## 2.7 Analyzer Filters (FILTER Panel)

The FILTER panel has been devised for definition of the filters which can then be used in the ANALYZER panel. Before you can select a user-definable filter in the analyzer, you must, of course, create it in the FILTER panel.

**Activating the FILTER panel:**
UPL front panel: FILTER
External keyboard: ALT + T
Mouse: (repeated) click on the right panel name, until the FILTER panel is displayed.

If the FILTER 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.

**Filter**

For the functions

- RMS & S/N (rms measurement) → 3 filters possible
- PEAK & S/N (peak measurement), → 3 filters possible(*)
- Q-PK & S/N (quasi-peak meas.) → 3 filters possible(*)
- THD+N/SINAD (distortion measurement) → 1 filter possible
- RMSSEL (selective RMS measurement) → 1 filter possible
- FILTSIM (filter simulation) → 3 filters possible
- RUB & BUZZ (loudspeaker measurement) → 2 filters possible
- WAVEFORM → 1 filter possible(*)
- 1/3-OCTAVE → 1 filter possible(*)
- FFT → 3 filters possible (*)

any desired filters from the filter selection window can be set in the ANALYZER panel. This window contains user-definable filters (the first 9) and weighting filters, which are referred to by their short names in the FILTER panel or by a name complying to the standard. You can select any desired filter (also several times) and assign to the ANALYZER measurement function.

The sum frequency response of all selected filters can be graphically displayed using the analyzer function FILTSIM (see 2.6.5.13).

***UPL-B29***: *For the functions marked (*****), no digital filter can be switched on in the high rate mode or in the ANLG 110 kHz analyzer. When switching from base rate mode to high rate mode with these functions being active, all filters are switched to OFF and the filter menu lines removed from the analyzer panel. When switching back to the base rate mode, the menu lines are displayed again while the filters remain switched off.*

***Note:*** *In the digital analyzer, the bandwidth of the filters depends on the selected sampling rate. If the sampling rate is reduced, the upper frequency limit may be set as low as the Nyquist limit.*

## 2.7.1 Weighting Filters

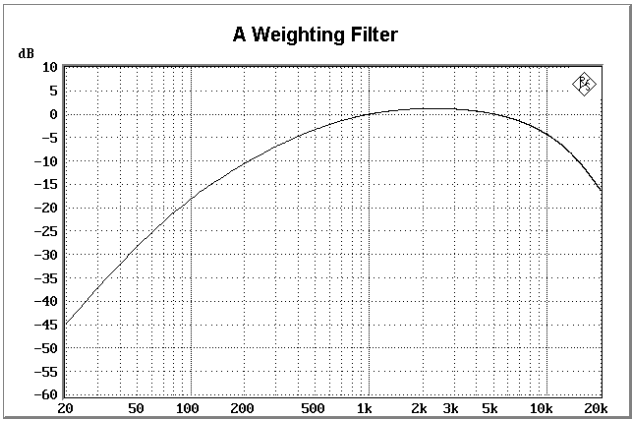
The user-definable filters in the UPL (see 2.7.2 Creating the User-definable Filters) are complemented by 13 pre-defined weighting filters, which are automatically matched to the current sample rate. Due to the digital realization, the frequency response absolutely complies with the standard. With a very small sample rate (e.g. 32 kHz in the DIGITAL instrument), some sections of the filter functions are close to the measurement range limit, resulting in distortions in these sections (with e.g. a sample rate of 32 kHz, distortions may occur in the range over 13.5 kHz). Yet, the filter is still within the permissible tolerances. For this reason, it is not possible to set weighting filters in combination with sample rates smaller than 30 kHz.

***Note:*** *The weighting filters cannot be set in the filter panel, but are automatically available with the filter command of the respective measuring function.*

Filter: A Weighting

Standard(s): DIN 45412

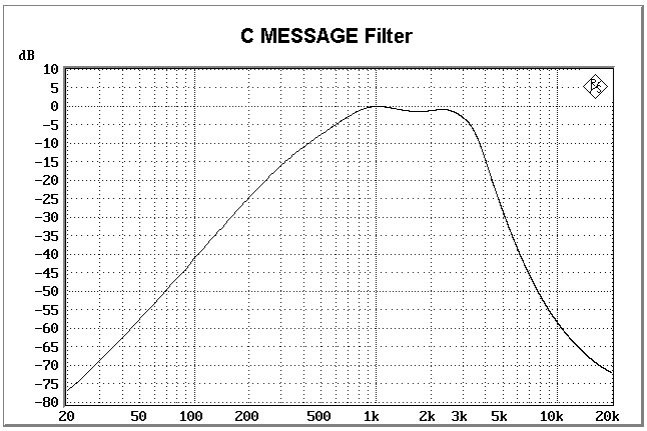
Application: Weighting for interference voltage measurements




Filter: C Message

Standard(s): IEEE 743-84

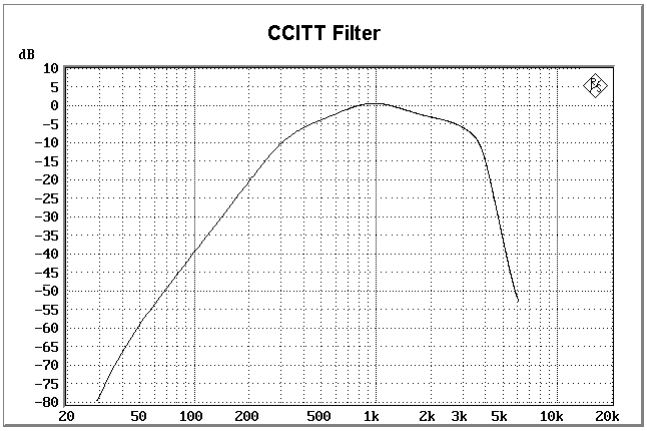
Application: Transmission measurements




Filter: CCITT

Standard(s): CCITT 0.41
IEEE Rec. 743-84
CISPR 6-76
CCITT Rec. P.53

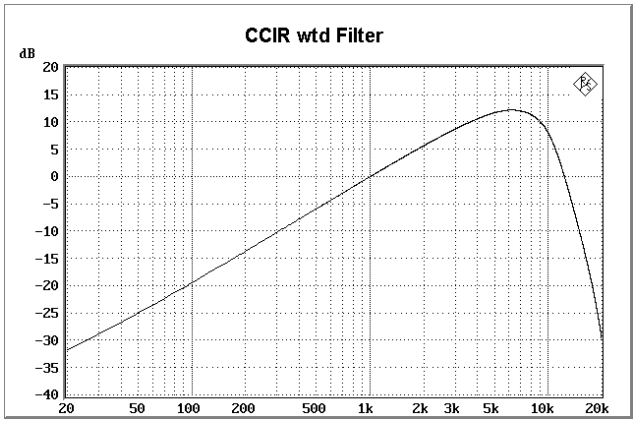
Application: Psophometric measurements



Filter: CCIR wtd

Normen: CCIR Rec. 468-4
DIN 45405
CCITT Rec. N21
CISPR 6-76

Application: Weighting for interference voltage measurements

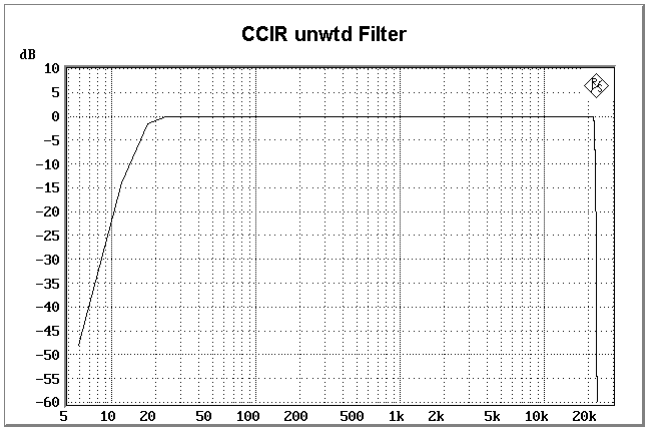



Filter: CCIR unwtd

Standard(s): CCIR Rec. 468-4

Application: Bandpass from 20 Hz to 20 kHz for band-limited, unweighted measurement to CCIR.

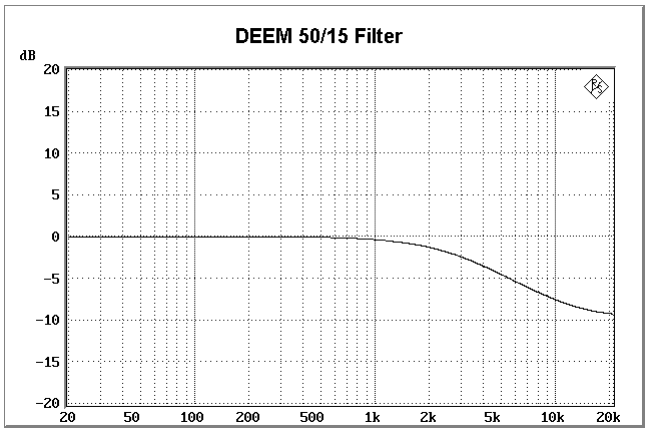
Note: Not available in analyzer 110 kHz




Filter: DEEM 50/15

Standard(s): CCIR Rec. 651

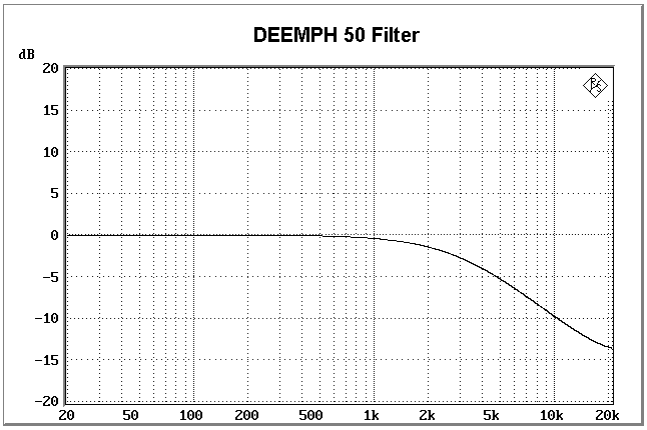
Application: Compact discs



Filter: Deemph 50

Standard(s): ARD Pfl.Heft 5/3.1

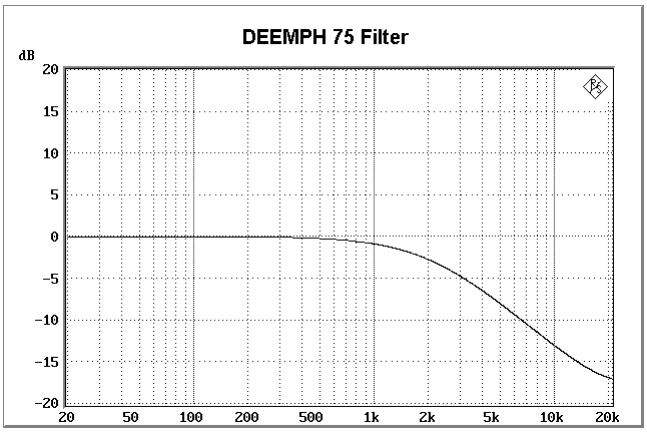
Application: Unweighted and weighted S/N measurements to DIN 45405




Filter: Deemph 75

Standard(s): same as Deemph 50

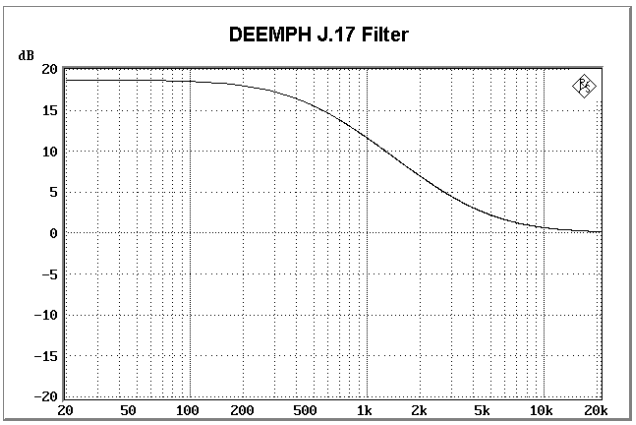
Application: Unweighted and weighted S/N measurements to DIN 45405




Filter: Deemph J.17

Standard(s): CCITT J.17

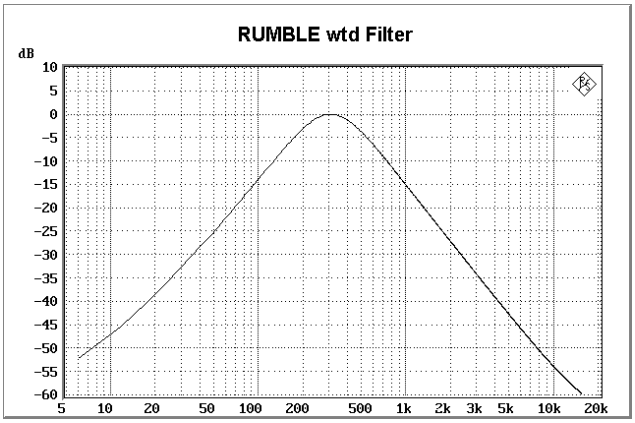
Application: Unweighted and weighted S/N measurements to DIN 45405



Filter: RUMBLE wtd

Standard(s): DIN 45539

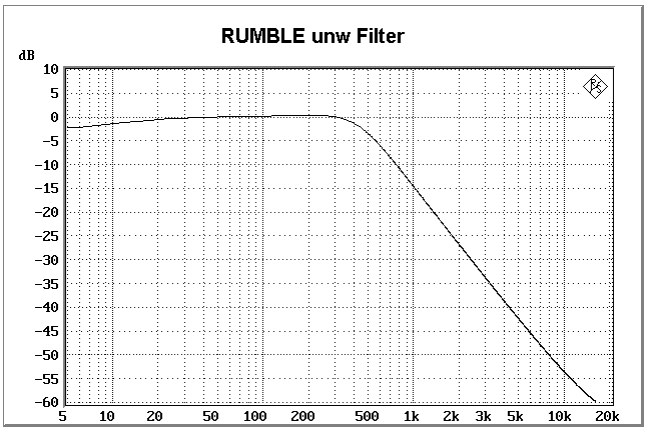
Application: Testing of record players
Weighted S/N measurements




Filter: RUMBLE unwtd

Standard(s): DIN 368.3
DIN 45539

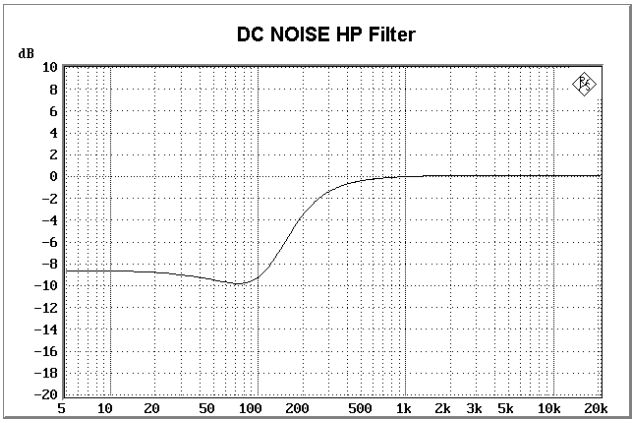
Application: Testing of record players
Unweighted S/N measurements

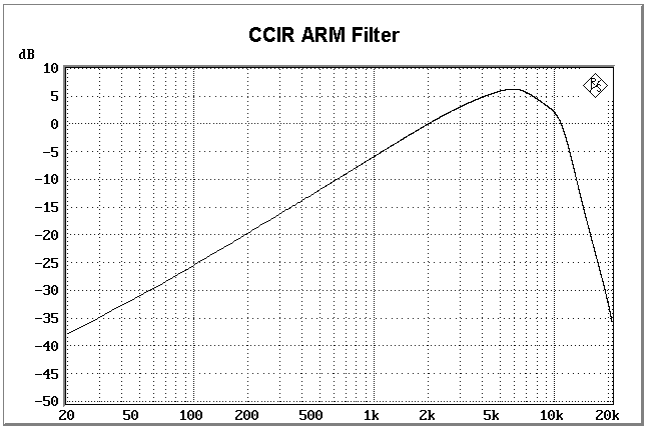



Filter: DC noise HP

Standard(s): ARD Pfl. Heft 3/4
ARD Pfl. Heft 12/2

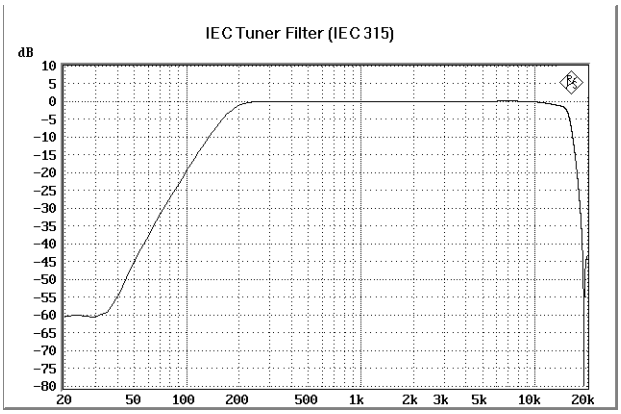
Application: Highpass for DC noise measurements (tape machines)





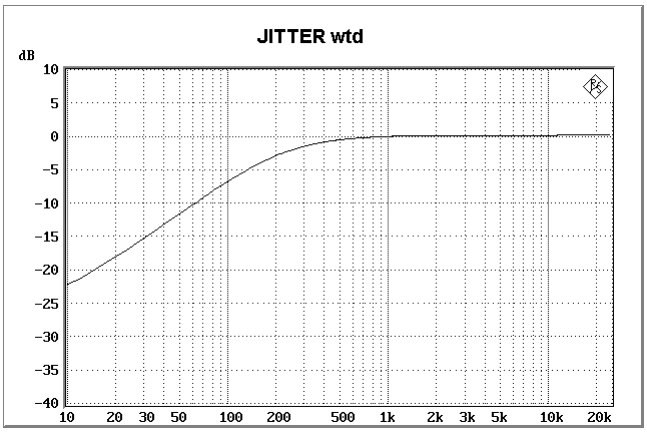

Filter: CCIR ARM

Standard(s): CCIR
DOLBY
NAB Standard




Filter: IEC Tuner
Standard: DIN/IEC 315

Application: Measurement on tuners




Filter JITTER wtd
Norm: AES 3

Application: Weighting of jitter transfer function
1st order highpass filter
-3 dB at 700 Hz
-20 dB at 70 Hz

The filter shown corresponds to the predecessor (prior to UPL 3.0) and can be activated with the call parameter '-o15'.

## 2.7.2 Creating the User-definable Filters

The FILTER panel is made up of 9 filter positions designated as FILTER 01 ... FILTER 09. Each filter position can be assigned a filter of type LOW-PASS, HIGH-PASS, BAND-PASS, BAND-STOP, NOTCH, 1/3 OCT FLT, OCTAVE FLT, FILE-DEF, which are referred to below. Each filter type is predefined by its cutoff frequencies and the desired filter attenuation. After the filter has been calculated, further filter data (settling time, actual attenuation, stopband range, which are displayed in a different color) are available in the FILTER panel.

There is also the possibility of reading in any desired filter by selecting ”FILE DEF”.

Any filter defined in the FILTER panel is provided with a short name, which is then used to call the filter in the ANALYZER panel. The short name refers to type and cutoff frequency of the filter.

The filters have been implemented as recursive filters (=IIR filters) with 8 poles.

The filters are defined in terms of their frequency limits, which is why the contents of the FILTER panel is independent of the selected ANALYZER instrument ANLG 22 kHz, ANLG 110kHz or DIGITAL. Filter parameters which used to make sense for a certain instrument may be futile in combination with another instrument.

**Example:**
A lowpass with a cutoff frequency of 50 kHz is a commonly used filter with the ANALYZER instrument ANLG 110kHz, however ineffective in the instrument DIGITAL or ANLG 110kHz.

For this reason, proceed in the following order when setting the filters:

1. Switch all filters in the ANALYZER panel off:
   Enter any desired filter parameters in the FILTER panel. The filter parameters are neither checked nor updated.
2. In the ANALYZER panel, select a filter from the FILTER panel: now, the parameters of the filters are checked:
   a) Valid filter parameters: filter is set
   b) Invalid filter parameters: error message on the screen, filter remains OFF
3. Try to modify in the FILTER panel filter parameters of a filter selected in the ANALYZER panel:
   A dialog window appears where you can enter the new filter parameters. When you press the O.K. key in the dialog window the filter parameters are checked.
   a) Valid filter parameters: filter is set
   b) Invalid filter parameters: error message on the screen, the dialog window remains open for further entry of filter parameters.

Exiting the filter dialog window using CANCEL or ESC causes

- the filter in the ANALYZER panel to be switched OFF.
- the most recently valid filter parameters to remain unchanged in the FILTER panel.

***Note:*** *A certain type of filter can be repeatedly assigned with the same or different filter parameters to the 9 filter positions!*
*The sum frequency response of the set filters can be displayed with the help of the simulation (see FILTSIM function).*
*You can select the filters in the ANALYZER panel in any desired order. For reasons of stability, it is however useful to select the filter with the ”hardest” characteristics (e.g. very narrow bandstop filters) as the last one (below in the panel).*
It is possible to superpose several filters of the same type and with equal filter parameters for one measurement function. To give an example, a very steep 80-dB lowpass (in this case, with 16 poles, yet double ripple in the passband range) can be realized by superposing two 40-dB lowpasses.

### 2.7.2.1 Common Parameters of All Filters

**Atten**

(=Attenuation). Specify the desired filter attenuation in dB (example: 40 dB). After the filter has been checked and set, the actually realized attenuation (usually higher) is entered. Filter attenuations can be implemented about every 10 dB.

***Exception:*** *The filter calculation file (see 2.7.2.6 Internal Calculation of Filters) has been modified.*

**Delay**

(Read only)
Enter the estimated settling time of the filter in seconds.
This value is updated only when the filter is checked.

***Exception:*** *File-defined filters. Subsequent to entry of the coefficients, the software calculates a delay and enters it in the menu line where it can be modified manually.*

**Shortname**

(Read only)
Specify a short name used later to call the filter in the ANALYZER panel. The short name is made up of an abbreviation (2 letters) for the filter type and the frequency (LP = lowpass, HP = highpass, BP = bandpass, BS = bandstop, TZ = third-octave filter, OC = octave filter, NO = notch filter).

### 2.7.2.2 Lowpass / Highpass

**Filter**

Select a lowpass or highpass.

**LOW PASS**

**HIGH PASS**

**Order**

Specifies the filter order

**4**
**8**

By reducing the filter order from 8 (standard) to 4, faster but less steep filters can be created. The order can be determined separately for each highpass or lowpass filter.

**Passband**

Specify the cutoff frequency of the passband range.

**Stopband**

(Read only). Display of the cutoff frequency of the stopband range, which is determined by the selected attenuation and passband range. This value is updated only when the filter is checked.

The basic filters used have eight poles, 'elliptic c'-type to /SAAL 88/ with a ripple of 0.1 dB in the passband range.

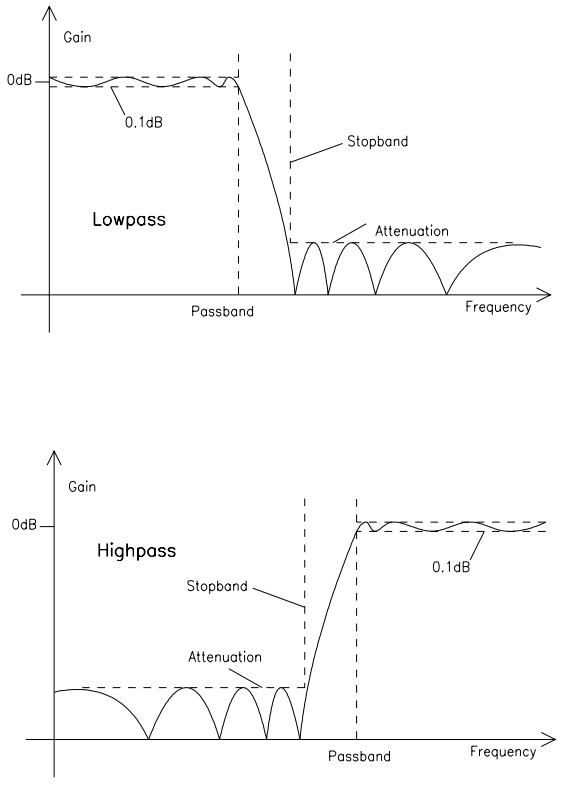



Fig. 2-33 LOWPASS and HIGHPASS frequency response together with filter parameters

### 2.7.2.3 Bandpass / Bandstop

**Filter**

**BAND PASS**

**BAND STOP**

**Passb Low** Enter the lower cutoff frequency of the passband range.

**Passb Upp** Enter the upper cutoff frequency of the passband range.

**Stopb Low** (Read only)
Display of the lower cutoff frequency of the stopband range, which is determined by the selection of attenuation and passband range. This value is updated only when the filter is checked.

**Stopb Upp** (Read only)
Display of the upper cutoff frequency of the stopband range, which is determined by the selection of attenuation and passband range. This value is updated only when the filter is checked.

The basic filters used have 4 poles, 'elliptic C'-type to /SAAL 88/ where one basic filter is used for the upper and one for the lower filter edge. As 'elliptic C' has a pole at infinity, a bandstop of this type features a pole in the center between the two passband frequencies.

Values for Passbd low and Passbd upp which are close to each other cause long settling times during realization and the danger of limit cycles (oscillations of the filter on account of self-excitation induced by rounding noise). In this case, it is useful to simulate the filters before the measurement (see analyzer function FILTSIM).

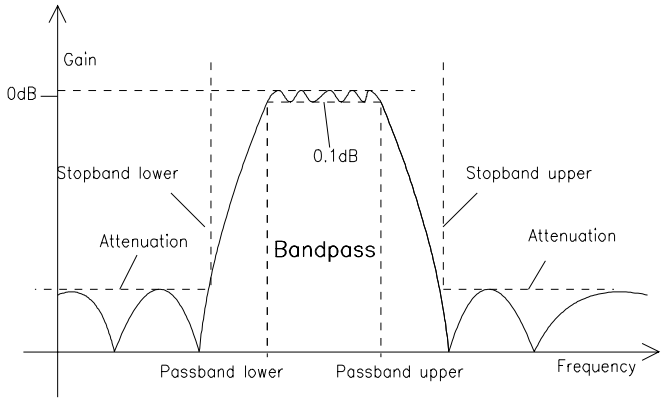



Fig. 2-34 BANDPASS frequency response together with filter parameters

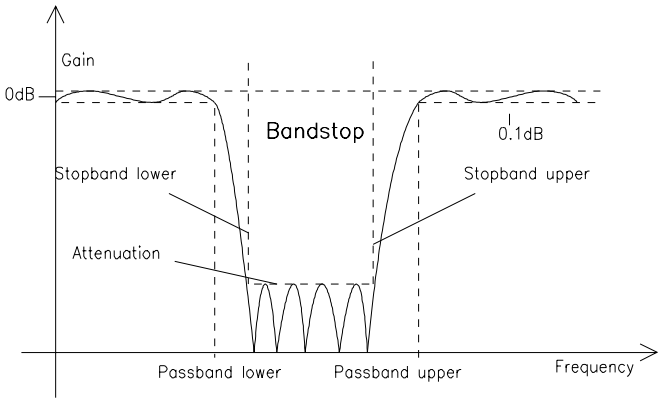



Fig. 2-35 BANDSTOP frequency response together with filter parameters

### 2.7.2.4 Notch

**Filter**

**NOTCH FLT**

**Center Freq**

Enter the center frequency of the bandstop.

**Width**

Enter the difference between upper and lower cutoff frequency of the passband range.

**Stopb Low**

(Read only)
Display of the lower cutoff frequency of the stopband range, which is determined by the selection of attenuation and passband range. This value is updated only when the filter is checked.

**Stopb Upp**

(Read only)
Display of the upper cutoff frequency of the stopband range, which is determined by the selection of attenuation and passband range. This value is updated only when the filter is checked.

The basic filters used have 4 poles, 'elliptic C'-type to /SAAL 88/ where one basic filter is used for the upper and one for the lower filter edge. As 'elliptic C' has a pole at infinity, a bandstop of this type features an attenuation pole at the center frequency.
Use:
Attenuation of single frequencies in the signal.

Small values for "width" cause long settling times during realization and the danger of limit cycles (oscillations of the filter on account of self-excitation induced by rounding noise). In this case, it is useful to simulate the filters before the measurement (see analyzer function FILTSIM).

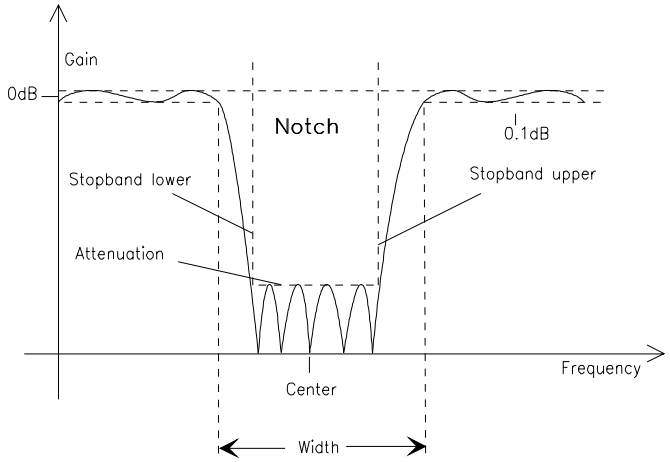



Fig. 2-36 Notch filter frequency response together with filter parameters

### 2.7.2.5 Third-octave / Octave

**FILTER**

**1/3 OCT FLT**

**OCTAVE FLT**

(1/3 OCT FLT = third-octave filter)

**Center Freq** Enter the center frequency of the bandstop.

**Width** (Read only)
Enter the difference between upper and lower cutoff frequency of the passband range.

These filters have been implemented as bandpasses (see 2.7.2.3 Bandpass / Bandstop) which are geometrically symmetrical to the center frequency, thus allowing the passband cutoff frequencies to be calculated from the center frequency:

1/3 octave filter: Passbd low = Center Freq / 1.12246
Passbd upp = Center Freq x 1.12246

Octave filter: Passbd low = Center Freq / 1.41421
Passbd upp = Center Freq x 1.41421

***Note***: *For these filters the 0,1dB-bandwidth is reduced in order to obtain an attenuation of 3 dB at the cut-off frequencies. Hence the effective bandwidth is lower than the theoretical values of third octave and octave filters.*

*theoretical bandwidth third octave:* $\sqrt[6]{2} - \frac{1}{\sqrt[6]{2}} = 0.2315 = 23.15\%$

*theoretical bandwidth octave:* $\sqrt[2]{2} - \frac{1}{\sqrt[2]{2}} = \frac{1}{\sqrt{2}} = 0.7071 = 70,71\%$

### 2.7.2.6 Internal Calculation of Filters

All filter parameters are transformed from the Z range (digital, sampled) to the s range (analog, continuous) using the sample rate valid for the respective instrument. In the s range, the filter parameters are normalized to a passband limit of 1.0. The filter suitable for this transformed filter with respect to the type (i.e., elliptic c and eight-pole for highpasses and lowpasses and four-pole for bandpasses) and minimum desired attenuation is searched for in the filter data base. This filter is then denormalized and retransformed while the actual stopband and actual attenuation are being calculated.
This transformation is performed with the currently effective sample rate. The predefined cutoff frequencies are maintained, however different stopband frequencies will be obtained (depending on the selected sample rate). When the sample rate on which the calculation is based does not match the actual clock rate (e.g. in the case of a wrong entry), both passband frequency and stopband frequency are shifted.
After the start of the measurement (e.g. through a new setting, pressing of the START key or in the case of SWEEP), UPL waits for a certain settling time per filter before the actual signal integration. This settling time is calculated on the basis of the desired attenuation and the filter coefficients. If (in exceptional cases) the time calculated is too small, the filters have not completely settled at the start of the measurement.
To remedy this, the following trick is possible:
If the FILE_DEF filter ”DELAY.COE” is selected, a settling time can be entered there which is considered in addition to the normal settling time in the measurement. Filter DELAY.COE has no function otherwise.

The filter data base is filled with the filters in the 'ref_lp.rlp' file in the C:\UPL\REF directory on start of the system software.

The filters contained in this file are derived from /SAAL 88/. Their ripple in the passband range is 0.1 dB.

**Note**: For the ANLG 110 kHz analyzer a reference lowpass filter of 74 dB and with 0.03 dB ripple is used for the RMS selective measurement.

### 2.7.2.7 File-defined Filter ("FILE-DEF")

For applications requiring additional filters which are not offered by the instrument, any desired filter can be read in from a file. The filter in the file must be an IIR filter with 8 poles/zeros. The filter must be designed (in the Z range, i.e. digital, sampled) with reference to the sample rate used in the respective ANALYZER instrument. Two data formats are supported:

a) **Coefficient output file of FDAS**, version 2.1 and 2.2. FDAS is a filter design program from the company of Momentum Data Systems. Select a cascade of biquads with 32-bit float number representation as implementation for generation of the filter with the help of FDAS.

   **Example:** see R&S_EXAM.COE file in the C:\UPL\USER directory

b) **ASCII file** where the poles and zeros (in the z level) must be entered as floating numbers. 8 poles and zero positions (4 pairs) only are permissible. Unused poles and zeros must be shifted to the origin of the z level.

   **File format:**

| | |
|---|---|
| 1st line: | Identification: 'pole zero file' |
| 2nd line: | Key word 'gain' followed by a float number: specification of filter gain |
| following lines: | Key word 'pole' or 'zero' followed by real and imaginary part. Complex conjugate pairs must be consecutive and be at the 1st, 3rd, 5th or 7th position, respectively. |

   The transfer function is given by:

$$S(z) = gain * \frac{\prod_{i=0}^{3} (z - z_{oi}) * (z - z_{oi}^*)}{\prod_{i=0}^{3} (z - z_{pi}) * (z - z_{pi}^*)}$$

   where S(z) is the normalized transfer function, $z_0$ are zeros and $z_p$ are poles.

   The filter should be checked using the simulation.

   Comment lines should begin with '#' and are permissible anywhere; no difference is made between upper-case and lower-case letters.

   **Example:** see R&S_EXAM.ZPZ file in the C:\UPL\USER directory

The coefficient file (*.COE) is valid only for the sampling rate defined when the filter was designed. Pole/zero files (*.NPZ) can be converted to the current sampling rate, their frequency response being maintained.

Both types are offered in the file box for the file-defined filters.

Literature:

/SAAL88/: Rudolf Saal, Handbook of Filter Design, 2nd edition, Hüthig 1988

## 2.8 STATUS Panel

**Activating the STATUS panel:**

UPL front panel: STATUS
External keyboard: ALT + S

The STATUS panel can be activated only in part-screen graphics mode (see 2.10.9 Switching between Full-screen and Part-screen Mode) and is always on the left side of the screen.

The STATUS panel displays only those command lines of a panel which have been ticked (select the position before the line using the tab ← keys, press SELECT, the tick is switched on and off (toggle function). The UPL thus offers the possibility of displaying a clearly structured excerpt from all settings on the left side of the screen.

Instead of using the other panels, the UPL can also be operated from the STATUS panel, allowing you to carry out constantly recurring operator sequences from one panel only. Use of the STATUS panel is especially advantageous for display and, if required, printout (see 2.14) of graphics on the right side together with the essential UPL settings on the left side of the screen.

Empty STATUS panel.
No command lines have
been ticked off.

```
STATUS

No commands selected!

Only commands which are
ticked off appear in
the STATUS-Panel.

For further information
press HELP!
```

Command lines in the GENERATOR,
ANALYZER and DISPLAY panel
have been ticked off.

```
STATUS

GENERATOR PANEL
» Channel (s)    1
» Output         BAL
» FUNCTION -     SINE
» FREQUENCY      10.000 Hz
» VOLTAGE        3.0000 V

ANALYZER PANEL
» Channel (s)    1
» CH1 Input      BAL
» FUNCTION -     RMS & S/N
» Meas Time      AUTO FAST

DISPLAY PANEL
» OPERATION      BARGRAPH
» Unit           V
» Spacing        LIN
```

Fig. 2-37 Status panel

# 2.9 Series of Measured Values, Files and Loadable Instrument Settings (FILE Panel)

The FILE panel is activated by pressing the FILE key (UPL front panel) or the key combination ”ALT F” (external keyboard). The FILE panel is always displayed on the left side of the screen.

## 2.9.1 Loading and Storing

Files can be stored to hard disk (drive ”C:”) or floppy disk (drive ”A:”). All system files are available on hard disk and, in the default setting, the user files too. The user files can also be written to or read from diskette.

UPL system software updates are also loaded from diskette (see 1.2.1 Enabling Software Options). For storing files on diskette, DOS- formatted 3.5” diskettes are required. Unformatted diskettes can be formatted on operating system level using the command

```
FORMAT A:
```

An external keyboard is required for this purpose.

Insert the diskettes into the drive with the metal slider pointing to the front and the label to the left. The diskette is ejected by pressing the eject key.

On the left side of the diskette, there is a lockable write protection; the disk is write-protected when the hole is free.

The individual types of files are characterized by reserved file types (file extensions), which are listed in the table below. It also provides information on where, i.e. in which panel, the file is loaded.

Table 2-35 Meaning of file extensions

| Extension | Meaning |
|---|---|
| .AES | Report information AES/EBU+S/P DIF |
| .BAT | Batch file for automatic execution of several programs; reserved (DOS) |
| .BPZ | Binary file with poles-zeros |
| .CAL | Calibration file; reserved for calibration factors |
| .COE | Coefficient file for filters (see 2.7.2.7) |
| .COM | Executable programs; (e.g. BIOSW.COM); reserved (DOS) |
| .DWL | Dwell time for automatic generator sweeps:<br>loaded in the GENERATOR panel, menu item ”Dwell List” |
| .ERR | Error file for limit violations<br>loaded in the DISPLAY panel by selecting Trace A/B →FILE; OPERATION → LIM REPORT; |
| .LOG | Prolog and epilog for HPGL (see 2.14 Printing / Plotting / Storing the Screen Contents (OPTIONS Panel)) |
| .PLT | Colour palette information for PCX and printer (see 2.14 Printing / Plotting / Storing the Screen Contents (OPTIONS Panel)) |

| Extension | Meaning |
|---|---|
| .EXE | Executable programs; (e.g. UPL_UI.EXE); reserved (DOS) |
| .FTF | Amplitude/frequency table for generation of noise in the frequency domain (see 2.5.4.11) |
| .GL | Screen hard copy (Destin HPGL file) is generated in the UPL for subsequent output to a HPGL printer |
| .HLP | Help file |
| .LLW | Limit curve (LOWER) loaded in the DISPLAY panel under the heading LIMIT CHECK, ”Lim, Lower” menu item ”File name” |
| .LUP | Limit curve (UPPER) loaded in the DISPLAY panel under the heading LIMIT CHECK, ”Lim, Upper” menu item ”File name” |
| .NPZ | reserved for filters |
| .NRM | Normalization file reserved for filters |
| .OUT | DSP files reserved for programs to be down-loaded to the DSPs |
| .PAC | Protocol analysis (AES/EBU, SP DIF), screen control file for channel status data |
| .PAU | Protocol analysis (AES/EBU, SP DIF), screen control file for channel status data |
| .PCX | Screen Hard Copy (Destin PCX file) generated in the UPL to be copied to other programs |
| .PGC | Protocol generation (AES/EBU, SP DIF), user data, file for channel status data |
| .PGU | Protocol generation (AES/EBU, SP DIF), user data, file for channel status data |
| .PPC | Protocol generation (AES/EBU, SP DIF), user data, file for user-definable PROTOCOL panel |
| .RLP | Reference lowpass (reserved for filters, see 2.7.2.7) |
| .SAC | Partial setup; loaded in the file panel under the heading LOAD INSTRUMENT, menu item Mode→ACT SETUP |
| .SCO | Setup; loaded in the FILE panel under the heading LOAD INSTRUMENT, menu item Mode→COMPL SETUP |
| .SPV | Sweep list for generator voltage loaded in the GENERATOR panel, menu item ”VOLTAGE” or ”TOTAL VOLT” (depending on the function) for X- or Z-axis sweep |
| .SPF | Sweep list for frequency of the generator or selective rms measurement; loaded in the GENERATOR panel, menu item ”FREQUENCY”, ”MEAN FREQ” or in the ANALYZER panel, menu item ”File name” for X- or Z-axis sweep |
| .SPO | Sweep list for burst duration<br>loaded in the GENERATOR panel, menu item ”ON-TIME” for X- or Z-axis sweep |
| .SPI | Sweep list for burst interval<br>loaded in the GENERATOR panel, menu item ”INTERVAL” for X- or Z-axis sweep |
| .TRC | Trace lists for recording of measured values<br>loaded in the DISPLAY panel by selecting Trace A/B → FILE |
| .TTF | Time table for generation of arbitrary signals (see 2.5.4.10) |
| .VEQ | Equalizer file<br>loaded in the GENERATOR panel, menu item ”Equal File” or as RANDOM Freq-File |
| .ZPZ | Pole-zero file reserved for filters |
| .CFG | File with control instructions for working directories |

***Note:*** *Reserved files must not be changed or renamed.*

### 2.9.1.1 Loading and Storing of Instrument Setups and Complete Setups

Setups are loaded and stored by entering a file name in menu item ”Filename”. If the desired file name is already in the menu line, one simply has to open and close the appertaining selection box. (see 2.3.2 Data Entry).

**LOAD INSTRUMENT STATE** Loading an instrument setup

An instrument state can be loaded either user-defined or with reference to an application. The untrained user is advised to start with the application level which provides a great number of predefined measurement setups. The default setup or user-defined setups can only be loaded via USER DEF.

The working directory of the setup is loaded together with the instrument setup, i.e., the current working directory is modified. This is usually useful in order for the file names in the setup to be referred to correctly (if they were stored without path name).

When loading a setup from the application level the *current* working directory is entered in the application setup and, thus, remains valid. It is therefore easier to *use* the application setups. (Pathless) file names are not used in the application setups.

The working directory entered in the application setup will, however, preferably *not be overwritten* for preconfiguring the application setups (once) when the setups are to be stored at their original location and the original working directory is to be retained. This can be achieved using two methods:

- Do not load the application setups from the application level but directly via USER DEF.
- Start the UPL using the **command line parameter "-tappl"**; the application setups will not be modified even when being loaded from the application level, then.

**Applicat**

Permits the instrument to be preset according to the application.

**USER DEF**

Instrument setup according to user-defined measurement or instrument presettings.

Setups stored under a user-defined name can be explicitly loaded by selecting the respective item.

***Note**: USER DEF must also be selected when the default setup is loaded or a PCX picture should be displayed. (See next menu line).*

**ANLG – ANLG**
**ANLG – DIGI**
**DIGI – ANLG**
**DIGI – DIGI**

Instrument setup depending on the domain (analog or digital) selected for generator and analyzer and on the measurement to be performed. The first word denotes the generator domain, the second the analyzer domain.

After selecting one of these items, the application can be selected in a special dialog box of the next menu line (Measuring).

ACTUAL setups are used for these measurements, which are stored in the UPL directories SETEXAM \ AA to SETEXAM \ DD and assigned a 40-character info text describing the application. The setups are sorted in alphabetical order according to this info text.

The setups can of course also be directly accessed (under USER DEF). The experienced user is free to adapt the files and/or their info text to specific requirements or to extend the directories by adding own SAC setups.

***Note**:*

- *To use this application level the EXAMPLE/SETUP floppy must be installed.*
- *Upon new installation of the EXAMPLE/SETUP floppy, all application setups are updated. For this reason modified setups should be stored under another file name.*

**Mode**

(available only when Applicat USER DEF is selected) Determines what should be loaded and displayed.

**DEFAULT**

(Default setup)
The Rohde & Schwarz default setup (see **3.5** is to be loaded.
This includes all presently inactive functions and instruments. A change of this setup is not recommended but possible by overwriting the DEFAULT SETUP file with a setup stored under the COMPL SETUP mode.

**COMPLETE**

(Complete setup)
The complete instrument setup is to be loaded.
This includes all presently inactive functions and instruments as well as the comments that can be entered for a hardcopy (see **2.14 Printing / Plotting / Storing the Screen Contents (OPTIONS Panel)**).
Under this item only **complete setups** (with any file extension, for instance *.SET) can be loaded.

**ACTUAL**

(Actual setup)
The *actual* instrument setup (with or without measured values or traces) is to be loaded. Loading a current setup does *not* affect inactive instruments and functions.
Under this item only **actual setups** and **actual+data setups** (with any file extension) can be loaded. The latter contain in addition measured values and traces and therefore require a longer total loading time especially when the traces are to be displayed.

**SETUP**

An instrument setup is to be loaded. The type of setup (actual or complete) is identified by means of the type extension.
Under this item any setup with the file extensions ***.SAC or *.SCO** can be loaded; other extensions are not permissible.

**VIEW PCX**

This item allows the display of 4-bit) PCX pictures at a 1:1 scale. PCX files recorded in the UPL can thus be subsequently displayed on the UPL.
The PCX picture is displayed until any key is pressed.
The PCX image can be output to a connected printer by pressing the HCOPY key, if PRINTER/SPC is set under Hardcopy Destination in the OPTIONS panel.

***Note**:* *The PCX pictures do not contain softkeys. The current (unlabelled) softkeys are therefore displayed.*

**Measuring**

(available only when Applicat USER DEF is *not* selected). Opens a dialog box where the measurements pertaining to the selected application are listed in alphabetical order. The name of the (SAC) file loaded when a measurement is selected is indicated in addition. From this information the experienced user can see the files to be modified to suit his specific requirements.
When loading a setup from the application level the *current* working directory is entered in the application setup and, thus, remains valid. It is therefore easier to *use* the application setups.

Refer to the notes at the beginning of this section for modification of the application setups.

**STORE INSTRUMENT STATE** Storing an instrument setup

**Mode**

Selection of what is to be stored.

**COMPLETE**

(Complete setup)

The *complete* instrument setup is to be stored .
This includes all currently inactive functions and instruments and all comments that can be entered for a hardcopy (see 2.14 Printing / Plotting / Storing the Screen Contents (OPTIONS Panel)). A file with the extension .SCO occupies about 80 Kbytes of mass storage.

**ACTUAL**

(Actual setup)
The *actual* instrument setup is to be stored. This includes all currently active instruments and functions. A file with the extension .SAC occupies about 8 Kbytes of mass storage.

**ACTUAL+DATA**

(Actual setup including data)
The current instrument setup *including measured values* and *curves* is to be stored. The required storage capacity depends on the size of the active traces.
The measurement or sweep should be TERMINATED prior to storage to make sure that valid measured data are available.
If only measured values (without *curves*) are to be stored, the traces in the display panel must be switched OFF.

***Note:*** *If valid measured* ***curves*** *are available, this type of setup requires considerably more memory capacity (up to 100 Kbyte) and longer loading times than the actual setup. For this reason, this type should only be used when the curves are really needed.*

When loading a new instrument setup, the previous setting is overwritten. All lists (equalizer, limits, etc.) are filled with files the names of which are contained in the new setup. If a file cannot be loaded (e.g. the specified equalizer file has been cleared), an error message is generated and the file name is entered into the menu line as the error source.

***Note:*** *When loading setups, their file names may not exist (e.g. because they have been deleted or the setup has been adopted from another UPL). In such cases, the cause of error (usually "not found") is stated below the respective entry (e.g. "File name").*

**Attrib**

(Attributes); For storing only.

**READ ONLY**

The stored file is write-protected.

**READ/WRITE**

The stored file can be deleted or overwritten.

Deleting a write-protected file requires the R attribute to be deleted using the DOS command ATTRIB at the operating system level.
Syntax: `ATTRIB -R file name`
The use of an external keyboard is necessary for this purpose. It is therefore recommended that the write protection be used only when a setup is not to be changed.

**Info Disp**

(Info display), is displayed when the setup is *loaded* (LOAD INSTRUMENT STATE).

A comment with a maximum of 39 characters can be entered in each setup in the FILE panel under the menu item "Info Text" for a more detailed description of the measurement task or the like. When loading a setup, this comment can be displayed via the file selection window so that the purpose of the setup is known before it is actually loaded.

**OFF**

The "Info text" of a selected setup is not displayed, scrolling in the file selection window is possible at maximum speed.

***Note:*** *When a floppy is to be accessed (drive A:), the info display should preferably be switched off as otherwise scrolling in the file selection window would be considerably slowed down because of the long access times required for opening floppy files.*

**ON**

The info text for the selected setup is displayed in the user info line. Since the info text has to be read out of every setup, scrolling in the file selection window is slightly slowed down.

**Info Text**

Indicated when a setup is *stored* (STORE INSTRUMENT STATE).

Entry of a comment of maximum 39 characters for a more detailed description of the measurement to be performed, the DUT or the like. When a setup is *loaded,* this comment can be displayed via the file selection window (see "Info Disp").

**Filename**

Causes a file with the specified name to be loaded or stored.

If the file cannot be opened, an error message and ”not found” is entered in the menu line.

For entering file names, see 2.3.2.5.

### 2.9.1.2 Loading and Storing of Series of Measured Values and Block/List Data

Series of data from recorded sweeps and/or FFTs, waveform data or filter simulation data can be stored in a file for several purposes:

- To load them at a later date as a record, for the purpose of comparison or subsequent processing. The series of measured values are loaded using the DISPLAY panel commands and are displayed in the form they were stored. They can however be provided with a different scaling or converted into other units.
- The files can be called from other programs and their data further processed. This is best be done using the EXPORT or ASCII format. The structure of an ASCII file is shown in some examples (R&S_EXAM.TRC in the C:\UPL\USER directory) which are provided with detailed comments. For more detailed descriptions refer to section **2.9.1.3 Format of Block/Listen Data**. The EXPORT format has neither a header nor a supplement and can therefore be directly imported into other programs. Since it has no additional information it cannot be loaded in UPL / UPD.
- Stored traces can be used in the UPL for several purposes: As reference traces for other traces if the results are displayed in relative units. For this, the stored traces are loaded by means of FILE under Reference in the DISPLAY panel. Moreover, the trace files can be used to provide equalization data for the generator.

The data are stored in files using commands in the FILE panel (also see 2.3.2.5 Entry of File Names). A series of measured values (Y or Y2) and its associated X-axis values are stored by means of Store TRACE A or TRACE B. If a variable reference value (i.e. a reference value as a function of the X-axis) and a relative unit (i.e. a unit needing a reference) are active, the reference values too are stored in the file. If a Z-axis sweep is selected in the generator, the Z-axis values too are stored. The entire scaling information as well as the function labeling are appended in coded form. If User Label is switched to on in the DISPLAY panel, user-defined function labels and units are also stored.

With command Store TRACE A + B, the data of the second series (trace B with the scaling of Y2) are stored, too, with their associated reference values. The corresponding format can be loaded as a dual trace by means of DUAL FILE in the DISPLAY panel. If Scan count >1 in the DISPLAY panel is active, which is always the case with Z-axis sweeps, the above series of measured values are stored not as one but as several scans. Scan groups too can be loaded from the DISPLAY panel as a unit (see 2.9.3.3 Scan Count >1).

The files are loaded for the functions they are needed. In the GENERATOR panel, for example, the sweep, dwell, and equalization files are loaded. Sweep and dwell files are also used in the analyzer mode for selective rms measurements. In the DISPLAY panel, traces (from sweeps or FFTs), reference traces (for sweeps) and limit-value files (limit files) are loaded.

All measured values are stored with their basic units: levels in V, frequencies in Hz, times in s, phases in degrees, related quantities in %. Notice that S/N data - such as S/N levels - have to be indicated in positive dB values, i.e. 0 dB is 100%, 20 dB means 1000%, the numerical value being 1000.

**Store traces and sweep lists**

**Store TRACE/LIST**

During a sweep, various buffers are created for sweep parameters, measured values, limit exceedings and waiting times, if any. This menu item serves to select which one of these buffers is to be stored.

**TRACE A**
**TRACE B**

Store the TRACE A or the TRACE B buffer; (specify in the DISPLAY panel which measured values are to be collected in which trace buffer) (see 2.10.1 Parameters for Display of Traces and Spectra). In addition to the trace data, the values of the appropriate X-axis as well as the values for scaling from the display panel are stored to permit the curve to be displayed as it was scaled in storing.
If a variable reference and a relative unit are used, the corresponding reference trace is stored too. If Scan count >1 is selected in the DISPLAY panel, a group of traces, or pair of traces, determined by Scan count is stored in the file (with reference traces, if applicable).

**TRACE A+B**

A pair of traces (or a group of pairs of traces if Scan count is set to >1) is stored in a file. The pair(s) of traces can be loaded as a unit by means of DUAL FILE under TRACE A.

***Note:*** *When storing traces, also the X axis and in the case of a 2-dimensional sweep the Z axis are stored.*
*For an assignment to the sweep parameter see X Axis and Z Axis in the GENERATOR panel (see 2.5.4.2 Sweeps ). The list formats (file types) can be seen from the table in section 2.9.1.*

**X AXIS**

Store the list with the sweep points for the sweep parameter lying on the X-axis (for generation of lists used in the list sweep).
For the generation of a sweep list, proceed as follows:
**GENERATOR panel**

- Activate the sweep system (”Sweep Ctrl → AUTO SWEEP”)
- Set the X-axis to the desired parameter (e.g. FREQ for the frequency sweep list)
- Select the start and stop values as well as spacing of the desired parameter (recommended: LIN POINTS or LOG POINTS)
- Enter the number of sweep points, which determine the number of entries in the sweep list generated later.

Start the sweep by pressing the START key. When the sweep enters the SWP ... RUNNING state, the sweep list is available; the sweep can be aborted.

Generating or modifying sweep lists is also possible using a text editor (e.g. EDIT from DOS).

**Z AXIS**

Store the list with the sweep points for the sweep parameter lying on the Z-axis (with two-dimensional sweep only, for generation of lists used in the list sweep).

For generation of the Z-sweep list, it is advisable to proceed as described under generation of the above-mentioned X-list, however, set the values for the Z-axis in the GENERATOR panel.

Generating or modifying sweep lists is also possible using a text editor (e.g. EDIT from DOS).

**Store**

**DWELL VALUE**

For sweeps with time synchronization only; store the buffer for the dwell time. The time data are obtained either from a file (with list sweep) or they are all equal (with Next Step DWELL). The dwell time or the file name for the active dwell list is entered in menu item ”Dwell” or ”Dwell List” in the GENERATOR panel (see 2.5.4.2 Sweeps).

**LIM UPPER**
**LIM LOWER**

The upper or lower limit curve (tolerance mask) is stored to file.
When a limit curve is loaded as is described in Section 2.10.7 Limit Check, a list of all interpolated X-Y pairs is output.

**EQUALIZATN**

Equalization)
Special case: store the frequency response of a device under test, e.g., as equalization file, which can then be read in for frequency-response compensation purposes

- in a sweep with a generator sinewave signal under menu item ”Equal. file” in the GENERATOR panel
- or as generator RANDOM function with Domain FREQ and Equaliz FILE.

For this purpose, the inverse frequency response normalized at any frequency can be stored (see menu item Norm Freq or Invert 1/n). The measurement data (frequency response) must be provided in one of the trace buffers, which can be selected under menu item ”Volt sourc”.

For generation of an equalization file, proceed as follows:
Connect the DUT to channel 1 and select this input/output in the generator and the analyzer. The generator is set to a frequency sweep using „FUNCTION → SINE“ (cf. 2.5.4.2 Sweeps). In the analyzer, the swept voltage of the DUT is determined using the function RMS & S/N. Entry of TRACE A → FUNC CH1 in the DISPLAY panel fills the trace buffer A, which is then referred to as data source for the equalization file using the command Voltsource → TRACE A described below. Prior to storing the equalization file by entry of file name, the user should enter a standard frequency (e.g., 1 kHz) and Invert 1/n ON.

Data obtained by filter simulation can also be converted into an equalization file. To this end select the function → FILTERSIM and set TRACE A → FUNC CH1 in the DISPLAY panel. In contrast to the above-mentioned file-generation, neither a sweep must be performed nor the DUT connected.

**LIM REPORT**

(Limit report)
Stores the list of limit violations. With sweeps and FFT, 0, 1, 2 or 3 is entered into this error-report block. Information on how to interpret this code is given below. The limits or limit curves are indicated in the DISPLAY panel under menu items LIM UPPER and LIM LOWER (cf. 2.10.7 Limit Check).

**Format**

Selection of file format used for storing. (The format need not be specified for loading as UPL / UPD automatically identifies the stored format).

**REAL**

Data are stored in binary form and assigned the basic unit. (File extension: .TRC)
Advantage: fast access when loading the data into UPL / UPD, short files.
Disadvantage: this format cannot be read by the user.

**ASCII**

Data are stored in ASCII format and assigned the basic unit. (File extension: .TRC)
Advantage: data can be read and processed by UPL / UPD and by any text editor or other program.
Disadvantage: when reading data into external programs, the auxiliary information has to be removed and numeric results may have to be converted from the basic unit to the required unit.

**EXPORT**

Data are stored as plain text in tabulated form without auxiliary information. (File extension: .EXP)
Trace data are displayed with the unit used in the graphics display (display: numeric value with unit), reference data with the basic unit (display: numeric value without unit). The columns are separated by tab stops; headers (before each new scan) always start with '#'.
Advantage: the data can be read and processed without any problem by any text editor or other program. Data need not be converted.
Disadvantage: EXP files cannot be read by UPL / UPD because the auxiliary information has been removed.

**Voltsource**

For Store → EQUALIZATN only.

**TRACE A**
**TRACE B**

The trace buffer specified here must be the one containing the measurement data; the ANALYZER and DISPLAY panels must be appropriately configured (see "Store → EQUALIZATN").

The voltage data are read from the trace buffer A/B.

**Normfreq**

For Store → EQUALIZATN only.

Specify the frequency on the voltage value of which is normalized. Selecting the frequency at which the frequency response curve has its maximum means that the equalization file contains values from 0 to 1 only. If any other frequency is selected, factors higher than 1 occur.

**Invert1/n**

For Store → EQUALIZATN only.

Inverting the frequency response causes, with the equalizer switched on, the device under test to get an equalized frequency response. Application: constant (independent of frequency response) outgoing power, pre-/ deemphasis

**ON** The equalization curve is stored in inverted form.

**OFF** The equalization file is not inverted.

**Filename**

Causes the trace or list to be stored under the specified file name.

If the file cannot be opened, an error message and ”not found” is displayed in the menu line.

For entering file names, see 2.3.2.5.

### 2.9.1.3 Format of Block/List Files

## Overview

The following text describes the format of the trace/list files, as it is used internally for storage of measured values and sweep, dwell, equalization and limit lists. This is of interest for the user only, if he wants to copy values into other programs, edit files or create new files for internal use. The subsequent description is intended to offer support in this case. You may additionally refer to the supplied example files (R&S_EXAM.*) in the directory \UPL\USER. These ASCII files contain comments and some of them are even available in various versions (e.g., R&S_EXAM.TRC, R&S_E209.TRC, R&S_E212.TRC).

## Numeric data formats (ASCII and REAL)

All values are stored with their basic units. Physically useful values have an exponent between E 6 (120 dB or mega) and E-12 (-240 dB or pico). (They are converted with the units set for curve representation).

In contrast, numbers are interpreted as factors to the reference value for limit files (cf. 2.10.7 Limit Check).

Notice in advance the description of the differences between the REAL format (binary according to 4-byte IEEE Standard) and the readable ASCII notation. The advantage of the first format is the compact setup and fast access, since the numbers do not have to be converted. However, the user normally prefers using the ASCII format which is easier to handle.

In the REAL format, the numbers are not separated by a separator and they are arranged in successive blocks, e.g., all X-values first, succeeded by the Y-values. With multiscan data (cf. 2.9.3.3 Group of Curves) the X-values then come again, followed by the Y-values etc.

In the ASCII format, all data of an index are arranged in a printable line, the data are separated by a space character and the line is terminated by carriage return / line feed (called CR/LF in the following). Multiscan data are also arranged successively, in this format.

Up to version 211 of the file format, the ASCII numbers like the REAL numbers were arranged in blocks and all numbers were separated by CR/LF. If the previous format is continued to be used for reasons of compatibility, it can be generated by setting a call parameter. This parameter is -o8 and must be inserted in the AUTOEXEC.BAT subsequent to the line containing the UPL(bat) call using an editor on the DOS level.

## Setup

Explanation of the file setup can be most clearly arranged in simplified Backus-Nauer form. The meaning of each individual line is explained in detail in the following.

```
file := header_struct, trace [,info_struct]

    trace := scan | multiscan | fft_scan

        fft_scan := y_block, x_def [, y2_block]
        multiscan := scan 0, count 1, scan 1 [, count n, scan n]....
        scan := ascii_scan | real_scan

            ascii_scan := ascii_sample 0,  [, ascii_sample n ]...
                ascii_sample := x, [, y [, ref] [, y2 [, ref2] ] ], „CR/LF“

        real_scan := y_block [, x_block [, ref_block] [, y2_block [, ref2_block] ] ]
```

x_block, y_block, ref_block, y2_block and ref2_block are blocks of REAL (IEEE 4- byte float). With fft_scan, y_block and y2_block may also be ASCII numbers separated by CR/LF.

x, y, ref, y2, ref2 are numbers in the ASCII notation, separated by spaces. CR/LF is appended to ascii_sample.

The ASCII format allows for inserting comments. They begin with '#' character and are terminated by subsequent CR/LF. Maximum 80 characters are permitted.

## File

The first line explains that a trace/list file always consists of a header_struct and a trace of numbers, followed by an info structure, if desired. In the following, an individual chapter is dedicated to each of the above-mentioned key-words.

## File header (header_struct)

The header is always stored in the ASCII notation and contains 7 integers (16-bit integer) with the following meaning:

```
###### beginning of header
#
213  # version of fileformat this file is built with
0    # format: 0 for ASCII, first all y values then all x values
#              1 for binary (ieee float), successive blocks like format 0
#              2 for ASCII, pairs of values, first y then x values
1131 # mode:   16 bit integer consisting of
#              3 bits (LSBits) comb: 1 for y only, 2 for x+y, 3 for x+y+z,
#              DSP data: 4 for fft, 5 for waveform, 6 for filtsim
#              1 bit new: true since sw vers 2.09
#              2 bits dual: 0:for mono, 1:dual with equal scale,
#                           2:dual with 2 scales
#              2 bits multi: 0:single, 1:multi scan (2, 3 unused)
#              2 bits ref_trc_a: 0 no reference or value
#                                1: reference trace on file
#                                2, 3 unused
#              2 bits ref_trc_b: like ref_trc_a
#              4 bits (MSBits) reserved
3    # scan count (of first scan if multi scan)
5    # count of entries for scan 1
1    # x scale: 0 for lin, 1 for log
0    # y scale: 0 for lin, 1 for log
#
#----- beginning of scan 1
```

- The **first number** contains the version number of the file format. All previous formats can be read from an updated software version but not vice versa, which is why an update of the instrument software is advisable.

- The **second number** indicates the format. 0 means an earlier ASCII format, which contained the figures in successive blocks similar to the sequence used by the REAL format. No further details will be given here. - 1 means that the following numbers are given in the REAL format. 2 stands for the previously described ASCII format with y and x values arranged in pairs.

- With the **third number**, the individual bits are assigned a meaning, each:

  Bits 0 to 2 explain the data structure. Value

1 stands for one-dimensional row (e.g. sweep-list),

2 for two dimensions (e.g. x- and y-data),

3 for three dimensions (generally multiscan data with Z axis),

4 indicates two-dimensional data with fixed x-values (given by start and delta values), generally FFT data

5 like 4, but waveform data and

6 for filter simulation data.

Bit 3 is always set to one starting with version 209 and indicates that the subsequent data are also defined in the data structure described here.

Bits 4 and 5 indicate whether the trace is a mono trace (0) or a dual trace (1).

Bits 6 and 7 indicate single scan(0), multiscan (1), or multiscan with z-sweep (2).

Bits 8 and 9 indicate whether the y-axis contains a reference value (1) (thus, a y-data consists of 2 numbers) or not. If not, these bits are set 0.

Bits 10 and 11 have a similar meaning as bits 8 and 9, however, they refer to the second y-value (y2) with dual trace.

The remaining four bits have been reserved for extensions.

- The **fourth number** indicates Scan Count, the number of scans contained in this file.
- The **fifth number** represents the maximum index + 1, i.e., the number of x (or y, ref , y2, ref2) samples of a scan.

  Note that, with multiscan, each scan may consist of a different amount of x/y-data (e.g., with external sweep) which is why the current number of the following values is indicated before each new scan.

- The **sixth number** is a 0, if the X axis is linear, 1 stands for logarithmic scaling. For an interpolation of intermediate values of limit curves that are neither horizontal nor vertical, these values are used in the x and y direction. For a correct graphics display it is important for the file entries and the actual scaling to be in agreement, as the measurement points in the display are connected by a straight line. If the data do not match, bent curve sections (elliptic segments) are obtained in the calculation which are not drawn in the display and therefore not visible.

- The **seventh number** is similar to the sixth but refers to the Y axis.

## Trace

The header, especially the third number specifies how to interpret the subsequent trace.

- One-dimensional
  The group of one-dimensional traces/lists (e.g., frequency list of a sweep) is simply a sequence of numbers, which is separated in the ASCII notation by CR/LF and directly successive in the REAL format. Bits 0 to 2 of the third number in the header are assigned the value 1.

- Two-dimensional

  The significant group of two-dimensional data (e.g., dwell, equalization, limit) contains pairs of numbers in the ASCII format
  $x_0$ $y_0$ CR/LF
  $x_1$ $y_1$ CR/LF
  $x_2$ $y_2$ CR/LF etc.,
  x being the independent and y the dependent value.

  The sequence in the REAL format is $x_0$ $x_1$ $x_2$ .... $y_0$ $y_1$ $y_2$....This pattern applies always which is why it is not indicated with each of the subsequent items.

  Bits 0 to 2 of the third number of the header assume the value 2, i.e., sample and scan are defined as follows:
  ascii_sample = x, y
  scan = $sample_0$ [, $sample_n$]...
  real_scan = x_block, y_block

- Two-dimensional with reference value

  Mono traces (one-channel measurements) may contain a reference value or not; it is therefore put in brackets in the following notation:
  ascii_sample = x, y [, ref]
  This means that the numbers are arranged as follows:
  $x_0$ $y_0$ [ $ref_0$] CR/LF
  $x_1$ $y_1$ [$ref_1$] CR/LF
  $x_2$ $y_2$ [$ref_2$] CR/LF etc.

  A dual sample (two measured values for the same x-value) is obtained by:
  ascii_sample = x, y [,ref] , y2 [, ref2 ]

  Generalized, a sample is defined as follows:
  ascii_sample = x, [, y [, ref] [, y2 [, ref2] ] ]

  An ASCII scan is obtained by a number of samples:
  ascii_scan = $Sample_0$ [ $Sample_n$ ]...

  A REAL scan consists of a number of blocks:
  real_scan = y_block [, x_block [, ref_block] [, y2_block [, ref2_block] ] ]
  the x-block being defined as
  x_block .= $x_0$, $x_1$, [ $x_n$]...

- Three-dimensional (multiscans)

  Multiscans are obtained by successive series of scans:
  multiscan = $scan_0$, $count_1$, $scan_1$ [,$count_n$ , $scan_n$ ]....
  Notice that the number of data of $scan_0$ has been defined in the header, whereas the subsequent ones are indicated prior to the subsequent traces.
  If a multiscan has been obtained by a z-sweep, a one-dimensional field of z-values is added to the multiscan. Bits 0 to 2 of the third number of the header are set to 3.

- One-dimensional with steady X axis

The above-mentioned applies only for trace data which have been obtained by (internal or external) sweeps. FFT data, waveform data and filter-simulation data are characterized by a steady x-axis, i.e., the x-axis is defined by two values in this case. These values are the start value and difference value and named x_def; the structure is defined as fft_scan under Setup earlier in this section.

Multiscan, reference values and z-sweep are skipped, however, dual trace is possible. The different values of the bits 0 to 3 are selected for plausibility check with loading traces and do not imply different data structures.

## Info Structure (info_struct)

This data field contains values which appear in the DISPLAY panel and guarantee that a stored trace which is loaded corresponds exactly to its appearance prior to storage. Therefore, the scaling values, e.g., have to be included in the file. This structure is used with storage of trace A, trace B or dual trace, only.

It is reserved and should not be modified, since error could lead to undefined program states. The reason is that all error possibilities are eliminated with user entry and that this structure is considered to be consistent with use. Besides, it contains data which cannot be described here since they would go beyond the scope of this section. It is advisable, if required, to have a file created by the UPL by means of storing a trace variable/variable trace. All settings can be made in the DISPLAY panel and the structure described is completely inserted.

info_struct := trace_no, trace_group, x_info, y_info, y2_info, strings, norm_y1, norm_y2

trace_no indicates trace A (0), trace B (1) or dual trace (3).

trace_group indicates the type of x-axis, in order not to mix frequency and time axes.

x_info := unit, ref_val, ref_unit, log_flag, upper_val, upper_unit, lower_val, lower_unit
y_info and y2_info are set up like x_info.

strings .= x_string, y_string and y2_string are the user-defined axis labels.

norm_y1 and norm_y2 stand for the normalization factors.

unit consists of code (16 bits) and group (16 bits) and specifies the unit of the axis;

ref_val is the reference value used;

ref_unit is the unit assigned to the reference value (expressed again by means of code and group);

log_flag is 0 with linear scale (not zero with log);

upper_val is the top or right limit of the axis;

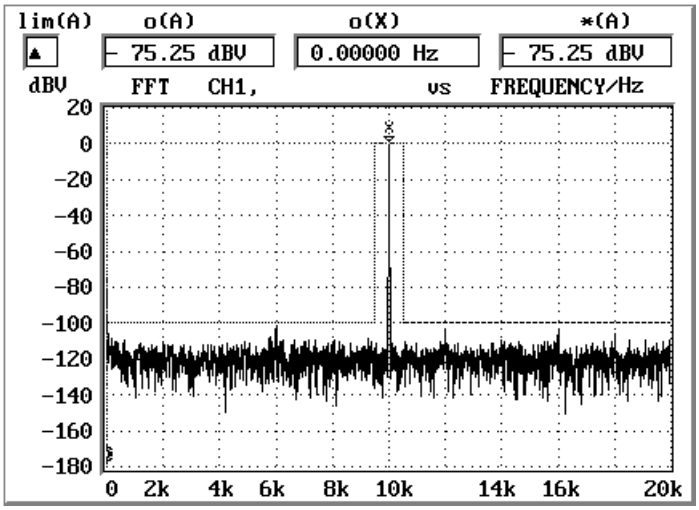
upper_unit indicates code and group of the assigned unit;

lower_val and lower_unit mean the values for the bottom or left limit of scale.

### 2.9.1.4 Editing Limit Files

Limit files can be edited at the MS-DOS level using any editor capable of generating text files. The sample files R&S_EXAM.LLW (LLW = **L**imit **L**o**W**er) and R&S_EXAM.LUP (LUP = **L**imit **UP**per) used for demonstrating the file structure are stored in the directory C:\UPL\USER.
Each file consists of a header followed by the actual data. Important information can be stored in addition with the aid of comment lines.
The significance of the 7 **header values** can be looked up in section 2.9.1.3 Format of Block/Listen Data**/** File header.

Example:
A limit file is to be edited with the aid of which the FFT curve of a DUT can checked for limit violations. The limit value curve should have the following characteristic:




The 7 header values are determined as described in section 2.9.1.3 Format of Block/Listen Data/ File header:

1st number = **213** Number of file format for UPL version 1.0.
The number for UPL versions > 1.0 can be determined by storing a trace file (see 2.9.1.2 Loading and Storing of Series of Measured Values and Block/List Data) and entering `TYPE xxx.TRC | MORE` at the DOS level.
The first number displayed is the number of the file format.

2nd number = **2** The data of this limit file are in the ASCII format, X and Y display next to each other.

3rd number = **10** 10 is the decimal equivalent of 1010:

d15 d0
0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0

↑ two-dimensional (X and Y values)
↑ always 1

4th number = **1** Number of data sets. 1 for limit files.

5th number = **6** Number of following X-Y pairs. Six values are required for the desired characteristic in the example.

6th number = **0** Linear interpretation of X axis. Irrelevant for the example using only horizontal and vertical lines.

7th number = **0** Linear interpretation of Y axis. Ditto

**The interpolation of intermediate values of the limit curves, which are neither horizontal nor vertical,** uses these data in the x and y direction. For a correct display of the graphic, the file entries must be in agreement with the actual scaling selected in the DISPLAY panel, as in the diagram the

measured values are always connected by straight lines. If the data do not match, bent curve sections (elliptic segments) are obtained in the calculation which are not displayed and therefore not detected.

Y values entered in the limit file must be multiplication factors which, together with the value specified in the DISPLAY panel under

```
DISPLAY
TRACE A        FUNCT CH1
Limit Ref      VALUE
               1.0000 V
```

form the level value used for the limit value check.

**Note:** *The **use of multiplication factors** in the limit file permits limit curves to be shifted in the display as required by a change of the `Limit Ref` value. Thus the curves can be adapted to a modified generator level or another DUT.*

Thus, the value 0.00001 (1 V • 0.00001 = 0.00001 V = -100 dBV) is calculated as the multiplication factor for the desired Y value -100 dBV.

| X values | Desired Y values in the graphics display | Multiplication factors to be entered in the limit files |
|---|---|---|
| 20 Hz | -100 dBV | 0.00001 |
| 9500 Hz | -100 dBV | 0.00001 |
| 9500 Hz | 0 dBV | 1.0 |
| 10500 Hz | 0 dBV | 1.0 |
| 10500 Hz | -100 dBV | 0.00001 |
| 20000 Hz | -100 dBV | 0.00001 |

**Content of the desired limit file:**

```
213
2
10
1
6
0
0
#----X-----Y---
20      0.00001
9500    0.00001
9500    1.0
10500   1.0
10500   0.00001
20000   0.00001
```

This file is stored at the MS-DOS level for instance under C:\UPL\USER\MYLIM.LUP and loaded for a display on the UPL screen as described in section 2.10.7 Limit Check.

```
DISPLAY
LIMIT CHECK ------------
  Lim Upper    FILE
  Filename     MYLIM.LUP
```

***Note:*** *Additional information on the use of limit files is given in the Application Note **1GA33_1E** (English) or **1GA33_1L** (American), which can be obtained from local Rohde & Schwarz sales organizations.*

### 2.9.1.5 Generating a Limit file from a Trace File

Example:
The passband range of a DUT with a C MESSAGE characteristic is to be checked with the aid of an upper and lower limit curve for compliance with a specified tolerance.

The simplest way to generate the two limit files is to create them from a trace file obtained by means of a sweep via a C MESSAGE filter. This ensures that the measured values of the limit curve correspond exactly to the x values of the sweep (provided they are not manually changed) so that the y values need not be interpolated for the detection of limit violations.

In this example the UPL-internal C MESSAGE filter is used.

**Creating the trace file:**

- Load the default setup:

```
┌──────── FILE ────────┐
│LOAD INSTRUMENT STATE │
│Mode        DEF SETUP │
```

- Establish an internal connection to the generator, set the C MESSAGE filter for the RMS measurement and select dBV as display unit.

```
┌──────── ANALYZER ────────┐
│Ch1 Input...GEN CH1       │
│Filter      C MESSAGE     │
│Unit Ch1    dBV           │
```

- Set an auto sweep with 10 sweep points (to obtain a manageable number of limit values later on) and an output level of 0 dBV:

```
┌──────── GENERATOR ────────┐
│SWEEP CTRL  AUTO SWEEP     │
│Points      10             │
│VOLTAGE     0.0000 dBV     │
```

- Switch to curve display and select a logarithmic scale for the X axis:

```
┌──────── DISPLAY ────────┐
│OPERATION    CURVE PLOT  │
│X AXIS                   │
│Spacing      LOG         │
```

  Switch to graphics windows ( ↔ key or ALT Z)
- The sweep is triggered with the SINGLE key and the curve of the C MESSAGE filter is displayed.
- This curve is now stored as TRACE file under the filename CMESS.TRC:

```
┌──────── FILE ────────┐
│STORE TRACE/LIST ---- │
│Format       ASCII    │
│Filename     CMESS.TRC│
```

  The file is now available under C:\UPL\USER\CMESS.TRC with frequency values in Hz and levels in V.
- Quit the UPL (SYSTEM key or CTRL F9).

**Creating limit files from the trace file**

Files CMESS.LUP (upper limit curve) and CMESS.LLW (lower limit curve) are generated from the CMESS.TRC file at the DOS level using any editor available by modifying the level values in V derived from the TRACE file so that the desired tolerance mask is obtained.

*The Y values to be entered in a limit file are **multiplication factors** which, together with the value entered in the DISPLAY panel under*

```
┌──────── DISPLAY ────────┐
│TRACE A        FUNCT CH1 │
│Limit Ref      VALUE     │
│               1.0000 V  │
```

*form the level value used for the limit check. The curve can be shifted by varying the* `Limit Ref`*.*

Content of C:\UPL\USER\CMESS.TRC:

```
213
2
10
1
10
1
0
#--X---------Y-------
20000      0.000251874
9283.18    0.00154384
4308.87    0.109695
2000       0.879042
928.318    0.978155
430.887    0.317451
200        0.0551856
92.8318    0.00598586
43.0887    0.000624106
20         7.48084e-05


The data following in this list are of
no importance for the generation of
limit files and are therefore left out.
```

➔

Content of C:\UPL\USER\CMESS.LUP:

```
213  ⎫
2    ⎪
10   ⎪
1    ⎬ Unchanged from CMESS.TRC
10   ⎪ 1)
1    ⎪ 2)
0    ⎭ 3)
#--X---------Y---
20000      0.0004
9283.18    0.01
4308.87    0.5
2000       1.2
928.318    1.1
430.887    0.5
200        0.08
92.8318    0.009
43.0887    0.0009
20         0.0004
```

Content of C:\UPL\USER\CMESS.LLW:

```
213  ⎫
2    ⎪
10   ⎪
1    ⎬ Unchanged from CMESS.TRC
10   ⎪ 1)
1    ⎪ 2)
0    ⎭ 3)
#--X--------Y----
20000      0.00001
9283.18    0.0008
4308.87    0.03
2000       0.7
928.318    0.9
430.887    0.16
200        0.03
92.8318    0.003
43.0887    0.0001
20         0.00001
```

**Multiplication factors** used for determining the limit values together with the `Limit Ref` value in the DISPLAY panel.

**1)** Number of limit values

**2)** Interpretation of X axis: 0 = linear, 1 = logarithmic

**3)** Interpretation of Y axis: 0 = linear, 1 = logarithmic

See 2.9.1.3 Format of Block/Listen Data / File header

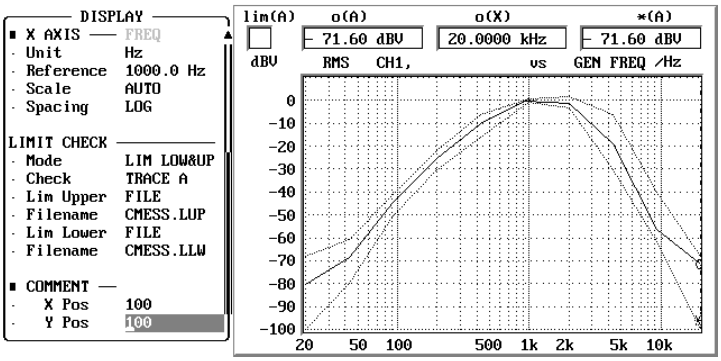
**Loading limit files and detecting limit violations:**

After starting the UPL again, the two limit files

```
DISPLAY
LIMIT CHECK ---------
Lim Upper     FILE
Filename      CMESS.LUP
Lim Lower     FILE
Filename      CMESS.LLW
```

are entered and the desired tolerance mask is displayed.

If a sweep is triggered now with the SINGLE key, the curve of the C MESSAGE filter is within the tolerance mask as expected, and no limit violation is signaled.



To test the limit check, a limit violation can be produced by increasing the 0-dBV sweep level in the GENERATOR panel to for instance 1 dBV or changing the `Limit Ref` value so that the limit curve is shifted.
In the top left-hand corner of the graphics display the icon



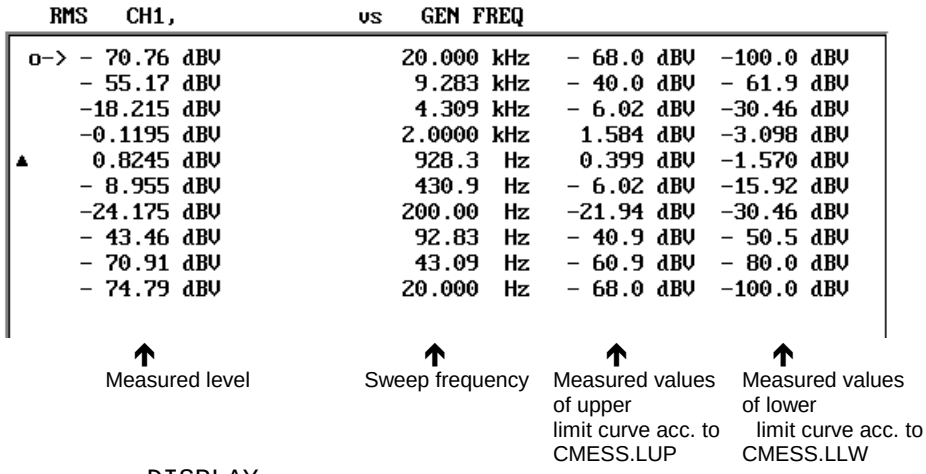

is displayed indicating with an arrow pointing upwards that a limit has been **exceeded**.

To find out the exact reason for the limit violation,




can be set in the DISPLAY panel. A list of all sweep parameters is displayed in which the limit violation is marked at the left by an arrow pointing upwards.
When selecting full-screen display (key ↔ followed by GRAPH or ALT Z and then ALT R) an extended list of sweep parameters is displayed with measured values of both limit curves.

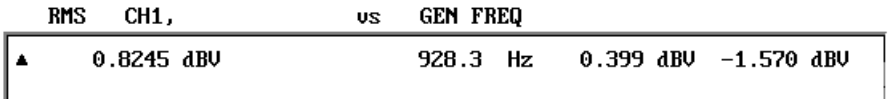
***Note:*** *If the **x values** from the trace file are read into the limit file **unchanged,** columns 3 and 4 display the product of the multiplication factor in the limit file and of the `Limit Ref` value in the DISPLAY panel. If the **x values have been changed,** the **interpolated** limit values for the frequencies in column 2 are displayed in columns 3 and 4.*







shows a list of limit violations. In this example there is only one entry:




***Note:*** *Further information on the use of limit files can be obtained from the Application Note **1GA33_1E** (English) or **1GA33_1L** (American) which can be obtained from local Rohde & Schwarz sales organizations.*

### 2.9.1.6 Generating a Limit File using an Application Program

Application Note ***1GA33_1E*** *(English) or* ***1GA33_1L*** *(American)* and the application program **LIMIT.BAS** are available for convenient generation of limit files for use in frequency response measurements. The application program can be obtained from local Rohde & Schwarz sales organizations.

The Universal Sequence Controller UPL-B10 must be installed in order to use the program. With the aid of this option, complete measurement sequences can be run under program control on the audio analyzer.

To be able to run the application program LIMIT.BAS under the Universal Sequence Controller UPL-B10, an Audio Analyzer UPL of version 1.0 or higher is required. An external keyboard must also be connected.

### 2.9.1.7 Limit Report

The limit report list is organized like the content of a limit file (see 2.9.1.4 Editing Limit Files) and includes the information 0, 1, 2 or 3 for each frequency value.

**0**: No limit violation

**1**: A value or curve defined as `MODE = LIM UPPER` in the DISPLAY panel was **exceeded** by a sweep or FFT curve.
If more than one sweep or FFT curve is displayed, e.g.
- one curve on trace A and one on trace B with `CHECK = TRACE A+B` selected in the DISPLAY panel,
- or several sweep scans are set in the DISPLAY panel,
then one of the curves has exceeded the upper limit.

**2**: A value or curve defined as `MODE = LIM LOWER` was **below this limit**.
If more than one sweep or FFT curve is displayed, one of the curves is below the lower limit.

**3**: If the Lim Lower and Lim Upper values or curves are simultaneously displayed in the `Mode = LIM LOW&UP` and more than one sweep curve is displayed, e.g.
- one curve on trace A and one on trace B with `CHECK = TRACE A+B` selected in the DISPLAY panel,
- or several sweep scans are set in the DISPLAY panel,
**3** indicates that one of the sweep curves is **below** the lower limit **and** that **at the same time** another sweep curve has **exceeded** the upper limit.
Code **3** cannot be assigned in the case of FFT curves as the limit check for `TRACE A+B` **cannot** be made simultaneously.

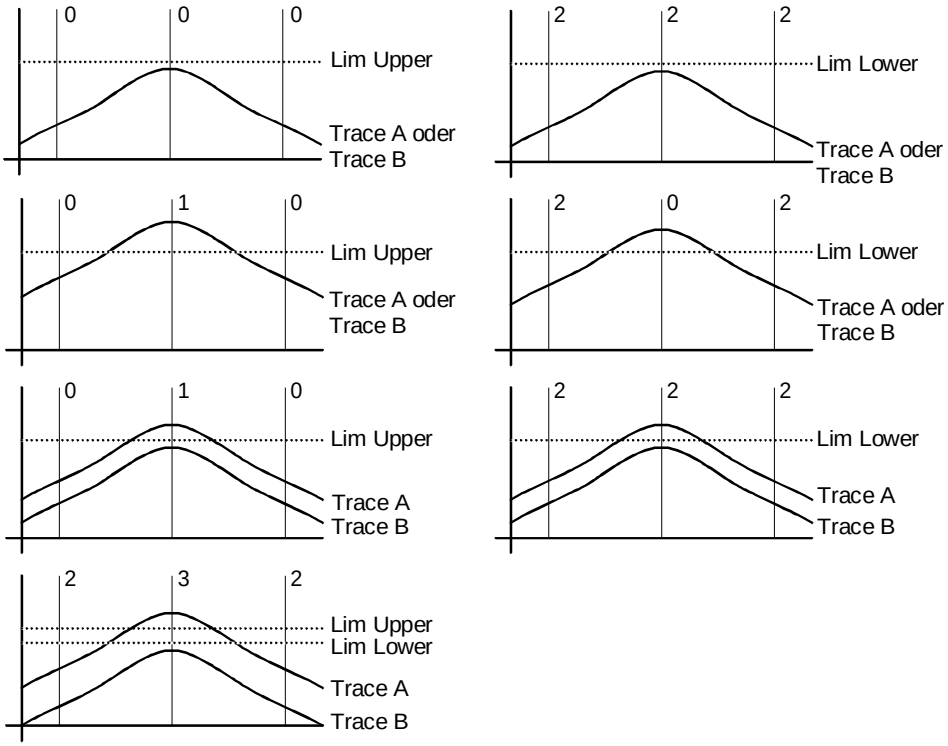



Fig. 2-38 Examples of limit violations and codes

When
`Format = ASCII` has been selected in the FILE panel under

```
┌──────── FILE ─────────┐
│STORE TRACE/LIST       │
│Store       LIM REPORT │
│Format      ASCII      │ or REAL,
```

codes 0, 1, 2 or 3 are stored as ASCII values, for
`Format = REAL` these values are stored in binary form (4 bytes each) to IEEE standard.

The X values for which a limit violation has been detected can be seen in a comparison of the traces files and the LIM REPORT file (SCPI does not offer a more convenient solution):

## Limit report for sweep curves:

The sweep curve used for a limit check can be selected as follows in the DISPLAY panel:

```
┌──────── DISPLAY ──────────┐
│LIMIT CHECK ---------------│
│CHECK       TRACE A        │ or TRACE B or TRACE A+B
```

***Note:*** `CHECK = TRACE A+B` *with a view to limit violations can only be set for sweep curves (not for FFT curves) if* `Scale B = EQUAL A` *has been selected for* `TRACE B` *(the scale of trace A is also assigned to scale B).*

To view limit violations on the screen, set

```
┌──────── DISPLAY ──────────┐
│ OPERATION SWP LIM REP     │.
```

Only limit violations will be displayed.

To determine the X values for which a limit violation has been detected, the trace file has to be generated for a comparison with the LIM REPORT file:

```
┌──────── FILE ─────────┐
│ STORE TRACE/LIST      │
│ Store      TRACE A    │ or TRACE B
│ Filename   XXX.TRC    │
└───────────────────────┘
```

In contrast to the screen display, where only limit violations are displayed under the setting `OPERATION = SWP LIM REP,` the trace file contains **all** sweep points.

Example:

Content of trace file

```
213
2
10
1     } see 2.9.1.3 File header
10
0
0
#--X---------Y-----

100         0.1138
166.81      0.2326
278.265     0.4104
464.159     0.6457
774.264     0.8959
1291.55     1.0891
2154.44     1.1521
3593.81     1.1058
5994.84     0.9271
10000       0.6069
```

Subsequent data are of no relevance for a check of the LIM REPORT file and are therefore left out.

Content of LIM REPORT file

```
213
2
9
1     } see 2.9.1.3 File header
10
0
0

0
0
0
0
0     } Limit report
1
1
1
1
0
```

## Lim report for FFT curves:

The FFT curve used for a limit check can be selected as follows in the DISPLAY panel:

```
┌──────── DISPLAY ──────────┐
│LIMIT CHECK ---------------│
│CHECK       TRACE A        │ or TRACE B
└───────────────────────────┘
```

***Note:*** *Limit violations of FFT curves can only be checked for TRACE A **or** TRACE B. Selection of TRACE A+B is not possible.*

To view limit violations on the screen, set

```
┌──────── DISPLAY ──────────┐
│ OPERATION SPC LIM REP     │
└───────────────────────────┘
```

Only limit violations are displayed on the screen.

To determine the X values for which a limit violation has been detected, the trace file has to be generated for a comparison with the LIM REPORT file:

```
┌──────── FILE ─────────┐
│ STORE TRACE/LIST      │
│ Store      TRACE A    │ or TRACE B
│ Filename   XXX.TRC    │
└───────────────────────┘
```

***Note:*** *In contrast to a sweep trace,* ***only*** *the limit violations are stored in the trace file for the FFT trace. Therefore, when a suitable upper limit value is selected, the noise floor of the FFT can be suppressed and the quantity of data reduced.*

Example:

Content of trace file

```
213 ⎫
2   ⎪
76  ⎪
1   ⎬ see 2.9.1.3 File header
3   ⎪
0   ⎪
0   ⎭
#--X---------Y-----
9984.38     0.5991
9996.09     0.9714
10007.8     0.8815
```

Subsequent data are of no relevance for a check of the LIM REPORT file and are therefore left out.

Content of LIM REPORT file

```
213⎫
2  ⎪
9  ⎪
1  ⎬ see 2.9.1.3 File header
3  ⎪
0  ⎪
0  ⎭

1 ⎫
1 ⎬ Limit report
1 ⎭
```

## 2.9.2 Editing Files and Directories

The following files are available under the heading UTILS in the FILE panel, which is called by pressing the FILE key.

The UPL software is supported by the DOS operating system and uses its file manager, which is normally not of importance for the user. It however provides extended capabilities, which you can make use of, if desired. For reasons of internal management, the UPL software assigns a fixed data type (extension) to each file type depending on its function, allowing the identification of the file type. The extension consists of up to three letters after the point in the file name and is usually not available to the user in other menu items (the extension used is specified in the menu items concerning files as well as in the list given in Section 2.9.1).

**Delete** — A file can be deleted using this command. All menu commands used to store files overwrite an existing file with the same name or create a new file.

**Work dir** — (Working directory)

If a directory is specified under "Work dir" that exists in the UPL, the specified directory is selected as working directory. If such a directory does not exist in the UPL, the entry is interpreted as a file name indicating a control file in which working directories can be specified for various types of file (with file extensions .SCO, .SAC, etch). If the control file cannot be found either, the user is offered three possibilities in a dialog box.

1. "Create": the entry is interpreted as the name of a new working directory which is opened and activated.
2. "Work Dir unaffected": this entry is stored under Work Dir without the previous work directory being changed. When a setup is loaded holding an entry generated in this way under Work Dir, the current working directory remains unchanged. *This means that by entering a non-existing working directory, setups can be generated which do **not** change the current working directory when loaded.*
3. "Back to filebox": an entry error has occurred, another working directory can be selected in the filebox.

**Specifying a directory:**

Files can be arranged in directories allowing classification depending on, for example, the user or the project. The working directory, which precedes all file names and path names (unless they begin with a "\" in the main directory) is thus selected. Independent of the working directory, there are also directories which are used by the UPL-internal software.

Example: Work Dir C:\UPL\DUT04

| No. | Data input | Data access to |
|---|---|---|
| 1 | SWEEP.SCO | C:\UPL\DUT04\SWEEP.SCO |
| 2 | \SWEEP.SCO | C:\SWEEP.SCO |
| 3 | \UPL\DUT05\SWEEP.SCO | C:\UPL\DUT05\SWEEP.SCO |

Storing files in the main directory (example 2) or in the UPL system directories (\UPL,\UPL\REF,\UPL\DRIVER, etc.) should be avoided.

**Entry of a file with control statements:**

The specified file contains control statements by which a working directory is defined for various types of file.

All file names entered into the file box without a path being specified are searched for in, and taken from, the working directory defined in the control file. The working directory shown in the file box under the specified file name can be checked against the file name displayed on the UPL.

| (Control file (ASCII text): | Meaning: |
|---|---|
| #Comment 1 | Any comment, marked with # |
| .SCO C:\EXAMPLE\SETUP | Loading and storing of setups |
| .SAC C:\EXAMPLE\SETUP | according to \EXAMPLE\SETUP |
| .TRC C:\EXAMPLE\TRACE | Loading and storing of traces |
| #Comment 2 | |
| .PPC C:\UPL\USER | Protocol definitions |
| .PAC C:\UPL\USER | |
| .PAU C:\UPL\USER | |
| .* C:\UPL\USER | Preset directory |

The control file can be created at the DOS level using any type of editor capable of generating unformatted ASCII text.

.* Designates the working directory that is set if a type of file not included in the control file is entered (default directory).

# Marks comment lines.

Leading and filling blanks are ignored. Entries can be made in any order.

If no appropriate entry is found for a specified file type, the directory specified after ".*" is used as working directory. If no entry exists for ".*", the path information (e.g. C:\UPL\USER) is extracted from the file name designating the control file (e.g. C:\UPL\USER\EXTDIR:CFG) and entered as working directory. If in the control file a working directory is specified that does not exist, an error message is output.

***Note:*** *Several users can use setups jointly and store the results separately by using the same path for the setups and different paths for the data to be stored.*

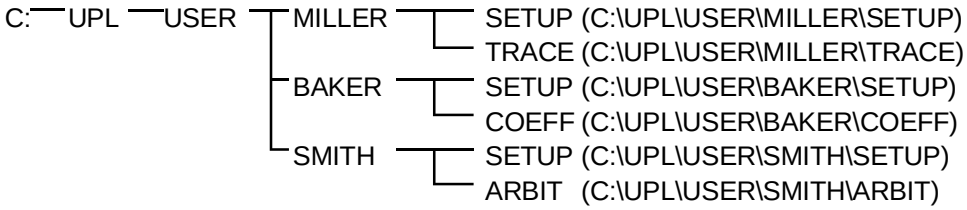
**Example:**

Mr. MILLER, Mr. BAKER and Mr. SMITH are sharing an UPL. Each user wants a working directory of his own with the corresponding setups using the .SCO and .SAC file types and each one establishes a path named SETUP.

| | |
|---|---|
| Mr. MILLER | mainly works with .TRC trace files and therefore needs a path named TRACE. |
| Mr. BAKER | mainly works with .COE filter coefficient files and therefore needs a path named COEFF. |
| Mr. SMITH | mainly works with .FFT arbitrary waveform files and therefore needs a path named ARBIT. |

All files of a type other than mentioned above are to be directly written to/read from the paths C:\UPL\USER\MILLER, C:\UPL\USER\BAKER or C:\UPL\USER\SMITH.

The above requirements can be fulfilled by structuring the working directories as follows (at the DOS operating system level):




The assignment of file types to working directories is made in separate control files which are best stored under C:\UPL\USER:

MILLER .CFG

```
# Working directories, depending on file type
.SCO   C:\UPL\USER\MILLER\SETUP
.SAC   C:\UPL\USER\MILLER\SETUP
.TRC   C:\UPL\USER\MILLER\TRACE
# Default working directory
.*     C:\UPL\USER\MILLER
```

BAKER.CFG

```
# Working directories, depending on file type
 .SCO  C:\UPL\USER\BAKER\SETUP
 .SAC  C:\UPL\USER\BAKER\SETUP
 .COE  C:\UPL\USER\BAKER\COEFF
 # Default working directory
 .*    C:\UPL\USER\BAKER
```

SMITH.CFG

```
# Working directories, depending on file type
.SCO   C:\UPL\USER\SMITH\SETUP
.SAC   C:\UPL\USER\SMITH\SETUP
.TTF   C:\UPL\USER\SMITH\ARBIT
# Default working directory
.*     C:\UPL\USER\SMITH
```

After switching on the UPL, each user enters, under "Work Dir" in the FILE panel, the path and name of his control file, or loads a setup in which the path and name of his control file are already entered.

## 2.9.3 Series of Measured Values (Sweeps and Scans) and Block/List Data

With sweeps, values measured as a function of a variable input quantity are recorded and can be represented in various ways graphically or as numbers. UPL can simultaneously record two traces (Trace A and Trace B). These are in the following referred to as 1 scan.

The variable input quantity, which is usually entered along the X-axis, is determined by the sweep parameters. There are three sweep modes, of which only one can be active at a time:
generator, analyzer and external/time-controlled sweep.

- In the generator sweep, the frequency or the output voltage can be automatically varied (in steps). For sine burst measurements, the ON time and the length of intervals (see 2.5.4.2 Sweeps) can be varied in addition.
- In analyzer sweeps, the "receive" frequency can be automatically stepped in (frequency-) selective rms measurements, with sweep parameter settings similar to those used in generator sweeps (see 2.6.5.3 RMS SELECT). If the multisine function (with up to 17 simultaneous frequencies) is active in the generator, a sweep list can be generated with UPL set to SWEEP CTRL GEN MLTSIN. With this list, the analyzer is automatically tuned to all generator frequencies in consecutive order.
- The third group of sweeps are external sweeps that are likewise set in the analyzer mode. With external sweeps, time-varying signals are analyzed that are not stepped by one of the UPL sweep systems but by external control. The analyzer picks up measurement values after a frequency or level change and interprets the frequency or level as X-axis parameters. Furthermore, measured values can be collected at certain intervals. In this case, time will be taken as the X-axis parameter.

In the DISPLAY panel, the set sweep parameters are always used for the X-axis. The units used depend on the physical quantity measured. The right-hand and the left-hand limit are determined by the start and the stop values of the sweep parameters and set using the X-axis autoscaling function.

### 2.9.3.1 Scan count =1

From the six values simultaneously measured, two can be used for the two independent Y-axes (trace A and trace B). These values may be the distortion factors of the left-hand and right-hand channel, for example, but also different physical quantities such as voltage and phase. The quantities to be measured are set in the ANALYZER panel; the values to be recorded as a trace are selected in the DISPLAY panel even if a trace is not to be displayed but stored in a file.

Measured values frequently have to be referenced to other values (the measured values being expressed in relative units). If a reference value is constant (e.g. 1 mW), it can be taken into account immediately. If the reference value is a function of the X-axis, a reference trace will result. With UPL, such traces can also be formed from a series of measured values, for example, or from the generator voltage or frequency, or may be loaded from a file (e.g. as reference traces).

In all, the following is stored for one scan: two traces, two reference traces and the X-axis data since, in the case of external sweeps, the latter are also obtained through measurements values and cannot be calculated.

### 2.9.3.2 Interpolation to a Common X Axis

To allow any traces to be used as reference traces or to be displayed simultaneously for the purpose of comparison, and measured by means of the movable cursors, all traces would have to have the same X values. However, any X divisions can be used on the UPL as the values of the traces and reference traces are interpolated to the set X-axis. The interpolated values are displayed as traces or numerals. The original X and Y values are displayed only if no sweep is selected (and thus no X-axis is set). (Excepted are all limit traces; they are displayed using the original and not the interpolated values (see 2.10.7 Limit Check).

For interpolation, the X and Y values of the four traces and reference traces are stored in the UPL, yielding a total of eight series of numbers plus the four interpolated series plus the current X-axis values. This results in 13 series of 1024 values each.

UPL also interpolates further series of numbers: the limit traces for the upper and lower ranges, the equalization trace for the generator voltage, and the dwell trace for sweep stepping. Thus, only a few measured values are required for each trace. In interpolation, linear or logarithmic scaling of the X and Y axes is taken into account as, when switching from linear to logarithmic scaling, segments of an ellipse would be displayed instead of a straight line.

All traces are interpolated once at the start of a sweep to make for enhanced measurement speed. In the case of external sweeps, the X values are unknown at the start of the sweep. In this case, interpolation cannot be made prior to the sweep but must be performed during the sweep.

### 2.9.3.3 Scan Count >1

The number of sweeps performed by UPL is not limited to one X sweep but can be increased to n sweeps by means of the setting Scan count <n> (in the DISPLAY panel). A group of traces will be obtained as graphical representation. All traces are stored (in the UPL and also as a file, if desired) and can be displayed as one unit, rescaled and recalled. In the Scan GROUP mode, the 13 series of numbers mentioned above are multiplied by the number of scans.

In the generator mode, a second sweep can be made in addition to the X sweep. The second sweep is referred to as Z sweep as it is usually represented along the Z axis. When Z sweep is selected, the number n of the scans is automatically set to the number of the Z points (Scan count is set according to the number of Z points).

In the Scan count >1 mode, a series of traces (or a series of pairs of traces) is usually displayed. In autoscaling of the Y axes, all available traces are included. Any other operations, e.g. setting the cursor to the min. or max. values, only apply to the current scan. For out-of-tolerance checks (limit checks), all traces are checked against the same two limit traces, the out-of-tolerance symbol applies to the current pair of traces.

The current scan (with one or two traces) is selected with the PAGE UP/PAGE DOWN keys on the keyboard. The current value, i.e. the scan index, is indicated by a number between the out-of- tolerance field and the left-hand cursor-value field. The scan index is set by remote control with command DISPlay:TRACe:INDex <n>.

The point of intersection of the cursor with the current trace (or pair of traces) is visually emphasized by means of a circle. It is thus possible to allocate the cursor values indicated in the windows unambiguously to the current scan.
The most recently recorded scan is displayed with a number (”#n”) in the upper left corner providing the space is not occupied by the out-of-tolerance field.

If one of the list modes (SWEEP LIST, SPECTR LIST, SWeeP LIMit REPort or SPeCtrum LIMit REPort) is selected, the corresponding lists are generated anew after a change of the scan index (with the PAGE UP/ PAGE DOWN keys), since only one scan (pair of traces with X axis) can be displayed at a time.

With FFT, a large amount of numbers (up to 7424) is obtained, although no more than one scan is available. For this reason, the scan index is used for organizing the number in 1-k blocks and selecting them accordingly. This is not only useful for the screen display but also for reading the block data via remote control or the universal scan control with BASIC (UPL-K1). With remote-control command DISPlay:TRACe:INDex, a 1-k block is selected to which the subsequent inputs and outputs with FFTs refer. With sweeps, the command serves for selecting a desired scan from a group (or to select the Z index). The index runs from 0 to Scan count -1.

Another way of reducing the numbers transferred with FFTs is by using the out-of-tolerance function. Only values above the limit value defined by UPPER LIMIT are accepted as measurement values and can be read with LIST1 and TRAC1 or TRAC2 if OPERATION SPC LIM REP is set in the DISPLAY panel. In this case, the error report block which is read in with "CALC:LIM:REP?" is meaningless, since all values would have to be marked as being out-of-tolerance (i.e. by 1) (see 3.10.10 Commands for Input/Output of Block Data).

In the case of sweeps, "0" is entered in the trace index in the error report block if no sweep values are out of tolerance. If the limit in channel 1 is exceeded, 1 is entered, with channel 2, 2 is entered; if limit violations occur in both channels, 3 is entered. The X and Y values belonging to this index will be found under the same index in the LIST1 and TRAC1 or TRAC2 blocks.

If no group of traces is selected (Scan count =1), the measurement currently being taken is indicated by means of a gap moving along the trace. If several traces are displayed on the screen (Scan count >1), the gap may no longer be visible; instead, the set sweep value is marked by an arrow on the X axis.

With time-controlled measurements, which are selected by means of START COND TIME TICK or TIME CHART in the ANALYZER panel, the time is entered along the X axis. With these measurements, the X axis can be extended using the scan group mode. The stop value results, for example, from time = 1 s and points = 100 to yield 100 s. With scan count = 5, the monitoring period is extended to 500 s. The cursor value always indicates the total time; with scan index = 5, 400 to 500 s would be obtained in this case. As for the traces, however, the X-axis values would be in the range 0 to 99 in this

example.

# 2.10 Graphical Data Presentation (DISPLAY and GRAPHICS Panels)

The DISPLAY panel is used to set how the measurement results are graphically **presented**. Important: **what (and how)** is measured is set in the ANALYZER panel, or, with sweeps, in the GENERATOR panel. How the measurement is displayed can be changed at a later date, too. Also, curves can be retrieved from files and redrawn.

The DISPLAY panel is built up using the front-panel key DISPLAY or key combination Alt-D on the external keyboard. The menu items in the DISPLAY panel affect the GRAPHICS panel which occupies either 2/3 of the screen (part-screen graphics mode) or the complete screen (full-screen graphics) (selectable by the □◄►□ key or key combination ALT-Z).

**OPERATION**

| | |
|---|---|
| **CURVE PLOT** | The results of a sweep, function of time (waveform) or FFT are entered as line diagram in the Cartesian coordinate system. As a rule, two dependent variables (TRACE A and TRACE B) can be displayed above an independent variable (X AXIS). With LIMIT check activated, the tolerance masks are also included. The extensive command menu provided on the softkeys allows you to scale and zoom the display and to dimension the display using the Cursors (see 2.10.1 and 2.10.2 Trace and Spectrum Display). |
| **SWEEP LIST**<br>**SPECTR LIST** | The measurement results of a sweep or (post) FFT are output in the form of digits. The three columns (TRACE A, TRACE B and X AXIS) are complemented by a fourth column where violations of the UPPER or LOWER LIMIT curve are marked. In full-screen graphics mode, two additional columns indicate the LIMITS (interpolated between intermediate values!) (see 2.10.3 and 2.10.4) if LIMIT CHECK has been activated (see 2.10.7). |
| **SWP LIM REP**<br>**SPC LIM REP** | As opposed to TRACE LIST, the digit lines with measured values exceeding the tolerances only are displayed (see 2.10.3 and 2.10.4), which is possible only with LIMIT CHECK activated (see 2.10.7). |
| **BARGRAPH** | The current measured values are displayed in analog form as bars ('signal level meter'). This type of indication is ideally suited for measurements where the relative size or change in size - and not the exact value - is desired. Max. 3 BARGRAPHS are displayed. The extreme values are marked by trailing pointers (see 2.10.5 and 2.10.6).<br>The bargraphs #1 and #2 are freely selectable, the bargraph #3 is automatically assigned the following functions (in the order of their priority):<br><br>1. with activated sweep: swept parameter<br>2. (x-axis or sweep curve)<br>3. with activated phase measurement: phase<br>4. with activated frequency measurement: frequency channel 1 or 2<br>5. Generator frequency (if selected generator function permits frequency to be entered) |

**OPERATION**

**SPECTRUM**

With FUNCTION FFT or POST FFT selected in the ANALYZER panel, the frequency spectrum calculated by the DSP is displayed (SPECTRUM is automatically set with FFT or FILTER SIM selected in the ANALYZER panel).

With FUNCTION MOD DIST, DFD or THD selected in the ANALYZER panel, the spectrum components of the stimulae and interference products can be displayed in the form of a histogram (see 2.10.1 and 2.10.2).

**PROTOCOL**

In the GRAPH window, the protocol data of the digital interface are displayed. Evaluation of the protocol is made simultaneously with the respective function (see 2.10.8).

**PROTO AUTO**

PROTO AUTO enables the automatic decoding of the channel status bits irrespective of the professional bit value (see 2.10.8 PROTOCOL Analysis).

**Mode**

(With FFT spectrum only)

**DEL BEF WR**

This is to select a trace, or pair of traces (trace A and trace B). Each new trace will overwrite the previous trace(s).

**MAX HOLD**

This key is used to switch on the MAXimum HOLD function. FFT AVERAGE cannot be set unequal to 1 in the ANALYZER panel with OVERL/MAX H selected, see 2.6.5.12.

***Note:*** *MAX Hold can only be selected if the display is switched off (Avg count 1).*

**WATERFALL**

Shifts the single curves in the z-axis to obtain a spatial impression. One channel only can be traced at a time, which is why 1 or 2 must be selected under ”Channel(s)” in the ANALYZER panel. To obtain a useful display, scaling is to be set as follows:

1. TRACE Top is to be set such that the upper half (or 3/5) of the coordinate system is empty (i.e. is not occupied by the first trace).
2. X-AXIS Right such that about half of the coordinate system is free.
3. TRACE Bottom is to be set above the noise limit, making noise invisible by clipping and emphasizing significant spectral components.

***Note:*** *Waterfall can only be selected with one-channel analyzer.*

**Scan count**

(With CURVEPLOT, SWEEP LIST, SWP LIM REP and BARGRAPH operation only, not with spectrum displays)

Defines the number of single traces or trace pairs to be measured and displayed. If a Z sweep is selected in the generator, the number of Z values is automatically entered in Scan Count.

**1**

A single trace or a trace pair (Trace A and B) should be measured or loaded. Each new curve overwrites the previous one. With this setting a continuous sweep (without Z axis) is performed repeatedly but only the last one is stored.
If a single-scan trace is loaded from the file, the file overwrites the current contents of the trace buffer.
If a multiscan trace is loaded from the file, only the 1st scan is loaded into the trace buffer, all others are ignored.

**>1**

With this setting, not only one measurement sequence (sweep run, scan) is measured and displayed but as many as required. However, only the selected number, but not more than 17, are internally stored in or read from a file. Non-stored scans are only displayed in the curve plot and lost during rescaling, storing/loading of trace files or upon storing/loading of ACTUAL+DATA setups.
A continuous sweep (without Z axis) is terminated after the specified number of sweeps but only the last 17 sweeps are stored.
If a single-scan trace is loaded from a file, this scan is *appended* to the existing scans.
If a multiscan trace is loaded from the file, the trace buffer is *cleared* and the number of scans specified here is loaded into the trace buffer, all other scans of the file are ignored.
If more than the specified number of scans are performed, only the last (max. 17) scans are stored.
If more than 17 scans are specified, only the last 17 are stored.

For more details refer to section (see 2.9.3.3 Scan Count >1)

***Note**: Scan Count can be **increased** any time for storing more scans in the trace buffer. **Reducing** the Scan Count clears the trace buffer and provides an empty display again.*

**User Label**

**OFF**

The units and function labeling in the graphical display are automatical generated by UPL.

**ON**

The user can assign his own units and function labels. This is of interest in particular for remote control if measured values were converted. The labeling is entered in UNIT/Label under Trace A/B or X axis. When User Label is switched from OFF to ON, the labeling assigned by UPL appears in the input fields and can be overwritten by the user.

## 2.10.1 Parameters for Display of Traces and Spectra (DISPLAY Panel)

**TRACE A**

**TRACE B**

Is used to select which measurement results are to be collected and graphically represented as TRACE A (or TRACE B) e.g. in the case of a sweep.

***Note**: Display of the trace can be switched OFF (invisible) by means of a softkey.*

**OFF**

No measured values are collected and hence, nothing can be displayed under this TRACE.

**FUNC CH1**

(Function Channel 1)
The results of the measurement of channel 1 currently selected in the ANALYZER panel by way of FUNCTION are used. Possible only when FUNCTION in the ANALYZER panel is not OFF.

**FUNC CH2**

As above, however for channel 2.
(Frequency Channel 2)

**FREQ CH1**

Frequency meter channel 1. Possible only with FREQ/PHASE in the ANALYZER panel not OFF and OPERATION not SPECTRUM.

**FREQ CH2**

Frequency meter channel 2. Possible only with FREQ/PHASE in the ANALYZER panel set to FREQ and OPERATION not SPECTRUM.

**PHASE**

Phase meter between channel 1 and 2. Possible only with FREQ/PHASE in the ANALYZER panel set to FREQ&PHASE and OPERATION not SPECTRUM.

**INP RMS CH1**

RMS measurement results channel 1. Only possible if measuring function THD or THD + N/SINAD and channel 1 are set.

**INP RMS CH2**

RMS measurement results channel 2. Only possible if measuring function THD or THD + N/SINAD and channel 2 are set.

**HOLD**

Does not collect new values but continues to display the old trace.
HOLD is only accepted as input if valid trace data or FFT data are provided.

A sweep stored in a file in the FILE panel (TRACE LIST) can be recalled and displayed, e.g. for comparison purposes, using this option.
Sweep lists can be stored as a group of traces (Scan count >1 in the DISPLAY panel) in a file. To recall this group of traces, Scan count must also be set to this number, otherwise an error message is output. (See 2.9.1.2 Loading and Storing of Series of Measured Values and Block/List Data, and 2.9.3.3 Scan Count >1).
If a pair of traces is stored in a file (with Store TRACE A + B in the FILE panel) and if this pair is loaded by means of FILE, only trace A is used and trace B is ignored. To load the pair of traces, the parameter DUAL FILE should be used.

**TRACE A/B**

*(continued)*

**FILE**

Sweep lists and FFT files can be loaded.

The following basic conditions must be satisfied to load a sweep list.
- The display OPERATION must be set to CURVE PLOT, SWEEP LIST or SWP LIM REP.
- All sweeps must be switched to OFF (or START COND to AUTO) or the sweep parameter (FREQ, VOLT, TIME) must be identical to the X-axis of the trace file to be loaded.

The following condition must be satisfied to load an FFT or FILTER SIM file.
- The display OPERATION must be set to SPECTRUM, SPECTR LIST or SPC LIM REP.

For loading a waveform file
- the WAVEFORM function must be set in the ANALYZER panel (this causes CURVEPLOT to be set automatically in the display).

When loading the trace file, TRACE A has the function of a ”master” trace; trace B is the ”slave” trace:

- The ”master” trace can always be loaded as soon as the above basic conditions are satisfied. In addition to the trace data, the stored display settings including the complete X-axis are also loaded (cf. Section 2.9.1.2, menu item STORE → TRACE A/B). If a sweep has been selected, the loaded trace is interpolated on the X list specified by the sweep.
- When trace A is switched off, TRACE B becomes the ”master” trace.
- Being the ”slave” trace, TRACE B must conform to the X-scale of the ”master” trace; i.e., only the trace data and the appropriate Y-scale are loaded. The curve is interpolated on the X-axis already specified. If this X-axis is incompatible, the ”slave” trace is switched off.

**DUAL FILE**

In the FILE panel, a pair of traces can be stored as a unit in a file by means of TRACE A + B under STORE. The pair of traces can be recalled by means of DUAL FILE (under TRACE A). The parameter of trace B, too, is set to dual trace and the scaling of both traces as well as any reference values or reference traces are loaded from the file.

**GROUP DELAY**

GROUP DELAY can be switched on only, if FREQ/PHASE has been set to FRQ&GRPDEL in the ANALYZER panel (this is possible with two-channel measurement, only). The group delay calculated from the phase measurement is displayed).

**Filename**

(Displayed with TRACE A/B FILE only)

The name of the file with a sweep or FFT to be displayed is entered. If an error occurs during loading, ”NOT FOUND” is output in this line.

**Scale B**

**EQUAL A**

The second (dependent) measured value is displayed using the same scaling as for Trace A. Any values for UNIT, REFERENCE, SCALE, SPACING, TOP and BOTTOM need not be entered for the second axis. This requires however that the same function is selected for TRACE A and B (only the channel may be different).

**NOT EQUAL A**

Different scaling for the second sweep.

**Unit**

Is used to specify the unit with which the results are to be displayed (see 2.4 Units). Recorded sweeps can be redisplayed with other units at any time. Traces loaded using TRACE A/B FILE therefore need not be drawn in the same way as they have been stored.

**Unit/Label**

Entry of a string which specifies a freely definable unit and axis label. The string consists of 5 characters for the unit which are centered and if need be padded with blanks, and 12 characters for the axis label which are also centered and if need be padded with blanks. There is a separate ”Unit/Label” command for each trace and the x-axis.

**Reference**

Displayed only if a relative unit is selected in the menu item "Unit".

Selection of reference. This may be a single numeric value or a data record (reference trace). It applies to all numeric values of the trace, i.e. top, bottom, measured and limit values.

**MAX**

The maximum value of the sweep is adopted once as reference value.

*** CURSOR**
**o CURSOR**

The value on which the cursor is placed is adopted once
(not with BARGRAPH)

**VALUE:**

A numeral with unit is entered.

**FILE**

The reference trace is loaded from the file. The file name is entered in the following line.
If a pair of traces is stored in a file, trace A is loaded. If a reference trace is assigned to trace A, the reference is ignored. If Scans GROUP is selected, a group of traces is loaded. If the number of traces stored does not coincide with the Scan count number, an error message is output.

**Reference**

**OTHER TRACE**

The reference trace is loaded with the trace data of the other trace. Every new measured value of the other trace is simultaneously entered in this reference trace and is then immediately available for representation of the new test point. If the other trace is OFF or inactive (e.g. because an invalid file name has been entered), a corresponding warning is output. If the other trace is incompatible (e.g. TRACE A FREQ CH1 and TRACE B → INP RMS CH1), a corresponding warning is output. If the other trace is set to FILE or HOLD, the compatibility is not checked.

**MEAS CH1**

The reference trace is cleared and then loaded with the measured values of channel 1. These are

- function measurement results of channel 1 if trace ”FUNC CH1” or ”FUNC CH2” is selected
- frequency measurement results of channel 1 if trace ”FREQ CH1” or ”FREQ CH2” is selected
- input rms measurement results of channel 1 if trace ”INP RMS CH1” or ”INP RMS CH2” is selected

This choice is only offered if both channels are activated and TRACE (with activated phase measurement) is not set to FREQ CH1 or PHASE.

**MEAS CH2**

The reference trace is cleared and then loaded with the measured values of channel 2 (as above, applying for channel 2).

**GEN TRACK**

The reference trace is cleared and loaded with the currently valid generato in every measurement. This is

- the generator rms value valid at the respective test point if trace ”FUNC CH1” or ”FUNC CH2” is selected,
- the generator frequency valid at the respective test point if trace ”FREQ CH1” or ”FREQ CH2” is selected,
- the generator rms value valid at the respective test point if trace ”INP RMS CH1” or ”INP RMS CH2” is selected.

**HOLD**

The reference trace is not changed any more. If HOLD is selected without valid reference trace data being provided, a warning is output and the last valid reference is set again.

**FILE INTERN**

This option can be selected only if a reference trace was stored in the file. FILE INTERN is set automatically if a trace loaded from a file has a reference trace assigned to it.

**REF 997 Hz**
**REF 1000 Hz**

The value measured at 997 Hz or 1 kHz is taken once as a reference value for a single sweep run. With FFT traces, the nearest bin (actually measured frequency line) is taken, with frequency sweeps interpolation is made between the two neighbouring points.
If the X axis is not the frequency axis (for example in the case of level sweeps or waveform traces), an error message is output and the reference value remains unchanged.

**Limit Ref**

Selection of reference for calculating limit curves if the selected unit is **not** a relative unit.

***Note**: Limit files consist of dimensionless numerals and become a physical unit only by a multiplication with the reference value. For this reason a reference value is also required for non-referenced values in the display.*

**MAX** — The maximum value of the measurements is taken as a reference value.

**∗ CURSOR**
**o CURSOR** — The value marked by the ∗- or o-cursor is used as a reference (not in the case of BARGRAPH).

**VALUE:** — A numeral with unit is entered.

**Normalize**

Normalizes the displayed trace, if a related (e.g., dBr or V/Vr) and a floating reference value - like OTHER TRACE, MEAS CH1, MEAS CH2 or GEN TRACK- are used. A defined value can be specified to be 0 dBr or V/Vr = 1 by shifting the complete trace (multiplying it with the normalization value).

**VALUE** — The normalization factor is entered as a numeric value.

**o CURSOR** — The required normalization value is calculated by means of normalizing the y-value of the current o-cursor position. This is usually the value with 1 kHz, which implies that the cursor has been set to 1 kHz before. By acknowledging this selection, the value is entered under VALUE.

**∗ CURSOR** — As above, however, the ∗ cursor is used.

**Scale**

**AUTO ONCE**

Uses the minimum and maximum values of the current sweep for scaling of TRACE A and B (once) and rescales after changing the function using FUNCTION in the ANALYZER panel or TRACE A/B in the DISPLAY panel. The sweep or FFT start/stop values of the GENERATOR or ANALYZER panel are adopted for the X-axis. The following menu items TOP and BOTTOM or LEFT and RIGHT are no longer displayed because they have been set in doing so.
If there are not yet any measured values available, preset range limits are used for the time being and rescaled after the end of the sweep. When changing the measurement function (using TRACE A/B or FUNCTION in the ANALYZER panel with FUNC CH1/2 or GRAPH ON/ OFF with SMPTE, THD and DFD) an automatic rescaling is performed after the first measurement in the SCALE AUTO ONCE state. (Re-) START does not initiate a new scaling.
If Scan count >1 is selected, AUTO ONCE is executed only when all scans have ended (e.g. z-sweep).
The full-scale values of the new scaling are determined about 5 % lower or higher than the exact values. Using an intelligent algorithm, 'even' values appropriate for the scale are selected.

**MANUAL**

Leaves the scaling to the user.

With a new scaling the image is deleted and redrawn after the rescaling. This applies also to an FFT started by the Single key. With FFT in Continuous mode (started by Start key), however, the running FFT is still drawn, the new scaling being considered only in the next FFT.

***Note:*** *If scale AUTO ONCE is selected, autoscaling is performed when switching between LIN and LOG.*

**Spacing**

**LIN**

Divides the Y-axis linearly.

**LOG**

Divides the Y-axis logarithmically. With logarithmic units (dB) selected, LIN only can be selected.

***Notes:*** *If Scale → AUTO ONCE is selected, autoscaling is performed when switching between LIN → LOG.*

**Top**

The menu item is displayed only with TRACE A/B SCALE MANUAL. The item serves to set the upper value of the Y-axis (of the scale for the measured values). Negative or 0 values are not permissible with SPACING LOG and logarithmic (dB-) units.

**Bottom**

(With TRACE A/B SCALE MANUAL), the menu item serves to set the lower value of the y-axis (of the scale for the measured values). The value must be smaller than that of TOP. Negative or 0-values are not permissible with SPACING LOG and logarithmic (dB) units.

***Notes on scaling the Y axis:***

- A newly selected display unit is assigned to all values from top to bottom but other units may be subsequently selected. Thus it is possible, for instance, to select a logarithmic scale (e.g. dBr) as a unit and to enter absolute units for the top and bottom values (e.g. in Volt).
- *Exception:* If a reference trace is active, entering an absolute unit for the top and bottom values is physically meaningless. For this reason no unit is offered in this case, the numeric values are assigned the unit selected under "Unit".
- If a referenced unit is set for the top or bottom value, the trace is vertically shifted when the reference value is changed.

**Left**

(With X AXIS SCALE MANUAL), the menu item sets the left value of the X-axis (of the independent value). Negative or 0 values are not permissible with SPACING LOG and logarithmic (dB) units.

**Right**

(With X AXIS SCALE MANUAL), the menu item sets the right value of the X-axis (of the independent value). The value must be selected higher than that for LEFT. Negative or 0-values are not permissible with SPACING LOG and logarithmic (dB) units.

**COMMENT**

Allows the entry of a comment with a length of max. 27 characters, which is output together with the curve in the case of OPERATION CURVE PLOT.

**X Pos**

(X Position)
Defines the X-position of the comment. X is the relative distance to the 0-point (bottom, left) in % (0 to 100) of the coordinate system.

**Y Pos**

(Y Position)
Defines the Y-position of the comment. Y is the relative distance to the 0-point in % (0 to 100) of the coordinate system. 0-point is on the left side at the bottom. The reference point for the text is the first letter (bottom, left).

## 2.10.2 Trace and Spectrum Display (GRAPH panel)

Basically, two dependent values (TRACE A and TRACE B) can be displayed above an independent value (X AXIS), the scales for TRACE A and TRACE B being displayed on the left-hand and right-hand margin, respectively (unless the same scaling has been selected by way of TRACE B, SCALE B: EQUAL A). The measurement functions selected for display are faded in on the upper margin in the form of letters.

Overrange values are not displayed (the curve is interrupted). Underrange values are indicated in the status line SWEEP INFO in the top, right corner. Measured values not fitting into the selected coordinate system are displayed as horizontal line at the top or bottom.

With THD, MOD DIST and DFD measurements, the measured values can be displayed in the form of a histogram above the frequency axis (with OPERATION SPECTRUM), the frequency axis being not true to scale and invariable.

To allow any traces to be used as reference traces or to be displayed simultaneously for the purpose of comparison, and measured by means of the movable cursors, all traces would have to have the same X-values. However, any X divisions can be used on the UPL as the values of the traces and reference traces are interpolated to the set X-axis. The interpolated values are displayed as traces or numerals. The original X and Y values are displayed only if no sweep is selected (and thus no X-axis is set). (Excepted are all limit traces; they are displayed using the original and not the interpolated values (see 2.10.7 Limit Check).)

There are two cursors marked by * and o, respectively. They can be moved across the display using the rotary knob or the direction keys. The measured values below the cursor positions are displayed in three windows (depending on the function set, also difference values). The cursor jumps from measured value to measured value. If there are more measured values than can be displayed as points (e.g. with FFT), the maximum out of the measured values displayed on one point is displayed. Here, the cursor jumps from line to line.

Also, the cursor can be moved outside the coordinate system and indicate the appertaining values. In this case, its symbol is placed in the top corners.

If no group of traces is selected (Scan count =1), the measurement currently being taken is indicated by means of a gap moving along the trace. If several traces are displayed on the screen (Scan count >1), the gap may no longer be visible; instead, the set sweep value is marked by an arrow on the X-axis.

The current scan (with one or two traces) is selected with the PAGE UP/PAGE DOWN keys on the keyboard. The current value, i.e. the scan index, is indicated by a number between the out-of- tolerance field and the left-hand cursor-value field. The point of intersection of the cursor with the current trace (or pair of traces) is visually emphasized by means of a circle. It is thus possible to allocate the cursor values indicated in the windows unambiguously to the current scan.

With LIMIT check switched on (see 2.10.7 Limit Check), the tolerance masks are displayed, too.

An extensive command menu on the softkeys allows you to scale, zoom the display, select the cursor functions and to set markers on the single frequency lines or the harmonics of the FFT.

The cursor can be moved and the softkeys can be operated only after the GRAPHICS panel has been selected using the front-panel key GRAPH or the key combination ALT-R.

The softkey menus have max. 3 levels. The extremely left key (labeled with ”BACK”) always returns to the preceding menu level. Its designation is indicated above the BACK softkey and constitutes together with the text displayed in center above the remaining 7 softkeys the heading of the current menu.

Some softkeys indicate ON or OFF states, where ◯ is the symbol for OFF and ◉ for ON.

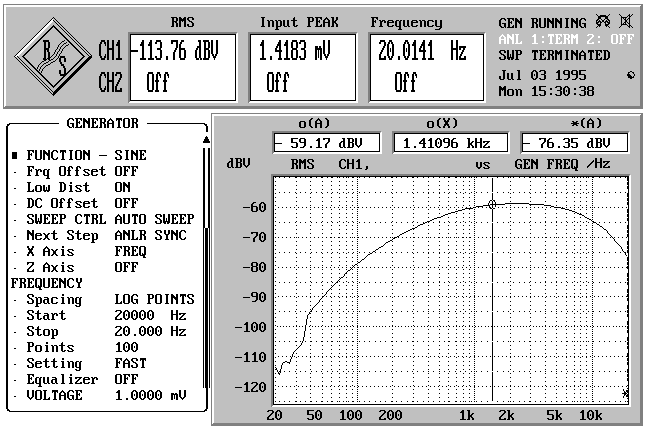



Fig. 2-39

The first two levels of the softkey menu tree are dealt with below. A third level, if any, is explained subsequently.

CURVE

A

B

switches the display of curves or lines on or off (toggle key). Display only is affected. (With TRACE A/B in the DISPLAY panel OFF, nothing can be displayed. Changing a function (using TRACE A/B in the DISPLAY panel) switches A and B to ON.)

AUTOSCAL

ALL

A

B

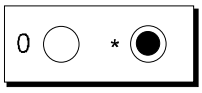
X

Rescales the X- and Y-axes using the present measured values of a sweep or the FFT. If there are no measured values, the preset range limits are used and scaled after the end of the sweep. The present display including the axes are deleted and subsequently redrawn (see also AUTOSCALE).

The left-hand trace-A axis only is rescaled, the trace A curve is redrawn.

The right-hand trace-B axis only is rescaled, the trace B curve is redrawn. Is ignored with SCALE B set to EQUAL A.

The X-axis only is rescaled (not with SPECTRUM and Analyzer FUNCTION THD, MOD DIST or DFD).



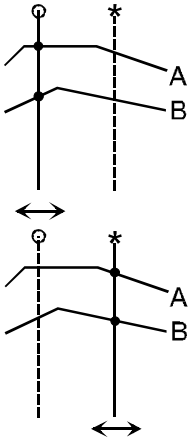

Switches alternately the *-cursor or the o-cursor active. Only the active cursor can be moved using the rotary knob or the direction keys and can display the measured values. The softkeys pressed subsequently (HLINE, SET TO and ON/OFF) refer to the active cursor. The inactive cursor is displayed in short dashes.
The o-cursor is used for the ZOOM function and as reference for the *-cursor and horizontal cursor. The *-cursor can be switched over to horizontal line (not with SPECTRUM).

*** CURSOR**

The subsequent softkeys serve to select the various cursor functions. The units of the numerical values are determined by the axis scaling.

**A , B**

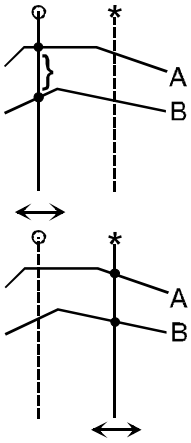
Display of the measured values of curves A and B at the cursor position as well as the appertaining X-value.

| Graphics | Labeling of display field | Selected softkey |
|---|---|---|
|  | oA<br>oB<br>oX<br><br>*A<br>*B<br>*X | oCURSOR A,B<br><br><br><br>*CURSOR A,B |



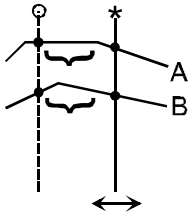
**A - B**

Display of the difference value between curves A and B at the position of the cursor and of the X-value (useful only with identical physical variables).

| Graphics | Labeling of display field | Selected softkey |
|---|---|---|
|  | oA-oB (unit of A !)<br>oX<br><br>*A-*B (unit of B !)<br>*X | oCURSOR A-B<br><br><br><br>*CURSOR A-B |

*** - o**

(With active *-cursor only). Display of the difference between the values at the positions of the *- and o-cursor on curve A (or curve B) and the difference between the X-values.

| Graphics | Labeling of display field | Selected softkey |
|---|---|---|
|   | *A-oA<br>*B-oB<br>*X-oX | *-o |

**HLINE →**

(With active *-cursor and Operation Curve Plot only). Switchover of *-cursor to horizontal cursor. The subsequent command level is described further below.

**SET TO →**

Sets the active cursor to specific values. The subsequent softkey command level is described further below.

**ON/OFF**

Switches alternately the cursor on and off. A deactivated cursor is no longer displayed.

**ZOOM**

Zooms the display in X-direction. The ZOOM function is not active with histogram indication (OPERATION SPECTRUM and simultaneously Analyzer FUNCTION THD, MODDIST or DFD).

**AT o UP**

Zooms the display on the X-axis by the factor 2 (repeated activation is possible). The center used is the o-cursor which is then also placed in the center. Changes the LEFT and RIGHT parameters of the X-axis in the DISPLAY panel.

**AT o DOWN**

Compresses the display on the X-axis to half the size (can be activated repeatedly). The o-cursor is the center, which afterwards is in the middle. Changes the LEFT and RIGHT parameters of the X-axis in the DISPLAY panel.

**CEN TO o**

Sets the center of the X-axis of the new coordinate system to the value of the o-cursor without zooming. Changes the LEFT and RIGHT parameters of the X-axis in the DISPLAY panel.

**o TO ***

The end values of the new (zoomed) X-axis are predefined by the X-values of the two cursors which will subsequently be placed on these cursor values. Changes the LEFT and RIGHT parameters of the X-axis in the DISPLAY panel. In order to obtain a scrolling effect, the cursors can be shifted to X-values outside the displayed range; the values continue to be displayed.

UNZOOM

Restores the original X-axis, defined by X AXIS LEFT and RIGHT. UNZOOM is also performed internally when modifying and setting a parameter which changes the X-axis. Restores the original LEFT and RIGHT parameters of the X-axis in the DISPLAY panel.

UNDO

Cancels the last ZOOM action (one-time).

MARKER

TRACEA →

TRACEB →

(With FFT only). Switches the display of markers in the form of triangulars above the marked measured value on trace A (or B) ON. The functions are on the next softkey level and described below.

MORE

The **functions of the third (and last) level** of the softkey menu is referred to in the following:

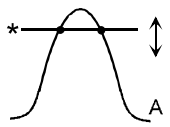
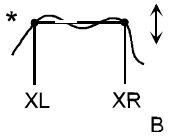
* CURSOR

HLINE

A

B

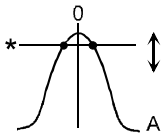
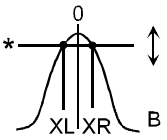
(With Operation Curve Plot (not with FFT) only)
The *-cursor is switched over to horizontal line. Its Y-value and the X-values of its intersections with trace A (or B) are displayed, if available. If there are several intersections, the extreme, right-hand and the extreme, left-hand intersections are used. When changing its position via rotary knob or direction keys the cursor jumps from measured value to measured value, usually meeting exactly only 1 intersection (left or right). The other (last) intersection is no longer valid and therefore marked by an "i" in the display. With softkey B, the intersections with trace B are displayed.

| Graphics | Labeling of display field | Selected softkey |
|---|---|---|
|  | *Y<br>*XAL<br>*XAR | HLINE A |
|  | *Y<br>*XBL<br>*XBR | HLINE B |

Δ A

Δ B

The *-cursor is switched over to horizontal line. The difference between its Y-value and that of the o-cursor is displayed. The intersections with trace A or, as the case may be, trace B are displayed (see above). Application: e.g. simple measurement of the -3-dB points.

| Graphics | Labeling of display field | Selected softkey |
|---|---|---|
|  | oA-*Y<br>*XAL<br>*XAR | Δ HLINE A |
|  | oB-*Y<br>*XBL<br>*XBR | Δ HLINE B |

MARKER

A

B

MAX

With FFT only; sets the first marker (triangle marked by ”X”) to the maximum value of trace A (or B).

o-CURSOR

With FFT only; sets the first marker to the value defined by the o-cursor. Trace A (or B) is used.

VIEW OFF

With FFT only; deletes the first marker on trace A (or B) and the harmonics.

HARM ◉

(Harmonics) with FFT only; sets or deletes alternately the markers 2 to 9 of the harmonics (frequency multiples) of the first marker. The values of trace A (or B) are marked. With the first marker (triangle marked by ”X”) being on the fundamental wave, k2 to k9, for example, are marked.

CURSOR

SET TO

MIN A

MIN B

(Not with FFT). The active cursor is set to the minimum value of the sweep (in the displayed section). It is also displayed as the cursor value. The measured values of trace A (or trace B) are used.

IMAX A

IMAX B

(With FFT only). The active cursor is placed on the interpolated maximum, which may be higher than the values displayed (see 2.6.5.12 FFT). This value is displayed as a cursor value, too.

MAX A

MAX B

The active cursor is placed on the maximum value of the sweep (in the displayed section). It is also displayed as the cursor value. The Y-values of trace A (or trace B) are used.

MARKER

(With FFT only). The active cursor is placed on marker 1 of the FFT. Its value is then displayed as a cursor value.

NEXTHARM

(With FFT only). The active cursor is placed on the next marker of the FFT. Its value is then displayed as a cursor value.

MORE

SETREF

(Set Reference)
Sets the reference value TRACE A REFERENCE in the DISPLAY panel to the current value of the *-cursor. In this case, the cursor must not have HLINE function. Effective only with relative scaling units and causes trace A to be redrawn. Applies analogously to TRACE B, where SCALE B must not be set to EQUAL A.

A WITH *

B WITH *

A WITH o

B WITH o

Sets the reference value TRACE A REFERENCE to the current value of the o-cursor. In this case, the cursor must not have HLINE function. Effective only with relative scaling units and causes trace A to be redrawn. Applies analogously to TRACE B, where SCALE B must not be set to EQUAL A.

## 2.10.3 Parameters for the Display of Lists

**TRACE A**

Used to select the measurement results that are to be collected during a sweep as TRACE A (or TRACE B) and which are then displayed as a list of numbers in the GRAPHICS panel (graphics window).

**TRACE B**

**FUNC CH1**

(Function channel 1)
The results of the current measurement of channel 1, which has been selected in the ANALYZER panel by way of FUNCTION, are used. Possible only when FUNCTION in the ANALYZER panel is not OFF.

**FUNC CH2**

As above, however of channel 2.

**FREQ CH1**

(Frequency Channel 1) Frequency meter channel 1. Possible only when FREQ/PHASE in the ANALYZER panel is not set to OFF.

**FREQ CH2**

Frequency meter channel 2. Possible only when FREQ/PHASE in the ANALYZER panel is set to FREQ.

**PHASE**

Phase meter between channel 1 and 2. Possible only when FREQ/ PHASE in the ANALYZER is set to FREQ&PHASE.

**HOLD**

Does not collect any new values but holds the old ones.
HOLD is only accepted as input if valid trace data or FFT data are provided.

**OFF**

Switches the display in the form of a list off.

**FILE**

**DUAL FILE**

A sweep stored to file in the FILE panel (STORE TRACE/LIST) can be recalled and displayed, e.g. for comparison purposes, using this option. The subsequent menu line is required for this purpose.
Also see 2.10.1, Trace A/B FILE and DUAL FILE.

**GROUP DELAY**

The group delay calculated from the phase is used.

**FILE NAME**

(Displayed with TRACE A/B FILE only). Enter the name of the file with a sweep or FFT to be displayed. If any error occurs during loading, ”NOT FOUND” is output in this line.

**UNIT**

Determines the unit with which the results are to be displayed (see also Section 2.4 Units). Recorded sweeps can be reprinted at any time using any other unit.

When, after selection of a new function or a new instrument, the present unit can no longer be used, the units set for the measurement in the ANALYZER or GENERATOR panels are automatically adopted for the new function.

**REFERENCE**

The reference value is required for the relative units and the limit curves.

**MAX**

The maximum value of the sweep is adopted once as reference value.

**o CURSOR**

The value the cursor is placed on is adopted once.

**VALUE:**

A numeric value with unit is entered.
Further settings see under 2.10.1 Reference ...

**...**

## 2.10.4 Display (GRAPH) of Lists

The results of an FFT or a sweep are output as numeric values using SPECTR LIST or SWEEP LIST. TRACE A, TRACE B and X AXIS are displayed in 3 columns which are complemented by a fourth column in which measurement results exceeding the UPPER or LOWER LIMIT curve are indicated by way of arrows (triangles) pointing upward or downward. To this end, LIMIT CHECK must be activated in the FILE panel. In full-screen graphics mode, the LIMITS, if active (LIMIT CHECK not OFF), are indicated in additional two columns (interpolated in the case of intermediate values).

The symbol for the o-cursor is displayed in the left edge of the screen in the line with the value on which the cursor is placed (also with trace presentation). After a new picture has been set up the cursor is placed in the center and can be moved using the rotary knob or the direction keys. When the cursor reaches the edge of the picture, the display is scrolled line for line. Any new sweep deletes an old line replacing it by a new line.

As opposed to SWEEP OR SPECTR **LIST**, **LIM REPORT** displays only those measured values exceeding the upper tolerance mask (LIMIT UP) or the lower tolerance mask (LIMIT LOW). LIMIT CHECK must be activated in the FILE panel for this purpose. Any new sweep deletes the old display completely and sets it up anew from top to bottom. If there are more lines than can be displayed on the screen, the picture segment can be shifted using the rotary knob or the direction keys.

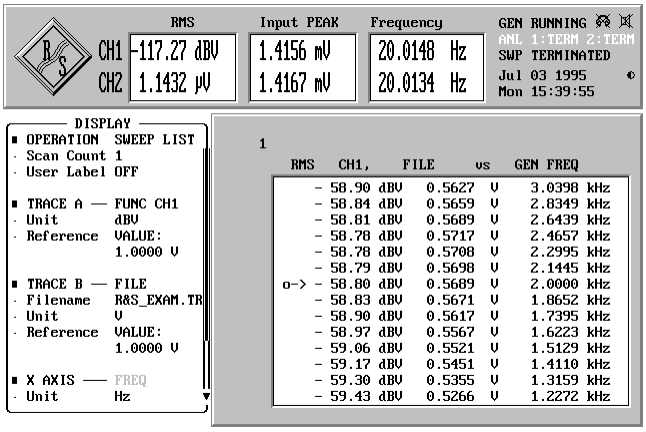



Fig. 2-40 Page/ up/down : scan select

## 2.10.5 Parameters for BARGRAPH Display

**BARGRAPH1**

Used to select the measurement results that are to be indicated as bargraph.

**BARGRAPH2**

| | |
|---|---|
| **FUNC CH1** | (Function channel 1)<br>The results of the current measurement of channel 1, which has been selected in the ANALYZER panel by way of FUNCTION, are used. Possible only when FUNCTION in the ANALYZER panel is not OFF. |
| **FUNC CH2** | As above, however of channel 2. |
| **FREQ CH1** | Frequency meter channel 1. Possible only when FREQ/PHASE in the ANALYZER panel is not set to OFF. |
| **FREQ CH2** | Frequency meter channel 2. Possible only when FREQ/PHASE in the ANALYZER panel is set to FREQ. |
| **PHASE** | Phase meter between channel 1 and 2. Possible only when FREQ/ PHASE in the ANALYZER is set to FREQ&PHASE. |
| **OFF** | Switches the display off |
| **GROUP DELAY** | The group delay calculated from the phase is used. |

**BARGRAPH X**

Displays the x-value of the current sweep. If no sweep is active, the display contains, if possible
the phase, if phase measurement is switched on
frequency of channel 1 or channel 2 or generator frequency (if selected generator function allows for frequency input),
if frequency measurement is switched on

**UNIT**

Determines the unit with which the results are to be displayed (see also Section 2.4 Units).

**REFERENCE**

The reference value is required for the relative units.

| | |
|---|---|
| **MAX** | The maximum value is adopted once as reference value. |
| **VALUE** | A numeric value with unit is entered. |
| **...** | Refer to Section 2.10.1 Reference ... for further settings. |

**Scale**

**AUTO ONCE**

Uses the minimum and maximum values for scaling (once) and rescales after changing the function using FUNCTION in the ANALYZER panel or TRACE A/B in the DISPLAY panel. The menu items LEFT and RIGHT are no longer displayed because they have been set in doing so. For BAR 3, the sweep start/stop values are adopted from the GENERATOR or ANALYZER panel.

**MANUAL**

Leaves the subsequent scaling to the user.

**SPACING**

**LIN**

Linear spacing of the display axis.

**LOG**

Logarithmic spacing of the display axis. With logarithmic units (dB) selected in UNIT, LIN only can be selected.

**LEFT/BOTTOM**

(With SCALE MANUAL,) sets the bottom left value of the display. Negative or 0-values are not permissible in combination with SPACING LOG or logarithmic (dB) units.

**RIGHT/TOP**

(With SCALE MANUAL,) sets the top right value of the display. The value must be higher than that of LEFT. Negative or 0-values are not permissible in combination with SPACING LOG or logarithmic (dB) units.

AUTOSCAL

ALL

Rescales the axes of BAR1 and BAR2 using the current maximum values of the measurement and BAR3 using the sweep start/stop values.
If there are no measured values, the range limits are used.

BAR1

Only BAR1 is rescaled (otherwise as ALL).

BAR2

Only BAR2 is rescaled (otherwise as ALL).

BAR3

Only BAR3 is rescaled (otherwise as ALL).

## 2.10.6 BARGRAPH Display (GRAPHICS Panel)

BARGRAPH indication is used to display the current measured values in analog form as bars. Bargraph display is suited for applications in which the relative magnitude or changes in magnitude are significant and not the exact value. A maximum of 3 bargraphs can be displayed. Values exceeding the displayable range are indicated by a triangular arrow on the left or right side.

The peak values measured in the monitoring interval (after Start) are marked by a pointer, identifiable by the thin line, its left end marking the minimum value, the right end the maximum value. The pointer can be reset using the Start key.

With limit check activated in the FILE panel (LIMIT not OFF), also the limit values (interpolated in the case of intermediate values) are displayed in the form of brackets. When changing the independent axis (e.g. the frequency with sweeps), the brackets are automatically set to the appropriate values. The bargraph changes its colour when the limits are exceeded.

The minimum and maximum values during the monitoring interval are displayed as numeric values above the bargraphs. In full-screen mode, the difference between maximum and minimum value is indicated, too.

BARGRAPH3 represents the current X-value of the set sweep, the measured frequency or phase or the generator frequency. The field remains empty when no sweep is started.

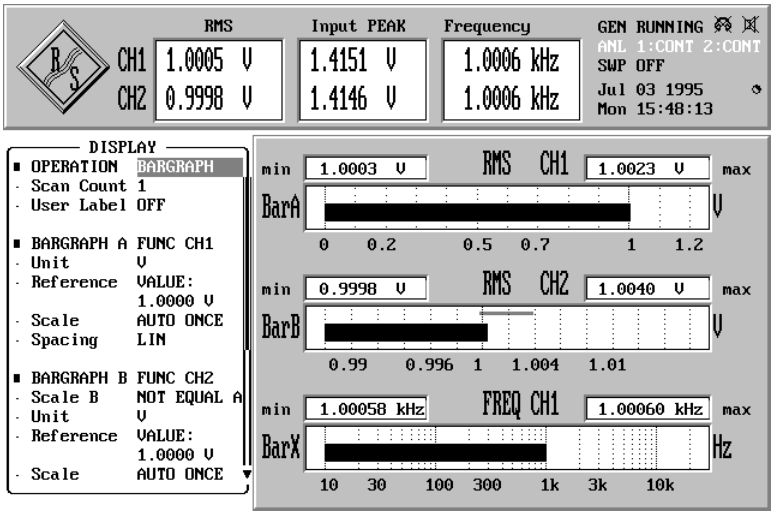



Fig. 2-41 Bargraph display

## 2.10.7 Limit Check

The following commands are available under the heading LIMIT CHECK in the DISPLAY panel which is called by pressing the DISPLAY key or the key combination Alt-D on the external keyboard.

A lower and an upper limit or, as the case may be, a limit curve can be defined for the measurement, each measured value of a sweep or an FFT being compared with the limits. With trace display, they are included in the coordinate system; with bargraph indication, they are marked by lines (varying in position). With SWEEP LIST, lines containing measured values out-of-tolerance are marked by a triangle. With LIM REPORT active, measured values violating the limits are indicated or stored. (See also OPERATION command in the DISPLAY panel in Section **2.10** and STORE TRACE/LIST in the FILE panel in Section 2.9.1.2.)

With CURVE PLOT, exceeding of limits is marked in the top, left edge by an arrow pointing downwards (lower limit is violated) or by an arrow pointing upwards (upper limit or limit line is exceeded). A single exceeded limit marks the whole sweep as out-of-tolerance. Unlike underrange values, overrange values (measured with overdriving) are out-of-tolerance values.

When relative units are used, the limits are converted using the reference value in the DISPLAY panel.

**Check**

Determines which trace (or bargraph) is checked.

**TRACE A**

**TRACE B**

Either trace A (or BARGRAPH 1) or trace B (or BARGRAPH 2) can be checked.

**TRACE A + B**

Both curves are checked together for a limit violation. As there is only one tolerance band, this is only useful if the measured physical quantity is the same. To ensure that this is the case, this selection item is only be available when "Trace B EQUAL A" is selected. The reference value of trace A is used.

**Mode**

**LIM LOWER** The lower limit is checked.

**LIM UPPER** The upper limit is checked.

**LIM LOW&UP** The lower and upper limits are checked.

**OFF** Limit check is OFF.

**Lim Upper**

**Lim Lower**

Determines how the lower/upper limit value is defined.

**VALUE**

A value with unit which is constant for all X values is entered for the upper/lower limit. If a relative unit is entered, the appertaining reference value is taken from the DISPLAY panel (TRACE A/B REFERENCE).

**OFF**

A lower/upper limit curve is defined below.

**Filename**

This serves to load the file with the limit curve. If mode LIM LOWER or LIM LOW&UP is switched on, the curve for the lower limit can be loaded, which contains the extension .LLW to the file name. In mode UPPER or LIM LOW&UP, this is the file with extension .LUP.
These files contain x-y pairs, with the y-value being a factor which is multiplied with the set reference value (TRACE A (or B) REFERENCE VALUE from the DISPLAY panel) to obtain an absolute value. By changing the reference value, the tolerance band on the y-scale can be offset. The following measurements are relative measurements, which is why there is no reference value and only the units % and dB: THD, THD+N, MOD DIST, DFD, WOW&FL.
The limit value must be entered in %, e.g. 5 for 5% for the upper limit value, a lower limit (LIM LOWER) being not required.

Only a few sampling points are required. The intermediate values necessary for tolerance monitoring of a sweep or an FFT are interpolated at the start of a sweep. This requires an indication whether the axes for x and y are linear or log, to ensure that correct values are calculated for segments not running horizontally or vertically (slanted segments). These lines become elliptical in the other division. If points are required before or after the last sampling point, the last slopes of the interpolation are continued.
In the case of full-screen mode, the interpolated limit values are indicated for every measured value in the graphics window with OPERATION SWEEP/SPECTR LIST or SWP/SPC LIM Report.

***Note:*** *The file format is described in the example data R&S_EXAM.LLW and R&S_EXAM.LUP in the form of comments. The parameters of the measured points are arranged in blocks one after the other, i.e. first the y-values then the x-values. In the files R&S_E212.LLW and R&S_E212.LUP the parameters of the measured points are arranged in pairs, i.e. y- and x-values in one line.*

## 2.10.8 PROTOCOL Analysis

When a digital analyzer is used, the audio data contents can be monitored and displayed as well as the transmitted information analyzed. The latter is the channel status and user data, the meaning of which depends on their application and protocol. Additionally, this protocol analysis includes display of other (transmission) errors. To activate the protocol analysis, PROTOCOL measurement function must be selected in the ANALYZER panel (see 2.6.5.15).

Screen display:

The screen (consisting of 16 lines of 50 characters each) is divided into two sections:

TOP: Fixed protocol elements:

Validity: shows the state of the validity bit in the respective channel. If the two channels are equal, L=R is indicated in addition.

Parity errors: indicates the error status (yes/no).

Errors: indicates the errors that have occurred:

| | |
|---|---|
| LOCK: | PLL not locked |
| CONFIDEN: | cannot be decoded (eye opening less than half a bit) |
| CODING: | coding error detected |
| NONE: | no error |

BOTTOM: These 13 lines can be matched to the currently used protocol with the aid of a protocol control file.

Changing status bits are displayed and output in red.
Bits that have not changed since the latest output are displayed in green.
Comments (PRINT command) are displayed in yellow.

The colours for the protocol can be changed in the OPTIONS panel under TRACES COLOR/LINE (see 2.15.5.4 Graphics Display with Selectable Colours)

**OPERATION**

**PROTOCOL**

**PROTO AUTO**

In what form the channel status or user data are displayed depends on which protocol file (Proto File) is selected.

The channel status data are visualized by automatic decoding of the professional bits:

- If bit #0 is set (professional mode), the protocol file for the professional mode R&S_AES3.PAC will be loaded. The remaining bits will be decoded in the professional mode.
- If bit #0 is reset (professional mode), the protocol file for the consumer mode R&S_CONS.PAC will be loaded. The remaining bits will be decoded in the consumer mode.

***Note:*** *For the user data, the protocol file must always be explicitly named, ie if display of the user data is selected ('Source USER L' or 'USER R'), PROTO AUTO has the same effect as PROTOCOL.*

Protocol Analysis: Channel Status Left

| | | | | |
|---|---|---|---|---|
| Validity: L=R 1=Y | | | Parity errors: _____<br>Errors: NONE | |
| Byte: | = = = = = = = | AES3 | = = = == = = | |
| 0: | Format: | professional | Mode: | linear PCM |
| | Emph: | J.17 | Source: | unlocked |
| | Rate: | not ind | | |
| 1: | Chanmod: | stereo | Usermod: | AES18 |
| 2: | Auxmod: | 20 no | Length: | 23/19 R:0 |
| 3-4: | Vector: | 12 | Grade: | 2 |
| | enh. Rate | 96 kHz | Scaling: | 1/1.001 |
| 6-13: | Origin: | UPL _ | Destin: | R&S _ |
| 14-21: | Local: | 01234567 | Time: | 12:45:00 |
| 22: | Reliabty: | 0-5:1 6-13:0 | 14-17:0 | 18-21:0 |
| 23: | CRC L: | _____ | CRC R: | _____ |
| Measured sample rate: 96000.2 | | | | |

↑ Text entered by UPL

↓ as of here: user-defined

This example was generated with the protocol file R&S_aes3.pac.

***Note:*** *Channel status data are decoded in the professional mode (and encoded in the GENERATOR panel) according to the AES3 recommendation of 1 November 98, which has preliminary status.*

| **Source** | Select the data to be displayed. |
|---|---|
| **CHAN STAT L** | Channel status data left are displayed. |
| **CHAN STAT R** | Channel status data right are displayed. |
| **USER L** | User data left are displayed. |
| **USER R** | User data right are displayed. |

With CHAN STAT L or R, the following line is read out on the screen (for OPERATION PROTOCOL):

**Proto File**

Proto File selects the interpretation file for channel status data.
Selection from: file name, preset type of file: *.pac

Upon entering a file name, one of the following actions is performed on the channel status data:

- decoding in the consumer or professional mode (R&S_CONS.PAC or R&S_AES3.PAC),
- displaying in binary code (R&S_BIN.PAC),
- displaying in hexadecimal code (4 bit grouped together to a hex figure each) (R&S_HEX.PAC),
- displaying in ASCII mode ((R&S_ASC.PAC)).

Description:

The protocol information is displayed in two sections; the two upper lines are displayed in a fixed format and contain information on validity, parity, other errors and differences between the two channels. The other lines are formatted using the specifications in the file, the individual bits being assigned any output text you desire. This file can be modified to suit any protocol you desire.

Example: see R&S_AES3.PAC

File format: same as with USER L or USER R, see below

***Note:*** *This line does not appear in OPERATION PROTO AUTO; the correct protocol file is loaded instead.*

With USER x, the following lines are displayed:

**FORMAT**

Format selects the interpretation mode.

| | |
|---|---|
| **BINARY** | User data are represented in a 01010 sequence.<br>Representation is block aligned. |
| **HEX** | User data are represented as a hexadecimal, numerical sequence.<br>Representation is block aligned. |
| **ASCII** | User data are represented as text.<br>Representation is block aligned. |
| **FILE** | Interpretation, block aligned |

With FILE, the following line is displayed:

**Proto File**

Proto File selects the interpretation file for user data.

Selection from: file name, preset type of file: *.PAU

File format:

The protocol file has the following structure:

One line for each operation, followed by parameters which are separated by commas. The parameters allow the representation of any bits (1 to 32) from the selected data, the output position being freely selectable. Each line must not contain more than 255 characters.

Operations:

PRINT: Text output (independent of data)

Example:

PRINT 26, 5, "Usermod:"

(in column 26, line 5 the text ”Usermod:” is entered)

VALUE: Output of values, either as hex number (default) or as text provided that an assignment is present.

Example:

VALUE 17, 3, BIT:2-4, 0="not ind", 4="no empf", 6="50/15 "

(in column 17, line 3, the contents of the three bits (2,3,4) are represented as hex (or text, in case the value is 0, 4 or 6)

VALUE 17,11, CRC _ L _ ERR

(in column 17, line 11, the contents of the CRC left frequency counter is represented)

***Note as to the output width:***
*If there are text assignments, the longest text determines the output width; In case there are no text assignments, the number of bits to be represented determines the output width.*

As a data source, the following specifications are permissible:

- 'BIT' followed by ':' and definition of the bits:
  - a number from 0 to 191: single bit
  - an interval (e.g. 4-9): combined sequence of bits, max. 32 bits permissible
- 'CRC_L_ERR': error indication of CRC_error left.
- 'CRC_R_ERR': error indication of CRC_error right.
- 'MEASURED_RATE': measured sample rate (represented as a 5.1-digit floating number (e.g. '48001.2')

BINARY: same as VALUE, however default output as bit pattern

TEXT: Text output (in ASCII) using a number of letters determined by the number of selected bits; each TEXT operation allows only 32 bits to be represented; for longer text outputs, several subsequent text lines are to be used.

Example:

TEXT 17, 8, BIT:48-79
(in column 17, line 8, the contents of the 32 bits is represented as text)
Characters that cannot be printed are replaced by '?' or, if '0', by '.' .

TIME: Time output (in the form of 12:45:56) of the selected number divided by the specified rate. Number/rate are interpreted as seconds since midnight.

Examples:

TIME 35, 9, BIT:144-175, RATE:48000.0
TIME 35, 9, BIT:144-175, RATE:SET _ RATE

(in column 35, line 9, the contents of the 32 bits are represented as time (e.g. 12:34:45)

'RATE:' Should correspond to the sample rate, can be specified as floating number.
As an alternative, the following specifications are also possible:
MEASURED _ RATE: measured clock rate
SET _ RATE: clock rate set in the panel

## 2.10.9 Switching between Full-screen and Part-screen Mode

Part-screen graphics mode offers the possibility of complementing the graphical representation with another panel. The large measured value display on the upper screen edge is maintained, too. In full-screen graphics mode, the graphics has been scaled up to occupy the complete screen. The only differences between part-screen and full-screen mode are the two additional columns with the limits for the output of lists (SWEEP/SPECTR LIST and SWP/SPC LIM REPORT) and the display of the difference between minimum and maximum value with BARGRAPH, which are offered in full-screen mode only.

After having selected the GRAPHICS panel using the GRAPH key (or key combination Alt-R), you can choose between full-screen and part-screen mode using the front-panel key □◄►□ (or key combination Alt-Z) or by clicking the mouse (see also 2.3 General Instructions for Use and 2.3.1 Panels).

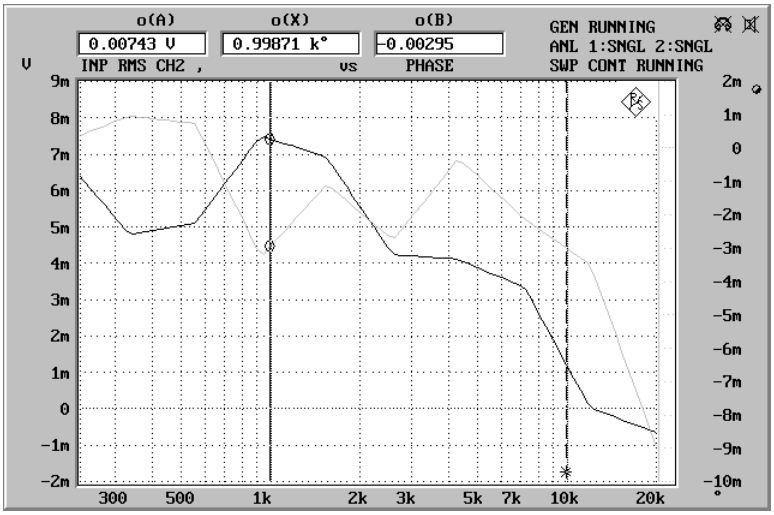



Fig. 2-42 Full-screen display

# 2.11 Starting and Stopping Measurements or Sweeps

## 2.11.1 Overview of Measurement and Sweep Systems

Basically, a differentiation is made between measurements and sweeps:

- Measurements, in the narrower sense, are understood to be single or continuous measurements of frequency, phase, input peak, or one of the measurement functions. The latter include S/N measurements, which can be activated during the AC level measurement functions (RMS, peak and quasi-peak), and in which the measurement is first performed with and then without a generator signal and the two results are then referenced to each other. The FFT function, too, is handled as a measurement, and so is the post-FFT function, which can be activated for some measurement functions although the relevant frequency lines are represented graphically or in the form of tables (similarly to sweeps).
- Sweeps are test runs in which the individual measurements are triggered by predefined generator or analyzer settings or by external events. Generator and analyzer sweeps are defined either by entering the start and stop values, the spacing and the points/step or by means of a sweep list. With both methods, a list of settings (along the X axis) is defined, which is executed after the sweep is started. In the case of generator sweeps, the list may be two-dimensional, i.e. include two variable generator parameters. This is referred to as Z sweep because the Z axis is swept in addition to the X axis. External sweeps (adjustable in the ANALYZER panel under "Start Cond"), on the other hand, have no fixed X axis. Instead, the X axis is defined by an external voltage or frequency or by a time tick. The sweep system will be activated when a sweep is switched on.

Measurements and sweeps are controlled by means of control keys START (Ctrl F5), SINGLE (Ctrl F6) and STOP/CONT (Ctrl F7), an by specific events referred to as abort events. The control keys and abort events control the measurement system when the sweep system is inactive (no sweep switched on). When the sweep system is active (generator, analyzer or external sweep switched on), the selected sweep is controlled by the control keys and abort events, and the sweep in turn controls the measurement system.

**Abort event:**

Definition:
Any event that renders a current measurement or sweep invalid. Occurs, if settings in the GENERATOR, ANALYZER or FILTER panels and in the relevant sections of the STATUS panel, which influence the measurement or sweep, have been modified.

**Effects:**

- The current measurement or sweep is aborted and restarted.
- A completed (single) measurement is restarted.
  (Note: This is valid only for manual control, no restart is done under remote or automatic control.)
- A completed (single) sweep is set "invalid" (upper right of status display).
- A completed (single) sweep normally remains unaffected in order to make it possible for the user to draw the single scans of a multiscan trace with changed UPL settings. Only if sweep settings are changed by the "abort event" (e.g. changing of start/stop, number of sweep points) the sweep is set "invalid" (status display upper right in display).

### 2.11.2 Switching Measurement Modes On and Off

UPL can measure up to six parameters simultaneously and display them numerically or graphically. These parameters are:

- Measurement functions of channels 1 and 2
- Input peak or rms of channels 1 and 2
- Frequency of channels 1 and 2, or frequency of channel 1 and phase difference between channels 1 and 2

Measurement modes can be switched off

- directly by user entries (channel selection, switching off of "Input Disp", "Frequency" or "Function" in the ANALYZER panel); this will be indicated by "OFF" in the window for the corresponding measured value,
- indirectly by selecting a test function, an analyzer instrument or an input that is not compatible with the selected measurement mode (measurement modes selected in the ANALYZER panel but not physically feasible, e.g. frequency measurement with the DC measurement function on, are marked by "------" in the window for the corresponding measured value).

In the (single) measurement mode, all measurement functions that are switched on and active are performed. A measurement is completed when all relevant results (including a settling period, if applicable) are available. Only then can a sweep be stepped or a triggered result be fetched in the remote control mode. This also means that the measurement speed of the UPL as a whole is determined by the speed of the slowest measurement mode or function. To achieve maximum measurement speed, it is recommended that only the measurement modes really needed be switched on.

***Note:*** *In analyzer 110 kHz channels 1 and 2 are measured sequentially by which the measured time nearly doubles for 2 channel operation compared to 1 channel measurement.*

The display of measured values can be switched off completely irrespective of the selected measurement mode. In this case, the status displays, too, are switched off. Switch-off is effected by selecting the "Meas Disp" menu item in the OPTIONS panel or by pressing the Ctrl D hotkey on the external keyboard. Switch-off of the display results means a substantial reduction of measurement time. This mode is useful, for example, if only the generation and representation of sweep traces and spectra is of interest and not the output of individual measured values.

## 2.11.3 Operating States of Measurement System (No Sweep Active)

The operating states of the measurement system are displayed in the upper right corner of the

ANL WAIT FOR TRIG: The analyzer waits for the trigger condition set with START COND (cf. 2.6.4).

ANL1: 2:

Status information separate for analyzer channel 1 | 2:

| | |
|---|---|
| OFF: | channel switched off, no status information |
| SNGL: | single measurement running |
| CONT: | continuous measurement running |
| TERM: | single measurement terminated |
| STOP: | measurement interrupted |

There are further messages indicating, for example, operating states relating to running measurements (e.g. RANG) or to terminated measurements (e. g. OVER in case no valid result was obtained due to OVERRANGE).
See section 2.3.4 for further details on these status displays.

**Continuous measurement:**
The system operates with continuous measurements as the default mode. The UPL is set to this mode after switch-on. The UPL goes through all active measurement functions asynchronously until one of the following events occurs:

- SINGLE key is pressed: Switch over to single measurements is made. A measurement already started will always be completed. When all measurements are completed, the system stops in the TERMinated status. To reactivate the continuous measurement mode, press START or STOP/CONT.
- STOP/CONT key is pressed: The current measurement is stopped and the system is brought to the STOP status. To reactivate the continuous measurement mode, press START key or press STOP/ CONT key again.
- START key is pressed: The current measurement is aborted, the non-return pointers and the min./max. values of the BARGRAPH as well as FFT averaging are reset, and the continuous measurement is restarted.
- Occurrence of an abort event (see 2.11.1): The current measurement is aborted and continuous measurement is restarted.

**Single measurement:**
Each type of measurement is performed only once, then the system stops in the TERMinated status. This status does not necessarily mean that a valid result was obtained. If an error occurs during a measurement, the message "Input? Press Show-IO" appears in the window for the corresponding measured value, and an NAN value (Not A Number, 9.97e37) is read via remote and automatic control. A single measurement will be restarted, after completion of the previous measurement, by pressing the SINGLE key or by the occurrence of an abort event.

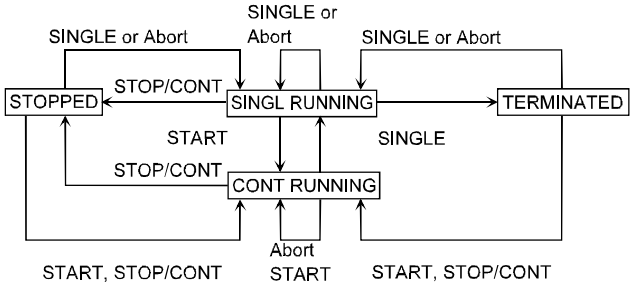



Fig. 2-43 Status diagram of measurement system (no sweep active)

## 2.11.4 Overview of Sweep Modes

The UPL features a variety of sweep modes which are briefly described in the following:

**Predefinable sweeps:**

- Generator sweeps
  - Time-synchronous sweeps (DWELL sweeps)
  - Sweeps synchronized with the analyzer (AUTO sweeps)
  - Manual sweeps (MANU sweeps)
- Analyzer sweeps
  - Sweeps synchronized with the analyzer (AUTO sweeps)

**External sweeps:**

- Time-tick sweeps
- Time-chart sweeps
- External frequency sweeps
- External level sweeps
- External level trigger

All of the above sweeps can be performed as single or as continuous sweeps. All predefinable sweeps can be performed as parameter sweeps with a constant increment or as list sweeps.

All generator sweeps can be performed as one- or two-dimensional sweeps (X or Z sweeps) provided that there is more than one sweepable parameter for the selected generator function.

External sweeps have no fixed X-axis. The X value for each measurement point is determined during the sweep.

One-dimensional sweeps can be performed as single sweep or as group of traces, two-dimensional sweeps can be performed as group of traces only. Single or group traces can be selected under menu item "Scan count" in the DISPLAY panel:

- With count = 1, only one trace is shown for every sweep; the old trace is successively erased as the new trace is drawn.
- With count >1, all traces recorded as from START are superimposed on top of each other. The last 17 traces are internally stored and can be rescaled if required.

With manual sweeps, the GRAPHICS panel will be activated automatically when a sweep is started. After starting a sweep, each sweep point must be triggered separately by means of the rotary knob or the cursor keys. Sweep stepping has priority over the current measurement being performed, i.e. the generator will be set to the sweep point next selected even if the previous measurement is not yet completed.

External level trigger can be regarded as an intermediate between a sweep and a measurement. On the one hand, this function behaves like an external one-point level sweep, on the other hand, the measured value is not stored in the trace buffers and therefore cannot be represented as a sweep curve or list.

### 2.11.5 Switching Sweeps On and Off

The various sweep modes are selected directly in the associated panels of UPL:

- Generator sweeps under SWEEP CTRL in the GENERATOR panel
- Sweeps of the tracking filters of the RMS SEL function under SWEEP CTRL in the ANALYZER panel
- External sweeps under START COND in the upper section of the ANALYZER panel

Before a sweep is switched on, it must be ensured that no other sweep is active.
If another sweep is active, an error message is output prompting the user to switch the sweep off that is not needed.
After switching a sweep mode on, the measurement system will continue to perform continuous or single measurement; only by starting the sweep will the sweep system take over and control the measurement system.
When switch-off is made during a running sweep, the system will return to the continuous measurement mode.

## 2.11.6 Operating States of Sweep System

The operating states of the sweep system are displayed in the upper right of screen:

| | |
|---|---|
| SWP OFF | sweep system switched off |
| SWP INVALID | sweep invalid due to changes of parameters or because sweep is not yet started |
| SWP CONT RUNNING | continuous sweep running |
| SWP SNGL RUNNING | single sweep running |
| SWP MANU RUNNING | manual sweep running |
| SWP TERMINATED | single sweep terminated |
| SWP STOPPED | sweep was stopped, can be continued. |

**Continuous sweeps:**
Continuous sweeps are started by pressing the START key. When the stop value of a sweep is attained, restart is made from the start value. This is continued until one of the following events occurs:

- In continuous sweeps with Scan count >1: when the number of sweep runs defined in "Scan count" is completed, the sweep system goes to the SWP TERMINATED" status.
  ***Note**:* *With Z sweeps, the number of Z-axis points is transferred to the DISPLAY panel as the lower limit of "Scans".*
- SINGLE key is pressed: switchover to single sweep is made. The trace currently drawn is completed, then the system goes to the "SWP TERMINATED" status. To reactivate the continuous sweep mode, press START key. To activate the continuous measurement mode, press STOP/CONT key.
- STOP/CONT key is pressed: the current sweep, and the system, are stopped ("SWP STOPPED status). To reactivate the continuous sweep mode, press START key (sweep is restarted), or press STOP/CONT key again (sweep is continued). To activate the continuous measurement mode, switch the sweep mode off.
- START key is pressed: the current sweep is aborted, the non-return pointers and the min./max. values of the BARGRAPH as well as FFT averaging are reset, and the continuous sweep is restarted.
- Occurrence of an abort event (see 2.11.1): the current sweep is aborted and continuous sweep is restarted.
- The sweep mode is switched off: switchover is made to the continuous measurement mode.

**Exceptions:**

- Level- or frequency-triggered external sweeps: trigger values that are closer to the start value by more than the difference relative to the latest measured value are detected as a retrace and the sweep is restarted.
- Level-triggered external sweeps: the level must fall below the start value after each externally triggered measurement for the level trigger to be ready for the next measurement.
- All external sweeps: when the STOP/CONT key is pressed, the current sweep is terminated (SWP TERMINATED status). Continuation of that sweep is not possible. (cf. 2.11.7 Operating Modes of External Frequency and Level Sweeps and 2.6.4 Starting the Analyzer).

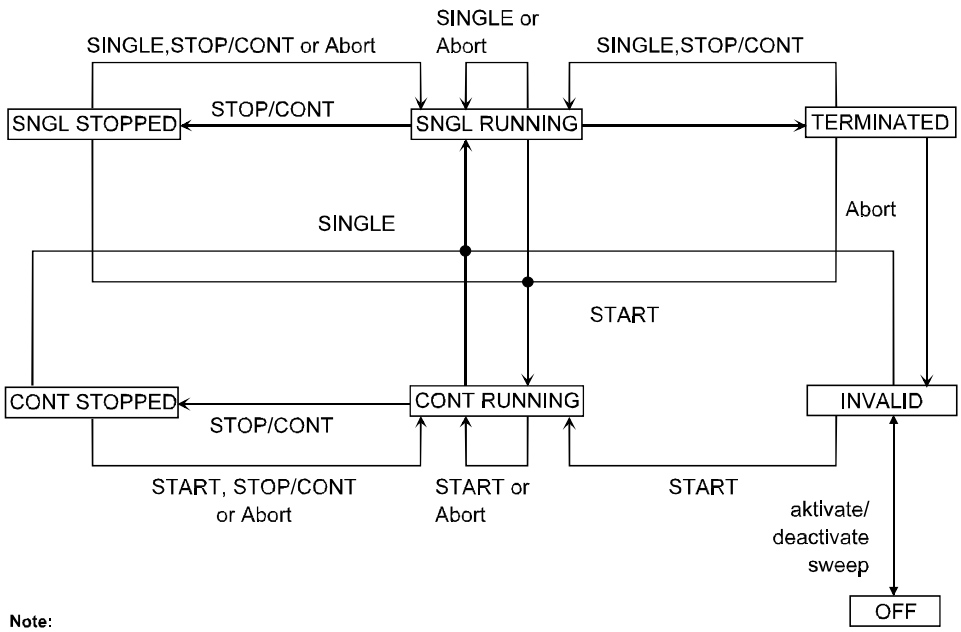



Fig. 2-44 State diagram of sweep system

**Single sweeps:**

Single sweeps are started by pressing the SINGLE key and are performed only once. When the stop value (of the X axis) is attained, the system goes to the SWP TERMINATED status. With Z sweeps, therefore, each new Z point (and the corresponding X-axis sweep) must be triggered separately.
A running single sweep is stopped or aborted by one of the following events:

- SINGLE key is pressed: the current single sweep is aborted and then restarted.
- STOP/CONT key is pressed: the current measurement and the sweep system are stopped (SWP STOPPED status). To reactivate the single sweep, press SINGLE key (sweep is restarted), or press STOP/CONT key again (sweep is continued).
- START key is pressed: the current sweep is aborted, the non-return pointers and the min./max. values of the BARGRAPH as well as FFT averaging are reset, and continuous sweep is started.
- Occurrence of an abort event (see 2.11.1): the current single sweep is aborted and then restarted.
- The sweep mode is switched off: switchover is made to the continuous measurement mode.

After termination of a single sweep, the following can happen:

- SINGLE key is pressed: the single sweep is restarted.
- STOP/CONT key is pressed: switchover is made to the continuous measurement mode.
  To reactivate the single sweep, press SINGLE.
- START key is pressed: the non-return pointers and the min./max. values of the BARGRAPH as well as FFT averaging are reset, and continuous sweep is started.
- Occurrence of an abort event: the sweep system goes to the SWP INVALID status.
- The sweep mode is switched off: switchover is made to the continuous measurement mode.

Deviating from these general status transitions, there are the following **special conditions** for some sweep modes:

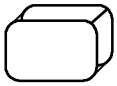
- Level- or frequency-triggered external sweeps: trigger values closer to the start value than the last measured value are ignored. Trigger values beyond the stop value cause the current single sweep to be terminated (resulting in SWP TERMINATED status).

- Level-triggered external sweeps: a single sweep is considered terminated following the first externally triggered measurement (resulting in SWP TERMINATED status). Pressing the SINGLE key makes the level trigger ready for the next trigger event.

- All external sweeps: when the STOP/CONT key is pressed, the current sweep is terminated (SWP TERMINATED status). Continuation of that sweep is not possible.

**Summary: key functions**

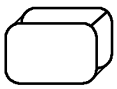
START



Start continuous or manual sweep (only with active sweep system, see 2.5.5.2 Sweeps) and active measurements.
Digital analyzer: AES/EBU receivers are reset if a lock error has occurred.
**Sweep system active:**
Resets sweeps (peak-, average values and non-return pointers are reset and graphical representation deleted) and starts sweeps; new state: RUNNING
With manual sweep selected, any new sweep setting must be triggered using the rotary knob.
While the sweep is running, any entries in the GENERATOR, ANALYZER or FILTER panel or in the corresponding sections in the STATUS panel cause the sweep to be aborted. Permissible keys (not changing the state):
- softkeys
- rotary knob

**Sweep system inactive (sweep state OFF):**
Resets measurements (averaging, peak-, average values and non-return pointers are reset) and (re)starts continuous measurement.

SINGLE

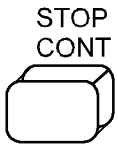


**Sweep system active:**
In the sweep states SNGL RUNNING, MANU RUNNING, STOPPED, TERMINATED or INVALID:
- Starts a single or manual sweep

In the sweep state CONT RUNNING:
- Switches from continuous to single sweep

**Sweep system inactive (sweep state OFF):**
Key refers to single/continuous measurement:
- Analyzer state SNGL RUNNING, STOPPED or TERMINATED: starts a single measurement

- Analyzer state CONT RUNNING: switches from continuous to single measurement.




**Sweep system active:**
In the sweep state CONT RUNNING or SNGL RUNNING

- Aborts the sweep; new state: STOPPED
- Analyzer is switched to ”wait for trigger”.

In the sweep state STOPPED:

- Continues the sweep without reset; new state: SNGL RUNNING or CONT RUNNING

In the sweep state INVALID or TERMINATED:

- Continuous measurement is started.

**Sweep system inactive (sweep state OFF):**
Key refers to single /continuous measurement

- Analyzer state ...RUNNING: aborts the measurement immediately
- Analyzer state STOPPED or TERMINATED: starts continuous measurement.

## 2.11.7 Operating Modes of External Frequency and Level Sweeps

With external sweep, the analyzer has to decide independently, whether a new measured value is applied, which is to be recorded and displayed. It is important that the x-axis is continuously rising or falling. A reversal of the sweep direction must be interpreted as retrace or ignored. The question is: when does a new sweep begin and what are "outliers" which can be ignored.

The following settings are of importance for an answer:

Start condition
Stop condition
Possibly settling
Starting the measurement using the START key
Terminating the measurement using the STOP key

- An external sweep which is started using the **SINGLE** key starts as soon as the start condition is reached and terminates after the stop condition has been reached. TERMINATED is then displayed, i.e., the sweep is terminated. In order that the end of an external sweep will be recognized, the stop condition must be set such that it can be recognized with certainty. For example, by a frequency sweep up to 20 kHz, the stop condition must be set a little before 20 kHz, which means that the entire length of the sweep cannot be acquired. With a single measurement, measured values are only plotted in ascending order. Stray measurement values which would lead to a backward signal are ignored. In this operating mode, it is recommended to set Scan count to 1 in the DISPLAY panel.

- An external sweep which is started using the **START** key starts as soon as the start condition is reached and is not terminated automatically. Every discontinuity in the measurement sequence or the reaching of the stop condition causes the actual sweep to be aborted. If the start condition is again satisfied, the trace up to this point is completely deleted and a new sweep is plotted. In this operating mode it is thus not allowed that an external sweep contains any stray measurement values which would lead to a backward signal. If the stop condition is set such that it is never reached (e. g. to 25 kHz when the sweep only goes up to 20 kHz), the external sweep is actually plotted up to the last measured point. If several external sweeps should be measured in a quasi-continuous operating mode and displayed, the display mode Scan count >1 must be selected in the DISPLAY panel. Each new sweep start then increments the scan index, all sweeps are simultaneously displayed and can be evaluated.

## 2.11.8 Several Sweep Traces Displayed in a Diagram

To be able to compare different sweeps, it is useful to display them in a single diagram. This can be done in different ways in the DISPLAY panel:

***Note**: Unless specified otherwise, a generator frequency sweep without Z sweep is assumed for all examples:*

| | |
|---|---|
| SWEEP CTRL | AUTO SWEEP |
| X axis | FREQ |
| Z axis | OFF |

1. Two separate traces can be displayed with an identical or different Y axes. Each trace may contain up to 17 single scan curves. Provided they contain dimensioned values, the traces may be referenced to each other so that the deviation of each sweep point can be directly read (e.g. in dB).

   | | |
   |---|---|
   | TRACE A | FUNCT CH1 |
   | Unit | dBr |
   | Reference | OTHER TRACE |
   | TRACE B | FUNCT CH2 |
   | Unit | V |
   | Reference | VALUE |

   Trace B is displayed in V, Trace A is referenced to Trace B and displayed in dBr.

2. A trace file containing the sweep trace or a trace group of a previous (reference) measurement can be loaded into each of the two traces. Thus it is possible to compare

   – a currently measured sweep trace to a reference trace, or

   | | | |
   |---|---|---|
   | TRACE A | FUNCT CH1 | |
   | TRACE B | FILE | |
   | Filename | ref2trcb.trc | (contains 1 mono scan, for instance) ) |

   – two previously measured and stored sweep traces.

   | | | |
   |---|---|---|
   | TRACE A | FILE | |
   | Filename | ref2trca.trc | (contains 1 mono scan, for instance) |
   | TRACE B | FILE | |
   | Filename | ref2trcb.trc | (contains 1 mono scan, for instance) |

3. Each trace can be referred to a reference trace. In this case the trace is displayed with the selected *relative* unit. Two traces of this kind can be simultaneously displayed in one diagram.

   | | | |
   |---|---|---|
   | TRACE A | FUNCT CH1 | |
   | Reference | FILE | |
   | Filename | ref3trca.trc | (contains 1 mono scan, for instance) |
   | TRACE B | FUNCT CH2 | |
   | Reference | FILE | |
   | Filename | ref3trcb.trc | (contains 1 mono scan, for instance) |

   The SINGLE key starts a 2-channel sweep measurement

4. Within one trace, a group of up to 17 scans can be processed, i.e. rescaled and stored. Any number of scans can be displayed; the number can be specified under Scan Count. Each scan can be triggered using the SINGLE key. After each scan (TERMINATED is indicated as sweep status), the user may not only change settings on the DUT but also any parameter on the UPL (except sweep parameters). Thus it is possible, for instance, to record a scan in another measurement mode (THD all even, THD all odd) or with another measurement function (THD, THD+N), provided the basic unit of the measurement function is not changed. (It is not possible, for instance, to make up a trace with scans of RMS measurements and THD measurements.) The measured curves can also be stored as a single trace.

| | |
|---|---|
| Scan Count | 3 |
| FUNCTION | THD |
| Meas Mode | ALL EVEN |
| SINGLE key starts | scan #1 |
| Meas Mode | ALL ODD |
| SINGLE key starts | scan #2 |
| FUNCTION | THD+N/SINAD |
| Meas Mode | THD+N |
| SINGLE key starts | scan #3 |

***Notes****:*

- *If Scan Count > 17 is selected, only the last 17 of the recorded scans can be processed. Previous scans are only visible on the screen and lost during rescaling or storing..*
- *Pressing the START key clears all previously recorded or loaded scans.*
- *To clear previous scans and to record a single one, press the START and then the SINGLE key*

5. Using the SINGLE key, scans may be added to a multiscan trace or individual scans can be replaced, provided a valid sweep is set. By loading a stored (reference) multiscan trace (dual traces are also possible), a new sweep measurement can be added to the curves of a reference trace (and stored).

| | | |
|---|---|---|
| Scan Count | 10 | |
| TRACE A | DUAL FILE | |
| Filename | ref5trc.trc | (contains 5 stereo scans, for instance) |
| TRACE A | FUNCT CH1 | |
| SINGLE key starts | scan #6 | |

***Note****: Pressing the START key clears all previously recorded or loaded scans.*

6. Single scans can be loaded together with a measured or loaded multi- or single-scan trace provided the X and Y axes are compatible.

| | | |
|---|---|---|
| Scan Count | 10 | |
| TRACE A | DUAL FILE | |
| Filename | ref5trc.trc | (contains 5 stereo scans, for instance) |
| Filename | ref61trc.trc | (contains 1 stereo scan, for instance) |
| Filename | ref62trc.trc | (contains 1 stereo scan, for instance) |
| Filename | ref63trc.trc | (contains 1 stereo scan, for instance) |
| Filename | ref64trc.trc | (contains 1 stereo scan, for instance) |
| Filename | ref65trc.trc | (contains 1 stereo scan, for instance) |

This (stereo) multiscan made up to 10 stereo scans can be stored again under a new file name (under STORE TRACE A+B in the FILE panel).

***Note****: When combining a multiscan and several single scans, the multiscan must be loaded first. Combining two or more multiscans is not possible.*

7. Single scans can be loaded or recorded together with an existing Z sweep. For this purpose Z sweep must be switched off in the GENERATOR panel after completion and Scan Count be increased by the number of additional scans.

| | | |
|---|---|---|
| Z axis | VOLT | (in GENERATOR panel) |
| POINTS | 10 | (in GENERATOR panel) |
| Scan Count | 10 | (display only) |
| TRACE A | FUNCT CH1 | |
| TRACE B | FUNCT CH2 | |

The START key triggers the Z sweep. When the sweep is terminated:

| | | |
|---|---|---|
| Z axis | OFF | (in GENERATOR panel) |
| Scan Count | 12 | |
| TRACE A | DUAL FILE | |
| Filename | ref71trc.trc | (contains 1 stereo scan) |
| Filename | ref72trc.trc | (contains 1 stereo scan) |

***Note**:*

*Only single scans (mono or stereo) can be recorded or loaded with a recorded or loaded multiscan.*

8. When a setup stored as ACTUAL+DATA contains a complete sweep, the setup is loaded with all its recorded sweep traces. The sweep can be continued with the SINGLE key provided a sufficiently high Scan Count has been set.

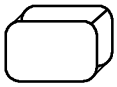
   Thus an ACTUAL+DATA reference setup can be created, for instance, to which the sweep trace of the DUT can be added. This new trace group can of course be stored again as an ACTUAL+DATA setup or as a multiscan trace file.

***Note**:*

*The START key clears all previous sweep traces.*

## 2.12 Display of Selected Inputs / Outputs

SHOW I/O

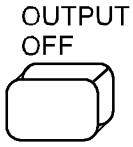


Shows a picture of the UPL front panel; the active inputs and outputs are marked by arrows.

The LC display shown indicates which inputs and outputs have been selected on the UPL rear panel.

Pressing the key while the message ”Input? Press SHOW I/O” is being output in (at least) one of the measured value displays causes the messages on measurement errors, which may have occurred, to be displayed, too (see Section 2.3.6 Error Messages).

## 2.13 Fast Switch-off of Outputs




Switches off all outputs (incl. the clock lines of the digital interfaces).
To protect the analyzer input after overloading (input voltage into 300 Ω and 600 Ω higher than 25 V), the generator output is automatically switched off and the OUTPUT OFF LED lights as if the OUTPUT OFF had been pressed..

States:
- The level of the digital outputs is set to 0 V; no clock.
- Analog outputs are terminated (impedance is retained); output level = 0 V.
- Digital inputs supply no clock.

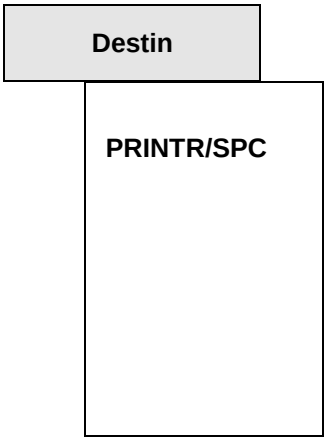
When switched off, the lines can be reactivated only by pressing the OUTPUT OFF key again. After an overload of analyzer inputs, measurements can be continued if the overload has been eliminated and the input impedance switched to 200 kΩ.

An LED indicates the state of the key. LED on signifies OUTPUT OFF. Additionally the generator status display indicates "Output Off", so this state is noticable in case of using an external monitor and no attention is payed to the UPL .

## 2.14 Printing / Plotting / Storing the Screen Contents

Use the H COPY (hardcopy) key on the front panel to initiate printing, plotting or storing to file of the screen contents displayed at the instant the key is pressed.

The following menu items are available in the OPTIONS panel under the heading SCREEN HARD COPY.




(Destination) indicates where and in which format the printout should be performed. The printout is triggered with the H COPY key (see below):

Graphics are output in the form of pixel data to a printer using its special print format (abbreviation **SP**e**C**ial). Printing is performed in the background while the UPL is accomplishing other tasks.

***Note:*** *Printing is in progress in the background while the UPL is performing further measurements. This output can be accelerated by stopping the measured value output or the sweep using the STOP/CONT key.*

**Destin** (*continued*)

**PLOTTR/HPGL**

Control characters are output in HP-GL format, a language specifically defined for plotters, yet also supported by some printers (see Destin = PRINTR/HPLG below). HP-GL format offers the advantage of the resolution being determined by the output unit instead of by the UPL screen (slashes without disturbing stages). The size of the output is defined by the configuration of e.g. the plotter as all vectors are plotted relative to the configuration (see under P1, P2 ”point” and ”size/rotate” in the plotter manual).

**FILE/PCX**

Screen hard copy to a file using PCX format.
The PCX format (pixel format) was defined by the ZSoft company for PC Paintbrush and is accepted by most programs capable of loading graphics (MS WINDOWS programs and others).

**FILE/HPGL**

Screen hard copy to a file using HP-GL format.

Apart from most plotters (eg R&S DOP 2), some laser printers and some programs with graphics import capabilities also understand the HP-GL format. It is vector-oriented and offers the advantage of the resolution being determined by the output unit instead of by the UPL screen (slashes without disturbing stages). In addition, the size of the output is defined by the configuration of eg the plotter as all vectors are drawn relative to the configuration (see also plotter manual).

***Note:*** *If HPGL data are to be used as a drawing in other programs, the result obtained is not always optimal. A few widespread (Windows) programs ignore e.g. the text format instructions or do not properly present the colour and the dashed lines. Therefore, programs are available on the market for matching and printing purposes.*

**PRINTR/HPGL**

Screen hard copy to a printer using HP-GL format.
Control characters are output in HP-GL format, a language specifically defined for plotters, yet also supported by some printers.
In most cases printers have to be enabled to interpret HPGL information by a sequence. This prolog is provided in a prolog file with the name GL_PRO.LOG. There is also a file with the name GL_EPI.LOG for the epilog. These files are located in the UPL\REF directory and may be changed by the user. For each character to be sent the files contain 1 - 3 (ASCII-) characters with following space interpreted as 1 Byte in decimal notation. As example the files HPLJ3_P.LOG and HPLJ3_E.LOG are delivered which initialize and reset the printer laserjet3 as desired.
All files mentioned can be found in the subdirectory \UPL\REF.

**PRINTR/PS**

Screen hard copy to a printer using PostScript format.

**FILE/PS**

Screen hard copy to a file using PostScript format.

**FILE/EPS**

Screen hard copy to a file using encapsulated PostScript format.
Colors and line styles for PostScript Outputs see 2.14.4.1 PostScript Configuration File PS.CFG

**Copy**

(With Destin PLOTTR/HPGL, FILE/HPGL, PRINTR/HPGL, PRINTR/PS, FILE/PS and FILE/EPS only)

**SCREEN**

The complete screen contents is output, including all labels and cursor displays as well as the curves/bargraphs with scales. In part-screen graphics mode, the display of the current measured values and a panel are additionally included. The softkeys and operator guidance line are masked out and replaced by date, time and R&S logo.

**CURVE/GRID**

The curves/bargraphs including the scales and scale labels are output, however not the cursors and other labels.

**CURVE**

The curve(s) displayed on the screen are transmitted only, thus reducing the time required for output.

***Note:*** *If the 3-panel display is selected, an UPL PostScript copy is **not** prepared for CURVE/GRID and CURVE (empty space) as this display does not contain a trace.*

Default: SCREEN

**Printname**

(With Destin PRINTR/SPC only)

**drivername**

For most laser and ink-jet printers as well as for dot-matrix printers with 9 or 24 pins, a printer driver can be selected as described below which converts the internal graphics (pixel-) format into control characters for the connected printer with graphics capabilities.
To print out in colour, select the appropriate colour printer (colour). Otherwise select the type (B/W). The R&S PDN printer corresponds to the type Fujitsu DL 2000 series.
If the new printer drivers, version 2.11 and later are used, it is possible that the size of figures printed out will be different than they previously were. The size of the print-out can be set by selecting a different resolution with the new command Prn Resol and the commands X Scaling and Y Scaling. The size of the print-out can be read out in cm with Prn Width and Prn Height. Because it is possible that a changed resolution Prn Resol can change the background colour of the frame of the GRAPH panel and of the measurement result display field such that any text no longer stands out enough, the colour of the background can be switched to white using the new command Frame Col.

Printer 0 (default printer) has a particular meaning. It represents the printer which the user selected last. Loading a setting from file (SETUP) does not overwrite the type selected by the user, if this printer 0 is set in the setup.

***Note:*** *Printing is performed in the background while the UPL is already carrying out further measurements. To speed up the output, stop the measured value output or the sweep using the STOP/CONT key.*

**FrameCol**

(Only with Destin = PRINTR/SPC, FILE/PCX, PRINTR/PS, FILE/PS, FILE/EPS)

Selecting the background colour of a GRAPH panel frame and the measurement result display for printing out the display contents or copying them to a file.

**WHITE**

WHITE should be selected if a grey background is too dark for easy reading.

**FILE DEF**

Colour defined in files.
Destin = PRINTR/SPC, FILE/PCX
Colour No. 2 (backgrnd frames) defined in files UPL\REF\PRN_BW.PLT (BW printer) or \UPL\REF\PRN_CL.PLT (colour printer) is used.
Destin = PRINTR/PS, FILE/PS, FILE/EPS
The colour information for the frames of the GRAPH panel is taken from the PostScript configuration file \UPL\REF\PS.CFG, key word "Background Frame Color" .

Default: WHITE

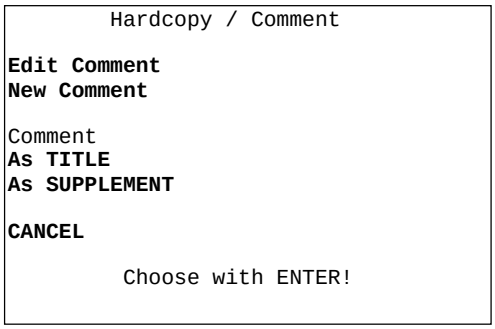
**Comment**

(Only with Destin PRINTR/SPC, PRINTR/PS, FILE/PS, FILE/EPS)
Defines if a comment is to be printed together with the screen contents.

**ON**

Destin = PRINTR/SPC:
After pressing H COPY (CTRL F8), a selection box appears with the following options: create comment, edit comment, and generate screen hardcopy.

Destin = PRINTR/PS, FILE/PS, FILE/EPS
Pressing the HCOPY key causes a window to be opened, where text can be entered or edited and a selection can be made whether the text should be inserted as a headline (TITLE) **above** the UPL plot or as a comment (SUPPLEMENT) **below**:




TITLE and SUPPLEMENT cannot be entered simultaneously.

Two text lines in Times New Roman Bold are reserved for the TITLE. A variable number of text lines (5 to 28) in Times New Roman can be entered as a SUPPLEMENT, depending on the orientation (`PORTRAIT|LANDSCAPE`) and the selected number of plots per page (`Plots/Page`). (See gray areas in the drawing under plots/page further down).

**OFF**

After pressing H COPY, a screen hardcopy is generated without a comment.

Default: ON

**Left Mrgn**

(Only with Destin PRINTR/SPC)
Margin of a hard copy

Specified range: 0 to 80 characters

***Note:*** *Not all printers support the positioning of the graphics printout!*

Default: 10

**Prn Resol**

**LOW**

**MEDIUM**

**HIGH**

(Only with Destin PRINTR/SPC)
Whether a resolution can be set and which one depends on the printer used. The resolution affects the size of the printing format. The actual size of the printing format is shown in the lines Prn Width and Prn Height.

Low resolution (*e.g.* 75 dpi)

Medium resolution (*e.g.* 150 dpi)

High resolution (*e.g.* 300 dpi)

Default: HIGH

**X Scaling**

**Y Scaling**

(Only with Destin PRINTR/SPC)
Each printer has a specific resolution in dots/inch of the X and Y axes which, in conjunction with the screen resolution, may not always yield a suitable print format. To obtain a well-balanced ratio for the X and Y axes and to make optimum use of the available sheet area, some printers require scaling of the X and Y axes (preferably in integer multiples), as well as the assignment of a suitable print format (landscape or portrait).

***Note:*** *When using non-integer multiples, pixels are suppressed or printed several times, which may degrade the quality of the hardcopy.*

The actual size of the printing format is shown in the lines Prn Width and Prn Height. For an orthomorphic projection, a width/height ratio of 640/435 = 1.47 must be set.

Specified range: 0.1 to 10 for X and Y axes

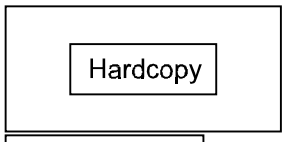
**Orientatn**

**LANDSCAPE**

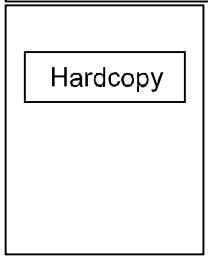
**PORTRAIT**

(Only with Destin PRINTR/ SPC, PRINTR/PS, FILE/PS and FILE/EPS)

= Horizontal format




= Vertical format




***Note****:* *PostScript printouts (up to 6 pictures/page) are automatically placed optimal with no regard to selected orientation; see Plots/Page below!*

Default: LANDSCAPE

**Color**

(Only with Destin PLOTTR/HPGL, FILE/HPGL, PRINTR/HPGL, PRINTR/PS, FILE/PS and FILE/EPS)

**ON**

Destin = FILE/HPGL:
Information is stored **in colours** in the file referred to as "Filename".

Destin = PLOTTR/HPGL, PRINTR/HPGL:
Relation of colors to **color pens** see 2.14.2 Output in HP-GL Format

Destin = PRINTR/PS, FILE/PS and FILE/EPS
Information, which scan or which line will be painted in which color, in which line style and in which line width, is taken from file C:\UPL\REF\PS.CFG (see 2.14.4.1 PostScript Configuration File PS.CFG).

**OFF**

Destin = FILE/HPGL:
Information is stored in **black-and-white** mode in the file referred to as "Filename".

Destin = PLOTTR/HPGL, PRINTR/HPGL:
Only **one color pen** is used.

Destin = PRINTR/PS, FILE/PS and FILE/EPS:
Curves, bargraphs and linegraphs in gray shades. Information, which scan or which line will be painted in which **shades of gray**, in which line style and in which line width, is taken from file C:\UPL\REF\PS.CFG (see 2.14.4.1 PostScript Configuration File PS.CFG).

Default: OFF

**Filename**

(with destinations FILE/PCX, FILE/HPGL, FILE/PS and FILE/EPSonly)
Filename under which the PCX, HPGL or PostScript information is stored.

**Destin = FILE/PCX**
A PCX file with the extension *.PCX is created under the specified file name.

**Destin = FILE/HPGL**
A HPGL file with the extension *.GL is created under the specified file name.

**Destin = FILE /PS:**
A PostScript file with the extension *.PS is created under the specified file name. This file can be sent in DOS (e.g. `copy TEST.PS PRN:`) to a PostScript printer.

**Destin = FILE /EPS:**
An Encapsulated PostScript-File with the extension *.EPS is created under the specified file name. It differs from a *.PS file only in the first and second line (printed in bold in the example below):

Example:
`%!PS-Adobe-3.0` **`EPSF-3.0`**
**`%%BoundingBox: 45 205 559 733`**

The BoundingBox contains information about dimensions and position of the image in the PostScript default coordinate system in pixels (one pixel = 1/72 inch = 0.35 mm) and informs the program executing the image integration on the size and position of the plot.
Data **`45 205 559 733`** from the above example specify the X and Y coordinates of the bottom left-hand and top right-hand corner of the plot in the PostScript default coordinate system.

To avoid this name having to be entered in the OPTIONS panel every time a printout is triggered, the user is queried on storing a file under the name of an already existing file, whether

- this file should be overwritten as from now (without any further query),
- the file should **not** be stored (and therefore not overwritten),
- a new file name should be generated by an automatic increment of the (end) number of the file name displayed in the OPTIONS panel.

***Notes on automatic increment:***

- If the name does **not** contain a number, **one** number is added (starting with 1).
- If the filename contains **at least one** number, the numbers are considered spacers and incremented as long as there is no filename overflow (new filename contains more characters than the original one).
- When the last possible number is exceeded, an error message is output.

***Examples for automatic increment:***

| | | | |
|---|---|---|---|
| SCREEN.PCX | → SCREEN**1**.PCX | ... | SCREEN**9**.PCX |
| SC**1**BW.PCX | → SC**2**BW.PCX | ... | SC**9**BW.PCX |
| SC**06**COL.PCX | → SC**07**COL.PCX | ... | SC**99**COL.PCX |

**Plot on**

(With Destin PLOTTR/HPGL, PRINTR/HPGL and PRINTR/PS only)
Select the interface for HP-GL output.

**COM2**

The printer is connected to the serial COM2 interface (RS-232). Data transmission parameters for transmitter (UPL) and receiver (printer) must be identical. The parameters are set in the UPL with the COM2 PARAMETER commands in the OPTIONS panel and on the printer normally by means of slide switches.

**LPT1**

Some plotters and most of all printers can also be operated using the (parallel) printer interface. This setting is required especially for laser printers with HP-GL interpreter or PostScript printer.

**IEC BUS**

Some plotters and printers offer an IEEE-Bus interface. The bus address of the plotter/printer is set with the subsequent menu line 'IEC Adr.'

Default: COM2

**IEC Adr**

(With Destin PLOTTR/HPGL or PRINTR/HPGL only, if 'Plot on = IEC Bus' is selected)

IEEE-Bus address of plotter or printer connected.

**Prn Width**

(Only with Destin PRINTR/SPC, display function only)
Width of the printing format in cm.

An orthomorphic projection of the printing format results when the width/height ratio is 640/435 = 1.47 (435 is the height of the printing format in pixels without the softkey row).

**Prn Height**

(With Destin PRINTR/SPC, display function only)
Height of the printing format in cm.

**Paper Size**

(With Destin = PRINTR/PS, FILE/PS or FILE/EPS only)
Paper format

**A4**

The UPL plots are optimally positioned for paper format A4 (21 cm * 29.6 cm) and made up of 600 * 845 pixels (one pixel = 1/72 inch = 0.35 mm) in the PostScript default coordinate system.

**LETTER**

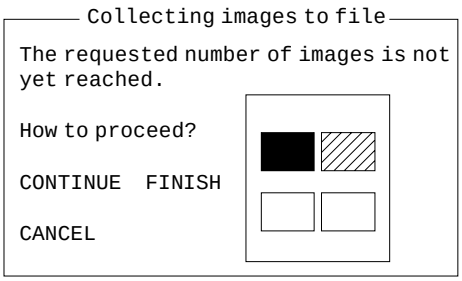
The UPL plots are optimally positioned for paper format LETTER (21.6 cm * 27.9 cm) and made up of 617 * 797 pixels.

Default: A4

**Plots/Page**

Number of UPL plots to be positioned on a PostScript page.

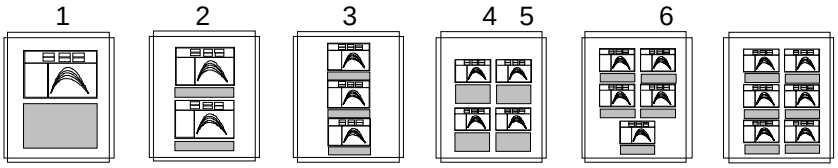
When two or more UPL plots (Plots/Page≥ 2) are printed on a page, the HCOPY key opens up a window where the page to be printed and the positions of the UPL plots are displayed:



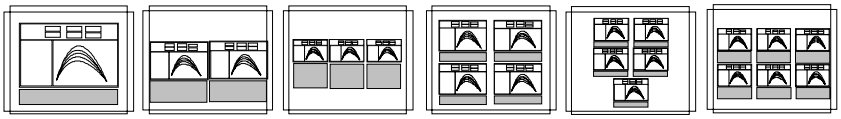

Filled-out box: the image has been already positioned
Hatched box: this image is being processed
Empty box: these images remain to be positioned

This window also allows the PostScript output to a printer or file to be aborted. Already positioned images are retained.

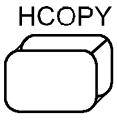
Automatic positioning, depending on paper orientation:
Orientatn = PORTRAIT




Orientatn = LANDSCAPE



Specified range: 1 to 6
Default: 1




(CTRL F8)

If Comment OFF is selected, pressing H COPY triggers a hardcopy without comments.

If Comment ON is selected, a dialog box opens after H COPY has been pressed. It is then possible to create a new comment for the printout, to edit an existing one or to actually trigger the hardcopy. In this box it can also be decided whether the hardcopy should be printed

- with or without comment
- with or without form feed.

***Note**: With form feed suppressed, several screen copies may be printed on the same page.*

While a print procedure is in progress, pressing H COPY opens a dialog box where the printer output can be stopped or continued. A new screen copy can only be started after the previous one has been either terminated or aborted.

There are 4 kinds of outputs available; the user can determine the colour representation in different ways:

## 2.14.1 Screen Copy to Printer (pixel-oriented)

If dialog or selection boxes are active on the screen, their content is printed too. Thus particularly error messages or help texts can be printed.
Besides, an additional comment of max. 1500 characters can be entered via a dialog box and also printed out. This comment is also stored as additional file under the same name but with the extension ".CTX" when a COMPL SETUP is stored and loaded, too, when this setup is loaded. The comment file can be edited using a text editor.
Specify the type of device used for printout of the hard copy in the OPTIONS panel. Activate this panel by pressing the OPTIONS key or key combination ALT-O on the external keyboard.

If display of the cursors and their associated values in the display fields is not desired, the pointers can be switched off. Select OFF in the softkey menu under *-cursor and o-cursor.

**Starting a screen copy:**

Press the H COPY key (or CTRL-F8 on the external keyboard) if **no** printout is in progress. UPL requires a few seconds to prepare the screen copy and then continues with the measurements while printing is taking place in the background.

Different dialog boxes may be displayed when the hardcopy key is pressed:

- "Printer not ready" (error message):
  The connected printer is not switched on, it is OFF-LINE or the printer is not connected at all. After eliminating the fault, hardcopy can be restarted.

- "Hardcopy already in progress!":
  A screen copy is being made. Prior to starting a hardcopy the previous procedure must be terminated or interrupted.

- "Hardcopy / Comment".
  A comment or form feed can be added to the screen copy. If this is not desired, the dialog box can be blanked by selecting "Comment OFF" in the OPTIONS panel.

**Speeding up a screen copy:**

A hardcopy is in progress in the background while the UPL continues with the measurements. Copying can be speeded up by stopping the result output or sweep with the STOP/CONT key.

The print command can be output via remote control using the HCOPy:WAIT command. In this case printing is performed in the foreground and the time required for printing only depends on the speed and the buffer size of the printer. The program is continued when the printing procedure is terminated. This mode is recommended when several copies are to be made in succession as in this case it can be ensured that a new copy is only started after the previous one has been completed.

**Aborting a screen copy:**

A stroke of the H COPY key during printing opens a dialog box with the aid of which the current copy procedure can be stopped. Printing is stopped while the dialog box is displayed on the screen.

- If the procedure is aborted **before** the actual printout is started, i.e. during its preparation, the printer output is not started.
- If the procedure is aborted while the printout is **in progress**, all characters sent to the printer before the stop will be printed. The printout of these characters, which are already in the printer buffer, can only be stopped at the printer itself, i.e. by switching the printer off.

## Colour handling

Pixel-oriented data on printer via printer driver for ,e.g., a hard copy of screen
Colour printers use another colour system than the screen (additive colour system red, green, blue with screen in contrast to subtractive colour system, e.g., cyan, magenta, yellow and black with printers). Also, the print-out of a yellow curve on a black background on white paper leaves something to be desired. Therefore, the colours are converted and can be adapted to user requirements. The desired colour for each of the 16 possible colours is read from the file PRN_CL.PLT, which can be edited by the user.
The only way to utilize shades of gray for differentiation purposes on black and white printers is to leave out individual points. This process, which is called dithering, is controlled by the file PRN_BW.PLT. The file contains cells of 8 x 4 points for each "gray" pen and can also be changed by the user to meet his needs. The colour 10 (Trace B) is dithered only, if the printer resolution exceeds one printer point per screen pixel.
Both files described above are located in the directory \UPL\REF and contain a description of their contents in the form of comments.
The colour No. 2 is used for the background of the frames and is drawn light-gray on the screen. If the black inscription does not contrast enough with this background, the latter can be set to WHITE using the command FrameCol. The colour specified in the file is no longer used, as is the case with selection of FILE DEF.

## 2.14.2 Output in HP-GL Format

Vector-oriented outputs in HP-GL format are usually output to plotters (Destin = PLOTTR/HPGL), however some laser printers also support the HP-GL format (Destin = PRINTR/HPGL), e.g. for plotting measurement traces. The output data can be filed, too (Destin = FILE/HPGL).

The colours for screen output and the assignment of the plotter pens can be looked up in the table below:

Table 2-38 Colours of screen output and assignment of plotter pens

| Function/ type | UPL-LCD | UPL colour monitor | Plotter pen | Recommended colour |
|---|---|---|---|---|
| Panel | black | black | 1 | black |
| Trace A | black | green | 2 | green |
| Trace B | grey | yellow | 3 | blue |
| Axes B | grey | yellow | 3 | blue |
| Scales | grey | red | 4 | light red (thin line) |

Prior to output of the HPGL data and vectors an initialization sequence is transmitted to the drawing device at the selected interface or to the file. With plotters, this sequence may be the information about P1/P2 points (sheet or drawing size) or on the sheet format (portrait/ landscape). Printers usually require an initialization sequence to be able to interpret HPGL information. If Destin = PRINTR/HPGL is selected this sequence is loaded in a prologue file designated GL_PRO.LOG. There is also an epilogue sequence, which is designated GL_EPI.LOG. These files are stored in the UPL/REF directory and can be modified by the user as required. They contain, for each character to be sent, 1 to 3 (ASCII) characters followed by a blank. This sequence is interpreted as 1 byte in decimal notation. HPLJ3_P.LOG and HPLJ3_E.LOG are supplied as sample files for initialization and reset of Laserjet3 printer. All files referred to are included in the \UPL\REF directory.

## 2.14.3 Output in PCX Format

Outputs in PCX format to file for further processing in other programs (Destin = FILE/PCX).

The PCX file format contains a palette information. In this version used by UPL it consists of 16 entries, which assign the 16 colour types one colour, each, by means of indicating the respective red, green and blue portions. With black/white printout (Color OFF), only 16 black/gray/white hues are assigned. These palettes are filed in the UPL\REF directories under the names PCX_BW.PLT and PCX_CO.PLT. They can be edited by the user if other colours are required. The files contain comments indicating which pen is used for which colour.
The colour No. 2 is used for the background of the frames and is drawn light-gray on the screen. If the black inscription does not contrast enough with this background, the latter can be set to WHITE using the command FrameCol. The colour specified in the file is no longer used, as is the case with selection of FILE DEF.

## 2.14.4 Output in PostScript Format

Outputs in vector orientated PostScript format on a PostScript capable printer (Destin = PRINTR/PS) or on file for further processing (Destin = FILE/PS) or integration into other programs (Destin = FILE/EPS).

PostScript is a frequently used graphics format for use with high-quality terminals, e.g. laser printers. The PostScript format implies a complete programming language with commands permitting a high-quality graphics hardcopy to be made irrespective of the printer type, provided the printer is equipped with a PostScript option.

Upon a stoke of the HCOPY key, UPL generates a plot of the screen content or of parts thereof with the aid of suitable PostScript commands. These commands are sent to the PostScript printer either directly or via the LPT1 or COM2 interface, or they are stored in a file (*.PS) which may be processed by users familiar with PostScript and viewed on the screen of a PC with the aid of a *previewer*.
This procedure should be adopted in the development phase of the PostScript copy to save paper and toner.
An Encapsulated PostScript file (*.EPS) can also be created. This file allows the UPL plots to be integrated into another PostScript file, document or graphics representation (see section 2.14.4.2 Integrating and Output of PostScript Files).

Frequently used previewers are **GhostScript**, **GhostView** and **GSview**. They are available as free-ware on the Internet under the address **http://www.cs.wisc.edu/~ghost/**.

Up to 6 different UPL plots including head line or comments can be stored in a PostScript file according to a fixed pattern, format A4 or LETTER, PORTRAIT or LANDSCAPE, colour or monochrome print and the desired screen section being selectable.

PostScript settings are done in the OPTIONS panel:

Information about traces and lines to be printed and colour/shade of gray, line pattern and line width to be used can be seen in the PostScript configuration file PS.CFG (see section 2.14.4.1 PostScript Configuration File PS.CFG).

**Overview of PostScript commands in the OPTIONS panel:**

```
SCREEN HARD COPY ----
Destin     PRINTR/PS    Output of PostScript format to printer
           FILE /PS     Output of PostScript format to file (*.PS)
           FILE  /EPS   Output of Encapsulated PostScript format to file (*.EPS)
Color      ON | OFF
Copy       SCREEN       | CURVE/GRID | CURVE
Comment    ON           | OFF
Paper Size A4           | LETTER
Orientatn  LANDSCAPE    | PORTRAIT
Plot on    COM2         | LPT1            For Destin  PRINTR/PS only
Plots/Page 1...6
Filename   A:\UPL.PS                     For Destin FILE /PS only
           A:\UPL.EPS                    For Destin FILE /EPS only
```

## 2.14.4 1 PostScript Configuration File PS.CFG

The PostScript configuration file C:\UPL\REF\PS.CFG is a text file which contains all information about colour, gray level, line width and line pattern for

- curves of TRACE A (Scan 1 to 17),
- curves of TRACE B (Scan 1 to 17),
- limit curves (upper, lower)
- Y grid (low, medium and high priority)
- X grid (low, medium and high priority)

With **logarithmic scales** the grid line priority
"high" has the values ..., 0.1, 1, 10, ...,
"medium" the values ..., 0.5, 5, 50, ... and
"low" is used for all other lines.

With **linear scales** the assigned grid line priority depends on the start and end value of the scale and is therefore difficult to predict.

**The file has to be edited with an ASCII editor in the DOS operating system.**
Several comment lines in the header of file PS.CFG inform on permissible line patterns, colours, gray shades and line widths.

Example of a PostScript configuration file PS.CFG

```
# The following linestyle strings are available:
# ------ or ______, ------,  ......,  .-.-.-
#
# The following color strings are available:
# red, green, blue, yellow, magenta, cyan,
# black, gray9, gray8, gray7, gray6, gray5,
# gray4, gray3, gray2, gray1, white
#
# The following gray levels are available:
# 0.0 (black) ... 1.0 (white)
#
# The following width values are available:
# Values > 0.0
#
#
#         ----------- Line ---------
#         Style   Color   Gray Width
TRAC A
Scan1:    ______  red     0.1  1.0
Scan2:    ------  green   0.2  1.0
Scan3:    ......  blue    0.3  1.0
Scan4:    .-.-.-  cyan    0.4  1.0
Scan5:    ------  magenta 0.5  1.0

TRAC B
Scan1:    ------  green   0.1  1.0
Scan2:    ------  gray1   0.2  1.0
Scan3:    ......  gray2   0.3  1.0
Scan4:    .-.-.-  gray3   0.4  1.0
Scan5:    ------  gray4   0.5  1.0

LIMIT LINE
Upper:    ......  yellow  0.4  2.5
Lower:    ......  yellow  0.4  2.5

GRID Y
Priority low:    ......  blue    0.4  1.0
Priority medium: ......  blue    0.4  1.0
Priority high:   .-.-.-  blue    0.4  1.0

GRID X
Priority low:    ......  red     0.4  1.0
Priority medium: ......  red     0.4  1.0
Priority high:   ......  red     0.4  1.0

#        color      gray
#       r  g  b
BACKGROUND COLOR
Frame: 0.7 0.7 0.7   0.7
Plane: 1.0 1.0 1.0   1.0
```

The expressions printed in bold are keywords required by the UPL for the search of parameters under Style, Color, Gray and Width. The parameters must be in the same line as the keyword and separated by at least one blank. Only the lines required for creating the PostScript format must be available. Faulty or missing entries are recognized when the file is accessed and in this case an error message is output on the UPL screen.

The following can be selected:
Style: 4 line patterns
Color: 17 colours and shades of gray for a colour PostScript copy (`Color = ON`)
Gray: Any number of gray shades for a monochrome PostScript copy (`Color = OFF`)
Width: Any number of line widths

## 2.14.4 2 Integrating and Output of PostScript Files

### Integrating PostScript files in word processing and design programs

The EPS files created by the UPL are particularly suitable for integrating PostScript files in word processing and design programs. Most of these programs cannot interpret the contents of an EPS file. As a rule they show a frame with or without diagonal lines, or a light-gray rectangular with the name of the EPS picture is displayed instead of the drawing. However, the EPS file is completely and correctly printed out.

To get an idea of the picture content in word processing or design programs, a coarsely rastered bit map can be inserted in the EPS file. The bit map can be evaluated and displayed by some user programs without interpretation of the EPS file.

For this purpose a bit map has to be inserted into the EPS file generated in the UPL. The picture in the EPS file is in the form of a hexdump. The free-ware program **GSview** mentioned before is particularly suitable in this case.

**Example:**

After the start of **GSview**, the name of the EPS file into which the bit map should be integrated is entered under **File - Open**. Under **Bearbeiten - EPS Vorschau einfügen** (Edit - Insert EPS preview) a selection of graphics formats for creating the bit map is displayed, e.g. **Windows Metafile.** Subsequently the name of the EPS file with bit map is specified.

An EPS file with a bit map thus generated can be integrated in Microsoft Word 6.0, for instance, where the bit map is displayed in the Word document.

**Example:**

After starting the Windows program **Microsoft Word 6.0,** a window is opened with **Einfügen - Grafik** (Insert - Graphics), where the **file type Encapsulated Postscript (*.EPS)** and the **file name** of the EPS file to be inserted are selected.

The bit map is now displayed in the document. With **File Print...** the PostScript picture (not the bit map) is printed with the highest possible resolution, provided the correct PostScript printer driver is installed (see "Printout of PostScript files").

The Windows graphics program **CorelDRAW 5.0** is able to directly interpret and display an EPS file of the UPL:

**Example:**

**File - Import - Aufzulistender Dateityp (**file type listed) **- PostScript (Interpreted) (*.eps, *.ps)**

### Printing PostScript files:

If a PostScript printer is available, EPS files can be directly printed, e.g. with command "**copy SCREEN.EPS prn:**" in **DOS.** Under **Windows** a printout at this low level is not possible. Here it is advisable to integrate the EPS file as described in a word processing or design program, a graphics program or in GSview with subsequent printout.

For printing EPS files that have been integrated in a word processing or design program, or *.PS or *.EPS files loaded with GSview, an appropriate PostScript printer driver should be installed. **It is not sufficient** to just connect a PostScript printer; a suitable PostScript printer driver should also be available.

Without an adequate printer driver being installed, Windows does not know that a PostScript printer is available and only an empty frame or, if a bit map is integrated in the EPS file, a coarsely rastered bit map is printed.

*To obtain a true PostScript hardcopy, a Postscript printer driver is **indispensable**, e.g. printer driver* **"HP LaserJet 4/4M PostScript"** for **HP laser printer LaserJet 4 Plus.**
*Only in this case the original EPS file will be printed with the highest possible resolution.*

## 2.14.5 Output of Measurement Traces and Lists

The following menu item is available in the OPTIONS panel under the heading PRINT.

The measured values and other block data are output to printer as numbers (in ASCII code) using this key (immediately executed, the H COPY key need not be pressed).

| Type | |
|---|---|
| | The first column contains the data selected in the following. The values which would be on the X-axis with Curve Plot, usually the swept values, are contained in the second column. |
| **OFF** | Function is off. |
| **TRACE A**<br>**TRACE B** | Prints the measured values selected for TRACE A (or TRACE B) in the DISPLAY panel. Also, units (and reference values, if any) are taken over from the DISPLAY panel. |
| **EQUALIZATN** | Prints the values of the equalization table. |
| **LIM REPORT** | Prints only values exceeding the limits. Limit check must be activated. |
| **DWELL VALUE** | Prints the values for the sweep dwell time. |
| **LIM UPPER** | Prints the upper limit curve. |
| **LIM LOWER** | Prints the lower limit curve. |
| **X AXIS** | Prints the values of the X-axis only. |
| **Z AXIS** | Prints the values of the Z-axis only. |
| **TRACE A + B** | Prints both traces next to one another. The X-axis is output in the 3rd column. |

# 2.15 Setting and Displaying Auxiliary Parameters (OPTIONS Panel)

Activate the OPTIONS panel by pressing the OPTIONS key (UPL front panel) or key combination ALT-O (external keyboard). The panel is displayed on the right side of the screen.

## 2.15.1 Selecting the Remote-Control Interface (IEC/IEEE Bus/COM2)

**Remote via**

Defining the interface for UPL remote control.
The selection only affects the talker/listener mode but not the controller mode (e.g. via Automatic Sequence Controller UPL-B10).

**IEC BUS**

Remote control via the built-in IEC/IEEE-bus interface.

**COM2**

Remote control via the serial COM2 interface. Interface parameters are defined further down in the COM2 PARAMETER menu.

***Note:*** *UPL uses 2 serial interfaces (9-pin).*
*COM1 is not used by the instrument software and available for user applications (e.g. mouse).*
*COM2 is generally reserved for the instrument software (remote control, plotter control). In the event that it is used for user-specific applications make sure that it is not defined as a remote-control or plotter interface by a device setting, not even for a brief period of time.*

**UPL IEC adr**

Defining the IEC/IEEE-bus address for the UPL to an IEC/IEEE bus.

*Displayed only when "Remote via IEC BUS" has been selected.*
Application: see **2.17 Connecting External Devices**

*Note: The IEC/IEEE-bus address set or selected on UPL start-up remains unchanged when a setup or a default setup is loaded.*

Specified range 0 to 31
Default: 20

Unit : none

*COM2 PARAMETER*

*Defining the parameters for the serial COM2 interface. The parameters set here apply to remote control and hardcopy printout on a plotter on which the COM2 interface is selected. The parameters determined here comply with those of the connected instrument (host computer or plotter).*

*The following parameters are standard setting for the COM2 interface of the UPL:*
*9600 baud, even parity, 7 data bits, 1 stop bit.*
*These standard parameters are set upon UPL switch-on when the BACKSPACE key is pressed (loading the DEFAULT setup), UPL -d is entered at the DOS level or after (re)installation of an UPL software.*
*The COM2 parameters set upon UPL start-up or selected by the user remain unchanged when a setup or the default setup is loaded. Thus it can be ensured that interface parameters having to comply with those of the connected instrument are not inadvertently overwritten.*

***Note:*** *Interface parameters should not be changed via the COM2 remote control.*
*COM1 parameters can only be changed with the DOS command MODE at the operating system level. This can be done:*

- *by changing the AUTOEXEC.BAT file,*
- *after quitting the UPL with the aid of the SYSTEM key,*
- *after execution of the SHELL command in the automatic sequence controller (UPL-B10).*

Further information on **baud rate**, **parity**, **data bits** and **stop bits** can be obtained from the UPL online help or the DOS help at the operating system level with command HELP MODE under section "Configure Serial Port".

**Baud Rate** — Transmission rate in baud (bits/s)

**2400 Baud**
**3600 Baud**
**4800 Baud**
**7200 Baud**
**9600 Baud**
**19200 Baud**
**38400 Baud**
**56000 Baud**

Default setting: 9600 baud

**Parity** — Parity check

**NONE** — Switching off the parity check

**EVEN** — Check for even parity (default setting)

**ODD** — Check for *odd* parity

**Data Bits** — Number of data bits

**7**
**8**

Default setting: 7

**Stop Bits** — Number of stop bits

**1**
**2**

Default setting: 1

| **Handshake** | Type of synchronization |
|---|---|
| **RTS/CTS** | Handshake between UPL and controller via RTS and CTS lines (default setting).<br>This is the simplest handshake procedure and probably the most used one in practical applications. The intelligence for a proper communication between controller and UPL is provided in the RS-232 interface ICs and the driver programs so that the user need not prepare a respective software.<br>Suitable RS232 connection cable for RTS/CTS handshake between controller and UPL see 3.17 Remote Control via RS-232 Interface |
| **XON/XOFF** | Software handshake between UPL and controller. This procedures uses the control characters XON and XOFF (ASCII character DC1 = 11 hex and DC3 = 13 hex). If the UPL is temporarily unable to receive control commands or data (trace data), it sends the XOFF code. When ready again to receive, it sends the XON code. By providing an adequate software the user has to ensure that the controller does not send data when the UPL has signaled with XOFF that it is unable to process data. If the UPL sends data to the controller (measurement results, trace data, query responses) and the controller is temporarily unable to receive them, it sends XOFF. The UPL stops data transmission which is continued only after the controller has sent an XON.<br>Suitable RS232 connection cable for XON/XOFF handshake between controller and UPL see 3.17 Remote Control via RS-232 Interface |

## 2.15.2 Beeper On/Off

**Beeper**

| | |
|---|---|
| **ON** | A brief audible warning is output in the case of error messages, when specified ranges or limits are exceeded and at the end of sweeps. |
| **OFF** | Beeper switched off. |

## 2.15.3 Keyboard Settings

The settings refer to both the UPL front panel and the external keyboard (if available).

**Rep rate**

(Repetition rate)

Number of generated key codes per second (unit: Hz) with repetitive triggering.

Specified range: 0 (no repetitive triggering) to 50 Hz
Default: 10 Hz

**Rep delay**

(Repetition delay)

Time delay until repetitive triggering responds
(Unit: s).

Specified range: 0.25 to 1.0 s
Default: 0.5 s

## 2.15.4 Language of Help Texts

**Language**

Selecting the language used for online help. Key functions of the external keyboard remain unchanged but they can be changed for instance via the auxiliary program BOOTSET.BAT.

***Note**: The selected language is not changed when a setup or default setup is loaded.*

| | |
|---|---|
| **ENGLISH** | Help texts are displayed in English |
| **GERMAN** | Help texts are displayed in German |

The external keyboard functions are assigned with the aid of various AUTOEXEC.BAT files generated through copying with the auxiliary program BOOTSET.BAT.
For UK, AUTOEX_E.BAT and for GR, AUTOEX_D.BAT is copied to C:\AUTOEXEC.BAT. These files then call up the configuration file C:\UPL\USERKEYB.BAT where the standard keyboard assignment can be overwritten or further user-defined actions performed.

## 2.15.5 Display Settings

**Extern disp** (External Display)

**INTERN ONLY** Display on the built-in LCD screen only.
***Note**: With model UPL-66 this menu item is ignored and COLOR set instead. Otherwise there would be a risk of (inadvertently) selecting (eg by loading a setup with this setting) and switching off the external monitor switched off. In this case UPL could only be operated "blind".*

**BOTH COLOR** Additional display on the external VGA monitor (see **2.17 Connecting External Devices**); use a colour monitor for colour output. The display has been optimized for colour display, thus leading to reduced contrast quality on the built-in LCD screen.

**BOTH AUTO** Additional display on the external VGA monitor (see **2.17 Connecting External Devices**); the display mode (colour or monochrome) is adapted to the built-in LCD screen. Since the display has been optimized for the built-in LCD, the contrast quality is not reduced.

**BOTH BW** Additional display on the external VGA monitor (see 2.17 Connecting External Devices), however only monochrome. The contrast quality on the built-in monochrome LCD screen is not reduced in this mode.

### 2.15.5.1 Switching the Measurement Display ON/OFF

**Meas Disp** (Measurement Display)

**OFF** Measured value and status displays are switched off. This increases the performance of the measurement routines. Sweeps are up to 15% faster. To be recommended for sweeps and FFTs if maximum performance is required. The status display reads the message
"MEAS DISPLAY OFF"
"Ctrl D to resume"

**ON** The measured value displays are switched on, measured value and status display are activated.

***Note:** The MEAS DISP OFF/ON states can be switched via an external keyboard using the key combination Ctrl D.*

### 2.15.5.2 Reading Rate of Measurement Results

**Read Rate**

| | |
|---|---|
| **MAX SPEED** | Maximum output speed of measurement results |
| **6/S** | 6 measurement results / second |
| **3/S** | 3 measurement results / second |
| **1/S** | 1 measurement result / second |

***Note:*** *The setting is only effective in the measurement mode Continuous. With sweeps, start condition timechart and single triggered measurements, the measurement results are always output at maximum speed.*
*The output speed over the IEC/IEEE bus is not influenced, and is always at a maximum.*

### 2.15.5.3 Resolution of Measurement Results

**Read Resol**

| | |
|---|---|
| **CHOICE ...** | A selection box appears after the SELECT key is pressed, in which the resolution of the measured value in trailing decimal places can be inputted for each measurement result window.<br>0: automatic display of the trailing decimal places<br>1 to 4: 1 to 4 trailing decimal places, whereby the result may be filled out with zeros |

### 2.15.5.4 Graphics Display with Selectable Colours

When individual traces, trace groups (see section 2.9.3.3 Scan Count >1) and bars are displayed, a specific colour or shade of gray can be assigned to each trace or bar for easy distinction. Colour or shade of gray depends on the colour or monochrome representation selected under the menu item `Extrn Disp` (see section 2.15.5 Display Settings).
In addition a line pattern and line width can be assigned to sweep traces and trace groups.
Settings for colour/shade of gray, line pattern, line width are made in the OPTIONS panel under

**DISPLAY** ——————————
**TRACES COLOR/LINE** ——

The settings for colour and line pattern for max. 17 scans in channel A and channel B are stored in the self-explanatory text file C:\UPL\REF\TRCCOL.CFG.
**In exceptional cases** this file can be edited using an ASCII editor in the DOS operating system, on the condition that positions and length (correct number of trailing blanks) of the text are not changed.

***Note****: If the file has been destroyed by mistake, it can be newly created using commands* `Scan conf = DEFAULT` *with a default setting.*
*All scans of TRACE A are green (uninterrupted, narrow line), and all scans of TRACE B yellow (dotted, narrow line).*

The colour and line-pattern settings stored in this file are setup-independent and **remain unchanged when a setup or the default setup is loaded.**

**Trace groups:**
For trace group display (see 2.9.3.3 Scan Count >1) a colour/shade of gray and a line pattern can be assigned to max. 17 scans in channel A and channel B (DISPLAY panel: `Scan count ≥ 2`).
If more than 17 scans are displayed on the UPL, the 18th scan is assigned the colour and line pattern of the 1st scan, etc.

**Single sweep traces:**
If only one sweep trace is displayed in channel 1 and channel 2
(DISPLAY panel: `Scan count = 1`), the colour/shade of gray and the line pattern specified under `Scannr.A = 1` and `Scannr.B = 1` will be assigned. Settings for `Scannr.A/B = 2...17` are meaningless.

**Display of FFT, waveform and filter simulation:**
ANALYZER panel:
FUNCTION = FFT | WAVEFORM | FILTER SIM
For displaying the traces in channel 1 and channel 2 for the above-mentioned measurement functions the colour/shade of gray specified under `Scannr.A = 1` and `Scannr.B = 1` is assigned. Assigning a line pattern is not useful and not performed.
Settings for `Scannr.A/B = 2...17` are meaningless.

**Bargraph for DFD, THIRD OCT and MOD DIST measurement:**
ANALYZER panel:
FUNCTION = DFD | THIRD OCT | MOD DIST
For a vertical bar display of channel 1 or channel 2 for these measurement functions, the colour/shade of gray specified under `Scannr.A = 1` and `Scannr.B = 1` is assigned. Assigning a line pattern is not useful and not performed.
Settings for `Scannr.A/B = 2...17` are meaningless.

**Bargraph display:**
The horizontal bars for BarA, BarB and BarX are displayed in the colour/shade of gray specified under `Scannr.A = 1.` If a limit violation occurs for one the bars (DISPLAY panel: LIMIT CHECK...) the colour/shade of gray changes as specified under `Scannr.B = 1` . Settings for `Scannr.A/B = 2...17` are meaningless.

**PROTOCOL panel:**
Parameters are displayed in the colour/shade of gray specified under `Scannr.A = 1,` comments are printed as specified under `Scannr.B = 1.` Variable parameters are always printed in red.

**Result display:**
The six measured values in the result display are represented in the colour/shade of gray specified under `Scannr.A = 1`, if no display of trace groups has been selected (DISPLAY panel: `Scan count ≥ 2`).

**Scan conf**

**MANUAL**

Colour/shade of gray and line pattern for each scan number entered with commands `Scannr.(A)` and `Scannr.(B)` can be separately changed.

**DEFAULT**

Automatic assignment of colour and line pattern to 17 scans of Trace A and Trace B. All scans of Trace A are green (uninterrupted), those of Trace B yellow (dotted), thin lines.

**AUTO COLOR**

Automatic assignment of colours to 17 scans of Trace A and Trace B, GREEN, YELLOW, BLUE, CYAN, MAGENTA and WHITE being assigned repeatedly in exactly this order. BLACK, DARK GRAY and LIGHT GRAY are assigned to the monochrome display.

Traces A and B are distinguished by the type of lines used, ——— for trace A and ..... for trace B.

***Note:*** *If WHITE proves to be unfavourable for a scan because the limit lines are (normally) drawn in white, different colours can be assigned to these scans using the following commands.*

**AUTO LINE**

Automatic assignment of line patters to 17 scans of Trace A and Trace B, with the 4 thin line patterns ——— , `------`, `......` and `.-.-.-` being assigned repeatedly in this order.

To distinguish the traces, trace A is shown in green and trace B in yellow

**Scannr.(A)**
**Scannr.(B)**

Scan number 1 to 17, to which a colour/shade of gray or a line pattern is to be assigned using commands `Color(A/B)` and `Line(A/B)`.

If the **scan number 0** is entered, all 17 scans are assigned the same colour/shade of gray and the same line pattern, when command

```
Color(A/B)
```

or

```
Line(A/B)
```

is entered.

Specified range: 0 to 17
Default: 0

**Color (A)**
**Color (B)**

Assignment of colour/shade of gray to individual scans

**GREEN**
**YELLOW**
**BLUE**
**CYAN**
**MAGENTA**
**WHITE**

**BLACK**
**DARK GRAY**
**LIGHT GRAY**

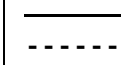
**Colour** of scan number specified with command
`Scannr.(A)`
or
`Scannr.(B)`,
if colour display is selected using command `Extrn Disp = BOTH COLOR`.

**Shades of gray** specified with command
`Scannr.(A)`
or
`Scannr.(B)`,
if monochrome display is selected using command `Extrn Disp`

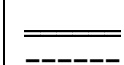
***Note:*** *If colour/shade of gray is selected while* **`Scannr.(A/B) = 0`***, all 17 scans will be assigned the same colour. To avoid this being done inadvertently, a query has to be confirmed before the command is executed.*

**Line (A)**
**Line (B)**

Line pattern for scan number specified with
`Scannr.(A)`
or
`Scannr.(B)`.



Normal line width



Triple line width

***Note:*** *If line pattern is selected while* **`Scannr.(A/B) = 0`***, all 17 scans will be assigned the same pattern. To avoid this being done inadvertently, a query has to be confirmed before the command is executed.*

## 2.15.6 Calibration

**Calibration ANL**

**Zero Auto**

Dynamic offset calibration

**OFF**

DC offset calibration of the A/D converter or analog board is OFF; the most recently valid calibration factors are used.

***Note:*** *Calibration should be switched off for short periods only (e.g. for the execution of a sweep), as otherwise large measurement errors may occur.*
*If autorange is used for the measurement, "Zero Auto ONCE" should be called up before calibration is switched off to make sure that **all** ranges which may be required are calibrated.*

**ON**

The DC offset of the A/D converter or the analog board are cyclically calibrated for each voltage range. The length of the calibration interval is 10 minutes at operating temperature; the intervals are shorter when the UPL warms up.

***Note:*** *A cyclic calibration is not performed while a sweep is running; it is delayed until the sweep is terminated or stopped. This does not apply to precision measurements (Dynamic Mode PRECISION) since the measurement accuracy has priority over the sweep speed.*

**ONCE**

Immediate offset calibration of the A/D converter or analog board for all ranges. Then the setting returns to the previously selected menu item.

***Note****: Only the **currently** selected analyzer instrument is calibrated.*

**Calibration GEN**

**Low Dist**

Displayed only when the low-distortion generator is fitted.Permits automatic calibration of low-distortion generator.

**OFF**

Calibration of low-distortion generator inactive.

**ONCE**

Automatic calibration of low-distortion generator. Then the setting changes to OFF.
Allowed only after an operating time of at least one hour.

**Calibration DIG**

**PhaseToRef**

Displayed only with Jitter option UPL-B22 installed.
Permits automatic calibration of digital Phase To Ref measurement and generation.

**OFF**

Calibration of digital Phase To Ref measurement inactive.

**ONCE**

Automatic calibration of digital Phase To Ref measurement. Then the setting changes to OFF.

## 2.15.7 Version Display and Service Functions

The version numbers of software, analog and digital hardware and of options are displayed in the OPTIONS panel. Released software options are marked by INST (installed). As these menu items cannot be edited, they cannot be selected by the cursor.

**VERSIONS**

**SOFTWARE ----------**

| | |
|---|---|
| Software | <version number> |
| Setup | <version number> |
| CPU board | <processor type> |
| Anlg board | <version number> |
| Dig. board | <version number> |

**OPTIONS ----------**

| | |
|---|---|
| B1 Low Dist | < version number > |
| B4 Rem Ctrl | INST/-NA- |
| B2 DigAudio | <version number> |
| B29 Dig96 | <version number> |
| U8 GSM DAI | <version number> |
| B5 Speaker | <version number> |
| B21 DA Prot | INST/-NA- |
| B22 DA Jitt | INST/-NA- |
| B23 Coded | INST/-NA- |
| B10 SeqCtrl | INST/-NA- |
| B6 Coher | INST/-NA- |
| B33 ITU O33 | INST/-NA- |
| B8 PhoneTst | INST/-NA- |
| B9 3G Tests | INST/-NA- |

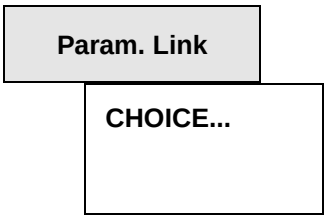
Any software, hardware or option which is not installed is marked by the letters -NA- (Not Available). Otherwise the version number is displayed for an installed hardware option or INST (installed) for a released software option.

Software options are released by entering the instrument-specific installation key under the menu item "InstallKey"; the installation key comes with a detailed description.

The service functions are also contained in the OPTIONS panel. They are given under menu item DIAGNOSTIC, protected by a password and not accessible to the user.

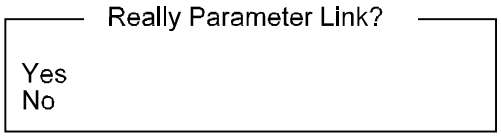
Only one of hardware options B2, B29 and U8 can be installed.

## 2.15.8 Transfer of Parameters (Parameter Link Function)



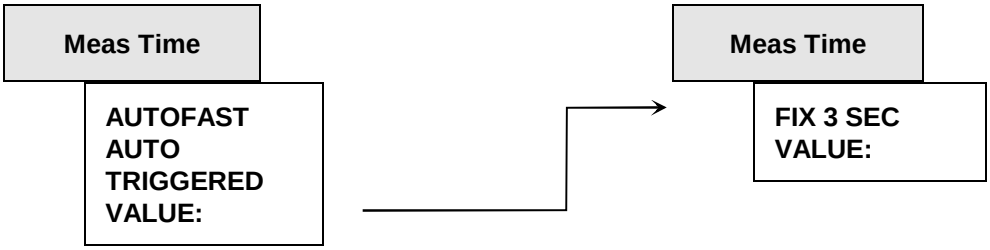

"Parameter Link" offers the possibility of transferring generator and analyzer settings to another signal or test function or to another instrument. The corresponding selection box is opened by pressing the SELECT key. The selected options are marked by a tick, see next page.

If a setting is made in UPL that enables the transfer of parameters in accordance with the options selected (marked with a tick), the user is prompted to confirm the transfer:




If YES is entered, the parameter setting is transferred to the new signal function when the signal function is changed. For the transfer, a corresponding command line must exist and the setting to be transferred must be selectable for the old and the new function.

Example:
Parameter Link with switchover from
RMS measurement function to DC measurement function




When switching from RMS to DC measurement mode, the setting VALUE: can be transferred. Transfer of the settings AUTO FAST, AUTO and TRIGGERED is not possible as these are not available for the DC measurement function.
Numerical values are transferred only if a corresponding command line exists and if the unit for a value in question is available for the new function or instrument. Transferring values from an analog to a digital instrument and vice versa is therefore not possible, nor is it useful. If the range of values of the new function or instrument is limited so that it does not allow transfer of the value despite appropriate unit, the value to be transferred is set to the upper or lower limit value of this range.

**Explanation of menu items of parameter link box**

**Changing Gen Function keeps**
**FUNCTION parameters**

When the signal function is changed, the settings of the old function are transferred to the new function.

**Changing Gen Instrument keeps**
**Output Config.**

When an instrument is changed, the configuration settings (those relating to the generator outputs) are transferred to the new instrument. No settings will be transferred for changeovers made between analog and digital instruments.

**Changing Gen Instrument keeps**
**FUNCTION + Parameters**

When an instrument is changed, the signal function and associated settings are transferred to the new instrument provided the signal function and settings are permissible for the new instrument.

**Changing Anl Instrument keeps**
**FUNCTION parameters**

When the measurement function is changed, the settings of the old function are transferred to the new function.

**Changing Anl Instrument keeps**
**Input Config.**

When an instrument is changed, the configuration settings (settings relating to the analyzer inputs) are transferred to the new instrument. No settings will be transferred for changeovers made between analog and digital instruments.

**Changing Anl Instrument keeps**
**START COND**

When an instrument is changed, the START COND settings are transferred to the new instrument.

**Changing Anl Instrument keeps**
**INPUT DISP**

When an instrument is changed, the INPUT DISP settings are transferred to the new instrument.

**Changing Anl Instrument keeps**
**FREQ/PHASE**

When an instrument is changed, the FREQ/PHASE settings are transferred to the new instrument provided that the function can be applied in the new instrument.

**Changing Anl Instrument keeps**
**FUNCTION + Parameters**

When an instrument is changed, the measurement functions and associated settings are transferred to the new instrument provided the measurement function and settings are permissible for the new instrument.

**Function tracking Gen → Anl**
**MDIST, DFD, POL, FM → W&F**

When the signal function of the generator is changed, the appropriate measurement function for the analyzer is set.

If any signal functions, measurement functions or configuration settings cannot be transferred, a warning will be output.

## 2.15.9 Selecting the Sampling Mode

With option UPL-B29 (digital audio 96 kHz) only

If the new hardware option UPL-B29 is used, UPL can be operated in two different sampling modes to be selected under DIGITAL AUDIO I/O in the OPTIONS panel or via hotkeys on the external keyboard. The selection of the sampling mode influences the generator as well as the analyzer and is therefore all performed in the OPTIONS panel.

**Sample Mode**

Sampling mode

**BASE RATE**

In the base rate mode (BRM), option UPL-B29 performs basically as UPL-B2.
Clock frequencies up to 55 kHz can be generated and analyzed.
Maximum performance of UPL without reduction of functions.

Hotkey (external keyboard): ALT B

**HIGH RATE**

In the high rate mode (HRM), UPL can generate and analyze clock frequencies up to 106 kHz. Some measurement functions in two-channel operation are performed at lower speed. Analyzer functions are slightly reduced:

- no RUB&BUZZ measurement
- THIRD OCT measurement only analog
- THIRD OCT, WAVEFORM, PEAK and QPEAK measurements only without filter
- digital phase measurement not possible with all measurement functions

Hotkey (external keyboard): ALT H

***Note:*** *In the HRM, the performance and the number of analog measurements are also reduced. This mode should therefore only be selected if the higher sampling rate is required for the generator or analyzer.*

## 2.16 Macro-Operation

With the UPL, setting and measurement sequences can be written as BASIC programs or else recorded via the built-in program generator (see 3.16.4.3 Logging Mode - UPL-B10). Option UPL-B10 (Automatic Sequence Control) is required to do this. The generated BASIC programs can be stored (preferred file extension: .BAS) and called and used in various ways:

1. Call from BASIC user interface:

   Once the BASIC user interface has been activated by pressing F3 (on the external keyboard) or BACKSP (on the UPL keyboard), the program can be loaded with LOAD (softkey or F11) and then started with RUN (softkey or F6). The program name needs to be typed during loading. After the program has been quit, the UPL user interface is reactivated with F3 or the LOCAL key.

2. Automatic start of a BASIC program on switch-on:

   The UPL can be configured to load and execute (once) a particular program at switch-on. After the program has been quit, the UPL user interface is reactivated with F3 or the LOCAL key. The BASIC program can be either of the following:

   - the program INIT.BAS under C:\UPL\USER\, if the power-up mode has been set to 2 with the aid of utility programs BASSET or UPLSET.
   - any program whose name is entered with "-bn<filename>" as a call parameter when UPL is started.

3. Call from UPL user interface:

   Via the menu item "Exec Macro" on the OPTIONS panel, a BASIC file name can be selected with the aid of the standard file box. In the file box, all files with the extension .BAS are listed as standard. The selected BASIC program is loaded and started automatically. After the program has been quit, the UPL user interface is automatically reactivated.

   Advantages of this method:

   - All BAS files (macros) available in the selected directory are displayed in the file box.
   - Faster and more convenient file handling: the file can be selected directly from the UPL file box and does not need to be typed (possibly plus path) after activating the BASIC user interface.
   - As no file name needs to be typed, a macro of this type can also be started without an external keyboard (which is required for typing text into a BASIC user interface).

4. Call from an external control program via IEC/IEEE-bus interface:

   Any BASIC program can be loaded and started with the IEC/IEEE-bus command SYST:PROG:EXEC. After the program has been quit, a 1->0 transition is generated in the RUN bit (#14) of the operation register. This is communicated to the controller via SRQ or serial poll so that it can fetch the measurement results. Data exchange between the external control program and the BASIC program can be performed via the measurement-result displays and the measurement-result buffers.

   Advantages of this method:

   - Modular measurement tasks; the controller is not directly involved with *how* the measurement is executed in UPL.
   - Reduction of controller workload; once the macro has been started, the controller can handle other tasks.
   - The measurement algorithms implemented in the BASIC programs of UPL-B10 also be called with a single keystroke in manual mode (see above).

**Exec Macro**

The file bearing the name shown here is loaded and executed as a BASIC file. It is essential this file was generated with the Rohde&Schwarz BASIC, eg in the autocontrol option of either UPD or UPL (UPD-K1 or UPL-B10).

Recommended file extension: .BAS

If the file cannot be opened or if it contains invalid BASIC lines, a BASIC error message is issued.

For infor about entering file names, see 2.3.2.5

# 2.17 Connecting External Devices

***Important:***
*It is recommended to use shielded cables for connection of external devices!*
*Otherwise spurious emissions may slightly increase, adversely affecting a very sensitive device under test.*

All connectors below are located on the UPL rear panel (see 2.1.2 Rear-panel View).

## IEC/IEEE bus

Option: UPL-B4 (IEC-625/IEEE-488 interface)
Applications:

- Remote control of UPL from a host computer; select the address in the OPTIONS panel: "UPL IECadr" (see 2.15.1 IEC/IEEE-bus Address).
- SCREEN HARD COPY on a plotter connected to the IEC/IEEE bus; settings in the OPTIONS panel: "Destin → PLOTTER", "Plot on → IEC BUS", "IEC-Adr" (see 2.14 Printing / Plotting / Storing the Screen Contents (OPTIONS Panel)).

For IEC/IEEE-bus operation, see 3 Remote Control

## RS-232 (COM1, COM2)

2 serial interfaces

The serial interfaces COM1 ad COM2 have the following standard configuration:

transmission rate 9600 baud
even parity,
7 data bits,
1 stop bit,
none retry.

Use of COM1 (free for user-defined instruments):

- Connection of mouse or rollkey; permits alternative operation of panels and softkeys (see 1.1.7 Connecting a Mouse, 2.3 General Instructions for Use).

Use of COM COM2 (reserved for instrument software):

- Remote control of UPL from a host computer. For remote-control operation see **3 Remote Control**.
- SCREEN HARD COPY on a plotter connected to COM2; settings in the OPTIONS panel: "Destin → PLOTTER", "Plot on → COM2" (see 2.14.1 Screen copy to printer (pixel-oriented)).

The interfaces can be reconfigured
- at operating system level using the DOS command MODE (changing to DOS with the SYSTEM key),
- automatically on power up of the UPL by making an appropriate entry into the AUTOEXEC.BAT file,
- when using the Universal Sequence Controller UPL-B10.

**SYNTAX**

**mode com*m*** [:] [b[,b[,d[,s[,r]]]]]
**mode com*m*** [:] [**baud**=*b*] [**parity**=*p*] [**data**=*d*] [**stop**=*s*] [**retry**=*r*]

**Parameter**

**com*m***

Denotes the number of the pin for asynchronous data transmissions (COM). Valid values for m are 1 or 2.
If one of the following five parameters is omitted, **mode** uses the last setting of the omitted parameter. If the short form of the syntax is used (without the words **baud =, parity =, data** etc.), the **mode** command identifies the parameters by their position. If no value is entered for a particular parameter, the comma preceding the next parameter must be entered.

**baud**=*b*

Denotes the first two positions of the transmission rate in bits per second. The following list contains the valid values for b and the corresponding transmission rates:

| | |
|---|---|
| 11 | 110 baud |
| 15 | 150 baud |
| 30 | 300 baud |
| 60 | 600 baud |
| 12 | 1200 baud |
| 24 | 2400 baud |
| 48 | 4800 baud |
| 96 | 9600 baud |

This parameter can be abbreviated by omitting **baud =** and entering a value for *b*.

**parity** =*p*

Determines how the parity bit is used by the system to check transmission errors. *p* may assume one of the following values: **n** (none), **e** (even) or **o** (odd). The standard value is **e**. This parameter can be abbreviated by simply omitting **parity =** and specifying a value *p*.

**data** =*d*

Denotes the number of data bits per character: Valid values for *d* are 7 or 8. The standard value is 7 data bits. This parameter can be abbreviated by simply omitting **data =** and specifying a value for *d*.

**stop** =*s*

Denotes the number of stop bits defining the end of a character: 1 or 2. If the transmission rate 110 has been set, 2 stop bits are used as standard. Otherwise, the standard value is 1. This parameter can be abbreviated by simply omitting **stop =** and entering a value for *s*.

**retry** =*r*

Determines what is to happen in the case of a time exceeded error if **mode** attempts to send an output to a serial printer. The option causes a part of **mode** to remain resident in the working memory. The following list contains the valid values for r and a short description of their meaning.

e Output an error following a status check of a busy pin

b Indicate "busy" following a status check of a busy pin

p Try until the interface accepts the output.

r Indicate "ready" following a status check of a busy pin

n Do not try again (standard). **none** can also be indicated for this value.

This parameter can be abbreviated by omitting **retry** = and specifying a value for *r*.

Serial interface:
Typical connections to external device with 9-pin connector (PC) using the acknowledge signal lines.

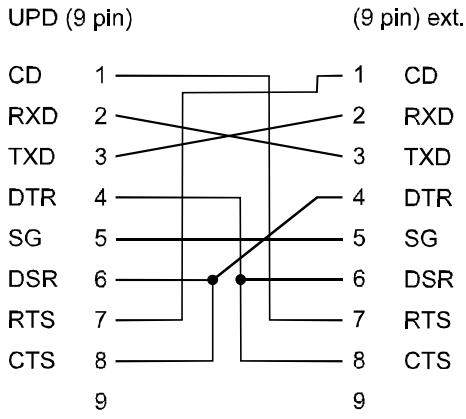



Fig. 2-44 9-pin serial interface

Typical connections to external device with 25-pin serial connector using the acknowledge signal lines.

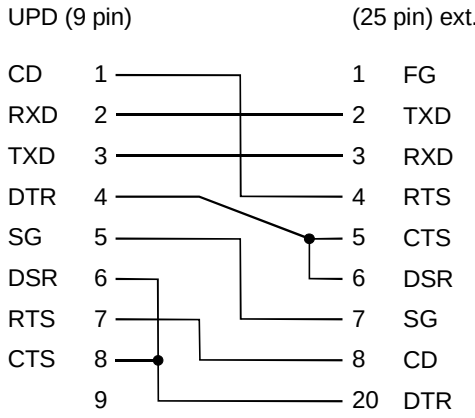
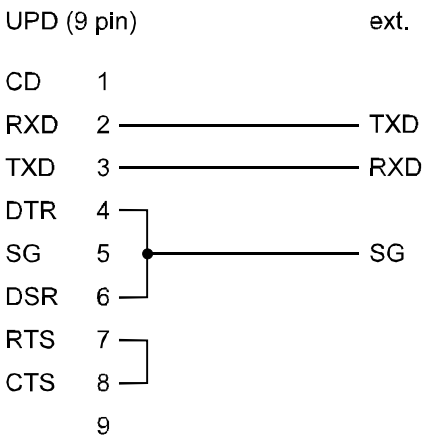



Fig. 2-45 25-pin serial interface

25-pin serial interface without acknowledge signal lines




**FG:** Frame Ground,
**TXD:** Transmitted Data,
**RXD:** Received Data,
**RTS:** Request to Send,
**CTS:** Clear to Send,
**DSR:** Data Set Ready,
**SG:** Signal Ground,
**CD:** Carrier Detect,
**DTR:** Data Terminal Ready.

Fig. 2-46 25-pin serial interface without acknowledge signal lines

***Note:*** *The connection cable between UPL (9-pin connector) and the external device (e.g. plotter) should be configured as described in the instrument manual (of the plotter, for instance). The UPL side can be connected up as in the case of connection of an ISA (IBM-PC)-compatible computer.*

## Centronics

Parallel interface for connection of a printer (see 2.14.5 Output of Measurement Traces and Lists)

## VGA (external VGA monitor)

CRT interface for connection of a (colour or monochrome) VGA monitor
Advantages:

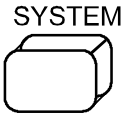
- Larger screen size
- Colour trace representation possible even for an UPL with monochrome screen

Switchover to the external monitor in the OPTIONS panel using the menu item "Extrn disp → BOTH..." (see 2.15.5 Display Settings)

***Note:*** *When connecting an external monochrome VGA monitor, the file C:CONFIG.SYS must be changed (for more detailed explanation see comment in this file).*

## 2.18 UPL Used as Computer

The UPL software is created on the basis of the MS-DOS® operating system from Microsoft. MS-DOS commands and programs are available when exiting the UPL software.




This key (or key combination CTRL-F9 on the external keyboard) is used to exit the UPL software. A dialog box is then displayed in which the command must be confirmed in order to avoid the inadvertent exit to the MS-DOS® operating system.

***Note:*** *The key combinations CTRL-C or CTRL-PAUSE (via external keyboard only) have the same function as the SYSTEM key. Pressing these keys inadvertently therefore does not cause a program interruption.*

At the operating system level, the user is responsible for not changing or deleting the files required by the UPL. Also, the directory structure used should be maintained (see 1.2.1 Enabling Software Options). The CONFIG.SYS and AUTOEXEC.BAT files required for starting the UPL should be modified by experienced users only.

The following three ways are possible for restarting the UPL software:

1. Call the UPL.BAT batch file by way of >UPL (where ”>” is the input request by MS-DOS® and need not be entered).
2. Press the CTRL, ALT and DEL keys simultaneously in order to trigger a warm start.
3. Switch the UPL off and (after a few seconds) on again.

Due to the License Agreement with Microsoft, office applications are not allowed to be installed on the system.

### 2.18.1 Setting the Realtime Clock

If the display of time or date is no longer correct in the UPL, the PC realtime clock must be set. This is effected at the operating system level using the DOS commands TIME and DATE. Exit from the current mode and access to the operating system is made using the SYSTEM key (cf.).