the instrument setup Player.set. This setup or a modified setup made from Player.set must be loaded in the UPV before starting the macro. Please be aware that the setup Player.set also uses the generator part and generates the test signal Player.wav, so you can also test any 4-pole device using the UPV generator as a source instead of playing the file in the DUT. In case this is not required,the UPV generator may be switched to function Sine. Then the wav file will not be loaded together with the setup, which will speed up the setup loading time.

5   Setting the Test Parameter

The test level is given in the file Player.wav and cannot be changed. The file is scaled so that the peak amplitude reaches nearly full scale (-0.3 dB). Only in cases where the UPV generator is used, the generator level can be set in the generator function panel. The modified setup can then be stored under any convenient name. Please be aware that for the display of the frequency response graph, screen 2 has to be selected.

Any modified setup for the measurement may be stored and later recalled. The setup must be loaded into the UPV before starting the macro.

6   Starting the Software

The executable Player.exe can be copied into any directory of the UPV. The measurement is initiated by double-clicking this exe or by selecting Sequence – Run Macro from the UPV menu. It also possible to configure one of the quick start buttons to launch the measurement macro.

Player.exe can also be started by IEEE control with the command (it is assumed that the exe was copied into the directory D:\UPV\USER):

SYST:PROG:EXEC 'D:\UPV\USER\Player.exe'

The end of the program execution can be queried by reading bit 14 of the status operation register in the status operation system of the UPV. This bit is set to 1 as long as the macro is running, after finishing of the macro this bit is reset to 0.

After termination of the macro, the results are displayed on the UPV screen:
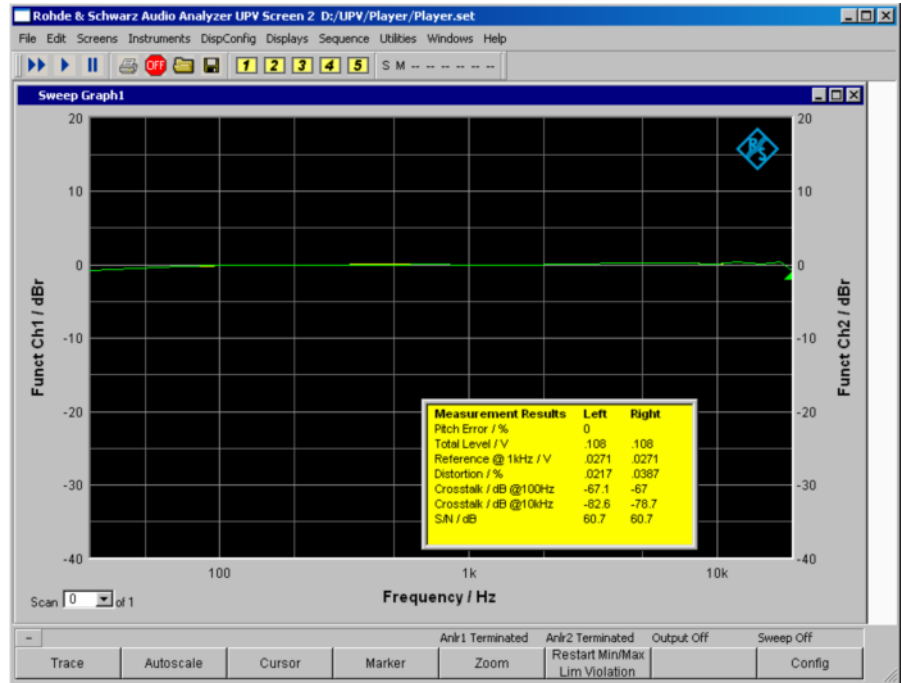
The results can further be read out remotely using the commands:

| trac:load:swe_ay?	Returns the frequency response values in dB relative to 1 kHz for channel 1
trac:load:swe_by?	Returns the frequency response values in dB relative to 1 kHz for channel 2
trac:load:swe_ax?	Returns the used frequencies in Hz for channel 1
trac:load:swe_bx?	Returns the used frequencies in Hz for channel 2

The calculated values are available with the commands:

|	
syst:mem:str1?	Returns the pitch error (speed error) in %
syst:mem:str2?	Returns the total RMS level channel 1 and channel 2 in V (values are comma separated)
syst:mem:str3?	Returns the reference level at 1 kHz for channel 1 and channel 2 in V
syst:mem:str4?	Returns the THD distortion at 1 kHz for channel 1 and channel 2 in %
syst:mem:str5?	Returns the crosstalk attenuation at 100 Hz (130 Hz) right to left and left to right in dB
syst:mem:str6?	Returns the crosstalk attenuation at 10 kHz (9900 Hz and 10100 Hz) right to left and left to right in dB
syst:mem:str7?	Returns the noise level from 20 Hz to 20 kHz in channel 1 and channel2 in V
syst:mem:str8?	Returns the signal to noise ratio from 20 Hz to 20 kHz in channel 1 and channel2 in dB

7 Appendix: Using the Quick Launch Buttons

The UPV offers 8 quick launch buttons which can be utilized either for loading pre-defined setups or for starting pre-defined macros. The quick launch buttons are on the toolbar which is either displayed permanently on top of the UPV window (can be set in "Utilities → Config Panel") or appears on the right side when the mouse is moved to the right edge of the UPV window.

The assignment of the buttons can be defined in "Utilities → Quick Launch Config …":
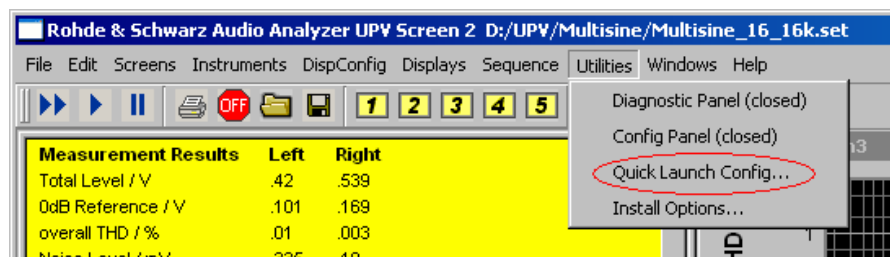
Fig. 1 Starting the Quick Launch Config Panel

This menu opens the following configuration panel:
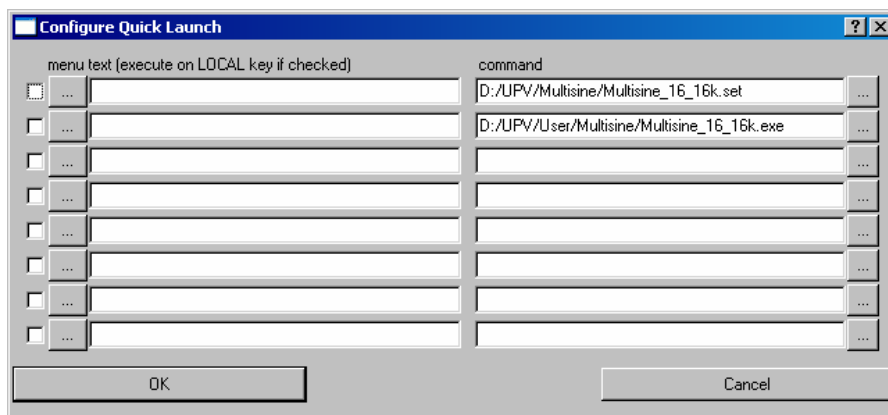
Fig. 2 Quick Launch Config Panel

Use the "…" buttons on the right side to browse to the setup file of exe file which should be called by the respective button. The "…" buttons on the left side can be utilized to specify icons on the buttons. Text entered in the text box on the left side will be displayed as tool tip text for the respective button when the mouse cursor is staying on the area of the button.

8   Ordering information

UPV

Audio Analyzer	DC … 250 kHz	1146.2003.02

For additional information about audio analyzers and other measurement equipment, see the Rohde & Schwarz website www.rohde-schwarz.com.