MESSZEIT

User manual of the „MESSZEIT“ program

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Version 2018

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Content:

1. Introduction

The MESSZEIT program is used for computer-controlled measurements with measuring devices which, as computer interfaces, are known as IEC-Bus, HPIB or GPIB.

Several devices can be addressed and read at the same time, and devices from many manufacturers can be used. Furthermore, with the program HPGRAFIK it offers the possibility of graphical representation of stored measurement results as well as the conversion and further evaluation of the data.

The program can be run on HP 9000 computers with the HPBASIC-WS and HP-UX / RMB-UX operating systems and on PCs with the HTB emulation software and Linux with TAMS-BASIC.

In particular, measuring devices such as signal generators, RF power meters, Spectrum analyzers, network analyzers, digital oscilloscopes, digital voltmeters and an abundance of auxiliary devices such as power supplies, relay matrices from well-known manufacturers such as HP / Agilent, Rohde & Schwarz, Tektronix, Keithley, Wiltron / Anritsu are equipped with GPIB interface.

Unfortunately, the measuring devices are often used in "manual operation", although they have much more to offer, namely the possibility of their control and readout by computer. Of course, this is of primary interest for devices that already digitally save a complete measurement result internally, such as spectrum or network analyzers and digital oscilloscopes. This measurement result can then be read out as a file by the computer, converted there if necessary in various formats for documentation purposes and displayed and printed out.

However, even simpler devices such as signal generators and power meters can be combined into measuring stations by means of a computer control, with which measurements are possible that cannot be carried out by hand, such as clock-controlled time-dependent measurement with several measuring devices at the same time, simultaneous measurement with several measuring devices depending on a stimulating device or e.g. error-corrected reflection measurements and transmission function measurements.

Since the late 1970s, these measuring devices have been equipped with a uniform interface for computer control, which their "inventor" called HPIB (Hewlett-Packard Interface Bus), and in today's definition mostly GPIB (General Purpose Interface Bus) or IEC.

This is an 8-bit parallel bus system with additional handshake lines, which allows the addressing of up to 30 devices by a control computer (controller). Because of the bus load, a maximum of 16 devices can be operated simultaneously on one interface of a computer, the distance between two devices can be a maximum of 2m (in exceptional cases up to 4m).

Both the hardware (24-pin connector, TTL level) and the transmission protocol are internationally standardized (IEEE-488.1 and IEC-625), with newer devices there is also a uniform syntax for the control commands (IEEE-488.2). Using bus extenders with coaxial cables, fiber optic cables or Ethernet, devices that are further away can also be controlled and read out. Interface cards for the GPIB are available for most common computers, including PCs, of course.

In the early days of this technology, the required programs were mostly written in the laboratories of companies and research institutions themselves (typically in the programming language HP-BASIC or RMB, sometimes also in C), but this generally resulted in special programs for very specific devices and completely led to certain applications. At the time, computers of the HP-9000 series with HP-BASIC were more or less the standard for these tasks, the PC was only introduced many years later

and only reached the capabilities of the HP-9000 computers in this field a decade later. Later, the measuring device manufacturers also offered programs for certain measuring stations (e.g. EMC measuring stations from R&S) and often only for reading out certain individual measuring devices (HP, Tektronix, Keithley). The prices for this were often in the same order of magnitude as the devices themselves. In general, these programs are not intended to address several devices at the same time, especially not those from different manufacturers.

In recent years, graphic programming languages such as HP / Agilent-VEE and Lab-View from National Instruments have become established for self-programming, although it must be noted that these products are not user programs either, but only programming languages like RMB.

Interested parties can either program themselves in one of these languages (or in the classic programming languages) or use ready-made user programs that are available on the market. An example of a finished, universally usable and freely available program is the MESSZEIT program.

Although it does not correspond to the user interface of Windows programs, despite its age it fulfills all the essential requirements for the desired measurement tasks. The main aim was to avoid self-programming of measuring programs for different measuring devices and to define measuring sequences by filling out tables with standardized measurement commands (manufacturer and Device type-independent).

This allows measurement sequences to be compiled and executed without knowledge of a programming language and without knowledge of the functions of the GPIB. The program was originally written for HP-9000 workstation computers, which are equipped with an HPIB interface by default and which, thanks to the "HP-BASIC" programming environment, allow measuring device programming in high-level language and in an ideal way.

The operating systems used were HP-BASIC and (especially for servers and evaluation computers) HP-UX with HP-BASIC attached. The computer family HP-9000 (series 200 and 300) as well as HP-BASIC were maintained and further developed practically until the end of the company HP as a measuring device manufacturer in the year 2000, and many measuring stations are still in operation with these computers today. In order to be able to continue using the considerable software investments in laboratory operations, the programming language / programming environment HP-BASIC was ported to PCs by the TRANSERA company from the end of the nineties and can now be run as "HT-BASIC" on practically every PC. In addition, the company TAMS implemented the HP-BASIC on PCs under LINUX.

2. Tasks of the MESSZEIT program, basic functions

2.1. Tasks of MESSZEIT

The MESSZEIT program fulfills the following requirements:

· **Time-dependent measurements with several devices at the same time**, Time-dependent measurements with several devices at the same time, e.g. change in rf or direct voltages over a long period of time, frequency drift of oscillators, increase in attenuation of lines and components in the case of ionizing radiation, changes in temperatures over time, etc..,

· **Measurements with several devices depending on the setting value of a first device** („Parameter-Measurements “), e.g. RF power at several measuring points depending on the frequency of a signal generator (transmission functions), output power from amplifiers depending on the input power from a signal generator, adaptation measurements with directional couplers or measuring bridges

depending on the frequency, antenna diagrams (antennas -Power as a function of the angular position of a turntable or rotor),

· **Direct readout of spectrum and network analyzers, oscilloscopes** and similar devices with digital memory that output an entire file on one command,

· Operation of all existing GPIB devices via corresponding **device drivers**, with the option of including new devices in the program via self-written drivers,

· Most devices are operated using a **set of standardized command** words that are accepted by all device drivers,

· **Configuration** of the measurement setup and the measurement processes via **input tables** in order to completely avoid programming work on the program language level for the end user.

· **Graphical representation** of measurement results,

· **Conversion, evaluation and manipulation** of measurement files.

2.2. Basic functions of MESSZEIT

The MESSZEIT program consists of a basic program package for carrying out the measurements, an evaluation part for the graphic display and conversion of the measurement files (via the HPGRAFIK module), a large number of device drivers (currently over 100 types), a device list as a file and various help and configuration files. The program offers the following basic functions:

· Selection of up to 16 devices from a device list.

· Checking the switch-on status of the devices.

· "Manual setting" for all selected and switched-on measuring devices via a standardized computer menu (same appearance and function for different devices)

· "Time-dependent measurements" operating mode. This means that all connected and selected measuring devices can be read out or controlled with adjustable cycle times. The measurement results are saved in files depending on the measurement time and can be displayed graphically.

· "Parameter measurements" mode. A first measuring device can be selected as a stimulating device here. Its output signal (frequency, amplitude, voltage, etc.) is gradually increased from a start value to a stop value. For other devices, their measured values at each step are saved as files depending on the stimulating value and can be displayed graphically.

· Special programs for controlling measuring stations can be reloaded. These can call subroutines of MESSZEIT as well as device driver programs.

· The device selection list as well as the tables for timing and measurement commands can be saved in a configuration file and called up again for a later measurement.

2.3. Basic functions of HPGRAFIK

The program part 'HPGRAFIK' is used for the graphic display and for the evaluation or manipulation of measured value files from MESSZEIT, but also files from other sources. The program offers the following basic functions:

• Graphical representation of measurement files

The graphic output of files can be done on:

- internal graphic screen (black / white or color),
- additional color graphics screen (HP-9000),
- Printer as a screen copy
(e.g. Think-Jet, Laser-Jet for HP-9000, Windows standard printer (PC)),
- local HPGL plotter
- Network HPGL plotter (HP-9000 / SRM),
- HPGL files.

• Print out files in tabular form

• Conversion, modification, manipulation of files
- simple arithmetic operations such as shifting, compressing, stretching, taking the logarithm, forming absolute amounts, etc..,
- Linking several files (Addition, subtraction, multiplication, division, concatenation),
- Averaging, smoothing, integration, differentiation
- Curve adaptation (Fit) to file value pairs.
etc.

• Conversion of measured values into other measured quantities / dimensions
e.g. Volt – Watt, Watt – dBm, dBm – dBuV, dB – SWV, Rho - Z

• Conversion of measured value files using special programs that can be loaded

• New creation of measured value files

• manual entry of value pairs in lists,

• Digitization of paper templates with a digitizing tablet,

• Calculation of function values.

2.4. GPIB-Testprogram

With the help of a very simple test program it is possible, e.g. for the development of device drivers, to send single-line command sequences to a GPIB device, to read and display a device response and to generate poll and trigger commands.

3. MESSZEIT- user interface

3.1. HP-BASIC-User interface

As already mentioned, the program was written in HP-BASIC for the HP-9000 family of computers. It therefore largely uses the HP BASIC user interface used on these computers. When porting HPBASIC to PCs under the HTB program, this user interface is emulated and the user programs such as MESSZEIT or HPGRAFIK run within this emulation. For users who have no knowledge of how to operate the original computer, this user interface, which in some cases differs considerably from the operation of PCs and, above all, Windows, should be briefly presented. The operating menus used in MESSZEIT and HPGRAFIK are also explained.

The user interface described below appears immediately on HP 9000 computers with the HP Basic WS operating system. The process “rmb” must be started under HP-UX and Linux. The interface then appears in an X11 window (or on the entire screen if no X11 system was started).

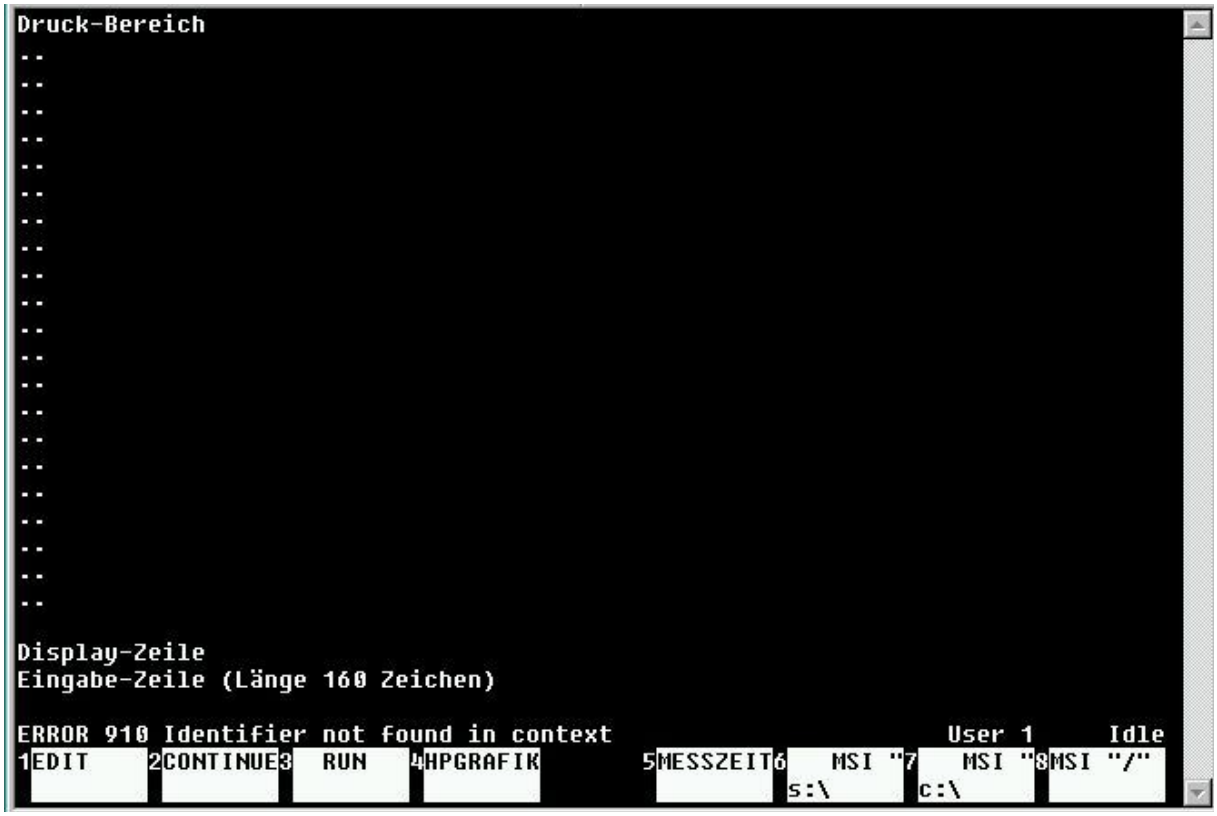


Fig.1: HP-BASIC / RMB user interface

On PCs with Windows, the currently installed HTB version is started as a program, the user interface appears in a Windows window. The DOS version of HTB can be started on a PC with MS-DOS-5/6/7 (Windows-95/98 in DOS mode) by entering "htb386" in the HTB directory; the user interface appears on the full screen.

RMB or HTB can be started multiple times under all Windows and X11 systems. This makes it possible to use one window for the measurements and another for the simultaneous file analysis.

The Fig.1. shows the HP BASIC user interface on the standard screen or window. Their display area consists of 26 lines of 80 characters each, of which 22 lines make up the print area. Underneath is a so-called display line (**Display-Zeile**) on which messages can appear regardless of the print area.

This is followed by an input line (**Eingabe Zeile**) of 160 characters, which is displayed as two lines on the standard screen. Below is the error message and status line. Below the display area are the labeling fields for the eight function keys f1 - f8.

With the exception of a few menus, text is entered in the input line; the input is then completed with <RETURN>. The cursor position in the input line can be moved with the horizontal cursor keys. With the SHIFT-arrow left or SHIFT-arrow-right the cursor is set to the beginning or the end.

The print area can be scrolled up and down with the vertical cursor keys, the keys Page - ^ / Prev and Page-v / Next. The HIL rotary knob and the HIL mouse can also be used on HP 9000 computers. This roll function is blocked in some menus, instead it is used to move the selection lines.

The assignments of the associated function keys are displayed in the eight function key labeling fields. The functions assigned as standard by the operating system are replaced by program-specific functions in various program segments of MESSZEIT and HPGRAFIK; these are executed immediately by pressing the button. In Fig.1. the keys f1, f2 and f3 are assigned the system functions "EDIT", "CONTINUE" and "RUN", while the keys f4 and f5 trigger the start of the programs MESSZEIT and HPGRAFIK. With f6 and f7 two different disk drives are selected, with f8 you jump to the root of the file system by entering the further path.

The standard assignment before the program start is saved in the SYSKEY file; it can be edited (see 4.5.). With the "Menu" and "System / User" keys on HP 9000 computers or with the f10 (or f12 depending on the HTB version) key on the PC keyboard, a further system assignment of the function keys can be called up. If the program persists due to a (rectifiable) error (see field message line), it can be continued with the "CONTINUE" key after the error has been rectified (e.g. switching on a measuring device again).

If the error cannot be eliminated, the program can be restarted with the "RUN" key. The program and almost all settings are retained in the working memory. If this does not lead to success either (eg if there are no device driver subroutines), a restart can be performed with the RESET function on the HP 9000 keyboard or the RESET button on the function bar of the HTB window respectively and then "RUN". Here too, the program and settings are retained in the working memory.

3.2. Program-Start, Start-Menu

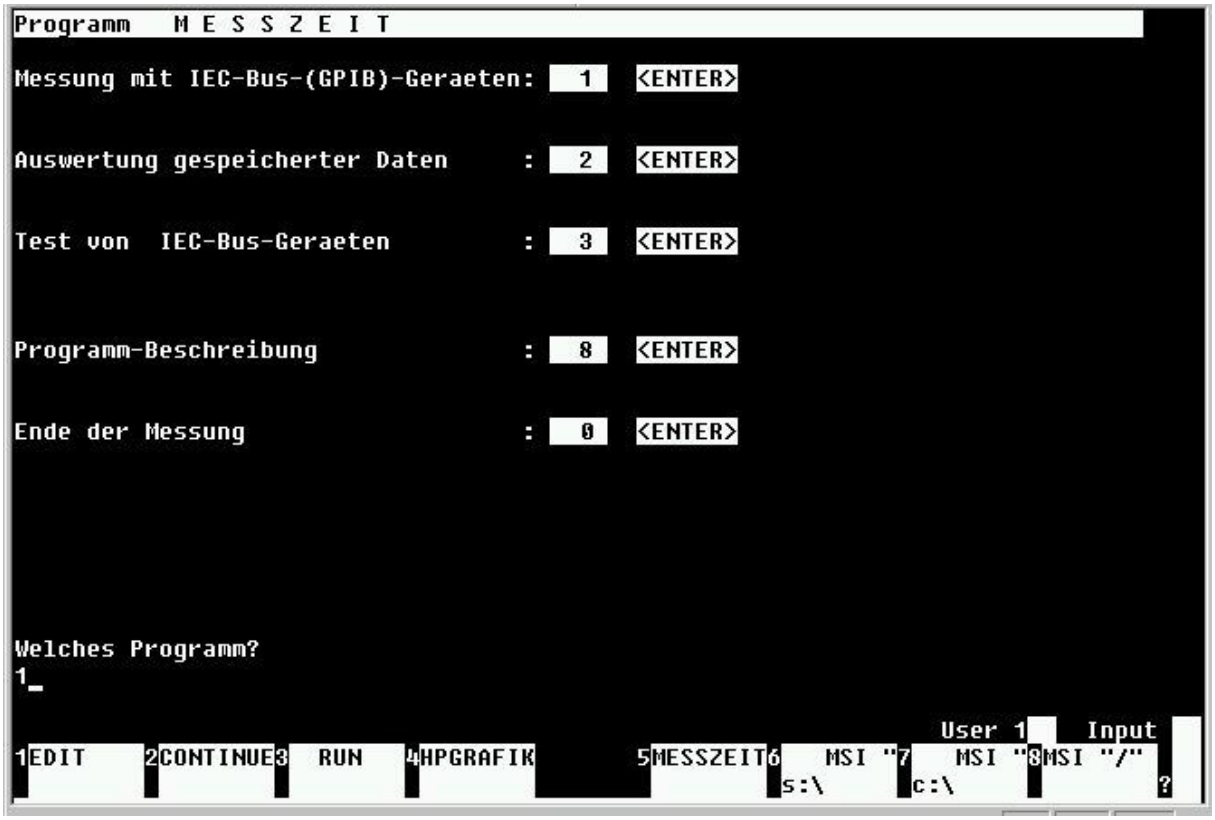


Figure.2.: MESSZEIT-Program-Start menu

> **Messung mit IEC bus (GPIB) geraeten** = Measurement with devices equiped with IEC (GPIB) bus
> **Auswertung gespeicherter Daten** = Evaluation of stored data
> **Test von IC bus Geraeten** = Test of IC bus devices

The MESSZEIT program is saved (if no other location has been selected) by default in the folder / MESSPROGRAMME <: mass storage identifier> (for HP-9000 computer) or <drive:> \ MESSPROGRAMME (for PC) together with all sub-folders for the MESSZEIT subroutines.

The program call is linked as standard with the function key f5 on the user interface, the program starts by pressing the function key. Alternatively, the program can be called in the command line:

LOAD „/MESSPROGRAMME/MESSZEIT“,1 <RETURN>
Or
LOAD „/MESSPROGRAMME/MESSZEIT:REMOTE 21,0“,1 <RETURN>

Or
LOAD „/MESSPROGRAMME/MESSZEIT:,1400,0“,1 <RETURN>

for HP-9000 computers,

LOAD „\MESSPROGRAMME\MESSZEIT“,1 <RETURN>
Or
LOAD „c:\MESSPROGRAMME\MESSZEIT“,1 <RETURN>

for PCs with HTB. Under HTB, the normal and the backslash can be used with the same meaning.

The part program (1, 2 or 3) is selected by entering the number in the input line and pressing the <RETURN> or f8 key (continue). The saved measurement files can contain 2050 value pairs as standard. If a higher number is required and the working memory is sufficient, this value can be increased by entering a higher number via f7. With an associated entry in the AUTOST program, this value can be set to a higher value by default.

3.3. Selection-Menu

In the course of the program, so-called selection menus appear in many places. These are used to select the content of the highlighted line or the highlighted field.

3.3.1. Full-screen selection menu

Fig.3 .: Selection menu with full screen width

In this example of the selection menu with the full screen width, a whole line of the print area is highlighted. The line to be selected is moved with the vertical cursor keys (in HP 9000 computers also with the rotary knob or the mouse). The selection is made by pressing the <RETURN> key or the f8 (OK) key. Alternatively, the line number can be written in the input line and sent with <RETURN> or f8.

By selecting line (0) you can jump back to the previous menu, the function key f6 (**ABBRUCH** = CANCEL) has the same function. With the function key f1 (**HILFE** = HELP), a help text can be displayed in many cases, which explains the menu item in more detail. The help text is exited with the function key f8 (END). If the help text is longer than one screen page, it can be scrolled up and down with the vertical cursor keys (in HP 9000 computers also with the rotary knob or the mouse).

3.3.2. Multi-column selection menu

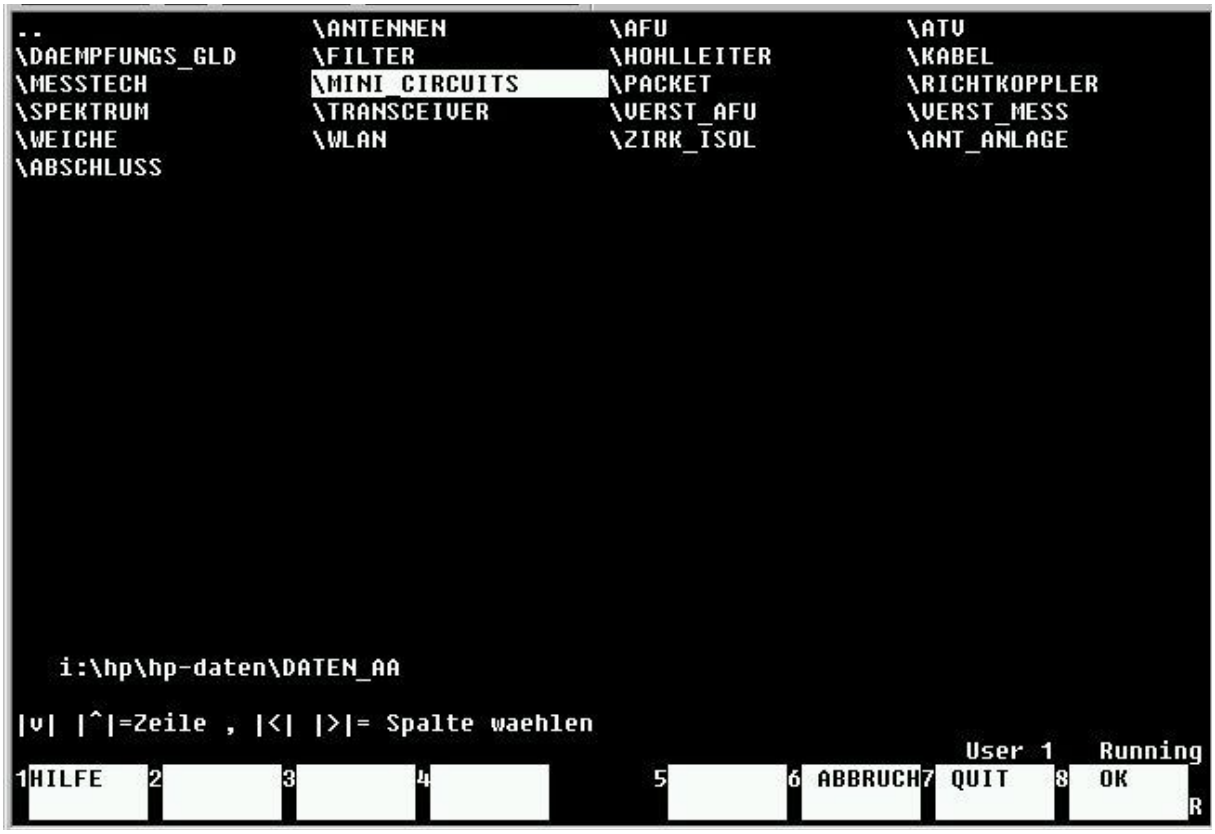


Fig.4 .: Multi-column selection menu

In this example of the selection menu, individual segments of a line can be highlighted with a multi-column text display. The field to be selected is moved here using the horizontal and vertical cursor keys (in HP 9000 computers also with the rotary knob or the mouse). The selection is made with <RETURN> or f8 (OK).

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

3.4. Switching menu / input menu

Another menu type, the so-called switch menu or input menu, is also used frequently in the course of the program. It enables the input of a text in the selected and highlighted menu line, not like above in the input line.

3.4.1. Input menu with full screen width

Fig.5 .: Example of an entry menu with full screen width

In the switch / input menu, the individual lines of the print area consist of a line number and a description on the left-hand side and the actual line content. In the case of multi-line menus, the content of a line can be selected by moving the highlighted area with the vertical cursor keys.

Text can be written directly in this highlighted area or the existing text can be edited. Fig.5. shows as an example the input menu for entering a mass storage path on an HP-9000 computer. The same menu is used under HTB, here the first line is left blank and the entire path is written in the second line. The menu must be exited with the function key f8 (**OK**) (not <RETURN>!). The input can be canceled with the f6 key (**ABBRUCH** = CANCEL).

If a mass storage path is displayed in the second line, a file selection menu can be called up by pressing the f1 key (**HILFE** = HELP), which displays the sub-folders of this path. A selected sub-folder can be selected and entered in the mass storage path.

3.4.2. Input / switch menu with small input fields

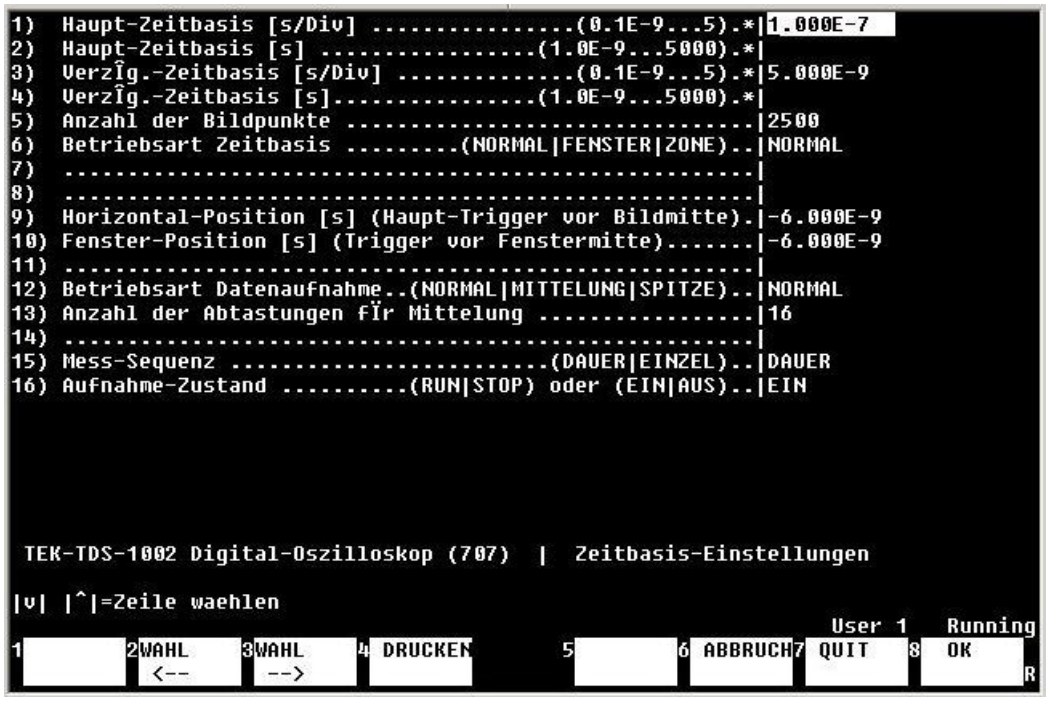


Fig.6 .: Example of an Input / switch menu with small input fields

The input menu is also often used with smaller input fields (typically 10 characters up to half the width of the screen). Standardized text blocks are usually entered here. If there is a certain number of possible entries, these can be called up one after the other using the function keys f2 (**WAHL ←**= CHOICE <-) and f3 (**WAHL ->** = CHOICE ->). In this case, you can also use f1 (**HELP**) to call up a list of the possible entries and select a value.

The vertical movement of the highlighted input field is carried out using the vertical cursor keys. The <RETURN> key moves the field one position down. There are also input menus with several input fields per line next to one another. The horizontal movement from one field to the next in the same line takes place with the <TAB> key or backwards with <SHIFT> <TAB>. The menu is closed with the entries made with the key f8 (**OK**) and exited, with f6 (**ABBRUCH** = CANCEL) the menu is exited without the changes or entries. The old values are then retained.

3.5. Single line input screen

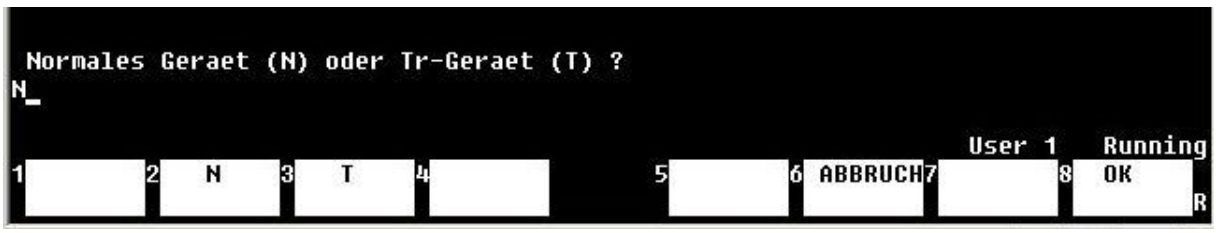


Fig. 7 .: Example of an Single line input screen

Similar to the basic view of the HP Basic user interface, the input line can be combined with a number of function key assignments defined for a specific program. Either a text can be written in the input line and terminated with <RETURN> or the function key f8 (**OK or ENDE**), or one of the assigned function keys is to be operated, the function of which is carried out immediately. This single-line input

screen is often combined with a (non-editable) text display in the print area, the content of which can be scrolled up and down with the vertical cursor keys if necessary.

3.6. Editor-Screen

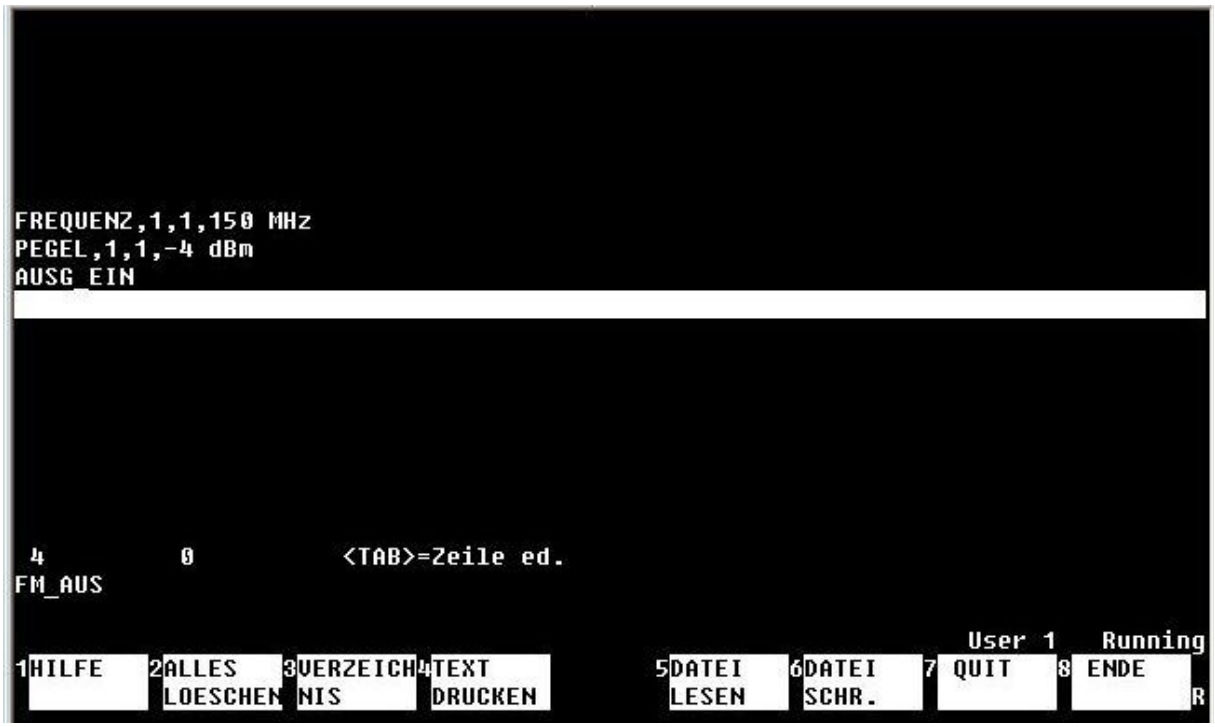


Abb.8.: Editor-Screen

Alles loeschen = Delete everything
Verzeichnis = Directory
Text drucken = Print text
Datei lesen = Read file
Datei schr. = Write file

The editor screen is used to enter or edit a multi-line text field. In contrast to the switching / input menus, the current text line is written in the input line below and ONLY saved in the text field with the <RETURN> key. It then appears in the print area above the highlighted line.

To edit lines that have already been entered, the text field can be scrolled up and down using the vertical cursor keys. The line to be edited must be in the highlighted area in the middle of the screen. 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 overwritten there. With <RETURN> it is then written back into the text field.

The editor screen is ended with the text field being passed on with the function key f8 (**ENDE**). To exit without forwarding or changing the existing text, press the f7 (**QUIT**) key.

With the <Insert line> key (HP-9000) or <SHIFT> <Insert> (PC), a new line can be inserted in the text field above the highlighted line, with the <Delete line> key (HP-9000) or . <SHIFT> <Del> (PC) the highlighted line can be deleted.

Via f5 (**DATEI LESEN** = READ FILE) an ASCII file can be loaded into the text field, with f6 (**DATEI SCHR**. = FILE WRITING) the text field can be written into an ASCII file. f1 (**HILFE** = HELP) shows a short help text

about the editor, f2 (**Alles loeschen =** delete everything**)** deletes the entire text field, f3 **(verzeichnis =** directory**)** shows the current mass storage path, with f4 the text field can be printed out on the set printer.

The editor screen is used for a number of tables in MESSZEIT and HPGRAFIK, e.g. for entering measurement times, command tables, value pairs for graphical representations, etc.

3.7. Loading and saving files

3.7.1. Loading files

If a new file is to be loaded, the query according to Fig. 9 is displayed on the screen. Loading is continued with the answer "**JA**" (key f7 or J <RETURN> or **OK** <f8>). With the answer "**NEIN** = NO" (key f6) or **N** <RETURN> the previously loaded file remains in the main memory.

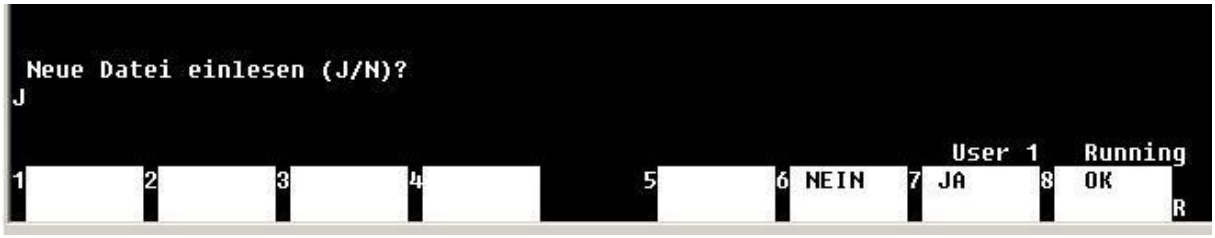


Fig.9 .: Query loading a file

(Neue datei einlesen = read a new file)

Fig.10 .: Continuation of the query loading a file

(Inhalts verzeichnis = Table of Contents / **verzeichnis wechsel** = directory change)

The loading query is continued as shown in Fig. 10. You can return to the previous query level with the **ABBRUCH** = ABORT **<**f6**>** key or with **A** <RETURN>. You can now choose between two selection methods, the classic text input of the file name and a file selection menu (**MENUE <**f7**>).**

Classic selection method:

With **J** <RETURN> the table of contents (**Inhalts verzeichnis**) of the current folder is displayed in the operating system display, with **N** <RETURN> this is omitted. In both cases you will then first be asked for the file type (see 4.1), i.e. DAT, ASC, DUX and then for the file number. The read-out can still be aborted by entering –1 as the file number.

The folder can be changed with the **WECHSEL** key **<**f5**>** or with **W** <RETURN>. A two-line input menu appears according to 3.4.1., In which the current path is displayed (Fig.11. For RMB and Fig.12. For HTB).

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

(Auswahl von massenspeicher (Mass) und Verzeichnis (Verz) fr Daten= Selection of mass storage and directory for the data **)**

The entries can be edited directly with the keyboard, whereby in the HTB version only the second line may contain a text. If the selection bar is on the second line, a selection menu can be displayed with the **HELP** key **<**f1**>**, which shows the folders below. The path menu is confirmed with **OK <**f8**>** or quit with **ABBRUCH** = Abort **<**f6**>** without changing the path.

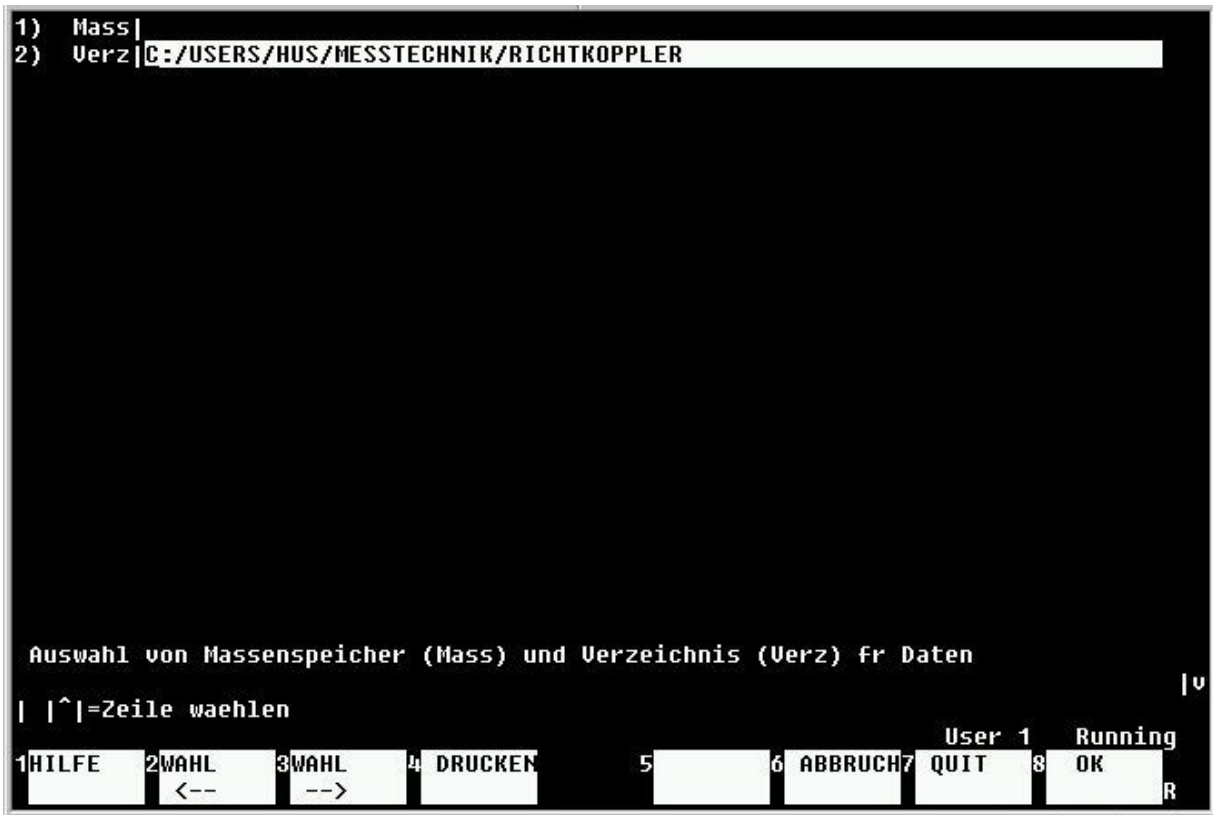


Fig.12 .: Mass storage path for PCs with HTB

File selection –Menu method:

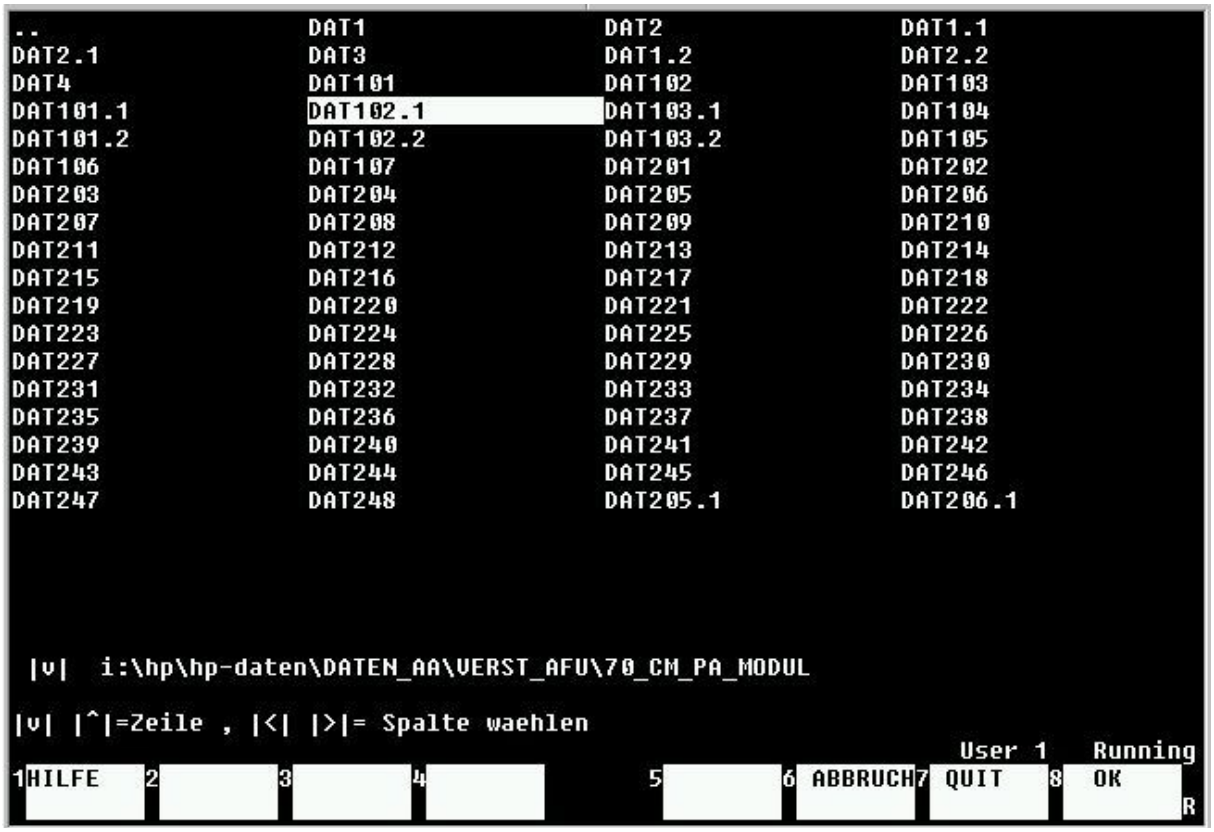


Fig .13.: File selection-Menu

(Spalte waehlen = Choose column**)**

The second selection method can be used with the **MENUE** <f7> or **M** <RETURN> key. A multi-line and multi-column selection menu appears, which shows the content of the current folder (files and sub-folders), see fig. 13.

The symbol ".." in the top left corner enables you to jump back to a higher-level folder. The selection fields beginning with a slash indicate sub-folders that can be accessed. The highlighted selection bar is moved with the horizontal and vertical cursor keys, the selection being made with <RETURN> or **OK <**f8**>.**

If the highlighted segment denotes a standard file (consisting of the prefix DAT, ASC or DUX and a subsequent number, see Chapter 4), the descriptive part of the file header can be displayed by pressing the **<**f1**>** (**HILFE** = HELP) key. By pressing **<**f1**>** again you return to the file menu, with <f8> (**LADEN** = LOAD) the selected file can be loaded directly.

The entire path to the current folder is shown in the display line. If the text field (i.e. the number of files available) is larger than the screen area, this is indicated in the display line by the additional symbols | v | and / or | ^ |. In this case, the next or previous screen page can be displayed using the "**Zeile v** = next Page " or "**Zeile ^ =** previous Page" buttons.

Beware!!
In contrast to HP 9000 computers, on PCs under HTB with the symbol "**..**" you can only jump back to the folder that was selected when the program was started. In an emergency, the start folder can be reset under the "**Umgebung** = Environment" menu (see fig. 25 of 6.2.6). Furthermore, the functions of the "Page v" and "Page ^" keys are swapped under HTB. In some cases, a folder then appears to be empty even though there is content. The correct display can then be achieved by pressing the "Page v" and "Page ^" buttons again.

3.7.2. Loading non-standard files

In many cases it is also possible to load measured values from ASCII files that do not correspond to the formats described in 4.1 and 4.2. Additional information about the respective file must be available for this, such as decimal points, separators for the data in a line, end-of-line characters, number of columns and lines.

After the classic file selection "IMP" (for IMPort) is specified as the file type and then the complete file name is entered in the next step. The non-standard file is simply selected in the menu selection. A selection menu then appears (Fig. 14) in which the additional information for the file must be entered. The pairs of values or sets of values are then loaded into the working memory.

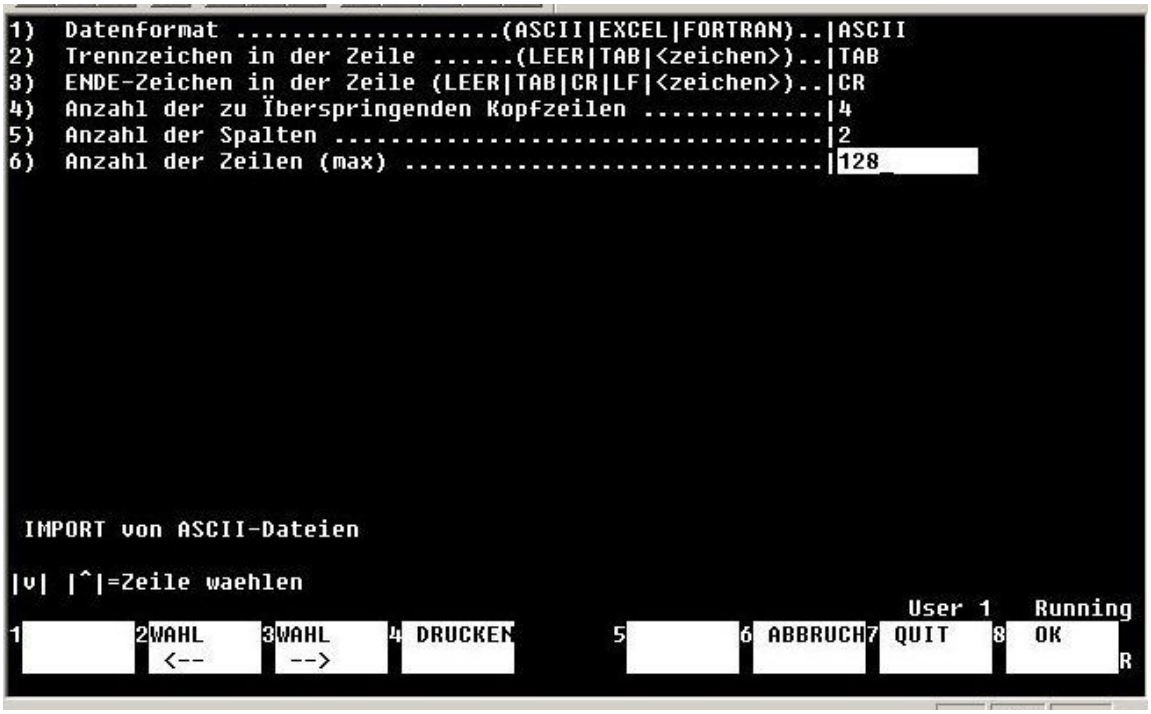


Fig.14 : Settings menu for non-standard files

Trennzeichen in der zeile = Separator in the line
ENDE - zeichen in der zeile (LEER | TAB | <zeichen>) = END character in the line (Empty|TAB| < character >)
Anzahl der zu uberspringenden kopfzeilen = Number of headers to be skipped
Anzahl der spalten = Number of columns
Anzahl der zeilen (max) = Number of lines (max)

3.7.3. Saving files

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

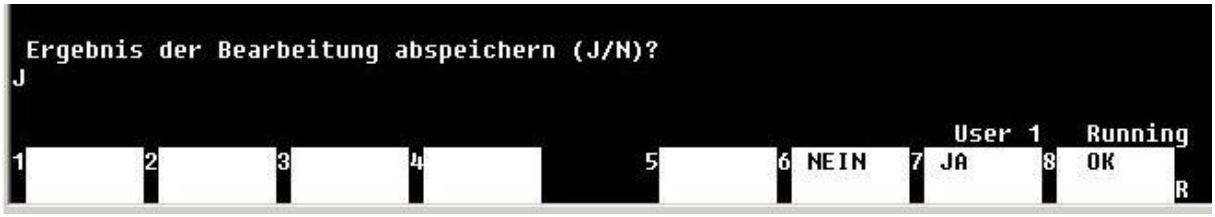


Fig.15 .: Query to save a file

(Ergebnis der Bearbeitung abspeichern = Save the result of the processing**)**

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

In addition to **Inhalts verzeichnis (=**directory display (J / N)), **WECHSEL** (=CHANGE), **ABBRUCH** (=CANCEL) and **MENU** functions, the **NEUES VERZEICHNIS** (=NEW DIRECTORY) <f4> function is

possible. This shows the currently valid mass storage path, and a new folder can be appended to this path by entering it via the keyboard. Only one folder can be added at a time, if several folders are to be created, the **NEUES VERZEICHNIS** (=NEW DIRECTORY) function must be executed several times one after the other.

If the **MENUE** function is selected, the entire file name must be entered via the keyboard while the menu is displayed, e.g. DAT27 or ASC333 and without separation of the file type and file number.

In the programs MESSZEIT and HPGRAFIK it is generally not allowed to overwrite existing file names with new files. This is useful in order not to lose measurement results under any circumstances. If files under 7.4. or 7.5. are edited and the results are to be saved in the same folder, it has proven to be practical to append a numerical extension to the file name separated by a point:

e.g. Original file: DAT25 Processed file: 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 number of files in measurement tasks, it is not particularly useful to give the files self-explanatory names (folder names can be used for this). Instead, a name format is used in MESSZEIT and HPGRAFIK, which consists of a prefix (first name) with three capital letters and a following decimal number (with or without a point). A suffix following a period, as is the case with other PC files, is not used. Examples are:

DAT17 ASC23.1 DUX4.129

Measurement results can be saved in MESSZEIT and HPGRAFIK in three file types. The standard type on HP 9000 computers is the binary file (**BDAT**) with the prefix **DAT**. It is significantly more space-saving on mass storage devices than the other types and is written and read significantly faster on these computers.

On PCs with HTB, these advantages are of little importance because of the larger hard disks and the higher computing speed. If there is no other entry in the configuration list, the programs use **DAT** by default. The second type is the ASCII file with the **ASC** prefix. It has the advantage that it can be read directly with any text editor and is best suited for exchanging data with other computer systems and programs.

The third type is the **HP-UX ASCII** file with the prefix **DUX**. It differs from the normal ASCII file in the UNIX convention, in which there is only an "LF" instead of the "CR-LF" at the end of the line. It is used in HP-UX / RMB systems to exchange data with other programs.

When prompted for a file to be saved or loaded, the type specified in the CONF_LISTE file is always displayed, if DAT is not specified. The type can be overwritten by a different type each time the query is made.

4.2. INT standard file

In order to be able to display the content and the meaning of a file at any time, each measurement file consists of the actual measurement values as well as a file header with meta data. This includes

the creation date, two lines of text description, Numerical and 10 text constants, some of which have fixed meanings and which are partly or freely available for specific measurement applications, as well as two numbers to indicate the columns and lines of the following measurement data field.

Table 1: INT-Standard-File

Definition of the INT-Standard-File in ASCII-Format:

All lines with a maximum length of 80 characters

Separator for numeric values in one line = "," (comma),
End character of a line = CR LF

The file consists of a File header (1st - 31st line) with a fixed number of lines and a data field from the 32nd line, the size of which is specified in the 5th line (number of columns, rows).

			Examples:
Line 1	filename	<prefix> <decimal number >	ASC27.1
Line 2.	Description (1)	ASCII-Char	
Line 3.	Description (2)	ASCII-Char	
Line 4	Date	ASCII-Char	17.01.2001
Line 5.	Columns rows of data field	<Num>,<Num>	3, 81
Line 6-21	16 lines with each a number	<decimal number>	9.58123
Line 22	10 lines with		f [MHz]
Line 31	ASCII-Text [40]	ASCII-Char	A [dB]
Line 32 to End	Data lines <Dec>, <Dec> [, <Dec>]		0.00, 1.25, -28.1
End	2-5 columns separated by comma		1.00, 1.27, -13.22

The ASCII text lines in lines 22-31 are partially defined in their meaning by the INT programs HPGRAFIK and MESSZEIT:

Line 23.:	X-axis labeling (1st column)	f [MHz]
Line 24.:	Y-axis labeling (2nd column)	A [dB]
Line 25.:	2. Y-axis descr. (3rd column)	Phi[Grad]
Line 26 :	3. Y-axis descr. (4th column)) etc.	

In user-specific application masks, all numerical and text header variables can be assigned specific meanings.

4.3. Measurement applications

For certain measurement applications, some numerical and text constants in the header of the standard file can be assigned that are specified or entered via a menu. Before starting a measurement, the type of measurement application (number> 0) is requested. In this case, before 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, the assignments for measurement application no. 4 are shown in Table 2
.

Table 2: Assignment of the variables in the line header for application 4 'wobble measurement NEMP model simulation'

INT-Standard-File
==========

Num_var(0)	
Num_var(1)	
Num_var(2)	probe surface [m^2]
Num_var(3)	Dumping link [dB]
Num_var(4)	Distance conductor - probe [m]
Num_var(5)	Probe termination resistance [Ohm]
Num_var(6)	Level [dBm]
Num_var(7)	Start-Frequency [MHz]
Num_var(8)	Stop- Frequency [MHz]
Num_var(9)	LIN: Increment [MHz]; LOG: -Number of points (Negative value)
Num_var(10)	Conversion factor: Measuring resistor [Ohm] oder converter factor [S]
Num_var(11)	
Num_var(12)	
Num_var(13)	Measurement type (for this application = 4)
Num_var(14)	Measuring device nb.
Num_var(15)	Measuring channel nb.
String_var$(0)	
String_var$(1)	Dimension X-Axis
String_var$(2)	Dimension Y-Axis (1), Amplitude
String_var$(3)	Dimension Y-Axis (2), Phase
String_var$(4)	
String_var$(5)	
String_var$(6)	Dimension conversion-factor:
String_var$(7)	Type of Measurement probe ('R','W'= Resistor |'I','S'= Current transformer|'D'=Differential probe›)
String_var$(8)	Measurement object
String_var$(9)	

The currently available measurement applications are listed in the appendix with their assignments in the standard file. Further measurement applications can be written by the user as subroutines and saved in the / MESSPROGRAMME / SUB_PROGRAMME folder.

In addition, the following assignments of the numerical header values are usual in MESSZEIT measurement data:

Num_var(12)	[for time measurements with readout of complete files (e.g. oscilloscope): current time value] [for parameter measurements with readout of complete files (e.g. oscilloscope): value of the parameter]
Num_var(13)	Measurement type (Application-Nb.)
Num_var(14)	Measuring device nb.
Num_var(15)	Measuring channel nb.

4.4. File CONF_LISTE

The file CONF_LISTE is used to define settings that deviate from the standard settings in MESSZEIT and HPGRAFIK at the start of the program.

Table 3: Example of a file CONF_LISTE for HP-9000 / RMB

```
! Konfigurationsdatei CONF_LISTE
!-------------------------------------------------------------------------
! Benutzer: RMB Stand (Datum): 2000-12-01
!-------------------------------------------------------------------------
! All lines beginning with '!' are treated as comment lines! and not evaluated.
!-------------------------------------------------------------------------
!
Vorname$=DAT
! Vorname$=ASC
!
! Lin_typ=1
! Stift=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=1
Druckertyp_$=1
Drucker_dir$=/SRM_LASER
Druckerdatei$=DRUCK
Drucker_msi$=:REMOTE 21,2
!
! Disk=0
! Disk2=0
Datendir$=/USERS
```

```
Datendisk$=:REMOTE 21,0
Datendir2$=/USERS
Datendisk2$=:REMOTE 21,0
!
Up_pfad$=/MESSPROGRAMME/SPEZIALPROG
Up_msi$=:REMOTE 21,0
!
Fkt_pfad$=/MESSPROGRAMME/FUNKTION
Fkt_msi$=:REMOTE 21,0
!
Sub_pfad$=/MESSPROGRAMME/SUB_PROGRAMME
Sub_msi$=:REMOTE 21,0
!
Mess_pfad$=/MESSPROGRAMME
Mess_msi$=:REMOTE 21,0
```

Table 4: Example of a file CONF_LISTE for PCs with HTB

```
! Konfigurationsdatei CONF_LISTE
!-------------------------------------------------------------------------
! Benutzer: PC1 Stand (Datum): 2010-12-01
!-------------------------------------------------------------------------
!All lines beginning with '!' are treated as comment lines! and not evaluated.
!-------------------------------------------------------------------------
!
! Vorname$=DAT
Vorname$=ASC
!
! Lin_typ=1
! Stift=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 file is a normal ASCII file that can be viewed and changed with a text editor (for HP 9000 computers e.g. with the editor from HPGRAFIK under item 10). By default, all lines of CONF_LISTE are marked as comment lines by a preceding exclamation mark and are not read. For an active setting, the exclamation mark is removed with an editor and, if necessary, the desired setting is entered after the "=" sign.

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

In the second section, different graphics settings can be preset, which then appear in the graphics menu.

In the third section, a fixed file description text can be preset, which can still be edited before the file is saved.

Interface parameters and printer settings can be specified in the fourth and fifth sections.

The other lines are used to define paths for saving measurement files as well as paths for the program and subprogram files. On HP 9000 computers with RMB, the path and drive must be specified in separate lines. On PCs the path is entered in the path line with a drive letter in front, the MSI line remains empty or is commented out.

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

4.5. Function key assignment file SYSKEY

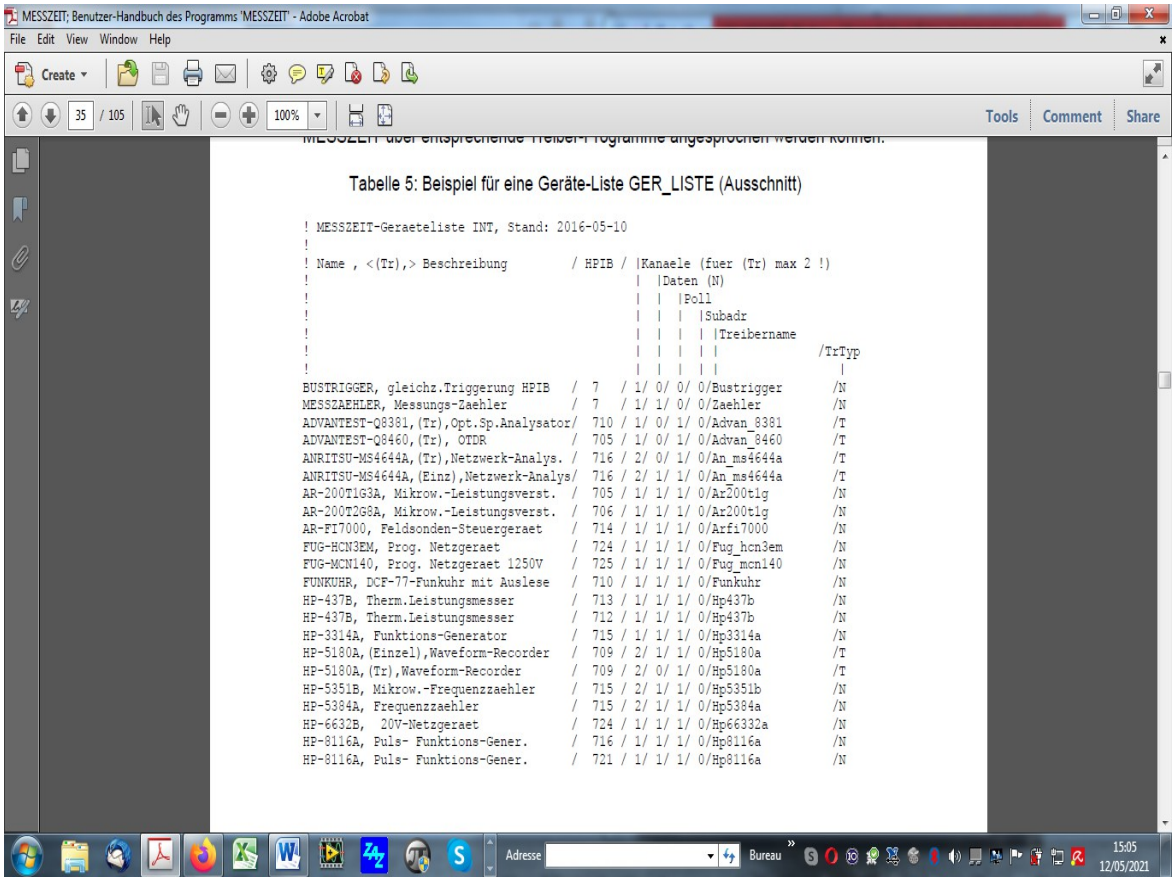
The system-wide assignment of the function keys is usually changed in the MESSZEIT / HPGRAFIK program package so that the program can be started directly via a function key. This assignment is saved in the binary (BDAT) file SYSKEY, the file is created via the AUTOST program. For this purpose it should be similar to the CONF_LISTE for HP-9000 / RMB in the folder / WORKSTATIONS, under HP-UX / RMB-UX in / users / xxx and on PCs with HTB in the HTB program folder.

The assignment can be changed with EDIT <function key> <RETURN>; text input <RETURN> and STORE KEY SYSKEY. This assignment has nothing to do with the function key assignments that appear together with a switch or selection menu and then disappear again.

4.6. File GER_LISTE

The ASCII file GER_LISTE contains a table of all GPIB / HPIB devices that can be addressed by MESSZEIT via the corresponding driver programs.

Table 5: Example of a file GER_LISTE (extract)



It is located in the folder / MESSPROGRAMME / GER_TREIBER and contains the name and a short description for each device, which are displayed in MESSZEIT in the device selection menu. The GPIB bus address and also some program parameters that are included in the selection menu are not displayed. The individual fields are separated by slashes. Lines beginning with an exclamation mark are not evaluated.

The complete list of all available devices (in directory / MESSPROGRAMME / GER_TREIBER / LISTEN / GER_LISTE_A) includes more than a hundred different types. Therefore, a current list GER_LISTE should be created for a measuring station from this overall list by deleting unneeded devices. If necessary, the addresses must also be changed in such a way that no address conflicts occur. A measuring device can also be entered several times with different addresses

4.7. Measurement configurations-Files

The measurement configuration of a MESSZEIT run with all settings can be saved in a configuration file and called up again when the program is restarted. The numbers of the measuring devices called up, the type of measurement (time / parameters), the measuring time tables or the parameter table and the measuring command tables for all measuring devices that are switched on are saved. The file has the name structure CNF <decimal number> and is a binary (BDAT) file that cannot be read by the user without tools. If necessary, it can be read with the
program /MESSPROGRAMME/HILFSPROGRAMME / BTEXT.

5. Basics of measurement with GPIB devices

5.1. Type of GPIB-Device

In the list of available GPIB devices, a distinction must be made between several measuring device classes:

- **Normale Measuring device (N)** , Group 1

  In the event of an action (e.g. AUSLESEN = Reading, MESSEN = Measuring), these provide a measured value (e.g. digital voltmeter, frequency counter, power meter).

  This also includes devices with "sources" (e.g. signal generators, voltage sources). These then return the set value as a measured value (e.g. frequency, voltage, power).

- **Devices without data output**, Group 2, (Example : Relay switch…)

  These devices are addressed via commands, but do not return any measured values. In the device selection discussed later, some of them are nevertheless selected as normal devices (N devices).

- **T- or Tr-Device (T)** , Group 3

  These devices have their own digital memory and mostly also a screen display, e.g. digital oscilloscopes, network / spectrum analyzers. In the event of an action (e.g. AUSLESEN = Read out) they return an entire measured value file.

T-devices such as digital oscilloscopes and spectrum analyzers can often be selected as either T-devices or N-devices. As a T device they return a measured value file when they are read out, and as an N device only one value. This is then specified more precisely in a secondary command (see 5.2.6.), E.g. maximum Y value, cursor value, rise time, period duration, etc.

5.2. Principle of the unified command syntax

One of the main goals of the MESSZEIT program is the ability to define measurement sequences with several measuring devices in the form of a measurement command table. Unfortunately, the various GPIB devices sometimes have very different command syntax, even if there have been efforts to standardize them since IEEE-488.2. The end user is therefore not to be expected to determine the respectively valid command sequence for each device from the manual and to enter it in the table. In addition, actions can often only be achieved by executing several command lines sequentially.

For this reason, MESSZEIT uses its own device driver (subroutine) for each device type, the input command syntax of which is standardized, whereas the communication between device driver and device takes place with device-specific commands. For this purpose, a set of general measurement commands was set up that can be understood by every device driver. Typical measurement commands for the individual device classes are:

- Normal Device (N)

AUSLESEN	Read an (already existing) value
AUSLESEN,2,1,A,2,B	Read two measuring channels
MESSEN	1x Trigger 1x read

- Sources as N devices

FREQUENZ,1,1,145MHz	Setting the frequency and read the value
PEGEL,1,1,-60dBm	Set the level and then read
SPANNUNG,1,1,2.75V	Set a voltage and then read (no comma in the setting!)

- T- oder Tr- Device (T)

AUSLESEN	Read an entire data set in a file
AUSLESEN,2,1,A,2,B	Read two measuring channels in two files
MESSEN 1x triggern,	Trigger 1x, read in file

- Devices without data output

SCHALTEN,2,1,EIN,2,AUS	Switch on 1st channel, switch off 2nd channel

In addition, there are special measurement commands that only one or a few devices can understand.

The measurement command lines have the following structure:

5.2.1. Simple command

<Hauptbefehl>
<Main command>

e.g.	MESSEN	(Measure)
	AUSLESEN	(Read)
	TRIGGERN	(Trigger)
	AUSG_EIN	(Output on)

5.2.2. Command specifying the channel of a device

<Hauptbefehl> , 1 , <Nr. des Geräte-Kanals> , <Zeichenfolge>

*(*Main command>,1,) (No. of the device channel) (String)

e.g. MESSEN,1,1,A Measure with channel 1
AUSLESEN,1,2,B Read channel 2

Character string is irrelevant, but must be present! There must be no comma (,) in the string!

5.2.3. Command for device with several channels

<Hauptbefehl>, <Anzahl Kanäle>, <1.Kanal>, <Zeichen>, <2. Kanal>, <Zeichen>
*(*Main command) (Nb. of channels) (1st channel) (character) (2nd channel) (character)

e.g. AUSLESEN,2,1,A,2,B Read channel 1 and 2

The data are written to different measurement channels (files).

5.2.4. Setting command with specification of the device channel

<Hauptbefehl> , 1 , <Nr. des Geräte-Kanals> , <Einstellung>
*(*Main command) (No. of the device channel) (Setting)

e.g. FREQUENZ,1,1,150 MHz Frequency setting in channel 1
SPANNUNG,1,2,200 mV Voltage in channel 2
ZEIT,1,1,50.E-6 Time in channel 1

If the setting has no dimension the base value is used (V, A, Hz, s, ...). There must be no comma (,) in the setting!

5.2.5. Setting command for devices with several channels

<Hauptbefehl>, <Anzahl Kanäle>, <1.Kanal>, <Einst.1>, <2. Kanal>, <Einst.2>
*(*Main command) (Nb. of channels) (1st channel) (Setting 1) (2nd channel) (Setting 2)

e.g. SPANNUNG,2,1,-24 V, 2,-15 V Set two-channel voltage sources
SCHALTEN,3,1,EIN,2,AUS,3,EIN Control of three relay channels

5.2.6. Command with specification of the device channel and secondary command

<Hauptbefehl> , 1 , <Nr. des Geräte-Kanals> , <Sekundär-Befehl>
*(*Main command) (No. of the device channel) (Secondary command)

e.g. MESSEN,1,1,PEGEL Measure channel 1, before set level (dBm)
AUSLESEN,1,2,FREQUENZ 2GHz Read channel 2, *before set frequency*

The secondary command must not contain a comma (,), semicolons (;) are permitted.
As well for device with several channels

5.3. Command list

The main command is a word from the general command set that can be used to address practically any device. Often, however, not all main command words are implemented in the respective device driver. All device-specific special commands (see device manual) can be accessed via :

EINSTELLEN,1,1,<spezialkommando>

Readout commands:

The following readout commands can be used as main commands. With normal devices, they generate a value pair ((measured value, time) or (measured value, parameter)) in the file of the associated measurement channel, with T devices they read out an entire file from the measurement device and save it on the mass storage device (disk , Network).

These commands are marked with (M) in the command description of the individual measuring devices.

MESSEN	Trigger a measurement and readout (If there are several device sub-channels, see 5.2.3.)
AUSLESEN	Read a device measurement If necessary, the measurement must have taken place in another way, e.g. free-running, using the TRIGGERN command (If there are several device sub-channels, see 5.2.3.)

Data entry commands:

The following data entry commands can also be used as main commands. If the device is a signal source, the setting value is then output as with a read-out command and saved as a pair of values in the associated file. In this case the command is marked with (M) in the device description. In other cases, the entry is only used as a correction value. Then the value is not output again.

WERT or WERT_EIN	Input a value into a device and re-output as a measured value *Entry of a value to a device with sub-channels see 5.2.4. and 5.2.5.*
SPANNUNG STROM PEGEL FREQUENZ LEISTUNG	The entry is made with the usual dimensions or without dimensions (then the standard dimension is used). Syntax according to 5.2.4. or 5.2.5.
INCREMENT_W DECREMENT_W	Increase or decrease a value by the setting value (see 5.2.4. and 5.2.5.)
INCREMENT_U DECREMENT_U	as above for tension
INCREMENT_I DECREMENT_I	as above for intensity
INCREMENT_P DECREMENT_P	as above for level

INCREMENT_F as above for Frequency
DECREMENT_F

Further measurement and setting commands usually do not generate a value pair in the measured value file and are only used for setting. These are described in more detail in the command descriptions for the individual measuring devices. Examples are:

OFFSET_MESSEN
REF_MESSEN
OFFSET
REFERENZ

Typical switching commands are:

AUSG_EIN
AUSG_AUS
SCHALTEN
TRIGGERN
VORBEREITEN
REF_EIN
REF_AUS
OFFSET_EIN
OFFSET_AUS
EINHEIT
MESSFUNKTION
TRIGGERQUELLE
NULL
RESET
LOCAL

These are also described in more detail in the command descriptions for the individual measuring devices.

The secondary commands often have the same wording as the main commands. In contrast to the main commands, a secondary command must not contain a comma (,); any parameters of the secondary command are separated from it by spaces or possibly semicolons. More details can be found in the command descriptions for the measuring devices.

The length of the command line is limited to 80 characters. All commands should be written in UPPER CASE as far as possible, but this is not mandatory in the newer HTB versions. Valid numbers must be entered for all numeric parameters. The character strings (s-parameters) are fixed for some devices and actions, otherwise any strings (e.g. comments) or empty strings can be used. However, a string that is followed by a valid numerical parameter (channel number) cannot simply be omitted.

6. Measurement with GPIB devices, MESSZEIT

6.1. Program-Start

6.1.1. Enter the mass storage standard path (see 3.2)

After the start of the program and selection of the option “**Messung mit IEC-Bus-(GPIB)-Geraeten** = Measurement with IEC-BUS (GPIB) devices" (see fig. 2), the mass storage standard path for the

measurement files is entered first. This is normally already preset in the CONF_LISTE file, but can be overwritten. This path can also be changed after the measurement has been completed and the storage query has been made. The input menu for this path input is described in 3.4.1.

6.1.2. Load a measurement configuration file (CNF file)

A previously saved measurement configuration can then be loaded. This contains the numbers of the measuring devices to be used as well as the tables of the measuring times or parameter settings and the measuring command tables. The configuration files have the prefix CNF (see 4.7.) And are usually saved together with the measurement files, but they can also be placed in their own folders. The procedure for loading the file and for navigating in the file system is the same as for the measurement files (see 3.3 File selection menu). Loading this file is done via option 7 of the MESSZEIT main menu (see fig 18).

6.1.3. Selection of the measuring devices from the device list GER_LISTE

The devices required for the current measurement must be selected from the total number of measuring devices specified in the GER_LISTE file. For this purpose, the numbers of the measuring devices are entered in the input line, separated by commas. The devices will later be operated in the order given by this input line. In particular, the stimulating device must come first in parameter measurements. The device driver programs are then loaded for the selected devices. A device can also be entered multiple times. This is useful, for example, if settings are to be made first during a measuring cycle and then data are to be read out from the same device.

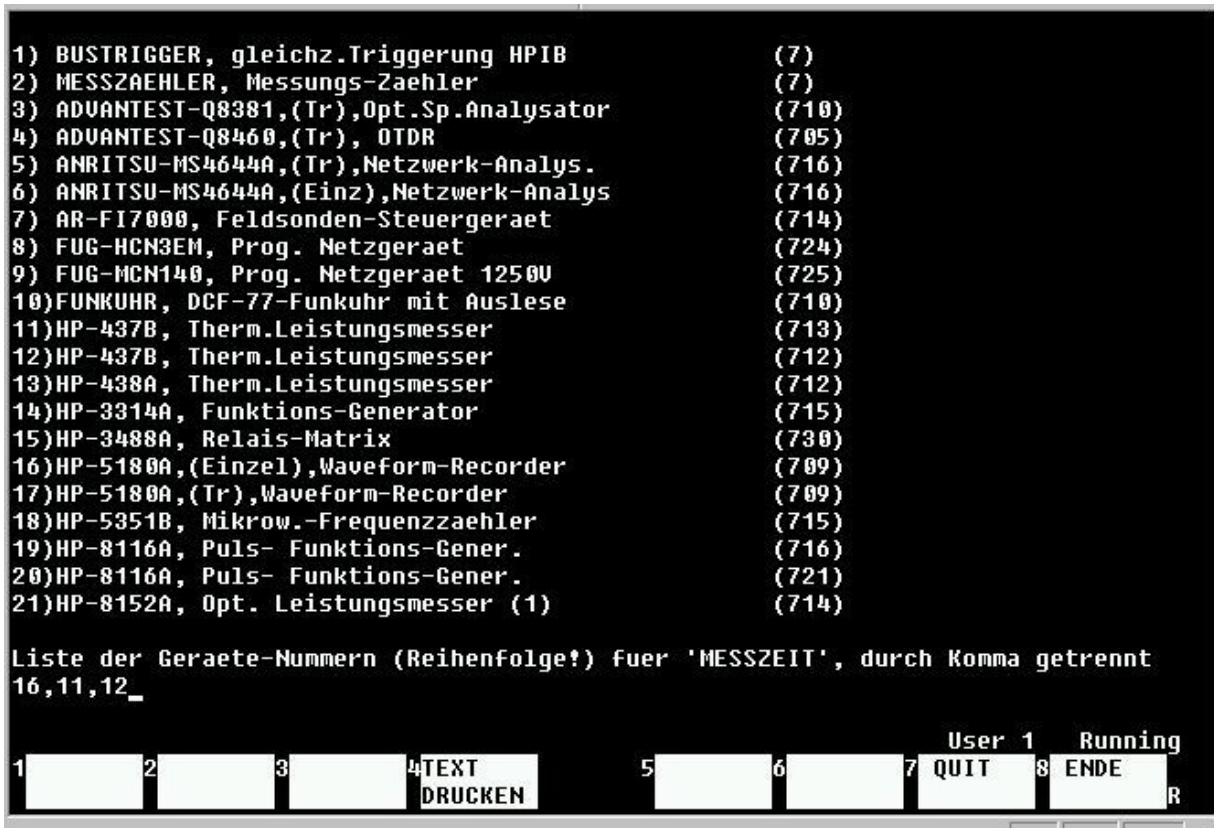


Fig.17 .: Selection of the measuring devices from GER_LISTE file

Liste der Geaete Nummern (Reihenfolge!) fuer 'MESSZEIT', durch Komma getrennt = List of device numbers (in order!) for 'MESSZEIT', separated by commas

It should be noted that although the hardware settings affect selected devices, any settings and data stored in the device driver's software are only valid and accessible for one device at a time. There is no communication between the devices (i.e. the device driver programs), neither between multiple entries of the same device nor between different devices. Exceptions to this are some RF signal generators and some RF power meters, which can communicate the current frequency to one another. More details can be found in the corresponding device driver descriptions.

6.1.4. Selection of the measuring application

At the end of the program start sequence, you will be asked to enter a measuring application (see 4.3.). If an application> 0 is entered, an input menu for measurement-specific information is displayed with each subsequent measurement file saving, which is then additionally saved in the file header.

6.2. MESSZEIT - Main-Menu

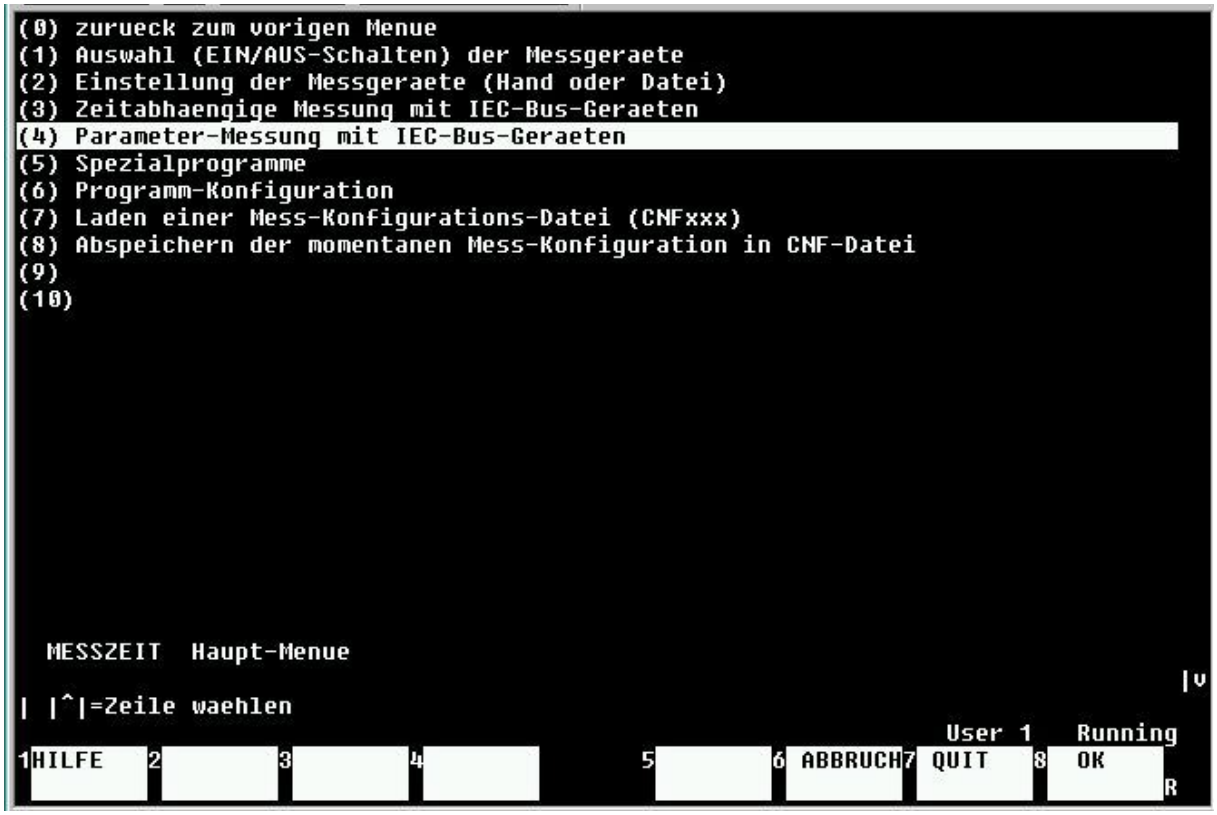


Fig.18.: MESSZEIT – Haupt Menue (Main menu)

Zurueck zum vorigen menue = Back to the previous menu
Auswahl (Ein /Aus schalten) der messgeraete = Selection (switch on / off) of the measuring devices (6.2.1)
Einstellung der messgeraete (Hand oder datei) = Setting of the measuring devices (manual or file) (6.2.2)
Zeitabhaengige messung mit IEC bus geraeten = Time-dependent measurement with IEC bus devices (6.2.3)
Parameter messung mit IEC bus geraeten = Parameter measurement with IEC bus devices (6.2.4)
Spezialprogramme = Special program (6.2.5)

Programm-Konfiguration = Configuration program (6.2.6)
Laden einer Mess-konfigurations-datei (CNFxxx) = Loading a measurement configuration file (CNFxxx) (6.2.7)
Abspeichern der momentanen Mess-konfiguration in CNF-datei = Saving the current measurement configuration in a CNF file (6.2.7)

After the program start sequence has ended, the MESSZEIT main menu appears. All functions of this menu can be executed repeatedly, whereby the number, type and order of the measuring devices is fixed. If this is to be changed, the main menu must be exited the **ABBRUCH** (=CANCEL) command or "0" and the program start sequence must be run through again. The main menu can also be exited in order to carry out a data evaluation with program HPGRAFIK in the meantime (via menu of fig. 2, part "2"). If program part "1" (MESSZEIT) is called up again afterwards and the selection of the measuring devices has not changed, all the settings made in the main menu and the submenus are retained. With the key f1 (HELP) a short help text can be displayed for each menu item.

6.2.1. Selection (EIN (=ON)/AUS (=OFF)) of the measuring devices (Option 1, menu fig. 18)

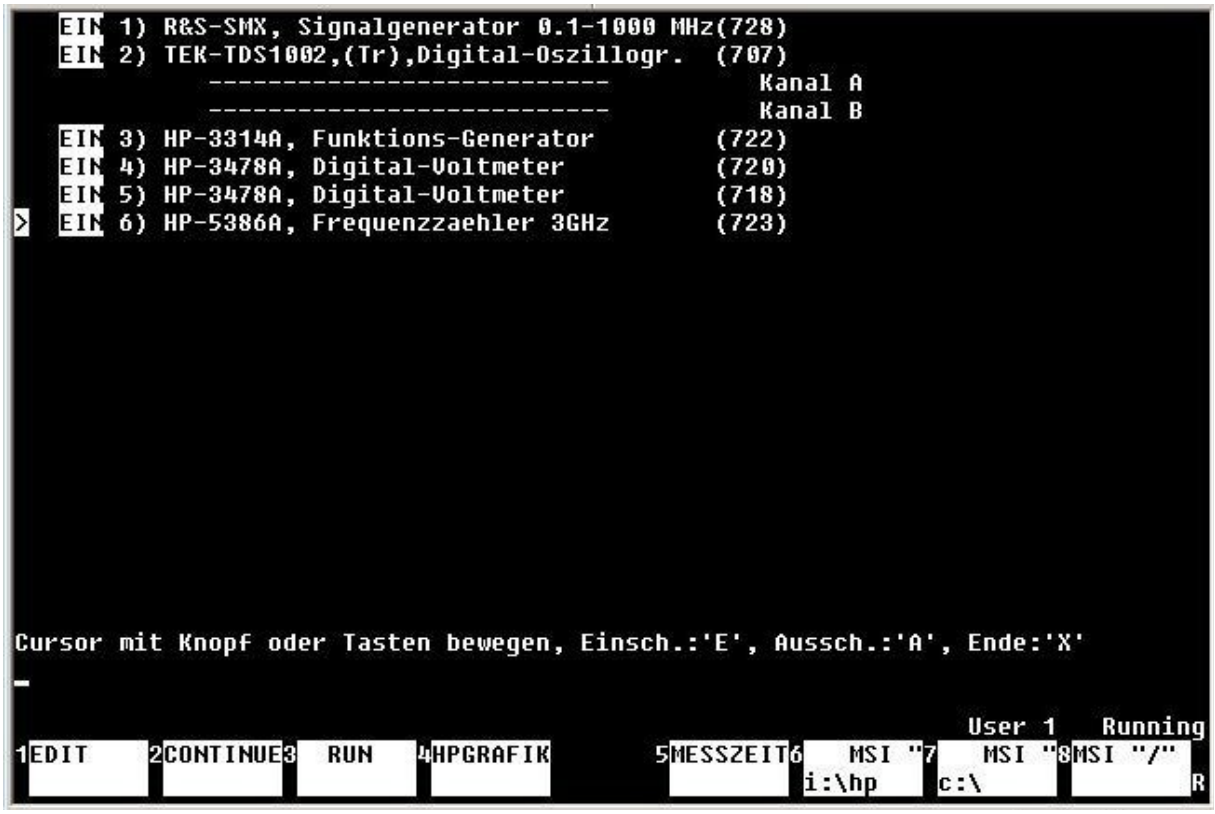


Fig.19 .: Switching the selected devices EIN (=ON) / AUS (=OFF)

Cursor mit knopf oder tasten bewegen, Einsch.:'E', Aussch.:'A', Ende:'X' = Move cursor with knob or keys, In:'E', Out:'A', End:'X'

A certain number of measuring devices were selected at the start of the program. These measuring devices loaded via their drivers now have to be switched on separately. Not all previously selected devices have to be switched on; measurements can also be carried out with a subset. The switch-on status can also be changed within the main menu.

It is switched on by moving the marker to the line of the selected device and pressing the 'E' key. Devices are switched off by pressing the 'A' key. When all required devices are switched on, the

process is completed by pressing the 'X' key. The computer then checks whether all switched-on devices are connected.

If a device has separate GPIB sub-channels (e.g. oscilloscope with programmable channels), these must also be switched on. With other Tr devices with several channels, these are displayed, but do not have to be switched on separately.

If one or more devices are not connected, this is reported. By pressing the <RETURN> key you can then return to the switch-on menu and (after the error has been eliminated) a new switch-on check can be carried out with 'X'. With 'A' or 'Q' the process can be aborted and returned to the calling menu.

6.2.2. Manual setting of the measuring devices (Option 2, menu fig. 18)

In this menu item the measuring devices that are switched on can be set or queried via the keyboard of the control computer. This can be useful if the control computer is located away from the measurement setup. Often, the front panel operation of a device is not understandable and instructions for use are not at hand. In this case it is easier to be able to use a setting menu that looks the same for all devices.

The following actions are possible:

(1) Manual setting of a measuring device via a screen menu
(2) Protocol of a measuring device setting (display on screen or printout)
(3) RESET for all connected and switched on devices
(4) LOCAL (release of the front panel setting) for all devices that are switched on
(5) Query all device settings
(6) Restore device settings

In the manual setting menu, the set values are recorded by the measuring device with the f8 (**OK**) key; the f6 (**ABBRUCH** = CANCEL) key exits the menu without changing the settings. With a number of older measuring devices, the settings cannot be read out from the device. In this case, the menu does not show any settings the first time it is called up; the settings made in the device driver are saved in the software in the case of subsequent calls and displayed again.

6.2.3. Time-dependent measurements mode (Option 3 menu fig. 18)

The task of this operating mode is to carry out actions with (several) measuring devices at regularly recurring times (measuring cycle, sampling time). At each cycle time, the action entered in the command table is carried out for each switched-on device and each sub-channel. If it is a read-out command (see 5.2.) and the device is an N device (see 5.1.), a separate measurement channel with its own measurement file is set up for each device and each sub-channel. At each cycle time, the measured value read out is stored in the respective file together with the time value as a pair of values.

If the device is a Tr device, a whole set of value pairs (e.g. screen content) is read out and saved as a file at each readout time.

Fig.20 .: Specific menu for time-dependent measurements

Zeitabhaengige messungen mit IEC bus geraete = Time dependant measurements with IEC bus devices

The minimum necessary entries are the completion of a time table and a measurement command table before a measurement. Other tables are optional. The contents of all tables are retained as long as the original measuring device selection according to 6.1.3 is retained.

(1) **Messzeiten (intervalle 1-36) = Fill in the time table (1 – 36 intervals)**

Fig.21.: Completion of a time table with the editor

The time table is filled out in the editor screen according to 3.6. A table line is entered in the lower input line, with <RETURN> the content is inserted to the table. To edit a table line, move the line to be changed with the cursor keys in the highlighted selection bar and transfer it to the input line with <TAB>, where it can then be edited. With the key f6 (**DATEI SCHR** = FILE WRITE) the table can be written into an ASCII file for documentation purposes and reloaded into the editor with f5 (**DATEI LESEN** = READ FILE). The editor is exited with **f8** (END) and the table is transferred to the measuring program.

Each line consists of a pair of values <X>, <Y>, separated by commas, whereby X defines the length of a measuring interval in [s] and Y the repetitive sampling time in [s]. This setting, labeled RELATIV, can be changed to the ABSOLUT setting immediately before the editor appears. In this case, X denotes the absolute end time of an interval since the start of the measurement. The standard setting is RELATIV.

If the value of the sampling time is greater than the length of the measuring interval, only one action takes place at the beginning of the measuring interval. No action takes place for sampling time = 0, for negative values the sampling time increases logarithmically from the set value.
Each line in the time table defines a measuring interval with a certain length. Up to 36 measurement intervals with different lengths and different sampling times can be generated under (Option 1 of figure 20).

In the simplest case (only one measuring interval) the time table consists of only one line:

e.g. 120, 5 (for 120s it is measured every 5s)

If several lines are entered, several measuring intervals are defined which are processed one after the other.

e.g. 120, 5 (for 120s it is measured every 5s)
3000,100 (for 3000s is measured every 100s)
10, 11 (only 1x is measured in the interval, since cycle time> interval time)

(2) **Messzeiten (intervalle 37-72) = Fill in a second time table (37-72 intervals)**

In a second time table, further measuring intervals can be set up if more than the 36 intervals in the first table are required.

(3) Messbefehle (intervalle 1-36) = Filling out the measurement command table (1-36 intervals)

Fig.22 .: Completion of a measurement command table with the editor

For each connected and switched on device, a table is filled in which the action is to be carried out during the measuring cycle. The number of lines in the command table of a device corresponds to the number of measurement intervals in the time table. Here, too, the command entered in the input line must be transferred to the table with <RETURN> and then the table must be exited with f8 (**ENDE**).

The individual devices are called up one after the other, while a device is called up, a description of the relevant commands (instructions for use) can be called up with f1 (**HILFE** = HELP).

(4) Ausfüllen einer zweiten Messbefehls tabelle = Filling out a second measurement command table

In a second measurement command table, additional lines can be filled in if more than 36 intervals have been defined in the time table.

(5) Mess-Vorbereitung (Messbefehle vor den Start) = Measurement preparation (measurement commands before the start)

Before starting the actual measurement, settings can be made for each switched-on device using a further measurement command table. To do this, as in (3), the devices are called up one after the other, and a table is filled out for each device. The number of lines is independent of those in (1) - (4), and no entries have to be made. The commands in a table are processed one after the other, no data is saved. This is useful, for example, to switch on outputs before a measurement, to make settings on devices, to define start parameters for values to be changed later or to select certain measurement value dimensions.

(6) Mess-Abschluss (Messbefehle nach den Mess-ende) = Measurement completion (measurement commands after the end of measurement)

As in (5), settings can also be made on each device after the measurement has ended. The tables for the devices are called up one after the other. Here, for example, outputs can be switched off again, voltages or levels can be reset to zero or small values so that the measurement setup is not left in an undesired state after the end of the measurement.

(7) START-/STOP- Bedingungen (conditions)

The actual measurement is normally started by pressing a function key <f1>, and it can also be ended with this key before the measurement time has elapsed. Alternatively, the start of the measurement can also be triggered by a signal on a computer interface. The interface address via which an interrupt can be entered at the start can be specified here.

(8) Eingabe einer Beschreibung vor der Messung = Enter a description before the measurement

When measuring with N devices, a two-line description is requested after the end of the measurement for each file to be saved. If Tr devices with read-out commands are available, their file is saved immediately each time without any further query. In order to save a description in this case, it can be entered beforehand for all subsequent files.

(9) Messung = Start of measurement

The measurement can be started by selecting (9). First, the file name for the file (s) to be saved is requested, with the option of changing the folder specified at the beginning. Then all entered measurement command tables are analyzed for readout commands, and a corresponding number of measurement channels are set up and displayed on the screen.

The actual measurement start is carried out by pressing the function key <f1> (**MESSSTART** = Start measurement). The readings that follow one after the other are displayed on the screen in order to be able to check that the process has been carried out correctly. The measurement usually ends after the times specified in the time tables have elapsed. Before this time, the measurement can be ended with the <f1> (**MESS-ENDE** = End measurement) key or canceled with <f2> (**ABBRUCH** = ABORT). When terminating with <f1>, all measured values recorded up to that point are retained in the files.

If at least one measurement preparation table has been filled out under (5), the display **MESS-VORB** (= Measurement-Preparation) appears as the **f1** key label instead of **MESS-START**. In this case, the <**f1**> key triggers the measurement commands with these tables one after the other, then **<f1>** appears as **MESS-START** (=Start measurement), and the actual measurement can begin with another actuation.

The current screen display of the readout results can be redirected to a printer <**f5**> or the first V-24 (RS-232) interface <**f3**>. However, this is only possible and useful for very slow measurements and with a reliably connected terminal device, since otherwise the entire measurement will be blocked in the event of an error.

After completion of the measurement, a series of queries for the graphic display and storage of the individual measurement channels are displayed, which are further explained in 6.3. The measurement configuration can be saved in a CNF file and a new measurement can then be started directly or returned to the main menu.

(10) Letzte Messung noch einmal auslesen = Read the last measurement again

All measurement data with N devices are retained in the main memory after the measurement has been completed. These can be read out and saved again individually. The respective measuring channel can be taken from the table at the start of the measurement or from the display in (11) or (12). With T devices, a complete file is saved during the measurement, so this is no longer directly available (but can of course be read out again with HPGRAFIK). If the menu item (10) is used on a T device, the current content of the device data memory (screen content) is read out again and can be saved again if necessary.

(11) Kanal-Tabelle auf Bildschirm = Channel table on screen

(12) Kanal-Tabelle auf Drucker = Channel table on printer

The table of the measurement channels for N devices determined under (9) at the start of the measurement can be displayed again here.

(13) Rettung der Ergebnis-Matrix = Rescue of the result matrix

Irrecoverable errors can occur during the measurement, which can lead to the program crashing. Above all, this can be caused by non-reacting measuring devices (incorrect setting, time exceeded, cable fault, etc.). A normal readout of the measurement results is no longer possible after a RESET of the program. However, the contents are still available in an internal matrix of the main memory; they can still be read out via this menu item after restarting the program before a new measurement has been started. The read-out file has one column each for the time and all measurement channels and must be loaded with HPGRAFIK and converted to individual files. This mechanism can only be used for particularly important and non-repeatable measurements.

(14) Test (Handauslösung) = Test (Manual release)

For test purposes, a measurement can also be started with (14) instead of with (9). In this case, the actions in the command lists are not automatically triggered by the points in time in the time table, but individually by hand using a function key. This can be helpful for troubleshooting in measurement setups.

6.2.4. Parameter messung mir IEC bus = Parameter measurements with IEC bus (option 4 of menu fig. 18)

The task of this operating mode is to carry out actions with (several) measuring devices depending on the setting values of the first device, e.g. measuring the RF power of a power meter depending on the frequency of a signal generator or measuring the current of a device depending on the voltage.

For this purpose, the stimulating device must come first when selecting the measuring devices from GER_LISTE (6.1.3.). During the measurement, all devices (including the first) are addressed in the order in which they were selected, as in 6.2.3, and the actions in the command list are carried out. If it is a read-out command (see 5.2.) and the device is an N device (see 5.1.), a separate measurement channel with its own measurement file is set up for each device and each sub-channel. For each step of the stimulating device, the measured value read out is stored in the respective file together with the stimulating setting value as a pair of values.

If the device is a Tr device, a whole set of value pairs (e.g. screen content) is read out and saved as a file at each readout time. The current parameter value is also saved in the header of the file (see 4.2.) in order to enable the file to be assigned to a stimulating value during the evaluation.

Since the stimulating device is also read out at each step, this means that the readout value of the first device is registered in the first measurement channel as a function of the setting value of the first device (redundantly). Normally this first channel does not need to be saved. The file can, however, be useful in individual cases if the difference between the target and actual value is to be displayed in later evaluations.

The actions or readout of the devices during a step take place one after the other at the maximum possible speed, determined by the reaction and readout time of the devices and the bus speed. In some cases, e.g. relay switching, switching sources ON / OFF, transient behavior of measurement objects, a longer waiting time must be planned between the devices. For this purpose, the (pseudo) device "BUSTRIGGER" can be set between two devices, which offers the WAIT command with specification of the waiting time.

The measurement command tables (see below figure 23, the associated menu after selection of the option 4 of the menu figure 18) are entered in the same way as for time-dependent measurements (6.2.3.).

Figure 23 : **Parameter Messungen mit IEC bus geraeten menue** = Menu for parameter measurements with IEC bus devices

In contrast to these, however, there is only one measuring interval, so only one line must be entered in the table for each measuring device.

(1) Eingebe mess parameter = Enter measurement parameters

The first step with this menu is to fill in a source table for the first measuring device. Figure 24 is the menu appearing after selection of option 1 of the menu figure 23.

Fig.24 .: Source table for parameter measurements

Eingabe von Mess-Parameters fuer Parameter-messung = Entry of measurement parameters for parameter measurement

The following are entered:

Nummer des Messgeraetes = Stimulating device number	always 1
Unterkanal des Messgeraetes = Sub-channel of the stimulating device	(e.g. 1; 2; 3...)
Start-Wert = Start value of the source	(e.g. Start-Frequency)
Stop-Wert = End value of the source	(e.g. Stop-Frequency)
Schrittweite = Increment	(e.g. increment)
Dimension des parameters = Dimension of the source value	(e.g. MHz)

The menu is exited with <8> (OK).

(3) Messbefehle = Measurement commands

A command table is then filled out for each additional measuring device as in 6.2.3. (3) (time-dependent measurements). Each table can only contain one row. The table for the first (stimulating)

device is already determined by filling in the source table. It is displayed first, but should not be changed. Typically an entry of the form appears here

INCREMENT_x,1,u,<Schrittwert> . (step value)

(5) Mess-Vorbereitung = Measurement preparation (measurement commands before the start)

An entry is made in the preparation table for the first (stimulating) device by entering the parameters. The input value <start value> - <step size> is entered in order to reach the start value with the first cycle. This entry must be retained, but additional lines with additional preparation commands can be added. There are no restrictions for the following devices.

(6) Mess-Abschluss (Messbefehle nach Mess-Ende) = Measurement completion (measurement commands after the end of the measurement)

The measurement completion commands can be carried out as in 6.2.3. Here, for example, a source can be switched off again or reset to an initial value in order not to leave the measurement setup in an undesired state after the end of the measurement.

(9) Messung = Start of the measurement

The measurement can be started by selecting (9). First, the file name for the file (s) to be saved is requested, with the option of changing the folder specified at the beginning. Then all entered measurement command tables are analyzed for readout commands, and a corresponding number of measurement channels are set up and displayed on the screen.

The actual measurement start takes place in two steps. Since a start value is set in the preparation table of the first device, the display **MESS-VORB** (=Measure preparation) appears as the <f1> key label. By pressing them, the preparation measurement commands are executed one after the other, then <f1> appears as **MESS-START** (=Mesurement start), and the actual measurement can begin with another activation of <f1>.

The value pairs (measured value, source value) are displayed on the screen as in 6.2.3. The measurement ends when the stop value in the parameter list is reached or the measurement has been prematurely terminated with <**f1**> or **<f2**>. The direct storage of T measurement files during the process is also displayed. After the end of the measurement, queries are made for graphic display and storage of the measurement results from the N devices.

All other functions in menus (7), (8), (10) - (14) do not differ from those of the time-dependent measurements (6.2.3.).

6.2.5. Spezialprogram (option 5 menu fig. 18)

Under the menu item '**Spezialprogramme**' (=Special programs) of the main menu, sub-programs for special measuring applications can be loaded, which largely use the sub-program structure of MESSZEIT.

6.2.6. Program-Configuration (option 6 menu fig. 18)

In this item of the main menu, a number of settings for the MESSZEIT program can be made, mainly folders or paths for measurement files and sub-programs as well as the selection of printers.

Fig .25.: Menu Program-Configuration

The **UMGEBUNG** (=ENVIRONMENT) menu (see fig. 26) appears under (1). The folders for reading and saving measurement files can be entered here. A path for this is already requested during the start of MESSZEIT. This path can be changed in the sub-item "(1) **Massenspeicher und Inhaltsverzeichnis (lesen)** (=Mass storage and table of contents (read))" of the **UMGEBUNG** (=Environment) menu. It applies to all operations during the measurement.

The sub-item "(2) **Massenspeicher and Inhaltsverzeichnis (abspeichern)** (=Mass storage and table of contents (save))" is only relevant for the second part of the program (see fig 2 **Auswertung von Daten** (=evaluation of data), HPGRAFIK). In this part, separate paths can be specified for read and write operations.

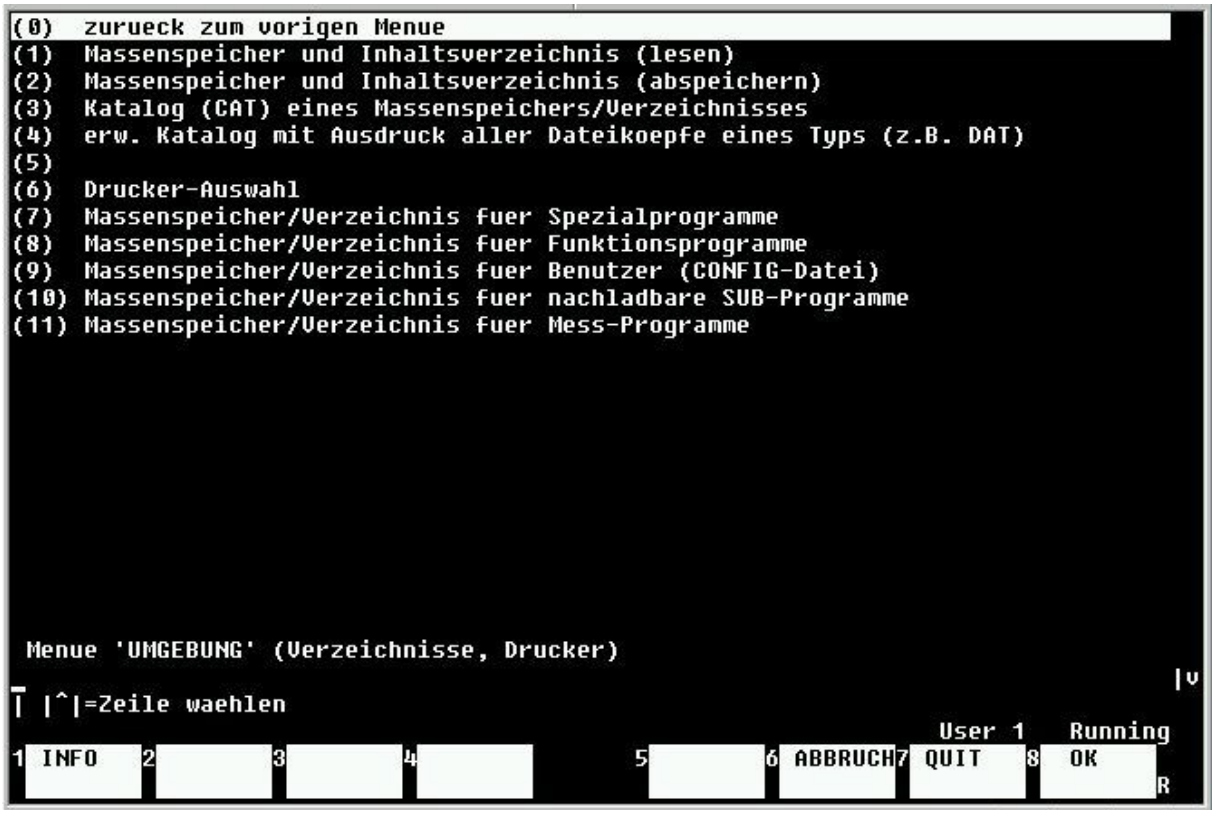


Fig.26.: Menu UMGEBUNG (ENVIRONMENT)

In the menu item "(3) **Katalog eines Massenspeichers** / **Verzeichnisses** (=Catalog of a mass storage device / directory)", a folder structure in menu form can be called up, which is independent of the paths selected in (1) and (2). In this way, a search for files can be carried out independently of the measurement.

The menu item "(4) **erw Katalog mit Ausdruck aller Dateikopfe eines Typs** (=add catalog with printout of all file headers of a type)" enables the description (file headers) of all files in a folder to be printed out. The folder used for this can be selected in a file selection menu (see 3.3.2.). The printout takes place either on the screen or on the printer or in an ASCII text file in the same folder. The name

of this file is preset to " Katalog_" and a serial number. In this way you can quickly create an overview of the measurements in a folder.

Under "(6) **Drucker-Auswahl** (=Printer selection)", the printer can be selected for printing out graphs and tables. This menu appears again in program part 2 (see figure 2, HPGRAFIK) and is explained in more detail there. A HPIB printer appears as the standard setting for HP 9000 computers and the standard Windows printer for PCs with HTB. If possible, these settings should not be changed during measurement operation. Furthermore, all printouts should be moved to part 2 (Auswertung von Dateien = evaluation of files), since a printer that is not working properly can block the measuring operation.

In the menu items (7) - (11) the paths for the subroutines of MESSZEIT can be defined. This is only necessary for a non-standard installation on a different drive or in a different path.

In the menu item "(2) **Verzeichnis fur Gerate-treiberprogramme** (=Directory for device driver programs)" of the PROGRAM CONFIGURATION menu (menu of fig. 25), an alternative path for all device driver programs and the GER_LISTE file can be specified. This can be useful if, deviating from a standard measuring station, you want to temporarily operate another measuring station with different device addresses and possibly other device types. For this purpose, a new folder must be created instead of the ../GER_TREIBER folder, in which a (possibly modified) file GER_LISTE and all required device driver subroutines must be present.

In the menu item "(3) **Definieren einer Mess-anwendung** (=Define a measuring application)" of the PROGRAM CONFIGURATION menu, the selection of the measuring application made when the program was started can be changed later (see 4.3.).

In the menu item "(4) **Planung einer Messung** (=Preparation of a measurement)" of the PROGRAM CONFIGURATION menu, the complete menu (figure 20) " **Zeitabhangige Messung mit IEC-Bus-Geraten** (=Time-dependent measurement with IEC bus devices)" appears again. In contrast to the main menu, however, all entries for the time and measurement command tables can be made here without the measuring devices being connected to the computer. This option was created in order to be able to prepare a larger measurement operation on a second computer while measurements are being carried out on the first computer.

6.2.7. Load and save a measurement configuration files (option 7 and 8 menu fig. 18)

In the main menu of MESSZEIT, a measurement configuration (see 4.7. And 6.1.2.) can be loaded under menu items (7) and (8) or the current configuration can be saved as a CNF file.

6.3. Display of measurement results

After completion of a measurement sequence according to 6.2.3 or 6.2.4, the final result for each channel of each device can be graphically displayed, saved and printed out. The graphic representation corresponds to the corresponding point in the HPGRAFIK evaluation program (see 7.3.). If a measurement is to be discarded as a whole, all further inquiries can be skipped with the first inquiry with "A" (**Abbruch**=abort).

In the graphics settings menu, it is sufficient to leave the setting “(1) **Grafik-Ausgabegerat** = Graphics output device” at “0” (**Bildschirm** = screen) and leave the setting “(2) **Grenzen der Grafik** = Limits of the graphics” at “AUTO”. In this case, the X and Y axes are automatically scaled. The other settings are then not relevant. All other setting options are dealt with in Chapter 7 (**Auswertung gespeicherter**

Daten = evaluation of stored data, HPGRAFIK) and are usually only important there. If possible, the question of how to print out the graphic should be answered with an "N" (see above).

After confirmation, the files are saved in the folder requested before the start of the measurement. If the folder should nevertheless be changed, all questions must be canceled and the measured data must then be read out again under menu item 10 (fig 20 or 23) for time-dependent or parameter measurements.

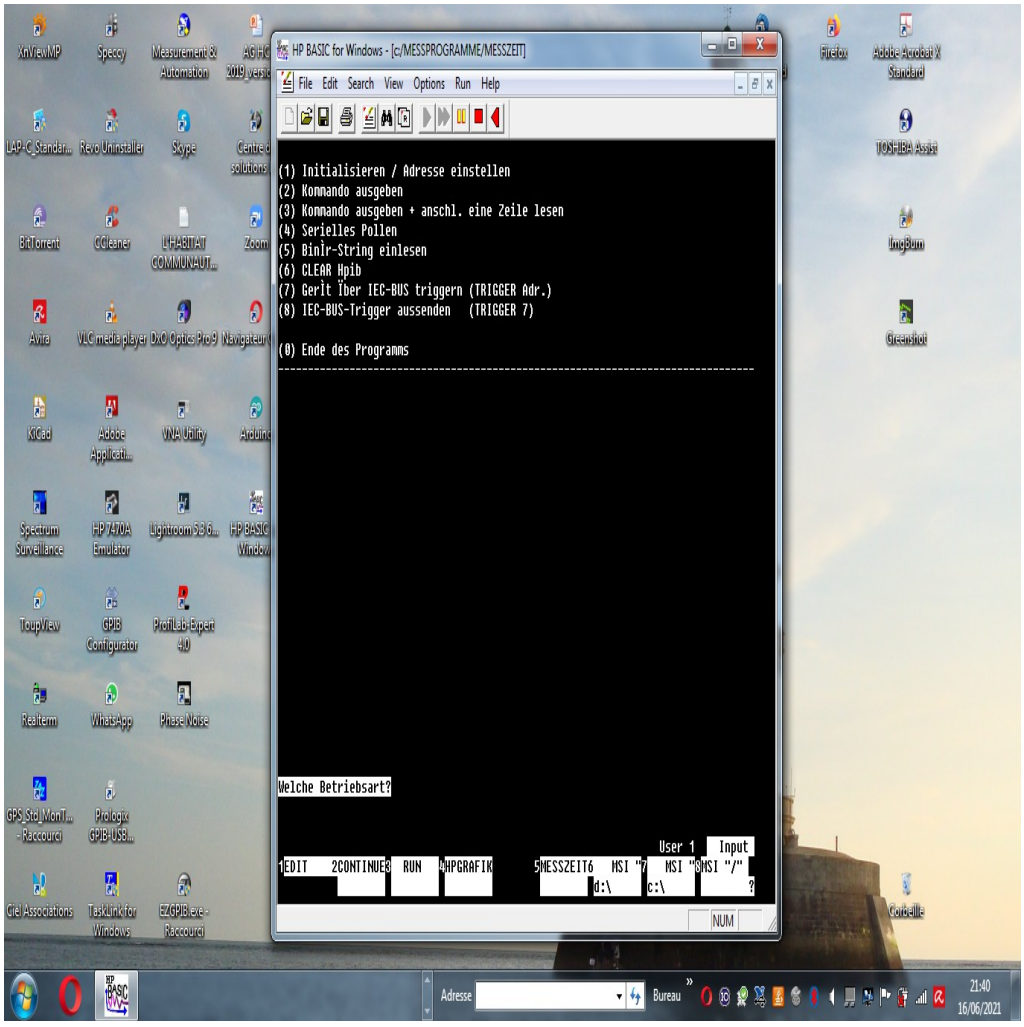
6.4. Immediate readout of screen content from measuring devices

MESSZEIT offers the possibility to display, read out and save the screen content of T devices (oscilloscopes, spectrum analyzers, network analyzers etc.) without filling out any tables for time-dependent or parameter measurements. The devices only have to be selected during the program start and switched on in the main menu.

For this purpose, the menu item "(10, fig. 20 or 23) **Letzte Messung noch einmal auslesen** = Read out last measurement again" is used in the program menus for time-dependent and parameter measurements. This means that a (renewed) readout of the entire measurement currently present in the device takes place for a T device, which can then be displayed in the computer and stored on a data carrier.

8. GPIB-Testprogramm

This simple GPIB test program, which is called when the program is started with "3" (fig 2), enables simple tests even with measuring devices that are not (yet) supported by MESSZEIT. It can therefore be useful for developing device driver subroutines. The associated menu with the following commands are possible (figure 26):



1) **Initialisieren / Adresse einstellen** = Initialize / set address

2) **Komando ausgeben** = Output a command to the device

3) **Komando ausgeben und anschl. eine zeile lesen** = Issue a read command and read the response

4) **Serielles Pollen des Gerats** = Serial polling of the device

5) **Einlesen eines Binar-Strings aus dem Gerat** = Reading a binary string from the device

6) **Rucksetzen des Gerate-Interface (CLEAR)** = Resetting the device interface (CLEAR)

7) **Triggern eines Gerates uber GPIB** = Triggering a device via GPIB

8) **Aussenden eines Bus-Triggers auf dem GPIB** = Sending a bus trigger on the GPIB

Appendix 1

List of Devices supported by MESSZEIT

Pseudo-Geräte:

BUSTRIGGER	gleichz.Triggerung mehrerer HPIB-Gerate
MESSZAEHLER	Messungs-Zahler

Advantest:

ADVANTEST-Q8381	Opt.Spektrum-Analysator
ADVANTEST-Q8460	OTDR

Anritsu:

ANRITSU-MS4644A	Netzwerk-Analysator

AR (Amplifier Research):

AR-FI7000	Feldsonden-Steuergerat
AR-200T1G3A	Mikrow.-Leistungsverst.
AR-200T2G8A	Mikrow.-Leistungsverst.

HP / Agilent / Keysight:

HP-436A	Therm. Hf-Leistungsmesser
HP-437B	Therm. Hf-Leistungsmesser
HP-438A	Therm. Hf-Leistungsmesser
HP-853A	Spektrum-Analysator-Grundgerat
HP-3314A	Funktions-Generator
HP-3437A	System-Digital-Voltmeter
HP-3478A	Digital-Voltmeter
HP-3488A	Relais-Matrix
HP-3577A	Netzwerk-Analysator
HP-5180A	Waveform-Recorder
HP-5316A	Frequenzzahler
HP-5316B	Frequenzzahler
HP-5343A	Mikrow.-Frequenzzahler
HP-5344A	Synchronisier-Einheit
HP-5350B	Mikrow.-Frequenzzahler
HP-5351B	Mikrow.-Frequenzzahler
HP-5352B	Mikrow.-Frequenzzahler
HP-5384A	Frequenzzahler
HP-5385A	Frequenzzahler
HP-5386A	Frequenzzahler
HP-6631B	System-Netzgerat

HP-6632A	System-Netzgerat
HP-6632B	System-Netzgerat
HP-6633A	System-Netzgerat
HP-6633B	System-Netzgerat
HP-6634A	System-Netzgerat
HP-6634B	System-Netzgerat
HP-8116A	Puls- Funktions-Generator
HP-8152A	Opt. Leistungsmesser
HP-8153A	Opt. Leistungsmesser
HP-8158B	Optischer Abschwacher
HP-8340A	Mikrowellen-Wobbelgenerator
HP-8350B	Mikrowellen-Wobbelgenerator
HP-8563A	Spektrum-Analysator (HP-856x)
HP-8569B	Spektrum-Analysator
HP-8593E	Spektrum-Analysator (HP-859x)
HP-8620A	Mikrowellen-Wobbler mit zus. DAC (DELTA-PSC)
HP-8620C	Mikrowellen-Wobbler
HP-8656B	Signalgenerator 0.1-990 MHz
HP-8657A	Signalgenerator 0.1-1040MHz
HP-8657B	Signalgenerator 0.1-2080MHz
HP-8702B	Netzwerk-Analysator opt.
HP-8714ES	Netzwerk-Analysator 0.3-3000 MHz
HP-8720C	Netzwerk-Analysator 0.05-20 GHz
HP-8753A	Netzwerk-Analysator
HP-8753B	Netzwerk-Analysator
HP-8755C	Netzwerk-Analysator skalar mit zus. ADC 59313A
HP-8757C	Netzwerk-Analysator skalar
HP-8901A	Modulations-Analysator
HP-11713A	Abschwacher-/Relais-Treiber
HP-33120A	Arbitrar-Funktionsgenerator
HP-33250A	Arbitrar-Funktionsgenerator
HP-34401A	Digital-Multimeter
HP-34410A	Digital-Multimeter
HP-34970A	Messwert-Erfassungs-System (Digital-Voltmeter/Relais)
HP-53131A	Frequenzzahler
HP-54502A	Digital-Oszilloskop
HP-54720D	Digital-Oszilloskop
HP-59301A	ASCII-Parallel-Konverter
HP-59306A	Relais-Treiber
HP-59307A	VHF-Schalter
HP-59313A	Analog-Digital-Konverter
HP-59501A	Digital-Analog-Konverter
HP-59501B	Digital-Analog-Konverter
HP-66332A	System-Netzgerat
HP-83630A	Mikrowellen-Wobbelgenerator (HP-836x)
HP-83712A	Mikrowellen-Signalgenerator (HP-8371x)
HP-85645A	Mikrowellen-Nachl.generator

HP-81110A	Puls-Generator
HP-DSO6000	Digital-Oszilloskop
HP-E3631A	3-fach-Netzgerat
HP-E3641A	35V-60V-Netzgerat
HP-E4407B	Spektrum-Analysator (E440x)
HP-E4417B	Hf-Leistungsmesser
HP-E4419B	Hf-Leistungsmesser (E441x)
HP-E5062A	Netzwerk-Analysator (E506x)
HP-E8257D	Mikrowellen-Signalgenerator
HP-N1914A	Hf-Leistungsmesser

Keithley:

Keithley-181	Digital-Nanovoltmeter
Keithley-182	Digital-Nanovoltmeter
Keithley-195	Digital-Multimeter
Keithley-197	Digital-Multimeter
Keithley-617	Digital-Elektrometer+Spannungsquelle
Keithley-705E	Relais-Scanner
Keithley-2410	SMU (Digital-Voltmeter + Spannungsquelle)

Ortec:

ORTEC-879	Zahler-Interface
ORTEC-974	Vierfach-Zahler-Timer
ORTEC-996	Zahler-Timer

Philips:

PM5390S	Signalgenerator 9kHz-1 02GHz

Rohde & Schwarz:

R&S-DPSP	Hf-Eichleitung (Abschwacher)
R&S-FSP	Spektrum-Analysator
R&S-FSW	Spektrum-Analysator
R&S-NAP	Hf-Durchgangs-Leistungsmesser
R&S-NGPV	Stromversorgungsgerat
R&S-NRP2	Hf-Leistungsmesser
R&S-NRVD	Hf-Spannungs-/Leistungsmesser
R&S-NRVS	Hf-Spannungs-/Leistungsmesser
R&S-PCW	Code-Converter
R&S-PSN	Relaismatrix
R&S-RSG	Hf-Eichleitung (Abschwacher)
R&S-SMB100A	Signalgenerator 9kHz-20GHz
R&S-SMC100A	Signalgenerator 9kHz-3.3 GHz
R&S-SMDS	Signalgenerator 10kHz-1 GHz

R&S-SMDW	Signalgenerator 10kHz-500MHz
R&S-SME	Signalgenerator 5 kHz -6 GHz
R&S-SMIQ	Signalgenerator 5 kHz -6 GHz
R&S-SML	Signalgenerator 9kHz-3.3 GHz
R&S-SMLU	Signalgenerator 25-1000 MHz
R&S-SMPC	Signalgenerator 5kHz-1.3 GHz
R&S-SMPU	Signalgenerator 50kHz-1 GHz
R&S-SMR	Signalgenerator 10MHz-40 GHz
R&S-SMS	Signalgenerator 0.4-1040 MHz
R&S-SMT	Signalgenerator 5 kHz -6 GHz
R&S-SMX	Signalgenerator 0.1-1000 MHz
R&S-SPN	Nf-Generator 1 Hz-1.3 MHz
R&S-SWP	Wobbler 0.4-2500 MHz
R&S-UDS5	Digital-Multimeter
R&S-URV4	Hf-Millivoltmeter
R&S-URV5	Hf-Millivoltmeter / Leistungsmesser
R&S-UVZ	Relais-Scanner
R&S-XPC	Signalgenerator 5kHz-1.3 GHz
R&S-ZVRE	Netzwerk-Analysator
R&S-ZVB	Netzwerk-Analysator

Tektronix:

TEK-RTD710A	Transienten-Recorder
TEK-CSA803	Sampling-Oszilloskop
TEK-TDS310	Digital-Oszilloskop
TEK-TDS320	Digital-Oszilloskop
TEK-TDS340	Digital-Oszilloskop
TEK-TDS350	Digital-Oszilloskop
TEK-TDS350	Digital-Oszilloskop
TEK-TDS360	Digital-Oszilloskop
TEK-TDS380	Digital-Oszilloskop
TEK-TDS640A	Digital-Oszilloskop
TEK-TDS694C	Digital-Oszilloskop
TEK-TDS784D	Digital-Oszilloskop
TEK-TDS1002	Digital-Oszilloskop (TDS1xxx)
TEK-TDS1012	Digital-Oszilloskop (TDS1xxx)
TEK-TDS2002	Digital-Oszilloskop
TEK-TDS2012	Digital-Oszilloskop
TEK-TDS3014C	Digital-Oszilloskop
TEK-TDS3034C	Digital-Oszilloskop
TEK-TDS3054C	Digital-Oszillogr. (TDS3xxx)
TEK-TDS5034B	Digital-Oszilloskop
TEK-TDS5054B	Digital-Oszilloskop
TEK-TDS5104B	Digital-Oszilloskop (TDS5xxx)
TEK-TDS6604B	Digital-Oszilloskop (TDS6xxx)
TEK-7612D	Transienten-Recorder

TEK-7912AD	Transienten-Recorder

Wandel & Goltermann / Narda:

WG-EMR300	Feldstarke-Messgerat mit RS232-GPIB-Wandler
WG-EMC300	Feldstarke-Messgerat mit RS232-GPIB-Wandler

Sonstige:

ANT-SP-797	LWL-Dampfungs-Messplatz
BIOMATION-8100	Transienten-Recorder mit GPIB-Interf.
BONN-BSA-1001	Hf-Leistungsverstarker
DELTA-PSC44	ADC-DAC fur Netzgerate-Steuerung
FUG-HCN3EM	Prog. Netzgerat
FUG-MCN140	Prog. Netzgerat 1250V
ICS-4823	Parallel-Interface
ICS-4833	Parallel-Interface
ISEL	Drehtisch+Linearantrieb
LDX-3207B	Stromquelle (Laser LED)
LDT-5910	Temperaturregler
NAT-3	Relais-Matrix
Newport-2832	Opt.Leistungsmesser
OMRON-E5CK	Temperatur-Regler
PHD-1975XQ	Opt. Abschwacher
G1000DXC	Yaesu-Rotor mit GS-232B-Interface
SENTINEL-1000FOL	LWL-Uebertragungsstrecke
SIEPEL-GPIB	Modenverwirbelungskammer-Steuerung
TRANS-PC	Transientenrecorder

Appendix 2

Header of the INT standard file

Assignment of the variables in the file header for general applications (application = 0) and for special measuring applications (application> 0)

Without selecting a specific measurement application (application = 0), the following assignments are used. It should be noted that with time measurements and with parameter measurements with storage of an entire file (Tr devices) certain variables can be assigned differently.

Num_var(0)	
Num_var(1)	
Num_var(2)	
Num_var(3)	
Num_var(4)	
Num_var(5)	
Num_var(6)	[some applications: level or other fixed value]
Num_var(7)	[**Parameter measurements** and some applications: start value]
Num_var(8)	[**Parameter measurements** and some applications: stop value]
Num_var(9)	[**Parameter measurements** and some applications: step size (pos) or number of points logarithmic (neg)]
Num_var(10)	[some applications: conversion factor]
Num_var(11)	
Num_var(12)	[for **time measurements** with readout of complete files (e.g. oscilloscope): current time value] [for **parameter measurements** with readout of complete files (e.g. oscilloscope): value of the parameter]
Num_var(13)	Measurement type (application no.)
Num_var(14)	Measuring device no.
Num_var(15)	Measuring channel no.
String_var$(0)	
String_var$(1)	Dimension X-Axis
String_var$(2)	Dimension Y-Axis (1)
String_var$(3)	(Dimension Y-Axis (2))
String_var$(4)	(Dimension Y-Axis (3))
String_var$(5)	(Dimension Y-Axis (4))
String_var$(6)	Dimension conversion factor:
String_var$(7)	[some applications: type of measuring device]
String_var$(8)	Measurement object
String_var$(9)	[some applications: Suppression of the query 'Graphic (J / N)?' and entering a description, String_var $ (9) = 'NEIN']

If a measuring application> 0 is selected, further variables are assigned in the file header. The contents are queried in an input menu before the file is saved and transferred to the variables. In some cases, the description strings of the head are also pre-assigned values from this menu, so that the input / editing of the description can be carried out more quickly.

The subroutines for the measuring applications are located in the folder / MESSPROGRAMME / SUB_PROGRAMME and have the name 'Anwend_ <Nr.>', e.g. ' Anwend_15'. They are called via the further subprogram 'App_ <No.>', e.g. 'App_15'. Both

subroutines are reloaded by MESSZEIT as required. Some of the measurement application numbers have been deleted or blocked for general use in the meantime; these numbers can be re-used by newly written subroutines.

Assignment of the variables in the line header for the application 'fiber optic attenuation measurement' (application_1)

Num_var(0)	
Num_var(1)	
Num_var(2)	Länge der Glasfaser [m]
Num_var(3)	Bestrahlungszeit [s]
Num_var(4)	Dosisleistung [cGy/s] (für TRANS-Messung nicht relev.)
Num_var(5)	Dosis [cGy] (für TRANS-Messung)
Num_var(6)	Wellenlänge [nm]
Num_var(7)	Lichtleistung [uW]
Num_var(8)	Faser-Temperatur ['C]
Num_var(9)	Bestrahlung-Nr.
Num_var(10)	Umrechnungsfaktor
Num_var(11)	
Num_var(12)	
Num_var(13)	Messtyp (für diese Anwendung =1)
Num_var(14)	Messgerät-Nr.
Num_var(15)	Messkanal-Nr.
String_var$(0)	
String_var$(1)	Dimension X-Achse
String_var$(2)	Dimension Y-Achse
String_var$(3)	
String_var$(4)	
String_var$(5)	
String_var$(6)	Dimension Umrechnungs-Faktor (z.B. dB/V)
String_var$(7)	Bestrahlungsquelle (z.B. CO-60, Febetron-X, Febetron-e)
String_var$(8)	Glasfaser-Typ
String_var$(9)	

Assignment of the variables in the line header for the 'Current measurement' application (Application_2)

Num_var(0)	
Num_var(1)	
Num_var(2)	
Num_var(3)	
Num_var(4)	
Num_var(5)	
Num_var(6)	
Num_var(7)	
Num_var(8)	
Num_var(9)	
Num_var(10)	Conversion factor: measuring resistance [Ohm] or converter factor [S]
Num_var(11)	
Num_var(12)	
Num_var(13)	Measurement type (for this application = 2)
Num_var(14)	Measuring device no.
Num_var(15)	Measuring channel no.
String_var$(0)	
String_var$(1)	Dimension X-Axis (Frequency)

String_var$(2)	Dimension Y-Axis (Amplitude)
String_var$(3)	Dimension Y-Axis (2) (Phase)
String_var$(4)	
String_var$(5)	
String_var$(6)	Dimension conversion factor: [Ohm] or [S]
String_var$(7)	Type of transducer (model no.)
String_var$(8)	Measurement object
String_var$(9)	

Assignment of the variables in the line header for the application 'nuclear radiation spectroscopy' (application_3)

Num_var(0)	
Num_var(1)	
Num_var(2)	Ngr
Num_var(3)	Grp
Num_var(4)	Etl
Num_var(5)	Etc
Num_var(6)	Mlc
Num_var(7)	Rna
Num_var(8)	Mrc
Num_var(9)	Rba
Num_var(10)	Stunde
Num_var(11)	Minute
Num_var(12)	Sekunde
Num_var(13)	Messtyp (für diese Anwendung =3)
Num_var(14)	(Messgerät-Nr.)
Num_var(15)	(Messkanal-Nr.)
String_var$(0)	
String_var$(1)	Dimension X-Achse
String_var$(2)	Dimension Y-Achse
String_var$(3)	
String_var$(4)	
String_var$(5)	
String_var$(6)	(Dimension Umrechnungs-Faktor (z.B. keV/Kanal))
String_var$(7)	
String_var$(8)	
String_var$(9)	

Assignment of the variables in the line header for application 4 'wobble measurement '

Num_var(0)	
Num_var(1)	
Num_var(2)	Sondenfläche [m^2]
Num_var(3)	Dämpfungsglied [dB]
Num_var(4)	Abstand Leiter - Sonde [m]
Num_var(5)	Sonden-Abschluss-Widerstand [Ohm]
Num_var(6)	Pegel [dBm]
Num_var(7)	Start-Frequenz [MHz]
Num_var(8)	Stop- Frequenz [MHz]
Num_var(9)	LIN: Schrittweite [MHz]; LOG: -Anzahl der Punkte (neg. Wert)
Num_var(10)	Umrechnungsfaktor: Messwiderstand [Ohm] oder Wandlerfaktor [S]
Num_var(11)	
Num_var(12)	
Num_var(13)	Messtyp (für diese Anwendung = 4)
Num_var(14)	Messgerät-Nr.

Num_var(15)	Messkanal-Nr.
String_var$(0)	
String_var$(1)	Dimension X-Achse
String_var$(2)	Dimension Y-Achse (1), Amplitude
String_var$(3)	Dimension Y-Achse (2), Phase
String_var$(4)	
String_var$(5)	
String_var$(6)	Dimension Umrechnungs-Faktor:
String_var$(7)	Typ der Mess-Sonde ('R','W'=Widerst.|'I','S'=Stromwandler|'D'=Diff.Sonde›)
String_var$(8)	Messobjekt
String_var$(9)	

Assignment of the variables in the line header for application 5 'General wobble measurement'

Num_var(0)	
Num_var(1)	
Num_var(2)	
Num_var(3)	Additional attenuation [dB]
Num_var(4)	
Num_var(5)	Termination resistor [Ohm]
Num_var(6)	Level [dBm]
Num_var(7)	Start-Frequency [MHz]
Num_var(8)	Stop- Frequency [MHz]
Num_var(9)	LIN: Increment [MHz]; LOG: - Number of points (neg. Value)
Num_var(10)	Conversion factor: measuring resistance [Ohm] or converter factor [S]
Num_var(11)	
Num_var(12)	
Num_var(13)	Measurement type (for this application = 5)
Num_var(14)	Measuring device no.
Num_var(15)	Measuring channel no.
String_var$(0)	
String_var$(1)	Dimension X-Axis
String_var$(2)	Dimension Y-Axis (1), Amplitude
String_var$(3)	Dimension Y-Axis (2), Phase
String_var$(4)	
String_var$(5)	
String_var$(6)	Dimension conversion factor:
String_var$(7)	Type of measuring probe ('R', 'W' = resistance | 'I', 'S' = current transformer | 'D' = diff. Probe ›)
String_var$(8)	Measurement object
String_var$(9)	

Assignment of the variables in the line header for application 10 'Probe measurement, missile'

Num_var(0)	
Num_var(1)	(Sonden-Datei)
Num_var(2)	Sondenfläche [m^2]
Num_var(3)	Dämpfungsglied [dB]
Num_var(4)	Abstand Leiter - Sonde [m]
Num_var(5)	Sonden-Abschluss-Widerstand [Ohm]
Num_var(6)	Pegel [dBm]
Num_var(7)	Start-Frequenz [MHz]
Num_var(8)	Stop- Frequenz [MHz]
Num_var(9)	LIN: Schrittweite [MHz]; LOG: -Anzahl der Punkte (neg. Wert)

Num_var(10)	Umrechnungsfaktor: Messwiderstand [Ohm] oder Wandlerfaktor [S]
Num_var(11)	Symmetrierglied-Dämpfung [dB]
Num_var(12)	Geräte-Konfigurations-Liste (GKL) Nr.
Num_var(13)	Messtyp (für diese Anwendung = 10)
Num_var(14)	Mess-Konfigurationsliste (MKL) Nr.
Num_var(15)	Bau-Unterlagen-Verzeichnis (BUV) Nr.

String_var$(0)	Symmetrierglied (Typ)
String_var$(1)	Dimension X-Achse
String_var$(2)	Dimension Y-Achse (1), Amplitude
String_var$(3)	Dimension Y-Achse (2), Phase
String_var$(4)	Pointing-Vektor im körpereigenen System (Px,Py,Pz)
String_var$(5)	E-Vektor im körpereigenen System (Ex,Ey,Ez)
String_var$(6)	Mittelpunkt Testvolumen im körpereigenen System (Mx,My,Mz)
String_var$(7)	Mess-Sonde, Typenbezeichnung, oder ('R','W'=Widerst.|'I','S'=Stromwandler| 'D'= Diff.Sonde›)
String_var$(8)	Sondenposition im körpereigenen System (Sx,Sy,Sz)
String_var$(9)	Sonden-Hauptvektor im körpereigenen System (SHx,SHy,SHz)

Assignment of the variables in the line header for application 11 'Transfer function'

Num_var(0)	
Num_var(1)	
Num_var(2)	
Num_var(3)	
Num_var(4)	Abstand Leiter - Sonde [m]
Num_var(5)	
Num_var(6)	
Num_var(7)	Start-Frequenz [MHz]
Num_var(8)	Stop- Frequenz [MHz]
Num_var(9)	LIN: Schrittweite [MHz]; LOG: -Anzahl der Punkte (neg. Wert)
Num_var(10)	
Num_var(11)	
Num_var(12)	Geräte-Konfigurations-Liste (GKL) Nr.
Num_var(13)	Messtyp (für diese Anwendung = 11)
Num_var(14)	Mess-Konfigurationsliste (MKL) Nr.
Num_var(15)	Bau-Unterlagen-Verzeichnis (BUV) Nr.

String_var$(0)	
String_var$(1)	Dimension X-Achse
String_var$(2)	Dimension Y-Achse (1), Amplitude
String_var$(3)	Dimension Y-Achse (2), Phase
String_var$(4)	Pointing-Vektor im körpereigenen System (Px,Py,Pz)
String_var$(5)	E-Vektor im körpereigenen System (Ex,Ey,Ez)
String_var$(6)	Mittelpunkt Testvolumen im körpereigenen System (Mx,My,Mz)
String_var$(7)	Mess-Sonde, Typenbezeichnung
String_var$(8)	Sondenposition im körpereigenen System (Sx,Sy,Sz)
String_var$(9)	Sonden-Hauptvektor im körpereigenen System (SHx,SHy,SHz)

Assignment of the variables in the line header for application 13 'Mode swirl chamber, CW calibration'

Num_var(0)	
Num_var(1)	
Num_var(2)	
Num_var(3)	

Num_var(4)	
Num_var(5)	Position E-Feld-Sonde
Num_var(6)	Pegel [dBm]
Num_var(7)	
Num_var(8)	
Num_var(9)	
Num_var(10)	
Num_var(11)	
Num_var(12)	
Num_var(13)	Messtyp (für diese Anwendung = 13)
Num_var(14)	Messgeraet-Nr.
Num_var(15)	Messkanal-Nr.
String_var$(0)	
String_var$(1)	Dimension X-Achse
String_var$(2)	Dimension Y-Achse
String_var$(3)	
String_var$(4)	
String_var$(5)	
String_var$(6)	Validierung (Leer|Beladen)
String_var$(7)	RX-Antenne
String_var$(8)	Messobjekt
String_var$(9)	NEIN (Unterdrueckung der Abfrage Darstellen u. Speichern)

Assignment of the variables in the line header for application 15 'Antenna field measurement'

Num_var(0)	
Num_var(1)	
Num_var(2)	RX gain / attenuation [dB]
Num_var(3)	TX-Attenuation [dB]
Num_var(4)	TX cable length [m]
Num_var(5)	RX cable length [m]
Num_var(6)	Generator power P(gen)[dBm]
Num_var(7)	Start-Frequency f(start)[MHz]
Num_var(8)	Stop-Frequency f(stop) [MHz]
Num_var(9)	
Num_var(10)	Distance TX-Ant - RX-Ant X=[m]
Num_var(11)	Position RX-Ant. vert. Z=[m]
Num_var(12)	Position RX-Ant horiz. Y=[m]
Num_var(13)	Measurement type (for this application = 15)
Num_var(14)	Measuring device no.
Num_var(15)	Measuring channel no.
String_var$(0)	
String_var$(1)	Dimension X-Axis, Frequency
String_var$(2)	Dimension Y-Axis, Level
String_var$(3)	
String_var$(4)	TX-Cable (Typ)
String_var$(5)	RX-Cable (Typ)
String_var$(6)	RX amplifier
String_var$(7)	RX-Antenne (Probe)
String_var$(8)	TX-Antenne (Measurement object)
String_var$(9)	Graphic description (JA|NEIN)