Audio Analyzer 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
- Interface tester
- Freely programmable filters
- Versatile functions
- Compact unit with integrated PC
- Automatic test sequences
- Extensive online help

ROHDE&SCHWARZ

Audio analysis today and tomorrow

Analog and digital

Audio signal processing is nowadays no longer conceivable without the use of digital techniques. Yet, analog technology continues to exist and undergoes constant improvement. State-of-the-art measuring instruments must therefore be able to handle both analog and digital signal processing.

Audio Analyzer UPL performs practically all types of analog measurement, from frequency response measurements through to externally controlled sweeps with reference traces, determination of 3rd-order difference frequency distortion, spectral display of demodulated wow and flutter signals, etc. In contrast to many other audio analyzers, UPL is capable of performing real dual-channel measurements in the audio-frequency range, ie there is no need for switch-over between two inputs and this type of measurement is not limited to a few special cases.

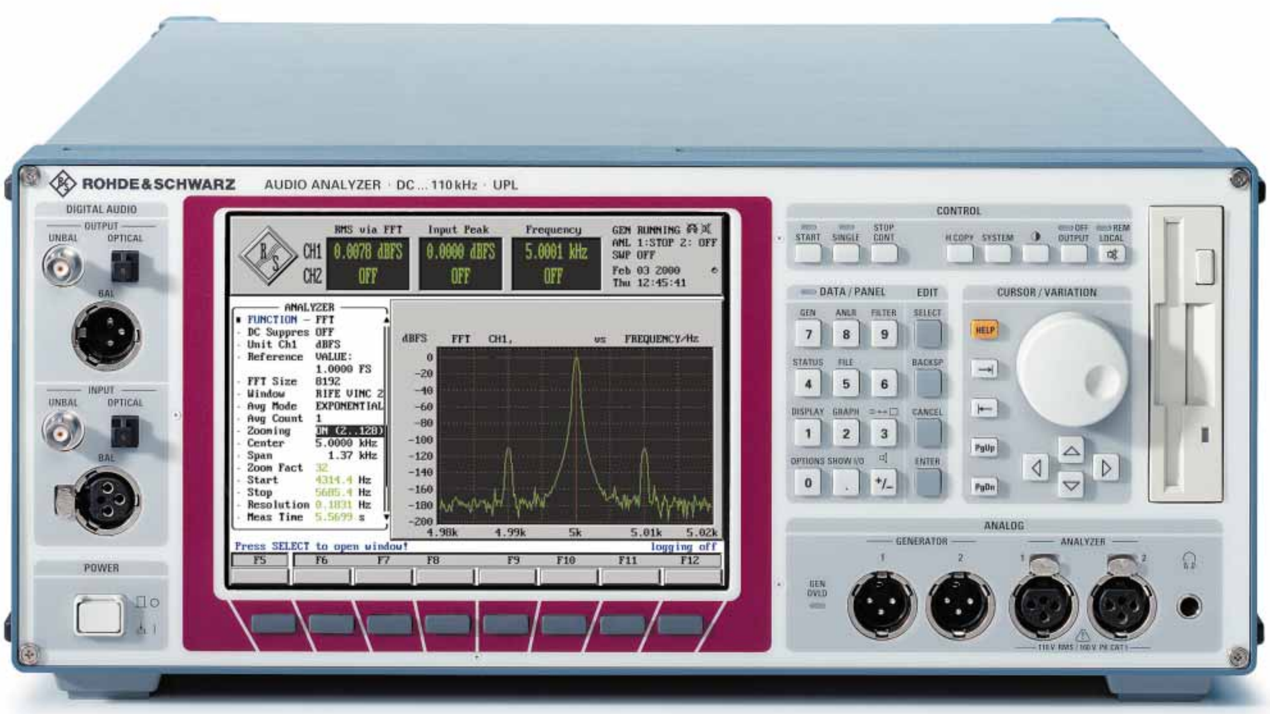
The generator is every bit as versatile: it supplies any conceivable signal from sinewave and noise signals through to multi-sinewave signals comprising up to 7400 frequencies.

In addition to all this, UPL features excellent technical data: analog sinewave generation with harmonics of typ. –120 dB, spectrum displays with a noise floor below –140 dB for analog and –160 dB for digital interfaces, FFT with a maximum frequency resolution of 0.05 Hz, etc.

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 many more features.

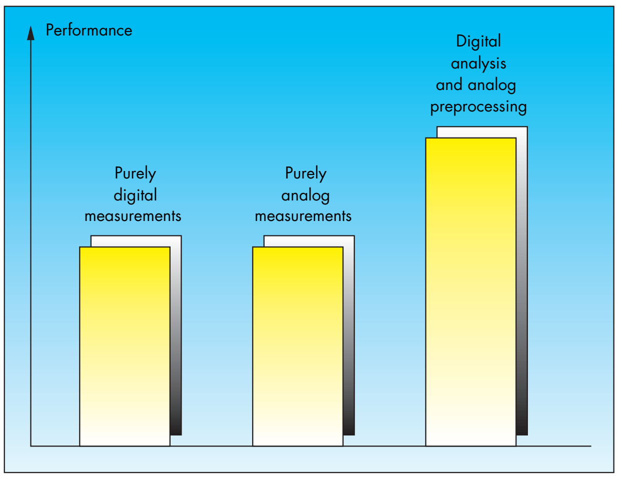
Superior analysis concept

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 technically more advanced than those of present-day technology (see graph below). This concept guarantees performance and flexibility by far superior to instruments providing purely analog or digital measurements.

- The filters, too, are implemented digitally, resulting in an infinite number of filters as it were, and this also for measurements on analog interfaces. Simply choose the type of filter (eg highpass), cutoff frequency and attenuation: that's all you have to do to loop a new filter into the test path



The intelligent combination of analog and digital measurement techniques paves the way for future applications

The above measurement concept offers many other advantages over merely analog concepts:

- The test routines for analog and digital interfaces are identical. This allows, for instance, the direct comparison of IMD measurements made ahead of and after a converter
- All test functions are available both on the analog and the digital interfaces. This makes it possible to measure at any point of a common analog and digital transmission path. Only this ensures efficient and complete testing
- In intermodulation measurements, spurious components are measured selectively for all frequencies in accordance with the mathematical formula of the relevant test standards. This procedure avoids the measurement of adjacent components along with the spuria, which is usually inevitable with analog test methods
- Measurement speed is as a rule 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

Certified Quality System
ISO 9001
DQS REG. NO 1954-04

Certified Environmental System
ISO 14001
REG. NO 1954

A future-proof investment

Nobody can accurately predict today what effects future developments in digital technology will have on the audio world and what will be the resulting test requirements. This is however no problem for Audio Analyzer UPL. Since all test functions are implemented digitally, UPL can be adapted to changing requirements by simply loading the necessary software – and this also for the analog interfaces.

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

A competent partner

The name of Rohde & Schwarz stands for excellent quality – thousands of audio analyzers have proven records at satisfied customers and have been in operation successfully for many years. After the purely analog UPA and UPD, which still holds the top position in today's audio measurement technology, Audio Analyzer UPL has been developed to complete the product line.

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

Naturally, Rohde & Schwarz instruments are certified in compliance with ISO 9001 and ISO 14001.

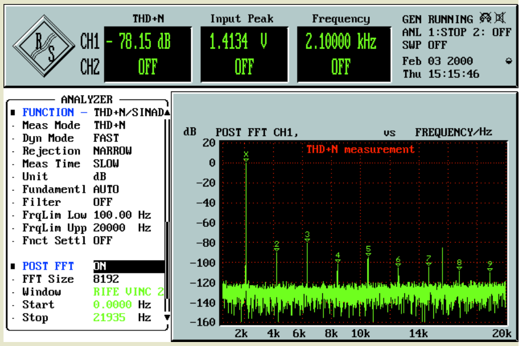


Fig. 1: Automatic marking of harmonics in THD+N measurements makes nonharmonics visible at a glance

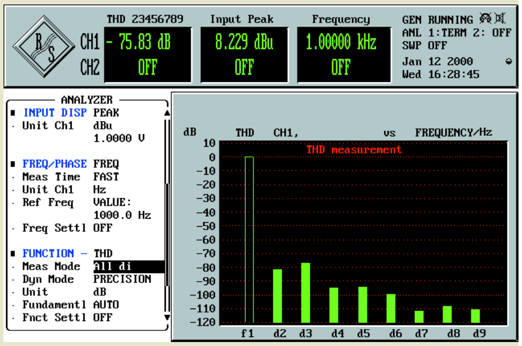


Fig. 2: In THD measurements, single harmonics, all harmonics or any combination of harmonics can be measured

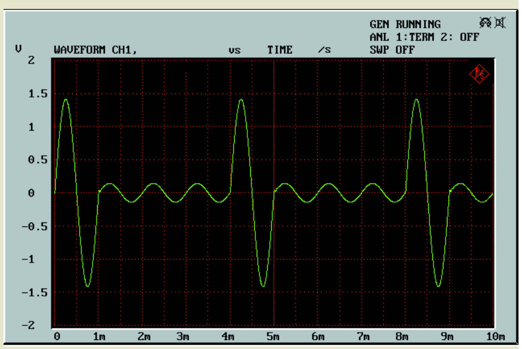


Fig. 3: The waveform function displays the test signal in the time domain. The example shows a sinewave burst

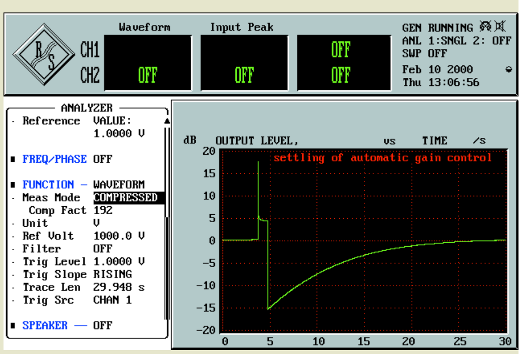


Fig. 4: The transient characteristics of an AGC play an important role in testing hearing aids or automatic volume control on tape recorders

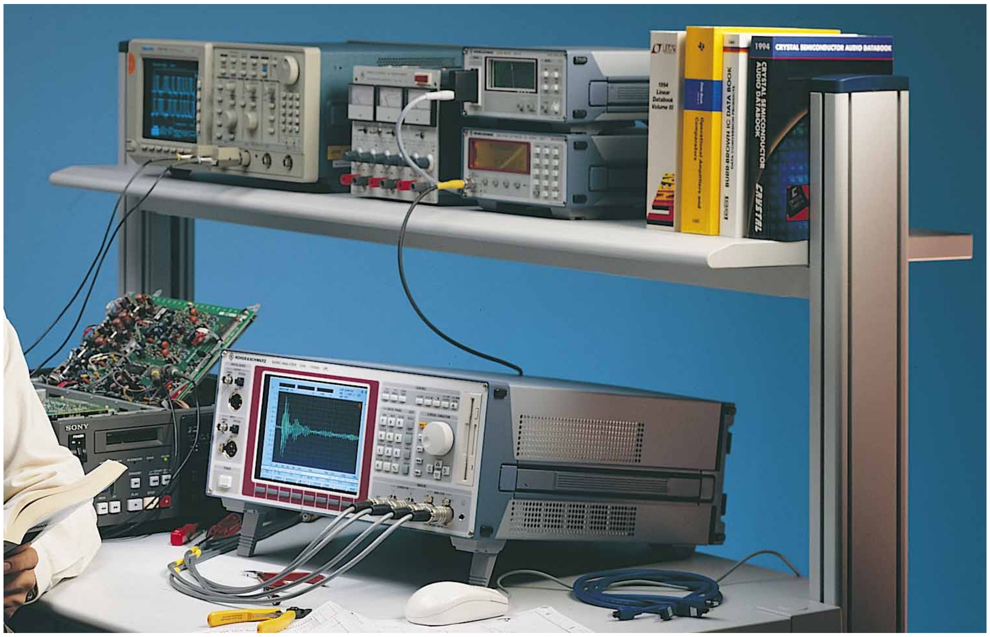
An allrounder

Test signals – as you like it

The generators of UPL supply an extremely wide variety of analog and – with options UPL-B2 or UPL-B29 – digital test signals:

- **Sinewaves**
  for level and harmonic distortion measurements. The signal can be applied to an equalizer with user-selectable nominal frequency response, eg 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**
  comprising up to 17 sinewaves of any frequency and with the same or different amplitude; setting the phase is also possible with UPL-B6
- **Sine burst signal**
  with adjustable interval and on-time as well as programmable low level, eg for testing AGCs
- **Sine² burst**
  also with adjustable interval and on-time, eg for testing rms rectifier circuits
- **Special multitone signal**
  comprising 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, eg for acoustic measurements; setting of crest factor with UPL-B6
- **Arbitrary waveforms**
  for generating any voltage curve of up to 16k points. Test signals can be output in different file formats, eg voice and music signals stored as WAV files
- **Two-channel sinewave signals**
  for the two digital output channels when 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

UPL offers a wealth of measurement functions both for analog and – with option UPL-B2/-B29 – for digital interfaces.

- **Level or S/N**
  with rms, peak or quasi-peak weighting;
  high measurement speeds due to automatic adaptation of integration times to 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 (eg 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 the harmonics or any combination of harmonics can be measured (Fig. 2)
- **Modulation distortion**
  to DIN-IEC 268-3. 2nd and 3rd order intermodulation is measured
- **Intermodulation**
  using the difference tone method. 2nd and 3rd order intermodulation is measured
- **Wow and flutter**
  to DIN IEC, NAB, JIS or the 2-sigma method to DIN IEC where the demodulated-signal spectrum is also displayed
- **DC voltage**
- **Frequency, phase and group delay**
- **Polarity**
  Signal paths are checked for reversed polarity
- **Crosstalk**
- **Waveform function**
  for representing the test signal in the time domain (Fig. 3). Waveforms can be smoothed by interpolation. Slow sequences can be displayed compressed, eg for analyzing the transient response of compander or AGC circuits (Fig. 4)
- **Extended Analysis Functions UPL-B6:**
  coherence and transfer functions for determining the transfer characteristics of complex test signals;
  third octave analysis mainly for acoustic measurements;
  rub & buzz measurements 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, where as a rule not the whole range of test functions is needed but economical solutions to cater for large batches. UPL is an ideal choice for this task. It optimally complements its "bigger brother", Audio Analyzer UPD, which is mainly employed in development. The operating concept of the two units based on the same IEC/IEEE-bus commands is identical, so there is no problem using them jointly

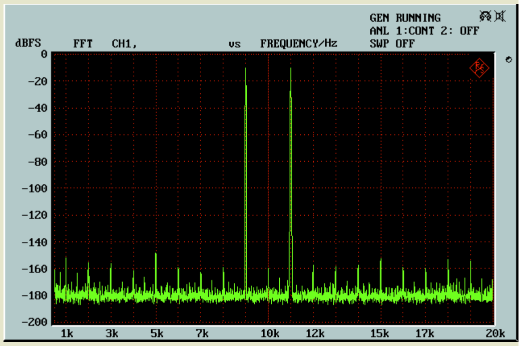


Fig. 5: FFT spectrum of two-tone signal shown on full screen

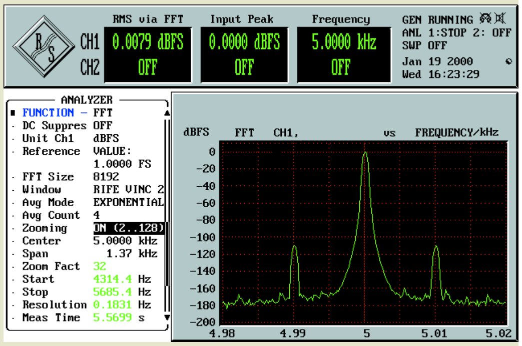


Fig. 6: With the zoom FFT function, sidebands spaced only a few hertz from the signal can be displayed

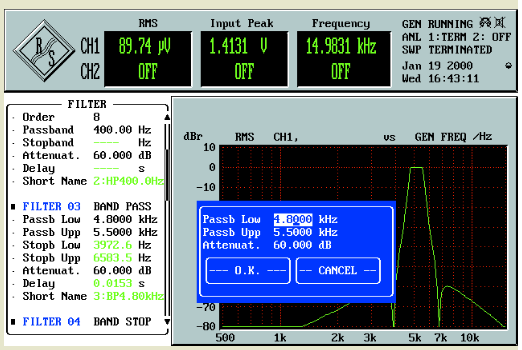


Fig. 7: Filters can be defined by entering just a few parameters

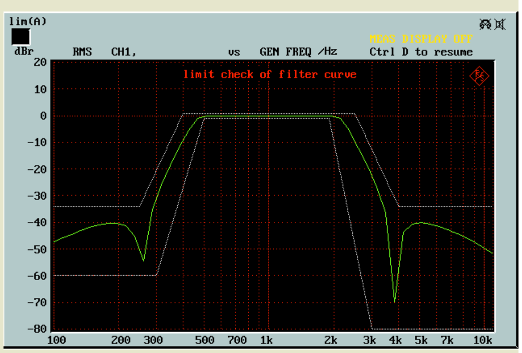


Fig. 8: Tolerance curves enable fast go/nogo tests

All-in package

Spectrum analysis

With its FFT analyzer, 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. It should be emphasized that this is not just a scale expansion but the measurement is really made at a higher resolution (Fig. 6).

Programmable filters

The filters of UPL are software-implemented so that the user can define any number of filters. The most common weighting filters are provided as standard. Further 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 shows its strength in particular where special requirements have to be met: special filters can be implemented using commercial filter design programs. The data are transferred to UPL and the created filter is looped into the signal path.

A variety of sweep functions

For continuous variation of the test signals, UPL offers amplitude and frequency sweeps and for bursts additionally sweeps of interval and on-time. 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.

In measurements of external signals, these 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. Results will be stable even for DUTs with unknown or unstable transient response thanks to the settling function.

The strengths of UPL show up 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

- 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 are supplied as standard
- Remote control via IEC/IEEE bus or RS-232-C interface
- Postprocessing of results directly in 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. Easy generation of programs with built-in program generator

Audio Analyzer UPL is a compact unit with an integrated controller. It avoids the disadvantages of external PC control, which is found in other audio analyzers.

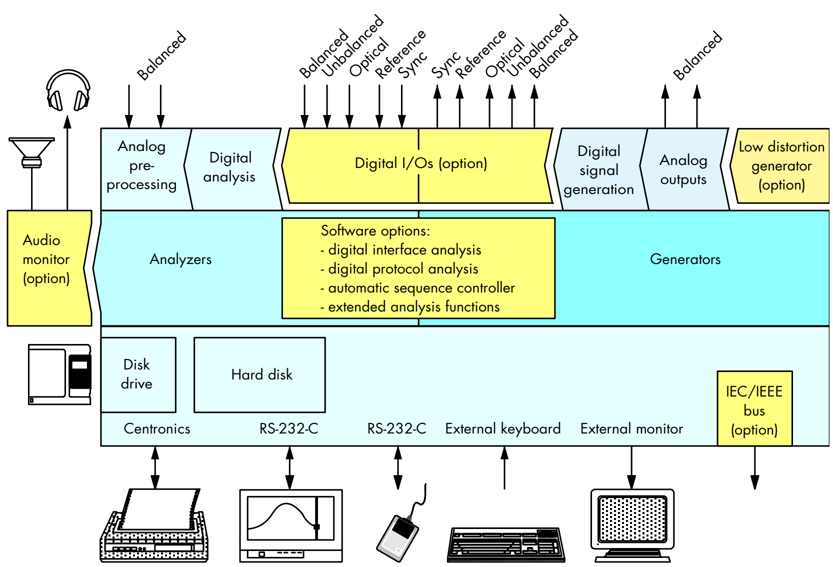
The instrument is easy to transport as it requires no external equipment such as keyboard, monitor or other PC peripherals.

UPL is supplied ready for use. Installation is nothing more than unpacking the unit and switching it on for starting 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, monitor or interface connections, which distorts measurement results. Not so with UPL: the instrument has specified EMC characteristics which also include the internal PC. In contrast to conventional PCs, UPL features elaborate screening such as magnetically shielded power transformers and coated filter pane in front of the display.

And a real boon: the price of UPL includes the internal PC.

Block diagram of UPL



Interfaces, protocol analysis, jitter

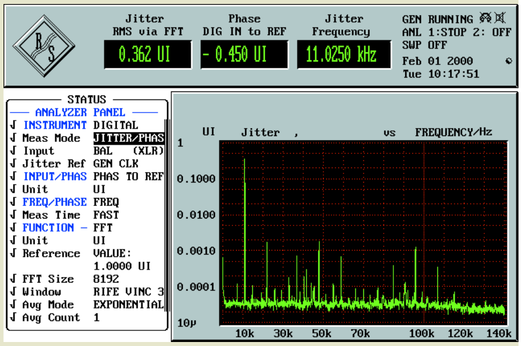


Fig. 9: Individual interference components can easily be found with the aid of the jitter spectrum

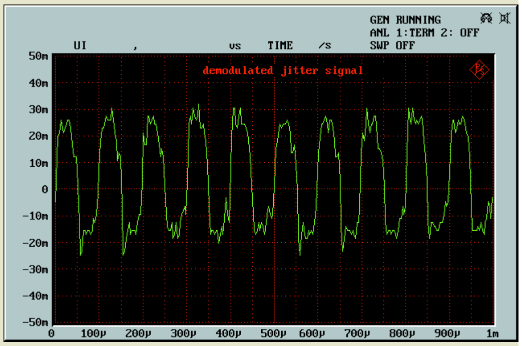


Fig. 10: Display of jitter signal in time domain

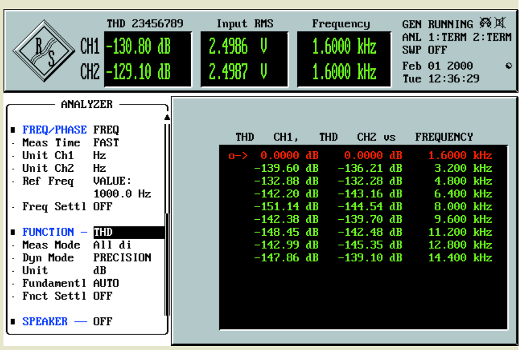


Fig. 11: Complete measured-value tables can be output for all functions

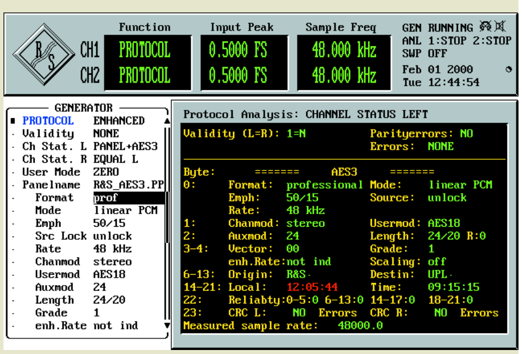


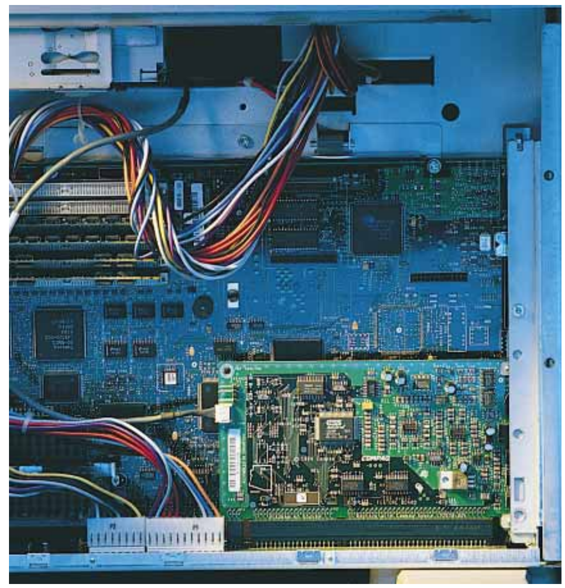
Fig. 12: UPL generates and analyzes additional data in digital data streams in line with all common standards. The data are represented in binary form, as hexadecimal numbers, as ASCII characters or evaluated in consumer or professional format

Analog interfaces

- Balanced inputs with high common-mode rejection and various impedances commonly used in the studio. Measurements can be made on lines with phantom feed
- Balanced outputs, floating (eg to prevent hum loops)
- The generator outputs can be internally connected to the analyzer inputs so that different types of measurement can be made without the need for changing the cabling
- The clock rates of the analyzer and generator are independent of each other. This allows measurements on sample rate converters
- The word length can be selected between 8 and 24 bits independently for generator and analyzer

Digital audio interfaces (options UPL-B2 and UPL-B29)

- Balanced (XLR), unbalanced (BNC) and optical (TOSLINK) inputs and outputs for connecting consumer electronics and professional studio equipment
- 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 irrespective 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) to AES 11, and the generator in addition to wordclock, video sync signals (PAL/SECAM/NTSC) and to 1024 kHz reference clocks
- Both generator and analyzer can be driven at clock rates of 35 kHz to 106 kHz. The clock signal can also be produced internally by the generator



Improvement of audio quality of sound cards and multimedia equipment – a task for UPL

Digital protocol analysis and generation (option UPL-B21)

This software option extends the functions of options UPL-B2 and UPL-B29 by an in-depth analysis and generation of additional digital data:

- Analysis of channel status and user data. The data are output in binary form, as hexadecimal numbers, as ASCII characters or, in the case of channel status data, evaluated in the professional or consumer format to 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 to AES 3 or IEC 958 in 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's requirements
- Simultaneous measurement of clock rate and display of interface errors (such as parity error)

Jitter and interface tests (option UPL-B22)

With this option, the physical parameters of digital audio interfaces can be examined. UPL-B22 extends the functions of options UPL-B2 and UPL-B29.

Signal analysis:

- Measurement of jitter amplitude and display of jitter signal in the frequency and time domain (Figs 9 and 10)
- 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)

Signal generation:

- The clock of the output signal can be "jittered" by superimposing a sinewave or noise signal of variable amplitude
- When generating digital audio data – with option UPL-B1fitted – jitter and common-mode interference may 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

Digital components of various data formats and clock rates are the stock-in-trade of professional users. They call for a measuring instrument offering top performance at all interfaces at 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

Designed for convenience

Efficient online help

UPL offers a variety of help functions to provide optimum support for the user:

HELP function

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

SHOW I/O key

If no results can be displayed, eg because no input signal or an incorrect input signal is present, information on possible causes will appear upon pressing SHOW I/O. Moreover, the input and output configuration will be displayed.

Info boxes

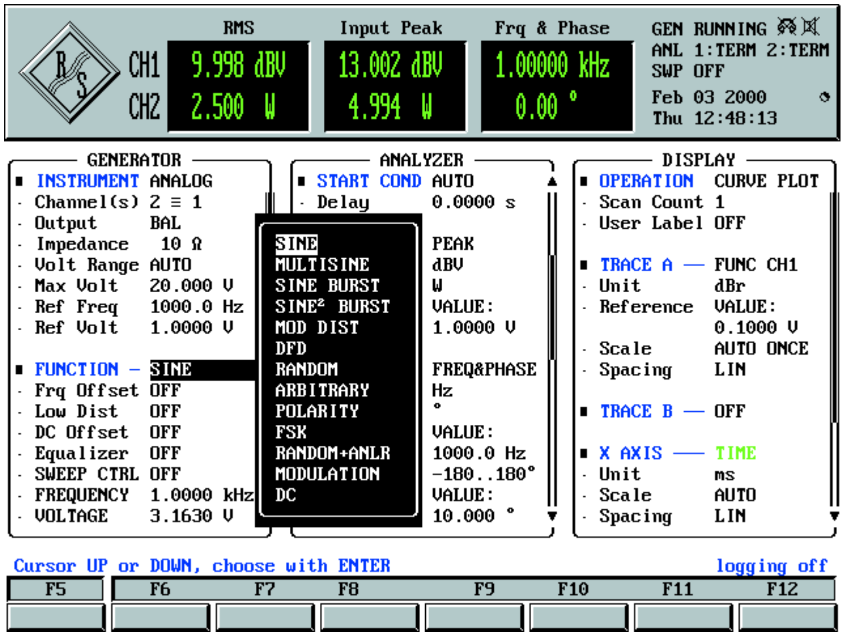
These highlighted boxes inform the user of any incorrect settings.

Online help

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

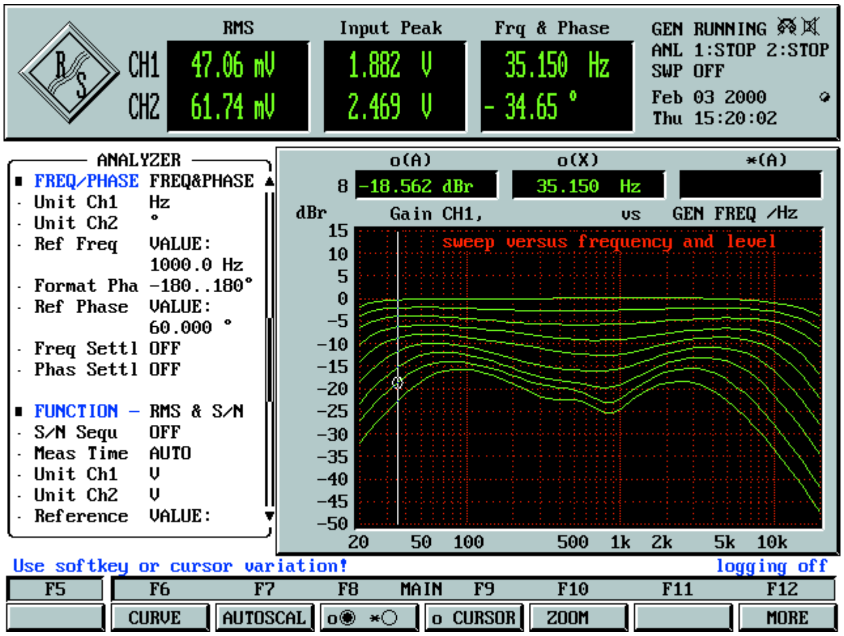
Protection against illegal entries

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.



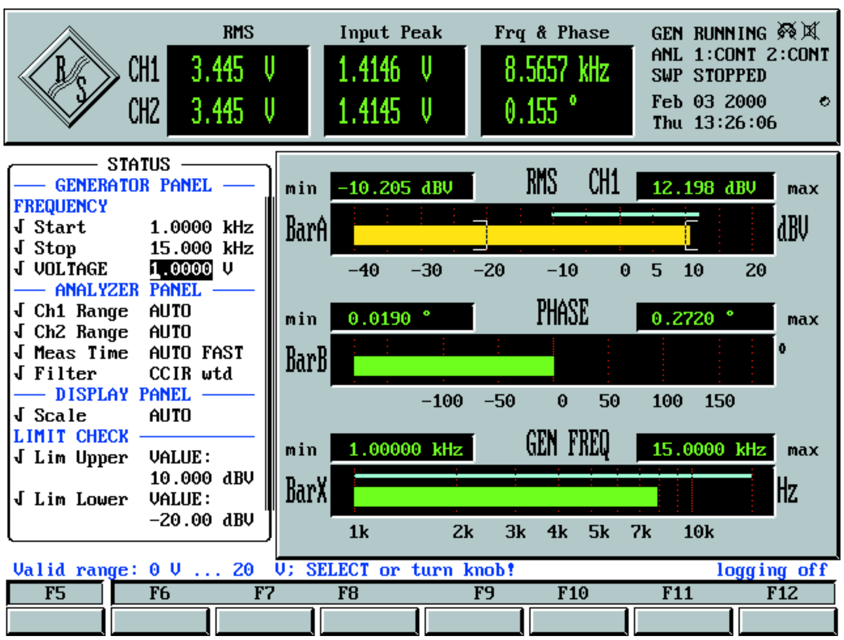
A wealth of functions – yet easy to operate

- Related functions and settings are combined in panels that can be called 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 given 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 simplify familiarization with the instrument
- Uncomplicated entries: the user simply needs to open a menu and make an entry or selection
- Continuous status information on generator, analyzer and sweep
- Rapid operating sequences through the use of softkeys, eg for graphical representations
- The user can choose between operation via mouse, external keyboard or front panel. This choice makes sense since the working space required by a mouse is not always available
- Short learning time thanks to an easy-to-understand operating concept treating analog and digital measurements in the same way



Results at a glance

- Real-time 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 modes range from traces and bargraphs through spectrum display to three-dimensional waterfalls



It is often the case that only a few parameters need to be modified after a measurement sequence has been started. Therefore, entry lines can be selected from the input panels for the generator, analyzer, etc, by marking them with a tick. 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 UPL can also be operated from the status panel

Fast and efficient

High measurement speed

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

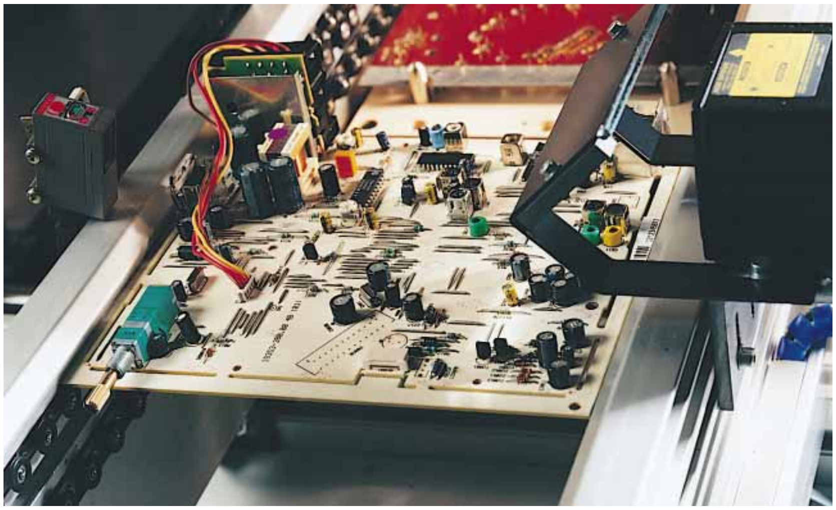
- All operations involving elaborate computing are carried out by digital signal processors. The PC is merely used for control of the unit and display of results
- UPL can perform even complex test functions simultaneously on both channels. This feature alone reduces the time for stereo measurements by 50% compared with 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
- 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, not of an office environment
- Display windows not needed can be switched off, which also cuts down 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 made

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/nogo decisions can be made already 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
- Model UPL66 is specially tailored to the requirements of production. It comes without a display and keypad, thus saving purchasing 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

UPL66 – special model for use in test systems, with the full flexibility of the standard model



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 UPL make for high availability and reduce running costs

- Remote-control capability via the IEC/IEEE bus is a must in large-scale production systems. In the design of Audio Analyzer 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 UPL-B10, it is no longer necessary to look up IEC/IEEE-bus commands

SCPI

Universal Sequence Controller UPL-B10
allows measurement sequences to be generated and executed, thus turning UPL into an automatic test system. Programming of measurement sequences 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, ie test sequences can be programmed without a single line to be typed by the user. The program thus generated does not just give the sequence of keys to be pressed but contains the instructions in easy-to-read IEC/IEEE-bus syntax according to SCPI.

BASIC commands can then be used to modify the program, eg 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 UPL can be transferred to an external controller after slight modifications for the remote control of 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 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

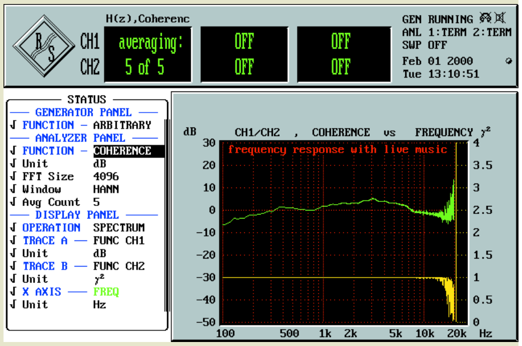


Fig. 13: Transfer and coherence function for determining the transfer characteristic with the aid of complex test signals (eg music or voice)

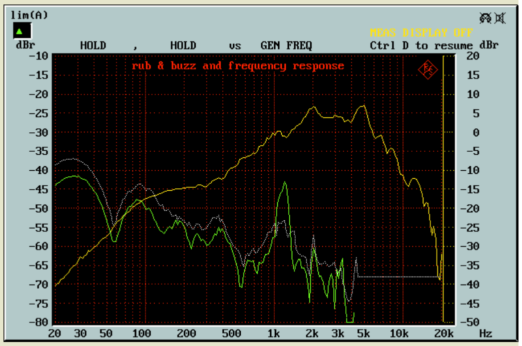


Fig. 14: Frequency response and rub & buzz function for quality assurance in loudspeaker production

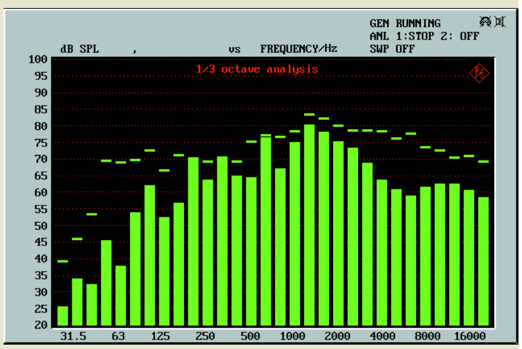


Fig. 15: Third-octave analysis used mainly in acoustics

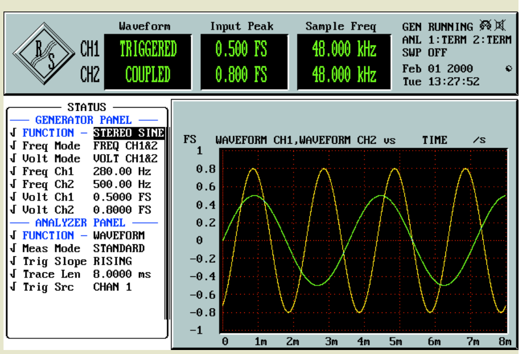


Fig. 16: Different signals for both channels may be generated at the digital audio outputs

Low Distortion Generator UPL-B1
is essential for all applications requiring extremely pure analog signals or an extended frequency range up to 110 kHz. Its inherent distortion is well below that of the built-in universal generator which already has excellent specifications.

When digital audio data are 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 UPL-B2/-B29
contain the digital audio interfaces (balanced, unbalanced and optical) for the standard sampling rates 44.1 kHz and 48 kHz, UPL-B29 also for the extended rates up to 96 kHz. Either UPL-B2 or UPL-B29 can be fitted. For further information on options and associated software extensions (Digital Audio Protocol UPL-B21 and Jitter and Interface Test UPL-B22) refer to pages 8 and 9.

Audio Monitor UPL-B5
adds a headphones output and a built-in loudspeaker to UPL. The input signal of the analog and digital interfaces and – with level, THD+N and rub & buzz measurements – the filtered or weighted signal can be monitored.

Extended Analysis Functions UPL-B6
In modern audio systems, the transfer characteristics are dynamically adapted to the input signals. With conventional, static test signals as input signals, the dynamic processes are not activated and thus the signals cannot be analyzed. **Coherence and transfer function** 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 referred to the input spectrum (Fig. 13). The required complex test signals stored in various formats can be directly called from the UPL hard disk using the standard generator function Arbitrary.

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).

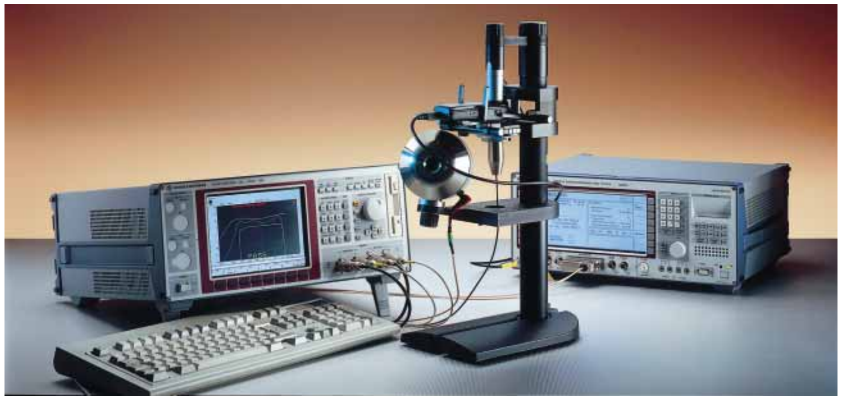
The **third-octave analysis** is an important measurement in acoustics. The levels of up to 30 third-octave bands are simultaneously measured in compliance with class 0 of IEC 1260 (Fig. 15).

In multitone signal generation, UPL-B6 allows also the phase and crest factor to be set.

UPL-B6 is also required for generating two-channel sinewave signals at the digital outputs (Fig. 16).

Further functional extensions of UPL-B6 are under preparation.

Acoustic measurements on GSM mobile phones with Audio Analyzer UPL16



Hearing Aids Test Accessories UPL-B7
Audio Analyzer UPL with option UPL-B7 forms a complete test system for all standard measurements on hearing aids. UPL needs merely be fitted with options UPL-B5 and UPL-B10. 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 couplers. The associated software allows complete measurements to IEC60118 or ANSI S3.22.

For further information on this application refer to data sheet PD 757.2696, Test System UPL + UPL-B7 for Hearing Aids.

Measurements on hearing aids

Acoustic measurements on GSM mobile phones with UPL16 or option UPL-B8
The acoustic transmission and reproduction quality of a mobile phone is the most important characteristic in every-day use. Various test methods have been standardized for determining acoustic characteristics. **Audio Analyzer UPL16** was developed for conformance tests on GSM mobiles. It performs all audio measurements in line with chapter 30 of GSM 11.10, phase 2. Access to the internal digital signals of special test mobile phones is via the standard digital audio interface (DAI).

GSM 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 GSM mobile phones.

Mobile Phone Test Set UPL-B8 is now 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.

For further information refer to data sheet PD 757.5889, Acoustic Test of GSM Mobiles.

Automatic Audio Line Measurement to ITU-T O.33, UPL-B33
serves for automatic measurements of all relevant parameters of broadcast links according to ITU-T O.33. Generator and analyzer are normally located at different sites. They are synchronized with the aid of FSK signals. The operator may utilize the standard sequences defined by ITU-T O.33 or prepare his own. Option UPL-B10 is needed for the use of UPL-B33.

Remote Control UPL-B4
enables remote control of UPL via the RS-232-C interface or IEC625/IEEE488 interface. The commands employed largely meet SCPI standards.

Universal Sequence Controller UPL-B10
allows measurement sequences to be generated and executed. For detailed information see page 13.

150 Ω Modification UPL-U3
changes the source impedance of the analog generator from 200 Ω to 150 Ω.

Specifications

Data without tolerances are typical values.

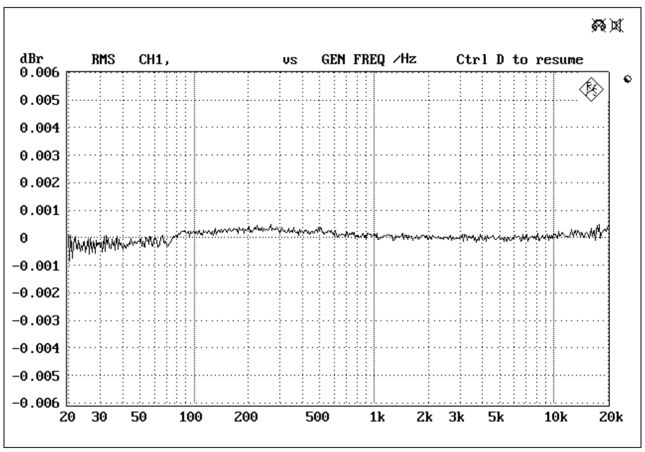
Analog analyzers

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

Analyzer	Frequency range
ANLG 22 kHz	DC/10 Hz to 21.90 kHz[1]
ANLG 110 kHz	DC/20 Hz to110 kHz[1]
Level measurements (rms)	
Accuracy at 1 kHz	±0.05 dB
Frequency response ref. to 1 kHz)	
20 Hz to 22 kHz	±0.03 dB, typ. 0.003 dB (V_{in}<3 V)
10 Hz to 20 Hz	±0.1 dB
22 kHz to 50 kHz	±0.1 dB
50 kHz to 110 kHz	±0.2 dB

Inputs

XLR connectors	2 channels, balanced (unbalanced measurements possible with XLR/BNC Adapter UPL-Z1), floating/grounded and AC/DC coupling switchable
Voltage range	0.1 µV to 110 V (rms, sine)
Measurement ranges	18 mV to 100 V, in steps of 5 dB
Input impedance	100 kΩ ±1% shunted by 120 pF, each pin against ground 300 Ω, 600 Ω, ±0.5% each, P_{max} 1 W
Crosstalk attenuation	>120 dB, frequency <22 kHz, 600 Ω
Common-mode rejection (V_{in} <3 V)	>100 dB at 50 Hz, >86 dB at 1 kHz, >80 dB at 16 kHz
Generator output	each input channel switchable to the other output channel, input impedance: balanced 200 kΩ, unbalanced 100 kΩ



Typical frequency response, measured with internal generator/analyzer at analog interfaces

Measurement functions

RMS value, wideband	
Accuracy	
Measurement speed	
AUTO	±0.05 dB at 1 kHz, sine
AUTO FAST	±0.1 dB additional error
Integration time	
AUTO FAST/AUTO	4.2 ms/42 ms, at least 1 cycle
VALUE	1 ms to 10 s
GEN TRACK	2.1 ms, at least 1 cycle
Noise (600 Ω)	
with A filter	1 µV
with CCIR unweighting filter	<2 µV, 1.6 µV typ. (ANLG 22 kHz)
Filter	weighting filters and user-definable filters, up to 3 filters can be combined, analog notch filter in addition (expansion of dynamic range by up to 30 dB)
Spectrum	post-FFT of filtered signal

1) DC/AC coupling.

RMS value, selective	
Bandwidth (–0.1 dB)	1%, 3%, 1/12 octave, 1/3 octave and user-selectable fixed bandwidth, minimum bandwidth 20 Hz
Selectivity	100 dB (80 dB) with analyzer ANLG 22 kHz (110 kHz) bandpass or bandstop filter, 8th order elliptical filter, analog notch filter in addition
Frequency setting	– automatic to input signal – coupled to generator – fixed through entered value – sweep in selectable range
Accuracy	±0.2 dB + ripple of filters
Peak value	with analyzer ANLG 22 kHz only
Measurement	peak max, peak min, peak-to-peak, peak absolute
Accuracy	±0.2 dB at 1 kHz
Interval	20 ms to 10 s
Filter[2]	weighting filters and user-definable filters, up to 3 filters can be combined
Quasi-peak	with analyzer ANLG 22 kHz only
Measurement, accuracy	to CCIR 468-4
Noise (600 Ω)	<8 µV with CCIR weighting filter
Filter[2]	weighting filters and user-definable filters, up to 3 filters can be combined, analog notch filter in addition
DC voltage	
Voltage range	0 V to ±110 V
Accuracy	±(1% of measured value + 0.1% of measurement range)
Measurement ranges	100 mV to 100 V, in steps of 10 dB
S/N measurement routine	available for measurement functions – rms, wideband – peak – quasi-peak indication of S/N ratio in dB, no post-FFT
FFT analysis	see FFT analyzer section
Total harmonic distortion (THD)	
Fundamental	10 Hz to 22 kHz
Frequency tuning	automatic to input or generator signal or fixed through entered value
Weighted harmonics	any combination of d_2 to d_9, up to 110 kHz
Accuracy	
Harmonics <50 kHz	±0.5 dB
<110 kHz	±0.7 dB
Inherent distortion[3][4]	
Analyzer ANLG 22 kHz	
Fundamental 20 Hz to 10.95 kHz	<–110 dB, typ. –115 dB
10 Hz to 20 Hz	<–100 dB
Analyzer ANLG 110 kHz	
Fundamental 50 Hz to 20 kHz	<–100 dB, typ. –105 dB
Spectrum	bar chart showing signal and distortion
THD+N and SINAD	
Fundamental	10 Hz to 22 kHz
Frequency tuning	automatic to input or generator signal or fixed through entered value
Input voltage	typ. >100 µV with automatic tuning
Bandwidth	upper and lower frequency limit selectable, one weighting filter in addition
Accuracy	
Bandwidth <50 kHz	±0.5 dB
<100 kHz	±0.7 dB
Inherent distortion[3]	
Analyzer ANLG 22 kHz	
Bandwidth 20 Hz to 21.90 kHz	typ. –110 dB at 1 kHz, 2.5 V <–105 dB +2 µV [5] typ. –108 dB +1.5 µV
Analyzer ANLG 110 kHz	
Bandwidth 20 Hz to 22 kHz	<–95 dB + 2.5 µV, typ. –100 dB + 1.75 µV
20 Hz to 110 kHz	<–88 dB + 5 µV, typ. –95 dB + 3.5 µV
Spectrum	post-FFT of filtered signal

2) With UPL-B29 only in base rate mode.

3) Total inherent distortion of analyzer and generator (with option UPL-B1), analyzer with dynamic mode precision.

4) >3.5 V: typ. 3 dB less; <0.5 V: sensitivity reduced by inherent noise (typ. 0.25/1.25 µV with analyzers 22/110 kHz).

5) At full-scale level of measurement range (<–100 dB + 2 µV with auto range), <–100 dB for input voltage >3.5 V.

Modulation factor (MOD DIST)

Measurement method	selective to DIN IEC 268-3
Frequency range	lower frequency 30 Hz to 2700 Hz
	upper frequency 8 x LF to 100 kHz[1]
Accuracy	±0.50 dB
Inherent distortion[2]	
Upper frequency 4 kHz to 15 kHz	<–96 dB (–90 dB), typ. –103 dB
15 kHz to 20 kHz	<–96 dB (–85 dB)
Spectrum	bar chart showing signal and distortion

Difference frequency distortion (DFD)

Measurement method	selective to DIN IEC 268-3 or 118
Frequeny range	difference frequency 80 Hz to 2 kHz
	center frequency 200 Hz to 100 kHz[3]
Accuracy	±0.50 dB, center frequency <20 kHz
Inherent distortion[4] DFD d_2	<–112 dB, typ. –125 dB
DFD d_3	<–96 dB, typ. –105 dB
Spectrum	bar chart showing signal and distortion

Wow and flutter	with analyzer ANLG 22 kHz only
Measurement method	DIN/IEC, NAB, JIS, 2-sigma to IEC-386
Weighting filter OFF	highpass 0.5 Hz, bandwidth 200 Hz
ON	bandpass 4 Hz to IEC-386
Accuracy	±3%
Inherent noise	<0.0005% weighted
	<0.001% unweighted
Spectrum	post-FFT of demodulated signal

Time domain display (WAVEFORM)

Trigger	rising/falling edge
Trigger level	–200 V to +200 V, interpolated between samples
Trace length	max. 7424 points
Standard mode	1- to 32-fold interpolation
Compressed mode	2- to 1024-fold compression (envelope for AGC measurement), with analyzer ANLG 22 kHz only

Frequency [5]

Frequency range	20 Hz to 110 kHz
Accuracy	±50 ppm

Phase [5]	with analyzer 22 kHz only
Frequency range	20 Hz to 20 kHz
Accuracy	±0.5°

Group delay[5]	with analyzer 22 kHz only
Frequency range	20 Hz to 20 kHz
Accuracy in seconds	Δφ/(Δf x360), where Δφ = phase accuracy in °, Δf = frequency step

Polarity test

Measurement	polarity of unsymmetrical input signal
Display	+POL, –POL

[1] For upper frequency >20 kHz, the bottom limit of lower frequency is reduced.

[2] Input voltage >200 mV, typical values apply between 0.5 V and 3.5 V. Lower frequency >200 Hz, values in ( ) for lower frequency <200 Hz. Dynamic mode precision; level ratio LF:UF = 4:1.

[3] For center frequencies >20 kHz the bottom limit of the difference frequency is reduced.

[4] Input voltage >200 mV, typical values apply between 0.5 V and 3.5 V, dynamic mode precision (at DFD d2), center frequency 7 kHz to 20 kHz.

[5] With measurement functions RMS, FFT and THD+N only, accuracy applies to 8k FFT with zoom factor 2, Rife-Vincent-2 window; S/N ratio >70 dB.

Analog generators

An 18-bit ΔΣ D/A converter is used for analog signal generation. The characteristics of the basic generator can be improved and extended with a low-distortion RC oscillator (Low Distortion Generator UPL-B1):

– sine with reduced distortion
– frequency range up to 110 kHz

Outputs

XLR connectors, 2 channels, floating, balanced/unbalanced switchable, short-circuit-proof; max. current <120 mA with external feed

Balanced

Voltage	0.1 mV to 20 V (rms, sine, open-circuit)
Crosstalk attenuation	>115 dB, frequency <20 kHz
Source impedance	typ. 10 Ω , 200 Ω (150 Ω with UPL-U3) ± 0.5%, 600 Ω ± 0.5%
Load impedance	>400 Ω (incl. source impedance)
Output balance	>75 dB at 1 kHz, >60 dB at 20 kHz

Unbalanced

Voltage	0.1 mV to 10 V (rms, sine, open-circuit)
Crosstalk attenuation	>115 dB, frequency <20 kHz
Source impedance	5 Ω
Load impedance	>200 Ω

Signals

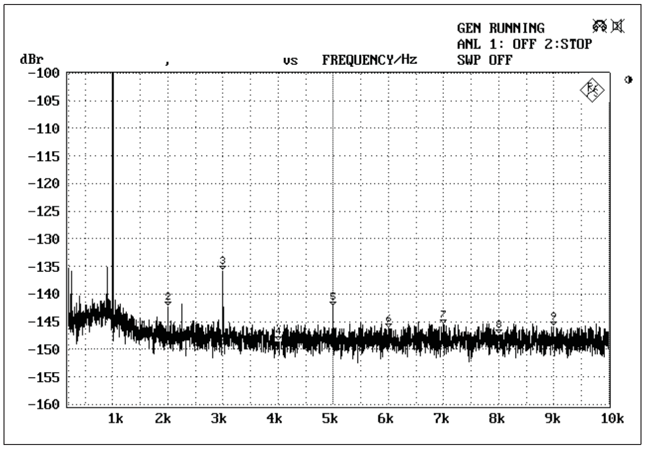
Sine

Frequency range	2 Hz to 21.75 kHz
Frequency accuracy	±50 ppm
Level accuracy	±0.1 dB at 1 kHz
Frequency response (ref. to 1 kHz)	
20 Hz to 20 kHz	±0.05 dB
Inherent distortion THD+N	
Measurement bandwidth	
20 Hz to 22 kHz	<–94 dB, typ. –98 dB
20 Hz to 100 kHz	<–86 dB
Sweep parameters	frequency, level

Sine (with low distortion generator option)

Frequency range	10 Hz to 110 kHz	
Frequency accuracy	±0.5% at 15°C to 30°C	
	±0.75% at 5°C to 45°C	
Level accuracy	±0.1 dB at 1 kHz	
Frequency response (ref. to1 kHz)		
20 Hz to 20 kHz	±0.05 dB	
10 Hz to 110 kHz	±0.1 dB	
Harmonics	typ. <–115 dB (<–120 dB at 1 kHz), measurement bandwidth 20 Hz to 20 kHz, voltage 1V to 5 V	
Inherent distortion (THD)		
Fundamental 1 kHz, 1 V to 10 V	<–120 dB typ.	
20 Hz to 7 kHz	<–105 dB	
7 kHz to 20 kHz	<–100 dB	
Inherent distortion (THD+N)[6]		Meas. bandw.
Fundamental 1 kHz, 2.5 V	–110 dB typ.	22 kHz
20 Hz to 20 kHz	<–100 dB +2 µV	22 kHz
20 Hz to 20 kHz	<–88 dB +5 µV	100 kHz
Sweep parameters	frequency, level	

[6] Total inherent distortion of analyzer and generator, analyzer with dynamic mode precision.



Typical spectrum of low distortion generator at 1 kHz, 1 V

MOD DIST		for measuring the modulation distortion
Frequency range	lower frequency	30 Hz to 2700 Hz
	upper frequency	8 x LF to 21.75 kHz
Level ratio (LF:UF)		selectable from 10:1 to 1:1
Level accuracy		±0.5 dB
Inherent distortion		<–94 dB (typ. –100 dB) at 7 kHz, 60 Hz <–84 dB (typ. –90 dB), level ratio LF:UF = 4:1
Sweep parameters		upper frequency, level
DFD		for measuring the difference tone
Frequency range	difference freq.	80 Hz to 2 kHz
	center frequency	200 Hz to 20.75 kHz
Level accuracy		±0.5 dB
Inherent distortion[1]	DFD d_2	< –114 dB, typ.–120 dB
	DFD d_3	< –92 dB, typ. –100 dB
Sweep parameters		center frequency, level

Multi-sine	
Frequency range	2.93 Hz to 21.75 kHz
Frequency spacing	adjustable from 2.93 Hz
Frequency resolution	<0.01% or matching FFT frequency spacing
Dynamic range	100 dB, referred to total peak value
Characteristics	
Mode 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 UPL-B6)
Mode 2	1 to 7400 spectral lines (noise in frequency domain), distribution: white, pink, 1/3 octave, defined by file; crest factor selectable (with UPL-B6)
Sine burst, sine² burst	
Burst time	1 sample up to 60 s, 1-sample resolution
Interval	burst time up to 60 s, 1-sample res.
Low level	0 to burst level, absolute or relative to burst level (0 with sine² burst)
Bandwidth	21.75 kHz (elliptical filter)
Sweep parameters	burst frequency, level, time, interval
Noise	
Distribution	Gaussian, triangular, rectangular
Arbitrary waveform	loaded from file
File format	
*.TTF (internal)	memory depth max. 16 k
*.WAV [2]	reproduction of audio files (mono), duration approx. 10 s per Mbyte RAM
Clock rate	48 kHz
Bandwidth	21.75 kHz (elliptical filter)

Polarity test signal	
Sine² burst with following characteristics:	
Frequency	1.2 kHz
On-time	1 cycle (0.8333 ms)
Interval	2 cycles (1.6667 ms)
FM signal	
Carrier frequency	2 Hz to 21.75 kHz
Modulation frequency	1 mHz to 21.75 kHz
Modulation	0% to 100%
AM signal	
Carrier frequency	2 Hz to 21.75 kHz
Modulation frequency	1 mHz to 21.75 kHz
Modulation	0% to 100%
DC voltage	
Level range	0 V to ±10 V (±5 V unbalanced), sweep possible
Accuracy	±2%
DC offset[3]	0 V to ±10.0 V (±5 V unbalanced)
Accuracy	±2%
Residual offset	<1% of rms value of AC signal

Digital analyzer (option UPL-B2 or -B29)

Frequency limits specified for measurement functions apply to a sampling rate of 48 kHz. For other sampling rates limits are calculated according to the formula: $f_{new} = f_{48\,kHz}$ x sampling rate/48 kHz.

Inputs

Balanced input	XLR connector, transformer coupling
Impedance	110 Ω
Level (V_{PP})	min. 200 mV, max. 12 V
Unbalanced input	BNC, grounded
Impedance	75 Ω
Level (V_{PP})	min. 100 mV, max. 5 V
Optical input	TOSLINK
Channels	1, 2 or both
Audio bits	8 to 24
Clock rate	35 kHz to 55 kHz with UPL-B2 or UPL-B29 in base rate mode 35 kHz to 106 kHz with UPL-B29 in high rate mode synchronous to DAI or DARS
Format	professional and consumer format to AES3 or IEC-958 as well as user-definable formats at all inputs

Measurement functions

All measurements at 24 bits, full scale

RMS value, wideband	
Measurement bandwidth	up to 0.5 times the clock rate
Accuracy	
AUTO FAST	±0.1 dB
AUTO	±0.01 dB
FIX	±0.001 dB
Integration time	
AUTO FAST/AUTO	4.2 ms/42 ms, at least 1 cycle
VALUE	1 ms to 10 s
GEN TRACK	2.1 ms, at least 1 cycle
Filter	weighting filters and user-definable filters, up to 3 filters can be combined
Spectrum	post-FFT of filtered signal
RMS value, selective	
Bandwidth (–0.1 dB)	1%, 3%, 1/12 octave, 1/3 octave and user-selectable fixed bandwidth, min. bandwidth 20 Hz
Selectivity	100 dB, bandpass or bandstop filter, 8th order elliptical filter

1) Center frequency >5 kHz, difference frequency <1 kHz; DFD d2 –100 dB (typ.) with DC offset.
2) With UPL-B29 only in base rate mode.

3) No DC offset 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.

Frequency setting	– automatic to input signal – coupled to generator – fixed through entered value – sweep in selectable range
Accuracy	±0.2 dB + ripple of filters

Peak value

Measurement	peak max, peak min, peak-to-peak, peak absolute
Accuracy	±0.2 dB at 1 kHz
Interval	20 ms to 10 s
Filter[1]	weighting filters and user-definable filters, up to 3 filters can be combined

Quasi-peak

Measurement, accuracy	to CCIR 468-4
Filter[1]	weighting filters and user-definable filters, up to 3 filters can be combined

DC voltage

Measurement range	0 to ±FS
Accuracy	±1%

S/N measurement routine	available for measurement functions: – rms, wideband – peak – quasi-peak indication of S/N ratio in dB, no post-FFT
FFT analysis	see FFT analyzer section

Total harmonic distortion (THD)

Fundamental	10 Hz to 21.90 kHz
Frequency tuning	automatic to input or generator signal or fixed through entered value
Weighted harmonics	any combination of d_2 to d_9, up to 21.90 kHz
Accuracy	±0.1 dB
Inherent distortion[2]	
Fundamental 42 Hz to 21.90 kHz	<–130 dB
24 Hz to 42 Hz	<–112 dB
12 Hz to 24 Hz	<–88 dB
Spectrum	bar chart showing signal and distortion

THD+N and SINAD

Fundamental	10 Hz to 21.90 kHz
Frequency tuning	automatic to input or generator signal or fixed through entered value
Stopband range	fundamental ±28 Hz, max. up to 2nd harmonic
Bandwidth	upper and lower frequency limit selectable, one weighting filter in addition
Accuracy	±0.3 dB
Inherent distortion [2]	
Bandwidth 20 Hz to 21.90 kHz	
Fundamental 28 Hz to 21.90 kHz	<–126 dB
24 Hz to 28 Hz	<–109 dB
20 Hz to 24 Hz	<–96 dB
Spectrum	post-FFT of filtered signal

Modulation factor (MOD DIST)

Measurement method	selective to DIN IEC 268-3
Frequency range	
Lower frequency	30 Hz to 2700 Hz[3]
Upper frequency	8 x LF[3] to 21.25 kHz
Accuracy	±0.2 dB
Inherent distortion[2]	
Level LF:UF 1:1	<–133 dB
4:1	<–123 dB
10:1	<–115 dB
Spectrum	bar chart showing signal and distortion

Difference frequency distortion (DFD)

Measurement method	selective to DIN IEC 268-3 or 118
Frequency range	
Difference frequency	80 Hz to 2 kHz[3]
Center frequency	200 Hz to 20.90 kHz
Accuracy	±0.2 dB
Inherent distortion[2] DFD d_2	<–130 dB
DFD d_3	<–130 dB
Spectrum	bar chart showing signal and distortion

Wow and flutter

Measurement method	DIN/IEC, NAB, JIS, 2-sigma to IEC-386
Weighting filter OFF	highpass 0.5 Hz, bandwidth 200 Hz
ON	bandpass 4 Hz to IEC-386
Accuracy	±3%
Inherent noise	<0.0003% weighted <0.0008% unweighted
Spectrum	post-FFT of demodulated signal

Time domain display (WAVEFORM)

Trigger	rising/falling edge
Trigger level	–1 FS to +1 FS, interpolated between samples
Trace length	max. 7424 points
Standard mode	1- to 32-fold interpolation
Compressed mode	32- to 1024-fold compression (envelope for AGC measurement)

Frequency[4]

Frequency range	20 Hz to 20 kHz
Accuracy	±50 ppm

Phase[4]

Frequency range	20 Hz to 20 kHz
Accuracy	±0.5°

Group delay[4]

Frequency range	20 Hz to 20 kHz
Accuracy in seconds	$\Delta\varphi/(\Delta f \times 360)$, where $\Delta\varphi$ = phase accuracy in °, Δf = frequency step

Polarity test

Measurement	polarity of unsymmetrical input signal
Display	+POL, –POL

Digital generator (option 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: $f_{new} = f_{48\,kHz}$ x sampling rate/48 kHz.

Outputs

Balanced output	XLR connector, transformer coupling
Impedance	110 Ω, short-circuit-proof
Level (V_{PP} into 110 Ω)	0 V to 8 V, in 240 steps
Accuracy	±1 dB (rms)
Unbalanced output	BNC, transformer coupling
Impedance	75 Ω, short-circuit-proof
Level (V_{PP} into 75 Ω)	0 V to 2 V, in 240 steps
Accuracy	±1 dB (rms)
Optical output	TOSLINK
Channels	1, 2 or both
Audio bits	8 to 24
Clock rate	35 kHz to 55 kHz with UPL-B2 or UPL-B29 in base rate mode 35 kHz to 106 kHz with UPL-B29 in high rate mode internal: generator clock or synchronization to analyzer external: synchronization to word clock input, video sync, DARS, 1024 kHz
Format	professional and consumer format to AES3 or IEC-958 as well as user-definable formats at all outputs

1) With UPL-B29 only in base rate mode.
2) Total inherent distortion of analyzer and generator.
3) Fixed frequency, independent of sampling rate.

4) Only for measurement functions RMS, FFT and THD+N, accuracy applies to 8k FFT with zoom factor 2, Rife-Vincent-2 window; S/N ratio >70 dB. Phase and group delay in high rate mode only with RMS without filter.

Signals

All signals with 24 bits, full scale

General characteristics

Level resolution	2^{-24}
Audio bits	8 to 24 bits, LSB rounded off
Dither	for sine, stereo sine, DFD and MOD DIST in high rate mode for sine only
Distribution	Gaussian, triangular, rectangular
Level	2^{-24} FS to 1 FS
Frequency accuracy	±50 ppm (internal clock), ±1 ppm relative to clock rate
Frequency offset	for sine, stereo sine, DFD and MOD DIST 0 or +1000 ppm
DC offset	0 to ±1 FS adjustable

Sine

Frequency range	2 Hz[1] to 21.90 kHz
Total harmonic distortion (THD)	<–133 dB
Sweep parameters	frequency, level

MOD DIST

	for measuring the modulation distortion
Frequency range	
Lower frequency	30[1] to 2700 Hz[1]
Upper frequency	8 x LF[1] to 21.90 kHz
Level ratio (LF:UF)	selectable from 10:1 to 1:1
Inherent distortion[2]	
Level LF:UF 1:1	<–133 dB
4:1	<–123 dB
10:1	<–115 dB
Sweep parameters	upper frequency, level

DFD

	for measuring the difference tone
Frequency range	
Difference frequency	80 Hz to 2 kHz[1]
Center frequency	200 Hz[1] to 20.90 kHz
Inherent distortion[2]	
DFD d_2	<–130 dB
DFD d_3	<–130 dB
Sweep parameters	center frequency, level

Multi-sine

Frequency range	2.93 Hz to 21.90 kHz
Frequency spacing	adjustable from 2.93 Hz
Frequency resolution	<0.01% or matching FFT frequency spacing
Dynamic range	>133 dB
Characteristics	
Mode 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 UPL-B6)
Mode 2	1 to 7400 spectral lines (noise in frequency domain), distribution: white, pink, 1/3 octave, defined by file; crest factor selectable (with UPL-B6)

Sine burst, sine² burst

Burst time	1 sample up to 60 s, 1-sample resolution
Interval	burst time up to 60 s, 1-sample res.
Low level	0 to burst level, absolute or referred to burst level (0 for sine² burst)
Sweep parameters	burst frequency, level time, interval

Noise

Distribution	Gaussian, triangular, rectangular

Arbitrary waveform

	loaded from file
File format	
*.TTF (internal)	memory depth max. 16 k
*.WAV[3]	reproduction of audio files (mono), duration approx. 10 s per Mbyte RAM
Clock rate	sampling rate of generator

[1] Fixed frequency, independent of sampling rate.
[2] Total inherent distortion of analyzer and generator.
[3] With UPL-B29 only in base rate mode.

Polarity test signal

Sine² burst with following characteristics:

Frequency	1.2 kHz[1]
On-time	1 cycle
Interval	2 cycles

FM signal

Carrier frequency	2 Hz[1] to 21.9 kHz
Modulation frequency	1 mHz[1] to 21.9 kHz
Modulation	0% to 100%

AM signal

Carrier frequency	2 Hz[1] to 21.9 kHz
Modulation frequency	1 mHz[1] to 21.9 kHz
Modulation	0% to 100%

DC voltage

Level range	0 to ±1 FS, can be swept

Digital audio protocol (option UPL-B21)

Generator

Validity bit	NONE, L, R, L+R
Channel status data	mnemonic entry with user-definable masks, predefined masks for professional and consumer format to AES3 or IEC-958
User data	loaded from file (max. 384 bits) or set to zero

Analyzer

Display	validity bit L and R
Error indication	block errors, sequence errors, clock rate errors, preamble errors
Clock rate measurement	50 ppm
Channel status display	user-definable mnemonic display of data fields, predefined settings for professional and consumer format to AES3 or IEC-958, binary and hexadecimal format
User bit display	user-definable mnemonic display, block-synchronized

Jitter and interface test (option UPL-B22)

Generator

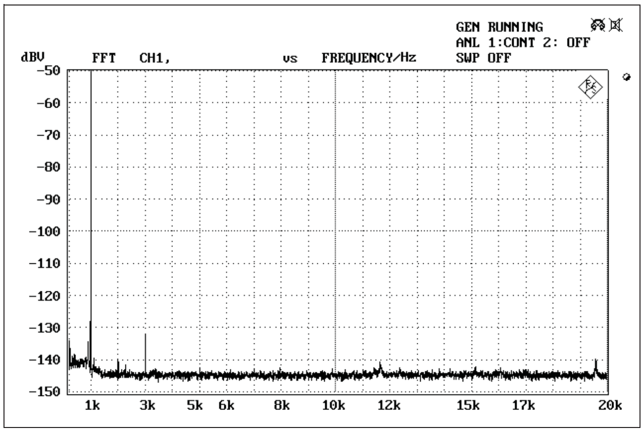
Jitter injection	
Waveform	sine, noise
Frequency range	10 Hz to 21.75 kHz (sine to110 kHz with option UPL-B1)
Amplitude (peak-to-peak)	0 to 5 UI (corresp. to 0 to 800 ns at f_A = 48 kHz)
Common mode signal	for balanced output
Waveform	sine
Frequency range	20 Hz to 21.75 kHz (110 kHz with option UPL-B1)
Amplitude (V_{PP})	0 V to 20 V
Phase (output to reference)	adjustable between –64 and +64 UI (corresp. to ±50% of frame)
Cable simulator	100 m typical audio cable

Analyzer

Input signal	
Amplitude (V_{PP})	0 V to 10 V
Clock rate	35 kHz to 55 kHz with UPL-B2 35 kHz to 106 kHz with UPL-B29
Jitter measurement	amplitude, frequency, spectrum 0 to 5 UI typ. for f <500 Hz, decreasing to 0.5 UI for up to 50 kHz
Measurement limit	200 ps (noise floor with 8k FFT)
Reclocking	input signal sampled with low-jitter clock signal and available at reference output (XLR connector on rear)
Common mode test	at balanced input
Amplitude (V_{PP})	0 V to 30 V
Frequency, spectrum	20 Hz to 110 kHz
Phase (input to reference)	–64 to +64 UI (corresp. to ±50% of frame)
Delay (input to output)	100 µs to 500 ms

FFT analyzer

Frequency range	
Digital 48/96 kHz	DC to 21.9/43.8 kHz
ANLG 22/110 kHz	DC to 21.9/110 kHz
Dynamic range	
Digital	>135 dB
ANLG 22 kHz	120 dB/105 dB[1]
ANLG 110 kHz	115 dB/85 dB[1]
Noise floor	
Digital	–160 dB
ANLG 22 kHz	–140 dB/110 dB[1]
ANLG 110 kHz	–120 dB/90 dB[1]
FFT size	256, 512, 1k, 2k, 4k, 8k points (16k with zoom factor 2)
Window functions	rectangular, Hann, Blackman-Harris, Rife-Vincent 1-3, Hamming, flat top, Kaiser (ß = 1 to 20)
Resolution	from 0.05 Hz with zoom, from 5.86 Hz without zoom
Zoom	2 to 128 (2 to 16 mit ANLG 110)
Averaging	1 to 256, exponential or normal



Typical noise floor of FFT analysis at analog inputs

Filter

For all analog and digital analyzers. Up to 3 filters can be combined as required. All filters are digital filters with a coefficient accuracy of 32 bit floating point (exception: analog notch filter).

Weighting filters	– A weighting – C message – CCITT – CCIR weighted, unweighted – CCIR ARM – deemphasis 50/15, 50, 75, J.17 – rumble weighted, unweighted – DC noise highpass – IEC tuner – jitter weighted

[1] With/without analog notch filter.

User-definable filters

8th order elliptical, type C (for highpass and lowpass filters also 4th order), passband ripple +0/–0.1 dB, stopband attenuation approx. 20 dB to 120 dB selectable in steps of approx. 10 dB (highpass and lowpass filters: stopband attenuation 40 to 120 dB).

Highpass, lowpass filters	limit frequencies (–0.1 dB) selectable, stopband indicated
Bandpass, bandstop filters	passband (–0.1 dB) selectable, stopband indicated
Notch filter	center frequency and width (–0.1 dB) selectable, stopband indicated
Third octave and octave filters	center frequency selectable, bandwidth (–0.1 dB) indicated
File-defined filters	any 8th order filter cascaded from 4 biquads, defined in the z plane by poles/zeroes or coefficients

Analog notch filter

For measurements on signals with high S/N ratio, this filter improves the dynamic range of the analyzer by up to 30 dB to 140 dB for analyzer 22 kHz, or 120 dB for analyzer 110 kHz (typical noise floor of FFT). The filter is also used for measuring THD, THD+N and MOD DIST with dynamic mode precision.

Characteristics	available in analog analyzers with measurement functions: – rms, wideband – rms, selective – quasi-peak – FFT analysis
Frequency range	10 Hz to 22.5 kHz center frequency (f_c)
Frequency tuning	– automatic to input signal – coupled to generator – fixed through entered value
Stopband	typ. >30 dB, f_c ±0.5%
Passband	typ. –3 dB at 0.77 x f_c and 1.3 x f_c, typ. +0/–1 dB outside 0.5 x f_c to 2 x f_c

Sweep

Generator sweep

Parameters	frequency, level, with bursts also interval and duration, one- or two-dimensional
Sweep	linear, logarithmic, tabular, single, continuous, manual
Stepping	– automatic after end of measurement – time delay (fixed or loaded table)

Analyzer sweep

Parameters	frequency or level of input signal
Sweep	single, continuous
Trigger	– delayed (0 to 10 s) after input level or input frequency variation, settling function selectable – time-controlled
Settling	for level, frequency, phase, distortion measurements, settling function: exponential, flat or averaging

Sweep speed

Two-channel rms measurement 20 Hz to 20 kHz, 30-point generator sweep logarithmic (frequency measurement switched off, Low Dist off).

with GEN TRACK	0.5 s
AUTO FAST	1 s
AUTO	2.5 s

Display of results

Units	
Level (analog)	V, dBu, dBV, W, dBm, difference (Δ), deviation (Δ%) and ratio (without dimension, %, dBr) to reference value
Level (digital)	FS, %FS, dBFS, LSBs deviation (Δ%) or ratio (dBr) to reference value
Distortion	% or dB, referred 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 f/f_{ref}, 1/3 octave, octave or decade) to reference value (entered or stored, current generator frequency)
Phase	°, 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 (not UPL66)	8.4" LCD, colour
Display modes	– display of any sweep trace – display of trace groups – bargraph display with min./max. values – spectrum, also as waterfall display – list of results – bar charts for THD and intermodulation measurements
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-labelling for graphs – change of unit and scale also possible for loaded traces
Test reports	
Functions	– screen copy to printer, plotter or file (PCX, HPGL, Postscript) – lists of results – sweep lists – tolerance curves – list of out-of-tolerance values – equalizer traces
Printer driver	supplied for approx. 130 printers
Plotter language	HP-GL
Interfaces	2 x RS-232-C, Centronics, IEC 625 (option UPL-B4)
Storage functions	– instrument settings, optionally with measured values and curves – spectra – sweep results – sweep lists – tolerance curves – equalizer traces
Remote control	via IEC 625-2 (IEEE 488) and RS-232; commands largely to SCPI (option UPL-B4)

Audio monitor (option UPL-B5)

Headphones connector	6.3 mm jack
Output voltage (U_P)	max. 8 V
Output current (I_P)	max. 50 mA
Source impedance	10 Ω, short-circuit-proof
Recommended headphone impedance	600 Ω

Extended analysis functions (option UPL-B6)

Coherence and transfer functions	can be displayed simultaneously
Frequency range	DC to 21.9 kHz
Frequency resolution	from 5.86 Hz
Averaging	2 to 2048
FFT length	256, 512, 1k, 2k, 4k, 8k points
Rub & buzz measurement	simultaneous measurement of frequency response, rub & buzz and polarity[1]
Frequency range	10 Hz to 110 kHz
Tracking highpass filter	2 to 20 times fundamental
Lower/upper frequency limit	selectable
Measurement time (200 Hz to 20 kHz, 200 points log.)	2 s
Multi-sine generator function	extended functions
Mode 1	crest factor or phase of each component selectable
Mode 2	crest factor selectable
Third octave analysis	for analyzer ANLG 22 kHz and digital 48 kHz
Number of third octaves	30
Frequency range	22 Hz to 22 kHz
Level accuracy	
Center frequency	±0.2 dB
22 Hz to 22 kHz	±1.0 dB (IEC 1260, class 0)
Stereo sine	in digital generator only
Frequency range	2 Hz[2] to 21.9 kHz
Frequency	adjustable for each channel
Phase	0 to 360° (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 UPL-B7)

Consisting of acoustic test chamber, acoustic 2 cm³ coupler, various battery adapters, connecting cables, software for measurements to IEC60118 and ANSI S3.22

Additionally required: options UPL-B5 and UPL-B10

Modification UPL-U3

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

1) With UPL-B29 only in base rate mode.
2) Fixed frequency independent of clock rate.

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-GS, UL, cUL
Power supply	100/120/220/230 V ±10%, 50 Hz to 60 Hz, 160 VA
Dimensions (W x H x D)	435 mm x 192 mm x 475 mm
Weight	12.6 kg

Ordering information

Order designation		
Audio Analyzer	UPL	1078.2008.06
Audio Analyzer (for conformance tests on GSM mobile phones)	UPL16	1078.2008.16
Audio Analyzer (without display and keypad)	UPL66	1078.2008.66
Accessories supplied	power cable, operating manual, backup system disks with MS-DOS operating system and user manual, backup program disk with operating and measurement software	
Options		
Low Distortion Generator	UPL-B1	1078.4400.02
Digital Audio I/O 48 kHz	UPL-B2	1078.4000.02
Digital Audio I/O 96 kHz	UPL-B29	1078.5107.02
Digital Audio Protocol	UPL-B21	1078.3856.02
Jitter and Interface Test	UPL-B22	1078.3956.02
Remote Control	UPL-B4	1078.3804.02
Audio Monitor	UPL-B5	1078.4600.03
Extended Analysis Functions	UPL-B6	1078.4500.02
Hearing Aids Test Accessories	UPL-B7	1090.2704.02
Mobile Phone Test Set	UPL-B8	1117.3505.02
Universal Sequence Controller	UPL-B10	1078.3904.02
Line Measurement to ITU-T O.33	UPL-B33	1078.4852.02
XLR/BNC Adapter Set	UPL-Z1	1078.3704.02
150 Ω Modification	UPL-U3	1078.4900.02
Recommended extras		
19" Rack Adapter	ZZA-94	0396.4905.00
Service manual		1078.2089.24

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