

2 Graphical User Interface

2.1 Overview

The graphical user interface is very similar to the widely used standard interface for MS-WINDOWS. This environment permits the user to perform all operations in interactive mode. The dialogs and input masks provide a complete overview of all possible settings, such as file and graphics operations, parameter settings, measuring and analyzing functions, etc. The measurement results can be easily transferred to other WINDOWS programs in tabular or graphical format.

When using the mouse (or the trackball), various functions are very easily accessible by means of the fields in the **Main Toolbar**. The same is true for the **Device Toolbar**, which permits to start the device dialogs (activation in the menu **Options**):



As soon as the mouse cursor rests one second on an icon then an explanation is displayed next to the icon. Note: At that moment the global Windows system keys like e.g. ALT+TAB are not effective.

The **status bar** is used to display short help texts for various menu items:



The background of the main window of the application can be assigned a graphics of the WMF type (Windows Metafile Format), i.e. a vector graphics. E.g. a representation of the test setup generated with a respective graphics program could be displayed there. Any WMF file can be defined as **Background** display via a file selection window.

The graphical user interface contains the following submenus:

- File
- Edit
- Test
- Options
- Window
- Help

The submenus are explained in greater detail in the following chapters.

2.2 Files

The core of the software contains a local database for management of all occurring file types. This data base uses its own file names and file attributes, which are not directly derived from a DOS file system. Thus it is possible to use longer file names and any additional descriptive texts for each database element.

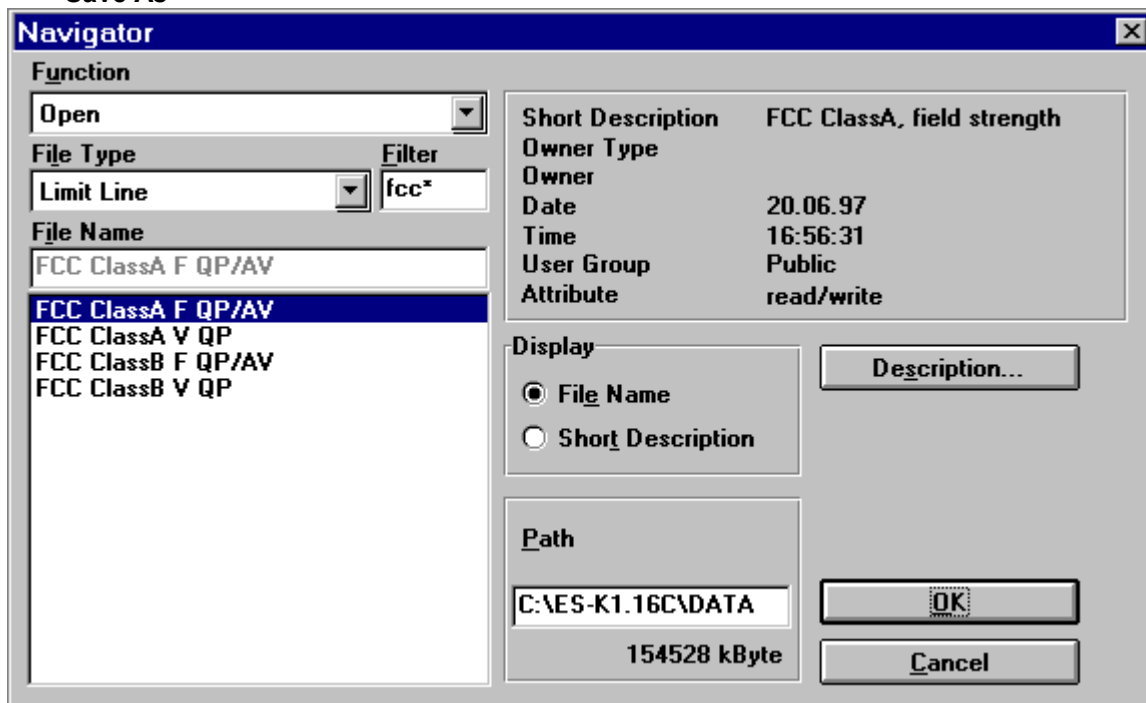
In the following, database elements are referred to as files, however, they are not to be understood in the sense of DOS files.

By exporting database elements, a new external database is created or extended (e.g. on a floppy disk), from where these data can be imported again at a later point in time.

File functions are selected from two **Navigators** in the **File** menu. One Navigator provides functions on the **internal** (local) database whereas the other one offers the functions on **external** (exported) databases.

File functions on the **internal** database:

- Delete
- Export
- Move
- New
- Open
- Rename
- Save As

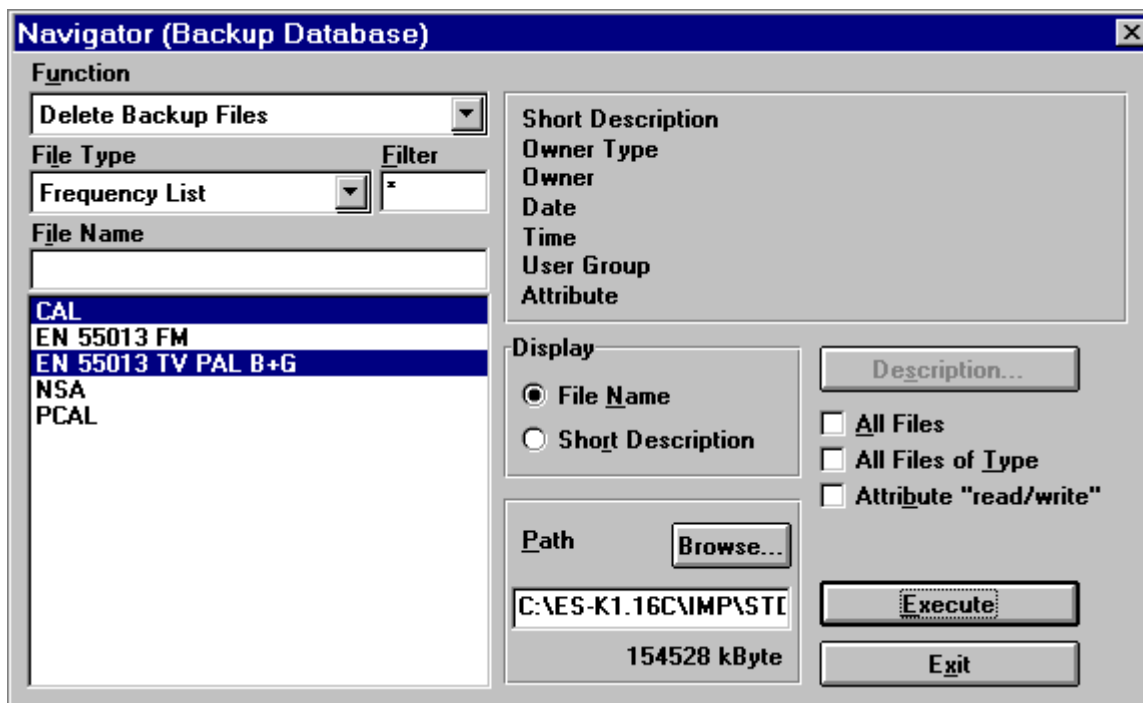


File functions on the **external** database:

- Delete Backup Files
- Import

Note:

File names should not contain special characters and should not start with a blank or an underscore.



The submenu **New** offers all kinds of file types.

Open is possible only with files that already exist.

If a new or existing file of any file type is opened for editing then the matching editor will be automatically loaded.

If a new file has been created or modified, this modification has usually not been stored yet. Using **Save** or **Save As** the file is saved under its existing name or under a new name (in the local database).

Rename simply changes the name of a file.

Using **Delete** a file can be deleted from the local database, unless it can be modified by an editor at this point in time (e.g. an opened graphic). It is also possible to mark several files of the same file type and delete them at the same time.

The function **Export** permits to export files. To this end, a drive must be selected first. The files to be exported are marked and copied to the external database by means of **Execute**; should this database not exist yet, it is newly created there. If retention of the user name is not activated, the file is copied with the attribute Public.

Move means that files are exported and right after deleted. This way it is possible to easily archive data that are currently not being used, e.g. onto a server.

The function **Import** permits files to be copied from external databases to the local database. To this end, a drive must be specified and the required file type selected (depending on the contents of the external database). The individual files can then be marked and imported using **OK**. A prompt protects against unintentional overwriting of the files in the local database.

For **Import** the drive and the directory path can be set by making use of the **Browse...** dialogue. The total pathname will be shown in a text field.

The same is true for **Export** and **Move**. With these functions the pathname can also be edited. If the given path doesn't exist then it will be automatically created with the first file transfer.

Note that the maximum length of the path must not exceed 37 characters.

Export and **Move** can optionally be done in a way so that all transferred files in the external database will have the file attribute *'read only'* thus automatically protecting those files against overwriting. On the other hand **Import** can change the file attribute of all transferred files to *'read/write'* thus enabling immediate editing of those files.

Besides, with **Export**, **Import** and **Move** either all files of the current filetype or the whole source database can be selected for the transfer. This way a complete backup can easily be done (also see filetype 'Test Configuration').

The menu item **Delete Backup Files** is used to delete specific files in an external database (i.e. exported files).

The field **Filter** allows to reduce the displayed file names to those which match the string characters, with an asterisk representing any sequence of characters (similar to MS-DOS wildcards for file names).

The following table shows all available **File Types** including their function:

File type	Function	Editor
Sequence	A sequence of scripts	Sequence editor
Script	An automatic test procedure	Script editor (can only be operated with option ES-K2)
Script Parameters	Definition of script parameters	Script parameter editor
Measurement result	Display of measurement results	Table editor
Graphics configuration	Definition and display of graphics	Graphics configuration editor
Limit line	Definition of limit line	Table editor
Transducer	Definition of probe transducer (e.g. for antenna, absorbing clamp)	Table editor
System transducer	Definition of system transducer (e.g. for cables, paths)	Table editor
Report header	Definition of report header	Report header editor
Report configuration	Definition of report configuration	Report configuration editor
Scan table	Definition of scan table	Scan editor
Sweep table	Definition of sweep table	Sweep editor
Frequency list	Definition of frequency list	Table editor
Test configuration	Definition of files belonging to a test	Test configuration editor
Text file	Definition of a description text	Text editor

The associated files are displayed in the selection window **File Name**. When a file is selected (when a letter is entered, the mark slips to the first file with the same initial, if provided), file-specific information is output in an extra field. This information is user-defined and can be edited by clicking on the key **Description** (see below).

In a further field, the drive (belonging to the local database) and the available storage capacity are displayed.

OK is used to check the entries; when a file is created or opened, the respective editor is loaded. **Abort** closes the dialog window without saving the settings.

The key **Description** permits to edit specific file information. The following dialog window appears on the screen:

The user may enter the purpose of the file in the editable field **Short Description**. For a detailed description, use the input field below.

The access status of the file ("read/write", "read only", "not removable") can be set in the window **Attribute**.

The window **Owner** refers to a fixed reference of the respective file, at the moment only for script parameter sets. It indicates with which script the respective parameter set is connected.

In the text field **Application Info** the user name of the original user of the file is additionally recorded; this text field cannot be edited.

With **User Group**, the file is either assigned to the user group which includes the original user of the file, or defined as "Public", i.e. generally accessible.

OK is used to check and save the settings, **Abort**, on the other hand, ignores them; in both cases, the window is closed.

Close (menu **File**) is used to close an open text file or graphics configuration, which means that it is no longer available for processing for the time being. If the file has been modified, the user is asked whether he wishes to store the modifications in the file. Without storage, the modifications will be lost for good.

2.3 Filetypes

2.3.1 Script

A script constitutes an automatic program run which is controlled by the program text (FSL = Flexsys Script Language; similar to the programming language PASCAL) (Interpreter). Thus, almost all functions that are accessible in interactive mode can be automated so that even complex measurement runs can still be operated and reproduced.

Generation or modification of a script is performed by the script editor of the script development environment (Option ES-K2); it also permits to execute scripts in single steps and inspect variables (debugger).

2.3.2 Script Parameters

A script can be assigned parameters. The script parameters can be edited directly or when the script is started and can be stored as a complete parameter set. Various parameter sets can be created for each script that uses script parameters. During execution of a script, all parameters are constant, i.e. they cannot be changed any more.

2.3.3 Sequence

A sequence describes a sequence of automatic program runs or scripts. If the individual scripts are executed without user interaction, very complex measurement tasks can thus be handled fully automatically.

2.3.4 Measurement Result

A measurement result (trace) consists of a list (thousands of lines are possible) with columns for frequency and level. A measurement result is produced by functions such as scan or sweep, which is why the name of the respective scan or sweep table is also recorded internally.

2.3.5 Limit Line

Complying with a specification, limit lines are frequency-dependent maximum values for measured values, displayed as lines. They are defined as frequency/level pairs, the level being assigned the required unit.

2.3.6 Transducer and System Transducer

Since the measuring instruments only measure the voltage at the input, the measured values must be corrected in order to take into account the frequency characteristic of sensors and cables.

The (probe) transducer describes the frequency-dependent correction (represented as frequency/level pairs) of sensors, i.e. antennas, current probes, etc., the associated level unit (dB μ V, dB μ A, dB μ V/m, etc.) having to be specified for the transducer.

System transducers, on the other hand, are correction values (frequency/level pairs) with the unit dB, defining the frequency-dependent characteristics of cables, amplifiers, attenuators, power dividers, etc.

Note:

When opening a transducer file then a so called "source unit" will be displayed which cannot be modified. It is the level unit found at the input of the measuring instruments, dB μ V with EMI measurements.

2.3.7 Graphics Configuration

A graphics configuration describes the appearance of the graphics (always level versus frequency). Thus frequency range and level range are defined on the one hand and the elements to be displayed such as traces, limit lines, transducers with type of display and colour on the other hand. Furthermore, marker, deltamarker or legend are determined here.

2.3.8 Report Header

The report that is part of the test typically contains various specifications that are relevant to the test. This includes e.g. test conditions, test site, designation of the EUT or name of the user. This information is recorded as report header.

2.3.9 Report Configuration

For generation of a test report, a report configuration is used, which permits to vary the appearance of the report. It permits to define a combination of e.g. report header, graphics and measurement results which is to be included in the printout with this report configuration.

2.3.10 Scan/Sweep Table

A scan or sweep is used to record a section of the frequency spectrum.

In the case of a **Scan**, the test frequency is repeatedly increased by the defined step size (or, as an alternative, set to the next frequency of a frequency list), and a (peak and/or average) level is measured until the end of the specified frequency range has been reached. Depending on the specifications, a single sweep may contain thousands of test points. A scan is usually a time-consuming procedure, however, it permits to measure the spectrum in detail.

Contrary to this, a **Sweep** (only with analyzers) permits fast measurement of the spectrum (only with the PEAK detector): the spectrum is also measured completely, however, with a limited frequency resolution of e.g. 900 pixels per sweep. This resolution is usually not sufficient to analyze the spectrum thoroughly. Sweeps therefore constitute an appropriate means for obtaining a fast overview of the spectrum, whereas scans are required for a detailed analysis, not least because of the detectors defined in the specifications.

All test parameters required for a scan or sweep - e.g. the setting of the attenuation, test bandwidth or correction values to be used - are defined in a scan/sweep table which must always be selected for such a measurement run.

2.3.11 Frequency List

A frequency list serves various purposes. It may be used, e.g., to display a list of ambients at an open-area test site, but also to list critical frequency points of a EUT, which are to be measured by means of a frequency list scan.

2.3.12 Test Configuration

The filetype Test Configuration provides a link between files to export, move or import these files bundled. For instance, a Test Configuration could contain a link to all those files that belong to a test or to a test series.

Besides it is possible to create a kind of "test template":

On a server (in a directory that can only be read) there could be a number of test configurations including all the linked files, ready for use with the Import function. By importing of one of those Test Configurations, all files that are necessary to run a test (e.g. scan tables, transducers, limit lines, scripts) could then be transferred into the local database.

Using the same Test Configuration - extended by the measurement results - could then enable to export or move all the files from the test into a certain directory on e.g. a file server.

A Test Configuration is a kind of bracket around selected files with those files being listed only, i.e. without the file contents. Through exporting, moving or importing of a Test Configuration those files listed inside will also be transferred.

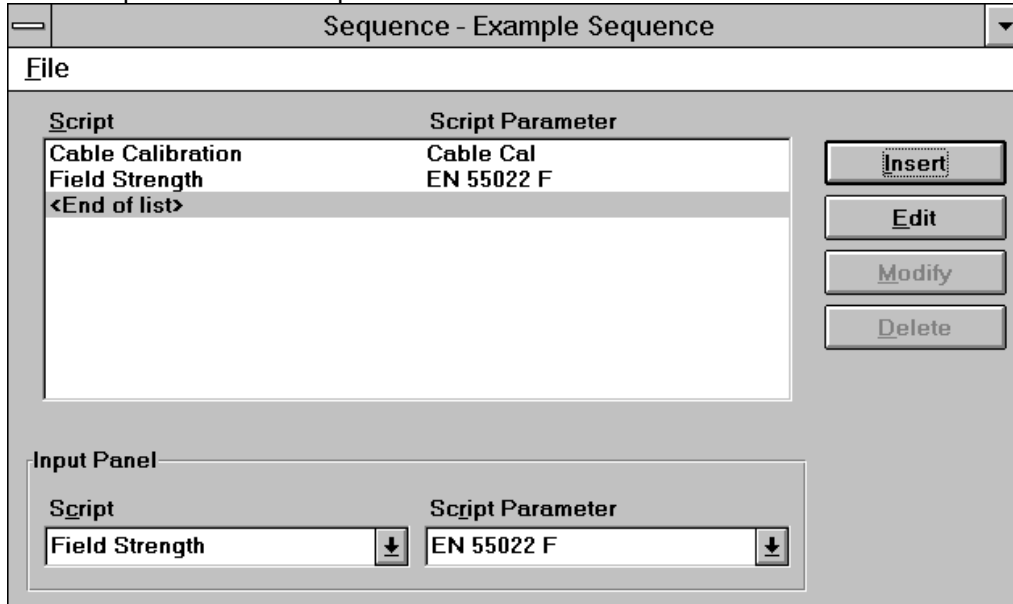
2.3.13 Text File

The filetype Text can hold any kind of text or comment (max. 30000 characters) that shall be part of the application's database. Text files can be directly printed, be stored as a DOS text file (default extension is .LOG) or be part of a test report.

2.4 Editors

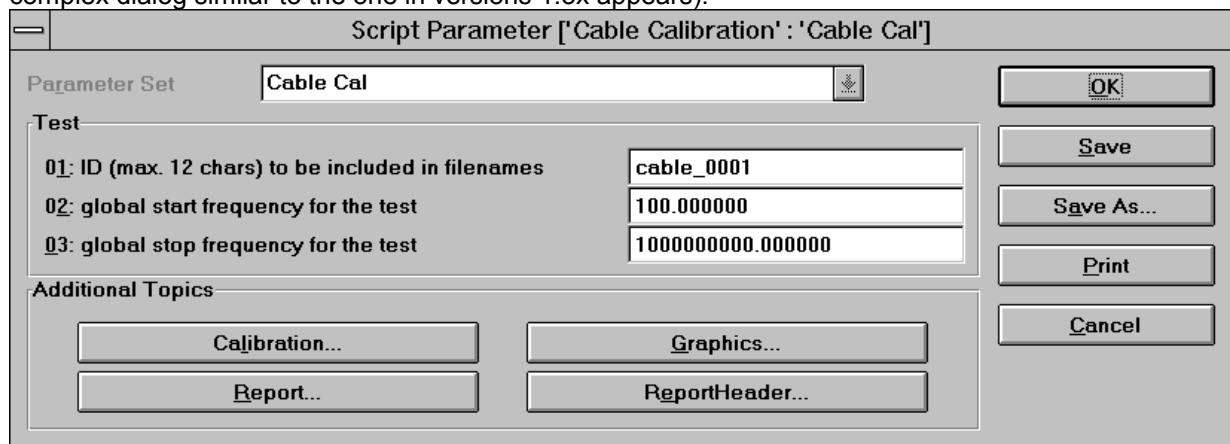
2.4.1 Sequence Editor

The sequence editor is used to define a sequence for execution of the scripts. A sequence of scripts with a defined parameter set each can be entered in a list.



2.4.2 Script Parameter Editor

If a script parameter set or a script containing script parameters is opened, the following dialog is displayed (only with extended syntax for the parameter definition; without extended syntax, a less complex dialog similar to the one in versions 1.3x appears):



The heading of the dialog contains both the name of the associated script and the name of the selected script parameter set. The parameter set to be used is set using the selection menu at the very top of the dialog window. The main parameters are shown below, the short description at the left and a select or edit element at the right. In the lower area of the dialog, additional keys for further topics can be offered depending on the syntax of the associated script. Thus, further groups of parameters are accessible.

The total script parameter set can be stored (maybe under another name) or printed out by means of **Print**. If a script has been started, it is actually only run after the dialog has been left (the last modifications are saved using OK or ignored using Cancel), unless the run is interrupted by means of the additional **Stop** key.

Notes:

If a new parameter set is to be created using **New...**, an existing script must be defined as **Owner** in the dialog **Description...**

If new parameters are added to a script, the old parameter set remains compatible. The additional parameters are assigned their standard values.

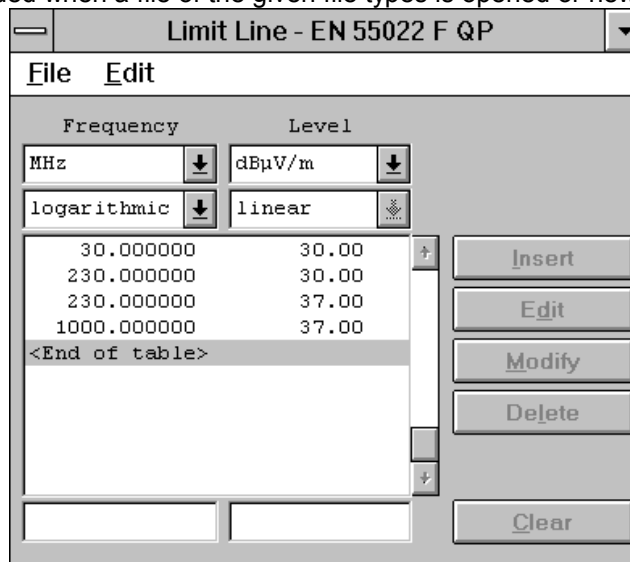
If parameters are deleted from a parameter set, the parameter set can still be used.

If a script is deleted, all parameter sets assigned to the script are deleted as well.

2.4.3 Table Editor

The table editor permits the user to generate or modify frequency lists, limit lines, measurement results, probe transducers and system transducers.

The editor is always loaded when a file of the given file types is opened or newly created.



The dialog window is divided into three areas. The upper area contains the selection window, where the user may define e.g. units. The table contents are displayed in the middle area. The lower area contains input fields.

The frequency unit is always offered, whereas a level unit is not available for frequency lists. The intermodulation mode for the frequency can be set to linear or logarithmic for limit lines and transducers (interpolated lines with linear or logarithmic display). The source unit is always dBµV (in the case of transducers), the correction level unit is always dB for system transducers.

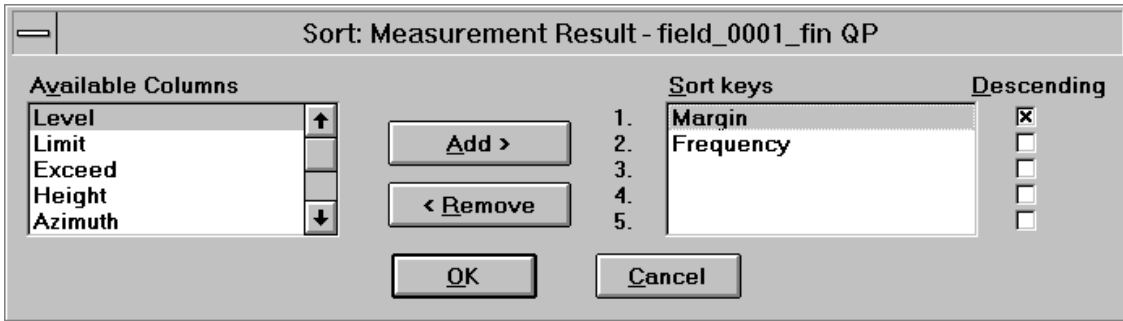
The lower input fields permit to enter new lines, which can be inserted into the list ahead of the active line using **Insert**. As an alternative, the active line in the list can be overwritten by means of **Modify**. **Edit** (or a double-click) permits to copy the contents of the active line into the input fields. The active line can be removed from the list by means of **Delete**, which causes the next line in the list to become active.

Copy permits to copy the complete contents into the clipboard. If particular lines have been selected (marked), only these are copied. Thus data can be very easily transferred to other applications.

The menu item **Print** permits the complete list to be directly output to the printer without the need for a report configuration.

The **column layout** can be extended (**Add Column...**) or modified (**Modify Column x...**) in various ways: Up to ten columns can be represented, the elements of which can be edited almost at will (the file types limit line, transducer and system transducer require rising frequencies). Added columns can again be deleted "from back to front" (**Delete Column**). The longer one of the two headings determines the width of the column. Possible file types are floating-point numbers, integers or character strings (max. 15 characters); a large number of physical units is available for the unit of numerical values.

For **Sorting** of lists (only for file types measurement result and frequency list), a very flexible window dialog is available:

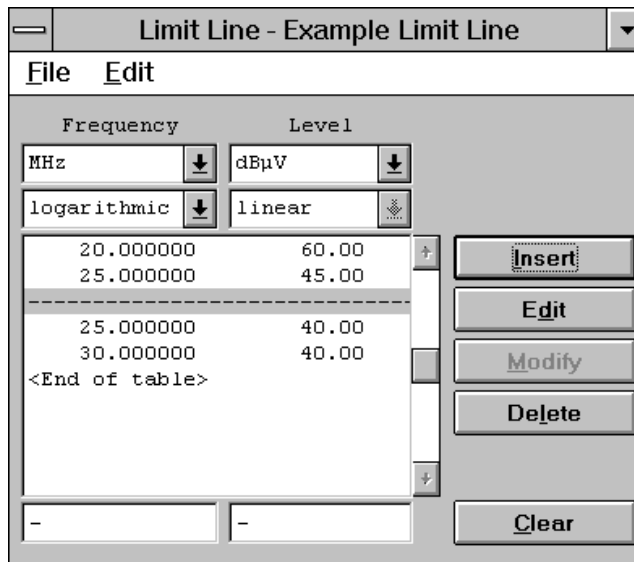


Up to five columns can be defined as **sorting keys** (decreasing priority) with optionally rising or falling values for the elements. Measurements which are not sorted with rising frequency, however, should not be displayed with line graphics display, since the sequence in the list is valid for the graphics.

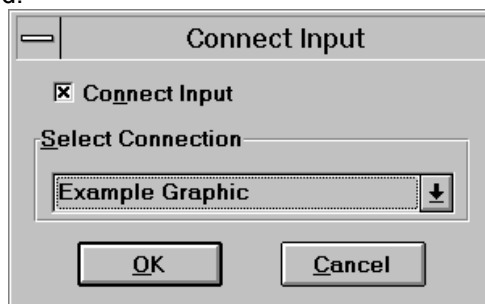
The columns described in the left field can be selected individually and entered or added as sorting criterion by means of **Add**. Likewise, they can be removed again by means of **Remove**, the subsequent entries being shifted accordingly.

Sorting is always accomplished with falling values if the associated select box has been marked, otherwise, rising values are used. **OK** starts the sorting procedure.

The file type **Limit Line** also permits to define gaps by entering just a minus sign into the edit fields for frequency and level:



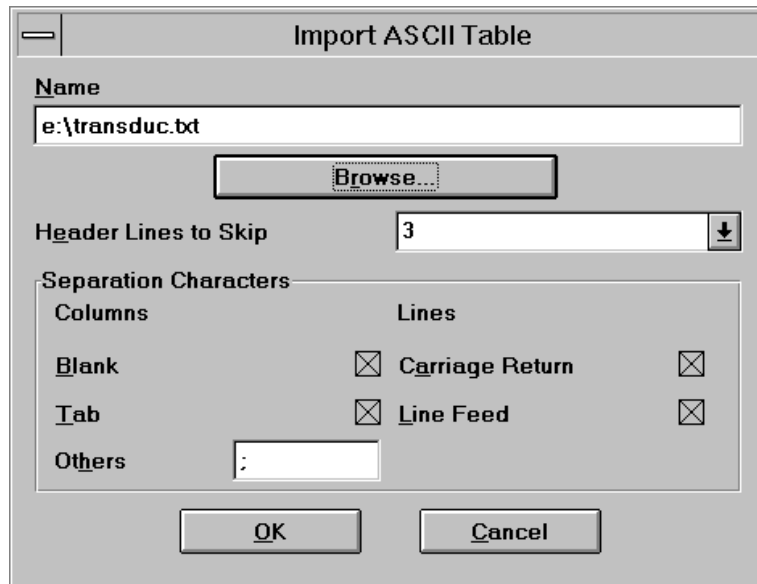
The file type **Frequency List** is provided with a special function which allows comfortable editing of a frequency list: **Connect Input...** determines from which of the opened graphics the marker frequency is to be transferred to the edit field:



If there is such a connection, the frequency is continuously updated in the edit field of the frequency list when the marker is shifted.

Data lists are often available as files. For example, ever more antennas are delivered along with a floppy disk that contains the correction factor as a DOS (text) file in an ASCII format. Such a list can be easily transferred into the ES-K1:

When creating a new table file (transducer, system transducer, limit line, measurement result list, frequency list), then the empty columns (including those that are added) can be filled with the content of the ASCII file. Before starting the import, the units for frequency, level, etc. have to be selected according to those in the ASCII file. By selecting **File => Import ASCII Table...** the following dialogue comes up:



The DOS filename (including pathname) of the ASCII file to be imported has to be entered in the field *Name*. Alternatively the file can be searched in the file system by pressing **Browse...**. The number of header lines to be skipped enables to ignore those lines that include header information - therefore a modification of the ASCII file is not necessary.

The type of separators between numbers as well as between lines has to be defined. Separators between numbers are blanks (spaces), tabulators or any other user defined character; carriage return or line feed can be selected as line separators. Characters that cannot be part of a number will be ignored until a valid field separator will be found. For example, a line like

```
+5.6789E+007MHz +2.345E+001dBµV/m 3:45p.m.
```

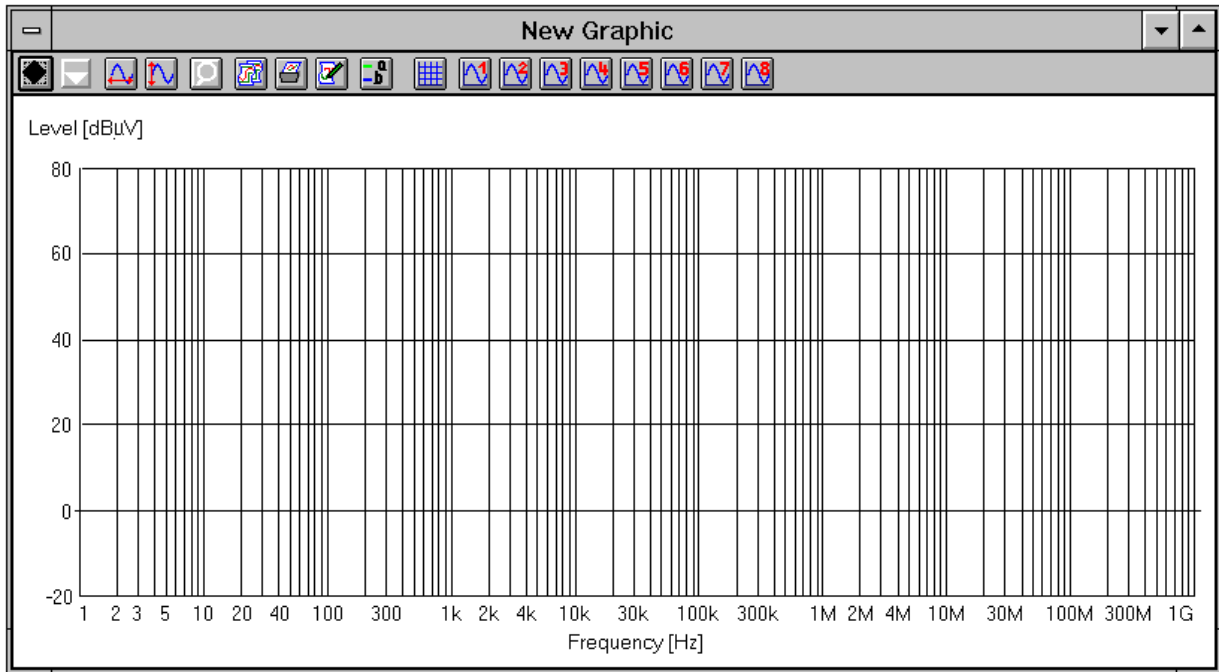
will be correctly be interpreted if there is an extra string column defined.

If a column within a line cannot be filled then this will be indicated with an asterisk.

2.4.4 Graphics Configuration Editor

This editor permits the user to generate or modify a graphic. Graphics are used for presentation of the measurement results. To this end, a number of functions such as Zoom, Marker, Legend and Element configuration are available.

If the editor is loaded via **New...**, a standard value is assigned to each element and a standard graphics appears on the screen.



The name of the graphic is indicated in the heading of the dialog window. The dialog window is divided into two areas. The upper area contains the function bar for configuration of the graphics elements. Up to 8 trace elements can be edited independently of each other. The lower field displays the configured graphics. A complete graphics configuration comprises the elements grid, traces 1 to 8, marker and legend. All graphics settings are accessible via the menu item **Edit**.

The status information on marker and delta marker are then displayed in the graphics window above the diagram.

Grid 

The function **Grid...** permits the user to configure the grid on his own.

Value range, unit and label can be selected for the two axes separately. Besides, the scale type of the X-axis may be defined as linear or logarithmic, whereas the Y-axis is always linear. In addition, the dialog permits to set the colour of the grid as well as to fade out the horizontal or vertical lines.

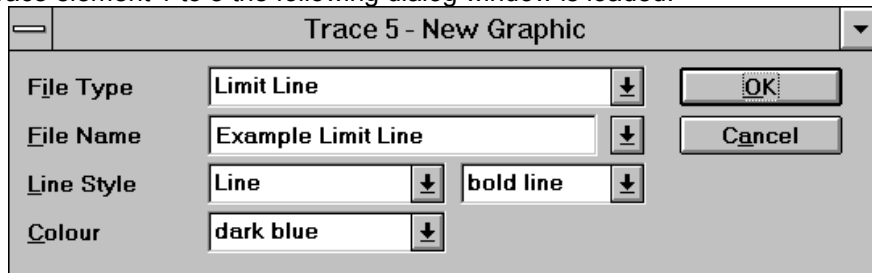
The frequencies of a diagram can easily be modified through shortcuts for the frequency units. A frequency of e.g. 300 MHz can be entered as *300M*.

The line style of the diagram grid can be selected. A dotted line for example makes it easier to recognise horizontal limit lines as well as harmonic signals from a quartz oscillator.

The (linear or logarithmic) display of voltages is also possible.

Trace  ... 

Using the function **Trace x...** the user can determine the graphics configuration on his own. When selecting the trace element 1 to 8 the following dialog window is loaded:



Possible **File Types** for the display are measurement result, limit line, probe transducer and system transducer. The appropriate file is selected in the field **File Name**; the trace can only be displayed if the level unit corresponds to that of the diagram.

The alternative type of trace “constant” is used to display a horizontal line; instead of a file name, the associated level will be entered then.

The line style and the colour can be set for each trace; various options are possible for line and dotted display.

Note: The active traces are always drawn „from back to front“, i.e. trace 8 is always at the very bottom (but still on the grid), trace 1 is always at the very top.

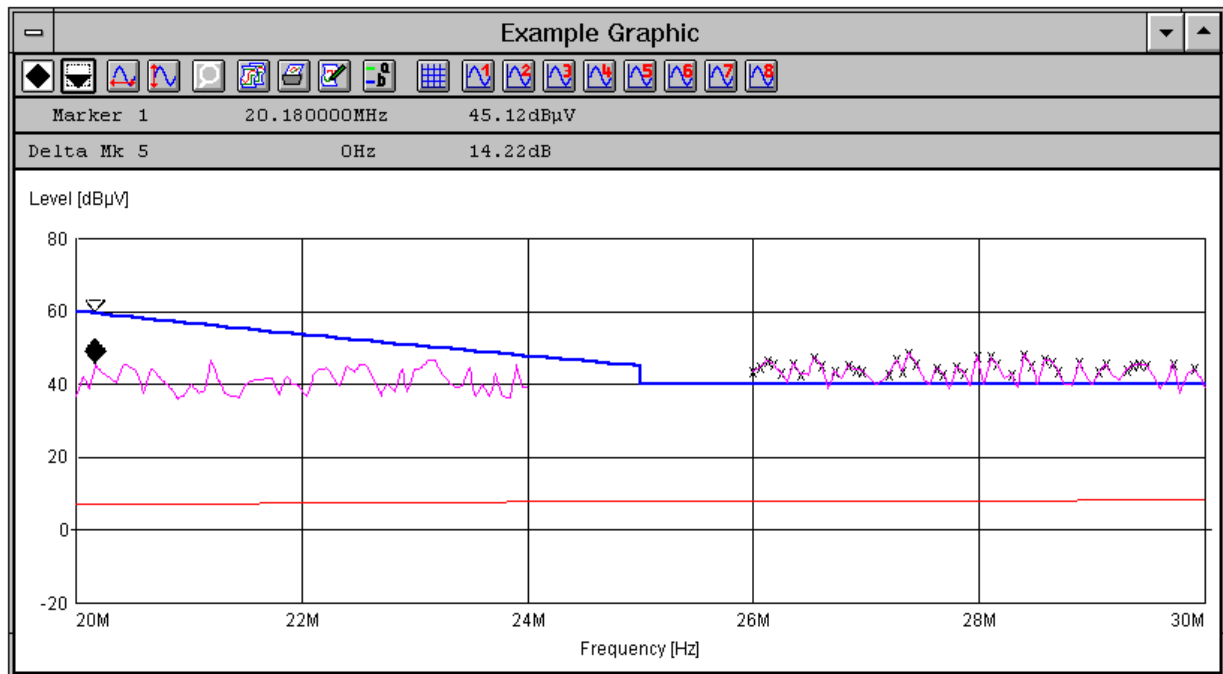
Autoscale X , **Autoscale Y** 

Automatic scaling of the graphic - for the two axes separately - leads to a complete display of all displayed traces. The associated value range of the grid is changed accordingly.

Marker , **Deltamarker** 

The functions **Marker** and **Deltamarker** permit the user to position two markers in the graphics for interactive graphical evaluation of the measurement results. First, the marker is activated and positioned. Then, the deltamarker can be added; however, it cannot be used without the marker.

The status information on marker and deltamarker is indicated inside the graphics window above the diagram. The markers can be shifted using the mouse or the *Cursor keys Left and Right*. If the mouse is used, the active marker can be moved by selecting the marker with the left mouse key and shifting it to the new position with the mouse key depressed. When using the cursor keys Left and Right, the marker is shifted in the desired direction on the trace. The speed at which the marker is moved can be increased by means of the key combination *Ctrl + Cursor key left / right*. If **Pixel Mode** is activated, the markers are not shifted on the trace points, but in the pixel grid of the graphics display. The function **Marker Coupled** synchronizes the deltamarker to the marker. The currently active marker can also be set to a particular frequency using **Set Marker...** (*Ctrl + M*) or to the maximum of the examined trace using **Marker -> Max** and to the minimum using **Marker -> Min**. If more than one trace element is displayed, the markers can be set to the next trace element using **Next Trace** or **Previous Trace** or by means of the cursor keys Up/Down.



Zoom 

The function **Zoom** permits the user to enlarge any section of a graphics area. The area is selected by pressing the left mouse key and shifting to the opposite corner with the mouse key depressed. After releasing the mouse key, the zoomed part of the graphics is displayed on the screen. Zooming is possible several times. If the zoom is active, the function symbol is emphasized and permits to return to the original display. Zooming enables to achieve better presentations, however, it is not taken into account when the graphics configuration is saved.

Copy 

A graphic can be copied to the clipboard with all included elements. It is not copied as a rigid pixel graphic which requires a lot of storage capacity, but in a more complex and flexible WINDOWS-internal vector format. The memory requirements are dependent on the contents of the diagram.

Print 

If a printer driver has been installed for printing, a diagram can also be directly output as a whole-page graphic without the need for a report configuration.

Legend 

The function **Legend** provides a short description of the displayed trace elements.

Both the line style (short designation) and trace name are indicated for a trace element. It is possible to change to the next trace element by clicking on the arrow keys. The key can then be switched on or off; if it is switched on, the function symbol is emphasized.

The following short forms are used:

- LIM Limit line
- MES Measurement result
- XTP Probe transducer
- XTS System transducer.

2.4.5 Report Header Editor

This editor permits the user to generate or modify a report header.

Field	Value
1. Heading	Example Report Header
2. Heading	
EUT	Dummy
Manufacturer	Rohde & Schwarz
Operating Condition	Normal
Test Site	Munich
Operator	Donald Duck
Test Specification	Virtual Mode
Comment	Simulation with Function Generator

The text for the report header is entered into the editable fields. A text of max. 20 characters can be entered in the left column, a text of max. 50 characters in the right column.

2.4.6 Report Configuration Editor

This editor permits the user to generate or modify a report configuration:

The actual configuration is indicated in the „Selection“ field, whereas the individual elements can be selected in the „Available“ field.

The entries for the "selection" are performed by means of **Add**. Each element (report header (max. 1), scan or sweep table (max. 16 each), graphics configuration (max. 2), measurement result (max. 16), probe or system transducer (max. 4 each), limit line (max. 4)) is determined in the selection windows File Type and File Name in the "Available" field. An element selected in the „Selection“ field can be removed using the **Delete** key.

The **Graphic Arrangement** can be set such that the diagrams are arranged half-page, at least half-page until the end of page or whole-page.

Besides, all pages can be provided with a **footnote** consisting of date, time and a predefined text (max. 40 characters).

The layout of the test report can be defined to a certain extent.

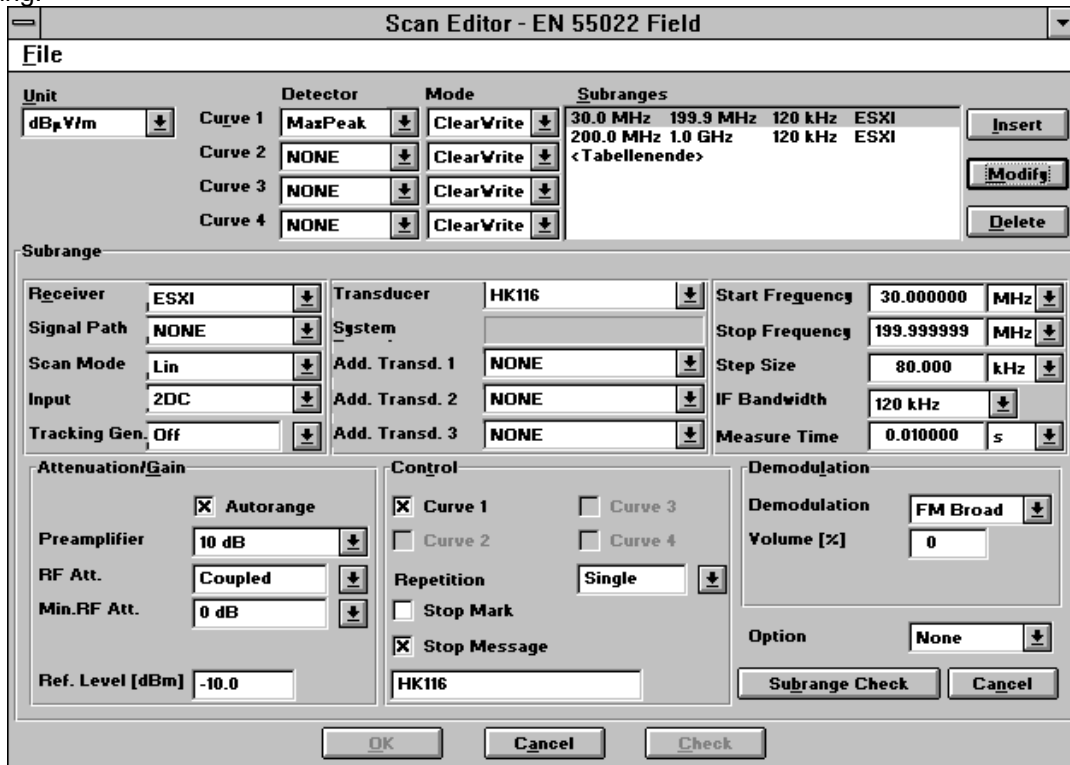
For each part of the test report (e.g. report header, graphics, result list) a number of lines can optionally be reserved. A value of '0' means no reservation, i.e., the number of printed lines simply depends on the content of the referring part. If a number of lines is given, then exactly this number of lines will be printed, which means that depending on the content of the current part there will be either empty lines at the end or some lines may be cut off. The legend and the marker of a graphics diagram are handled separately from the diagram, i.e., the graphics diagram can be printed in a reproducible size. Scan and sweep tables can optionally be printed in a compact format (the main parameters in a single line per range and per detector).

The most recently defined layout will automatically be used as a default for a new report configuration. When starting a printout with a report configuration then the content as well as the report header selected inside can be edited (a shortcut for editing).

2.4.7 Scan/Sweep Editor

These editors permit the user to generate or modify a scan or sweep table. Such a table determines the settings of the test receivers used for performing the scan/sweep.

The two editors are very similar, so that the differences will only be mentioned if required in the following.



The dialog window is divided into two areas. The upper area displays the general settings of the scan table. The settings of a selected subrange are indicated in the lower area (the appearance of the dialog varies according to the selected receiver). For modification, the selection can be made by a *double-click*

on the selection window **Subranges**. The subranges (max. 30) can be edited independently of each other.

Note:

The frequency ranges of the various subranges must not overlap. The frequency ranges must be arranged in increasing order.

When a new table is created, the appropriate **unit** for the level and all required **detectors** (only peak in the case of sweeps) are determined first. The **detector mode** MaxHold (maxima reduction) only makes sense in conjunction with multiple scans/sweeps, otherwise the mode ClearWrite (overwrite) is used.

Subsequently, the **subranges** defined in the lower area can be lined up by means of **Insert** or subsequently overwritten by means of **Modify**. By double-clicking on an existing subrange, the associated parameters are transferred into the lower area.

For definition of a subrange, the appropriate **receiver** must be determined first, which causes the remaining fields to be adapted to the facilities of the hardware and be assigned standard values.

The probe transducer must comply with the subrange with respect to frequency range and level unit, but it can also be set to *NONE* for the time being. If various switching paths have been defined by means of the RSU superhandler, they can be selected as **Signal Path**, a **System Transducer** defined to this end being displayed to the right (grey, i.e. cannot be changed). Up to three **additional system transducers** for cable attenuations, etc. can also be activated.

Settings for the **scan/sweep mode** and for the receiver input used are also dependent on the hardware, e.g. in the case of the **Tracking Generator**, which is only required for measurements on four-terminal networks.

The fields for the **start and stop frequency** are to be defined such that the selected transducers match the frequency range. Note that the settings of the next subrange are valid for the stop frequency if this stop frequency is identical with the start frequency of the next subrange.

A **step size** can only be entered for scans; normally, it is determined by the IF bandwidth (factor of approx. 0.5 to 0.7).

The **IF bandwidth** (resolution bandwidth), in turn, results from the specification; in the case of sweeps, the video bandwidth may also be set.

The **measuring time** (for scans) or the **sweep time** is also dependent on the IF bandwidth, but also on the detectors used.

The settings for **attenuation/gain** are dependent on the device used, of course. In particular in the case of analyzers, note that the signal levels to be expected lie within the dynamic range. In the case of scans, this can in most cases be achieved by activating the **autorange** function, which causes the attenuation to be matched accordingly as soon as the signal exceeds the dynamic range.

Usually, **demodulation** of the test signal is only of interest for single measurements which are based on a scan table.

In the case of analyzers, measurements according to the standard require the use of the **Preselection**.

The entries made for **Setting** control the procedure. On the one hand, it is possible to determine which of the preselected detectors is to be used in the current subrange, on the other hand, a multiple scan/sweep (**repetition**) can be defined, i.e. instead of "Single" any multiple or even "Continuous" (must be aborted explicitly), which is also possible in combination with maxima reduction for the detector. In the case of a few receivers, this may be performed by the device itself (**Repetition by device**), which accelerates the procedure, however without updating the graphics.

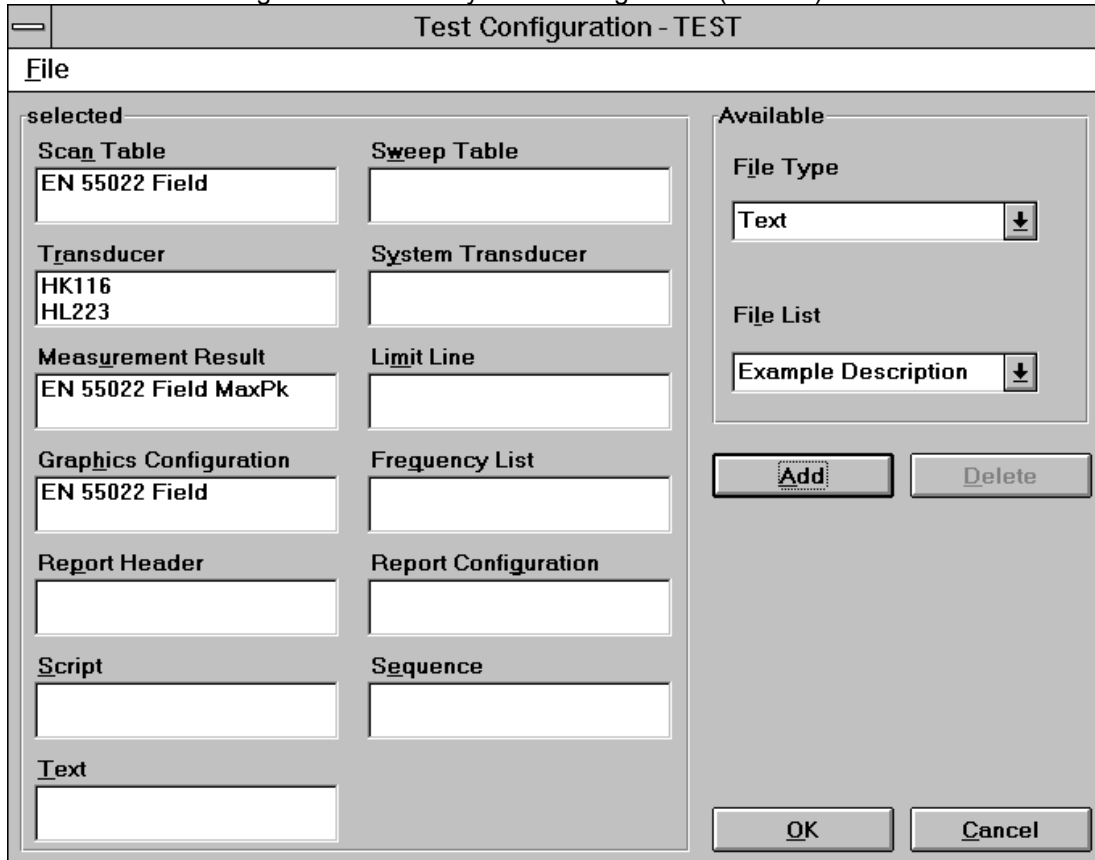
If the procedure is to be aborted when changing from one subrange to the next, e.g. in order to be able to mount another antenna, the **stop mark** must be activated. Thus, the procedure is stopped before this subrange is executed and must be continued by the user (or, as an alternative, be aborted for good). In addition, a **stop message** can be activated, so that the entered text (up to approx. 15 characters) is also output; e.g. a prompt to mount a particular antenna may thus be output.

Check subrange is used to determine whether the specifications for the subrange are consistent. Then the subrange can be transferred to the list of all subranges (appropriate position must be preselected) by means of **Insert** or **Modify**; the table will be definitely stored when the dialog is closed with **OK**.

A scan or sweep table can also be defined with voltage as the measurement unit, a non-level unit. In this case the transducers works as a linear factor (levels: the transducers are simply added to the raw reading). Any additional system transducers (e.g. a cable loss or a preamplifier) can still be included (as with levels) through the normal level definitions.

2.4.8 Test Configuration Editor

This editor can be used to generate or modify a test configuration (see 2.3).

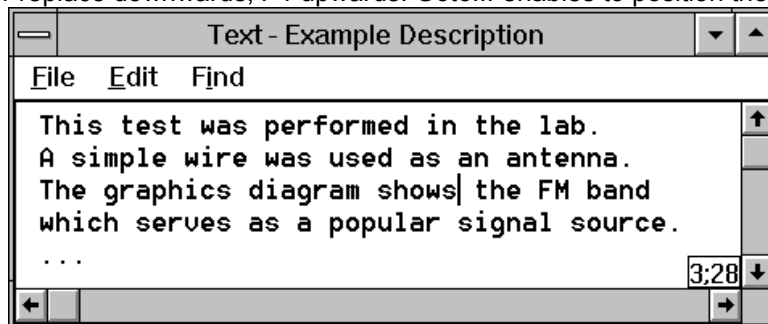


The actual configuration is indicated in the "Selection" field, whereas the individual elements can be selected in the „Available“ field.

The entries for the "selection" are performed by means of **Add**. Each element is determined in the selection windows "File Type" and "File Name" in the "Available" field. An element selected in the "Selection" field can be removed using the **Delete** key.

2.4.9 Text Editor

The text editor is quite similar to the Windows text editor "Notepad". Text can be inserted at the current cursor position. The position of the cursor (line ; column) is displayed in the right lower corner of the editor window. Edit -> Wrap toggles the automatic line wrapping. The typical clipboard functions are available in the same menu. The 'search' menu contains the function *Search...* and *Replace...* . *F3* repeats a search or replace downwards, *F4* upwards. *Goto...* enables to position the cursor into any line.

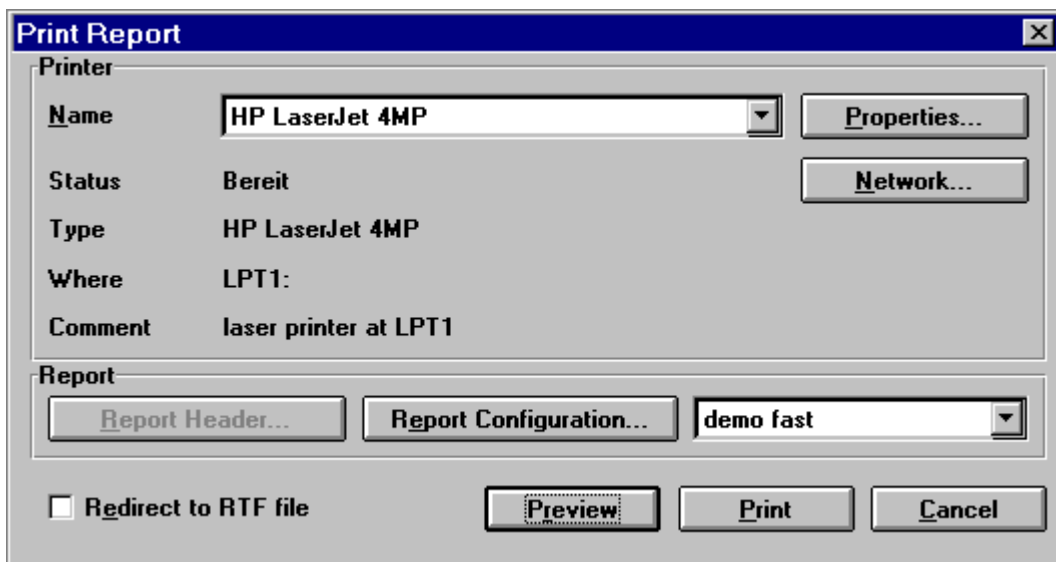


2.5 Report

The 'test report' function generates an output of test relevant results either onto a printer or into a file.

2.5.1 Print...

This function is used to output a report on the selected printer. Before the output can be started, the report configuration to be used has to be selected (the layout of the dialog depends on the operating system):



From this dialog it is possible to edit the content of the report configuration as well as the report header selected inside (a shortcut for editing).

If a graphics configuration or a list file only shall be printed, then the dialog looks quite similar, but without any selections referring to report configurations.

With **Preview** a print preview of the hardcopy layout will be started. The preview window enables to display the pages either separate or two at a time.

Pressing the **Print** button starts the normal hardcopy on the selected printer.

If the option "**Redirect to RTF file**" is selected, then with **Print** no hardcopy will be created, but instead a file dialog will come up (with **Preview** after closing of the preview window) which enables to specify the file name (and the path) of the RTF file to be created.

An RTF file ("Rich Text Format") stores texts and graphics in a generic Windows format which can directly be imported into any text processing software with the ability to edit the file further in any way. This way a complete test report can be stored in a single file which can be used at a later time (maybe on another PC) to generate documentation on the test.

2.5.2 Printer Setup...

This function is used for selection of the printer device driver only. The available device drivers are displayed. The selection is made by *clicking* on the device driver name. The associated interface is also shown.

Properties... permits to specify the settings of the selected printer (e.g. output format, paper feed, etc.)

Notes:

In the event that the provided printer is not listed in the selection window, the respective device driver must be installed. A detailed description is to be found in the WINDOWS operating manual or can be obtained by the WINDOWS online help.

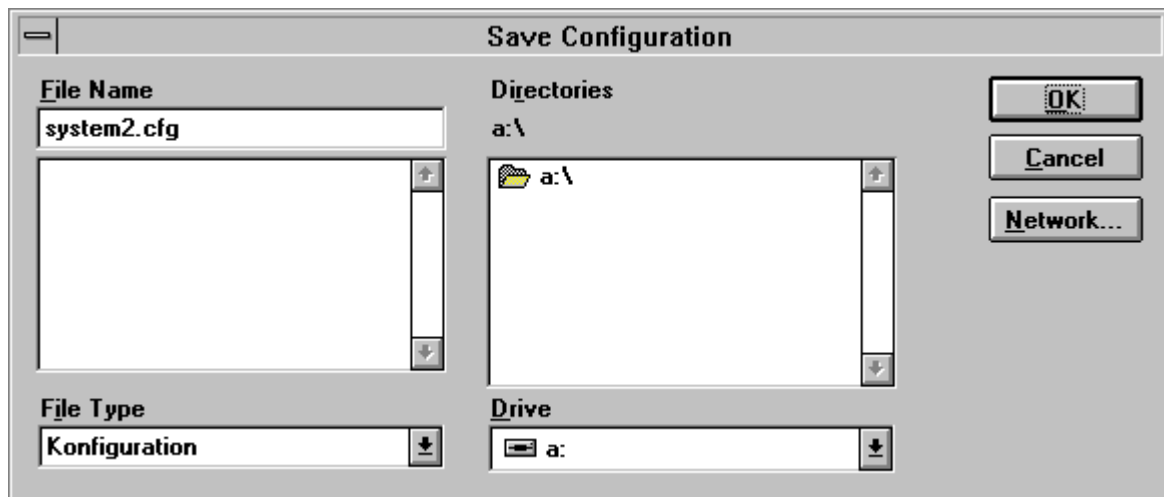
A report can be output into a file in ASCII format. For this purpose, the device driver **Generic/Text only** must be provided together with the interface **FILE:**, installed as continuous printer without formfeeds. During the output, an additional window for entering a DOS file name is opened. This ASCII file can be easily imported into other software applications.

2.6 Special Functions

2.6.1 Configuration

The function **Save Configuration...** enables the user to save all files of the application that include configuration data (*.INI) in a given directory on floppy disk or hard disk (as copy).

Vice versa, **Load Configuration...** permits a software configuration to be restored. Thus, the configuration can also be used for another installation of the software.
After this step the application must be closed and restarted!



2.6.2 Quit (Alt-F4)

Terminates the program ES-K1 and saves various general settings. If files have been modified but not saved yet, an additional prompt is displayed.

2.7 Options Menu

The menu **Options** is used for setting general parameters, e.g. device configuration and dialog language.

The menu consists of the following functions:

- Device Configuration
- Selftest
- Simulator
- Login
- User List
- Change Password
- Edit Accessory
- Configure Accessory
- Main Toolbar Visible
- Device Toolbar Visible
- Toolbar Strings Visible
- Status Bar Visible
- Background
- Change Language

The functions will be explained in detail on the following pages.

2.7.1 Device Configuration

The function Device Configuration enables the user to incorporate new devices in the software or modify the configuration for the provided devices.

The loaded device drivers are displayed in the upper selection window. They can be selected by double-clicking on the device name. Then the specific device settings can be performed.

Name	Device	Description	Interface	Addr	Mode	Active	Busy
ESXI	ESMI		GPIB0	20	virtual	Yes	No
MAST	HCM		GPIB0	15	virtual	Yes	No
TURNTABLE	HCT		GPIB0	15	virtual	Yes	No
ESH2-Z5	ESH2-Z5		GPIB0	18	virtual	Yes	No
ESH3-Z5	ESH3-Z5		GPIB0	20	virtual	Yes	No

Input Field: Device

Name: **Device:** **Interface:** **Mode:** physical virtual

Description: **Address:** Active

All device functions can be executed in two different operating modes:

a) physical mode

The parameters are set on the device.

b) virtual mode

The settings are simulated by the software. The device is not addressed.

A (newly) installed device driver can be inserted by means of **Load**. After actuating the key, the respective device can be selected for editing in the selection window **Device**.

The device to be incorporated (designation of the device driver) is selected by means of **Device**; the function **Load** must already have been executed.

The **Name** is used to establish a reference to the software.

A short **description** - e.g. "Analyzer" - can be assigned to each device.

When the software is started, the communication via the specified **interface** is checked. The software settings must comply with the implemented hardware. The interface "GPIB0" (IEEE bus) is used as standard.

The **IEEE address** is important for the connected devices. For proper communication, the IEEE addresses in the device configuration must comply with the hardware settings on the device.

The **operating mode** determines whether the device is to be operated in **physical** or **virtual** mode.

All devices that are to be addressed or simulated via the software must be set to **active**. Before a device can be set to active, the respective device driver must be installed. The software recognizes an existing device driver, and **Yes** is displayed in the column *Active*. If the instrument is just being used, **Yes** is also entered in the column *Busy*.

Modify is used to transfer the modified settings to the device configuration.

Insert transfers the settings to the device configuration (above the currently selected device) as a new device.

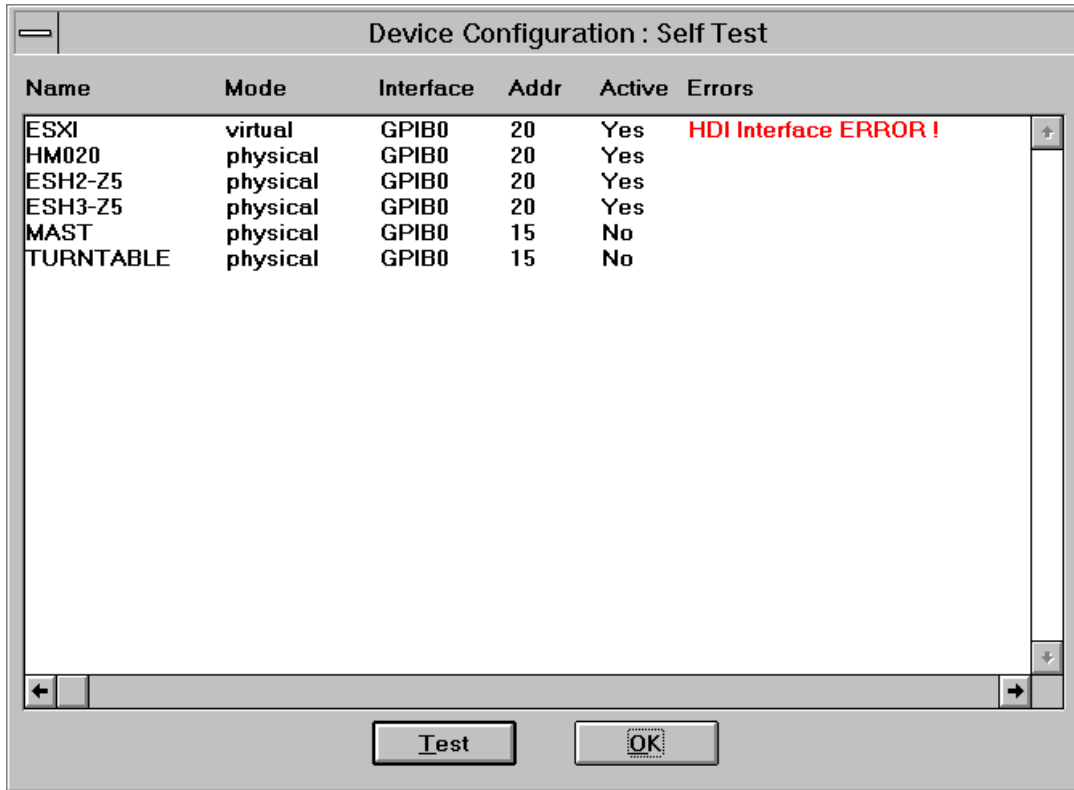
Delete is used to remove the selected device from the device configuration.

The definition of the device-specific **Properties** (see description of the respective device driver) must comply with the hardware of the device.

2.7.2 Selftest

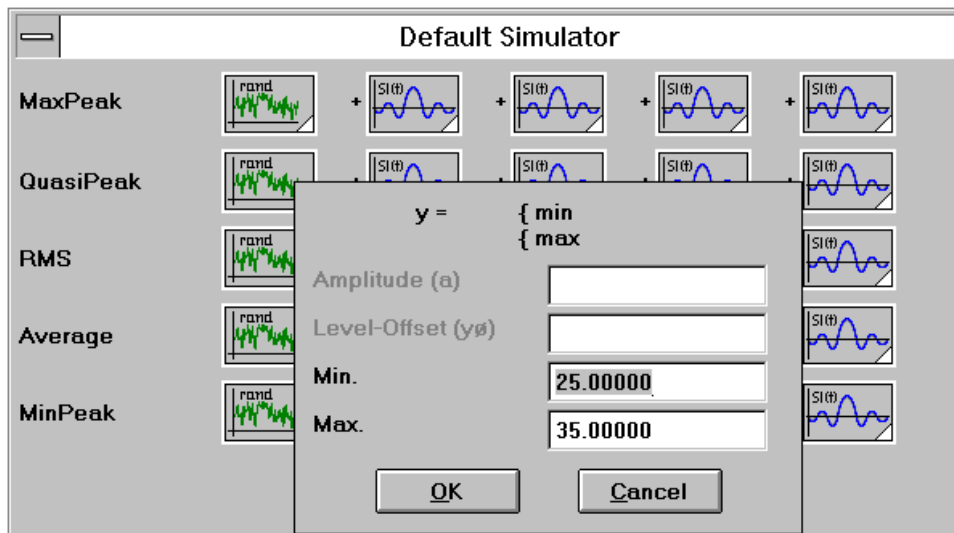
The menu item **Selftest** repeats checking of the device list (according to the device configuration) as in the case of the software start. This is particularly useful if one or several devices were not yet in operation by mistake when the software was started: In this case, the software does not have to be restarted, and correction of the device configuration (for subsequently changing the devices not found from the virtual to the physical operating mode) is not necessary.

Note: The abbreviation "HDI" means "handler device interface" and refers to the interface, normally to the GPIB system. If an error message tells about an "HDI" problem, then make sure that the devices to be controlled are ready for operation (maybe switching off and on again helps) and that all bus cables are working properly.



2.7.3 Simulator

The function generator permits to simulate a scan or sweep with devices operated in virtual mode. A dialog window is opened for defining the settings (see below). A total of up to 5 basic functions can be superimposed (see below). The basic function is selected by clicking on the white triangle in the function symbol.



Sine function

$$y(f) = y_0 + a * \sin(2\pi * (f - f_0) / F)$$

Amplitude (a), level offset (y_0), period (F) and freq. offset (f_0) can be specified in a dialog window by clicking on the function symbol. The sine function can be used for simulation of broadband interference.

Si-Function ($\sin(x)/x$)

$$y(f) = y_0 + a * \sin(2\pi * (f - f_0) / F) / (2\pi * (f - f_0) / F)$$

Amplitude (a), level offset (y_0), period (F) and freq. offset (f_0) can be specified in a dialog window by clicking on the function symbol. The Si-function can be used for simulation of narrowband interference.

Square function

$$y(f) = y_0 \text{ with } f < s \text{ and } f > e$$

$$y(f) = a + y_0 \text{ with } s \leq f \leq e$$

Amplitude (a), y-offset (y_0), start frequency (s) and stop frequency (e) can be specified in a dialog window by clicking on the function symbol. The square function can be used for simulation of broadband interference.

Random function

$$y(f) = [\text{min} ; \text{max}]$$

Minimum value (min) and maximum value (max) can be specified in a dialog window by clicking on the function symbol. The random function can be used for simulation of background noise.

2.7.4 Login, User List and Change Password

The Software ES-K1 is provided with password protection. This is of great importance for two reasons:

1. the data are protected against unauthorized access
2. the system configuration is only changed by authorized people

The program includes three user classes with different rights of access:

1. System manager
2. Extended
3. Standard

Besides, every user is assigned to a user group.

The rights of access are distributed as follows:

Ÿ The **system manager** has access to all components and data of the software.

Ÿ The **user with extended access rights** is assigned the same access rights as a system manager, with the following exceptions:

Ÿ Processing of the device configuration

Ÿ Processing of the path configuration

Ÿ Processing of the user groups

Ÿ Processing of the user list

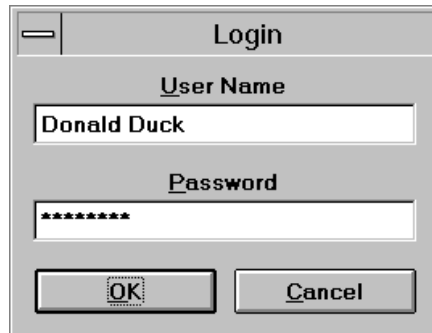
Ÿ Processing of the files outside his group (exception: files with the attribute **Public** may be processed)

Ÿ The **user with standard access rights** has the same access rights as a user with extended access rights, with the following exceptions:

Ÿ Processing of the file type script

Ÿ Reading of the files outside his group (exception: files with the attribute **Public** can be read)

When the software is started, the following dialog window appears:



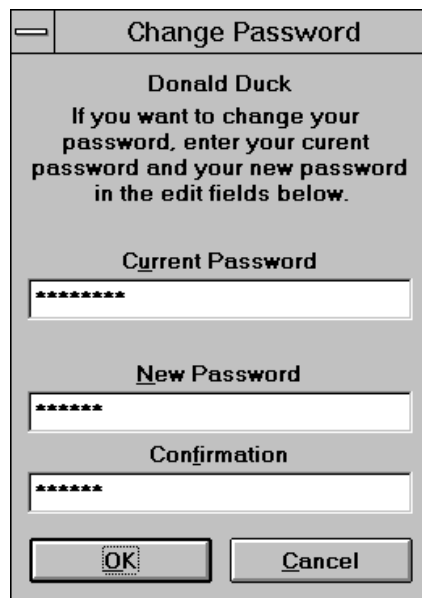
The user must enter his user name and password in this window. On pressing the **OK** key, the settings are checked and, in the case of a correct login, the main menu is entered. The **Cancel** key is used to abort the start of the software and open Windows.

Option Login

This function is used to reregister a user in the software. The currently registered user is thus logged out automatically. Besides, the same is true as for login on starting of the software.

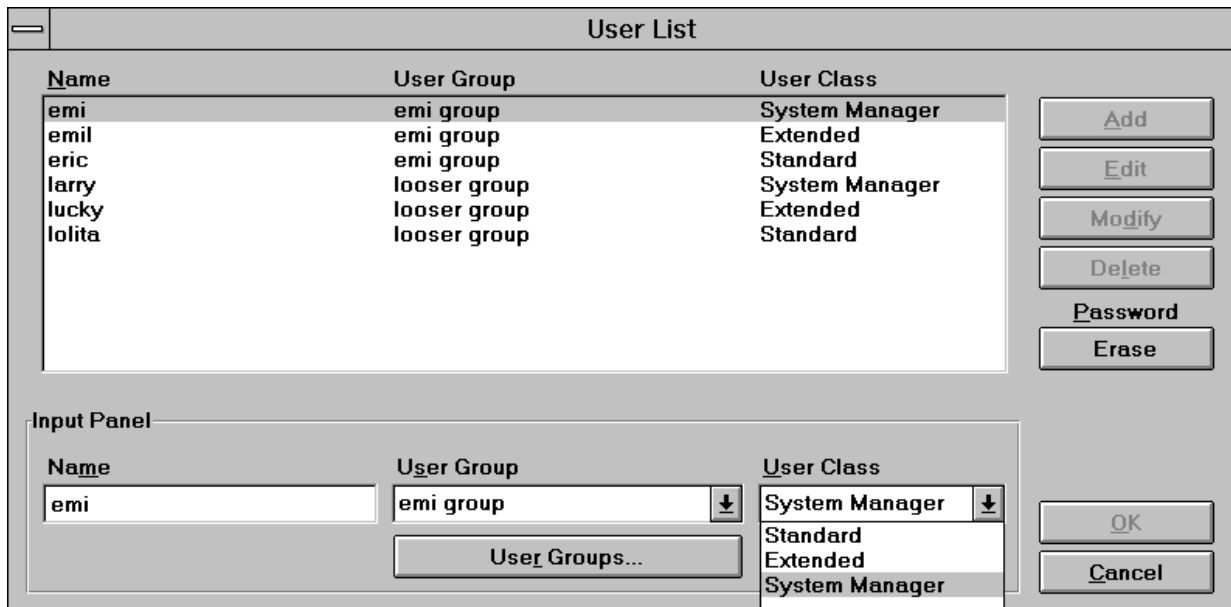
Option Change Password

To change the password, both the old and the new password must be entered (twice to avoid typing errors):

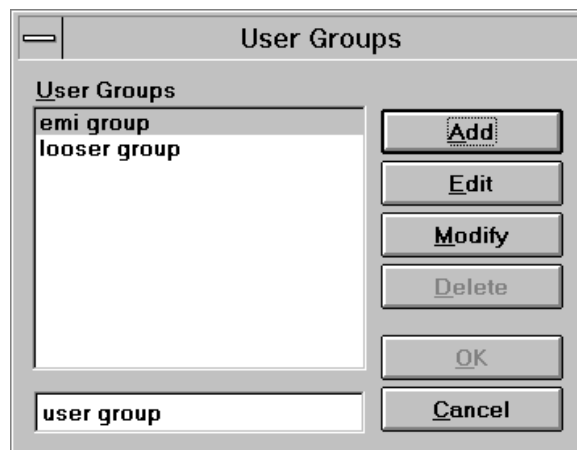


Option **User list**

In this dialog window, a user group and a user class are assigned to the user and made known to the system. The password can also be cancelled in this window, which permits the respective user to assign a new password without having to specify the old one:



For every user, an existing **user group** is to be selected and one of the three user classes allocated. The list of user groups can be edited via an extra dialog window:



2.7.5 Edit Accessory and Configure Accessory

see 2.8.4.2 Single Measurement

2.7.6 Main Toolbar, Device Toolbar and Status Bar

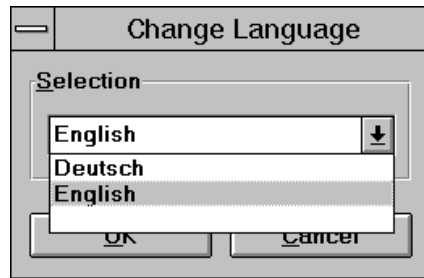
see 2.1 Overview

2.7.7 Background

see 2.1 Overview

2.7.8 Change Language

This function permits the user to change the language used in the dialog; at the moment, only English and German are offered.



2.8 Measurement Functions

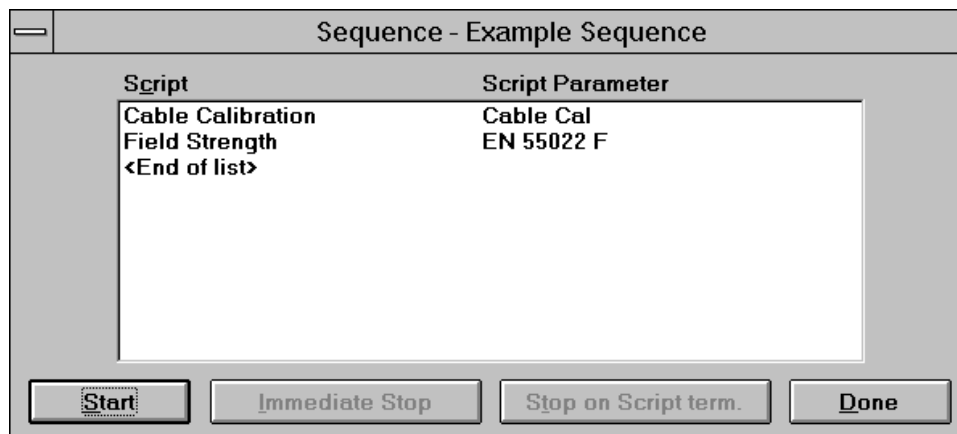
The menu **Test** is used e.g. for execution of the various measurement functions, for starting of scripts and for operation of the devices.

2.8.1 Interactive Device Dialog

Set Device permits to select a device entered in the device configuration for single operation. This function is identical with the selection of a device with the (activated) Device Toolbar. The dialog window of the respective device driver is opened and the settings can be made by the user in interactive mode. If an error occurs during the device access, the cause of the error must be determined by referring to the operating manual of the device involved. A detailed description of the dialog windows can be obtained from the respective description of the device driver.

2.8.2 Sequence

Execute Sequence... offers a choice of the provided sequences. A selected sequence can then be started using **Start** and is continued until the end unless it is aborted before by pressing the keys **Immediate Stop** or **Stop on Script term.**



2.8.3 Script

Execute Script... offers all provided scripts, however, only "main scripts" (MAINSCRIPT) can be started, whereas all other scripts are included in the main scripts (INCLUDE"...", SUBSCRIPT). After confirming the selection by means of **OK**, the devices are checked. The devices that are in virtual mode are indicated in a window.



Subsequently, the dialog for the script parameter editor is displayed. It permits to select and edit the desired parameter set (see 2.4.2)

The script is executed using **OK** or **Cancel** (the last modifications on the parameter set are saved or ignored) or aborted using **Stop**. During the script run, the script can be interrupted and continued again or aborted for good.

2.8.4 Measurement Functions

The submenu **Measurement** permits to select the EMI measurement functions. The following measurement functions are offered:

- Y Scan
- Y Sweep
- Y Single measurement

2.8.4.1 Scan and Sweep Functions with Automatically Generated Graphics

As soon as a table has been selected in the dialog for starting a scan or a sweep, the remaining fields are assigned names (derived from the table names) and the entire frequency range of the table is set. It is then possible to vary these entries at will, e.g. to define a limited frequency range or skip a suggested detector by deleting the result name. If the receiver is not capable of measuring in parallel with various detectors, the traces are recorded sequentially.

In the case of scans, it is additionally possible to select a **frequency list**. In this case, the measurement is not made with the step size specified in the scan table, but only at the frequencies of the frequency list that lie within the given frequency range.

If **Overwrite** is set, already existing measured values are completely deleted and overwritten. Otherwise, existing measured data are only overwritten or supplemented in the given frequency range.

If **Autosave** is set, the results are automatically saved. If the selection switch is not set, the data are lost unless they are displayed as a list or graphically.

Besides, the dialog permits to generate a **graphics configuration** for all data (traces) produced in the measurement run. For this purpose, a name for a configuration must be given for graphical display of the measurement results. If there is no graphics configuration under the given name yet, a new configuration with appropriate settings with respect to frequency range, level unit and traces is created. Otherwise, the existing graphic is only opened and the traces are entered; this however means that it might become necessary to adjust the diagram, thus making a currently measured curve visible.

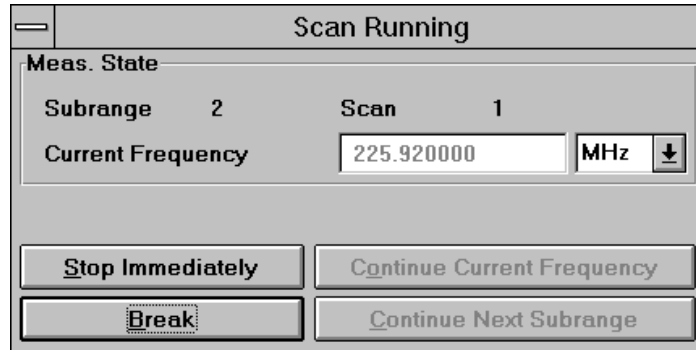
When starting a scan or a sweep, then besides the graphics configuration the software also can create a default **test configuration** or a default **report configuration**.

The test configuration holds all referring files: The scan/sweep range table, the transducer and system transducers inside the range table, the graphics configuration, measurement results and the selected report configuration (incl. its report header if defined).

If 'Overwrite' is selected then a new test configuration will be created. If not, then the entries will simply be added into an existing test configuration.

As a report configuration either an existing one can be selected which will simply be added to the test configuration, or a new one can be *created* which by default contains the following file entries: The scan/sweep range table, the graphics configuration and scan measurement results if those results were gained with a frequency list.

Once started, the progress of the scan or sweep can additionally be observed in a field at the current frequency; note that scan results are supplemented in blocks, whereas in the case of sweeps, only complete sweep subranges (according to the sweep table) are added.



A scan or sweep can be interrupted by the user and continued again. As soon as the scan or sweep has been aborted, it can be continued exactly at this position (frequency display), in the next subrange (if provided) or at a given frequency: For this purpose, the frequency display must be edited appropriately; depending on the set value, existing measurement results will be overwritten or there will be a gap in the measurement run. Thus, a test does not have to be repeated completely if a sudden change in the measurement conditions is detected immediately. The measurement run is simply aborted and continued at a lower frequency after correction of the measurement conditions.

If the stop frequency of a subrange and the start frequency of the next subrange are identical, this frequency is measured with the settings of the upper subrange. If both subranges are used, e.g. with different antennas (transducers), the stop frequency of the lower subrange should be slightly reduced (e.g. by one step size).

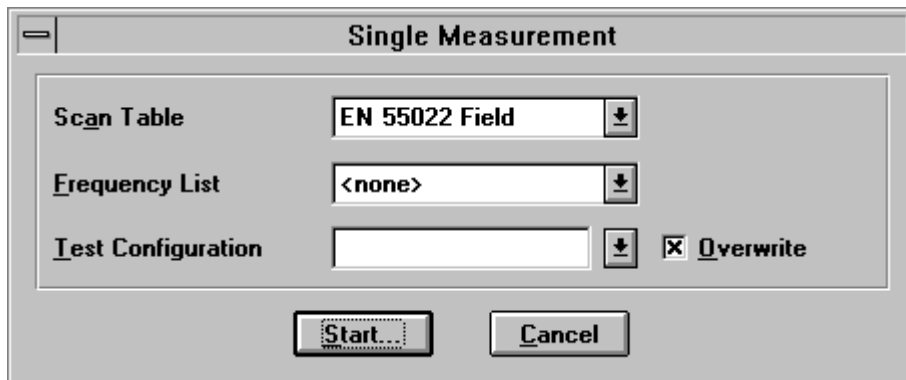
At the end of a scan or sweep, the frequency dependent transducer factor of the last range can optionally be programmed into the receiver - depending on the instrument's capabilities (if the number of correction values in the receiver is not sufficient then they will be interpolated). This way measurements can be done from the front panel of the instrument without any control from the software, but still with level readings that include a transducer correction. As long as the software controls the instrument, any transducer correction will be done in the software only which is much faster. The **transducer download** can be activated in the device properties dialogues of the receivers.

2.8.4.2 Single Measurement

The dialog for interactive single measurements offers the following functions:

- a frequency variation is immediately set on the receiver with the next measurement
- the frequency variation by means of keys uses either the step size of the given scan table or the frequencies of a selected **frequency list**
- a measurement result is always produced or an existing measurement result varied or extended
- the measurement result can be extended by **predefined columns** which will be automatically filled with the **settings of accessories** (polarisation, artificial mains network lines, etc.) at the time of the measurement
- the frequency display can be coupled to a **marker** located on a trace for display of the measurement result

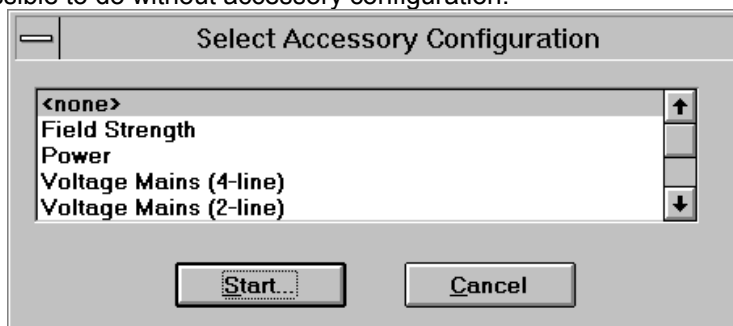
When a single measurement is started, the **Scan Table** to be used and an optional **Frequency List** are to be selected:



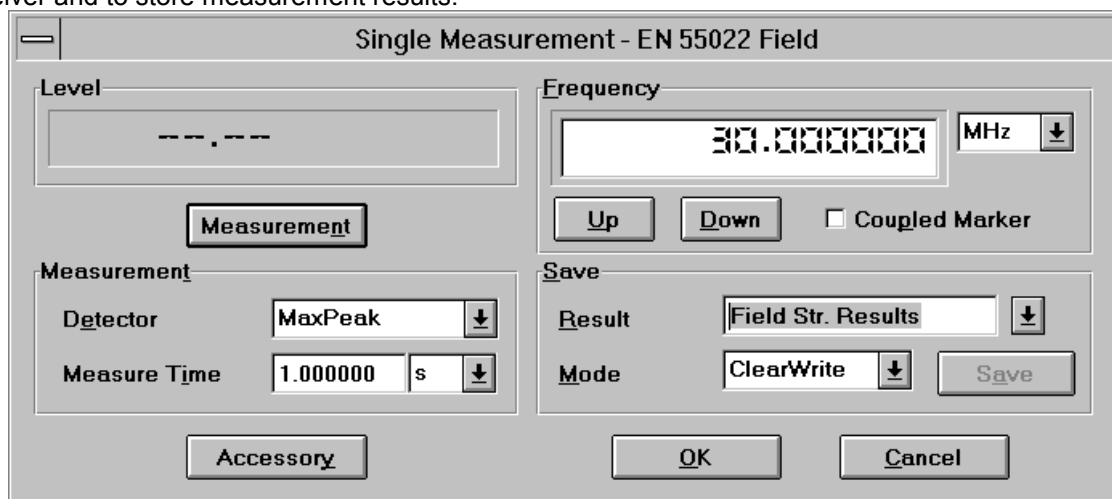
When starting a single measurement, then the software can optionally create a default **Test Configuration** which holds all referring files (scan/sweep table, transducer, system transducers, measurement result file).

If 'Overwrite' is selected then a new test configuration will be created. If not, then the entries will simply be added into an existing test configuration.

Subsequently, a choice of the **Accessory Configuration** is offered (determines the column layout of the produced measurement result and the accessory to be connected; for editing of the configuration see below). It is also possible to do without accessory configuration:



Then the actual **Single Measurement dialog** is displayed, which is used to control the respective receiver and to store measurement results:



The frequency may vary throughout the entire frequency range of the associated scan table. Besides, the detector and the measuring time can be varied; all other test parameters result from the settings of the scan table.

The value for the measurement time can be defined at will; however, depending on the receiver used, the next higher possible measuring time may be set on the instrument.

Using the key **Measurement**, the first measurement run is started and repeated continuously. Each frequency variation causes a corresponding change on the receiver (a variation of detector or measuring time is transferred by means of **Measurement** or a further frequency variation).

Save is used to insert the current measured value in the measurement result or vary it together with accessory settings if selected and if the associated device dialogs have been started before (see below).

The frequency display can be coupled to the marker of a diagram. For this purpose, the **Coupled Marker** function must be activated in the dialog window on the one hand and an appropriate device configuration opened on the other hand, in which the specified measurement result is indicated and on the trace of which the marker is located. For already existing test points, the marker frequency and the test frequency shown in the single measurement dialog correspond to each other, i.e. shifting of the marker also causes a frequency variation in the receiver.

If a frequency list has been selected with the scan table, the **Up/Down** keys only permit to set the frequencies of the list lying inside the frequency range of the scan table; of course, additional intermediate values can be set by editing the frequency display, and the measurement result can be extended accordingly.

Columns can automatically be added to the measurement result, in which the current settings of accessory devices are stored for each measurement. If a single measurement result is stored, the associated accessory settings are automatically entered in the respective fields (i.e. next to frequency and level, e.g. the turntable angle). To this end, the columns must be defined accordingly, i.e. the columns must be assigned to the accessory (e.g. an automatic antenna mast) and the associated parameter (e.g. polarisation). For this purpose, two dialogs are provided, the first one allowing to edit the setup of all columns, the second one to produce a combination of these columns.

The menu item **Edit Accessory** (options) is used to open a dialog which permits to define a column for each accessory parameter (of the accessory devices active in the device configuration):

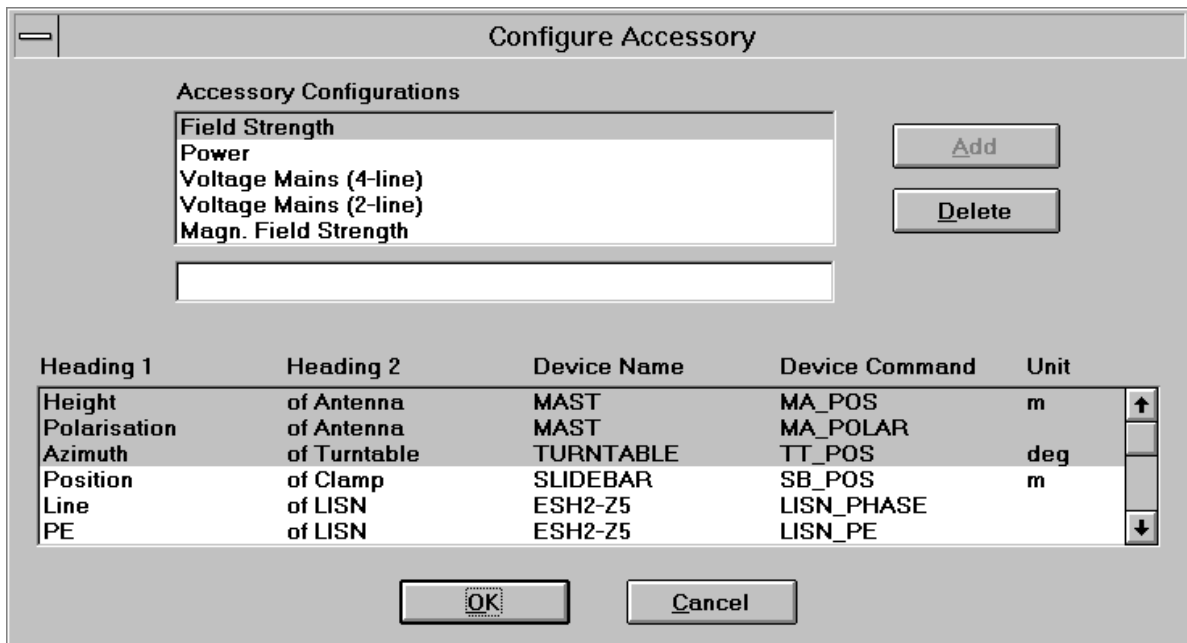
Heading 1	Heading 2	Device Name	Device Command	Unit
Height	of Antenna	MAST	MA_POS	m
Polarisation	of Antenna	MAST	MA_POLAR	
Azimuth	of Turntable	TURNTABLE	TT_POS	deg
Position	of Clamp	SLIDEBAR	SB_POS	m
Line	of LISN	ESH2-Z5	LISN_PHASE	
PE	of LISN	ESH2-Z5	LISN_PE	

Below the table, there are input fields for defining a new column:

- Heading 1:
- Heading 2:
- Device Name:
- Device Command:

The first heading must be clearly designated; the width of the column is determined by the longer one of the two headings (max. 15 characters). When a (symbolic) device name has been selected, the associated device command (query for a particular setting) must also be selected. Such a column definition can then be appended to the existing list and also modified or deleted subsequently.

The second dialog is started by means of the menu item **Configure Accessory** (options):



The upper field lists the names of the column configurations, whereas the lower field shows all existing column definitions (produced with the dialog **Edit Accessory**). When a name has been selected in the upper field, the associated columns are marked in the lower field; this marking can be changed at will (best to be done using the mouse key with simultaneously pressed Ctrl key) and any combinations can be formed, which become valid immediately when the dialog is terminated with OK. The edit field in the middle permits to generate new column configurations, which can be edited immediately or subsequently by means of a marking in the lower field.

To make a column configuration effective the following steps are needed:

First the device dialogs have to be started (they might be iconized).

Then the single measurement dialog has to be started, which requires to select a scan table (plus optionally a frequency list and a test configuration, see above) and a column configuration.

Now a measurement can be started.

The name of the measurement result file has to be entered or selected.

When the **Save** key is pressed for the first time the columns will be added to the file and the result along with the device positions will be stored.

2.9 Evaluation Functions

The menu **Test** is used e.g. for execution of the various analyzing functions. The submenu **Evaluation** includes the following functions:

- Acceptance Analysis
- Peak Reduction
- Subrange Maxima Reduction
- Subrange Minima Reduction
- Maxima Reduction
- Octave Maxima Reduction
- NB / BB Discrimination
- Conversion to ... / MHz
- Unit Conversion
- Merge Data
- Exclude Ambients
- Weighted Addition
- Reduce to Freq.List
- GTEM Correlation

Most evaluation functions permit to generate a **Graphics Configuration** including all data relevant to the evaluation (e.g. input/output files, limit line). To this end, a name for a configuration for graphical display of the data must be specified. If there is no existing graphics configuration under the specified name yet, a new configuration with appropriate settings of frequency range, level unit, traces, etc. is created (if an evaluation function uses two different level units at the same time, two graphics configurations are created accordingly); otherwise, the existing graphics is only opened.

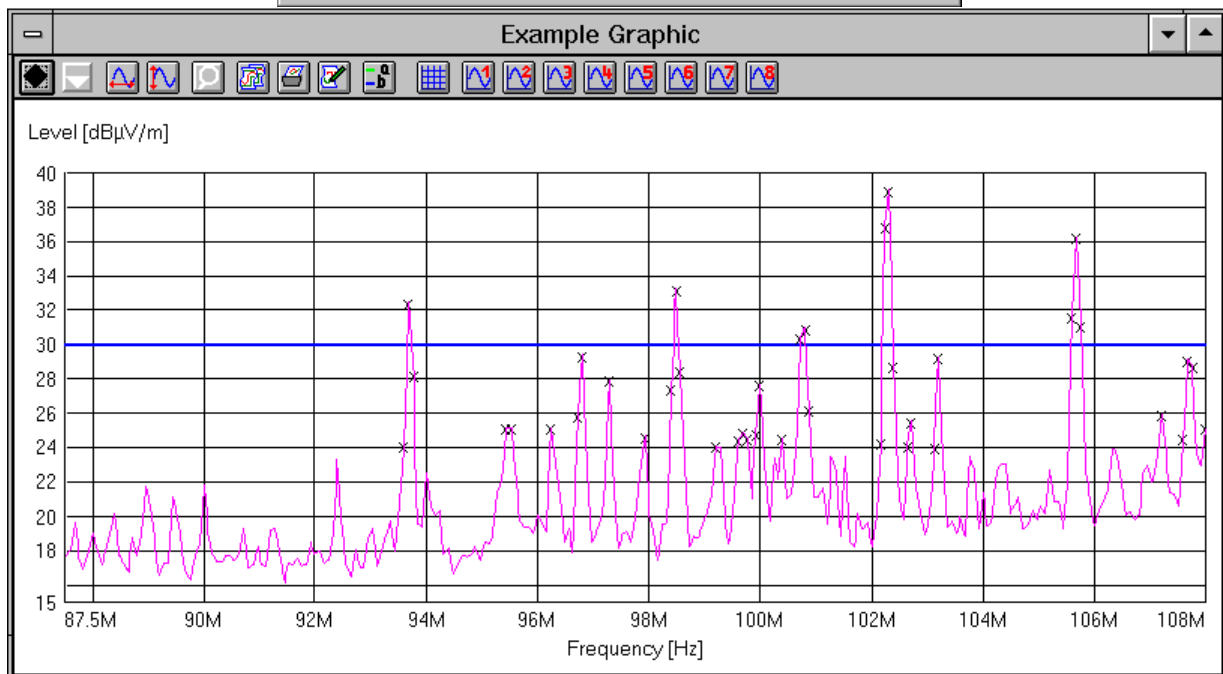
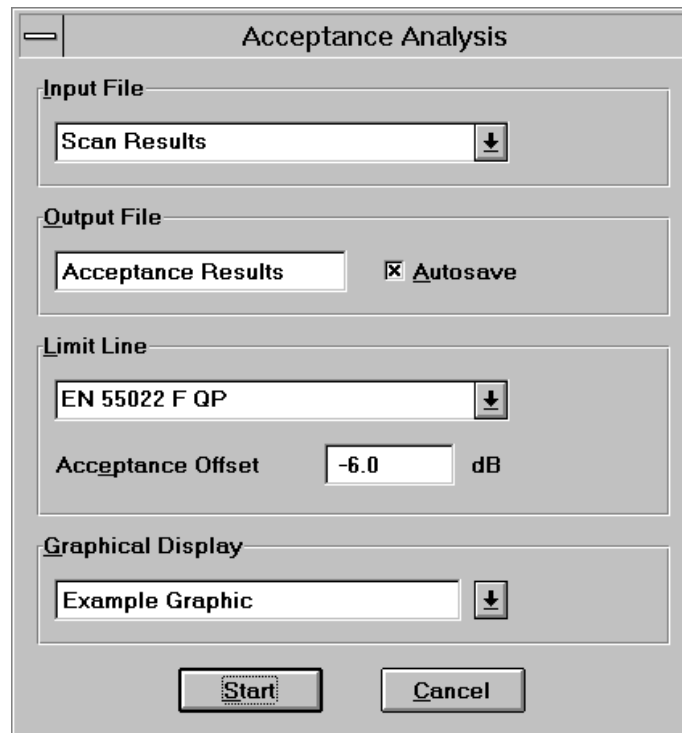
The duration of the evaluation functions is usually a few seconds; however, it may be longer if large input files are involved and if they are to be displayed graphically at the same time. The GTEM Correlation requires very time-consuming calculations so that the size of the input file makes itself felt clearly.

Evaluation functions with a specified limit line ignore all test points of the input file for which the limit value is no longer defined.

2.9.1 Acceptance Analysis

The acceptance analysis is used to filter off signals which are further off a specified limit line. This includes in particular the background noise of the receiver. The acceptance analysis is implemented by means of an imaginary acceptance line which cuts off all measured values falling below it. The acceptance line runs parallel to a limit line with a specified offset (e.g. an offset of -10 dB means 10 dB below the limit line).

If the offset is very large (e.g. 200 dB), all signals are cut off, if it is very small (e.g. -200 dB), they are all maintained.

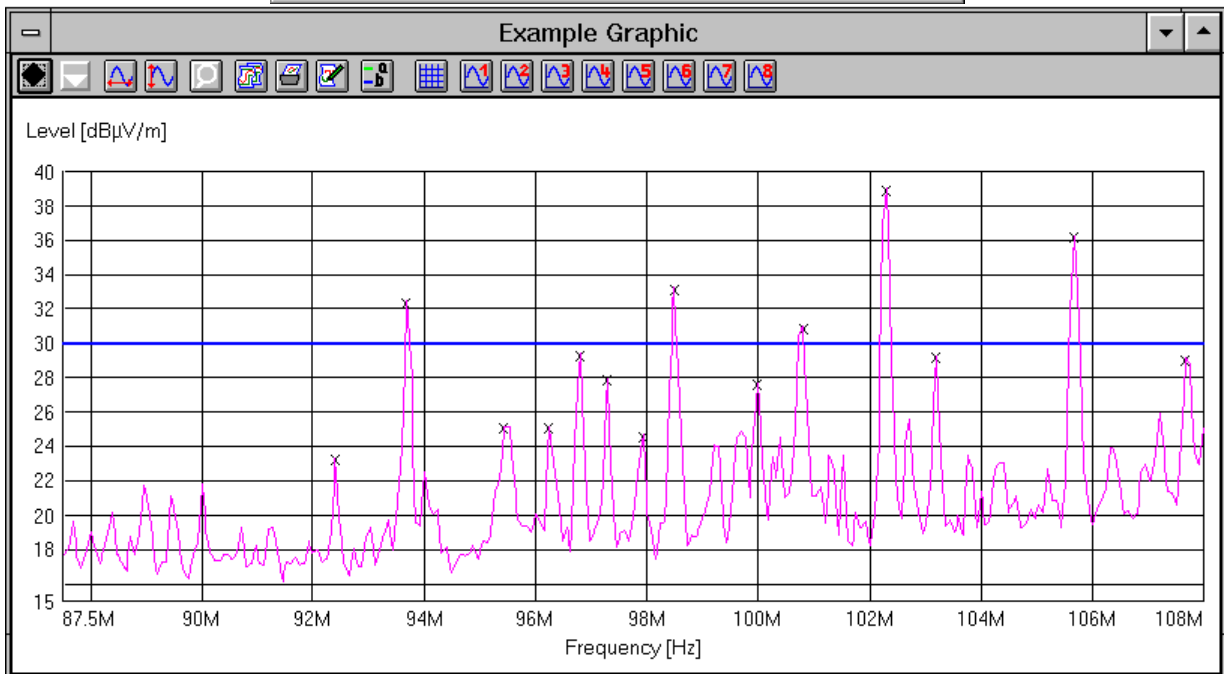
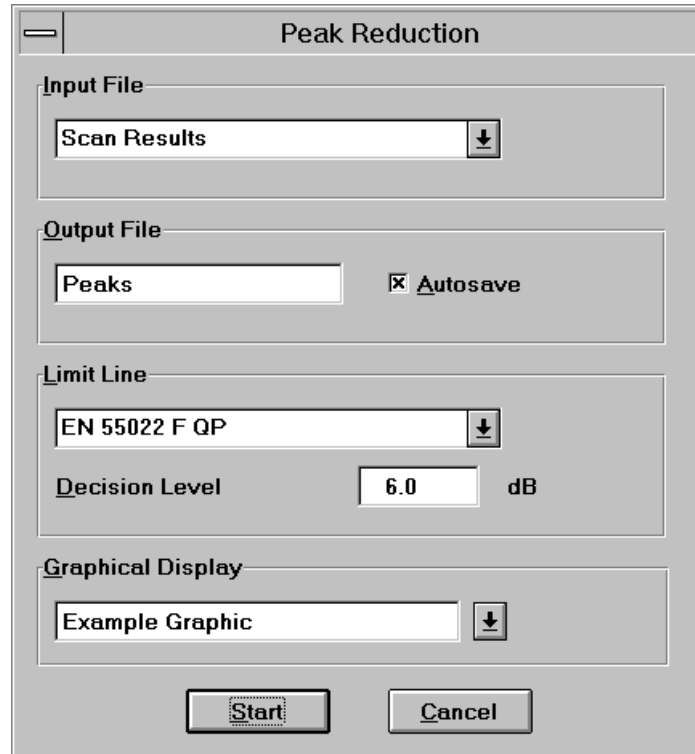


2.9.2 Peak Reduction

This function is used to determine all "Peaks" (preferably narrowband interference) depending on a user-defined decision level. For this purpose, the trace is analyzed by means of a special algorithm. The decision level determines how far a local maximum must exceed the adjacent lower test points to be considered as a "Peak" and appear in the output file (see flowchart on next page).

If a limit line is also specified, not the absolute level characteristic of the trace is examined, but the distance between the test point and the respective limit value.

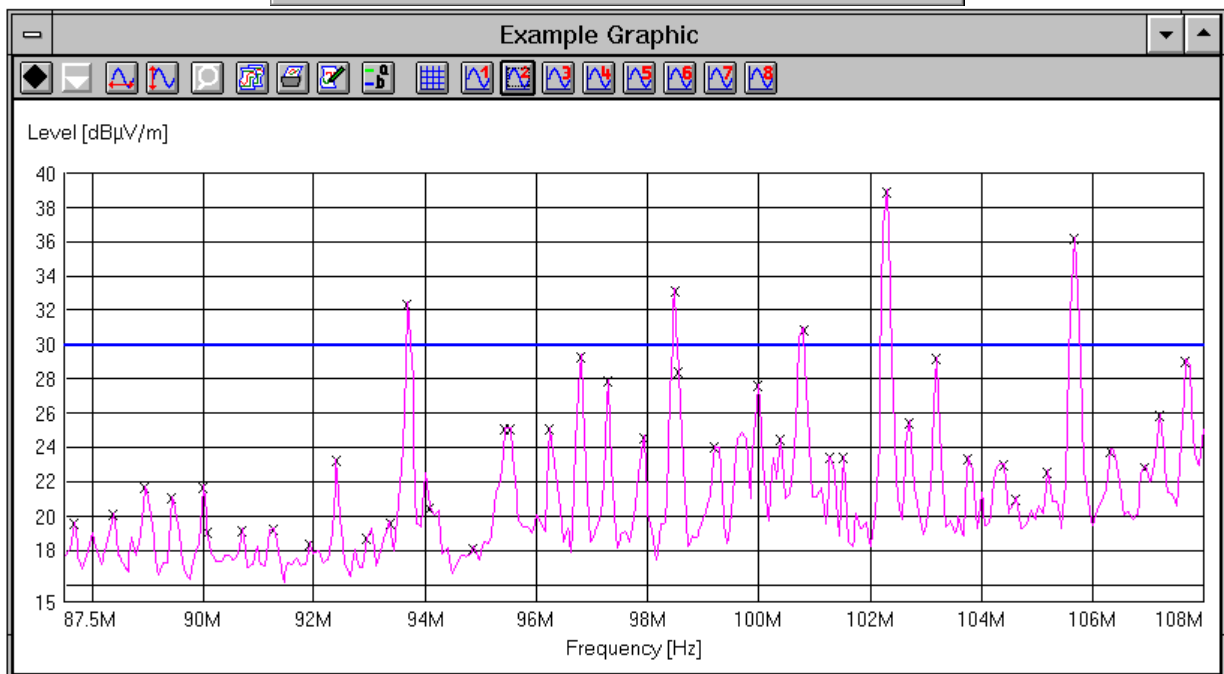
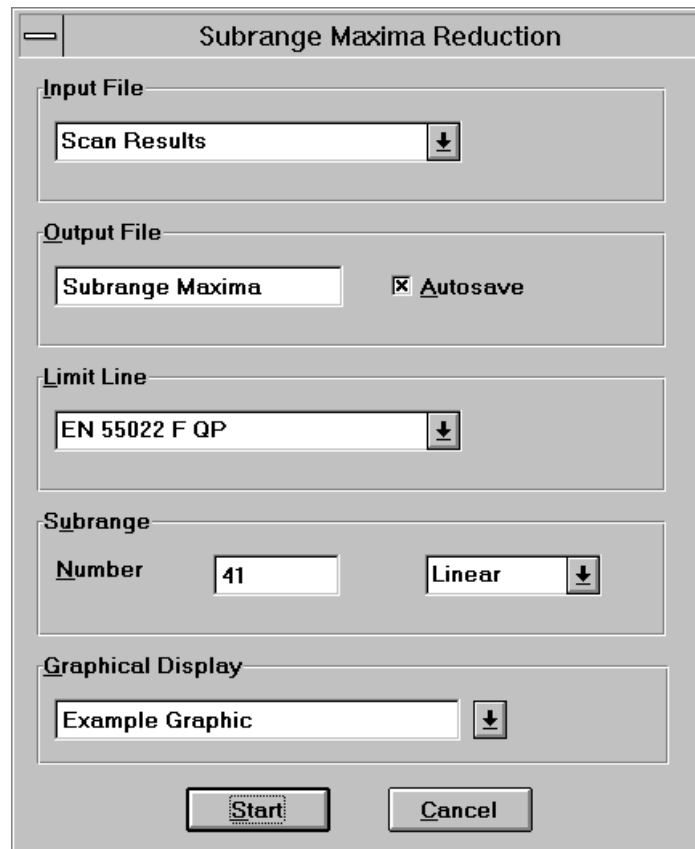
With a decision level of 0 dB, all local maxima are detected as "Peaks", whereas, with a value of e.g. 20 dB, only distinctive narrowband signals are detected.



2.9.3 Subrange Maxima Reduction

This function is used to split the trace of the input file into a given number (max. 1000) of subranges. The maximum is determined for each subrange and transferred to the output file. If a limit line is also specified, not the absolute level characteristic of the trace is examined, but the distance between the test points and the respective limit value. The limits of the subrange are equidistant for linear or logarithmic scales.

The function is suitable for detecting broadband signals in addition to narrowband signals over the complete measured spectrum.



2.9.4 Subrange Minima Reduction

This function is used to determine the subrange minima of a measurement result. It is used for example in open-area measurements: It permits to identify frequency points which are little or not at all occupied by external signals. Such frequencies are best suited for measuring antennas or similar. The handling of the parameters for subrange minima reduction is similar to that of the subrange maxima reduction (see 2.9.3).

2.9.5 Maxima Reduction

This function is used to transfer a given number (max. 1000) of maximum levels of the input file into the output file. If a limit line is also specified, not the absolute level characteristic of the trace is examined, but the distance between the test points and the respective limit value. Thus it is possible to focus e.g. on the 10 most critical points of a measurement result.

2.9.6 Octave Maxima Reduction

This function is used to split the trace of the input file into frequency octaves. For each octave, a given number of level maxima is determined and transferred into the output file. If a limit line is also specified, not the absolute level characteristic of the trace is examined, but the distance between the test points and the respective limit value.

2.9.7 Narrowband/Broadband Discrimination

This function is used to discriminate between narrowband (NB) and broadband interference (BB). Four methods are provided, the tuning methods analysing only the shape of the trace:

Peak/Average value comparison:

Two data lists are available, one being measured with the PEAK detector, the other with the AVERAGE detector.

Narrowband interference:

$$(\text{PEAK} - \text{AVERAGE}) \leq \text{decision level.}$$

Potential broadband interference:

$$(\text{PEAK} - \text{AVERAGE}) > \text{decision level.}$$

Peak/RMS value comparison:

Two data lists are available, one being measured with the PEAK detector, the other with the RMS detector (root mean square).

Narrowband interference:

$$(\text{PEAK} - \text{RMS}) \leq \text{decision level.}$$

Potential broadband interference:

$$(\text{PEAK} - \text{RMS}) > \text{decision level.}$$

Tuning methods

a) Tuning by +/- one bandwidth:

A data list is available that was measured with a scan step size of
0.45 ... 0.55 * IF bandwidth.

The decision range lies between reference level and the decision level (e.g. 3 dB below). A total of 2 adjacent levels are investigated.

Narrowband interference:

The 2nd adjacent levels lie below the decision range and the 1st adjacent levels lies below the reference level.

Potential broadband interference:

The point has not been identified as being a narrowband signal.

Note:

Those points at the edge of a scan range will also be analysed, with the "missing" point assumed as fulfilling the condition for narrowband interference.

Only potential **broadband interference** that is not located close to (+/- one IF bandwidth) narrowband interference is actually determined as broadband interference.

b) Tuning by +/- two bandwidths:

A data list is available which was measured with a scan step size of
0.60 ... 0.75 * IF bandwidth (0.45 ... 0.60 * IF bandwidth).

The decision range lies between reference level and the decision level (e.g. 3 dB below). A total of three (four) adjacent levels are investigated.

Narrowband interference:

The 3rd (4th) adjacent levels lies below the decision range and the remaining two (three) adjacent levels lie below the reference level.

Potential broadband interference:

The point has not been identified as being a narrowband signal.

Note:

Those points at the edge of a scan range will also be analysed, with the "missing" point(s) assumed as fulfilling the condition for narrowband interference.

Only potential **broadband interference** that is not located close to (+/- two IF bandwidths) narrowband interference is actually determined as broadband interference.

2.9.8 Conversion to ... / MHz

This function is used to add a broadband factor to a level as is required in particular specifications for the description of broadband interference.

The level unit is changed to "level unit per MHz" (for military specifications in the USA). The IF bandwidth depends on the scan or sweep table and the frequency at which the level has been measured. The broadband factor is: $-20 * \log(\text{IF bandwidth} / 1 \text{ MHz})$.

As a further "conversion" (numerical values remain unchanged), the unit can be changed to "level unit per bandwidth" (for military specifications in France).

The following conversions are possible:

Level unit before conversion	Level unit after conversion with .../MHz	Level unit after conversion with .../BW
"dB μ V"	"dB μ V/MHz"	"dB μ V/BW"
"dB μ V/m"	"dB μ V/m/MHz"	"dB μ V/m.BW"
"dB μ A"	"dB μ A/MHz"	"dB μ A/BW"
"dB μ A/m"	"dB μ A/m/MHz"	"dB μ A/m.BW"

2.9.9 Unit Conversion

This function is used for unit conversion. The following conversions are possible (R: characteristic impedance, e.g. R = 50 ohms):

Unit	Unit after conversion
dB μ V	$y \text{ dB}\mu\text{A} = x \text{ dB}\mu\text{V} - 20 \log(R)$
	$y \text{ dBpW} = x \text{ dB}\mu\text{V} - 10 \log(R)$
	$y \text{ dBm} = x \text{ dB}\mu\text{V} - 10 \log(R) - 90$
dB μ V/MHz	$y \text{ dB}\mu\text{A/MHz} = x \text{ dB}\mu\text{V/MHz} - 20 \log(R)$
dB μ V/m	$y \text{ dB}\mu\text{A/m} = x \text{ dB}\mu\text{V/m} - 20 \log(R)$
dB μ V/m/MHz	$y \text{ dB}\mu\text{A/m/MHz} = x \text{ dB}\mu\text{V/m/MHz} - 20 \log(R)$
dB μ A	$y \text{ dB}\mu\text{V} = x \text{ dB}\mu\text{A} + 20 \log(R)$
	$y \text{ dBpW} = x \text{ dB}\mu\text{A} + 10 \log(R)$
	$y \text{ dBm} = x \text{ dB}\mu\text{A} + 10 \log(R) - 90$
dB μ A/MHz	$y \text{ dB}\mu\text{V/MHz} = x \text{ dB}\mu\text{A/MHz} + 20 \log(R)$
dB μ A/m	$y \text{ dB}\mu\text{V/m} = x \text{ dB}\mu\text{A/m} + 20 \log(R)$
dB μ A/m/MHz	$y \text{ dB}\mu\text{V/m/MHz} = x \text{ dB}\mu\text{A/m/MHz} + 20 \log(R)$
dBm	$y \text{ dBpW} = x \text{ dBm} + 90$
	$y \text{ dB}\mu\text{A} = x \text{ dBm} + 90 - 10 \log(R)$
	$y \text{ dB}\mu\text{V} = x \text{ dBm} + 90 + 10 \log(R)$
dBpW	$y \text{ dBm} = x \text{ dBpW} - 90$
	$y \text{ dB}\mu\text{A} = x \text{ dBpW} - 10 \log(R)$
	$y \text{ dB}\mu\text{V} = x \text{ dBpW} + 10 \log(R)$
dBpT	--

2.9.10 Merge Data

This function is used to merge all values of two measurement result lists. If the frequencies are the same, the complete line will be entered into the data list with the maximum/minimum level (Maxhold/Minhold). If the frequencies are not the same, both lines will be entered into the data list. The column structure in the two data lists must comply with each other.

2.9.11 Exclude Ambients

This function is used for removing ambients from a measurement result.

Two methods can be selected:

1. All entries of the **frequency range** between a start and a stop frequency are removed.
2. Small ranges are removed according to a frequency list. A delta range about the frequencies must be entered with a **factor**:
 $\text{Delta range} = \text{Frequency} * \text{Factor} * 10 \text{ ppm}$ (10 millionth)
 z.B. Frequency= 100 MHz, Factor = 50
 $\text{Delta range} = 100 \text{ MHz} * 50 * 10e-6 = 50 \text{ kHz}$, i.e. $\pm 25 \text{ kHz}$ about 100 MHz

2.9.12 Weighted Addition

The **weighted addition** permits to treat two data sets in **correlated** (addition of the voltages), **uncorrelated** (addition of the powers) or even **direct** mode (addition of the levels). In the **direct** mode, even negative factors can be easily used, i.e. even any subtractions can be implemented, since the values are not logarithmized:

direct: $\text{dest} = a * \text{source1} + b * \text{source2}$

correlated: $\text{dest} = 20 \log [a * 10^{\text{source1}/20} + b * 10^{\text{source2}/20}]$

uncorrelated: $\text{dest} = 10 \log [a * 10^{\text{source1}/10} + b * 10^{\text{source2}/10}]$

a, b: Factors (weighting) of the data sets.

2.9.13 Reduce to Frequency List

Using the evaluation function **Reduce to Frequ.List**, a frequency list can be generated from a measurement result: As input file, an existing measurement result file is selected and, by means of the evaluation function, an output file of the type frequency list is generated with the specified name. Figuratively speaking, only the first column of the measurement result, i.e. the one with the frequency, is transferred. Such a file may e.g. serve the purpose of running a scan only at the frequencies of this frequency list.

2.9.14 GTEM Correlation

This function is used for converting emitted EMI that has been measured by an EUT in a GTEM cell (Gigahertz Transverse Electromagnetic). This function permits to compare the data with the measured electrical field of an open-area test site (OATS).

The correlation algorithm is based on the following model:

- a) The test item is measured in the directions x, y and z in the GTEM cell. The respective results are referred to as V_x , V_y and V_z .
- b) Based on V_x , V_y and V_z the interfering power of the test item is calculated depending on the GTEM dimensions.
- c) The calculated interfering power is simulated as follows:
The test item is replaced by a dipole which is aligned according to the polarization of the test antenna and corresponds to the calculated interfering power. The corresponding electrical fieldstrength is calculated at the position of the antenna. In the case of an anechoic chamber with metal floor, the maximum fieldstrength of the various antenna heights is the corresponding electrical fieldstrength.

Two methods can be selected:

a) Measurement result conversion

The interfering voltages V_x , V_y and V_z are measured. The fieldstrength characteristic is obtained by means of correlation and can be directly compared with the respective fieldstrength limit line.

The input files correspond to the interfering voltages of the test item measured in three orthogonal directions. At least one input file must be specified. The scan or sweep tables of the input files must be identical. Input files that are not entered are set to zero. The output files correspond to the fieldstrengths for horizontal and vertical polarization. At least one output file must be specified. Output files that are not entered are not calculated.

b) Conversion of Limit Lines

In contrast to the first method, the fieldstrength limit line is first converted into a voltage limit line $V_{x,y,z} = (V_x^2 + V_y^2 + V_z^2)^{1/2}$. The advantage of this method is that the resulting interfering voltage from V_x , V_y and V_z can be directly compared with the calculated limit line.

Additional values determines the number of the additional sampling points for calculation of the limit line. Since the number of sampling points is usually very small and the conversion results in a more complex trace, it is advisable to use more sampling points - e.g. 100. The calculation is performed in two steps:

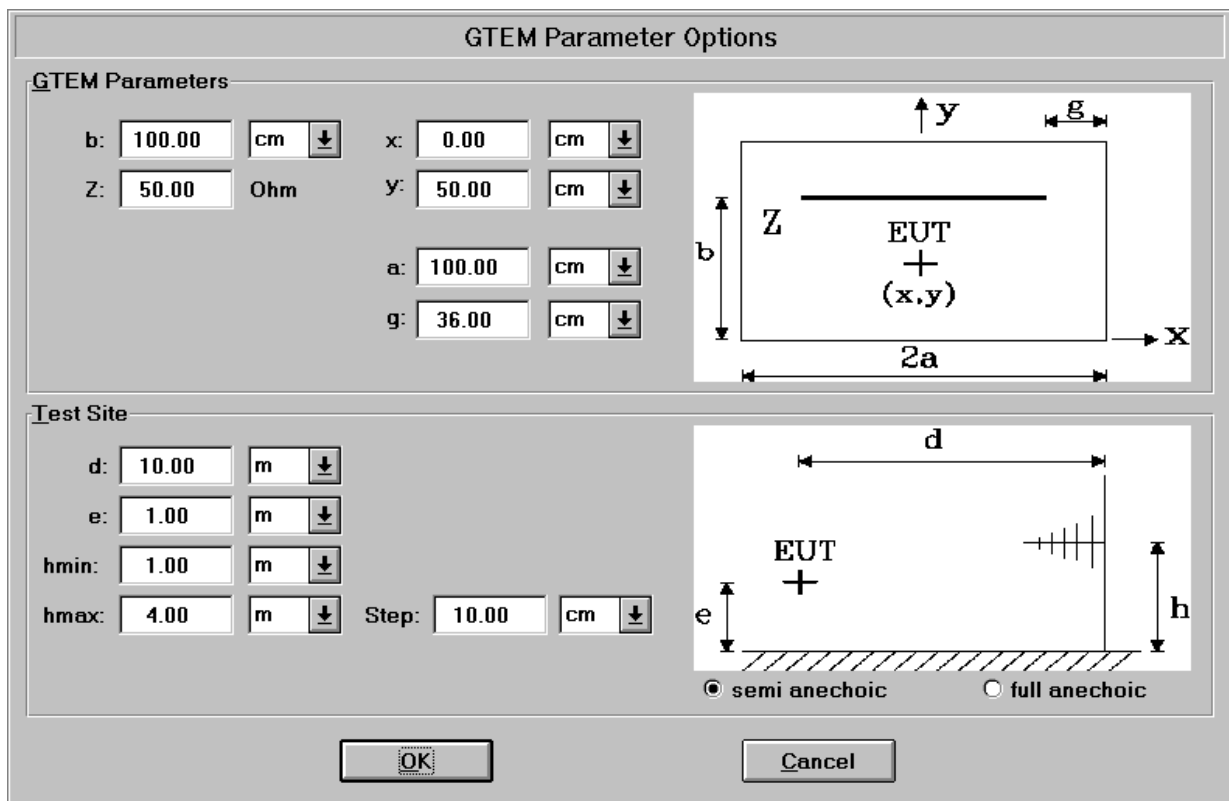
First of all, each point of the entered limit line (frequency / level) is converted.

In addition to the provided points, the entire frequency range is divided into the specified number of sampling points, linearly or logarithmically (according to the intermodulation mode of the limit line).

Each of these sampling points (frequency / interpolated level) is then converted.

The output files correspond to the respective voltage limit lines of the entered fieldstrength limit line of the standard used. A distinction is made between limit lines for horizontal, vertical and horizontal+vertical polarization. Output files that are not specified are not calculated.

The key **Start** checks the settings and the correlation is started. When selecting the key **Option ...** an additional dialog window for entering the parameters for the GTEM dimensions and the reference open-area test site is opened.



The fields **GTEM Parameters** permit to set the dimensions of the GTEM cell. The geometry of a GTEM cell is defined by $a = b$ and $g = 0.36 * a$. The values x and y indicate the middle of the test item. These values are normally $x = 0.0$ and $y = 0.5 * b$. When changing the value b , the values for a , g and y are automatically adapted. The value Z indicates the impedance of the GTEM cell, the standard value for Z is 50 ohms.

The fields **Test Site** determine the dimensions of the reference open-area test site.

With **semi anechoic** selected, the measurement is simulated for a test site with conductive ground plane. In this case, the maximum level is calculated between minimum antenna height $hmin$ and maximum antenna height $hmax$.

With **full anechoic** selected, on the other hand, the measurement is simulated for a test site with absorbing ground plane. In this case, the level is calculated for one antenna height only.

2.9.15 S-LINE Correlation

This function is used for converting emitted EMI that has been measured by an EUT in a S-LINE cell (Gigahertz Transverse Electromagnetic). This function permits to compare the data with the measured electrical field of an open-area test site (OATS).

The correlation algorithm is based on the following model:

- a) The test item is measured in the directions x, y and z in the S-LINE cell. The respective results are referred to as V_x , V_y and V_z .
- b) Based on V_x , V_y and V_z the interfering power of the test item is calculated depending on the S-LINE dimensions.
- c) The calculated interfering power is simulated as follows:
The test item is replaced by a dipole which is aligned according to the polarization of the test antenna and corresponds to the calculated interfering power. The corresponding electrical fieldstrength is calculated at the position of the antenna.

Two methods can be selected:

a) Measurement result conversion

The interfering voltages V_x , V_y and V_z are measured. The fieldstrength characteristic is obtained by means of correlation and can be directly compared with the respective fieldstrength limit line.

The input files correspond to the interfering voltages of the test item measured in three orthogonal directions. All three input file must be specified. The scan or sweep tables of the input files must be identical.

The output file corresponds to the fieldstrength.

Algorithm:

S in [V^2], U_{Meas} in [$dB\mu V$]

$$S = 10^{\frac{U_{Meas,x}-120}{10}} + 10^{\frac{U_{Meas,y}-120}{10}} + 10^{\frac{U_{Meas,z}-120}{10}}$$

L in [$dB\mu V/m$], f in [MHz], S in [V^2]

C1: Cell Correction Factor

C2: OATS Correction Factor

$$L = 106 + C1 + C2 + 20 \log(f) + 10 \log(S)$$

b) Conversion of Limit Lines

In contrast to the first method, the fieldstrength limit line is first converted into a voltage limit line $V_{x,y,z} = (V_x^2 + V_y^2 + V_z^2)^{1/2}$. The advantage of this method is that the resulting interfering voltage from V_x , V_y and V_z can be directly compared with the calculated limit line.

Additional values determines the number of the additional sampling points for calculation of the limit line. Since the number of sampling points is usually very small and the conversion results in a more complex trace, it is advisable to use more sampling points - e.g. 100. The calculation is performed in two steps:

First of all, each point of the entered limit line (frequency / level) is converted.

In addition to the provided points, the entire frequency range is divided into the specified number of sampling points, linearly or logarithmically (according to the intermodulation mode of the limit line).

Each of these sampling points (frequency / interpolated level) is then converted.

The output file corresponds to the respective voltage limit line of the entered fieldstrength limit line of the standard used.

Algorithm:

U_{Limit} in [dB μ V] , L in [dB μ V/m] , f in [MHz]

C1: Cell Correction Factor

C2: OATS Correction Factor

$$U_{Limit} = 14 - C1 - C2 + L - 20 \log (f)$$

S-LINE Correlation

S-LINE Parameter

S-LINE Type: S-LINE 700

Cell Factor: S-LINE 700

Test Site

Correction Factor: S-LINE OATS 10 m

Conversion Mode

Convert Measurement Result

Convert Limit Line

Additional Points: 10

Input File(s)

E: EN 55022 F QP

Output File

V: EN 55022 S-LINE QP

Graphical Display

Input File(s): <none>

Output File: <none>

Start **Cancel**

The fields **S-LINE-Parameter** determine the the S-LINE type and the appropriate cell factor (a system transducer).

The field **Test Site** enables to select the appropriate correction factor (a system transducer) for the site, depending on the distance between EuT and antenna.

The **Start** button checks the settings and the correlation is started.