

# Spectral and Time-Domain Analysis of Recorded Wave Files on the Audio Analyzer R&S® UPV

## Application Note

### Products:

- | R&S®UPV            | R&S®UPV-K63
- | R&S®UPV-B2
- | R&S®UPV-K61

The instrument setup provided in this application note allows to analyze a degraded speech signal stored into a wave file and to display its FFT spectrum and waveform.

# Table of Contents

<b>1</b>	<b>Background .....</b>	<b>3</b>
<b>2</b>	<b>Preparations .....</b>	<b>4</b>
2.1	Loading the Setup .....	4
2.2	Choosing the Interface for Connection between Generator and Analyzer .....	4
2.3	Loading the Wave File of the Degraded Signal .....	5
2.4	Setting the FFT Resolution and Analysis Length .....	5
2.5	Using the UPV Monitor .....	7
<b>3</b>	<b>Analysis .....</b>	<b>8</b>
3.1	Starting the Analysis.....	8
3.2	Display of Results .....	8
3.2.1	FFT Spectrum .....	8
3.2.2	Waveform .....	9
<b>4</b>	<b>Literature.....</b>	<b>10</b>
<b>5</b>	<b>Ordering Information .....</b>	<b>10</b>

# 1 Background

The audio analyzer R&S® UPV is herein below called “UPV”.

Instrumental speech quality evaluation using algorithms like PESQ or POLQA allow to obtain a Mean Opinion Score (MOS) value which predicts subjective judgement of the speech quality by a large number of listeners under well-defined listening conditions. However, if the MOS score is lower than expected, information is needed about the nature of the degradation, in order to track down the cause of the degradation. Common types of degradation are distortion, added noise and dropouts. Steady-state noise can be detected in the spectrum of the degraded signal. Noise bursts and dropouts can be detected in the waveform of the degraded signal.

The application program of application note 1GA62 and the CMWRun scripts for speech quality tests allow to store the degraded speech signals into wave files. This application note presents a UPV instrument setup which allows to load and play the degraded signal, and to display the spectrum and waveform.

## 2 Preparations

### 2.1 Loading the Setup

Copy the setup file “SpeechAnalysis\_AD.set” provided in the application notes download to the UPV hard disk, e.g. to folder “D:\UPV\Setups”. Use menu item “File → Load Setup” in the menu of the UPV window to load the setup.

### 2.2 Choosing the Interface for Connection between Generator and Analyzer

The setup performs FFT analysis and display of the waveform of the signal stored in a wave file. To avoid unintentional playout of the signal to external circuits and feeding of noise into the generator output from outside, any connection on generator output 1 should be removed before the analysis described in this application note.

If the UPV is equipped with the digital audio interface option UPV-B2, the connection from the generator output to the analyzer input can also be established on the digital audio interface, which allows lossless transfer of the digital samples from the generator to the analyzer. For this purpose the “Instrument” in both the Generator Config panel and Analyzer Config panel should be set to “Digital Audio”.

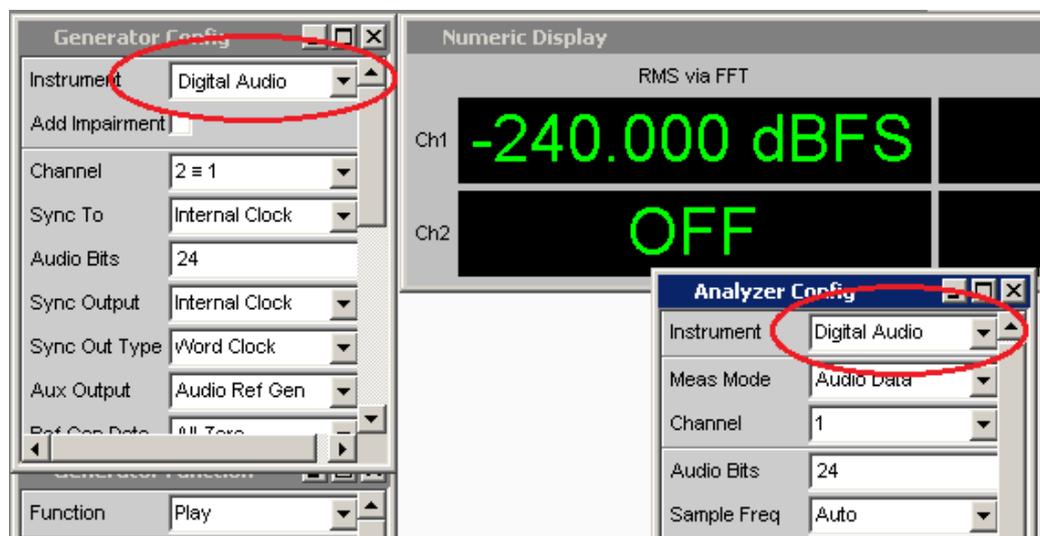
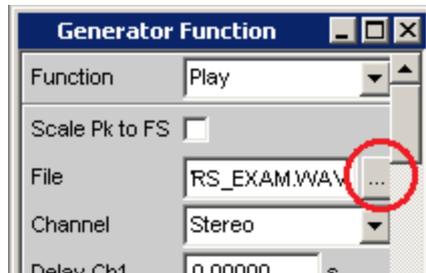


Figure 1: Configuration settings for digital audio connection between generator and analyzer

## 2.3 Loading the Wave File of the Degraded Signal

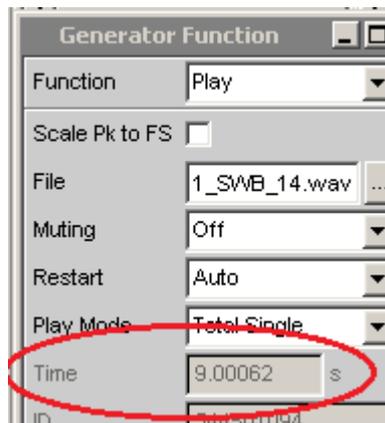
Click on the “...” button besides the “File” field in the generator function panel to open the file selector and browse to the desired wave file.



**Figure 2: Selection of the wave file to be analyzed**

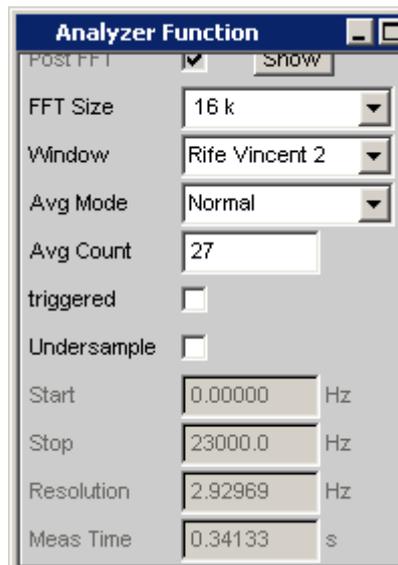
## 2.4 Setting the FFT Resolution and Analysis Length

In the Generator Function panel, the length of the wave file is displayed in the “Time” field.



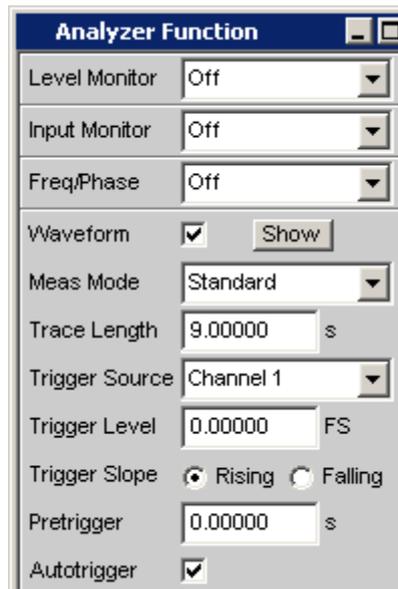
**Figure 3: File length information in the Generator Function panel**

In the Analyzer Function panel the FFT resolution can be set in the “FFT Size” field. The resulting acquisition time for one FFT is displayed in the “Meas Time” field. To get the FFT spectrum averaged over the complete signal duration, set the number of FFTs to be averaged in the “Avg Count” field to the next higher integer from the wave file duration divided by the acquisition time of one FFT.



**Figure 4: FFT settings in the Analyzer Function panel**

The length of the waveform display is set in the “Trace Length” field in the Analyzer Function panel.



**Figure 5: Waveform settings in the Analyzer Function panel**

The maximum trace length in the “Standard” mode of the waveform display is 10 seconds. For displaying longer signal durations the “Meas Mode” has to be changed to “Undersample” or “Compressed”. In “Undersample” mode only every n-th sample is displayed. The compressed mode displays the absolute maximum value of respective n subsequent samples such that the upper envelope of the waveform is displayed. The possible display length is  $n * 10$  seconds in both modes.

## 2.5 Using the UPV Monitor

During the analysis the speech signal can be played to the speaker or to headphones connected to the headphones jack on the UPV front panel. The respective settings can be done in the Auxiliaries panel which is opened with menu item “Instruments → Auxiliaries”.



**Figure 6: Monitor settings in the Auxiliaries panel**

The monitor can be switched on and off using the button with the speaker symbol on the UPV front panel. After pressing the volume button to the right of the speaker button, the volume can be adjusted with the rotary knob. Pressing the volume button again closes the volume window and returns the control to the general UPV window.

## 3 Analysis

### 3.1 Starting the Analysis

Make sure that the UPV output is on before you start the analysis. The “Output Off” LED on the front panel must be off and the status bar in the UPV window must display “Gen Running”.

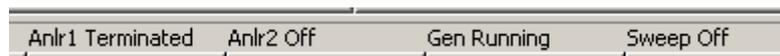


Figure 7: Status panel on bottom of the UPV window

If the output is off, it can be activated by pressing the “OUTPUT” button on the front panel or by clicking on the “OFF” button in the toolbar.



Figure 8: UPV toolbar

To start a single analysis, first press the “START” button in the front panel or the “▶▶” button in the toolbar of the UPV window. This restarts the playback of the generator and starts the analysis. To stop the analysis after it has completed, press the “Single” button on the front panel or the “▶” button in the toolbar immediately after starting the analysis.



Figure 9: Control panel on the UPV front panel

### 3.2 Display of Results

#### 3.2.1 FFT Spectrum

The FFT spectrum is displayed on screen 3 in the UPV window. The screens can be changed with the yellow buttons in the toolbar or with the SCREEN button on the front panel.

Use the softkeys below the screen for Cursor functions. See the UPV manual for details.

Display unit and the scaling of the graph can be set in the FFT Graph config panel which is open on screen 2.

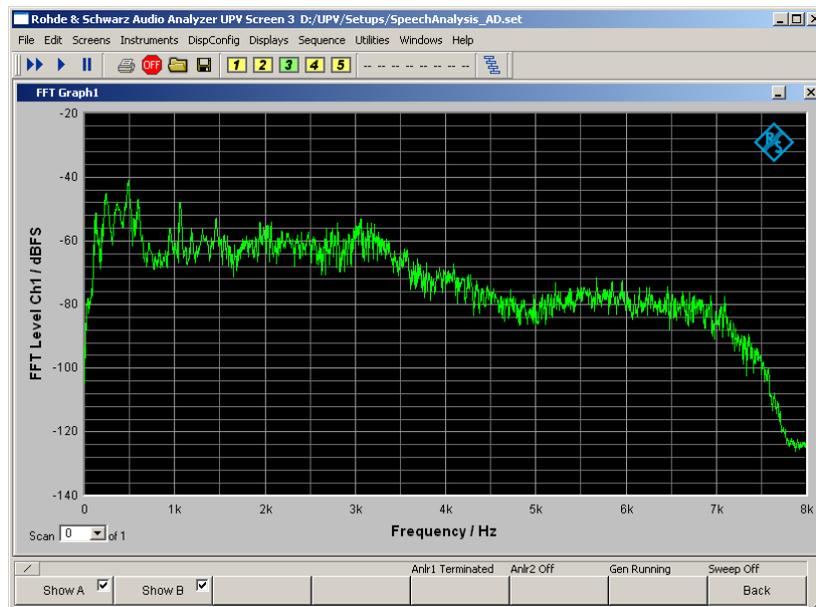


Figure 10: FFT Graph

### 3.2.2 Waveform

The waveform graph is displayed on screen 5. Also here Cursor functionality is available using the softkeys.

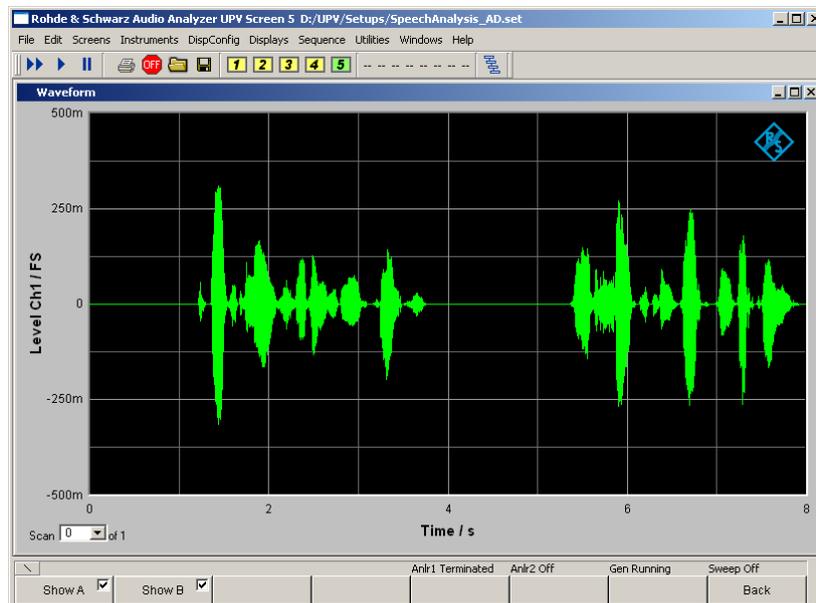


Figure 11: Waveform Graph

The scaling can be configured in the Waveform Graph Config panel which is open on screen 4. The time scaling is automatically adjusted to the length of the waveform set in the Analyzer Function panel.

## 4 Literature

- Rohde & Schwarz Application Note 1GA62 “Test Automation Tool for POLQA® and PESQ® Speech Quality Tests”  
[http://www.rohde-schwarz.com/en/search/applications\\_63466.html?term=1GA62](http://www.rohde-schwarz.com/en/search/applications_63466.html?term=1GA62)
- Rohde & Schwarz Application Note 1MA204 “Voice over LTE (VoLTE) Speech Quality Measurements”  
[http://www.rohde-schwarz.com/en/search/applications\\_63466.html?term=1MA204](http://www.rohde-schwarz.com/en/search/applications_63466.html?term=1MA204)
- UPV User Manual  
[http://www.rohde-schwarz.com/en/manual/r-s-upv-user-manual-manuals-gb1\\_78701-29019.html](http://www.rohde-schwarz.com/en/manual/r-s-upv-user-manual-manuals-gb1_78701-29019.html)

## 5 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
Digital audio interfaces AES/EBU, S/P DIF	R&S®UPV-B2	1146.4306.02
XLR/BNC Adapter Set	R&S®UP-Z1MF	1411.3306.02
Headset Cable Set for UPV	R&S®UP-Z9	1411.3106.02
Universal Sequence Controller	R&S®UPV-K1	1401.7009.02
SW for PESQ Measurements	R&S®UPV-K61	1401.7309.02
Listening quality analysis POLQA, to ITU-T rec. P.863	R&S®UPV-K63	1402.1156.02
Universal Radio Communication Tester	R&S®CMU200	1100.0008.02
Wideband Radio Communication Tester	R&S®CMW500	1201.0002K50

## 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



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