ROHDE & SCHWARZ

Brilliant sound —
brilliant measurements

Audio Analyzer UPA

10 Hz to 100 kHz

PD 756.5310.22

Custom-tailored to suit any application...

Options

- Synthesizer generator
- Fully automatic distortion meter
- Wow and flutter meter
- Special filters
  A-weighting, stop filters, bandpass and lowpass filters, tracking bandpass filter
- Customized filters
- DC output

UPA 3 ... the cost-effective comprehensive solution

The **Audio Analyzer UPA 3** is a cost-effective combination of the Audio Analyzer UPA fitted with generator (option UPA-B6) and distortion meter (option UPA-B8). This equipment configuration makes the UPA 3 a complete AF test set for measuring the transmission characteristics of audio components.

Fitted with distortion meter and generator, the UPA 3 reflects the most frequently used option configuration of the UPA. The range of applications includes, for instance, measurement of

- frequency response
- phase
- S/N ratio
- attenuation/gain
- crosstalk
- distortion/SINAD
- noise voltages

Further options can be fitted to enhance the measurement capabilities of the UPA 3 (see specifications on page 19).

Audio Analyzer

UPA 10 Hz to 100 kHz

- Simultaneous measurement of level and frequency
- Psophometric measurements to DIN, CCIR, CCITT
- Combined digital and analog displays
- Fully automatic test run with logging of measured values
- Switch-selectable input and output impedances
- Two filter options at a time
- DC voltage measurement

UPA 4 ..the improved model for CD measurements

- Built-in distortion meter
- Inherent distortion better than –97 dB
- Frequency response <0.03 dB
- Inherent noise voltage <3 μV

Measuring the signal quality of digital sound storage media such as the CD (compact disc) and also DAT (digital audio tape) is extremely demanding. The **Audio Analyzer UPA 4** has especially been designed for this purpose. Its built-in distortion meter has more capabilities than previously required for checking the quality of analog recordings.

The UPA 4 reliably measures distortions down to –90 dB (0.003%) within a test bandwidth up to 20 kHz in line with relevant specifications. The measurement range can even be extended to –100 dB (0.001%), if the displayed value is corrected by the calculated noise components. Due to rms weighting, the total power of these components is obtained by adding up their individual squared values.

The UPA 4 can additionally be fitted with the options of the Audio Analyzer UPA, such as generator, various filters as well as wow and flutter meter. The Audio Analyzer UPA 4 is ideally suited for all measurements on CD players and high-performance audio equipment in production, quality control and service.

Characteristics

The **Audio Analyzer UPA** is a system-compatible, broadband level meter and psophometer with built-in frequency counter which can be extended by options to form a complete audio test assembly (**UPA 3** and **UPA 4**, see pages 2 and 3):

- Synthesizer generator (10 Hz to 110 kHz, 0.1 mV to 12.4 V, distortion >80 dB, floating outputs, switch-selectable output impedance: 30, 200 or 600 Ω)
- Fully automatic distortion meter for measurement of total and selective harmonic distortion or SINAD (10 Hz to 100 kHz with readout of d_2 to d_9 or d_{TOTAL} and THD down to 0.003%)
- Special filters: A-weighting, stop filters, bandpass and lowpass filters, tracking bandpass filter, customized filters
- Wow and flutter meter to DIN, CCIR, IEC, NAB, JIS with amplitude variation meter

The integration of all measuring functions in one instrument allows system performance which could not be achieved by separate instruments, since many functions such as level and frequency measurement are carried out simultaneously and the results are available at the same time.

In addition to the usual highpass and lowpass filters, the Audio Analyzer UPA is fitted with special filters, all standard weighting filters and rectifiers. The balanced and unbalanced inputs and outputs are fully floating. The UPA is thus suitable for virtually all **AF and audio applications** and considerably facilitates and improves these measurements.

Besides the use in development laboratories, a major application of the UPA will be in automated testing of mass-produced consumer electronics equipment, where practically all measurement functions of the UPA are required and used. Since the balanced inputs of the UPA exhibit a common-mode rejection of more than 110 dB at 50 Hz with a permissible common-mode voltage of 250 V, all standard measurements on balanced studio lines can be carried out which until now were practically not possible in automatic mode.

One of the main applications of the UPA is in automated testing in the production of quality hifi systems

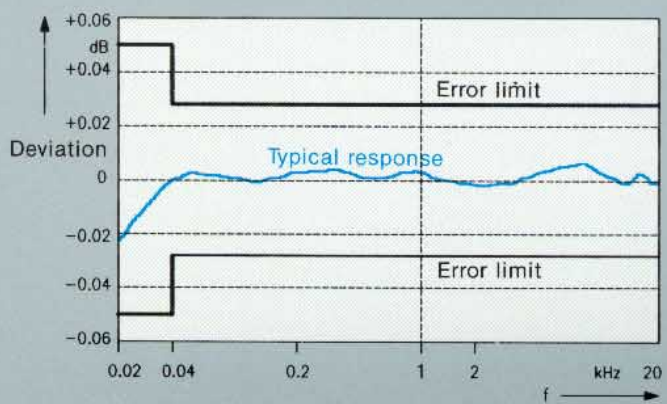
Applications

The basic configuration of the UPA already features excellent system characteristics as a:

- **Level meter**
  It allows broadband measurement of voltages in the AF range (10 Hz to 100 kHz) with switch-selected readout of the result as true rms or quasi-peak value. A measurement range from a few μV up to 300 V for the unbalanced input and up to 35 V for the balanced input as well as a total error of less than 1% in the frequently used AF range from 30 Hz to 20 kHz make the UPA an ideal precision level meter. The two test inputs can be switched as two-channel inputs, eg for measurement of crosstalk or level differences in stereo equipment.
- **Frequency counter**
  The frequency counter of the UPA measures in the range from 8 Hz to 250 kHz. It provides reliable results even with voltages of less than 10 mV and a signal-to-noise ratio of less than 20 dB.
- **Phase meter**
  With the aid of an automatic test routine the UPA determines the phase difference between 0 and 180° of two audio signals with equal frequency. For this purpose the audio signals are measured at the unbalanced inputs and their difference at a balanced input.
- **DC voltmeter**
  DC voltages in the range from 10 mV to 300 V can be measured at the unbalanced test inputs.

Two separate displays A great advantage in all applications is the simultaneous indication of level and frequency on two separate displays, both parameters being **measured fully automatically.** If required, automatic level measurement can be switched off or internal measurement ranges programmed. To meet the different requirements, the measurement speed can be selected separately for level and frequency. In system operation via the IEC/IEEE bus, fast rates up to about 20 measurements per second can be obtained, each individual measurement providing a stable result.

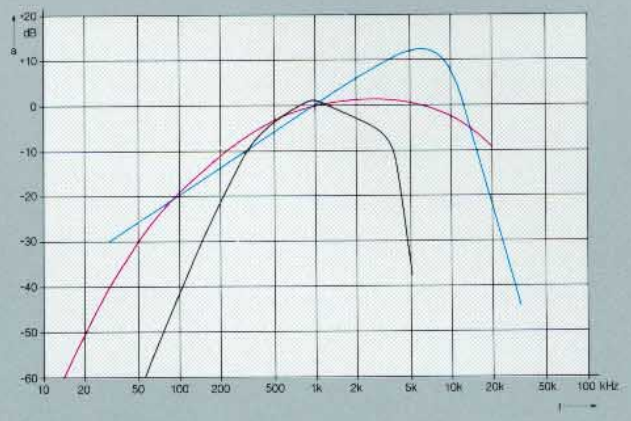
Quality assessment of car radios with cassette recorder, for instance, is also an application of the UPA



Frequency response of UPA 4 in the range 20 Hz to 20 kHz (unbalanced input, RMS, measurement range 1 V)

Filters for any measurement

Weighting filter, meter rectifiers A psophometric determination of the signal-to-noise ratio in audio engineering according to CCIR and DIN and in telephone or speech channels to CCITT requires weighted measurements which simulate the physiological effect of noise on a listener with average hearing. The UPA is therefore fitted with suitable weighting filters and meter rectifiers with standard-defined dynamic response for the indication of quasi-peak or rms values. An unweighted noise measurement is also defined by standards. For this purpose a 22.4-Hz highpass and a 22.4-kHz lowpass filter can be switched into circuit. Other switch-selectable filters, eg a 300-Hz highpass and a 100-kHz lowpass, as well as the connection of an external filter or incorporation of special filters offer a large variety of possibilities for limiting the test bandwidth or suppressing special interfering frequencies. One or two optional special filter PCBs can be inserted into the UPA, if required.



Passband curves of noise weighting filters:

blue Weighting to CCIR 468-4 and DIN 45 405 for professional audio engineering

black Weighting to CCITT O. 41 for telephone channels

red A-weighting to DIN IEC 651 (fitted in option UPA-B2) for audio equipment in the home

The **Special Filter UPA-B2** (option) comprises:

- A-filters to IEC DIN 651 for noise weighting of home audio equipment
- Pilot-tone trap with 15-kHz lowpass filter
- Line-frequency trap with 13-kHz lowpass filter
- Narrowband bandpass filters for selective level measurement at the standard frequencies 315 Hz, 1 kHz, 3.15 kHz, 6.3 kHz, 10 kHz and 12.5 kHz
- Additional, selectable fixed center frequencies of 8, 9, 10, 11, 12, 13, 14, 15, 15.5, 16, 17, 18, 19, 20 and 25 kHz
- Continuously tunable, narrowband bandpass filter for selective level measurement in frequency range 23 Hz to 25 kHz (generator tracking filter)
- Telephone bandpass filter 320 Hz to 3.4 kHz for unweighted measurements in telephone or speech channels
- Bandpass filter 2 kHz to 10 kHz for fast distortion measurement at 1 kHz
- Lowpass filters with cutoff frequencies of 350 Hz, 1.04 kHz, 3.5 kHz, 7 kHz, 10.4 kHz and 15 kHz

The filter curves on page 7 illustrate several setting possibilities of Special Filter UPA-B2. The desired filter can be switched into the signal path by direct entry of a number (1 to 19) and combined with filters of the UPA basic configuration as desired.

Bandpass filter No. 19 allows setting of the passband frequency either directly or by allocating the generator frequency in the range from 23 Hz to 25 kHz. This narrowband tracking filter allows selective level measurements throughout the specified frequency range.

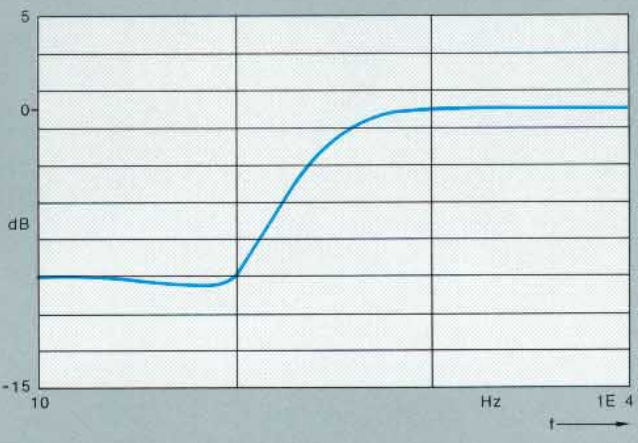
The **Filter Circuit Board UPA-B3** (option) is a printed circuit breadboard with 8-bit control section, decoder and analog switches. This partly fitted special filter can be used by the customer to configure his own specific filters.

Under the type designation **UPA-B4** (option), Rohde & Schwarz is developing and manufacturing **customized filters;** depending on the circuitry required, it may be possible to accommodate several filters on one plug-in board.

The Filters UPA-B3/-B4 can be combined with the filters of the UPA basic configuration as desired and can also be switched into the signal path simply by entering a number.

Two slots are provided in the UPA for accommodating the Special Filter UPA-B2 plus Filter Circuit Board UPA-B3/-B4 or even two different Filter Boards UPA-B3/-B4.

Example of customized filter for residual signal measurement after tape erasure

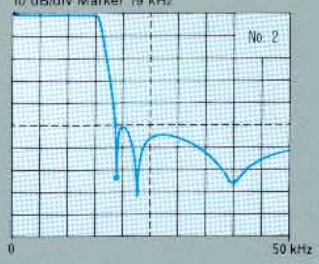


A-filter

A-filter + pilot-tone trap

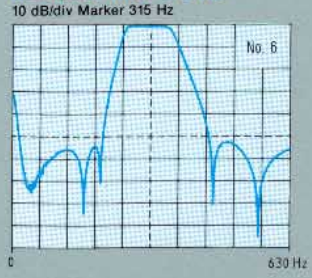
A-filter + line-frequency trap

Pilot-tone trap with lowpass filter

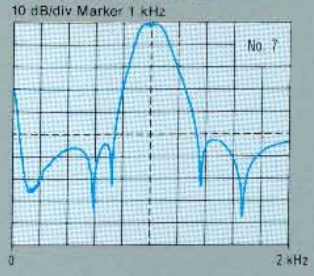


Line-frequency trap with lowpass filter

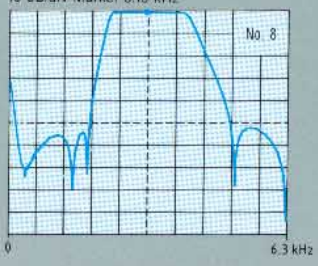
Bandpass filter 315 Hz



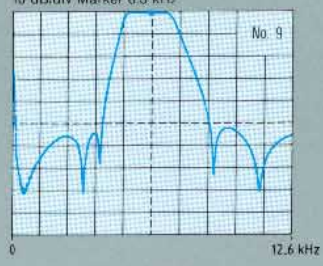
Bandpass filter 1 kHz



Bandpass filter 3.15 kHz

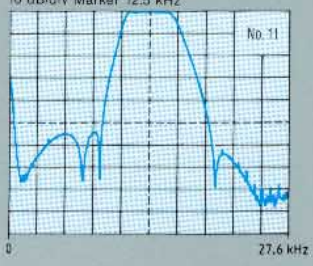


Bandpass filter 6.3 kHz

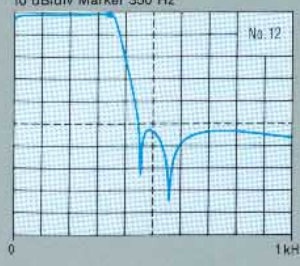


Bandpass filter 10 kHz

Bandpass filter 12.5 kHz

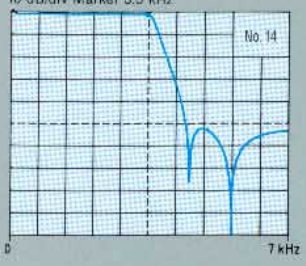


Lowpass filter 350 Hz

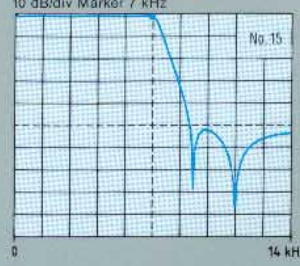


Lowpass filter 1 kHz

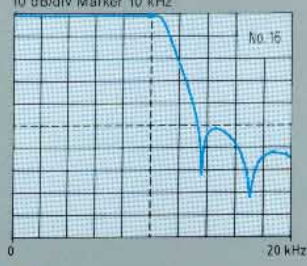
Lowpass filter 3.5 kHz



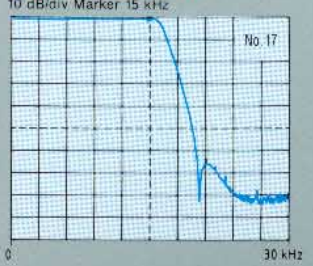
Lowpass filter 7 kHz



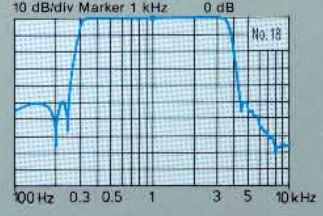
Lowpass filter 10 kHz



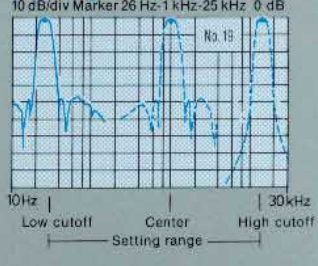
Lowpass filter 15 kHz



Telephone bandpass filter 320 Hz to 3.4 kHz



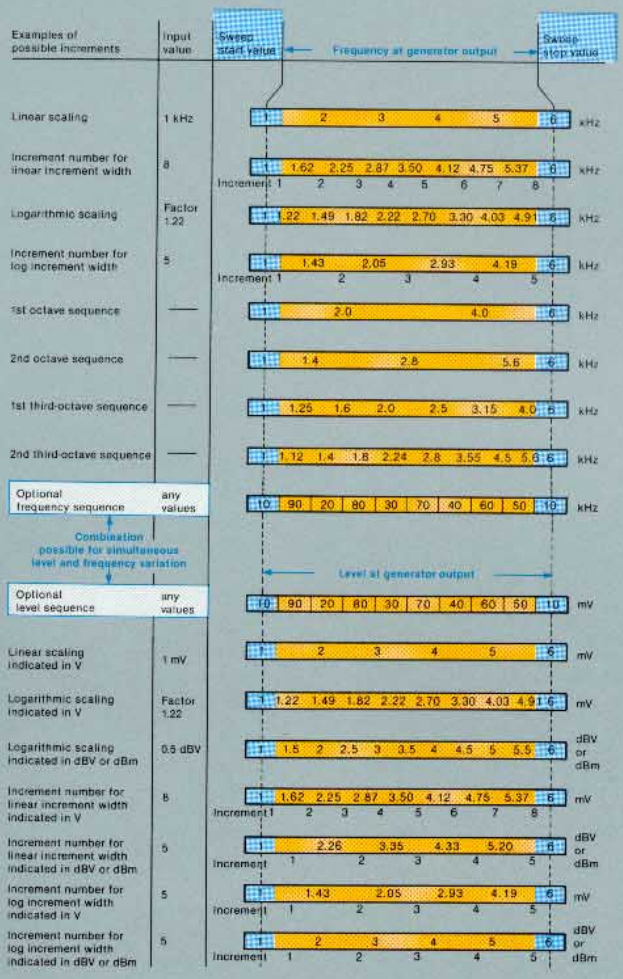
Contin. tunable bandpass (3 setting examples)



Generator

The generator (option UPA-B6, fitted as standard in UPA 3) extends the UPA to form an **audio test assembly.** With a SINAD of more than 80 dB, the generator provides highly stable sinewave voltages with great level accuracy which are adjustable from 0.1 mV to 12.4 V. The voltage can be set in V or mV, or the level in dBV or dBm(Z), the latter being the output of the actual power level referred to any value of impedance Z. The frequency is crystal-accurate from 10 Hz to 110 kHz with a resolution of 0.1 Hz in the lower range, 1 Hz in the medium and 10 Hz in the upper frequency range. Short level and frequency setting times allow fast rates in computer-controlled measurements.

Sweep possibilities for frequency and level



Outputs Connection of the generator to a device under test is very easy due to universal outputs with precise reference values and special features, such as

- coaxial or balanced (switch-selectable), floating, matching with the test inputs of UPA;
- high internal crosstalk attenuation: better than 80 dB at 20 kHz;
- output signal can be switched either to right or left channel or to both channels simultaneously — this makes signal allocation easy when measuring crosstalk as well as level or phase differences in stereo channels;
- real, ohmic output impedance with narrow tolerances, switch-selectable: 30, 200 or 600 Ω.

Signal-to-noise ratio measurement With the aid of the generator the UPA can measure the signal-to-noise ratio fully automatically. It is only necessary to preselect the reference level and reference frequency for the S/N ratio. As a result of this automatic measurement the logarithmized ratio of signal-to-noise is read out in dB.

Automatic sweep The generator can be set to automatic sweeping of level or frequency increments. The limit and increment value, the time between the individual sweeps and the desired sweep mode (single sweep or automatic repetition) can be entered via the keyboard.

For special applications, any desired level and/or frequency sequence can be defined in 1 to 99 steps.

The sweep function allows fast and convenient investigations of test items, such as measurement of

- frequency response,
- phase difference (as a function of input frequency),
- distortion (as a function of input voltage or frequency),
- signal-to-noise ratio (as a function of input voltage) and
- dynamic range.

The results are automatically plotted or listed on a printer, or on a XY recorder using the DC output option.

Wow and flutter meter

Fitted with the wow and flutter meter (option UPA-B9), the Audio Analyzer forms an automatic test system for measuring pitch variations or wow and flutter of magnetic tape units, record players and drives, using different weighting criteria in line with international standards. Pitch variations are weighted by the UPA with

- quasi-peak-responding rectification to DIN, CCIR and IEC at a reference frequency of 3.15 kHz,
- average-responding rectification to NAB at 3 kHz and
- rms-responding rectification to JIS at 3 kHz.

A standard filter with a centre frequency of 4 Hz is used for physiological assessment of wow and flutter.

Wow and flutter measurements Broadband wow and flutter in the range 0.1 to about 300 Hz can be measured without weighting. The inherent noise of the wow and flutter meter is 0.001%, ensuring precise evaluation of all kind of equipment from a simple cassette recorder through to professional studio machines or precision record players. For sound-recording equipment it is also of vital importance to **measure the absolute or rotational speed.** The frequency counter integrated in the UPA measures the reproduction frequency. After input of a nominal frequency the error or drift can be indicated on the frequency display, pitch variations being simultaneously read out.

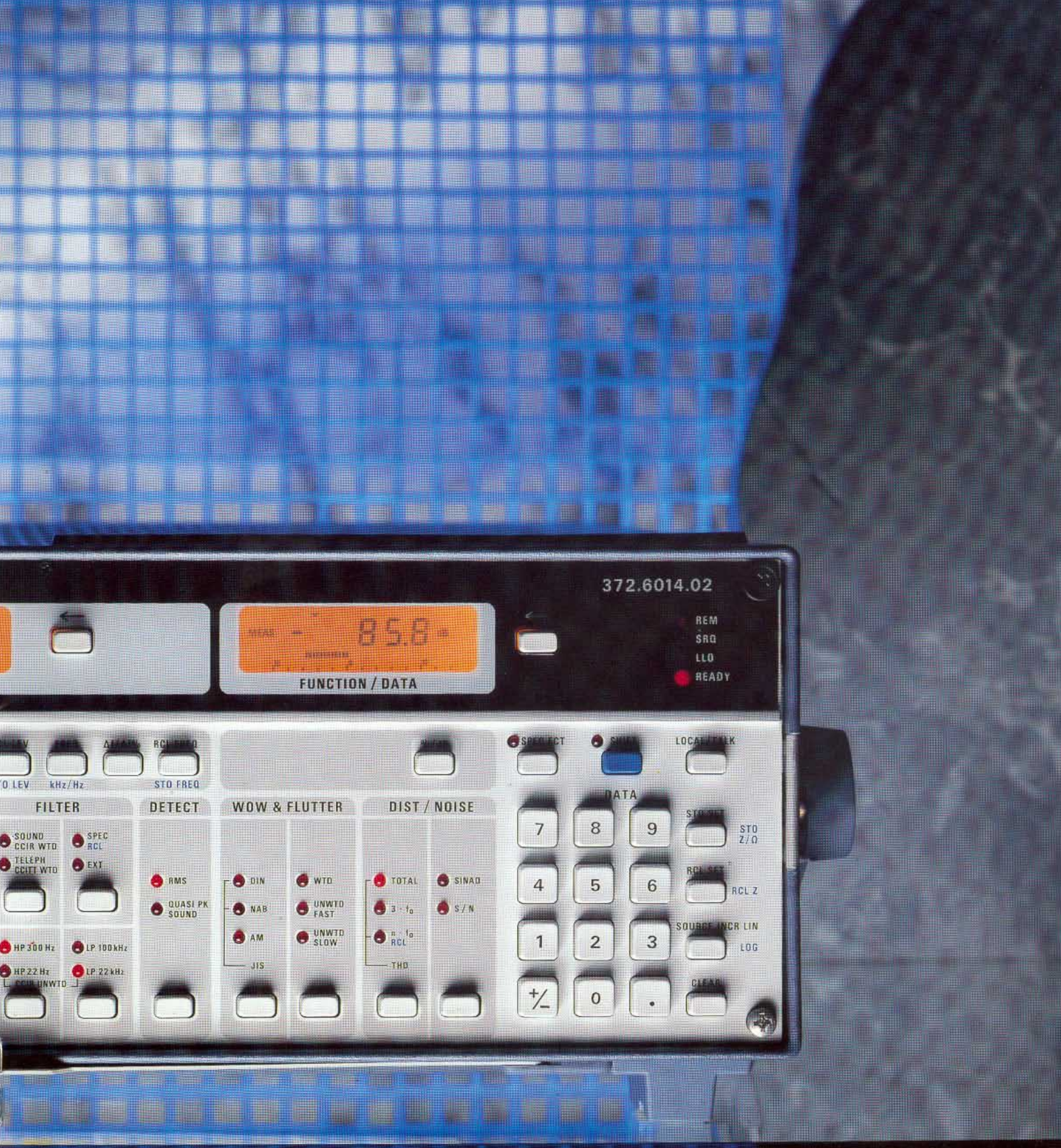
The optional wow and flutter meter can also **measure amplitude variations** to allow further quality assessment of magnetic sound equipment. Tape-guide problems in the area of the sound heads but also faults in the premagnetization or defects due to inhomogeneity of the magnetic layer of the tape are thus detected quickly. At recording frequencies of about 2 to 20 kHz amplitude variations can be read out in % or dB with or without weighting. The variation measurement range extends from 0 to nearly 100% or 0 to 20 dB.

A special feature in the case of heavily fluctuating results in pitch and amplitude measurements is the **statistical weighting** on the basis of the normalized **2-σ frequency** of the Gaussian distribution curve over a defined test period of 5, 10 or 20 s.

Particularly exacting requirements are called for measurements in the studio; no problem for UPA

Photo: Georg Neumann GmbH, RIAS Berlin, K 10

AUDIO ANALYZER
UPA



IEC 625 Bus

IEEE 488

Distortion meter

The distortion meter (option UPA-B8, fitted as standard in UPA 3 and UPA 4) allows continuous measurement of non-linear amplitude distortion at fundamental frequencies from 10 Hz to 100 kHz, the following modes being selectable:

- Measurement of total harmonic distortion including broadband noise
- Selective measurement of harmonic distortion d_2 to d_9
- Indication of SINAD
- Indication of distortion or SINAD level, with selected reference
- Indication of total harmonic distortion (THD), with order of harmonics preselected

Distortion can be measured down to 0.003% or −90 dB (−100 dB when calculating noise components, see UPA 4 on page 3), and SINAD up to +90 dB.

The distortion or SINAD measurement is carried out fully automatically. Internal presetting based on the result of frequency measurement and automatic fine tuning are made to ensure suppression of the fundamental. A HOLD function allows current presettings of the fundamental rejection filter to be maintained. This presetting is however also possible by direct entry of the frequency value or generator frequency selection. This will increase the measurement rate or improve the setting accuracy in the case of very noisy signals.

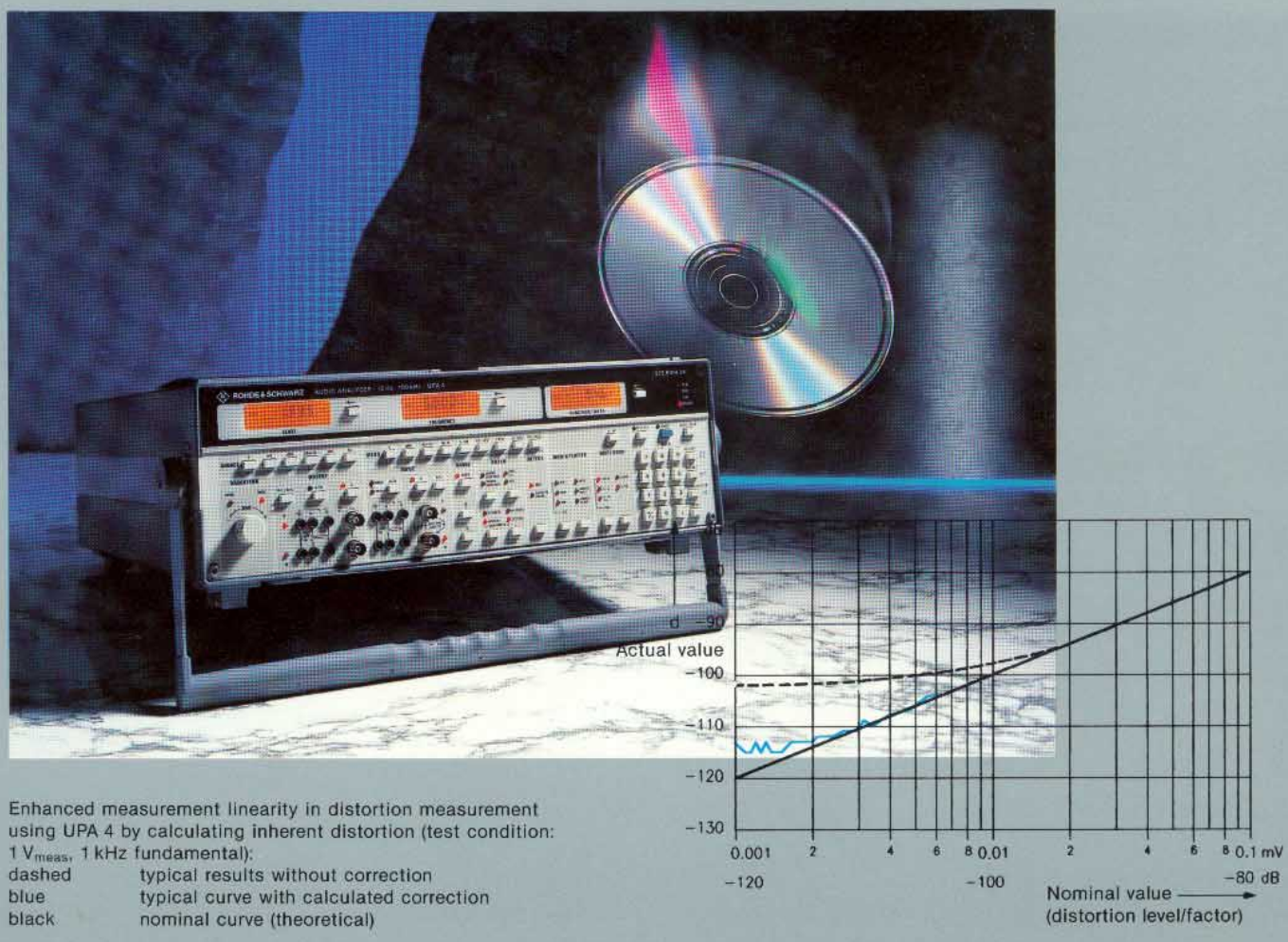
An important field of application for selective distortion measurement is the direct display of the third harmonic, especially on magnetic sound equipment. After suitable evaluation signal spectra up to an upper frequency limit of about 300 kHz can also be displayed.

SINAD measurement The SINAD value is a measure used in radiotelephony for joint evaluation of harmonic distortion and receiver sensitivity; it is read in dB and defined as the logarithmic ratio of

$$\frac{\text{signal + noise + distortion}}{\text{noise + distortion}}$$

In addition to broadband measurement, the SINAD ratio is also often weighted to CCITT. For this purpose the telephone- or speech-channel filter can be switched on.

The **distortion or SINAD level** can be read out in % or dB, but also as an absolute value for special applications; and it can be derived as a reference value from the current measurement or entered via the UPA keyboard. If a distortion or SINAD level measurement with reference is selected, the relative deviation from the reference value is read out in △% or △dB.



Enhanced measurement linearity in distortion measurement using UPA 4 by calculating inherent distortion (test condition: 1 V_{meas}, 1 kHz fundamental):

dashed	typical results without correction
blue	typical curve with calculated correction
black	nominal curve (theoretical)

Normally, the TOTAL distortion measurement function applies, which includes all harmonics as well as broadband interference. In addition, the **THD function** (total harmonic distortion) permits the selective measurement of combinations of 2nd- to 9th-order harmonics excluding broadband interference. Especially with noisy signals, such as occur in radiotelephones with a lot of inherent noise, THD measurements provide qualitative assessment of harmonic distortion.

Examples of THD measurements (V_2 to V_9: V_{rms} of harmonics; V_{THD}: V_{rms} of distortion level)

Selection of display mode Keys for selection of the display mode allow voltage- or power-referred values eg in dBV, dBm(Z), W(Z), to be displayed in addition to the absolute units for voltage and frequency. Values referring to power require a reference impedance Z which can be entered on the UPA. For everyday measurements the indication of relative values for voltage (%, dB) and frequency (△f, △f%) proves particularly useful. Reference values can be entered directly or taken from the ongoing measurement (see table below).

Display and conversion possibilities

	Key	Display
Voltage	V	V_{in}
Level	dBV	$20 \lg \frac{V_{in}}{1\,V}$
	dBm (Z)	$10 \lg \frac{V_{in}^2}{Z \times 1\,mW} = dBV = 20 \lg \frac{V_{in}}{0.775\,V}$ ($Z = 600\,\Omega$)
	%/dB	$\frac{V_{in} - V_{ref}}{V_{ref}} \times 100\%$ or $20 \lg \frac{V_{in}}{V_{ref}}$
	W (Z)	$\frac{V_{in}^2}{Z}$
Frequency	FREQ	f_{in}
	△f/△f%	$f_{in} - f_{ref}$ or $\frac{f_{in} - f_{ref}}{f_{ref}} \times 100\%$
Function	**%/dB**	
Wow and flutter		in %
AM, distortion		in % or dB
SINAD, S/N		in dB
Special function		
Distortion or SINAD level		in V, △% or △dB
Phase		in degrees

Operation

The UPA is operated by **function keys** and for a large variety of settings by direct entry on a **numerical keypad** with monitoring facility on the DATA display. With linear and logarithmic increment selection, quasi-continuous variation of the generator level and frequency is possible using the **spinwheel.** Special functions allow less common functions, auxiliary or service settings to be recalled. Since all entries are internally checked by the microprocessor program, incorrect operation is excluded to a large extent.

Examples of special functions

Definition	Input sequence
Select IEC-bus address 7	1 . 7 SPEC FCT
Write protection for total setup	6 . 1 1 SPEC FCT
Select FAST level measurement	1 0 . 1 SPEC FCT
Start frequency sweep	2 9 SPEC FCT
Enter 0.01 V as distortion reference value	3 7 . 2 SPEC FCT 0 . 0 1 V/mV STO LEV
Select phase measurement	3 8 . 1 SPEC FCT

Non-volatile memory Up to 50 complete instrument setups including all functions and numerical entries can be stored in a non-volatile memory with battery backup. Existing setups can be protected against inadvertent overwriting. The last setting is stored automatically. After a power failure or after switching the UPA off and on, each stored setup can be recalled by simply pressing two keys. This also facilitates operation if complicated function or display settings, for instance with indication of relative measured values, are frequently needed.

Display of test results For indication of the test results the UPA has three liquid-crystal displays for level, frequency and function/data. For adjustment or setting to a given nominal value it is very helpful if in addition to the **digital display** there is also an analog presentation showing changes of the test results. A high-resolution bar display is therefore provided on the UPA. Major changes can easily be detected on this **analog display**, whereas minor changes can better be recognized on the digital display.

The user may choose between three display modes for the LCDs by pressing the appropriate key:

- 7-segment digital display
- digital display combined with analog bar display
- analog bar display with indication of range

Setting values, background illumination The LCDs also permit digital readout of the generator setting values or reference values. For adaptation to ambient light, the displays are provided with continuously variable background illumination.

Remote control With a remote-control interface to IEC 625-1, even the basic model of the UPA can be remotely controlled and used in automatic test assemblies. The great variety of IEC-bus commands for instrument setting and output of the results allows flexible and clear programming in system operation. The IEC-bus commands are given in easy-to-read plain text which may also be in abbreviated form.

An interesting feature is the **IEC/IEEE-bus request function.** Each header of an IEC/IEEE-bus command transmitted from the controller to the UPA can be complemented with "?". The UPA responds with an ASCII string in plain text representing the instrument setting. This considerably simplifies the preparation of IEC/IEEE-bus control programs.

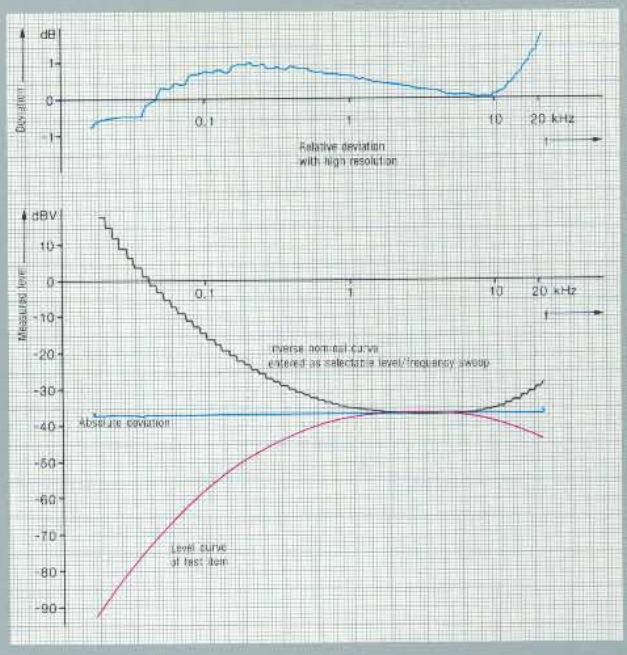
Logging results Logging of the test results is possible on a recorder via the analog outputs or on a printer via the IEC/IEEE-bus interface fitted as standard. The hardcopy is printed out at a keystroke or in automatic sweep mode as a graphics plot or as a list. The complete automatic test run with data logging and output of diagrams is performed without the use of an external process controller.

Examples of IEC-bus commands

Definition	Plain-text command	Shortest form
Result of level measurement in dBV	"MEASUREMENT (LEVEL DBV)"	"M(L DBV)"
FAST frequency measurement rate	"RATE (FREQUENCY FAST)"	"RAT(F F)"
Selection of distortion measurement	"DISTORTION (TOTAL MODE (AUTO))"	"DIST(T M(A))"
Wow and flutter Select 2-sigma measurement	"WOWFLUTTER (DIN WTD ONSIGMA)"	"W(D W ON)"
Trigger single measurement	"TRIGGER (SINGLE)"	"T(SI)"

AC output is provided eg for connection of an oscilloscope, monitor or headphones for voltage and frequency measurements. When wow and flutter as well as distortion are measured, the variation or distortion signal is available at the AC output (isolation between the test inputs and the AC output).

DC output A two-channel DC output (option UPA-B1) allows XY representation with many different scales of measurement functions, eg on a connected recorder. The two output channels may be allocated as desired to the three measurement parameters: level, frequency and function. In conjunction with the sweep capabilities of the generator, the measurement functions can be recorded without the use of a process controller.



Recording of results via DC outputs on XY recorder:

Freely selectable level/frequency sweep for documenting the departure of the measured results from the nominal response

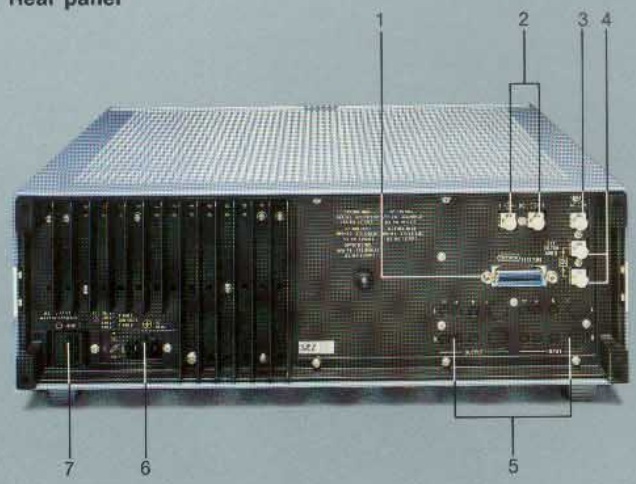
```
MACDDB   -005.37E+0  SOUHZ     02.500E+3
MACDDB   -005.63E+0  SOUHZ     02.800E+3
MACDDB   -005.75E+0  SOUHZ     03.100E+3
MACDDB   -007.68E+0  SOUHZ     03.400E+3
MACDDB   -012.37E+0  SOUHZ     03.700E+3
MACDDB   -017.75E+0  SOUHZ     04.000E+3
MACDDB   -022.92E+0  SOUHZ     04.300E+3
MACDDB   -027.87E+0  SOUHZ     04.600E+3
MACDDB   -032.84E+0  SOUHZ     04.900E+3
MACDDB   -038.21E+0  SOUHZ     05.200E+3
MACDDB   -044.69E+0  SOUHZ     05.500E+3
MACDDB   -055.22E+0  SOUHZ     05.800E+3
```

Above Listing of results on IEC-bus printer, in talk only mode

Below Data logging on IEC-bus printer, in talk only mode

```
                F R E Q U E N C Y - S W E E P - R E P O R T

   Level        [x] Scale          dB      0      -7.5      -15      -22.5     -30
                [.] Ref-Line               -3
   Phase        [*] Scale          DEG     90      67.5      45       22.5      0
                [:] Ref-Line               45

    Freq     |    Lev [x]  |  Fnct [*]  |
  200.0  Hz  -000.27E+0    001.10E+0
  240.1  Hz  -000.19E+0    001.31E+0
  288.3  Hz  -000.15E+0    001.58E+0
  346.1  Hz  -000.11E+0    001.89E+0
  415.5  Hz  -000.07E+0    002.27E+0
  498.8  Hz  -000.05E+0    002.72E+0
  598.9  Hz  -000.03E+0    003.27E+0
  719.0  Hz  -000.03E+0    003.93E+0
  863.1  Hz  -000.03E+0    004.71E+0
 1.036 kHz  -000.03E+0    005.65E+0
 1.244 kHz  -000.05E+0    006.75E+0
 1.494 kHz  -000.10E+0    008.09E+0
 1.793 kHz  -000.14E+0    009.68E+0
 2.153 kHz  -000.19E+0    011.57E+0
 2.584 kHz  -000.28E+0    013.79E+0
 3.103 kHz  -000.41E+0    016.43E+0
 3.725 kHz  -000.59E+0    019.45E+0
 4.472 kHz  -000.83E+0    022.91E+0
 5.369 kHz  -001.15E+0    026.82E+0
 6.446 kHz  -001.58E+0    031.18E+0
 7.739 kHz  -002.13E+0    035.92E+0
 9.291 kHz  -002.82E+0    040.98E+0
 11.15 kHz  -003.64E+0    045.96E+0
 13.39 kHz  -004.60E+0    051.12E+0
 16.08 kHz  -005.69E+0    055.85E+0
 19.30 kHz  -006.89E+0    060.21E+0
 23.17 kHz  -008.18E+0    064.14E+0
 27.82 kHz  -009.56E+0    067.67E+0
 33.40 kHz  -010.97E+0    070.55E+0
 40.10 kHz  -012.42E+0    073.34E+0
 48.14 kHz  -013.92E+0    075.17E+0
 57.79 kHz  -015.42E+0    076.76E+0
 69.38 kHz  -016.95E+0    078.62E+0
 83.30 kHz  -018.47E+0    080.66E+0
100.00 kHz  -020.01E+0    082.49E+0

Additional Status Information :

Output      : RIGHT C
Generator   : Level =  1.0000 V
Sweep       : Start =  200.00 Hz , Stop =  100.00 kHz
 (Freq.)      Increment = log / 34 Steps over SWEEP-Range
              Delay = 150 ms

Input       : LEFT  C
Range       : Auto
Filter      : HP 22 Hz
Detector    : RMS
Rate        : Level (Fast) , Freq. (Fast)

Display     : Level (Meas) , Freq. (Source)
References  : Level =   0.9893 V  , Freq. =  1000.0 Hz
              Impedance =  600.00 Ohm

+- Notes ------------------------------------------------ Date    /  /    ---+
|                                                                             |
+- END -- Report generated with UPA ------------------ c/86 Rohde & Schwarz --+
```

Rear panel



Rear connector panel

1 IEC-bus connector
2 DC outputs (option 1)
3 AC output
4 Connector for external filters
5 Space provided for incorporation of test inputs and generator outputs
6 AC supply connector, voltage selector
7 Power switch

Specifications

AF level meter

Voltage measurement range	10 µV to 300 V, unbalanced 10 µV to 35 V, balanced
Range selection	autoranging or manual
Frequency range	10 Hz to 100 kHz
3-dB bandwidth	3 Hz to 300 kHz
Weighting filters	
Highpass filter	22 Hz[1]), 300 Hz
Lowpass filter	22 kHz[1]), 100 kHz
Noise filters	noise weighting filter to DIN 45405/CCIR 468-4, telephone weighting filter to CCITT O.41/P53, A-filter to DIN IEC 651 (contained in option UPA-B2)
Special filters	plug-in cards, options UPA-B2, UPA-B3 and UPA-B4
Test inputs	
Balanced	two three-contact female connectors to DIN 41628, switchable R/L channel
Unbalanced	two BNC female connectors, floating, switchable R/L channel
Input impedance	selectable 1 MΩ ±1% (unbal.) or 600 Ω, 20 kΩ ±1% (bal.)
Input capacitance	<130 pF (unbal.), <200 pF (bal.)
Unbalance rejection for balanced input	>110 dB at 50 Hz, >60 dB at 16 kHz, to DIN 45405
Common-mode rejection for unbalanced input	>50 dB at 50 Hz
Crosstalk attenuation R/L	>80 dB at 20 kHz (termination 600 Ω)
Permissible input voltage (AC + DC)	
Unbalanced input	V_{rms} = 300 V, V_p = 500 V, V_p = 10 V (BNC outer conductor referred to ground)
Balanced input	V_{rms} = 35 V, V_p = 100 V (a referred to b), V_p = 350 V (a or b referred to ground)
Rectifiers	rms-responding rectifier, max. crest factor = 5; quasi-peak-responding rectifier to DIN 45405 and CCIR 468-4
Level indication	
Digital display	5-digit readout in mV, V, dBm(Z), mW(Z) or W(Z), derived from measured voltage and reference impedance; relative indication in % or dB, referred to reference value entered
Maximum resolution	1 µV, 0.01 dB or 0.01%
Analog display	fast bargraph indication of absolute or relative values with simultaneous digital display of full-scale deflection or measured value
Error limits with RMS (sinewave)[2])	
10 to 30 Hz	±3% ±1 digit, additionally ±1% in 0.3-mV range
30 Hz to 20 kHz	±1% ±1 digit
20 to 100 kHz	±3% ±1 digit
Additional error with crest factor <3	±0.5%
≥3 <5	±1.5%
Error limits with quasi-peak (sinewave)[2])	
10 to 30 Hz	±4% ±1 digit
30 Hz to 20 kHz	±1% ±1 digit
20 to 100 kHz	±3% ±1 digit
Inherent noise	
Unbalanced (600 Ω)	
CCITT, weighted (RMS)	<2 µV
CCIR, weighted (QPK)	<10 µV
CCIR, unweighted (QPK)	<7 µV
Without filter (RMS)	<15 µV
Without filter (QPK)	<30 µV
Balanced (600 Ω)	
CCITT, weighted (RMS)	<5 µV
CCIR, weighted (QPK)	<20 µV
CCIR, unweighted (QPK)	<30 µV
Measuring time[3])	
in level mode SLOW, f >10 Hz	<1.2 s/measurement, about 3 display changes/s in manual mode
FAST, f >300 Hz	<50 ms/measurement with RMS, <85 ms/measurement with QPK

DC voltage measurement

Voltage measurement range	0 to ±300 V
Range selection	autoranging or manual
Test inputs	see AF level meter, but unbalanced only
Indication	
Digital display	2½ digits, units and relative measurement see AF level meter
Max. resolution	10 mV
Analog display	see AF level meter
Error limits	±1% ±1 digit
Measurement rate	SLOW, FAST, switch-selected

Frequency counter

Frequency measurement range	8 Hz to 250 kHz
Required input voltage	>10 mV (S/N ratio >20 dB)
Frequency indication	5-digit readout in Hz, kHz or relative value in Hz, kHz or in %
Analog display	fast bargraph indication of absolute or relative values with simultaneous digital display of full-scale deflection or measured value
Resolution	
8 to 99.999 Hz	0.001 Hz
90 to 999.9 Hz	0.01 Hz
900 Hz to 9.9999 kHz	0.1 Hz
9 to 99.999 kHz	1 Hz
90 to 249.99 kHz	10 Hz
Error limits	±0.005% ±1 digit

Measuring time[4])

		Level mode SLOW	Level mode FAST
Frequency mode	SLOW	<660 ms or 380 ms + 9 × period[5])	<330 ms
	FAST	<420 ms or 380 ms + 2 × period[5])	<90 ms

Phase measurement

Indication	digital readout in degrees
Range of indication	0 to 180 degrees
Resolution	0.1 degree

[1]) The combination of these two filters corresponds to a filter for unweighted noise measurement to DIN and CCIR.

[2]) In automatic mode; SLOW measurement rate without additional error caused by inherent noise. With FAST measurement rate for f >300 Hz additional error of max. −2% from 300 Hz to 1 kHz.

[3]) Valid for digital display of level in line with IEC-bus TRIGGER (MODE [LEV]) and DISPLAY (LEVEL VALUE), triggered measurement with Group Execute Trigger without range switching. Measurement functions wow and flutter, distortion, SINAD and S/N switched off.

[4]) Valid for digital display of frequency in line with IEC-bus TRIGGER (MODE [FREQ]) and DISPLAY (FREQ VALUE), triggered measurement with Group Execute Trigger without level range switching. Measurement functions wow and flutter, distortion, SINAD and S/N switched off.

[5]) The greater value is applicable.

[6]) Valid in FAST frequency mode.

Distortion meter (option UPA-B8, standard in UPA 3 and UPA 4)

Frequency range (fundamental)	10 Hz to 100 kHz
(harmonics)	20 Hz to 300 kHz
Frequency adjustment	automatic or by frequency preselection
Minimum input voltage	12 mV (10 to 400 Hz), 1.2 mV (>400 Hz to 100 kHz)
Display modes (digital, analog)	total distortion d_{TOTAL} in % or dB, selective distortion d_2 to d_9 in % or dB, total harmonic distortion d_{THD} in % or dB, SINAD in dB, distortion or SINAD level in mV, V or relative in % or dB, referred to reference value entered
Range of indication	0.0001 to 100%, −120 to 0 dB (distortion); 0 to 120 dB (SINAD); 1 µV to 300 V (distortion or SINAD level); −100 to 1000% or ±140 dB (relative distortion or SINAD level)

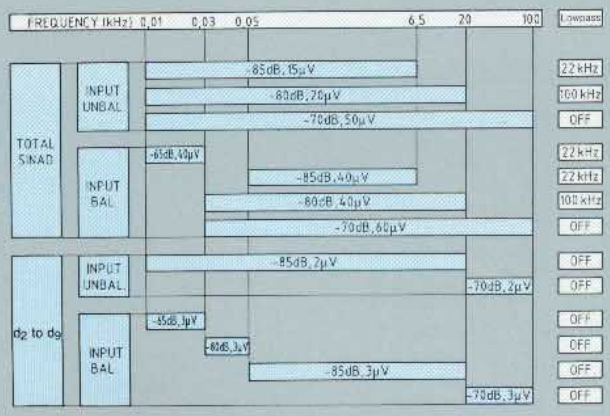
Error limits (in automatic mode, without additional error caused by inherent noise)

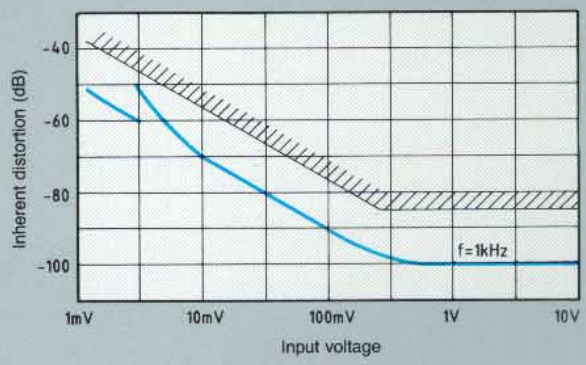
d_{TOTAL} or SINAD	
20 Hz to 20 kHz	±1 dB (harmonics up to 100 kHz)
10 to 20 Hz and 20 to 100 kHz	±2 dB (harmonics up to 300 kHz)
d_2 to d_9, d_{THD} (for signals with frequency components up to max. 400 kHz)	
Harmonics up to 100 kHz	±2 dB (d_n, max. −10 dB)
Harmonics up to 300 kHz	±3 dB (d_n, max. +30 dB above d_n)

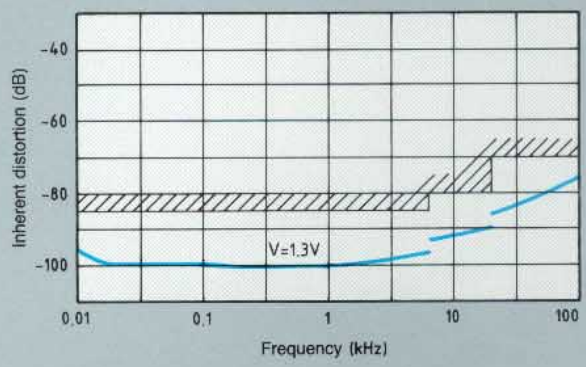
Measuring time (d = −20 to −70 dB, without switchover of level range)

	min.	max.	typ.
10 to 400 Hz (SLOW level meas.)			
d_{TOTAL} or SINAD	1.8 s	10 s	3.4 s
d_2 to d_9	2.3 s	22 s	9 s
0.3 to 100 kHz (FAST level meas.)			
d_{TOTAL} or SINAD	0.6 s	5.5 s	1.3 s
d_2 to d_9	0.7 s	6.5 s	1.5 s

Limit values of inherent distortion (automatic mode, the greater value of inherent distortion or 20 log $\frac{\text{noise voltage}}{\text{input voltage}}$ dB being applicable)







The blue curves represent the typical inherent distortion (d_{TOTAL}/SINAD, unbalanced input)

Specifications

Generator (option UPA-B6, standard in UPA 3)

Principle of operation ..... AF synthesizer
Frequency range ..... 10 Hz to 100 kHz, adjustable up to 110 kHz
Setting ..... entry via keyboard in Hz or kHz, manually using spinwheel or sweep mode
Indication ..... 5-digit display
Resolution
10 Hz to 999.9 Hz ..... 0.1 Hz
1 kHz to 9.999 kHz ..... 1 Hz
10 kHz to 110 kHz ..... 10 Hz
Error limits ..... ±0.01%
Frequency switching time ..... <50 ms (frequency error ±0.5%), <100 ms (frequency error ±0.1%)

Outputs
Balanced ..... two three-contact female connectors to DIN 41628, switchable R/L, R+L channel
Unbalanced ..... two BNC female connectors, floating, switchable R/L, R+L channel
Unbalance rejection (bal. output >1 V) ..... >80 dB at 1 kHz, >60 dB at 16 kHz, to DIN 45404, IEC 268-1, with termination 2 × 300 Ω (bal.) and 10 kΩ (unbal.)
Crosstalk attenuation ..... >80 dB at 20 kHz between R and L, with termination of 600 Ω
Output impedance (throughout level range) ..... 30 Ω, 200 Ω or 600 Ω, switch-selected; tolerance ± (0.5 Ω + 0.5%)
Output voltage, unloaded ..... 0.1 mV to 12.4 V
Level setting ..... entry via keyboard in V, mV, dBV or dBm or manually using spinwheel or sweep mode
Indication ..... 5-digit readout
Resolution
dBV and dBm ..... 0.01 dB
0.1 to 2.999 mV ..... 0.001 mV
3 to 29.99 mV ..... 0.01 mV
30 to 299.9 mV ..... 0.1 mV
300 mV to 2.999 V ..... 1 mV
3 to 12.4 V ..... 10 mV
Load impedance ..... >200 Ω
Max. load current ..... 54 mA
Output circuit ..... short-circuit-proof, switched off in case of external feeding

Distortion (incl. noise voltage, the greater value of inherent distortion or 20 log $\frac{\text{noise voltage}}{\text{output voltage}}$ dB being applicable)

Frequency range	Output voltage <10 mV	Output voltage 10 to 300 mV	Output voltage >300 mV	Lowpass filter
30 Hz to 20 kHz	<−75 dB, 7 μV	<−75 dB, 10 μV	<−80 dB	100 kHz
10 to 30 Hz and 20 to 100 kHz	<−65 dB, 10 μV	<−65 dB, 15 μV	<−67 dB <−70 dB	—

Error limits of output voltage at 1 kHz ..... ±1%
Frequency response flatness (ref. to 1 kHz)
10 Hz to 20 kHz ..... ±0.5%
20 to 100 kHz ..... ±1%
Level setting time ..... <10 ms

S/N ratio measurement
(with generator, option UPA-B6)
Signal frequency range ..... 30 Hz to 100 kHz
Indication of S/N ..... digital and analog in dB
Range of indication ..... 0 to 120 dB
Resolution ..... 0.1 dB
Error limits (without consideration of inherent noise) for
S/N ≤60 dB ..... ±1 dB
>60 dB ..... ±2 dB
Inherent S/N ratio (the smaller value of S/N ratio or 20 log $\frac{\text{output voltage}}{\text{noise voltage}}$ dB being applicable) >85 dB or <20 μV, with highpass filter 22 Hz and lowpass filter 100 kHz
Measuring time[6])
in level mode SLOW (f >30 Hz) .... 4 s
FAST (f >300 Hz) .... 1.7 s

Wow and flutter meter (option UPA-B9)

Amplitude variation meter
Frequency range ..... 2 to 20 kHz
Range of variation
Level ..... 0 to 20 dB
Frequency ..... 0.1 to 300 Hz
Weighting ..... with quasi-peak-responding rectifier to DIN 45507
Unweighted measurement ..... SLOW, FAST, selectable
Statistical weighting ..... 2-σ method, selectable
Indication ..... digital and analog readout in dB and %
Maximum resolution ..... 0.001 dB or %
Error limits
0 to 3 dB ..... ±0.25 dB
>3 to 12 dB ..... ±1 dB
>12 to 20 dB ..... ±2.5 dB
Measuring time ..... 2 s
with 2-σ weighting ..... 5, 10 or 20 s

Wow and flutter meter
Wow and flutter meter
Reference frequency ..... 3.15 kHz to DIN, IEC, CCIR; 3 kHz to NAB, JIS
Tolerance range ..... within ±5%
Range of frequency variation .... 0.1 to 300 Hz
Weighting, rectification ..... quasi-peak-responding to DIN 45507, IEC 386 and CCIR 409-2, average-responding to NAB, rms-responding to JIS
Maximum resolution 0.001%
Unweighted measurement ..... SLOW, FAST, selectable
Statistical weighting ..... 2-σ weighting, selectable
Measurement range ..... 0.003 to 5%
Error limits ..... ±10%
Required input voltage ..... 30 mV
Measuring time ..... 2 s
with 2-σ weighting ..... 5, 10 or 20 s

Filter

Special filter (option UPA-B2)
A-filter ..... to DIN IEC 651
Bandstop filters ..... pilot-tone trap with 15-kHz lowpass filter, line-frequency trap with 13-kHz LP filter (both filters can also be combined with A-filter)
Bandpass filters ..... standard frequencies 315 Hz, 1 kHz, 3.15 kHz, 6.3 kHz, 10 kHz and 12.5 kHz; additional, selectable fixed center frequencies of 8, 9, 10, 11, 12, 13, 14, 15, 15.5, 16, 17, 18, 19, 20 and 25 kHz with adjustable passband frequency from 23 Hz to 25 kHz (generator tracking function); telephone bandpass filter 320 Hz to 3.4 kHz; bandpass filter 2 kHz to 10 kHz for fast distortion measurement at 1 kHz
Lowpass filters ..... 350 Hz, 1.04 kHz, 3.5 kHz, 7 kHz, 10.4 kHz and 15 kHz
Passband ripple ..... better than ±0.5 dB for bandstop, bandpass and lowpass filters (passband corresponds to cutoff frequencies defined above)
S/N ratio ..... >40 dB for bandpass and lowpass filters
>40 dB for f ≥130 Hz | adjustable
>35 dB for f ≥ 65 Hz | bandpass
>30 dB for f ≥ 23 Hz | filter
Filter circuit board (option UPA-B3) ..... plug-in filter board for customized filters (can be fitted in UPA together with special filter option UPA-B2)
Customized filter (option UPA-B4) ..... development and manufacture of filters to customer's specific requirements; price and delivery on request; this filter board can be inserted together with UPA-B2 or UPA-B3

General data

Rated temperature range	0 to +50 °C, for use in class 1 to IEC 359 (no condensation)
Storage temperature range	−40 to +70 °C
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz (50 VA), safety class 1 to VDE 0411 and IEC 348
RFI suppression	DBP approval number to regulations 527/1979
Mechanical stress	to IEC 359, class 1
Compact unit	width: 19", height: 3 units
Dimensions (W×H×D), weight	470 mm × 162 mm × 480 mm, 16 kg

DC output (option UPA-B1)

Two-channel design, measurement function and scaling selectable	±10 V, Z_{out} = 1 kΩ
Resolution	12 bits

Remote control

Interface	IEC 625-1 (IEEE 488), connector: 24-contact Amphenol, control of all instrument functions, incl. Serial Poll, Parallel Poll
Interface functions	SH1, AH1, L4, T5, SR1, RL1, DC1, Dt1, PP1

UPA 4

UPA 4

The Audio Analyzer UPA 4 has the same specifications as the Audio Analyzer UPA with built-in option UPA-B8. The following additional data refer to the unbalanced inputs with rms weighting:

Frequency response, referred to 1 kHz, range 100 mV to 10 V

20 to 40 Hz	±0.05 dB
40 Hz to 20 kHz	±0.03 dB

Total inherent distortion

in 1-V range from 0.5 to 1.1 V, in 3-V range from 1.5 to 3.5 V, 22-kHz lowpass filter connected	<−97 dB
With 2 mV, 1 kHz and A-weighting filter switched on (contained in UPA-B2)	<−50 dB

Inherent noise voltage

unbalanced input terminated with 50 Ω, 22-kHz lowpass filter connected	≤3 μV

Ordering information

Order designation	▶ Audio Analyzer	
UPA (basic model)	372.6014.02	
UPA 3 (with generator and distortion meter)	372.6014.03	
UPA 4 (especially for CD measurements)	372.6014.04	

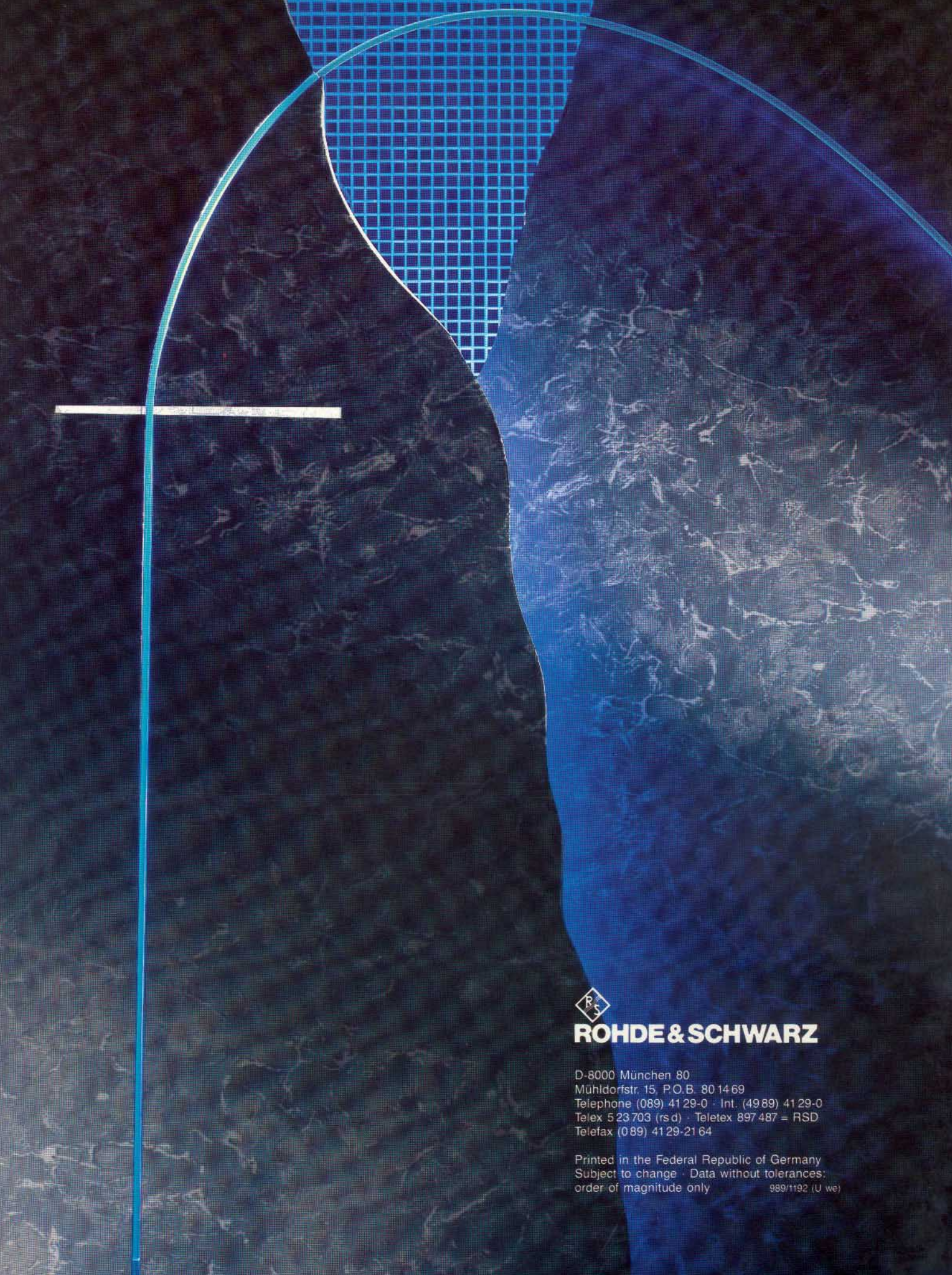
Extensions (options)

Generator (standard in UPA 3)	UPA-B6	373.0010.02
Distortion Meter (standard in UPA 3, 4)	UPA-B8	373.1616.02
Wow and Flutter Meter	UPA-B9	373.2612.02
Special Filter	UPA-B2	373.1216.02
Filter Circuit Board, without components	UPA-B3	373.1545.02
Customized Filter	UPA-B4	1002.1200.xx
DC Output	UPA-B1	373.2512.02

Recommended extras

19" Rack Adapter	ZZA-8	078.8439.00

An application program and application note for UPA 4 is available free of charge on request.



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