

HPGRAFIK

User manual for the program «HPGRAFIK»
Version 2018

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1. Introduction

The HPGRAFIK program is used (i) for the graphic representation of the results of MESSZEIT, WOB300, ZPVWOB or other measurement programs using the same library of subroutines and (2) the conversion and an in-depth evaluation of the results. On the other hand, it can read ASCII files and other formats, modify them and save them as a standard file. HPGRAFIK is also included as a graphic part in the MESSZEIT program.

HPGRAFIK can run on HP-9000 computers with HP-BASIC-WS and HP-UX / RMB-UX operating systems and on PC using HTB or Linux emulation software from TAMS-BASIC.

In the early days of computer-controlled measurement technology, the programs were mainly developed in the laboratories of companies or research institutes (generally written in the programming language HP-BASIC or RMB, or partly in C). This led to very specific device and application programs. At the time, HP-9000 Series computers running HP-BASIC were almost standard for these tasks. The PC was introduced many years later and only reached the performance of HP-9000 computers a decade later. Then came commercial products for graphical representation and evaluation of measurement files, mainly for use on PC.

HPgraphik was originally designed as a universal data evaluation program on the HP-9000 workstation with the GPIB communication interface and in the "HP-BASIC" programming environment in order to activate the programming of measuring devices in a high level language. HP-UX has arrived as the operating system associated with HP-BASIC (especially for evaluation servers and computers).

The HP-9000 family of computers (200 and 300 series) and HP-BASIC were maintained and developed almost until the end of HP (in 2000) as a manufacturer of measuring equipments. Many measurement environments based on HP-BASIC are still in operation today. Due to the considerable software investments and to be able to continue using this programming language, the HP-BASIC environment at the end of the 90s was taken over by TRANSERA. Software written in "HT-BASIC" can thus be run on almost all PCs. On the other hand, TAMS has implemented HP-BASIC on PC under LINUX.

2 Features of the HPGRAPHICS program

The program "HPGRAFIK" is used for the graphic representation and the evaluation or manipulation of measurement data coming from MESSZEIT, but also from files from other sources. The following basic functions are provided by the program:

- Graphical display of measurement files

The graphic output of the files can be done on:

- Computer-specific graphic screen (black / white or color),
 - Additional color graphics screen (HP-9000),
 - Printer in screenshot
(e.g. Think-Jet, Laser-Jet for HP-9000, standard printer Windows (PC)),
 - Local HPGL plotter
 - Networked HPGL plotter (HP-9000 / SRM),
 - HPGL files.
- Print files in tabular form
 - Conversion, modification, manipulation of files
 - Simple arithmetic operations like:
Displacement, stretch, logarithm, absolute value, etc.,
 - Link several files (Addition, subtraction, multiplication, division, chaining),
 - Averaging, smoothing, integration, differentiation
 - Fit curve with pairs of file values.
etc.
 - Conversion of measured values to other quantities / sizing
eg. Volt - Watt, Watt - dBm, dBm - dBuV, dB - SWV, Rho - Z
 - Conversion of data files using special downloadable programs
 - Creation of data files
 - Manual entry of value pairs in list form,
 - Scanning of table of values on paper with a digitizing tablet
 - Calculation of function values.

On PCs with Windows, the HTB user interface appears in a Windows window. The DOS version of HTB can be run on a PC with MS-DOS-5/6/7 (Windows-95/98 in DOS mode) and by entering "htb386" in the HTB directory. The user interface then occupies the entire screen.

Several RMB or HTB processes can be launched in parallel on Windows and X11 systems. This allows to have a window for measurements and another for the simultaneous evaluation of files.

Fig. 1. presents the standard screen of the HP-BASIC user interface. This interface consists of 26 lines of 80 characters each, of which 22 lines make up the display area. These 22 lines are followed by a 1 line of 80 characters as the message display line and then 2 lines for entries. And followed by a line for error and status messages. The functions of the 8 keys (f1 - f8) are displayed at the bottom of the screen.

With the exception of some menus, the text entered in the input area ends with a <RETURN>. The cursor position in this area can be moved using the <or> keys. By pressing the SHIFT and > keys at the same time, the cursor is placed at the end and with the <key at the beginning.

The display area can be scrolled with the vertical cursor keys (^ key up and v key down). On HP-9000 computers, the HIL rotary knob and the HIL mouse can also be used. This scrolling function is blocked in some menus, the menu selection bar is moved vertically instead

At the level of the function keys, their assignment is displayed by the program. Certain system assigned functions are replaced by specific functions by the MESSZEIT and HPGRAFIK programs. In Fig. 1 the f1, f2 and f3 keys are programmed with the "EDIT", "CONTINUE" and "RUN" system functions while the f4 and f5 key trigger the start of the HPGRAFIK and MESSZEIT programs. With f6 and f7 two different disk drives are selected here, and with f8 you access the root of the file system. The default assignment before starting the program is stored in the SYSKEY file, which can be edited (see 4.5.).

With the "Menu" and "System / User" buttons on HP-9000 computers or with the f10 key (or f12 depending on the HTB version) on the PC keyboard, another assignment of the function keys can be called.

If the program stops due to an error (correctable) (see the error / status message line), once the error has been corrected (e.g. when restarting a measuring device), this can be restarted with the "CONTINUE" key. If the error cannot be corrected, the program can be restarted by pressing the "RUN" key. The program with almost all the parameters then remains in the working memory. Even if this does not lead to success, (for example, if the peripheral control

routines do not exist), you can use the RESET function on the HP-9000 keyboard or the RESET button on the toolbar of the window. HTB then "RUN" to restart. In this case also, the program and the parameters remain in the working memory.

3.2. Program start, start menu

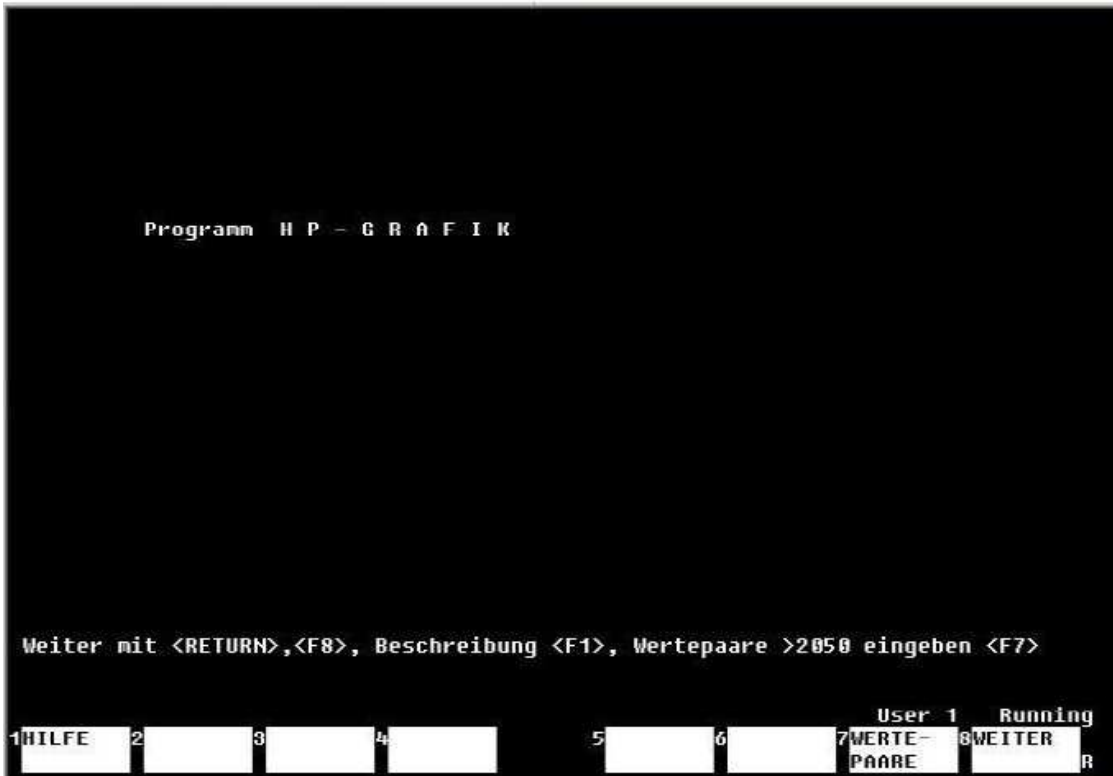


Fig.2.: HPGRAFIK program start menu

The HPGRAFIK program is standard (if no other location has been selected) in the / MESSPROGRAMME <: mass storage identifier> (for HP-9000 computers) or <drive:> \ MESSPROGRAMME (for PC) folder with all the saved subfolders for the MESSZEIT / HPGRAFIK subroutines.

The call to HPGRAFIK is linked by default to the function key f4 of the user interface (see Figure 1). The program is started by pressing this function key. Alternatively, the program can be called by the following command lines:

Either:

```
LOAD "/ MESSPROGRAMME / HPGRAFIK", 1 <RETURN>
```

or

```
LOAD "/ MESSPROGRAMME / HPGRAFIK: REMOTE 21.0", 1 <RETURN>
```

or

```
LOAD "/ MESSPROGRAMME / HPGRAFIK:, 1400.0", 1 <RETURN>
```

for HP-9000 computers,

```
LOAD "\ MESSPROGRAMME\HPGRAFIK ", 1 <RETURN>
```

or

```
LOAD "c: \ MESSPROGRAMME\HPGRAFIK ", 1 <RETURN>
```

for PC with HTB. Under HTB, a normal or backslash can be used interchangeably.

The saved measurement files can contain 2050 pairs of default values. If a higher number of pairs is desired and if the available RAM is sufficient, this value can be increased by entering a higher number using the f7 key (see Figure 2). A higher default value can be entered in the AUTOST program.

3.3. Selection menus

Selection menus appear at many points during the execution of the program. Their selection is made by a highlighted area to complete or inquire.

3.3.1 Selection menu at full screen width



Fig.3.: Selection menu at full screen width

In the print area, the selected menu line is highlighted. The vertical cursor is used to select a menu line (in the case of HP-9000 computers also with the rotary button or the mouse). The selected line is activated by pressing the <RETURN> key or the f8 (OK) key. Alternatively, a menu line number can be written in the entry line and activated by <RETURN> or f8.

By selecting line (0) you return to the previous menu. The function key f6 (ABBRUCH = ESCAPE) has the same function. With the function key f1 (HILFE = HELP) a help text can be displayed in many cases, giving a detailed explanation. The help text is left with the function key f8 (END). If the text is longer than a screen page, you can scroll it using the vertical cursor keys (also with the rotary knob or the mouse on HP-9000 computers).

3.3.2 Multi-columns selection menu



Fig.4.: Multi-columns selection menu

In the case of the display of texts on several columns, an individual selection at the level of each column can be carried out. The selection can be made with the horizontal and vertical cursor keys (in the case of HP-9000 with the rotary button or the mouse). The selection is confirmed by the <RETURN> or f8 (OK) key.

This form of the menu is used, among other things, to select files and folders (see 3.7).

3.4. Change menu / input menu

Another type of menu, the input menu, is also frequently used during program execution. It allows you to enter text in the selected menu line, outside of an entry in the screen entry line.

3.4.1. Entry menu with full screen width



Fig.5.: Entry menu with full screen width

In this type of menu, individual lines consist of a line number and a description on the left margin and their content. If this menu has several lines, you can move from line to line with the vertical cursor keys, the highlighting indicating the cursor position. In the highlighted area text can be written directly or changed. Fig. 5. provides an example of entering a mass storage path on an HP-9000 computer. Under HTB, which uses the same menu, in this example the first line is left blank and the storage path is detailed at the level of the second line. The recording must be confirmed with the function key f8 (OK) (but not with a <RETURN>!). The entry can be canceled with the f6 key (ABBRUCH = CANCEL).

The f1 key (HILFE = HELP) calls up another menu which displays the sub-folders for this path. Selecting one of the subfolders allows you to enter it as a mass storage path.

3.4.2. Input menu with small input fields



Fig.6.: Input menu with small input fields

As shown in Figure 6, menus are often used with reduced input fields (on the right of the screen and generally 10 characters up to half the width of the screen). The cursor position is identified by a highlighted field and movement among the fields is carried out by the vertical cursor keys. The <RETURN> key moves the cursor position one position down. Usually at the level of a highlighted field, the entry is based on a list of standardized texts. In this case you can use the function keys f2 (WAHL = SELECTION <-) or f3 (SELECTION ->) to call them one after the other. In addition, the f1 (HELP) key calls up the list of possible entries and one of the texts can be selected there.

There are also input menus with several fields side by side on a line. The horizontal movement to the right from one field to another in the line is done with the <TAB> key or to the left with <SHIFT> <TAB>.

The entry is saved by pressing the f8 key (OK). The f6 key (ABBRUCH = CANCEL) on the other hand exits the menu without saving the texts entered. The old values are then retained.

3.5 Single line entry screen

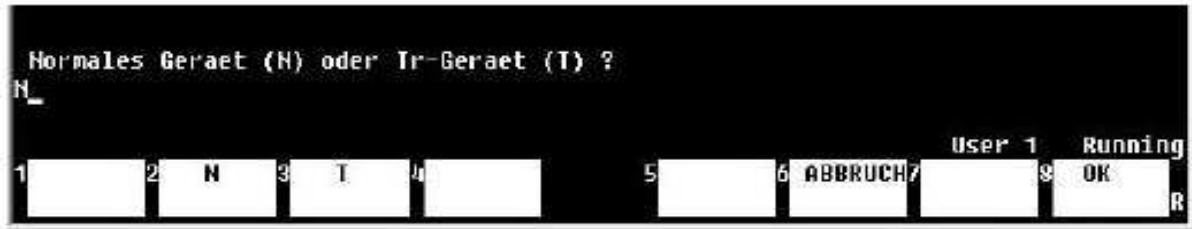


Fig.7.: Single line input area screen

Another input area is also located at the bottom of the 22 lines of the display area. Entry in this area is often associated with a certain number of function keys defined by the program. A text can optionally be entered there. The entries can be combined. The <RETURN> key or the f8 (OK) function key validate the entry. Pressing one of the associated function keys also validates the entry.

This input area is often combined with text (not editable) in the display area, the content of which can be scrolled up and down with the vertical cursor keys if necessary.

3.6 Editor screen

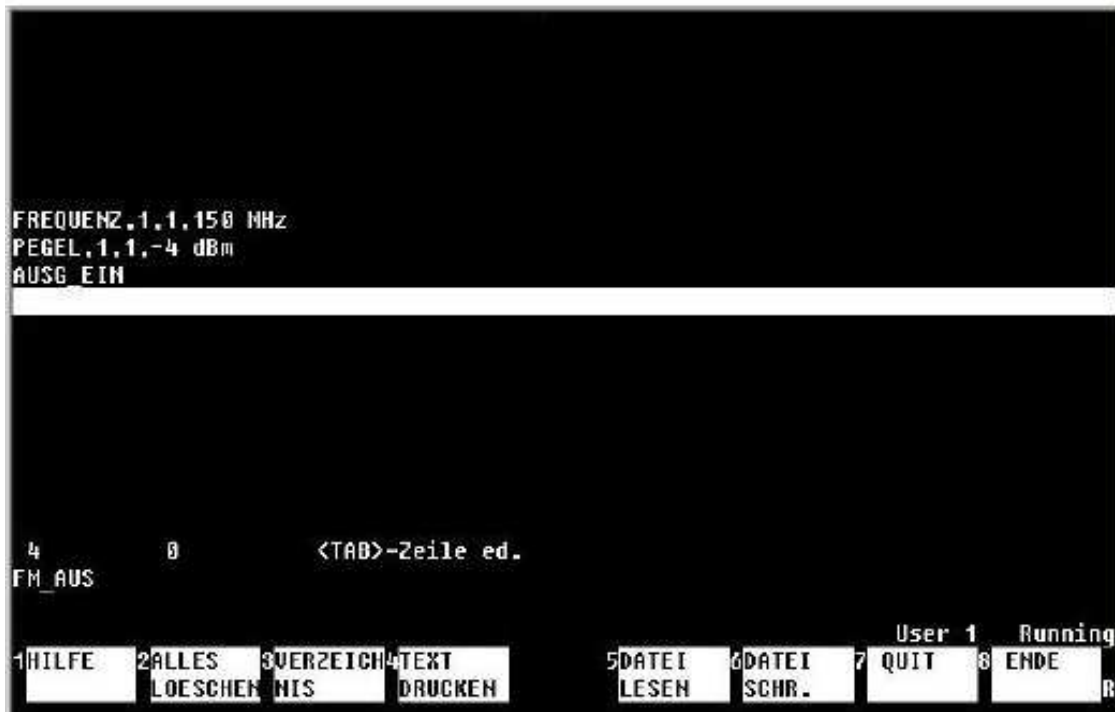


Fig.8.: Editor screen

The editor screen allows you to enter, edit or save text on multiple lines. The text entry area is the one identified by a highlighted area which is saved after a <RETURN>. The highlighted area then moves down one line.

To modify the lines that have already been entered, you can select one of the lines by navigating the text up and down using the vertical cursor keys. The line to be changed should be highlighted. With the <TAB> key (for an HP-9000 with HIL keyboard <TAB> or <SELECT>, with Nimitz keyboard <SHIFT> <EXECUTE>) this line is copied into the input line and can be edited or can be rewritten. With a <RETURN>, it is then returned to the area where it had been copied.

With the function key f8 (ENDE = END), the editor text is saved and the edit mode is closed. To finish without transmitting or modifying the existing text, press the f7 (QUIT) key.

In edit mode and in the text field, with the <Insert line> (HP-9000) or <SHIFT> <Insert> (PC) key a new line above the highlighted line can be inserted and with the key <Delete line> (HP-9000) or <SHIFT> <suppr> (PC) the highlighted line is deleted.

Via f5 (DATEI LESEN = FILE READING) an ASCII file can be loaded in the text area and with f6 (DATEI SCHR. = SAVE) a text can be saved in a file in ASCII format. f1 (HILFE = HELP) displays a short help text, f2 (ALLES LOESCHEN = DELETE ALL) deletes all the text, f3 (VERZEICHNIS = DIRECTORY) displays the storage path, and with f4 (TEXT DRUCKEN = TEXT PRINT) the text is printed.

The editor screen appears for a certain number of tables in MESSZEIT and HPGRAPHIK, for example to enter measurement times, command tables, pairs of values for graphical representations.

3.7. Upload and save files

3.7.1. Upload files

If a new file has to be loaded, the request is presented according to Fig. 9 below. With the response "JA = YES" (key f7) or J in the entry line followed by a <RETURN> or OK <key f8> the loading is carried out. With the answer "NEIN = NO" (key f6) or N in the entry line followed by <RETURN> or the key <f8> the file previously loaded remains in the working memory.



Fig.9.: File upload request



inhalts-verzeichnis = table of contents
verzeichnis-wechsel = change of directory

Fig.10.: Continuation of the request to load a file

The loading request continues in accordance with Fig. 10. With the key "ABBRUCH = ESCAPE <f6>" or with a <RETURN> (because N = nein is displayed by default), you can return to the previous request. You can now choose between two selection methods, the classic one by entering the file name or via a file selection menu with the key (MENUE <f7>).

Case of the classic selection method:

With J in the entry line followed by <RETURN>, the table of contents of the current folder appears in the display area, and with N <RETURN> there is not this display. In both cases, the file type is then requested (see 4.1), namely DAT, ASC, DUX then the file number. The selection can always be canceled by entering -1 as the file number.

According to figure 10, the current folder can be modified with the WECHSEL = CHANGE <f5> key or with W <RETURN>. A two-line entry menu in accordance with § 3.4.1 displays the current path (Fig.11. For RMB and Fig.12. For HTB)



Fig.11.: Mass storage path for HP-9000 (RMB) computers

The name of the current folder can be changed with the keyboard. In the HTB version only the second line can contain text. When this second line is selected, you can use the HELP key <f1> to open a selection menu, which shows the files and sub-folders (see figure 13). The current folder is confirmed with OK <f8> and with ABBRUCH=CANCEL <f6> there is no modification of the current folder.

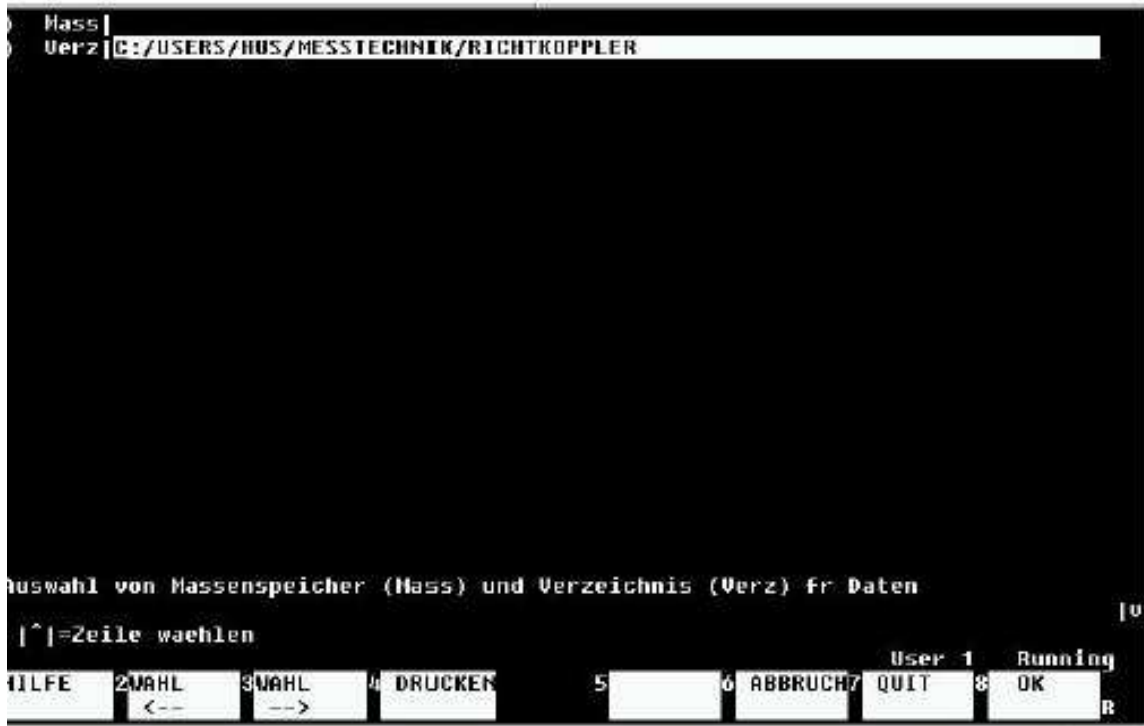


Fig.12.: Mass storage path for PCs with HTB

File selection menu after pressing the f1 key:

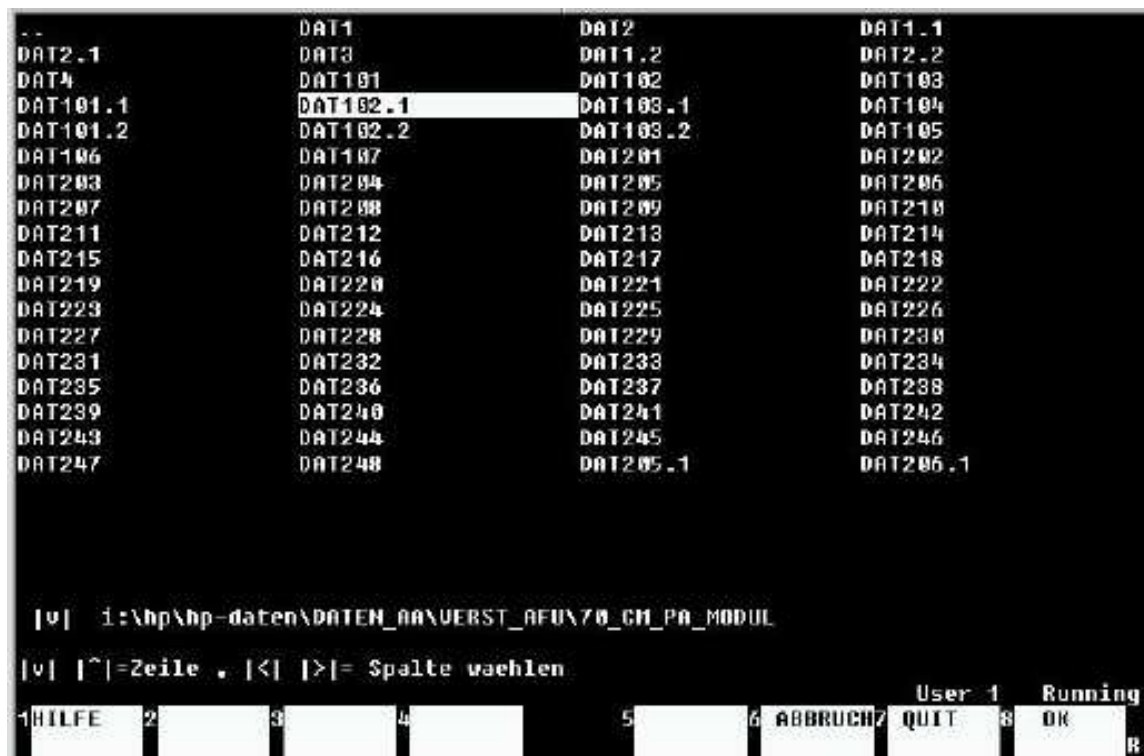


Fig.13.: File selection menu

Case of the 2nd selection method

In the menu of figure 10, use the MENU <f7> or M <RETURN> key to select the second selection method. A multi-row and multi-column selection menu then appears, which shows the elements of the current folder (files and sub-folders). The ".." symbol in the upper left corner allows you to return to a parent folder. An item with a slash indicates a sub-folder that you can open after selection. Moving in the rows and columns of the elements is done using the vertical and horizontal movement keys. A selection is made with <RETURN> or OK <f8>.

If the highlighted segment designates a standard file (consisting of the prefix DAT, ASC or DUX and followed by a number, see chapter 4), the description of the file header can be displayed by pressing the key <f1> (HELP). Press <f1> (ZURUCK = BACK) again to return to the upper level of the tree structure, and with <f8> (LADEN = CHARGER) the selection data can be loaded.

The full path to the current folder is displayed in the display line. If the number of elements in the current folder exceeds the screen display capacity, this is indicated in the display line by the symbol | v | and / or | ^ |. In this case, the "Bild v (next page)" or "Bild ^ (Previous page)" keys can be used to display the next or previous screen page.

Beware !!

Unlike HP-9000 computers, on PCs with HTB the symbol ".." allows you to return only to the folder selected at the start of the program. If necessary, the start-up folder can be defined in the "Umgebung = Environment" menu. In addition, the functions of the "Bild v (next page)" or "Bild ^ (previous page)" keys are reversed under HTB. In some cases, a folder will appear empty even if there is content. By pressing the "Bild v (next page)" or "Bild ^ (previous page)" buttons again, the correct display can be obtained.

3.7.2. Loading non standard files

ASCII files corresponding to measurement data can also be loaded without corresponding to the formats described in 4.1 and 4.2. For this, additional information on these files must be available, such as decimal separator, single line data separators, end of line characters, number of columns and lines.



Fig.14.: Settings menu for non-standard files

So after selecting the "IMP" file (for IMPort) and confirming, then the full file name is entered in the next step. The non-standard file is simply selected from the menu selection. A specific menu then appears (see Fig. 14), in which additional information concerning the file must be entered. Then the pairs of values or sets of values are loaded into memory.

3.7.3. Save files

The measurement files are saved in the same way as when loading standard files.



Fig.15.: Request to save a file

ergebnis der bearbeitung abspeichern (J / N) = record the result of the treatment (J / N)



Fig.16.: Continuation of the request to save a file

Between a request to display the table of contents (Inhalts-verzeichnis = Table of contents) (J / N), a change (WECHSEL = CHANGE), cancellation of the registration (ABBRUCH = CANCEL) and the display of the menu (MENU), the function NEUES VERZEICH = NEW DIRECTORY <via f4> are also possible. The current storage path is then displayed, and a new folder can be added to this path by a keyboard input. Only one folder can be added at a time, and if several folders are to be created one after the other, the NEUES VERZEICH = NEW DIRECTORY function must be repeated.

If the MENUE function is selected, the full name of the file must be entered using the keyboard, for example DAT27 or ASC333 and without separation between the type and the file number.

In the MESSZEIT and HPGRAFIK programs, it is generally not allowed to replace existing file names with new files. This is useful to avoid losing measurement results. If files are

modified according to 5.4 or 5.5 and the results must be saved in the same folder, it is practical to add a numeric extension separated by a dot to the name of the file:

eg. Original file: DAT25 File after saving: DAT25.1

In this way, the link between the files is directly visible.

4. File types, file formats

4.1. File types, file names

Because of the large potential number of measurement files, it is not useful to give the files explicit names. For this, MESSZEIT and HPGRAFIK use a name format, which consists of a prefix with three capital letters followed by a decimal number (with or without periods). After a dot, as with other files on PC, there is no use of letters. For example:

DAT17 ASC23.1 DUX4.129

The measurement results can be saved in MESSZEIT and HPGRAFIK in three file formats. The standard format on HP-9000 computers is the binary format (BDAT) with the prefix DAT. For these computers, it is much more compact on storage devices than other formats and is written and read much faster. On the other hand with PCs with HTB, these advantages are not as significant due to the available size of the hard disks and a higher computing speed. If there is no format specified, the programs use the default DAT format.

The second format is the ASCII file with the prefix ASC. It has the advantage of being read directly with any text editor and is better suited for exchanging data between other systems and programs.

The third format is the HP-UX-ASCII file with the prefix DUX. It differs from the ASCII file according to the UNIX standard, in which there is only one "LF", instead of a "CR-LF" at the end of the line. It can be used with HP-UX / RMB systems.

When saving or loading a file, the standard format displayed is the one specified in the configuration file (see CONF_LISTE at § 4.4), if the DAT format is not specified. The format can be changed each time by a different format.

4.2. INT standard file

In order to be able to display the content and meaning of a file at any time, each measurement file consists of a header with metadata in addition to the measurement values. These include the creation date, two lines of text, 16 numeric constants and 10 text constants, some of which have fixed meanings and some of which are available for certain measurement applications or are freely available, as well as two numbers to indicate the number of columns and rows in the measurement data field.

Table 1: INT standard file

Definition of the standard INT file in ASCII format:

All lines have a maximum length of 80 characters

Separator <Trenn> between numeric values on a line = "," (comma),

End of line character = CR LF

The file includes :

a file header (1st - 31st line) with a fixed number of lines and a data field on the 32nd line, the size of which is indicated on the 5th line (number of columns, lines).

For example:

1st line	File name	<prefix> <decimal number>	ASC27.1
2nd line	Description (1)	ASCII-Char	
3rd line	Description (2)	ASCII-Char	
4th line	Date	ASCII-Char	17.01.2001
5th line	Columns, rows of data	<Num>, <Num>	3, 81
6th line - 21st line	16 lines each with a number	<decimal number>	9.58123
22nd line to 31st line	10 lines of ASCII characters [40]		f [MHz] A [dB]
32nd data line		<Dez>, <Dez> [, <Dez>]	0.00, 1.25, -28.1
End	2 to 5 columns separated by a comma		1.00, 1.27, -13.22

The texts of lines 22 to 31 have a predefined meaning in the INT programs of HPGRAFIK and MESSZEIT:

Line 23 : X axis label	(1st column)	f [MHz]
Line 24 : Y axis label	(2nd column)	A [dB]

Line 25 : 2nd Y axis label (3rd column) Phi [degrees]
 Line 26: 3rd Y axis label (4th column)
 etc.

In the context of user-specific applications, all numeric and text header variables can have specific meanings.

4.3 Measuring applications

For certain measurement applications, numerical and text constants in the header of the standard file can receive fixed values or values entered via a menu. Before starting a measurement, the type of measurement application (number > 0) is requested. In this case, each time a measurement is saved, a specific input menu is displayed, in which additional information on the measurement can be entered. These are saved in the file header and are also displayed as a menu when reading a file with HPGRAFIK

As an example, Table 2 shows the assignments for the measurement application 4.

Table 2:

INT standard file

=====

Assigning text in the line header for application 4
 "Simulation with NEMP model sweep measurement"

Num_var (0)	
Num_var (1)	
Num_var (2)	Probe area [m ^ 2]
Num_var (3)	Attenuator [dB]
Num_var (4)	length from conductor to probe [m]
Num_var (5)	Probe resistance [ohm]
Num_var (6)	level [dBm]
Num_var (7)	start frequency [MHz]
Num_var (8)	stop frequency [MHz]
Num_var (9)	LIN: wobulation step [MHz]; LOG: - number of points (negative value)
Num_var (10)	Conversion factor: measurement of resistance [Ohm] or of conversion factor [S]
Num_var (11)	
Num_var (12)	
Num_var (13)	Type of measurement (for this application = 4)
Num_var (14)	num. of the measuring device.
Num_var (15)	num. of the measurement channel

String_var \$ (0)
 String_var \$ (1) Dimension of the X axis
 String_var \$ (2) Dimension of axis Y (1), amplitude
 String_var \$ (3) Dimension of axis Y (2), phase
 String_var \$ (4)
 String_var \$ (5)
 String_var \$ (6) Dimension conversion factor:
 String_var \$ (7) Type of the measuring probe
 ('R', 'W' = resistance | 'T', 'S' = power transformer | 'D' = diff. probe >)
 String_var \$ (8) Object to be measured
 String_var \$ (9)

The available measurement applications and their assignments are listed in the appendix in the standard file. Additional measurement applications can be written by the user as subroutines and saved in the / MESSPROGRAMME / SUB_PROGRAMME folder (see below).

In addition, the following headers are common in MESSZEIT files:

Num_var (12) [for time measurements with File selection (eg oscilloscope): hour value]
 [for parameter measurements with complete reading of Files (eg.
 oscilloscope): value of the parameter]
 Num_var (13) Type of measure (application number)
 Num_var (14) num. of the measuring device
 Num_var (15) number of the measurement channel

Configuration list: CONF_LISTE file

Table 3: List of CONF_LISTE file configurations for HP-9000 / RMB

```
! Fichier de configuration CONF_LISTE
! -----
! Utilisateur: RMB (date): 2000-12-01
! -----
! All lines starting with '!' are considered lines of
! comments and are therefore not executed
! -----
!
Vorname$=DAT
!Vorname$=ASC
!
! Lin_typ=1
! Stiff=1
! Plotter=0
! Gittertyp$=GITTER
! Frag_gitter$=AUTO
! Gxtyp$=LIN
! Gytyp$=LIN
! Gxlabel$=X
! Gylabel$=Y
! Gxmin=0
! Gxmax=0
! Gymin=0
! Gymax=0
! G_besch$=Text
! G_besch2$=Text2
!
! Besch$=Text
! Besch2$=Text2
!
! V24_adr=9
! V24_baudrate=9600
! Dcomm_adr=20
! Dcomm_baudrate=9600
!
Drucker=10
Druckertyp_$=1
! Drucker_dir$=/SRM_LASER
! Druckerdatei$=DRUCK
! Drucker_msi$=:REMOTE 21,2
!
! Disk=0
! Disk2=0
Datendir$=C:\USERS
Datendisk$=
Datendir2$=C:\USERS
Datendisk2$=
!
Up_pfad$=C:\MESSPROGRAMME\SPEZIALPROG
Up_msi$=
!
Fkt_pfad$=C:\MESSPROGRAMME\FUNKTION
Fkt_msi$=
!
Sub_pfad$=C:\MESSPROGRAMME\SUB_PROGRAMME
Sub_msi$=
!
Mess_pfad$=C:\MESSPROGRAMME
Mess_msi$=
```

Tableau 4: List of configurations in the CONF_LISTE file for PCs with HTB

```
! Fichier de configuration CONF_LISTE
! -----
! Utilisateur: PC1   (date): 2010-12-01
! -----
! All lines starting with '!' are considered lines of
!
! comments and are therefore not executed
! -----
!
! Vorname$=DAT
Vorname$=ASC
!
! Lin_typ=1
! Stiff=1
! Plotter=0
! Gittertyp$=GITTER
! Frag_gitter$=AUTO
! Gxtyp$=LIN
! Gytyp$=LIN
! Gxlabel$=X
! Gylabel$=Y
! Gxmin=0
! Gxmax=0
! Gymin=0
! Gymax=0
! G_besch$=Text
! G_besch2$=Text2
!
! Besch$=Text
! Besch2$=Text2
!
! V24_adr=9
! V24_baudrate=9600
! Dcomm_adr=20
! Dcomm_baudrate=9600
!
Drucker=10
Druckertyp_$=1
! Drucker_dir$=/SRM_LASER
! Druckerdatei$=DRUCK
! Drucker_msi$=:REMOTE 21,2
!
! Disk=0
! Disk2=0
Datendir$=C:\USERS
Datendisk$=
Datendir2$=C:\USERS
Datendisk2$=
!
Up_pfad$=C:\MESSPROGRAMME\SPEZIALPROG
Up_msi$=
!
Fkt_pfad$=C:\MESSPROGRAMME\FUNKTION
Fkt_msi$=
!
Sub_pfad$=C:\MESSPROGRAMME\SUB_PROGRAMME
Sub_msi$=
!
Mess_pfad$=C:\MESSPROGRAMME
Mess_msi$=
```

The configuration list of the file CONF_LISTE is used to define non-standard parameters in MESSZEIT and HPGRAPHIC when the program starts.

The CONF_LISTE file, in ASCII format, can be opened with a text editor (for HP-9000 computers, eg with the HPGRAFIK editor, according to paragraph 5.10) and can be modified there. By default, all lines of CONF_LISTE beginning with an exclamation point are comment lines and are therefore not executed. To execute them, the exclamation mark must be deleted and, if necessary, insert the desired parameter after the "=" sign.

In the first section, ASC instead of DAT can be predefined as the standard file type for storing measurements.

In the second section, different graphic parameters can be predefined, which then appear in the graphic menu.

In the third section, a fixed file description text can be predefined, which can always be modified before saving the file.

In the fourth and fifth sections, the interface parameters and the printer parameters can be defined.

The other lines are used to define paths for storing measurement files and paths for program and subroutine files. On HP-9000 computers with RMB, the path and the drive must be specified on separate lines, on PCs, the path is specified in the line identified by " Verz " with the letter of the selected drive, the line MSI remains empty or is commented out.

On HP-9000 computers running HP-BASIC-WS, the CONF_LISTE file is located by default in the / WORKSTATIONS folder, under HP-UX / RMB-UX in the / users / xxx folder. On PCs with HTB, CONF_LISTE should, if possible, be in the HTB program folder.

4.5. SYSKEY file for assignment of function keys

The assignment of the function keys is generally changed in the MESSZEIT / HPGRAFIK environment so that the program can be started via a function key. This assignment is stored in the binary file (BDAT) of SYSKEY, which is loaded by the AUTOST program. For this purpose, it must be located as the CONF_LISTE file for HP-9000 / RMB in the / WORKSTATIONS folder, under HP-UX / RMB-UX in / users / xxx and on PCs with HTB in the HTB program folder. The (re-)allocation can be done via EDIT <function key> followed

by a <RETURN>; Text input followed by a <RETURN> and saved again via (RE-)STORE KEY SYSKEY.

This assignment has nothing to do with the function key assignments that appear with a switching or selection menu.

5. Evaluation of stored data (HPGRAPHIK)

5.1. Basic introductory remarks

The HPGRAPHIK program offers the following features:

- Graphic display of already recorded measurements
- Printing graphics
- Modification of measurement files
 - Add, subtract, multiply files
 - smoothing, curve adjustment, integration,
 - conversions, for example dB -> SWR, dBm-> W
 - Link, attach files
 - subsequent edition

- Entering pairs of values / sets of values via the keyboard
- Entry of pairs of values using a digitizing tablet
- Calculation of function values and saving in a file
- Calculation of data files with existing or user-developed subroutines

Graphic representations can also be saved as an HPGL file or in typical PC graphic formats so that they can be integrated into text documents.



Fig.17.: HPGRAFIK main menu

The menu option (1) (Auslese von transientenrecorder-messungen = Reading transient recorder measurements) is only available for backward compatibility reasons. It is used to read files from an old measurement program.

5.2. Program configuration (menu option 2)

Here, the reading and recording folders of the measurement files can be entered and the printers selected.

Unlike the MESSZEIT program, the HPGRAFIK program for reading and saving files uses separate paths. This has the advantage that when evaluating large quantities of measurement results and saving the results, the records do not have to be changed constantly.

The selection of option 2 in menu of figure 17, leads to the menu of figure 18.

5.2.1. Mass storage and table of contents (reading)

The path entered in the CONF_LISTE configuration file for read operations or the path requested at the start of the program is specified here and can be edited (Option 1 in menu).

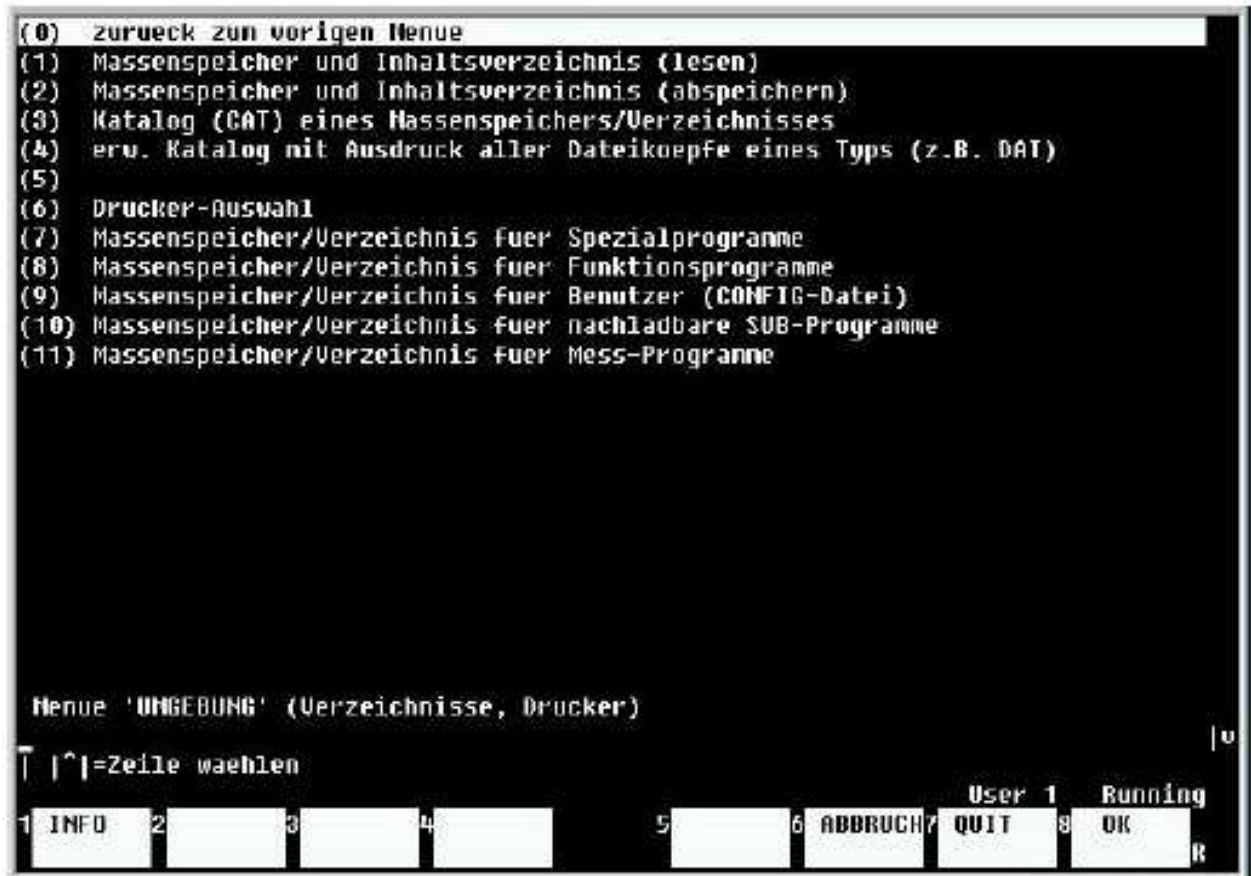


Fig.18.: Menu following the selection of option 2 in main menu (fig 17 =UMGEBUNG)

5.2.2. Mass storage and table of contents (recording)

This option (Option 2 in menu) is used to save files following operations such as conversion, manipulation, new entry, calculation of function values. The path indicated in the CONF_LISTE file for memory operations or the path indicated at the beginning of the program section can be edited here. In many cases, it is identical to the read path.

5.2.3. Option 3-menu figure 18 : Catalog of a storage / directory

A display of the folder structure in the form of a menu can be called here, regardless of the paths selected in (1) and (2). In this way, files can be searched independently of the read and write operations. The file header with description of standard files can also be displayed here, but no files can be loaded.

5.2.4. Option 4 - Menu figure 18 : Extensive catalog with printing of all file headers of a single type

This option prints the description (file header) of all the files in a folder. The folder used here can be selected in a file selection menu (see 3.3.2.). Printing is done either on the screen or the printer or in an ASCII text file in the same folder. The name of this file is predefined on "Catalog_" with a sequential number. This way you can quickly create an overview of the measurements in a folder.

5.2.5. Option 6 - Menu figure 18 : Selecting the printer

This option is used to select the printer for printing graphics and tables. In most cases, this is already predefined in the CONF_LISTE file. Otherwise, the standard printer is displayed under option 1. A selection of printers is very different between HP-9000 computers and PCs with HTB and Windows. In the first case, the printer is directly addressed by the computer, while in a Windows environment, print jobs are generally executed via the management of Windows printers.

The following options are available for HP-9000 computers:

- (1) Local standard printer with HPIB 701 address (Thinkjet, Quietjet, old thermal printers and dot-matrix printers,
- (2) local Deskjet printer with HPIB 701 address or with HPIB / parallel converter and the address of converter 701,
- (3) local laser printer with serial interface (ISC = 9),
- (4) printers accessible via an SRM network,
- (5) laser printers accessible via an SRM network,
- (6) manual entry of the HPIB address for (1) and (2),
- (7) Printing in a network file or on printers connected via a TCP / IP network,
- (8) local color printer with parallel interface.

Only the following items are offered on PCs with HTB and Windows:

- (1) Default local printer (Windows printer)

The printer defined in the menu can be connected locally or to a network.

In newer HTB versions (9, 10), one of the Windows printers can be selected from a printer configuration menu in the HTB environment, regardless of other computer settings.

5.2.6. Paths for subroutines

Option 7 - menu figure 18 : Mass storage and directory for special programs

By default, this storage is identified under the directory / MESSPROGRAMME / SPEZIALPROG. It can however be modified by a specific entry in the CONF_LISTE file or by modifying this path. The contents of this folder with its subfolders contains, for example, conversion programs for files and special physical calculation programs with inputs and outputs via standard files. The specifically developed or modified subroutines can be kept in an alternative path.

Option 8 - Menu figure 18 : Mass storage / directory for function programs

In a specific path, programs specifically developed for the calculation of function values can be saved.

Option 9 to 11 - Menu figure 18 : Mass memory / directory for MESSZEIT subroutines

Changes to these paths are only necessary if MESSZEIT has not been installed with the standard folder structure.

5.3. Graphical representation of files (Option 3 - Menu figure 17)

This option is used to display one or more result files, to print the graph (on printer or plotter) or to generate a file in HPGL format (xxx.plt). Several curves can be drawn according to the parameters of the first file and (depending on the equipment associated with the computer), a certain number of colors can also be chosen. The scaling of the X and Y axes can be done automatically or manually, the axis labels can be extracted from the file or entered manually. In addition, line types, symbols at the measurement points and the addition of grid / frame / axes can be selected. In addition to the Cartesian display X-Y, the display in polar coordinates is also possible.

The selection of option 3 leads to the request to load a new file according to the dialog detailed in 3.7.1. After selection, the new file is loaded into main memory. Otherwise, the old file remains in memory and can be displayed and printed again. If you return from Option 4, 5, 8, or 9 of the main menu (Fig.17) to the option 3 all results of manipulation, calculation or input remain in memory and can be displayed without new file loading.

3.7.1 also describes how non-standard ASCII files (eg EXCEL files, CSV files, etc.) can be loaded and displayed graphically. A loaded file is then available for other operations, for example for saving as a standard file.

The phase of selecting or not selecting a file is followed by the menu in Figure 19 in which all the parameters essential to the display can be adjusted:

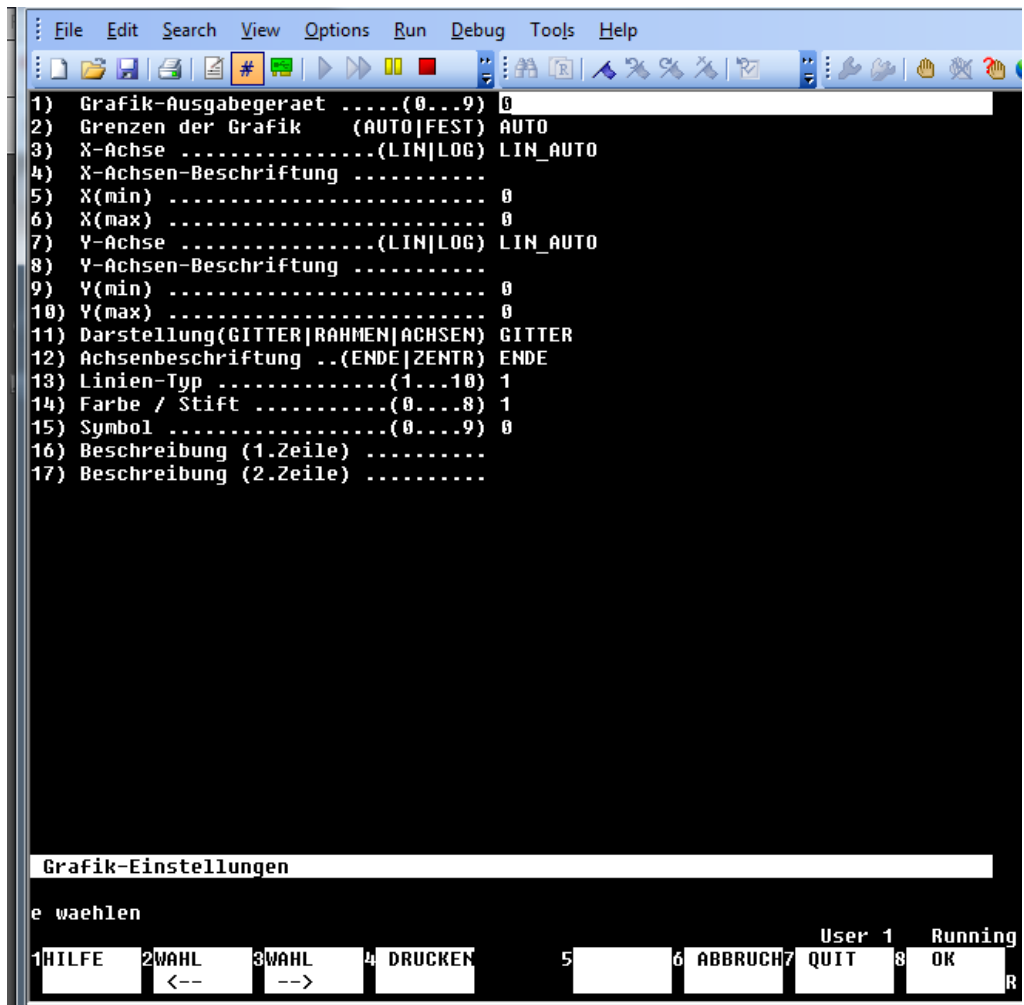


Fig.19.: Graphic settings menu

Option 1 : Graphic output device (Grafik-Ausgabegerät)

The graphic output device can be selected with the <f1> key (HELP) via another menu or entered via the keyboard. The default setting is "0" (monitor / printer). On HP-9000 computers, a second monitor can be selected, as well as a number of local or networked plotters. On PCs with HTB, these 2nd interfaces are generally not available, so output in this case takes place on the screen or on the printer.

With the selection "5" (output to file), the graph can be saved in a file in HPGL format rather than on the screen. This is also possible with several curves that we want to draw one after the other. The HPGL file (file name Abb_xxx.PLT) can be saved and then imported into a text document.

Option 2 : Limits of the graph (Grenzen der Grafik : AUTO | FEST)

With the AUTO choice, the X and Y axes are automatically scaled. If you want to manually set the scale, then select FEST (Manual). The default setting is AUTO. You can choose between the possible settings using the <f2> (WAHL = SELECT ←) and <f3> (WAHL = SELECT →) keys.

Option 3 : Axis X (X-Achse)

If option 2) is manual, then you can change LIN to LIN_AUTO, LOG, LOG_AUTO or POL (via the <f2>, <f3> keys or by manual entry). Fixed or automatic scaling for the X axis is possible here, and X values can also be entered as angles in a polar coordinate display.

Option 4 : X-axis labeling (X-Achsen-Beschriftung)

The X-axis label comes from the header of the loaded file. It can be changed manually (only for graphical display). If an axis label in a file is to be changed permanently, this must be done in the file manipulation menu.

Option 5 : = X (min), option 6) = X (max)

The minimum and maximum X values are determined from the values in the file and displayed accordingly. They can only be changed for display if option 2) is FEST (= manual) and option 3) is LIN or LOG. If these two parameters are set to "0", scaling will be done automatically.

Option 7 : Axis Y (Y-Achse)

If option 2) is FEST (= manual), you can then switch between the parameters LIN, LIN_AUTO, LOG and LOG_AUTO (via the keys <f2>, <f3> or by manual entry). Fixed or automatic scaling for the Y axis is possible here.

Option8), (9), (10) Yaxis labeling, Y (min), Y (max) [Y Achsen beschriftung, Y(min), Y(max)]

As for the X axis, the setting values for the Y axis are extracted from the file.

Option 11 : Representation (GRID | FRAMEWORK | AXIS)

Here, the global display can be switched between a coordinate grid (standard setting), a frame around the graphic area or two axes. The default value can be defined in the CONF_LISTE file. Switching can also be performed with <f2> and <f3>.

Option 12 : Axis labels (END | ZENTR) [Achsen-Beschriftung]

The axis label can be placed either at the end of an axis or in the middle. This option can also be defined in the CONF_LISTE file.

Option 13 : Line type [Linien-Typ]

With this option, a line type can be chosen between two measurement points. In addition to the entry, a selection can be made via <f1> (HELP) which displays the following menu:

- 1 = solid line between value pairs [durchgezogene linie]
- 2 = dot on the value pair [Punkt am wertepaar]
- 3 = long dashed line [weit gepunktete linie]
- 4 = narrow dashed line [eng gepunktete linie]
- 5 = broken line [gestrichelte linie]
- 6 = dash-dotted line [Strich-punktierte linie]
- 7 = broken line with small gaps [weit-eng-gestrichelte linie]
- 8 = double dotted line [strich-doppelpunktierte Linie]
- 9 = line with small end bars [durchgezogene Linie mit kleinen Endbalken]
- 10 = line with large end bars [durchgezogene Linie mit grossen Endbalken]

The different types of lines are only visible if there is a sufficient distance between the measurement points. The setting is meaningless for a few hundred measuring points and "1" must then be entered.

Option 14 : Color / Pen [Farbe / Stifte]

The color of the curve to be plotted can be selected either by a numeric entry or by menu with HELP <f1>.

B/W screen	color screen	Plotter
0 = komplement	(komplement)	
1 = Draw	white	black
2 =	red	red
3 =	yellow	yellow
4 =	green	green
5 =	cyan	violet
6 =	blue	blue
7 =	magenta	aqua
8 =		black (P3)
<0 = delete	(delete)	

The default setting is "1" (white on the black screen, black on the printer or white plotter paper). Colors are based on screen setting options and sometimes different with plotter settings.

Option 15 : Symbol

A symbol can be drawn at each measurement point on the curve, the selection of which is made either by entering a number, or for the menu obtained with the <f1> HELP key.

- 0 = no symbol
- 1 = plus sign (+)
- 2 = cross (X)
- 3 = rectangle
- 4 = rhombus
- 5 = triangle, point upwards
- 6 = triangle, point downwards
- 7 = circle
- 8
- 9 = error bar (only for files with 2 or 3 Y columns)

Here again, a selection other than "0" only makes sense if the measuring points are sufficiently spaced. The selection "(9) error bar" can only be selected if a file contains the necessary information. The vertical size of the error bar is taken over from the 2nd Y column of the file, the positive and negative vertical size of the bar from the 2nd and 3rd Y column.

Options 16) et 17 : Description [Beschreibung]

Two lines of text can be inserted at the bottom of the graph. This is normally not necessary, since the description of the file from its header is also printed during a print request. This may be necessary for plotters to introduce additional labels (for example, color assignment).

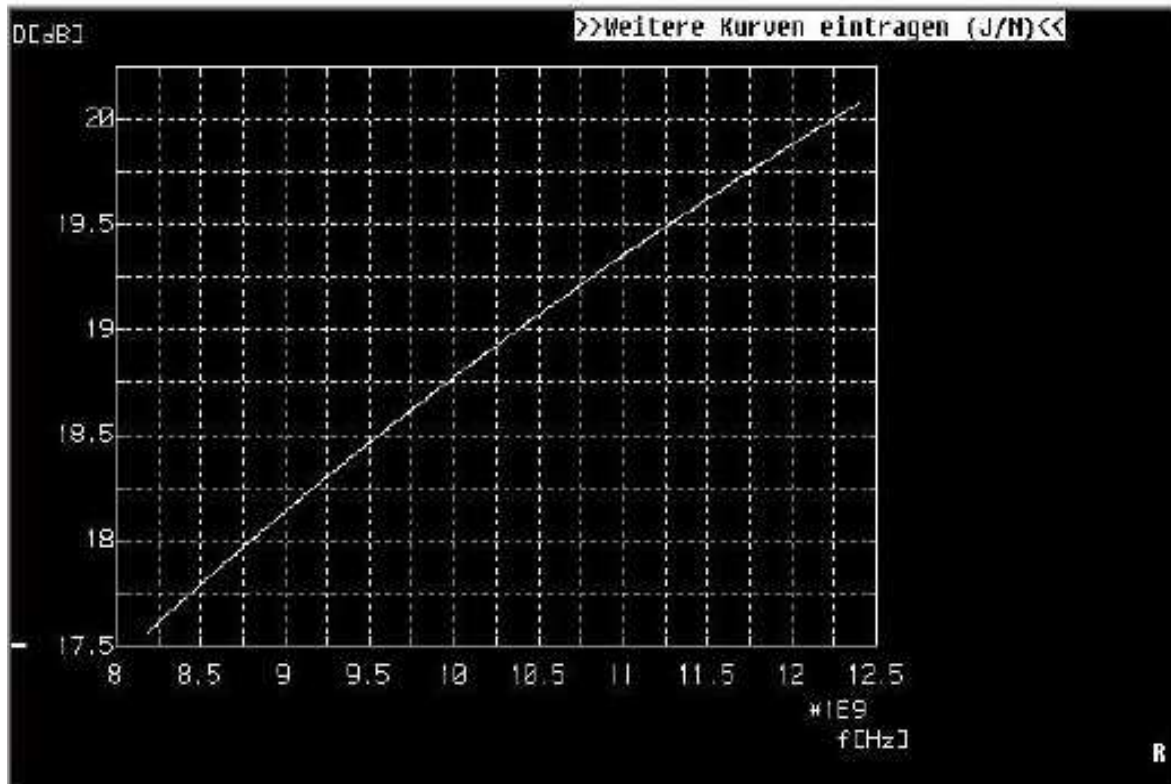


Fig.20.: Graphical representation of a measurement curve

After filling the menu in Figure 19, the curve of the measurement data is displayed on the screen with a grid or a plot made on plotter or saved in a file. To check the graphs, it is recommended to first display it on a screen (option 0), before going to plotter or saving a file without changing the parameters and without reloading.

After viewing the graph, you are prompted to enter another curve (Weitere kurven eintragen = Enter further curves J / N). If the answer is (J), it is then entered in the X and Y limits of the first curve and with its axis labels. You will then be asked to print the graph.

Before the print request, a cursor can be displayed on the screen by entering "C", a cursor which can be moved with the mouse, the rotary button (HP-9000) and the cursor keys. The X and Y coordinates of the cursor position are then displayed at the top of the screen so that the values of a measurement curve can be read quickly.

5.4. File content calculations (manipulation) - (Option 4 – Menu figure 17)

This option "Manipulation von Datei = file manipulation" is used to evaluate, convert and link measurement data, eg:

- Simple arithmetic operations
(Displacement, compression, stretching, logarithm, calculation of absolute values, etc.),
- Link several files (addition, subtraction, Multiplication, division),
- Calculation of means, smoothing, integration, differentiation,
- Adjustment of curves to file values, etc.

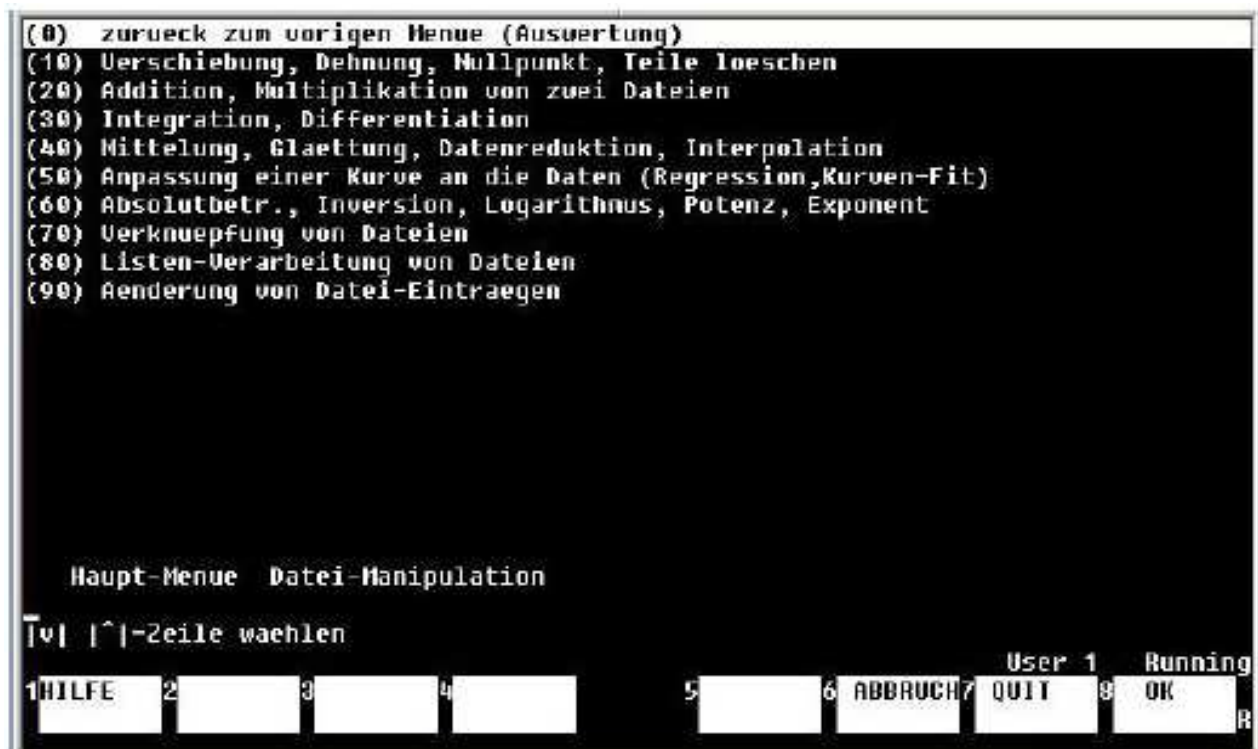


Fig.21.: File manipulation menu (obtained after selecting option 4 from menu 17)

A file that is already in memory does not need to be reloaded and can be processed immediately. Reloading is however possible at any time. Most operations, however, can only be performed with files with two columns of data (one column Y). With multi-column Y files, when loading it will be asked which column Y to use.

Selecting an option in the "Manipulation" menu in Figure 21 leads to a certain number of sub-menus depending on the types of calculation.

In all submenus, a new file can be loaded with <f4> and the result of a modification (on the contents of the current file) can be saved with <f2>. If two files must be linked in a single processing step, the second file can be loaded with <f3> (UNTERGRUND LADEN = LOAD ADDITIONAL FILE). The result of a modification can be checked at any time with <f5> (GRAFIK ZEIGEN = DISPLAY THE RESULT) by a display on the screen.

5.4.1. Option 10 menu figure 21 – Verschiebung, Dehnung, Nullpunkt, Teile Loeschen (Shift, stretch, zero point, delete parts)

Selecting option 10 of menu in Figure 21, leads to the following submenu:

```
(0) zurueck zum vorigen Menue
(1) Addition einer Konstanten zu allen Y-Werten (Y-Verschiebung)
(2) Addition einer Konstanten zu allen X-Werten (X-Verschiebung)
(3) Multiplikation aller Y-Werte mit einer Konstanten (Y-Dehnung/Stauchung)
(4) Multiplikation aller X-Werte mit einer Konstanten (X-Dehnung/Stauchung)
(5) Definieren eines Y-Nullpunkts und entspr.Y-Verschiebung
(6) Definieren eines X-Nullpunkts und X-Verschiebung (nur X>=0 bleiben)
(7) Loeschen des Anfangsbereichs einer Datei
(8) Loeschen des Endbereichs einer Datei
(9) Begrenzen der Y-Werte nach unten (MAX(Y,Ymin))
(9.1) Begrenzen der Y-Werte nach oben (MIN(Y,Ymax))

MENUE      Verschiebung, Dehnung, Nullpunkt, Teile loeschen

|v| |^|-zeile waehlen

1HILFE  2KURUE  3UNTERG_  4DATEI
         ABSP.  LADEN  LADEN
5GRAFIK  6 ABBRUCH7  QUIT  8  OK
         ZEIGEN
```

Fig.22.: Option submenu: Verschiebung, Dehnung, Nullpunkt, Teile Loeschen (= Shift, stretch, zero point, delete parts) – From option 10 of figure 21

The first options (no 1 to 4) in the submenu allow simple conversions on individual files:

Here, all the X or Y values of a file are added or multiplied by a constant entered on the keyboard.

Option 5) Definition of a zero point Y and corresponding offset Y

A new Y zero point can be defined in the range of Y values of a file and all Y values are then recalculated. The new zero point Y can be entered using the keyboard or marked in a graphic representation with the cursor.

Option 6) Definition of a zero point X and an offset X

A new zero point X can be defined in the range of X values of a file and all X values are then recalculated. All new pairs of values with $X < 0$ are deleted. The new zero point X can be entered using the keyboard or marked in a graphic representation with the cursor.

Options 7), (8) Remove start and end areas from a file

All value pairs in a file whose X values are less than or greater than a constant are deleted. The constant X can be entered using the keyboard or marked in a graphic representation with the cursor.

Options 9), (9.1) Limitation of Y values up and down

All Y values in a file are limited up or down with the value of a specified constant.

(9.2) Normalize the minimum Y to a constant ($Y \rightarrow Y - Y_{\min} + \text{constant}$)

(9.3) Normalization of the maximum Y to a constant ($Y \rightarrow Y - Y_{\max} + \text{constant}$)

The minimum (9.2) or maximum (9.3) Y value of a curve is set to a specified "constant" value. All other Y values are shifted accordingly:

$Y \rightarrow Y - Y_{\min} + \text{constant}$ or $Y \rightarrow Y - Y_{\max} + \text{constant}$.

In this way, a curve which deviates from a minimum (Y_{\min}) or maximum (Y_{\max}) value can be displayed.

5.4.2. Addition, multiplication of two files (Option 20 menu of figure 21)



Fig.23.: Sub menu from the selection of option 20 of the menu of figure 21

(Addition, multiplikation von zwei dateien = Addition, multiplication of 2 files)

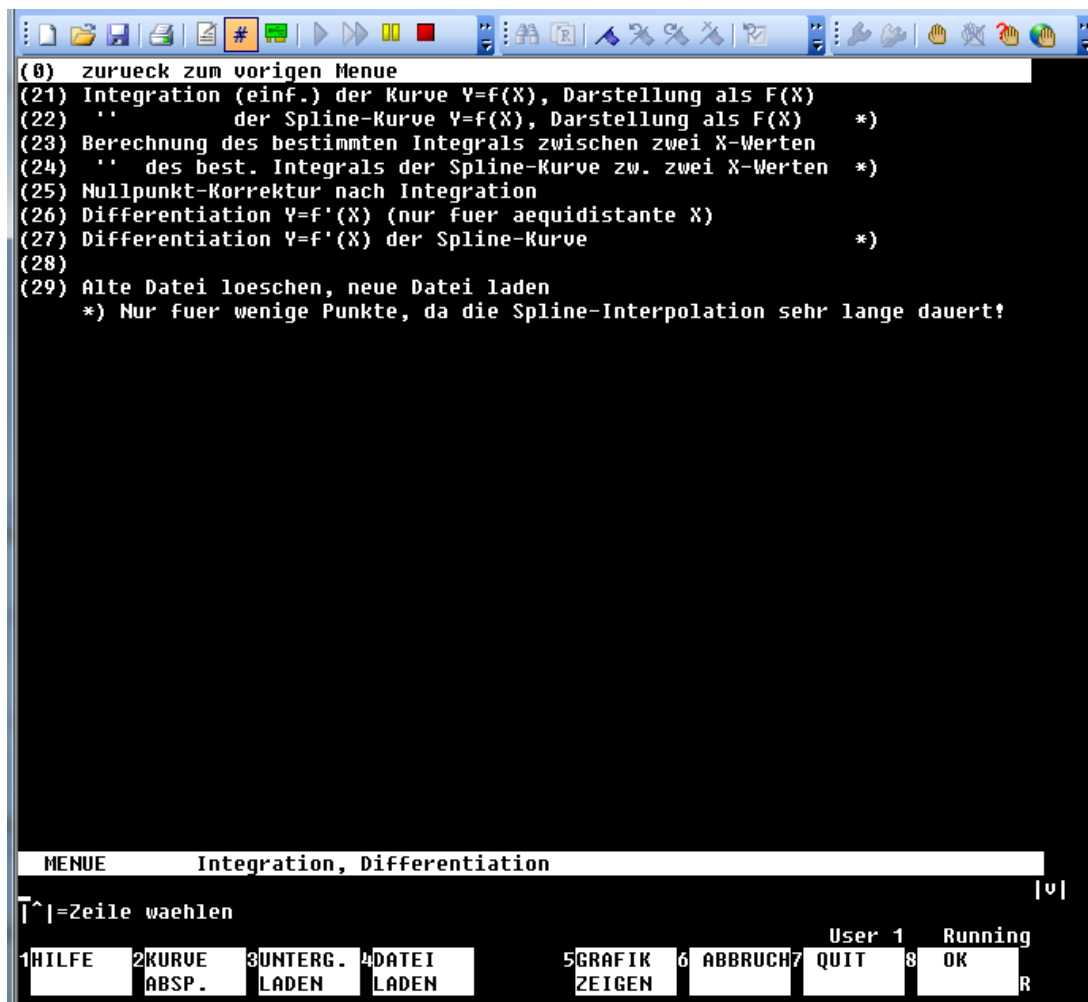
With this option, the Y values of two files can be linked. The first file is the file that is in working memory or a file loaded via <f4>, the second file (background) is loaded in a separate working memory area and loaded with <f3> (UNTERG . LADEN = LOAD THE BACKGROUND FILE). The result of the processing is then located in the working memory and can be checked with <f5> and saved with <f2>. The following operations are possible:

- Current file - background file
- Current file + background file
- Current file / background file
- Current file * background file

The operations are applied to the Y values of the two files for the same X values (not to those with the same line number!). Since in many cases the X points of the two files are not the same, the value pairs of the main file are previously interpolated with the X values of the background file. If the X value ranges of the two files do not overlap, then an error message is issued and the operation is canceled. If the X zones only partially overlap, a warning message is issued due to possibly incorrect interpolation.

5.4.3. Integration, differentiation (Option 30 menu of figure 21)

Selecting this option gives the following menu:



With this option the following calculations can be performed on files:

(21) Integration of the curve $Y = f(X)$ and representation as $Y = F(X)$

(22) Fit a spline type curve to the data and integrate the spline curve.

The spline curve is supposed to produce a "smoother" plot of a curve with few points. However, it is common to observe a form of oscillation, which does not reflect reality. For many points, the computing time is very high, especially on HP-9000 computers.

(23) Calculation of the integral between two X values

The limits of integration can be entered by keyboard or determined in a graph by marking two values with the cursor. The result is displayed on the screen.

(24) Calculation of the integral of a spline curve

The calculation is performed as in (23), the comments concerning the interpolation of a spline also apply here.

(25) Zero point correction after integration

When integrating a curve according to (21), an "error" often results from the fact that the original curve contains a constant part (for example a DC part).

The result then consists of an increasing straight line with integration of the measurement result. This can be corrected by marking a Y value in the graphic display at the end of the curve and by subtracting the straight line from the integration result.

(26) Differentiation of the curve $Y = f(X)$ and representation $Y = f'(X)$

This operation can only be applied to curves with equidistant X values. In case of doubt, the curve can be interpolated beforehand on another curve with equidistant X values (see 5.4.4.).

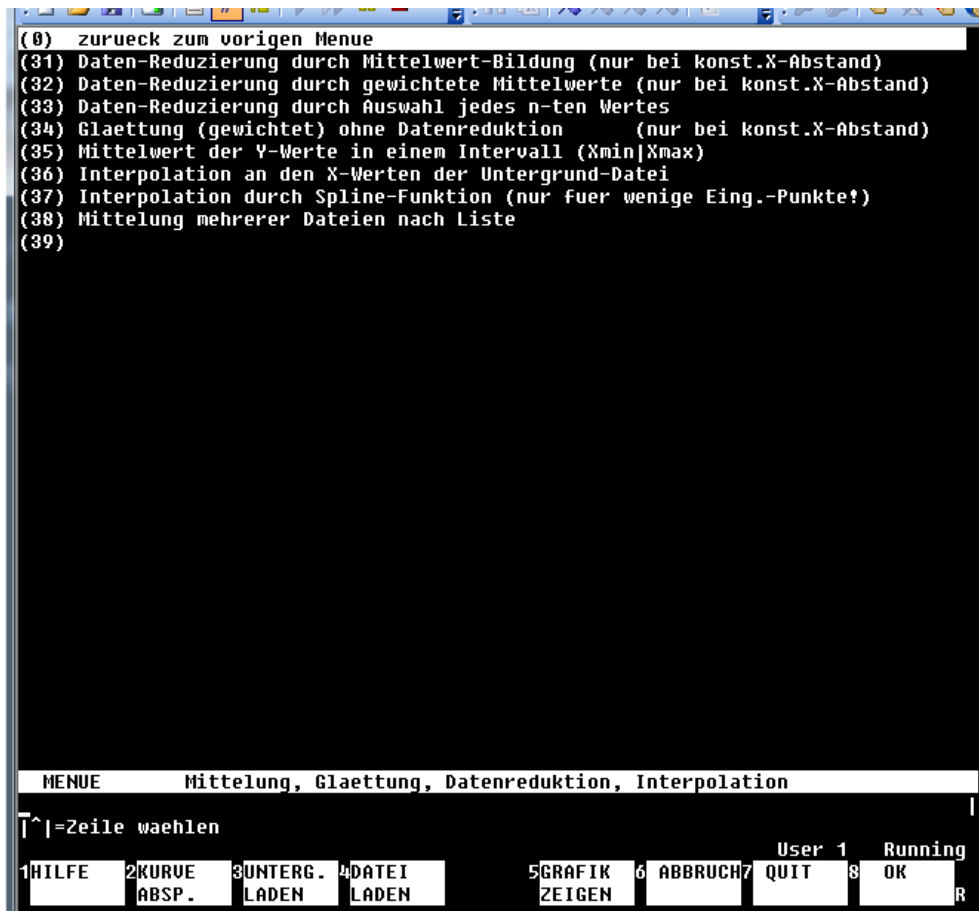
(27) Differentiation of the spline curve $Y = f(X)$

With a few points, the differentiation according to (26) makes no sense. This problem can possibly be solved by a spline interpolation (see also the remarks on (22)).

5.4.4. Averaging, smoothing, data reduction, interpolation (Option 40 menu of figure 21)

Mittelung, Glättung, Datenreduktion, Interpolation

Selecting this option brings up the following menu:



With this option, affected noise curves can be made more attractive or meaningful by smoothing operations or averaging. The result does not necessarily have to better reflect the physical facts. If the theoretical functional aspect is already known, an adjustment of the curve according to 5.4.5. may give better results. In addition, the number of points can be reduced and the pairs of values can be interpolated to the X values of another file.

(31) Data reduction thanks to the average

(32) Data reduction thanks to weighted averages

For files with equidistant X values, by averaging or weighted average over a number of points an improvement in the signal-to-noise ratio can be obtained.

(33) Data reduction by selecting each nth value

In this case, the file whose data is reduced will not improve the S / N ratio.

(34) Smoothing (weighted) without data reduction

Here (with an equidistant X), a weighted average over a certain number of points (moving averages) is carried out without reduction of the data for each measurement point.

(35) mean value of the Y values in an interval (Xmin | Xmax)

Average limits can be entered using the keyboard or determined on a graph by marking two values with the cursor. The result is displayed digitally on the screen.

(36) Interpolation on the X values of the background file

If a file does not contain equidistant X values, but these are required for other calculations, or if a specific X grid is required, the curve values can be interpolated on the X values of a second file. This is loaded into the background memory with the <f2> key.

(37) Interpolation by spline function

If a file contains only a few points, a spline function can be used to draw a curve with more pairs of values between the measurement points. However, there is a risk of oscillation, which does not reflect reality. For many points, the computation time is very high, in particular on HP 9000 computers. An alternative consists in adapting a known function curve to the data.

(38) Average of several files according to a list

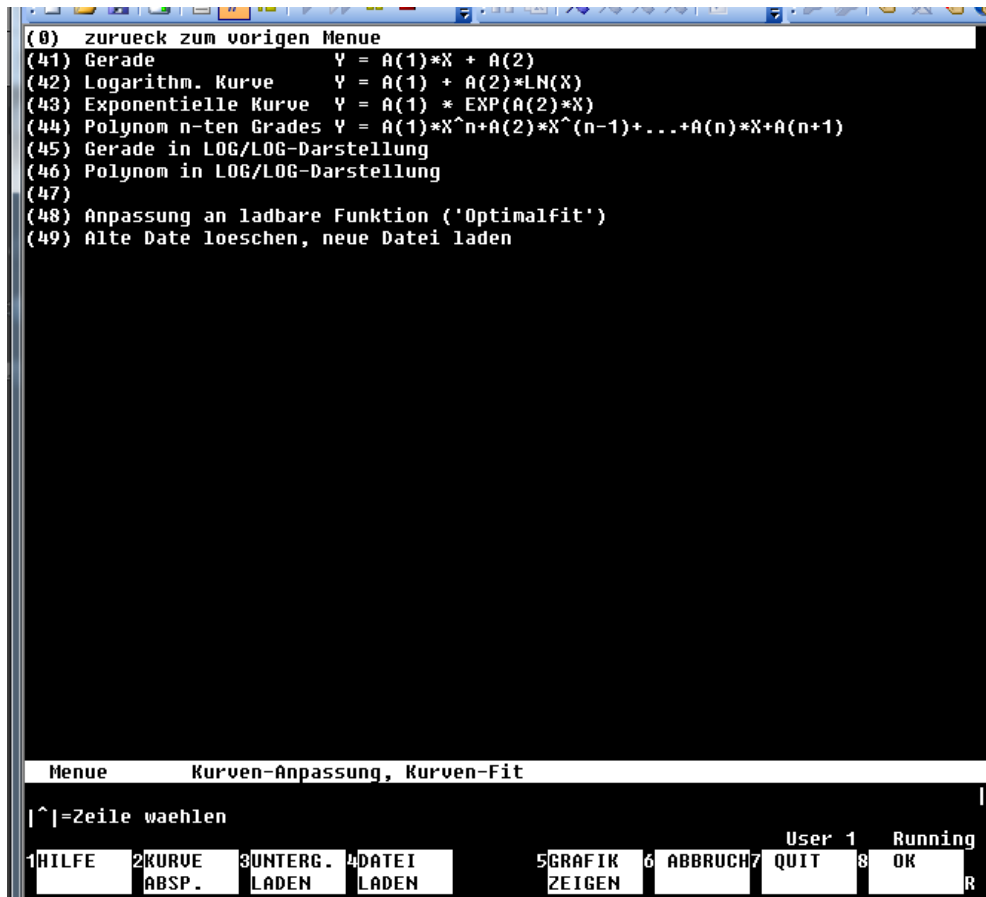
A greater improvement in signal-to-noise ratio can be obtained if a measurement is repeated several times and the Y values of the measurements are averaged.

The menu option displays a screen in the editor area in which the names of the files to be averaged are displayed. For files with three to more columns, the number of column Y can be

specified, separated by a comma. If the files do not have the same base X values, all subsequent files are interpolated to the X values of the first file.

5.4.5. Option 50 menu figure 21 - Adaption of a curve to data (regression, curve fit)

Selecting this option brings up the following menu:



If the functional dependence of the Y values of a measurement on the X values is known, the adjustment of such a curve offers the best possibility of graphical representation. The following functions can be selected here:

- (41) Linear curve $Y = A(1) * X + A(2)$
- (42) Logarithmic curve $Y = A(1) + A(2) * LN(x)$
- (43) Exponential curve $Y = A(1) * EXP(A(2) * X)$
- (44) Nth degree polynomial $Y = A(1) * X^n + A(2) * X^{(n-1)} + \dots + A(n) * X + A(n+1)$

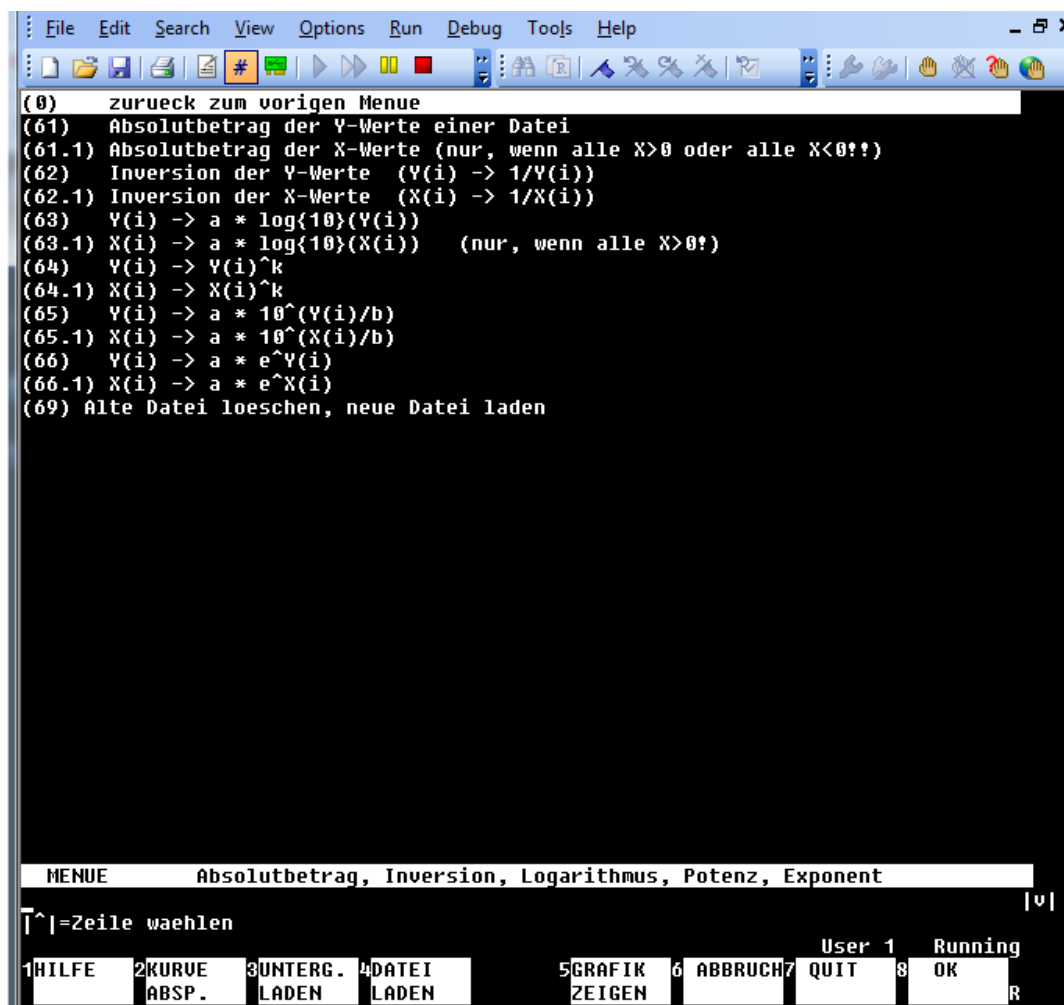
- (45) straight line in LOG / LOG representation
- (46) Polynomial in a LOG / LOG representation

The option (48) which uses the Optimalfit function is not yet available.

The limits between which the adjustment takes place can be defined using the keyboard or determined on a graph by marking two values with the cursor. The result can be displayed on the screen. The X and Y axes must be defined in LOG mode in the case of options 45 and 46. If "P" is entered in the graph below, the parameters A (n) and the scatter are displayed in a list. In particular, higher-grade polynomial calculations require considerable computing time, which is particularly noticeable on HP-9000 computers.

5.4.6. Option 60 of the menu of figure 21 - Absolute quantity, inversion, logarithm, power, exponent

Selecting this option brings up the following menu:



The following operations are applied to the values of a file:

(61), (61.1) Absolute value of all Y or X values

All Y or X values in a file are replaced by their absolute value. For X values, this operation can only be performed if all $X > 0$ or all $X < 0$.

(62), (62.1) inversion of all the values Y or X

All Y or X values in a file are replaced by $1 / Y$ or $1 / X$.

(63), (63.1) Calculation of the logarithm of the values Y or X

All Y or X values in a file are replaced by $a * \log_{10}(Y)$ or $a * \log_{10}(X)$, with X values only if all $X > 0$.

(64), (64.1) calculating the exponential of the values Y and X

All Y or X values in a file are replaced by Y^k or X^k .

(65), (65.1) Calculation of the inverse logarithm of the values Y and X

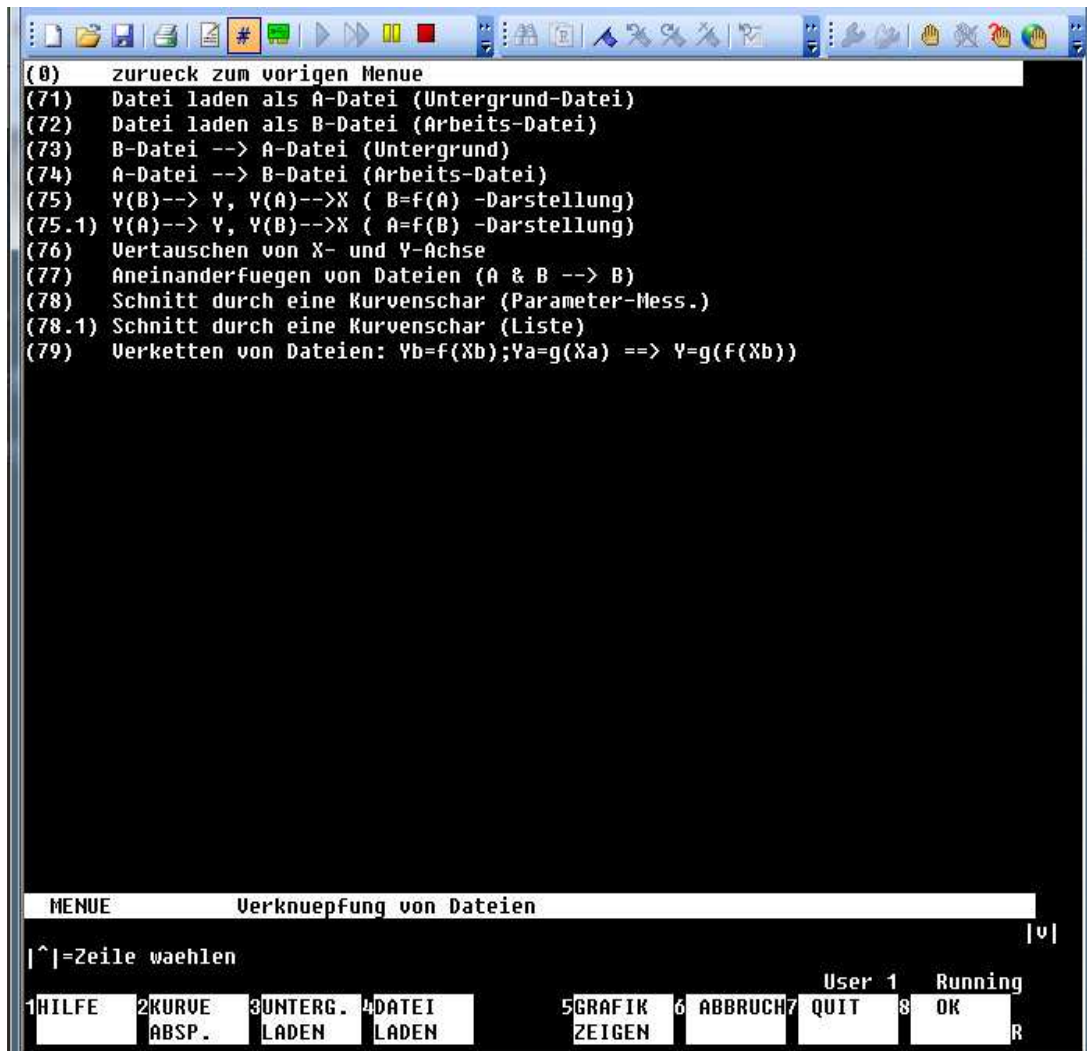
All Y or X values in a file are replaced with $a * 10^{(Y/b)}$ or $a * 10^{(X/b)}$.

(66), (66.1) exponential function

All Y or X values in a file are replaced with $a * e^Y$ or $a * e^X$.

5.4.7 Figure 70 of menu on figure 21 - Verknüpfung von Dateien = Linking files

Selecting this option brings up the following menu:



The following operations are applied to two files, one in working memory and one in "background memory".

(71) The background file (file A) is loaded using the <f3> key

(72) The file is loaded into the working memory (file B) using the <f4> key

(73) Copy of the working memory file (B) to the background file (A)

(74) Copy of background file (A -) in working memory (B)

(75) Illustration of the dependence of the Y values of the working file (B) with the Y values

of the background file (A):

$$Y(B) \rightarrow Y; Y(A) \rightarrow X$$

(75.1) Illustration of the dependence of the Y values of the background file (A) on Y values of the working memory file (B):

$$Y(A) \rightarrow Y; Y(B) \rightarrow X$$

(76) Swap the values of the X and Y axes of a file

(77) Join the pairs of values from two files

The file with the lowest X values is loaded into the background memory, the file with the highest X values is loaded in the main memory. After the operation, the merged file is in working memory (The reverse order is also possible). If the X value ranges of the two files partially overlap, the value pairs are sorted according to the ascending X values.

(78) Cross-section through a family of curves (parameter measurements)

If a parameter measurement is made so that an entire file is saved for each step value of a parameter (for example from a digital oscilloscope, spectrum analyzer or network analyzer), a cut in the resulting family of curves can then be performed. For this, the associated Y value is determined for a fixed X value of the files shared in each file and this is entered in a diagram with the parameter value belonging to the file.

For example, with a network analyzer, the transfer function S21 between a transmitting antenna and a receiving antenna can be measured and stored in a specific range as a function of the frequency. After each measurement, the antenna rotates one step and the angle value is saved as a parameter. Once all the angles have been processed, the directional diagram of the antenna, that is to say the transfer function S21 can be calculated as a function of the angle value (parameter).

To select the files and parameters, a menu is displayed in which the file type, the first and the last file number in the folder as well as the number of files to ignore and the X value of the files to be read are specified. The program then loads all the files marked one after the other, reads the value Y belonging to the value X and displays all the values Y according to the parameter in the working memory.

(78.1) Cut through a family of curves (list)

If the family of curves was not obtained from a parameter measurement as in (78), the parameter is not available in the header of the file and must be entered manually. To do this, an Edit screen opens where a list can be entered manually.

A triple value composed of [X (i), X (file (i), file name (i))] is entered in each line. The X (i) are adopted as the X values of the file to be generated, the value Y of the file at position X (file (i)) read from file i is used as the Y value of the file to be generated. The pairs of values are sorted in ascending order according to the values X (i).

For example.

```
-20, 1.5E9, DAT1
-15, 1.5E9, DAT2
-10, 1.5E9, DAT3
-5, 1.5E9, DAT4
0, 1.5E9, DAT5
5, 1.5E9, DAT6
10, 1.5E9, DAT7
15, 1.5E9, DAT8
20, 1.5E9, DAT9
```

In principle, an oblique cut through the family of curves is also possible if the X (file (i)) are not constant but increase or decrease. The table can also be created with an ASCII editor, saved and loaded in the editor window with <f5> before the start of the evaluation. The table can also be saved as an ASCII file with <f6> for repeated use.

(79) Concatenate files

Usually, a physical quantity is measured as a function of time or of another parameter. If a calibration or conversion curve for this variable is available as a file, this chaining operation can be used to convert the Y values according to the second file:

$$Y_b = f(X_b); Y_a = g(X_a) \rightarrow Y = g(f(X_b))$$

If it is not already available, the working file is loaded with <f4>, the background file (Umrechnungs-Datei = conversion file) with <f3>. A new work file is created, in which the X values from the old work file (file B) are transferred to the new work file, while the Y values from the work file (file B) are the X of values (interpolated) and are inserted in the

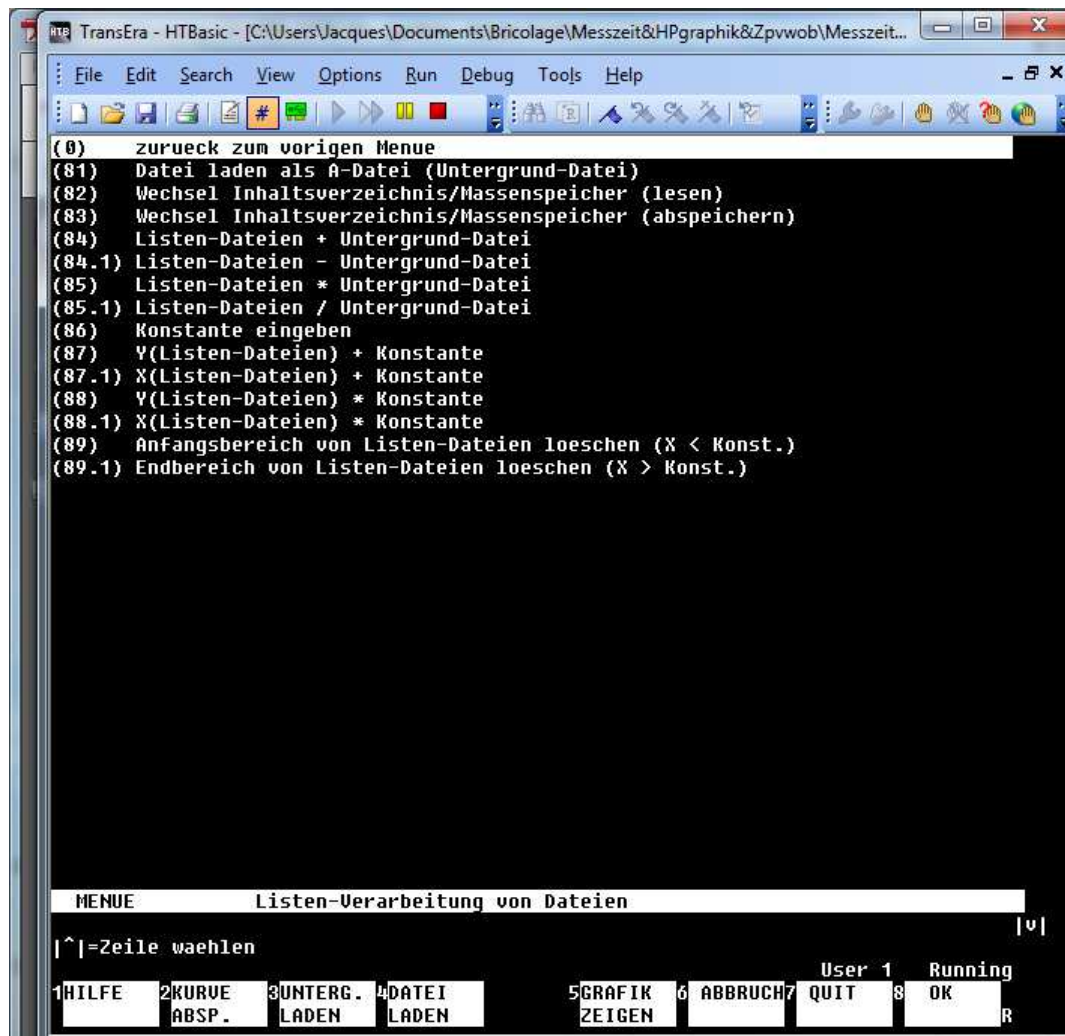
background file. The associated Y values of the background file (file A) then give the Y values of the new file.

For example :

The output power of a test object must be measured in a specific frequency range with an RF diode detector. The measurement file contains the direct output voltage of the diode as a function of the frequency. The file "Output power [dBm] as a function of the DC voltage of the diode" serves as the conversion curve. If this conversion file is loaded in the background memory, the file "Output power [dBm] as a function of frequency" can be created with this operation.

5.4.8. Option 80 of the menu of figure 21 - Processing on a list of files

Selecting this option brings up the following menu:



With this option, certain operations can be performed automatically on all the files specified in a list. This facilitates the identical conversion of a large number of files.

All files to be converted must be in a separate "Read" directory and numbered accordingly.

The converted files (result files) are saved in a separate "Ergebnis-Dateien= Result files" directory, which must be empty before the operation.

Depending on the selection of the operation, the type of files to be read and saved (DAT | ASC | DUX) as well as the number of the first and last files to be read are specified in a menu. If the labels for the X and Y axes (label) are empty, they are taken from the file read, otherwise modified using the keyboard. The selected operation is then launched.

The result files are written to the ' Abspeichern=Save' directory (83) under the same file numbers as the source files (!).

(81) Load the file as file A (Untergrund-Datei = background file)

The background file is required for operations (84), (84.1), (85), (85.1). (Same function with function key f3 (UNTERG. LADEN = LOAD BACKGROUND)). The background file remains in the working memory even for repeating subsequent operations.

(82) Change of table of contents / mass storage (lesen=reading)

In the following operations, the files are read from this directory. Only the files really necessary for the operations must be in this directory. The path to the directory is kept in the working memory even to repeat these operations later.

(83) Change of table of contents / mass storage (abspeichern=backup)

In the following operations, the converted files are written to this directory. The directory must be empty before the operation. The directory path is kept in the working memory even if the following operations are repeated. Caution: During a new list operation, a new empty directory for the result files must be selected.

(84) File list + background file

(84.1) File list - background file

(85) File list * Background file

(85.1) File list / background file

Selecting one of these menu options starts the operation automatically for all files in the list.

The Y values of the files in the list are calculated with the Y values of the secondary file. If

the X points of the files are different, the secondary file is previously interpolated at the points of the files in the list. The files loaded under (81) are not modified.

(86) Enter a constant

A constant is required for operations (87), (87.1), (88), (88.1), (89), (89.1). This constant is kept in the working memory even when these are repeated later.

(87) Y (list files) + constant

(87.1) X (list files) + constant

(88) Y (list files) * constant

(88.1) X (list files) * constant

(89) Delete the start area of the list files (for the values of X <Const.)

(89.1) Delete the end zone of the list files (for the values of X > Const.)

Selecting these options starts the operation automatically on all the files in the list.

The Y and X values of the files in the list are modified by the value of the constant. The result files are written to the 'Save' directory (83) with the same file numbers (!).

(89) Delete the start zone of the list files (X <Const.)

In the result file, the value pairs of the files in the list are deleted for the values of X <to the constant.

(89.1) Delete the end zone of the list files (X > Const.)

In the result file, the value pairs of the files in the list are deleted for the values of X > at constant.

The Y and X values of the respective list files are offset against the constant. The result files are written to the 'Abspeichern=Save' (83) directory under the same file numbers (!).

(89.2) Normalize the files in the list to the minimum ($Y \rightarrow Y - Y_{\min} + \text{constant}$)

(89.3) Normalize the files in the list to the maximum ($Y \rightarrow Y - Y_{\max} + \text{constant}$)

In the result files, the minimum (89.2) or maximum (89.3) Y value of the curves in the list files is fixed on the value of the constant. All other Y values are shifted accordingly:

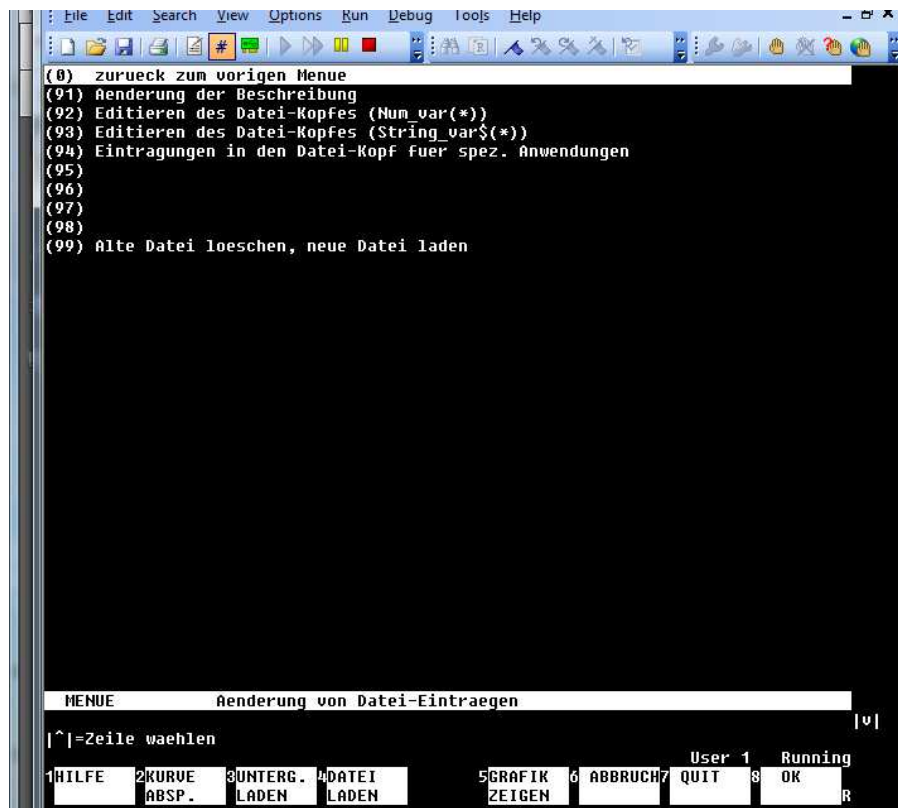
$Y \rightarrow Y - Y_{\min} + \text{constant}$ or

$Y \rightarrow Y - Y_{\max} + \text{constant}$.

In this way the deviation of the curves from a specified minimum or maximum value can be displayed. For example, normalization (89.3) is used to normalize the directional diagram of an antenna with respect to the maximum value at 0 dB (constant = 0).

5.4.9. Menu item 90 in Figure 21 - Editing file header

Calling this option brings up the following menu:



In addition to the measurement data, each standard file (see 4.2.) contains a file header with additional information. This content can be edited, especially after editing and converting files, and saved to the new file. The modifications (in particular (92) - (94)) are kept in the working memory if the file has not been saved.

(91) Change of description

The description of the file (on 2 lines) can be edited and modified during the recording process.

(92) Modification of the file header (case of Num_var parameters (*))

The 16 file header entries can be changed here, for example the measurement type, measuring device, measuring channel, parameter value for parameter measurements, etc. (see § 4.3 for more information).

(93) Modification of the file header (case of String_var \$ (*) parameters)

The 10 text entries of the file header can be modified, in particular the labels of the X and Y axes, provided that they have not already been modified by an operation (see § 4.3 for more information).

(94) Entries in the file header for special applications

If a measurement application > 0 was selected at the start of a measurement, an additional menu is displayed each time a file is saved, in which special information on the measurement can be saved. These tables can be called later and the content can then be edited.

5.5. File processing with special programs (Option 5 of menu figure 17)

The MESSZEIT / MESSPROGRAMME / SPEZIALPROG program folder and its subfolders contain a number of subroutines which can be loaded later by MESSZEIT and HPGRAFIK. The subroutine is selected using a file selection menu in accordance with § 3.3.2. After selecting the subroutine confirmed with <RETURN> or <OK>, the program starts immediately. Since many of these routines are used to convert files, you will be asked to load a new file at the start. If no new file is loaded in this case, the conversion takes place with the file in working memory. The result of the conversion is then available in the working memory for all other operations.

The following types of subroutines can be selected:

- Simple conversion programs generally without further user intervention can be found in the ./UMRECHNUNG folder.

The Y values of a two-column file are converted. The label of the Y axis is modified accordingly:

UMR_V_W	voltage [V] → power [W]
UMR_W_V	power [W] → voltage [V]
UMR_DBM_W	power [dBm] → power [W]
UMR_W_DBM	power [W] → power [dBm]
UMR_DBM_V	power [dBm] → voltage [V]

UMR_V_DBM	voltage [V] → power [dBm]
UMR_V_DBUV	voltage [V] → voltage level [dBuV]
UMR_DBUV_V	voltage level [dBuV] → voltage [V]
UMR_DBM_DBUV	power level [dBm] → voltage level [dBuV]
UMR_DB_SWV	Return loss [dB] → standing wave ratio
UMR_GI_AF	Isotropic antenna gain [dB] → antenna factor [dB / m]
UMR_AF_GI	antenna factor [dB / m] → antenna gain (i) [dB]

- The file format conversions can be found in the ./DATEIEN folder. These programs allow the simultaneous conversion of many files from one format to another:

DAT_ZU_ASC	Convert all DAT files in a folder to files ASC
DAT_ZU_DUX	Convert all DAT files in a folder to files DUX
SIG_ZU_DAT	Convert all SIG files in a folder to files DAT
ASCII_ZU_DAT	Conversion of all ASCII files in a folder to DAT files

- Mathematical calculation programs on files can be found in the ./MATHEMATIK folder

FFT_R	Fast Fourier transformation of a file (mainly for transforming pulse files into the frequency domain)
MITTELWERT	Average of all Y values in a file and entered in a new file.

- Calculations and file conversions can be found in the ./HF_ETECHNIK folder

S2P_EXTR	Reading of an ASCII file with parameter S (xxx.s2p) in Touchstone format or Supercompact, extracting an S parameter and saving it as standard file.
KOAXKABEL	Reading of a normalized coaxial cable attenuation File (dB/100m) and calculation of the attenuation for a certain frequency and a certain length
RAUSCHEN	Play two noise power files (noise source ON / OFF) and noise factor calculation using the Y factor method
DBM-TABELLE	Calculation of a dBm table and storage as a standard file

- Calculation of antenna data, fields and associated measurement values

D_FREIRAUM	Calculation of the attenuation in free space between two antennas with
------------	--

gain, frequency, distances entered, with manual entry or gain file dependent on frequency

EMPF_LEIST	Calculation of the power of a receiving antenna with gain dependent on the frequency (file) and intensity of the input and output field as file
ANT_FELD	Calculation of the intensity of the field of an antenna depending on the frequency, input file: gain / power, output to file
FELDMESS	Calculation of the field strength of a receiving antenna from the output voltage of a connected detector.
FELDSTAERKE	Calculation of the intensity of the distant field of a transmitting antenna from the voltage on a detector connected to a directional coupler
RICHTKOPPLER	Calculation of the power at the output of a directional coupler from the voltage of a detector connected to a directional coupler.

Other specifically developed subroutines can be stored in the ./SONST subfolder or in other folders and called if necessary

5.6. Data transmission (Option 6 menu of figure 17)

In this menu, files can be transferred via serial interfaces (V24 / RS232) (mainly relevant for HP-9000 computers without network connection). In addition, the F_KOPIE or 1DIR programs can be called here, with which copying large amounts of files between folders and mass storage devices is also possible in the RMB / HTB user interface (mainly relevant for HP computers -9000).

5.7. Print files as a table (Option 7 menu of figure 17)

The file in the working memory can be printed on the screen or on a printer in the form of a table.

5.8. Manual entry of value pairs, digital tablet (Option 8 menu of figure 17)

Here, a new file can be created and saved by entering pairs of values or sets of values. In addition, the file in the working memory can be modified and saved again. To do this, a screen editor according to § 3.6 is called. An array of numeric values can also be saved or loaded as an ASCII file. With the function key <f8>, the entry is completed and transferred to a standard file in the working memory.

In addition, pairs of values can be entered here with a digitizing tablet. This is mainly used to convert paper measurement curves to files. An already loaded file can also be highlighted on the graphics screen for scanning with the tablet. HP-IB / GPIB tablets (ISC = 6) and tablets with HIL connection (HP-9000 computer with HIL keyboard interface) can be used.

All of the value pairs entered are sorted following an increasing value of X after the end of the entry.

5.9. Calculation of function values (Option 9 menu of figure 17)

The curve of a specific function is often required in the form of a graph and a file for comparison or demonstration purposes. In the folder / MESSPROGRAMME / FUNKTION, there are a number of function subroutines which can be loaded and called up under the menu option (1) in the function menu. After entering the parameters of the function, it is calculated and saved in the working memory with <f8>. The curve can be checked with <f5> (display the graph) before being saved with <f2>.

Alternatively, a function contained in the text of the HPGRAFIK program can be edited with the menu option (2) of the RMB / HTB program editor. Then the program must be restarted and this file can be calculated with option 3).

5.10. Text editor (Option 10 menu of figure 17)

The MESSZEIT / HPGRAFIK text editor (see § 3.6) can be called with this menu option in order to be able to create and edit ASCII files. This is particularly useful for HP-9000 computers without HP-UX and without Windows X11, because in this case there is no specific text editor. In all Windows environments, however, a separate text editor outside RMB / HTB is preferable for such tasks.