ROHDE&SCHWARZ

Measuring Instruments
and Systems Division

Service Manual

AUDIO ANALYZER

UPA

372.6014.02

UPA 3

372.6014.03

UPA 4

372.6014.04

VOLUME 1

The Service manual consists of 2 volumes

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3.2.2.3 Function Check of the Keyboard

All keys can be tested using the code on the FUNCTION/DATA display 13 following input of special function 61, key sequence 61/SPEC.FCT. Press each key briefly. The test routine can be left by pressing the CLEAR key 23 twice.

Key No. *	Designation	Code
1	SOURCE V	1
1	SOURCE mV	2
1	SOURCE dBV	3
1	SOURCE dBm(Z)	4
3	SOURCE kHz	5
3	SOURCE Hz	6
5	MEAS V	7
5	MEAS dBV	8
5	MEAS dBm(Z)	9
5	MEAS W(Z)	10
7	MEAS %/dB	11
8	RCL/STO LEV	12
10	MEAS FREQ	13
11	MEAS Δf/Δf%	14
12	RCL/STO FRQ	15
14	FNCT %/dB	16
	-	17
	-	18
	-	19
40	OUTPUT R/L/R+L	20
40	OUTPUT a/b	21
40	OUTPUT c	21
35	INPUT a/b	23
35	INPUT c	24
35	INPUT R/L	25
34	RANGE AUTO	26
34	RANGE ↑	27
34	RANGE ↓	28
33	FILTER CCIR/CCITT	29
30	FILTER SPEC/EXT	30

Key No. *	Designation	Code
32	FILTER HP	31
31	FILTER LP	32
29	DETECT	33
28	WOW & FLUTTER	34
27	WOW & FLUTTER WTD	35
26	DIST	36
25	NOISE	37
19	SPEC FCT	38
17	SHIFT	39
18	LOCAL/TALK	40
24	7	41
24	8	42
24	9	43
20	STO SET	44
24	4	45
24	5	46
24	6	47
21	RCL SET	48
24	1	49
24	2	50
24	3	51
22	SOURCE INCR	52
24	+/-	53
24	0	54
24	.	55
23	CLEAR	56
4	LEVEL ↑	57
	-	
9	FREQUENCY ↑	59
	-	
15	FUNCTION ↑	61

* The key Nos. correspond to those given under Section 2.1.1 and Fig. 2-1.

Item No.	PUC test program	Response by UPA Response by PUC*	Explanation
3	300 IECSRQGOTO360	-	Branch instruction when SRQ is detected.
	310 S=0	-	Control variable
	320 IECOUT10, "SRQ(ENABLE)"	-	Enable SRQ
	330 IECOUT10, "TRIGGER (SINGLE)"	LED "SRQ" lights up	Measured-value triggering
	340 IF S=0 THEN X=0: GOTO 340	-	Wait loop for SRQ and Serial Poll
	350 STOP	-	Program stop
	360 IECSPL10,V%	LED "SRQ" extinguished	Serial Poll
	370 PRINTV%:S=1	80 *	Output SRQ byte
	380 IECIN10,M$: PRINTM$	Output string *	Measured-value output string in M$ and output on screen
	390 IECRETSRQ	-	RETURN instruction of SRQ subroutine
Set the TALK ONLY mode on the UPA for test step 4. Press the Local/Talk key and enter the key sequence 1.31/SPEC FCT. Continue test program with RUN 400.			
4	400 IEC←ERR	-	PUC programming as LISTEN ONLY instrument
	410 IEC$IN M$ 420 IF ST<>0 THEN 410 430 PRINT M$ 440 GOTO 410	- Output string *	Read loop: a corresponding output string appears on the screen each time the LOCAL/TALK key is pressed.
Terminate test program using stop key.			

Measurement: Check the display.
Permissible deviaton:
±1% of correct value ±1 Digit

Input voltage	Min.	Rated value	Max.	Unit
5 V	4.94	5.00	5.06	V
3 V	2.96	3.00	3.04	V
1 V	0.98	1.00	1.02	V
0 V	0.02	0.00	0.02	V
-5 V	5.06	-5.00	-4.94	V

3.2.5 Range Switchover with Unbalanced Input

3.2.5.1 AC Measurement

UPA setting: Set range as in Table 3-1 (autoranging off)
BNC input, channel R
Filters HP 300 Hz and LP 22 kHz
Detector RMS
Digital display in V
Test speed LEVEL SLOW

Test setup: See Fig. 3-1 for voltages > 100 mV:
Set test voltage between 100 mV and 300 V,
f = 1 kHz according to table.

See Fig. 3-2 for voltages < 100 mV:
Adjust attenuation set to 20-dB position. Set 1 V with f = 1 kHz on calibrator and adjust until the same readout of the measured value is obtained in the 100-mV range of the UPA as in Fig. 3-1 without the attenuation set.

The required input voltages can be obtained by switching the attenuation set up to 70 dB in 10-dB steps.

Measurement: Check the measured-value display

Permissible deviation:
±1% of correct value ±1 digit.

3.2.6 Range Switchover with Balanced Input

UPA setting: Set range as in Table 3-2
(autoranging off)
Input a/b 20 kΩ, channel R
Filters HP 300 Hz and LP 22 kHz
Detector RMS
Readout in V
Test speed LEVEL SLOW

Test setup: As in Fig. 3-3
Set test voltages 1 V and 10 V, f = 1 kHz

Measurement: Check the measured-value display

Permissible deviation:
±1% of correct value ±1 digit.

Table 3-2

Input voltage	Range	Min.	Rated value	Max.	Unit
1 V	1 V	989.9	1000.0	1010.1	mV
10 V	10 V	9.899	10.000	10.101	V

Table 3-3

Voltage 30 V, range 30 V, balanced input 20 kΩ, RMS				
Frequency	Min.	Rated value	Max.	Unit
10 Hz	29.09	30.00	30.91	V
30 Hz	29.69	30.00	30.31	V
1 kHz	29.69	30.00	30.31	V
20 kHz	29.69	30.00	30.31	V
100 kHz	29.09	30.00	30.91	V

Voltage 3 V, range 3 V, balanced input 20 kΩ, RMS				
Frequency	Min.	Rated value	Max.	Unit
10 Hz	2.909	3.000	3.091	V
30 Hz	2.969	3.000	3.031	V
1 kHz	2.969	3.000	3.031	V
20 kHz	2.969	3.000	3.031	V
100 kHz	2.909	3.000	3.091	V

Voltage 3 V, range 3 V, unbalanced input, RMS				
Frequency	Min.	Rated value	Max.	Unit
10 Hz	2.909	3.000	3.091	V
30 Hz	2.969	3.000	3.031	V
1 kHz	2.969	3.000	3.031	V
20 kHz	2.969	3.000	3.031	V
100 kHz	2.909	3.000	3.091	V

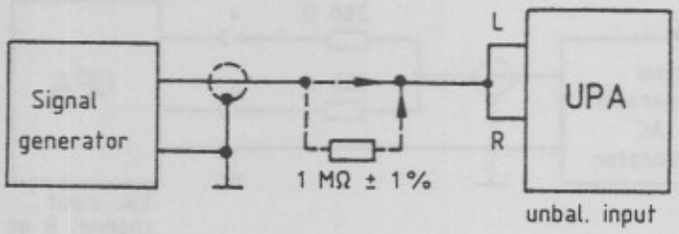
Voltage 3 mV, range 3 mV, unbalanced input, RMS				
Frequency	Min.	Rated value	Max.	Unit
10 Hz	2.909	3.000	3.091	mV
30 Hz	2.969	3.000	3.031	mV
1 kHz	2.969	3.000	3.031	mV
20 kHz	2.969	3.000	3.031	mV
100 kHz	2.909	3.000	3.091	mV

Voltage 10 V, range 10 V, unbalanced input, QPK				
Frequency	Min.	Rated value	Max.	Unit
10 Hz	9.599	10.000	10.401	V
30 Hz	9.899	10.000	10.101	V
1 kHz	9.899	10.000	10.101	V
20 kHz	9.899	10.000	10.101	V
100 kHz	9.699	10.000	10.301	V

3.2.8.2 Unbalanced Input c

UPA setting: BNC input (c, unbalanced)
Channel L or R
Range 1 V (autoranging off)
Detector RMS

Test setup:



Set signal generator to 1 V, 100 Hz.

Measurement: Connect signal generator directly to the BNC inputs L and R connected in parallel.
Read display on UPA: V1.

Connect a resistance of 1 MΩ into the internal conductor of the connection using a special adapter.
Read display on UPA: V2.

Calculate input impedance from

$$R = 1\ M\Omega \cdot \frac{1}{\frac{V1}{V2} - 1}$$

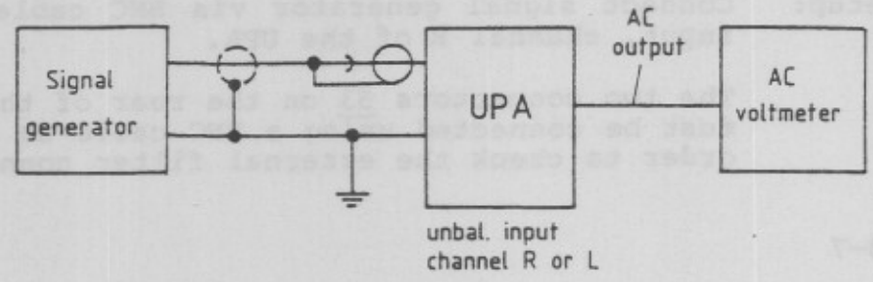
Nominal value R = 1 MΩ ± 1% (0.99 to 1.01 MΩ)

Check with channel settings L and R.

3.2.10 Common-mode Rejection of the Unbalanced Input c

UPA setting: Input c
Channel R or L
Filter LP 100 kHz
Measuring range and detector as in Table 3-6

Test setup:



Short-circuit BNC input and connect signal generator to the internal conductor of the interconnecting cable.

Measurement: Check the permissible displayed values on the AC voltmeter.

Table 3-6

Voltage	Frequency	Measuring range	Detector	Max. voltage at AC output	Common-mode rejection
.7 V	50 Hz	3 V	RMS	22 mV	>50 dB
7 V	1 kHz	0.3 V	Q peak	70 mV	>50 dB
7 V	16 kHz	1 V	Q peak	70 mV	>40 dB

3.2.12 Filter Curves

3.2.12.1 SOUND Weighting Filter to CCIR

UPA setting: Input c, channel R
Autoranging
Filter SOUND
Detector: quasi-peak
Digital display in dBV
Relative display in dB as in Table 3-8

Test setup: Connect signal generator to input, channel R of UPA via BNC cable, test voltage 1 V

Table 3-8

Frequency / Hz	Rated value / dB	Tolerance / dB
6300	12.2 dBV	±0.2 ref. value
Reduce displayed value by 12.2 dBV and store as reference value in the UPA; select relative dB display using %/dB key.		
6300	12.2	0 ±1 digit
31.5	-29.9	±2.0
63	-23.9	±1.4
100	-19.8	±1.0
200	-13.8	±0.8
400	-7.8	±0.5
800	-1.9	±0.3
1000	0	±0.2
2000	+5.6	±0.5
3150	+9.0	±0.5
4000	+10.5	±0.5
5000	+11.7	±0.5
6300	+12.2	0 ±1 digit
7100	+12.0	±0.2
8000	+11.4	±0.4
9000	+10.1	±0.6
10000	+8.1	±0.8
12500	0	±1.2
14000	-5.3	±1.4
16000	-11.7	±1.6
20000	-22.2	±2.0
31500	-42.7	+2.8/-5

3.2.12.3 Highpass Filters

UPA setting: Input c, channel R
Autoranging
Filter HP 300 Hz or 22 Hz
Detector RMS
Digital display in dBV

Test setup: See Fig. 3-1
Test voltage 1 V

Table 3-10

Connect 300-Hz highpass filter		
Frequency / Hz	Rated value / dBV	Tolerance / dB
60	-60	±2
150	< -24	-
300	-3	±0.5
1000	0	±0.1
10000	0	±0.1

Connect 22-Hz highpass filter		
Frequency / Hz	Rated value / dBV	Tolerance / dB
11.2	-18	±2
22.4	-3	±1
31.5	0	±0.5
100	0	±0.1
1000	0	±0.1
10000	0	±0.1

3.2.13 Inherent Noise Display with Level Measurement

UPA setting: Channel R
Autoranging
Digital display in V
Further settings as in Table 3-12

Test setup: Terminate BNC input, channel R with <600 Ω.

Table 3-12

Test setting		Display / µV
Unbalanced input c	Filter off, RMS	<15
	Filter off, quasi-peak	<30
	SOUND WTD, quasi-peak	<10
	TELEPHON WTD, RMS	< 2
	HP 22 Hz, LP 22 kHz, quasi-peak	< 7
Balanced input a/b 600 Ω	TELEPHON WTD, RMS	< 5
	SOUND WTD, quasi-peak	<20
	HP 22 Hz, LP 22 kHz, quasi-peak	<30

Additional requirements for UPA4:

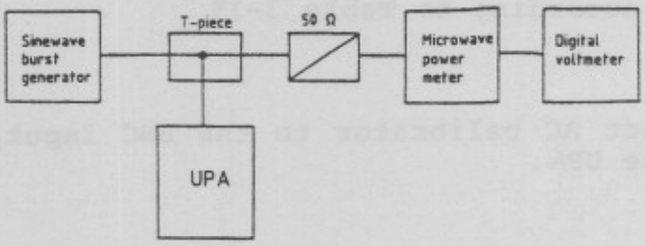
Test setup: Terminate BNC input, channel R with 50 Ω

Test setting		Display / µV
Unbalanced input c	Filter LP 22 kHz, RMS	<3

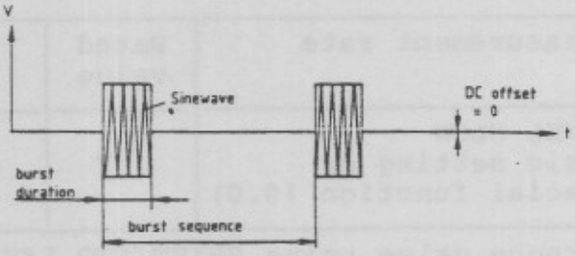
3.2.15 RMS Weighting

UPA setting: BNC input, channel R
Autoranging
Filter off
Detector RMS
Display in V
Test speed LEVEL SLOW

Test setup:



Waveform of input signal:



Measurement: Adjust the amplitude of the 5-kHz sinewave such that a value of 1 V is displayed on the UPA. The DC voltage value at the output of the microwave power meter is the reference value for the further measurement. Set generator to sinewave burst function, burst sequence frequency 100 Hz, modify burst duration according to test table and adjust the amplitude until the reference value of the sinewave setting is reached on the digital voltmeter.

Table 3-14

Waveform of input signal	Crest factor $\frac{V_{peak}}{V_{rms}}$	Input voltage V_{rms}	Display	
			Rated value	Tolerance
Sinewave	$\sqrt{2}$	1 V	1 V	±1 digit
Sinewave burst duration 2.2 ms	3	1 V	1 V	±5 mV
Sinewave burst duration 0.8 ms	5	1 V	1 V	±15 mV

Measurement: Check the display according to table

Table:

Input signal	Measurement rate	Display Rated value	Display max. ripple
3 V, 50 Hz	LEVEL SLOW (SPEC FCT 10)	0 V	±18 digit
3 V, 1 kHz	LEVEL SLOW (SPEC FCT 10)	0 V	±3 digit
3 V, 50 Hz	LEVEL FAST (SPEC FCT 10.1)	±Vp = ±4.3 V	*)

*) no AC suppression

3.2.17 Transient Response with RMS Measurements

UPA setting: BNC input, channel R
Measuring range 1 V
Filter LP 100 kHz
Detector RMS
Select relative display %Δ as analog bar with ±1% (special function 12.2)
Measurement rate LEVEL SLOW or FAST

Test setup: Connect function generator to the BNC input, channel R, of the UPA.
Select manual triggering,
sinewave signal 1 V, 5 kHz.

Measurement: With a continuous signal, adjust the relative display on the UPA to 0% using SHIFT/STO LEV.
Switch off continuous signal.
Switch on signal on generator and observe bar display.

Input signal 0 → 100%	Overshoots Rated value	Overshoots Tolerance
Measurement rate LEVEL SLOW (special function 10.0)	0%	+0.3%
LEVEL FAST (special function 10.1)	0%	+0.3%

3.2.18.2 Pulse Sequence

UPA setting:

Test setup:

See Section 3.2.18.1.

Measurement: Adjust the amplitude of the function generator such that the display is equal to 1 V with a continuous 5-kHz sinewave signal. Adjust sinewave burst sequence of frequency 5 kHz and burst duration 5 ms.

Read the maximum value on the digital display.

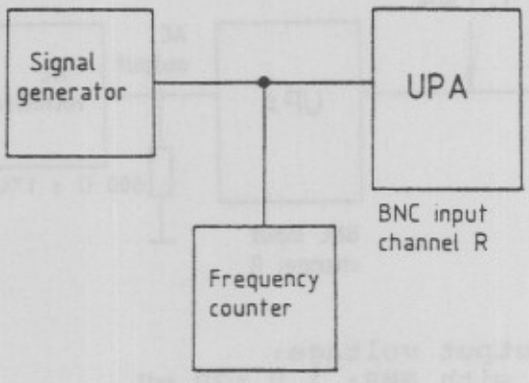
The bar display provides additional information for observing the dynamic repsonse of the display.

Pulse rate / Hz		2	10	100
Current display referred to display with continuous signal Rated value %		48	77	97
Limit value in %	min.	43	72	94
	max.	53	82	100

3.2.19 Frequency Counter

UPA setting: BNC input, channel R
Measuring range 1 V
Filter off
Detector RMS
Digital frequency display
Measurement rate FREQUENCY FAST
(basic setting or special function 11.1)

Test setup:



Measurement: Counter accuracy:

With a test voltage of 1 V, set frequencies between 8 Hz and 250 kHz.

Check the UPA frequency display:
maximum deviation from rated frequency:
$\pm 5 \times 10^{-5}$ ±1 digit.

With test frequency 9 kHz:
max. deviation of display: ±0.6 Hz.

Counter sensitivity:

Reduce test voltage to 20 mV, frequency 100 kHz.

Test: the frequency display of the UPA must remain stable.

3.2.21 Generator (Option UPA-B6)

3.2.21.1 Frequency Setting

UPA setting: Output voltage 1 V
BNC output, channel R
Display FREQUENCY SOURCE

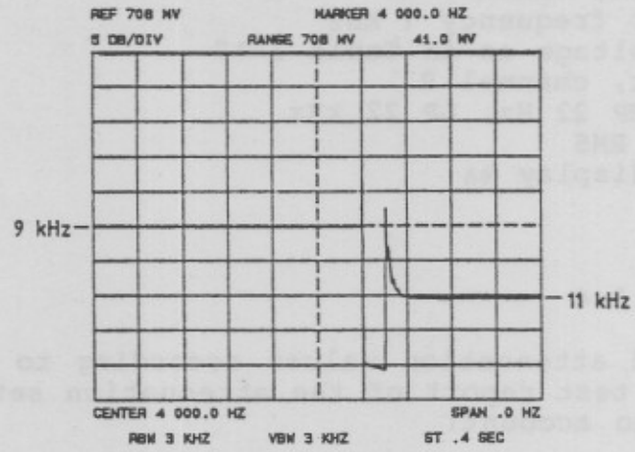
Test setup: Connect generator output c, channel R, of the UPA to the frequency counter using a BNC cable.

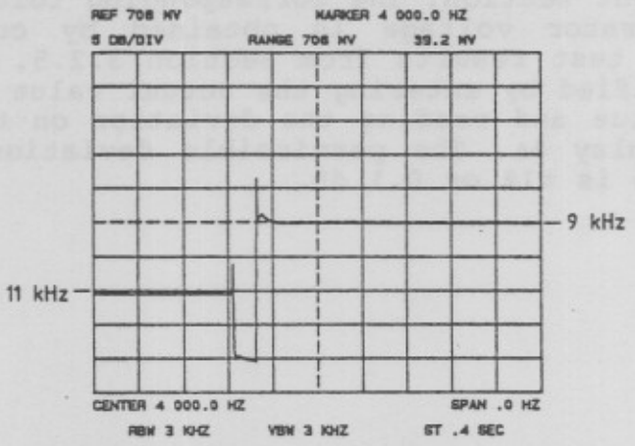
Measurement: Set the frequencies on the UPA according to Table 3-16 and check the frequencies using the frequency counter.

Table 3-16

Frequency setting and SOURCE display	Min.	Rated value	Max.	Unit
90000 Hz	89991	90000	90009	Hz
9000 Hz	8999.1	9000.0	9000.9	Hz
900 Hz	899.91	900.00	900.09	Hz
50370 Hz	50365	50370	50375	Hz
63620 Hz	63614	63620	63626	Hz

Test: The switchover time of the frequency must be <50 ms using the analyzer evaluation.





Horizontal resolution 40 ms/div

3.2.21.3 Frequency Variation using Spin Wheel

UPA setting: Press Hz or kHz key in the SOURCE field.
Frequency auto-increment (internal basic setting or special function 21.0).

Test: The frequency display must increase by 1 digit with each notch of the spin wheel in the clockwise direction. Each notch in the counterclockwise direction must lead to a decrease in the displayed value by 1 digit.

3.2.21.5 Frequency Response of the Output Voltage

UPA setting: BNC output, channel R
R_S = 30 Ω, 200 Ω or 600 Ω
Generator frequency and output voltage according to Table 3-18
BNC input, channel R
Filter off
Detector RMS
Digital display %Δ

Test setup: See Fig. 3-4

Measurement: Measure the generator output voltage using the UPA measurement section. The tolerance of the generator voltage is obtained by comparing with the test results from Section 3.2.5. The frequency-dependent tolerances of the output voltage are obtained with reference to 1 kHz.

The permissible deviation is:
±0.5% between 10 Hz and 20 kHz
±1% between 20 kHz and 100 kHz

Table 3-18 Testing the frequency response

Test settings:

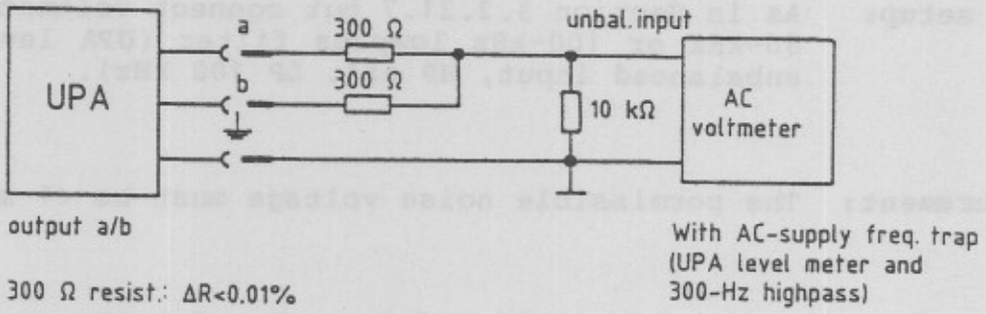
Frequency	Unit	
10	Hz	Measure the frequency response at the following levels: 10 V 2.5 V 0.1 V
30	Hz	
100	Hz	
1	kHz	
5	kHz	
10	kHz	
20	kHz	
50	kHz	
100	kHz	

In order to test the output circuit completely, repeat the test procedure for channel L and for the balanced outputs a/b, channels R and L. Be careful to use a voltmeter with balanced input for taking measurements at the balanced outputs with R_S = 200 Ω or 600 Ω.

3.2.21.7 Unbalance Rejection of Balanced Output a/b

UPA setting: Output a/b, channel R, R_S = 30 Ω
Output voltage and frequency according to Table 3-19.

Test setup:



output a/b

300 Ω resist.: ΔR<0.01%

With AC-supply freq. trap (UPA level meter and 300-Hz highpass)

Table 3-19 Testing the unbalance rejection

Voltage	Frequency	Permissible unbalance voltage	Unbalance rejection
10 V	1 kHz	<1 mV	>80 dB
10 V	16 kHz	<10 mV	>60 dB

3.2.21.10 Level Switch-off

UPA setting: Output voltage 10 V
Frequency 20 kHz
Switch BNC output c on and off again
Channel R

Test setup: Connect a voltmeter (with 80-kHz or 100-kHz lowpass filter) to the generator output c, channel R (UPA level meter with LP 100 kHz).

Test: The measured voltage value must be <100 µV.

3.2.21.11 Protection Against External Voltages

UPA setting: Output voltage 50 mV
Switch balanced output a/b on, Channel R
R_S = 30 Ω

Test setup: Connect DC voltage source to generator output a/b, channel R; limit maximum current to 300 mA.

Test: The generator output must be switched off from the external voltage source when the +5 V supply is switched on; this can be recognized in that the LED of channel display R is extinguished and the error message Er08 is output on the function/data display.

Switch off DC voltage source, press key a/b twice - LED R must light up again - and switch on -5 V supply. Check automatic switch-off and corresponding switch-on as for the positive external voltage.

3.2.22 Special Filter (Option UPA-B2)

UPA setting: BNC input, channel R
Measuring range 1 V (autoranging off)
Filter off
Detector quasi-peak
Function field off
Display in dBV

Test setup: Connect signal generator with V_{rms} = 1 V to the BNC input, channel R of the UPA.

3.2.22.1 A-weighting to DIN IEC 651

- Measuring range 1 V
- Switch on A-filter (1 / SPEC filter)

→ **Test the calibration with f = 1 kHz:**

- Signal generator to 1 kHz (±1 Hz)
- Permissible deviation referred to the display with the filters switched off ..... ±0.03 dB

3.2.22.2 Pilot Tone Trap with Lowpass Filter

- Measuring range 1 V
- Switch on 19-kHz trap (2/SPEC. filter)
- Display in dBV

Testing the insertion loss at 1 kHz:

- Permissible deviation referred to the display with the filters switched off ..... ±0.2 dB

Testing the attenuation characteristic:

Frequency/Hz	Rated value/dB	Tolerance/dB
1 kHz	0	Reference
15 kHz	0	±0.5
19 kHz ±1 Hz	< -60 * < -50	- -

* in the restricted temperature range 20 to 30°C

Note: Switch on autoranging at f = 19 kHz

3.2.22.3 Line Frequency Trap with Lowpass Filter

- Measuring range 1 V
- Switch on 15.625-kHz trap (3/SPEC. filter)
- Display in dBV

Testing the insertion loss at 1 kHz:

- Permissible deviation referred to the display with the filters switched off ..... ±0.2 dB

Testing the attenuation characteristic:

Frequency/Hz	Rated value/dB	Tolerance/dB
1 kHz	0	Reference
13 kHz	0	±0.5
15.625 kHz ±1 Hz	< -60 * < -50	- -

* in the restricted temperature range 20 to 30°C

Note: Switch on autoranging at f = 15.625 kHz

3.2.22.5 Lowpass Filters

- Measuring range 1 V
- Select lowpass filters in the special filter setting according to the test instructions
- RMS detector
- Display in dBV

Testing the attenuation characteristic:

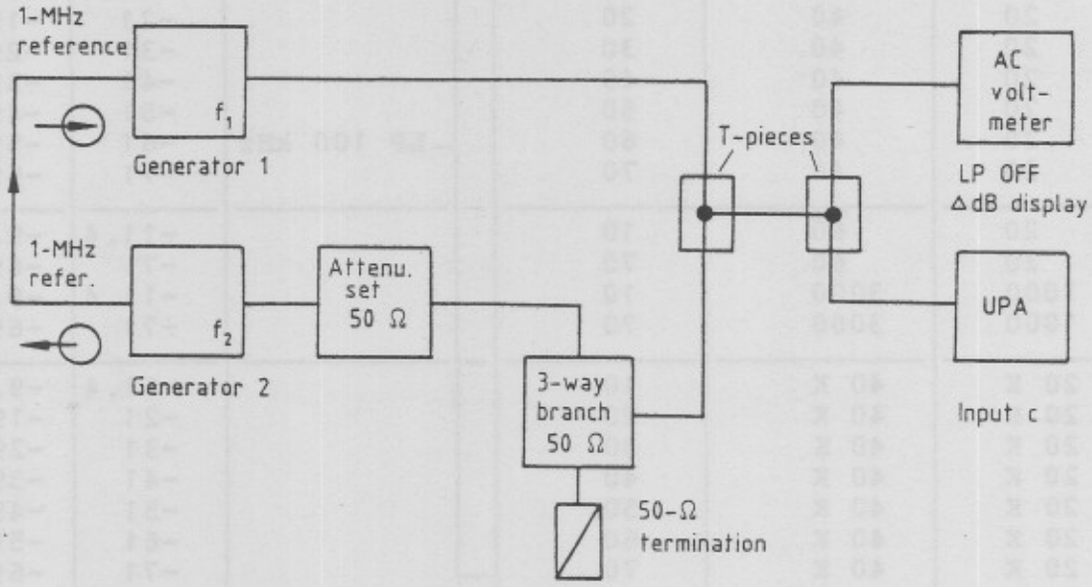
Lowpass filter	Special filter No.	Frequency	Rated value dBV	Tolerance dB
0.35 kHz	12	100 Hz 315 Hz 1000 Hz	0 0 < -40	±0.5 ±0.5 -
1.04 kHz	13	100 Hz 1 kHz 3.15 kHz	0 0 < -40	±0.5 ±0.5 -
3.5 kHz	14	1 kHz 3.15 kHz 6.3 kHz	0 0 < -40	±0.5 ±0.5 -
7 kHz	15	1 kHz 6.3 kHz 10 kHz	0 0 < -40	±0.5 ±0.5 -
10.4 kHz	16	1 kHz 10 kHz 15 kHz	0 0 < -40	±0.5 ±0.5 -
15 kHz	17	1 kHz 12.5 kHz 20 kHz	0 0 < -40	±0.5 ±0.5 -

Frequency/Hz	Voltage/V	Measuring range on UPA	Filter on UPA	Residual distortion/dB
Additional requirements for UPA4:				
40	1	1	LP 22 kHz	< -97
40	2	3		
1 K	1	1		
1 K	2	3		
20 K	1	1		
20 K	2	3		
1 K	0.002	Auto	A-Filter (Nr. 1 OPT.-B2)	< -50
UPA input a/b; 20 kΩ, channel R				
10	21	30 V	LP 22 kHz	< -68
30	21	30 V	LP 100 kHz	< -83
50	21	30 V	LP 22 kHz	< -88
1 K	0.0030	10 mV	LP 100 kHz	< -38
1 K	0.0030	10 mV	without	< -34

3.2.23.2 Measurement Accuracy of Total Harmonic Distortion

UPA setting: Input c, channel R, range 3 V,
special function 3.1, select filter according to Table 3-23
Function DISTORTION TOTAL, dB

Test setup:



Generator 1: Unbalanced, external reference input
(item 6, Section 3.1)

Generator 2: Z_S = 50 Ω, 7.44 V
(item 2, Section 3.1) External reference output

Settings with each frequency combination according to Table 3-23:

a) Generator 1: 3.72 V, f1
Attenuation set: 40 dB
Generator 2: f2
AC voltmeter: Store input voltage as reference value

b) Generator 1: 1 mV
Generator 2: Correct voltage such that AC voltmeter displays -40.0 dB

c) Generator 1: Set 3.72 V again
Attenuation set: Attenuation value a

Measurement: Adjust settings according to Table 3-23 and check the harmonic distortion

3.2.23.3 Residual Distortion and Noise with Selective Harmonic Distortion Measurement

UPA setting: Select input and measuring range according to table 3-24, filter off
Function DISTORTION n x f_o, dB,
Select the harmonics according to Table 3-24.

Test setup: Connect low-distortion sinewave generator to the BNC input, channel R of the UPA

Measurement: Adjust the frequency and voltage according to the table and check the residual distortion.

Table 3-24

Frequency/Hz	Voltage/V	Measuring range on UPA	Harmonics n	Residual distortion/dB
UPA input c; channel R				
10	3.4	3 V	2	< -85
10			3	
1 K			2	
1 K			3	
20 K			2	
20 K			3	
100 K			2	< -70
100 K			3	
100 K	0.0030	10 mV	3	< -64
UPA input a/b; 20 kΩ, channel R				
100 K	0.0030	10 mV	3	< -60
Additional requirements for UPA4: UPA4 input c; channel R Set filter LP to 22 kHz, function THD using SPEC FCT 33.1 and n = 2 - 9.				
40	1	1	2 - 9	< -105
40	2	3		
1 K	1	1		
1 K	2	3		
20 K	1	1		< -100
20 K	2	3		

Table 3-25

Frequency f1 Hz	Frequency f2 Hz	Frequency f3 Hz	Harmonics n	Harmonic distortion Min. dB	Harmonic distortion Max. dB
10.5	21	882	2		
98	196	882	9		
315	630	8820	2		
980	1960	8820	9	-42	-38
3150	6300	88200	2		
9800	19600	88200	9		
36500	73000	146000	2		
29200	116800	146000	5		
58400	116800	292000	5		

Checking the measurement accuracy:

Level on generator 1: 3.72 V
Level on generator 2: 7.44 V
Level on generator 3: 1 mV

Setting with each frequency combination according to Table 3-26:

a) Generator 1: f1
Attenuation set: 40 dB
Generator 2: f2
Generator 3: 1 mV, f3
AC voltmeter: Store measured voltage as reference value

b) Generator 1: 1 mV
Generator 2: Correct voltage such that AC voltmeter displays -40 dB

c) Generator 1: Set voltage to 3.72 V again
Attenuation set: Attenuation value a
Generator 3: Level b in dBV

3.2.24 Wow and Flutter Meter (Option UPA-B9)

3.2.24.1 Wow and Flutter Measurements

UPA setting: BNC input, channel R
Measuring range 1 V (autoranging off)
Filter off
Detector RMS
Function WOW&FLUTTER, DIN, NAB, JIS, WTD or UNWTD according to test instructions
Combined display (digits and bar)

Test setup: Connect signal generator with frequency modulation to the BNC input, channel R, of the UPA.

→ **Testing the input bandpass filter:**

- Signal generator setting: 1 V without FM
  f_o = 3 kHz and 3.15 kHz
- UPA setting: W&F, DIN, UNWTD
- Check: The W&F display on the UPA must settle in each case to a very small inherent noise value.
- Signal generator setting: f_o = 1 kHz and 6.3 kHz
- Check: The W&F display is cleared.

→ **Testing the level comparator:**

- Signal generator setting: 120 mV without FM
  f_o = 3.15 kHz
- UPA setting: W&F, DIN, UNWTD
- Check: The W&F display on the UPA must settle to a very small inherent noise value.
- Signal generator setting: 40 mV
- Check: The W&F display is cleared.

→ **Testing the frequency response with weighted wow & flutter measurements:**

- UPA setting: DIN, WTD

- Signal generator setting:
  1 V
  f_o = 3.15 kHz
  f_{MOD} as specified

  With f_{MOD} <4 Hz, the 2-sigma test method should be selected on the UPA to enable more accurate reading:
  input 30.1/SPEC.FCT,
  start with the key SPEC.FCT.

  Set f_{MOD} = 4 Hz on the signal generator and adjust the frequency deviation such that the W&F display on the UPA is exactly 5%.

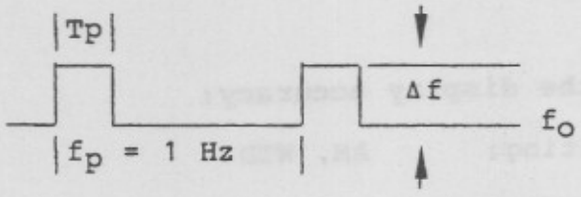
f_{MOD} Hz	Weighting dB to DIN 45507	Tolerance dB	Rated value %
0.2	-30.6	+10/-4	0.093 to 0.47
0.315	-19.7	±4	0.33 to 0.82
0.4	-15.0	±4	0.56 to 1.41
0.63	-8.4	±2	1.51 to 2.39
0.8	-6.0	±2	1.98 to 3.15
1	-4.2	±2	2.45 to 3.88
1.6	-1.8	±2	3.22 to 5.11
2	-0.9	±2	3.57 to 5.67
4	0 reference	±0	5(set value)
6.3	-0.9	±2	3.57 to 5.67
10	-2.1	±2	3.13 to 4.96
20	-5.9	±2	2.02 to 3.2
40	-10.4	±2	1.19 to 1.9
63	-14.2	±4	0.61 to 1.55
100	-17.3	±4	0.43 to 1.09
200	-23.0	±4	0.22 to 0.56

→ **Testing the pulse response to DIN:**

- UPA setting: W&F, DIN, WTD, measurement rate LEVEL FAST (10.1/SPEC.FCT.)

- Signal generator setting: 1 V
  f_o = 3.15 kHz
  Adjust the frequency deviation with f_{MOD} = 4 Hz such that exactly 5% is displayed on the UPA (sinewave modulation).

  Set the signal generator to squarewave modulation with the same deviation, pulse frequency 1 Hz and pulse width as below.



Pulse width T_p ms	Rated value %	Tolerance %
10	1.05	±0.15
30	3.1	±0.3
60	4.5	±0.3
100	5	±0.2

Test with pulse width 100 ms:

The bar display on the UPA must return to 2.05% ±0.2% between the pulses.

3.2.25 DC Output (Option UPA-B1)

UPA setting: Call service function level with special function 60 or 60.0. Enter further special functions according to Table 3-27 to set defined DC voltage values at the DC outputs.

Test setup: Connect a DC voltmeter to outputs DC1 50 or DC2 51 on the rear of the instrument.

Table 3-27

Input	Measurement	Output voltage Rated value	Tolerance
SPEC.FCT 62.1	at DC1	-10 V	±15 mV
62.0	at DC1	0 V	±15 mV
62.2	at DC1	+9.995 V	±15 mV
62.4	at DC2	-10 V	±15 mV
62.3	at DC2	0 V	±15 mV
62.5	at DC2	+9.995 V	±15 mV

Leave the service level again after the test by pressing the CLEAR key.

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
	DC measurement	3.2.5.2				
	5 V		4.94	....	5.06	V
	0 V		-0.02	....	0.02	V
	-5 V		-5.06	....	-4.94	V
	50 V		49.4	....	50.6	V
	0 V		-0.2	....	0.2	V
	-50 V		-50.6	....	49.4	V
	300 V		296	....	304	V
	0 V		-2	....	2	V
	-300 V		-304	....	-296	V
6	Measuring range switchover, balanced input, RMS	3.2.6		....		
	10 V		9.899		10.101	V
	1 V		989.9		1010.1	mV
7	Frequency response with level measurements: Balanced input, RMS	3.2.7				
	3 V, 10 Hz		2.909	....	3.091	V
	3 V, 30 Hz		2.969	....	3.031	V
	3 V, 20 kHz		2.969	....	3.031	V
	3 V, 100 kHz		2.909	....	3.091	V
	Unbalanced input, RMS					
	3 V, 30 Hz		2.969	....	3.031	V
	3 V, 1 kHz		2.969	....	3.031	V
	3 V, 20 kHz		2.969	....	3.031	V
	3 mV, 10 Hz		2.909	....	3.091	mV
	3 mV, 20 kHz		2.969	....	3.031	mV
	3 mV, 100 kHz		2.909	....	3.091	mV
	Unbalanced input, quasi-peak					
	10 V, 10 Hz		9.599	....	10.401	V
	10 V, 30 Hz		9.899	....	10.101	V
	10 V, 20 kHz		9.899	....	10.101	V
	Additional requirement for UPA4: Unbalanced input, RMS, reference 1 kHz					
	100 mV, 1 V, 20 Hz		-0.05	....	+0.05	dB
	100 mV, 1 V, 40 Hz		-0.03	....	+0.03	dB
	100 mV, 1 V, 20 kHz		-0.03	....	+0.03	dB
	10 V, 20 Hz		-0.05	....	+0.05	dB
	10 V, 40 Hz		-0.03	....	+0.03	dB
	10 V, 20 kHz		-0.03	....	+0.03	dB

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
14	Highpass filters HP 300 Hz Attenuation rel. to 1 kHz 60 Hz 300 Hz HP 22 Hz Attenuation rel. to 1 kHz 11.2 Hz 22.4 Hz	3.2.12.3	 - -3.5 -16 -4		 -60 -2.5 -20 -2	 dB dB dB dB
15	Lowpass filters LP 100 kHz Attenuation rel. to 1 kHz 100 kHz 300 kHz LP 22 kHz Attenuation rel. to 1 kHz 22.4 kHz 44.8 kHz	3.2.12.4	 -3.5 - -4 -		 -2.5 -27 -2 -24	 dB dB dB dB
16	Inherent noise display, Unbalanced input Without filter, RMS Without filter, quasi-peak SOUND WTD, quasi-peak TELEPHON WTD, RMS HP 22 Hz, LP 22 kHz, quasi-peak Balanced input 600 Ω TELEPHON WTD, RMS SOUND WTD, quasi-peak HP 22 Hz, LP 22 kHz, quasi-peak	3.2.13	 - - - - - - - -		 15 30 10 2 7 5 20 30	 µV µV µV µV µV µV µV µV
	Addition to UPA4: Unbalanced input LP 22 kHz, RMS		 -		 3	 µV

R & S

Date: .....

Audio Analyzer UPA

Generator Option UPA-B6

Ord. No.: 373.0010.02

Name: .....

Serial No.: .....

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
1	Frequency setting	3.2.21.1				
	90000 Hz		89991	....	90009	Hz
	9000 Hz		8999.1	....	9000.9	Hz
	900 Hz		899.91	....	900.09	Hz
	50370 Hz		50365	....	50375	Hz
	63620 Hz		63614	....	63626	Hz
2	Frequency range	3.2.21.2	-	....	-	-
3	Spin wheel funct.	3.2.21.3				
4	Output voltage	3.2.21.4				
	5 V, 1 kHz		4.95	....	5.05	V
	0.5 V, 1 kHz		0.495	....	0.505	V
	50 mV, 1 kHz		49.5	....	50.5	mV
	5 mV, 1 kHz		4.95	....	5.05	mV
	15 dBV, 1 kHz		14.9	....	15.1	dBV
	15.8 dBV, 1 kHz		15.7	....	15.9	dBV
	5 dBV, 1 kHz		4.9	....	5.1	dBV
	-70 dBV, 1 kHz		-70.1	....	-69.9	dBV
	19 dBV, 1 kHz		18.9	....	19.1	dBV
	16 dBV, 1 kHz		15.9	....	16.1	dBV
5	Frequency response of output voltage	3.2.21.5				
	2.5 V, 10 Hz		-0.5	....	+0.5	%
	30 Hz		-0.5	....	+0.5	%
	100 Hz		-0.5	....	+0.5	%
	1 kHz		0	Ref.	0	%
	5 kHz		-0.5	....	+0.5	%
	10 kHz		-0.5	....	+0.5	%
	20 kHz		-0.5	....	+0.5	%
	50 kHz		-1	....	+1	%
	100 kHz		-1	....	+1	%
				....		
	10 V, 10 Hz		-0.5	....	+0.5	%
	1 kHz		0	Ref.	0	%
	20 kHz		-0.5	....	+0.5	%
	100 kHz		-1	....	+1	%
	0.1 V, 10 Hz		-0.5	....	+0.5	%
	1 kHz		0	Ref.	0	%
	20 kHz		-0.5	....	+0.5	%
	100 kHz		-1	....	+1	%

R & S Date: .....

Audio Analyzer UPA

Special Filter Option UPA-B2

Ord. No.: 373.1216.02 Name: .....

Serial No.: .....

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
1	A-weighting at 1 kHz	3.2.22.1	-03	...	+0.3	%Δ
	Attenuation rel. to 1 kHz					
	16 Hz		-66.7	...	-53.7	dB
	31.5 Hz		-40.9	...	-37.9	dB
	63 Hz		-27.7	...	-24.7	dB
	100 Hz		-20.1	...	-18.1	dB
	315 Hz		-7.6	...	-5.6	dB
	800 Hz		-1.8	...	+0.2	dB
	1000 Hz		-	0	-	dB
	3150 Hz		+0.2	...	+2.2	dB
	6300 Hz		-2.1	...	+1.4	dB
	10 kHz		-6.5	...	-0.5	dB
	12.5 kHz		-10.3	...	-1.3	dB
	20 kHz		-19.3	...	-6.3	dB
2	Pilot tone trap	3.2.22.2				
	Attenuation at 1 kHz rel. to 1 kHz		-0.2	...	+0.2	dB
	15 kHz		-0.5	...	+0.5	dB
	19 kHz		-	...	-60 *	dB
			-	...	-50	
3	Line frequency trap	3.2.22.3				
	Attenuation at 1 kHz rel. to 1 kHz		-0.2	...	+0.2	dB
	13 kHz		-0.5	...	+0.5	dB
	15.625 kHz		-	...	-60 *	dB
			-	...	-50	

* restricted temperature range 20 to 30°C

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
5	LP 0.35 kHz Attenuation	3.2.22.5				
	at 100 Hz		-0.5	...	+0.5	dB
	315 Hz		-0.5	...	+0.5	dB
	1000 Hz		-	...	-40	dB
	LP 1.04 kHz Attenuation					
	at 100 Hz		-0.5	...	+0.5	dB
	1 kHz		-0.5	...	+0.5	dB
	3.15 kHz		-	...	-40	dB
	LP 3.5 kHz Attenuation					
	at 1 kHz		-0.5	...	+0.5	dB
	3.15 kHz		-0.5	...	+0.5	dB
	6.3 kHz		-	...	-40	dB
	LP 7 kHz Attenuation					
	at 1 kHz		-0.5	...	+0.5	dB
	6.3 kHz		-0.5	...	+0.5	dB
	10 kHz		-	...	-40	dB
	LP 10.4 kHz Attenuation					
	at 1 kHz		-0.5	...	+0.5	dB
	10 kHz		-0.5	...	+0.5	dB
	15 kHz		-	...	-40	dB
	LP 15 kHz Attenuation					
	at 1 kHz		-0.5	...	+0.5	dB
	15 kHz		-0.5	...	+0.5	dB
	20 kHz		-	...	-40	dB

Item No.	Characteristic			Measure as in Section	Min.	Actual value	Max.	Unit
2	Measurement accuracy, total harmonic distortion, unbalanced input			3.2.23.2				
	f1	f2	a					
	10Hz	20Hz	10dB		-12.4	...	-8.4	dB
	10Hz	20Hz	70dB		-72	...	-68	dB
	20Hz	40Hz	10dB		-11.4	...	-9.4	dB
	20Hz	40Hz	20dB		-21	...	-19	dB
	20Hz	40Hz	30dB		-31	...	-29	dB
	20Hz	40Hz	40dB		-41	...	-39	dB
	20Hz	40Hz	50dB		-51	...	-49	dB
	20Hz	40Hz	60dB		-61	...	-59	dB
	20Hz	40Hz	70dB		-71	...	-69	dB
	20Hz	60Hz	10dB		-11.4	...	-9.4	dB
	20Hz	60Hz	70dB		-71	...	-69	dB
	1kHz	3kHz	10dB		-11.4	...	-9.4	dB
	1kHz	3kHz	70dB		-71	...	-69	dB
	20kHz	40kHz	10dB		-11.4	...	-9.4	dB
	20kHz	40kHz	20dB		-21	...	-19	dB
	20kHz	40kHz	30dB		-31	...	-29	dB
	20kHz	40kHz	40dB		-41	...	-39	dB
	20kHz	40kHz	50dB		-51	...	-49	dB
	20kHz	40kHz	60dB		-61	...	-59	dB
	20kHz	40kHz	70dB		-71	...	-69	dB
	20kHz	100kHz	10dB		-11.4	...	-9.4	dB
	20kHz	100kHz	70dB		-71	...	-69	dB
	24kHz	48kHz	10dB		-12.4	...	-8.4	dB
	24kHz	48kHz	70dB		-72	...	-68	dB
	100kHz	300kHz	10dB		-12.4	...	-8.4	dB
	100kHz	300kHz	20dB		-22	...	-18	dB
	100kHz	300kHz	30dB		-32	...	-28	dB
	100kHz	300kHz	40dB		-42	...	-38	dB
	100kHz	300kHz	50dB		-52	...	-48	dB
	100kHz	300kHz	60dB		-62	...	-58	dB
	Additional requirement for UPA4:							
	Measuring linearity				-96	...	-94	dB

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
5	Measurement accuracy selective distortion measurement	3.2.23.4				
	f1 kHz / f2 kHz / f3 kHz / a dB / Harm. n					
	17.5 / 70 / 35 / 40 / 4		-42	...	-38	dB
	17.5 / 70 / 35 / 70 / 4		-72	...	-68	dB
	30 / 60 / 120 / 40 / 2		-42	...	-38	dB
	30 / 60 / 120 / 70 / 2		-72	...	-68	dB
	20 / 40 / 120 / 40 / 2		-42	...	-38	dB
	20 / 40 / 120 / 70 / 2		-72	...	-68	dB
	70 / 140 / 420 / 40 / 2		-43	...	-37	dB
	70 / 140 / 420 / 70 / 2		-73	...	-67	dB
	75 / 300 / 150 / 40 / 4		-43	...	-37	dB
	75 / 300 / 150 / 60 / 4		-63	...	-57	dB
	100 / 200 / 400 / 40 / 2		-43	...	-37	dB
	100 / 200 / 400 / 60 / 2		-63	...	-57	dB

Item No.	Characteristic	Measure as in Section	Min.	Actual value	Max.	Unit
1	Attenuation characteristic DIN UNWTD FAST	3.2.24.1				
	f_{Mod} 0.2 Hz		2.65	...	2.98	%
	0.315 Hz		3.05	...	3.42	%
	0.63 Hz		3.62	...	4.07	%
	1 Hz		3.97	...	4.46	%
	4 Hz		-	5	-	%
	20 Hz		4.83	...	5.18	%
	63 Hz		4.83	...	5.18	%
	100 Hz		4.83	...	5.18	%
	200 Hz		4.46	...	5.0	%
	300 Hz		3.34	...	4.46	%
	Pulse response to DIN, WTD					
	Relative display with pulse width					
	10 ms		0.9	...	1.2	%
	30 ms		2.8	...	3.4	%
	60 ms		4.2	...	4.8	%
	100 ms		4.8	...	5.2	%
	Minimum display with pulse width					
	100 ms		1.85	...	2.25	%
2	Display accuracy AM WTD f_{Mod} = 4 Hz	3.2.24.2				
	m = 17.1%		2.75	...	3.25	dB
	51.9%		9	...	11	dB
	81.8%		17.5	...	22.5	dB
	Inherent noise display		-	...	0.02	dB
	Carrier frequency influence AM WTD f_{Mod} = 4 Hz					
	f_o = 2 kHz		2.75	...	3.25	dB
	20 kHz		2.75	...	3.25	dB
	Difference Δ		-	...	0.05	dB

3.4 Maintenance

Under normal operating conditions, regular electrical or mechanical maintenance is not required. To guarantee correct operation of all functions, it is recommendable to check the back-up lithium battery for the CMOS RAM every 2 to 3 years.

3.4.1 Checking the Lithium Battery

A CMOS RAM with back-up battery is used to protect the stored settings and reference values as well as the calibration values when the UPA is switched off.

The battery service life is typically 10 years.

Check:

- Switch off instrument.
- Remove top cover of instrument and the screening cover.
- Connect a DC voltmeter to the battery terminals (see Fig. 4-2 for battery position).
- The voltage must be >2.5 V.
- Replace the battery if the voltage is too low.

Battery replacement:

- Remove the processor board A11 (Ord. No. 372.8317) from the instrument by pulling up on the plastic levers at the sides.

  Note: The solder side of the controller board must not be placed on a conductive surface in order not to short-circuit the lithium battery. For proper handling of the board refer to the relevant instructions to prevent electrostatic discharge.

- If the automatic self-test carried out when the UPA is switched on has not indicated any error messages, the data stored can be saved before removing the battery by connecting an external DC voltage of approx. 3 V in parallel to the built-in battery via a dropping resistor of 10 kΩ. Connect the positive pole to the battery solder tag and the negative pole to the screen of the processor board.
- Cut the plastic tie.
- Unsolder the lithium battery G1 and replace, ensuring that a short-circuit does not take place.
- Remove auxiliary power supply.

3.4.3 Software Calibration of the UPA

A software calibration must be carried out following repairs as in Section 5, if the error messages Er 21 and 22 occur, or to bring up the instrument to specification standard.

The software calibration comprises the following three steps:

1: Offset correction

2: AC level calibration

3: DC level calibration

Prior to a level calibration, an offset correction must always be performed. The AC or DC level calibration can be performed in either sequence.

If the UPA is calibrated completely, it is sufficient to call the calibration level during procedure 1 and leave it again when procedure 3 is finished. It is also permissible to terminate the left-hand channel (L) with a resistance for offset correction and simultaneously connect an appropriate calibration voltage to the right-hand channel (R).

2. AC level calibration		
Connect a calibration generator with a sinewave V_{rms} = 3 V, f = 1 kHz to signal input c, channel R of the UPA (permissible range of calibration voltage 2.5 V to 3.01 V).		
Procedure	**Manual entry**	**IEC-bus commands**
Call calibration level	SPEC FCT 50 or 50.0	CALIBRATION (ENABLE)
Display	CAL	CAL
Call calibration routine	SPEC FCT 50.2	—
Display	En. CAL	—
Enter the known calibration voltage value (tolerance <0.1 %)	Input sequence: [Value] [SHIFT] [V/mV] [STO LEV]	Corresponds to data of the following calibration command
Display	En.CAL	—
Enable calibration routine	SPEC FCT 50.2	CALIBRATION (LEVEL) data
Display during level calibration	CAL1, CAL2, CAL3	CAL1, CAL2, CAL3
Routine successfully terminated with display	CAL	CAL
Leave calibration level	Clear key	CALIBRATION (DISABLE)

Error messages which may occur before or during AC level calibration:

Display	Meaning
Er 22	Internal calibration values for AC or DC measurement are missing (when switching on the UPA).
* Er 22.1	Internal offset correction values for calibration are missing.
* Er 22.2	Reference value for calibration is missing.
* Er 22.3	Reference value for calibration out of tolerance (2.5 V to 3.01 V permissible).
* Er 22.8	Calibration for 300-Hz highpass filter faulty.
* Er 22.9	Basic calibration faulty (rms or quasi-peak measuring path).

Note: In IEC-bus mode, SRQ 113 (cal error) is generally output for the error messages marked by *).

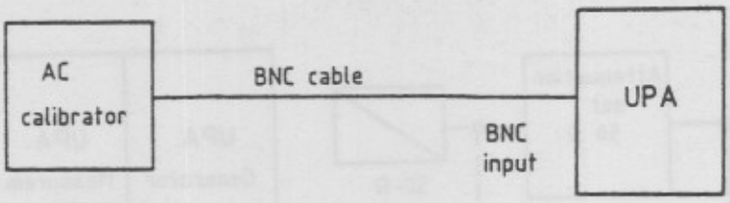


Fig. 3-1 Test setup for level and frequency response measurements

Sinewave voltage V_{rms} = 100 mV to 300 V
Frequency 10 Hz to 100 kHz

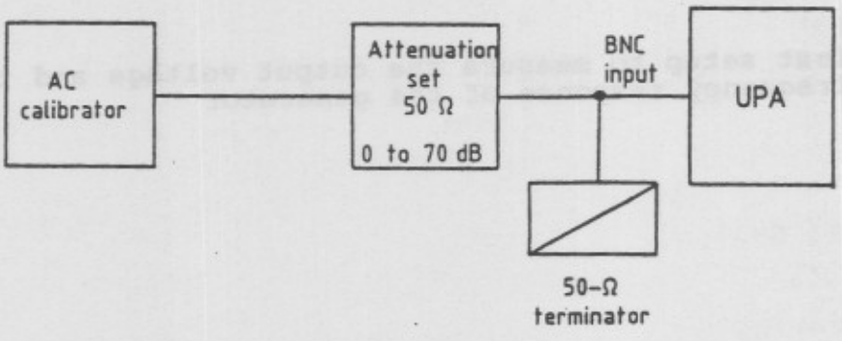


Fig. 3-2 Test setup for level and frequency response measurements

Sinewave voltage 0.1 mV to 100 mV
Frequency 10 Hz to 10 kHz

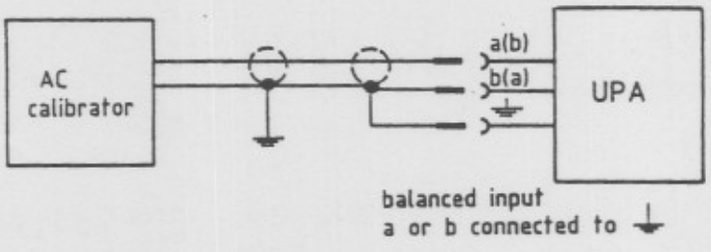


Fig. 3-3 Test setup for level and frequency response measurements

Balanced input
Sinewave voltage 100 mV to 35 V
Frequency 10 Hz to 100 kHz