

Products: SMU, SMATE, SMJ, SMR, SMA100, NRP, NRP-Z21, NRP-Z22, NRP-Z23

## Fast Scalar Network Analysis Using a Signal Generator and a Power Meter

### Application Note

This document presents a simple procedure for network analysis that is more cost-effective than the use of scalar network analyzers. It allows the accurate measurement of the transmission characteristics of filters, amplifiers and frequency converters over a large frequency and dynamic range. In order to reach very high measurement speeds, Rohde & Schwarz signal generators are operated in "List Mode", and Rohde & Schwarz power meters are operated in "Buffered Mode." The required programming for the signal generator and the power meter is illustrated by excerpts from a Visual Basic program which is available, free of charge, upon request.



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# 1 Overview

The transmission characteristics of RF components such as filters, amplifiers, or frequency converters are normally measured with a scalar network analyzer or a spectrum analyzer with tracking generator. If none is available, scalar measurements can also be carried out using an RF signal generator, a power meter and an external control program. The high speed required for scalar network analysis is achieved by utilizing the List Mode available in Rohde & Schwarz signal generators, and the Rohde & Schwarz power meter's Buffered Mode. This document contains a basic description of the procedure and the required programming commands. A free VB sample program is available upon request. This simple and very cost-effective setup may be used to accurately measure transmission characteristics over a large frequency and dynamic range. Such a setup could well be useful for applications in a production environment where fast, reproducible and cost-effective measurement applications are important.

### Typical applications:

Typical applications for the scalar network analysis procedure include the following:

- **Characterizing components in amplifiers, filters, and converters**  
This procedure is especially useful for conducting measurements on converters such as satellite TV converters. Unlike the selective measurements performed by a network analyzer, power meter measurements are broadband, and an unstable local oscillator frequency will not adversely affect measurement accuracy.
- **Balancing and documenting the transmission characteristics of filters**
- **Calibrating measurement setups**  
Complicated setups for measurements of, e.g., spurious up to 12.75 GHz in line with popular mobile communications standards (GSM, WCDMA) usually include filters, attenuators, and cables whose frequency response must be known.
- **Determining the compression point in amplifiers**  
The List Mode available in Rohde & Schwarz signal generators can also be used in conjunction with the power meter to conduct a fast power sweep in order to measure compression behavior in amplifiers, for example.

The following abbreviations are used when referring to Rohde & Schwarz test equipment:

- The R&S® SMU200A, SMATE200A, and SMJ100A vector signal generators are referred to as SMU200A, SMATE200A, and SMJ100A
- The R&S® SMR microwave signal generator is referred to as SMR
- The Power Meter R&S® NRP is referred to as NRP
- The R&S® NRP-Z11, NRP-Z21, NRP-Z22, NRP-Z23, and NRP-Z24 power sensors are referred to as NRP-Z11, NRP-Z21, NRP-Z22, NRP-Z23, and NRP-Z24.

## 2 Measuring Procedure

An RF signal generator with **List Mode** is used as the stimulator for fast scalar measurements. The SMA, SMATE, SMU und SMJ RF signal generators and the SMR family of microwave signal generators from Rohde & Schwarz can be used for this purpose.

Measurements are taken by a power meter with diode sensor, which can be operated in **Buffered Mode**, for instance the NRP-Z11/-Z21/-Z22/-Z24/-Z24 power sensors from Rohde & Schwarz which cover a frequency range from 10 MHz to 18 GHz.

The power measurement range of the NRP-Z11 and the NRP-Z21 is -67 dBm to +23 dBm, which means that in extreme cases, it is possible to achieve a dynamic range of up to 90 dB. For power ranges greater than +23 dBm, the user has the option of using one of the NRP-Z22/-Z23/-Z24 power sensors which have a preceding calibrated power attenuator and support a higher absolute power level. Optionally, the NRP power sensors can also be controlled directly via the USB port of a PC, without requiring the power meter base unit itself.

Also required is a controller with either a GPIB or LAN interface (with one exception: the SMR does not have a LAN interface and must be controlled via GPIB bus).

Depending on which generator is used, the measurement time is only approx. 2 ms to 4 ms per frequency point, including transmit delay. The power sensor buffer can store up to 1024 measured values and then transmit them as a block. By comparison, conventional solutions require a measuring time of approx. 20 ms per frequency point.

### List Mode in the signal generator

Rohde & Schwarz signal generators offer a special operating mode, called List Mode. This mode supports especially fast frequency and level setting times, which is accomplished by first creating a list of the various frequencies and levels in the controller. The list is then transmitted to the signal generator via the remote control interface. When the generator learns the list, i.e. when the list is started for the first time, it calculates and stores the required internal hardware settings for all frequency/level points. That means that in subsequent starts, the frequency/level list can be processed much faster than with conventional programming.

The signal generator's List Mode allows arbitrary spacing of the individual measurement points; for instance, the frequency points in a filter's passband can be spaced more closely than in the stopband, or a logarithmically-spaced "sweep" can be created.

The List Mode can also be used to conduct a power sweep in order to measure the compression point of an amplifier.

The run time of the frequency list and thus the ultimately achievable measuring speed is primarily determined by the frequency setting time for the generator and the required dwell time. The lower limit of the dwell time is determined by the measuring time required for the power meter and/or power sensor.

### **Buffered Mode in the power meter**

The counterpart to the List Mode provided by Rohde & Schwarz signal generators is the Buffered Mode offered by the NRP power meter and the NRP-Z11/-Z21/-Z22/-Z23/-Z24 power sensors, which allows very fast level measurements. After the start command is sent, a measured value is recorded for each external trigger and buffered internally in the power sensor. Up to 1024 values can be buffered. The negative edge of the generator's blanking signal is used as the trigger which indicates that a frequency change, or, in the case of a power sweep, a level change has taken place. That also synchronizes the generator setting and the capture of the measured value.

The measuring time required by the power meter is dependent on the preset trigger delay, the aperture time, and the time required for internal processing of the measured value. In practice, the shortest dwell time of 1.5 ms, coupled with an aperture time of 0.1 ms and a trigger delay of 0.1 ms, has proven useful. (Note: The power sensor requires twice the aperture time because the internal chopper amplifier is switched over.)

When the measuring sequence is completed, the measured values are transmitted from the sensor buffer to the controller, and the sample program displays them in a text box and saves them to a text file. Then the data can be processed or displayed with other programs such as Excel.

The SMA, SMATE, SMJ, or SMU can thus achieve a total measuring time of 200 ms for 100 measuring points, including transmission to the controller. For the SMR, the corresponding total measuring time is approx. 400 ms, which is due to the slightly longer frequency setting time.

### **Possible variations**

The NRP-Z sensors can also be operated as standalone units, without the NRP base unit. The integrated microcontroller has signal processing capabilities and can transmit the data to the controller via the USB port. That makes the solution even more cost-effective. However, the base unit is required if a direct display of the measured values is desired, although the Power Viewer software for Windows, which is included in the NRP-Z series, can be used for this. Alternatively, users may also use the NRPVIEW application software (see Application Note 1MA77).

## Fast Scalar Network Analysis

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Since triggering is required for the measuring sequence described above, the R&S NRP-Z3 active USB adapter is required in addition to the power sensor. The USB adapter is equipped with a BNC connector that routes an external trigger signal to the power sensor.

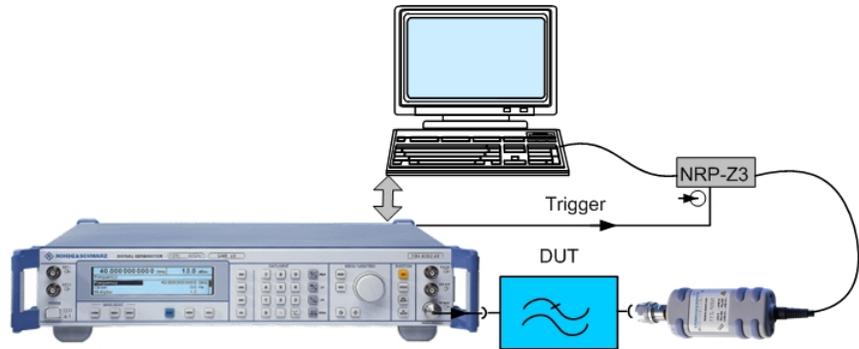


Fig. 1: Basic test setup for scalar network analysis with a signal generator, power sensor and a lowpass as the DUT

### **Limits and limitations**

The procedure described in this document allows fast and accurate scalar measurements in a wide frequency and dynamic range and is thus sufficient for many applications. Compared to a scalar network analyzer, the costs are lower by a factor of 2 or 3.

The possible maximum frequency range depends on the equipment used and ranges from a lower limit of 10 MHz to an upper limit of 18 GHz. This is the frequency range for the NRP-Z21/22/23/24 power sensors. The achievable upper frequency limit depends on the generator. On the SMA, SMJ, or SMU, the maximum frequency can be set to 3 GHz or 6 GHz, depending on the chosen frequency option. For the SMR microwave signal generator, the upper frequency limit goes up to 60 GHz.

Compared to selective measurements with a network analyzer, the dynamic range is limited due to the broadband measurement with the power sensor. The NRP-Z21 has a level range of -67 dBm to +23 dBm. At a level of -33 dBm and an aperture time of  $2 \times 0.1$  ms, it guarantees a display noise (2x standard deviation) of  $< 0.16$  dB; typical values are approx.  $< 0.1$  dB [1]. The relative display noise increases at lower levels, but that can be offset to a certain extent by a longer aperture time and a corresponding increase in dwell time. However, that does result in a longer measuring time.

Scalar measurements are always compared to a reference measurement (the sensor is connected directly to the generator output). In Buffered Mode, sensor errors do not have a negative effect because of the inactive internal frequency response correction.

The program can be used with any Rohde & Schwarz RF signal generator that supports List Mode, i.e. SMA, SMATE, SMJ, SMU, and SMR, but not with the economy models SML, SMV, or SM300.

As the objective is to achieve a high measuring speed, it is not possible to use thermal sensors, but only the fast NRP-Z11, -Z21, -Z22, -Z23, -Z24 diode sensors, which support Buffered Mode.

### 3 Test Setup

The setup is the same for all generators; the only difference is whether the measurements are performed with the combination of an NRP power meter and a power sensor, or whether the power sensor and the NRP-Z3 USB adapter are used.

#### Setup with NRP-Z21/NRP-Z3, controlled via USB adapter

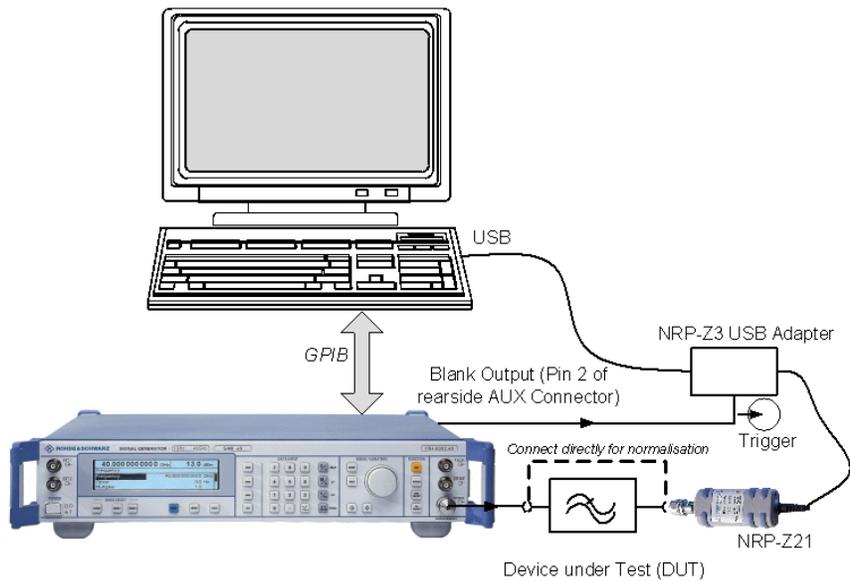


Fig. 2: Setup for a scalar network analysis in the 10 MHz to 18 GHz range with SMR and NRP-Z21/NRP-Z3, controlled via USB adapter

**Setup with NRP/NRP-Z3, controlled via the NRP base unit**

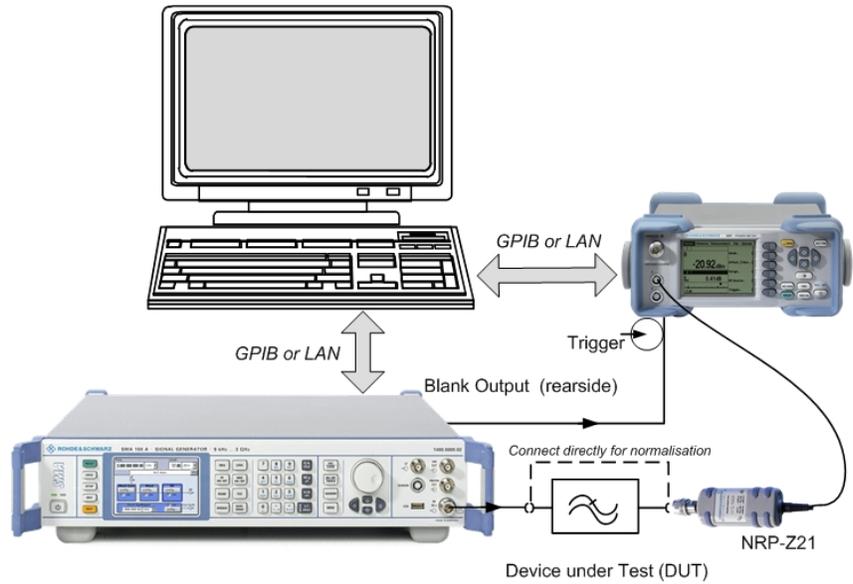


Fig. 3: Setup for a scalar network analysis in the 10 MHz to 3 or 6 GHz range with SMA100A, NRP, and NRP-Z21, controlled via GPIB bus or LAN interface

**Triggering with a blanking signal**

In order for the measurement value to be recorded synchronously with the signal generator’s frequency sweep, it is critical that the power meter or power sensor be triggered with the generator’s blanking signal. The following indicates the locations of the outputs which provide the blanking signal of the respective generators required for triggering the power meter base unit and/or the power sensor. The outputs are located on the rear panel of the device:

- On the SMR, it is pin 2 in the AUX port

**3 AUX**

Ground (Pin 9)

Blank (Pin 2)

Interface for direct control of additional, external devices.

Pin	Designation	Assignment
1	MARKER	Marker signal output for sweep mode.
2	BLANK	Blanking signal output for sweep mode.
3	TRIGGER	Trigger input for sweep, memory sequence and list modes.
4	STOP	Input for stopping the sweep.
5	Z-AXIS	combined MARKER/BLANK signal.
6 - 9	GROUND	

Fig. 4: Blanking signal at the AUX port on the rear panel of the **SMR** (pin 2), for triggering the NRP and/or the NRP-Z3

- On the SMU and the SMJ, it is in the USER1 connector (when programmed accordingly; the GPIB command is “**OUTP:USER1:SOUR ABL**”)

**19 USER connector**

USER

Input/output for configurable signals for triggering and control  
The following signals can be applied to the connector:

- Marker 4 (path A or B)
- Clock Out (path B, bit or symbol)
- CW mode Out (path A/B)
- No signal (blank) marker (path A/B)
- HOP (path A/B)

Fig. 5: USER1 connector on the rear panel of the **SMU** or **SMJ** (the GPIB command to program the port as the blanking signal output is “**OUTP:USER1:SOUR ABL**”)

- The SMA is equipped with a designated BNC output

### 10 Output of blanking signal



BLANK Output of blanking signal for the sweep operating mode.

Fig. 6: Blanking signal output on the **SMA100A**

## 4 Command Sequences for Various Configurations

In each of the following VB 6.0 examples, a list of 100 frequency and level points is transmitted to the generator, and the points are then measured. Signal generator and power meter are preset with the “Setup Instruments” command; cf. section **Instrument setup**. The measurements are started and continuously repeated with the “Start Measurement Sequence” command; cf. section **Starting the measuring sequence**.

Note:

These VB program excerpts illustrate how Rohde & Schwarz equipment is programmed for List Mode and Buffered Mode and how the measured values are read. An executable demo program is available upon request from [TM-Applications@rsd.rohde-schwarz.com](mailto:TM-Applications@rsd.rohde-schwarz.com); cf. chapter 7, “Additional Information.”

### Instrument setup

The program first sets the signal generator on the basis of the Preset state. Then a frequency/level list is created with the number of points (in the default state, 100 points in the 10 MHz to 3 GHz frequency range) and transmitted to the generator. Now the generator is switched to List Mode with the corresponding parameters, and a single run of the list is executed.

The power meter or power sensor is set on the basis of the Preset state and then switched to Buffered Mode with the corresponding parameters.

**Setting the SMA/SMJ/SMU and loading a frequency/level list:**

<b>VB6 Command</b>	<b>Function</b>
<pre> FSTART = 10e6 FSTOP = 3E9 N_points = 100 MAXINDEX = Str\$(N_points - 1) FSTEP = (FSTOP - FSTART) / (N_points - 1) SMA.WriteString "SYST:PRES" SMA.WriteString "OUTP:AMOD FIX" SMA.WriteString "OUTP:STAT ON" SMA.WriteString "SOUR:POW:LEV:IMM:AMPL 0" FBuffer = vbNullString LBuffer = vbNullString  For cnt = 0 To N_points - 1     Freq = FSTART + (cnt * FSTEP)     FBuffer = FBuffer + Trim\$(Str\$( Freq)) + "Hz,"     LBuffer = LBuffer + Trim\$(Str\$(0)) + "dBm," Next cnt  'size FBuffer, LBuffer must be &gt;= NRPZ buffer size FBuffer = Left\$(FBuffer, Len(FBuffer) - 1) LBuffer = Left\$(LBuffer, Len(LBuffer) - 1) SMA.WriteString "SOUR:LIST:SEL 'LIST0'" SMA.WriteString "SOUR:LIST:FREQ " + FBuffer SMA.WriteString "SOUR:LIST:POW " + LBuffer SMA.WriteString "SOUR:LIST:MODE AUTO" SMA.WriteString "SOUR:LIST:DWEL 1.5 ms" SMA.WriteString "SOUR:FREQ:MODE LIST" SMA.WriteString "SOUR:LIST:TRIG:SOUR SING" 'SMA.WriteString "OUTP:USER1:SOUR ABL  SMA.WriteString "SOUR:LIST:IND:STAR 0" SMA.WriteString "SOUR:LIST:IND:Stop " + MAXINDEX SMA.WriteString "SOUR:LIST:TRIG:EXEC" </pre>	<p>Start frequency 10 MHz Stop frequency 3 GHz 100 list points</p> <p>Calculate step size Preset Fixed attenuator setting RF output on Level setting 0 dBm</p> <p>Create frequency/level list</p> <p>Eliminate last ","</p> <p>Select LIST0 Fill frequency list Fill level list Auto list mode Dwell time = 1.5 ms Switch on List Mode Single run of list Only for SMU/SMJ: blanking signal to USER 1 output List start index 0 List stop index = MAXINDEX Start single run of list</p>

**Setting the SMR and loading a frequency/level list:**

<b>VB6 Command</b>	<b>Function</b>
FSTART = 10e6	Start frequency 10 MHz
FSTOP = 3E9	Stop frequency 3 GHz
N_points = 100	100 list points
MAXINDEX = Str\$(N_points - 1)	
FSTEP = (FSTOP - FSTART) / (N_points - 1)	Calculate step size
SMR.WriteString "SYST:PRES"	Preset
SMR.WriteString "OUTP:AMOD FIX"	Fixed attenuator setting
SMR.WriteString "OUTP:STAT ON"	RF output On
SMR.WriteString "SOUR:POW:LEV:IMM:AMPL 0"	Level setting 0 dBm
FBuffer = vbNullString	
LBuffer = vbNullString	
For cnt = 0 To N_points - 1	Create frequency/level list
Freq = FSTART + (cnt * FSTEP)	
FBuffer = FBuffer + Trim\$(Str\$( Freq)) + "Hz,"	
LBuffer = LBuffer + Trim\$(Str\$(0)) + "dBm,"	
Next cnt	Eliminate last ","
FBuffer = Left\$(FBuffer, Len(FBuffer) - 1)	
LBuffer = Left\$(LBuffer, Len(LBuffer) - 1)	
SMR.WriteString "SOUR:LIST:SEL 'LIST0'"	Select LIST0
SMR.WriteString "SOUR:LIST:FREQ " + FBuffer	Fill frequency list
SMR.WriteString "SOUR:LIST:POW " + LBuffer	Fill level list
SMR.WriteString "SOUR:LIST:MODE AUTO"	Auto list mode
SMR.WriteString "SOUR:LIST:DWEL 1.5 ms"	Dwell time = 1.5 ms
SMR.WriteString "SOUR:FREQ:MODE LIST"	Switch on List Mode
SMR.WriteString "SOUR:LIST:TRIG:SOUR SING"	Single run of list
SMR.WriteString ":TRIG:LIST"	Start single run of list

**Setting the NRP+NRP-Z21:**

<b>VB6 Command</b>	<b>Function</b>
NRP.WriteString "SYST:PRES"	Preset
NRP.WriteString "SYST:SPEED FAST"	Display off for max. speed
NRP.WriteString "init1:cont off"	Continuous meas. off
NRP.WriteString "SENS:Aver:STATE Off"	Averaging off
NRP.WriteString "SMO:STATE OFF"	Smoothing off
NRP.WriteString "SENS:AVER:COUNT:AUTO OFF"	Auto average count off
NRP.WriteString "SENS:AVER:COUNT 1"	Average count 1
NRP.WriteString "SENS1:POW:AVG:APER 0.1ms"	Aperture time 0.1
NRP.WriteString "Trig:Sour Ext"	External trigger
NRP.WriteString "TRIG:SLOP NEG"	Negative trigger slope
NRP.WriteString "TRIG:del .1ms"	Trigger delay 0.1 ms
NRP.WriteString "TRIG:COUNT 100"	Number of meas. cycles
NRP.WriteString "SENS:POW:AVG:BUFF:SIZE 100"	Buffer size = 100
NRP.WriteString "SENS:POW:AVG:BUFF:State ON"	Switch on buffered mode

**Setting the NRP-Z21/Z3 (USB adapter):**

<b>VB6 Command</b>	<b>Function</b>
Call rsnrpz_init("*", 1, 1, Handle)	Preset
Call rsnrpz_chan_reset (Handle, 1)	Sensor reset
Call rsnrpz_chan_setInitContinuousEnabled(Handle, 1, 0)	Continuous meas. off
Call rsnrpz_avg_setAutoEnabled(Handle, 1, 0)	Averaging off
Call rsnrpz_chan_setContAvSmoothingEnabled(Handle, 1, 0)	Smoothing off
Call rsnrpz_avg_setAutoEnabled(Handle, 1, 0)	Auto average count off
Call rsnrpz_trigger_setCount(Handle, 1, 1)	Average count 1
Call rsnrpz_chan_setContAvAperture(Handle, 1, 0.0001)	Aperture time 0.1ms
Call rsnrpz_trigger_setSource(Handle, 1, 4)	External trigger
Call rsnrpz_trigger_setSlope(Handle, 1, 1)	Negative trigger slope
Call rsnrpz_trigger_setDelay (Handle, 1, 0.0001)	Trigger delay 0.1 ms
Call rsnrpz_trigger_setCount(Handle, 1, 100)	Number of meas. cycles
Call rsnrpz_chan_setContAvBufferSize(Handle, 1, 100)	Buffer size = 100
Call rsnrpz_chan_setContAvBufferedEnabled(Handle, 1, 1)	Switch on buffered mode

### Starting the Measuring Sequence

When the measuring sequence is started, the command "INIT:IMM" starts the measuring process in the NRP. After a delay of 2 ms, the NRP is ready to record measured values, externally triggered, depending on the buffer size (100 in the default state). Execution of the frequency list is started with the EXECUTE LIST command. After the generator has been set to a frequency point on the list, a trigger for the power meter or power sensor is sent via the BLANK output.

Afterwards, the contents of the buffer are read with a "Fetch?" command.

### Using the SMA/SMJ/SMU or SMR signal generator, and measurement with NRP and NRP-Z21 via the GPIB bus interface:

VB6 Command	Function
NRP.WriteString "Init:IMM"	Start meas. sequence
Sleep 2	Sleep 2 ms
SMA.WriteString "SOUR:LIST:TRIG:EXEC;*WAI"	Execute list on SMA*
NRP.ReadString "*opc?", OPCBuffer	Wait until operation complete
NRP.ReadString "Fetch?", Result, 10000	Read result string

\*) Command for the SMA, SMJ, SMU. For the SMR, the corresponding command is ":TRIG:LIST;\*WAI"

**Using the SMA/SMJ/SMU or SMR signal generator, and measurement with NRP-Z21/NRP-Z3 via the USB interface:**

Command	Function
<pre> ReadPower X, Result  Public Sub ReadPowerBuffer(ByRef Handle As ViSession, ByRef Reading() As Double, ByVal N_points As Integer, ByVal SMA As VIF)     Dim Err As ViStatus     Dim Status As ViBoolean     Dim Number As Long     Dim Index As Integer      rsnrpz.rsnrpz_chans_initiate (Handle)     sleep 2      SMA.WriteString "SOUR:LIST:TRIG:EXEC:*WAI"     Do         rsnrpz.rsnrpz_chan_isMeasurementComplete Handle, 1, Status         Loop Until Status = VI_TRUE          ReDim Reading(0 To 99)         rsnrpz.rsnrpz_meass_fetchBufferMeasurement Handle, 1, 100, Reading(0), Number         For Index = LBound(Reading) To UBound(Reading)             Reading(Index) = Log(Abs(Reading(Index))) / Log(10)             Reading(Index) = (10 * Reading(Index)) + 30         Next Index     End Sub </pre>	<p>Run subroutine</p> <p>Subroutine ReadPower</p> <p>Start sensor measurement</p> <p>Sleep 2 ms until sensor is ready for trigger</p> <p>Execute list on SMA *</p> <p>Wait until measurement is complete</p> <p>Fetch buffer data (100 values)</p> <p>Convert W to dBm</p>

\*) Command for the SMA, SMJ, SMU. For the SMR, the corresponding command is “:TRIG:LIST;\*WAI”

## **5 User Interface of the Demo Program and Recording the Measuring Speed**

The input values are: start frequency, stop frequency and number of points.

As soon as the user clicks on SETUP INSTRUMENTS, these values are used to calculate an appropriate, constant step size, and a frequency/level list is generated and sent to the signal generator. Also, the signal generator and the power sensor are preset to List Mode and Buffered Mode, respectively.

The measuring process is activated by pressing START MEAS SEQUENCE. The large pane on the right shows index, frequency, and the measured level. In addition, the total measuring time (Total Meas. Time/ms) is displayed in the small field on the lower left side of the screen.

### **Measurements with the SMA:**

With the SMA, the total time required to measure 100 points is approx. 200 ms; cf. the results displayed in the small field on the lower left side of the screen (as shown in Fig. 7).

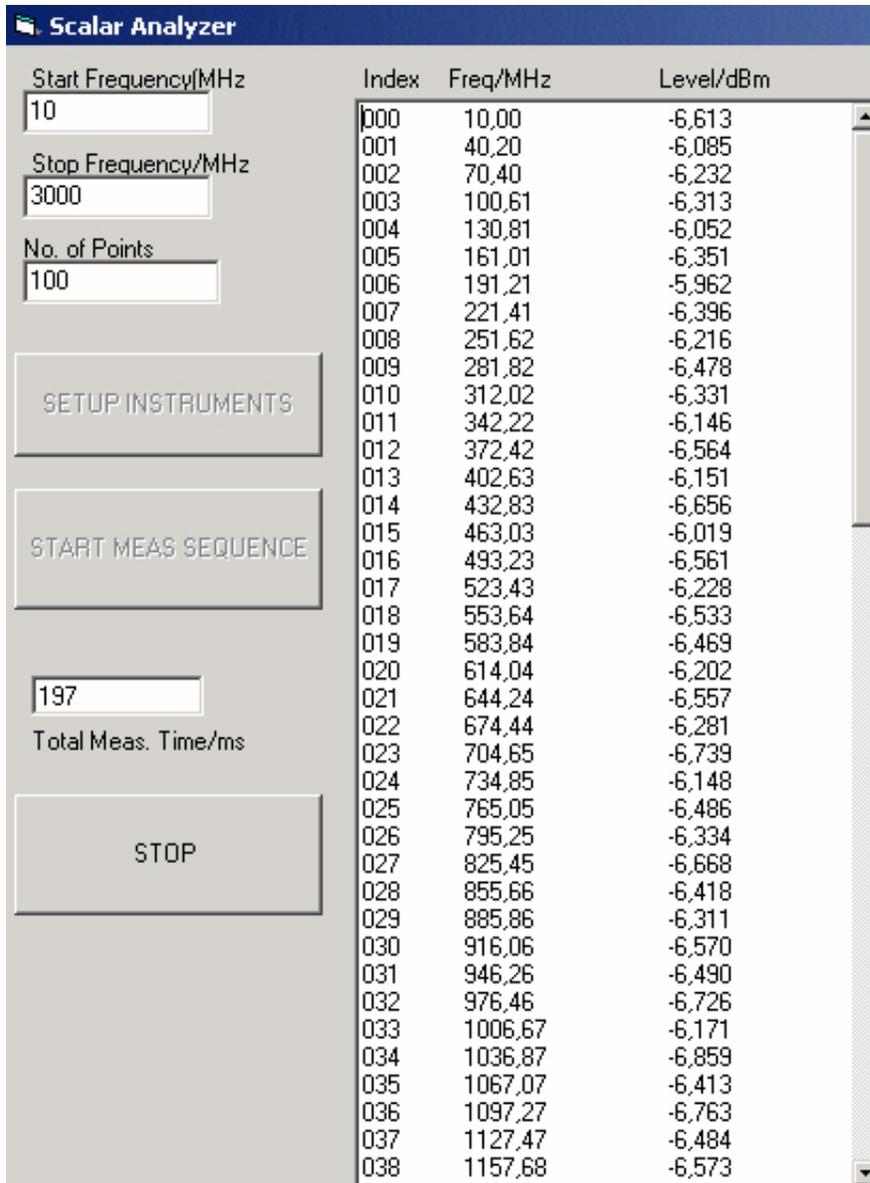


Fig. 7: User interface of a demo program for scalar network analysis with SMA and NRP-Z21, and recorded measuring speeds

### Measurements with the SMR:

For the SMR, the total time required to measure 100 points is approx. 390 ms.

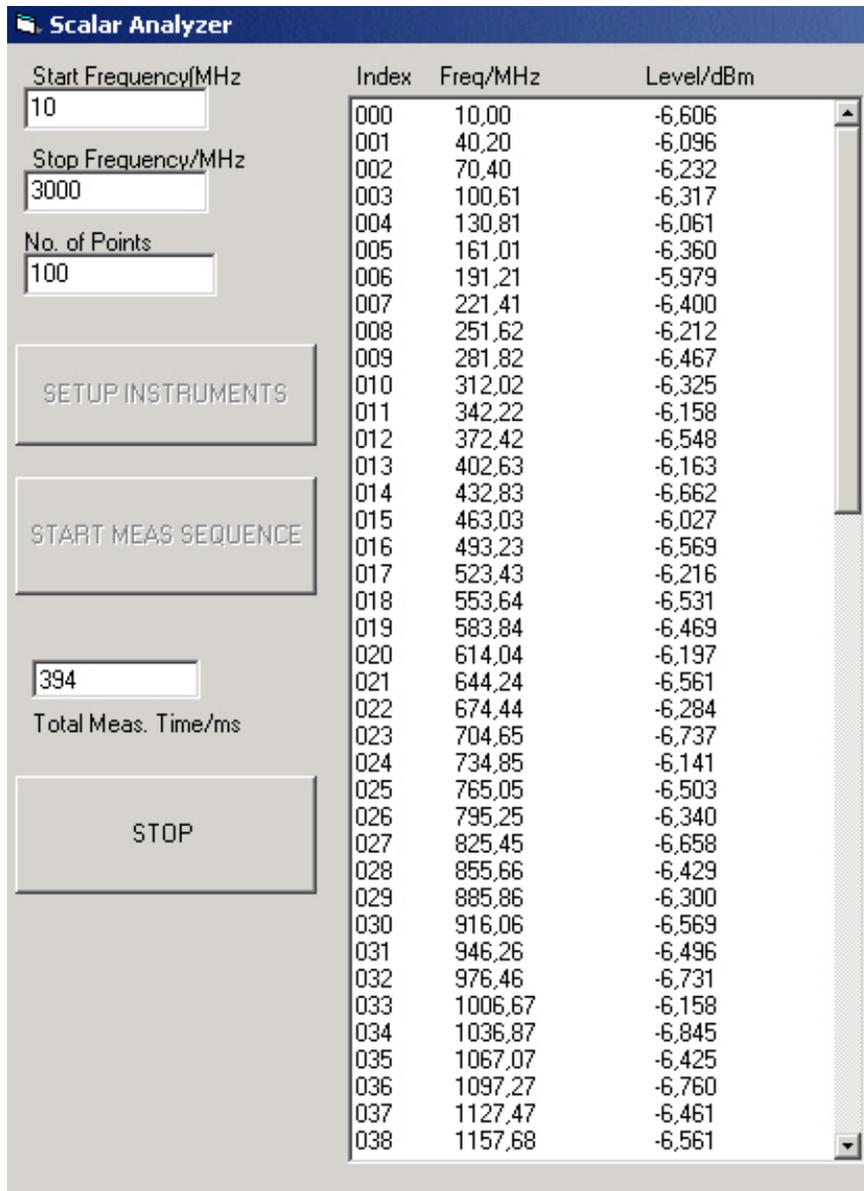


Fig. 8: User interface of a demo program for scalar network analysis with SMR and NRP-Z21, and recorded measuring speeds

## 6 References

- [1] Data sheet PD 0757.7023.21 Power Meter R&S® NRP
- [2] Technical Information TI\_ R&S® NRP-Z22/23/24.doc
- [3] Data sheet PD 0758.0822.32 Microwave Signal Generator R&S® SMR
- [4] Data sheet PD 0758.1893.32 Microwave Signal Generator R&S® SMR50/60
- [5] Data sheet PD 5213.6412.22 Signal Generator R&S® SMA 100A
- [6] Data sheet PD 5213.5074.22 Vector Signal Generator R&S® SMJ100A
- [7] Data sheet PD0758.1893.22 Vector Signal Generator R&S® SMATE
- [8] Data sheet PD 0758.0197.22 □Vector Signal Generator R&S® SMU200A
- [9] Application Note 1MA77\_4E.pdf

Rohde & Schwarz documentation is available on the web at: [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## 7 Additional Information

This application note is frequently updated. Please navigate to 1MA101 under "Application Notes" on the Rohde & Schwarz homepage ([www.rohde-schwarz.com](http://www.rohde-schwarz.com)) to download the current version. Please contact [TM-Applications@rsd.rohde-schwarz.com](mailto:TM-Applications@rsd.rohde-schwarz.com) to request a free version of the Visual Basic demo program. In order to process your request for a demo program, we need your specific configuration (model of signal generator used, sensor controlled directly via USB or via the NRP base unit).

Please direct any comments or suggestions to [TM-Applications@rsd.rohde-schwarz.com](mailto:TM-Applications@rsd.rohde-schwarz.com).

## 8 Ordering Information

### RF & Microwave Signal Generators and Options

SMR20	1 GHz to 20 GHz	1104.0002.20
SMR27	1 GHz to 27 GHz	1104.0002.27
SMR30	1 GHz to 30 GHz	1104.0002.30
SMR40	1 GHz to 40 GHz	1104.0002.40
SMR-B11	Frequency extension 0.01 GHz to 1 GHz	1104.4250.02
SMR50	10 MHz to 50 GHz	1134.9008.50
SMR60	10 MHz to 60 GHz	1134.9008.60

SMA100A	9 kHz to 3/6 GHz	1400.0000.02
SMA-B103	9 kHz to 3 GHz with electronic attenuator	1405.0209.02
SMA-B103L	9 kHz to 3 GHz without electronic attenuator	1405.0609.02

SMJ100A		1403.4542.02
SMJ-B103	100 kHz to 3 GHz	1403.8502.02
SMJ-B106	100 kHz to 6 GHz	1403.8702.02

SMU200A		1141.2005.02
SMU-B102	Frequency range 100 kHz to 2.2 GHz for 1st RF path 1)	1141.8503.02
SMU-B103	Frequency range 100 kHz to 3 GHz for 1st RF path 1)	1141.8603.02
SMU-B104	Frequency range 100 kHz to 4 GHz for 1st RF path 1)	1141.8703.02
SMU-B106	Frequency range 100 kHz to 6 GHz for 1st RF path 1)	1141.8803.02

SMATE200A		1400.7005.02
SMATE-B103	100 kHz to 3 GHz	1401.1000.02
SMATE-B106	100 kHz to 6 GHz	1401.1200.02

### Power Meters and Sensors

NRP		1143.8500.02
NRP-Z11	Average power sensor 10 MHz to 8 GHz, 200 pW to 200 mW	1138.3004.04
NRP-Z21	Average power sensor 10 MHz to 18 GHz, 200 pW to 200 mW	1137.6000.02
NRP-Z22	Average power sensor 10 MHz to 18 GHz / 2 nW to 1.5 W	1137.7506.02
NRP-Z23	Average power sensor 10 MHz to 18 GHz / 20 nW to 15 W	1137.8002.02
NRP-Z24	Average power sensor 10 MHz to 18 GHz / 60 nW to 30 W	1137.8502.02
NRP-Z3	USB adapter	1146.7005.02
NRP-Z4	Ethernet interface	1146.9308.02



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