Audio Analyzer UPL

The solution for the budget-conscious

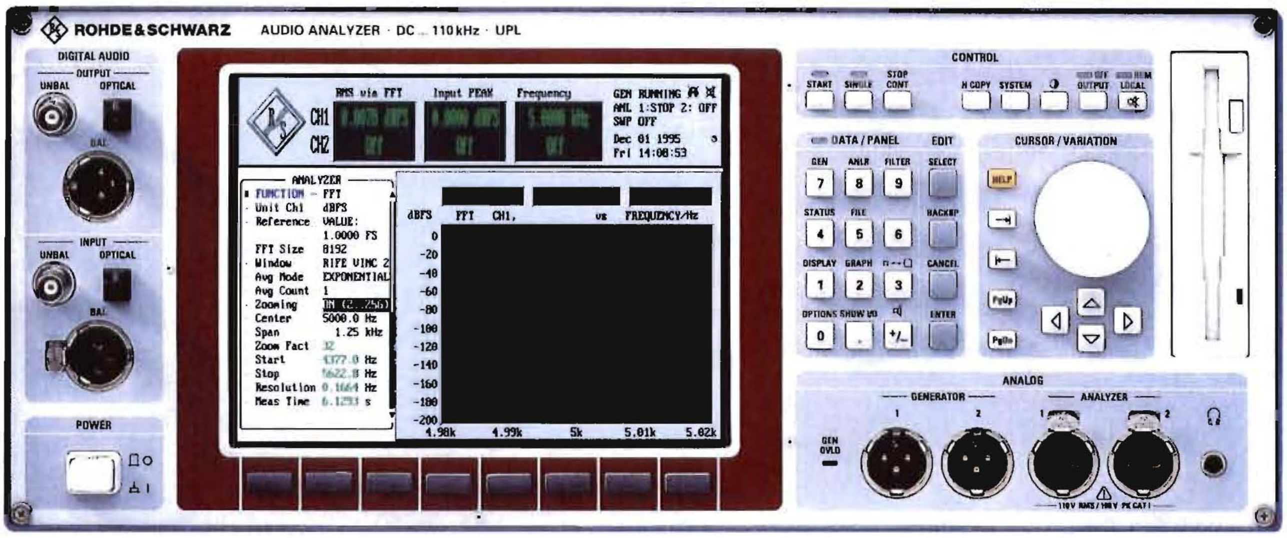
- For all interfaces: analog, digital and combined
- Real dual-channel measurements
- Maximum dynamic range
- FFT analysis
- Jitter analysis
- Interface tester
- Freely programmable filters
- Versatile functions
- Compact unit with integrated PC
- Automatic test sequences
- Extensive online help

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 switchover between two inputs and this facility 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.

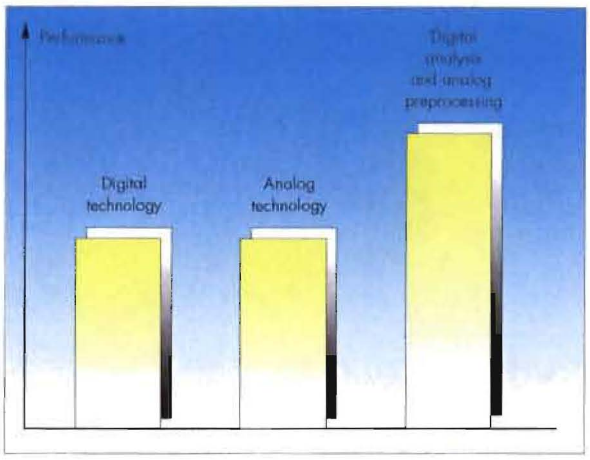
UPL provides signal monitoring via loudspeaker during the test, jitter measurements on digital audio signals, resynchronization of jittered digital audio signals by means of a jitter-free clock signal, and many more features.

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 wave 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 the scope required for measuring future converters, which will be technically more advanced than present-day devices (see graph on the right). This concept guarantees a performance and flexibility by far superior to instruments providing purely analog or digital measurements.

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

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



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

- 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.
- The filters, too, were implemented digitally, resulting in an infinite number of filters as it were, and this also for measurements on analog interfaces. Just 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.
- 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 1954-02

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 program.

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 are there to 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.

An allrounder

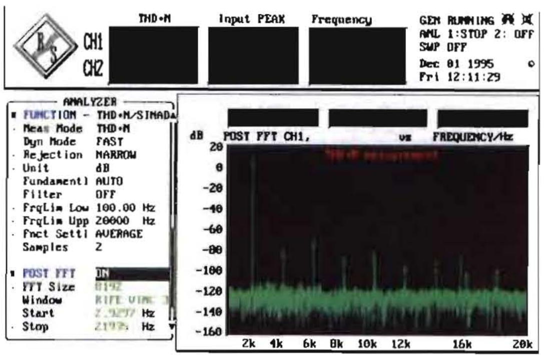


Fig. 1: Automatic marking of harmonics in THD+N measurements makes nonharmonics visible at a glance

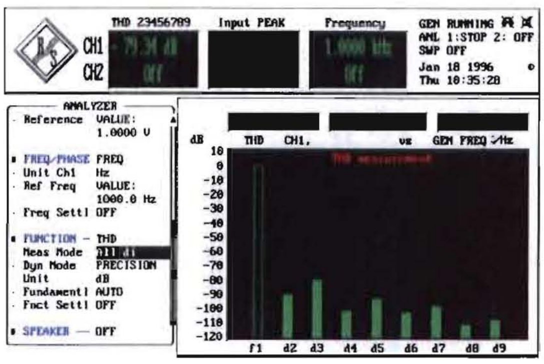


Fig. 2: In THD measurements, single harmonics, all harmonics or any combination of harmonics can be measured

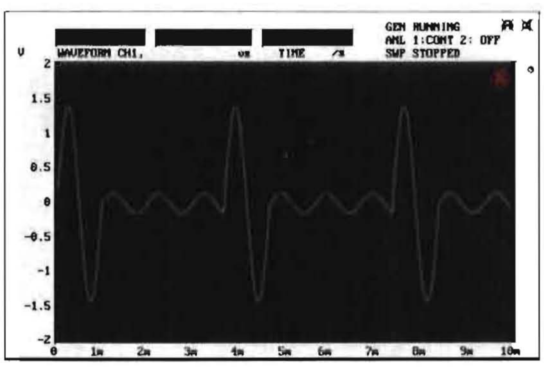


Fig. 3: The waveform function displays the test signal in the time domain. The example shows a sinewave burst

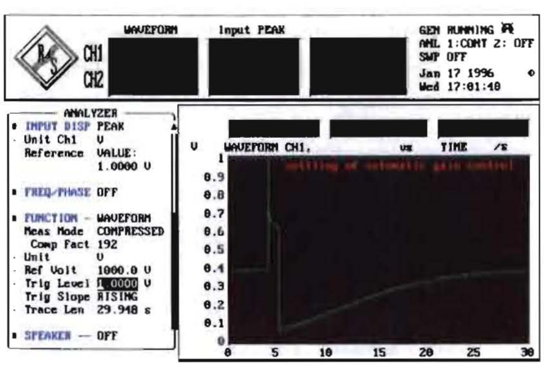
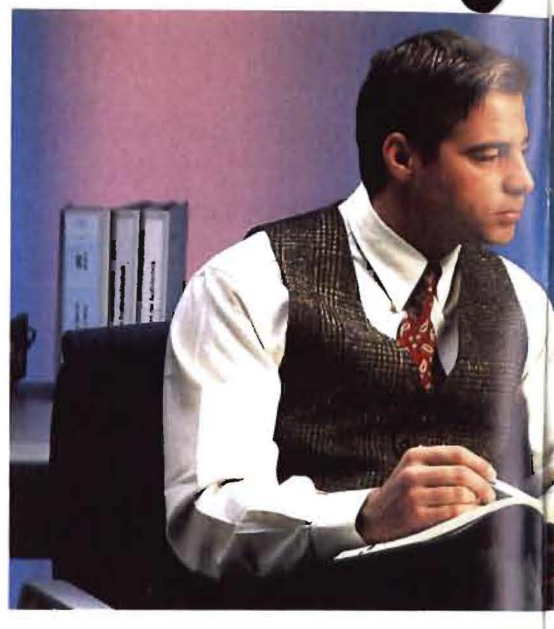


Fig. 4: The transient characteristics of an AGC play an important role in testing hearing aids or automatic volume control on tape recorders

Versatile test functions

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

- **Level or S/N**
  with rms, peak or quasi-peak weighting.
- **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)**
  Single 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.
- **Polarity test**
  for checking signal paths 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**
  with option UPL-B6; coherence and transfer functions; rub & buzz, etc.
- **DC voltage**
- **Frequency, phase and group delay**

Test signals – as you like it

The generators of UPL supply an extremely wide variety of analog and – with option UPL-B2 – 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.
- **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.
- **Multitone signal**
comprising up to 17 sinewaves of any frequency and with the same or different levels; setting of phase with UPL-B6
- **Sine burst signal**
with adjustable interval and on-time and programmable low level, eg for testing AGCs.
- **Sine² burst**
also with adjustable interval and on-time, eg for testing rms rectifier circuits.
- **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.

Signals can be measured with an offset, digital audio signals can be dithered with adjustable level, and selectable amplitude distribution can be added to digital audio signals.

A variety of sweep functions

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

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, and 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.

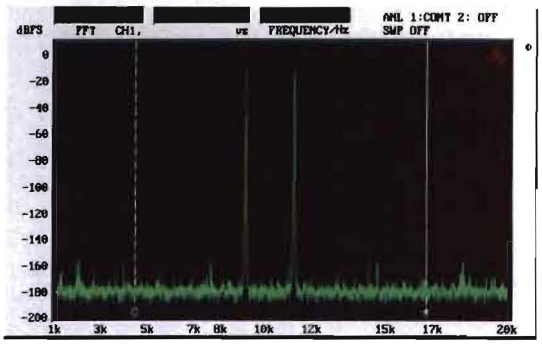


Fig. 5: FFT spectrum of two-tone signal shown on full screen

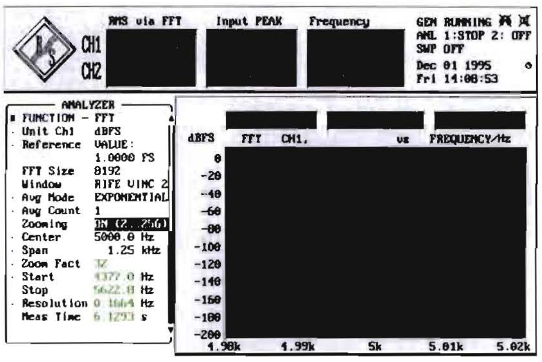


Fig. 6: With the zoom FFT function, sidebands spaced only a few hertz from the signal can be displayed

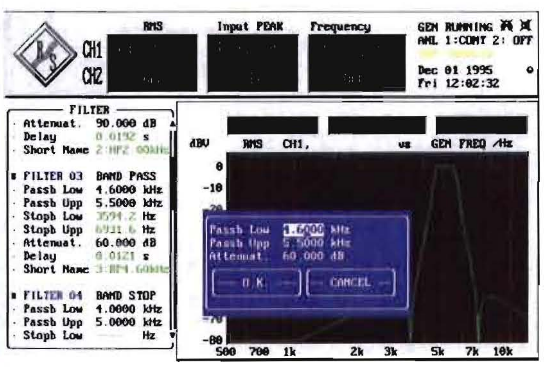


Fig. 7: Filters can be defined by entering just a few parameters

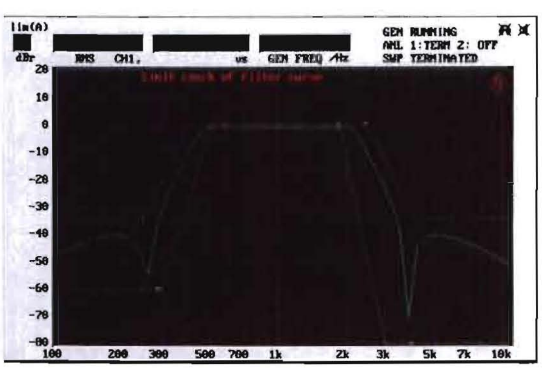


Fig. 8: Tolerance curves enable fast go/nogo tests

Fast and efficient

Spectral 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).

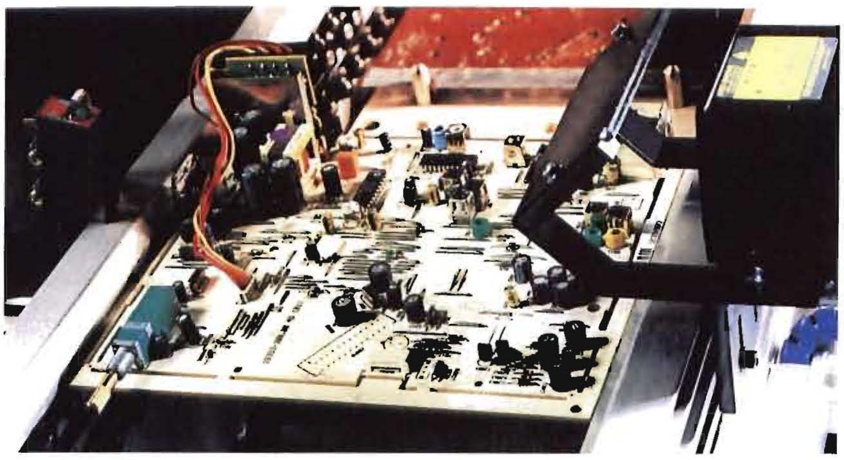
Programmable filters

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 designed filter looped into the signal path.

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 even 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.



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.

- Any display panels 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: 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. UPL66 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.
- 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.

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

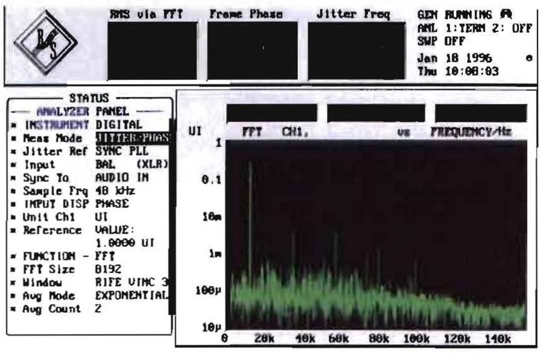


Fig. 9: Individual interference components can easily be found with the aid of the jitter spectrum.

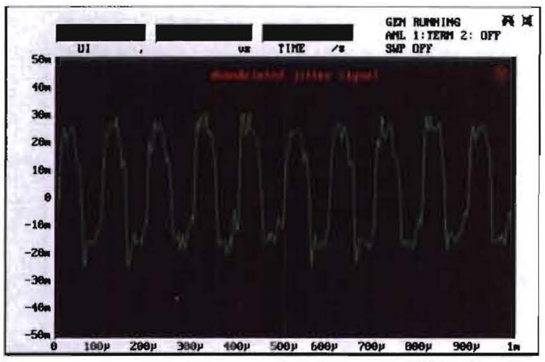


Fig. 10: Display of jitter signal in time domain

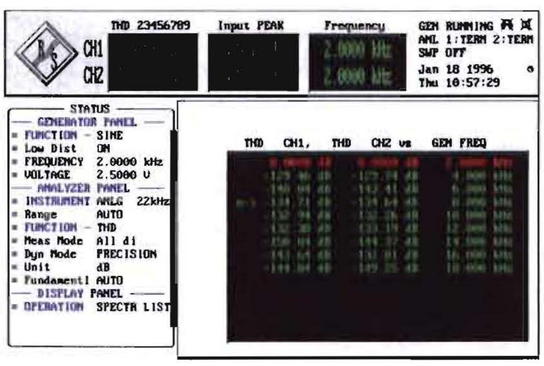


Fig. 11: Complete measured-value tables can be output for all functions

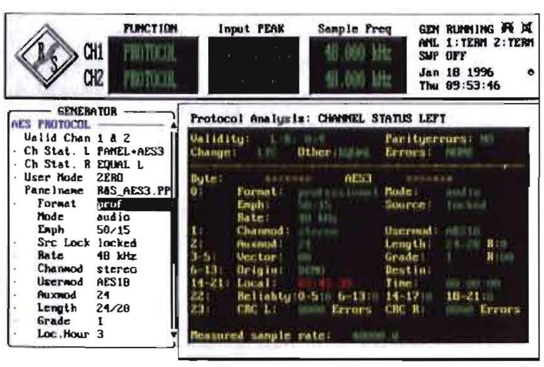


Fig. 12: UPL generates and analyzes additional data in digital data streams in line with all common standards. The data are represented in binary form, as hexadecimal numbers, as ASCII characters or evaluated in consumer or professional format

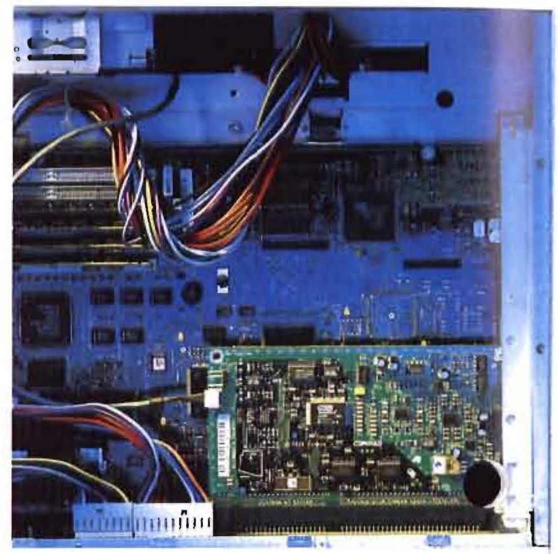
Interfaces, protocol analysis, jitter

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 (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.

Digital audio interfaces (option UPL-B2)

- 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 independent 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 word-clock, video sync signals (PAL/SECAM/NTSC) and to 1024-kHz reference clocks.
- The generator as well as the analyzer can be driven with clock rates of 27 to 55 kHz. The clock signals 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 converters.
- The word length can be selected between 8 and 24 bits independently for generator and analyzer.



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 option UPL-B2 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 option UPL-B2.

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.
- 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 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.

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 (page 13).

Efficient online help

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

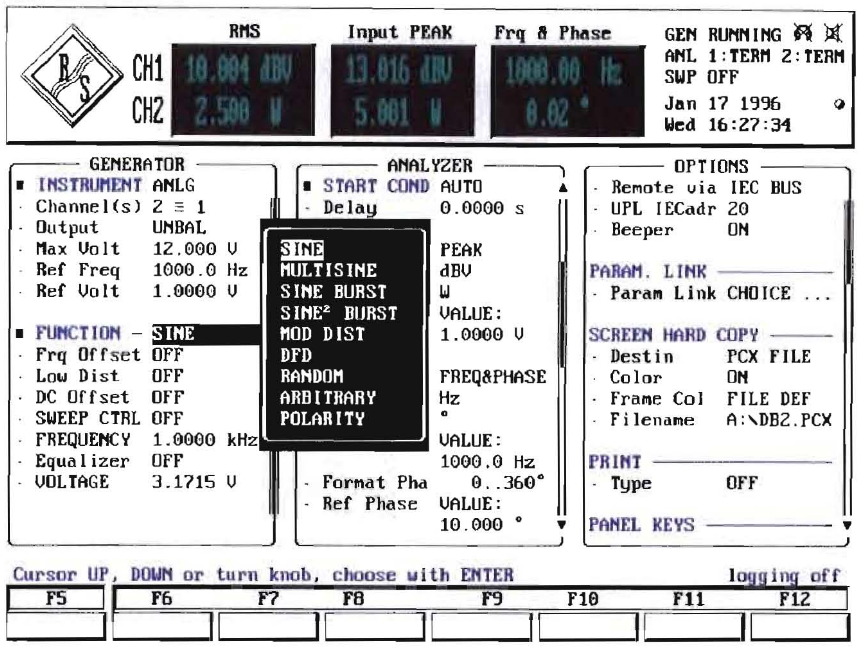
HELP function
HELP information can be called for each input field.

SHOW I/O key
If no results are 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.

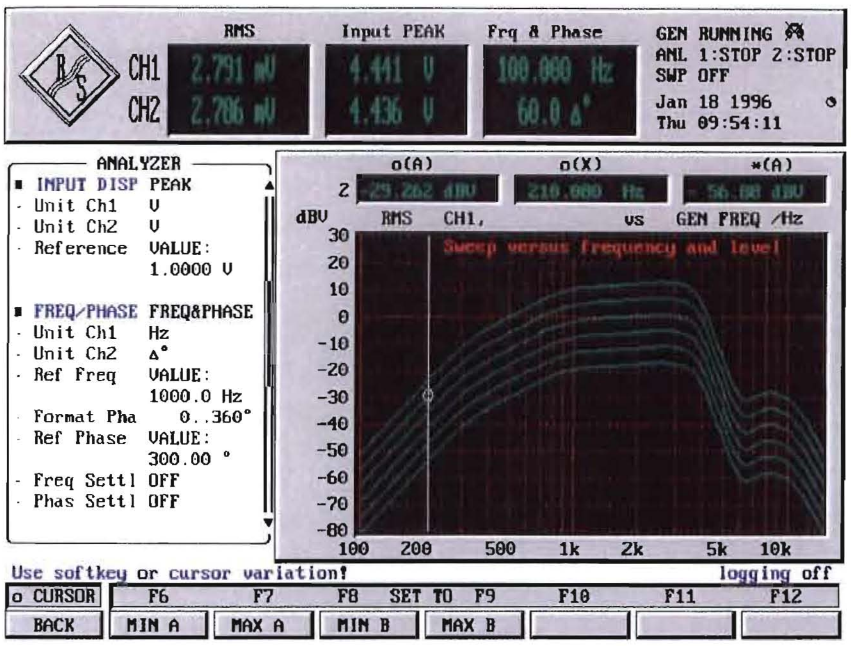
Online help
The permissible range of values is indicated for each menu item requiring the entry of a numerical value. This range takes into account any limitations resulting from higher-order parameters, eg the sample rate in the case of measurements on digital interfaces.

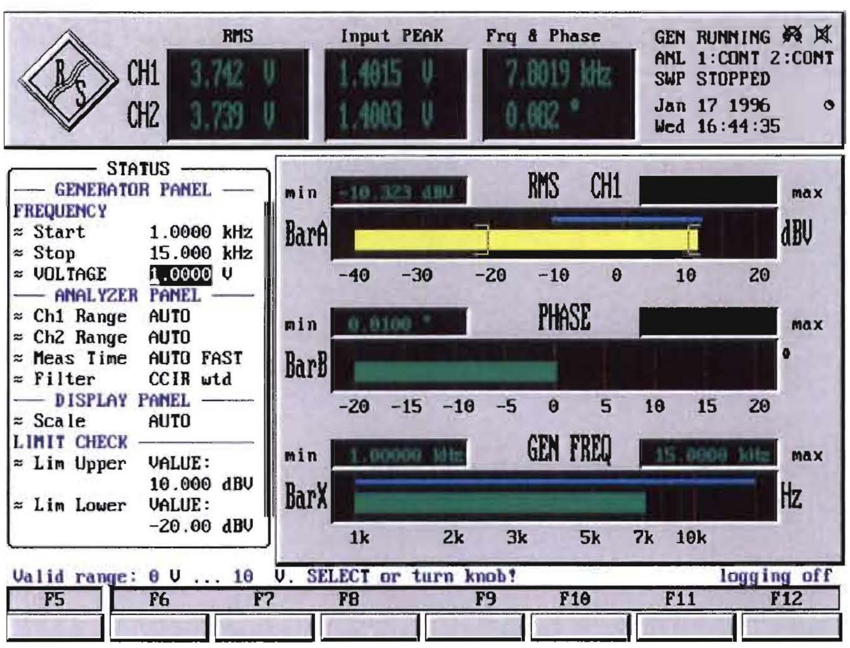
Protection against illegal entries
UPL will not accept entries outside the permissible range. An alarm tone will be issued, and the value changed to the permissible minimum or maximum value.



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.
- Uncomplicated entries: the user simply needs to open a menu and make 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 and transferred to a status panel. The status panel thus provides 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.

All-in package

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.

UPL features elaborate screening which will not be found in any conventional PC, including magnetically shielded power transformers and coated filter pane in front of the display.

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 keyboord, mouse, monitor, printer and plotter.
- Centronics interface for connecting printer or network.
- Drivers for all commercial printers 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.

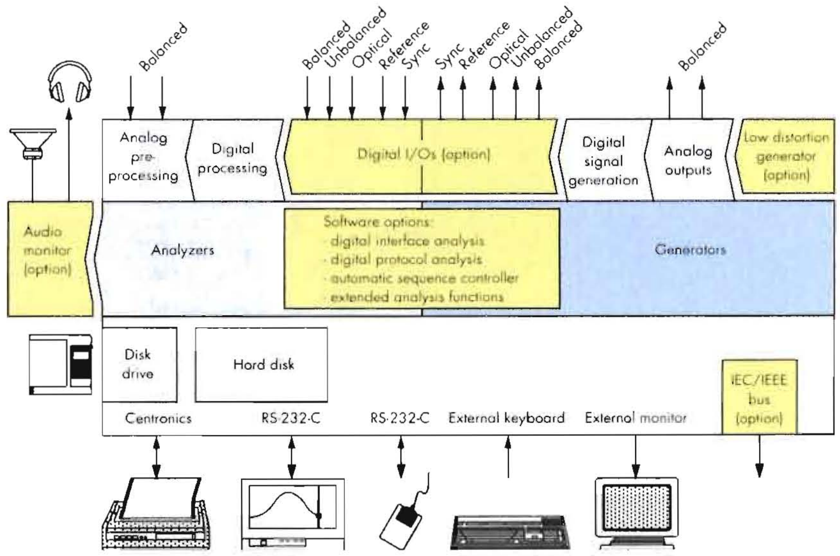
The instrument is easy to transport as it requires no external equipment such as keyboard, monitor or other PC peripherals.

UPL is supplied all ready to the customer. Installation is reduced to unpacking the unit and switching it on for starting the measurement. The user can forget about 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.

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

Block diagram of UPL



The options

Low Distortion Generator UPL-B1
The low distortion generator 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.

Digital Interface UPL-B2
contains the digital audio interfaces (balanced, unbalanced and optical). This option is described in detail on pages 8 and 9, including software extensions (protocol analysis and generation, UPL-B21, and jitter and interface test, UPL-B22).

Remote Control UPL-B4
enables remote control of UPL via the RS-232-C interface or the IEC/IEEE-bus interface to IEC625/IEEE 488. The commands implemented largely correspond to SCPI guidelines.

Audio Monitor UPL-B5
adds a headphones output and built-in loudspeaker to UPL. The input signal of the analog and digital interfaces and – with level and THD+N 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 can thus not be analyzed. *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 referred to the input spectrum.

Special tests are required in the development and production of hearing aids. No problem for UPL (see also Data Sheet PD 757.2696 "Measurements on hearing aids to IEC 118, ANSIS3.22 and S3.42").

With the *rub & buzz measurement,* manufacturing defects of loudspeakers are detected in next to no time by measuring the unwanted signals in the frequency range above that of typical distortion products.

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

Further functional extensions of UPL-B6 are under preparation.

Hearing Aids Test Accessories UPL-B7
This option includes an acoustic test chamber as well as all accessories required for measurements on hearing aids such as battery adapters, connecting cables and an acoustic coupler. The associated software enables the complete measurements to EN 60118 and ANSI 3.22 (for this, options UPL-B5 and -B10 must be fitted).

Universal Sequence Controller UPL-B10
enables 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. On the other hand, programs generated on UPL can after slight modifications be transferred to an external controller for the remote control of UPL. This greatly facilitates the generation of remote-control programs.

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 provided.

Analyzer	Frequency range
ANLG 22 kHz	DC/10 Hz to 21,90 kHz *)
ANLG 110 kHz	DC/20 Hz to 110 kHz *)
Level measurements (rms)	
Error limit at 1 kHz	±0.05 dB
Frequency response ref. to 1 kHz	
20 Hz to 22 kHz	±0.03 dB
10 to 20Hz	±0.1 dB
22 to 50 kHz	±0.1 dB
50 to 110 kHz	±0.2 dB

*) DC/AC coupling

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 range	18 mV to 100 V, in steps of 5 dB
Input impedance	100 kΩ ±1% shunted with 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

Measurement functions

RMS value, wideband	
Error limits	
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)
Filters	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
RMS value, selective	
Bandwidth (–0.1 dB)	1%, 3%, 1/12 octave, 1/3 octave and user-selectable fixed bandwidth, minimum bandwidth 10 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 through selectable range
Error limit	±0.2 dB + ripple of filters
Peak value	with analyzer ANLG 22 kHz only
Measurement	peak max., peak min., peak-to-peak, peak absolute
Error limit	±0.2 dB at 1 kHz
Interval	20 ms to 10 s
Filters	weighting filters and user-definable filters, up to 3 filters can be combined
Quasi-peak	with analyzer ANLG 22 kHz only
Measurement, error limits	to CCIR 468-4
Noise (600 Ω)	<8 µV with CCIR weighting filter,
Filters	weighting filters and user-definable filters, up to 3 filters can be combined, analog notch filter in addition
DC voltage	
Voltage range	0 to ±110 V
Error limit	±(1% of measured value + 0.1% of measurement range)
Measurement range	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
Error limits	
harmonics	
<50 kHz	±0.5 dB
<110 kHz	±0.7 dB
Inherent distortion*)	
Analyzer ANLG 22 kHz	
Fundamental 20 Hz to 10.95 kHz	<–110 dB, typ. –115 dB
10 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

*) Total inherent distortion of analyzer and generator (with option UPL-B1), analyzer with dynamic mode precision.
>3.5 V: typ. reduced by 3 dB; <0.5 V: sensitivity reduced by input noise (typ. 0.25/1.25 µV for analyzers 22/110 kHz).

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	>100 µV typ. with automatic tuning
Bandwidth	upper and lower frequency limit selectable, one weighting filter in addition
Error limits	
Bandwidth <50 kHz	±0.5 dB
<100 kHz	±0.7 dB
Inherent distortion*)	
Analyzer ANLG 22 kHz	
Bandwidth 20 Hz to 21.90 kHz	typ. –110 dB at 1 kHz, 2.5 V <–105 dB +2 µV **) 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

*) Total inherent distortion of analyzer and generator (with option UPL-B1), analyzer with dynamic mode precision.
**) For full measurement range (<–100 dB + 2 µV with auto range function).
<–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 to 2700 Hz
upper frequency	8xLF to 100 kHz*)
Error limit	±0.50 dB
Inherent distortion**)	
Upper frequency 4 to 15 kHz	<–96 dB (–90 dB), typ. –103 dB
15 to 20 kHz	<–96 dB (–85 dB)
Spectrum	bar chart showing signal and distortion

*) For upper frequency >20 kHz the bottom limit of lower frequency is reduced.
**) Input voltage >200 mV, typical values apply to 0.5 to 3.5 V.
Lower frequency >200 Hz, values in ( ) for lower frequency <200 Hz.
Dynamic mode precision; level ratio LF:UF = 4:1.

Difference frequency distortion (DFD)

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

*) For center frequency >20 kHz the bottom limit of the difference frequency is reduced.
**) Input voltage >200 mV, typical values apply to 0.5 to 3.5 V, dynamic mode precision (at DFD d_2), center frequency 7 to 20 kHz.

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
Error limit		±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 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 *)

Frequency range	20 Hz to 110 kHz
Error limit	±50 ppm

Phase *)

	with analyzer 22 kHz only
Frequency range	20 Hz to 20 kHz
Error limit	±0.5°

Group delay *)

	with analyzer 22 kHz only
Frequency range	20 Hz to 20 kHz
Measurement error in seconds	$\Delta\varphi/(\Delta f \cdot 360)$ **)

*) Only for measurement functions RMS, FFT and THD+N, error limits apply to 8k FFT with zoom factor 2, Rife-Vincent-2 window; S/N ratio >70 dB.
**) $\Delta\varphi$ = phase measurement error in °, Δf = frequency step.

Polarity test

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

Analog generators

An 18-bit $\Delta\Sigma$ 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 error	±50 ppm
Level error	±0.1 dB at 1 kHz
Frequency response (referred 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 error		±0.5% at 15 to 30 °C	
		±0.75% at 5 to 45 °C	
Level error		±0.1 dB at 1 kHz	
Frequency response (ref. to 1 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 1 to 5 V	
Inherent distortion (THD)			
Fundamental	1 kHz, 1 to 10 V	<–120 dB typ.	
	20 Hz to 7 kHz	<–105 dB	
	7 to 20 kHz	<–100 dB	
Inherent distortion (THD+N) *)			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	

*) Total inherent distortion of analyzer and generator, analyzer with dynamic mode precision.

MOD DIST

		for measuring the modulation distortion
Frequency range,	lower frequency	30 to 2700 Hz
	upper frequency	8xLF to 21.75 kHz
Level ratio (LF:UF)		from 10:1 to 1:1, selectable
Level error		±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 frequency	80 Hz to 2 kHz
	center frequency	200 Hz to 20.75 kHz
Level error		±0.5 dB
Inherent distortion*)	DFD d_2	<–114 dB, typ. –120 dB
	DFD d_3	<–92 dB, typ. –100 dB
Sweep parameters		center frequency, level

*) Center frequency >5 kHz, difference frequency <1 kHz; DFD d_2 –100 dB (typ.) with DC offset.

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 resolution
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
Memory size	max. 16 k
Clock rate	48 kHz
Bandwidth	21.75 kHz (elliptical filter)

Polarity test signal

Sine^2 burst with following characteristics:

Frequency	1.2 kHz
On-time	1 cycle (0.8333 ms)
Interval	2 cycles (1.6667 ms)

DC offset*)	0 to ±10.0 V (±5 V unbalanced)
Error	±2%
Residual offset	<1% of rms value of AC signal

*) 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.

Digital analyzer (with option UPL-B2)

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: $f_{new} = f_{48\,kHz} \cdot$ 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	27 to 55 kHz, synchronous to DAI or DARS
Format	professional and consumer format to 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
Error limits	
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
Filters	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 10 Hz
Selectivity	100 dB, bandpass or bandstop filter, 8th-order elliptical filter
Frequency setting	– automatic to input signal – coupled to generator – fixed through entered value – sweep through selectable range
Error limit	±0.2 dB + ripple of filters

Peak value

Measurement	peak max., peak min., peak-to-peak, peak absolute
Error limit	±0.2 dB at 1 kHz
Interval	20 ms to 10 s
Filters	weighting filters and user-definable filters, up to 3 filters can be combined

Quasi-peak

Measurement, error limits	to CCIR 468-4
Filters	weighting filters and user-definable filters, up to 3 filters can be combined

DC voltage

Measurement range	0 to ±FS
Error limit	±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
Error limit	±0.1 dB
Inherent distortion [1]	
Fundamental 42 Hz to 21.90 kHz	<–130 dB
24 to 42 Hz	<–112 dB
12 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
Error limit	±0.3 dB
Inherent distortion [1]	
Bandwidth 20 Hz to 21.90 kHz	
Fundamental 28 Hz to 21.90 kHz	<–126 dB
24 to 28 Hz	<–109 dB
20 to 24 Hz	<–96 dB
Spectrum	post-FFT of filtered signal

Modulation distortion (MOD DIST)

Measurement method	selective to DIN-IEC 268-3
Frequency range	
Lower frequency	30 to 2700 Hz[2]
Upper frequency	8xLF[2] to 21.25 kHz
Error limit	±0.2 dB
Inherent distortion [1]	
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[2]
Center frequency	200 Hz to 20.90 kHz
Error limit	±0.2 dB
Inherent distortion [1] 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
Error limit	±3%
Inherent noise	<0.0003% weighted <0.0008% unweighted
Spectrum	post-FFT of demodulated signal

[1] Total inherent distortion of analyzer and generator.
[2] Fixed frequency independent of sampling rate.

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	2- to 1024-fold compression (envelope for AGC measurement)
Frequency *)	
Frequency range	20 Hz to 20 kHz
Error limit	±50 ppm
Phase *)	
Frequency range	20 Hz to 20 kHz
Error limit	±0.5°
Group delay*)	
Frequency range	20 Hz to 20 kHz
Measurement error in seconds	$\Delta\varphi/(\Delta f \cdot 360)$ **)

*) Only for measurement functions RMS, FFT and THD+N, error limits apply to 8k FFT with zoom factor 2, Rife-Vincent-2 window; S/N ratio >70 dB

**) $\Delta\varphi$ = phase measurement error in °, Δf = frequency step.

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

Digital generator (with option UPL-B2)

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: $f_{new} = f_{48\,kHz} \cdot$ sampling rate/48 kHz.

Outputs

Balanced output	XLR connector, transformer coupling
Impedance	110 Ω, short-circuit-proof
Level (V_{pp} into 110 Ω)	0 to 8 V, in 240 steps
Error limit	±1 dB_{rms}
Unbalanced output	BNC, transformer coupling
Impedance	75 Ω, short-circuit-proof
Level (V_{pp} into 75 Ω)	0 to 2 V, in 240 steps
Error limit	±1 dB_{rms}
Optical output	TOSLINK
Channels	1, 2, or both
Audio bits	8 to 24
Clock rate	internal: 27 to 55 kHz or synchronization to analyzer external: synchronization to wordclock input, video sync, DARS, 1024 kHz
Format	professional and consumer format to IEC-958 as well as user-definable formats at all outputs

Signals

(all signals with 24 bits, full scale)

General characteristics	
Level resolution	2^{-24}
Audio bits	8 to 24 bits, LSB rounded off
Dither*)	
Distribution	Gaussian, triangular, rectangular
Level	2^{-24} FS to 1 FS
Frequency error	±50 ppm (internal clock), ±1 ppm relative to clock rate
Frequency offset*)	0 or +1000 ppm
DC offset	0 to ±1 FS adjustable

*) With sine, DFD and MOD DIST signals.

Sine	
Frequency range	2 Hz²) 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	30²) to 2700 Hz²)
Upper frequency	8xLF²) to 21.90 kHz
Level ratio (LF:UF)	from 10:1 to 1:1, selectable
Inherent distortion¹)	
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 kHz²)
Center frequency	200 Hz²) to 20.90 kHz
Inherent distortion	
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 resolution
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
Memory size	max. 16k
Clock rate	sampling rate of generator
Polarity test signal	
Sine² burst with the following characteristics:	
Frequency	1.2 kHz²)
On-time	1 cycle
Interval	2 cycles

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 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 IEC 958, binary and hexadecimal format
User-bit display	user-definable mnemonic display, block-synchronized

¹) Total inherent distortion of analyzer and generator.

²) Fixed frequency independent of sampling rate.

Jitter and interface test (option UPL-B22)

Generator	
Jitter injection	
Signal shape	sine, noise
Frequency range	10 Hz to 21.75 kHz (sine to 110 kHz with option UPL-B1)
Amplitude (peak-to-peak)	0 to 5 UI (corresp. to 0 to 800 ns at 48 kHz sampling rate)
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 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 to 10 V
Sampling rate	27 to 55 kHz
Jitter measurement	amplitude, frequency, spectrum 0 to 5 UI typ. for f <500 Hz, decreasing to 0.5 UI for f up to 50 kHz
Measurement limit	200 ps (noise floor with 8k FFT)
Reclocking	input signal is sampled with a low-jitter clock signal and available at reference output (XLR connector on the rear)
Common mode test	on balanced input
Amplitude (V_{pp})	0 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

Specifications apply to analyzer ANLG 22 kHz or digital analyzer; values in ( ) apply to analyzer ANLG 110 kHz.

Frequency range	DC to 21.9 kHz (110 kHz)
Dynamic range	
Digital	>135 dB
ANLG 22 kHz	120 dB/105 dB (with/without analog notch filter)
ANLG 110 kHz	115 dB/85 dB (with/without analog notch filter)
Noise floor	
Digital	−160 dB
ANLG 22 kHz	−140 dB/110 dB (with/without analog notch filter)
ANLG 110 kHz	−120 dB/90 dB (with/without analog notch filter)
FFT size	256, 512, 1 k, 2 k, 4 k, 8 k points (16 k with zoom factor 2)
Window functions	rectangular, Hann, Blackman-Harris, Rife-Vincent 1 to 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)
Averaging	1 to 256, exponential and normal

Filters

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 filter – IEC/IEEE tuner – Jitter weighted

User-definable filters
Design parameters:
8th order elliptical, type C (for highpass and lowpass filters also 4th order), passband ripple +0/−0.1 dB, stopband attenuation approx. 20 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
One-third 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 range	typ. >30 dB, f_c ±0.5%
Passband range	typ. −3 dB at 0.77 · f_c and 1.3 · f_c, typ. +0/−1 dB outside 0.5 · f_c to 2 · 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 (UPL model 06)	9", LCD (TFT), colour
Display modes	– display of any sweep – display of trace groups – bargraph display with min./max. values – spectrum, also as waterfall display – lists 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-C; commands largely to SCPI (option UPL-B4)

Audio monitor (option UPL-B5)

Headphone connector	6.3-mm jack socket
Output voltage	max. 8 V_p
Output current	max. 50 mA_p
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 1024
FFT length	256, 512, 1 k, 2 k, 4 k, 8 k points
Rub & buzz measurement	simultaneous measurement of frequency response, rub & buzz and polarity
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
Multisine generator function	extended functions
Mode 1	crest factor or phase of each component selectable
Mode 2	crest factor selectable
Further functions	being developed

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 60118 and ANSI 3.22
Additional requirements	options UPL-B5 and UPL-B10

150 Ω modification (option 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 to +45 °C
Storage temperature range	–20 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 to 60 Hz, 110 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 with colour LCD	UPL	1078.2008.06
Audio Analyzer without display and keyboard	UPL66	1078.2008 66
Accessories supplied	power cable, operating manual, backup 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	UPL-B2	1078.4000.02
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	1078.4600.02
Extended Analysis Functions	UPL-B6	1078.4500.02
Hearing Aids Test Accessories	UPL-B7	1090.2704.02
Universal Sequence Controller	UPL-B10	1078.3904.02
XLR/BNC Adapter Set	UPL-Z1	1078.3704.02
150 Ω Modification	UPL-U3	1078.4900.02
Recommended extras		
19" Rack Adapter	ZZA-9.4	0396.4905.00
Service manual		1078.2089.24

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