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Audio Analyzer R&S UPL

The solution for the budget-conscious

- For all interfaces: analog, digital, and combined
- Real dual-channel measurements
- Maximum dynamic range
- FFT analysis
- Jitter analysis

New options:
- Freely programmable filters
- Versatile functions
- Compact unit with integrated PC
- Automatic test sequences
- Extensive online help

- 3G Mobile Phone Test (R&S UPL-B9)
- LAN Interface (R&S UPL-B11)
- Coded Audio Signal Generation (R&S UPL-B23)
Audio analysis today and tomorrow

Analog and digital

Audio signal processing without digital technology is no longer conceivable. Yet, analog technology is still present and constantly being improved. State-of-the-art measuring instruments must therefore be able to handle both analog and digital signal processing.

The Audio Analyzer R&S UPL performs virtually every type of analog measurement: frequency response measurements; externally controlled sweeps with reference traces; determination of 3rd order differential frequency distortion; or spectral display of demodulated wow and flutter signals. In contrast to many other audio analyzers, the R&S UPL can perform real dual-channel measurements in the audio-frequency range, i.e. there is no need for switchover between two inputs and this type of measurement is not limited to a few special cases.

The generator is equally versatile: it supplies any conceivable signal whether sine wave, noise signals, or multi-sine wave signals comprising up to 7400 frequencies.

In addition, the R&S UPL features excellent technical data: analog sine wave generation with harmonics of typ. -120 dB; spectrum displays with a noise floor below -140 dB for analog and -160 dB for digital interfaces; and FFT with a maximum frequency resolution of 0.05 Hz.

The R&S UPL provides signal monitoring via loudspeaker, jitter measurements on digital audio signals, resynchronization of jittered digital audio signals by means of a jitter-free clock signal, and much more.

Superior analysis concept

The R&S UPL performs all measurements using digital signal processing. Analog signals to be tested undergo elaborate preprocessing before they are digitized and measured by means of digital routines. For example, in THD measurements, the fundamental is attenuated by means of a notch filter and the residual signal amplified by 30 dB before it is digitized. In this way, the dynamic range can be extended beyond that offered by the internal 20-bit converter. This provides sufficient margin for measuring converters of the future, which will be more advanced than those with present-day technology (see graph on right). This concept ensures performance and flexibility by far superior to instruments providing purely analog or digital measurements.
It also offers many other advantages over analog technology alone:

- The test routines for analog and digital interfaces are identical. This allows, for example, the direct comparison of IMD measurements made ahead of and after a converter.

- All test functions are available on the analog and the digital interfaces. This makes it possible to perform measurements at any point along a common analog and digital transmission path, the only way to ensure efficient and complete testing.

- The filters are also implemented digitally, yielding a more or less infinite number of them — and this also holds true for measurements on analog interfaces. To loop a new filter into the test path, you merely have to choose the type of filter (e.g. highpass, cutoff frequency and attenuation).

- Measurement speed is usually higher than with analog techniques since digital test routines can adapt their speed to the input frequency.

- And last but not least: Operation is the same for the analog and the digital interfaces — a feature that should not be underestimated.

In intermodulation measurements, spurious components are measured selectively for all frequencies in accordance with the mathematical formulae of the applicable test standards. This procedure prevents the inclusion of adjacent components in the measurements, which is usually inevitable with analog test methods.

A future-proof investment

No one can accurately predict the effects that future developments in digital technology will have on the audio world and the resulting test requirements. Yet this is not a problem for the Audio Analyzer R&S UPL. Since all test functions are implemented digitally, the R&S UPL can be adapted to changing requirements by simply loading the necessary software — and this also applies to analog interfaces.

One more benefit: Rohde & Schwarz is the only manufacturer to equip its audio analyzers with 32-bit floating-point signal processors throughout, thus offering plenty of capacity beyond the limits of today’s common 24-bit technology.

A competent partner

The name Rohde & Schwarz stands for excellent quality — thousands of audio analyzers are already in the hands of satisfied customers and have been operating successfully for many years. Following in the footsteps of the exclusively analog R&S UPA and R&S UPD, which still hold the top position in today’s audio measurement technology, the Audio Analyzer R&S UPL was developed to complement the product line.

As a competent partner we will be happy to advise you on the optimum use of our instruments. Our representatives are available all over the world, and our customer support center and application engineers in Munich can help you find the right solution to your measurement tasks. In addition, a wealth of suggestions and solutions can be found in our application notes and software.

As part of our emphasis on quality, Rohde & Schwarz instruments are certified in compliance with ISO 9001 and ISO 14001.
Test signals – made to order

The generators of the R&S UPL supply an extremely wide variety of analog and – when the options R&S UPL-B2 or R&S UPL-B29 are used – digital test signals:

- **Sinewaves**
  For level and harmonic distortion measurements. The signal can be applied in an equalizer with selectable nominal frequency response, e.g. for compensating the frequency response of the test assembly.

- **Two-tone signal**
  For modulation distortion analysis. Various amplitude ratios can be selected and the frequencies are continuously adjustable.

- **Difference tone signal**
  For intermodulation measurements with continuous setting of both frequencies.

- **Multitone signal**
  Can comprise up to 17 sinewaves of any frequency and with the same or different amplitude; setting the phase is also possible with the R&S UPL-B6.

- **Sine burst signal**
  With adjustable interval and ON time as well as programmable low level, e.g. for testing AGCs.

- **Sine2 burst**
  Also with adjustable interval and ON time, e.g. for testing rms rectifier circuits.

- **Special multitone signal**
  Can comprise up to 7400 frequencies with selectable amplitude distribution. The frequency spacing can be linked to the resolution used for the fast Fourier transform, thus enabling rapid and precise single-shot measurements of the frequency response of a DUT.

- **Noise**
  With a variety of probability distributions, e.g. for acoustic measurements; setting of crest factor with the R&S UPL-B6.

- **Arbitrary waveforms**
  For generating any voltage curve of up to 16k points. Test signals can be output in different file formats, e.g. voice and music signals stored as WAV files.

- **Two-channel sinewave signals**
  For the two digital output channels when the UPL-B6 is used.

- **AM and FM**
  For sinewave signals.

- **DC**
  Also with sweep function.

Signals can be generated with an offset. Moreover, digital audio signals can be dithered with adjustable level and selectable amplitude distribution.
Versatile test functions

The R&S UPL offers a wealth of measurement functions both for analog and digital interfaces.

- **Level or S/N**
  This function includes rms, peak or quasi-peak weighting and ensures high measurement speeds due to automatic adaptation of integration time to the input signal.

- **Selective level**
  The center frequency of the bandpass filter can be swept or coupled to the generator frequency, to the frequencies of a multitone signal (e.g. for fast frequency response measurements) or to the input signal.

- **SINAD or THD+N**
  The sum of all harmonics and noise is measured (Fig. 1).

- **Total harmonic distortion (THD)**
  Individual harmonics, all harmonics or any combination of harmonics can be measured (Fig. 2).

- **Modulation distortion**
  This measurement complies with DIN-IEC 268-3. 2nd and 3rd order intermodulation is measured.

- **Difference frequency distortion (DFD)**
  This intermodulation measurement uses the difference tone method. 2nd and 3rd order intermodulation is measured.

- **Wow and flutter**
  This measurement uses the DIN-IEC, NAB, JIS or 2-sigma method in accordance with DIN-IEC and also displays the demodulated-signal spectrum.

- **DC voltage**

- **Frequency, phase and group delay**

- **Polarity**
  Signal paths are checked for reversed polarity.

- **Crosstalk**

- **Waveform function**
  This function is used to represent the test signal in the time domain (Fig. 3). Waveforms can be smoothed by interpolation. Slow sequences can be displayed compressed, e.g. for analyzing the transient response of compander or AGC circuits (Fig. 4).

- **Extended Analysis Functions R&S UPL-B6**
  The coherence and transfer functions determine the transfer characteristics of complex test signals; third octave analysis is used mainly for acoustic measurements; rub & buzz is measured in loudspeaker production.

Tests on hi-fi components call for increasingly complex measurement techniques. Results obtained in the test lab must be verified in production, which usually requires economical solutions for handling large batches rather than the use of all available functions. The R&S UPL is an ideal choice for this task. It optimally complements its "bigger brother", the Audio Analyzer R&S UPD, which is mainly employed in development. The two units share the exact same IEC/IEEE bus commands, which means they have the same operating concept and can be used together.
**Spectrum analysis**

With its FFT analyzer, the R&S UPL is also capable of spectrum analysis. The number of samples for fast Fourier transform can be selected between 256 and 16k in binary steps (Fig. 5). A special feature is zoom FFT. The signal to be measured is digitally preprocessed to increase the frequency resolution by a factor of 2 to 128 over a selectable range. In this way, a maximum resolution of 0.05 Hz is attained. This is not merely a scale expansion, the measurement is actually performed at a higher resolution (Fig. 6).

**Programmable filters**

The filters of the R&S UPL are software-implemented, allowing the user to define any number of filters. The most common weighting filters are provided as standard. Additional filters can be programmed in a few seconds by entering the type (lowpass, highpass, bandpass, bandstop, notch, third octave or octave), frequency and attenuation (Fig. 7). The instrument's open architecture reveals its strength particularly where special requirements have to be met: special filters can be implemented by using commercial filter design programs. The data is transferred to the R&S UPL and the required filter is looped into the signal path.

**A variety of sweep functions**

For continuous variation of the test signals, the R&S UPL offers amplitude and frequency sweeps; in the case of bursts, it is also possible to perform sweeps of intervals and ON times. Sweeps are defined either by means of a table or via parameters such as start value, number of steps, linear/log stepping or time interval. It is also possible to sweep two variables simultaneously.

If external signals are applied during measurement, they can be used for analyzer sweeps (external sweeps). Many different start conditions can be set, allowing measurements to be triggered by a variety of events. Even if the DUT has an unknown or unstable transient response, the settling function will yield stable results.

**Multichannel measurements with Audio Switcher R&S UPZ**

The Audio Switcher R&S UPZ is used either to measure surround sound decoders or in production if several DUTs/channels have to be cabled. It is directly connected to the Audio Analyzer R&S UPL and panel-controlled via an RS-232-C interface. The 8-channel R&S UPZ is available as an input and output model and can be cascaded to up to 128 channels. *

* For more information, refer to data sheet PD 057/6985: Multichannel audio measurements on surround sound decoders.
The strengths of the R&S UPL become evident especially in mobile use. The unit is compact and lightweight and requires no additional equipment. Results are stored in the built-in PC and thus available for later use. Routine measurements can be repeated easily using stored instrument settings.

Everything in one package

The Audio Analyzer R&S UPL is a compact unit with an integrated controller. It avoids the disadvantages of external PC control found in other audio analyzers. The instrument is easy to transport as it requires no external equipment such as keyboard, monitor or other PC peripherals.

The R&S UPL is supplied ready for use. Installation merely consists of unpacking the unit and switching it on to start the measurement. The user is not burdened with problems that cropped up in the past with the installation of interface cards or PC software.

With audio analyzers controlled from an external PC, interference may be radiated from the PC, the monitor or interface connections, which distorts measurement results. Not so with the R&S UPL. the instrument has specified EMC characteristics which also include the internal PC. In contrast to conventional PCs, the R&S UPL provides elaborate screening features such as magnetically shielded power transformers and a coated filter pane in front of the display.

And the icing on the cake: the price of the R&S UPL includes the internal PC.

- Built-in hard disk and disk drive
- Connectors for keyboard, mouse, monitor, printer and plotter
- Centronics interface for connecting printer or network
- Drivers for commercial printers supplied as standard
- Remote control via IEC/IEEE bus or RS-232-C interface
- Postprocessing of results directly in the R&S UPL using standard software
- All results available in the common data formats, making it easy to import graphics into documents, for example
- Easy loading of function and software extensions via floppy disk
- Automatic test sequences and measurement programs with universal sequence controller, plus easy generation of programs with built-in program generator
Interfaces, protocol analysis, jitter

**Fig. 9:** Individual interference components can easily be found with the aid of the jitter spectrum.

**Fig. 10:** Display of jitter signal in time domain.

**Fig. 11:** Complete measured-value tables can be output for all functions.

**Fig. 12:** The R&S UPL generates and analyzes additional data in digital data streams in line with all common standards. The data is represented in binary form, as hexadecimal numbers, or as ASCII characters, or it is evaluated in consumer or professional format.

**Analog interfaces**
- Balanced inputs with high common-mode rejection and various types of impedance commonly used in the studio. Measurements can be made on lines with phantom feed.
- Balanced outputs, floating (e.g., to prevent hum loops).
- The generator outputs can be internally connected to the analyzer inputs so that different types of measurement can be performed without changing the cabling.

**Digital audio interfaces (options R&S UPL-B2 and R&S UPL-B29)**
- Balanced (XLR), unbalanced (BNC) and optical (TOSLINK) inputs and outputs for connecting consumer electronics and professional studio equipment are provided.
- The levels of the balanced and unbalanced outputs are adjustable so that the sensitivity of digital audio inputs can be determined.
- The format of the generated channel status data may be professional or consumer regardless of the selected interface.
- A reference (XLR) and a synchronization (BNC) input provided on the rear panel allow both the analyzer and the generator to be synchronized to the digital audio reference signal (DARS) in line with AES 11; in addition, the generator can be synchronized to wordclock, video sync signals (PAL/SECAM/NTSC) and 1024 kHz reference clocks.
- Both generator and analyzer can be operated at clock rates of 35 kHz to 106 kHz. The clock signal can also be produced internally by the generator.
- The clock rates of the analyzer and generator are independent of each other. This allows measurements on sample rate converters.

**Digital protocol analysis and generation (option R&S UPL-B21)**
- Analysis of channel status and user data. The data is output in binary form, as hexadecimal numbers, or as ASCII characters, or, in the case of channel status data, it is evaluated in the professional or consumer format in line with AES 3 or IEC 958 (Fig. 12).
• Generation of channel status data, user data and validity bits. Channel status data can be entered in binary form or via panel in line with AES 3 or IEC 958 using the professional or consumer format.

• Any bits can be combined under a symbolic name. In this way, data input and representation can easily be adapted to customer requirements.

• Simultaneous measurement of clock rate and display of interface errors (such as parity error).

Jitter and Interface Tests (option R&S UPL-B22)
The physical parameters of digital audio interfaces can be evaluated with this option. The R&S UPL-B22 extends the functions of options R&S UPL-B2 and R&S UPL-B29.

Signal analysis:
• Measurement of jitter amplitude and display of jitter signal in the frequency and time domain (Figs 9 and 10).
• The R&S UPL generates bit- or word-synchronous sync signals that allow the accurate display of digital audio signals on an oscilloscope (preamble, eye pattern, signal symmetry, superimposed noise, etc).
• Measurement of input pulse amplitude and sampling frequency.
• Measurement of phase difference between audio and reference input signal.
• Measurement of time difference between output and input signal. This allows delay times of equalizers, audio mixers, etc to be measured.
• Analysis of common-mode signal of balanced input (frequency, amplitude, spectrum).

Digital components of various data formats and clock rates are the stock-in-trade of professional users, who need a measuring instrument offering top performance on all interfaces with high accuracy and over a wide dynamic range. Operation is identical for analog and digital interfaces, which enhances operator convenience. Fast fault diagnosis is possible by means of stored test routines, allowing the elimination of problems immediately before transmission.

Signal generation:
• The clock of the output signal can be "jittered" by superimposing a sine-wave or noise signal of variable amplitude.
• When generating digital audio data – with option R&S UPL-B1 installed – jitter and common-mode interference can be added to the data stream.
• An input signal with jitter can be output jitter-free.
• A common-mode signal can be superimposed on the balanced output signal.
• Long cables can be simulated by means of a switchable cable simulator.
• The phase shift between the digital audio output and the reference output can be varied.

Generation of coded audio signals (option R&S UPL-B23)
With this option, the Audio Analyzer R&S UPL is able to generate AC-3-coded test signals (other data formats soon available) directly with the integrated generator, e.g. to measure surround sound decoders.

The number of channels, frequency or level sweep, start and stop frequency/level as well as the number of sweep points can be set, thus allowing flexible test sequence combinations.

The measurements are automatically synchronized between generator and analyzer.

The R&S UPL-B23 requires options R&S UPL-B2 or R&S UPL-B29. For more information refer to data sheet PD.0757.6985, Multichannel audio measurements on surround sound decoders.
Designed for convenience

**Efficient online help**

The R&S UPL offers a variety of help features:

**HELP function**
HELP information in German or English can be called up for each input field.

**SHOW I/O key**
If results cannot be displayed, e.g. because an input signal is either missing or incorrect, information on possible causes will appear upon pressing SHOW I/O. Moreover, the input and output configuration will be displayed.

**Info boxes**
These highlighted boxes indicate any incorrect settings.

**Online help**
The permissible range of values is indicated for each menu item requiring the entry of a numeric value. This range takes into account any limitations resulting from related parameters, e.g. the sample rate in the case of measurements on digital interfaces.

**Protection against invalid entries**
The R&S UPL will not accept entries outside the permissible range. An alarm tone will be issued and the value changed to the permissible minimum or maximum value.

A wealth of functions – yet easy to operate

- Related functions and settings are combined in panels that can be called up at a keystroke. Up to three panels can be displayed at a time.
- The operator is not burdened with unnecessary information. Only the parameters and settings needed for a specific application are displayed—the others are available in the background. (For example, the sweep parameters are transferred to the generator panel and displayed only when the sweep function is activated.)
- Fast access to frequently used instrument setups and a comprehensive library of standard measurements make the instrument easy to learn.
- Straightforward data entry: the user simply needs to open a menu and make an entry or selection.
- Continuously updated status information on generator, analyzer and sweep.
- Quick operating sequences through the use of softkeys, e.g. for graphical representations.
- The user can choose between operation via mouse, external keyboard or front panel. This choice is important since the working space required by a mouse is not always available.
- Short learning time due to an easy-to-understand operating concept that treats analog and digital measurements in the same manner.
Results at a glance

- Realtime display of results for one or both channels and several test functions.
- Simultaneous display of frequency and phase.
- With graphics, results can be read off with vertical and horizontal cursors. Tolerance curves or stored results can be added for comparison.
- Sets of traces can be displayed, stored and evaluated for both channels.
- Graphics options include traces and bar graphs, spectrum display, and three-dimensional waterfalls.

In many cases only a few parameters need to be modified after measurement sequence has been started. Therefore, entry lines can be selected from the input panels for the generator, analyzer, etc. by means of a checkmark. They are then transferred to a status panel. The status panel thus gives a summary of parameters for a measurement routine, which offers the following advantages:

- Instrument settings can be displayed together with graphical and numerical results.
- All important information can be printed on a single hardcopy.
- Instrument settings can be modified quickly without changing panels as the R&S UPL can also be operated from the status panel.
Fast and efficient

High measurement speed

In designing the Audio Analyzer R&S UPL, particular emphasis was placed on optimizing the measurement speed of the test system as a whole:

- All operations involving extensive number crunching are carried out by digital signal processors. The PC is merely used for controlling the unit and displaying results.
- The R&S UPL can perform even complex test functions simultaneously on both channels. This feature alone reduces the time for stereo measurements by 50% compared to most analyzers available on the market.
- The digital test routines adapt their speed optimally to the input frequency. This enhances measurement speed especially in the case of frequency sweeps.
- The R&S UPL performs harmonic distortion and IMD measurements using patented, digital test procedures that combine high accuracy with high measurement speed.
- Digital signal processing reduces setting and transient times achievable with purely analog instruments. These times are also taken into account in the test routines, yielding stable measurements without the need for activating settling functions (these are understood to be repeated measurements until results are within a tolerance band).

- The user interface was tailored to the requirements of a test environment, not an office one.
- Display windows not needed can be switched off, which also reduces the processing time. When all displays are switched off and results are output via the IEC/IEEE bus, more than 100 level measurements per second can be performed.

Use in production

Instruments to be used in production tests must satisfy a variety of requirements:

- High measurement speed is vital for achieving a high production throughput. By making appropriate use of the instrument functions, go/no-go decisions can already be made in the audio analyzer, thus reducing the run time of a DUT (Fig. 8).
- Two-channel measurements allow the simultaneous and thus time-saving determination of input and output characteristics.
- The use of FFT analysis provides a decisive advantage especially in the case of frequency response measurements, which are particularly time-critical (example: approx. 900 frequency values in 150 ms).
- Long calibration intervals, resulting from the extensive use of digital circuits, make for high availability of the instrument.
- The R&S UPL66 model is specially tailored to the requirements of production. It comes without a display and keypad, thus holding down costs. Yet the unit can be operated manually by connecting a PC keyboard and a VGA monitor, enabling fast fault localization in the event of production problems.

The R&S UPL66 – special model for use in test systems, with the full flexibility of the standard model.
Remote-control capability via the IEC/IEEE bus is a must in large-scale production systems. In the design of the Audio Analyzer R&S UPL, special importance was attached to data transfer via the IEC/IEEE bus. The logging mode can be used to speed up the generation of control programs for the IEC/IEEE bus. With the program generator provided in the R&S UPL-Bl0, it is no longer necessary to look up IEC/IEEE bus commands.

Universal Sequence Controller R&S UPL-Bl0

The R&S UPL-Bl0 is used to generate and execute measurement sequences, thus turning the R&S UPL into an automatic test system.

Measurement sequence programming is greatly facilitated by the built-in program generator. Each manual control step is recorded in the logging mode and translated into a complete line of the sequence program with correct syntax, i.e., test sequences can be programmed without the user typing a single line. The generated program does not just specify the sequence of keys to be pressed but contains the instructions in easy-to-read IEC/IEEE bus syntax according to SCPI.

High measurement speed, two-channel measurements and remote-control capability via the IEC/IEEE bus are a must in production systems. The long calibration intervals of the R&S UPL make for high availability and reduce costs.

BASIC commands can then be used to modify the program, e.g., for branching or graphic outputs.

Complete application programs based on the universal sequence controller are available for measurements on CD players, tuners, etc.

The universal sequence controller can also be used for remote control of external equipment via the IEC/IEEE bus or the RS-232-C interface. Moreover, programs generated on the R&S UPL can be transferred to an external controller after slight modifications for the remote control of the R&S UPL. This greatly facilitates the generation of remote-control programs.

Test assemblies for electroacoustic converters frequently consist of microphones and loudspeakers, whose frequency response must be compensated. The equalizer function of the R&S UPL furnishes tailor-made solutions for such tests. Comprehensive test routines can be implemented with the aid of the universal sequence controller.
Options and further applications

Low Distortion Generator R&S UPL-B1
This option is essential for all applications requiring extremely pure analog signals or an extended frequency range up to 110 kHz.

When digital audio data is produced by the universal generator, the low distortion generator may generate an analog signal or be used for superimposing jitter or common-mode interference.

Digital Interfaces R&S UPL-B2/-B29
These options contain the digital audio interfaces (balanced, unbalanced and optical) for the standard sampling rates 44.1 kHz and 48 kHz, and the R&S UPL-B29 also covers the extended rates up to 96 kHz. Either the R&S UPL-B2 or the R&S UPL-B29 can be installed. A detailed description of these options and their software extensions (Digital Audio Protocol R&S UPL-B21, Jitter and Interface Tester R&S UPL-B22 as well as the Coded Audio Signal Generation R&S UPL-B23) can be found on pages 8 and 9.

Audio Monitor R&S UPL-B5
This option adds a headphone output and a built-in loudspeaker to the R&S UPL. The input signal and -- in the case of level, THD+N and rub & buzz measurements -- the filtered or weighted signal can be monitored.

Extended Analysis Functions R&S UPL-B6
In modern audio systems, the transfer characteristics are dynamically adapted to the input signals. When conventional, static test signals are used as input signals, the dynamic processes are not activated and thus the signals cannot be analyzed. The coherence and transfer functions are the solution to this problem.

speech, music, noise, etc., are used as test signals, and the transfer characteristic is represented by analyzing the output spectrum referenced to the input spectrum (Fig. 13). The required complex test signals stored in various formats can be directly called from the R&S UPL hard disk.

With the rub & buzz measurement, manufacturing defects of loudspeakers can be found in no time by measuring the unwanted signals in the frequency range above that of typical distortion products (Fig. 14).

The third-octave analysis is an important measurement in acoustics. The levels of up to 32 third-octave bands are simultaneously measured in compliance with class 0 of IEC 1260 (Fig. 15).

In multitone signal generation, the R&S UPL-B6 also allows the phase and crest factor to be set. The R&S UPL-B6 is also required for generating two-channel sine-wave signals at the digital outputs (Fig. 16).

Further functional extensions of the R&S UPL-B6 are currently being developed.

Hearing Aids Test Accessories R&S UPL-B7
The Audio Analyzer R&S UPL with the option R&S UPL-B7 forms a complete test system for all standard measurements on hearing aids. The R&S UPL merely needs to be equipped with options R&S UPL-B5 and R&S UPL-B10. The R&S UPL-B7 includes an acoustic test chamber as well as all accessories required for measurements on hearing aids such as battery adapters, connecting cables and acoustic...
Acoustic measurements on GSM mobile phones with Audio Analyzer R&S UPL 16.

Acoustic measurements on GSM mobile phones with the R&S UPL 16 or option R&S UPL-B8/-B9
The acoustic transmission and reproduction quality of a mobile phone is the most important characteristic in everyday use. The Audio Analyzer R&S UPL 16 was developed for conformance tests on GSM mobiles. It performs all audio measurements in line with chapter 30 of GSM 11.10 and 3GPP TS 51.010 Release 99, phase 2. Access to the internal digital signals of special test mobile phones is via the standard digital audio interface (DAI).

Network operators, consumer test institutes, etc., are particularly interested in measuring and comparing acoustic characteristics of commercial mobiles. A highly accurate test method is also required for quality assurance and sampling inspection in the production of mobile phones.

The Mobile Phone Test Set R&S UPL-B8 is available for these applications. With the aid of this option all necessary audio measurements can be performed on GSM mobile phones without the DAI interface. The 3G Mobile Phone Tests R&S UPL-B9 provide the same functionality, but expanded to 3G mobile phones and to the latest 3GPP specifications TS26.131 and 132. These tests are validated and can therefore be used for type approvals. R&S UPLB8 and -B9 require options R&S UPL-B6 and -B10. For further information refer to data sheet PD 0757.5888, Acoustic Test of GSM Mobiles.

The Automatic Audio Line Measurement to ITU-T G.33, R&S UPL-B33 performs automatic measurements of all relevant parameters of broadcast links according to ITU-T G.33. The generator and analyzer are normally located at different sites. Operators may utilize the standard sequences defined by ITU-T G.33 or prepare their own. Option R&S UPL-B10 is needed for the use of the R&S UPL-B33.

The Remote Control R&S UPL-B4 enables remote control of R&S UPL via the RS-232-C interface or IEC/IEEE 488 interface. The commands largely meet SCPI standards.

With option LAN Interface R&S UPL-B10, the Audio Analyzer R&S UPL can be connected to Novell networks in line with 10/100 BASE-T standard in order, for example, to exchange data or access the network printer (not for R&S UPL 16).

The 150 Q Modification R&S UPL-U3 changes the source impedance of the analog generator from 200 Q to 150 Q.

* For further information on this application refer to data sheet PD 0757.2696, Test System R&S UPL + R&S UPL-B7 for Hearing Aids.
Specifications

Analog analyzers

For analog measurements two analyzers with different bandwidths, specifications and measurement functions are available:

Analyzer
- Analyzer ANLG 22 kHz
- Analyzer ANLG 110 kHz

(For analog measurements only)

<table>
<thead>
<tr>
<th>Specification</th>
<th>ANLG 22 kHz</th>
<th>ANLG 110 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>0.1 Hz to 22 kHz</td>
<td>0.1 Hz to 110 kHz</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.5 dB</td>
<td>±0.5 dB</td>
</tr>
<tr>
<td>Measurement speed</td>
<td>AUTO/FAST</td>
<td>AUTO/FAST</td>
</tr>
<tr>
<td>Measurement range</td>
<td>100 mV to 100 V</td>
<td>100 mV to 1000 V</td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>±0.5%</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Input impedance</td>
<td>1 MΩ</td>
<td>10 MΩ</td>
</tr>
<tr>
<td>Crosstalk attenuation</td>
<td>&lt;2 V</td>
<td>&lt;2 V</td>
</tr>
<tr>
<td>Common-mode rejection (V&lt;3 V)</td>
<td>&gt;60 dB at 1 kHz</td>
<td>&gt;60 dB at 1 kHz</td>
</tr>
</tbody>
</table>

Analyzer ANLG 22 kHz

- Frequency range: 0.1 Hz to 22 kHz
- Measurement range: 100 mV to 100 V, in steps of 5 dB
- Measurement accuracy: ±0.5% of measured value
- Input impedance: 1 MΩ
- Crosstalk attenuation: <2 V
- Common-mode rejection (V<3 V): >60 dB at 1 kHz

Analyzer ANLG 110 kHz

- Frequency range: 0.1 Hz to 110 kHz
- Measurement range: 100 mV to 1000 V, in steps of 10 dB
- Measurement accuracy: ±0.5% of measured value
- Input impedance: 10 MΩ
- Crosstalk attenuation: <2 V
- Common-mode rejection (V<3 V): >60 dB at 1 kHz

Inputs

- XLR connectors: 2 channels, balanced/unbalanced measurements possible with XLR-3-3 (balanced) or XLR-3-2 (unbalanced) connector
- Voltage range: 10 mV to 100 V
- Measurement range: 100 kHz, frequency >22 kHz, 1 kHz
- Measurement accuracy: ±0.5% measured value
- Input impedance: 1 MΩ
- Crosstalk attenuation: <2 V
- Common-mode rejection (V<3 V): >60 dB at 1 kHz

Generator output

- Voltage range: 0 V to ±110 V
- Measurement range: 100 mV to 100 V, in steps of 10 dB
- Measurement accuracy: ±0.5% of measured value
- Input impedance: 1 MΩ
- Crosstalk attenuation: <2 V
- Common-mode rejection (V<3 V): >60 dB at 1 kHz

Measurement functions

- RMS value, wideband
- Accuracy: ±0.5 dB at 1 kHz
- Frequency range: 0.1 Hz to 22 kHz
- Measurement range: 100 mV to 100 V, in steps of 5 dB
- Measurement accuracy: ±0.5% of measured value
- Input impedance: 1 MΩ
- Crosstalk attenuation: <2 V

FFT analysis

- Total harmonic distortion (THD)
- Fundamental frequency: 10 Hz to 22 kHz
- Weighted harmonics: any combination of d<sub>1</sub> to d<sub>5</sub>
- Accuracy: ±0.5 dB
- Inherent distortion: ±0.5% ±1 dB

Analyzer ANLG 22 kHz

- Frequency range: 0.1 Hz to 22 kHz
- Measurement range: 100 mV to 100 V, in steps of 10 dB
- Measurement accuracy: ±0.5% of measured value
- Input impedance: 1 MΩ
- Crosstalk attenuation: <2 V
- Common-mode rejection (V<3 V): >60 dB at 1 kHz

Analyzer ANLG 110 kHz

- Frequency range: 0.1 Hz to 110 kHz
- Measurement range: 100 mV to 1000 V, in steps of 10 dB
- Measurement accuracy: ±0.5% of measured value
- Input impedance: 10 MΩ
- Crosstalk attenuation: <2 V
- Common-mode rejection (V<3 V): >60 dB at 1 kHz

THD+N and SINAD

- Fundamental frequency: 10 Hz to 22 kHz
- Weighted harmonics: any combination of d<sub>1</sub> to d<sub>5</sub>
- Accuracy: ±0.5 dB
- Inherent distortion: ±0.5% ±1 dB

Audio Analyzer R&S SPL

With R&S SPL, BSK only in base rate mode.

Total harmonic distortion of analyzer and generator (with option R&S UPL 81): analyzer with dynamic mode precision.

THD+N and SINAD: with automatic tuning, upper and lower frequency limit selectable, one weighting filter in addition.
### Accuracy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Units</th>
<th>Accuracy</th>
<th>Inherent distortion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral range</td>
<td>&lt;60 kHz</td>
<td>±0.5 dB</td>
<td>±0.5 dB</td>
<td></td>
</tr>
<tr>
<td>&lt;100 kHz</td>
<td>&lt;10 dB</td>
<td>±0.7 dB</td>
<td>±0.7 dB</td>
<td></td>
</tr>
</tbody>
</table>

#### Modulation factor (MODI DIST)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
<th>Inherent distortion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.005%</td>
<td>±0.001%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
<td>±0.00%</td>
</tr>
</tbody>
</table>

#### Difference frequency distortion (DFD)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
<th>Inherent distortion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.005%</td>
<td>±0.001%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
<td>±0.00%</td>
</tr>
</tbody>
</table>

#### Wow and flutter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.00%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
</tr>
</tbody>
</table>

#### Time domain display (WAVFORM)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.05%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.05%</td>
</tr>
</tbody>
</table>

#### Group delay

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.5 ms</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.5 ms</td>
</tr>
</tbody>
</table>

### Analog generators

An 18 bit A/D converter is used for analog signal generation. The characteristics of the basic generator can be improved and extended with a low-distortion FC oscillator (Low Distortion Generator R&S OP-61). — with reduced distortion:

- ± frequency range up to 110 kHz

#### Outputs

- XR connectors, 2 channels, floating, balanced/unbalanced switchable, short-circuit-proof, max. current ≈ 20 mA with external feed

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balanced Voltage</td>
<td>±0.1 mV</td>
</tr>
<tr>
<td>Frequency range</td>
<td>±0.005%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
</tr>
<tr>
<td>Unbalanced Voltage</td>
<td>±0.1 mV</td>
</tr>
<tr>
<td>Frequency range</td>
<td>±0.005%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
</tr>
</tbody>
</table>

#### Signals

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.005%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
</tr>
</tbody>
</table>

#### Sine (with low distortion generator option)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>±0.005%</td>
</tr>
<tr>
<td>Spectrum</td>
<td>±0.00%</td>
</tr>
</tbody>
</table>

### Polarity test

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>+100 dB</td>
</tr>
<tr>
<td>Display</td>
<td>+100 dB</td>
</tr>
</tbody>
</table>

### Notes

1. Total inherent distortion of analyzer and generator with option R&S GPS-61.  
2. At full scale sweep of measurement range: ±10 dB.  
3. ±5% deviation from calibration at ±10 kHz.  
4. Typical value for ±10 kHz.  
5. ±5% deviation from calibration at ±10 kHz.  
6. ±5% deviation from calibration at ±10 kHz.  
7. ±5% deviation from calibration at ±10 kHz.  
8. ±5% deviation from calibration at ±10 kHz.

---

*Audio Analyzer R&S UPL 17*
Arbitrary waveform
Interval
Low level
Burst time
Sine burst, sine burst
Burst time
Interval
Low level
Sweep parameters
Noise
Distribution
Arbitrary waveform
Clock rate
Bandwidth

MOD DIST
Frequency range
Lower frequency
Upper frequency
Level ratio (LF/UI)
Level accuracy
Inherent distortion
Sweep parameters

DIO
Frequency range
difference freq.
center frequency
Level accuracy
Inherent distortion
Sweep parameters

Multi-tone
Frequency range
Frequency spacing
Frequency resolution
Dynamic range
Characteristics

Mod 1
1 to 17 spectral lines
- level and frequency selectable for each line
- phase of each component optimized for minimum crest factor
- phase of each component or crest factor selectable (with R&S UPL-B6)

Mod 2
1 sample up to 60 s, 1 sample resolution
burst time up to 60 s, 1 sample res.
0 to burst level, absolute or relative to burst level (0 with sine burst)
21.75 kHz (elliptical filter)
burst frequency, level, time, interval
Gaussian, triangular, rectangular
loaded from file

Frequency
1 kHz
Interval
2 cycles (16667 ms)
Carrier frequency
2 Hz to 21.75 kHz
Modulation frequency
1 kHz to 21.75 kHz
Modulation
0% to 100%
Carrier frequency
2 Hz to 21.75 kHz
Modulation frequency
1 kHz to 21.75 kHz
Modulation
0% to 100%
Level range
0 V to ±10 V (±5 V unbalanced)
Accuracy
±2%
DC offset
0 V to ±10 V (±5 V unbalanced)
Accuracy
±2%

Sine burst with following characteristics:
Frequency
1 kHz
ON time
1 cycle (8333 ms)
Interval
2 cycles (16667 ms)
Carrier frequency
2 Hz to 21.75 kHz
Modulation frequency
1 kHz to 21.75 kHz
Modulation
0% to 100%
Carrier frequency
2 Hz to 21.75 kHz
Modulation frequency
1 kHz to 21.75 kHz
Modulation
0% to 100%
Level range
0 V to ±10 V (±5 V unbalanced)
Accuracy
±2%

DC offset is not specified for signal generation with Low Dist. On. With DC offset, the AC voltage swing will be reduced; specified inherent distortion values apply to DC offset = 0.

Digital analyzer (option R&S UPL-B2 or -B29)

Frequency limits specified for measurements apply to a sampling rate of 48 kHz. For other sampling rates limits are calculated according to the formula:
1/f = 1/2π • sampling rate/48 kHz.

Inputs
Balanced input
Impedance
Level (V) Min.
110Ω
Unbalanced input
Impedance
Level (V) Min.
75 Ω
Optical input
10/100/1000 Mbit/s
Channels
1, 2 or both
Audio bits
8 to 24
Clock rate
3.36 or 5.04 MHz with R&S UPL-B2 or R&S UPL-B29
3.12 to 106 kHz with R&S UPL-B29 in high-rate mode

Format
AES3 or IEC-958 as well as industry-standard formats at all inputs

Measurement functions
All measurements at 24 kHz, full scale

RMS value, wideband
Measurement bandwidth
up to 0.5 times the clock rate
Accuracy
±0.1 dB

Audio Analyzer R&S UPL
### RMS value, selective
Bandwidth: 1.0 kHz

### Selectivity
- 1 kHz, 1.3 kHz, 2.5 kHz
- Use-selectable fixed bandwidth, min. bandwidth 20 Hz

### Frequency setting
- Analog: 4.5 kHz, 20 MHz
- Digital: 8 kHz, 20 MHz

### Accuracy
- Peak value
  - ±0.2 dB + ripple of filters
- Peak frequency
  - ±28 Hz, fixed through entered value
- Peak-to-peak
  - ±50 Hz
- RMS
  - ±0.2 dB at 1 kHz
- Bandwidth
  - ±1°
- Phase
  - ±50 ppm
- Accuracy
  - ±0.2 dB + ripple of filters
- Frequency limits
  - ±0.5°
- Accuracy in seconds
  - ±1%
- Polarity test
  - ±3%
- Relative phase
  - ±0.5°

### Time domain, frequency range
- 20 Hz to 20 kHz
- ±0.2 dB + ripple of filters
- Frequency
  - ±0.1 dB
- Accuracy in seconds
  - ±1%
- Accuracy at 20 Hz
  - ±100 ppm
- Accuracy at 20 kHz
  - ±3%
- Accuracy at 100 kHz
  - ±3%
- Accuracy at 300 kHz
  - ±3%
- Accuracy at 600 kHz
  - ±100 ppm
- Accuracy at 2 MHz
  - ±3%

### Filters
- 1 kHz, 1.3 kHz, 2.5 kHz
- Use-selectable fixed bandwidth, min. bandwidth 20 Hz

### Measurement mode
- Frequency
  - ±0.5°
- Accuracy in seconds
  - ±1%
- Accuracy at 20 Hz
  - ±100 ppm
- Accuracy at 20 kHz
  - ±3%
- Accuracy at 100 kHz
  - ±3%
- Accuracy at 300 kHz
  - ±3%
- Accuracy at 600 kHz
  - ±100 ppm
- Accuracy at 2 MHz
  - ±3%

### Trigger
- External trigger
- Internal generator
- External sync
- Internal generator
- External sync
- External sync
- Internal generator
- External sync

### Display
- Time domain
  - Waveform (WAVEFORM)
  - Time domain display
  - Frequency domain
- Frequency
  - ±0.1 dB
- Accuracy in seconds
  - ±1%
- Accuracy at 20 Hz
  - ±100 ppm
- Accuracy at 20 kHz
  - ±3%
- Accuracy at 100 kHz
  - ±3%
- Accuracy at 300 kHz
  - ±3%
- Accuracy at 600 kHz
  - ±100 ppm
- Accuracy at 2 MHz
  - ±3%

### Digital generator (option R&S UPL-B2 or -B29)
- Frequency limits specified for the signals apply to a sampling rate of 48 kHz. For other sampling rates limits are calculated according to the formula:

\[
V_{rms} = \frac{48}{f} V_{ grounded} + \frac{48}{f} V_{ ungrounded}
\]

### Outputs
- Relaxed output
  - XLR connector, transformer coupling
  - 110 V, short-circuit-proof
  - 0 V to 8 V, in 240 steps
  - ±1 dB (rms)
- Unbalanced output
  - BNC, transformer coupling
  - 75 Ω, short circuit-proof
  - 0 V to 8 V, in 240 steps
  - ±1 dB (rms)
- Optical output
  - Toslink
- Audio bits
  - 1, 2 or both
- Clock rate
  - 8 to 24
- 35 kHz to 50 kHz with R&S UPL-B2 or R&S UPL-B29 in base rate mode
- 35 kHz to 108 kHz with R&S UPL-B29 in high rate mode
- Internal generator clock or synchronization to analyzer external: synchronization to word clock input, video sync, DARS, 1024 kHz
- Professional and consumer formats
  - AES3, AES/EBU, IEC-386 as well as user-definable formats at all outputs

### Digital domain
- Bandwidth
  - 1 kHz, 1.3 kHz, 2.5 kHz
- Use-selectable fixed bandwidth, min. bandwidth 20 Hz

### Measurement method
- Frequency range
  - ±0.1 dB
- Accuracy in seconds
  - ±1%
- Accuracy at 20 Hz
  - ±100 ppm
- Accuracy at 20 kHz
  - ±3%
- Accuracy at 100 kHz
  - ±3%
- Accuracy at 300 kHz
  - ±3%
- Accuracy at 600 kHz
  - ±100 ppm
- Accuracy at 2 MHz
  - ±3%

### Accuracy
- ±0.2 dB + ripple of filters
- ±0.5°
- ±3%

### Digital domain
- Bandwidth
  - 1 kHz, 1.3 kHz, 2.5 kHz
- Use-selectable fixed bandwidth, min. bandwidth 20 Hz

### Measurement method
- Frequency range
  - ±0.1 dB
- Accuracy in seconds
  - ±1%
- Accuracy at 20 Hz
  - ±100 ppm
- Accuracy at 20 kHz
  - ±3%
- Accuracy at 100 kHz
  - ±3%
- Accuracy at 300 kHz
  - ±3%
- Accuracy at 600 kHz
  - ±100 ppm
- Accuracy at 2 MHz
  - ±3%

### Accuracy
- ±0.2 dB + ripple of filters
- ±0.5°
- ±3%
## Signals

All signals with 24 bit, full-scale

### General characteristics

<table>
<thead>
<tr>
<th>Level resolution</th>
<th>Audio bits</th>
<th>Dither</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distribution</th>
<th>Frequency accuracy</th>
<th>Frequency offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaussion, triangular, rectangular</td>
<td>±50 ppm (internal clock)</td>
<td>±1 ppm relative to clock rate</td>
</tr>
</tbody>
</table>

### Sweep parameters

<table>
<thead>
<tr>
<th>Sweep parameters</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### MOD DIST

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Level range</th>
<th>Inherent distortion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High level</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Frequency analog

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Level range</th>
<th>Frequency accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High level</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Multi-sine

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Frequency resolution</th>
<th>Dynamic range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Characteristics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode 1</td>
</tr>
</tbody>
</table>

### Sine burst, sine burst

<table>
<thead>
<tr>
<th>Burst time</th>
<th>Burst level</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Noise

<table>
<thead>
<tr>
<th>Noise</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gaussion, triangular, rectangular</td>
</tr>
</tbody>
</table>

### Arbitrary waveform

<table>
<thead>
<tr>
<th>Format</th>
<th>Arbitrary waveform loaded from file</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Digital audio protocol (option R&S UPL-B21)

#### Generator

<table>
<thead>
<tr>
<th>Validity bit</th>
<th>Channel status data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### User data

<table>
<thead>
<tr>
<th>Data</th>
<th>User data loaded from file (max 384 bits) or set to zero</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Analyzer

<table>
<thead>
<tr>
<th>Display</th>
<th>Error indication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>block errors, sequence errors, clock rate errors, preamble errors</td>
</tr>
</tbody>
</table>

#### Jitter and interface test (option R&S UPL-B22)

#### Generator

<table>
<thead>
<tr>
<th>Jitter injection</th>
<th>Frequency range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amplitude (peak-to-peak)</th>
<th>Common mode signal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Amplitude (Vpp)</th>
<th>Phase (output to reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(input to looks)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(output to looks)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cable simulator</th>
<th>100 m typical audio cable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

1. Feed frequency independent of sampling rate
2. Total harmonic distortion of analyzer and generator

---

Audio Analyzer R&S UPL
Window functions:
- Kaiser (parameter β, default 4), Hamming, Hanning (flat top), Blackman-Harris.
- Rectangular, triangular, square, raised cosine.
- Cauchy, Dolph-Chebyshev, Hann.
- 8th order elliptical, Butterworth, Chebyshev, sinc.
- Arbitrary filters.

Noise floor:
- Digital: 1.0 µVrms.
- Analog: 100 µVrms.

Sweep features:
- Linear, logarithmic, triangular, single, continuous.
- Triggerable.
- Time-controlled.
- Frequency, phase, distortion measurements.
- Exponential, flat, or average.

Sweep speed:
- Two-channel rms measurement 20 Hz to 20 kHz, 30 point generator sweep.
- Logarithmic frequency measurement switched off, Low Dist off.
- Generator bandwidth.
- Frequency and level of input signal.
- Time-controlled.

User-defined filters:
- Butterworth, Chebyshev, sinc, Hamming, Kaiser.
- Arbitrary filters.

Input and output:
- Input 0 V to 10 V, 25 kHz to 50 kHz.
- Output 756, 512, 1k, 4k, 8k points.

Sweep types:
- Single, continuous.
- Triggerable.
- Time-controlled.

Delay:
- 10 µs to 500 ms.

Limiting:
- ±100 dB.

Frequency range:
- Digital: 49.96 kHz.
- Analog: 20/110 kHz.
- Dynamic range: >135 dB.

Resolution:
- Digital: 0.05 Hz.
- Analog: 1.0 Hz.

Resolution:
- Digital: 0.05 Hz.
- Analog: 1.0 Hz.

User-definable filters:
- Butterworth, Chebyshev, sinc, Hamming, Kaiser.
- Arbitrary filters.

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- Arbitrary filters.

Input and output:
- Input 0 V to 10 V, 25 kHz to 50 kHz.
- Output 756, 512, 1k, 4k, 8k points.

Sweep types:
- Single, continuous.
- Triggerable.
- Time-controlled.

Delay:
- 10 µs to 500 ms.

Limiting:
- ±100 dB.

Frequency range:
- Digital: 49.96 kHz.
- Analog: 20/110 kHz.
- Dynamic range: >135 dB.

Resolution:
- Digital: 0.05 Hz.
- Analog: 1.0 Hz.

Resolution:
- Digital: 0.05 Hz.
- Analog: 1.0 Hz.

User-definable filters:
- Butterworth, Chebyshev, sinc, Hamming, Kaiser.
- Arbitrary filters.

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- Output 756, 512, 1k, 4k, 8k points.

Sweep types:
- Single, continuous.
- Triggerable.
- Time-controlled.

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- 10 µs to 500 ms.

Limiting:
- ±100 dB.

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- Analog: 20/110 kHz.
- Dynamic range: >135 dB.

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### Display of results

<table>
<thead>
<tr>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level (analog)</strong></td>
<td>V, dBu, dBV, V, dBm, difference (dB), deviation (±Δ% or ratio (without dimension), %, dB) to reference value</td>
</tr>
<tr>
<td><strong>Level (digital)</strong></td>
<td>FS, FS%, DSB, LSB, deviation (±Δ%) or ratio (dB) to reference value</td>
</tr>
</tbody>
</table>

### Distortion

| % or dB, referenced to signal amplitude, THD and THD+N in all available level units (absolute or relative to selectable reference value) |

### Frequency

| Hz, difference (Δ), deviation (±Δ%) and ratio (as quotient F1/F2, ±3 octave, octave or decade) to reference value (entered or stored, current generator frequency) |

### Phase

| φ, rad, difference (Δ) to reference value (entered or stored) |

### Reference value (level) | Fixed value (entered or stored) |

### Current value of a channel or generator signal | permits direct measurement of gain, linearity, channel difference, crosstalk. In sweep mode, traces (other trace or loaded from file) can be used as a reference too. |

### Graphical display of results

#### Monitor (optional R&S UPL-B5)

- **Display modes**
  - 0.1" LCD, colour
    - display of any sweep trace
    - display of track groups
    - bar graph display with min-max values
    - spectrum, also as waterfall display
    - list of results
    - bar charts for THD and intermodulation measurements
    - autoscale
    - X-axis zoom
    - full-screen and part-screen mode
    - 2 vertical, 1 horizontal cursor line
    - search function for max. values
    - marker for Harmonics (spectrum)
    - user-labeling for graphs
    - change of unit and scale also possible for loaded traces

#### Display functions

- Autoscale
- X-axis zoom
- Full-screen and part-screen mode
- 2 vertical, 1 horizontal cursor line
- Search function for max. values
- Marker for Harmonics (spectrum)
- User-labeling for graphs
- Change of unit and scale also possible for loaded traces

### Test reports

<table>
<thead>
<tr>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>screen copy to printer, plotter or file (PC, HP), Postscript</td>
</tr>
<tr>
<td>lists of results</td>
</tr>
<tr>
<td>sweep lists</td>
</tr>
<tr>
<td>tolerance curves</td>
</tr>
<tr>
<td>list of out-of-tolerance values</td>
</tr>
<tr>
<td>equalizer traces</td>
</tr>
</tbody>
</table>

### Printer driver

- IEC 623-2
- IEEE 488
- HP-GL

### Plotter language

- HP-GL

### Interfaces

- USB 2.0, RS-232/C, Centronics
- IEC 623-2 (optional R&S UPL-B4)

### Storage functions

- Instrument settings, optionally with measured values and curves
- Spectra
- Inert results
- Sweep lists
- Tolerance curves
- Equalizer traces

### Remote control

- IEC 623-2 (IEEE 488) and RS-232, commands largely SDP, (optional R&S UPL-B4)

### Audio monitor (option R&S UPL-B5)

- **Headphone connector**
  - 6.3 mm jack
- **Output voltage (U0)**
  - max. 8 V
- **Output current (I0)**
  - max. 50 mA
- **Source impedance**
  - 10 Ω, short-circuit proof
- **Recommended headphone impedance**
  - 600 Ω

### Extended analysis functions (option R&S UPL-B6)

#### Coherence and transfer functions

| can be displayed simultaneously |

| Frequency range | DC to 21.9 kHz |
| Frequency resolution | from 0.01 Hz |
| Averaging | 2 to 256 |
| FFT length | 256.5, 128, 64, 32 points |

| Rub & buzz measurement |

| simultaneous measurement of frequency response, rub & buzz |
| Frequency range | 10 Hz to 11 kHz |
| Tracking highpass filter |
| Lower/lower frequency limit | 2 to 20 times fundamental |
| Measurement time | selectable |
| Sweep time (200 Hz to 20 kHz, 200 points log) | 2 s |

#### Multi-sine generator function

- **Mode 1**
  - Crest factor or phase of each component selectable
- **Mode 2**
  - Crest factor selectable

#### Third octave analysis

- for analysis ANSI 22 kHz and digital 48 kHz
- Number of third octaves | 32
- Frequency range | 22 Hz to 22 kHz
- Level accuracy | ±0.2 dB
- Center frequency | 22 Hz to 22 kHz
- Measurement time | 2 Hz to 21.9 kHz

#### Stereo sine

- Frequency range | 0 to 3000 Hz (same frequency in both channels)
- Frequency | 0 to 3000 Hz (same frequency in both channels)
- Level | adjustable for each channel or channel ratio 2:1
- Sweep parameters: |
  - frequency and level of channel 1 |
  - Other functions |
  - under development |

### Hearing aids test accessories (option R&S UPL-B7)

- Consisting of acoustic test chamber, acoustic 2 cm² coupler, various battery adapters, connecting cables, software for measurements to IEC 60118 and ANSI S3.21
- Additionally required |
  - options R&S UPL-B1 and R&S UPL-B12

- With R&S UPL-B29 only in base rate mode
- Fixed frequency in dependence of click rate
LAN Interface for R&S UPL06/66
(option R&S UPL-B11)

Connector (rear panel)  RJ45
Supported standards  10Base-T (IEEE standard 10 Mbit/s)
                   100Base-Tx (IEEE standard 100 Mbit/s 100Base-T)
LAN client        Novell Netware
Supported protocols  IPX, TCP/IP

Modification R&S UPL-U3

Change of source impedance of analog generator to 150 Ω
(instead of 200 Ω set as standard) at the factory.

General data
Operating temperature range  0 °C to +45 °C
Storage temperature range  -20 °C to +60 °C
Humidity  max. 85% for max. 60 days;
           below 65% on average/year,
           no condensation
EMI  EN 50081-1
EMS  EN 50082-1
Safety standards  DIN EN 61010-1, IEC 1010-1, UL 3111-1, CAN/CSA C 22.2
           No. 1010-1
Conformity marks  VDE-0550, UL, cUL
Power supply  100/120/230/240 V ±10%,
              50 Hz to 60 Hz, 100 VA
Dimensions (W x H x D)  431 mm x 192 mm x 495 mm
Weight  12.6 kg

Ordering information
Order designation
Audio Analyzer  R&S UPL
Audio Analyzer  R&S UPL16
(for conformance tests on
GSM mobile phones)
Audio Analyzer  R&S UPL66
(without display and keypad)

Options
Low Distortion Generator  R&S UPL-B1
Digital Audio 48 kHz  R&S UPL-B2
Digital Audio 96 kHz  R&S UPL-B29
Digital Audio Protocol  R&S UPL-B21
Jitter and Interface Test  R&S UPL-B22
Coded Audio Signal Generator  R&S UPL-B23
Remote Control  R&S UPL-B4
Audio Monitor  R&S UPL-B5
Extended Analysis Functions  R&S UPL-B6
Heating Aid Test Accessories  R&S UPL-B7
Mobile Phone Test Set  R&S UPL-B8
3G Mobile Phone Tests  R&S UPL-B9
Universal Sequence Generator  R&S UPL-B10
LAN Interface for R&S UPL26/46
Line Measurement to ITU-T G.953
XLR/BRIC Adaptor Set
150 Ω Modification

Recommended extras
19" Rack Adapter  R&S ZZA-94
Service manual  R&S UPL-Z2
Audio Switcher (Input, female)  R&S UPL2
Audio Switcher (Output, male)  R&S UPL2

Order designation  R&S UPL
Order designation  R&S UPL16
Order designation  R&S UPL66

Power cable, operating manual, backup
system disks with MS-DOS operating
system, backup program disk with oper-
ating and measurement software.

Accessories supplied
power cable, operating manual, backup
system disks with MS-DOS operating
system, backup program disk with oper-
ating and measurement software.

Audit Analyst R&S UPL 23
Multichannel audio measurements on surround sound decoders

with the Audio Analyzer UPL, Option UPL-B23 and Audio Switcher UPZ

Option UPL-B23
- Generation of coded test signals in AC-3 format (Dolby Digital)
- User-selectable sweep parameters

Audio Switcher UPZ
- Available as input and output switcher
- Cascading of up to 128 channels

- Direct operation via the Audio Analyzer UPL
- Control via RS-232-C for universal applications
Coded audio signals

It is hard to imagine the current audio world without keywords such as surround sound, 5.1 channels, etc. Originally designed for use in movie theaters, these multichannel transmission methods have in the meantime found their way into private households.

In all multichannel methods, the six channels generally used are data-reduced for transfer in the digital audio formats established for stereo transmission. In the home units, such as audio/video receivers, the data streams are decoded for analog and multichannel replay.

Previous method

Up to now, measuring surround decoders necessarily involved defining and storing coded test sequences on a DVD or the PC hard disk. The DVD player/PC was connected to the OUT, where the test signals were decoded and finally measured by an audio analyzer at the analog outputs. Since the test files and the measurements ran on different instruments, synchronization was difficult, leading to extended measurement times.

Modern solution: Audio Analyzer UPL plus UPL-B23

The UPL-B23 option enables the Audio Analyzer UPL to generate AC-3-coded test signals directly with the built-in generator. The measurements are synchronized automatically between the generator and the analyzer.

This has the following advantages:

- The internal synchronization considerably speeds up measurements
- Test sequences can be combined much more flexibly, since the number of channels, frequency or level sweep, start and stop frequency/level as well as the number of sweep points can be set directly, settings are made in a similar way to those for a standard analog sweep
- The test signals are no longer recorded on DVD/PC, thus saving time previously spent on combining and coding the test signals
- Additional hardware, such as a PC or DVD player, is not required

Functional description

Several thousand AC-3-coded test files are stored on the hard disk of the Audio Analyzer UPL, with each individual file representing a defined frequency/level combination. The files required for a sweep are loaded into the DSP and replayed until the analyzer yields a settled measurement result. The analyzer then switches automatically to the next file (= next frequency/level point), and the next measurement is triggered until the complete sweep has been processed.

Each of the WAV files used contains one or more complete sine periods. The files can thus be combined to form a test sequence without interruption and artifacts. The DUT remains synchronized to the AC-3 data stream.

Test files available

The AC-3 format (Dolby Digital) is currently supported, and other data formats are in preparation. At present, the test files are:

- Stereo signals (coded with 192 kbit/s) and 5.1-channel signals (448 kbit/s), for frequency and level sweeps; these signals allow the measurement of frequency response, linearity, SNR ratio and harmonic distortion
- Test signals for the individual channels (448 kbit/s) to determine crosstalk attenuation
Audio Switcher UPZ

Measuring surround decoders
Surround applications for use in the home generally have six channels. In order to test 5.1 decoders, the six channels are connected to the Audio Analyzer UPL via the Audio Switcher UPZ. The UPZ is controlled directly from the UPL panel via an RS-232-C interface.

For professional surround applications, the Audio Switcher UPZ comprises 8 channels, with two output channels to allow the two UPL measurement channels to be used simultaneously.

Input/output model
Like the Audio Analyzer UPL, the Audio Switcher UPZ has XLR connectors. Since there is a difference between male and female connectors in the XLR system, the UPZ is available both as an input and an output model.

It is possible to cascade up to 16 input switchers plus 16 output switchers, allowing up to 128 input and output channels to be switched.

Extended range of applications
The Audio Switcher UPZ can be operated not only via the UPL. Through its RS-232-C interface, it can also be controlled directly from other units or a controller. This opens up new possibilities; for instance, in broadcasting stations, where studio operations require the switching of several audio channels. The UPZ may also be used in production; for instance, when car radios are tested, measurements can be performed at all four loudspeaker outputs.
Specifications

Coded Audio Signal Generation UPL-823

**Format**
- AC-3 (IEC 61937)

**Coding**
- 192 kbit/s
- 448 kbit/s
- 5.1 multichannel
- Single channel

**Frequency range**
- 20.800 Hz to 20 kHz

**Level range**
- 0 dBFS to ~120 dBFS

**Sweep parameters**
- frequency, level

Audio Switcher UPZ

**Electrical data**
- **Signal amplitude**
  - 20 kHz: +14 dB typ.
  - 100 kHz: +12 dB typ.
- **Series resistance**
  - +0.3 Ω typ. (per signal pair)
- **Shunt capacitance**
  - <0.1 pF typ. (per signal pair to ground)

**General data**
- **Operating temperature range**
  - 0°C to +50°C
- **Humidity**
  - 95% relative humidity at +40°C; meets IEC 68-2-3 (no condensation)

**EMI**
- EN 55011-1
- EMV EN 55022-2
- Safety standards
  - DIN EN 61010-1, IEC 61010-1
  - UL 3111-1, CAN/CSA C 22.2 No. 1010-1

**Test marks**
- VDE-0615, cULus
- **Power supply**
  - 100 V to 120 V (AC) ±10%
  - 200 V to 240 V (AC) ±10%
- **Power consumption**
  - **Input switcher**
    - 5 VA typ.
    - 10 VA max.
  - **Output switcher**
    - 5 VA typ.
    - 12 VA typ. (all channels active)
    - 15 VA max.
- **Remote control**
  - via RS-232-C

**Dimensions**
- 427 mm x 43 mm x 350 mm
- **Weight**
  - 3.7 kg

1) For maximum relay life: 5 W or 0.2 A max.
2) Between any two channels into 600 Ω.

Ordering Information

**Order designation**
- Coded Audio Signal Generation: UPL-823
- Audio Switcher (input, female): UPZ
- Audio Switcher (output, male): UPZ

**Accessories supplied (UPZ)**
- power cable, operating manual, service manual, RS-232-C extension cable

**Recommended extras (UPZ)**
- 19" Rack Adapter
  - ZZA-111

- For maximum relay life: 5 W or 0.2 A max.
- Between any two channels into 600 Ω.
From our principles

We are an independent manufacturer of electronic equipment and systems.

Our name is synonymous with innovation, precision and quality. A leading position on the European market and worldwide presence are the solid basis to our success.

Who we are and what we do

Rohde & Schwarz is an internationally active company in the fields of test and measurement, information technology and radiocommunications. For more than 60 years the company group has been developing, producing and marketing a wide range of electronic products for the capital goods sector. The company is headquartered in Munich. With 5600 employees worldwide and subsidiaries and representatives in over 70 countries around the world, the Rohde & Schwarz group achieves an annual turnover in excess of 1.0 billion Euro. The company is highly export-oriented.

More than 70% of the total turnover is achieved outside Germany. Due to the comprehensive know-how and the innovative strength of its employees, Rohde & Schwarz is among the technological leaders in all of its business fields.

Today the Rohde & Schwarz group of companies is active in the following fields:

- Test and measurement
- Radiocommunications systems
- Mobile radio
- Broadcasting
- Radiomonitoring and radolocation
- Information security
- Services

The quality and environmental management system of Rohde & Schwarz has been certified to DIN EN ISO 9001 and 14001 and complies with the standards of ADAP 110 and 150. The company has approval for the development, production, installation and servicing of avionic communication equipment and is the first German transmitter manufacturer authorized to carry out BZT (Federal Approvals Office for Telecommunications) approval testing for radio transmitter systems.
Our business fields and products

Rohde & Schwarz is the largest manufacturer of electronic test and measurement equipment in Europe. Our T&M instruments and systems are setting standards worldwide in research, development, production and service. We are the key partner for the industry and network operators as far as all measurement tasks in the field of analog and digital communication.

Mobile radio measurements
- Complete range of measuring instruments, test sets and systems for mobile and base stations of analog and digital mobile communication networks
- Radiocommunication testers for use in production, development and service
- Go/NoGo testers
- Signal generators and analyzers as well as power meters
- Protocol testers
- Coverage and interference measurement systems
- Type-approval test systems

EMC measurements
- Complete EMC test centers
- Turnkey systems for measurement of electromagnetic interference (EMI) and electromagnetic susceptibility (EMS)
- Test receivers and EMI spectrum analyzers for compliance and precompliance measurements
- Full range of accessories:
  - Artificial mains networks
  - Antennas and masts
  - Field probes
  - Transducers
- Software

General-purpose and RF measurements
- RF and microwave signal generators
- ARB generators
- Spectrum and network analyzers
- Audio and modulation analyzers
- Voltmeters and power meters
- Field-strength test receivers
- Process controllers
- Power supply units

Automatic test systems
- Type-approval and certification test systems
- Production test systems for communication terminal equipment
- Coverage measurement systems for all modern radio networks
- EMC test systems and test centers
- Board test systems (in-circuit and functional testers)
- Monitoring, coverage and transmitter test systems for both analog and digital sound and TV broadcasting

Video and broadcast measurements
see page 9
Our business fields and products

Rohde & Schwarz is one of the leading international suppliers of professional HF, VHF and UHF radio systems for use in stationary and mobile ground stations, on ships and in aircraft. Embassies, governmental authorities and armed forces worldwide use our radio equipment for voice, data and image transmission. We support our customers by providing product-related consulting, logistics concepts and services. With the new digital software radio generation for tactical mobile, stationary, as well as shipborne and airborne use, we have created a means of communication that ensures interoperability within national task forces and with allied nations in UN and NATO missions.

ATC systems
- VHF and UHF radio systems for ground-to-air communications
- Radio direction finding systems
- Remote monitoring and control of ATC systems
- Mobile ATC towers

Air defence systems
- VHF/UHF radio systems for voice and data transmission
- Integrated methods for secure and protected transmission
- Network management including frequency and key management

Avionics
- HF, VHF, UHF airborne transceivers for secure and protected voice and data transmission

Naval communication systems
- Systems for internal and external communications
- Integrated control and message handling systems
- HF broadband systems

Army communication systems
- Tactical multiband radio equipment
- HF transmitting/receiving systems for stationary and mobile use
- Network integration and radio link to Internet

Mobile radio

Rohde & Schwarz ranks among the leading suppliers of MPT-1327 and TETRA mobile radio systems for the professional user. Worldwide installations at Ministries of the Interior, commuter traffic enterprises, at railway stations and airports as well as for public network operators speak for the effectiveness of our solutions.

Trunked radio systems
- Network engineering
- Switching systems
- Base stations
- Network management and applications
- Turnkey systems
Our business fields and products

For 50 years sound and TV broadcasting has been one of the key activities of Rohde & Schwarz. We are the only supplier of a complete range of transmission, monitoring, measurement and datacasting equipment in the world. We are international leaders as regards equipment and T&M systems and instruments for the new digital transmission methods DAB, DVB and MPEG2.

Sound and TV broadcast transmitters
- VHF FM sound broadcast transmitter systems from 20 W to 20 kW
- Analog TV transmitter systems from 20 W to 40 kW
- Digital audio broadcast (DAB) systems from 50 W to 1 kW
- Digital video broadcast (DVB-T, ATSC) systems from 50 W to 10 kW

Measurement and monitoring systems
- Monitoring systems for terrestrial transmitter stations
- Measurement systems for development, production and maintenance of transmitters

Video and broadcast measurements
- Generators and analyzers for MPEG2, DVB and ATSC transport streams, for use in development, production and monitoring
- Picture quality analyzers
- Analog baseband generators and analyzers
- Signal generators and test receivers, modulators and demodulators for analog sound and TV broadcasting standards as well as for DvB-C/S, DVB-T and DTV-ATSC
- TV network analyzers
- Studio measurement equipment

Datacasting
- Inserter for inserting additional data in Internet format for DVB and DAB
- Software for cyclical provision of contents and for transmission of Internet-based TV and radio programs
- Software for data service management
- Software for data processing at the receiver end
Our business fields and products

- Rohde & Schwarz is worldwide a leading manufacturer of equipment and systems for detection, location and analysis of radiocommunication signals in the following fields of application:
  - Information security
  - National and international radiomonitoring
  - Frequency management

We are leading in the design and implementation of full-coverage automatic radiomonitoring and frequency management systems. Many years of experience and ultramodern technology are the sound basis of our receivers, direction finders, signal analyzers and antennas:

- Receivers
  - Fast search receivers
  - Stationary and portable monitoring receivers
  - Computer-controlled receiving systems

- Direction finders
  - Extremely fast, broadband, digital radiomonitoring direction finders for stationary and mobile/portable use
  - Automatic radiolocation networks using direction finders

- Signal analyzers
  - Versatile signal analyzers for flexible use
  - Automatic signal classifiers
  - Signal decoders, demodulators

- Antennas
  - Receiving and transmitting antennas
  - Test antennas
  - Complex antenna systems

Information security

- ROHDE & SCHWARZ SIT GmbH provides solutions for secure and reliable utilization of modern information and communication technology. Key activities are in the development of crypto products and systems for the protection of information in modern data processing and communication systems as well as consulting and information security analyses for industry and government authorities.
  - Hardware and software crypto products
  - Customized crypto systems
  - Consulting and IT security analyses

Services

- With its Central Service in Munich and its Cologne Plant, Rohde & Schwarz maintains two of Europe’s largest service centers for T&M and communications equipment. We offer our customers a powerful global service network comprising more than 50 service centers worldwide.
  - Calibration, maintenance and repair
  - Customized service contracts
  - Planning, development, system integration
  - Development of customer-specific systems
  - Technical documentation and logistics
  - Electronic information systems, multimedia applications

- Our training centers in Cologne and Munich offer a comprehensive choice of courses on T&M and communications topics, which on request can also be held at the customer’s
1938 World's first portable crystal clock
1948 Europe's first VHF sound broadcast transmitter
1964 Europe's first air-traffic noise monitoring system
1967 Europe's first automatic IC test system
1974 First microprocessor-controlled radio measurement system
1975 World's first quality monitoring system for TV signals
1980 Europe's first stereo/dual sound TV transmission system
1984 First processor for automatic setup of shortwave links
1986 Introduction of radio data system RDS for sound broadcasting in Germany
1990 First compact test set for GSM transmitters and receivers
1992 Exclusive supplier of reference test equipment for type-approval testing of GSM mobile phones
1995 Technical equipment for world's largest pilot project for digital audio broadcasting (DAB)
1996 First integrated HF voice/data radio for use in commercial aircraft for fully automatic worldwide transmission of flight data
1997 Order for nationwide DVB-T transmission network in Great Britain (largest DVB project worldwide)
1999 World's first operational universal software radios for use on military platforms
2001 World's first tap-proof GSM mobile phone

Munich
- Company headquarters in Munich house the R&D departments, systems engineering and assembly, training and service center, central divisions and administration.
- ROHDE & SCHWARZ GmbH & Co. KG
  Mühldorferstraße 15 · 81671 München
  Phone +49 89 41 29-0
  Fax +49 89 41 29-121 64
  Internet www.rohde-schwarz.com

Memmingen
- The plant in Memmingen is responsible for the final production and delivery of all Rohde & Schwarz equipment.
- ROHDE & SCHWARZ Messgerätebau GmbH
  Riedbachstraße 58 · 87700 Memmingen
  Phone +49 8331 10-80
  Fax +49 8331 10-811 24

Teisnach
- The Rohde & Schwarz plant in northern Bavaria produces the mechanical and electrical parts for the equipment production in Memmingen.
- ROHDE & SCHWARZ Messgerätebau GmbH
  Kaikenrieder Straße 27 · 94244 Teisnach
  Phone +49 9923 85-70
  Fax +49 9923 85-711 74
Cologne

- Rohde & Schwarz Cologne Plant is one of Europe's largest service centers for electronic T&M and communications equipment. Services include maintenance and repair, training, technical documentation and logistics (also in conjunction with multimedia applications), system integration and adaptation as well as services for information and communications technology projects. The Cologne Plant is an accredited calibration laboratory of the German Calibration Service.

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Subsidiaries

ROHDE & SCHWARZ Vertriebs-GmbH (RSV)

- Founded in Berlin in 1946 and relocated to Munich in 1961, RSV is responsible for domestic sales of Rohde & Schwarz products as well as products of other make marketed on behalf of RSE (see page 15). RSV has a marketing network throughout Germany.

ROHDE & SCHWARZ Vertriebs-GmbH
Mühlhofstraße 15 · 81671 München
PO Box 80 14 69 · 81614 München
Phone +49 89 41 29-137 74
Fax +49 89 41 29-137 77
E-mail CustomerSupport@rohde-schwarz.com

ROHDE & SCHWARZ International GmbH (RUSIS)

- Since the end of 1993, RUSIS has been responsible for sales of Rohde & Schwarz products outside Europe. The company coordinates agencies, representatives and other business partners in the Asia-Pacific region, Middle East, Africa, North and Latin America.

ROHDE & SCHWARZ International GmbH
Mühlhofstraße 15 · 81671 München
PO Box 80 14 60 · 81614 München
Phone +49 89 41 29-124 62
Fax +49 89 41 29-136 62

ROHDE & SCHWARZ Engineering and Sales GmbH (RSE)

- Founded as a subsidiary in 1972 and headquartered in Munich, RSE is primarily involved in marketing complementary products from other manufacturers. The objective of RSE is a vertical completion of the Rohde & Schwarz product line in close cooperation with headquarters and the representatives abroad. The companies represented by RSE include renowned manufacturers such as the Rohde & Schwarz cooperation partner Advantest from Japan.

ROHDE & SCHWARZ
Engineering and Sales GmbH
Mühlhofstraße 15 · 81671 München
PO Box 80 14 29 · 81614 München
Phone +49 89 41 29-137 11
Fax +49 89 41 29-137 23
R&S BICK Mobilfunk GmbH
- R&S BICK Mobilfunk GmbH with headquarters in Bad Münster specializes in the development and implementation of professional mobile radio systems. In particular, the company supplies TETRA and MPT-1327 mobile radio networks and applications.

R&S BICK Mobilfunk GmbH
Fritz-Hahn-Str. 7 31848 Bad Münster
Phone +49 50 42 998-0
Fax +49 50 42 998-105
E-mail rsbick@rsbick.rohde-schwarz.com
Internet www.rsbick.de

ROHDE & SCHWARZ FTK GmbH
- ROHDE & SCHWARZ FTK GmbH with headquarters in Berlin develops and supplies products and systems in the field of analog and digital audio broadcasting as well as solutions for the transmission of ancillary data via digital broadcast channels (datacasting). The variety of services offered also includes development services for radiocommunication and broadcasting equipment.

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Wendenschlossstraße 168, Haus 28 12557 Berlin
Phone +49 30 658 91-122
Fax +49 30 655 50-221
E-mail hotline.ftk@ftk.rohde-schwarz.com

ROHDE & SCHWARZ SIT GmbH
- ROHDE & SCHWARZ SIT GmbH provides solutions for security in information technologies. Key activities are in the development of crypto products and systems for the protection of information in modern data processing and communication systems as well as consulting and IT security analyses for industry and government authorities.

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Tektronix
- The company was founded in 1946 and with its headquarters in Beaverton, Oregon is now fully devoted to test and measurement products after selling its line of printers and video/network equipment in 1999. In the fiscal year 2001, Tektronix achieved a total turnover of 1.235 billion US$. In North America, the Tektronix product range is enhanced by almost the full range of T&M products from Rohde & Schwarz. The two companies also cooperate in the development of test and measurement instruments for special applications.

Advantest
- Advantest, a Tokyo-based company founded in 1954, is the world’s leading supplier of semiconductor test systems. The second most important business field is test and measurement equipment. In the fiscal year 2000, Advantest had a total turnover of 262 billion Yen. Advantest and Rohde & Schwarz have concluded a mutual sales agreement for T&M products: Advantest sells Rohde & Schwarz equipment in Japan and Rohde & Schwarz markets Advantest test and measurement instruments in Europe, the Middle East, in Brazil, Australia, South Africa and other countries. The two companies also cooperate in the development of T&M equipment for the Japanese market.
<table>
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<th>Phone</th>
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<td>RÖHDE &amp; SCHWARZ – Praha s.r.o. E vergova 33c, 16031 Praha 6</td>
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<td>+420 2 24 37 70 43</td>
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<tr>
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<td>+45 43 43 77 44</td>
<td><a href="mailto:rcae@vonpekt.com">rcae@vonpekt.com</a></td>
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<tr>
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<td>REPRESENTACIONES: MANFRED WEINER, Urbanización Jardines del Bazar</td>
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<td>+503 22 25 22 01</td>
<td><a href="mailto:mercurycenter@actusnet.net">mercurycenter@actusnet.net</a></td>
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<td>Egypt</td>
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<td><a href="mailto:sa_uas@uasnet.com">sa_uas@uasnet.com</a></td>
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<td>El Salvador</td>
<td>RÖHDE &amp; SCHWARZ DANMARK A/S Estonian-Branch Office Norva unit 13</td>
<td>+372 8 14 31 23</td>
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<td>Estonia</td>
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<td>+358 9 47 88 30</td>
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<td>Finland</td>
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<td>+33 1 41 36 10 00</td>
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<tr>
<td>France</td>
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<td>+33 2 99 55 57 80</td>
<td>+33 2 89 41 91 31</td>
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<td></td>
<td>RÖHDE &amp; SCHWARZ FRANCE 27 Rue du Bignon, Bât. A 30103 Cotonou Benin</td>
<td>+33 5 61 38 10 69</td>
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<td>Subsidiary Hannover RÖHDE &amp; SCHWARZ FRANCE Technopark 3 B 507</td>
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<td><a href="mailto:sales.Hannover.info@schwarz.com">sales.Hannover.info@schwarz.com</a></td>
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<td></td>
<td>Subsidiary Toulouse RÖHDE &amp; SCHWARZ FRANCE Technopoli 3 37614 Libonne Cédex</td>
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<td>Subsidiary Tunisie RÖHDE &amp; SCHWARZ FRANCE Technopoli 3 37614 Libonne Cédex</td>
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<td>Communications equipment</td>
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<td>+958 60 75 66</td>
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<td>+92 57 226 32 11</td>
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<td>Peru</td>
<td>BUP INGENIEROS S.A.</td>
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<td>Portugal</td>
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<td>Romania</td>
<td>ROHDE &amp; SCHWARZ</td>
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<td>+40 1 410 60 05</td>
<td>+40 1 411 20 13</td>
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</table>
Increased support and service

Rohde & Schwarz expands US sales network for audio analyzers

113th AES Convention, Los Angeles — Rohde & Schwarz, the European market leader in audio analyzers, is strengthening its commitment to the US market. By expanding its sales network, the company wants to provide its numerous customers and partners with improved onsite support and service. The network includes twelve new representatives, thus covering the entire US market. By taking this action, Rohde & Schwarz intends to expand its market share worldwide.

All representatives and sales activities are coordinated from sales headquarters in Beaverton, Oregon, handling exclusively audio analyzers. Rohde & Schwarz markets and sells a broad scope of audio analyzers for analog and digital testing of audio components. The portfolio of successful products such as the analog R&S UPA and the R&S UPD now features the R&S UPL as well.

Contact address for readers:
Rohde & Schwarz GmbH & Co. KG. Mühldorferstr. 15. 0-81671 München
Tel.: +49 89 4129-13779. Fax: +49 89 4129-13777. E-Mail: customersupport@rsc.rohde-schwarz.com

Relay switching matrix for audio measurements available in two models

New audio switcher for surround instruments

113th AES Convention, Los Angeles — The new Audio Switcher UPZ from Rohde & Schwarz permits analog outputs of surround instruments to be connected to the two input channels of Audio Analyzer UPL for measurements. Any input can be connected to either of the two outputs. This considerably speeds up and simplifies measurements.

Most surround instruments are currently equipped with six (sometimes up to eight) analog outputs. The switcher is required to connect the analog outputs of the DUT to the two input channels of the audio analyzer. The audio switcher is a relay switching matrix with eight inputs and two outputs. Any input can be connected to either of the two outputs. If several channels are required, switchers can be cascaded. Since the audio-typical XLR connector system only allows a male connector to be connected to a female connector, UPZ is available in two models. The input switcher is equipped with eight female inputs and two male outputs while the output switcher has eight male outputs and two female inputs.

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Rohde & Schwarz

The Rohde & Schwarz group of companies with headquarters in Munich develops, produces and markets communications, information and T&M instruments and systems with the emphasis on mobile radio, broadcasting, EMC measurements, general-purpose and RF test equipment, radiomonitoring and radio location, radioncommunications as well as IT security. Rohde & Schwarz has subsidiaries and representatives in over 70 countries. The group with its more than 5,000 employees achieves an annual turnover in excess of one billion Euro worldwide.

Rohde & Schwarz extends functions of Audio Analyzer UPL

Fast measurements on audio decoders

- 113th AES Convention, Los Angeles — Measurements on audio decoders can now be carried out easily thanks to the new functions added to Audio Analyzer UPL from Rohde & Schwarz. Coded test signals can be output directly by the measuring instrument. Complete test sequences can also be performed for all standard measurements. Thanks to a library containing several thousand preset signals, measurements can be performed in next to no time.

Modern audio technology is increasingly using coded audio formats in surround applications. Up to now, the play-back units used in applications of this type could only be measured with the aid of complex and time-consuming procedures. With the new option for Audio Analyzer UPL from Rohde & Schwarz, measurements on audio decoders can be carried out quickly and easily.

The option enables UPL to directly output coded test signals. In addition, complete test sequences permit all measurements to be performed in line with current standards. To achieve short measurement times and fast sweeps, single and short test signals are taken from a library containing several thousand files and combined to form a sequence. Sequence advance is in sync with the analyzer. This considerably simplifies operation [look and feel]. Long complex waveforms can be stored on the hard disk in wav-format and directly played back by UPL.

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