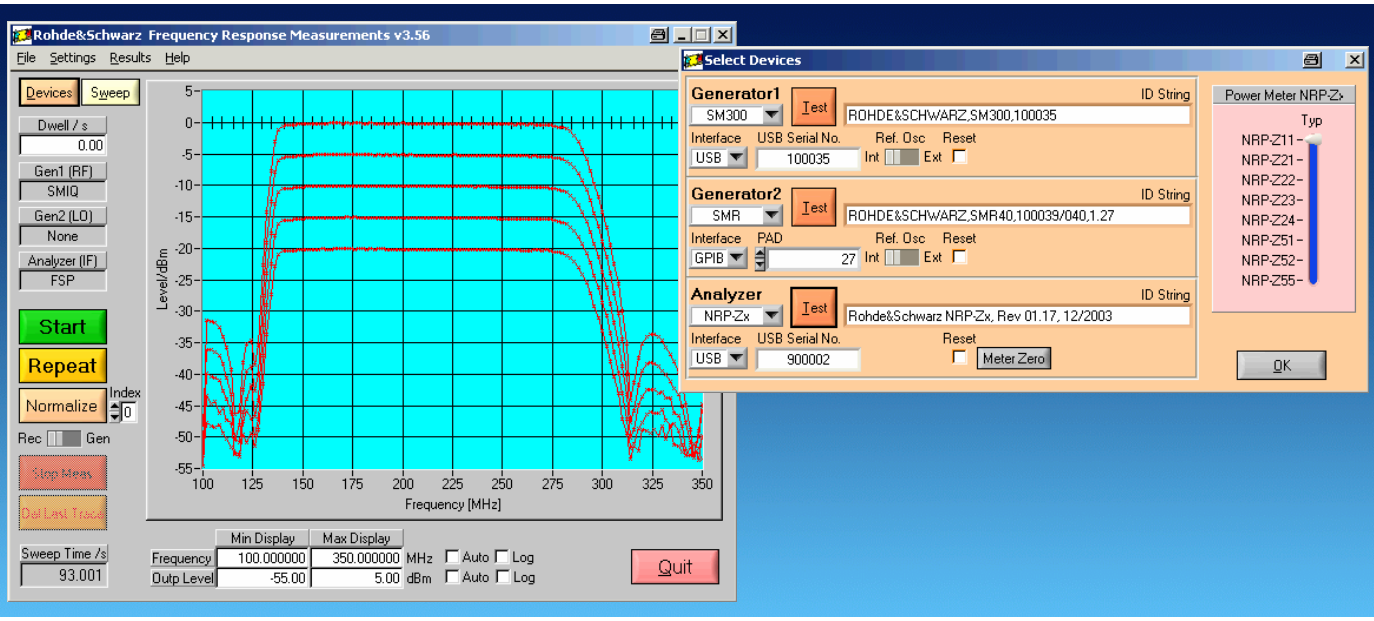

Products: SMU, SME, SMGU, SMHU, SMHU58, SMIQ, SML, SMP, SMR, SMT, SMY, SMV, SM300, ESCS, ESHS, ESIB, ESPC, ESS, ESVB, ESVD, ESVN, ESVS, FSE, FSP, FSU, FSQ, FS300, NRVD, NRVS, NRT, NRP, URV35, URV55, NRP-Zx

Program for Frequency Response Measurements

FreRes

This application note introduces the program FreRes. Use this program to measure the frequency and/or level response of a device under test, using a generator as signal source and a power meter, a receiver or a spectrum analyzer as indicator

ROHDE&SCHWARZ

Contents

1 Overview

This application note introduces the program **FRERES**. Use this program to measure the frequency and level response of a device under test, using a generator as signal source and a power meter, an emi receiver or a spectrum analyzer as indicator. Virtually any Rohde & Schwarz signal generator, spectrum analyzer, or power meter is supported (see table 1-1).The program runs under Windows 98ME/2000/XP and comes with a comprehensive help file **FRERES.CHM**.

Table 1-1 Supported sources and indicators

Supported sources		Supported indicators	
SMU200A	Vector Signal Generator	ESHSxx	EMI Test Receiver
SMIQ02	Vector Signal Generator	ESIB7	EMI Test Receiver
SMIQ02E	Vector Signal Generator	ESIB26	EMI Test Receiver
SMIQ03	Vector Signal Generator	ESIB40	EMI Test Receiver
SMIQ03E	Vector Signal Generator	ESPC	EMI Test Receiver
SMIQ06	Vector Signal Generator	ESS	EMI Test Receiver
SMV03	Vector Signal Generator	ESVBxx	Test Receiver
SM300	Vector Signal Generator	ESVD	Test Receiver
SML01	Signal Generator	ESVNxx	Test Receiver
SML03	Signal Generator	ESVSxx	EMI Test Receiver
SME02	Signal Generator	ESCS30	EMI Test Receiver
SME03	Signal Generator	FSEA20	Spectrum Analyzer
SME03A	Signal Generator (fast CPU)	FSEA30	Spectrum Analyzer
SME03E	Signal Generator	FSEB20	Spectrum Analyzer
SME06	Signal Generator	FSEB30	Spectrum Analyzer
SMGU	Signal Generator	FSEK20	Spectrum Analyzer
SMHU	Signal Generator	FSEK30	Spectrum Analyzer
SMHU58	Signal Generator	FSEM20	Spectrum Analyzer
SMP02	Signal Generator	FSEM30	Spectrum Analyzer
SMP03	Signal Generator	FSIQ3	Spectrum Analyzer
SMP04	Signal Generator	FSIQ7	Spectrum Analyzer
SMP22	Signal Generator (high power)	FSIQ26	Spectrum Analyzer
SMR20	Signal Generator	FSP3	Spectrum Analyzer
SMR27	Signal Generator	FSP7	Spectrum Analyzer
SMR40	Signal Generator	FSP13	Spectrum Analyzer
SMT02	Signal Generator	FSP30	Spectrum Analyzer
SMT03	Signal Generator	FSU8	Spectrum Analyzer
SMT06	Signal Generator	FSU3	Spectrum Analyzer
SMY01	Signal Generator	FSQ3	Spectrum Analyzer
SMY02	Signal Generator	FSQ8	Spectrum Analyzer
		FSQ26	Spectrum Analyzer
		FS300	Spectrum Analyzer
		NRVD	Dual Channel Power Meter
		NRVS	Single Channel Power Meter
		NRT NRP	Power Reflection Meter Power Meter
		NRP-Zx	All available Power Sensors
		URV35	Level Meter
		URV55	Level Meter

2 Software Features

FreRes provides functions for setting up the following measurement instruments and parameters:

- Source selection and GPIB setup.
- Indicator selection and GPIB setup.
- Sweep parameters setup.
- Graphic panel parameters setup.
- Measurement normalization.
- Repeated measurements.
- Save results as an ASCII file or a bitmap.
- Print results as a listing or a diagram.
- Load and display a previously saved ASCII file.
- Store individual measurement configurations.

3 Hardware and Software Requirements

Hardware Requirements

- Pentium II 450 MHz or higher, 128 MByte RAM, 50MByte free harddisc space, XGA monitor (1024x768), optional LAN interface
- National Instruments GPIB interface card
- Optional Agilent GPIB interface card

Software Requirements

- OS Windows 98SE / 2000 / ME / XP
- NI-GPIB v1.7 (or higher) IEEE-488.2 driver from National Instruments (see http.//www.natinst.com for latest revision).
- Optional Agilent GPIB driver
- NI-VISA v3.01 (or higher) driver from National Instruments (see http.//www.natinst.com for latest revision).
- Optional Agilent VISA driver
- RSIB-Passport v1.4 (or higher) – (see R&S application note 1EF47 at *hhtp://www.rohde-schwarz.com*)
- When using a R&S NRP-Zx Power Sensor install the corresponding VXIpnp driver and NRP-Toolkit first (see *hhtp://www.rohde-schwarz.com* for latest revision) and read the device's installation instructions before running it with FreRes.
- When using a R&S SM300 Vector Signal Generator and/or FS300 Analyzer install the corresponding VXIpnp driver(s) first (see *hhtp://www.rohde-schwarz.com* for latest revisions) and read the installation instructions before running them with FreRes.

4 Connecting the Instruments

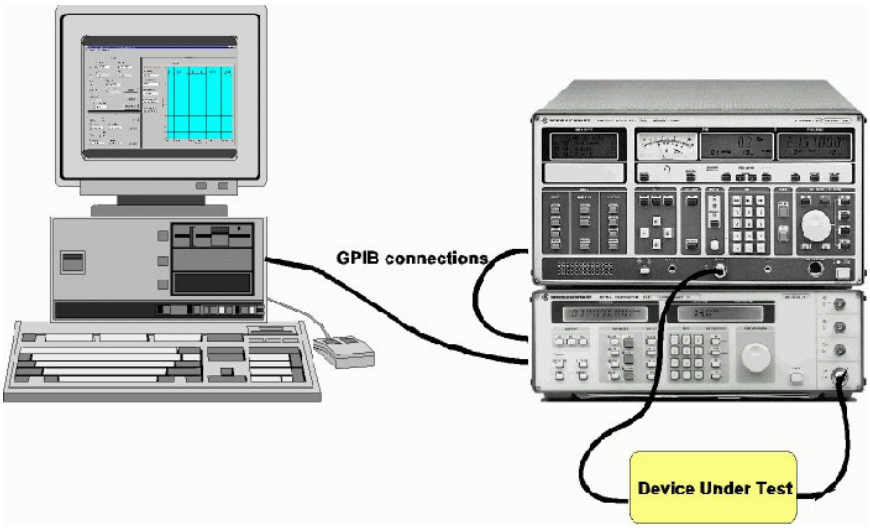

Fig. 1 Connecting computer to instruments

- Connect the source and the indicator via GPIB cables to the PC acting as controller.
- The DUT (device under test) is normally connected in the cable path between the source and the indicator.

5 Installing the Software

Download

FreRes.exe is a self extracting zipped file containing:

FreRes v3.xx.msi
DistFile.cab

Installation

Run **FRERES V3.XX.MSI** to install Frequency Response. The setup procedure creates a user defined directory (default C:\Program Files\Rohde&Schwarz\FreRes) containing following files:

FreRes.EXE
FreRes.CFG
FreRes.DAT
FreRes.CHM
RsDevLib.DLL
RsFunLib.DLL

6 Starting the Software/Measurement

Start the program with: *Start -> Programs -> Frequency Response / Frequency Response* or - double click on **FRERES.EXE** in the installion directory. The main menu appears using the previous configuration. The configuration is saved in the file **FRERES.CFG.** FreRes is largely self explanatory. See the online help (**FRERES.CHM**) for additional information.

User Interface

Main Menu

The main menu appears as shown below and features 5 pull-down menus; File, Settings, Run, Results and Help.

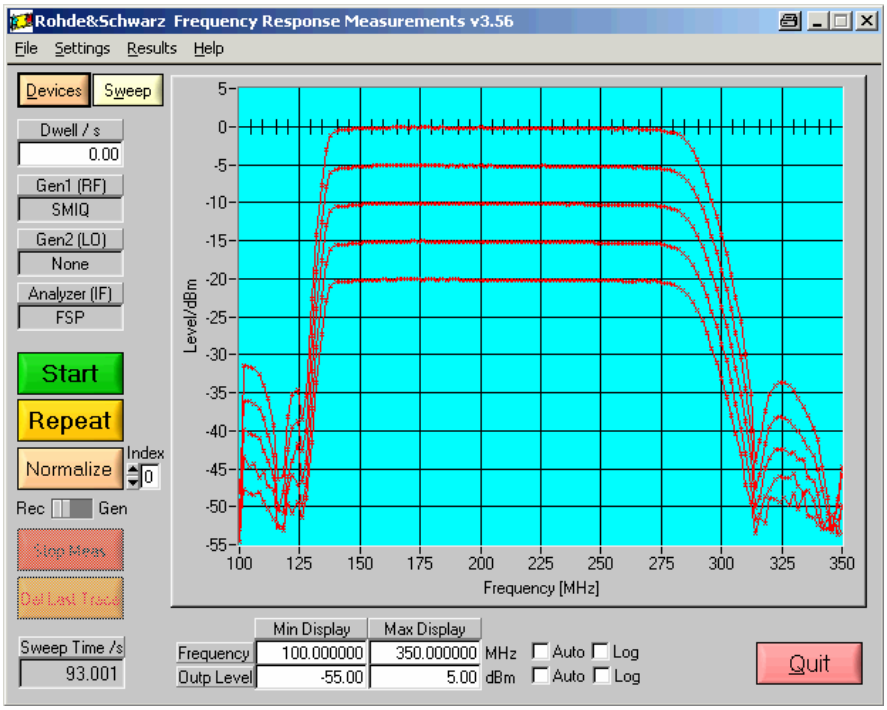

Fig. 2 Main Menu

File

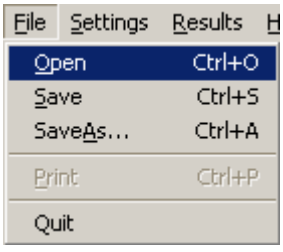

Fig. 3 File Menu

- **OPEN** – open a configuration file previously stored with **SAVE** or **SAVE AS**.
- **SAVE** – store the current configuration into the previously selected file.
- **SAVE AS** – store the current configuration into a selected file.

The default extension is "**.CFG**". When you close the program the current configuration is saved in "**FRERES.CFG**". This file is automatically loaded when FreRes is run next time.

Settings

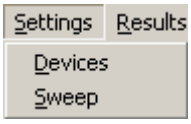

Fig. 4 Settings Menu

- **DEVICE** – Opens Device configuration window. See chapter '**SELECT DEVICES**' for details.
- **SWEEP** – Specifies **FreRes** sweep parameters. See chapter '**CONFIGURE SWEEP PARAMETERS**' for details.
- **DISPLAY** – Specifies **FreRes** display parameters. See chapter '**CONFIGURE DISPLAY PARAMETERS**' for details.

Results

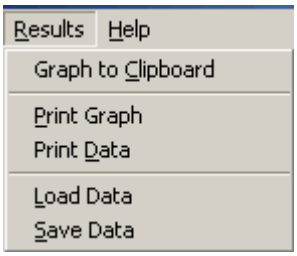

Fig. 5 Results Menu

- **GRAPH TO CLIPBOARD** – Transfers results graph to the controller's clipboard for use with other programs.
- **PRINT GRAPH** – Send results graph to a printer.
- **PRINT DATA** – Sends results to a printer. See chapter "*Measurements Data Result*" for a detailed description of the data format.
- **SAVE DATA** – Saves results; a list file is generated. The default extension is ***.rdt**.
- **LOAD DATA** – Loads and displays previously stored results.

Help

Fig. 6 Help Menu

- **CONTENTS** – Opens online help, displaying list of contents.
- **ABOUT** – Displays information about program version.

Performing a Measurement

This section describes how to prepare a test run, by selecting the source and indicator devices, configuring the test sweep and results display.

Select Devices

From Settings > Device select the source(s) and indicator to use.

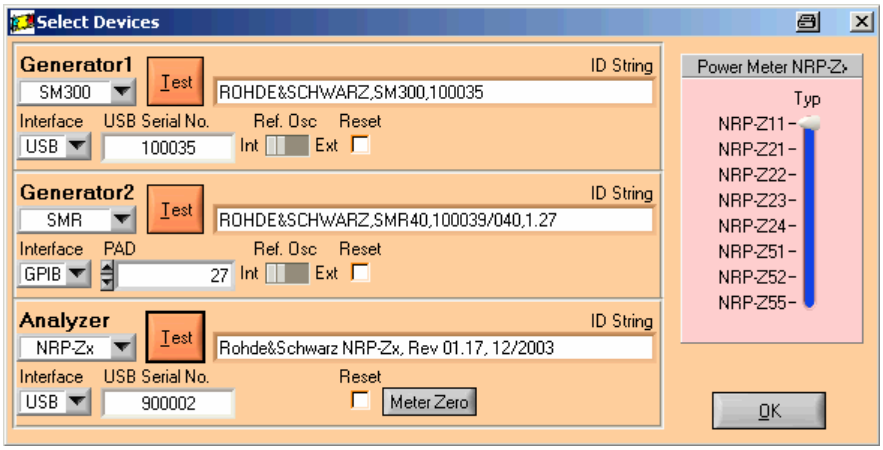

Fig. 7 Select Devices

Select the source from the **GENERATOR1** / **GENERATOR2** list and enter the correct GPIB-, IP address or USB serial number. **TEST** will query the instrument's ID string and display it in the message box.

Select indicator from the signal **ANALYZER** list and enter the correct GPIB address. **TEST** will query the instrument's ID string and display it in the message box.

When the **RESET** checkbox is turned ON the instrument performs a reset as soon as the according **TEST** or **START** button (see fig. 2, p. 6) is pressed.

Note: An error message will pop up in case no appropriate VISA driver is installed (e.g. NI-VISA v3.01 and higher) or a NRP-Zx, FS300 or SM300 driver has not been installed before selecting it in the FreRes device menu (see Software Requirements p.4).

- **INTERFACE** (Analyzer) – Allows selection of interface type. Range: GPIB, LAN or USB.
- **IP ADDR** – In case the LAN Interface is selected this control is visible. See FSx analyzer / SMU generator manual for correct setup (e.g. 89.10.71.55).
- **USB SERIAL NO** – Generator SM300, spectrum analyzer FS300 serial number which is printed on the device's rear side or can be displayed on the front panel by pressing SYS -> INFO -> STATISTICS (SM300/FS300). The NRP-Zx serial no. is printed on the power sensor's label.

Note: The R&S SM300 Vector Signal Generator and FS300 must be set to remote mode manually by pressing SYS -> CONFIG -> INTERFACE-> ENTER -> AUTO -> ENTER before initializing it or starting a scan.

- **REF.OSC** – Selects **INT**ernal or **EXT**ernal reference oscillator of according device.
- **METER ZERO** – Is visible in case a NRP-Zx, NRVS, NRVD, URV35 or URV55 power sensors is selected as **ANALYZER** device type. By pressing this button the program turns OFF the Generator1 RF output and zeroes the power sensor. Then the Generator1 RF output is turned back ON.

- **RS232 PORT** – Is visible as soon as an URV35 meter is selected.
- **BAUD** – Baudrate of RS232 device. Range 9600 bps.
- **PARITY** – Parity of RS232 device. Range 0, 1 or 2.

Some instruments need further information concerning reference level, IF-bandwidth and detector type (ESPC). An additional window pops up if necessary.

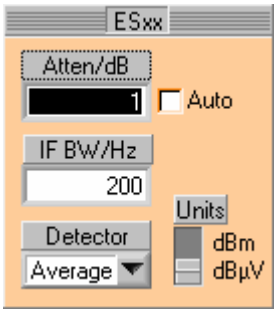

Fig. 8 ESPC Detector Setup

Configure Sweep Parameters

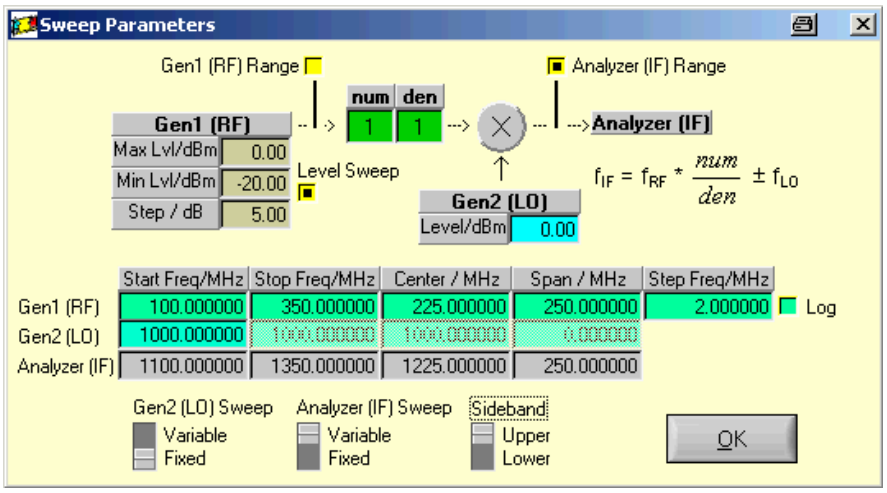

Fig. 9 Sweep Parameters

This menu allows configuration of frequency and level sweep. A second generator can be configured for measuring frequency shifting DUTs such as mixers, numerators and denumerators.

- **GENERATOR1 (RF)** – The generator providing the RF frequency.
  - **MIN LVL** – minimal (start) level. Range depends on device type.
  - **MAX LVL** – maximal (stop) level. Range depends on device type.
  - **STEP** – step level.
  - **LEVEL SWEEP** – Turn level sweep ON or OFF. When turned OFF MAX LVL and STEP controls are dimmed. The number of level sweeps is calculated as *N = (Max Level – Min Level) / Step Level + 1*
  - **START FREQ**uency – Sweep start frequency. This value is changed, if CENTER or SPAN controls are used.
  - **STOP FREQ**uency – Sweep stop frequency. This value is changed, if CENTER or SPAN controls are used.
  - **CENTER** – Sweep center frequency. This value is changed, if START FREQ or STOP FREQ controls are used.
  - **SPAN** – Sweep start frequency. This value is changed, if START FREQ or STOP FREQ controls are used.
  - **STEP** – sweep step frequency. Is dimmed if LOGARITHMIC sweep mode is selected.
  - **SPAN** – sweep span frequency. Is dimmed if LINEAR sweep mode is selected.
  - **LOG** – Linear (not checked) or logarithmic (checked) sweep mode. If Log mode is selected STEP is dimmed and COUNT undimmed.

- **GEN**erator**2 (LO)** – The generator acting as local oscillator.
  - **LEVEL** – absolute LO level.
  - **START FREQ**uency – LO start frequency. Is dimmed if GEN2 (LO) SWEEP is set to FIXED.
  - **STOP FREQ**uency – LO stop frequency. Is dimmed if GEN2 (LO) SWEEP is set to FIXED.
  - **CENTER** – LO center frequency. This value is changed, if START FREQ or STOP FREQ controls are used.
  - **SPAN** – LO start frequency. This value is changed, if START FREQ or STOP FREQ controls are used.

- **ANALYZER (IF)** – Analyzer settings.
  - **START FREQ**uency – Analyzer start frequency.
  - **STOP FREQ**uency – Analyzer stop frequency.
  - **CENTER** – Analyzer center frequency.
  - **SPAN** – Analyzer start frequency.

Note: Analyzer settings are automatically adapted to start-stop (center span) frequencies and Lin/Log mode. This feature ensures correct plot visibility without auto scale activation. Changing display parameters only affects generator1 sweep settings in case ANALYZER (IF) SWEEP is set to FIXED.

- **RF RANGE** – FreRes graph window shows measured level over generator1 frequency range.
- **IF RANGE –** FreRes graph window shows measured level over analyzer frequency range.
- **GEN2 (LO) SWEEP –** Variable / Fixed frequency range.
- **ANALYZER (IF) SWEEP –** Variable / Fixed frequency range. If set to Fixed the frequency sweep range of generator 1 is automatically set to variable.

Note: GEN2 and ANALYZER SWEEP switches cannot be set to FIXED simultaneously.

- **SIDEBAND** – In case a mixer and a second generator are involved, the resulting analyzer frequency is $f_{IF} = f_{Gen1} * num / den + f_{Gen2}$ when the switch is set to **UPPER**. In case **LOWER** is chosen, the analyzer frequency results to $f_{IF} = |f_{Gen1} * num / den + f_{Gen2}|$.

Configure Graphics Display

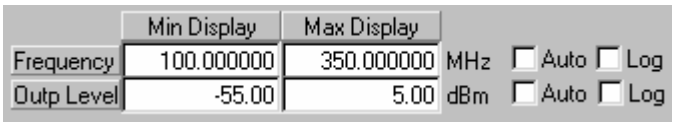

Fig. 10 Graphics Display

Set scaling for X- and Y- Axes

Set the scale type:

- **LOG** – logarithmic display when checked (unchecked for linear display). Set limits manually or automatically:

- **START** – the minimum value shown.
- **STOP** – the maximum value shown.
- **AUTO** – minimum and maximum values are automatically matched to test results.

Testing

- **START** – starts frequency sweep. Existing measurement plots are deleted prior to the new run. Measured points are displayed in real time. At the end of a sweep all points are connected by a line to enhance readability.
- **REPEAT** – starts measurement without deleting existing measurement plots. Pressing **NORMALIZE** causes all further measurements to be normalized to the first measurement scan invoked by **START**.
- **NORMALIZE** – uses current measurement as reference for measurements to come. There are two different correction methods:

Fig. 11 Normalize Measurement

  - **REC –** The resulting value is corrected after measurement.
  - **GEN –** The generator level is corrected before measurement.
  - **INDEX** – selects Level Sweep index to normalize to. If no Level Sweep is selected Index is set to 0.
- **STOP MEAS** – stops measurement immediately. After measurement has been stopped both the **NORMALIZE** and the **REPEAT** buttons become active.
- **DEL LAST TRACE** – deletes last trace if there are more than one traces.

Measurement Data Format (ASCII)

The format used for results data in an ASCII file is shown below. The file's default extension is "***.DAT**".

Example: **D:\RSAPPL\TEST.DAT**

```
Repetition  Count: 001
Level Sweep Count: 005
Measurement Count: 011
1100.000000 -39.516 -36.738 -32.923 -28.101 -23.279
1120.000000 -39.974 -37.379 -33.381 -28.376 -23.584
1140.000000 -40.279 -37.624 -33.839 -28.925 -24.195
1160.000000 -40.706 -37.868 -34.053 -29.108 -24.378
1180.000000 -40.523 -37.837 -34.175 -29.047 -24.836
1200.000000 -41.194 -38.997 -35.335 -30.238 -26.209
1220.000000 -41.805 -39.119 -35.945 -31.459 -27.338
1240.000000 -41.255 -38.966 -35.548 -31.550 -27.582
1260.000000 -42.202 -40.004 -36.922 -32.252 -28.559
1280.000000 -41.591 -39.516 -36.677 -32.557 -28.101
1300.000000 -41.317 -39.424 -36.220 -32.008 -27.491
```

The format used for results data in an ASCII file is shown below. The left column shows the frequency steps and the resulting level (power) values for one trace with 5 level sweeps.

*Note: To export data correctly to Microsoft Excel, save the file with an *.xls extension. Under Excel the data is formatted to match local country settings (e.g. decimal point).*

7 Additional Information

Please contact **TM-Applications@rsd.rohde-schwarz.com** for comments and further suggestions.

8 Ordering Information

Signal Generator		
SMU200A	(100 kHz to 3.0 GHz)	1141.2005.02
SME02	(5 kHz to 1.5 GHz)	1038.6002.02
SME03	(5 kHz to 3.0 GHz)	1038.6002.03
SME06	(5 kHz to 6.0 GHz)	1038.6002.06
SMIQ03B	(300 kHz to 3.3 GHz)	1125.5555.03
SMIQ03HD	(300 kHz to 3.3 GHz)	1125.5555.33
SMIQ04B	(300 kHz to 4.4 GHz)	1125.5555.04
SMIQ06B	(300 kHz to 6.0 GHz)	1125.5555.06
SML01	(9 kHz to 1.1 GHz)	1090.3000.11
SML02	(9 kHz to 2.2 GHz)	1090.3000.12
SML03	(9 kHz to 3.3 GHz)	1090.3000.13
SMP02	(10 MHz to 20 GHz)	1035.5005.02
SMP03	(10 MHz to 27 GHz)	1035.5005.03
SMP04	(10 MHz to 40 GHz)	1035.5005.04
SMP22	(10 MHz to 20 GHz)	1035.5005.22
SMR20	(10 MHz to 20 GHz)	1104.0002.20
SMR27	(10 MHz to 27 GHz)	1104.0002.27
SMR30	(10 MHz to 30 GHz)	1104.0002.30
SMR40	(10 MHz to 40 GHz)	1104.0002.40
SMR50	(10 MHz to 50 GHz)	1104.0002.50
SMR60	(10 MHz to 60 GHz)	1104.0002.60
SMT02	(5 kHz to 1.5 GHz)	1039.2000.02
SMT03	(5 kHz to 3.0 GHz)	1039.2000.03
SMT06	(5 kHz to 6.0 GHz)	1039.2000.06
SMV03	(9 kHz to 3.3 GHz)	1147.7509.13
SM300	(9 kHz to 3GHz)	1147.1498.03

Test Receiver		
ESCS30	(9 kHz to 2750 MHz)	1102.4500.30
ESIB7	(20 Hz to 7 GHz)	1088.7490.07
ESIB26	(20 Hz to 26,5 GHz)	1088.7490.26
ESIB40	(20 Hz to 40 GHz)	1088.7490.40
ESPI3	(9 kHz t 3 GHz)	1142.8007.03
ESPI7	(9 kHz t 7 GHz)	1142.8007.07
ESVN40	(9 kHz to 2750 MHz)	1056.9497.40
Spectrum Analyzer		
FSEA30	(20 Hz to 3.5 GHz)	1065.6000.35
FSEB30	(20 Hz to 7.0 GHz)	1066.3010.35
FSEK30	(20 Hz to 40 GHz)	1088.3494.35
FSEM30	(20 Hz to 26.5 GHz)	1079.8500.35
FSIQ3	(20Hz to 3.5GHz)	1119.5005.13
FSIQ7	(20Hz to .7 GHz)	1119.5005.17
FSIQ26	(20Hz to .26 GHz)	1119.6001.27
FSP3	(9 kHz to 3 GHz)	1093.4495.03
FSP7	(9 kHz to 7 GHz)	1093.4495.07
FSP13	(9 kHz to 13 GHz)	1093.4495.13
FSP30	(9 kHz to 30 GHz)	1093.4495.30
FSP40	(9 kHz to 40 GHz)	1093.4495.40
FSU3	(20 Hz to 3 GHz)	1129.9003.03
FSU8	(20 Hz to 8 GHz)	1129.9003.08
FSU26	(20 Hz to 26.5 GHz)	1129.9003.26
FSQ3	(20 Hz to 3 GHz)	1155.5001.03
FSQ8	(20 Hz to 8 GHz)	1155.5001.08
FSQ26	(20 Hz to 26 GHz)	1155.5001.26
FS300	(9 kHz to 3GHz)	1147.0991.03
Power Meters		
NRVD		0857.8008.02
NRVS		1029.2908.02
NRT		1080.9506.02
NRP		1143.8500.02
NRP-Z11	(10 MHz to 8 GHz)	1138.3004.02
NRP-Z21	(10 MHz to 18 GHz)	1137.6000.02
NRP-Z22	Average Power Sensor	1137.7506.02
NRP-Z23	Average Power Sensor	1137.8002.02
NRP-Z24	Average Power Sensor	1137.8502.02
NRP-Z51	Thermal Power Sensor	1138.0005.02
NRP-Z3	USB adapter (active)	1146.7005.02
NRP-Z4	USB adapter (passive)	1146.8001.02
NRP-Z2	Sensor Extension Cable	1146.6750.05
NRP-Z2	Sensor Extension Cable	1146.6750.10

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