2.5 Generators (GENERATOR Panel)

Activating the GENERATOR panel:

- *UPL front panel*: GEN
- *External keyboard*: ALT + G
- *Mouse*: (repeated) clicking of the panel name, until the generator panel is displayed.

If the GENERATOR panel is already visible on the screen, it can be activated also by actuating one of the TAB keys (repeatedly) or by mouse-click.
Advantage: The panel need not be established again.

- The GENERATOR panel is always displayed on the left side of the screen and consists of two segments: configuration and function.

GENERATOR	
GENERATOR	DIGITAL
CHANNEL(s) : : : :	CH1
FUNCTION :	SINE

Select instrument (analog or digital).

Configuration segment for setting the outputs.
(output connectors, channel select, output impedance / sample frequency, etc.)
see 2.5.2 Configuration of the Analog Generator
see 2.5.3 Configuration of the Digital Generator

Functions (waveforms) of the Generator, see 2.5.4

When changing the *function* (generator signal)

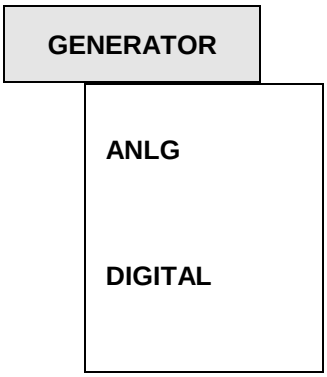
- the current function is stored to the hard disk;
- the desired function is loaded from the hard disk, initialized and, if possible, started.

When changing the *generator* (e.g. **DIGITAL** instead of **ANLG**)

- the current generator with all settings and the current function is stored to the hard disk;
- the desired generator with the currently active function is loaded from the hard disk, initialized and, if possible, started.

Note: *The "parameter link" function which can be selected in the OPTION panel may be used to influence the UPL with changes of function and instrument. As requested, existing settings in the function and/or configuration segment of the generator panel are accepted for the new function or instrument - if physically possible. A change of instrument from ANLG to DIGITAL can be performed by way of example without the function and its frequency parameters changing in the panel.*

2.5.1 Selecting the Generator



The GENERATOR panel contains the settings for the analog and the optional digital generators.

ANLG

Two-channel analog generator, frequency range:
- 2 Hz to 21.75 kHz with universal generator
- 10 Hz to 110 kHz low-distortion generator (UPL-B1 option)

DIGITAL

Two-channel digital generator, frequency range:
- 2 Hz to 21.93 kHz with option UPL-B2 (digital audio I/O)
- 2 Hz to 43.86 kHz with option UPL-B29 (digital audio 96 kHz)

The standard analog generator can be supplemented by the Low-distortion Generator option (UPL-B1) for sinewave generation in the analog range, thus allowing for generating a particular low-distortion sinewave signal with a frequency of up to 110 kHz.

- Frequency range of the digital GENERATOR

The maximum generator output frequency is given by:

$$f_{max} = sample\ frequency \times 117 / 256$$

The sample frequency is set in the configuration segment of the GENERATOR panel using the menu item Sample-Frq.

There are 3 states the active generator (visible in the panel) can assume (see 2.3.5 Status Display):

- RUNNING: The set function (generator signal) is output via the specified interface.
- BUSY: Generator output signal is calculated.
- HALTED: Generator is halted, no output signal; the outputs are terminated.

RUNNING, i.e. a signal is constantly output, is the normal status of the generator. It is automatically restarted after a generator reset.

The generator can be manually restarted at all times by calling the generator or the function (open the respective selection window and confirm using ENTER). This may be required with burst signals to enable beginning of a new interval (with the burst phase).

The setting of some signals (e.g. specific noise signals) involves a lot of computations. During this time, the generator does not produce any signal and is in the BUSY state. After having successfully concluded the computations, the generator automatically re-enters the RUNNING state. If further settings are made or keys are pressed during computation, the computation is aborted and automatically restarted. The generator shortly assumes the HALTED state.

Other reasons for halting the generator (HALTED):

- Faulty setting (e.g. wrong file name for an equalization or sweep list).
  Remedy: eliminate the cause of error; restart, if required.
- On the digital instrument:
  Applying a too high external frequency (generator is ”overrun”).
  Remedy: reduce the external clock frequency and restart.

2.5.2 Configuration of Analog Generator

The generator can be used as balanced or unbalanced source with one or two output channels. Various internal resistors are selectable.

The complete generator is designed to be floating to frame potential.

The below overview of possible settings is followed by substitute circuit diagrams showing the three balanced and unbalanced output.

Channel(s)

The deactivated channel is internally terminated with the internal impedance set.

OFF	both channels off
1	channel 1 on, channel 2 off
2	channel 2 on, channel 1 off
2 ≡ 1	identical signal on both channels

Output

The XLR connectors can be operated either balanced (BAL) or unbalanced (UNBAL).

UNBAL	an unbalanced signal is generated at the XLR connector; the maximum output level is 10 V.
BAL	a balanced signal is generated at the XLR connector; the maximum output level is 20 V. The output impedance can be selected in 3 steps. I

Impedance

Selection of generator source impedance with Output BAL selected.

10 Ω
200 Ω (150 Ω)
600 Ω

The possibility for selecting a generator source impedance of **150** Ω is offered when the standard generator source impedance of 200 Ω is changed to 150 Ω by means of Modification Analog Generator UPL-U3 (Order No. 1078.4900.02).

The output impedance of an unbalanced output is generally 5 Ω.

Volt Range

The selected voltage range determines the setting of the generator source impedance.

AUTO

The internal signal paths are driven at maximum level, the output voltage is set with the aid of the output amplifier.
Advantage: optimum noise and THD values for measurements with constant level, e.g. frequency sweep.

In the next menu line under "Max Volt" a maximum voltage can be entered; voltages higher than those specified here are *not permissible.*

FIX:

The output amplifier is set to the specified maximum voltage. The actual output voltage is obtained from small digital values on the D/A converter. When the output voltage changes, setting the analog hardware is not required. **Advantages**: no voltage drops on attenuator switchover. Faster level changes and better transient response for measurements with slight level variations, e.g. frequency sweep using an equalization file. (This setting should be used for loudspeaker measurements).

Enter the numeric value of the voltage range in the next menu line; voltages higher than those specified here *are not possible.*

Note: *This setting is ignored when the low-distortion generator option (UPL-B1) is used. Level control of the low-distortion generator is always performed in line with the AUTO algorithm.*

Max Volt

Limit value for the output voltage; prevents the inadvertent entry of exceeded voltage values.

The RMS value for sinewave signals is entered, i.e. the peak value of Max Volt is $\sqrt{2}$ times higher.

Ref Freq

Reference value for relative frequency units.
A change of the reference frequency causes all reference-related frequency settings to be changed.
The relative frequency of the generator signal is retained.

For instance, by varying the reference frequency the fundamental of a distortion spectrum set by means of a multisine signal may be shifted without the harmonics having to be recalculated and reset by the user.

Note*:* *If a generator frequency sweep is active ("X-Axis FREQ"), and AUTO scaling has been selected in the DISPLAY panel for the X axis, the reference value will be used as the Y-axis reference value in the DISPLAY panel when a new value is entered.*

Ref Volt

Reference value for the relative voltage units.
A change of the reference level causes all reference-related voltage inputs to change.
The relative voltage of the generator signal is retained.

Varying the reference voltage may, e.g., shift a level sweep defined by relative start and stop levels by a constant "gain factor".

***Note**:* *If a generator level sweep is active (X-Axis VOLT) and AUTO scaling has been selected in the DISPLAY panel, the reference value will be used as the X-axis reference in the DISPLAY panel when a new value is entered.*

2.5.2.1 Unbalanced Output (Output UNBAL)

The unbalanced output signal is applied between pin 2 (hi) and pin 3 (lo) of the XLR connector.

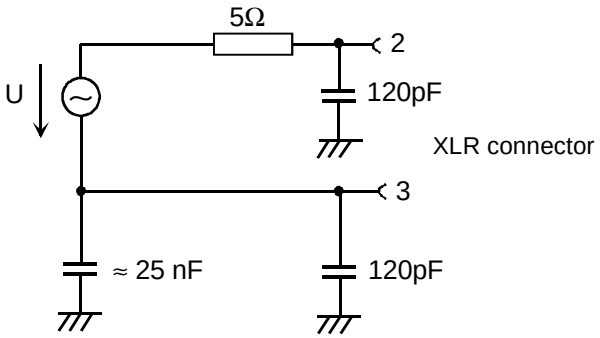
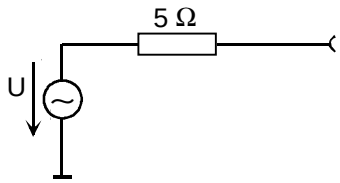


Fig. 2-12 Unbalanced output

Depending on the selected channel setting, the following output circuits are possible (capacitances are omitted):

Channel(s)
1 or 2



Channel(s)
2 ≡ 1

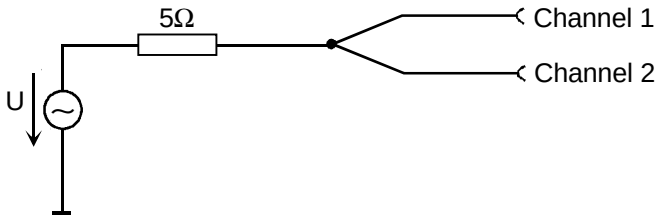


Fig. 2-13 Unbalanced output

2.5.2.2 Balanced Output (Output BAL)

The output signal is applied between contacts 2 and 3 of the XLR female connector. The source impedance is presented by two equal resistors, one in each signal line.

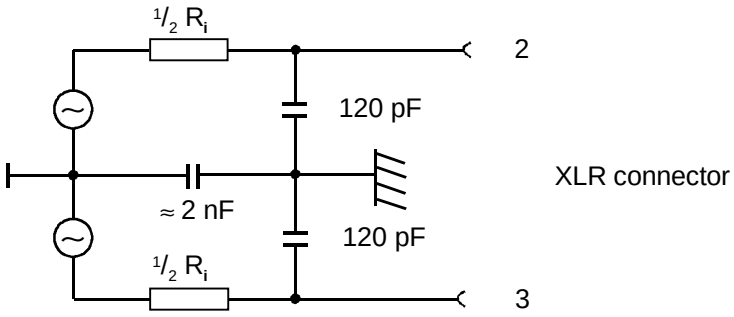
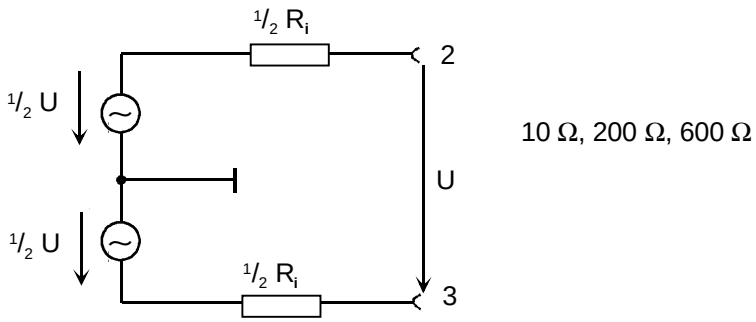


Fig. 2-14 Balanced output

Depending on channel and impedance, the following output circuits are obtained.
(Capacitances are not included in the figure):

Channel(s)
1 or 2



Channel(s)
2 ≡ 1

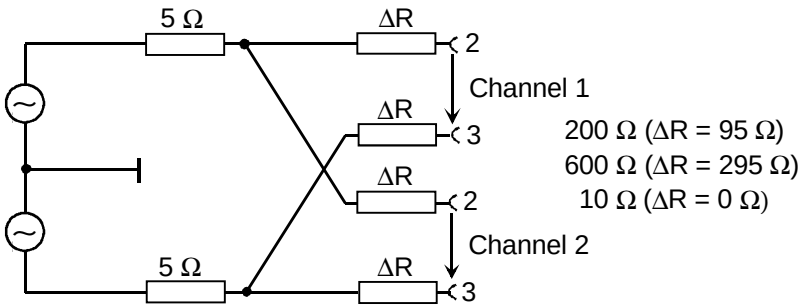


Fig 2-15 Balanced output

2.5.2.3 Output Power

The output amplifier, attenuator and all internal resistors are short-circuit proof. The peak current is limited to about 200 mA. With a maximum rms value of the output voltage of 20 V balanced and 10 V unbalanced, the maximum power loss in the load resistor (with a short-circuit in the internal resistor) is 2.8 W or 1.4 W.

Delicate devices under test might be damaged or even destroyed by an output voltage inadvertently selected too high. For this reason, the maximum settable voltage can be limited (Max Volt).

2.5.3 Configuration of the Digital Generator

Src Mode

(Source Mode); indicates what is to be generated at the digital interfaces.

AUDIO DATA

The function generator generates digital audio data. An analog jitter signal produced by the auxiliary generator (AUX GEN) or a common signal can added to the audio data stream. The audio signal is available at all digital interfaces.

JITTER

The function generator generates an analog jitter signal. All frequency and level settings refer to the jitter signal, the audio data remain constant. The audio signal is available at all digital interfaces.

PHASE

Like AUDIO DATA, the frame phase of the audio data stream to the REF output (rear of instrument) can be set. The user-defined phase depends on the following conditions

Sync To: GEN CLK only
Sync Out: ***not*** SYNC PLL
Ref Out: REF GEN only
Jitter Ref: GEN CLK only (ANALYZER panel

Note*: Although an audio signal can also be generated under this menu, PHASE should only be selected if the definable phase reference is required.*

COMMON ONLY

A balanced analog signal is superimposed onto the audio data stream on the two lines of the XLR connector. All frequency and level settings refer to the analog common signal, the audio data remain constant. The common-mode signal is available at the BAL digital interfaces only.

PhaseToRef

Displayed only, if PHASE has been selected as source mode.
Setting of the frame phase between the digital audio output and the REF output (rear).
Specified range: -64 UI to +64 UI (corresponds to -180º to +180º).
Units: UI | %FRM | ºFRM | ns

Unbal Out

indicates what is applied to the UNBAL (BNC) output.

AUDIO OUT

The *generated* AUDIO data are present (also at BAL (XLR) and optical output).

AUDIO IN

The digital AUDIO data received (at the UNBAL or BAL input) are present (front panel), e.g., an oscilloscope for examining the input signal may be connected here.

Cable Sim

(Cable Simulation)

A cable length of approx. 100 m can be simulated at the UNBAL (BNC) or BAL (XLR) outputs.

OFF Cable simulation switched off.

LONG CABLE Cable simulation switched on for both electrical outputs (BAL and UNBAL).

Note: *Cable simulation is effective even if the AUDIO IN signal is applied to the UNBAL (BNC) output.*

Sync To

(Generator synchronized to)

indicates what the digital audio generator is synchronized to. Depending on the "Src Mode", certain selections cannot be made.

AUDIO IN Synchronization to the audio input signal;
not possible with JITTER ONLY or PHASE.

REF IN Synchronization to the REF IN input signal
(XLR socket on the rear panel);
not possible with PHASE.

SYNC IN Synchronization to the SYNC IN input signal
(BNC connector on the rear panel)
not possible with JITTER ONLY or PHASE.

GEN CLK Synchronization to the internal clock generator

Sync Mode

is displayed only if the generator is synchronized to the SYNC IN input (rear); indicates the synchronization mode used.

VIDEO 50 Sample frequency synchronized to a video frequency of 50 Hz. (Europe).

VIDEO 60 Sample frequency synchronized to a video frequency of 60 Hz (USA).

Note: *with VIDEO 50 and VIDEO 60, an appropriate composite video signal must be applied to the SYNC input*

UPL-B29: *VIDEO 60 can only be operated with fixed frequencies of at least 48 kHz.*

1024 kHz Sample frequency synchronized to a 1024-kHz reference signal.

WORD CLK Sample frequency synchronized to the word-clock signal at the SYNC input.

WRD CLK INV Sample frequency synchronized to the inverted word-clock signal at the SYNC input.

Sample Frq

Setting the output clock rate.

Depending on the selected synchronization in the generator-menu line "Sync To" the following information on the clock rates can be given:

32 kHz
44.1 kHz
48 kHz

with option UPL-B2 (digital audio I/O) only

88.2 kHz

with option UPL-B29 (digital audio 96 kHz) in the high rate mode only

96 kHz

with option UPL-B29 (digital audio 96 kHz) in the high rate mode only

UPL-B29: *For selecting the fixed frequencies 88.2 kHz and 96 kHz, the menu line "Sample Mode" in the OPTIONS panel must be set to HIGH RATE.*
The fixed frequency 32 kHz is no longer supported.
The fixed frequency 44.1 kHz cannot be selected if the "Sync Mode" is set to VIDEO 60.

VALUE

The fixed frequencies can be selected when the generator is internally clocked or synchronized via the SYNC IN female connector. This is specified in the menu line

"Sync To" GEN CLK or SYNC IN

EXTERN

The generator must be clocked internally in order to enable a user-definable value to be entered under "VALUE":

"Sync To" GEN CLK

An external clock can be entered as a numeric value when the generator is synchronized to a word-clock signal (inverted, if required) via the SYNC IN or via the REF IN female connector:

"Sync To" SYNC IN
"Sync Mode" WORD CLK or WORD CLK INV

Important: *If the frequency entered does not correspond to the frequency applied, the frequencies of the generated signals vary correspondingly! The applied sample frequency must be in the range between* ***27 kHz and 55 kHz*** *(option UPL-B2) or* ***40 kHz and 106 kHz*** *(option UPL-B29. If these limits are exceeded the synchronization may be lost and the processor of the generator may be overloaded*

Status display: GEN: ORUN;

Remedy: *Reduce the external clock rate and restart the generator by acknowledging the generator instrument.*

SYNC TO ANL

If the generator is synchronized to the input signal of the analyzer, this selection item is displayed; it cannot be modified. The synchronization to the analyzer is defined in menu line

"Sync To" AUDIO IN

The numeric value of the sample frequency is copied from the analyzer panel and cannot be modified in the generator panel.

Note *The selected sample frequency can be copied automatically into the Channel -Status Bits. The Channel status file or the "Panelfile" used here has to contain appropriate keywords*

*(see 2.5.3.2 AES/EBU protocol definition). The example files with the extensions *PGC and *PPC are already configurated. Using the panel file the user can choose in the protocol menu of the generator panel whether the automatism should be applied ("Rate GEN SMPLFRQ") or whether a fixed sample rate should be entered into the Channel Status Bits*.

Sync Out

specifies the clock signal applied to the SYNC OUT output (BNC female connector on the rear of the instrument).

AUDIO IN	Digital AUDIO input signal (front panel)
REF IN	REF IN input signal (XLR female connector on the rear panel);
SYNC PLL	signal from the internal synchronization PLL (e.g., input signal with eliminated jitter)
GEN CLK	internal generator clock

Type

indicates the type of SYNC OUT signal

WORD CLK	word-clock signal (sample frequency)
BIPHASE CLK	biphase clock signal (128 times the sample frequency)

Ref Out

specifies the signal applied to the REF OUT output (XLR female connector on the rear).

AUDIO IN	(buffered) audio input signal;
AUD IN RCLK	audio input signal reclocked by the internal synchronization PLL
AUDIO OUT	generated audio signal (same as on the front panel)
REF GEN	generated reference signal, which can be defined constant low (ALL ZERO) or constant high (ALL ONE) in the next menu line "Data".

Data

is displayed only, if REF GEN has been selected for REF OUT signal.

Defines the audio data which are output at the REF OUT output (XLR female on the rear panel).

ALL ZERO	all data bits are *re*set (low level)
ALL ONE	all data bits are set (high level)

Audio Bits

Displayed only when Src Mode AUDIO DATA is selected. Word width of generated audio samples in bits.

Value range: 8 to 24

If the word width is reduced, the values of the audio samples are rounded to the specified word width.

Unbal Vpp

Sets the output voltage of the digital signal at the UNBAL (BNC) interface. Peak-to-peak voltage upon termination with nominal impedance (75 Ω); without termination the voltage is twice as high.

Setting range: 0 mV to 2.125 V; resolution 8.33 mV

This voltage is always ¼ of the voltage at the BAL (XLR) interface.

Bal Vpp

Sets the output voltage of the digital signal at the BAL (XLR) interface. Peak-to-peak voltage upon termination with nominal impedance (110 Ω); without termination the voltage is twice as high.

Setting range: 0 mV to 8.5 V

This voltage is always 4 times as high as the voltage at the UNBAL (BNC) interface.

Max Volt

Displayed only if Src Mode AUDIO DATA or phase has been selected. Limit value for entry of the output; prevents inadvertent entry of impermissibly high voltage values .

Ref Freq

Reference value for the relative frequency units.
A change of the reference frequency causes all reference-related frequency inputs to change.
The relative frequency of the generator signal is retained.

By varying the reference frequency, the fundamental of a distortion spectrum set by means of multisine can for example be shifted without the harmonics having to be recalculated and set again by the user.

Note: *If a generator frequency sweep is active (X-Axis FREQ) and AUTO scaling is selected for the X axis in the DISPLAY panel, the reference value is used in the DISPLAY panel as the X-axis reference when a (new) value is entered.*

Ref Volt

Reference value for the relative voltage units.
A change of the reference level causes all reference-related voltage inputs to change. The relative voltage of the generator is retained.

By varying the reference voltage, a level sweep defined with relative start and stop levels can for example be shifted by a constant gain factor.

Units (depending on source mode):

AUDIO DATA/PHASE: FS | %FS | dBFS | Δ% | LSBs | dBr | bits

JITTER ONLY : UI | %UI | dBUI | ppm | ns | UIr | dBr

COMMON ONLY: V | mV | µV | dBV | dBu

Note: *If the reference value is entered with a reference-related unit (e.g. dBr), the entered value is converted to the basic unit in relation to the previous reference value and then stored. This new reference value is displayed in relation to the* ***new*** *reference value (e.g. 0 dBr). Thus any reference value can be varied by a desired factor or dB value.*

Example: *0.174 FS - 10 dBr = 0.055 FS*

Note: *If a generator frequency sweep is active (X-Axis FREQ) and AUTO scaling is selected for the X axis in the DISPLAY panel, the reference value is used in the DISPLAY panel as the X-axis reference when a (new) value is entered.*

2.5.3.1 Generating Jitter, Phase and Common Mode

With digital audio interfaces, there are two types of signals to be measured, e.g. within a quality check. One is the digitally coded analog signal, and the other the digital signal. The latter too has analog parameters such as peak-to-peak voltage, frequency etc. It may be subject to interference like an analog signal. Noise or AC voltage may be superimposed, which may cause the signal slopes to be shifted. This effect is called jitter and, if it is strong enough, the audio signal can no longer be decoded or regenerated correctly. An exactly defined interference signal is to be generated by the UPL generator to examine the compatibility to jitter.

The signal lines can be designed as balanced lines which is quite usual in analog technology. Thus, injected interference, e.g. from grounded (hum) loops, would be ineffective. However, in practice this attenuation is not always sufficient so that a common-mode voltage of sufficiently high magnitude may prevent decoding and regeneration. The UPL can generate a common-mode voltage on the digital signal in order to test instruments. Of course, a common-mode signal cannot be generated at the unbalanced and the optical output.

The UPL can thus generate and simulate two different interferences of the digital audio signals: specific shifting of the signal slopes (JITTER ONLY) and the superimposition of the digital lines (COMMON ONLY) by a common-mode voltage. The sine and noise functions (arbitrary and random) are particularly suited for practical applications.

For many applications, it would be useful to determine the audio content of the signal in addition to the jitter or common-mode signal, i.e. to generate an audio signal impaired by jitter or a common-mode voltage. Thus the influence of the disturbing signal on the audio signal can be measured with option UPL-B1 fitted. UPL offers an operating mode for this case too. An additional sinewave generator (AUX GEN) can be switched on in the source modes AUDIO DATA and PHASE where any digital audio signal can be generated to superimpose either a jitter or a common-mode signal on the audio signal.

Jitter and delay are usually stated in UI (unit interval). UI is defined as the smallest pulse width of the digital audio signal (eye width) and is independent of the selected sampling rate. One UI corresponds to the clock period of the digital signal (biphase clock). With digital audio signals, one UI corresponds to 128th of the sampling period; at 48 kHz one UI is approx. 163 ns.

If several, digitally-coded signals have to be combined, as is commonly done in the studio, the signal synchronization is also of importance. Associated frames containing the instantaneous values (samples) of the left and right channels must not be delayed to such an extent that the timing tolerances of the receiver are exceeded. The UPL can simulate this error by rendering the phase between the digital output on the front panel and the independent reference generator with output on the rear panel adjustable. This refers to the phase within a frame (or 64 bits or 128 UI).

Even if the clock frequency is precisely generated by the various instruments, the frequencies tend to drift with respect to one another, which can be noticed as a phase offset (see above). This drift causes omission or doubling of individual samples. This effect can be avoided by distributing a frame sync or word clock to all instruments for synchronization, or by synchronizing them to a common clock frequency (e.g. 1024 kHz or the video sync pulses). Hence, if the UPL is to behave like an ideal source of digital signals, it must be integrated into this synchronization concept. It can, therefore, be synchronized via the SYNC IN female on the rear panel to the signals selected by means of the Sync Mode command.

In addition to the method described above, the generator can also be synchronized to the digital signal at the analyzer input using a clock frequency. A differentiation has to be made between the input on the front panel and the input of the reference receiver on the rear panel. Moreover, the generator can be operated with an own crystal oscillator.

The mode set (phase, jitter or common mode), i.e. the superimposed interference voltage always refers to the digital output on the front panel. The reference generator whose output is on the rear panel is always used as reference. If the generator is operated with external synchronization, (‘Sync To’ does not select GEN CLK), the reference corresponds to the synchronization. Besides, the synchronization output (‘Sync Out’ on the rear panel) is always without jitter or phase shift.

2.5.3.2 AES/EBU Protocol Definition

Selection of the digital generator causes the additional section PROTOCOL to be displayed in the GENERATOR panel. This section sums up the commands for definition of the protocol information (channel status data, user data, validity, parity).

PROTOCOL

Determines the scope of the protocol information generated.

PANEL OFF

No possibility to enter channel status data. The state last defined is stored statically in the setup and restored again when the UPL is switched on or during setup loading. Same internal behaviour as STATIC.
If the generated channel status data is irrelevant, the menu lines not wanted can be deleted from the generator panel.

STATIC

Only static channel status data - identical for both channels - can be generated with or without a valid CRC. This operating mode is always possible without any restrictions. The range of functions depends on whether or not the UPL-B21 option (Digital Audio Protocol) is installed.
If the UPL-B21 is not installed, the bits can only be reset or defined via a file.
If the UPL-B21 option is installed, the audio bits can additionally be entered in binary form or via a static protocol panel.

ENHANCED

Only selectable if the UPL-B21 option (Digital Audio Protocol) is installed.
The full scope of protocol data generation can be entered and is displayed in the generator panel.
Besides the valid CRC, the local time code can also be generated which is reset and a count started when the generator starts up.
In this mode, also the analyzer has to be set to protocol analysis. Therefore, the following settings are automatically executed in the analyzer panel when ENHANCED is switched on:

- INSTRUMENT DIGITAL
- Anlr Mode AUDIO DATA
- FUNCTION PROTOCOL

As soon as one of the 3 analyzer menu lines mentioned is changed, the ENHANCED mode is switched to PANEL OFF.

Validity

Set the validity identification within the AES/EBU data stream.

NONE

No validity bit set

1&2

Validity bit set in both channels

Ch Stat. L

defines the way in which channel status data LINKS are generated. This includes the operating mode (AES3, CRC or RAW), which has to be identical for the left and right. If left is selected for raw data generation, ie if neither AES3 nor CRC are defined, the operating mode can be freely selected via the menu line Ch Stat. R.

ZERO

All channel status data bits are 0. (The operating mode (AES3, CRC, RAW) is defined with the command Ch Stat. R).

FILE + AES3

UPL generates local timecode and CRC, other channel status data are defined using the following file.

PANEL + AES3

UPL generates local timecode and CRC, other channel data are set using the panel defined by the ”Panelfile” file.

FILE + CRC
PANEL + CRC

As FILE + AES3 or PANEL + AES3, however UPL does not generate local timecode, which is a fixed setting instead.

FILE

As FILE + AES3 or PANEL + AES3, however UPL generates neither local timecode nor CRC (RAW mode).

PANEL

The setting that can be made under this menu item affects Ch Stat. R. Any settings under Ch Stat. R. that are incompatible with the selection made here causes a corresponding error message to be output and the setting to be rejected.

The following restrictions apply:

- PANEL (= user-definable generator commands) can only be used with Ch Stat L or Ch Stat R.
- The operating mode must be the same for both channels.

BINARY...

If this parameter is selected, a menu is displayed which allows for binary entry of the individual channel-status bits. The data are copied in by actuating the OK field. BIN ENTRY can be used once with CH Stat L or Ch Stat R, only. The SELECT key (or space bar on the external keyboard) causes the respective bit to change from 0 to 1 or vice versa.

Note: *Local Time Code is a counter defined in accordance with AES3 which indicates the time elapsed since the beginning of transmission in samples. This counter is incremented by the UPL in the PANEL+AES and/or FILE+AES modes by 192 per frame. The value indicated in the file or panel is used as start value.*

Filename

Specifies a file containing the channel status data for LEFT.

Preset file type: *.pgc

Data are defined in single lines. Keywords in the file specify for which bits and side (left, right or both) the data are intended.
With this command only the definitions containing information data for the left or for both sides are considered. Thus the same file can be used for both sides.

Syntax:

Side: AES_CHAN_STAT or AES_CHAN_STAT_BOTH indicate the beginning of data for both sides. Analogously, AES_CHAN_STAT_RIGHT and AES_CHAN_STAT_LEFT indicate the beginning of data for one side.

These keywords may be used in any order and as often as desired.

Data: Values in the file are entered with the following line:

Keyword BIT followed by a destination range and the respective value.

Example: BIT:12-15, 1

(bits 12-15 are assigned 0001)

The ***time*** of the UPL can be specified using the keyword TIME instead of a value. To obtain the number of samples made since midnight, the time is multiplied by the currently selected sample rate (see section 2.5.3).

Example: BIT:112-143, *TIME*

The ***sample rate*** selected in the configuration section of the UPL generator (see section 0) can be entered automatically into the specified bit position using keyword RATE_TRK. UPL. UPL recognizes by means of the bit position whether the sample rate has to be coded in the consumer or the professional format and enters the respective values accordingly.

Example:
BIT:6-7, *RATE_TRK* (professional format)
BIT:35-38,*RATE_TRK* (enhanced rate for professional format)
BIT:24-27, *RATE_TRK* (consumer format)

Example file: R&S_AES3.PGC (Professional format)

Notes*: The local time (bit #112 to #143) is set to 0 when the generator is started and upcounted with the sample rate, i.e. it indicates the number of samples made since the generator start. In protocol analysis the time elapsed since the start of the generator can be determined by considering the sample rate.*

The absolute time (bit #144 to #175)) with the number of samples made since midnight is loaded when the generator is started and remains unchanged. In protocol analysis the time of the generator start can be determined by considering the sample rate.

Thus the actual time can be determined at any time by adding Local and Time.

Ch Stat. R

Specify how to generate the Channel Status data RIGHT.

The setting that can be made here is a function of Ch. Stat. L. The PANEL can be assigned only once. The operating mode (AES3, CRC, RAW) must be the same for both channels.
For more details on the individual commands, refer to Ch. Stat L.

ZERO

All channel status data bits are 0. (Operating Mode (AES3, CRC, RAW) is defined by Ch. Stat L. When Left is also set to ZERO, the operating mode is RAW).

EQUAL L

Both sides are the same. All definitions made for the left side are copied to the right. The operating mode is defined by Ch. Stat L.

FILE+AES3

This selection is displayed only when ZERO, FILE+AES3 or PANEL+AES3 have been selected for Ch. Stat L.

PANEL+AES 3

This selection is displayed only when ZERO, FILE+AES3 have been selected for Ch. Stat L.

FILE+CRC

This selection is displayed only when ZERO, FILE+CRC or PANEL+CRC have been selected for Ch. Stat L.

PANEL+CRC

This selection is displayed only when ZERO or FILE+CRC have been selected for Ch. Stat L.

FILE

This selection is displayed only when ZERO, PANEL or FILE have been selected for Ch. Stat L.

PANEL

This selection is displayed only when ZERO or FILE have been selected for Ch. Stat L.

BIN ENTRY

This selection is displayed only, if BIN ENTRY has not yet been selected with Ch. Stat L.

Filename

Specify a file containing Channel Status data for RIGHT.

preset type of file: *.pgc

The data are each defined in a line. Keywords in the file specify for which bits and side (left, right or both) the data are defined (see also specifications for the left side).
When using this command, only those definitions containing data for the right or for both sides are considered. This allows you to use the same file for both sides.

Format: see Ch. Stat. L

User Mode

Specify how to generate the user data.

ZERO

All user bits are initialized to be 0.

FILE DEF

User bits are output according to the definitions in the subsequent file.

Note: *Changing the user bits stops both the generator and the analyzer for a short time.*

Filename

Specify a file containing user data.

Preset type of file: *.pgu

The file contains both user data for the left and the right side. The keyword AES_USER_DATA_LEFT is used to indicate the beginning of data for the left side. Analogously, AES_USER_DATA_RIGHT is used for the right side.

In the following lines, values must be entered as hexadecimal numbers without any further designations . Each line contains 32 bits.
The UPL repeats block-synchronously user bits read in, the length of each cycle being equal for both sides. 192 user bits can be read in on each side. Reading in less bits on one side than on the other causes zeros to be inserted. 6 (or a multiple thereof) result in correlated user data from the beginning of the block.
The maximum permissible number of user bits is 4096 words = 16384 bytes = 131072 bits per side.
Example: AES_USER_DATA_RIGHT
0x55504E20 # = 'UPL '

Panelfile

Specify a file which contains the definitions of the freely programmable panel. This menu item is displayed only when a panel has been specified for Ch. Stat L or Ch. Stat R.

Preset type of file: *.PPC

This file allows you to define an input field tailored to meet the current requirements. This file, thus, defines the screen display for entry of the actual values. To this end, enter the respective command designations, the permissible range of values and the destination of the setting into the file. Sample files for the “professional“ and “consumer“ format according to IEC 958 are contained in the “C:\UPL\USER“ file supplied with the instrument (R&S_AES3.PPC and R&S_CONS.PPC). 4 types of commands are permissible:

- **Selection commands**

  Entering the keyword SELECTION or EXTSELECT followed by parameters defines a selection command.
  When the keyword RATE_TRK is entered with parameters specifying the sample rate, a special selection command is defined which causes item GEN SMPLFRQ to be additionally displayed in the panel. RATE_TRK may only be used where the bits for the sample rate are defined (in the consumer or professional format); otherwise this keyword has the same effect as SELECTION.

***xamples*:**

⇒ SELECTION " Use", BIT:0, 0="CONS", 1="PROF"
(Bit 0 of the channel status data can be switched between CONS and PROF using the menu line 'Use'.)

⇒ SELECTION " Usermod", BIT:12-15, 0="not ind", 3="USER"
(The four bits 12 to 15 can be switched between not ind and USER using the menu line 'Usermod'.)

⇒ RATE_TRK " Rate", BIT:6-7,
0="not ind", 1="44.1 kHz", 2="48 kHz", 3="32 kHz "

- Bits 6 and 7 of the channel status data can be switched between "ANLR TRACK", "not ind", "44.1 kHz", "48 kHz", "32 kHz" and "GEN SMPLFRQ" using the menu line "Rate". By selecting GEN SMPLFRQ the sample rate selected in the generator configuration section is automatically transferred to the channel status data. Frequencies above 48 kHz (with option UPL-B29) are shown as "not indicated", according to standard AES3.

- RATE_TRK " enh.Rate", BIT:35-38,
  0="not ind",1="24 kHz",2="96 kHz",3="192 kHz",
  9="22.05 kHz",10="88.2 kHz",11="176.4 kHz",15="User def"
  Bits 35 to 38 of the channel status data can be switched between the encoded sampling points and (in addition) GEN SMPLFRQ by means of the menu line "enh. Rate". By selecting GEN SMPLFRQ, the sampling rate selected in the configuration section of the generator is automatically adopted for the channel status data. Frequencies below 88.2 kHz are encoded as "not indicated".

***otes*:**

⇒ The channel status data are encoded according the AES3 recommendation of 1 November 98. Max. 12 normal selection commands and 3 extended ones are permissible.

⇒ The BIT interval must not be larger than 32.
⇒ Max. 8 selections per command (SELECTION) are permissible. Any value within the specified range of bits can be assigned to the selections.
⇒ In the case of overlapping bit ranges, the most recent setting overwrites the bits defined before.

Up to 24 selection possibilities are permissible with EXTSELECT.

- **Text commands**

  Entering the keyword TEXT followed by parameters defines a text command.

  ***Example*:**
  ⇒ TEXT " Origin", BIT:48-79
  (The 32 bits 48 to 79 of the channel status data are filled with the text characters to be entered here.)

  ***Note*:**
  ⇒ Up to 4 selection commands are permissible.
  ⇒ The BIT interval must not be larger than 32, i.e. max. 4 text characters (ASCII) per command are permissible.

- **Value commands (normal)**

  Entering the keyword VALUE followed by parameters defines a value command, which allows the specification of status bits as numbers. These numbers can even be multiplied by a multiplier specified in the file.

  ***Example*:**
  ⇒ VALUE " Abs.Hour", BIT:144-175, MULT:SET_RATE

  ⇒ MULT:3600 (The value defined here is entered into the 32 bits 144 to 175, the number after MULT (3600 * and SET_ RATE = set sample rate) being multiplied by the value before it is entered.)

  ***Note*:**
  ⇒ Max. 12 value commands are permissible.
  ⇒ The BIT interval must not be larger than 32, the entry is limited to 31 bits.
  ⇒ The two keywords MULT are optional. The keyword SET_RATE can also be used as multiplier.

- **Value commands (additive)**

  The entry of the keyword ADDVALUE followed by parameters defines a value command, the value being added to already available values.

  ***Example*:**
  ⇒ ADDVALUE " Abs.Min", BIT:144-175, MULT:2880000
  ⇒ (The value entered here is added to the 32 bits 144 to 175 of the channel status data. Prior to the addition, the number after MULT (2880000 = 60 ∗ 48000) is multiplied by the value.)

Note: See under value command (normal).

Examples:
R&S_AES3.PPC for panel acc. to AES3 format
R&S_CONS.PPC for panel acc. to consumer format

In the panel, the UPL displays the commands in the order
1. SELECTION/EXTSELECT/RATE_TRK
2. VALUE / ADD VALUE
3. TEXT

In the file, any desired order is permissible.

2.5.4 Functions

FUNCTION	
SINE	Single sine, dither may be included.
MULTISINE	Up to 17 sines
SINE BURST	Sine burst signal
SINE^2 BURST	Asymmetrical sine burst
MOD DIST	Test signal for intermodulation distortions
DFD	Test signal for difference frequency distortions
RANDOM	Random noise
ARBITRARY	Arbitrary waveform and WAV file output
POLARITY	Test signal for polarity measurements
FSK	Frequency shift keying;, only if the UPL-B33 option is installed; only required for ITU-T O.33 (line measurement). Not available in the digital generator of the UPL16.
STEREO SINE	Stereo sine, digital only, only if the UPL-B6 option is installed. Not available in the digital generator of the UPL16.
MODULATION	Frequency or amplitude modulation (sine signal).
DC	DC signal.
CODED AUDIO	Digitally coded audio data to IEC 61937. Only digital if the UPL-B23 option is installed.

Note:

When the function is changed, the generator is briefly stopped. The output signal is then set to 0 V or 0 FS.

2.5.4.1 Common Parameters for Generator Signals

2.5.4.1.1 Common Parameters for SINE, DFD, MOD DIST Signals

Frq Offset

Frequency offsets when entering frequencies.

+1000 ppm

Set the frequency with an offset of +0.1%

*Note: If the generator frequency is referenced to per GENTRACK with frequency offset switched on, the **set** frequency and not the actually generated one is used as reference (see 2.6.5.1, RefGen)*

OFF

Set the frequency without offset

Dither

For the digital generator, only (DIG 48 kHz) option UPL-B2 or UPL-B29, only

ON

A noise component is superimposed on the signals. The amplitude of the noise component can be entered in the next menu line. The power density function (PDF) can be entered further down. It is recommended to use only low noise amplitudes, eg the final 1 to 3 LSB.

***UPL-B29**: In the high rate mode, dither can only be generated for the sinewave signal, whereas the base rate mode also enables multitone signals.*

OFF

No superimposed noise

PDF

Only for the digital generator (DIG 48 kHz), with activated dither
Select the amplitude distribution (probability distribution function) of the superimposed noise signal.

GAUSS

Gaussian distribution

TRIANGLE

Triangular distribution from -peak to +peak

RECTANGLE

Equivalent distribution from -peak to +peak

2.5.4.1.2 Common Parameters for All Generator Functions

DC Offset

permits the superposition of a settable direct voltage on the generator output

ON

The signals are superimposed a DC voltage content. The amplitude of the DC voltage content can be entered in the next menu line.
This selection is permitted for all functions of the function generator, except for the (analog) low-distortion generator.

OFF

no DC voltage signal active

Note: *for the analog generators, offset is limited on ± 5 V (UNBAL) or ± 10 V (BAL)*

2.5.4.1.3 Equalization of the Signals SINE, SINE BURST, DFD, MULTISINE, RANDOM

Equalizer

Activate/Deactivate an equalizer table including frequency specifications and appertaining voltage amplification factors. Depending on the frequency, the set voltage can be multiplied by an equalizing factor (after interpolation between the adjacent frequency points) before they are switched to the outputs. The equalized voltage can be measured internally by means of the analyzer.

Note: *When entering equalizing factors > 1 it may occur that the equalized voltage exceeds the selected maximum voltage (entry under menu item Max Volt) or the physically feasible voltage. If this is the case, the voltage output is limited (to the smaller of the two values).*

Typical application:
Simulating the effects of a preemphasis; measurement with constant power on DUTs with frequency response.

ON

Equalizer is switched on. Menu item ”Equal. file” is activated, i.e. the file listed under this menu item is loaded.

Note: *If the generator voltage is referenced to per GENTRACK with the equalizer switched on, the **set** voltage and not the equalized one is used as reference (cf. 2.6.5.1 Reference).*

OFF

Output voltage is not affected.

Equal. file

(Equalizer file)
with Equalizer → ON only;
Menu item for entry of the equalizer file name. The file is opened and saved in an internal buffer.

Entering an invalid name (disk drive not ready, file not found, invalid format, etc.) leads to the output of an error message and the entry ”not found” in the menu line.

For entering a file name, see 2.3.2.5;
For generation of an equalizer file, see 2.9.1.2 Loading and Storing of Series of Measured Values and Block/List Data ("Store → EQUALIZATN").

2.5.4.1.4 Amplitude Variation of the Signals MULTISINE, RANDOM and ARBITRARY

Ampl Var

Selection of type of modulation. In contrast to the classic modulation as it is offered (for sine signals) by the MODULATION function, 2 different methods of amplitude modulation are offered here. Besides, the signal is not modulated with the set level, which is approximated by +/- 100% maximum, but variated by 0 ... –100%. For distinction from modulation, this procedure is referred to as "amplitude variation" and "variation" instead of "amplitude modulation" and "modulation depth".

OFF

The amplitude variation is switched off, the generator signal is not modulated.

SINE

The generator signal is amplitude-modulated from 0% - 100% in the form of a sinewave.

BURST

The generator signal is switched on and off periodically.

Mod Freq

with "Ampl Var SINE", only: setting of the modulation frequency

Range of values: 1µHz to f_{max}
f depending on the generator; see 2.5.1 Selecting the Generator

Variation

with "Ampl Var SINE", only: setting of the variation in %.,which the signal is reduced by, ie., is varied.

Range of values: -100 to 0 %

Example: *Output levels of 9.90 V to 10.0 V are obtained with a carrier amplitude of 10 V and a variation of -1 %.*

ON TIME

with "Ampl Var BURST", only: entry of the burst duration, i.e., the time while the sine is switched on.

Specified range:lower limit : (1 sample)
analog: t_{min} = 20.83 µs
digital: t_{min} = 1 / sample frequency
upper limit: 60 s – t_{min}
Units: s | ms | µs | min

***Side effect**:*

If a burst duration is entered which exceeds the interval length, the latter is increased to burst duration + t_{min}.

Remark on the unit:

In contrast to the SINE BURST function, the burst duration cannot be entered in cycles, since the signal is not a single sine.

INTERVAL

with "Ampl Var BURST", only: entry of the burst interval length (burst period), i.e., the sum of burst duration and break time.

Specified range: lower limit: set burst duration.
upper limit: 60 s
Units: s | ms | µs | min

Remark on the unit:

In contrast to the SINE BURST function, the burst period cannot be entered in cycles, since the signal is not a single sine.

2.5.4.2 Sweeps

With many generator functions, it is useful to output signal parameters (level, frequency, in the case of burst signals also switch-on time and length of intervals) not only statically but to vary them with respect to time. A sweep system allowing 2 parameters to be varied simultaneously (two-dimensional sweep) is available for these signals.

- One-dimensional sweep: the parameter specified under X-axis is varied from start to stop or according to the LIST file.
- Two-dimensional sweep: the parameter specified under Z-axis is set to the start value or the first entry in the 1st LIST file. The parameter defined under X-axis is varied from start to stop or in accordance with the 2nd LIST file. The Z-parameter is then set to the next value and the sweep of the X-parameter starts again from the beginning. The two-dimensional sweep is concluded when the Z-parameter has assumed its final value. When a Z sweep is switched on, Scan count is set according to the number of Z points.

The so-called ”LIST buffers”, with a length of 1024 entries each, serve as data source for the sweep parameters. The total length of the LIST buffers is obtained by multiplying the lengths of X- and Z-buffer; with one-dimensional sweeps, the length of the Z-buffer is to be defined as 1. If you specify too many items, the last ones, i.e. those exceeding 1024 are ignored. Each buffer contains a table, which can either be derived from user specifications (normal sweep) or is loaded from a file (list sweep; see Sweep→Ctrl).

With normal sweeps, tables with equidistant rising or falling values are generated depending on whether the start value is lower or higher than the stop value. As soon as a “normal“ sweep is switched on or a new start value is selected, the start value is set in the instrument hardware, in order to keep the settling time with starting of sweep as short as possible.

With “list-controlled sweeps“, the values for the sweep parameters can be spaced as desired, however, they must be consecutive (just as with “normal“ sweep) (2.9.3 Series of Measured Values (Sweeps and Scans) and Block/List Data).

If a running sweep is stopped or switched off, the swept parameters retain the current numeric values.

Note: *Sweeping from high to low frequencies allows the beginning of the sweep curve to be displayed faster than its end because high frequencies require less measuring time.*

For starting and stopping the sweep, see **2.11**.

Table 2-26 List of sweepable function parameters depending on the function selected:

Function	VOLTAGE	FREQUENCY	ON-TIME	INTERVAL
SINE	yes	yes	---	---
MULTISINE	no	no	---	---
SINE BURST	yes	yes	yes	yes
$SINE^2$ BURST	yes	yes	yes	yes
MOD DIST	yes (total Volt)	yes (user frequency)	---	---
DFD	yes (total Volt)	yes (mean frequency)	---	---
RANDOM	no	---	---	---
RANDOM+ANLR	no	---	---	---
ARBITRARY	no	---	---	---
FSK	no	no	---	---
POLARITY	no	---	---	---

Remark:

In addition to the above generator sweeps, several analyzer sweeps can be performed:

- time-controlled analyzer sweeps are selected under menu item START COND in the ANALYZER panel (for all measurement functions)
- external frequency or level sweeps are also selected in the ANALYZER panel under menu item START COND (for all measurement functions)
- the bandpass mean frequency can be swept in the RMS SELECTIV measurement.

Only one generator or one analyzer sweep can be active at a time. If a 2nd sweep is selected, the first sweep is switched off again and a warning is read out.

SWEEP Ctrl

Activate/Deactivate the sweep system and specify the data source and sweep run.

OFF

The sweep system is switched off; all parameters are entered directly into the panel by the user.

AUTO SWEEP

The sweep runs automatically after having pressed the START or SINGLE key (see 2.11 Starting and Stopping of Measurements or Sweeps).
The data of the sweep parameters are obtained from user specifications (start/stop value and step size or number of points); normal sweep
Sweep stepping can be synchronized with the analyzer in menu item Next Step.

AUTO LIST

The sweep runs automatically after having pressed the START or SINGLE key (see 2.11 Starting and Stopping of Measurements or Sweeps).
The data of the sweep parameters are read from file; (list sweep) for generation of lists, see 2.9.1.2, menu item STORE TRACE/LIST,
Store → X AXIS, Store → Z AXIS
Sweep stepping can be synchronized with the analyzer in menu item Next Step.

MANU SWEEP

The sweep is controlled by means of the rotary knob and/or the cursor keys. When you press the START key, the 1st measured value only is recorded. Any further sweep point must be explicitly requested using the rotary knob or by pressing a cursor key (see 2.11 Starting and Stopping of Measurements or Sweeps.
The data of the sweep parameters are obtained from user specifications (start/stop values and step size or number of points); normal sweep.
When sequencing the manual sweep, the result of the current measurement is not waited for, i.e. the current measurement and possibly a set analyzer delay are aborted.

MANU LIST

The sweep is controlled by means of the rotary knob and/or the cursor keys. When you press the START key, the 1st measured value only is recorded. Any further sweep point must be explicitly requested using the rotary knob or by pressing a cursor key (see 2.11 Starting and Stopping of Measurements or Sweeps).
The data of the sweep parameters are read from a file; list sweep.
For generation of lists, refer to 2.9.1.2, menu item STORE TRACE/LIST,
Store → X AXIS, Store → Z AXIS
When sequencing the manual list sweep, the result of the current measurement is not waited for, i.e. the current measurement and possibly a set analyzer delay are aborted.

Notes on manual sweep:

- *In order to control manual sweeps using the rotary knob or the cursor keys, the graphics must be active (full-screen or part-screen mode). When the sweep is started, the switchover to the graphics panel occurs automatically.*
- *The feature "manual sweep" can be used to vary generator parameters with a user-definable increment. The increment is defined by a fixed "step" (with MANU SWEEP) or by a variable step size defined per file (with MANU LIST). In remote control mode, the command "INIT:NEXT<n>" is used to continue.*

- *Individual sweep points can be skipped by turning the rotary knob fast. Also, sweep points can be repeated by turning the rotary knob back.*
- *The measured values are represented by means of crosses in the Curve Plot mode. With the DISPLAY panel setting Scan count >1 selected, these crosses are not deleted before being updated but remain on the screen. With strongly fluctuating measurement values, the representation approximates the shape of a bar. If sweep steps are skipped or advanced too fast, a NAN (Not A Number) value is entered. When reaching the end of sweep, the complete trace (with the latest measured values) is obtained.*

Next step

With automatic sweep stepping ("Sweep Ctrl → AUTO SWEEP" or "Sweep Ctrl → AUTO LIST") only.
Select the sweep synchronization.

ANLR SYNC

Analyzer synchronization:
The sweep continues after a valid measured value has been obtained; recommended in generator/analyzer mode.

DWELL VALUE

Time synchronization with fixed time:
The sweep continues after a specified time has elapsed. The time is defined in menu item "Dwell". Required for sweeps with external analyzer.

DWELL FILE

Time synchronization using times specified in a list:
The sweep continues after specified times which are read out of a list and interpolated on the basis of the existing X-axis.
Required for sweeps with external analyzer, if the measuring or settling time of the analyzer and/or the DUT depends on the respective sweep point.

Dwell File

With automatic sweep ("Sweep Ctrl → AUTO LIST") and list-controlled time synchronization ("Next step → DWELL FILE") only.
Specify a file containing the dwell times

The file is opened and loaded into an internal buffer.

If the name entered is not valid (drive not ready, file not found, invalid format, etc.), an error message is output and the reason for the fault is entered into the menu line.
For entry of file names, see 2.3.2.5; for generation of the list, see 2.9.1.2 Loading and Storing of Traces and Lists.

Dwell

Only with automatic sweep and list-controlled time synchronization ("Next step → Dwell:value").

Enter a dwell time for all sweep points.

Specified range:	0 to 1000 s.
Units:	s | ms | µs | min
Resolution:	1 ms

X Axis

With an active sweep system only.
Select the sweep parameter (one-dimensional sweep) or the 1st sweep parameter (two-dimensional sweep).

VOLT	Signal voltage (SINE, SINE BURST, SINE^2 BURST) or total voltage (MOD DIST, DFD) is swept.
FREQ	Signal frequency (SINE, SINE BURST, SINE^2 BURST), useful frequency (MOD DIST) or center frequency (DFD) is swept.
ON TIME	Time of high level with burst signals is swept.
INTERVAL	Interval time with burst signals is swept.

Z Axis

With active sweep system, only
Select the 2nd sweep parameter for a two-dimensional sweep.

OFF	Sweep is one-dimensional
VOLT	Sweep is two-dimensional, the 2nd. sweep parameter is the signal voltage (SINE, SINE BURST, SINE^2 BURST) or total voltage (MOD DIST, DFD).
FREQ	Sweep is two-dimensional, the 2nd sweep parameter is the signal frequency (SINE, SINE BURST, SINE^2 BURST, SQUARE), wanted frequency (MOD DIST) or center frequency (DFD).
ON TIME	Sweep is two-dimensional, the 2nd sweep-parameter is the time of the high level (only with burst signals).
INTERVAL	Sweep is two-dimensional, the 2nd sweep parameter is the interval time (only with burst signals).

Note: *With two-dimensional sweeps of "ON TIME" and "INTERVAL", the minimum value of "INTERVAL" must exceed the maximum "ON TIME" value. With normal sweep, this is ensured by limitation and, if required, correction of the start and stop values with entry already. However, with list sweep, the user should make sure that this condition is met in the lists used, since a required, automatic correction is not carried out until the sweep is running - thus, unexpected results may be obtained.*

Note: *Theoretically, the same parameter may be entered for the X and Z axes (e.g., VOLT in both directions) - and this is not prohibited in the operator surface. This does, however, not make sense in normal practical use*

Spacing

With normal sweep only
(Sweep Ctrl → AUTO SWEEP or Sweep Ctrl → MANU SWEEP);
Determine the sweep range spacing.

LIN POINTS

The sweep range is linearly divided by a number of points to be specified. The number is entered under menu item "Points".

LIN STEPS

Beginning from "Start", the sweep range is divided into intervals using a linear step size to be specified under menu item "Step".

LOG POINTS

The sweep range is logarithmically divided by a number of points to be specified. The number is entered under menu item "Points".

LOG STEPS

Beginning from "Start", the sweep range is divided into intervals using a logarithmic step size to be specified under menu item ”Step” (multiplier without unit)

Note: *No conversion is performed when switching from ... POINTS to ...STEPS and vice versa; the set values are retained in the back-ground. The numeric value for ”STEP” remains the same when switching between LIN STEPS and LOG STEPS.*

Start

With normal sweep only
(Sweep Ctrl → AUTO SWEEP or Sweep Ctrl → MANU SWEEP)
Enter the start value for the (above) sweep parameter.
Specified range, unit and resolution: as for the appertaining sweep parameter.
If a start value is entered that is identical with the stop value, the stop value is automatically loaded with the old start value.
In this way, the sweep direction can be easily reversed by means of a single entry.
Note: *The start value of the sweep parameter is set in the instrument hardware with entry already (not with starting the sweep). The settling time with starting the sweep can thus be minimized.*

Stop

With normal sweep only
(Sweep Ctrl → AUTO SWEEP or Sweep Ctr → MANU SWEEP)
Enter the stop value for the (above) sweep parameter
Specified range, unit and resolution: as for the appertaining sweep parameter.
If a stop value is entered that is identical with the start value, the start value is automatically loaded with the old stop value.
In this way, the sweep direction can be easily reversed by means of a single entry.

Points

With normal sweep only
(Sweep → AUTO SWEEP or Sweep Ctrl → MANU SWEEP) and
Spacing → LIN POINTS or Spacing → LOG POINTS selected.

Specified range: 2 to 1024.
Units: None (integer)

Enter the number of sweep points for the (above) sweep parameter. The sweep range is divided into (points - 1) steps. 2 points at least (start and stop value) are required.

Step

With normal sweep only
(Sweep Ctrl → AUTO SWEEP or Sweep Ctrl → MANU SWEEP) and
Spacing → LIN STEPS or Spacing → LOG STEPS selected.

Enter the step size for the (above) sweep parameter.

With *linear* step, the absolute step size is always entered, i.e., the number value is positive even, if the start value exceeds the stop value.

With logarithmic step, the multiplication factor is entered, which is required for each sweep point to obtain the next sweep point. If start and stop value are interchanged (reversal of the sweep direction), the reciprocal value is constituted.

Specified range: see operator guidance line. The step size is to be selected as high as to result in not more than 1023 individual steps.

Unit and resolution: With linear spacing as for the appertaining sweep parameter. With logarithmic spacing, no unit can be entered (factor without unit).
Exception: *In the case of voltage sweeps (x-axis Volt), the logarithmic scaling can be entered either as a factor or in dB.*

FREQ FILE

With list sweeps only (Sweep Ctrl → AUTO LIST or
Sweep Ctrl → MANU LIST)

Enter a file name for the frequency list. For the entry of file names see 2.3.2 Data Entry

The signal frequency (SINE, SINE BURST, $SINE^2$ BURST), the useful frequency (MOD DIST) or the center frequency (DFD) is swept.

VOLT FILE

With list sweeps only (Sweep Ctrl → AUTO LIST or
Sweep Ctrl → MANU LIST)

Enter a file name for the amplitude list. For the entry of file names see 2.3.2 Data Entry

The signal voltage (SINE, SINE BURST, $SINE^2$ BURST) or the total voltage (MOD DIST, DFD) is swept.

ONTIM FILE

With list sweeps only (Sweep Ctrl → AUTO LIST or Sweep Ctrl → MANU LIST)

Enter a file name for the "ON-time" list of burst signals. For the entry of file names see 2.3.2 Data Entry

The burst duration (SINE BURST, $SINE^2$ BURST) is swept.

INTV FILE

With list sweeps only (Sweep Ctrl → AUTO LIST or Sweep Ctrl → MANU LIST)

Enter a file name for the interval list of burst signals. For the entry of file names see 2.3.2 Data Entry

The burst interval (SINE BURST, $SINE^2$ BURST) is swept.

2.5.4.3 SINE

Frq Offset

See 2.5.4.1 Common Parameters for the Generator Signals.

Dither

For digital generators only;
See 2.5.4.1 Common Parameters for the Generator Signals.

PDF

For digital generators only;
See 2.5.4.1 Common Parameters for the Generator Signals.

Low Dist

(Low-distortion generator) for the analog generator only.

Activating/Deactivating the low-distortion generator (see 2.5.1 Selecting th Generator)

ON

(with UPL-B1 option only);
the sine is generated by the low-distortion generator.

OFF

The sine is generated by the universal generator.

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions.

SWEEP CTRL

see 2.5.4.2 Sweeps

Frequency

Entry of the sine frequency; can be used as sweep parameter.
Specified range: 10 Hz to f_{max}
f_{max} generator-dependent; cf. 2.5.1 Selecting the Generator
Resolution: 1 MHz
Unit: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Equalizer

see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM

The sine voltage is corrected.

ON

Equalizer switched on. Menu item "Equal. file" is activated, i.e. the file indicated there is loaded.

OFF

Output voltage not affected.

Equal. file

(Equalizer file)
with Equalizer → ON only;
see2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM

Voltage

Entry of the sinewave amplitude; can be used as sweep parameter;
see 2.3.2 Data Entry

Specified range:
- digital: 0 to 1 FS (audio data or phase mode)
  0 to 2.5 UI (jitter mode)
  0 to 7.071 V_{rms} (common mode)
- analog: 0 to 10 V_{rms} for UNBAL
  0 to 20 V_{rms} for BAL

Note: *Voltage limitation of the rms value by means of menu item "Max Volt", see 2.5.2 Configuration of the* Analog Generator */ 2.5.3 Configuration of the* Digital Generator

Units:

digital (audio data or phase mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr

digital (jitter mode):
UI | %UI | dBUI | ppm | ns | UIr | dBr

analog and digital common mode:
V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

Peak-to-peak amplitude (analog): $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$;

2.5.4.4 MULTISINE

Up to 17 single sine voltages can be superposed on each other.

The phase angles of the single sine voltages are automatically optimized such that the maximum total peak value is as low as possible. The resulting total peak value thus being frequency-dependent, the voltage may increase when varying individual frequencies. The set maximum voltage (”Max volt”, see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator) is however never exceeded since the worst case is taken as the basis for linear superposition when entering the single voltages.

Further ***special multi-tone signals*** are selected using the functions

- MOD DIST (2 sinewave amplitudes with the ratios 1:1 to 10:1)
- DFD (2 equivalent sinewave amplitudes)
- SINE (1 sinewave with any amplitude)
- RANDOM, domain FREQ (7488 sinewave lines at fixed frequency offset with any amplitude)

With the first 3 functions, a “Frq Offset“ or (with digital generator), in addition, ”Dither” with ”PDF” can be set.

Note:

- *The generator is interrupted while calculating a new multi-tone signal. The output signal is definitely set to 0 V or 0 FS.*

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

Spacing

Set the frequency spacing:

USER DEF

The value entered is corrected to the next settable value.
The specified range depends on the selected generator and its sample rate (see 2.5.1 Selecting the Generator):
Lower limit:
- ANLG: 2.9 Hz
- DIG instruments: Int. sample frequency / 16384

Units: Hz, kHz

ANLR TRACK

The value for the FFT analysis frequency spacing is automatically adopted. The value is also displayed in the ANALYZER panel under "FFT:Resolution" (see 2.6.5.12 FFT). This setting is ideal for an analysis using the rectangular window. With no FFT selected in the analyzer, the setting is rejected (error message!).

Equalizer

see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM

Each active frequency line is corrected.

ON

Equalizer switched on. Menu item "Equal. file" is activated, i.e. the file indicated there is loaded.

OFF

The output voltage of all frequency lines is not affected.

Equal. file

(Equalizer file)
with Equalizer → ON;
see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM

Mode

Select the input mode for the individual sine voltages:

EQUAL VOLT

The same amplitude applies for each single sine; it is entered as “Volt No1“.

DEFINE VOLT

An individual amplitude can be defined for each single sine.

Crest Fact

Selects the algorithm for determining the phase of individual sinewaves and thus of the crest factor of the complete signal.
This menu item is only displayed with option UPL-B6 installed.

OPTIMIZED

The crest factor is automatically *minimized* by internally optimizing the individual phases.

VALUE:

Definition of *desired crest factor.* The phase of the individual sinewaves are modified internally so that the resulting crest factor closely approaches the desired value. The accuracy of this method depends on the number of lines.

DEFINE PHAS

Entry of *phases* of all active sine lines.

No of sine

Specified range: 1 to 17
Units: none

Entry of number of desired tones, i.e. the number of sines to be edited. In EQUAL VOLT mode, the entry also influences the maximum amplitude that can be entered for a single sine tone (see "Volt No (i) ").

For a better overview, settings for up to 17 frequencies and levels are not made in the GENERATOR panel, but in a special dialog window, which is opened automatically with selection of "No of sine" or command "Choice ..." below. In this window, the individual frequency, phase and level menu items can be copied into the STATUS panel by ticking them off. Subsequent to closing the window, they can be displayed and entered in the STATUS panel.

Choice ...

Opens a special dialog window where the individual sine frequencies and levels can be displayed and entered in a clearly arranged form.

All frequency and level items marked in the menu of this window are transferred into the STATUS panel where they can be displayed and entered even after this window has been closed.

***Note**: The dialog window described here is also automatically opened when "No of sine" is entered.*

Freq No (i)

Enter the sinewave frequency i (i = 1 to 17)

Specified range: f_{min} to f_{max} (depending on generator)
f_{min}: Value from spacing
f_{max}: see 2.5.1 Selecting the Generator

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

The single frequencies may lie as close to each other as desired or may even be superposed on each other (taking the resolution into account).

Phase No (i)

Entry of phase of individual sinewave i (i = 1 to 17)

This menu item is only displayed when software option UPL-B6 is installed and DEF PHASE was selected as crest factor.

The reference point is the assumed time T0, where all sinewaves start with the phase 0.
If sinewave No. 1 is to be used as reference frequency, it must be assigned the phase 0.

Specified range: 0 to 360°
Unit: ° or RAD

If two or more individual lines have the same frequency, i.e. are superimposed, the first of the two lines determines the (common) phase which is assigned to all subsequent frequency lines.

Volt No (i)

Enter the sinewave amplitude i (i = 1 to 17)

Specified range: t the total voltage V reduced by the dc voltage is available for each of n single sines (n = "No of sin", 1 to 17). To avoid overranging the (phase-optimized) overall signal may be reduced by reducing the post-amplification.

digital (audio data or phase mode):
V_{max} = 1 FS
(jitter mode): V_{max} = 2.5 UI
(comm mode): V_{max} = 7.071 V_{rms}
analog: V_{max} = 10 V_{rms} for UNBAL
V_{max} = 20 V_{rms} for BAL

Note: *Voltage limitation of the rms value by menu item "Max volt", see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator*

V_{max} is split up into the single sine voltages as follows:

- in EQUAL VOLT mode, any sine may be as large as (V_{max} DC)/n
- in DEFINE VOLT mode, any sine may be as large as the difference between (V_{max} DC) and the sum of all other active single sines

Units:
digital (audio data or phase mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr
digital (jitter mode):
UI | %UI | dBUI | ppm | ns | UIr | dBr
analog and digital common mode:
V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r | dBu | dBV | dBr | dBm | Δ%V | ΔV | ΔmV | ΔµV

peak-to-peak amplitude (analog): $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$;

Total Gain

Entry of a gain factor (in dB), which allows to vary the rms value resulting from superimposition of the individual voltages. To avoid overranging the permitted range of values is varied such that the resulting overall signal does not exceed the permitted (or possible) generator output level.

Unit: dB

TOTAL PEAK

Read only, no input field
Indicates total peak value of multi-tone signal. The value is usually below of the single peak values due to internal phase optimization

Units: digital (audio data or phase mode):
FS | %FS | dBFS | LSBs | bits
digital (jitter mode):
UI | %UI | dBUI | ppm | ns
analog and digital common mode:
V | mV | µV | dBu | dBV | dBm

TOTAL RMS

Read only, no input field (only analog)
Indicates total rms value of multi-tone signal.

Units: V | mV | µV | dBu | dBV | dBr | V/V_r | Δ%V | ΔV | ΔmV | ΔµV

Ampl Var

Selection of the type of modulation, see 2.5.4.1.4 Amplitude Variation of MULTISINE, RANDOM and ARBITRARY

OFF

The amplitude modulation is switched off, the generator signal is not modulated.

SINE

The generator signal is amplitude-modulated in the form of a sinewave from 0% to -100%.

BURST

The generator signal is switched on and off periodically;

Mod Freq

with "Ampl Var SINE", only: setting of the modulation frequency; see 2.5.4.1.4

Variation

with "Ampl Var SINE", only: setting of the variation in %, see 2.5.4.1.4.

ON TIME

with "Ampl Var BURST", only: entry of the burst duration, see 2.5.4.1.4.

INTERVAL

with "Ampl Var BURST", only: entry of the burst-interval length (burst period) , see 2.5.4.1.4.

2.5.4.5 SINE BURST

Sine periodically varying between high and low level. Like the normal sine, the signal can optionally be equalized.

Equalizer

see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM

ON

The sine voltage is equalized.

OFF

Equalizer is switched on. The menu ”Equal. file” is activated, i.e., the file indicated there is loaded.

output voltage is not influenced

Equal. file

(Equalizer file) only, if equalizer → ON
see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM.

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

SWEEP CTRL

see 2.5.4.2 Sweeps.

FREQUENCY

Entry of the sine frequency; can be used as sweep parameter;
see 2.3.2 Data Entry

Specified range: 10 Hz to f_{max}
f_{max} depending on generator; see 2.5.1 Selecting the Generator

Resolution: 1 MHz

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Side-effect: ON TIME is adjusted, if required.

VOLTAGE

Entry of the high-level sine amplitude, i.e. the amplitude during burst time; can be used as sweep parameter; see 2.3.2.5.

Specified range: 0 to V_{max}

digital: V_{max} = 1 FS

analog: V_{max} = 10 V_{rms} for UNBAL

V_{max} = 20 V_{rms} for BAL

Note: *Voltage limitation of the rms value by menu item "Max volt", see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator*

Units: digital (audio data mode):

FS | %FS | dBFS | LSBs | bits | Δ% | dBr

analog:

V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

peak-to-peak amplitude (analog): $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$;

Side effect: Low Level is adjusted, if required.

Low Level

Enter the low-level sine amplitude, i.e. the amplitude during OFF time.

Specified range: 0 to high level (VOLTAGE)

Units:

digital (audio data mode):

FS | %FS | dBFS | LSBs | bits | Δ% | dBr |
%on | dBon

analog:

V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm | V/on | %on | dBon |
Δ%V | ΔV | ΔmV | ΔµV

As to the unit: *In addition to the standard voltage specifications (absolute or relative to the reference value), further relative units referring to high level can be used. They are*

%on, dBon; in the analog range also V/on

If a unit of this kind is selected, the ratio

"low level : high level"

is always kept constant when the high level is varied. This means that changing VOLTAGE (also during a sweep) changes the low level, too.
With all other units, varying VOLTAGE affects the low level only when VOLTAGE becomes smaller than the low level.

peak-to-peak amplitude (analog): $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$;

ON TIME

Entry of the burst duration, i.e. the time during which the sine has its high level; can be used as sweep parameter.

Specified range:	lower limit:	(1 sample)
	analog:	t_{min} = 20.83 µs
	digital:	t_{min} = 1 / $sample_{Frq}$
	upper limit:	60 s -t_{min}
Unit:	s | ms | µs | cyc | kcyc | Mcyc	

Side effect: *Entering a burst duration exceeding the length of an interval causes the interval length to be increased to burst duration.*

Note as to the unit: *Apart from standard time specifications, the burst duration can also be specified in cycles. The selection of this unit, which is relative to frequency, results in the number of cycles - and not the burst time - remaining constant when the frequency is changed, i.e. increasing the frequency decreases the duration of the burst signal. If INTERVAL is not specified in cycles, the ratio ON–TIME : INTERVAL is reduced.*

INTERVAL

Entry of the burst interval length; can be used as sweep parameter.

Specified range:	lower limit:	set burst duration.
	upper limit:	60 s
Units:	s | ms | µs | cyc | kcyc | Mcyc | min	

Note as to the unit: *Apart from standard time specifications, the burst interval can also be specified in cycles. The selection of this unit, which is relative to frequency, results in the number of cycles - and not the interval time - remaining constant when the frequency is changed, i.e. increasing the frequency decreases the interval of the burst signal, If the ON TIME is not specified in cycles, the ratio ON–TIME : INTERVAL is increased.*

Note*: If generator settings are modified or a measurement is (re-)started, the generator is automatically restarted and starts the interval (considering the Burst On Delay) with ON TIME, i.e. with High Level.*

BurstOnDel

(Burst on delay)

When starting the generator (e.g., subsequent to changing or acknowledging the function) or starting the measurement, the burst signal normally adopts the “burst on“-state, i.e. the high level. Certain applications, however, require the high level state to be delayed, e.g., in order to trigger to the high level. The start delay of the burst signal is intended to be used for these applications; the generator puts out the low level.

Specified range: 0 to 60 s

2.5.4.6 SINE² BURST

Sine²-wave signal which is periodically switched on and off. Either positive or negative pulses (also partial pulses) can be generated (by entering a negative voltage). Typically, the signal is not DC-free.

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

SWEEP CTRL

see 2.5.4.2 Sweeps

FREQUENCY

Entry of the sine²-wave frequency; can be used as sweep parameter; see 2.3.2 Data Entry

Specified range: 10 Hz to f_{max}
f_{max} depending on generator;
see 2.3.2 Selecting the Generator

Units: Hz | kHz | ΔHz | ΔkHz | f/f_r | Δ%Hz | Terz Oct | Dec

Resolution: 1 MHz

Note: *The period of this signal is defined as the time required for a pulse.*

Side effect*:* "ON TIME" is adjusted, if required.

VOLTAGE

Entry of the sine²-wave amplitude; can be used as sweep parameter.

Specified range: 0 to V_{max}
digital: V_{max} = 1 FS
analog: V_{max} = 10 V_{rms} for UNBAL
V_{max} = 20 V_{rms} for BAL

Units:
digital (audio data mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr
analog:
V | mV | µV | V_{pp} | mV_{pp} | $µV_{pp}$ | V/V_r |
dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

Note: *Voltage limitation of the rms value by means of menu item "Max volt", see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator*

As to the unit: When entering negative voltages, the pulse is inverted. Conversion into logarithmic units (dBFS, dBu, dBr, dBV) is not possible in this case.

peak-to-peak amplitude (analog): $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$;
V_{rms} is the rms value during pulse time, the level during OFF time is not considered when calculating the rms value.

ON TIME

Entry of the pulse duration, i.e. the time the sine^2 is switched on; can be used as sweep parameter; see 2.3.2 Data Entry

Specified range:	lower limit:	(1 sample)
	analog:	t_{min} = 20.83 µs
	digital:	t_{min} = 1 / $sample_{frq}$
	upper limit:	60 s - t_{min}
Units:		s | ms | µs | cyc | kcyc | Mcyc | min

***Side effect**: Specifying a burst duration longer than the interval length causes the latter to be increased to burst duration.*

***As to the unit:** Apart from standard time specifications, the pulse duration can also be specified in cycles. The selection of this unit, which is relative to frequency, results in the number of cycles - and not the pulse time - remaining constant when the frequency is changed, i.e. increasing the frequency decreases the pulse duration. If the INTERVAL is not entered in cycles, the ratio ON–TIME : INTERVAL is reduced.*

INTERVAL

Entry of the interval length; can be used as sweep parameter; see 2.3.2 Data Entry

Specified range:	lower limit:	set burst duration
	upper limit:	60 s
Units:		s | ms | µs | cyc | kcyc | Mcyc | min

***As to the unit:** Apart from standard time specifications, the pulse interval can also be specified in cycles. The selection of this unit, which is relative to frequency, results in the number of cycles - and not the pulse time - remaining constant when the frequency is changed, i.e. increasing the frequency decreases the interval length of the burst signal. If the ON TIME is not entered in cycles, the ratio ON–TIME : INTERVAL increases.*

***Note**: If generator settings are modified or a measurement is (re-)started, the generator is automatically restarted and starts the interval (considering the Burst On Delay) with ON TIME.*

BurstOnDel

(Burst On Delay)

When starting the generator (e.g., subsequent to changing or acknowledging the function) or starting the measurement, the burst signal normally adopts the “burst on“-state, i.e. the high level. Certain applications, however, require the high level state to be delayed, e.g., in order to trigger to the high level. The start delay of the burst signal is intended to be used for these applications; the generator puts out the low level.

Specified range: 0 to 60 s

2.5.4.7 MOD DIST (Two-tone Signal to SMPTE)

Superposing 2 sinewave signals: low-frequency interfering signal and high-frequency useful signal; interfering signal is 1 to 10 times stronger than useful signal.

For intermodulation measurements to SMPTE (Society of Motion Picture and Television Engineers) and modulation distortion analysis to .

Frequencies

- Recommendation DIN 45403, sheet 4: or DIN-IEC 268-3:
  interfering signal
  f1 < = 1.4 x lower limit frequency of DUT
  f1 > = 31.5 Hz
  useful signal f2
  f2 > = 0.7 x upper limit frequency of DUT
  f2 > = 8 x f1

- SMPTE standard:
  interfering signal: f1 = 60 Hz
  useful signal: f2 = 7 kHz

Amplitude ratio interfering signal : useful signal:
4:1 (SMPTE); to DIN, 10:1 is also possible

With the LDG option fitted, the useful signal in the analog range can be generated by the universal generator or, alternatively, by the low-distortion generator.

Notes:

- *For intermodulation measurements to MOD DIST, an appropriate measurement function is to be set in the ANALYZER panel (see 2.6.5.8).*
- *If the selection "Function tracking Gen → Anl" is ticked off in the OPTIONS panel under menu item "Param Link", the measurement function MOD DIST is switched on in conjunction with the function changeover of the generator to MOD DIST:*

Frq Offset	See 2.5.4.1 Common Parameters for the Generator Signals
Dither	For digital generators only; see 2.5.4.1 Common Parameters for the Generator Signals ***UPL-B29***: *The dither generator can be switched on in the base rate mode only.*
PDF	For digital generators only; see 2.5.4.1 Common Parameters for the Generator Signals
DC Offset	see 2.5.4.1 Common Parameters for the Generator Signals
SWEEP CTRL	see 2.5.4.2 Sweeps

UPPER FREQ

Entry of the er the useful frequency; can be used as sweep parameter. see

Specified range: 240 Hz to f_{max}

f_{max} depending on generator; see 2.5.1

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Resolution: 1 MHz (50 Hz for DIG 768 kHz)

LOWER FREQ

Entry of the interfering frequency; can be used as sweep parameter.

Specified range: 30 Hz to UPPER FREQ / 8

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Resolution: 1 MHz

VOLT LF:UF

Enter the ratio interfering level : useful level as a real number.

Specified range:1.0 to 10.0

In the analog range, this ratio affects the level of the total rms voltage which can be input via "TOTAL VOLT".

Unit: none

TOTAL VOLT

Entry of the total amplitude of both sinewave signals; can be used as sweep parameter.

Specified range:

digital: 0 to 1 FS

analog: 0 to 10.964 V_{rms} for UNBAL

0 to 21.927 V_{rms} for BAL

Note: *The selectable analog voltage depends on the voltage ratio "Volt LF:UF"; specifications refer to a voltage ratio of 10:1.*

Note: *Voltage limitation of the rms value by means of menu item "Max volt", see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator*

Units:

digital (audio data mode):

FS | %FS | dBFS | LSBs | bits | Δ% | dBr

analog:

V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

In the analog range, the maximum peak voltage is $\sqrt{2}$ x 10 V (UNBAL) or $\sqrt{2}$ x 20 V (BAL). Hence, the following restriction applies:

$V_{pp} \leq 28{,}284\ V_{pp}$ (UNBAL) or
$V_{pp} \leq 56{,}569\ V_{pp}$ (BAL)

$V_{pp} = V_{1pp} + V_{2pp}$

The total voltage is divided into useful signal and interfering signal in a (selectable) ratio. The maximum total rms voltage, which is obtained from the square sum of the single rms values, thus depends on the level ratio interfering signal : useful signal. The specifications for the specified range stated above are relative to the ratio 10 : 1. The closer the ratio comes to the value 1 : 1, the lower the maximum obtainable total rms voltage. With 1 : 1, it is 7,0711 V_{rms} (UNBAL) or 14,142 V_{rms} (BAL).

As a rule, the relationship between total peak-to-peak voltage and total rms voltage *can be expressed as follows:*

$$V_{pp} = \frac{V_{eff} \times 2 \times \sqrt{2} \times (k+1)}{\sqrt{(k^2+1)}}; \qquad k = \text{"VOLT LF:UF"}$$

2.5.4.8 DFD (Difference Frequency Distortion)

Two closely spaced sinewave signals of the same amplitude; for intermodulation measurements (DFD method to DIN-IEC 268-3, former DIN 45403, Sheet 3).

With the LDG option fitted, the low-frequency sinewave in the analog range can be produced by the function generator or, alternatively, the low-distortion generator.

Note: *For intermodulation measurements to DFD, an appropriate measurement function is to be set in the ANALYZER panel (see 2.6.5.9).*

Note: *If the selection "Function tracking Gen → Anl" is ticked off in the OPTIONS panel under menu item "Param Link", the measurement function MOD DIST is switched on in conjunction with the function changeover of the generator to MOD DIST:*

Frq Offset

see 2.5.4.1 Common Parameters for the Generator Signals

Dither

For digital generators only;
see 2.5.4.1 Common Parameters for the Generator Signals

PDF

For digital generators only;
see 2.5.4.1 Common Parameters for the Generator Signals

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

Equalizer

see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM. Each of the two difference tone frequencies is corrected.

ON

Equalizer switched on. The menu item "Equal. file" is loaded, i.e. the indicated file is loaded.
It may happen that the two (equal) sine voltages are weighted with different correction factors so that they are no longer recognized as DFD signal by the analyzer. If an error message of this kind is displayed, switch to the IEC 118 measurement mode which is more tolerant to differences of the DFD lines.

OFF

The output voltage of the two difference tone frequencies is not affected.

Equal. file

(Equalizer file)
with Equalizer → ON only;
see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM.

Mode

Selection of entry mode for DFD frequencies.

IEC 268

Entry of center frequency (MEAN FREQ) and difference frequency (DIFF FREQ). If a frequency sweep is selected (for the X or Z axis), the center frequency is swept.

IEC 118

Entry of upper DFD frequency (UPPER FREQ) and difference frequency (DIFF FREQ). If a frequency sweep is selected (for the X or Z axis), the UPPER FREQ is swept.

Note: *When measuring the DFD, one of the two standards can be selected under the menu item "Meas Mode".*

SWEEP CTRL

see 2.5.4.2 Sweeps

MEAN FREQ

Entry ofer the mean frequency; can be used as sweep parameter.

Specified range: 200 Hz to (f_{max} - 500 Hz)
f_{max} depending on generator;
see 2.5.1 Selecting the Generator

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Resolution: 1 MHz;

DIFF FREQ

Enter the frequency difference between both sines

Specified range:80 Hz to 0.55 * MEAN FREQ, max. 1 kHz
f_{min} depending on generator;
see 2.5.1 Selecting the Generator

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Resolution: 1 MHz

Rec. to DIN-IEC 268-3: 80 Hz

TOTAL VOLT

Entry of the total amplitude of both sinewave signals; can be used as sweep parameter, see 2.3.2.

Specified range: digital: 0 to 1 FS
analog: 0 to 8.485 V_{rms} for UNBAL (BNC)
0 to 16.971 V_{rms} for BAL (XLR)

Note: *Voltage limitation of the rms value by means of menu item "Max volt", see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator*

Units:
digital (audio data mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr
analog:
V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

The maximum peak-to-peak voltage in the analog range is $\sqrt{2}$ x 10 V (UNBAL) or $\sqrt{2}$ x 20 V (BAL). Hence the following limitation applies:

$U_{pp} \leq 28{,}284\ V_{pp}$ (UNBAL) or

$U_{pp} \leq 56{,}568\ V_{pp}$ (BAL)

$U_{pp} = U_{1pp} + U_{2pp}$

With two equivalent single voltages $U_{1pp} = U_{2pp}$, the maximum permissible total rms voltage is:

$$U_{eff} = \sqrt{\left(\frac{U_{1PP}}{2\cdot\sqrt{2}}\right)^2 \cdot 2} = \frac{U_{1pp}}{2} = \frac{U_{pp}}{4}$$

2.5.4.9 Random (Pseudo Noise)

Set generator signals which have the same or similar characteristics as noise (e.g. closely spaced sine lines in the frequency domain). There are two ways of defining these signals:

- Specify the amplitude density distribution in the time domain (Domain: TIME)
- Specify the amplitude frequency distribution in the frequency domain (Domain: FREQ)

This function is available in all generators.

Note:

- *The generator is interrupted while calculating a new noise signal. The output signal is definitely set to 0 V or 0 FS.*

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

Domain

Selection of domain for definition of the noise signals

FREQ

Sine lines with settable amplitudes are generated and superposed on each other using defined frequency spacings to produce the output signal. In order to minimize the resulting peak value of the signal, each line is phase-optimized relative to the other lines. Minimum form factors (=peak/rms) can thus be obtained. Depending on the selectivity of the analyzer, the output signal is not displayed as a sequence of single lines, but as a noise signal with continuous level above the frequency.
The frequency-defined noise allows for generating up to 7488 single tones with any amplitude (multitone).

Special application:
When the frequency spacing of the sine lines generated here **exactly** matches the analysis spacing used for the FFT, an FFT analysis is feasible without leakage. A selectivity of one line can thus be obtained with the square window. The setup consisting of this generator and analyzer allows you to precisely determine the frequency response of a device under test at one go. (see 2.6.7.3 Fast Frequency Response Measurement

Note: *As the optimization is very compute-bound, a few seconds of computing time before the output is started may be required by the generator, especially with small frequency spacings and wide noise band. → Status display: "GEN: BUSY". Entering data while GEN: BUSY is being displayed aborts the computations and the generator enters the GEN:HALTED state. The generator restarts automatically.*

TIME

In this mode, noise signal generation is effected by nested random functions which have been optimized to produce evenly distributed noise. Periodicity is the case only after a runtime of at least 1 day.

Spacing

Definition of the frequency spacing, i.e. the space between the individual frequency lines:
(displayed with domain = Freq only)

USER DEF

The frequency spacing can be set manually. The value entered is corrected to the next settable value. The limits and settable frequency values depend on the sample rate (see 2.5.1 Selecting the Generator) and the selected generator. The lower frequency limit for the digital instruments is the ratio

system clock rate / 16384

Units: Hz, kHz

ANLR-TRACK

The value specified for the FFT analysis spacing is automatically adopted. The value is also displayed in the ANALYZER panel under "FFT:Resolution" (see 2.6.5.12 FFT). This setting is ideal for an analysis using the rectangular window. With no FFT selected in the analyzer, the setting is rejected (error message!).

Shape

(displayed with Domain = FREQ only)

Specify the function which is used to determine the amplitudes of the single sine lines.

WHITE

All the sine lines between start value (see below) and stop value have the same amplitude.

PINK

The amplitude of the sine lines between start and stop value is proportional to $\sqrt{1/f}$

THIRD OCT

As PINK, however band-limited to $^1/_3$ octave = 1 third-octave (TOCT) with settable mean frequency (“third-octave noise“).

FILE

The amplitudes of the single lines are set using floating numbers which are read from a file.

Shape File

There are two different file formats for Domain FREQ: the ASCII file with the extension .FTF which is generally written by the user and the equalization file with the extension VEQ! which is normally generated from trace data (sweep or FFT). The latter is also offered in the basic setting in the file panel. It can however be overwritten by the user. - For Domain TIME, a file can't be loaded.

File format 1:
The file is a pure ASCII file where the amplitudes of the single frequency lines starting from 0 Hz are entered as floating numbers; the space between the lines is determined by "Spacing" which can be entered in the panel. The numbers specify only the amplitude ratio between the lines and not the output amplitude (which is determined after phase optimization using "VOLTAGE PEAK"). The file must have a line with the keyword `'FREQUENCY_FILE'` before the numbers. Comment lines begin with '#' and are allowed anywhere. No difference is made between upper-case and lower-case letters.
The preset type of file is '.FTF' (= frequency table file).

Example: `'r&s_exam.ftf' in directory C:\UPL\USER.`

File format 2:

The EQUALIZATN file in the file panel which was generated with Store Trace/List is used. The inverted form of a frequency response is generally used (Invert 1/n ON) so that, using this "pre-distorted" spectrum, a flat frequency response can be achieved after the DUT. Both of the formats ASCII and REAL can be loaded, the standard file extension is: VEQ!

Using an equalization file which was obtained from an FFT:
Feed the noise signal from the generator into the DUT, set an FFT with a rectangular window such that a closed trace (comparable with a sweep curve) results and save the FFT as an Equalization file.
The essential settings in detail from left to right:

GENERATOR Panel:		ANALYZER Panel:	FILE Panel	
FUNCTION	RANDOM	FUNCTION FFT	Store	EQUALIZATN
Domain	FREQ	Window RECTANGULAR	Invert 1/n	ON
Spacing	ANLR TRACK		Filename	XXX.VEQ
Shape	WHITE			

To display the straightened trace, feed the noise signal including the shape file XXX.VEQ into the DUT.

GENERATOR Panel:	
FUNCTION	RANDOM
Domain	FREQ
Spacing	ANLR TRACK
Shape	FILE
Shape File	XXX.VEQ

Equalizer

(displayed with FREQ domain only)

see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM.
Each frequency line is corrected.

ON

Equalizer switched off. The menu item "Equal. file" is activated, i.e. the file indicated there is loaded.

The set voltage (peak or RMS) and the calculated crest factor refer to the *non-equalized* total signal (as is the case with single and multi-tone signals). Therefore, the voltage measured at the outputs is not identical with the values for VOLT PEAK and VOLT RMS indicated in the GENERATOR panel.

OFF

The output voltage of all frequency components of the noise signal is not affected.

Equal. file

(Equalizer file)

with Equalizer → ON only;
see 2.5.4.1.3 Equalization of SINE, SINE BURST, DFD, MULTISINE, RANDOM.

Crest Fact

(displayed with Domain Freq only)

Selects the algorithm for determining the phase position of the individual frequency lines and thus the crest factor of the complete signal.

OPTIMIZED

Automatic *minimization* of crest factor by internally optimizing the individual phases.

VALUE:

Presetting a *desired crest factor.* The phase of the frequency lines is modified internally so that the resulting crest factor closely approaches the desired value. The accuracy of this method depends on the total number of lines thus spacing and frequency range

Lower Freq

(is displayed with Domain = FREQ, only)
Set the lower limit of the range for generated noise (with Shape WHITE and PINK). The limits for this setting are
f_{ugr} = 1 x spacing

f_{ogr} =117/256 x sampling rate - 1 x spacing

The values entered are rounded to integer multiples of ”spacing”.

Upper Freq

(is displayed with Domain = FREQ, only)

Set the upper limit of the range for generated noise (with Shape WHITE and PINK). The limits for this setting are
f_{ugr} = Lower freq + 1 x spacing
f_{ogr} =117/256 x sampling rate

The values entered are rounded to integer multiples of ”spacing”..

MEAN FREQ

(displayed with Domain = FREQ, Shape THIRD OCT))

Set the mean frequency at $^1/_3$ octave. The output starts at the line next to the mean frequency/ 1.12246 and ends with the line next to the mean frequency x 1.12246.

VOLT PEAK

Set the peak output level.

VOLT PEAK and VOLT RMS are coupled via the crest factor (which is constant for a specific signal). A change of VOLT PEAK therefore immediately affects the figure for VOLT RMS. If the crest factor is changed, RND PEAK will remain unchanged.

Specified range: 0 to V_{max}

digital: V_{max} = 1 FS
V_{max} = 10 V (Mode Common)
V_{max} = 2,5 UI (Mode Jitter)
analog: V_{max} = 14,142 V für UNBAL
V_{max} = 28,284 V für BAL

Units:

digital (audio data or phase mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr
digital (jitter mode):
UI | %UI | dBUI | ppm | ns | UIr | dBr
analog and digital common mode:
V | mV | µV | V/V_r | dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

VOLT RMS

Setting of rms output voltage (in the analog generator only).

VOLT PEAK and VOLT RMS are coupled via the crest factor (which is constant for a specific noise signal). A change of VOLT RMS therefore affects the VOLT PEAK value.

Units: V | mV | µV | V/V_r | dBu | dBV | dBr | dBm | Δ%V | ΔV | ΔmV | ΔµV

***Note**: Entry of VOLT RMS is only possible when the generator is RUNNING. Since the crest factor is not yet known during calculation of the noise signal (GEN BUSY), the entry is at first rejected and the voltage 0.0 is entered. To ensure that the generator outputs a noise signal of correct (peak) amplitude after the calculation, VOLT PEAK should be entered, which is possible any time.*

PDF

(displayed with domain = TIME)

(PDF = probability density function) Select the amplitude distribution function of the output signal:

GAUSS Normal (Gaussian) distribution which is cut off at triple the σ-value of the Gaussian distribution curve.

TRIANGLE Triangle distribution from -peak to +peak.

EQUIVALENT Equivalent distribution from -peak to +peak.

***Note**: The Gaussian and triangle distributions are obtained by calculation on the basis of equivalent distribution.*

Ampl Var

Selection of type of modulation; see 2.5.4.1.4

OFF The amplitude modulation is switched off, the generator signal is not modulated.

SINE The generator signal is amplitude-modulated from 0% to 100% in the form of a sinewave.

BURST The generator signal is switched on and off periodically.

Mod Freq	with "Ampl Var SINE", only: setting of the modulation frequency; see 2.5.4.1.4
Variation	with "Ampl Var SINE": setting of the variation in %., see 2.5.4.1.4.
ON TIME	with "Ampl Var BURST", only: entry of the burst duration , see 2.5.4.1.4.
INTERVAL	with "Ampl Var BURST", only: entry of the burst-interval length (burst period) , see 2.5.4.1.4.

2.5.4.10 Arbitrary (User-Programmable Signal)

Outputs a user-defined waveform. Five formats with different origins and lengths are supported:

1. **TTF format**: ASCII file with a maximum of 16384 samples. The individual samples are entered as a sequence of numbers (FLOAT format). For the output, the maximum value is equivalent to the peak voltage specified in the VOLTAGE PEAK field, while the other samples are levelled relative to the maximum. The file must contain a line with the keyword `TIMETAB_FILE` before the numbers. Comment lines begin with '#' and can be placed anywhere. No distinction is made between upper-case and lower-case letters. The recommended and preset file extension is '.TTF' (= time table file).
2. **AWD format:** Output file of arbitrary waveform designer. It may contain a maximum of 16384 samples. The recommended and preset file extension is .AWD.
3. **WAV format:** Supports 8-bit and 16-bit formats; 16-bit format requires models 06 or 66 (Pentium CPU). WAV is a standardized waveform format that is widely used in the PC world (sound cards). WAV files may be stored at any sampling rate. However, for use in UPL it should match the selected sampling rate (48 kHz only for analog). If necessary, the WAV file can also be converted to 48 kHz - which is supported by analog and digital applications - by means of a suitable sound-card tool. WAV files of any length are accepted, so they are not restricted to 16384 samples. To load and display large WAV files in 16-bit format, the RAM needs to be extended to enhance performance.

   Option UPL-B29: *WAV files can be loaded in the base rate mode only.*
4. **CPR format:** This is a special compressed waveform format which accepts any word width up to 16 bits and can therefore be adapted to the performance of a 486-based UPL. A tool is available for generating CPR files by compressing WAV, TTF and AWD files to the required word width (13 bits as standard, 4 to 16 bits can be selected). It is recommended to extend the RAM when working with CPR files.

   Option UPL-B29: *CPR files can be loaded in the base rate mode only.*
5. **ACC format**: This is a special, compressed waveform format for WAV files containing AC3 or MPEG data coded in line with IEC 61937. A tool is available for generating ACC files by compressing specially coded WAV files such that the output of stereo signals is possible. It is recommended to extend the RAM when working with ACC files. ACC files can only be output in the digital generator.

   Option UPL-B29: ACC files can be loaded in the base rate mode only.

Notes:

Arbitrary waveform designers are software packages for the generation of all types of waveforms, which run on AT-compatible PCs (as on UPL, for example).

- *The samples are output at the selected sampling rate. If the file was generated for a different sampling rate, the output frequencies are changed accordingly.*
- *The entered waveform is continuously output (no gaps), independent of the actual number of samples. The number of samples is determined by the number of waveform points in the file.*
- *The samples in the WAV, ACC and CPR files are sent online from the hard disk or the extended memory to the DSP generator. A buffer of approx. 2 s is used in the process. If PC capacity is simultaneously used for other tasks, eg the user interface, the buffer may get emptied. In this case the generator will be muted, the buffer refilled and file is output from the start.*
- *If the RAM capacity for outputting the WAV, ACC or CPR files is insufficient, the file must be read directly from the hard disk, which results in a slower transfer between CPU and DSP. As a result, the generator will be more frequently switched-off (muted) and restarted. This can be remedied by*

  ⇒ enhancing the extended memory by means of a RAM expansion

  ⇒ reducing the audio bits with the aid of the COMPRESS program (not for ACC files)
- *The generator is briefly stopped while loading a new file. The output signal is definitely set to 0 V or 0 FS.*
- Loading of ACC files is useful and practicable in the digital generator, only

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

Filename

Name of file from which the waveform is to be loaded. All files are listed in the above formats as default. The extensions for WAV, ACC and CPR files are compulsory, while TTF and AWD formats also accept different extensions, as these files also have an internal code.

Example: `'r&s_exam.ttf' in directory C:\UPL\USER.`

VOLT PEAK

Setting of the peak output level; not for ACC files. *Level setting is not possible with ACC files, since all bits must be transferred unchanged*

VOLT PEAK and VOLT RMS are coupled via the crest factor (which is constant for a specific signal). A change of VOLT PEAK therefore immediately affects the figure for VOLT RMS.

Specified range: 0 to V_{max}

digital: V_{max} = 1 FS
V_{max} = 10 V (Mode Common)
V_{max} = 2,5 UI (Mode Jitter)

analog: V_{max} = 14,142 V für UNBAL
V_{max} = 28,284 V für BAL

Units:

digital (audio data or phase mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr

digital (jitter mode):
UI | %UI | dBUI | ppm | ns | UIr | dBr

analog and digital common mode:
V | mV | µV | V/V_r | dBu | dBV | dBr | dBm | Δ%V | ΔV | ΔmV | ΔµV

VOLT RMS

Only for format AWD und TTF; Setting of rms output voltage (in the analog generator only).

VOLT PEAK and VOLT RMS are coupled via the crest factor (which is constant for a specific noise signal). A change of VOLT RMS therefore affects the VOLT PEAK value.

Units: V | mV | µV | V/V_r | dBu | dBV | dBr | dBm | Δ%V | ΔV | ΔmV | ΔµV

Ampl Var

Selection of the type of modulation; see 2.5.4.1.4. Amplitude variation cannot be performed with using WAV, ACC or CPR files.

OFF

The amplitude modulation is switched off, the generator signal is not modulated.

SINE

The generator signal is amplitude-modulated in the form of a sinewave from 0% to -100%;.

BURST

The generator signal is switched on and off periodically.

Mod Freq

with "Ampl Var SINE" only: setting of the modultion frequency, 2.5.4.1.4

Variation

with "Ampl Var SINE", only: setting of the variation %., see 2.5.4.1.4.

ON TIME

with "Ampl Var BURST", only: entry of the burst duration , see 2.5.4.1.4.

INTERVAL

with "Ampl Var BURST", only: entry of the burst-interval length (burst period) , see 2.5.4.1.4.

2.5.4.11 POLARITY (Polarity Test Signal)

Specific SINE^2 BURST signal with the following characteristics:

FREQUENCY: sample rate /80 (DIGITAL)
1.2 kHz (ANALOG)
ON-TIME: 1 cyc
INTERVAL: 2 cyc

The amplitude of the signal only can be selected by the user. The signal is not DC-free.

DC Offset

see 2.5.4.1.2 Common Parameters for All Generator Functions

VOLTAGE

Enter the SINE^2 amplitude;

Specified range:
digital: 0 to 1 FS
analog: 0 to 10 V_{rms} for UNBAL (BNC)
0 to 20 V_{rms} for BAL (XLR)

Note: *Voltage limitation of the rms value by means of menu item "Max volt", see 2.5.2 Configuration of the Analog Generator / 2.5.3 Configuration of the Digital Generator*

Units:
digital (audio data mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr
analog:
V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm |
Δ%V | ΔV | ΔmV | ΔµV

peak-to-peak amplitude (analog): $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$;

V_{rms} is the rms value during pulse time, the level during OFF time is not considered in rms value calculation.

2.5.4.12 FSK (Frequency Shift Keying)

This item can only be selected with option UPL-B33 built-in (line measurements to ITU-T O33).
Frequency shift keying generates a sequence of two different sinewave frequencies where each is output for 9 ms (baud rate 110). The data coded in this way can only be defined from option UPL-B33 or UPL-B10.
Frequency #1: 1850 Hz, logic 0
Frequency #2: 1650 Hz, logic 1

Voltage

Level of each frequency

2.5.4.13 STEREO SINE

Sine with different signals for the left and right channel. Available only in the digital generator (ADATA or PHASE mode) and with option UPL-B6 installed.
The frequencies of the two channels can differ in phase or frequency.
The level in the two channels can be linked to each other by a fixed factor or be completely different.

Frq Offset

See 2.5.4.1.1 Common Parameters for SINE, DFD, MOD DIST

Dither

See 2.5.4.1.1 Common Parameters for SINE, DFD, MOD DIST

PDF

See 2.5.4.1.1 Common Parameters for SINE, DFD, MOD DIST

DC Offset

See 2.5.4.1.2 Common Parameters for All Generator Functions.

Freq Mode

Determines the type of frequency entry in the left and right channel.

FREQ&PHASE

Left (CH1) and right channel (CH2) have the same frequency but a selectable phase with a fixed delay. The phase delay between the two channels remains constant during frequency sweep.

FREQ CH1&2

The frequency of the left (CH1) and right channel (CH2) can be entered independently of each other. During frequency sweep, the frequency of the left channel is swept while that of the right channel remains unchanged.

Volt Mode

Determines the type of level entry in the left and right channel.

VOLT&RATIO

The levels of the left (CH1) and right channel (CH2) have a fixed offset. The offset remains constant during level sweep.

VOLT CH1&2

The level of the left (CH1) and right channel (CH2) can be entered independently of each other. During level sweep, the level of the left channel is swept, that of the right channel remains unchanged.

SWEEP CTRL

See 2.5.4.2 Sweeps
The setting of Freq Mode and Volt Mode decides about the parameter changed during frequency or level sweep.

FREQ&PHASE: the (common) frequency is swept
FREQ CH1&2: the frequency of the left channel (CH1) is swept
VOLT&RATIO: the level of the left channel (CH1) is swept; the offset between the right and left channel remains constant
VOLT CH1&2: the level of the left channel (CH1) is swept; the right channel (CH2) remains constant.

Frequency

(Freq Mode FREQ&PHASE only) Entry of common sine frequency for both channels. Can be used as sweep parameter.

Specified range: 2 Hz to f_{max}
f_{max} depending on generator;
See 2.5.1 Selecting the Generator
Resolution: 1 mHz
Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Freq Ch1

(Freq Mode FREQ CH1&2 only) Entry of sine frequency of left channel. Can be used as sweep parameter.

Specified range: 2 Hz to f_{max}
f_{max} depending on generator;
See 2.5.1 Selecting the Generator
Resolution: 1 mHz
Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Freq Ch2

(Freq Mode FREQ CH1&2 only) Entry of sine frequency of left channel. May be used as sweep parameter.

Specified range: 2 Hz to f_{max}
f_{max} depending on generator;
See 2.5.1 Selecting the Generator
Resolution: 1 mHz
Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Phase Ch2:1

(Freq Mode FREQ&PHASE only) Entry of phase delay between right and left channel with the left channel (CH1) as reference channel. During the sweep this phase remains constant and cannot be swept.

Specified range: 0 to 360°
Unit: ° or RAD

Equalizer

ON

OFF

See **2.5.4.1.3 Equalization of SINE, SINE BURST,** DFD, MULTISINE, RANDOM
The sine voltage is equalized.

The equalizer is switched on. The menu item 'Equal. file' is activated, ie the indicated file is loaded.

Unaffected output voltage

Equal. file

(Equalizer file) only with equalizer → ON
See **2.5.4.1.3 Equalization of SINE, SINE BURST,** DFD, MULTISINE, RANDOM.

Volt Ch1

Entry of sine amplitude of left channel; may be used as sweep parameter.

Specified range: 0 to 1 FS

Caution: *Limiting of rms voltage with menu item 'Max Volt' see **2.5.3 Configuration of the Digital Generator**.*

Units: FS | %FS | dBFS | LSBs | bits | Δ% | dBr

Volt Ch2

(Volt Mode VOLT CH1&2 only) Entry of sine amplitude of right channel. Remains constant during sweep.

Specified range: 0 to 1 FS

Caution: *Limiting of rms voltage with menu item 'Max Volt', see **2.5.3 Configuration of the Digital Generator***

Units: FS | %FS | dBFS | LSBs | bits | Δ% | dBr

Volt Ch2:1

(Volt Mode VOLT&RATIO only) Entry of level offset between channel 2 (right channel) and channel 1 (left channel) as numeric value.

The level of the right channel is reset upon each entry of 'Volt CH2:1' or 'Volt Ch1' and limited to 1.0 FS or 'Max Volt'.

Specified range: 0.0 to 100 k

Unit: none

2.5.4.14 MODULATION (modulated sine)

Setting a modulated sinewave signal. Either FM or AM can be used.

Mode

Determines the type of modulation.

FM

Frequency modulation; output of a frequency-modulated sinewave signal.

AM

Amplitude modulation; output of amplitude-modulated sinewave signal.

Mod Freq

Setting the modulation frequency

Specified range: 1 µHz to f_{max} f depending on generator; See 2.5.1 Selecting the Generator

Carr Freq

Setting the carrier frequency

Deviation

(with Mode FM) Setting the deviation in %.

Specified range: 0 to 100 %

Example: *Output frequencies of 3960 Hz to 4040 Hz are obtained with 4 kHz carrier frequency and 1% deviation.*

Mod Depth

(with Mode AM) Setting of modulation depth in %.

Specified range: 0 to 100 %

Example: *Output levels of 9.90 V to 10.1 V are obtained at 10 V carrier amplitude and 1% modulation depth.*

Carr Volt

Setting the carrier amplitude

2.5.4.15 DC Voltage

SWEEP CTRL

See 2.5.4.2 Sweeps

Voltage

Entry of DC amplitude; may be used as sweep parameter.

Specified range: digital (audio data mode):
0 to 1 FS
analog: 0 to 5 V for UNBAL (BNC)
0 to 10 V for BAL (XLR)

Caution: *Limiting of rms voltage with menu item 'Max Volt', see 2.5.2 Configuration of the Analog Generator*

Units:
digital (audio data mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr
analog: V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | V/V_r |
dBu | dBV | dBr | dBm | Δ%V | ΔV | ΔmV | ΔµV

2.5.4.16 Coded Audio (Coded Audio Signals)

This function allows digitally coded (and compressed) audio signals to IEC 61937 to be output. Basically, all formats coded in the audio window of the AES-EBU data stream (MPEG, AC-3, AAC, DTS) can be played.

The CODED AUDIO function uses a library of several thousand short WAV files generated for the individually offered frequency/level combinations and containing a small number of frames. The WAV files are loaded automatically and played repetitively when a (new) frequency or a (new) level is entered. Since only those frequencies are set whose integer periods fit into such a package, the output signal has no hops. When the frequency or level is changed, switchover to the first frame of the new file is performed without any interruption at the end of the last frame of the old file. This ensures that the DUT does not have to synchronize again. The exact characteristics of the library used depend on the selected format and are explained there.

The user sets a new frequency or a new level in the same way as with a 'normal' sine. The UPL software automatically activates the next suitable frequency/level pair. Frequency and level sweeps can also be set as usual. Since the analyzer is synchronized to the generator and continuous sweep stepping can be synchronized to the analyzer (next step ANLR SYNC), very fast sweeps can be performed.

This function is available only in the digital generator and can be selected only if the two channels are switched on and the UPL-B23 option (Coded Audio Signal Generation) is installed.

Presently, the UPL-B23 only contains the AC-3 digital format (Dolby Digital); other formats are in preparation.

Notes:

- *The digital generator is directly connected to the digital input of the (AC-3) decoder. The decoded and D/A-converted output signal is measured with the analog analyzer of the UPL.*
- *For S/N measurements, the noise measurement is not performed using a pause frame but using a very soft signal level (-120 dB). This prevents the DUT from muting.*
- *While this generator function only generates individual (single or multichannel) sounds, the ARBITRARY function of the digital generator also allows any signals (e.g. multisine, noise) of any length to be played. These signals must be generated by the user as coded WAV files and converted into ACC files by means of the COMPRESS program. The ACC files are then output in the generator. User-defined signal sequences can also be played this way. Synchronization of the analyzer is via the external sweep.*

Optimization for UPL 06/66 with at least 32 Mbyte RAM:

If sufficient RAM is available, it is recommended to activate a RAM drive to accelerate downloading from the hard disk. If the UPL-B23 was installed in the service center or ordered when the UPL was purchased, the RAM drive option is already available.

If a RAM drive is activated, the WAV files required for signal generation are automatically cached on the RAM drive (if they are used more than once) and can be downloaded extremely quickly from the RAM. If a generator sweep is set and started, for example, the first sweep takes the normal and the following sweeps a far shorter measurement time.

To install a RAM drive (see section 1.2.3 Installation of Virtual Drive (RAMDRIVE)*)*

Format

AC-3

Coding format (presently only AC-3 available); has an effect on the frame length and on the frequency resolution.
A separate library of WAV files is installed for each format. If the format selection is extended, an upgraded UPL-B23 option has to be installed.

Dolby Digital: up to 6 sound channels; can be output either individually, as 5.1 multichannel or as stereo signal. Frequency and level can also be selected. All other parameters for "Audio Service", "Bitstream Information" and "Preprocessing" are invariable default settings.
The AC-3 format is selectable only at a sampling rate of 48 kHz. It contains frames with a length of 1536 samples. Each WAV file contains 1 to 6 frames. The frequency resolution *per frame* is therefore:
48000 Hz / 1536 = 31.25 Hz.

***Notes**:*

1. *User-defined AC-3 signals of any length can be played with the ARBITRARY function. The AC-3 sequences have to be available as WAV files and compressed to the UPL-internal ACC format by means of the COMPRESS.EXE utility program.*
2. *When measurements are carried out on AC-3 decoders, their delay has to be taken into account in the analyzer panel. The measurement should be performed with settling switched on to avoid settling problems of the DUT.*

Chan Mode

(Channel mode) selection of channels producing sound.

2/0	**192 kb/s**
5.1	**448 kb/s**
L	**448 kb/s**
C	**448 kb/s**
R	**448 kb/s**
LS	**448 kb/s**
RS	**448 kb/s**
LFE	**448 kb/s**

Stereo mode at 192 kb/s. Frequency and level variation or sweep is possible. Coding of samples at 24 bits.
Field of application: Frequency response and linearity measurements

Multichannel sound with all channels at 448 kb/s. Frequency and level variation or sweep is possible. Coding of samples at 24 bits.
Field of application: Frequency response and linearity measurements

Single channels at 448 kb/s. Limited frequency selection, fixed level (-20 dB). Coding of samples at 16 bits.
Field of application: crosstalk measurement.
L: front left; C: (front) center; R: front right;
LS: rear left; RS: rear right;
LFE: low frequency enhancement.

Frequency

42	**Hz**
997	**Hz**
15	**kHz**

Fixed frequency selection for crosstalk measurements and linearity (level) sweeps. Displayed only in single channel modes or when level variation is selected.

Exactly 41.7 Hz
Exactly 994.8 Hz
Exactly 15000.0 Hz

SWEEP CTRL

See 2.5.4.2 Sweeps

Vari Mode

(Variation mode) determines which parameter can be varied or swept. Displayed only in multichannel modes (2/0 or 5.1).

VOLTAGE

Level can be varied in 24 steps of –5 dBFS between 0 dBFS and -120 dBFS. One of 3 fixed settings can be selected as frequency.
Field of application: Linearity measurements

FREQUENCY

Frequency can be varied. The level is at -20 dB.
Field of application: Frequency response measurements

***Notes**:*

1. *When the sweep is switched on (SWEEP CTRL), the selected variation mode is taken as the X axis. When the sweep is switched off (SWEEP CTRL OFF), the X axis is taken as the variation mode.*
2. *A level sweep over more than 25 points is useless since only a maximum of 25 different levels can be set.*

FREQUENCY

Entry of sine frequency; may be used as sweep parameter. Displayed only in multichannel modes (2/0 or 5.1) with frequency variation selected.
As described under "Format", the frequency resolution per frame is 31.25 Hz. The more frames are coded, the finer the frequency resolution is. The frequency resolution required determines the number of frames and the maximum length of the WAV files. The longer the WAV files, the longer the download times and the total measurement time. To offer a compromise between frequency resolution and measurement speed, the length of the WAV files is limited to 6 frames. This corresponds to a frequency resolution of 5.21 Hz.
This high frequency resolution is required only for low frequencies since a logarithmic frequency division is normally performed for frequency response sweeps. To avoid obtaining too many frequency values (and WAV files) the frequency resolution towards higher frequencies is limited so that fewer frames are required for coding. This increases the measurement speed at higher frequencies.

Frequency range:	5 Hz to 1 kHz	1 kHz to 3 kHz	3 kHz to 20 kHz
Resolution:	5.21 Hz	10.42 Hz	31.25 Hz
Number of frames:	1 to 6	1 to 3	1

Value range: 5.21 Hz to 20 kHz (sampling rate only 48 kHz)

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Notes:
1. *To further increase the measurement speed during sweeps, as many frequency points as possible should be an integer multiple of 31.25 Hz for frequencies below 3 kHz. This can be implemented by a list sweep.*
2. *The RMS measurement time GEN TRACK does not provide the usual high-precision results with Coded Audio since the generator frequency cannot be synchronized to the exact measurement time. It is therefore recommended to use the measurement time AUTO or AUTO FAST.*

VOLTAGE

Entry of sine amplitude; may be used as sweep parameter. Displayed only in multichannel modes (2/0 or 5.1) with level variation selected.

The level can be varied in 24 steps of -5 dBFS between 0 dBFS and –120 dBFS.

Value range (only digital, audio data mode):
-120 dBFS to 0 dBFS

Units (only digital, audio data mode):
FS | %FS | dBFS | LSBs | bits | Δ% | dBr

2.5.5 Auxiliary Generator

With option UPL-B1 (low-distortion generator) fitted, an additional sinewave generator is available for producing analog or noise signals up to 110 kHz in the source mode AUDIO DATA or PHASE. Thus,

- *digital* audio data of any signal shape and an *analog* sinewave signal or
- *digital* audio data of any signal shape and a *superimposed* noise signal (jitter or common mode signal)

can be generated *simultaneously.*

The auxiliary generator has the same specifications as the low-distortion generator and its own (1-dimensional) sweep system for sweeping either the level or frequency.

AUX GEN — Activation of auxiliary generator and selection of use.

OFF	Auxiliary generator switched off; audio data are generated without a noise signal, analog outputs switched off (high-impedance).
ANALOG OUT	Audio data are generated without a noise signal. In addition to the digital signal (at the BAL, UNBAL and optical outputs) an analog signal is generated at the analog XLR connector. Frequency and level of the analog signal can be set or swept.
COMMON MODE	A common mode signal is superimposed onto the audio data, the analog outputs are switched off (high-impedance). Frequency and level of the noise signal can be set or swept.
JITTER	A jitter signal is added to the audio data, the analog outputs are switched off (high-impedance). Jitter frequency and level can be set or swept.

2.5.5.1 Auxiliary Generator Used as Analog Generator

The generator can be used as a balanced or unbalanced source with one or two output channels. Different source impedances can be selected. The low-distortion generator is used, level control is via the output amplifier.

Channel(s)

Selection of output channel; disabled channels are terminated with the set output impedance.

OFF	Both channels off
1	Channel 1 on, channel 2 off
2	Channel 2 on, channel 1 off
2 ≡ 1	Same signal on both channels

Output

XLR connectors can be used as balanced (BAL) or unbalanced (UNBAL) output.

UNBAL	An unbalanced signal is generated at the XLR connector; The maximum output level is 10 V.
BAL	A balanced signal is generated at the XLR connector; the maximum output level is 20 V. The output impedance can be selected in three steps.

Impedance

Selection of output impedance, with BAL selected; the output impedance of the unbalanced output is 5 Ω.

10 Ω
200 Ω
600 Ω

Anlg Freq

Entry of sinewave frequency of analog signal

Specified range: 2 Hz to 110 kHz

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Anlg Ampl

Entry of sinewave amplitude of analog signal

Specified range: 0 to 10 V_{rms} for UNBAL
0 to 20 V_{rms} for BAL

Units: V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | dBu | dBV | dBm

Peak-to-peak amplitude: $V_{ss} = V_{rms} \times 2 \times \sqrt{2}$

2.5.5.2 Auxiliary Generator Used as Common Mode Generator

The auxiliary generator superimposes a common-mode sinewave signal on the digital output signal.

***Note**: This common mode signal can also be generated by the function generator in the source mode COMMON ONLY. Signal shapes other than sinusoidal are possible for the noise signal (e.g. noise), but the audio data cannot be set.*

Comm Freq

Entry of common mode frequency

Specified range: 2 Hz to 110 kHz

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

Comm Ampl

Entry of common mode amplitude

Specified range: 0 to 7.071 V_{rms}

Units: V | mV | µV | V_{pp} | mV_{pp} | μV_{pp} | dBu | dBV | dBm

Peak-to-peak amplitude: $V_{pp} = V_{rms} \times 2 \times \sqrt{2}$

2.5.5.3 Auxiliary Generator Used as Jitter Generator

The auxiliary generator superimposes a sinewave jitter signal on the digital output signal.

***Note**: This jitter signal can also be generated by the function generator in the source mode JITTER ONLY. Signal shapes other than sinusoidal are also possible for the jitter signal (e.g. noise), but the audio data cannot be set.*

Jitt Freq

Entry of jitter frequency

Specified range: 2 Hz to 110 kHz

Units: Hz | kHz | ΔHz | ΔkHz | f/fr | Δ%Hz | Toct | Oct | Dec

JittPkAmpl

Entry of jitter peak amplitude

Specified range: 0 to 0,25 UI

Units: UI | %UI | dBUI | ppm | ns

***Note**: For all applications for which the jitter peak amplitude of the auxiliary generator is not sufficient, the jitter signal can also be generated by the function generator in the source mode JITTER ONLY. Setting audio data is not possible in this case.*

2.5.5.4 Auxiliary Generator Sweep

The sweep system of the auxiliary generator is similar to that of the function generator (see 2.5.4.2 Sweeps). A 2-dimensional sweep, i.e. simultaneous sweep of frequency and level, is not implemented.

SWEEP CTRL

see 2.5.4.2 Sweeps

FREQ FILE

Entry of a file name for the frequency list (list sweep).

For entering file names see 2.3.2 Data Entry

VOLT FILE

Entry of a file name for the amplitude list (list sweep).

For entering file names see 2.3.2 Data Entry