ROHDE&SCHWARZ

Measuring Instruments
and Systems Division

Operating Manual

AUDIO ANALYZER

UPA

372.6014.02

Printed in the Federal
Republic of Germany

372.9236.12 - 1

Table of Contents

2 Operation

The values in this section are not guaranteed; only the technical data on the data sheet are binding.

The designations of the controls refer to Figs. 2-1 and 2-2 (in the appendix).

2.1 Explanation of the Controls

2.1.1 Front Panel, Fig. 2-1

Item No.	Designation	Function
1	SOURCE V mV dBV dBm(Z)	Function keys. 1. Input of generator level unit. 2. Assignment of LEVEL display 2 to generator. 3. Assignment of generator level to spin wheel. 4. Subsequent pressing of key to enter a level step value for the spin wheel.
2	LEVEL	5-digit LCD display with special display facilities.
3	SOURCE kHz Hz	Function keys. 1. Input of generator frequency unit. 2. Assignment of FREQUENCY display 6 to generator. 3. Assignment of generator frequency to spin wheel. 4. Subsequent pressing of key to enter a frequency step value for the spin wheel.
4	◄	Key to change the mode of the LEVEL display 2.
5	MEAS V dBV dBm(Z) W(Z) V/mV dBV dBm W/mW	Function keys. First function: input of unit in which the input signal is to be displayed. Second function: specification of unit for reference level input.
6	FREQUENCY	5-digit LCD display with special display facilities.

Item No.	Designation	Function
7	MEAS %/dB	Key for selecting relative level measurements %: Display of percentage deviation between input value and reference level. dB: Display of deviation between input value and reference level in dB.
8	MEAS RCL LEV STO LEV	Function key. First function: call stored reference level. Second function: subsequent pressing for reference level input.
9	◄	Key to change the mode of the FREQUENCY display 6.
10	MEAS FREQ kHz/Hz	Function key. First function: display of input frequency in Hz or kHz. Second function: specification of unit Hz or kHz for reference frequency input.
11	MEAS Δf/Δf%	Key for selecting relative frequency measurements. Δf: Display of deviation between input value and reference frequency in Hz or kHz. Δf%: Display of percentage deviation between input value and reference frequency.
12	MEAS RCL FREQ STO FREQ	Function key. First function: call of stored reference frequency. Second function: subsequent pressing for reference frequency input.
13	FUNCTION/DATA	5-digit LCD display with special display functions.

Item No.	Designation	Function
14	%/dB	Key for selecting distortion measurements or wow & flutter measurement AM. %: Display in percent. dB: Display in dB.
15	◄—	Key to change the mode of the FUNCTION/DATA display 13.
16	REM SRQ LLO READY	LEDs to indicate the status during remote control (IEC bus) REMOTE: remote mode activated. SERVICE REQUEST LOCAL LOCKOUT: switchover to manual mode using the LOCAL key 18 is not possible READY: valid data in output buffer or data output on displays 2, 6, 13 in manual mode.
17	SHIFT	Key to select the second function level (blue key labelling). The LED indicates that a key entry is being made at the second function level.
18	LOCAL/TALK	Key for conditional interrupt of REMOTE status and for data output in Talk Only mode.
19	SPEC FCT	Key to enter and recall a special function and start the 2-sigma measurement or sweep. The LED indicates that the 2-sigma measurement or sweep is being carried out.
20	STO SET STO Z/Ω	First function: key to store complete instrument settings Second function: subsequent pressing for impedance value input for level measurements in dBm or W and for generator level setting in dBm.

Item No.	Description	Function
21	RCL SET RCL Z	First function: key to call a complete device setting Second function: press for brief display of current impedance value on the FUNCTION/ DATA display 13.
22	SOURCE INCR LIN INCR LOG	First function: 1. Key to enter a linear frequency or level step value for generator setting via the spin wheel 41. 2. Key to recall the current step value onto the FUNCTION/DATA display 13. Second function: key to enter a logarithmic frequency or level step value for generator setting via the spin wheel 41.
23	CLEAR	Correction key to establish a standardized state.
24	7 8 9 4 5 6 1 2 3 +/- 0 .	Numeric keypad to enter values with a decimal point and sign.
25	NOISE SINAD S/N	Rollkey to select noise measurements: SINAD: combined SIGNAL NOISE DIS- TORTION measurements S/N: SIGNAL/NOISE measurements LEDs to indicate the set state.

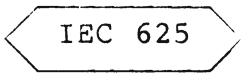
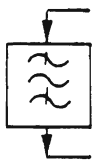
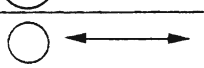
Item No.	Designation	Function
26	DIST	Rollkey. First function: 1. Selection of distortion measurements. TOTAL: total distortion factor $3xf_o$: distortion factor of the 3rd harmonic. nxf_o: distortion factor of the nth harmonic (n = 2 to 9). 2. Subsequent pressing for input of required ordinal number for the function nxf_o. Second function: call of ordinal number entered for nxf_o with short display on FUNCTION/DATA display 13.
	TOTAL $3 \cdot f_o$ $n \cdot f_o$ — THD	LEDs to indicate the set state. THD setting see SPEC FCT 33
27	WOW & FLUTTER	Rollkey to select the signal weighting for wow & flutter measurements. WTD: Standardized noise weighting UNWTD FAST: Unweighted noise measurements UNWTD SLOW: Unweighted noise measurements with additional display
	WTD UNWTD FAST UNWTD SLOW	LEDs to indicate the set state.
28	WOW & FLUTTER	Rollkey to select the wow & flutter mode DIN, NAB or AM. DIN: Pitch variation measurements in % to DIN, IEC, CCIR. Reference value 3.15 kHz and quasi-peak value rectifier. NAB: Pitch variation measurements in % to NAB. Reference value 3 kHz and mean value rectifier. AM: Amplitude variation measurements in dB with quasi-peak value rectifier.
	DIN NAB — JIS AM	LEDs to indicate the set value. JIS setting see SPEC FCT 31

Item No.	Designation	Function
29	DETECT RMS QUASI PK SOUND	Key to select the RMS rectifier or the quasi-peak value rectifier (QUASI PK SOUND) for level measurements. LEDs to indicate the set state.
30	FILTER SPEC/RCL EXT	Rollkey. First function: 1. Selection of a special filter or the external filter. 2. Subsequent pressing for input of special filter number selected from various special filters. Second function: call of special filter number with brief display on the FUNCTION/DATA display 13. LEDs to indicate the set state.
31	FILTER LP 100 kHz LP 22 kHz	Rollkey to select the filter: lowpass LP 100 kHz or LP 22 kHz. LEDs to indicate the set state.
32	FILTER CCIR UNWTD HP 300 Hz HP 22 Hz	Rollkey to select the filter: highpass HP 300 Hz or HP 22 Hz. LEDs to indicate the set state.
33	FILTER SOUND CCIR WTD TELEPH CCITT WTD	Rollkey to select the weighting filter: SOUND CCIR WTD or TELEPH CCITT WTD for the noise level measurement. LEDs to indicate the set state.

Item No.	Designation	Function
34	RANGE AUTO	Key to switch the level autoranging function on and off. LED indicates that the autoranging function is switched on.
	▲	Key to fix and to increase the level measuring range step by step (manual range selection).
	▼	Key to fix and to decrease the level measuring range step by step (manual range selection).
35	INPUT L/R	Key to switch over the input channels.
	L	LED indicates that channel L is selected.
	R	LED indicates that channel R is selected.
	a/b	Key to activate the balanced input 37.
	600 Ω	LED indicates that the balanced input with the input impedance 600 Ω is selected.
	20 kΩ	LED indicates that the balanced input with the input impedance 20 kΩ is selected.
	c	Key to activate the unbalanced input 36. LED indicates that the unbalanced input is selected.
36	INPUT c 1 MΩ	Input connectors for the unbalanced channel L or R.
37	INPUT ⏚ a b	Input connectors for the balanced channel L or R.
38	OUTPUT c 30 Ω	Output connectors for the unbalanced output of the generator in channel L or R.

Item No.	Designation	Function
39	OUTPUT ⏚ 30 Ω a b	Output connectors for the balanced output of the generator in channel L or R.
40	OUTPUT L/R	Key to switch over the generator output channels.
	L	LED indicates that output channel L is selected.
	R	LED indicates that output channel R is selected.
	a/b	Key to switch the balanced generator output on and off. LED indicates that the balanced generator output is selected.
	c	Key to switch the unbalanced output of generator on and off. LED indicates that the unbalanced output of generator is selected.
41	VARIATION - VAR +	Spin wheel to change the generator frequency or level.
	LEVEL	LED indicates that the spin wheel changes the generator level.
	FREQ	LED indicates that the spin wheel changes the generator frequency.

2.1.2 Rear Panel, Fig. 2-2

Item No.	Designation	Function
50		Socket for the IEC bus interface.
51	1 DC 2 	BNC terminals for the analog outputs 1 and 2. Outer conductor at chassis potential.
52	AC 	BNC terminal for AC voltage output, monitor connection for voltage, distortion factor and wow & flutter measurements. Outer conductor at chassis potential.
53	EXT FILTER 600 Ω 	BNC terminal for input of an external filter. BNC terminal for output of an external filter. Outer conductor at chassis potential.
54 57	INPUT/OUTPUT a b c L R	Optional retrofit of signal inputs/ generator outputs to items 36 to 39 on the front panel.
58	110 V T 0,8 B 120 V 220 V T 0,4 B 240 V 47-63 Hz	AC supply voltage selector, fuse holder and power connector.
59		Power switch: ◯ Off | On

2.2 Preparations for Use

2.2.1 Setting Up the Instrument

The UPA should be used in a horizontal or slightly tilted position. To tilt the instrument, press against the pivots of the handle using the palms of your hands, rotate the handle into the required position and latch in again.

The venting slots on the top and bottom of the instrument must not be covered. The UPA can be used at ambient temperatures between 0 and 50 °C. Dew formation should be prevented. Should this nevertheless occur occasionally, the instrument must be dried out before switching on.

2.2.2 Rack Mounting

The UPA can be fitted into 19-inch racks using the 19-inch adapter, type ZZA-8 (recommended extension). The two panels, the handle and the two side strips must be removed.

Since the power switch is located on the rear panel of the instrument, a two-pole switch for switching off the power supply must be immediately accessible as a safety precaution when rack mounting.

2.2.2.1 Retrofit of the Input/Output Connectors to the Rear Panel

If required, the connectors for the input signal 36, 37 and the generator output 38, 39 can be fitted on the rear panel 54 to 57. The UPA can then be directly connected via the subrack cabling. No additional parts are required for this conversion.

Proceed as follows:

+ Remove power cable.

+ Remove the bottom panel and cover after loosening the corresponding Phillips screws. Remove the labelled panel at the front after loosening the two bottom Phillips screws and dismantling the rotary knob using an Allen key. Tilt the rear panel to the back after loosening the four Phillips screws.

+ Unscrew the connector supporting board at three mounting points and pull out to the front.

+ Also unscrew the dummy panel from the three mounting points on the inside of the rear panel and remount in the empty position of the front panel.

- Fit the connector supporting board together with the cabling to the position provided in the rear panel; cut the cable ties until the length is sufficient.
- Reconnect the front and rear panels.
- Connect cables to the motherboard.
- Complete the instrument, if required using the rack mounting set.

2.2.3 Power Supply

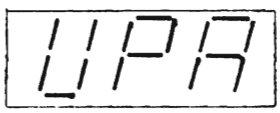
The UPA is designed for connection to AC networks (sinewave) with voltages of 100 V, 120 V, 220 V and 240 V each with a tolerance of ± 10 % and frequencies between 47 and 63 Hz. The instrument is set in the factory for a 220 V supply but can easily be converted to another value. Proceed as follows: **disconnect the power cable,** lift off the fuse holder cap using a Phillips screwdriver, change the fuse if required and reinsert the cap such that the triangular mark points to the required voltage (Fig. 2 in the Appendix).

A fuse T 0.4 B DIN 41571 is required for 220 V and 240 V, a fuse T 0.8 B DIN 41571 for 100 V and 120 V.

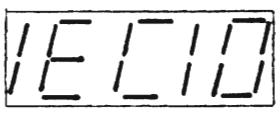
Connect the UPA to the supply via the power connector and the supplied cable. The regulations for protection class I to VDE 0100 and 0411 must be observed.

2.2.4 Switching On

The UPA is switched on using the power switch 59 on the rear panel. After switching on, the following characters may appear in the displays 2, 6, 13:

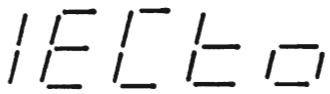


(firmware coding)



Display 6 indicates the microprocessor firmware release.

Display 13 indicates the current IEC bus device address (in the example above: decimal 10) or, in Talk Only mode, the following:

(see Section 2.4). 

The basic instrument setting then follows automatically (see Section 2.3.10).

If error messages are displayed on 13 during the switch-on routine, the cause can be determined according to Section 2.3.11.

Which options are incorporated in the UPA can be checked by entering special function 60.5 (see also Section 2.3.9).

For this purpose, the codes for the options incorporated in the UPA then appear in sequence in the display 13 (also see Section 2.5):

Option:	Display:
UPA-B2	OPt.2
UPA-B3	Opt.3
UPA-B6	OPt.6
UPA-B8	OPt.8
UPA-B9	OPt.9
No option or only UPA-B1 contained	OPt.-

2.2.4.1 Adjusting the Brightness of the LCDs

The background of the LCDs 2, 6, 13 is automatically set to medium brightness when the UPA is switched on.

The brightness can be continuously adjusted for the ambient conditions via special function 4.1 using the rotary knob 41.

Procedure:
- → Enter special function 4.1 on the keyboard to enable adjustment of the brightness (see Sections 2.3.9 and 2.3.4).
- → Set the required brightness using rotary knob 41.
- → The rotary knob 41 for variation of the brightness is disabled again by entering special function 4.0.

Once the brightness is set, it is **retained** even following switch-off/on of the UPA and is **not** affected by the basic setting after switching on. When storing complete instrument settings (see Section 2.3.6.1), the brightness setting is **ignored** .

2.2.5 Connection of Other Instruments in Series

2.2.5.1 Connection of Balanced-to-Ground Devices

Balanced-to-ground devices can be connected to the balanced inputs/outputs a/b 37, 39 or 55, 57 of the UPA via balanced, screened, two-core cables with a three-pin plug to DIN 41628. The UPA housing must be connected to the ground of the balanced device under test via the cable screen.

2.2.5.2 Connection of Unbalanced-to-Ground Devices

Unbalanced-to-ground devices are connected to the inputs/outputs c 36, 38 or 54, 56 of the UPA via a BNC cable. The insulated BNC connectors and the corresponding input and output circuits mean that the UPA can carry out floating measurements on unbalanced devices. The outer conductors of the BNC connectors should be connected to the nearer-to-ground terminal of the device under test.

2.2.5.3 Connection of an External Filter

An external filter can be connected between the two BNC terminals 53 on the rear panel. The outer conductors of the BNC terminals are at the potential of the UPA housing.

The attenuation of the external filter during operation can be taken into account during voltage or level measurements using a special calibration routine (see Section 2.3.1.4.8).

2.2.5.4 Connection to the AC Voltage Output

A BNC cable is used for the connection to the AC output 52 on the rear panel. The output is used as a monitor connection for voltage/level, distortion factor and wow & flutter measurements. Headphones can also be connected to the BNC terminal via a corresponding adapter.

The outer conductor of the BNC terminal is at the potential of the UPA housing.

2.2.5.5 Connection to the DC Voltage Outputs (Option UPA-B1)

Depending on the measuring function selected, DC voltages proportional to the measured values are present at the BNC terminals 51 on the rear panel. The polarity depends on the measuring function. BNC cables are used for the connection. The outer conductors are at the potential of the UPA housing.

2.2.5.6 Connection to the IEC-bus Interface

A standardized 24-core cable is used for the connection to the IEC 625-1 and IEEE 488 socket 50 (recommended extension).

In order to ensure a reliable connection, tighten the two screws on the plug into the nuts fitted on the socket.

2.3 Manual Operation

2.3.1 Measurement Section

2.3.1.1 Operating Mode/Channel Settings of the Measurement Section

The basic setting when the UPA is switched on selects the unbalanced-to-ground mode with the BNC input connector c 36 or 54 on channel R 35.

The input signal can be connected to four inputs:

+ Symmetrical input a/b with an input resistance of 600 Ω or 20 kΩ, with channels L and R.

+ Non-symmetrical input c with input resistance of 1 MΩ, with channels L and R.

The UPA only measures the input signal at the selected input connector.

The balanced input is selected using key a/b. Pressing key a/b automatically selects the input resistance. The LED 600 Ω or 20 kΩ 35 indicates which of the two input resistances is activated. The unbalanced input is selected using key c.

Concerning the mutual interaction of the keys a/b and c, it should be noted that the higher input impedance of 20 kΩ is always selected when changing from input c to input a/b in order to protect the input from overloading.

Pressing the a/b key again switches to the 600 Ω input impedance.

The input connector for the required input channel can be selected using key L/R 35. The current channel assignment is indicated on the LEDs L and R 35.

This enables both channels of two-channel devices to be connected to the UPA without inconvenient recabling when measuring both channels.

It should be noted that the UPA input is only connected to the device under test for the selected channel and both poles of the other channel are switched off and not loaded.

The crosstalk attenuation between the two inputs is down >80 dB at 20 kHz and an internal or terminating impedance of ≤ 600 Ω.

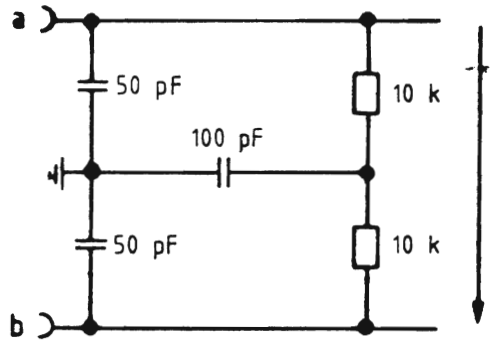
2.3.1.1.1 Measurements on Balanced-to-Ground Voltage Sources

Inputs a/b 37 or 55 are provided for measurements on balanced-to-ground voltage sources and cables.

This balanced mode is selected using key a/b 35. This mode is characterized by the balanced-to-ground configuration of the input impedance, high unbalanced attenuation and high permissible common-mode voltages.

The balanced mode with the input impedance of 20kΩ between connectors a and b is switched on when the key is pressed once; this is indicated by the associated LED 35. Pressing the key again switches to the input impedance of 600 Ω.

Input a/b
Channel L or R

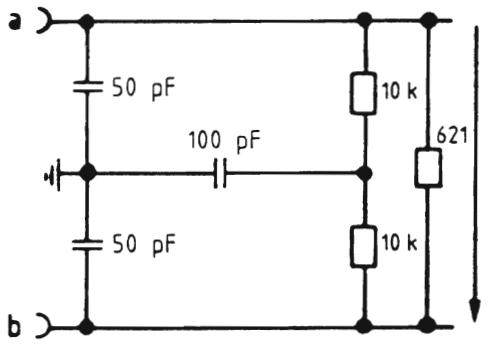


Operating mode a/b,
R_i = 20 kΩ
Balanced, high impedance,
DC coupling!

Fig. 2-3 Equivalent circuit diagram of the test input

This mode corresponds to the requirements for high-impedance balanced measurements to CCITT, IEC and DIN.

Input a/b
Channel L or R



Operating mode a/b,
R_i = 600 Ω
Balanced, low impedance,
DC coupling!

Fig. 2-4 Equivalent circuit diagram of the test input

This mode is used if a device with a balanced output is to be measured under load or if the measurement takes place at the end of a non-terminated line.

2.3.1.1.2 Permissible Voltages at the Inputs a/b

The rms value of the input voltage between connector a and b must not exceed 35 V and the peak value 100 V. This also applies with a superimposed DC voltage.

The peak value of the common-mode voltage must not exceed 350 V between connector a or b and housing.

The relevant safety regulations must be observed when using hazardous voltages >50 V.

2.3.1.1.3 Measurements on Unbalanced Voltage Sources

The coaxial inputs c 36 or 54 are provided for measurements on unbalanced voltage sources.

The unbalanced mode is selected using key c 35 and indicated by the associated LED. This mode enables floating measurements to be made on non-symmetrical sources.

Particularly excellent noise voltage suppression is obtained if the instrument housing is connected to the reference near ground potential point of the source.

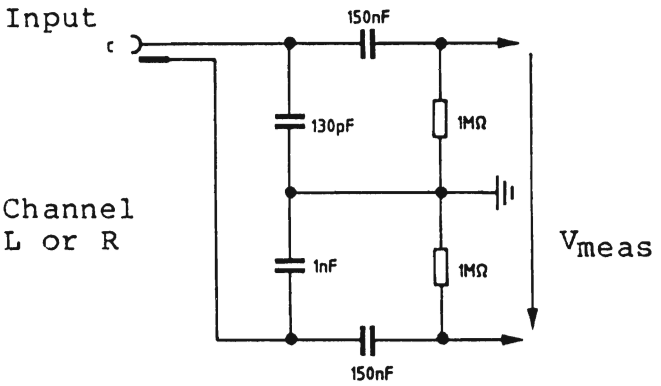


Fig. 2-5 Equivalent circuit diagram of the test input

2.3.1.1.4 Permissible Voltages at the Inputs c

The rms value of the voltage at the BNC connectors must not exceed 300 V and the peak value 500 V between the inner and outer conductors.

The peak value of the connected voltage must not exceed 10 V on the outer conductors of the BNC connectors compared to the instrument housing.

The relevant safety regulations must be observed when using hazardous voltages >50 V.

2.3.1.2 Switching On the Autoranging Function

The LED of the autoranging function 34 lights up when the UPA is switched on. This means that internal range selection automatically ensures that the correct range is set for a level measurement.

An internal monitoring function prevents large measuring errors as a result of amplifier and rectifier overloading. Thus the autoranging function can select a higher measuring range for input signals with large pulse or noise components than corresponds to the display range for the specified tolerances. The same response is possible with connected filters if the frequency of the input signal lies outside the transmission range of the filter.

In such cases the displayed value is smaller than the lower limit of a measuring range. A range violation is signalled: the last position of the numeric display flashes or the last position of the range value with a bar display flashes.

If manual range selection is set, the autoranging function can be selected on the UPA using the key AUTO.

Procedure: → Press key AUTO 34.

Without further manual settings, a signal of e.g. 10 µV to 300 V can be connected to connector c 36 or 54 and its level displayed on the LEVEL display 2 in the required unit.

2.3.1.3 Holding the Current Range and Manual Range Selection

It is sometimes meaningful to switch off the autoranging function and to operate with a fixed range setting. It may be necessary for the user to hold a range selected by the autoranging function if the input voltage is briefly disconnected and unnecessary switching to the most sensitive range is to be prevented.

The level measuring range can be set or changed manually using keys 34 ↑ and ↓.

Possible operations:

A) Press AUTO key 34
   → LED AUTO is extinguished and the current range is held.
   → Modification of current range possible step by step using the keys RANGE ↑ and RANGE ↓.

B) Press key RANGE ↑ or RANGE ↓
   → The autoranging function is switched off (LED AUTO extinguished) and the current range is increased or decreased by one step.

RANGE appears on the LEVEL display 2 as a response to the RANGE keys and the final value of the selected range is briefly indicated.

The maximum or minimum range possible remains set on overrange or underrange (can be recognized in that the RANGE display does not change on the LEVEL display).

The held or manually set range is switched to the next higher range if the input signal exceeds the selected range. If the measured level returns to the set range, the range is automatically returned to the held value.

The upper limit can also be violated if there are large pulse or noise components in the input signal or, if filters are connected into the circuit, if frequency components outside the transmission range would overload the amplifiers and rectifiers in the UPA. In such cases a higher range is selected than corresponds to the actual input value.

Switching to a higher measuring range can be suppressed by entering special function 3.1 (see Section 2.3.9). This function is cleared again by the AUTO key 34 when the autoranging function is switched on.

If the level of the input signal is reduced below the held measuring range, the selected range is retained nevertheless. In this case the accuracy decreases as the input signal becomes smaller.

Violations of the upper or lower range limit are indicated by a completely or partially flashing level display.

Numeric level display with or without bar display:
(see Section 2.3.5).

Violation of upper limit: complete numeric display flashes.
Violation of lower limit: last digit of numeric display flashes.

Bar display with range:
(see Section 2.3.5).

Violation of upper limit: complete range value flashes.
Violation of lower limit: last digit of range value flashes.

A range is violated if the measured value is outside the values listed in Table 2-1 for a set range.

The UPA range in unbalanced mode extends from approx. 10 µV to 300 V and is divided into 13 ranges in 10-dB steps. The measuring range in balanced mode extends from approx. 10 µV to 35 V and is divided into 11 ranges in 10-dB steps.

Table 2-1 Level measuring ranges

Range No.	Rated value	Measuring range	Remark
01	0.3 mV	0* to 0.35 mV	
02	1 mV	0.3 mV to 1.1 mV	
03	3 mV	0.95 mV to 3.5 mV	
04	10 mV	3 mV to 11 mV	
05	30 mV	9.5 mV to 35 mV	
06	100 mV	30 mV to 110 mV	
07	300 mV	95 mV to 350 mV	
08	1 V	0.3 V to 1.1 V	
09	3 V	0.95 V to 3.5 V	
10	10 V	3 V to 11 V	
11	30 V	9.5 V to 35 V	
12	100 V	30 V to 110 V	Only with unbalanced mode of measurement section
13	300 V	95 V to 300 V	

* Limited by inherent noise.

2.3.1.4 Filters

Eight filter settings can be selected in the FILTER field of the UPA using keys 30 to 33. These can be connected into the measuring circuit in 4 groups which can be combined as desired.

The following filters are present in the UPA:

- SOUND filter to CCIR
- TELEPHON filter to CCITT

- Highpass filter 300 Hz
- Highpass filter 22 Hz

- Lowpass filter 100 kHz
- Lowpass filter 22 kHz

- Special filter (option)
- Connection of an external filter

2.3.1.4.1 Weighting Filters SOUND to CCIR and TELEPHON to CCITT

Two standardized filters are available for psophometric examination of noise voltages:

+ SOUND filter: Standardized weighting filter for weighted noise measurements in sound channels to CCIR 468-3 and DIN 45405.

+ TELEPHON filter: Standardized weighting filter for weighted noise measurements in telephone and speech channels to CCITT P53.

These can be selected using the corresponding key

Procedure: + Press key 33.
A roll function is then possible:
SOUND - TELEPH - switch off both filters - SOUND

Which filter is active, if any, can be seen on the LEDs 33 SOUND CCIR WTD and TELEPH CCITT WTD.

It should be noted when selecting the SOUND or TELEPHON filter that other functional settings are influenced.

SOUND filter:
+ Activation of QUASI PK SOUND detector.
+ All other filters switched off.
+ Influencing of test functions distortion factor, SINAD or wow & flutter is indicated by error message Er 10.

TELEPHON filter:
+ Activation of RMS detector.
+ All other filters switched off.

This mutual influencing of functions is designed such that meaningful instrument setting is obtained which generally leads to correct results. The user can change the recommended setting at any time by connecting further filters after the weighting filter has been selected or by changing the detector assignment to the filter.

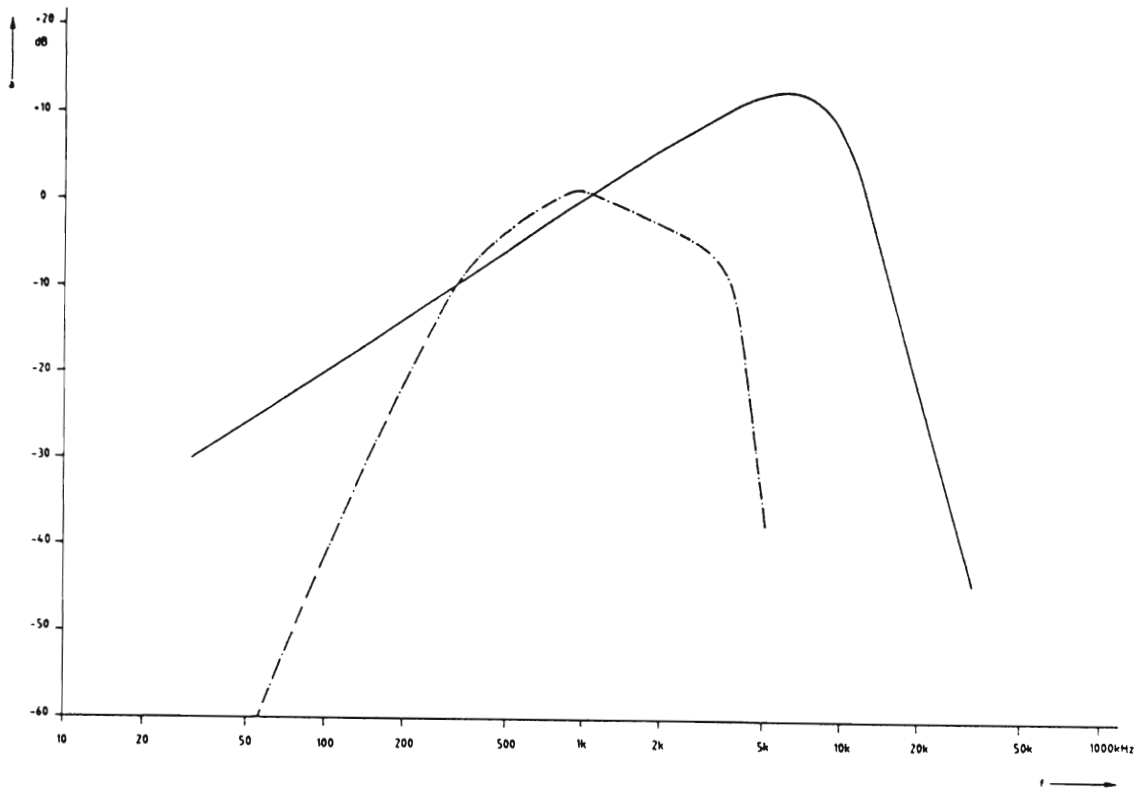


Fig. 2-6 Attenuation characteristic of the noise evaluation filters

——— Evaluation for sound channels to CCIR 468-3 and DIN 45405

— . — Evaluation for telephone channels to CCITT P53

2.3.1.4.2 Highpass Filter

Two highpass filters with cut-off values of 22 Hz and 300 Hz are available for suppression of low-frequency noise voltages. They are selected using key 32 and indicated on the LEDs (HP 300 Hz and HP 22 Hz).

Procedure: → Press Hp key
A roll function is then possible:
HP 300 Hz on - HP 22 Hz on - HP switched off - HP 300 Hz on - .....

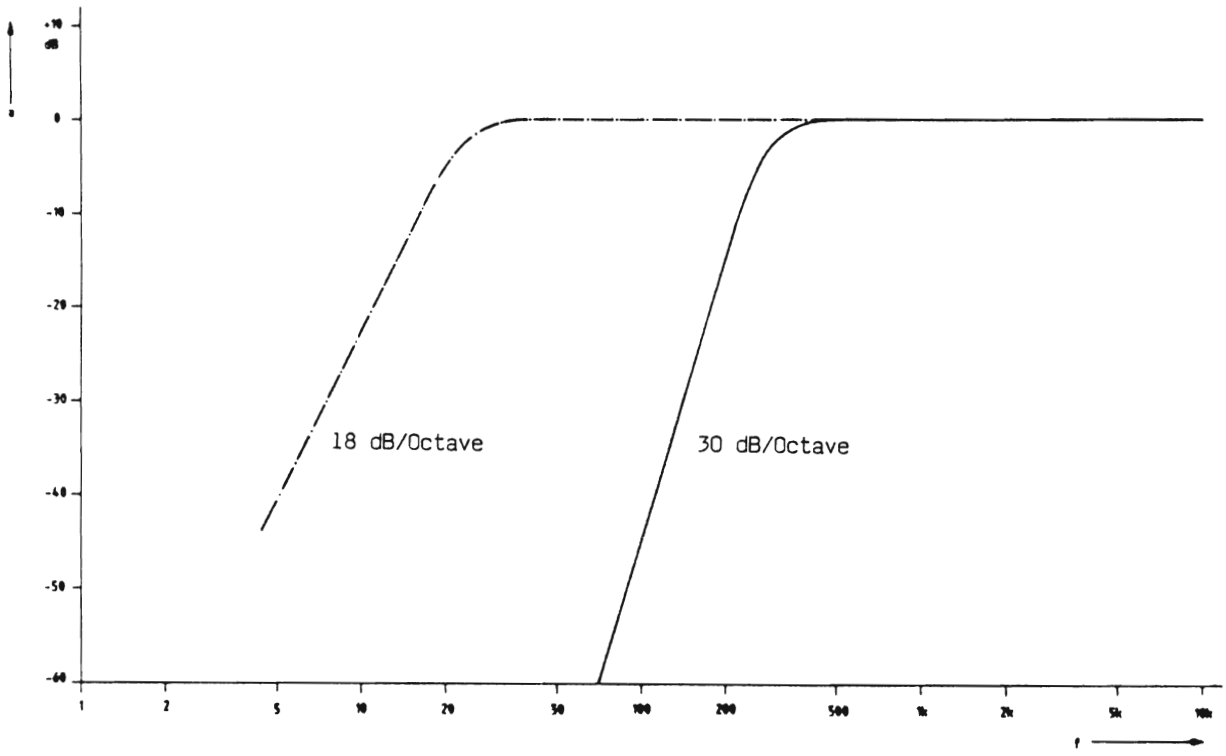


Fig. 2-7 Attenuation characteristic of the HP filters

——— Highpass 300 Hz
— . — Highpass 22 Hz

2.3.1.4.3 Lowpass Filter

Two lowpass filters with cut-off values of 22 kHz and 100 kHz are available for suppression of high-frequency noise voltages. They are selected using the LP key 31 in the FILTER block.

Procedure: → Press LP key
A roll function is then possible:
LP 100 kHz - LP 22 kHz - LP switched off - LP 100 kHz - .....

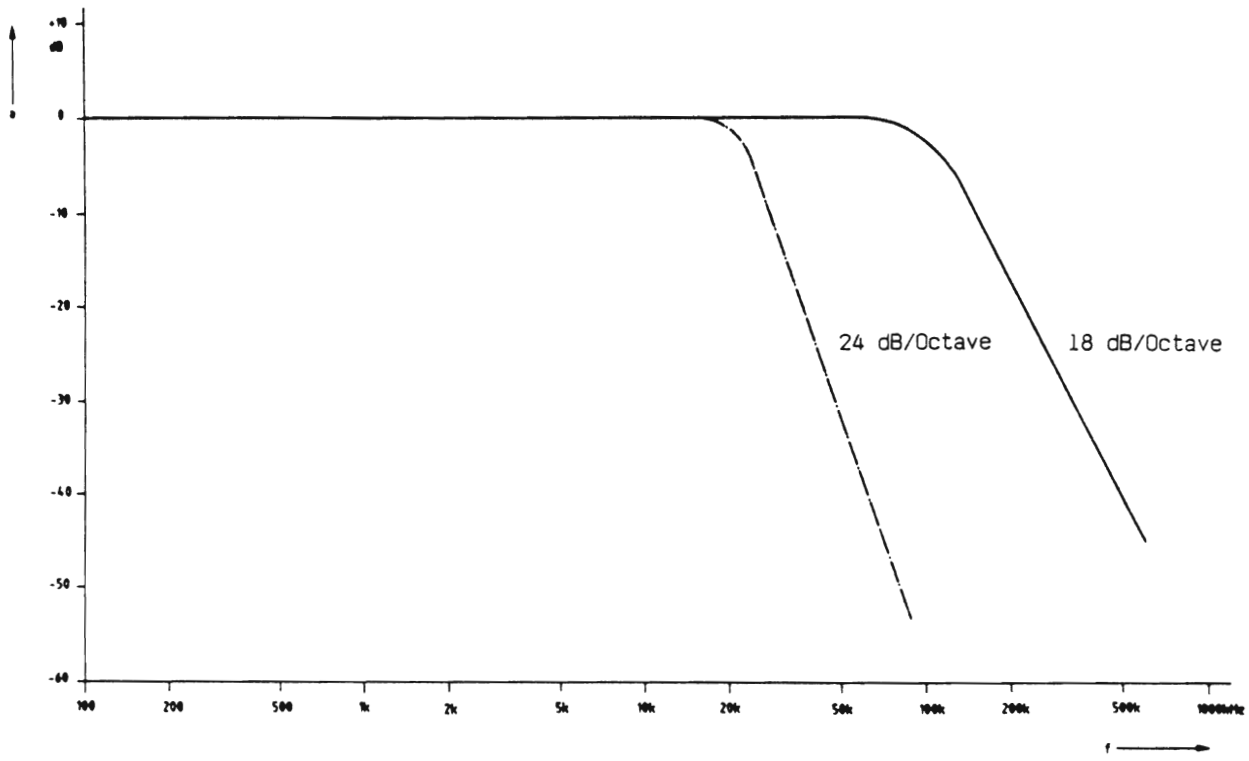


Fig. 2-8 Attenuation characteristic of the LP filters

——— Lowpass 100 kHz
— . — Lowpass 22 kHz

2.3.1.4.4 Bandpass Filter to CCIR for Unweighted Noise Measurements

Combination of the highpass HP 22 Hz with the lowpass LP 22 kHz (Sections 2.3.1.4.2 and 2.3.1.4.3) results in a bandpass filter which is used for unweighted noise voltage measurements in sound channels to CCIR 468-3 or DIN 45 405. The key inscription CCIR UNWTD in the filter field indicates this (see Section 2.1).

2.3.1.4.5 Special Filters (Options UPA-B2 and UPA-B3)

See Section 2.5 for installation of the option. Selection of the special filter setting without the option being fitted is not possible.

The SPEC filter with number 1 is selected in the special filter position when the UPA is switched on but is only connected into the measuring circuit when key 30 is pressed and the associated LED SPEC lights up.

Procedure: → Press key 30.
A roll function is then possible:
SPEC filter on - EXT filter on - both filters switched off - SPEC filter on - .....

Option UPA-B2:

With the option UPA-B2 fitted, the filter referred to as SPEC in the filter block of the UPA consists of 17 different filters which can be addressed using the numbers 1 to 17 (see 2.3.1.4.6).

1:	A-filter	
2:	Pilot tone trap 19 kHz **with lowpass filter 15 kHz**	
3:	Line frequency trap 15625 Hz **with lowpass filter 13 kHz**	
4:	1 and 2 combined	
5:	1 and 3 combined	
6:	315 Hz	bandpass filters
7:	1 kHz	
8:	3.15 kHz	
9:	6.3 kHz	
10:	10 kHz	
11:	12.5 kHz	
12:	350 Hz	lowpass filters
13:	1.04 kHz	
14:	3.5 kHz	
15:	7 kHz	
16:	10.4 kHz	
17:	15 kHz	

The filter curves are shown in diagram 373.1339 in the appendix. For the filter characteristics, see also Section 3.2.22.

Option UPA-B3:

The special filter board UPA-B3 is a printed circuit board for mounting user-specific filters.

To this end, the option provides

- → Supply voltage terminals for ±15 V and 5 V with a loading capacity of 50 mA each
- → An 8-bit data register with 256 ways of filter control, which can be addressed by directly entering 0 to 255.
- → Two four-way analog switches at the input and output.

When fitting filters, note the following:

- The input resistance must be >2 kΩ.
- The filter output line must be dc coupled via a resistance of R ≤10 kΩ (avoid entering a SPEC filter setting to which no filter circuit is assigned!)
- Between input and output of the filters, the total gain should be g = 1 in the passband.
- The modulation range at the input and output can be up to V_{rms} = 3.5 V and V_p = ±10 V.
- When using active filters, the offset voltage must not exceed ±10 mV.
- Pin X1.12AC must remain open.

Table for conversion of the special filter code to control lines S1 to S8 of the special filter board UPA-B3:

Control lines								B3 SPEC filter code
S8	S7	S6	S5	S4	S3	S2	S1	
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
1	1	1	1	1	1	1	1	255
				analog switches D2 and D3				
				D	C	B	A	

0: analog switch open
1: analog switch closed

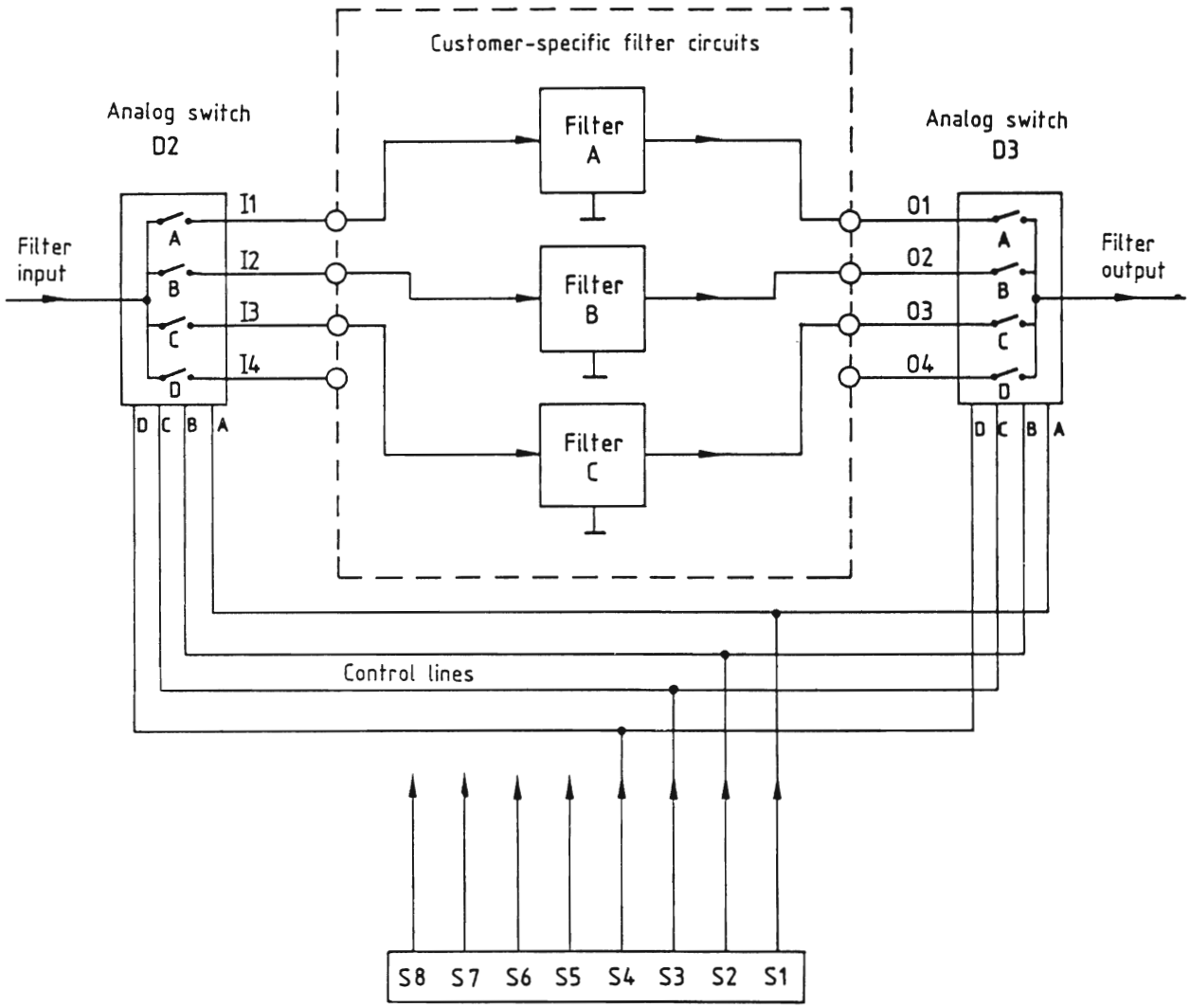
Example:

The following section of the special filter board UPA-B3 shows the customer-specific wiring of filters A, B and C.

Activating filter A: SPEC filter no. 1
Activating filter B: SPEC filter no. 2
Activating filter C: SPEC filter no. 4

Activating filter A parallel to filter B: SPEC filter no. 3
Activating filter A parallel to filter C: SPEC filter no. 5

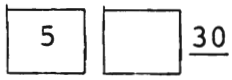
(See Input of the Special Filter Number 2.3.1.4.6 and IEC-bus commands 2.4.7.2 FILTER SETTING.)



2.3.1.4.6 Input of the Special Filter Number

Procedure:
- Enter filter numbers using numeric keypad 24 (see Section 2.3.4 "Entering Numbers via the Keyboard") according to the built-in options B2 (1 to 17) or B3 (0 to 255).
- Press the SPEC/EXT key 30 in the FILTER block.

Example: SPEC filter No. 5 is to be selected.



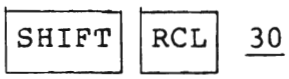
The selected number of the SPEC filter remains stored until changed by a new entry.

2.3.1.4.7 Recalling the Selected Special Filter Number

It is possible to briefly display the special filter number on the FUNCTION/DATA display 13 to enable the user to recall an already stored SPEC filter number.

Procedure:
- Press key SHIFT 17.
  All displays enter the HOLD state at the same time.
- Press key RCL 30 (second function of SPEC EXT key labelled in blue).

Example: Recall current SPEC filter number.



2.3.1.4.8 External Filter

It is possible to connect an external filter into the measuring circuit of the UPA via two BNC terminals 53 on the rear panel.

Procedure: + Press key 30 in the FILTER block (several times if necessary) until LED EXT 30 indicates that the external filter is connected.

A roll function is then possible:
SPEC filter on - EXT filter on - both filters off - SPEC filter on - .....

The LEVEL display 2 only indicates a very small inherent noise voltage if an external filter is not connected.

This is not a faulty function of the UPA and no error message is output.

The EXT filter connection is designed for a filter with a characteristic impedance of 600 Ω. The internal or terminating impedance on the terminals of the UPA is 600 Ω.

The transmission loss may lie between -6 and 6 dB. The transmission loss of an external filter can be measured and stored for a particular frequency using a special calibration routine in the UPA.

When using this filter, the stored transmission loss is used to calculate a correction value for the level display.

Calibration of the transmission loss:

+ Apply a sinusoidal voltage, preferably > 10 mV, to the test input.

+ Select operating mode and input channel L or R.

+ Select the test frequency corresponding to the desired reference frequency for the transmission response of the external filter.

+ Connect an external filter to terminals 53 (rear panel).

+ Enter special function 50 for calibration (see Section 2.3.9);
CAL appears on the FUNCTION/DATA display 13.

+ Call calibration routine by entering special function 50.3.

+ After display **En.EFI** appears, enter special function 50.3 again.

+ The routine determines the transmission loss of the external filter. At the end of routine, **CAL** is displayed.

- Values outside the attenuation range of -6 dB to +6 dB, e.g. as a result of faulty connections or unsuitable filters, produce an error message on the FUNCTION/DATA display 13. It can then be expected that the result is displayed with a large error.

- An attempted calibration with the external filter not connected or with attenuation values outside -20 dB to +20 dB causes the error message Er 23.9 to be output on the FUNCTION/DATA display.

- The CLEAR key 23 is used to leave the calibration level.

An existing attenuation value is cleared by a new calibration; it can be reset to the initial value 0 dB by a further special function.

Reset calibrated attenuation value to 0 dB:

- Call calibration level using special function 50 (see Section 2.3.9);
  CAL appears on the FUNCTION/DATA display 13.

- Enter special function 50.4.

- Enter special function 50.4 again when **EFI.0 dB** is displayed.

- The display **CAL** appears again following execution of the special function.

- The CLEAR key 23 is used to leave the calibration level.

2.3.1.5 Selecting the Rectifier Circuit

The rms detector is automatically selected when the UPA is switched on. All AC voltages are measured, calculated and displayed as rms values.

The key in the DETECT block of the UPA can be used to switch to the quasi-peak value rectifier QUASI PK. All AC voltages are then measured, calculated and displayed as weighted peak values.

The quasi-peak value rectifier is used to measure noise voltages in professional audio applications to CCIR 468-3 and DIN 45405. The quasi-peak value is a value which takes into consideration the waveform of the input signal. It is defined such that the rms value is displayed when measuring a sinusoidal voltage and not the peak value which is higher by $\sqrt{2}$.

Procedure: - Press key 29 in the DETECT block.
A switchover function is then possible:
QUASI PK - RMS - QUASI PK - RMS - .....

The LED RMS or QUASI PK SOUND 29 indicates which of the two rectifiers is currently switched on.

Selection of the rectifier in conjunction with the filter SOUND or TELEPH and the noise measurement DIST or SINAD may result in a mutual influencing of settings which is indicated by the error message Er 10 on the FUNCTION/DATA display.

Quasi-peak measurement in combination with LEVEL FAST mode does not comply with the standard, because the time constant of the rectifier connected after the averaging lowpass is considerably reduced from 180 ms to 1 ms as against the CCIR 468 standard.
Due to the small averaging time, the measurement results obtained for particularly narrow or sporadically occurring pulses in LEVEL FAST mode with quasi-peak measurement are not useful because they differ too much from one another.
For coherent signals, the quasi-peak measurement delivers identical results in LEVEL FAST and LEVEL SLOW mode.

2.3.1.6 Level and Frequency Measurements

2.3.1.6.1 Level Display of Input Signal without Reference

The level of the input signal applied to the input connectors 36, 37 or 54, 55 can be displayed in the units V/mV, dBV, dBm (Z), W/mW (Z) on the LEVEL display 2. The operator cannot influence whether the level is displayed in V or mV or in W or mW. When selecting the power-related units dBm (Z) or W (Z), the entered impedance value (see Sections 2.3.1.6.9 and 2.3.1.6.10) is used in the calculation.

Procedure: → Press one of the keys V, dBV, dBm (Z) or W (Z) 5.

The LEVEL display 2 is assigned to the test unit when one of these keys is pressed.

The following equations are used for display of the level in dBV, dBm or W:

$$\text{Level display in dBV} = 20 \times \lg \frac{|V|}{V}$$

$$\text{Level display in dBm} = 10 \times \lg \frac{V^2}{Z \times 1\ \text{mW}}$$

$$\text{Level display in W} = \frac{V^2}{Z}$$

V_m: Measured value
Z: Reference impedance;
600 Ω after power-up or enter separately.

The power-based input level in dBm or W is calculated and displayed as if a resistor of magnitude Z were connected to the input connector.

2.3.1.6.2 Level Display of Input Signal with Reference

The level of the input signal applied to the input connectors 36, 37 or 54, 55 can be displayed as a percentage deviation in % or as a logarithmic deviation in dB referred to a reference value. The reference value to be used during the measurements must be entered previously (see Sections 2.3.1.6.5 to 2.3.1.6.7).

Procedure: → Press key %/dB 7. Repeated pressing changes the reference-based display of the level into % or dB.

Which of the two level units is displayed can be recognized by the unit in the LEVEL display 2.

Calculation of the percentage deviation of the input level from the reference value in %:

Linear variables are always used in the % display.

$$\% \text{ value} = ((V - V_{REF}) / V_{REF}) * 100 \quad \text{(voltage-based)}$$
$$\% \text{ value} = ((P - P_{REF}) / P_{REF}) * 100 \quad \text{(power-based)}$$

V = Measured input voltage
P = Calculated power at Z ($P = V^2 / Z$)

Which of the two equations is used for the % calculation depends on the level unit previously output on the LEVEL display and is identified by % V or % W.

Voltage-based % calculation with units V and dBV.
Power-based % calculation with units dBm (Z) and W (Z).

Calculation of the logarithmic deviation of the input level from the reference value in dB:

$$\text{dB value} = 20 \times \lg \frac{|V|}{V_{REF}}$$

$$\text{or} \quad 10 \times \lg \frac{P}{P_{REF}}$$

or A/dBV - A_{REF}/dBV
or A/dBm - A_{REF}/dBm

Level values — A_{REF} :
Input voltage — V_{REF} : } Reference values
Power — P_{REF} :

2.3.1.6.3 Frequency Display of Input Signal without Reference

The frequency of the input signal applied to connectors 36, 37 or 54, 55 can be displayed in the unit Hz or kHz on the FREQUENCY DISPLAY 6. The operator cannot influence the unit used for the frequency.

Procedure: → Press key FREQ 10 in the MEAS block.

The FREQUENCY display 6 is then assigned to the measurement section.

2.3.1.6.4 Frequency Display of Input Signal with Reference

The frequency of the input signal applied to connectors 36, 37 or 54, 55 can be output on the FREQUENCY display as a linear deviation Δf or as a percentage deviation in % from a frequency reference. The frequency reference must be previously entered (see Sections 2.3.1.6.5, 2.3.1.6.6 and 2.3.1.6.8).

Procedure: → Press key Δf/Δf% 11. Repeated pressing changes between the reference-based frequency display Δf or Δf%.

Which of the two possibilities is displayed is indicated by the symbols on the FREQUENCY display 6.

Calculation of the linear deviation of the input frequency from the reference value in Δf:

$$\Delta f = f_{MEAS} - f_{REF}$$

Calculation of the percentage deviation of the input frequency from the reference value in Δf%:

$$\Delta f\% = (f_{MEAS} - f_{REF}) / f_{REF} * 100$$

2.3.1.6.5 Reference Value Input via the Keyboard

The UPA requires reference values for relative measurements of the level in % or dB and the frequency in Δf or Δf%. These reference values are either entered on the keyboard or transferred directly from the measurement.

Sections 2.3.1.6.2 and 2.3.1.6.4 describe how the reference values are used for the relative displays.

Procedure:

- Input of reference value using numeric keypad 24 (see Section 2.3.4 "Entering Numbers via the Keyboard")
- Press key SHIFT.
- Enter desired unit V, mV, dBV, dBm, W, mW 5 or kHz, Hz 10. The keys V/mV, W/mW and kHz/Hz are multifunction keys which change the unit according to the blue labelling each time they are pressed. The current unit is indicated on the FUNCTION/DATA display 13.
- Press key STO LEV or STO FREQ; the STO LEV key 8 is used to enter a reference level and the STO FREQ key 12 to enter a reference frequency.

Example: Input of reference level 25.3 mW.

2	5	.	3	SHIFT	W/mW	W/mW	STO LEV 8

The number entered is indicated on the FUNCTION/DATA display 13.

The input of reference values is permissible within the following limits:

V/mV: -1000 V to +1000 V
dBV: -200 dBV to +200 dBV
W/mW: 0 mW to 10000 W
Hz/kHz: 0 Hz to 99999 kHz

All values which lie outside the specified ranges cause an error message to be output on the FUNCTION/DATA display.

A new reference value input clears the last valid value in the reference level or frequency memory.

A reference level of 1 V and a reference frequency of 1 kHz are the default values if no reference values are entered following power-up.

2.3.1.6.6 Transfer of Displayed Value as Reference Value

A value displayed on the LEVEL display 2 or on the FREQUENCY display 6, provided it is not a %, dB or Δ display, can be transferred as a reference value into the reference value memory. It is irrelevant whether the displayed value originates in the generator or the measurement section or is already a reference value.

If a reference-based %, dB or Δ display is present, the absolute value of the voltage or frequency measurement can be transferred as the reference value.

Procedure:
- → Press SHIFT key
- → With a reference level transfer, press the STO LEV key
- → With a reference frequency transfer, press the STO FREQ key

Examples: A) The value indicated on the FREQUENCY display is to be transferred to the frequency reference memory.

SHIFT | STO FREQ | 12

B) The reference-based display 10.8 % Δ is indicated on the LEVEL display. The display is to be based on the current measured value as the reference value.

Display 10.8 % Δ

SHIFT | STO LEV | 8

New display 0.0 % Δ

None of the displays is changed any more when the SHIFT key 17 is pressed. The displays are retained until a further key is pressed.

A HOLD function is thus assigned to the SHIFT key.

Pressing one of the STO LEV or STO FREQ keys cancels this HOLD function and transfers the displayed value or the internal measured value to the reference memory. A new reference value input clears the last valid value from the reference level or frequency memory.

If UFLO or OFLO is displayed because of range violations and OFLO because of a value >10000 W, it is not possible to transfer a reference value from the display and the error message Er 09 or Er 01 is output.

2.3.1.6.7 Recalling the Current Reference Level

It is possible to indicate the current reference level on the LEVEL display 2 so that the user can recall a reference level already stored.

Procedure: → Press key RCL LEV 8.

The reference level is displayed in the unit in which it was originally entered.

It remains displayed until another level display is selected by pressing one of the unit keys 1, 5 or 7.

2.3.1.6.8 Recalling the Current Reference Frequency

It is possible to indicate the current reference frequency on the FREQUENCY display 6 so that the user can recall a reference level already stored.

Procedure: → Press key RCL FREQ 12.

The reference frequency is displayed in the unit Hz or kHz in which it was originally entered.

It remains displayed until another frequency display is selected by pressing one of the unit keys 3, 10 or 11.

2.3.1.6.9. Input of Impedance for dBm and W Display

It is possible with the UPA to enter a reference impedance Z in the range from 0.0001 to 99999 Ω from the keyboard for display of the measured level in dBm or W and for level output of the generator in dBm.

The impedance value to be entered is a purely arithmetic value. Sections 2.3.1.6.1 and 2.3.2.3.6 describe the relationship to the corresponding measured value display and level output.

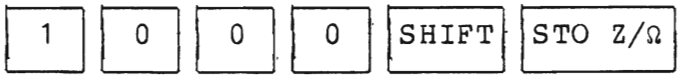
The impedance Z applies to both the generator and the measurement section and cannot be specified separately.

Procedure: → Enter impedance value in Ω using the keypad 24 (see Section 2.3.4 "Entering Numbers").

→ Press key SHIFT 17.

→ Press key STO Z/Ω 20.

Example: Input of impedance value 1000 Ω.



The entered number is indicated on the FUNCTION/DATA display 13. Illegal values lead to an error message on the FUNCTION/DATA display after pressing key STO Z/Ω.

All settings and calculations in the UPA which are based on the impedance value Z are immediately carried out using the new value.

If no impedance value is entered following power-up, all settings and calculations in the UPA are based on an impedance of 600 Ω.

2.3.1.6.10 Recalling the Current Impedance Value

It is possible to briefly display the impedance value on the FUNCTION/DATA display 13 so that the user can recall the stored impedance value upon which the calculations in dBm (Z) or W (Z) are based.

Procedure: → Press SHIFT key 17.
The other displays enter the HOLD status at the same time.

→ Press key RCL Z 21.

A FUNCTION value is cleared from the FUNCTION/DATA display during the time the impedance value is displayed.

2.3.1.6.11 Measuring Speed

Two measuring speeds - SLOW/FAST - can be selected for level and frequency measurements to enable adaptation to various measuring requirements.

The SLOW mode is set for level measurement and the FAST mode for frequency measurement when the UPA is switched on.

The measuring speeds are switched over using special functions (see Section 2.3.9): special function 10.1 switches to the level measuring speed FAST, 10.0 returns to the SLOW mode.

Special function 11.0 is used to switch to the frequency measuring speed SLOW, 11.1 returns to the FAST mode.

The measuring speed for level and frequency measurements is also indicated by the changing triangular markers on the left above the digits of the corresponding display.

The FAST mode can be recognized by the two triangular markers on the right above the digits in the LEVEL display 2 or FREQUENCY display 6.

Filtering of the output voltages from the meter rectifier is coupled to the speed of level measurement. Low-frequency voltages can therefore only be measured with a slow measuring rate.

The lower frequency limit for level measurement is 10 Hz in SLOW mode or 300 Hz in FAST mode. (Note additional error in FAST mode from 300 Hz to 1 kHz. See Section 1 SPECIFICATIONS!).

In the case of the level measuring speed FAST, the 22 Hz highpass filter (see Section 2.3.1.4.2) is automatically connected into the measuring circuit if none of the filters - HP 300 Hz or SOUND or TELEPHON - was previously selected. This assignment can be subsequently changed again by the user. It should also be noted that the standardized dynamic conditions for the meter rectifier do not apply in FAST mode. Noise levels cannot therefore be measured according to standards CCIR, DIN and CCITT.

Frequency measurements above 8 Hz can be made independent of the selected measuring speed. The measuring or gate time of the frequency meter is increased by a factor of 8 (>262 ms or ≥8 measuring cycles) in SLOW mode compared to FAST mode (>33 ms or ≥1 measuring cycle). The larger avaraging time in SLOW mode results in less fluctuations of the displayed value, especially with signals with a low-frequency spurious modulation.

The level and frequency measurements are made in a common cycle whose duration is determined by selecting the individual measuring speeds. The LED READY 16 lights up at the rate of the data output.

The measuring speed for level and frequency measurements is also indicated by the changing triangular markers on the left above the digits of the corresponding display.

Quasi-peak measurement in combination with LEVEL FAST mode does not comply with the standard, because the time constant of the rectifier connected after the averaging lowpass is considerably reduced from 180 ms to 1 ms as against the CCIR 468 standard.
Due to the small averaging time, the measurement results obtained for particularly narrow or sporadically occurring pulses in LEVEL FAST mode with quasi-peak measurement are not useful because they differ too much from one another.
For coherent signals, the quasi-peak measurement delivers identical results in LEVEL FAST and LEVEL SLOW mode.

2.3.1.7 DC Measurement

The DC measuring mode can be switched on using SPEC FCT 7.1 and is indicated by output of "-dc-" on the frequency display. SPEC FCT 7.0 enables to switch back to AC measurement.

The DC measurement can only be performed on an unbalanced test channel.

This test channel is automatically cut in when the DC measurement is selected. The DC mode allows DC voltages from 0 to ±300 V to be measured. When measuring on floating sources, the applied voltages are divided into equal parts between the inner conductor and the outer conductor, the permissible limit value of 10 V for the outer conductor being exceeded if the applied voltage is >20 V. In this case, errors in measurement will occur.

Remedy: Produce a potential reference on the test item by connecting a resistance <10 kΩ to the ground of the housing.

The relevant safety regulations must be observed when using hazardous voltages >50 V.

Selection of a balanced input in DC mode produces the error message Er 10.

Though all settings referring to an AC voltage measurement or frequency measurement are irrelevant in connection with a DC measurement, they are not inhibited and the corresponding LEDs go on lighting. Only when switching over to AC measurement do they gain in significance again.

When selecting the level measuring speed for the DC measurement, observe the following relation:

"Slow" (SPEC FCT 10.0): with filtering of AC voltage
"Fast" (SPEC FCT 10.1): without filtering of AC voltage

Like the AC level display, the DC voltage display also allows to set all display units (V, dBV, dBm(Z), W, %, dB) using the function keys 5 and 7. With dB display, the magnitude of the measured DC voltage value is used.

As with the AC level display, the range keys 34 are used for range selection.

DC level measuring ranges:

Range number	Nominal value	Range display	Measuring range
01	5 V	10 V	0 V to ±5.50 V
02	50 V	100 V	±(4.70 V to 55.0 V)
03	500 V	1000 V	±(47.0 V to 300 V)

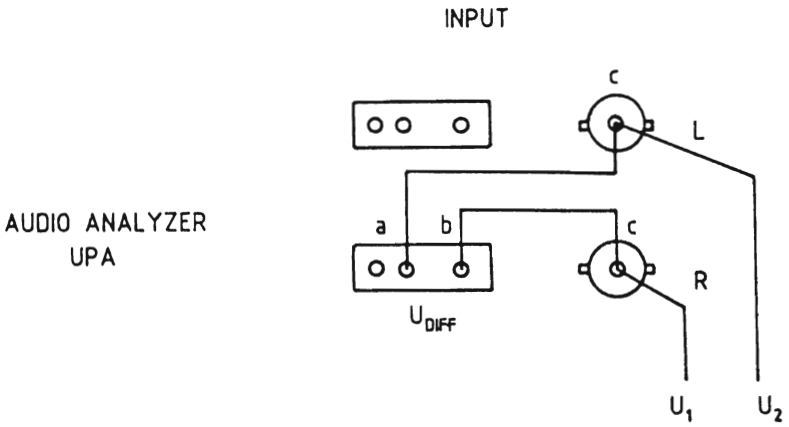
The DC outputs DC1 and DC2 can also be used for the DC measurement. For display of the measured DC voltage in V, the scaling of the DC output is according to SPEC FCT 46.x (see 2.3.7.6).

Measured DC voltages are applied to the DC output as positive value.

2.3.1.8 Phase Measurement

Due to the floating balanced and unbalanced test inputs, the UPA can be used to determine the phase difference between two AF signals of the same frequency by means of three voltage measurements.

The following circuit is required to obtain a valid phase measurement result from the automatic internal measurement of the UPA. In an automatic measuring cycle, the levels of the voltages the phase difference of which is to be determined are measured successively at the unbalanced inputs as well as their differential level at the balanced input R. The balanced input L remains open.

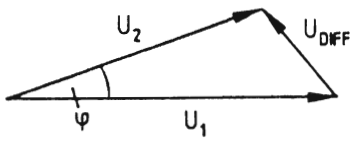


Signal supply for the phase measurement

The phase measurement is switched on using SPEC FCT 38.1. This automatically switches off a different function measurement. Er 10 is displayed if DC measurement is active. Depending on the channel and input selected via keys 35, one of the three voltages is always displayed on the LEVEL display. During the phase measurement, it is not possible to select the balanced input with channel L.

The result of the phase measurement is the magnitude of the phase shift of both input signals between 0 and 180 degrees. It is indicated on the FUNCTION/DATA display 13 in degrees.

The result is calculated internally by the UPA from the three level measurement results according to the following method of calculation:



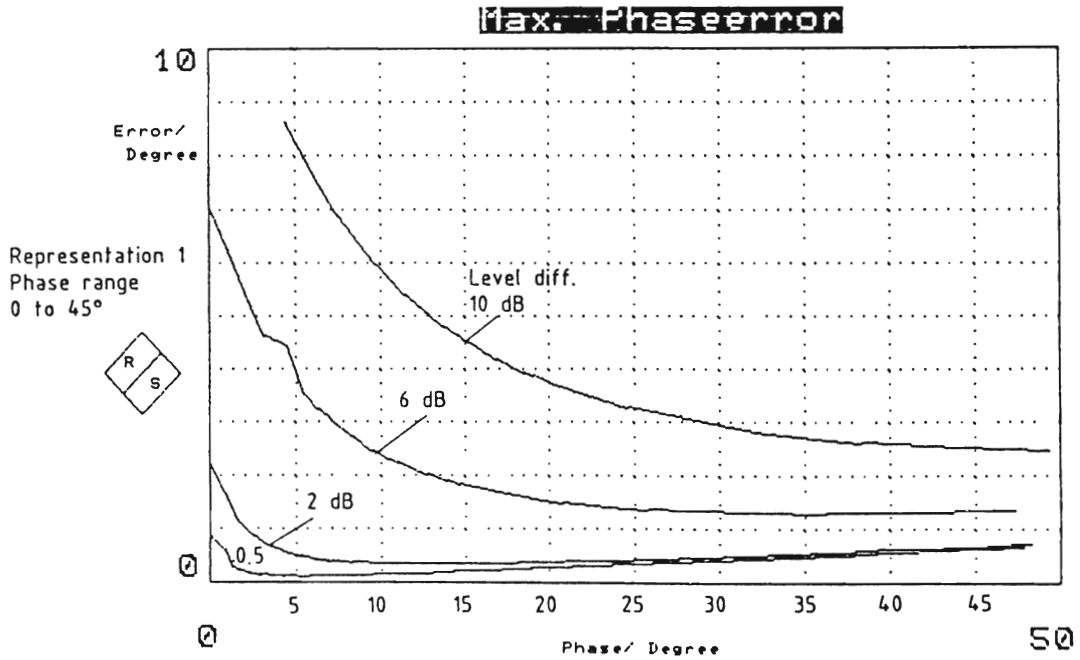
$$\varphi = 2 \cdot \arctan \sqrt{\frac{(S - U_2) \cdot (S - U_1)}{S\,(S - U_{DIFF})}}$$

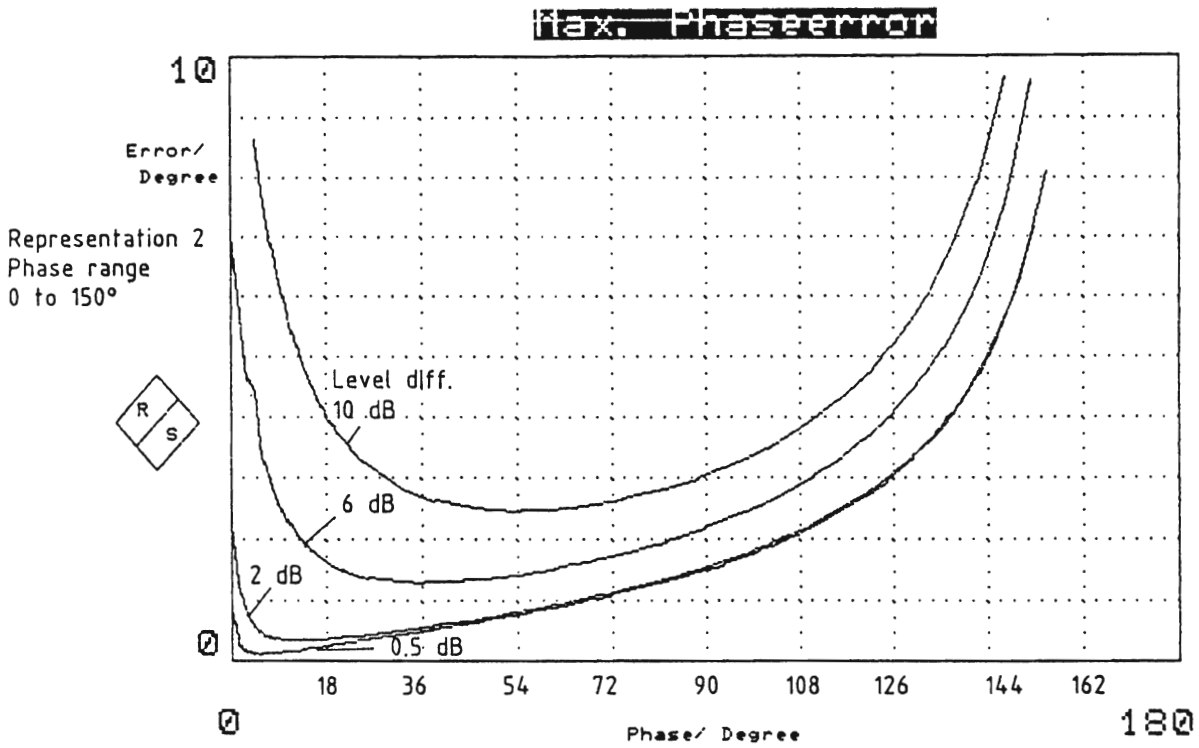
$$S = \frac{1}{2}(U_{DIFF} + U_1 + U_2)$$

Accuracy of the phase measurement:

The absolute measuring error of the test voltage as well as the frequency response of the UPA is not relevant to the phase measurement. The result of the phase measurement is merely affected by linearity and range errors of the test voltages V1 (=U1) and V2 (=U2) and by the absolute measuring error of the differential level V_{diff} (=U_{diff}). If the test signals V1 and V2 are of approximately the same magnitude and the measurement is made in the very same measurement range, there are no linearity and range errors of V1 and V2, and the accuracy of the phase measurement result is only affected by the resolution of the measured value and the absolute measuring error of the differential level V_{diff}. With level differences greater than 2 dB, it is not always ensured that the two test signals are measured in the same measurement range. In this case, a greater measuring error is to be assumed.

The following diagrams indicate the phase error in degrees, depending on the phase shift and the level difference of V1 and V2:





Accuracy of the phase measurement with the UPA with different level differences.

For measuring the phase of two test signals with a frequency >300 Hz, the output of the phase measurement result can be accelerated by increasing the level measuring speed using SPEC.FCT 10.1 and by switching off the autoranging facility, thus allowing to achieve a measuring speed of approx. 2 phase measurement results per second.

2.3.2 Generator Unit (Option UPA-B6)

An operation in the SOURCE field 1, 3, 40, 41 or with one of the functions linked to the generator unit leads to brief output of **no OP** on the FUNCTION/DATA display 13 if the option is not fitted. See Section 2.5 for fitting the option.

2.3.2.1 Operating Mode/Channel Setting of Generator

The basic setting when the UPA is switched on selects the unbalanced-to-ground mode c, channel R 40, BNC output connector 38 or 56. The generator level is set to 1 mV, the generator frequency to 1 kHz.

The generator signal can be connected to one of four outputs:

Channel L/output a/b: symmetric mode, R_i = 30 Ω
Channel R/output a/b: symmetric mode, R_i = 30 Ω
Channel L/output c: non-symmetric mode, R_i = 30 Ω
Channel R/output c: non-symmetric mode, R_i = 30 Ω

The balanced generator output is selected using key a/b 40.

The unbalanced generator output is selected using key c 40.

Outputs a/b and c cannot both be assigned a generator signal; both can be switched off, however.

The selected mode is indicated by the LEDs of keys a/b and c 40.

The associated LED is extinguished if an already activated key a/b or c 40 is pressed again. The generator level is connected to 0 V and the generator output circuit remains connected to the previously selected output connector. The internal impedance for a connected device under test also remains constant.

The changeover key L/R 40 can be used to select the output connector for the required channel L or R. It is therefore possible to connect two-channel devices to the UPA without inconvenient recabling or external switchover.

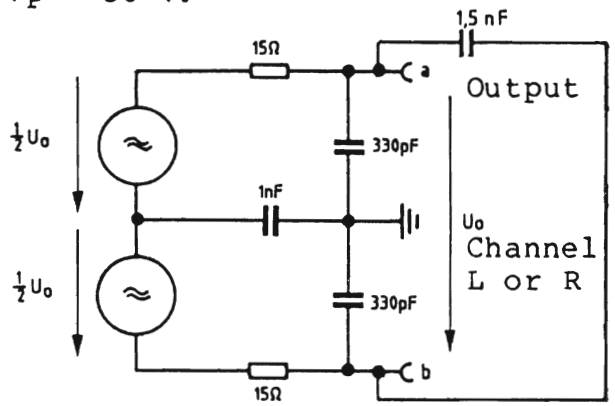
It must be noted that the UPA output is only connected to the device under test for the selected channel. Both poles of the other channel are switched off and terminated internally by an impedance of 1 kΩ.

The crosstalk attenuation between the two channels is >80 dB down at 20 kHz and a terminating impedance of ≤600 Ω.

2.3.2.1.1 Balanced-to-Ground Generator Output

The outputs a/b 39 and 57 are provided for connection to balanced-to-ground devices under test.

Balanced mode is selected using key a/b 40. This mode has the following characteristics: balanced-to-ground, high rejection of unbalanced-to-ground and high permissible common-mode voltage up to V_P = 50 V.



Mode a/b
Z_{OUT} = 30 Ω
Balanced
DC coupling

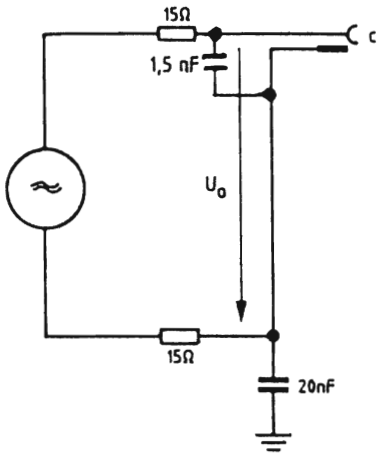
Fig. 2-9 Equivalent circuit diagram of generator output

This operating mode corresponds to the CCITT, IEC, DIN and IRT (Institut für Rundfunktechnik) requirements for balanced-to-ground sources.

2.3.2.1.2 Unbalanced-to-Ground Generator Output

The coaxial generator outputs (BNC connectors) c 38 and 56 are provided for connection of unbalanced devices.

Unbalanced mode is selected using key c 40. This mode enables a floating connection to unbalanced-to-ground devices under test.



Output

Channel
L or R

Mode c
Z_{OUT} = 30 Ω
Unbalanced
Floating
DC coupling

Fig. 2-10 Equivalent circuit diagram of generator output

2.3.2.1.3 Overload Protection and Input Protection

The generator output is overload-proof and shortcircuit-proof whatever the operating mode.

The output signal may be distorted with loads <200 Ω, depending on the magnitude of the set voltage. **No error indication** is output on the instrument. In addition to the overload protection, the generator output is also protected against external inputs.

Signals from external sources up to 35 V do not damage the generator output circuit. The generator circuit is disconnected from the output connectors if the applied current exceeds a value of approx. 250 mA. The error message Er 08 is output on the FUNCTION/DATA display 13.

The switched off status can also be recognized in that the LEDs for the mode and channel displays 40 are switched off.

Switching on again following elimination of the external input is carried out by pressing the corresponding keys again. The last selected setting prior to the forced switch-off is reinstated.

2.3.2.2 Frequency Setting of Generator

2.3.2.2.1 Frequency Entry via the Keyboard

The frequency range of the UPA generator is from 10 Hz to 110 kHz. The generator frequency 1 kHz is automatically set when the UPA is switched on.

Any generator frequency can be selected directly by entering the frequency value using the keypad.

Procedure: → Enter the frequency value (see Section 2.3.4 "Entering Numbers via the Keyboard").

→ Enter the unit kHz or Hz by pressing the corresponding key in the SOURCE block 3.

Example: Set a generator frequency of 23.95 kHz.

(SOURCE block)

Inputs which exceed the limits of the UPA lead to an error message on the FUNCTION/DATA display 13 following input of the unit kHz or Hz.

2.3.2.2.2 Variation of Frequency After Switching On the UPA

The generator is automatically set to a frequency of 1 kHz when the UPA is switched on.

The spin wheel 41 can be used to change the frequency according to the automatic assignment for frequency variation:

Frequency change per step	Frequency range
0.1 Hz	10.0 Hz to 999.9 Hz
1 Hz	1.000 kHz to 9.999 kHz
10 Hz	10.00 kHz to 110.00 kHz

This assignment is cleared if a new frequency step value is entered from the keyboard (see Sections 2.3.2.2.3 and 2.3.2.2.4). It can be set again by entering special function 21.0 (see Section 2.3.9).

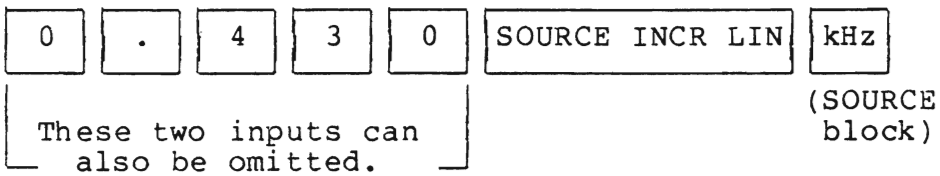
In order to observe the change in frequency, the FREQUENCY display must be switched to the generator by pressing the key kHz or Hz 3 in the SOURCE block.

2.3.2.2.3 Linear Variation of Frequency in Selectable Steps

The set frequency can be varied in selectable linear steps using the rotary knob VAR. The step size is defined by entering a number on the keypad.

Procedure:
- → Enter frequency step size sign on keypad 24 (see Section 2.3.4 "Entering Numbers via the Keyboard").
- → Press key SOURCE INCR LIN 22.
- → Press key kHz or Hz 3 in the SOURCE block.

Example: Input linear frequency step size 0.430 kHz



Values <0 Hz/kHz or >110 kHz lead to an error message on the FUNCTION/DATA display 13.

A new entry for the frequency step value clears the old value, i.e. also the automatic assignment of the frequency variation.

The automatic assignment can be set again as in Section 2.3.2.2.2. Special functions 21.0 and 21.1 can be used to switch between automatic step values and manually entered step values (see Section 2.3.9).

Depending on the direction of rotation, each step of the spin wheel 41 increases or decreases the current frequency by the specified frequency step value.

Violation of the UPA limits by rotating the spin wheel no longer changes the last valid value, even if the spin wheel is rotated further. A subsequent rotation in the opposite direction then produces a change in the frequency by the specified frequency step value.

The input 0 Hz or 0 kHz produced by rotating the spin wheel 41 does not change the current frequency. Variation by the spin wheel can therefore be suppressed.

2.3.2.2.4 Logarithmic Variation of Frequency

The set frequency can be varied logarithmically by entering a multiplication value >1. The frequency is then increased or decreased by the entered factor depending on the direction of rotation of the spin wheel 41.

Procedure:

- Assign the spin wheel to the frequency variation after pressing key kHz or Hz in the SOURCE field.
- Enter the multiplication factor via keypad 24 (see Section 2.3.4 "Entering Numbers via the Keyboard").
- Press key SHIFT 17.
- Press key SOURCE INCR LOG 22.

Example: Input of logarithmic frequency step value 2.

2	SHIFT	SOURCE INCR LOG

Increase the current frequency by a factor of 2 with each step of the spin wheel in the clockwise direction. Decrease the current frequency by a factor of 2 with each step in the counterclockwise direction.

Multiplication factors smaller than 1 lead to an error message on the FUNCTION/DATA display 13.

A new entry for the frequency step value clears the old value, i.e. also the automatic assignment of the frequency variation.

The automatic assignment can be set again as in Section 2.3.2.2.2. Special functions 21.0 and 21.1 can be used to switch between automatic step values and manually entered step values (see Section 2.3.9).

Violation of the UPA limits no longer changes the last valid value, even if the spin wheel is rotated further.

A subsequent rotation of the spin wheel 41 in the opposite direction then produces a change in the frequency by the specified factor. Rotation of the spin wheel with the multiplication factor 1 does not change the generator frequency. Variation of the generator frequency by the spin wheel 41 can therefore be suppressed.

2.3.2.2.5 Variation of Frequency in Octave and Third-octave Sequences to DIN 45401

Via special function 21.x, the generator frequency can be varied in octave or third-octave steps using the spin wheel.

Special function 21.2 = 1st octave sequence
Special function 21.3 = 2nd octave sequence
Special function 21.4 = 1st third-octave sequence
Special function 21.5 = 2nd third-octave sequence

Input of special function see 2.3.9.1.

After the special function has been entered, the generator is set to a frequency of the desired sequence which comes closest to the previously set generator frequency.

Using the spin wheel 41, the frequency can be varied according to the selected sequence.

Violation of the UPA limits no longer changes the last valid value, even if the spin wheel is rotated further. A subsequent rotation of the spin wheel in the opposite direction produces a change in the frequency.

Return to auto increment or manually entered step values is possible via special functions 21.0 or 21.1 (see 2.3.9).

1st octave sequence	2nd octave sequence	1st third-octave sequence	2nd third-octave sequence
16.0 Hz	11.2 Hz	10.0 Hz	11.2 Hz
31.5 Hz	22.4 Hz	12.5 Hz	14.0 Hz
63.0 Hz	45.0 Hz	16.0 Hz	18.0 Hz
125.0 Hz	90.0 Hz	20.0 Hz	22.4 Hz
250.0 Hz	180.0 Hz	25.0 Hz	28.0 Hz
500.0 Hz	355.0 Hz	31.5 Hz	35.5 Hz
1.0 kHz	710.0 Hz	40.0 Hz	45.0 Hz
2.0 kHz	1.4 kHz	50.0 Hz	56.0 Hz
4.0 kHz	2.8 kHz	63.0 Hz	71.0 Hz
8.0 kHz	5.6 kHz	80.0 Hz	90.0 Hz
16.0 kHz	11.2 kHz	100.0 Hz	112.0 Hz
31.5 kHz	22.4 kHz	125.0 Hz	140.0 Hz
63.0 kHz	45.0 kHz	160.0 Hz	180.0 Hz
	90.0 kHz	200.0 Hz	224.0 Hz
		250.0 Hz	280.0 Hz
		315.0 Hz	355.0 Hz
		400.0 Hz	450.0 Hz
		500.0 Hz	560.0 Hz
		630.0 Hz	710.0 Hz
		800.0 Hz	900.0 Hz
		1.0 kHz	1.12 kHz
		1.25 kHz	1.4 kHz
		1.6 kHz	1.8 kHz
		2.0 kHz	2.24 kHz
		2,5 kHz	2.8 kHz
		3.15 kHz	3.55 kHz
		4.0 kHz	4.5 kHz
		5.0 kHz	5.6 kHz
		6.3 kHz	7.1 kHz
		8.0 kHz	9.0 kHz
		10.0 kHz	11.2 kHz
		12.5 kHz	14.0 kHz
		16.0 kHz	18.0 kHz
		20.0 kHz	22.4 kHz
		25.0 kHz	28.0 kHz
		31.5 kHz	35.5 kHz
		40.0 kHz	45.0 kHz
		50.0 kHz	56.0 kHz
		63.0 kHz	71.0 kHz
		80.0 kHz	90.0 kHz
		100.0 kHz	

2.3.2.3 Level Setting of the Generator

2.3.2.3.1 Level Input via the Keyboard

The adjustable range of the generator open-circuit voltage is 0.1 mV to 12.4 V. The output level can be directly selected by entering the required number on the keypad together with the level unit.

Procedure:
- → Enter level value via keypad 24 (see Section 2.3.4 "Entering Numbers via the Keyboard").
- → Enter the required unit in V, mV, dBV or dBm(Z) via the SOURCE block 1.

Example: Generator level setting -10.5 dBV

[+/-] [1] [0] [.] [5] [dBV]

(SOURCE block)

Inputs which violate the limits of the UPA lead to an error message on the FUNCTION/DATA display 13 after entry of the unit.

2.3.2.3.2 Variation of the Level After Switching On the UPA

The generator is automatically set to a level of 1.0 mV when the UPA is switched on. The level can be changed upwards or downwards according to the automatic assignment of the UPA using the spin wheel 41 if the spin wheel is assigned to the level variation. The spin wheel is assigned to the generator frequency after switching on the UPA, as can be seen on the LED FREQ. The assignment of the spin wheel can be changed as follows:

- → Press the mV or V key in the SOURCE block 1 of the generator. The LED FREQ is extinguished and the LED LEVEL lights up.

The LEVEL display 2 is then also assigned to the generator and indicates the current generator level.

Automatic assignment for the level variation via the spin wheel after switching on the UPA:

Level variation per step	Level range
0.001 mV	0.100 mV to 2.999 mV
0.01 mV	3.00 mV to 29.99 mV
0.1 mV	30.0 mV to 299.9 mV
1 mV	300 mV to 2.999 V
10 mV	3.00 V to 12.4 V
0.01 dB	dBV or dBm

This assignment is cleared if a new level step size is entered via the keyboard (see Section 2.3.2.3.3). It can be recalled by entering the special function 20.0 (see Section 2.3.9).

2.3.2.3.3 Variation of the Level in Selectable Steps

The current level of the generator can be varied in selectable steps using the spin wheel ± VAR 41. The level is increased or decreased by the specified step value depending on the direction of rotation of the spin wheel 41.

Procedure:

- Enter the level step value (see Section 2.3.4 "Entering Numbers via the Keyboard").
- Press key SOURCE INCR LIN 22.
- Press one of the keys V, mV, dBV or dBm (Z) in the SOURCE block 1.

Example: Input of a level step of 0.5 dBm.

.	5	SOURCE INCR LIN	dBm(Z)

(SOURCE block)

The following inputs lead to an error message on the FUNCTION/ DATA display 13:

<0 V/mV or >12.4 V
<0 dBV/dBm or >100 dBV/dBm

A valid new input clears the old value, i.e. also the automatic assignment of the level variation.

The automatic assignment can be set again as in Section 2.3.2.3.2. Special functions 20.0 and 20.1 can be used to switch between automatic step values and manually entered step values (see Section 2.3.9).

Violation of the UPA limits no longer changes the last valid value, even if the spin wheel is rotated further. A subsequent rotation of the spin wheel 41 in the opposite direction then produces a change in the frequency by the specific step value.

The level variation can be suppressed by entering an increment of 0 V/mV/dBV or dBm(Z).

2.3.2.3.4 Logarithmic Variation of the Level

The current generator level can be varied logarithmically by entering a multiplication factor > 1. The level is increased or decreased by the entered factor depending on the direction of rotation of the spin wheel 41.

Procedure:
- Assign the spin wheel to the level variation by pressing one of the keys V, mV, dBV or dBm(Z) in the SOURCE block 1.
- Enter multiplication factor on numeric keypad 24 (see Section 2.3.4).
- Press key SHIFT 17.
- Press key SOURCE INCR LOG 22.

Example: Entry of multiplication factor 2.

2	SHIFT	SOURCE	INCR LOG

Increase level value by the factor of 2 with each step of the spin wheel in the clockwise direction. Decrease level value by a factor of 2 with each step in the counterclockwise direction.

The multiplication or division only acts on the voltage value irrespective of the displayed level unit. An internal conversion of the factor into a dB value is carried out if the value displayed is in dBV or dBm.

Multiplication factors of less than 1 lead to an error message on the FUNCTION/DATA display 13.

A new valid input clears the old value, i.e. also the automatic assignment of the level variation.

The automatic assignment can be set again as in Section 2.3.2.3.2. Special functions 20.0 and 20.1 can be used to switch between automatic step values and manually entered step values (see Section 2.3.9).

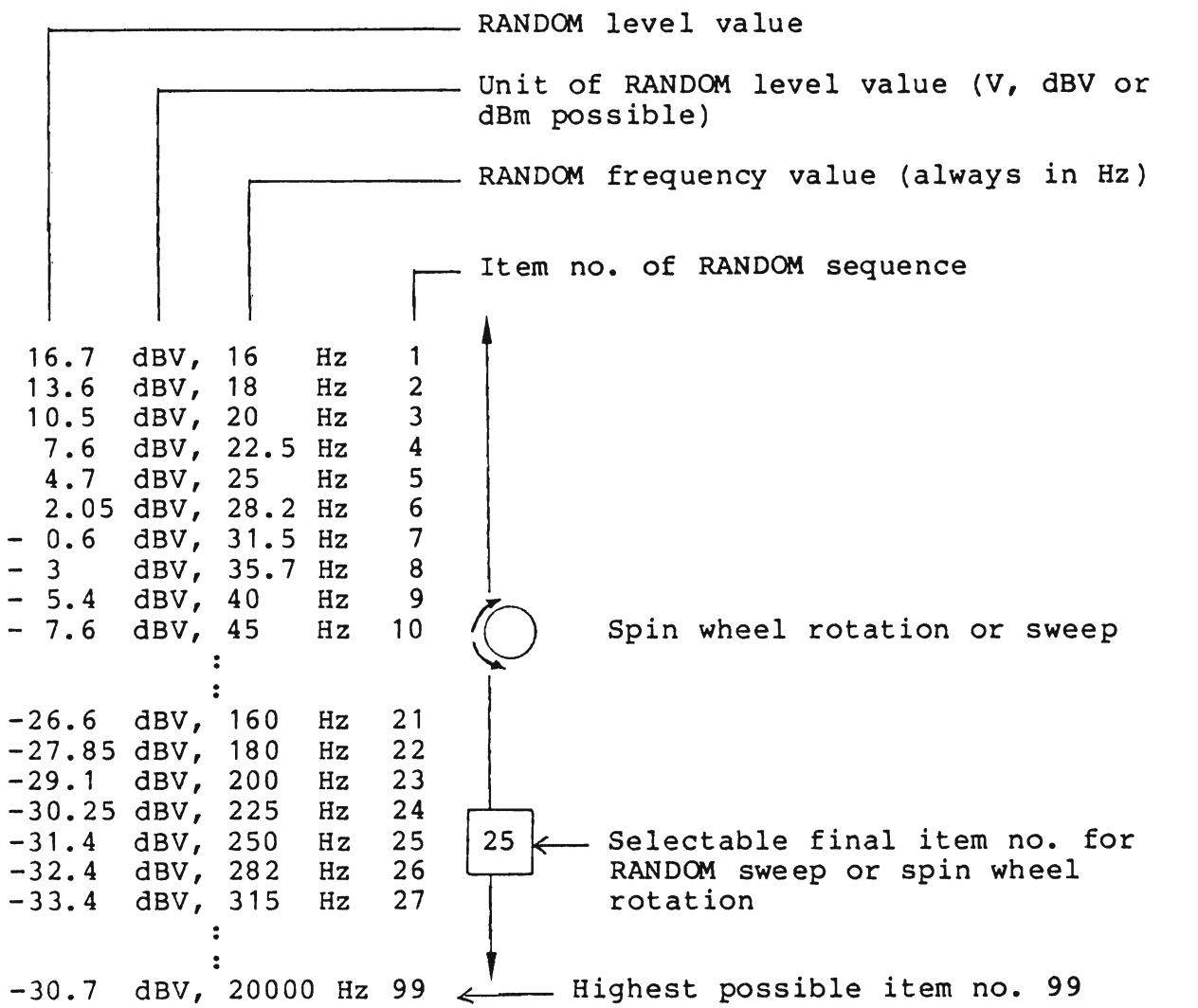
The last valid level does not change any more if the upper or lower limit values are violated, even if the spin wheel 41 is rotated further.

Rotation in the opposite direction then produces a change in the level by the specified factor. Rotation of the spin wheel 41 with the multiplication factor 1 does not change the generator level. The variation can therefore be suppressed.

2.3.2.3.5 Random Level and Frequency Sequence (RANDOM Sequence)

In contrast to the ways of incrementing described before, the random level and frequency sequence permits to enter a maximum of 99 random level and frequency values which are output individually or in combination by the generator by means of spinwheel rotation, sweep or IEC-bus control. This way of incrementing will be referred to as RANDOM sequence in the following.

Model of a RANDOM sequence with definition of terms:



The random level and frequency sequence permits a sweep (referred to as RANDOM sweep in the following) with the following possibilities:

RANDOM sweep with random frequency values:
E.g. for frequency response measurements with given frequency sequences.

RANDOM sweep with random level values:
E.g. for measurements on compandor and expandor circuits with given level sequences.

RANDOM sweep with simultaneous change in random level and frequency values:
E.g. for displaying a frequency response difference between nominal values and measured values of a test item. The inverse nominal frequency response is entered as a random level and frequency sequence with a maximum of 99 pairs of level/frequency values. The value pairs are simultaneously output at the generator output!

Setting of random level and frequency sequence by calling up SPEC FCT 24

Level/frequency selection of RANDOM sequence

With spin wheel rotation or sweep, the values of a RANDOM sequence can be output at the generator output in three different ways:
1) Simultaneous output of level and frequency values
2) Output of frequency values (level remains unchanged)
3) Output of level values (frequency remains unchanged)

The text "rAnd" ("rAnd" stands for random) in connection with the LEVEL or FREQUENCY display indicates the current setting.

The last setting is retained even after switching the UPA off/on!

The current setting can be varied by entering 0 for level values only, 1 for frequency values only, 2 for combination of level and frequency values, or by pressing the +/-key on the keypad of the UPA. The selected setting is indicated both by the displays and by the LEDs on the spin wheel.

Pressing of the SPEC FCT key without changing the setting causes the current setting to be retained and allows to change the level offset of the RANDOM level values.

→ When the SPEC FCT key is pressed, a scroll is made to the next possible entry within SPEC FCT 24.

Changing the level offset of the RANDOM level values:

The indication "OFFS." in the LEVEL display refers to the current level offset in the FUNCTION/DATA display.
The last setting is retained even after switching the UPA off/on!

In a RANDOM sweep or when rotating the spin wheel, the level offset is considered together with the level values of the RANDOM sequence in order to shift the stored level values jointly.

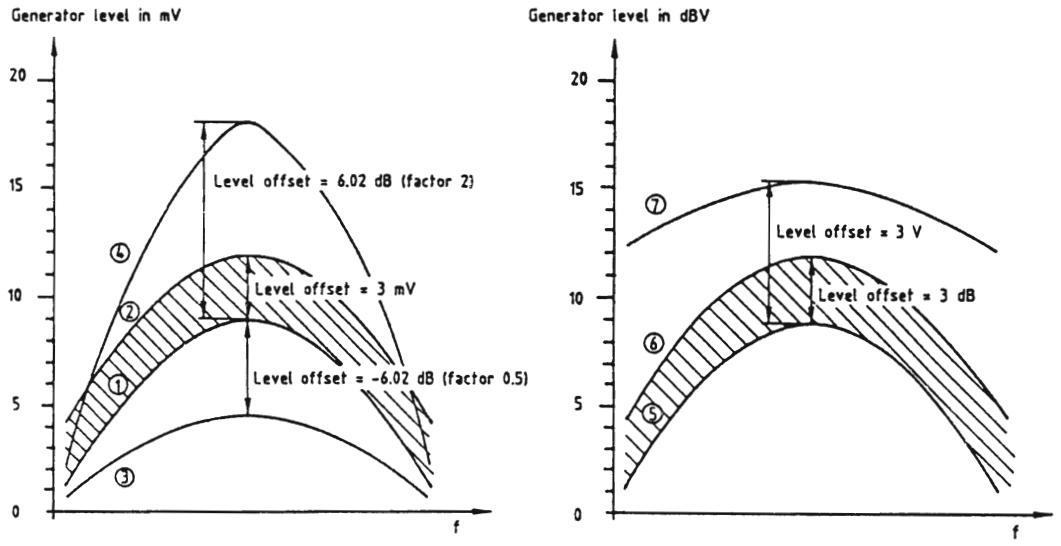
Depending on the frequency values, the RANDOM level values can be regarded as a curve which, due to level offset indication, can be parallel-shifted in order to be matched to different test items.

For changing the level offset value, the desired offset value is to be entered via the keyboard of the UPA and terminated by pressing a unit key in the SOURCE block of the UPA.

Level offset value in V or mV:
is added to the level value stored in the RANDOM sequence. Prior to generator output, level values stored in dBV or dBm(Z) in the RANDOM sequence are converted to V and then added to the level offset value. The SOURCE value is still output in dBV or dBm(Z).

Level offset value in dB:
If a level offset value is transferred with the unit keys dBV or dBm(Z), a factor is calculated from this value which is displayed as level offset in dB and by which each level value stored in the RANDOM sequence is multiplied prior to generator output. For matching the random level sequence to a test item, the level offset is usually entered in dB in order to enable parallel shifting of the curve in logarithmic diagrams without changing the shape of the curve.

If a generator level outside the permissible generator limits is calculated from the RANDOM level and the level offset value, 12.4 V or 21.84 dBV is set for illegally high level values and 0.1 mV or -80.0 dBV for illegally low level values.



Curve 1 and 5: Level/frequency values determined by random sequence

Curve 2 and 6: Parallel-shifted curve due to appropriate selection of unit of level offset value referred to generator level display unit, e.g.
Generator level display in V or mV, level offset in V or mV or generator level display in dBV, level offset in dB.

Curve 3, 4, 7: Different shape of curve due to inappropriate selection of unit of level offset value referred to generator level display unit.

→ By pressing the SPEC FCT key, a scroll is made to the next possible entry within SPEC FCT 24.

Final item of RANDOM sequence:

The last setting is retained even after switching the UPA off/on!

The text "End POS" in the displays indicates that the final item can now be changed for a spin wheel rotation or RANDOM sweep. A RANDOM sweep or a spin wheel rotation always starts with the values of item no. 1 and ends with the values of the displayed final item. The final item no. is selectable between 2 and 99. The new value is transferred into the memory by pressing the SPEC FCT key.

→ Pressing of the SPEC FCT key enables the **sweep time** to be entered within SPEC FCT 24, see 2.3.2.5.1.

→ Pressing of the SPEC FCT key enables the **print and plot mode for output of sweep measurement results** to be entered within SPEC FCT 24, see 2.3.2.5.1.

→ Pressing of the SPEC FCT key enables the

Entry of level and frequency values for a RANDOM sequence:

The current values stored under the item number indicated in the FUNCTION/DATA display with POS x are output on the LEVEL and FREQUENCY display of the UPA: The measured values, generator values and refererence values are not distinguished by display of the designations MEAS, SOURCE or REF.

Upon delivery of the UPA, the memory area for the random level and frequency sequence contains 99 linearly stepped pairs of level/frequency values. These values can be changed at any time by entering the new value via the keyboard of the UPA. The value is transferred into the memory for the RANDOM sequence by pressing the unit keys in the SOURCE field of the generator. The values assigned to item x (POS x) can be varied until the next item of the random sequence POS x+1 is selected by pressing the SPEC FCT key.

The entry 24.x SPEC FCT (even when entering pairs of level/frequency values) permits direct selection of an item no. x = 1 to 99 without having to move to this item by pressing the SPEC FCT key several times.

If the preselected final item is reached, "End POS" is briefly displayed on the LEVEL and FREQUENCY display.

Nevertheless, further random values can be entered beyond the final item no. up to POS 99.

Upon reaching POS 99, further pressing of the SPEC FCT key does not produce an effect any more and the SPEC FCT 24 is to be left by pressing the Clear key twice.

Correction of input values:

When entering values for a RANDOM sweep, incorrectly entered values can be cleared by pressing the CLEAR key 23 and entered once again.

Abort:

A parameter entry for a RANDOM sweep can be aborted by pressing the CLEAR key 23 twice.

Switching between RANDOM sequence and NORMAL increment:

RANDOM sequence → NORMAL increment:
- SPEC FCT 20, 21 or 26
- If, during a RANDOM sweep, a normal sweep is triggered by means of SPEC FCT 29.0 or 29.1, the sweep is immediately continued with the current parameters of the NORMAL sweep.

NORMAL increment → RANDOM sequence:
- SPEC FCT 24
- If, during a normal sweep, a RANDOM sweep is triggered by means of SPEC FCT. 29.2, the sweep is immediately continued with the current parameters of the RANDOM sweep.

General remarks on RANDOM sweep:

The RANDOM sweep is not affected by the sweep limits of the NORMAL sweep or by the spin wheel limits:
Variation of the sweep start parameters or sweep stop parameters by means of SPEC FCT 26.0, 26.1, 26.3, 26.4 or activation of spin wheel limiting by means of SPEC FCT 22 and 23 does not affect the RANDOM sweep.

If the RANDOM sweep is activated by means of SPEC FCT 24.0, the parameters for NORMAL sweep are no longer relevant but remain unchanged.

The RANDOM sequence as well as the level offset of the RANDOM level values and the final item are stored in the RAM with battery backup so that the complete data set is retained after switching the UPA off/on. It is **not possible to store several RANDOM sequences** as complete instrument settings.

2.3.2.3.6 Conversion of Generator Levels

A current generator level can be converted into the desired unit by pressing one of the unit keys in the SOURCE block 1.

The LEVEL display 2 is assigned to the generator at the same time as the key is pressed so that the converted generator level is displayed and the spin wheel 41 is assigned to the change in level, signalled by the LED LEVEL.

Display of the generator level in dBV is based on the following formula:

$$\text{Level in dBV} = 20 \times \lg \frac{|V_0|}{V}$$

Generator levels can be converted from V to dBm or vice versa by means of two methods of calculation which are switch-selectable via SPEC FCT 25.

SPEC FCT 25.0: Reference to terminal voltage, taking into account the generator output impedance R_i = 30 Ω.

$$\text{Displayed value A in dBm} = 10 \lg \left[\frac{V_0^2}{Z \times 1\ \text{mW}} \cdot \left(\frac{Z}{R_i + Z} \right)^2 \right]$$

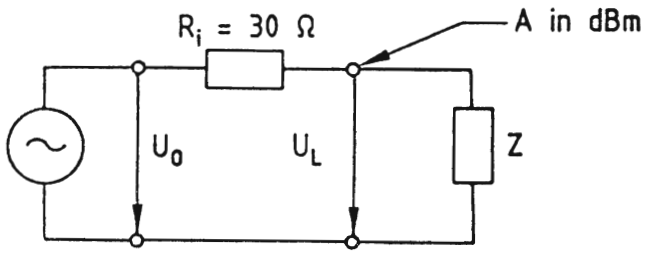
V_0: Generator open-circuit voltage

R_i: Generator impedance, 30 Ω

Z: Reference impedance, 600 Ω following power up or to be entered via keyboard (see Sections 2.3.1.6.9 and 2.3.1.6.10).

Example:

Z = 600 Ω
V_0 = 813 mV
V_L = 775 mV
A = 0 dBm

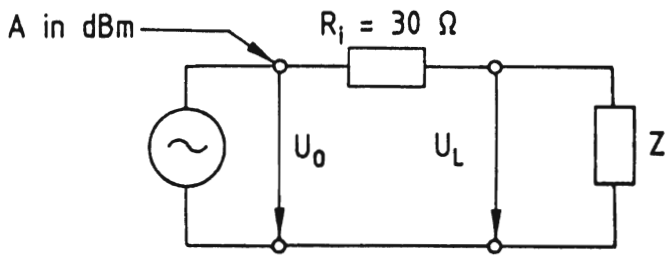


SPEC FCT 25.1: Reference to open-circuit voltage (ignoring the generator output impedance)

$$\text{Displayed value A in dBm} = 10 \lg \frac{V_0^2}{Z \times 1\ \text{mW}}$$

Example:

Z = 600 Ω
V_0 = 775 mV
V_L = 738 mV
A = 0 dBm



The level dBm(Z) is defined such that a power level of dBm is output to a resistor of magnitude Z connected to the generator connector. It should be noted that a conversion of the generator level takes place if there is a change in the reference impedance and the generator no-load voltage therefore remains unchanged. The generator level display and output in dBV or dBm always has a resolution of 0.01 dB.

The setting once selected via SPEC FCT 25 **remains stored** even when the UPA is switched off/on and is **not** influenced by the basic setting after switch-on. When storing a complete instrument setting, SPEC FCT 25 is **not taken into account!**

2.3.2.4 Recalling the Frequency or Level Step Size of the Spin Wheel

The current frequency or level step size for the spin wheel 41 can be displayed briefly on the FUNCTION/DATA display 13 by pressing the key SOURCE INCR LIN.

Whether the frequency or level step size is output on the FUNCTION/DATA display depends on the spin wheel assignment and is indicated by the LED LEVEL or FREQ.

Display of the step size briefly interrupts the contents of the FUNCTION/DATA display 13. The display subsequently resumes its previous assignment.

The word SOURCE in the FUNCTION/DATA display 13 indicates the generator setting during the brief step size display. A number with unit indicates the current step size of the spin wheel. A number without a unit indicates the factor for the logarithmic change in frequency or level.

The messages which can be briefly displayed have the following meaning:

A-Inc: automatic increment for level and frequency variation indicated by the LEDs LEVEL and FREQUENCY on the spin wheel.
SFI=1: 1st octave sequence
SFI=2: 2nd octave sequence
SFI=3: 1st third-octave sequence
SFI=4: 2nd third-octave sequence
rAnd : RANDOM sequence active. The level/frequency selection is indicated by the LEDs LEVEL and FREQ on the spin wheel.

If a linear or logarithmic step number has been entered during input of sweep parameters using SPEC FCT 26.2 or SPEC FCT 26.5, not the selected number of steps, but the corresponding linear step size or a multiplication factor is displayed on the FUNCTION/DATA display when pressing the SOURCE INCR key.

2.3.2.5 Sweep

The UPA can be caused to automatically perform level or frequency increments by simulating rotation of the rotary knob.

This feature which is referred to as **sweep** in the following requires several parameters to be entered via special function 26.

2.3.2.5.1 Entry of Parameters for NORMAL Sweep

Start level and stop level:

26.0 SPEC FCT: Start level (basic setting: 1 mV)
26.1 SPEC FCT: Stop level (basic setting: 1 V)

After calling up the respective special function, the current value is output on the FUNCTION/DATA display. It can be varied by entering a new value via the keyboard.

The input is terminated by pressing one of the keys V, mV, dBV and dBm(Z) in the SOURCE block 1.

Level increment:

26.2 SPEC FCT: (Basic setting: auto increment or SPEC FCT 20.0)

After calling this special function, the FUNCTION/DATA display shows the current increment value, "A-Inc" for automatic increment or "StEP" for a step number.

A new increment can be entered by entering a new value or SPEC FCT 20.x.

Value input: The input of a new value is terminated by pressing one of the keys V, mV, dBV or dBm(Z) in the source block, or by means of the same key sequence as used for input of the spin wheel increment (see 2.3.2.3.3 to 4). Spin wheel increment and sweep increment are identical!

SPEC FCT 20.0: Switchover to automatic increment.

SPEC FCT 20.1: Switchover to manually entered increment.

SPEC FCT 20.10: Input facility for linear step number.
"StEP.Li" appears in the level display.

SPEC FCT 20.11: Input facility for logarithmic step number.
"StEP.Lo" appears in the level display.

The FUNCTION/DATA display shows the current step number which can be varied by entering a new value in the range from 1 to 10000. The input is terminated by pressing the SPEC FCT key. The sweep range is swept with the specified number of steps from the sweep start value to the sweep stop value with linear step size (SPEC FCT 20.10) or with logarithmic step size (SPEC FCT 20.11).

Example: Linear step number = 5!

Sweep start					sweep stop
Level in V: 1	2.8	4.6	6.4	8.2	10
Level in dBV: 0	8.94	13.26	16.12	18.28	20
Step 1	2	3	4	5	

Example: Logarithmic step number = 5!

Sweep start					sweep stop
Level in V: 1	1.585	2.512	3.98	6.31	10
Level in dBV: 0	4.00	8.00	12.00	16.00	20
Step 1	2	3	4	5	

Logarithmic magnitudes in dBV und dBm are incremented linearly or logarithmically, starting from the **voltage value** in V!

Start frequency and stop frequency

26.3 SPEC FCT: start frequency (basic setting: 1 kHz)
26.4 SPEC FCT: stop frequency (basic setting: 10 kHz)

After calling the respective special function, the FUNCTION/DATA display indicates the current value which can be changed by entering a new value on the keypad.
The entry is terminated by pressing one of the keys Hz or kHz in the SOURCE block 3.

Frequency increment:

26.5 SPEC FCT: (Basic setting: automatic increment or SPEC FCT 21.0)

After calling this special function, the FUNCTION/DATA display shows the current increment value, "A-Inc" for automatic increment, "SFI.1 - 4" for special frequency increment or "StEP" for a step number.

A new increment can be entered by entering a new value or SPEC FCT 21.x.

Value input: The input of a new value is terminated by pressing one of the keys Hz or kHz in the source block or by means of the same key sequence as used for input of the spin wheel increment (see 2.3.2.2.2 to 5). Spin wheel increment and sweep increment are identical!

SPEC FCT 21.0: Switchover to automatic increment

SPEC FCT 21.1: Switchover to manual entry of increment.

SPEC FCT 21.2: 1st octave
SPEC FCT 21.3: 2nd octave
SPEC FCT 21.4: 1st third octave
SPEC FCT 21.5: 2nd third octave

SPEC FCT 21.10: Input facility for linear step number. "StEP.Li" appears in the FREQUENCY display.

SPEC FCT 21.11: Input facility for logarithmic step number. "StEP.Lo" appears in the FREQUENCY display.

The FUNCTION/DATA display shows the current step number which can be varied by entering a new value in the range from 1 to 10000. The input is terminated by pressing the SPEC FCT key. The sweep range is swept with the specified number of steps from the sweep start value to the sweep stop value with linear step size (SPEC FCT 21.10) or with logarithmic step size (SPEC FCT 21.11).

Example: Linear step number = 5!

Sweep start					sweep stop
in kHz: 1	2.0	3.0	4.0	5.0	6
step	1	2	3	4	5

Example: Logarithmic step number = 5!

Sweep start					sweep stop
in kHz: 1	1.431	2.048	2.930	4.193	6
step 1	2	3	4	5	

Sweep time:

26.6 SPEC FCT: (Basic setting: 0.15 s)

The sweep time is defined as the period of time for each increment which passes after setting the generator and before transferring the measured value, thus allowing the generator and a test item to settle.

After calling up this special function, the current sweep time is output in seconds on the FUNCTION/DATA display. The basic setting value of 0.15 seconds usually ensures (preferably for IEC-bus operation) that the generator is in a steady-state condition before the measurement is started. Depending on the required frequency accuracy and settling time of the test item, this sweep time can be varied within the limits of 0 to 5 seconds by entering a new value via the keyboard.

Sweep time 0 s: frequency tolerance ±0.5 %
Sweep time 0.05 s: frequency tolerance ±0.1 %
The input is terminated by pressing the SPEC FCT key.

Print and plot mode for output of sweep measurement results:

Use of SPEC FCT 26.7 or 27.0.

"IEC Out" is displayed on the UPA and one of the following expressions on the FUNCTION/DATA display:

"OFF": No output of measured values via the IEC-bus interface.

"Print": Automatic output of measured values to an IEC-bus printer in Talk Only IEC-bus mode (see 2.4.18 "Measured Value Output in Talk Only Mode").

"Plot": Automatic output of a test log to an IEC-bus printer in Talk Only IEC-bus mode (see 2.4.18 "Measured Value Output in Talk Only Mode" as well as 2.3.2.7 "Logging of Measured Values via the IEC-bus Interface").

The current setting can be changed by entering 0 for "OFF", 1 for "Print", 2 for "Plot" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

Scroll:

Individual sweep parameters can be changed by selecting the appropriate special function 26.0 to 26.7. If several sweep parameters are to be changed, a scroll facility permits automatic display of the next parameter after completion of an input. If no change is made, a further sweep parameter can be displayed by pressing the SPEC FCT key.

In combination with the displays LEVEL or FREQUENCY, START, STOP, INC, SEC and PRINT characterize the displayed value as START level, STOP level, INC level, START frequency, STOP frequency, INC frequency, SEC (sweep time), PRINT mode, START level, etc. in the specified sequence. During input of the sweep parameters, incorrectly entered values can be deleted and reentered by pressing the CLEAR key 23.

By pressing the CLEAR key 23 twice, the input of sweep parameters can be **aborted** .

Summary of the possible sweep inputs:

SPEC FCT	26(.0)	SWEEP Start level
SPEC FCT	26.1	SWEEP Stop level
SPEC FCT	26.2	SWEEP Increment level
SPEC FCT	26.3	SWEEP Start frequency
SPEC FCT	26.4	SWEEP Stop frequency
SPEC FCT	26.5	SWEEP Increment frequency
SPEC FCT	26.6	SWEEP Time
SPEC FCT	26.7	SWEEP Print/plot

2.3.2.5.2 Entry of Parameters for Random Sweep

All parameters for the RANDOM sweep are to be entered via SPEC FCT 24.

If only the sweep parameters "sweep time" or "print and plot mode for output of sweep measurement results" are of interest, the desired menu "sweep time" can be entered by pressing the SPEC FCT key three times. By pressing the SPEC FCT key once more, the menu "print and plot mode for the output of sweep measurement results" is selected:

→ Enter 24 SPEC FCT

Level/frequency selection of RANDOM sequence: see 2.3.2.3.5

→ Scroll by pressing the SPEC FCT key

Change level offset of RANDOM level values: see 2.3.2.3.5

→ Scroll by pressing the SPEC FCT key

Final item of RANDOM sequence: see 2.3.2.3.5

→ Scroll by pressing the SPEC FCT key

Sweep time:

The sweep time is the period of time for each RANDOM or NORMAL sweep step which passes after setting the generator and before transferring the measured value in order to allow the generator and a test item to settle.

After pressing the SPEC FCT key, the displays indicate "SEC" as well as the current sweep time in seconds. A default value of 0.15 seconds usually ensures that the generator is in a steady-state condition (preferably for IEC-bus mode) before a measurement is started. Depending on the requirements placed upon frequency accuracy and settling time of the test item, the sweep time can be varied between 0 and 5 seconds by entering a new value on the keypad.

Sweep time 0 s: frequency tolerance ±0.5 %
Sweep time 0.05 s: frequency tolerance ±0.1 %
The entry is terminated by pressing the SPEC FCT key.

(The sweep time for a RANDOM sweep is identical with the sweep time for a NORMAL sweep (SPEC FCT 26.6), and in both cases **one and the same** storage variable is affected.

——► Scroll by pressing the SPEC FCT key

Print and plot mode for the output of sweep measurement results

IEC OUT is displayed on the UPA as well as one of the following texts on the FUNCTION/DATA display:

"OFF": No output of measured values via IEC-bus interface.

"Print": Automatic output of measured values to IEC-bus printer in Talk Only IEC-bus mode (see 2.4.18 "Measured Value Output in Talk Only Mode").

"Plot": Automatic output of test log to IEC-bus printer in Talk Only IEC-bus mode (see 2.4.18 "Measured Value Output in Talk Only Mode" as well as 2.3.2.7 "Logging of Measured Values via IEC-bus Interface").

The current setting can be changed by entering 0 for "OFF", 1 for "Print", 2 for "Plot" or by pressing the +/- key on the keypad of the UPA.

The entry is terminated by pressing the SPEC FCT key.

The print/plot setting for a RANDOM sweep is identical with the print/plot setting for a NORMAL sweep (SPEC FCT 26.7 or 27.0) because **one and the same** storage variable is affected in both cases.

A plotter output on a printer connected via IEC bus with a RANDOM sequence and **simultaneous change in the level and frequency values** requires an additional facility for selecting on which the printout of a function measurement curve is to depend.

For this case, SPEC FCT 27.12 becomes significant!
When SPEC FCT 27.12 is called, "run" is displayed on the LEVEL or FREQUENCY display.

The current setting can be varied by entering 0, 1 or by pressing the +/- key on the keypad of the UPA. "run" in connection with the LEVEL or FREQUENCY display indicates the selected setting.

"run" on the LEVEL display:	Depending on the generator level, the frequency curve and the function curve are printed. The frequency curve usually represents frequency values stored in the RANDOM sequence. Exception: test items the output frequency of which depends on an input level. (Selection of curves see SPEC FCT 27.8)
"run" on the FREQUENCY display:	Depending on the generator frequency, the level curve and the function curve are printed. (Selection of curves see SPEC FCT 27.8)

When the SPEC FCT key is pressed without changing the setting, the current setting is retained.

2.3.2.5.3 Sweep Direction

NORMAL sweep:
The direction of the sweep depends upon the start/stop parameters:

Sweep from lower to higher values: start value < stop value
Sweep from higher to lower values: start value > stop value

RANDOM sweep:
The direction of the sweep is always from item 1 to the defined final item.

2.3.2.5.4 Sweep Mode

For manual operation, three sweep modes can be selected using special function 28.0 to 28.2:

28.0 SPEC FCT: Single sweep
NORMAL sweep: Only one sweep is made in the direction determined by the START/STOP parameters.
RANDOM sweep: The sweep is performed only once from item 1 to the final item.

28.1 SPEC FCT: Automatic sweep repetition in one direction:
NORMAL sweep: The sweep is continuously repeated in the direction determined by the START/STOP parameters (see 2.3.2.5.3).
RANDOM sweep: The sweep is continuously repeated from item 1 to the final item.

28.2 SPEC FCT: Automatic repetition of RANDOM sweep with alternating direction (particularly suited for investigating test items with hysteresis).

NORMAL sweep: Sweep is started in the direction determined by the START/STOP parameters (start direction see 2.3.2.5.3) and continued in the opposite direction when a limit is reached.

RANDOM sweep: Sweep is started from item 1 (POS 1) to the final item (END POS) and continued in the opposite direction when a limit is reached.

2.3.2.5.5 Sweep Start

A sweep is started using special function 29:

29.0 SPEC FCT: Start of NORMAL frequency sweep
29.1 SPEC FCT: Start of NORMAL level sweep
29.2 SPEC FCT: Start of RANDOM sweep

The desired sweep is started with the current start parameter. A running sweep is indicated by lighting of LED 19. Besides, varying measured values or source values can be observed on the displays. Independent of the selected sweep increment, the sweep limits are always set! With automatic sweep repetition set via special function 28.1 or 28.2, LED 19 briefly flashes when a limit is reached. During a running sweep, pressing of a key always causes the associated function to be performed.

2.3.2.5.6 Sweep Halt

Key entries during a sweep which do not change the sweep parameters cause the sweep to be interrupted (not aborted). Thus, it is possible to change the UPA setting during the sweep without the need for aborting and restarting the sweep.

Pressing the CLEAR key for the first time during a sweep also causes the sweep to be halted.

Interruption of the sweep is indicated by lighting of LED 19. The sweep can be continued where halted (see 2.3.2.5.7).

Key entries during a sweep which change the sweep parameters or pressing the CLEAR key twice cause the sweep to be aborted (see 2.3.2.5.8).

2.3.2.5.7 Sweep Continue

An interrupted sweep (see 2.3.2.5.6) can be continued where interrupted by pressing the SPEC FCT key if LED 19 lights (sweep is not restarted).

2.3.2.5.8 Sweep Abort

Each running sweep can be aborted by pressing CLEAR key 23 twice. Changing the sweep parameters via SPEC FCT 26 during a sweep also causes the sweep to be aborted. LED 19 is extinguished. When the sweep is aborted, it must be restarted using SPEC FCT 29.x. A sweep initiated via the keyboard of the UPA is aborted by switching over from local to remote mode.

A sweep initiated by an IEC-bus command is aborted by switching over from remote to local mode using the LOCAL/TALK key 18. In both cases, the last generator values set in the sweep remain valid.

2.3.2.5.9 Synchronization of the Sweep with the Measuring Loop

Sweep without IEC-bus output:
Required sweep time for
level measuring speed SLOW (SPEC FCT 10.0): ..... > 0.3 s
level measuring speed FAST (SPEC FCT 10.1): ..... > 0 s

Sweep with IEC-bus output (print or plot):
It is ensured that the generator is in a steady-state condition before the measurement is started.

2.3.2.6 Limitation of Generator Range

The sweep values start level, stop level, start frequency and stop frequency can also be used for limitation of the generator level and/or frequency band. When the UPA is in local mode, a lower and an upper limit which cannot be violated can thus be freely selected by spin wheel rotation.

Level limitation may serve to protect a sensitive test item.

SPEC FCT 22(.0): Level limitation off (basic setting)
SPEC FCT 22.1: Level limitation on
SPEC FCT 23(.0): Frequency limitation off (basic setting)
SPEC FCT 23.1: Frequency limitation on

With active range limitation, direct input of level or frequency values (see 2.3.2.3.1/2.3.2.2.1) which lie outside the current sweep limits causes an error message to be displayed. If, with range limitation switched off, the generator is set to a frequency or level value which lies outside the sweep limits and if limitation is then switched on via SPEC FCT 22.1 or 23.1, rotation of the spin wheel 41 sets the generator to the next possible value within the sweep parameter limits.

Further rotation of the spin wheel only performs settings lying inside the specified limits.

If a particular number of linear or logarithmic steps is to be performed between initial and final value of an already selected range limitation, this step number must be indicated in the sweep parameter input level with SPEC FCT 26.2 (level increment) or SPEC FCT 26.5 (frequency increment) (see 2.3.2.5.1).

When the SOURCE INCR key is pressed, not the selected step number but the corresponding linear step size or a multiplication factor is shown on the FUNCTION/DATA display.

Caution!

By setting the RANDOM sequence (see 2.3.2.3.5 Level/frequency selection of RANDOM sequence), the range limitation is ignored and the random level and frequency values entered by the user are output. (The test item is no longer protected against overvoltages!) After switching off the RANDOM sequence (see 2.3.2.3.5 Switchover of RANDOM sequence to NORMAL increment) the range limitation is activated again.

2.3.2.7 Logging of Measured Values via the IEC-bus Interface

Using the IEC-bus interface together with a printer, a test log can be produced in connection with a sweep (referred to as "plot mode" in the following).

To this end, set the IEC-bus printer to LISTEN ONLY and the UPA to TALK ONLY using SPEC FCT 1.31 (see 2.4.1).

Example of plot output:

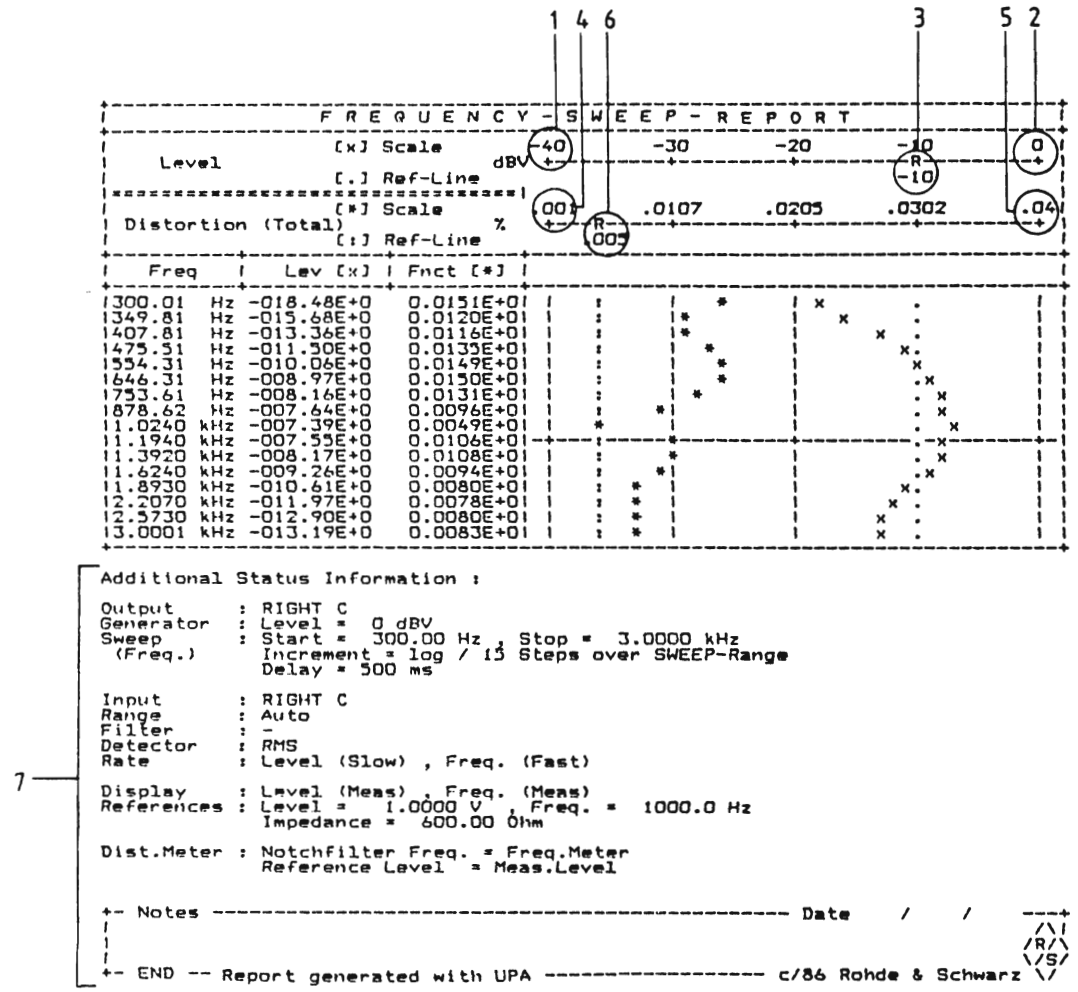


Fig. 2-10.1 Plot output of a frequency sweep with representation of the level and distortion factor curve on a test item.

Plot setting:

SPEC FCT 27.0:	IEC	Out	Plot
SPEC FCT 27.1:	Plot	1_Lo	-40
SPEC FCT 27.2:	Plot	1_Hi	0
SPEC FCT 27.3:	Plot	1_rEF	-10
SPEC FCT 27.4:	Plot	2_Lo	0.001
SPEC FCT 27.5:	Plot	2_Hi	0.04
SPEC FCT 27.6:	Plot	2_rEF	0.005
SPEC FCT 27.7:	Plot	FF	OFF
SPEC FCT 27.8:	Plot		ALL
SPEC FCT 27.9:	Plot	rEF.Ln	USE1
SPEC FCT 27.10:	Plot	InFo	On
SPEC FCT 27.11:	Plot	FILL	OFF

The left side of the test log lists the measured values numerically, the right side shows their curve shape. The plot mode depends on the current setting of the UPA.

Frequency sweep with SPEC FCT 29.0:
The **1st curve** represents the level as a function of frequency, identified with "LEVEL" and "*" on the printout.
With function measurement switched on, a 2nd curve represents e.g. distortion factor, S/N, phase ... as a function of frequency, identified with the function designation "Distortion, Phase ..." and "x" on the printout.

Level sweep with SPEC FCT 29.1:
The **1st curve** represents the frequency as a function of level, identified with "FREQUENCY!" and "*" on the printout.
With function measurement switched on, a 2nd curve represents e.g. distortion factor, S/N, phase ... as a function of level, identified with the function designation "Distortion, Phase ..." and "x" on the printout.

Overview of possible plot inputs:

SPEC FCT 27(.0)	Switch on plot mode
SPEC FCT 27.1	Scale 1: initial value
SPEC FCT 27.2	Scale 1: final value
SPEC FCT 27.3	Scale 1: reference value
SPEC FCT 27.4	Scale 2: initial value
SPEC FCT 27.5	Scale 2: final value
SPEC FCT 27.6	Scale 2: reference value
SPEC FCT 27.7	Select form feed
SPEC FCT 27.8	Only function plot
SPEC FCT 27.9	Select reference lines
SPEC FCT 27.10	Complete setting of UPA as additional information
SPEC FCT 27.11	Emphasize reference ranges

2.3.2.7.1 Print and Plot Mode:

Use of SPEC FCT 26.7 or 27.0

"IEC Out" is displayed on the UPA as well as one of the following expressions on the FUNCTION/DATA display:

"OFF":	see 2.3.2.5.1 (basic setting)
"Print":	see 2.3.2.5.1
"Plot":	Automatic output of a test log on a printer in Talk Only IEC-bus mode (see 2.4.18).

The current setting can be changed by entering 0 for "OFF", 1 for "Print", 2 for "Plot" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

2.3.2.7.2 Input of Scaling Values:

Identified with 1, 2, 4 and 5 in Fig. 2-10.1!

The user can determine the range in which to display the curves by entering scale values without units, the input values always referring to the unit indicated on the display of the UPA. If the displays indicate mV, mW or kHz values, the input values must always be specified in the basic unit V, W or Hz.

SPEC FCT 27.1:	Initial value of first scale	-100	Internal basic setting
SPEC FCT 27.2:	Final value of first scale	100	
SPEC FCT 27.4:	Initial value of second scale	-100	
SPEC FCT 27.5:	Final value of second scale	100	

Example: Performing a frequency sweep

- The measured level is indicated in V on the LEVEL display!
- The level curve is to be represented from 10 mV to 1.2 V!

Key sequence

27.1	SPEC FCT	0.01	SPECT FCT	1.20	SPEC FCT	CLEAR	CLEAR

2.3.2.7.3 Input of Reference Lines

Identified with 3 and 6 in Fig. 2-10.1

In order to emphasize striking points of the curves, reference lines can be entered. These reference lines bear no relation with the reference values stored in the UPA!

SPEC FCT 27.3: Input facility for the reference line of the first curve represented with ".".
(Internal basic setting: 0)

SPEC FCT 27.6: Input facility for the reference line of the function curve represented with ":".
(Internal basic setting: 0)

The input value without unit refers to the unit indicated on the display and should lie between the initial and the final scale values. If the displays show mV, mW or kHz values, the input values must always be indicated in the basic unit V, W or Hz.

Example: Level sweep with distortion factor measurement

- The distortion measurement result is indicated in dB on the FUNCTION/DATA display!
- The function reference line is to be set to -60 dB.

Key sequence | 27.6 | SPEC FCT | -60 | SPECT FCT | CLEAR | CLEAR |

2.3.2.7.4 Possible Choices for Form Feed

SPEC FCT 27.7 can be used to determine the position in the print-out at which a form feed is to be performed.

"Plot FF" is displayed on the UPA as well as one of the following expressions on the FUNCTION/DATA display:

"OFF": no form feed (basic setting)
"End": form feed at log end
"StArt": form feed at log start
"both": form feed at log start and log end

The current setting can be changed by entering 0 for "OFF", 1 for "End", 2 for "StArt", 3 for "both" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

2.3.2.7.5 Display of Function Curve Only

SPEC FCT 27.8 can be used to determine whether the function curve is to be displayed alone or together with the first curve.

"Plot" as well as one of the following expressions is displayed on the UPA:

"ALL": First curve and function curve (basic setting)
"Fnct OnlY": Function curve only

The current setting can be changed by entering 0 for "ALL", 1 for "Fnct OnlY" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

2.3.2.7.6 Display or Suppression of Reference Lines

SPEC FCT 27.9 can be used to determine if and in which way the reference lines are to be output, their positions having been entered using SPEC FCT 27.3 and 27.6 (see above).

"Plot rEF.Ln" is displayed on the UPA and one of the following expressions on the FUNCTION/DATA display:

"USE 1": (Internal basic setting)
Provided the specified values for the reference lines lie between the initial and final scale value, the reference line is output with each curve. If only one curve is output, only one reference line is displayed likewise.

"USE 2": The response depends on whether one or two curves are output.

One curve: Both reference lines are output for one curve, provided the specified values for the reference lines lie within the scale range.

Two curves: like "USE 1"

"OFF": No reference line is output.

The current setting can be changed by entering 0 for "USE 1", 1 for "USE 2", 2 for "OFF" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

2.3.2.7.7 Add Complete UPA Setting to Test Log

Identified with 7 in Fig. 2-10.1.

SPEC FCT 27.10 can be used to determine whether the complete UPA setting is to be added to the test log in plain text as additional information.

"Plot InFo" is displayed on the UPA and one of the following expressions on the FUNCTION/DATA display:

"On": Add complete UPA setting (basic setting)
"OFF": Test log only

The current setting can be changed by entering 0 for "OFF", 1 for "On" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

2.3.2.7.8 Reference Range Identification

Identified with "'''''''" in Fig. 2-10.3 and 2-10.4.

SPEC FCT 27.11 can be used to determine whether the range marked by the reference lines is to be emphasized by the output of"''''".

"Plot FILL" is displayed on the UPA and one of the following expressions on the FUNCTION/DATA display:

"OFF": No emphasis on reference range (basic setting)
"1.I==": One curve: Two reference lines: emphasis between the lines
One reference line: emphasis to the right of the line
Two curves: No emphasis on the reference range
"0.==I": One curve: Two reference lines: emphasis outside the lines
One reference line: emphasis to the left of the line
Two curves: No emphasis on the reference range

The current setting can be changed by entering 0 for "OFF", 1 for "1.I==", 2 for "0.==I" or by pressing the +/- key on the keypad of the UPA.

The input is terminated by pressing the SPEC FCT key.

2.3.2.7.9 Function Curve Assignment for RANDOM Sweep with Simultaneous Change in Level and Frequency

SPEC FCT 27.12 can be used to determine on which the printout of a function curve is to depend if a RANDOM sweep is to be performed with **simultaneous change in level and frequency.**

When SPEC FCT 27.12 is called, "run" is indicated in the LEVEL or FREQUENCY display.

The current setting can be changed by entering 0, 1 or by pressing the +/- key on the keypad of the UPA. "run" in connection with the LEVEL or FREQUENCY display indicates the selected setting.

"run" in the LEVEL display: Depending on the generator level, the frequency curve and the function curve are printed. The frequency curve usually represents the frequency values stored in the RANDOM sequence. Exception: Test items the output frequency of which depends on the input level. (Selection of curves see SPEC FCT 27.8).

"run" in the FREQUENCY display: Depending on the generator frequency, the level curve and the function curve are printed. (Selection of curves see SPEC FCT 27.8).

Scroll:

After the parameter has been transferred by pressing the SPEC FCT key, the next plot parameter is automatically displayed and can be varied as described before. If the parameter is not changed, a further plot parameter can be displayed by pressing the SPEC FCT key.

When entering plot parameters, incorrectly entered values can be deleted by pressing the CLEAR key 23 and reentered.

To abort the entry of plot parameters, press the CLEAR key 23 twice.

Example of plot output:

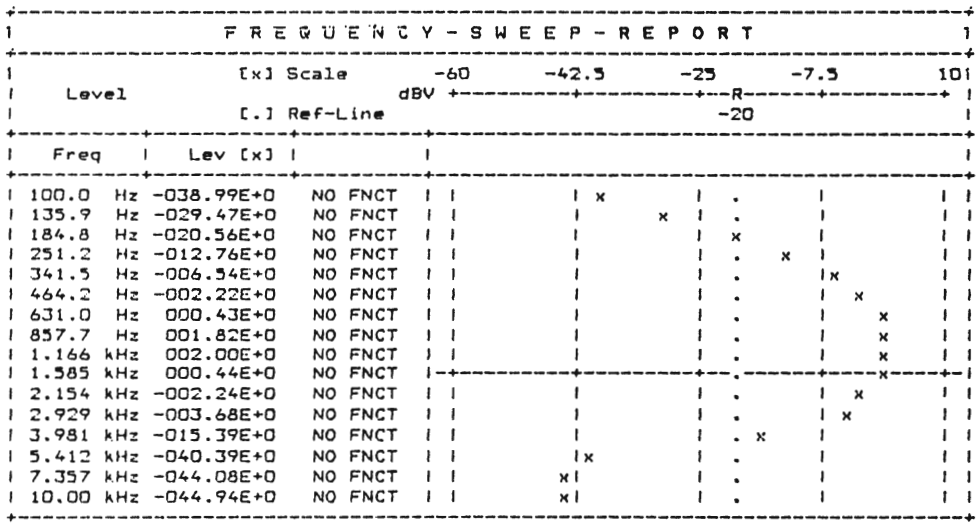


Fig. 2-10.2 Plot output of a frequency sweep with display of level curve on a test item.

Plot setting:

SPEC FCT 27.0:	IEC	Out	Plot
SPEC FCT 27.1:	Plot	1_Lo	-60
SPEC FCT 27.2:	Plot	1_Hi	10
SPEC FCT 27.3:	Plot	1_rEF	-20
SPEC FCT 27.4:	Plot	2_Lo	-100
SPEC FCT 27.5:	Plot	2_Hi	100
SPEC FCT 27.6:	Plot	2_rEF	0
SPEC FCT 27.7:	Plot	FF	OFF
SPEC FCT 27.8:	Plot		ALL
SPEC FCT 27.9:	Plot	rEF.Ln	USE1
SPEC FCT 27.10:	Plot	InFo	OFF
SPEC FCT 27.11:	Plot	FILL	OFF

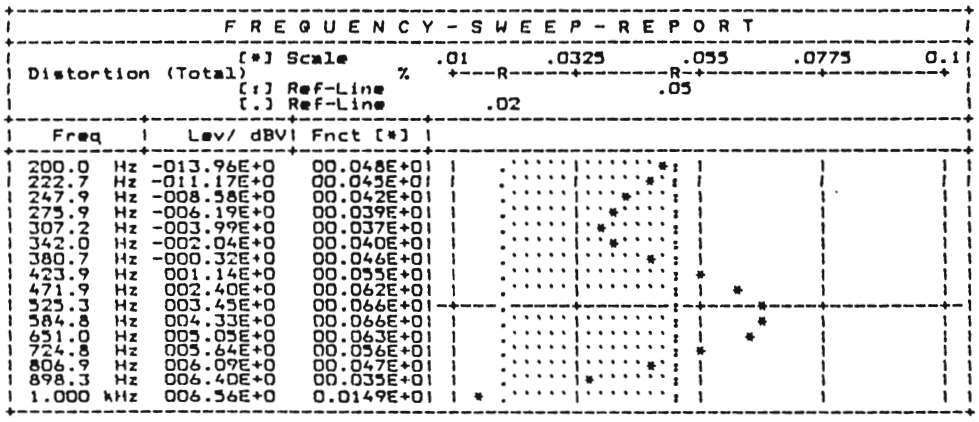


Fig. 2-10.3 Plot output of a frequency sweep with display of the distortion factor curve on a test item and emphasis on a range between the reference lines.

Plot setting:

SPEC FCT 27.0:	IEC	Out	Plot
SPEC FCT 27.1:	Plot	1_Lo	-100
SPEC FCT 27.2:	Plot	1_Hi	100
SPEC FCT 27.3:	Plot	1_rEF	0.02
SPEC FCT 27.4:	Plot	2_Lo	0.01
SPEC FCT 27.5:	Plot	2_Hi	0.1
SPEC FCT 27.6:	Plot	2_rEF	0.05
SPEC FCT 27.7:	Plot	FF	OFF
SPEC FCT 27.8:	Plot	Fnct	OnlY
SPEC FCT 27.9:	Plot	rEF.Ln	USE2
SPEC FCT 27.10:	Plot	InFo	OFF
SPEC FCT 27.11:	Plot	FILL I.	I==

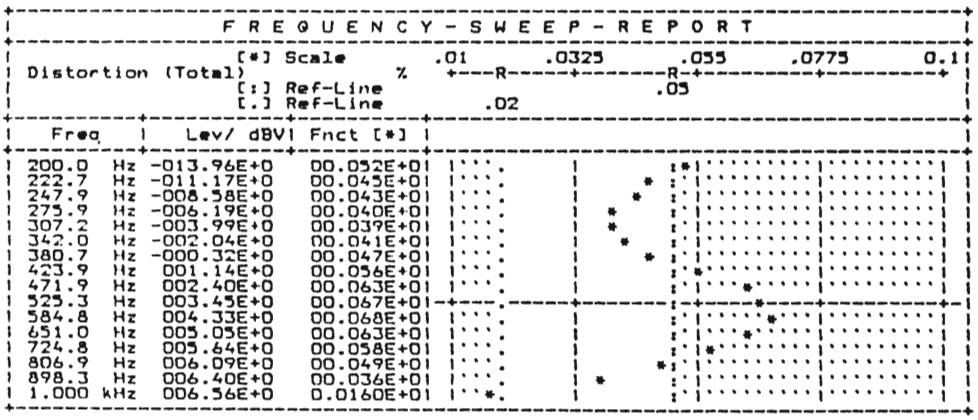


Fig. 2-10.4 Plot output of a frequency sweep with display of the distortion factor curve on a test item and emphasis on a range outside the reference lines.

Plot setting:

SPEC FCT 27.0:	IEC	Out	Plot
SPEC FCT 27.1:	Plot	1_Lo	-100
SPEC FCT 27.2:	Plot	1_Hi	100
SPEC FCT 27.3:	Plot	1_rEF	0.02
SPEC FCT 27.4:	Plot	2_Lo	0.01
SPEC FCT 27.5:	Plot	2_Hi	0.1
SPEC FCT 27.6:	Plot	2_rEF	0.05
SPEC FCT 27.7:	Plot	FF	OFF
SPEC FCT 27.8:	Plot	Fnct	OnlY
SPEC FCT 27.9:	Plot	rEF.Ln	USE2
SPEC FCT 27.10:	Plot	InFo	OFF
SPEC FCT 27.11:	Plot	FILL I.	==I

2.3.3 Function Unit

"no OP" is briefly output on the FUNCTION/DATA display 13 if one of the keys in the function unit 25, 26, 27, 28 is pressed without the associated option being present.

2.3.3.1 Wow & Flutter Measurements (Option UPA-B9)

Wow & flutter measurements are possible using the option UPA-B9. Wow & flutter measurements are pitch variation measurements with magnetic tape units, cassette recorders, record players and drives.

Pitch variations represent a frequency modulation generated by an interfering frequency. The signal is demodulated in order to measure the pitch variation. The demodulated signal is weighted and the ratio to the reference frequency of the input signal is produced. The result is the frequency deviation or the wow & flutter value and is displayed in %.

For further qualitative judgement of magnetic tape recorders, the amplitude variation measurement AM is provided in the wow & flutter block of the UPA. The amplitude variations are measured with a corresponding weighting. The result is the logarithmic variation width and is displayed in dB or %. The amplitude variation display AM refers to voltage drops as they are typical for tape recorders (dirty sound heads, dropouts).

For wow & flutter measurements, four modes are available:

Wow & flutter to DIN: (corresponding to DIN 45507, CCIR 409-3, IEC 386)
Reference frequency 3.15 kHz with quasi-peak value rectification.

Wow & flutter to NAB: (corresponding to THE NATIONAL ASSOCIATION OF BROADCASTERS)
Reference frequency 3.00 kHz with average-value rectification.

Wow & flutter to JIS: (corresponding to Japanese Industrial Standard C 5551)
Reference frequency 3 kHz with rms-value rectification. As with 2-sigma measurements, the rms meter is designed such that a steady wow and flutter display is obtained.

AM: Amplitude variation in dB or % referred to a carrier signal between 2 kHz and 20 kHz with quasi-peak value rectification.

Note: There is no connection between the rectification modes for wow & flutter weightings and the rms or quasi-peak detectors for the level measurement.

Selection of wow & flutter test method:
DIN, NAB, AM: Press key 28 in the WOW & FLUTTER block.

Procedure: → Press key 28 in the WOW & FLUTTER block.
A roll function is then possible:
DIN - NAB - AM - wow & flutter off - DIN - NAB - ...

JIS: Calling of SPEC FCT 31.1 (SPEC FCT 31.0 switches off any WOW & FLUTTER measurement).

Which type of wow & flutter measurement is active, if any, is indicated by the LED DIN, NAB or AM 28.
Simultaneous lighting of the LEDs DIN and NAB indicates that the JIS measurement is active.

Selection of the noise signal weighting is linked to selection of the wow & flutter function.

The user can select between three types of weighting:

WTD: Weighting of the noise signal using a standardized bandpass filter with a centre frequency of 4 Hz.

UNWTD FAST: Unweighted measurement with dynamic response of display as with weighted measurement.

UNWTD SLOW: Unweighted measurement and slow settling of the rectifier to steady the display with low-frequency noise.

The weighting method is selected using key 27 in the WOW & FLUTTER block.

Procedure: → Press key 27 in the WOW & FLUTTER block.
A roll function is then possible:
WTD - UNWTD FAST - UNWTD SLOW - WTD - .....

The LEDs WTD, UNWTD FAST and UNWTD SLOW indicate which of the noise signal weighting functions has been selected.

Pressing of the right-hand key 27 in the WOW & FLUTTER block of the UPA produces no effect if no wow & flutter function (DIN, NAB or AM) is switched on.

By pressing the DIST key 26, the NOISE key 25 as well as by activating the phase measurement, the wow and flutter function is automatically switched off.

The wow & flutter mode remains stored in the instrument when another function is selected and becomes valid again when the wow & flutter key 28 is pressed again.

The wow & flutter measuring ranges can be held or switched to autoranging via SPEC FCT 32 or via the IEC-bus command RANGE (WOW-FLUTTER...).

32(.0) Autoranging (basic setting)
32.1 Fixed range (hold current range)

	DIN, NAB, JIS	AM
32.2	0.1 %	2 dB or 20 %
32.3	0.3 %	6 dB or 50 %
32.4	1 %	20 dB or 90 %
32.5	3 %	>20 dB or 100 %

(see also SPEC FCT 32 Section 2.3.9, Table 2-2).

Methods of calculation:

- for pitch variation measurements:

$$\text{wow \& flutter value in \%} = \frac{|\pm \Delta f|}{f_o} \times 100$$

$\pm\Delta f$: weighted or unweighted frequency deviation
f_o: standard reference frequency (3.15 kHz or 3 kHz)

- for amplitude variation measurements:

$$\text{AM value in dB} = 20 \times \lg \frac{V_{max}}{V_{min}}$$

$$\text{in \%} = \frac{V_{max} - V_{min}}{V_{max}} \times 100$$

V_{max}, V_{min}: weighted or unweighted amplitude values

2.3.3.1.1 2-sigma Test Method for Wow & Flutter Measurements

The 2-sigma test method for wow & flutter measurements on tape units enables to steady the display and produce a rather reliable log of measured values with varying magnitude (pitch and amplitude variations). The 2-sigma measurement extends over a period of 5, 10 or 20 seconds and uses 50 single wow & flutter values to determine the result to be displayed.

This test method does not take into consideration exceptional values produced by faulty tapes, vibrations or interference on AC supply lines, which are purely accidental.

The 2-sigma measurement may extend over three different periods of time:

SPEC FCT	Time period (t)	Number of single measured values (M)	Number of eliminated greatest meas. values (E)
SPEC FCT 30.1:	5 s	50	3
SPEC FCT 30.2:	10 s	100	5
SPEC FCT 30.3:	20 s	200	10

With the 2-sigma test method, all peaks are eliminated according to the Gaussian distribution curve (independent of their magnitude) if they occur in less than 5 % of all cases.

From the number of single wow & flutter measurement results (M) collected within the selected period of time (t) with 100 ms per value, the UPA program eliminates the greatest measured values (E) (approx. 5 %) and displays the fourth greatest measured value as 2-sigma value.

With this test method, the fault against the exact mathematical calculation is merely 1 %.

Exact mathematical calculation of the 2-sigma value:

$$\sigma_{n-1} = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \overline{X})^2}{n-1}} \qquad \overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

(standard deviation) (mean value)

$$2 \text{ sigma} = \overline{X} + 2 \times \sigma_{n-1}$$

X_i: values from the table

n: number of collected values

The value X_i from the table which comes closest to 2 sigma with $X_i < 2$ sigma is displayed.

The 2-sigma test method is preset by means of

SPEC FCT 30.1 (measuring time 5 s)
SPEC FCT 30.2 (measuring time 10 s) or
SPEC FCT 30.3 (measuring time 20 s)

and switched off by means of 30.0. Presetting does not yet start a 2-sigma measurement.

The 2-sigma measurement can only be set if a wow & flutter measurement is already active which in turn requires the wow & flutter option; otherwise the error message Er 04 (illegal special function number) will be displayed.

After starting a 2-sigma measurement via the SPEC FCT key, an irregularly changing value can usually be observed on the FUNCTION/DATA display for a period of (t) seconds. After expiration of the (t) seconds, the displayed value does not change any more. The validity of the displayed value is also indicated by LED 19: The LED lights up when the 2-sigma measurement is started and is extinguished after expiration of the measuring time of (t) seconds, thus indicating that the measured value is now valid.

The 2-sigma test method can be applied to all wow & flutter measurements (to DIN, NAB, JIS or AM).

Since it is not possible to recognize the 2-sigma setting from outside, it is reset with each function change (wow & flutter to DIST or wow & flutter to NOISE) but also when the wow & flutter setting is changed in order to prevent wrong operation.

When storing complete instrument settings of the UPA with the 2-sigma measurement active, **the 2-sigma setting is retained** (see 2.3.6.1).

Recalling the complete settings of the UPA does not trigger a wow & flutter measurement with 2 sigma and is only started by pressing the SPEC FCT key.

The special function 30.1 **cannot** be displayed via the special function display (see 2.3.9.2), since pressing the corresponding key immediately triggers the 2-sigma measurement.

2.3.3.2 Distortion Factor Measurements (Option UPA-B8)

"no OP" is briefly output on the FUNCTION/DATA display if the distortion factor function is selected without the distortion meter UPA-B8 being fitted.

Four modes can be selected to measure the distortion factor of an input signal:

- TOTAL: The harmonics, including wideband noise, are incorporated.
- $3*f_o$: Only the third harmonic is considered.
- $n*f_o$: Only the nth harmonic is considered. n is an integer between 2 and 9 which can be entered via the numeric keypad (see Section 2.3.3.2.3).
- THD: A combination of harmonics of 2nd to 9th order is taken into account.

The distortion factor function is selected using the lefthand key in the DIST/NOISE block 26 (TOTAL, $3*f_o$, $n*f_o$) or SPEC FCT 33.x in the case of THD (see 2.3.3.2.4).

Procedure: → Press key 26 in the DIST/NOISE block.
A roll function is then possible via the distortion measurement functions
TOTAL - $3*f_o$ $n*f_o$ distortion factor measurement off - TOTAL - .....

Example: A distortion factor measurement for the nth harmonic is set and a measurement for the third harmonic ($3*f_o$) is to be made.

DIST DIST DIST DIST

[ ] [ ] [ ] or [3] [ ]

Which distortion factor measurement is active, if any, is indicated by the LEDs TOTAL, $3*f_o$ and $n*f_o$ 26. A THD measurement is indicated by simultaneous lighting of the LEDs TOTAL and $n*f_o$.

If a distortion factor measurement is selected, assignment to the rms rectifier is automatically made for level measurements.

Distortion factor measurements are switched off if the wow & flutter key 28 or the NOISE key 25 is pressed.

The distortion factor remains stored in the instrument when another function is selected and becomes valid again when the distortion factor key 26 is pressed again.

2.3.3.2.1 Switchover to Display Units %, dB, Volts, Δ%, ΔdB

The result of the distortion measurement can be displayed in %, dB, volts, Δ% or ΔdB on the FUNCTION/DATA display 13.

Display unit % or dB

The key %/dB 14 can be used to switch between the display units % or dB.

Display of distortion level in volts

Using SPEC FCT 37.1, the distortion level can be displayed in volts.

Display of distortion level with reference in Δ% or ΔdB

SPEC FCT 37.4 enables a distortion measurement the result of which (distortion level) is referred to a reference value. After switching on the UPA, the reference value is 1 V. The distortion level ratio, referred to a reference value, is displayed in Δ% or ΔdB and can be selected using the key %/dB 14.

Δ% value = ((Vdist - Vref) / Vref) * 100
Δdb value = 20 lg Vdist/Vref

Input of a new reference value via the keyboard:

The result of a distortion level measurement can be referred to any reference values between 0.001 mV and 300 V which can be entered via the keyboard.

Procedure:
- → Enter SPEC FCT 37.2. The current reference value is displayed!
- → Enter the reference value via the numeric keypad 24.
- → Press key SHIFT 17
- → Enter the desired unit using the key V/mV 5 (repeated pressing changes between the units).
- → Press key STO LEV 8.

Example: Input of a distortion level reference of 20.1 mV.

37.2	SPEC FCT	20.1	SHIFT	V/mV	V/mV	STO LEV

Transfer of a current distortion level as reference value:

With the distortion measurement switched on, the current distortion level is transferred as reference value using SPEC FCT 37.3. Before entering SPEC FCT 37.3, make sure that the distortion reading has settled on the FUNCTION display, since the measurement result cannot be displayed during the SPEC FCT input.
If SPEC FCT 37.3 is entered although no distortion or SINAD measurement is switched on, the error message Er 04 is output.

Returning to the display unit % or dB

This is achieved using SPEC FCT 37.0 with the distortion or SINAD measurement switched on. If neither distortion nor SINAD measurement is active, the distortion measurement TOTAL with the display unit % is switched on.

2.3.3.2.2 Distortion Measurement TOTAL

The TOTAL measurement considers all harmonic distortions **including** wideband noise.

Method of calculation for total distortion measurement:

$$d_{TOTAL} \text{ in } \% = \frac{\sqrt{V_2^2 + V_3^2 + \ldots + V_{NOISE}^2}}{V_{MEAS}} \times 100$$

$$d_{TOTAL} \text{ in dB} = 20 \times \lg \frac{d_{TOTAL}/\%}{100}$$

$$V_{TOTAL} \text{ in volts} = \sqrt{V_2^2 + V_3^2 + \ldots + V_{NOISE}^2}$$

$$\Delta\% \text{ value} = \frac{V_{TOTAL} - V_{REF}}{V_{REF}} \times 100$$

$$\Delta\text{dB value} = 20 \times \lg \frac{V_{TOTAL}}{V_{REF}}$$

d_{TOTAL}: distortion factor resulting from TOTAL measurement
V_{TOTAL}: rms value of distortion level of TOTAL measurement
V_2, V_3, : rms value of harmonic distortions
V_{NOISE}: rms value of wideband noise voltage
V_{MEAS} : rms value of test signal
V_{REF} : reference distortion level

2.3.3.2.3 Distortion Measurement $3*f_o$ and $n*f_o$

The measurement only considers the third or nth harmonic, respectively. The distortion measurement $3*f_o$ is simply a special case of the distortion measurement $n*f_o$; it is provided with its own key because this function is frequently required (e.g. for measurements on tape units).

Input of Ordinal Number n for Distortion Measurement $n*f_o$

The user can select the required ordinal number n using the keypad 24 for selective distortion factor measurements of individual harmonics.

Procedure:
- → Enter the required ordinal number between 2 and 9 (see Section 2.3.4 "Entering Numbers via the Keyboard").
- → Press the distortion factor key 26 in the DIST block.

Example: A distortion measurement is to be made for the 5th harmonic.

[5] [ ] DIST

The entered number is output on the FUNCTION/DATA display 13. Illegal inputs lead to an error message on the FUNCTION/DATA display.
A distortion function $n*f_o$ is only produced if a valid number is entered for the ordinal number n. The FUNCTION/DATA display 13 resumes its previous significance.
The selected ordinal number is stored until changed by a new entry.
Harmonics can be measured up to 300 kHz. If $n * f_o$ >300 kHz, the error message Er 12 will be output on the FUNCTION/DATA display.

Calculation for distortion measurement of a single harmonic

$$d_n \text{ in } \% = \frac{V_n}{V_{MEAS}} \times 100$$

$$d_n \text{ in dB} = 20 \times \lg \frac{V_n}{V_{MEAS}} = 20 \times \lg \frac{d_n/\%}{100}$$

$$V_n \text{ in volts} = V_n$$

$$\Delta\% \text{ value} = \frac{V_n - V_{REF}}{V_{REF}} \times 100$$

$$\Delta\text{dB value} = 20 \times \lg \frac{V_n}{V_{REF}}$$

d_n : distortion factor resulting from the measurement of a single harmonic
V_n : rms value of an harmonic with selected ordinal number n
V_{MEAS} : rms value of test signal
V_{REF} : reference distortion level

2.3.3.2.4 Distortion Measurement with Combinations of Harmonics (THD)

In the following, the distortion measurement with combinations of harmonics will be abbreviated by THD (Total Harmonic Distortion).

SPEC FCT 33 enables the THD measurement between d2 and d9 within selectable limits.

SPEC FCT 33.0: Distortion measurement off (reset).
SPEC FCT 33.1: THD measurement of **all** harmonics within the selected range.
SPEC FCT 33.2: THD measurement of **even** harmonics within the selected range
SPEC FCT 33.3: THD measurement of **odd** harmonics within the selected range

The UPA setting THD is indicated by the DIST LEDs:
The LED TOTAL and the LED $n*f_o$ light at the same time.

Unlike the distortion measurement TOTAL, the distortion measurement using SPEC FCT 33 does **not** consider wideband noise.

After selecting SPEC FCT 33.1, 33.2 or 33.3, "thd SEL.n" (SEL stands for select) is output on the first two displays of the UPA.
On the FUNCTION/DATA display,
AL.n1-n2 indicates all harmonics,
E. n1-n2 all even harmonics and
Od.n1-n2 all odd harmonics
within the limits n1 and n2, where n1 and n2 may assume the values 2 to 9.

Starting the measurement with the current parameters:

If no new limit values need be entered, the selected THD measurement can be started by pressing the CLEAR key 23 twice.

Input of limit values

is performed by means of keys 2 to 9 on the keypad of the UPA, whereby repeated pressing of the keys alternately changes the limit values as can be observed on the FUNCTION/DATA display.

The measurement of a single harmonic by indication of two **identical** limit values (n1 = n2) is **not** permitted and produces the error message Er 01.

It is **not** necessary to distinguish between even or odd values according to the selected THD measurement EVEN or ODD. The THD measurement is automatically performed with the harmonics that are possible in the selected range.
New input of the special function, if necessary, leads to a modification of the limit values according to the input, since only **one** pair of limit-value parameters is stored in the UPA for the three different THD measurements THD ALL, THD EVEN and THD ODD.
The input of 0 or 1 leads to the error message Er 01.

Examples:

SPEC FCT 33.1 Al.2-9: Measurement of harmonics d2,3,4,5,6,7,8,9
SPEC FCT 33.2 E .5-5: Error message Er 01
SPEC FCT 33.2 E .2-9: Measurement of harmonics d2, d4, d6, d8
SPEC FCT 33.2 E .3-5: Measurement of the harmonic d4
SPEC FCT 33.2 E .8-8: Error message Er 01
SPEC FCT 33.3 Od.6-6: Error message Er 01
SPEC FCT 33.3 Od.4-9: Measurement of harmonics d5, d7, d9
SPEC FCT 33.3 Od.6-8: Measurement of the harmonic d7

Scroll:

Pressing of the SPEC FCT key permits to switch continuously between THD ALL, THD EVEN, THD ODD, THD ALL, etc.
While entering parameters, wrong values can be deleted by pressing the CLEAR key 23 and entered again.

Starting the THD measurement:

The input of THD parameters can be **aborted** and the selected THD distortion measurement simultaneously **started** by pressing the CLEAR key 23 twice.

Measuring times of the THD measurement

can be calculated by summing up the measuring times required for the individual harmonics entered for the THD measurement.

If the highest harmonic exceeds 300 kHz, the error message Er 11 will be output.

Method of calculation for THD measurement:

$$d_{THD} \text{ in } \% = \frac{\sqrt{V_{n1}^2 + \ldots + V_{n2}^2}}{V_{MEAS}} \times 100$$

$$d_{THD} \text{ in dB} = 20 \times \lg \frac{d_{THD}/\%}{100}$$

$$d_{THD} \text{ in volts} = \sqrt{V_{n1}^2 + \ldots + V_{n2}^2}$$

$$\Delta\% \text{ value} = \frac{V_{THD} - V_{REF}}{V_{REF}} \times 100$$

$$\Delta\text{dB value} = 20 \times \lg \frac{V_{THD}}{V_{REF}}$$

For THD ALL (n1...n2) with n1,n2 = 2 to 9 or
EVEN (n1...n2) with n1,n2 = 2,4,6,8 or
ODD (n1...n2) with n1,n2 = 3,5,7,9

Measuring mode and ordinal numbers of the range of harmonics to be measured, selectable via SPEC FCT 33.x

V_{n1} : Rms value of the harmonic with ordinal number n1 as lower limit for the THD measurement.
V_{n2} : Rms value of the harmonic with ordinal number n2 as upper limit for the THD measurement.
d_{THD} : Distortion factor resulting from the THD measurement
V_{THD} : Rms value of distortion level of THD measurement
V_{REF} : Reference distortion level

2.3.3.2.5 Recalling of the Ordinal Number of the Distortion Measurement

The selected ordinal number n of the distortion measurement $n*f_o$ or the current THD measurement with the range of harmonics n1...n2 can be briefly output on the FUNCTION/DATA display 13.

Procedure: → Press the SHIFT key 17 (measurement is halted).
→ Press the DIST key 26 (second function of distortion key).

Example: Recalling the current ordinal number for the distortion measurement:

SHIFT DIST

Readount on the FUNCTION/DATA display:

- With measurement $n*f_o$: e.g. "nr 2" → harmonic with ordinal number d2
- With THD measurement: e.g. "AL.2-5" → all (d2, d3, d4, d5)
  "E .4-8" → even (d4, d6, d8)
  "Od.3-9" → odd (d3, d5, d7, d9)

2.3.3.2.6 Presetting Frequency For Distortion Measurements

The distortion measurement runs fully automatically. For suppression of the fundamental, presetting via the result of the frequency measurement and automatic fine tuning are performed internally. Presetting is also possible by entering a frequency value or by generator frequency assignment. This serves to increase the measuring speed or improve the accuracy of the setting in the case of heavily distorted signals.

The presetting frequency for the distortion factor measurement is selected using SPEC FCT 35:

35.0 Automatic selection by means of the measured frequency value (basic setting)

35.1 Generator frequency

35.2 Key entry
For calling the distortion measurement with a presetting frequency, the frequency value is to be entered using the following key sequence (e.g. input of 2-kHz presetting frequency via keyboard):

		SPEC FCT		SHIFT	kHz	STO FRQ
Key sequence	35.2		2.0			

If **SPEC FCT 35.2** is to be activated **without changing the current presetting frequency,** the value of the presetting frequency displayed in the FUNCTION/DATA display after calling SPEC FCT 35.2 is to be transferred by pressing the keys SHIFT 17 and STO FRQ 12.

Display of presetting frequency:
In order to merely display the current presetting frequency without activating SPEC FCT 35.2, leave SPEC FCT 35.2 after noting the value by pressing the CLEAR key twice.

35.3 Hold: Current frequency measurement result is stored and interpreted as presetting frequency.

If the frequency of the fundamental deviates by more than ±3 % from the presetting frequency (selectable via SPEC FCT 35.1 to 35.3) or if distortion factors >71 % or SINAD values <3 dB are measured (see below), the error message Er 11 (distortion meter cannot be tuned) will be displayed. This error message can be suppressed using SPEC FCT 36.1. SPEC FCT 36.0 enables the error message again (basic setting).

Note: Error detection with Er 11 is only possible if the frequency of the fundamental is not greater than 7 times the presetting frequency.

2.3.3.2.7 Measuring Distortion Factors >71 % or SINAD Values <3 dB

If the harmonic content or noise component of a test signal becomes greater than the fundamental, automatic tuning to the fundamental is no longer possible. In order to prevent this, use SPEC FCT 35.1 to 35.3 to preset the distortion meter to the desired fundamental of the test signal and SPEC FCT 36.1 to suppress the error message Er 11. This instrument setting allows to measure and display distortion factors >71 % or SINAD values <3 dB.

2.3.3.2.8 Increasing the Distortion Measuring Speed

The distortion measuring speed can be increased if high accuracy is dispensed with by disabling the most sensitive distortion measuring range using SPEC FCT 34.1. As a result of this, the measuring times for distortion factors <-65 dB (e.g. -70 dB) are shorter with IEC-bus operation. The maximum measuring time for the total distortion factor is

5.4 s in the frequency range 10 to 39 Hz
4 s in the frequency range 38 to 400 Hz

as opposed to max. 10 s in normal operation or with SPEC FCT 34.0.

The additional error given in Fig. 2-10.5 must be taken into account for the error limits indicated in the Specifications in the first section.

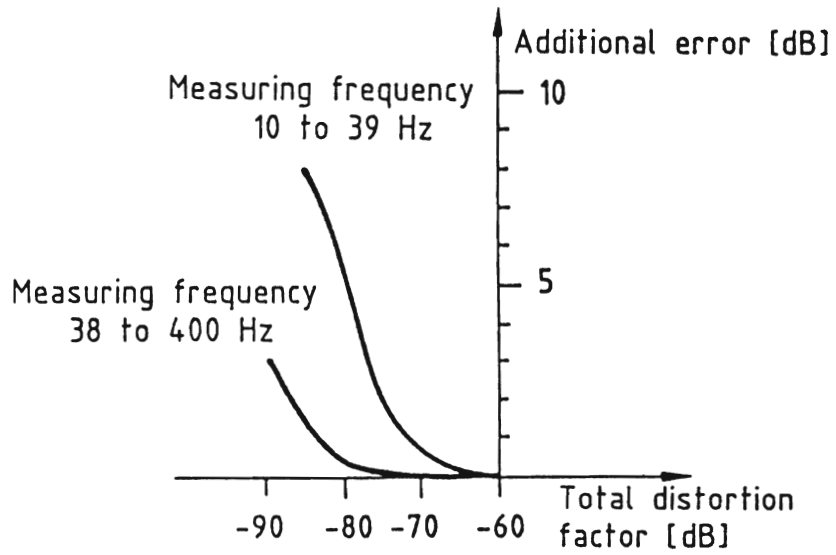


Fig. 2-10.5 Additional error with SPEC FCT 34.1 for measuring the total distortion factor with IEC-bus operation

With manual measurement, the additional error can be neglected if the steady state condition of the distortion display is waited for.

SPEC FCT 34.0 enables the most sensitive distortion measuring range again (corresponds to internal basic setting following SPEC FCT 8.0).

2.3.3.3 SINAD and Signal/Noise Measurements

Noise measurements can be made in the UPA according to two different methods:

- SINAD (with distortion factor option UPA-B8)
- Signal/noise S/N (with generator option UPA-B6)

"no Op" is briefly output on the FUNCTION/DATA display if the functions are set without the associated option being fitted.

The noise measurements are selected using the right-hand key 25 of the DIST/NOISE block.

Procedure: → Press key 25 in the DIST/NOISE block.
A roll function is then possible:
SINAD - S/N - noise measurement off - SINAD - S/N - - .....

Which noise measurement is active, if any, is indicated by the LED SINAD or S/N 25.

2.3.3.3.1 SINAD Measurements

The SINAD method is a combined signal, noise and distortion measurement. The output on the FUNCTION/DATA display 13 is the logarithmic ratio in dB.

If the SINAD function is selected, assignment to the rms rectifier is automatically made with level measurements.

Calculation:

$$\text{SINAD value in dB} = 20 \times \lg \frac{V_{MEAS}}{\sqrt{V_2^2 + V_3^2 + \ldots + V_{NOISE}^2}}$$

V_2, V_3, etc.: rms values of the harmonic distortions

V_{NOISE}: rms value of the wideband noise voltage

V_{MEAS}: rms value of the input signal

The conditions for the SINAD measurement are identical with those for the distortion factor measurement in the TOTAL mode (see 2.3.3.2). The described settings via special functions 34, 35 and 36 are also the same for both SINAD and DISTORTION.

As described in Sections 2.3.3.2 and 2.3.3.2.1, special function 37 enables the display of the SINAD measurement result in volts, Δ% or ΔdB without producing an effect on the display unit of the distortion measurement.

2.3.3.3.2 S/N Measurements

This function enables direct display of the signal/noise ratio of a device under test. It can be carried out with rms or quasi-peak value weighting.

An S/N measurement is made by connecting the device under test between the generator output and the signal input. The frequency and level values selected by the user are applied to the device under test by the generator.

The output signal of the device under test is measured by the measurement section of the UPA.

The generator is switched off after this measurement so that no signal is applied to the input of the device under test.

The output signal of the device under test (noise) is again measured and the ratio calculated with respect to the previously measured signal. The UPA controls the test sequence fully automatically. The logarithmic signal/noise ratio is output in dB on the FUNCTION/DATA display 13.

$$S/N \text{ in dB} = 20 \times \lg \frac{V_{MEAS}}{V_{NOISE}}$$

V_{NOISE}: wideband noise voltage

V_{MEAS}: Test voltage

V_{NOISE}, V_{MEAS}: rms or quasi-peak value

Setting the S/N measurement simultaneously influences other function measurements:

- Wow & flutter measurement and 2-sigma measurement are switched off.
- Distortion measurement is switched off.
- With the S/N measurement, the lower cutoff frequency is 30 Hz. The 20-Hz highpass filter (see 2.3.1.4.2) is automatically connected into the measuring circuit, unless one of the filters HP 300 Hz, SOUND or TELEPHON was previously selected.

2.3.4 Entering Numbers via the Keyboard

Many settings in the UPA require numbers to be entered via keypad 24.

Generator values Reference values Impedance values	Max. 5-digit with decimal point
Special filter number Ordinal number for distortion measurements Number of the complete instrument setting	Integer, max. 3-digit
Special function number	Max. 5-digit with decimal point

When a number is entered, the function value in the FUNCTION/DATA display 13 is cleared and the value entered via the keypad is displayed.

In the case of signed values, it should be noted that the sign key has a changeover function which is output on the FUNCTION/DATA display 13. If the sign key is not pressed, the entered value is displayed without a sign and thus is positive.

Up to 5 digits are meaningful. All further digits which can no longer be output on the FUNCTION/DATA display 13 are ignored. An error message is **not** output if too many digits are entered.

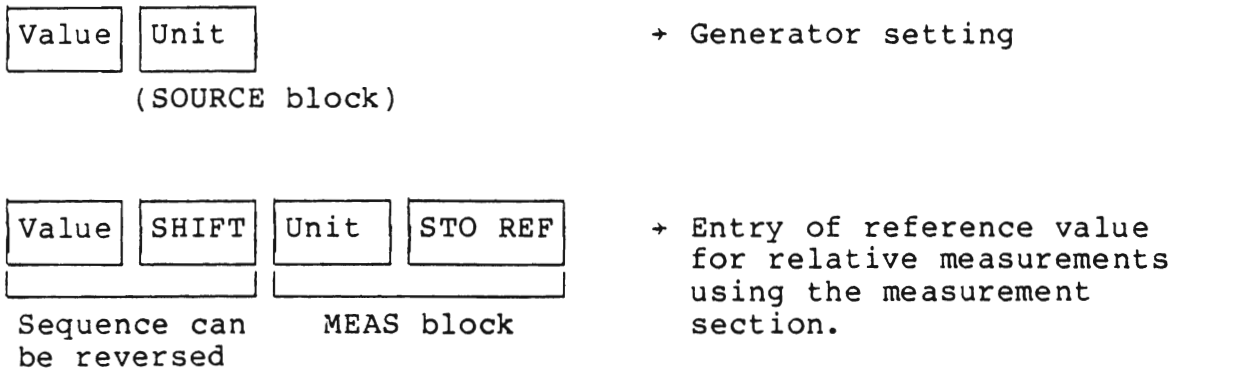
The number is assessed and tested for faults depending on the function keys subsequently pressed. The original FUNCTION/DATA display 13 appears again if the number entered has been correctly terminated by a subsequent function key or if the CLEAR key 23 is pressed.

Input values which violate the limits of the UPA briefly lead to an error message on the FUNCTION/DATA display 13.

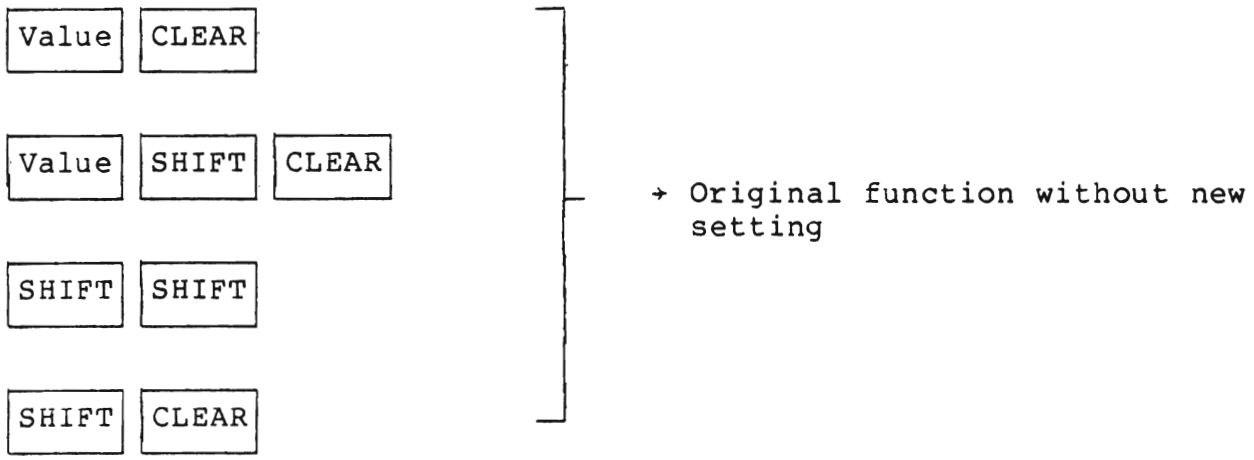
If the second function level is called using the SHIFT key in order to enter a number, all outputs on the displays enter a HOLD status which is retained until the input is terminated. The internal measuring process continues in the UPA, however.

Display of possible inputs and corrections:

Input examples:



Correction examples:



2.3.5 Display Settings

2.3.5.1 Digital Display

When the UPA is switched on, the measured values are output on the LCDs 2, 6, 13 as 7-segment numbers with unit.

Depending on the further operation, reference values for the measurement or generator settings are also output with their unit.

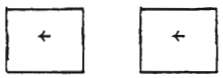
2.3.5.2 Analog Display in Bar Form

By pressing the keys 4, 9, 15 to the right of the display, it is possible to also select an analog display. Three display settings can be selected in sequence:

- Numerical display
- Numerical display combined with analog bar display
- Analog bar display with range

Key assignment: Key 4 for LEVEL display 2
Key 9 for FREQUENCY display 6
Key 15 for FUNCTION/DATA display 13.

Example: Measured values are output in digital form on the LEVEL display 2. An analog display is to be selected.



Press key 4 twice

Analog bar display with range is selected:

A bar display with a scale appears at the bottom edge in this type of display. The associated numerical value with unit specifies a rated range value and also represents the reference value of the superimposed scale.

The insertion of RANGE in the corresponding display indicates the selected display mode - bar display with range.

This is a quasi-analog display simulated by a bar. The bar consists of a large number of straight display elements arranged side by side which are rapidly triggered in sequence such that the observer obtains the impression of an analog bar with a varying length.

A suitable scale is displayed depending on the range and the unit - V, mV, W, mW, dBV, dBm etc.:

0 to 3
or
0 to 10

Linear display for level and frequency, % display for distortion and wow & flutter:
the scaling value 3 or 10 is the reference for the measured or displayed range value of the superimposed RANGE.

-10 to +10

Logarithmic display for level, distortion, SINAD and S/N in dBV, dBm or dB. The scale zero corresponds to the value of the superimposed RANGE; deviations can be read in the range from -10 to +10 dB.

Δ% display for level and frequency deviations:
the scaling value 10 corresponds to the value of the superimposed RANGE; the scale zero always corresponds to 0 %, deviations can be read in ± RANGE.

The range for the input voltage display can be automatically or manually adjusted using the keys of the RANGE block 34 (see also Sections 2.3.1.2 and 2.3.1.3).

The display range for % or dB deviations can also be selected automatically or manually.

Automatic display range selection is set if the % or dB representation is used first after switching on the UPA.

The automatic function can be switched off using the special functions 12... to 16... and a fixed display range can be selected. It is possible to return to autoranging if required (see Section 2.3.9).

2.3.5.3 Digital Display Combined with Analog Display

In many cases it is useful at high resolution to observe trends in measured values in analog form in addition to the digital display. An example is the adjustment to a specified nominal value. Large changes can be quickly recognized on an analog display. The digital display is more suitable for small changes.

The measured value representation can be selected on the displays 2, 6, 13 via a roll function using keys 4, 9, 15 (see Section 2.3.5.2).

The representation - digital display combined with analog bar display - indicates the measured value in digital form and an analog bar with scale.

The analog display corresponds to the display as in Section 2.3.5.2 except it is without measuring range and display range information.

2.3.6 Complete Instrument Settings

2.3.6.1 Storing Complete Instrument Settings

The complete settings of the UPA can be stored in a non-volatile RAM with battery backup. Up to fifty complete instrument settings can be stored (1 to 50). The current setting can always be called via number 0 even following power failure or after the UPA has been switched off and on again.

Proceed as follows to store a complete instrument setting under the number (1 to 50):

Procedure: → Enter the number
(see Section 2.3.4 "Entering Numbers via the Keyboard")

→ Press key STO SET 20.

Example: Store the current instrument setting under number 7

7	STO SET

The entered number is output on the FUNCTION/DATA display 13. Illegal inputs lead to an error message on the FUNCTION/DATA display.

A stored instrument setting contains:

→ Test and display functions

→ Reference values for relative measurements of level, frequency and distortion level

→ The impedance values Z for dBm and W displays

→ Generator level and frequency

→ Associated step numbers and sizes for the spin wheel

→ Sweep parameters

→ Plot parameters

→ Special function inputs

→ Scale factors for DC outputs

The basic setting is selected when the UPA is switched on independent of previous storage (see Section 2.3.10).

2.3.6.2 Recalling the Complete Instrument Settings

A stored complete instrument setting can be recalled using the following keys:

Procedure: → Enter the number (0 to 50) under which the desired complete instrument setting was stored (see Section 2.3.4 "Entering Numbers via the Keyboard").

→ Press key RCL SET 21.

Example: Recall the complete instrument setting stored under number 3

3	RCL SET

The entered number is output on the FUNCTION/DATA display 13. Incorrect numbers lead to an error message on the FUNCTION/DATA display.

The last valid status following UPA switch on/off or power failure - is always stored in complete instrument setting 0.

2.3.6.3 Write Protection for Complete Instrument Settings

In order to prevent complete instrument settings stored via the keyboard of the UPA from being deleted unintentionally, SPEC FCT 6.11 allows to activate a write protection. An attempted storage with the write protection activated causes the error message Er 04 to be output on the FUNCTION/DATA display. SPEC FCT 6.10 switches the write protection off again. Once selected via special function 6.x, the setting is **retained** even following switch-off/on of the UPA and is **not** affected by the basic setting after switching on.

2.3.7 DC Outputs (Option UPA-B1)

The UPA is equipped with two BNC connectors on the rear panel, designated as DC1 and DC2. These connectors supply a DC voltage which is proportional to the displayed value and may lie between -10 V to 0 V to +10 V. The DC voltage is produced by a 12-bit A/D converter and can be varied by 4.88 mV which is the highest resolution. The outputs are short-circuit-proof and have an output impedance of 1 kΩ.

Depending on the display assignment MEAS or SOURCE, the connectors can be assigned to the measurement section or the generator. The assignment to a particular display (LEVEL, FREQUENCY or FUNCTION) can be made using special function 40.x:

```
40.0: DC1 and DC2 are connected to 0 V
40.1: DC1 = LEVEL     /DC2 = FREQUENCY    :::
40.2: DC1 = LEVEL     /DC2 = FUNCTION
40.3: DC1 = FREQUENCY /DC2 = LEVEL
40.4: DC1 = FREQUENCY /DC2 = FUNCTION
40.5: DC1 = FUNCTION  /DC2 = LEVEL
40.6: DC1 = FUNCTION  /DC2 = FREQUENCY
```

Corresponding IEC-bus command:

DCSCAL(OUT (x))

Addressing of the DC outputs:

Display assignment MEAS:	Each time the display is addressed or, in the case of IEC-bus operation, a measured value is triggered.
Display assignment SOURCE:	Each time a generator value is directly entered or the spin wheel is rotated.

Which scale is selected for the output voltage depends solely on the displayed unit. The display assignment MEAS or SOURCE is insignificant. The scales of the DC output voltages can be selected via special function 41.x to 48.x.

After switching on the UPA, scale factors corresponding to the different units are set automatically. They can be obtained from the following tables.

Likewise, the special function Ø (basic setting), the IEC-bus command "CLEAR or CLR" or the universal command IECDCL cause a basic initialization of the UPA, thus setting the scale factors to the basic setting values.

::: = basic setting

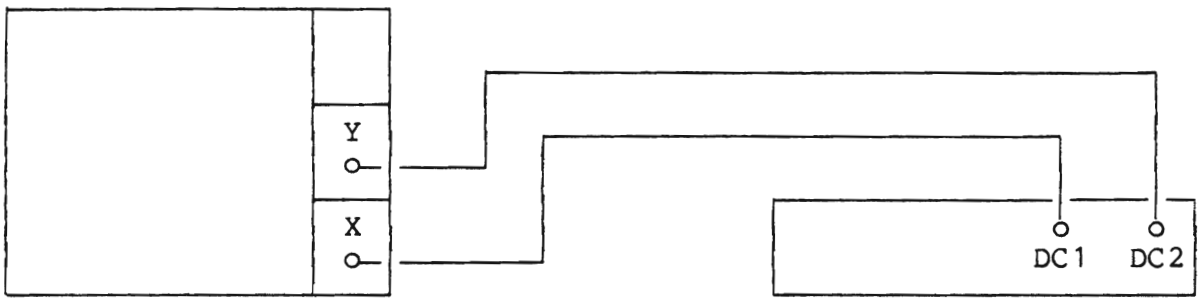
When storing the instrument setting, the current unit is stored together with the associated DC scale factor.

During normal UPA operation, the scale factor entered is retained for each unit or group of units, even if the displayed units are changed several times.

Usually, an XY recorder is connected to the DC connectors. The DC output voltages are scaled such as to support a sensitivity setting of 1 V/cm on the XY recorder.

Example:

Connecting an XY recorder to the UPA:



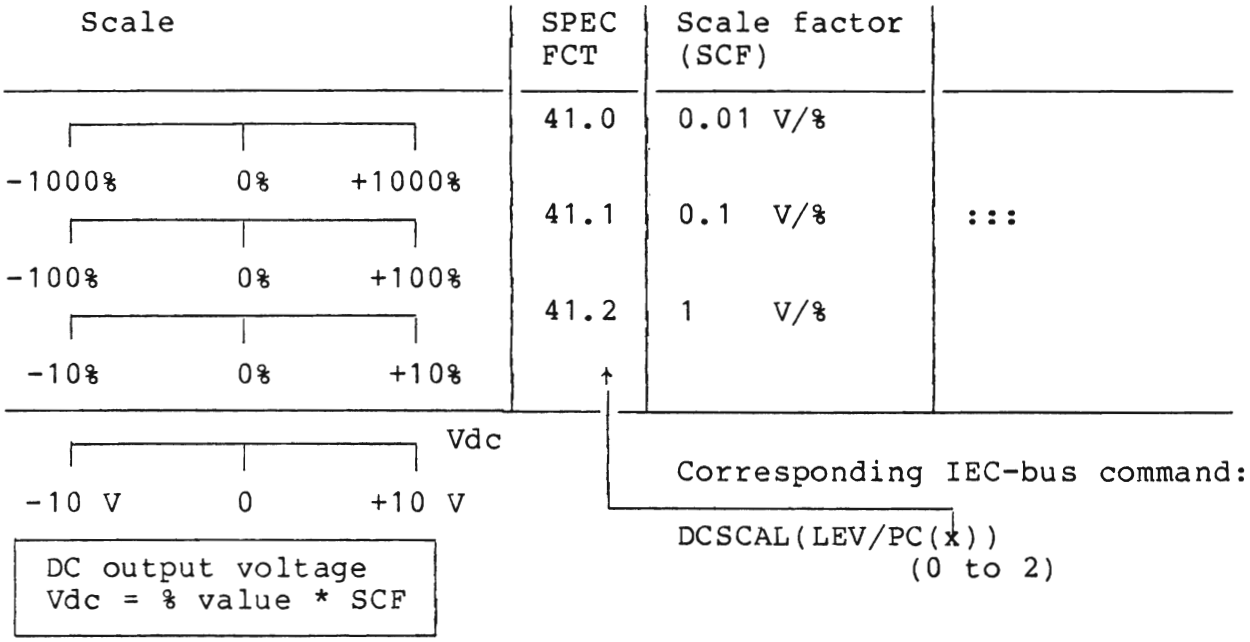
XY recorder

rear view of UPA

Sensitivity setting
on XY recorder,
usually 1 V/cm

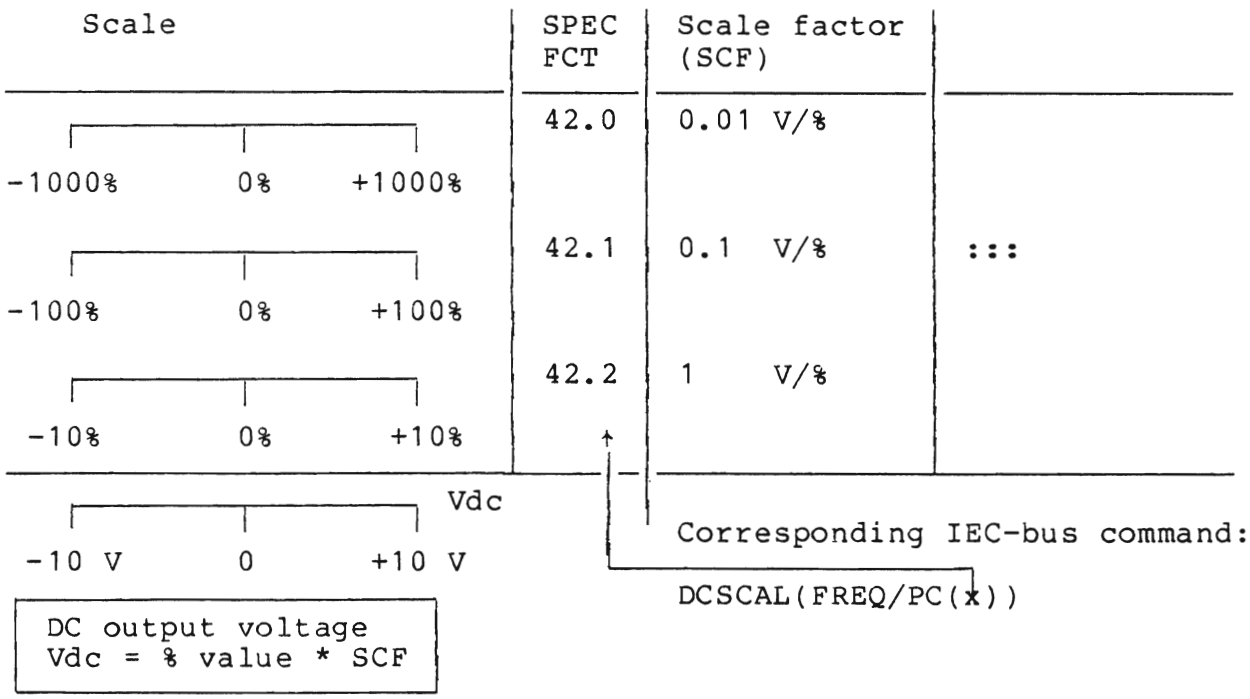
2.3.7.1 Scale of Reference-based Level Display in Δ%V or Δ%W

Input via special function 41.x



2.3.7.2 Scale of Reference-based Frequency Display in Δ%Hz

Input via special function 42.x



::: = basic setting

2.3.7.3 Scale of Measured Function Values in % and Δ%

Input via special function 43.x

Scale	SPEC FCT	Scale factor (SCF)
-1000% 0 1000%	43.0	0.01 V/%
-100% 0 100%	43.1	0.1 V/%
-10% 0 10%	43.2	1 V/%
-1% 0 1%	43.3	10 V/% :::
-0.1% 0 0.1%	43.4	100 V/%
-10V 0 +10		

Corresponding IEC-bus command:

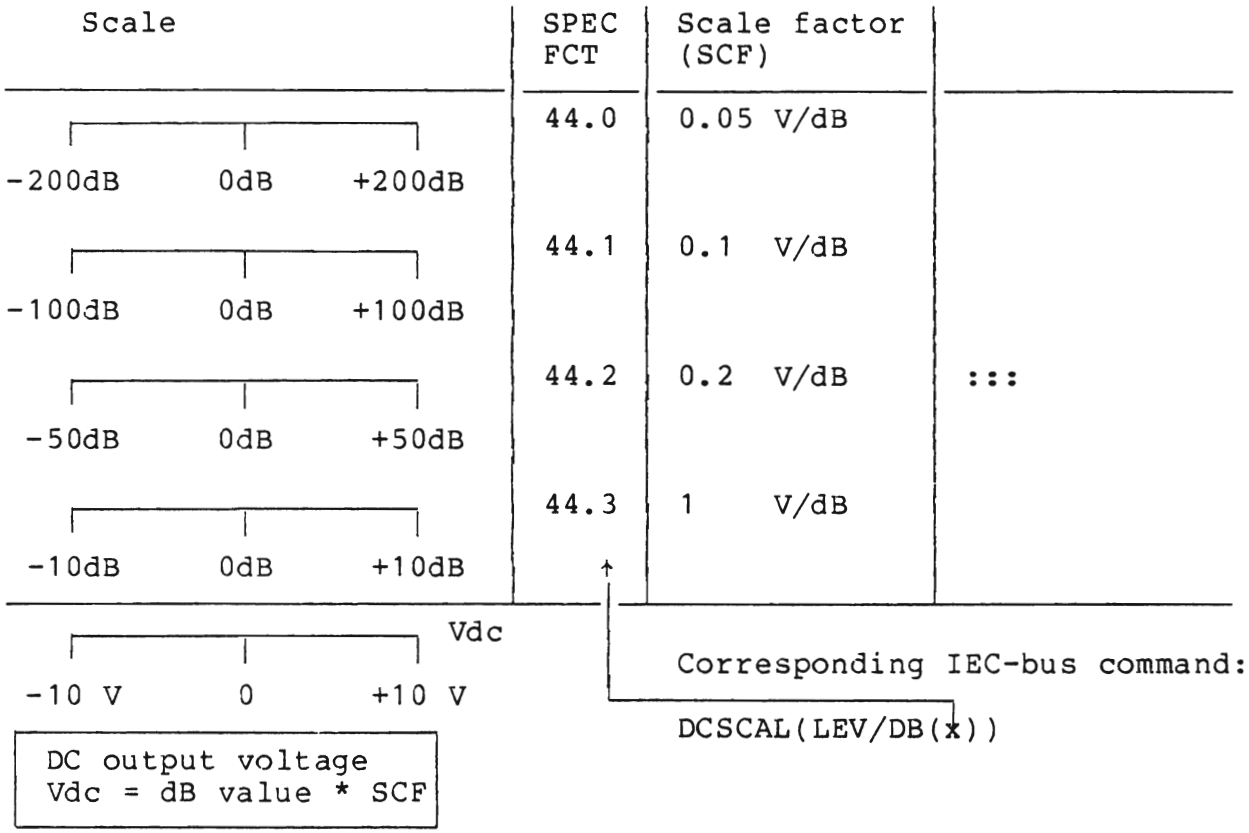
DCSCAL (FNCT/PC(x))

DC output voltage
Vdc = % value * SCF -10V

::: = basic setting

2.3.7.4 Scale of Level Units in dBV, dBm, dB

Input via special function 44.x



::: = basic setting

2.3.7.5 Scale of Measured Function Values in dB or ΔdB

Input via special function 45.x

Scale	SPEC FCT	Scale factor (SCF)	
-200dB 0dB +200dB	45.0	0.05 V/dB	
-100dB 0dB +100dB	45.1	0.1 V/dB	
-50dB 0dB +50dB	45.2	0.2 V/dB	:::
-10dB 0dB +10dB	45.3	1 V/dB	

Vdc
-10 V 0 +10 V

DC output voltage
Vdc = dB value * SCF

Corresponding IEC-bus command:

DCSCAL(FNCT/DB(x))

2.3.7.6 Scale of Level Units in V, W

Input via special function 46.x

Scale	SPEC FCT	Scale factor (SCF)	
0 500V,W 1000V,W	46.0	0.02 V/V or V/W	
0 50V,W 100V,W	46.1	0.2 V/V or V/W	
0 5V,W 10V,W	46.2	2 V/V or V/W	:::
0 0.5V,W 1V,W	46.3	20 V/V or V/W	
0 50mV,mW 100mV,mW	46.4	200 V/V or V/W	
0 5mV,mW 10mV,mW	46.5	2000 V/V or V/W	
0 0.5mV,mW 1mV,mW	46.6	20000 V/V or V/W	

Vdc
-10 V 0 +10 V

DC output voltage
Vdc = V or W value * SCF - 10 V

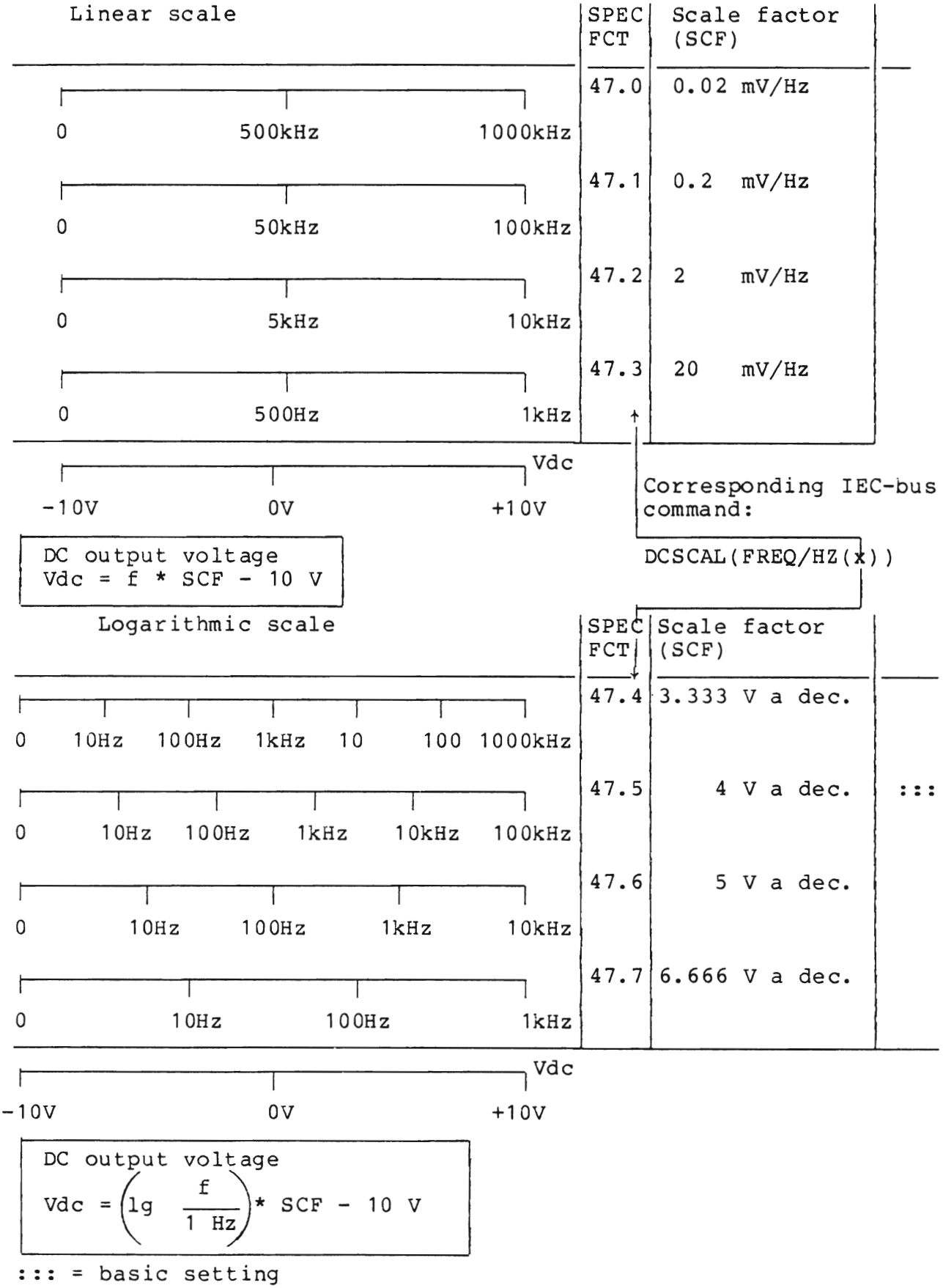
Corresponding IEC-bus command:

DCSCAL(LEV/VW(x))

::: = basic setting

2.3.7.7 Linear or Logarithmic Scale of Frequency

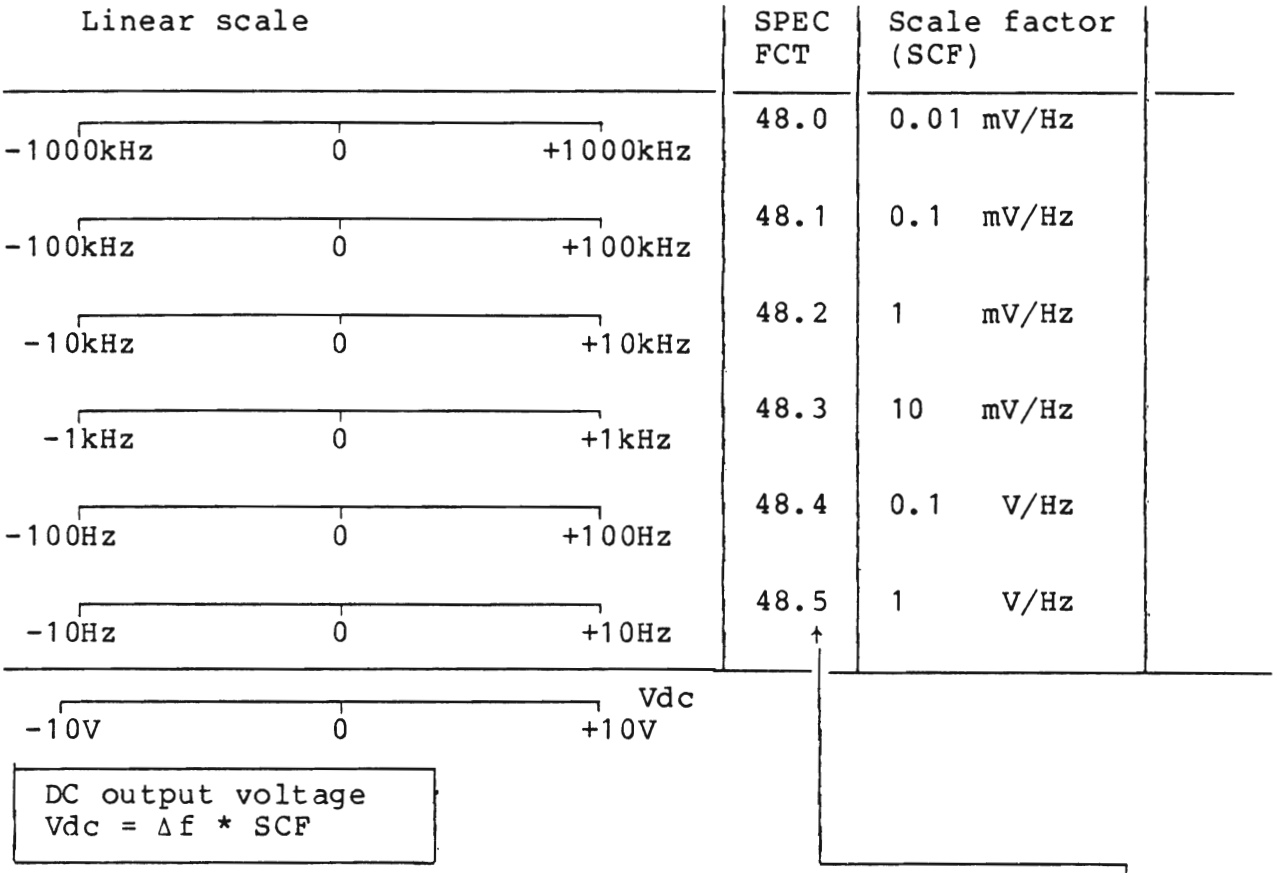
Input via special function 47.x



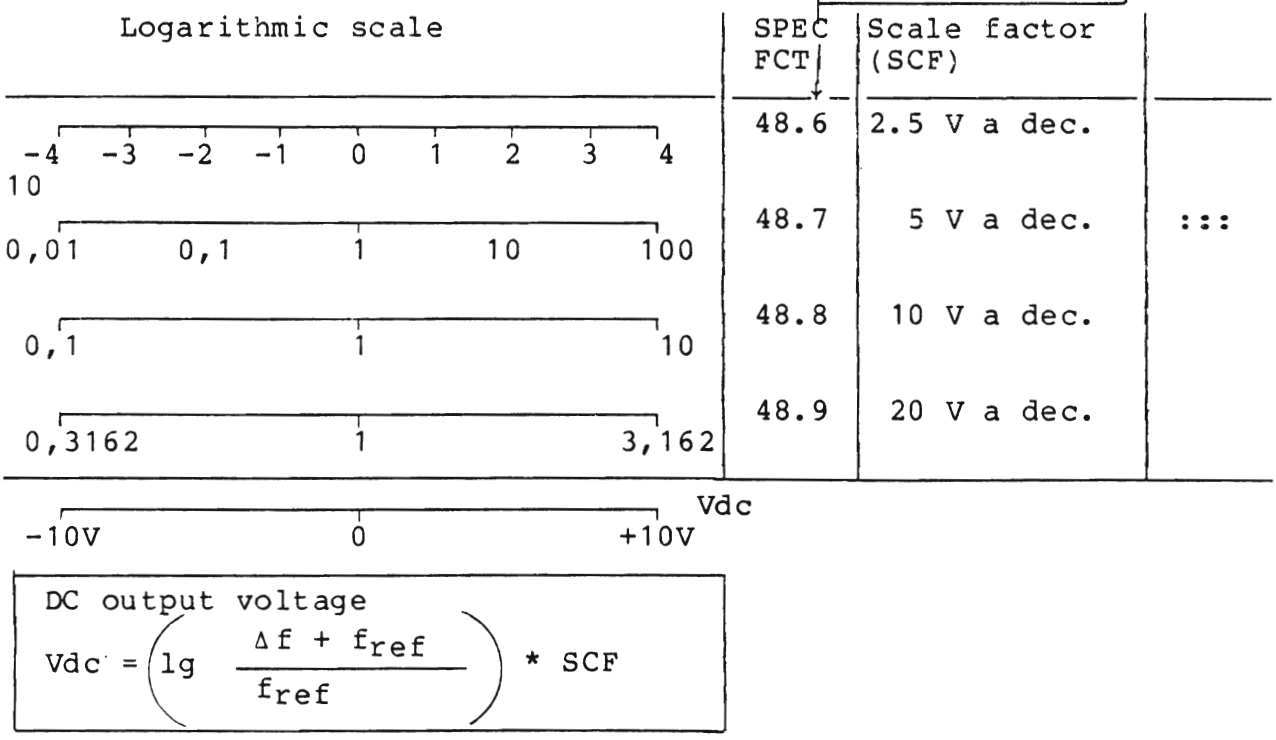
::: = basic setting

2.3.7.8 Linear or Logarithmic Scale of Frequency Offset Δf

Input via special function 48.x



Corresponding IEC-bus command: DCSCAL(FREQ/DHZ(x))



::: = basic setting

The scale values given for the logarithmic scale indicate the ratio

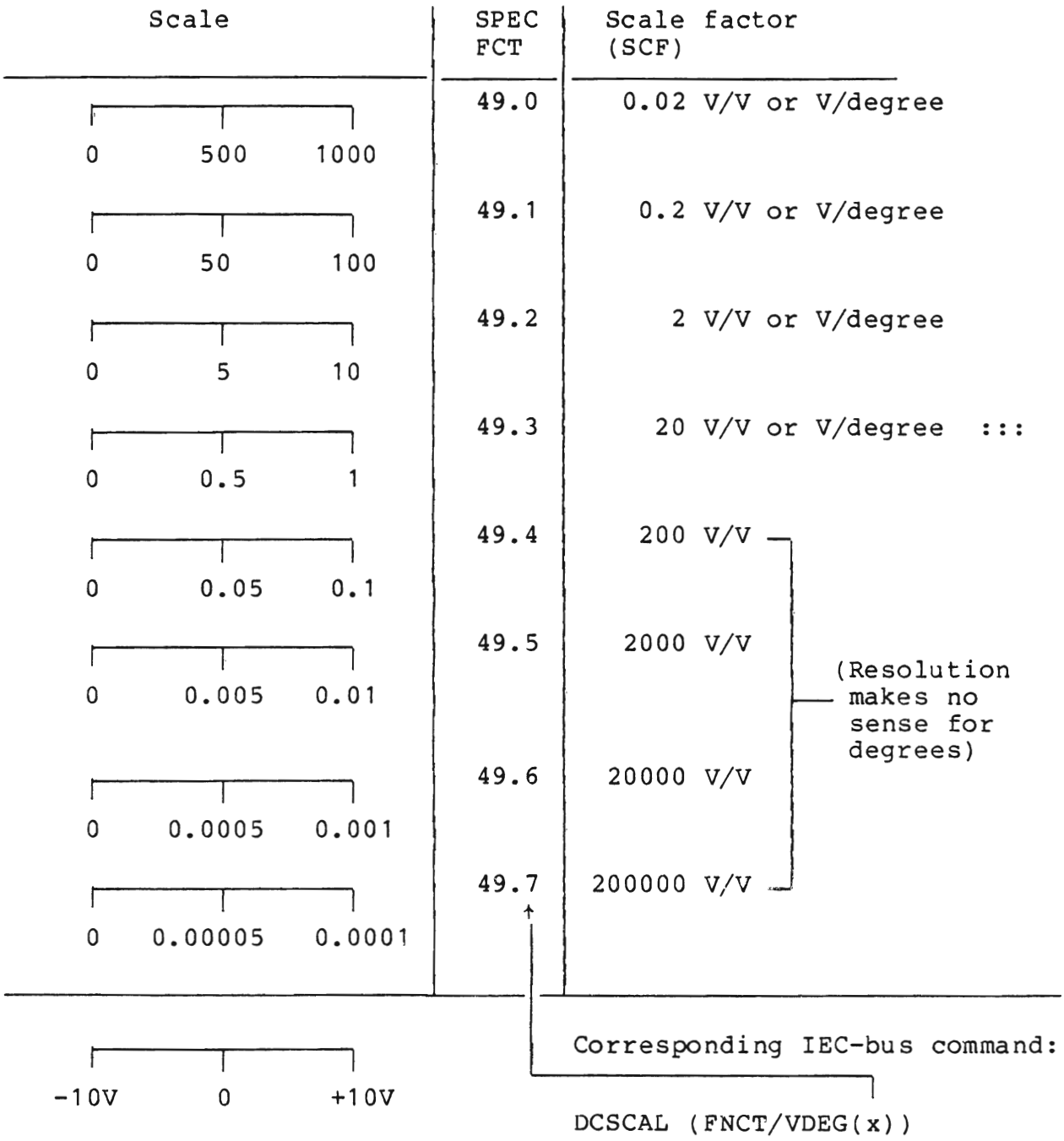
$$\frac{\Delta f + f_{ref}}{f_{ref}}$$

The actual test frequency can be determined by means of the following ratio:

$$f_{meas} = \left(\frac{\Delta f + f_{ref}}{f_{ref}} \right) * f_{ref}$$

2.3.7.9 Scale of Distortion Level in V or of Phase Angle in Degrees

Input via special function 49.x



DC output voltage
Vdc = Value in V or degrees * SCF - 10 V

::: = basic setting

2.3.8 AC Output

The AC voltage output allows connecting a monitor (oscilloscope, test instrument, etc.).

During voltage or level measurements, the shape of the input signal can be observed via the filters connected into circuit in the UPA, if required.

For the test functions wow & flutter as well as distortion factor, the variation or the distortion factor of the input signal can be displayed.

The potential separation between the test inputs and the AC output makes sure that the measurement is not influenced by connected devices.

Output of the signal at the AC output can be affected via special function 18.x.

18(.0) Automatic assignment (basic setting); for level measurements without function measurement, the assignment is to the level measurement section, with the function measurement switched on, the assignment is to the wow & flutter or distortion factor measurement.

18.1 Fixed assignment to level measurement

18.2 Assignment to wow & flutter or distortion factor measurement (if none of these functions is selected, the AC output remains switched off).

18.3 Switched off

Note: With distortion factor measurements, the complete distortion signal is always output:

In operation mode TOTAL: Bandwidth up to 400 kHz or restricted by the filters selectable on the UPA.

In operating mode N x (selective) f_o: Bandwidth depending on the product N x f_o due to internal automatic limitation to 22 kHz, 100 kHz or 400 kHz or additional restriction by filters selectable on the UPA.

2.3.9 Special Functions

2.3.9.1 Input of Special Functions

The special function level can be used to set further measuring and setting functions as well as auxiliary or service settings in the UPA.

A special function can be called as follows:

Procedure: → Enter special function number (see Table 2-2, Special functions and Section 2.3.4, Entering Numbers via the Keyboard.

The number to the right or the left of the decimal point can also be indicated with leading zeros and is to be considered an independent number.

→ Press key SPEC FCT 19.

Example: Enter special function 10.1

1	0	.	1	SPEC FUNC

Further permissible entries: 10.01, 10.001, 010.1, 010.01

The entered numerical value is output on the FUNCTION/DATA display 13. Illegal special function numbers lead to an error message on the FUNCTION/DATA display when the key SPEC FCT is pressed.

The special functions cannot be programmed directly via the IEC bus, as the required settings are already contained in the IEC-bus command syntax.

2.3.9.2 Display of the Active Special Functions

To enable checking which special functions are currently active in the UPA, the active special function numbers can be briefly output on the FUNCTION/DATA display.

The special function number is briefly displayed by pressing the SPEC FCT key 19.

Each time a SPEC FCT key is pressed, the active special function number is incremented and displayed. Special functions representing the basic setting or special functions used for service or calibration settings are not displayed.

This does not apply to special functions 30.1, 30.2, 30.3. By pressing the associated SPEC FCT keys, the 2-sigma weighting of the wow & flutter measurement is triggered.

Further exceptions:

- With active SPEC FCT 30.1, 30.2 or 30.3 (2-sigma weighting of wow & flutter measurement), the 2-sigma measurement is triggered when pressing the SPEC FCT key (see 2.3.3.1.1).
- An interrupted sweep is continued by pressing the SPEC FCT key (see 2.3.2.5.6).

Table 2-2: Special functions

SPEC FCT 0 Call internal or selectable basic setting (see SPEC FCT 8 and Section 2.3.10) Corresponding IEC-bus command: CLEAR or CLR as well as DCL and SDC
SPEC FCT 1 Display or entry of IEC-bus address 1 Display IEC-bus address 1.0 ┐ . ├ Set IEC-bus address 1.30 ┘ 1.31 Set Talk Only mode
SPEC FCT 2 Setting of output string for IEC-bus data output or Talk Only output 2(.0)* individual/numerical 2.1 individual/alphanumeric 2.2 parallel/numerical 2.3 parallel/alphanumeric ::: Corresponding IEC-bus command: STRING(SINGLE ALPHANUM) ALL NUM
SPEC FCT 3 Ranges 3(.0) Level autoranging ::: 3.1 Fixed level measuring range without switchover if range exceeded Corresponding IEC-bus command: RANGE (LEVEL AUTO) FIX

*: The inputs 2, 2. or 2.0 have the same meaning

::: = basic setting (see 2.3.10)

SPEC FCT 4 Brightness variation

4(.0) Switch off brightness variation via spin wheel :::
4.1 Switch on brightness variation via spin wheel

SPEC FCT 5 Display/LED test

SPEC FCT 6 Write protection for complete instrument setting

6.10 Switch off write protection.

6.11 Switch on protection against overwriting of a complete instrument setting.

Corresponding IEC-bus command: STORE (SET LOCK)
UNLOCK

SPEC FCT 7 AC/DC measuring mode

7.0 AC measuring mode :::
7.1 DC measuring mode

Corresponding IEC-bus command: MEASUREMENT (AC)
DC

SPEC FCT 8 Select basic setting

8(.0) Internal basic setting after switching on the UPA

8.1 Selectable basic setting after switching on the UPA (see Section 2.3.10)

8.2 Following switch-on, set the status valid before switching off. Response to SPEC FCT 0, IEC-bus command CLEAR or CLR as well as DCL and SDC: internal basic setting.

8.3 Following switch-on, set the status valid before switching off. Response to SPEC FCT 0, IEC-bus command CLEAR or CLR as well as DCL and SDC: selectable basic setting.

Corresponding IEC-bus command: STORE (BASICSET (0 to 3))

MEASURING SPEEDS

SPEC FCT 10 Level measuring speed

10(.0) Level measuring speed SLOW :::
10.1 Level measuring speed FAST

Corresponding IEC-bus command: RATE(LEVEL SLOW)
FAST

::: = Basic setting (see 2.3.10)

SPEC FCT 11 Frequency measuring speed

11(.0) Frequency measuring speed SLOW
11.1 Frequency measuring speed FAST :::
Corresponding IEC-bus command: RATE(FREQUENCY SLOW)
FAST

FIXED DISPLAY RANGE FOR BAR DISPLAY

SPEC FCT 12 Display range for level bar display with Δ%V or Δ%W measurements

12(.0) Autoranging :::
12.x Fixed display range for level bar display
x = 2: 1% range
x = 3: 10% range
x = 4: 100% range
x = 5: 1000% range
Corresponding IEC-bus command: DISPLAY (LEVEL BARGRAPH(x))
VALBAR(x)

SPEC FCT 13 Display range for frequency bar display with Δf% measurement

13(.0) Autoranging :::
13.x Fixed display range for frequency bar display
x = 1: 0.1% range
x = 2: 1% range
x = 3: 10% range
x = 4: 100% range
x = 5: 1000% range
Corresponding IEC-bus command: DISPLAY (FREQUENCY BARGRAPH(x))
VALBAR(x)

SPEC FCT 14 Display range for function bar display with wow & flutter bar display to DIN or NAB

14(.0) Autoranging :::
14.x Fixed display range for function bar display
x = 1: 0.01% range
x = 2: 0.03% range
x = 3: 0.1% range
x = 4: 0.3% range
x = 5: 1% range
x = 6: 3% range
x = 7: 10% range
Corresponding IEC-bus command: DISPLAY (FUNCTION BARGRAPH(x))
VALBAR(x)

::: = basic setting (see 2.3.10)

SPEC FCT 15 Display range for function bar display with wow & flutter AM bar display

15 (.0) Autoranging :::
15.x Fixed display range for function bar display
x = 1: 1% range or 0.1-dB range
x = 2: 3% range or 0.3-dB range
x = 3: 10% range or 1-dB range
x = 4: 30% range or 3-dB range
x = 5: 100% range or 10-dB range
x = 6: 100% range or 30-dB range
Corresponding IEC-bus command: DISPLAY (FUNCTION BARGRAPH(x)) VALBAR(x)

SPEC FCT 16 Display range for DISTORTION bar display

16(.0) Autoranging :::
16.x Fixed display range for DISTORTION bar display
x = 1: 0.01% range
x = 2: 0.03% range
x = 3: 0.1% range
x = 4: 0.3% range
x = 5: 1% range
x = 6: 3% range
x = 7: 10% range
x = 8: 30% range
x = 9: 100% range
Corresponding IEC-bus command: DISPLAY (FUNCTION BARGRAPH(x)) VALBAR(x)

SPEC FCT 18 Assignment of AC monitor

18(.0) Automatic assignment :::
18.1 Assignment to level measurement
18.2 Assignment to wow & flutter or distortion factor measurement
18.3 Switched off
Corresponding IEC-bus command: ACMONITOR (MODE (0...3))

::: = basic setting (see 2.3.10)

GENERATOR
SPEC FCT 20 Increment for generator level variation using spin wheel 20(.0) Auto increment ::: 20.1 Return to manually entered increment (if none has been entered: 1 mV) 20.10 Input facility for linear step number between sweep start level and sweep stop level. 20.11 Input facility for logarithmic step number between sweep start level and sweep stop level. SPEC FCT 20.10 and 20.11 can be called from the sweep parameter input level for level increment only (SPEC FCT 26.2). Corresponding IEC-bus command: INCREMENT (LEVEL AUTO)
SPEC FCT 21 Increment for generator frequency variation using spin wheel 21(.0) Auto increment ::: 21.1 Return to manually entered increment (if none has been entered: 10 Hz) 21.2 1st octave sequence 21.3 2nd octave sequence 21.4 1st third-octave sequence 21.5 2nd third-octave sequence 21.10 Input facility for linear step number between sweep start frequency and sweep stop frequency. 21.11 Input facility for logarithmic step number between sweep start frequency and sweep stop frequency. SPEC FCT 21.10 and 21.11 can be called from the sweep parameter input level for frequency increment only (SPEC FCT 26.5) Corresponding IEC-bus command: INCREMENT (FREQUENCY OKTAV1) OKTAV2 TERZ1 TERZ2
SPEC FCT 22 Limitation of generator range Level 22(.0) Switch off level limitation ::: (usable range 0.1 mV to 12.4 V) 22.1 Switch on level limitation using sweep parameters start level, stop level Corresponding IEC-bus command: SOURCE (LEVEL ONLIMIT) OFFLIMIT
SPEC FCT 23 Limitation of generator range Frequency 23(.0) Switch off frequency limitation ::: (usable range 10 Hz to 100 kHz) 23.1 Switch on frequency limitation using sweep parameters start frequency, stop frequency Corresponding IEC-bus command: SOURCE (FREQUENCY ONLIMIT) OFFLIMIT

::: = basic setting (see 2.3.10)

SPEC FCT 24 Input of RANDOM parameters

24(.0) The input level for RANDOM parameters is entered. The individual input facilities can be selected by repeated pressing of the SPEC FCT key.
- Level/frequency selection of RANDOM sequence
- Change level offset of RANDOM level values
- Final item of RANDOM sequence
- Sweep time
- Print and plot mode for output of sweep results
- Entry of level and frequency values for RANDOM sequence

24.1 to 24.99
Direct selection of level/frequency value of RANDOM item no. 1 to 99 with possible variation.

Corresponding IEC-bus command: INCREMENT(STEPRANDOM.....)

SPEC FCT 25 Switchover of generator level reference

25.0 Calculation with Ri = 30 Ω (referred to terminal voltage)
25.1 Calculation with Ri = 0 Ω (referred to open-circuit voltage)

SPEC FCT 26 Input of sweep parameters

		Basic setting:
26(.0)	SWEEP start level	1 mV
26.1	SWEEP stop level	1 V
26.2	SWEEP level increment	A-Inc
26.3	SWEEP start frequency	1000 Hz
26.4	SWEEP stop frequency	10 kHz
26.5	SWEEP frequency increment	A-Inc
26.6	SWEEP time	0.15 s
26.7	SWEEP print OFF/on	OFF

Corresponding IEC-bus command:

```
SWEEP (LEVEL START VOLT) data
              STOP  DBV
                    DBM
      (FREQUENCY START) data
                STOP
      (TIME) data

SWEEP (INCREMENT LEVEL      AUTO)
                            LOG )     data
                            VOLT)     data
                            DBV )     data
                            DBM )     data
                  FREQUENCY AUTO
                            OKTAV1
                            OKTAV2
                            TERZ1
                            TERZ2
                            LOG     ) data
                  FREQUENCY         ) data
```

::: = basic setting (see 2.3.10)

SPEC FCT 27 Input of plot parameters

		Basic setting:
27(.0)	Print/plot	OFF
27.1	Scale 1: initial value	-100
27.2	Scale 1: final value	100
27.3	Scale 1: reference value	0
27.4	Scale 2: initial value	-100
27.5	Scale 2: final value	100
27.6	Scale 2: reference value	0
27.7	Select form feed	OFF
27.8	Function plot	ALL
27.9	Select reference lines	USE1
27.10	Complete setting of UPA as additional information	ON
27.11	Emphasize reference ranges	OFF

Only for manual operation - no corresponding IEC-bus command!

SPEC FCT 28 Sweep mode

28(.0)	SWEEP single :::
28.1	SWEEP repeat (according to input of start/stop parameters)
28.2	SWEEP repeat (up / down / up / down)

SPEC FCT 29 Start of sweep

29(.0)	Start frequency sweep
29.1	Start level sweep

Corresponding IEC-bus command: SWEEP (LEVEL ENABLE)
FREQUENCY
in connection with TRIGGER command

::: = basic setting (see 2.3.10)

WOW & FLUTTER

SPEC FCT 30 2-sigma measurement

30(.0) Switch off :::
30.1 Preselect 2-sigma measurement with measuring time 5 s without starting the measurement
30.2 Preselect 2-sigma measurement with measuring time 10 s without starting the measurement
30.3 Preselect 2-sigma measurement with measuring time 20 s without starting the measurement
Corresponding IEC-bus command:
WOWFLUTTER (..... ..... OFFSIGMA)
ONSIGMA (t) t = measuring time in s (5, 10, 20)

SPEC FCT 31 Set WOW & FLUTTER JIS

31(.0) Switch off WOW & FLUTTER test method.
31.1 Switch on WOW & FLUTTER JIS. (LEDs DIN and NAB light simultaneously).
Corresponding IEC-bus commands: WOWFLUTTER (OFF)
WOWFLUTTER (JIS...)

SPEC FCT 32 WOW & FLUTTER range

32(.0) Autoranging :::
32.1 Fix current measuring range = FIX
32.2 0.1 % DIN/NAB, 2 dB AM = FIX (1)
32.3 0.3 % DIN/NAB, 6 dB AM = FIX (2)
32.4 1 % DIN/NAB, 20 dB AM = FIX (3)
32.5 3 % DIN/NAB = FIX (4)
Corresponding IEC-bus command:
RANGE(WOWFLUTTER AUTO or FIX(0))
FIX
FIX(1 to 4)

DIST/SINAD

SPEC FCT 33 Total Distortion Harmonic (THD) measurement

33 (.0) Switch off distortion measurement :::
33.1 THDALL: All harmonics
33.2 THDEVEN: Even harmonics } enter and activate n1...n2
33.3 THDODD: Odd harmonics
Corresponding IEC-bus command: DIST (K THDxxx (n1-n2).....)

SPEC FCT 34 Most sensitive distortion measuring range

34(.0) Enable :::
34.1 Disable (increase in measuring speed)
Corresponding IEC-bus command):
DISTORTION (ENABLE/LOWRANGE)
DISABLE/LOWRANGE

::: = basic setting (see 2.3.10)

SPEC FCT 35 Presetting frequency for the DISTORTION/SINAD measurement

35(.0) Automatic using measured frequency value :::
35.1 Depending on generator frequency
35.2 Depending on key entry
35.3 Hold current frequency value
Corresponding IEC-bus command: (0 or AUTO)
DISTORTION (... MODE (1 or SOURCE)
NOISE (SINAD (2 or FREQ) data
(3 or HOLD)

SPEC FCT 36 Disable/enable error message Er 11

36(.0) Enable error message Er 11 :::
36.1 Disable error message Er 11
Corresponding IEC-bus command: DISTORTION (... ONERROR ...)
OFFERROR
NOISE (SINAD ... ONERROR ...)
OFFERROR

SPEC FCT 37

37(.0): Resetting the DIST/SINAD unit to dB or %.
- No distortion or SINAD measurement switched on: Switch on distortion TOTAL measurement with display unit %.
- Distortion or SINAD measurement active: display unit dB or %.

Corresponding IEC-bus command: MEASUREMENT (FUNCTION PC or DB).

37.1 : Distortion or SINAD level measurement in volts **without** reference.
- No distortion or SINAD measurement switched on: Switch on distortion TOTAL measurement with display unit volts.
- Distortion or SINAD measurement active: display unit volts!

Corresponding IEC-bus command: MEASUREMENT (FUNCTION VOLT)

37.2 : Input of the reference level for distortion or SINAD measurement via the keyboard. Entry of values see 2.3.3.2.1.
Corresponding IEC-bus command: STORE (REFERENCE DISTORTION LEVEL) data

37.3 : Transfer of the reference level from the current DIST/SINAD measurement.
Corresponding IEC-bus command: TRIGGER (STORE)

37.4 : DIST/SINAD level measurement **with** reference in Δ% or ΔdB. Corresponding IEC-bus command: MEASUREMENT (FUNCTION DPC or DDB)

SPEC FCT 38

38(.0): Phase measurement off :::
38.1 : Phase measurement on
Corresponding IEC-bus command: PHASE (ON), PHASE (OFF)

::: = basic setting (see 2.3.10)

DC OUTPUTS
SPEC FCT 40 Assignment of DC outputs 40(.0) Both DC outputs switched off (0 V) 40.1 DC1 LEVEL / DC2 FREQ ::: 40.2 DC1 LEVEL / DC2 FUNCT 40.3 DC1 FREQ / DC2 LEVEL 40.4 DC1 FREQ / DC2 FUNCT 40.5 DC1 FUNCT / DC2 LEVEL 40.6 DC1 FUNCT / DC2 FREQ Corresponding IEC-bus command: DCSCAL(OUT(0 to 6))
SPEC FCT 41 Scale of level unit Δ%V and Δ%W SCF* 41(.0) -1000 % to 0 to +1000 % 0.01 V/% 41.1 -100 % to 0 to +100 % 0.1 V/% ::: Vdc = % value*SCF 41.2 -10 % to 0 to +10 % 1 V/% Corresponding IEC-bus command: DCSCAL(LEV/PC (0 to 2))
SPEC FCT 42 Scale of frequency unit Δ%Hz SCF* 42(.0) -1000 % to 0 to +1000 % 0.01 V/% 42.1 -100 % to 0 to +100 % 0.1 V/% ::: Vdc = %value*SCF 42.2 -10 % to 0 to +10 % 1 V/% Corresponding IEC-bus command: DCSCAL(FREQ/PC (0 to 2))
SPEC FCT 43 Scale of function unit in % und Δ% SCF* 43.0: -1000 to 0 to +1000% 0.01 V/% 43.1: - 100 to 0 to + 100% 0.1 V/% 43.2: - 10 to 0 to + 10% 1 V/% 43.3: - 1 to 0 to + 1% 10 V/% ::: Vdc = % value * SCF 43.4: - 0.1 to 0 to + 0.1% 100 V/% Corresponding IEC-bus command: DCSCAL (FNCT/PC (0 to 4))
SPEC FCT 44 Scale of level units dBV, dBm, dB SCF* 44(.0) -200 dB to 0 to +200 dB 0.05 V/dB 44.1 -100 dB to 0 to +100 dB 0.1 V/dB 44.2 -50 dB to 0 to +50 dB 0.2 V/dB ::: 44.3 -10 dB to 0 to +10 dB 1 V/dB Vdc = dB value*SCF Corresponding IEC-bus command: DCSCAL (LEV/DB (0 to 3))

* SCF = Scale factor

::: = basic setting (see 2.3.10)

SPEC FCT 45 Scale of function unit in dB and ΔdB

			SCF*	
45(.0)	-200 dB to 0 to +200 dB	0.05	V/dB	
45.1	-100 dB to 0 to +100 dB	0.1	V/dB	:::
45.2	-50 dB to 0 to +50 dB	0.2	V/dB	Vdc = dB value*SCF
45.3	-10 dB to 0 to +10 dB	1	V/dB	

Corresponding IEC-bus command: DCSCAL(FNCT/DB (0 to 3))

SPEC FCT 46 Scale of linear level units V and W

			SCF*		
46(.0)	0 to 1000	V,W	0.02	V/V,W	
46.1	0 to 100	V,W	0.2	V/V,W	
46.2	0 to 10	V,W	2	V/V,W	:::
46.3	0 to 1	V,W	20	V/V,W	Vdc = (V,W value*SCF)-10 V
46.4	0 to 0.1	V,W	200	V/V,W	
46.5	0 to 0.01	V,W	2000	V/V,W	
46.6	0 to 0.001	V,W	20000	V/V,W	

Corresponding IEC-bus command: DCSCAL(LEV/VW (0 to 6))

SPEC FCT 47 Scale of frequency lin. f and log. f

		linear	SCF*	
47(.0)	0 to 1000 kHz	2E-5	V/Hz	
47.1	0 to 100 kHz	2E-4	V/Hz	
47.2	0 to 10 kHz	2E-3	V/Hz	Vdc = (f*SCF)-10 V
47.3	0 to 1 kHz	2E-2	V/Hz	
		logarithmic		
47.4	0 to 1000 kHz	3.333	V a decade	
47.5	0 to 100 kHz	4	V a decade	:::
47.6	0 to 10 kHz	5	V a decade	Vdc = $\log_{10} \frac{f}{1\ Hz} * SCF$
47.7	0 to 1 kHz	6,666	V a decade	

Corresponding IEC-bus command: DCSCAL(FREQ/HZ (0 to 7))

SPEC FCT 48 Scale of reference-based frequency lin. Δf and log. Δf

		linear			SCF*	
48(.0)	-1000 kHz to 0 to	+1000 kHz	1E-5	V/Hz		
48.1	-100 kHz to 0 to	+100 kHz	1E-4	V/Hz	Vdc = Δf * SCF	
48.2	-10 kHz to 0 to	+10 kHz	1E-3	V/Hz		
48.3	-1 kHz to 0 to	+1 kHz	1E-2	V/Hz		
48.4	-100 Hz to 0 to	+100 Hz	1E-1	V/Hz		
48.5	-10 Hz to 0 to	+10 Hz	1	V/Hz		
		logarithmic				
48.6	8 decades 0.0001 to 1 to	10000	2.5	V a decade		
48.7	4 decades 0.01 to 1 to	100	5	V a decade	:::	
48.8	2 decades 0.1 to 1 to	10	10	V a decade		
48.9	1 decade 0.3162 to 1 to	3.162	20	V a decade		

$$Vdc = \lg\left[\frac{\Delta f + f_{ref}}{f_{ref}}\right] * SCF$$

Corresponding IEC-bus command: DCSCAL(FREQ/DHZ (0 to 9))

* SCF = Scale factor

::: = basic setting (see 2.3.10)

SPEC FCT 49 Scale of distortion level in V and phase angle in degrees

		SCF*	
49.0:	0 to 1000V or degrees	0.02	V/V or V/degree
49.1:	0 to 100V or degrees	0.2	V/V or V/degree
49.2:	0 to 10V or degrees	2	V/V or V/degree
49.3:	0 to 1V or degrees :::	20	V/V or V/degree
49.4:	0 to 0.1V	200	V/V ┐ (Resolution
49.5:	0 to 0.01V	2000	V/V ├ makes no sense
49.6:	0 to 1mV	20000	V/V │ for degrees)
49.7:	0 to 0.1mV	200000	V/V ┘

Vdc = (value in V or degrees * SCF) - 10 V

Corresponding IEC-bus command: DCSCAL (FNCT/VDEG (0 to 7))

SPEC FCT 50 Calibration

50(.0) Call of calibration level CAL
50.1 Call or enable internal offset correction EN.OFF
50.2 Call or enable AC level calibration EN.CAL
50.3 Call or enable calibration for correction of insertion loss of an external filter EN.EFI
50.4 Reset correction value or external filter to 0 dB EFI.0dB
50.5 Call or enable DC level calibration EN.DC

SERVICE

SPEC FCT 60 Service functions

60(.0) Call of service level
60.1 Display of firmware version number and EPROM check sums
60.2 13-bit routine for the OPTO interface to the measurement section
60.3 Hardware setting corresponding to previous entry
60.4 A/D converter test
60.5 Display of options
60.6 Offset measurement for distortion meter range 1
60.7 Offset measurement for distortion meter range 5

SPEC FCT 61 Key test (service routine)

61 Display of key numbers

SPEC FCT 62 Service routine for DC outputs

62(.0) 0 V at DC1
62.1 -10 V at DC1
62.2 +10 V at DC1
62.3 0 V at DC2
62.4 -10 V at DC2
62.5 +10 V at DC2

The output +10 V leads to 9.9951 V at the DC output

The call of the service level via 60.0 prevents the DC output values from being overwritten by measured values!

* SCF = Scale factor

::: = basic setting (see 2.3.10)

2.3.10 Setting Following Switch-on of UPA

The switch-on status of the UPA depends on the operating mode selected by means of SPEC FCT 8.

SPEC FCT 8.0: Internal basic setting
The switch-on status is set by means of an internal basic setting available in the program memory of the UPA. It is likewise set by calling SPEC FCT 0 and the IEC-bus commands CLEAR, CLR, DCL (Device Clear) or SDC (Selected Device Clear) (see Sections 2.4.6 and 2.4.20):

- MEAS section: Unbalanced input c (BNC connector), channel R.
  AC level range 300 V.
  Autoranging.
  RMS detector.
  LEVEL and FREQUENCY display referred to measurement section.
  Reference impedance Z 600 Ω.
  Reference level 1 V.
  Reference frequency 1 kHz.
  Special filter number 1 selected.
  Level measuring speed SLOW.
  Frequency measuring speed FAST.
  Distortion reference level 1 V.

- SOURCE section: Unbalanced output c (BNC connector), channel R.
  Level 1 mV.
  Frequency 1 kHz.
  Level and frequency step value for spin wheel: automatic assignment.
  Reference impedance Z 600 Ω.
  Generator present as option:
  LED FREQ lights up, spin wheel changes frequency. LEDs L and c light up.

SWEEP start level	1 mV
SWEEP stop level	1 V
SWEEP level increment	auto increment
SWEEP start frequency	1 kHz
SWEEP stop frequency	10 kHz
SWEEP frequency increment	auto increment
SWEEP time	0.15 seconds
SWEEP PRINT	OFF
SWEEP Print/plot	OFF
PLOT initial value scale 1	-100
PLOT final value scale 1	+100
PLOT reference line scale 1	0
PLOT initial value scale 2	-100
PLOT final value scale 2	+100
PLOT reference line scale 2	0
PLOT form feed	OFF
PLOT function	ALL
PLOT reference line	USE 1
PLOT instrument status	On
PLOT emphasize reference range	OFF

No generator level limitation
No generator frequency limitation

- FUNCTION section: No function switched on.
  FUNCTION display without output.
  First selection of WF AM: display unit: dB
  First selection DISTORTION: display unit: %
  First selection SINAD: display unit: dB

- Displays: Numerical display of measured values.

SPEC FCT 8.1: Freely selectable basic setting
The UPA must be set as desired after switching on. By calling SPEC FCT 8.1, this setting is stored in a non-volatile memory and causes the freely selectable basic status to be set each time the UPA is switched on. The basic status is likewise set after calling SPEC FCT 0 and by means of the IEC-bus commands CLEAR, CLR, DCL (Device Clear) or SDC (Selected Device Clear) (see Sections 2.4.6 and 2.4.20).

SPEC FCT 8.2 and SPEC FCT 8.3: Following switch-on, set the status valid before switching off
If the instrument is to be switched on with the setting status valid before switching off (particulary useful in the case of unexpected interruption of working or power failure), enter SPEC FCT 8.2 or SPEC FCT 8.3.

The two special functions merely differ in the response after calling the basic setting:

- With SPEC FCT 8.2 selected, the internal basic status is set in response to the input of SPEC FCT 0 or the IEC-bus commands CLEAR, CLR, DCL (Device Clear) or SDC (Selected Device Clear).

- With SPEC FCT 8.3 selected, the freely selectable basic status is set in response to the input of SPEC FCT 0 or the IEC-bus commands CLEAR, CLR, DCL (Device Clear) or SDC (Selected Device Clear).

Special functions and IEC-bus commands corresponding to the internal basic setting are marked in the corresponding sections of the operating manual and pointed out in the user's guide by means of colors.

Switch-on status of the UPA following abrupt power failure

If, during IEC-bus control (e.g. test program) or keyboard entry, operation of the UPA is abruptly interrupted due to a power failure, the internal instrument status may include discrepancies which will be eliminated by loading a basic setting after the next power-on.

If SPEC FCT 8.0 or 8.2 is set on power-off, the internal basic setting stored in the EPROM of the UPA is loaded.
If SPEC FCT 8.1 or 8.3 is set on power-off, the basic setting defined by the user is loaded.

Correction of the instrument status due to power-off does not produce an error message.
The measurement can be continued after setting the UPA as required via IEC-bus control or keyboard entry.

2.3.11 Error Messages

Error messages are output in the form **Er** and a number in the FUNCTION/DATA display 13:

Error code	Cause
Er 1	Illegal number entered
Er 2	Keys pressed in wrong sequence, general input error
Er 3.1	RAM error when storing instrument setting
.	
.	Er 3.x as warning:
.	This error message may occur after fitting a new pro-
3.9	cessor card or replacing the battery on the processor card following switch-on of the UPA. In this case, the error message Er 3.x is only meant to be a warning, since the memory areas for complete instrument settings are initialized with the basic setting.
	Er 3.x as message: If the program run is disturbed during storage of a complete instrument setting, the error message Er 3.x is displayed when recalling this complete instrument setting. New storage of the complete instrument setting eliminates the disturbance.
Er 4	Illegal or currently not permissible special function number
Er 5	Error in IEC-bus command syntax
Er 6	Error in IEC-bus data
Er 7	Currently illegal IEC-bus command
Er 8	External supply to generator output
Er 9	Transfer of underflow or overflow value from display as reference value
Er 10	Contradictory settings
	Example: Selection of quasi-peak detector or SOUND CCIR filter for level measurement while one of the function measurements - wow & flutter, distortion factor or SINAD - is active.
	If, by further pressing of the keys, the setting is changed such that it is no longer contradictory, the error message Er 10 will disappear again. The error message Er 10 can also be eliminated by pressing the CLEAR key 23.
Er 11	Distortion meter cannot be tuned.
Er 12	Illegal harmonic with selective distortion factor measurement.
Er 20	IEC-bus address missing (following UPA power-up)
Er 21	Internal offset correction values missing (following UPA power-up) see 3.4.2
Er 21.9	Internal offset measurement incorrect
Er 22	Internal calibration values for AC or DC measurement missing (following UPA power-up) see 3.4.2

Er 22.1	Internal offset correction values missing for calibration.
Er 22.2	Reference value for calibration missing
Er 22.3	Reference value for calibration out of tolerance (permissible range 2.5 V to 3.01 V)
Er 22.8	Calibration faulty for 300-Hz highpass filter
Er 22.9	Basic calibration incorrect
Er 23	Calibration value missing for the insertion loss of an external filter (following UPA power-up)
Er 23.7	Calibration for the insertion loss of an external filter outside tolerance (permissible range -6 to +6 dB)
Er 23.9	Attempt to calibrate with external filter not connected or with attenuation values outside the range -20 dB to +20 dB
Er 24	Call of calibration functions inhibited
Er 25	Call of service functions inhibited
Er 30	Hardware error in frequency meter
Er 31	Hardware error in A/D converter
Er 40	Indicates that Er 3, Er 20, Er 21, Er 22 or Er 23 has occurred following switch-on of the UPA.
Er 41	The Listen Only device (e.g. printer) connected to the IEC bus is not ready for use or its IEC-bus line is open.
Er 42	DC measurement not possible.

2.3.12 Notes and Warnings

The user is informed by flashing displays or by the output of letters or special characters on the displays:

All displays	**Meaning**
Numeric display value or RANGE	Upper range limit violated, selected measuring or display range automatically increased, measured values still valid.
Last digit of numeric display or RANGE value flashes	Lower range limit violated, measured values valid but outside error specification.
Scale of analog bar display flashes	Overflow of analog bar display range selected by the fixed display range.
Triangular markings above the numbers	Internal measuring cycle or measuring speed setting
OFLO	Overflow of measuring or display range
UFLO	Underflow of measuring or display range
-----	No measurement,
-----	measured level too low
R	
A	
N	Range values
G	
E	
MEAS	Value display
SOURCE	Generator setting display
REF	Reference value display

DISPLAY LEVEL	DISPLAY FREQUENCY	DISPLAY FUNCTION	**Meaning**
		--	Measurement result cannot yet be displayed
		A-Inc	Automatic increment for the spin wheel
		SFI=1 to 4	Special frequency increment
		rAnd	or RANDOM sequence
		no OP	Operation cannot be executed because option not present.

LEVEL	Display FREQUENCY	FUNCTION	Meaning
		IEC 0...30	IEC-bus address set
		IEC to	IEC talk only mode
		CAL	Entry for calibration possible.
		En.OFF	Internal offset correction routine can be called.
		OFF 1...3	Internal offset correction phase
		OFF.dc	
		En.CAL	Entry or enable for AC level calibration
		En. dc	Entry or enable for DC level calibration
		CAL 1...3	Internal level calibration phase
		CAL.dc	Internal DC calibration phase
		En.EFI	Calibration routine for correction of insertion loss of external filter can be called.
		EFI.0dB	Reset of calibration value to 0 dB for insertion loss of external filter can be called.
		nr...	Display of special filter numbers or harmonics for selective distortion measurement
		Opt.2...9	Options installed:
		Opt.-	No option or only Opt.-B1 installed
		Er...	Display of error messages
		tESt	Entry of servicing functions possible
	EP...	num. value	Display of EPROM checksums
	-dc-		Indication of DC mode on FREQUENCY and/or FUNCTION display
	notch	num. value	Presetting frequency of the notch filter for the distortion/SINAD measurement
StArt		num. value	Start level
StoP		num. value	Stop level
Inc		num. vlaue	Level increment
Inc		**A-Inc**	Automatic level increment
StP.Li		num. value	Linear level steps
StP.Lo		num. value	Logarithmic level steps
	StArt	num. value	Start frequency
	StoP	num. value	Stop frequency
	Inc	num. value	Frequency increment
	Inc	**A-Inc**	Automatic frequency increment
	Inc	**SFI.1**	1st octave
	Inc	**SFI.2**	2nd octave
	Inc	**SFI.3**	1st third-octave
	Inc	**SFI.4**	2nd third-octave
	StP.Li	num. value	Linear frequency steps
	StP.Lo	num. value	Logarithmic frequency steps
	SEC	num. value	Sweep time
IEC	**Out**	**OFF**	IEC-bus output mode
IEC	**Out**	**Print**	
IEC	**Out**	**Plot**	

LEVEL	Display FREQUENCY	FUNCTION	Meaning
rAnd	rAnd	StEP	Simultaneous change in RANDOM level/frequency values
rAnd		StEP	Change in RANDOM level values only
	rAND	StEP	Change in RANDOM frequency values only
OFFS		Num. value	Offset value for RANDOM level
End	POS	Num. value	Final item of RANDOM sequence
Plot	1_Lo	Num. value	Lower value of 1st scale
Plot	1_Hi	Num. value	Upper value of 1st scale
Plot	1_rEF	Num. value	Value of reference line of 1st scale
Plot	2_Lo	Num. value	Lower value of 2nd scale
Plot	2_Hi	Num. value	Upper value of 2nd scale
Plot	2_rEF	Num. value	Value of reference line of 2nd scale
Plot	FF	OFF	No form feed for plot output
Plot	FF	End	Form feed at the end of plot output
Plot	FF	StArt	Form feed at the start of plot output
Plot	FF	both	Form feed at the start and end of plot output
Plot		ALL	Output two curves
Plot	Fnct	OnlY	Output function curve only
Plot	rEF.Ln	USE1	One reference line with each curve
Plot	rEF.Ln	USE2	Two reference lines with one curve
Plot	rEF.Ln	OFF	Do not output reference line
Plot	InFo	On	Document instrument setting
Plot	InFo	OFF	Do not document instrument setting
Plot	FILL	OFF	No emphasis on reference range
Plot	FILL	1.I==	Emphasis between or to the right
Plot	FILL	0.==I	Emphasis outside or to the left

2.4 Control via IEC Bus

The UPA is fitted with a remote control interface to IEC 625-1/IEEE 488 (1975) and can therefore be connected to a data bus system for transmission of setting data and measured values - referred to as the IEC bus. All functions of the UPA can be remote controlled. The connection is on the rear panel (see Fig. 2-2 50, Section 2.2.5.6 and pin assignments in Fig. 2-11).

The interface-specific functions of the IEC bus (control lines, handshake lines and data lines) as well as the sequence of data transmission are described in the corresponding standards. The characters of the ISO 7-bit code used for transmission are listed in Table 2-3.

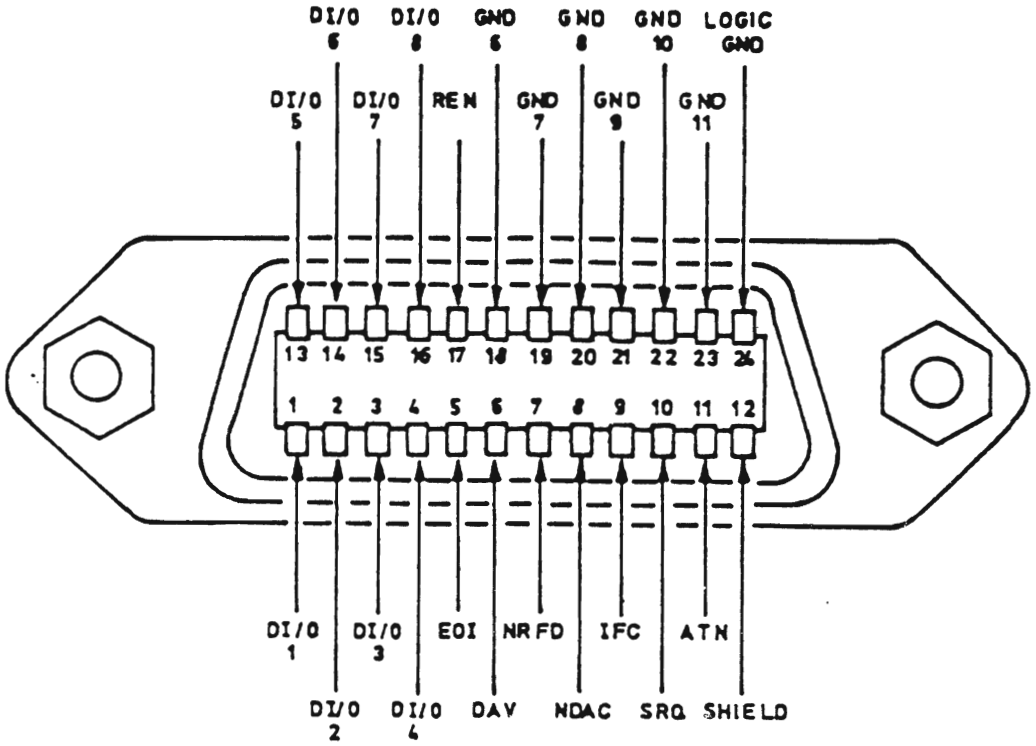


Fig. 2-11 Pin assignments

Table 2-3 ISO 7-bit code (ASCII code)

Messages sent and received with ATN = 1

Bits b_7 b_6 b_5 →					0 0 0	① MSG	0 0 1	MSG	0 1 0	MSG	0 1 1	MSG	1 0 0	MSG	1 0 1	MSG	1 1 0	MSG	1 1 1	MSG
Bits b_4	b_3	b_2	b_1	Column / Row	0		1		2		3		4		5		6		7	
0	0	0	0	0	NUL		DLE		SP		0		@		P				p	
0	0	0	0	1	SOH	GTL	DC1	LLO	!		1		A		Q		a		q	
0	0	0	0	2	STX		DC2		"		2		B		R		b		r	
0	0	0	0	3	ETX		DC3		§		3		C		S		c		s	
0	0	0	0	4	EOT	SDC	DC4	DCL	$		4		D		T		d		t	
0	0	0	0	5	ENQ	PPC ⑨	NAK	PPU	%		5		E		U		e		u	
0	0	0	0	6	ACK		SYN		&		6		F		V		f		v	
0	0	0	0	7	BEL		ETB		'	MA ⑤	7	MLA ⑥	G	MTA ⑦	W	MTA ⑦	g	⑧	w	⑨
0	0	0	0	8	BS	GET	CAN	SPE	(		8		H		X		h		x	
0	0	0	0	9	HT	TCT	EM	SPD	)		9		I		Y		i		y	
0	0	0	0	10	LF		SUB		*		:		J		Z		j		z	
0	0	0	0	11	VT		ESC		+		;		K		[		k		(	
0	0	0	0	12	FF		FS		,		<		L		\		l		¦	
0	0	0	0	13	CR		GS		-		=		M		]		m		)	
0	0	0	0	14	SO		RS		.		>		N		^		n		~	
0	0	0	0	15	SI		US		/		?	UNL	O		_		o		DEL	

Addressed command group (ACG) | Universal command group (UCG) | ④ Listen address group (LAG) | Talk address group (TAG)

Primary command group (PCG) | Secondary command group (SCG)

① MSG = Interface Message
② b_1 = DIO1 to b_7 = DIO7
③ Requires secondary command
④ Subset for alphanumeric codes
⑤ MA = Listen addresses for devices
⑥ MLA = Listen addresses for devices
⑦ MTA = Talk addresses for devices
⑧ Meaning defined by PCG Code
⑨ Meaning defined by PCG Code

2.4.1 Setting the Device Address / Talk Only

The current device address is briefly output on the FUNCTION/DATA display (13) when the UPA is switched on:

e.g. **IEC 10**

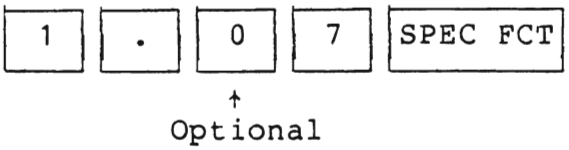
The device address remains stored, even when the instrument is switched off, in a RAM with battery back-up.

The IEC-bus address can be easily changed by entering special function 1... (see Section 2.3.9).

Numbers from 1.00 to 1.30 can be entered on the numeric keypad 24. The required new address in the range from 0 to 30 is on the right of the decimal point. The value 31 is interpreted as Talk Only mode.

Illegal inputs lead to an error message on the FUNCTION/DATA display.

Example: Enter device address 7



2.4.2 Recalling the Device Address

It is possible to output the current device address on the FUNCTION/DATA display 13 using a special function.

In this case the number 1 must be entered on the keypad 24 and the key SPEC FCT 19 then pressed.

IEC10 is then briefly output on the FUNCTION/DATA display where the number (10 in the example) is the set IEC-bus device address. If Talk Only mode is set, **IECto** is output.

The currently valid IEC-bus address can be briefly output in Local mode by pressing the LOCAL/TALK key. (No display if Talk Only mode is set.)

2.4.3 Interface Functions

The following interface functions are implemented in the UPA:

SH1	Source handshake function Complete capability
AH1	Acceptor handshake function Complete capability
T5	Talker function Series poll, Talk Only mode, Unaddress if MLA
L4	Listener function Unaddress if MTA
SR1	Service request function Complete capability
RL1	Remote/local switchover function Complete capability
DC1	Device clear function (reset) Complete capability
DT1	Device trigger function Complete capability
PP1	Parallel poll Setting remotely controlled

2.4.4 Device-specific IEC-bus Commands

The IEC-bus commands can be divided into the following functional groups:

Section 2.4.6	Basic setting
CLEAR CLR STORE (BASICSET (0 to 3))	

Section 2.4.7	Measurement section commands
INPUT (... FILTER (... MEASUREMENT (LEVEL or FREQUENCY ... RANGE (LEVEL ... RATE (... DISPLAY (LEVEL or FREQUENCY ... STORE (REFERENCE or IMPEDANCE ... RECALL (REFENRENCE or IMPEDANCE ...	

Section 2.4.8	Function commands in conjunction with options Wow & Flutter, (UPA-B9) Distortion, (UPA-B8) NOISE SINAD, (UPA-B8) NOISE S/N (UPA-B6)
MEASUREMENT (FUNCTION ... RANGE (WOWFLUTTER ... DISPLAY (FUNCTION ... WOWFLUTTER (... RECALL (SIGMABACKGROUND) DISTORTION (... NOISE (... STORE (REFERENCE DISTORTIONLEVEL ... RECALL (REFERENCE DISTORTIONLEVEL) PHASE (...	

Section 2.4.9	Generator commands
OUTPUT (... SOURCE (LEVEL or FREQUENCY ... SOURCE (... ONLIMIT or OFFLIMIT) INCREMENT (LEVEL or FREQUENCY or STEPRANDOM ... STORE (IMPEDANCE) RECALL (IMPEDANCE) RECALL (SOURCE ...	

Section 2.4.10	Sweep commands
SWEEP (LEVEL START or STOP .... SWEEP (FREQUENCY START or STOP .... SWEEP (TIME) .... SWEEP (INCREMENT .... SWEEP (LEVEL or FREQUENCY or STEPRANDOM ENABLE)	

Section 2.4.11	Commands for DC outputs and AC output
DCSCAL (... ACMONITOR (MODE (0 to 3))	

Section 2.4.12	Interface commands
DELIMITER (... SRQ (... STRING (...	

Section 2.4.13	Store/recall commands
STORE (SET (1 to 50)) STORE (SET LOCK or UNLOCK) RECALL (AKTUAL) RECALL (SET (1 to 50))	

Section 2.4.14	Trigger commands
TRIGGER (MODE ... TRIGGER (OFF) TRIGGER (INPUT) TRIGGER (AUTO) TRIGGER (SINGLE) TRIGGER (STORE)	

Section 2.4.15	Calibration commands
CALIBRATION (...	

Section 2.4.16	Inquiry commands
Header?	

Summary of commands in alphabetical order:

IEC-bus command	Section
ACMONITOR (MODE(0...3))	2.4.11
CALIBRATION (...	2.4.15
CLEAR	2.4.6
CLR	2.4.6
DCSCAL (...	2.4.11
DETECTOR (...	2.4.7
DELIMITER (...	2.4.12
DISPLAY (LEVEL or FREQUENCY ...	2.4.7
DISPLAY (FUNCTION ...	2.4.8
DISTORTION (...	2.4.8
FILTER (...	2.4.7
INCREMENT (...	2.4.9
INPUT (...	2.4.7
MEASUREMENT (LEVEL or FREQUENCY ...	2.4.7
MEASUREMENT (FUNCTION ...	2.4.8
NOISE (...	2.4.8
OUTPUT (...	2.4.9
PHASE (...	2.4.8
RANGE (LEVEL ...	2.4.7
RANGE (WOWFLUTTER ...	2.4.8
RATE (...	2.4.7
RECALL (AKTUAL)	2.4.13
RECALL (IMPEDANCE)	2.4.9
RECALL (REFERENCE or IMPEDANCE ...	2.4.7.8
RECALL (REFERENCE DISTORTIONLEVEL)	2.4.8
RECALL (SET (1...50)	2.4.13
RECALL (SIGMABACKGROUND)	2.4.8
RECALL (SOURCE ...	2.4.9
SOURCE (LEVEL or FREQUENCY ...	2.4.9
SOURCE (... ONLIMIT or OFFLIMIT)	2.4.9
SRQ (...	2.4.12
STORE (BASICSET (0...3))	2.4.6
STORE (IMPEDANCE)	2.4.9
STORE (REFERENCE or IMPEDANCE ...	2.4.7.8
STORE (REFERENCE DISTORTIONLEVEL ...	2.4.8
STORE (SET (1...50))	2.4.13
STORE (SET LOCK or UNLOCK)	2.4.13
STRING (...	2.4.12
SWEEP (LEVEL or FREQUENCY ...	2.4.10
SWEEP (INCREMENT ...	2.4.10
SWEEP (... ENABLE)	2.4.10
SWEEP (TIME) ...	2.4.10
TRIGGER (...	2.4.14
WOWFLUTTER (...	2.4.8

2.4.5 General Information on the IEC-Bus Command Syntax

All instrument-specific IEC-bus commands have a uniform format. They consist of a header (comprising only letters), perhaps an extension and, if required, a numeric component (data). Brackets and separators are used for optical and syntactic separation of individual command elements. Commands separated by commas can be combined into a command sequence which is terminated by a delimiter.

Examples:

```
IECOUT10, "SOURCE ( LEVEL DBV ) -10.25" CR
```

The ASCII characters CR (ODH), NL (OAH), ETX (03) or their combinations are permissible as delimiters. Activation of the EOI line has the same meaning.

Data can be written as pure numbers with sign and decimal point or with an exponent.

The following notations are permissible:
12.3/+.3/-0.2/-1.2E1/+0E0/
+.1E-3/-1.2E-03/0012.00E00/
Not permissible:
./.E/.E01/2E001/1.23 E01/
3.2E -03/2E+0.1/

The extensions are included in round brackets.

The command extensions must only consist of capital letters, numbers and the characters "/" and "&".

The header may only contain capital letters and generally explains the IEC-bus command by means of a plain text caption.

Device address 10

Output syntax for the process controllers PPC, PUC2, PUC10, PCA5 and PCA2 from R&S.

IECOUT10, "TRIGGER (MODE (5))"

If an expression in brackets follows an extension, this is an extension of the extension. Depending on the command, numbers, letters or the separator "/" may be present between the round brackets.

IECOUT10, "DELIMITER (TYPE (CR/NL))"

The individual command elements can be optically separated by any number of spaces. **Two or more extensions must be syntactically separated by at least one space.**

The sequence of letters in a header or extension as well as data must not be interrupted by spaces.

An IEC-bus command must not have more than the maximum number of 50 characters. The letter code of the header and extensions can be shortened down to a minimum of one letter.

The data can be indicated with or without extension. The exponent may consist of a maximum of two digits and a sign. A positive sign as well as one or several zeros to the left of the decimal point are optional. Spaces within the data are **not** permitted.

Example: The following entries are possible for the value 0.123:
0.123 .123 00.123 .123E0 0.123E00 .123E+0
123E-3/

An abbreviation is only correct if the sequence of letters from left to right is unequivocal compared to other sequences in the evaluation table used for the syntax test.

The shortest, still unequivocal abbreviation for header and extensions is identified in the user's guide by underlining.

The following forms could be possible for the command used for demonstration purposes:

IECOUT10, "SOURCE(LEVEL DBV)-10.25"
IECOUT10, "SOURCE(LEVEL DBV) -10.25"
IECOUT10, "SOURCE (LEVEL DBV)-10.25"
IECOUT10, "SO(L DBV)-10.25"
IECOUT10, "SOU (LEV DBV) -10.25"

Any number of IEC-bus commands can be combined in sequence, separated by commas, provided the maximum number of 50 characters for a bus command (including commas) to be sent on the IEC bus is not exceeded.

Example of a command sequence:

IECOUT10, "CLEAR, TRIGGER(MODE(LEV)), SRQ(ENABLE)" CR/NL

All commands received are checked for correct syntax; the data received are checked in order to make sure that they lie within the limit values.

If errors are found, e.g.
- option not present,
- syntax error or
- data error,

no further commands will be executed.

If there is an error in a sequence of commands separated by commas, no further commands are executed after the faulty command even if they are correct.

Instead a service request with appropriately set status byte is immediately generated and a brief error message output on the FUNCTION/DATA display 13.

2.4.6 Basic Setting

CLEAR
CLR

Instrument setting according to Section 2.3.10. It corresponds to the marked IEC-bus command sequence of this section and the user's guide.

STORE (BASICSET (0...3))

0 ≙ SPEC FCT 8.0:
Internal basic setting after switching on the UPA (see 2.3.10).

1 ≙ SPEC FCT 8.1:
Adopt freely selectable basic setting and set after switching on the UPA (see 2.3.10).

2 ≙ SPEC FCT 8.2:
After switching on the UPA, set the status prior to switching off.
SPEC FCT 0 or the IEC-bus commands CLEAR, CLR, DCL or SDC set the internal basic setting (see 2.3.10).

3 ≙ SPEC FCT 8.3:
After switching on the UPA, set the status prior to switching off (see 2.3.10).
SPEC FCT 0, or the IEC-bus commands CLEAR, DLC, or SDC set the selectable basic setting.

2.4.7 Measurement Section Commands

2.4.7.1 Setting the Channel

INPUT (RIGHT BAL2ØKOHM)
INPUT (RIGHT A/B2ØKOHM)
Measurement section is connected to the right-hand channel of the balanced input (37).
Input impedance 20 kΩ

INPUT (RIGHT BAL6ØØOHM)
INPUT (RIGHT A/B6ØØOHM)
--- ditto --- input impedance 600 Ω
--- ditto --- input impedance 600 Ω

INPUT (RIGHT UNBAL) :::
INPUT (RIGHT C)
Measurement section is connected to the right-hand channel of the unbalanced input (36).

INPUT (LEFT BAL2ØKOHM)
INPUT (LEFT A/B2ØKOHM)
Measurement section is connected to the left-hand channel of the balanced input (37).
Input impedance 20 kΩ.

INPUT (LEFT BAL6ØØOHM)
INPUT (LEFT A/B6ØØOHM)
--- ditto --- input impedance 600 Ω
--- ditto --- input impedance 600 Ω

INPUT (LEFT UNBAL)
INPUT (LEFT C)
Measurement section is connected to the left-hand channel of the unbalanced input (36).

::: = Basic setting

2.4.7.2 Setting the Filter

FILTER (STOFF)	:::	Switch off SOUND filter and TELEPHON filter.
FILTER (SOUND)		Switch on SOUND filter.
FILTER (TELEPH)		Switch on TELEPHON filter.
FILTER (HPOFF)	:::	Switch off highpass filters 300 Hz and 22 Hz.
FILTER (HP3ØØHZ)		Switch on highpass filter 300 Hz.
FILTER (HP22HZ)		Switch on highpass filter 22 Hz.
FILTER (LPOFF)	:::	Switch off lowpass filters 100 kHz and 22 kHz.
FILTER (LP1ØØKHZ)		Switch on lowpass filter 100 kHz.
FILTER (LP22KHZ)		Switch on lowpass filter 22 kHz.
FILTER (SEOFF)	:::	Switch off external filter and special filter.
FILTER (EXT)		Switch on external filter.
FILTER (SPEC (1 to 17))		Option UPA-B2 Switch on special filter with the
(0 to 255)		Option UPA-B3 given number.
1 =	:::	

2.4.7.3 Setting the Operating Mode AC/DC and the Output Unit for Level and Frequency

MEASUREMENT (AC)	:::	Operating mode AC
MEASUREMENT (DC)		Operating mode DC Simultaneously cuts in one of the unbalanced test channels.
MEASUREMENT (LEVEL VOLT)	:::	Definition of output unit for the measured level.
DBV		
DBM		
WATT		VOLT = V DPCV = Δ%V
DPCV		DBV = dBV DPCW = Δ%W
DPCW		DBM = dBm(Z) DDB = ΔdB
DDB		WATT = W
MEASUREMENT (FREQUENCY HZ)	:::	Definition of output unit for the measured frequency.
DHZ		
DPC		
		HZ = Hz
		DHZ = ΔHz
		DPC = Δ%

::: = Basic setting

2.4.7.4 Setting the Rectifier

DETECTOR (RMS) ::: Set RMS rectifier.

DETECTOR (QUASIPK) Set quasi-peak value rectifier.

2.4.7.5 Setting the Measuring Range for Level Measurement

RANGE (LEVEL AUTO or HOLD (0))
HOLD
HOLD (1 to 13)
FIX
FIX (1 to 13)

AUTO or HOLD (0) ::: Set level autoranging.

HOLD Hold current level measuring range **with** switchover if range is exceeded.

HOLD (1 to 13) Set level measuring ranges **with** switchover if range is exceeded.

AC measuring mode unbalanced:
level measuring range 1 to 13
(see 2.3.1.3)

AC measuring mode balanced:
level measuring range 1 to 11
(see 2.3.1.3)

DC measuring mode:
level measuring mode 1 to 3
(see 2.3.1.7)

FIX Fix current level measuring range **without** switchover if range is exceeded.

FIX (1 to 13) Fix level measuring ranges **without** switchover if range is exceeded.

AC measuring mode unbalanced:
level measuring range 1 to 13
(see 2.3.1.3)

AC measuring mode balanced:
level measuring range 1 to 11
(see 2.3.1.3)

DC measuring mode:
level measuring range 1 to 3
(see 2.3.1.7).

::: = Basic setting (see 2.3.10)

2.4.7.6 Setting the Measuring Speed

RATE (LEVEL SLOW)	:::	Set slow level measurement.
RATE (LEVEL FAST)		Set fast level measurement.

When switching on the measuring speed LEVEL FAST, the highpass filter 22 Hz is automatically switched on unless a highpass filter, the SOUND or the TELEPH filter were switched on before.

The switchover LEVEL SLOW/FAST is also possible for the DC measurement.

The following applies:

LEVEL SLOW	DC measurement **with** filtering of AC voltage
LEVEL FAST	DC measurement **without** filtering of AC voltage

RATE (FREQUENCY SLOW)		Set slow frequency measurement.
RATE (FREQUENCY FAST)	:::	Set fast frequency measurement.

2.4.7.7 Setting the Display Mode for Level and Frequency

DISPLAY (LEVEL / FREQUENCY) (VALUE / BARGRAPH / BARGRAPH (x) / VALBAR / VALBAR (x))

Basic setting: DISPLAY (LEVEL VALUE)
DISPLAY (FREQUENCY VALUE)

LEVEL, FREQUENCY

Defines the measurement assignment to which the DISPLAY command is to refer.

Before starting a measurement, make sure that the TRIGGER (MODE...) selected corresponds to the desired measurement assignment.

::: = Basic setting

VALUE

The measured value to be output on the display is displayed as a pure number.

BARGRAPH

The measured value to be output on the display is displayed as a bar together with the range (autoranging).

VALBAR

The measured value to be output on the display is displayed as a combination of the digital measured value and a bar display, but without range data (autoranging).

BARGRAPH (0 to 9)
VALBAR (0 to 9)

The number 0 switches on the autoranging function. The numbers 1 to 9 are used to fix the bar display range so that there will be **no** switchover into the next higher or lower display range if the upper or lower limits of the selected bar display range are violated.

Violations of the upper or lower range limits are indicated by the flashing scale in the display.

LEVEL BARGRAPH (0, 2 to 5)
LEVEL VALBAR (0, 2 to 5)

0: Return to autoranging
2: Fix ±1 % bar display
3: Fix ±10 % bar display
4: Fix ±100 % bar display
5: Fix ±1000 % bar display

The DISPLAY command acts **only** in connection with a reference-based display in Δ%V or Δ%W which is set using the command

MEASUREMENT (LEVEL DPCV)
DPCW

Example:

```
IECOUT10,"TRIGGER MODE (4))"
IECOUT10,"MEASUREMENT (LEV DPCV)"
IECOUT10,"DISP (LEV VALB (3))"
```

::: = Basic setting

FREQUENCY BARGRAPH (0 to 5)
FREQUENCY VALBAR (0 to 5)

0: Return to autoranging
1: Fix ±0.1 % bar display
2: Fix ±1 % bar display
3: Fix ±10 % bar display
4: Fix ±100 % bar display
5: Fix ±1000 % bar display

The DISPLAY command acts **only** in connection with a reference-based display in Δf% which is set using the command

MEASUREMENT (FREQUENCY DPC)

Example:

```
IECOUT10,"TRIGGER (MODE (4))"
IECOUT10,"MEASUREMENT (FRE DPC)"
IECOUT10,"DISP (FRE BAR (3))"
```

2.4.7.8 Storage and Recall of Reference Values

STORE (REFERENCE LEVEL VOLT) data
DBV
DBM
WATT

Transfer new reference level in V, dBV, dBm(Z) or W.

Basic setting: STORE (REFERENCE LEVEL VOLT) 1.0

STORE (REFERENCE FREQUENCY) data

Transfer new reference frequency (always in Hz)

Basic setting: STORE (REFERENCE FREQUENCY) 1000

STORE (IMPEDANCE) data

Transfer new impedance value (always in Ω)

Basic setting: STORE (IMPEDANCE) 600

RECALL (REFERENCE LEVEL)

Recall current reference level with brief output on the LEVEL display. The output value is transferred to the controller by an IECIN command.

RECALL (REFERENCE FREQUENCY)

Recall current reference frequency (always in Hz) with brief output on the FREQUENCY display. The output value is transferred to the controller by an IECIN command.

RECALL (IMPEDANCE)

Recall current impedance (always in Ω) with brief output on the FUNCTION/DATA display. The output value is transferred to the controller by an IECIN command.

Example:

```
IECOUT10,"REC(IMP)"
IECIN10, A$
PRINT A$
```

Recall of generator, reference or impedance values via the RECALL (...) IEC-bus commands is **not** triggered by a TRIGGER command, but the requested value can be transferred immediately following the RECALL command. A setting command between the RECALL command and the IECIN command would lead to an illegal recall value.

Example with the Controller PCA5:

Incorrect:

```
100 IECOUT10,"RECALL (IMPEDANCE)"
110 IECOUT10,"RANGE (AUTO)"
120 IECIN A$: PRINT A$
                .
                .
                .
```

Correct:

```
100 IECOUT10,"RECALL (IMPEDANCE)"
110 IECIN10, A$: PRINT A$
120 IECOUT10,"RANGE (AUTO)"
```

The data output mode selected by the STRING(SINGLE ...) or STRING(ALL ...) command is insignificant for the transfer of a value via the RECALL command.

However, the mode selected by STRING(... ALPHANUM) or STRING(... NUM) is taken into account and leads to a recall value with alphaheader in the case of ALPHANUM and to a recall value without alphaheader in the case of NUM.

2.4.8 Function Commands

2.4.8.1 Setting the Output Unit for Function Measurement

MEASUREMENT (FUNCTION PC) ::: Definition of output unit for
DB the function measurement result, provided the current function measurement permits the output unit to be changed:
VOLT
DPC
DDB

Wow&Fl. AM in %: (PC)
dB: (DB)

SINAD in dB: (DB)
volts: (VOLT)
Δ%: (DPC)
ΔdB: (DDB)

Distortion in %: (PC)
dB: (DB)
volts: (VOLT)
Δ%: (DPC)
ΔdB: (DDB)

If a function setting is performed without the display unit being effected by the MEASUREMENT command, the measurement result is output with the unit of the internal basic setting:

Wow&Fl. AM: display unit = dB
Distortion: display unit = %
SINAD: display unit = dB

The display unit cannot be altered for the following functions:
Wow & Fl. DIN, NAB, JIS always in %
S/N always in dB
Phase always in degrees

The function setting is performed first and then the function unit is selected.
A MEASUREMENT command referring to the functions given above or the output of a MEASUREMENT command without active function measurement remains ineffective; this is however **not** indicated by an error message, and the specified unit remains stored in the background until a function is set which permits this unit to be employed.

Example with Controller PCA5:

```
        :
100 IECOUT10, "DISTORTION (TOTAL)"
110 IECOUT10, "STORE (REF DISTORTIONLEVEL) 0.001"
120 IECOUT10, "MEASUREMENT (FUNCTION DDB)"
130 REM Function measurement result is displayed in ΔdB after
      triggering of the measured value.
```

Example with preset function unit:

```
100 IECOUT10,"MEASUREMENT(FUNCTION PC)"
110 IECOUT10,"TRIGGER(MODE(FNCT))"
120 IECOUT10,"STRING(SINGLE NUM)"
        :
    Further settings
        :
160 IECOUT10,"WOWFLUTTER(AM WTD)"
170 REM Function measurement result is displayed in % after
      triggering of the measured value.
```

2.4.8.2 Setting the Measuring Range for Wow & Flutter Measurement

RANGE (WOWFLUTTER AUTO or FIX (0))
FIX
FIX (1 to 4)

AUTO or FIX (0	:::	Set wow & flutter autoranging
FIX		Hold current wow & flutter measuring range.
FIX		Set wow & flutter measuring range.
(1)		0.1 % DIN/NAB, 2 dB AM
(2)		0.3 % DIN/NAB, 6 dB AM
(3)		1 % DIN/NAB, 20 dB AM
(4)		3 % DIN/NAB, (>20 dB AM)

A fixed wow & flutter measuring range set via SPEC FCT 32 or the IEC-bus command RANGE(WOWFLUTTER FIX (1 to 4)) is automatically combined with a fixed bar display range (provided bar display is selected).

::: = Basic setting

2.4.8.3 Setting the Display Mode for Function Measurement

```
DISPLAY (FUNCTION VALUE          )   :::
                  BARGRAPH
                  BARGRAPH (x)
                  VALBAR
                  VALBAR (x)
```

Explanation of the commands, see also 2.4.7.7.

FUNCTION BARGRAPH (0 to 9)
FUNCTION VALBAR (0 to 9)

This command is only meaningful in connection with the function setting wow & flutter or DIST and leads to an error message if no function measurement is switched on.

The numbers 1 to 9 always refer to the already **active** function measurement, i.e. the DISPLAY command must always be preceded by a function setting (see example below).

Fixed bar display range in connection with wow & flutter to DIN or NAB:

```
x = 0: Return to bar display autoranging   :::
x = 1: 0.01 %  ┐
x = 2: 0.03 %  │
x = 3:  0.1 %  │
x = 4:  0.3 %  ├─ Fix bar display range.
x = 5:    1 %  │
x = 6:    3 %  │
x = 7:   10 %  ┘
```

Fixed bar display range in connection with wow & flutter to AM:

```
x = 0: Return to bar display autoranging   :::
x = 1:   1 % or 0.1 dB  ┐
x = 2:   3 % or 0.3 dB  │
x = 3:  10 % or   1 dB  ├─ Fix bar display range.
x = 4:  30 % or   3 dB  │
x = 5: 100 % or  10 dB  │
x = 6: 100 % or  30 dB  ┘
```

::: = Basic setting

Fixed bar display range in connection with DISTORTION:

```
x = 0: Return to bar display autoranging   :::
x = 1:  0.01 %  ┐
x = 2:  0.03 %  │
x = 3:   0.1 %  │
x = 4:   0.3 %  │
x = 5:     1 %  ├ Fix bar display range.
x = 6:     3 %  │
x = 7:    10 %  │
x = 8:    30 %  │
x = 9:   100 %  ┘
```

Example with the Controller PCA5:

```
                                                        | Comment
10  IECTIME 10000                                       |
          .                                             |
          .                                             |
          .                                             |
100 IECOUT10,"TRIGGER (MODE (LEV/FREQ/FNCT))"           |
110 IECOUT10,"STRING (ALL ALPHANUM)"                    |
120 IECOUT10,"WOWFLUTTER (DIN WTD OFFSIGMA)"            |
130 IECOUT10,"MEASUREMENT (FUNCTION PC)"                | Output wow &
                                                        | flutter value in %
140 IECOUT10,"DISPLAY (FUNCTION BARGRAPH (6))"          | Fixed 3 % bar dis-
                                                        | play range
150 IECOUT10,"TRIGGER (SINGLE)"                         |
160 IECIN10, A$: PRINT A$                               |
          .                                             |
          .                                             |
          .                                             |
```

With this example, the wow & flutter measurement to DIN can be observed on the FUNCTION/DATA display using the bar display with range limit data. At the same time, the measured level, frequency and function values (wow & flutter to DIN) are output on the screen of the PCA5.

::: = Basic setting

SIGMABACKGROUND does not yet trigger the 2-sigma background measurement. For this purpose, the trigger command WOWFLUTTER (STARTSIGMABACKGROUND) is required.

OFFSIGMA: Switching off ONSIGMA or SIGMABACKGROUND.
The extensions ONSIGMA, SIGMABACKGROUND and OFFSIGMA can be indicated optionally. If the indication is missing, the previously valid setting is retained.

STARTSIGMABACKGROUND:
The trigger command for the 2-sigma background measurement is only meaningful if this measurement has been switched on before by means or SIGMABACKGROUND, otherwise the output of SRQ 97 as well as ER 07 points out an illegal command. When the result of the 2-sigma background measurement is available, SRQ 89 is triggered (see 2.4.17 SQR processing for 2-sigma background measurement with detailed program example).

Note:
Setting a wow & flutter measurement simultaneously switches off other function measurements and instrument settings.

- Distortion measurement is automatically switched off.
- Noise measurement (S/N or SINAD) is automatically switched off.
- RMS detector is switched on.
- SOUND and TELEPHON filter are switched off.

Due to the obligatory setting of the additional functions required for the wow & flutter measurement, handling is made easier for the user and the instrument setting produces valid wow & flutter values from the very start.

Example with the Controller PCA5:

```
10 IECTIME 10000: REM IEC-BUS MONITORING TIME 10 S.
          .
          .
100 IECOUT10,"TRIGGER (MODE(FNCT))"
110 IECOUT10,"WOWFLUTTER (DIN WTD ONSIGMA)"
120 IECOUT10,"TRIGGER(SINGLE)"
130 IECIN10, A$
140 PRINT A$
          .
          .
```

2.4.8.4.1 Recall of Measurement Result of 2-sigma Background Measurement

RECALL (SIGMABACKGROUND)

The measurement result is output on the FUNCTION/DATA display. The output value is transferred to the controller by means of an IECIN command.
Example with PCA5:
IECOUT10,"RECALL (SIGMABACKGROUND)"
IECIN10,A$: PRINT A$

If the 2-sigma measurement result is not yet available when recalled, dashes are faded in on the FUNCTION/DATA display and the value is marked as illegal (88888.E+8).

2.4.8.5 Setting the Distortion Factor Measurement

```
DISTORTION (OFF)                    :::
DISTORTION (TOTAL     )
           K(n)
           K THDALL  (n1-n2)
           K THDEVEN (n1-n2)
           K THDODD  (n1-n2)

DISTORTION (TOTAL ONERROR )
           TOTAL OFERROR

DISTORTION (TOTAL ENABLE/LOWRANGE
           TOTAL DISABLE/lowrange
           K (n) ONERROR            MODE (0 or AUTO)   )
                 OFERROR                 (1 or SOURCE))
                 ENABLE/LOWRANGE         (2 or FREQ)) data*
                 DISABLE/LOWRANGE        (3 or HOLD))

DISTORTION  K THDALL   (n1-n2)      MODE (0 or AUTO)
            K THDEVEN  (n1-n2)             .
            K THDODD   (n1-n2)             .
                                           .
```

n,n1,n2 may assume values from 2 to 9.

* Note that max. 50 characters including the delimiter are permitted!

TOTAL:

Total distortion measurement - wideband noise is incorporated into the distortion factor measurement (see 2.3.3.2).

K (n):

Distortion factor measurements consider the second to the ninth harmonic (see 2.3.3.2).

::: = Basic setting

K THDALL (n1-n2)

Measurement of all harmonics with the ordinal numbers n1...n2

K THDEVEN (n1-n2)

Measurement of all even harmonics in the range n1...n2

K THDODD ((n1-n2)

Measurement of all odd harmonics in the range n1...n2

The following notations are also possible for (n1-n2):
(n1n2), (n1.n2), (n1:n2), (n2;n2) and (n1/n2).

The indication of two identical limit values or a single value refers to a measurement with a **single** harmonic and is permitted if the values entered for the "K THDEVEN" measurement are even limit values or if the values entered for the "K THDODD" measurement are odd limit values. Otherwise, the error message Er 6 with SRQ 98 is output.

Example:
Correct: DIST (K THDEVEN (4-4)) or DIST (K THDEVEN (4))
Incorrect: DIST (K THDODD (6-6)) or DIST (K THDODD (6))

Omission of the term in parentheses indicates that all possible harmonics of the selected THD measurement are considered.

Example:

DIST (K THDALL) is equivalent to DIST (K THDEVEN (2-9)) and refers to the measurement of all harmonics d2, d3, d4, d5, d6, d7, d8, d9.

DIST (K THDEVEN) is equivalent to DIST (K THDEVEN (2-8)) and refers to the measurement of all even harmonics d2, d4, d6, d8.

DIST (K THDODD) is equivalent to DIST (K THDODD (3-9)) and refers to the measurement of all odd harmonics d3, d5, d7, d9.

The THD measurements do **not** incorporate wideband noise in the measurement (see 2.3.3.2.4).

If the limit values constitute a **range** of harmonics (n1 <> n2), it is **not** necessary to distinguish between even and odd limit values according to the selected THD measurement EVEN or ODD. The THD measurement is automatically performed with the possible harmonics.

MODE (0 or AUTO):

The result of the current frequency measurement is used as setting frequency for the distortion factor measurement. The specification MODE (...) may be completely omitted with this setting.

MODE (1 or SOURCE):

The generator frequency is used as setting frequency for the distortion factor measurement.

MODE (2 or FREQ):

The value in Hz which is added to the DISTORTION command as data is used as setting frequency for the distortion factor measurement.

Example: DISTORTION (TOTAL MODE (FREQ)) 1000
leads to the presetting frequency 1000 Hz.

MODE (3 or HOLD):

The measured frequency available with the valid distortion setting is used as setting frequency for the distortion factor measurement. This frequency value remains stored until the distortion setting is changed by selecting another MODE.

Setting the distortion factor without the distortion meter option UPA-B8 being fitted causes the message **no OP** to be briefly output on the FUNCTION/DATA display and leads to SRQ 104.

ONERROR: **OFFERROR:**	:::	Enable or disable the error message Er 11 or SRQ 112.
ENABLE/LOWRANGE: **DISABLE/LOWRANGE:**	:::	Enable or disable the lowest distortion measuring range for increasing the measuring speed (see 2.3.3.2.8 Increasing the Distortion Measuring Speed).

::: = Basic setting

Measuring distortion factors >71 % or SINAD values <3 dB:

If the harmonic content or noise component of a test signal becomes greater than the fundamental (distortion >71 %), the distortion meter will be automatically tuned to the fundamental (IEC-bus commands DIST(... MODE (1) ...) or NOISE(SINAD MODE (1)). In order to prevent this, use IEC-bus commands DIST (... MODE (1 to 3)) or NOISE(SINAD MODE (1 to 3)) to preset the distortion meter to the desired fundamental of the test signal and (... OFFERROR ...) to suppress the error message Er 11 or SRQ 112 (distortion meter cannot be tuned). This instrument setting permits to measure and display distortion factors >71 % or SINAD values <3 dB.

The extension ONERROR / OFFERROR can be indicated as an alternative. If it is not indicated, the previously valid setting is retained. After switching on the UPA, the error message Er 11 is enabled which corresponds to the extension ONERROR.

If the frequency of the fundamental deviates by more than 3 % from the presetting frequency or if distortion factors >71 % or SINAD values <3 dB are measured, the error message Er 11 or SRQ 112 is produced, the ASCII string "ERROR 11" being output instead of a numerical measurement result.

With the commands DIST(...) and NOISE(SINAD...), the extensions ONERROR/OFFERROR or MODE(...) produce a common function setting.

Setting the distortion factor measurement simultaneously influences other function measurements and instrument settings:

- Wow & flutter measurement and 2-sigma measurement are switched off.
- Noise measurements (S/N or SINAD) are switched off.
- RMS detector is switched on.
- SOUND and TELEPHON filters are switched off.

Example with the Controller PCA5:

```
10  IECTIME 10000: REM IEC-BUS MONITORING TIME 10 S.
        .
        .
        .
100 IECOUT10,"TRIGGER (MODE(LEV/FREQ/FNCT))"
110 IECOUT10,"DISTORTION (TOTAL)"
120 IECOUT10,"STRING (SINGLE ALPHANUM)"
130 IECOUT10,"TRIGGER (SINGLE)"
140 IECIN10, A$:  REM READ IN LEVEL VALUE
150 PRINT A$:     REM READ OUT LEVEL VALUE WITH ALPHAHEADER
160 IECIN10,B$:   REM READ IN FREQUENCY VALUE
170 PRINT B$:     REM READ OUT FREQUENCY VALUE WITH ALPHAHEADER
180 IECIN10,C$:   REM READ IN DISTORTION MEASUREMENT RESULT
190 PRINT C$:     REM READ OUT DISTORTION MEASUREMENT RESULT WITH
                  ALPHAHEADER
        .
        .
        .
```

2.4.8.6 Setting the Noise Measurement

NOISE (OFF) ::: NOISE (SINAD) NOISE (SINAD ONERROR) OFFERROR ENABLE/LOWRANGE DISABLE/LOWRANGE	Switch off S/N or SINAD measurement. Switch on SINAD measurement (2.3.3.3). The result of the current frequency measurement is used as reference frequency, if MODE is not indicated.
NOISE (SINAD ONERROR MODE (0 or AUTO)) OFFERROR (1 or SOUFRE)) ENABLE/LOWRANGE (2 or FREQ)) data * DISABLE/LOWRANGE (3 or HOLD)	MODE (...) see 2.4.8.6.1
NOISE (S/N)	Switch on S/N measurement (see 2.3.3.3 and 2.4.8.6.2)

* Note that max. 50 characters including the delimiter are permitted!

::: = Basic setting

2.4.8.6.1 SINAD Measurement

MODE (0 or AUTO):
The result of the current frequency measurement is used as setting frequency for the SINAD measurement.

Note: The specification MODE (...) may be completely omitted with this setting.

MODE (1 or SOURCE):
The generator frequency is used as setting frequency for the SINAD measurement.

MODE (2 or FREQ):
The value in Hz which is added to the NOISE command as data is used as setting frequency for the SINAD measurement.

Example: NOISE (SINAD MODE (FREQ)) 2000
leads to the presetting frequency 2000 Hz.

MODE (3 or HOLD):
The measured frequency value available with the valid SINAD setting is used as setting frequency for the SINAD measurement. This frequency value remains stored until the SINAD setting is changed by selecting another MODE.

Setting the SINAD measurement without the distortion meter UPA-B8 being fitted causes the message **no OP** to be briefly output on the display and leads to SRQ 104.

Setting the SINAD measurement simultaneously influences other function measurements and instrument settings:

- Wow & flutter measurement and 2-sigma measurement are switched off.
- Distortion measurement is switched off.
- RMS detector is switched on.
- SOUND filter is switched off, TELEPHON filter remains switched on.

Example with the Controller PCA5:

```
10  IECTIME 10000: REM IEC-BUS MONITORING TIME = 10 S.
          .
          .
          .
100 IECOUT10,"STRING (SINGLE_ALPHANUM)"
110 IECOUT10,"TRIGGER (MODE (FNCT))"
120 IECOUT10,"NOISE (SINAD)"
130 IECLAD10
140 IECGET
150 IECIN10, A$: ?A$
          .
          .
          .
```

ONERROR / OFFERROR: Enable or disable the error message Er 11 or SRQ 112 (see 2.4.8.5).

ENABLE/LOWRANGE, DISABLE/LOWRANGE Enable or disable the lowest distortion measuring range for increasing the measuring speed (see 2.3.3.2.6 Increasing the Distortion Measuring Speed).

Measurement of SINAD values <3 dB see 2.4.8.5

2.4.8.6.2 S/N Measurement

Setting the S/N measurement without the generator option UPA-B6 being fitted causes the message **no OP** to be briefly output on the FUNCTION/DATA display and leads to SRQ 104.

Setting the S/N measurement simultaneously influences other function measurements:

- Wow & flutter measurement and 2-sigma measurement are switched off.
- Distortion measurement is switched off.

With the S/N measurement, the lower cutoff frequency is 30 Hz. The 22-Hz highpass filter (see section 2.3.1.4.2) is automatically connected into the measuring circuit, unless one of the filters HP 300 Hz, SOUND or TELEPHON was previously selected.

Example with the Controller PCA5:

```
10  IECTIME 10000: REM IEC-BUS MONITORING TIME 10 S.
          .
          .
          .
100 IECOUT10,"STR (S N)"
110 IECOUT10,"TRIG (M(3))"
120 IECOUT10,"NOI(S/N)"
130 IECOUT10,"TRIG(SI)"
140 IECIN10,B$
150 PRINT "S/N RATIO = ";B$;"DB"
          .
          .
          .
```

2.4.8.7 Storage and Recall of Reference Values

STORE (REFERENCE DISTORTIONLEVEL) data

Basic setting:
STORE (REFERENCE DISTORTIONLEVEL)1
Transfer of a new distortion level reference in V (see also SPEC FCT 37.2) for the reference-based distortion level measurement within the limits of 1E-6V to 300 V with the output units Δ% or ΔdB.

Storage of the distortion level reference using the TRIGGER (STORE) command is described in Section 2.4.14.2!

RECALL (REFERENCE DISTORTIONLEVEL)

Recall of the current distortion level reference in V with output on the FUNCTION/DATA display.
Example with Controller PCA5:
IECOUT10,"RECALL (REF DIST)"
IECIN10,A$: PRINT A$

2.4.8.8 Phase Measurement

PHASE (ON)		Switch phase measurement on or off
PHASE (OFF)	:::	Information on phase measurement (see 2.3.1.8).

::: = basic setting

2.4.9 Generator Commands

2.4.9.1 Setting the Generator Output Channels

OUTPUT (RIGHT OFF)		The activated output of the right-hand generator channel (connector 38 or 39) is connected to 0 V. The output remains connected to channel R.
OUTPUT (RIGHT BAL) OUTPUT (RIGHT A/B)		The generator output is connected to the right-hand channel (39) of the unbalanced output.
OUTPUT (RIGHT UNBAL) OUTPUT (RIGHT C)	:::	The generator output is connected to the right-hand channel (38) of the unbalanced output.
OUTPUT (LEFT OFF)		The activated output of the left-hand generator channel (connector 38 or 39) is connected to 0 V. The output remains connected to channel L.
OUTPUT (LEFT BAL) OUTPUT (LEFT A/B)		The generator output is connected to the left-hand channel (39) of the balanced output.
OUTPUT (LEFT UNBAL) OUTPUT (LEFT C)		The generator output is connected to the left-hand channel (38) of the unbalanced output.

2.4.9.2 Setting the Generator Level and Generator Frequency

SOURCE (LEVEL VOLT) data DBV DBM	Transfer new generator level in V, dBV or dBm(Z). SRQ 104 is set if the generator option is not present.

Basic setting: SOURCE (LEVEL VOLT) 0.001

The settling time of the generator is already considered in the UPA program by corresponding HOLD times and need **not** be programmed on the controller.

SOURCE (FREQUENCY) data	Transfer new generator frequency (always in Hz). SRQ 104 is set if the generator option is not present.

Basic setting: SOURCE (FREQUENCY) 1000

::: = Basic setting

The IEC-bus command SOURCE (FREQUENCY) data

involves a settling time of 50 ms which results in a generator frequency with a frequency tolerance of max. ±0.5 %. If a higher accuracy is desired, longer settling times must be taken into account by adding program waiting times after this command. An additional program waiting time of 50 ms results in a frequency tolerance of only ±0.1 %.

2.4.9.3 Setting the Range Limitation of the Generator

SOURCE (LEVEL ONLIMIT)		Switch on limitation of generator level
OFFLIMIT	:::	Switch off limitation of generator level
SOURCE (FREQUENCY ONLIMIT)		Switch on limitation of generator frequency.
OFFLIMIT	:::	Switch off limitation of generator frequency.

Input of limit values see SWEEP (LEVEL START ...) data
STOP
FREQUENCY START) data
STOP

If limitation by means of the sweep parameters is active during IEC-bus operation, it is **not** possible to increase or decrease the level or the frequency in steps beyond the specified limits using the commands

INCREMENT (LEVEL UP), INCREMENT (LEVEL DOWN), INCREMENT (FREQUENY UP) or INCREMENT (FREQUENCY DOWN). The generator remains set to the value selected by the last possible increment step. This value is **not** necessarily identical to the specified limit value and depends upon the start value and increment value of the selected sweep.

With SRQ enabled, SRQ 88 is output upon reaching a limit.

Program example with PCA5, see page 2.4.17.

When switching over from LOCAL to REMOTE operation and vice versa, the defined limitation of the generator range (limitation on/limitation off) remains valid.

Make sure when writing programs that a selected limitation of the generator range is not accidentally cancelled by changing the sweep parameters.

::: = Basic setting

2.4.9.4 Setting and Triggering the Generator Increment

INCREMENT (LEVEL AUTO)		Switch on auto increment for level variation (SPEC FCT 20.0) with step sizes as described in 2.3.2.3.2.
INCREMENT (LEVEL LOG) data		Input of multiplication factor for logarithmic level variation as described in 2.3.2.3.4.
INCREMENT (LEVEL VOLT) data INCREMENT (LEVEL DBV) data INCREMENT (LEVEL DBM) data		Input of level increment in selectable steps as described in 2.3.2.3.3.
INCREMENT (LEVEL UP) INCREMENT (LEVEL DOWN)		Increase (UP) or decrease (DOWN) the level by one step.
INCREMENT (FREQUENCY AUTO)	:::	Switch on auto increment for frequency variation (SPEC FCT 21.0) with step sizes as described in 2.3.2.2.2.
INCREMENT (FREQUENCY LOG) data		Input of multiplication factor for logarithmic frequency variation as described in 2.3.2.2.4.
INCREMENT (FREQUENCY) data		Input of linear frequency increment in selectable steps as described in 2.3.2.2.3.
INCREMENT (FREQUENCY OCTAV1) INCREMENT (FREQUENCY OCTAV2) INCREMENT (FREQUENCY TERZ1) INCREMENT (FREQUENCY TERZ2)		Selection of an octave or third-octave sequence (SPEC FCT 21.2 to 21.5) as described in 2.3.2.2.5.
INCREMENT (FREQUENCY UP) INCREMENT (FREQUENCY DOWN)		Increase (UP) or decrease (DOWN) frequency by one step.

INCREMENT (STEPRANDOM LEVEL)
FREQUENCY)
BOTH)

Level/frequency selection of RANDOM sequence see 2.3.2.3.5
LEVEL: change level values only
FREQUENCY: change frequency values only
BOTH: simultaneous change in level and frequency values

::: = Basic setting

INCREMENT (STEPRANDOM OFFSET VOLT) data
DB

The level offset value of the RANDOM level values is entered in V or dB for the RANDOM level sequence. See 2.3.2.3.5.

INCREMENT (STEPRANDOM ENDPOSITION y))
Entry of final item for RANDOM sweep or spin wheel limitation with y = 2 to 99. See 2.3.2.3.5.

INCREMENT (STEPRANDOM (x) LEVEL VOLT) data
DBV) data
DBM) data

Entry of random level value in V, dBV or dBM as item x of the RANDOM sequence (x = 1 to 99). See 2.3.2.3.5.

INCREMENT (STEPRANDOM (x) FREQUENCY) data
Entry of random frequency value always in Hz as item x of the RANDOM sequence (x = 1 to 99). See 2.3.2.3.5.

INCREMENT (STEPRANDOM UP)
DOWN)
A single RANDOM step can be triggered using the RANDOM item no.
Item no. = item no. + 1 (UP) or
item no. = item no. - 1 (DOWN)
(Corresponds to spin wheel rotation in LOCAL mode.)

See detailed program example under 2.4.10.2

These UP/DOWN commands automatically involve a settling time of 50 ms which results in a generator frequency with a tolerance of max. ±0.5 %.

If a higher accuracy is desired, longer settling times must be taken into account by adding program waiting times after these commands. An additional program waiting time of 50 ms results in a frequency tolerance of only ±0.1 %.

INCREMENT commands are **not** permitted during an active sweep. If an INCREMENT command is nevertheless entered, it will be ignored and the error message Er 07 as well as SRQ 97 will be output.

If the frequency is to be varied during a running level sweep, this is possible by output of the SOURCE (FREQUENCY ...) command.

If the level is to be varied during a running frequency sweep, this is possible by output of the SOURCE (LEVEL ...) command (see program example in section 2.4.10).

2.4.9.5 Generator Sweep

SWEEP (.....)

The sweep commands are part of the generator commands. They are summed up in section 2.4.10 in a special group of commands.

2.4.9.6 Storage and Recall of Generator Impedance Value

Since the impedance is identical for measurement section and generator, the command description for the measurement section should be referred to: see Section 2.4.7.8.

STORE (IMPEDANCE)

RECALL (IMPEDANCE)

2.4.9.7 Recall of Generator Setting Values

RECALL (SOURCE LEVEL)

Recall current generator level in current unit with brief output on the LEVEL display. SRQ 104 is set if the generator option is not present. The output value is transferred to the controller by an IECIN command.

Example:

```
IECOUT10,"REC(SOU LEV)"
IECIN10, A$
PRINT A$
```

RECALL (SOURCE FREQUENCY)

Recall current generator frequency (always in Hz) with brief output on the FREQUENCY display. SRQ 104 is set if the generator option is not present. The output value is transferred to the controller by an IECIN command.

Example:

```
IECOUT10, "REC (SOU FRE)"
IECIN10, A$
PRINT A$
```

```
RECALL (STEPRANDOM (x) LEVEL )
       STEPRANDOM (x) FREQUENCY )
```

Recall of RANDOM level value or RANDOM frequency value to RANDOM item no. x (x = 1 to 99)
The alphaheader of the value received indicates the unit of the value stored.

Program example with PCA5:

```
          :
100 FOR I=1 TO 10
110 IEC OUT 10,"RECALL (STEPRANDOM("+STR$(I)+")LEVEL)"
120 IEC IN 10,RL$
130 IEC OUT 10,"RECALL (STEPRANDOM("+STR$(I)+")FREQUENCY)"
140 IEC IN 10,RF$
150 PRINT "POS ";I;" :";RF$;" Hz   ";RL$;" dBV"
160 NEXT I
          :
```

```
RECALL (STEPRANDOM ENDPOSITION)
```

Recall of final item no. for a RANDOM sweep.

Program example with PCA5:

```
          :
100 IEC OUT 10,"STRING (ALL NUM)"
110 IEC OUT 10,"RECALL (STEPRANDOM ENDPOSITION)"
120 IEC IN 10,A$:PRINT "Final item of RANDOM sweep = ";A$
          :
```

```
RECALL (STEPRANDOM OFFSET)
```

Recall of level offset value of RANDOM level values.
The alphaheader of the value received indicates the unit of the value stored.

Program example with PCA5:

```
          :
100 IEC OUT 10,"STRING (ALL ALPHA)"
110 IEC OUT 10,"RECALL (STEPRANDOM OFFSET)"
120 IEC IN 10;A$: B$=LEFT$(RIGHT$(A$,16),2)
130 PRINT "RANDOM level offset = ";RIGHT$(A$,10);" ";B$
```

2.4.10 Sweep Commands

2.4.10.1 Setting the Sweep Parameters

SWEEP (LEVEL START VOLT) data
STOP DBV
DBM

Transfers the start/stop parameters for the level sweep or the values for limitation of the generator level.

Basic setting:
SWEEP (LEVEL START VOLT) 0.001
SWEEP (LEVEL STOP VOLT) 1

SWEEP (FREQUENCY START) data
STOP

Transfers the start/stop parameters for the frequency sweep or the values for limitation of the generator frequency in Hz.

Basic setting:
SWEEP (FREQUENCY START) 1000
SWEEP (FREQUENCY STOP) 10000

SWEEP (TIME) data

Transfers the sweep time in seconds.
Sweep time 0 seconds:
frequency tolerance ±0.5 %
Sweep time 0.05 seconds:
frequency tolerance ±0.1 %

Basic setting:
SWEEP (TIME) 0.15

SWEEP (INCREMENT LEVEL AUTO) :::
LOG) data
VOLT) data
DBV) data
DBM) data

Transfers increment values forlevel sweep as with INCREMENTcommand. The sweep increment parameters are identical withthe increment parameters (see section 2.4.9.4).

SWEEP (INCREMENT FREQUENCY AUTO) :::
LOG) data
OCTAV1
OCTAV2
TERZ1
TERZ2
FREQUENCY) data

Transfers increment values for frequency sweep as with INCREMENT command. The sweep increment parameters are identical with the increment parameters (see section 2.4.9.3).

SWEEP (INCREMENT STEPRANDOM (x) LEVEL VOLT) data
DBV) data
DBM) data
STEPRANDOM (x) FREQUENCY) data
STEPRANDOM ENDPOSITION (y))
STEPRANDOM LEVEL)
FREQUENCY)
BOTH)
STEPRANDOM OFFSET VOLT) data
DB

x = 1 to 99
y = 2 to 99

Transfer of RANDOM sweep parameters (identical with INCREMENT (STEPRANDOM .....) command (see 2.4.9.4)

::: = Basic setting

2.4.10.2 Sweep Enable

SWEEP (LEVEL ENABLE)
FREQUENCY ENABLE

Enables the corresponding sweep. The level and the frequency cannot be enabled at the same time.

SWEEP (STEPRANDOM LEVEL ENABLE)
FREQUENCY ENABLE
BOTH ENABLE

Enabling the RANDOM sweep:

FREQUENCY: RANDOM sweep with setting of random frequency values
LEVEL: RANDOM sweep with setting of random level values
BOTH: RANDOM sweep with simultaneous setting of random level and frequency values:

When the sweep is enabled via the IEC bus, the sweep mode is always switched over to single sweep. Automatic sweep repetition via the IEC bus is not possible in a direct manner but can be initiated by means of a program loop.

The SWEEP (...ENABLE) command must be output prior to each new SWEEP.

With the sweep enabled using the command

SWEEP (LEVEL ENABLE) or SWEEP (FREQUENCY ENABLE)

a sweep step or a complete sweep is triggered using the following TRIGGER commands:

TRIGGER (SINGLE)
TRIGGER (STORE)
LADxx:GET

A single sweep step is triggered and synchronized with the internal measurement.

TRIGGER (INPUT)

A single sweep step is triggered by reading in a measured value (e.g. IECIN 10, A$) and synchronized with the internal measurement.

TRIGGER (AUTO)

A **complete sweep** inside the current sweep limits is triggered and synchronized with the internal measurement. This sweep corresponds to the freely running sweep in local mode.

In connection with a sweep, the DC outputs are to be used as usual (see 2.3.7).

Program example with PCA5 (NORMAL sweep):

```
10 PRINT "PERFORMING A SIMPLE FREQUENCY SWEEP FROM 2 KHZ"
20 PRINT "TO 10 KHZ IN STEPS OF 1 KHZ AT A GENERATOR
   VOLTAGE OF 3 V"
30 PRINT : IEC TIME 10000: IEC OUT 10,"CLR, SOURCE (LEVEL VOLT)3"
40 PRINT : IEC OUT 10, "SWEEP (FREQ START) 2000, SWEEP (FREQ
   STOP)10000, SWEEP (INCR FREQ)1000"
50 IEC OUT 10,"RATE(FREQ FAST),RATE (LEVEL FAST)"
60 IEC OUT 10,"SWEEP(FREQ ENABLE)"
70 FOR I=1 TO 9: IEC OUT 10,"TRIGGER (SINGLE)"
80 IEC IN 10, A$: PRINT A$: NEXT I: END
```

Program example with PCA5 (RANDOM sweep):

```
10 IEC TIME 10000: ON SRQ1 GOSUB 240: IEC OUT 10,"CLR,SRQ(EN)"
20 PRINT "--------  Brief program description  ------------": PRINT
30 PRINT "- Load inverse nominal curve of A-filter as freely programmable"
40 PRINT "  level-frequency sequence (RANDOM sequence)!"
50 PRINT "- Sweep with simultaneous change in level and frequency values"
60 PRINT "  via the A-filter of the special filter card UPA-B2"
70 PRINT "- Output of measured values of differential curve!": PRINT
80 REM ********** Load level values for the random sequence **********
90 DATA 16.7,-5.4,-17.5,-27.9,-35.2,-39.2,-41.1,-41.0,-39.9,-30.7
100 FOR I=1 TO 10: READ A: A$=STR$(A)
110 IEC OUT 10,"INC(STEPRANDOM("+STR$(I)+")L DBV)"+A$: NEXT I
120 REM ********** Load frequency values for the random sequence *********
130 DATA 16,40,80,180,400,800,1800,4000,8000,20000
140 FOR I=1 TO 10: READ A: A$=STR$(A)
150 IEC OUT 10,"INC(STEPRANDOM("+STR$(I)+")F)"+A$: NEXT I
160 IEC OUT 10,"FILTER(SPEC(1))": REM Switch on internal A-filter
170 IEC OUT 10,"TRIGGER(MODE(LEV))": REM Output level measurement results only
180 IEC OUT 10,"STORE(REFERENCE LEVEL DBV) -40": REM Load reference value
190 IEC OUT 10,"INC(STEPRAND ENDPOS(10)),INC(STEPRAND OFFS DB)0,MEAS(LEV DDB)"
200 IEC OUT 10,"SWEEP(STEPRAND BOTH EN),TRIGGER(SINGLE)": REM Enable sweep
210 PRINT "Measured values:": PRINT
220 IF V%=87 THEN END  ELSE GOTO 220: REM Wait for SRQ in endless loop
230 REM ************************ SRQ *******************************
240 IEC SPL 10,V%
250 IF V%<>80 AND V%<>87 THEN PRINT "SRQ error code = ";V%: STOP
260 IEC IN 10,A$: PRINT A$,: REM Fetch and output level measurement result
270 IEC OUT 10,"RECALL(SOURCE FREQU)": REM Recall generator frequency
280 IEC IN 10,B$: PRINT B$: REM Fetch and output generator frequency
290 IF V%=80 THEN IEC OUT 10,"TRIGGER(SINGLE)": GOTO 310: REM Trigger again
300 IF V%=87 THEN PRINT : PRINT "Sweep completed!"
310 ON SRQ1 GOSUB 240: RETURN
```

2.4.10.3 Sweep Halt or Continue

SWEEP (HALT)	A sweep is halted. The last generator setting remains valid.
SWEEP (CONTINUE)	A sweep is continued where interrupted by SWEEP (HALT). When finished, it is restarted.

A change in the sweep parameters using the IEC-bus commands SWEEP (LEVEL ...) SWEEP (FREQ ...), SWEEP (TIME ...), SWEEP (INCREMENT ...) always causes a running sweep to be reset.

Triggering the next sweep step by a TRIGGER command or the command SWEEP (CONTINUE) in conjunction with TRIGGER (AUTO) causes the sweep to be restarted.

Program example with PCA5:

```
10 PRINT "DEMONSTRATION OF SWEEP HALT AND SWEEP"
20 PRINT "CONTINUE FOR A LEVEL SWEEP FROM 1 V TO 5 V."
30 PRINT : IEC TIME 10000: IEC OUT 10,"CLR,TRIGGER(AUTO)"
40 IEC OUT 10,"SWEEP(LEV START V)1, SWEEP(LEV STOP V)5,
   SWEEP(INC LEV LOG)1.05, SWEEP(LEV ENABLE)"
50 PRINT "SWEEP HALT (H), CONTINUE (C) OR NEW START
   (N)?:";
60 INKEY BR$
70 IF BR$="H" THEN IEC OUT 10,"SWEEP (HALT)": GOTO 100
80 IF BR$="C" THEN IEC OUT 10,"SWEEP (CONT)": GOTO 100
90 IF BR$="N" THEN IEC OUT 10,"SWEEP (LEV ENABLE)": GOTO 100 ELSE
   GOTO 60
100 PRINT BR$: GOTO 50
```

2.4.10.4 Sweep Commands in Combination with Other Setting Commands

During a sweep via the IEC bus, the instrument setting can be changed by means of setting commands (exception: INCREMENT commands).

A programmed INCREMENT command is ignored and the error message Er 07 as well as SRQ 97 output.

The level can be varied during a running frequency sweep by output of the SOURCE (LEVEL ...) command.

Analogously, this also applies to level sweep with frequency variation.

Program example with PCA5:

```
10 PRINT "FREQUENCY SWEEP FROM 10 KHZ TO 50 KHZ IN STEPS OF
   2 KHZ"
20 PRINT "WITH THE GENERATOR LEVEL INCREASING BY 0.5 V FROM 1 V
   WITH EACH 10 KHZ INCREASE IN FREQUENCY"
30 PRINT : IEC TIME 10000: ON SRQ1 GOSUB 100: VW=1
40 IEC OUT 10,"CLR,SRQ(ENABLE),SOURCE(LEVEL VOLT)"+STR$(VW)
50 IEC OUT 10,"SW(FR STA)10000,SW(FR STO)50000,SW(INC FR)2000"
60 IEC OUT 10,"TRIGGER(INPUT),RATE(L F),RATE(F F),
   SWEEP(FREQ ENABLE)"
70 FOR I=1 TO 5
80 IEC IN 10,A$: PRINT A$: NEXT
90 PRINT: VW=VW+0.5: IEC OUT 10,"SOURCE(LEVEL VOLT)"+STR$(VW):
   GOTO 70
100 IEC SPL 10,V%: REM *** SRQ INTERRUPT ROUTINE ***
110 IF V%=87 THEN STOP
120 ON SRQ1 GOSUB 100: RETURN : REM *** END OF SRQ INTERRUPT
    ROUTINE ***
```

2.4.11 Commands for AC Output and DC Outputs

```
DCSCAL (OUT        (0 to 1 to 6))
       (LEV/PC     (0 to 1 to 2))
       (FREQ/PC    (0 to 1 to 2))
       (FNCT/PC    (0 to 3 to 4))
       (LEV/DB     (0 to 2 to 3))
       (FNCT/DB    (0 to 2 to 3))
       (LEV/VW     (0 to 2 to 6))
       (FREQ/HZ    (0 to 5 to 7))
       (FREQ/DHZ   (0 to 7 to 9))
       (FNCT/PC    (0 to 3 to 4))
       (FNCT/VDEG  (0 to 3 to 7))
                    |          |
                    |__________|__ Basic setting
```

IEC-bus command for setting the scale of the DC outputs for connection of an XY recorder or another recording instrument. Function description, see 2.3.7.

OUT (0 to 6)

See SPEC FCT 40, the numbers 0 to 6 corresponding to 40.0 to 40.6.

LEV/PC (0 to 2)

See SPEC FCT 41, the numbers 0 to 2 corresponding to 41.0 to 41.2.

FREQ/PC (0 to 2)

See SPEC FCT 42, the numbers 0 to 2 corresponding to 42.0 to 42.2.

FNCT/PC (0 to 4)

See SPEC FCT 43, the numbers 0 to 4 corresponding to 43.0 to 43.4.

LEV/DB (0 to 3)

See SPEC FCT 44, the numbers 0 to 3 corresponding to 44.0 to 44.3.

FNCT/DB (0 to 3)

See SPEC FCT 45, the numbers 0 to 3 corresponding to 45.0 to 45.3.

LEV/VW (0 to 6)

See SPEC FCT 46, the numbers 0 to 6 corresponding to 46.0 to 46.6. Measured DC voltage values are represented as positive magnitudes.

FREQ/HZ (0 to 7)

See SPEC FCT 47, the numbers 0 to 7 corresponding to 47.0 to 47.7.

FREQ/DHZ (0 to 9)

See SPEC FCT 48, the numbers 0 to 9 corresponding to 48.0 to 48.9.

FNCT/VDEG(0 to 7)

See SPEC FCT 49, the meaning of the numbers 0 to 7 corresponding to 49.0 to 49.7.

Depending on the display assignment, the DC outputs can be addressed by the test signal in the case of MEAS and by the generator output signal in the case of SOURCE.

Output of the test signals at the DC outputs:

The test signals are applied to the DC outputs whenever the IEC-bus command TRIGGER (MODE(...)) has been used to select a combination of level, frequency or function output two of which are assigned to the DC output by the IEC-bus command.

Example with the Controller PCA5:

```
IECOUT10,"TRIGGER(MODE(LEV/FNCT)),DCSCAL(OUT(2))"
```

Combined output of MEAS and SOURCE values to the DC outputs:

The generator output signals are applied to the DC outputs whenever the IEC-bus commands

SOURCE (LEVEL ...) or
SOURCE (FREQUENCY ...) or
RECALL (SOURCE LEVEL) or
RECALL (SOURCE FREQUENCY)

have been used to set the generator or recall the generator setting.

Note that the IEC-bus command TRIGGER (MODE(...)) must not allow level triggering if the generator level is to be output to a DC output or frequency triggering if the generator frequency is to be output to a DC output. Otherwise, the measured level and the generator level, e.g., or the measured frequency and the generator frequency will be output in alternating sequence via the very same DC output.

Output of a SOURCE value at the DC output DC1, e.g., and of a MEAS value at the DC output DC2 is possible.

Example with the Controller PCA5:

Incorrect:

```
100 IECOUT10,"TRIGGER (MODE (LEV/FREQ))"
110 IECOUT10,"SOURCE (LEVEL VOLT)1"
120 IECOUT10,"TRIGGER (SINGLE)":IECIN10,A$
130 IECOUT10,"RECALL (SOURCE LEVEL)":IECIN10,B$
140 PRINT B$,A$
```

Correct:

```
100 IECOUT10,"TRIGGER (MODE (FREQ))"
110 IECOUT10,"SOURCE (LEVEL VOLT)1"
120 IECOUT10,"TRIGGER (SINGLE)":IECIN10,A$
130 IECOUT10,"RECALL (SOURCE LEVEL)":IECIN10,B$
140 PRINT B$,A$
```

Output of the generator frequency in connection with measured level display, in particular, may become useful when recording a filter curve if, due to very high attenuation values in the stop-band of the filter, the measured level assumes very low values so that the frequency meter can no longer work properly (measured level < -80 dBV).

Example with the Controller PCA5:

```
10 PRINT "OUTPUT OF GENERATOR FREQUENCY AT DC OUTPUT DC2 AND ON"
20 PRINT "THE SCREEN IN CONNECTION WITH A LEVEL MEASUREMENT"
30 IEC TIME 10000
40 IEC OUT 10,"CLEAR, SOURCE(LEVEL DBV)10,MEAS(LEV DBV)"
50 IEC OUT 10,"SOURCE(FREQ)300,INCREM(FREQ LOG)1.08"
60 IEC OUT 10,"TRIG(MODE(LEV)),RAT(LEV F),RAT(FRE F)"
70 IEC OUT 10,"DCSCAL(LEV/DB(1))":REM DC-OUTP. -100TO 0 TO100 DBV
80 FOR I=1 TO 76
90 IEC OUT 10,"TRIG(SI)": IEC IN 10, A$
100 IEC OUT 10,"RECALL(SOURCE FREQ)": IEC IN 10,B$: PRINT B$,A$
110 IEC OUT 10,"INCREM(FREQ UP)": NEXT: END
```

ACMONITOR (MODE(0...3)) Assignment of AC monitor output according to SPEC FCT 18.0 to 18.3.
0: Automatic assignment
1: Level assignment
2: Wow & flutter or distortion assignment
3: Switched off

2.4.12 Interface Commands

2.4.12.1 Setting the Delimiter

DELIMITER (TYPE (0) or (NL))		Nine different delimiters (combinations) for the data or string output can be set via the IEC bus using the digits 0 to 8 or the plain text code.
	(1) or (CR)	
	(2) or (ETX)	
:::	(3) or (CR/NL)	
	(4) or (EOI)	
	(5) or (NL/EOI)	
	(6) or (CR/EOI)	
	(7) or (ETX/EOI)	
	(8) or (CR/NL/EOI)	

2.4.12.2 Setting the SRQ Mode

SRQ (DISABLE)	:::	No SRQ signal is output at all.
SRQ (ENABLE)		All causes which may lead to an SRQ signal (see Section 2.4.17) trigger an SRQ.
SRQ (SELECT)		All possible causes (see Section 2.4.17) except SRQ = 80 (measured value ready) lead to an SRQ signal.
SRQ (ERROR)		Only error SRQs (see Section 2.4.17) lead to an SRQ signal.
SRQ (VALUE)		All causes which may lead to an SRQ signal (see Section 2.4.17) trigger an SRQ. Unlike SRQ (ENABLE), the SRQ status byte allows to differentiate between level, frequency or function measurements (see 2.4.17).

::: = Basic setting

2.4.12.3 Setting the Value Output

STRING (SINGLE ALPHANUM)
STRING (SINGLE NUM)
STRING (ALL ALPHANUM) :::
STRING (ALL NUM)

SINGLE:

A request for measured value by the controller causes a value to be accepted from the UPA. If the UPA provides more than one output value (see TRIGGER (MODE (...)) the corresponding number of IECIN commands must be output in order to transfer all output values to the controller.

Example:

```
IECOUT7,"TRIGGER (MODE (LEV/FREQ/FNCT))"
                    .
                    .
IECIN10, A$
IECIN10, B$
IECIN10, C$
```

If more requests for measured value are caused by the controller than have been specified by the command TRIGGER (MODE (...)), the string UPA NOT TRIGGERED is output instead of a valid measured value.

ALL:

A request for measured value by the controller causes **all** output values specified in TRIGGER (MODE (...)) to be transferred from the UPA as a **single** string. The individual values can be separated by spaces.

ALPHANUM:

Measured values transferred from the UPA are provided with an alphaheader indicating type, unit and validity of the measured values. The alphaheader comprises 9 ASCII characters (see Section 2.4.18.2). Thus, the output of a measured value with alphaheader has a length of 19 ASCII characters.

NUM:

Measured values transferred from the UPA consist of a pure numerical value with a length of 10 ASCII characters (see Section 2.4.19.2).

::: = Basic setting

2.4.13 STORE/RECALL Commands for Complete Instrument Settings

STORE (SET (1 to 50))	Storage of complete instrument setting in a non-volatile RAM with battery backup. Memory space for 50 complete instrument settings is available. See also 2.3.6.1.
STORE (SET LOCK)	prevents overwriting of complete instrument settings stored; acts as SPEC 6.11.
STORE (SET UNLOCK)	cancels the command STORE (SET LOCK) and allows storage of complete instrument settings; acts as SPEC FCT 6.10.

If the write protection is activated, the command STORE(SET(1 to 50)) leads to the error message Er 07 on the FUNCTION/DATA display or to SRQ 97.

RECALL (AKTUAL or SET (0))	Recall of last valid UPA setting after switching the UPA off/on or power failure.
RECALL (SET (1 to 50))	Recall of one of 50 stored complete instrument settings. See also 2.3.6.2.

2.4.14 Trigger Commands

2.4.14.1 Setting the Trigger Facilities for Output of Measured Value

TRIGGER (MODE (1 or LEV))	Seven different possibilities for output of UPA values via the IEC bus can be set using digits 1 to 7 or plain text code. Depending on the STRING command, the adjacent measured values (combinations) are output following one or more IECIN commands.
(2 or FREQ)	
(3 or FNCT)	
::: (4 or LEV/FREQ)	
(5 or LEV/FNCT)	
(6 or FREQ/FNCT)	
(7 or LEV/FREQ/FNCT)	

TRIGGER (INPUT) This command sets the UPA such that a trigger is released by the controller on a request for measured value.

Example:
```
IECOUT10, "TRIGGER(INPUT)"
IECIN10, A$
```

This command has the advantage that the trigger command (TRIGGER(SINGLE)) can be omitted.

Caution! The trigger setting TRIGGER(INPUT) (following example, line 20) is reset if the recall value of a RECALL command is read in using an IECIN command (line 40). In this case, the command TRIGGER (INPUT) must again be output after reading in the recall value (line 50).

Example with Controller PCA5:

```
10 IEC TIME 10000: IEC OUT 10,"CLEAR"
20 IEC OUT 10,"TRIGGER(INPUT)"
30 FOR I=1 TO5: IEC IN 10,A$:PRINT A$: NEXT I: REM 5 Measured
   values
40 IEC OUT 10,"RECALL(SOURCE LEVEL)": IEC IN 10, B$: REM
   generator value
50 IEC OUT 10,"TRIGGER(INPUT)":
60 FOR I=1 TO 5: IEC IN 10,A$: PRINT A$: NEXT I: REM 5 Measured
   value
70 END
```

TRIGGER (AUTO) This command starts a free running measurement, i.e. the UPA starts a measurement automatically and then continues with the next as soon as the first one is terminated.

TRIGGER (OFF) ::: The TRIGGER (AUTO) and TRIGGER (INPUT) settings can be reset using this command.

::: = Basic setting

2.4.14.2 Trigger Commands

TRIGGER (SINGLE) — Just like the universal command GET, this command starts a measurement by the UPA in the selected setting and stores the result in the output buffers. An SRQ is sent after termination of the measurement if the interface is set accordingly.

TRIGGER (STORE) — This command has the same effect as the TRIGGER (SINGLE) command or the universal command GET except that the measured value is additionally transferred to the reference value memory as reference value.

A measurement triggered by TRIGGER (SINGLE) or TRIGGER(STORE) delivers a definite measurement result if SRQ Ready (80) has been signalled or if the measured values are transferred by one or several IECIN commands, provided the TRIGGER command is not followed by setting commands!

Setting commands following a TRIGGER (SINGLE) or TRIGGER (STORE) command produce illegal measured values or none at all!

Further information on TRIGGER(STORE) command:

Exception: If the measuring range is fixed by SPEC FCT 3.1 or RANGE (LEVEL FIX) and if an excessive input voltage applied to the test input causes a range overflow indicated with OFLOW on the LEVEL display, the measured level is **not** transferred as reference value and is indica ted as wrong data with SRQ 98.

Which measured values are transferred as reference values depends on the trigger mode (TRIGGER (MODE (...)) selected.

Transfer of the distortion level reference with TRIGGER (STORE):

The transfer of the distortion level reference with TRIGGER (STORE) is possible if TRIGGER (MODE (3 or FNCT))
5 or LEV/FNCT
6 or FREQ/FNCT
7 or LEV/FREQ/FNCT
is set in connection with the DISTORTION measurement. If one of the conditions is not fulfilled, it is not possible to transfer a distortion level reference and the previous value remains unchanged.

Example with the Controller PCA5:

```
100 IECOUT10,"TRIGGER (MODE (FNCT))"
110 IECOUT10,"DIST (TOTAL MODE (AUTO))"
120 IECOUT10,"TRIGGER (STORE)":IECIN10,A$: REM CORRECT TIMING
130 IECOUT10,"MEAS (FUNCT DDB)": REM SWITCH TO RELATIVE
                                 MEASUREMENT"
140 IECOUT10,"TRIGGER (SINGLE)": IECIN10,A$: PRINT A$
150 GOTO 140
```

Following the TRIGGER (STORE) command, the unit of the reference value valid **before** the TRIGGER (STORE) command is retained.

The new reference values are stored in the UPA in the basic unit (level reference in V, frequency reference in Hz) and converted to the current unit V, mV, dBV, dBm, W, mW, Hz or kHz for output on the display which may be caused by pressing the RCL LEV or RCL FREQ key or by a brief display during IEC-bus communication.

In the case of TRIGGER (STORE), the measured values need not always be processed further in the program, as, in some cases, new initialization of the reference value is all that is desired. Nevertheless, the measured values should be transferred via a directly following IECIN command to ensure correct timing.

Example with the Controller PCA5:

Correct:

```
100 IECOUT 10, "MEASUREMENT (LEVEL DBV)"
110 IECOUT 10, "TRIGGER (SINGLE)"
120 IECIN  10,A$: PRINT A$
                :
       Evaluation of measurement result

200 GOTO 110: REM loop for further measurements
```

Incorrect:

```
100 IECOUT10,"TRIGGER(SINGLE)"
110 IECOUT10,"MEASUREMENT (LEVEL DBV)"
120 IECIN10,A$: PRINT A$
```

2.4.15 Calibration Commands:

CALIBRATION (ENABLE)	Call of calibration level for further execution of a calibration.
CALIBRATION (OFFSET) CALIBRATION (LEVEL) data CALIBRATION (DC) data	The use of these commands is usually reserved to the service department. Calibration of the UPA measurement section using these commands is similar to the calibration process described in section 3.4.2. The known calibration voltage value (error limit <0.1 %) must be indicated in volts at the place of "data".
CALIBRATION (EXTFILT/CAL)	For calibration of the transmission loss of an external filter proceed as described in Section 2.3.1.4.8 and start the calibration using the calibration command.
CALIBRATION (EXTFILT/0DB)	Reset attenuated calibration value for external filter to 0 dB (according to Section 2.3.1.4.8).
CALIBRATION (DISABLE)	When the calibration is terminated, the calibration level is left again.

2.4.16 IEC-bus Inquiry Commands

Each header of an IEC-bus command can be provided with a "?" character and sent to the UPA by the controller. The UPA responds by sending back to the controller the current setting referring to the specified header as plain text IEC-bus commands.

Example with Controller PCA5:

```
IECOUT 10,"SWEEP?"
IECIN 10,A$: PRINT A$
```

A$ could include the following ASCII string:

```
SWEEP(LEVEL START VOLT) 1.000E-3,SWEEP(LEVEL STOP VOLT) 1000.0E-3,SWEEP(FREQUE
NCY START) 1000.0E+0,SWEEP(FREQUENCY STOP) 10.000E+3,SWEEP(TIME) 0.1500E+0,SWE
EP (INCREMENT .... send INCREMENT? for more information!
```

```
IECOUT 10,"INCREMENT?"
IECIN 10,A$: PRINT A$
```

A$ could include the following ASCII string:

```
INCREMENT(LEVEL AUTO),INCREMENT(FREQUENCY OKTAV1),INCREMENT(STEPRANDOM ENDPOSI
TION (21)),INCREMENT(STEPRANDOM OFFSET DB) 6.0200E+0,INCREMENT(STEPRANDOM BOTH)
```

The output ASCII string may be up to 250 characters long, however it contains only one delimiter or a combination of delimiters, as can be set using the IEC-bus command "DELIMITER (...)" (see 2.4.12.1). As a result of this, an ASCII string longer than 80 characters causes a line overflow to be displayed on the screen which cannot be traced back to a delimiter, however.

The UPA sends the current instrument setting as a reply to the following inquiry commands:

DCSCAL?	INPUT?	SOURCE?
DELIMITER?	MEASUREMENT?	SRQ?
DETECTOR?	NOISE?	STORE?
DISPLAY?	OUTPUT?	STRING?
DISTORTION?	PHASE?	SWEEP?
FILTER?	RANGE?	TRIGGER?
INCREMENT?	RATE?	WOWFLUTTER?

Special features of UPA reply to inquiry commands:
Inquiry syntax: OUTPUT?
Reply from UPA: OUTPUT (Open circuit! - External supply to generator!)
The comment indicates that the generator output has been switched off due to external supply to the generator (see 2.3.2.1.3).

Inquiry syntax: MEASUREMENT?
Reply from UPA: ...: MEASUREMENT(FUNCTION - Not active)
The comment indicates that no function measurement is active which is why no function unit can be assigned.

Inquiry syntax: CALIBRATION? or RECALL?
Reply from UPA: CALIBRATION (No information!) or RECALL (No information)
The comment indicates that this IEC-bus command does not permit output of additional information.

2.4.17 Service Request

By setting the SRQ line (Service Request) the UPA is able to request a service from the controller.

The SRQ is useful if the controller is to be informed of the end of a measurement, the end of autocalibration or an error. The interface can be set accordingly using the commands SRQ (DISABLE), SRQ (ENABLE) or SRQ (ERROR).

The controller used must be able to fulfil two tasks:

- The controller must interrupt the current program if the SRQ line = Low, branch into service subroutine and then continue executing the program at the point of interruption once the subroutine is completed.

- The controller must identify the calling device since the Service Request is transmitted by several devices on the same SRQ line. Identification is carried out using a Serial Poll and is necessary to determine the cause of the Service Request. The device status which led to transmission of the Service Request can be determined by decoding the status byte.

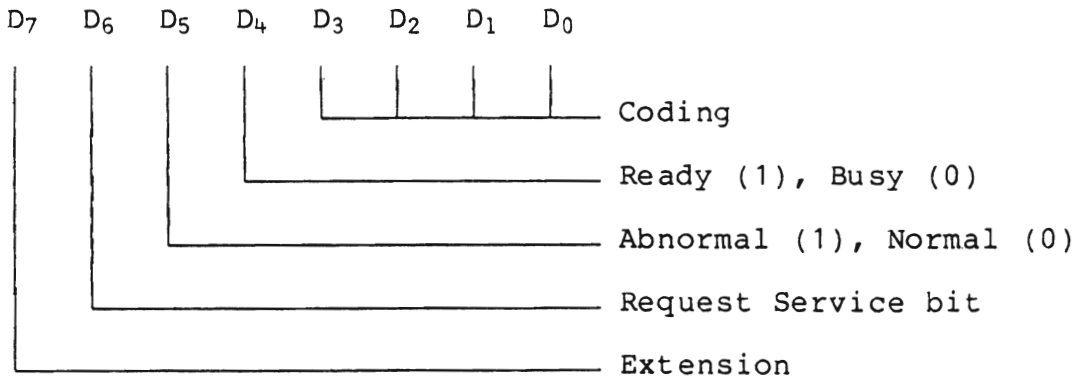
  Example with Process Controller PCA5:

  Program interrupt following SRQ is initialized by the command: **ON SRQ GOSUB n.**

  Transfer of SRQ status bytes: **IEC SPL a, v%.**

  n: line number
  a: decimal value of IEC address
  v%: Fixed-point variable into which the device status is read

  SRQ status byte:



Note:

The SRQ event "measured value/reference value ready" (SRQ status byte 80) is reset by any UPA setting command or input command that follows!

It should therefore be born in mind when writing the program that the trigger command TRIGGER(SINGLE), TRIGGER(STORE) or IECGET must not be followed by a setting command or input command in the main program before the measured value is called in the SRQ interrupt routine. Otherwise, the SRQ interrupt program would never be executed.

Program example with the controller PCA5 for output of the measured level and frequency value via SRQ Ready:

```
                                                    | Comment
----------------------------------------------------|-----------------------
10  IEC TIME 10000                                  | IEC-bus monitoring
                                                    | time 10 s
20  IEC DCL                                         | Basic setting of UPA
30  IEC OUT 10,"SRQ(ENABLE)"                        | Enable all SRQs
40  IEC OUT 10,"TRIGGER(SINGLE)"                    | Trigger transfer of
                                                    | measured value from
                                                    | UPA
50  ON SRQ GOSUB 140                                | Fix SRQ interrupt
                                                    | routine
60  I = 1
70  REM ********** USER PROGRAM **********
80  REM                                             | Random user program
90  PRINT "COUNTER I = ";I                          | interrupted by trans-
100 I = I + 1                                       | fer of measured value
110 REM                                             | from UPA.
120 GOTO 70
130 REM ***********************************
140 REM ******** SRQ-INTERRUPT ROUTINE ***
150 IEC SPL 10,V%                                   | Carry out Serial
                                                    | Poll
160 IF V% <> 80 THEN 220                            | Check SRQ status byte
170 PRINT "MEASURED VALUE:"
180 IEC IN 10,A$                                    | Read in and output
190 PRINT A$                                        | measured value of UPA.
200 IEC OUT 10,"TRIGGER(SINGLE)"                    | Trigger UPA again
210 GOTO 240
220 PRINT "ERROR:",V%                               | In the event of an
                                                    | error, output the SRQ
230 STOP                                            | status byte and halt
240 ON SRQ GOSUB 140: RETURN                        | the program. To enable
250 REM ***********************************| further SRQ interrupt
                                                    | handling, the SRQ in-
                                                    | terrupt program must
                                                    | be enabled once again
                                                    | and should make up the
                                                    | last command line to-
                                                    | gether with RETURN.
```

SRQ (VALUE)

The response of the UPA to the setting with SRQ (VALUE) depends on the setting STRING (ALL ...) or STRING (SINGLE ...).

SRQ (VALUE) in combination with STRING (ALL ...)

Following a TRIGGER (SINGLE) or a similar command, this setting causes a single Service Request (80) when all measured values are available (measured value ready).

Program example with the Controller PCA5:

```
10  IECDCL
20  IECTIME 10000
30  ON SRQ GOSUB 90
40  IECOUT 10,"SRQ (VALUE)"
50  IECOUT 10,"TRIGGER (MODE (LEV/FREQ/FNCT))"
60  IECOUT 10,"STRING (ALL ALPHANUM)"
70  IECOUT 10,"TRIGGER (SINGLE)"
80  GOTO 80
90  IECSPL 10,ST%
100 IF ST% <> 80 THEN PRINT "ERROR": STOP
110 IECIN 10,A$: PRINT A$
120 IECOUT 10,"TRIGGER (SINGLE)"
130 ON SRQ GOSUB 90: RETURN
```

SRQ (VALUE) in combination with STRING (SINGLE ...)

Depending on the setting TRIGGER (MODE (...)), a Service Request is output with each valid measured level, frequency or function value following a TRIGGER (SINGLE) or a similar command:

```
Measured level value     ready: SRQ 81
Measured frequency value ready: SRQ 82
Measured function value  ready: SRQ 83
```

Program example with the Controller PCA5:

```
10  IECDCL
20  IECTIME 10000
30  ON SRQ GOSUB 90
40  IECOUT 10,"SRQ (VALUE)"
50  IECOUT 10,"TRIGGER (MODE (LEV/FREQ/FNCT))"
60  IECOUT 10,"STRING (SINGLE ALPHANUM)"
70  IECOUT 10,"TRIGGER (SINGLE)"
80  GOTO 80
90  IECSPL 10,ST%
100 IF ST% >= 84 THEN PRINT "ERROR": STOP
110 IECIN 10,A$: PRINT A$
120 REM TRIGGER ONLY AFTER THE THIRD VALUE (FUNCTION VALUE WITH
    SRQ = 83)
    TRIGGER AGAIN!
130 IF ST% = 83 THEN IECOUT 10,"TRIGGER (SINGLE)"
140 ON SRQ GOSUB 90: RETURN
```

SRQ processing for RECALL command

Like a measured value, the recall value of a RECALL command is indicated to be ready with SRQ 80.
If the recall value is immediately read in using an IECIN command without waiting for an SRQ, an SRQ with the status 00 occurs which is considered in the SRQ subroutine (usually by immediate exit) (line 80).

Example with Controller PCA5:

```
10 IEC TIME 10000: ON SRQ1 GOSUB 70: IEC OUT 10,"CLEAR,SRQ (ENA-
   BLE)
20 IEC OUT 10,"RECALL(SOURCE FREQU)"
30 IEC IN 10,A$: PRINT A$: REM Recall generator frequency
40 IEC OUT 10,"TRIG(SINGLE)": REM Triggering of measured value
50 GOTO 50: REM Wait for SRQs in endless loop
60 REM *************** SRQ **************
70 IEC SPL 10,V% REM Read in SRQ status byte
80 IF V%=0 THEN GOTO 120: REM SRQ status byte is reset since the
90 REM  recall value has already been fetched in line 30.
100 IF V%=80 THEN IEC IN 10,A$:PRINT A$:IEC OUT 10,"TRIGGER (SIN-
    GLE)":GOTO 120
110 PRINT "error SRQ = ";V%: STOP
120 ON SRQ1 GOSUB 70: RETURN
```

SRQ processing for sweep end

The SRQ setting SRQ(ENABLE), SRQ(VALUE) or SRQ(SELECT) causes an SRQ with the status 87 to be output after a sweep. The SRQ output depends on the setting STRING(SINGLE...) or STRING(ALL...).

End of sweep in connection with STRING(ALL...):

SRQ 87 (end of sweep) is output instead of the last SRQ 80 (measured value ready).

Program example with PCA5:

```
10 PRINT "PERFORMING A LEVEL SWEEP FROM 1 V TO 2.5 V WITH A
   MULTIPLICATION FACTOR OF 1.07"
20 PRINT "AT A FREQUENCY OF 1000 HZ."
30 PRINT "DETECTION OF SWEEP END VIA SRQ 87!"
40 PRINT : IEC TIME 10000: ON SRQ1 GOSUB 90
50 IEC OUT 10,"CLR, SRQ(ENABLE), SWEEP(L STA V)1,
   SWEEP(L STO V)2.5"
60 IEC OUT 10,"SWEEP(INC L LOG) 1.07, SWEEP(L ENABLE),
   TRIGGER(SINGLE)"
70 IEC OUT 10,"RATE(LEVEL FAST), RATE(FREQ FAST)"
80 GOTO 80: REM *** ENDLESS LOOP ***
90 IEC SPL 10,V%: REM ** SRQ INTERRUPT ROUTINE **
100 IF V%<>80 AND V%<>87 THEN PRINT "ERROR SRQ = ";V%: STOP
110 IEC IN 10,A$: PRINT A$
120 IF V%=80 THEN IEC OUT 10,"TRIGGER(SINGLE)": GOTO 140
130 IF V%=87 THEN PRINT "END OF SWEEP!": STOP
140 ON SRQ1 GOSUB 90:RETURN:REM **END OF SRQ INTERRUPT ROUTINE**
```

End of sweep in connection with STRING(SINGLE...):

After triggering the last possible sweep step, SRQ 87 (end of sweep) is output. Then the measured values selected by means of the TRIGGER(MODE...) command are made available via SRQ 80, 81, 82 or 83.

Program example with PCA5:

```
10 PRINT "FREQUENCY SWEEP IN THIRD-OCTAVE STEPS FROM 1 KHZ TO
   10 KHZ AT A GENERATOR VOLTAGE OF 1 V"
20 PRINT "TRANSFER OF MEASURED VALUE IN SINGLE MODE WITH SRQ
   PROCESSING."
30 IEC TIME 10000: ON SRQ1 GOSUB 100: ME=0: REM ** ME = FLAG
   INDICATING END OF SWEEP **
40 IEC OUT 10,"CLR,SRQ(VAL),STR(S A),SOU(L V)1,
   SWEEP(INC FREQ TERZ2)"
50 REM ** SWEEP LIMITS WITH BASIC SETTING 1 TO 10 KHZ **
60 IEC OUT 10,"RATE(LEVEL FAST),RATE(FREQ FAST)"
70 IEC OUT 10,"SWEEP(FREQ ENABLE)"
80 IEC LAD 10: IEC GET
90 GOTO 90:REM ** ENDLESS LOOP **
100 IEC SPL 10,V%: REM ** SRQ INTERRUPT ROUTINE **
110 IF V%>=84 AND V%<>87 THEN PRINT "ERROR SRQ = ";V%: STOP
120 IF V%=87 THEN ME=1: GOTO 200
130 IF V%=81 THEN IEC IN 10,LEV$: PRINT LEV$
140 IF V%=82 THEN IEC IN 10,FRQ$: PRINT FRQ$
150 REM ** TRIGGER ONLY WHEN SRQ 82 HAS BEEN RECEIVED **
160 IF V%<>82 THEN GOTO 200:REM ** DO NOT TRIGGER AGAIN **
170 IF ME=0 THEN PRINT : GOTO 190 ELSE ME=0: PRINT "---NEW START
    OF SWEEP---"
180 IEC OUT 10,"SWEEP(FREQUENCY ENABLE)"
190 IEC LAD 10: IEC GET
200 ON SRQ1 GOSUB 100:RETURN:REM **END OF SRQ INTERRUPT ROUTINE**
```

SRQ processing upon reaching a generator range limit:

With SRQ enabled, SRQ 88 is output via an INCREMENT (... UP or DOWN) command upon reaching a generator range limit.

Program example with PCA5:

```
10 PRINT "DEMONSTRATION FOR LIMITATION OF GENERATOR VOLTAGE!"
20 IEC TIME 10000: IEC OUT 10,"CLR,SRQ(ENABLE)":ON SRQ1 GOSUB 150
30 INPUT "ENTER LOWER LIMIT IN VOLTS: ";PA$
40 INPUT "ENTER UPPER LIMIT IN VOLTS: ";PO$
50 INPUT "MULTIPLICATION FACTOR FOR LEVEL INCREMENT: ";PM$
60 PRINT "REACHING OF A LIMIT IS INDICATED BY SIGNAL TONE!"
70 IEC OUT 10,"SOURCE(LEVEL VOLT)"+STR$((VAL(PA$)+VAL(PO$))/2
80 IEC OUT 10,"SWEEP(L STA V)"+PA$+",SWEEP(L STO V)"+PO$
90 IEC OUT 10,"INCREMENT (LEV LOG)"+PM$+",SOURCE(LEV ONLIMIT)"
100 PRINT "TRIGGER LEVEL JUMP! LEVEL UP (U), LEVEL DOWN (D):";
110 INKEY UD$
120 IF UD$="U" THEN IEC OUT 10,"INCR(LEVEL UP)": PRINT "O.K.":
    GOTO 100
130 IF UD$="D" THEN IEC OUT 10,"INCR(LEVEL DOWN)": PRINT "O.K.":
    GOTO 100
140 GOTO 110
150 IEC SPL 10,V%: REM ** INTERRUPT ROUTINE **
160 IF V%=88 THEN PLAY "C9B9",1
170 IF V%>=96 THEN PRINT "ERROR SRQ = ";V%: STOP
180 ON SRQ1 GOSUB 150: RETURN:REM ** END OF INTERRUPT ROUTINE **
```

SRQ processing for the 2-sigma background measurement:

After the 2-sigma background measurement has been started using the IEC-bus command WOWFLUTTER (STARTSIGMABACKGROUND), the measurement result is made available with SRQ 89.
The measurement result is usually read in using the IEC-bus command RECALL (SIGMABACKGROUND) in connection with an IECIN command.

Program example with PCA5:

```
        .
        .
        .
200 IECSPL10,V%: REM SRQ interrupt routine
210 IF V%<>89 THEN GOTO 400: REM Error SRQ
220 IEC OUT 10,"RECALL(SIGMABACK)": REM Fetch value of the
    2-sigma background measurement
230 IEC IN 10,A$: PRINT "Result of the 2-sigma background
    measurement:";A$
        .
        .
        .
```

It is also possible to transfer the 2-sigma measurement result using a TRIGGER command.

Program example with PCA5:

```
        .
        .
        .
200 IECSPL10,V%: REM SRQ interrupt routine
210 IF V%<>89 THEN GOTO 400: REM Error SRQ
220 IEC OUT 10,"TRIGGER(MODE(3))": REM Trigger only FNCT
    measurement result
230 IEC OUT 10,"TRIGGER(SINGLE)"
240 IEC IN 10,A$: PRINT "Result of 2-sigma background
    measurement:";A$
        .
        .
        .
```

Program example of a 2-sigma background measurement with PCA5:

Measurement of the left-hand and right-hand channel of a tape unit using a multi-frequency test cassette with measurement of frequency response at 315 Hz, 3.15 kHz, 6.3 kHz, 10 kHz and 12.5 kHz and 2-sigma measurement simultaneously running in the background.

```
10  IEC TIME 10000
20  ON SRQ1 GOSUB 320
30  DIM NR$(5): DIM KO$(5)
40  DATA "6","8","9","10","11": REM SPEC filter numbers
50  FOR I=0 TO 4: READ NR$(I): NEXT I
60  DATA "315 Hz ","3,15 kHz","6,3 kHz ","10 kHz ","12,5 kHz"
70  FOR I=0 TO 4: READ KO$(I): NEXT I
80  IEC OUT 10,"CLEAR"
90  IEC OUT 10,"SRQ(SELECT)": REM Enable SRQ 89
100 IEC OUT 10,"RATE(LEVEL FAST),RATE(FREQ FAST)"
110 IEC OUT 10,"STRING (ALL NUM)": REM Only numerical values
120  IEC OUT 10,"TRIGGER(MODE(1))": REM Only level measurement
    results
130 IEC OUT 10,"WOWFLUTTER(DIN WTD SIGMABACK)": REM 2-sigma
    background measurement
```

```
140 IEC OUT 10,"RANGE(WOW FIX(3))": REM Fix 1% range
150 PRINT "- - -  R I G H T   C H A N N E L  - - -"
160 IEC OUT 10,"INPUT(RIGHT C)": REM Switch on right channel
170 GOSUB 420: REM Output attenuation values
180 PRINT
190 PRINT "- - -  L E F T  C H A N N E L  - - -"
200 IEC OUT 10,"WOW(STARTSIGMABACK)": Z1=TIME : REM Start 2-sigma
    measurement
210 IEC OUT 10,"INPUT(LEFT C)": REM Switch on left channel
220 GOSUB 420: REM Output attenuation values
225 REM  - - M e a s u r e  f r e q u e n c y  o f f s e t - -
230 IEC OUT 10,"FILTER (SPEC(8))": REM Set bandpass filter
    3.15 kHz
240 IEC OUT 10,"TRIGGER (MODE (2))": REM Trigger only frequency
    measurement result
250 IEC OUT 10,"STORE(REFERENCE FREQ) 3150": REM Enter reference
    frequency
260 IEC OUT 10,"MEASUREMENT (FREQ DHZ)": REM Display frequency
    offset in Hz
270 IEC OUT 10,"TRIGGER(SINGLE)": IEC IN 10,F$
280 PRINT : PRINT "Frequency offset of 3.15 kHz =  ";F$;" Hz"
290 GOTO 290: REM Wait for SRQ 89
300 REM
310 REM ************ SRQ INTERRUPT ******************
320 IEC SPL 10,V%
330 IF V%<=64 THEN GOTO 380
340 IF V%<>89 THEN GOTO 390: REM Error SRQ
350 IEC OUT 10,"RECALL(SIGMABACK)": REM Fetch value of 2-sigma
    background measurement
360 IEC 10,A$: PRINT "Result of 2-sigma background measurement:
    ";A$;" %"
370 PRINT "Total measuring time after start of 2-sigma:
    ";(TIME -Z1)*0.01;"sec": STOP
380 ON SRQ1 GOSUB 320: RETURN
390 PRINT "Error SRQ = ";V%
400 END: REM ****************************************
410 REM
420 REM **** SUBROUTINE for output of attenuation values ****
430 IEC OUT 10,"MEAS(LEVEL VOLT)": REM Level in volts
440 IEC OUT 10,"FILTER (SPEC(6))": REM Reference measurement with
    bandpass filter 315 Hz
450 IEC OUT 10,"TRIGGER(STORE)": REM Simultaneous storage of REF
    value
460 IEC IN 10,A$: REM Transfer reference value
470 PRINT "Reference level at 315 Hz =";A$;" volts"
480  IEC OUT 10,"MEASUREMENT(LEVEL DDB)": REM Switch to dB for
    attenuation
490 PRINT "Bandpass | attenuation as against reference level
500 PRINT "---------+-------------------------------------"
510 FOR I=0 TO 4: REM Transfer 5 different attenuation values
520 IEC OUT 10,"FILTER (SPEC("+NR$(I)+"))": REM Spec filters:
    6,8,9,10,11
530 IEC OUT 10,"TRIG(SINGLE)"
540 IEC IN 10,A$: PRINT KO$(I);"|          ";A$;" dB"
550 NEXT
560 RETURN : REM ************************************
```

SRQ Status Table

Device status	Status byte	Decimal	Hexa-decimal	SRQ ENA	SRQ VAL	SRQ SEL	SRQ ERR	SRQ DIS
Measured value or reference value ready	01010000	80	50H	*	*	-	-	-
Level value ready	01010001	81	51H	-	*	-	-	-
Frequency value ready	01010010	82	52H	-	*	-	-	-
Function value ready	01010011	83	53H	-	*	-	-	-
Calibration ready	01010110	86	56H	*	*	*	-	-
Sweep end	01010111	87	57H	*	*	*	-	-
Freely sel. generator range limit reached	01011000	88	58H	*	*	*	-	-
Result of 2-sigma background measurement ready	01011001	89	59H	*	*	*	-	-
Syntax error in IEC string	01100000	96	60H	*	*	*	*	-
Illegal IEC command	01100001	97	61H	*	*	*	*	-
Faulty data	01100010	98	62H	*	*	*	*	-
No measured value in output buffer (UPA NOT TRIGGERED)	01100011	99	63H	*	*	*	*	-
Hardware error	01100100	100	64H	*	*	*	*	-
Measured level is larger than permissible for the fixed measuring range	01100110	102	66H	*	*	*	*	-
Measured level is lower than permissible for the fixed measuring range	01100111	103	67H	*	*	*	*	-
Selected option is not fitted	01101000	104	68H	*	*	*	*	-
External voltage at generator output	01101001	105	69H	*	*	*	*	-
Distortion meter cannot be tuned or illegal harmonic with selective distortion factor measurement	01110000	112	70H	*	*	*	*	-
Faulty calibration	01110001	113	71H	*	*	*	*	-

*: SRQ output -: No SRQ

2.4.17.1 Parallel Poll

The Parallel Poll represents another way of finding out which device connected to the IEC bus has requested an SRQ. If several (max. 8) devices are connected to the IEC bus, the Parallel Poll gains in significance compared with the Serial Poll, as the Parallel Poll can be carried out faster than the Serial Poll. Prior to polling, each device is assigned its own IEC-bus data line ((DIO1 to DIO8) on which it can signal its status. The Parallel Poll does not change the SRQ status of the polled devices.

The devices intending to participate in the Parallel Poll are only set once, at the start of the main program. Devices not set for Parallel Poll do not then participate.

Example for the Controller PCA5:

```
100 ON SRQ GOSUB 1000
110 IECLAD 10
120 IECPPC
130 IECPPE 1 6
140 IECUNL
```

IECLAD 10: The device connected to the IEC bus is addressed as listener with address 10.

IECPPC: A command or a command sequence follows which indicates whether the polled device signals its SRQ status with 0 or 1 and which of the 8 IEC-bus data lines will be used for the reply.

IECPPE 1 6: The first parameter (1) indicates that the SRQ status is signalled with 1.
The second parameter (6) indicates that the SRQ status is signalled on the IEC-bus data line DI06.

IECUNL: All listener devices on the bus are unaddressed.

The Parallel Poll is triggered in the SRQ subroutine by the IECPPL instruction.

Example for the Controller PCA5:

```
1000 IECPPL A%
1010 IF A% AND 32 <> 0 THEN ...
```

During Parallel Poll, the status word is read into the integer variable A%. The IEC data line on which the Service Request has arrived and thus the device issuing the SRQ can subsequently be checked. The determined device can then signal its SRQ status (8-bit word) in a Serial Poll.

Example see Section 2.4.17.2.

2.4.17.2 Serial Poll

A meaningful Serial Poll is only possible if an SRQ subroutine is available into which the main program branches in the case of an SRQ interrupt. The subroutine is normally used for transfer of measured values or output in the case of an error.

For the Controller PCA5, for example, the BASIC command

```
100 ON SRQ GOSUB n
```

is provided. After execution of this command, the program branches into a subroutine when a service request occurs. In this subroutine which commences with line number n the calling device is usually identified by a serial poll and is then serviced. This command may be present at any place in the program but must have been read at least once before being executed for the first time. Return from the subroutine into the interrupted main program is accomplished using RETURN.

Following program branching, an ON SRQ GOSUB n line must be read again before response to another SRQ is possible.

In the SRQ subroutine, the device which is likely to have sent the SRQ is addressed and the device status read into a variable V% as 8-bit integer value:

```
1000 IECSPL 10, A%
```

The SRQ status stored in the integer variable can then be decoded using the SRQ status table.

An SRQ status polled by the command IECSPL is reset by this poll, i.e. a further IECSPL command with the same IEC-bus address in the same service routine would lead to the transfer of an undefined status byte.

Program example for Parallel and Serial Poll with Controller PCA5

Output level and frequency value:	Comment
10 IECTIME 10000	IEC-bus monitoring time 10 s.
20 IECDCL	All devices on the IEC bus in basic setting
30 ON SRQ GOSUB 230	Initialize SRQ interrupt routine
40 IECLAD 10	Address UPA with IEC-bus address 10 for Parallel Poll initialization
50 IECPPC	Parallel Poll configuration follows
60 IECPPE 1 8	Parallel Poll configuration: DIO8 = 1 in case of SRQ
70 IECUNL	Unaddress all listener devices on IEC bus
80 . . . 190	Initialize further devices for Parallel Poll
200 IECOUT 10,"SRQ(ENABLE)"	Enable all SRQs
210 IECOUT 10,"TRIGGER(SINGLE)"	Trigger measurement
220 GOTO 220	User program (endless loop)
230 IECPPL V% : REM SRQ SUBROUTINE	Start of SRQ interrupt program: read in Parallel Poll code
240 PRINT "PARALLEL POLL CODE = ";V%	Output Parallel Poll code
250 IF V% AND 128 = 0 THEN GOTO 320	Filter out DIO8, conditional program continuation in line 260 if Parallel Poll result from UPA; otherwise Parallel Poll of further devices with branching to line 320.
260 IECSPL 10,ST%	Read in SRQ status of UPA via Serial Poll
270 PRINT "SERIAL POLL CODE = ";ST%	Output Serial Poll code
280 IECIN 10,A$	Read in measured values of UPA
290 PRINT A$	Output measured values of UPA
300 IECOUT 10,"TRIGGER(SINGLE)"	Trigger UPA again
310 HOLD 1000	Waiting time 1 s
320 ON SRQ GOSUB 230: RETURN	Reinitialize SRQ interrupt routine and return to user routine.

2.4.18 Measured Value Output in Talk Only Mode

In order to log measured values without an IEC bus controller, data can be output to a Listen Only device with an IEC-625 interface via the IEC-bus connection. The device - e.g. a printer - is then set to LISTEN ONLY and the UPA to TALK ONLY (see Section 2.4.1 "Setting the Device Address/TALK ONLY).

In this mode the UPA is operated from the front panel and each value output on the display can be transferred to the Listen Only device by pressing the LOCAL/TALK key 18. **IEC to** is output on the FUNCTION/DATA display if the LOCAL/TALK key is pressed in Talk Only mode and the IEC-bus interface is not connected.

Talk Only mode during sweep

If, during a sweep triggered with SPEC FCT 29.x, measured values are to be output to a Listen Only device (e.g. printer) in Talk Only Mode, this device is to be set to LISTEN ONLY and the UPA to TALK ONLY as described above. In addition, SPEC FCT 26.7 or SPEC FCT 27.0 can be used to set the print or plot mode for the output of sweep measurement results (see 2.3.2.5.1 and 2.3.2.7).

Starting the sweep by means of SPEC FCT 29.x in the case of

"Print": Parallel to the individual sweep steps, the measured values are sent to the Listen Only device via the IEC bus.

"Plot" First the head of the test log, then, parallel to the individual sweep steps, the measured values and their curve and, at the end of the log, the UPA setting in plain text are sent to the Listen Only device via the IEC bus.

The time sequence of the individual sweep steps is considerably determined by the printing speed and cannot be **accelerated by** selecting the measuring speed FAST (SPEC FCT 10.1 and 11.1).

If the print mode is switched off with SPEC FCT 26.7 ("OFF"), the measured values are not automatically output to the IEC bus during the sweep. By pressing the Talk Only key, a single measured value output is caused and the sweep is interrupted (not aborted) at the same time. The interrupted sweep is continued by pressing the SPEC FCT key and further output of measured values is possible by pressing the Talk Only key.

The error message Er 41 points out to the user that the device connected to the IEC bus is faulty or the IEC-bus connection is open.

The data output in print mode is described in Section 2.4.19. The delimiter is fixed; each output is terminated by CR/NL (carriage return + new line).

2.4.19 Data Output

The UPA can output a measured value, the reference values, an error code and single-line or multi-line strings.

The output format is identical for the Talk Only mode and the Talk state following addressing by the controller.

2.4.19.1 Text String Output

The UPA is ready to reply to the controller at any time after being addressed as a Talker. Under certain conditions the UPA transmits a text string instead of data.

The string **UPA IN LOCAL MODE** is output following addressing as a Talker in local mode.

The string **UPA NOT TRIGGERED** is transmitted following addressing as a Talker in remote mode without previous triggering. With a correspondingly set interface, output of SRQ (99) is then linked.

The string **NO FNCT** is transmitted if a function result output is to take place using the setting command TRIGGER (MODE (...)) although the corresponding option is not fitted in the UPA or no function measurement is switched on.

The string **DC-MEAS** is transmitted if DC measurement is switched on and a measured frequency and/or a measured function value is to be output using the command TRIGGER (MODE ...)).

2.4.19.2 Data Output in Measuring Mode

There are two methods for data output to the IEC bus: with alphaheader or without alphaheader (numerical). The two methods are set using the special function 2... or the IEC-bus command STRING (...). Explanations see 2.4.12.3 and 2.4.17.

```
SPEC FCT 2.0 ≙ STRING (SINGLE NUM)
SPEC FCT 2.1 ≙ STRING (SINGLE ALPHANUM)
SPEC FCT 2.2 ≙ STRING (ALL    NUM)
SPEC FCT 2.3 ≙ STRING (ALL    ALPHANUM)
```

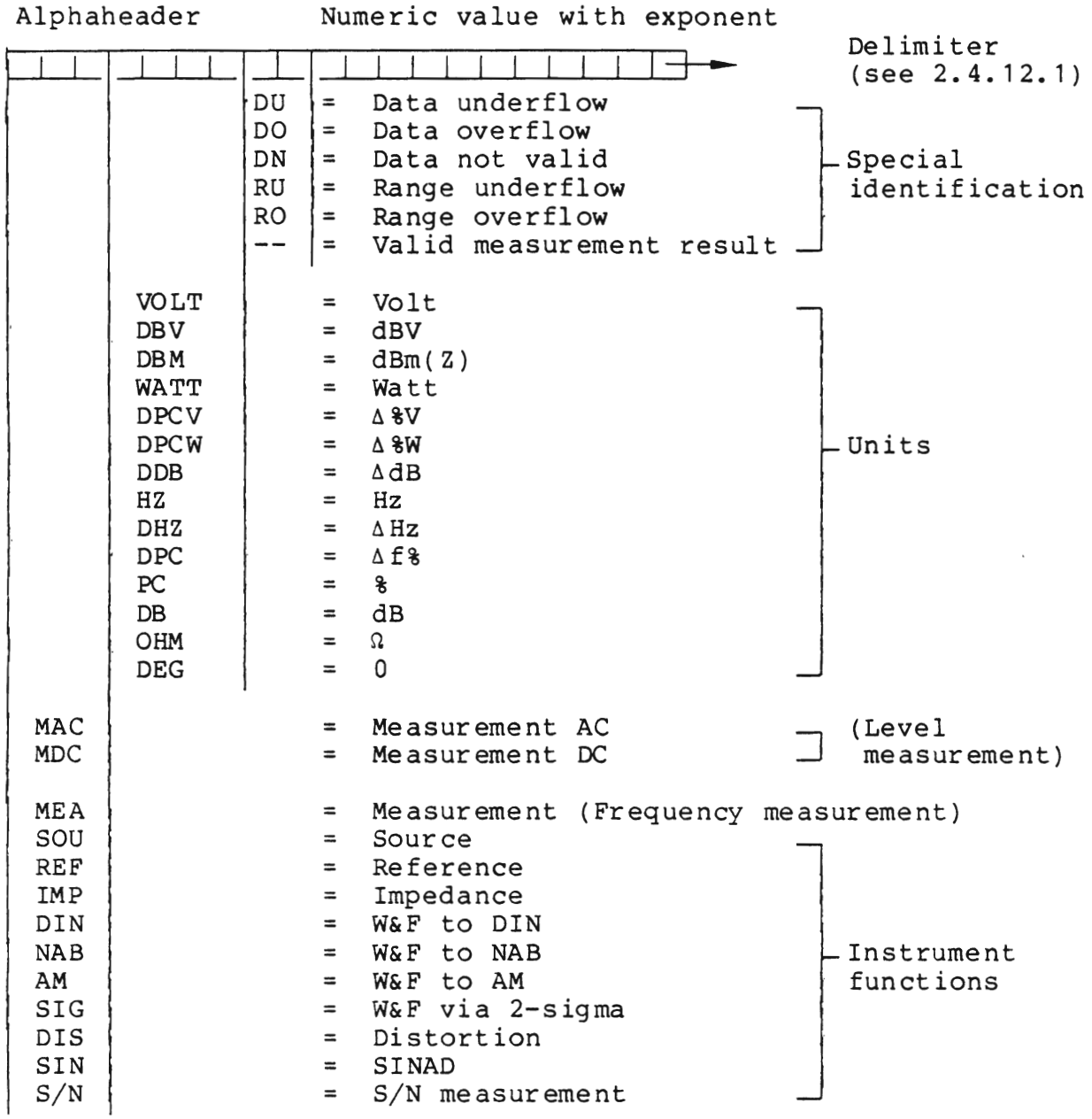
Numerical display:

A measurement result is always output as ASCII string with a length of 10 characters in combination with the delimiter specified by the DELIMITER command (see 2.4.12.1).

Example: `+1 10.25E+01` CR/NL
`+1 23.45E+03` CR/NL

Alphanumeric display:

A measurement result is always output as ASCII string with a length of 19 characters.



2.4.19.3 Measurement Speeds

In combination with the Controller PCA5, the following measurement speeds can be obtained:

Type of measurement	Measurements per second (approximate values)
Frequency measurement:	11
Level measurement:	20
Frequency and level measurement:	11
Frequency sweep with level measurement:	8
Level sweep with frequency measurement:	6
RANDOM sweep with level measurement:	7

For more detailed information, refer to the Specifications!

The measurement speed can be considerably increased by means of the TRIGGER(INPUT) command.

Program example with PCA 5:
By using the TRIGGER(INPUT) command, the measurement speed can be increased by approx. 20 % compared with the TRIGGER(SINGLE) command (next program example)!

```
10 IEC TIME 10000
20 IEC OUT 10,"CLEAR"
30 IEC OUT 10,"STRING(ALL NUM),TRIGGER(MODE(LEV))"
40 IEC OUT 10,"RATE(LEVEL FAST),RATE(FREQ FAST)"
50 IEC OUT 10,"TRIGGER(INPUT)"
60 DIM M$(100)
70 FOR I=0 TO 99: IEC IN 10,M$(I): NEXT I
80 STOP
```

Program example with PCA 5:
Each time a loop is executed, the TRIGGER(SINGLE) command used in line 60 causes the command interpreter of the UPA to be called which reduces the measurement speed by approx. 20 % compared with the TRIGGER(INPUT) command.

```
10 IEC TIME 10000
20 IEC OUT 10,"CLEAR"
30 IEC OUT 10,"STRING(ALL NUM),TRIGGER(MODE(LEV))"
40 IEC OUT 10,"RATE(LEVEL FAST),RATE(FREQ FAST)"
50 DIM M$(100)
60 FOR I=0 TO 99: IEC OUT 10,"TRIGGER(SINGLE)": IEC IN 10,M$(I):
   NEXT I
70 STOP
```

2.4.20 Addressed and Universal Commands

2.4.20.1 Device Clear

The universal command **DCL** (Device Clear) sent by the controller sets the UPA and all other devices connected to the IEC bus into a basic status and should be applied each time before the bus is used and at the start of a program.

Example with the Controller PCA5:

```
10 IECDCL
```

The basic setting (see 2.3.10) is also selected when switching on the UPA, using the device-specific IEC-bus command CLEAR or CLR as well as via special function 0.

2.4.20.2 Selected Device Clear

Reception of the addressed command **SDC** (Selected Device Clear) sets the UPA into the basic setting status and should be used at the start of a program.

Example with the Controller PCA5:

```
10 IECLAD 10
20 IECSDC
     .
     .
     .
```

2.4.20.3 Device Trigger

Upon reception of the addressed command **GET** (Group Execute Trigger), the UPA immediately starts a measurement with the previously selected setting. This trigger command corresponds to the device-specific trigger commands TRIGGER (SINGLE) or TRIGGER (STORE), but requires a somewhat shorter execution time and is therefore suitable for time-critical sequences.

Example with the Controller PCA5:

```
     .
     .
100 IECLAD 10
110 IECGET
     .
     .
```

2.4.20.4 Local Lockout (Lock Manual Operation)

The universal command **LLO** (Local Lockout) sent by the controller locks manual operation of the UPA and all devices connected to the IEC bus. The LOCAL/TALK key 18 provided on the front panel of the UPA is then inhibited. The purpose of this command is to prevent operating errors during IEC-bus controlled sequences.

2.4.20.5 Go to Local (Switch to Manual Operation)

Upon reception of the addressed command **GTL** (Go to Local), the UPA can again be manually operated. The LED REM is extinguished. Local lockout (see IEC command LLO) is reset.

Example with the Controller PCA5:

```
     .
     .
     .
100 IECLAD 10
110 IECGTL
```

Manual operation of UPA is enabled, LLO LED on the UPA is not extinguished, as Local Lockout status is still active in the UPA. Next addressing of the UPA as listener cancels manual operation facility.

Further possibility:

```
     .
     .
     .
100 IEC NREN
110 IEC REN
     .
```

Manual operation of UPA (and all devices connected to the IEC bus) is enabled, LLO LED on the UPA is extinguished.

2.5 Installation of Options

The UPA can be equipped with the following options:

DC OUTPUT UPA-B1, consisting of a printed circuit with BNC connectors and a ribbon cable

SPECIAL FILTER UPA-B2 or **SPECIAL FILTER UPA-B3,** consisting of the plug-in card A4

GENERATOR UPA-B6, consisting of the plug-in cards A1 output circuit and A2 frequency conditioning

DISTORTION UPA-B8, consisting of the plug-in cards A7 distortion 1 and A8 distortion 2

WOW&FLUTTER UPA-B9, consisting of the plug-in card A9

The options are already adjusted in the factory and can be easily retrofitted by the user.

Install the options as follows:

- Disconnect power cable.
- Remove the top cover and the top screen after loosening the corresponding Phillips screws.

For the DC OUTPUT option UPA-B1:

- Push out the two dummy covers in the rear panel for connector openings 51 from the inside.
- Remove plug-in card A3 (input section) out of the instrument by pulling up on the two levers at the same time.
- Insert the DC OUTPUT circuit board inside the rear panel such that the two BNC connectors pass through the openings just made.
- Fix the printed circuit from the rear of the instrument using the two Phillips screws supplied.
- Route the ribbon cable underneath the rear partition to the motherboard and connect to plug X21.
- Reassemble the instrument again.

For the options UPA-B2, -B3, -B6, -B8, -B9:

- Insert the plug-in cards into the provided locations according to the color codes of the guide rails and levers on the cards and press the levers down until they latch in place.

Information on the installed options is output on the FUNCTION/DATA display 13 when special function 60.5 is called up (enter 60.5/SPEC.FCT).