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FIG 1 The Audio Analyzer R&S®UPV shows what is possible today in audio measurements.

Audio Analyzer R&S®UPV

The benchmark in audio analysis

High-resolution digital media such as audio DVD place extremely high requirements on T&M equipment. The new Audio Analyzer R&S®UPV meets these requirements across the board – and also sets new standards in audio analysis.

Up to the limits

The Audio Analyzer R&S®UPV (FIG 1) is a new compact instrument for any type of audio measurement. If you work in a studio or develop and produce hi-fi and audio equipment, the R&S®UPV can handle any measurement task up to the limits of what is technically feasible. High-resolution digital media such as DVD can thus be mastered as perfectly as analog measurements up to 250 kHz. The analyzer's outstanding technology is easy to operate and ready for future applications. For example, future audio interfaces can easily be added via plug-in cards.

The analyzer in the R&S®UPV measures level, frequency, phase and dis-

tortion. It can perform fast and accurate frequency response measurements and simultaneously display the signals in the frequency and time domains. Moreover, it can replay audio signals via a loudspeaker and perform a wide range of other tasks. A digital filter bank with weighting filters and user-definable filters can handle virtually any requirement.

The generator in the R&S®UPV produces all signals up to 80 kHz required in the audio field, ranging from sinewave and intermodulation signals up to noise signals and multisine signals with several thousand single lines. If you need more, you can use the built-in arbitrary waveform generator or replay signals in WAV format from the hard disk.

All these signals can be output by using an additional digital equalizer with user-definable nominal frequency response or filtered in the time domain.

With the Digital Audio I/O R&S®UPV-B2 option, this variety of signals is also available at the digital audio interfaces (AES/EBU, S/P-DIF and optical). In addition, physical parameters such as level, jitter or sample frequency can be analyzed.

Landmark analysis concept

The entire analog measurement path from the input to the A/D converter and the DSP is truly dual-channel. In stereo measurements, this eliminates time-consuming switchover and settling operations. The R&S®UPV performs all measurements using digital signal processing. Signals to be measured are first subjected to complex preprocessing (fine-resolution levelling and fundamental rejection for distortion measurements) using analog measurement modules before they are digitized and fed to digital measurement routines. This concept

Numerous highlights

- ◆ Measurement bandwidth up to 250 kHz
- ◆ Dual-channel signal processing for maximum measurement speed
- ◆ Simultaneous performance of several measurements
- ◆ Graphical representation of all measurement results (FIG 2)
- ◆ FFT analysis up to 256 k points
- ◆ Generator for all audio signals up to 80 kHz
- ◆ Dual-channel analog generator
- ◆ Sinewave up to 200 kHz
- ◆ Filters for analyzer and generator
- ◆ Digital audio interfaces with sampling rates from 30 kHz to 200 kHz
- ◆ Plug-in cards for additional audio interfaces, e.g. for I²S

allows a higher dynamic range than that offered by the internal 24-bit converter. It also ensures a level of performance and versatility that is far superior to that offered by pure analog or digital measuring instruments.

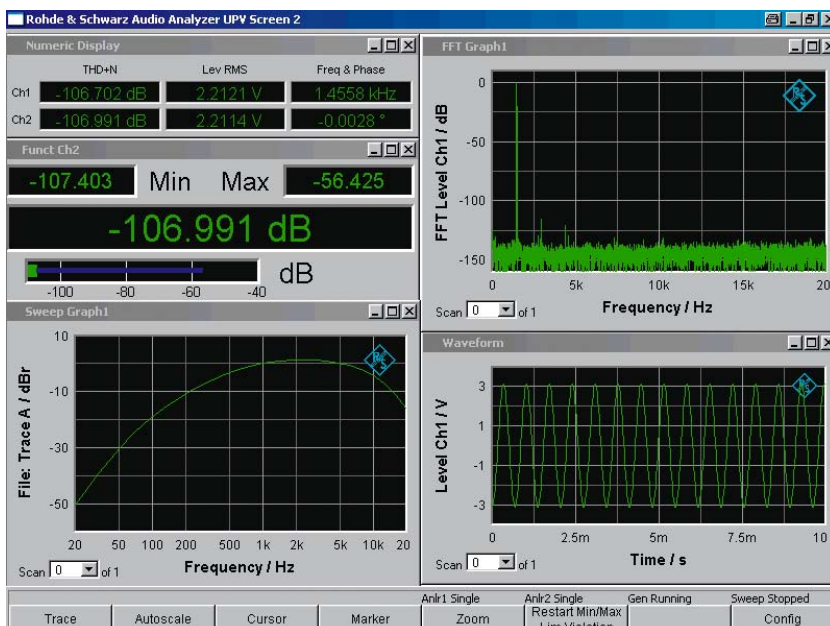
Analyzer operation and measurement methods are always the same no matter whether measurements are performed on analog or digital interfaces. This is truly a benefit for a variety of applications. For example, you can directly compare measurement results obtained in front of or after a converter. All measurement functions and test signals are available on both the analog and digital interfaces, enabling you to perform measurements at any point on a mixed analog/digital transmission path. This ensures efficient and comprehensive troubleshooting.

Since digital measurement routines can continuously adapt their measurement speed to the current input frequency, far higher measurement speeds than those known for analog measurements are achieved.

Wide range of measurement functions

- ◆ **Level**, both selective and wideband with rms, peak or quasi-peak weighting.
- ◆ **S/N ratio**
- ◆ **Distortions** (harmonic distortion, THD+N, SINAD). The individual harmonics can be displayed as a bargraph, or the complete frequency spectrum of distortions can be displayed.
- ◆ **Intermodulation** (modulation distortion, difference frequency distortion, dynamic intermodulation). The individual noise components can be displayed as a bargraph.
- ◆ A **digital prefilter** can be looped into the signal path irrespective of the measurement function. One example is an A-weighting filter for acoustic weighting. Up to three further filters can be looped into the measurement path depending on the measurement function.

FIG 2 The R&S®UPV displays measurement results in easy-to-read numeric values and graphs.



- ▶ ◆ **Frequency, phase and group delay.**
- ◆ **Complex FFT** (magnitude and phase) up to 256 k points.
- ◆ **Post FFT** for level, distortion and intermodulation measurements.
- ◆ **Waveform function** for displaying the measurement signals in the time domain.

Several measurement functions can be performed simultaneously. For example, you can measure the output level, frequency and phase as well as distortions on a DUT and, at the same time, graphically display the output signal in the time domain (waveform analysis) and in the frequency domain (FFT analysis).

Every filter is digital

The digital implementation of filters used in the R&S®UPV makes a virtually infinite number of filters available, even for

measurements on the analog interfaces. You merely have to select the type of filter (e.g. highpass/lowpass filter, band-stop filter, etc) as well as frequency and attenuation in order to loop a new filter into the measurement channel of the analyzer or into the path of the generator signal. In addition to these user-definable standard filter functions, the R&S®UPV of course offers all common weighting filters (e.g. A-weighting, CCITT-weighting or CCIR-2k-weighting) for standard-conforming measurements.

Test signals for any application

◆ **Sinewave signals.** You can insert an equalizer with user-selectable nominal frequency response after these signals in order to compensate the frequency response of the test setup, for example.

- ◆ **Stereo sine.** Frequency, level and phase are user-selectable in any channel. With the R&S®UPV-B3 option, this function is also available on the analog outputs.
- ◆ **Two-tone signals.** These signals are useful for intermodulation measurements (amplitude ratios and frequencies can continuously be adjusted).
- ◆ **Test signal.** You can use this signal to measure dynamic intermodulation distortion (DIM).
- ◆ **Multitone signals** of up to 7400 frequencies with selectable amplitude distribution can be generated. You can couple the frequency spacing to the analyzer resolution of the fast Fourier transform and thus quickly and accurately determine the frequency response of the DUT in a single shot.
- ◆ **Arbitrary signal.** The R&S®UPV can generate any voltage characteristic of up to 16384 points.

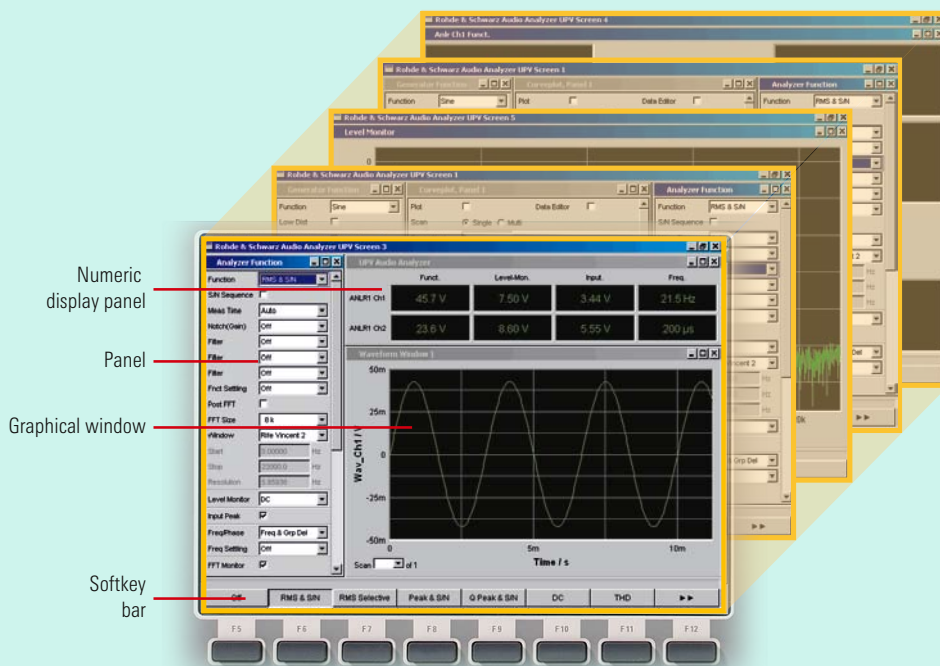


FIG 3 Convenient: You can select up to five virtual screens in no time by pressing a key.

Superb operating concept

The R&S®UPV is based on the Windows XP® Embedded operating system and thus offers a modern and intuitive user interface. When developing the instrument, Rohde & Schwarz kept its long-standing customers in mind. We retained many important features of the R&S®UPL operating structure as well as the names of parameter fields and functions. Users familiar with the R&S®UPL will therefore quickly master the new instrument.

- ◆ All settings are made in panels that contain all relevant functions and settings. They can be arranged and scaled as desired (and minimized or closed) on the colour SVGA LCD.
- ◆ To get a better overview, you can distribute the panels on up to five virtual screens and quickly switch from one screen to another by simply

- ◆ **Sine burst and sine² burst.** The R&S®UPV enables you to set the interval and on-time and to select the low level.
- ◆ **Noise.** You can generate noise with different amplitude distribution functions.
- ◆ **AM and FM.** You can set AM and FM for sinewave signals.
- ◆ **DC voltage.** You can set the DC voltage, including an offset for the other signals.
- ◆ **Dither.** You can generate dither at the level and amplitude distribution you need. Dither can be applied to the digital audio signals.

Linear or logarithmic sweep

The frequency and level of signals can be swept with linear or logarithmic sweep stepping. The generator can be synchronized to the measurement

Excellent specifications

- ◆ Level uncertainty 0.05 dB
- ◆ Frequency response 0.01 dB
- ◆ Input noise typ. 1 μ V
- ◆ SINAD typ. 115 dB (analog), 145 dB (digital)
- ◆ Analog sinewave signals with harmonic suppression of typ. 120 dB
- ◆ Noise floor for FFT typ. -140 dB (analog), -170 dB (digital)
- ◆ Maximum frequency resolution of fast Fourier transform of 0.2 Hz

function of the analyzer, which makes sweeps as fast as possible. Also, a time grid (fixed or variable, read from a file) can be set or the swept parameter can be manually stepped by using the rotary knob.

Measurements at digital audio interfaces

The R&S®UPV-B2 option provides the instrument with balanced, unbalanced and optical inputs and outputs for connecting professional studio and consumer equipment. Additional inputs and outputs on the rear panel allow you to synchronize operation to audio reference signals, to word clocks or to bit clocks and to generate such synchronization signals. The generator and analyzer can be operated independently of each other with variable clock rates from 30 kHz to 200 kHz.

In addition to the audio content, the R&S®UPV can also analyze physical interface parameters. This enables you to display the jitter spectrum, to measure the jitter amplitude and frequency, to generate output signals with jitter and to unjitter input signals.

Moreover, the new analyzer can measure the phase between the audio input and reference input and generate a phase shift between the audio output and reference output. The common-mode signal at the balanced input can be analyzed (frequency, amplitude, spectrum), and a common-mode signal can be superimposed on the output signal.

The R&S®UPV measures the input pulse amplitude and the sampling frequency. Since you can select the output level, you can analyze the sensitivity of digital audio inputs. A cable simulator can be added to the generator to simulate long cables.

Integrated PC

Neither a keyboard nor an external monitor is required for analyzer operation but can be connected. In addition to a hard disk, the R&S®UPV features a DVD drive and a CD burner. Large volumes of data

pressing a key (FIG 3). Thus, for example, you can place infrequently needed configuration panels all on one screen and use another screen to display a fast Fourier transform in full-screen mode.

- ◆ The instrument can be operated entirely from the front panel. The rotary knob (FIG 4) plays an important role. You can navigate within the panels by using only one hand and select the desired function by pressing the rotary knob. You can vary numeric values directly by using the rotary knob. This is of enormous advantage when making adjustments.
- ◆ Softkeys at the bottom of the screen give you fast access to changing functions. The contents of a selection field are displayed in this area, enabling you to also select the parameter without having to open the field.



FIG 4 The rotary knob, which can also be pressed, enables you to conveniently navigate within the panels.

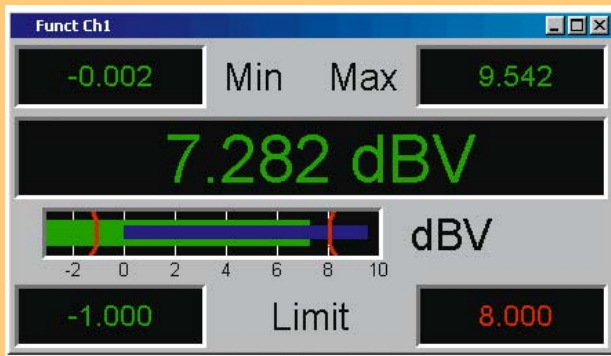


FIG 5
Comprehensive information: Min and Max values, tolerance limits, etc.

- ▶ can be transferred conveniently and quickly by using a USB stick. Software updates are child's play owing to the familiar Windows® concept: you simply start the required installation file from the USB stick, CD or a network drive.

The R&S®UPV can be remote-controlled via IEC/IEEE bus, RS-232-C and LAN, as well as from a detached PC via LAN by using Windows® Remote Desktop. All common interfaces are provided:

- ◆ Four USB connectors for mouse, external keyboard, USB stick, etc
- ◆ Connector for external monitor
- ◆ Parallel interface for connecting a printer
- ◆ LAN interface for connecting a network and for remote control
- ◆ IEC/IEEE bus and RS-232-C interface

Effective visualization of measurement results

The numeric display panel shows up to eight results in realtime for one or both channels and for several measurement functions. If a measurement function is switched off, its display field will also be deactivated. Any representation can be visualized with bars and limit value violations, and you can also add Min/Max values (FIG 5). You can open several

graphical windows and thus simultaneously visualize a sweep, the fast Fourier transform and the waveform, for example. If you change the size of the display field, the analyzer automatically adapts legends, font sizes, gridlines, etc.

You can measure the graphical display of a trace with vertical and horizontal cursors. You can also superimpose limit lines and stored measurement results on a trace and perform comparisons. You can display, store or evaluate groups of traces for both measurement channels.

Valuable tool in production

Many of its features make the R&S®UPV particularly useful in production:

- ◆ All measurement functions run simultaneously on both channels. Compared to other instruments on the market, this alone cuts the measurement time required for stereo measurements in half.
- ◆ In distortion and intermodulation measurements, the R&S®UPV provides digital methods that combine high accuracy with high measurement speed.
- ◆ Frequency response measurements which are performed using the special multitone signal and coupled FFT

analysis are fast. Since these measurements are very frequent, total time is significantly reduced.

- ◆ Due to digital signal processing, the internal setting and settling times are shorter than those obtained with purely analog instruments.
- ◆ An integrated program generator which, in the logging mode, generates a complete and syntactically correct IEC/IEEE-bus program line from each manual operating step minimizes the time required for creating control programs.
- ◆ Calibration intervals are lengthy due to the large number of digital components, yielding high instrument availability.

Ready for the future

As digitization progresses, it will bring about changes in audio technology and produce new measurement methods and interfaces. The Audio Analyzer R&S®UPV is ready to meet these challenges. Since all of its measurement functions are implemented digitally, they can easily be adapted to changing requirements by simply updating the software. Two plug-in cards at the rear of the instrument can accommodate additional hardware, e.g. new digital audio interfaces.

Walter Nestler

More information and data sheet at
www.upv.rohde-schwarz.com