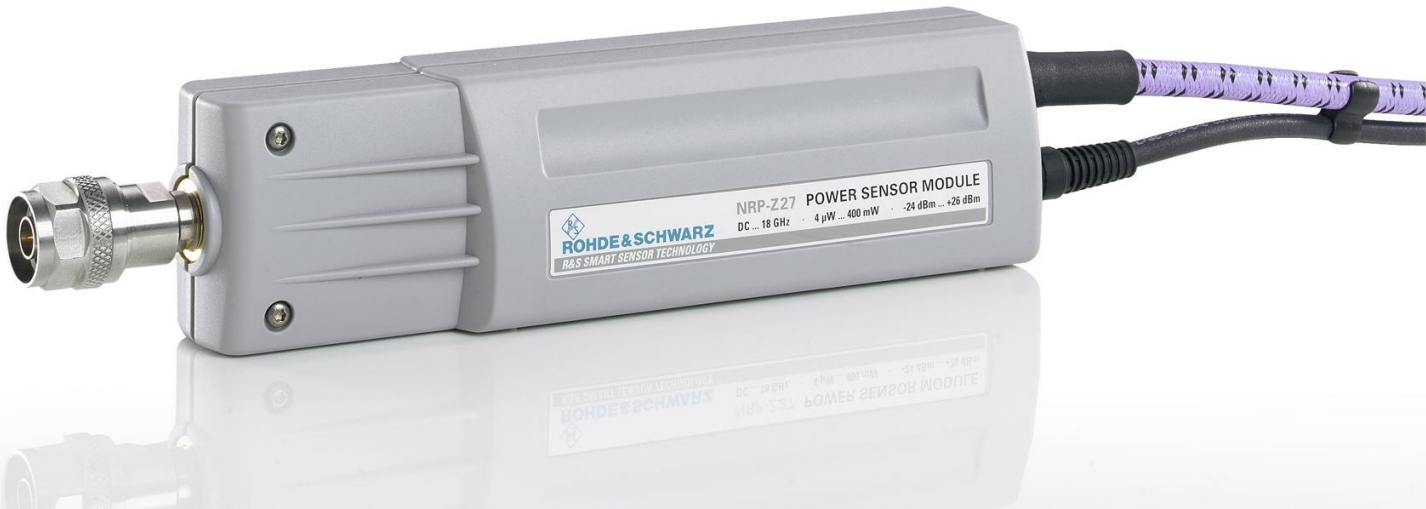


Operating Manual



Power Sensor Module

R&S[®] NRP-Z27
1169.4102.02

R&S[®] NRP-Z37
1169.3206.02

Printed in Germany



Dear Customer,

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG
Trade names are trademarks of the owners.

Operation of the Power Sensor Module R&S NRP-Z27/-Z37 on the R&S NRP base unit

The power sensor module supplied with this manual has firmware version **01.61** or later. To operate it on the R&S NRP base unit, all software components installed on the base unit must have version number **02.00** or later. If you want to use the distortion compensation (command group: SENSE:RGAMma, see page 6-12), the 'Main Program' must have at least version number **3.24**.

The version numbers of the software components can be read out under the menu item 'System Info', in the lines 'Main Program', 'Bootloader' and 'Keybd. Ctrl'. For firmware versions earlier than 02.00, the menu item 'System Info' can be found in the File menu; otherwise, in the System menu.



Certificate No.: 2002-36, page 1

This is to certify that:

Equipment type	Stock No.	Designation
NRP	1143.8500.02	Power Meter
NRP-B1	1146.9008.02	Sensor Check Source
NRP-B2	1146.8801.02	Second Sensor Input
NRP-B3	1146.8501.02	Battery Supply
NRP-B4	1146.9308.02	Ethernet Lan-Interface
NRP-B5	1146.9608.02	3rd und 4th Sensor
NRP-B6	1146.9908.02	Rear-Panel Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12
 EN55011 : 1998 + A1 : 1999, Class B
 EN61326 : 1997 + A1 : 1998 + A2 : 2001 + A3 : 2003

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2002

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2006-11-23

Central Quality Management FS-QZ / Radde



Certificate No.: 2002-36, page 2

This is to certify that:

Equipment type	Stock No.	Designation
NRP-Z3	1146.7005.02	USB Adapter
NRP-Z4	1146.8001.02/.04	USB Adapter
NRP-Z11	1138.3004.02/.04	Average Power Sensor
NRP-Z21	1137.6000.02	Average Power Sensor
NRP-Z22	1137.7506.02	Average Power Sensor
NRP-Z23	1137.8002.02	Average Power Sensor
NRP-Z24	1137.8502.02	Average Power Sensor
NRP-Z27	1169.4102.02	Power Sensor Module
NRP-Z37	1169.3206.02	Power Sensor Module
NRP-Z51	1138.0005.02	Thermal Power Sensor
NRP-Z55	1138.2008.02	Thermal Power Sensor
NRP-Z81	1137.9009.02	Wideband Power Sensor
NRP-Z91	1168.8004.02/.04	Average Power Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits
(73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility
(89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

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Central Quality Management FS-QZ / Radde

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1 Putting into Operation

NOTICE *Follow the instructions below precisely to prevent damage to the sensor – particularly when you are putting the power sensor module into operation for the first time.*

Unpacking the sensor

Remove the power sensor module from its packing and check that nothing is missing. Inspect all items for damage. If you discover any damage, inform the carrier responsible immediately and keep the packing to support any claims for compensation.

It is also best to use the original packing if the power sensor module is to be shipped or transported at a later date.



The power sensor module contains components which can be destroyed by electrostatic discharges. To prevent this happening, never touch the inner conductor of the RF connector and never open the power sensor module.

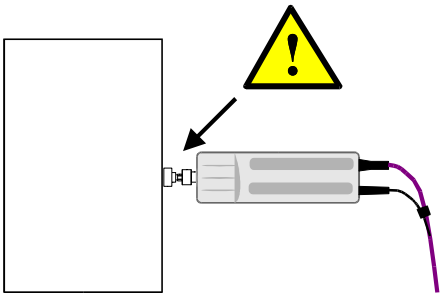
Connecting the sensor

NOTICE *To prevent EMI, the power sensor module must never be operated with its enclosure wholly or partially removed. Only use shielded cables that meet the relevant EMC standards.*

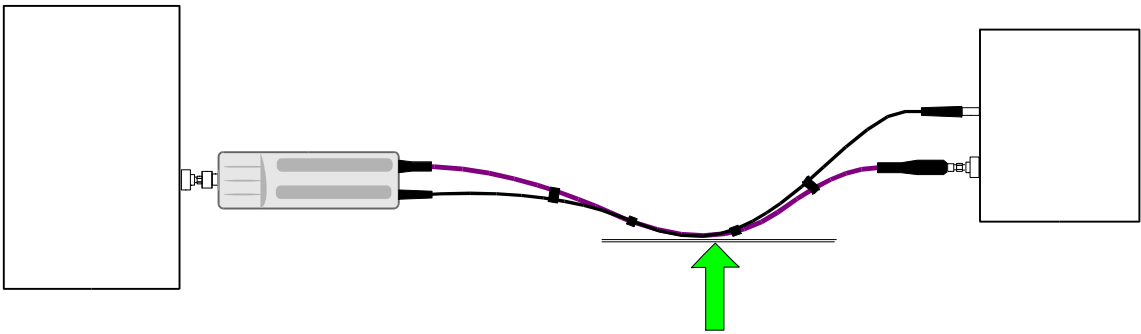
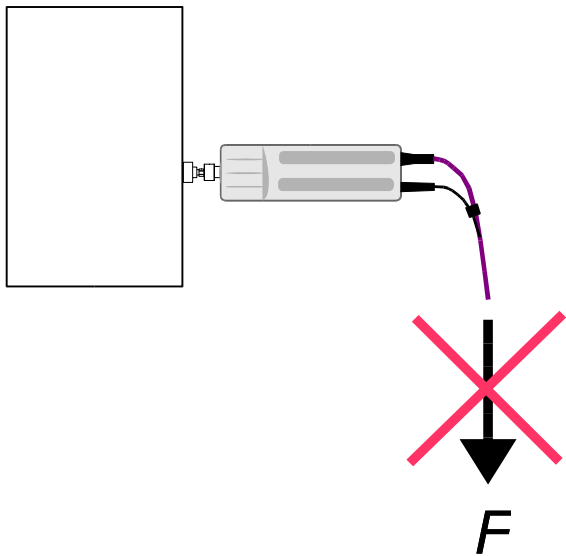
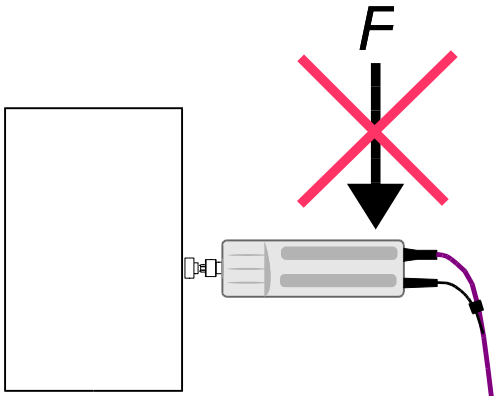
Never exceed the maximum RF power limit. Even brief overloads can destroy the integrated power sensor.

To prevent erroneous measurements, always terminate the RF output of the power sensor module (at the cable end) with a matched load or matched measuring instrument input.

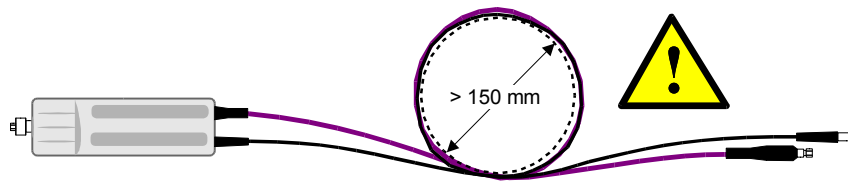
In many cases, the RF connector only requires manual tightening. However, for maximal measurement accuracy, the RF connector must be tightened using a torque wrench with a nominal torque of 1.36 Nm (12" lbs.) for the N connector of the R&S NRP-Z27, or 0.9 Nm (8" lbs.) for the 3.5 mm connector of both power sensor modules.



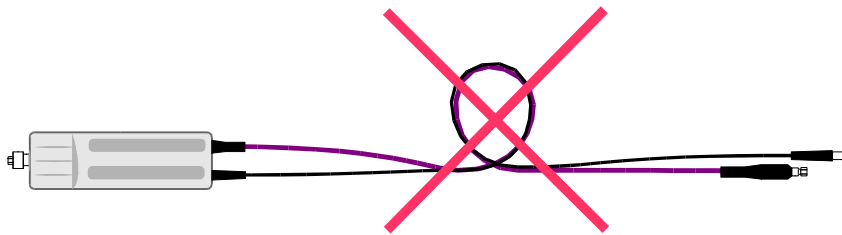
Do not apply excessive mechanical force to the RF connectors of the R&S NRP-Z27/-Z37 and DUT!



Make sure the bending radius of the RF connecting cable is at least 75 mm!



A tighter bend can permanently impair the measuring accuracy of the power measurement module!



Operation with the Measuring Receiver R&S FSMR

Connecting the power sensor module to the R&S FSMR

The power sensor module can be connected to the Measuring Receiver R&S FSMR when it is in operation. The multiple circular plug-in connector must be inserted, red marking upwards, into the *POWER SENSOR* connector. Then connect the 3.5 mm male connector of the RF cable with measurement input *RF INPUT 50 Ω* . If you are using model R&S FSMR26 or R&S FSMR50, you must first install the appropriate test port adapter with 3.5 mm female connector (R&S 1021.0512.00). With model R&S FSMR3, which has a built-in N-connector, screw on the adapter with the 3.5 mm female connector and male N connector that is supplied. Only the use of these adapters ensures correct functioning of the *VSWR Correction* function on the R&S FSMR.

Connecting the power sensor module to the DUT

The power sensor modules have a male N connector (R&S NRP-Z27) or a male 3.5 mm connector (R&S NRP-Z37) on their RF input and can thus be connected to any standard female N or 2.92 mm/3.5 mm/SMA connector, respectively. To connect the power sensor module to the DUT more easily and without tilting it, relieve it by slightly lifting it.

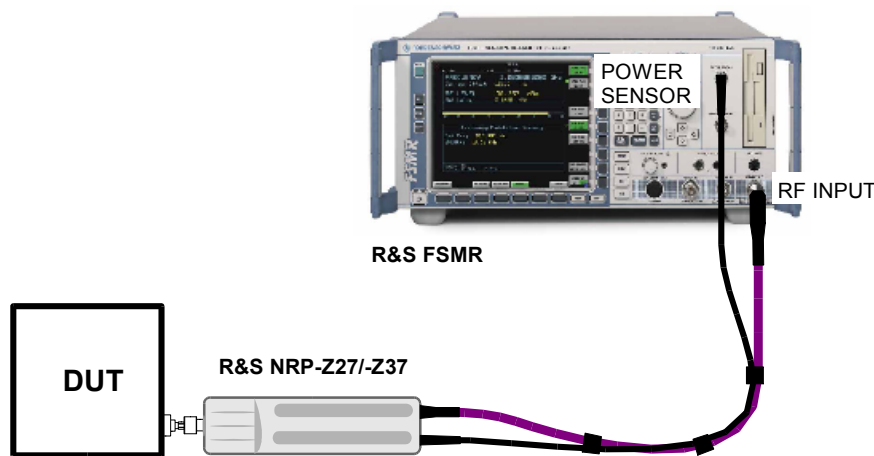


Fig. 1-1 Configuration with the R&S FSMR

Performing measurements

The R&S FSMR handles the power sensors modules in a manner similar to the sensors of the R&S NRP-Z series. To call up the power meter functionality, first press the PRESET key and then the PWR METER softkey. For further details on operation, refer to the operating manual for the R&S FSMR.

Operation with the Power Meter R&S NRP

Connecting the power sensor module

The power sensor module can be connected to the R&S NRP base unit when it is in operation. The multiple circular plug-in connector must be inserted, red marking upwards, into one of the R&S NRP base unit's sensor connectors. When the power sensor module is connected, it is detected by the R&S NRP base unit and initialized.

Terminate the output of the RF cable with a 3.5 mm precision termination (with female connector input). The exact matching value is insignificant as long as the standing wave ratio of the measurement frequency remains smaller than 1.05. Otherwise, you have to check whether the increased measurement uncertainty can be accepted (see the *Isolation* parameter in the specifications as well as *SENse:RGAMma* group of commands in chapter 6).

Connecting the power sensor module to the DUT

The power sensor modules have a male N connector (R&S NRP-Z27) or a male 3.5 mm connector (R&S NRP-Z37) on their RF input and can thus be connected to any standard female N or 2.92 mm/3.5 mm/SMA connector, respectively. To connect the power sensor module to the DUT more easily and without tilting it, relieve it by slightly lifting it.

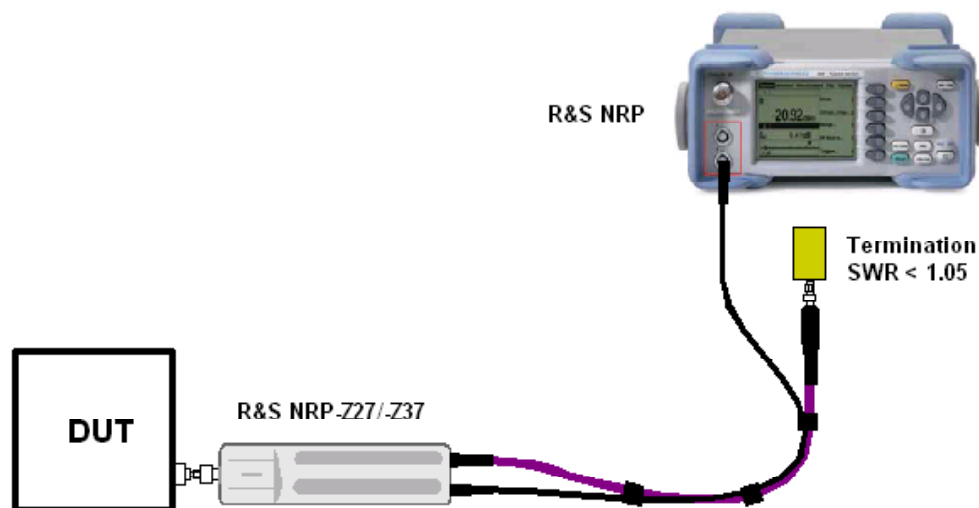


Fig. 1-2 Configuration with the R&S NRP

Performing measurements

The R&S NRP handles the power sensor modules in the same manner as the thermal power sensors of the R&S NRP-Z5x series. An exception is the S-parameter correction function, which is always activated in the power sensor modules. This function takes the integrated power splitter into consideration. Therefore, the influence of adapters or attenuators which are connected ahead of the input of the power sensor module cannot be compensated via the S-parameter correction function. However, compensation by using a global offset or an offset table is always possible.

PC control

Hardware and software requirements

The following requirements must be met if the sensor is to be controlled by a PC via an interface adapter:

- The PC must have a USB port.
- The PC's operating system must support the USB port. This is the case with Windows™ 98, Windows™ ME, Windows™ 2000, Windows™ XP and more recent versions of the Windows™ operating system.
- The USB device drivers in the supplied *NRP Toolkit* software package must be installed.

If these requirements are met, the sensor can be controlled using a suitable application program such as the NrpFlashup program contained in the NRP Toolkit (includes the modules Power Viewer, USB Terminal, Firmware Update and Update S-Parameters).

When you insert the CD-ROM supplied with the R&S NRP, the NRP Toolkit is automatically installed on your PC. The rest of the procedure is self-explanatory.

The sensor can be powered in two ways:

- *Self-powered* from a separate power supply via the Active USB Adapter R&S NRP-Z3.
- *Bus-powered* from the PC or a USB hub with its own power supply (*self-powered hub*) via the Active USB Adapter R&S NRP-Z3 or via the Passive USB Adapter R&S NRP-Z4.

Because the sensor R&S NRP-Z5x has a maximum current capacity of 100 mA and is therefore classified as a low-power device, it can be supplied with current from any stationary PC, laptop or notebook in the bus-powered mode.

Operation via the Active USB Adapter R&S NRP-Z3

Fig. 1-3 shows the configuration with the Active USB Adapter R&S NRP-Z3, which also makes it possible to feed in a trigger signal for the *Timeslot* and *Scope* modes. The order in which the cables are connected is not critical.

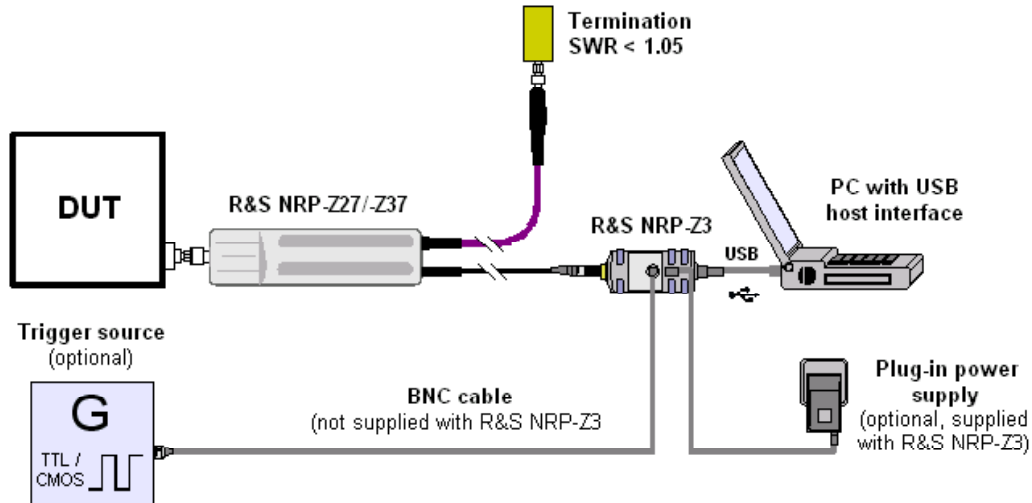


Fig. 1-3 Configuration with Active USB Adapter R&S NRP-Z3

The plug-in power supply for the R&S NRP-Z3 can be powered from a single-phase AC source with a nominal voltage range of 100 V to 240 V and a nominal frequency between 50 Hz and 60 Hz. The plug-in power supply autoselects to the applied AC voltage. No manual voltage selection is required.

The plug-in power supply comes with four primary adapters for Europe, the UK, the USA and Australia. No tools of any kind are required to change the primary adapter. The adapter is pulled out manually and another adapter inserted until it locks (Fig. 1-4).

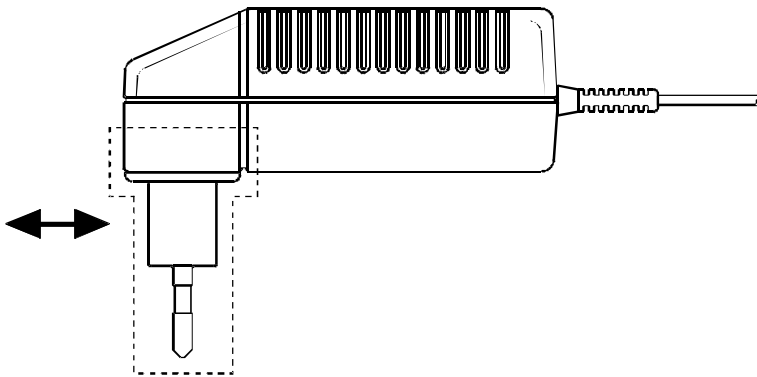


Fig. 1-4 Changing the primary adapter

The plug-in power supply is short-circuit-proof and has an internal fuse. It is not possible to replace this fuse or open the plug-in power supply.

NOTICE *The plug-in power supply is not intended for outdoor use.*

Keep within the temperature range of 0°C to 50°C.

If there is any condensation on the plug-in power supply, dry it off before connecting it to the AC supply.

Operation via the Passive USB Adapter R&S NRP-Z4

Fig. 1-5 is a schematic of the measurement setup. The order in which the cables are connected is not critical.

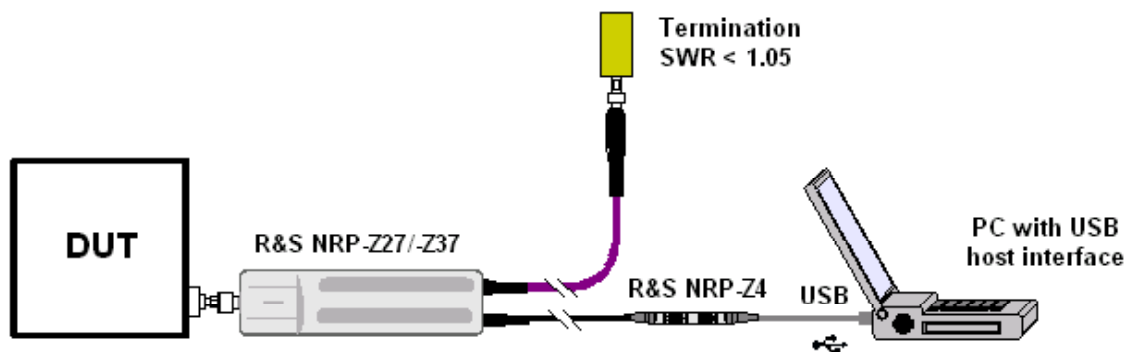


Fig. 1-5 Configuration with Passive USB Adapter R&S NRP-Z4

Connecting the sensor to the DUT

The power sensor modules have a male N connector (R&S NRP-Z27) or a male 3.5 mm connector (R&S NRP-Z37) on their RF input and can thus be connected to any standard female N or 2.92 mm/3.5 mm/SMA connector, respectively. To connect the power sensor module to the DUT more easily and without tilting it, relieve it by slightly lifting it.

Performing measurements

The R&S NRP uses the power sensor modules in the same manner as the thermal power sensors of the R&S NRP-Z5x series. An exception is the S-parameter correction function, which is always activated in the power sensor modules. This function takes the integrated power splitter into consideration. Therefore, the influence of adapters or attenuators which are connected ahead of the input of the power sensor module cannot be compensated via the S-parameter correction function. However, compensation by using a global offset or an offset table is always possible.

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2 Virtual Power Meter

You will find the **NrpFlashup** program that enables you to operate the power sensor module with a PC under Windows™ on the CD-ROM that accompanies the power sensor module. The program comprises several modules which can be started centrally via the Windows™ start-menu entry **NRP Toolkit**.

This section describes the **Power Viewer** program module. This is a virtual power meter which only uses a cut-down set of the sensor's functions. This means that after an extremely brief familiarization period, you can perform measurements.

The other modules in **NrpFlashup** are described in Chapter 3 of the operating manual (**Terminal** module) or in the service manual (**Firmware Update** module).

Overview

Start the virtual power meter using the **NRP Toolkit – Power Viewer** start-menu entry. The **Power Viewer** program window is displayed (Fig. 2-1).

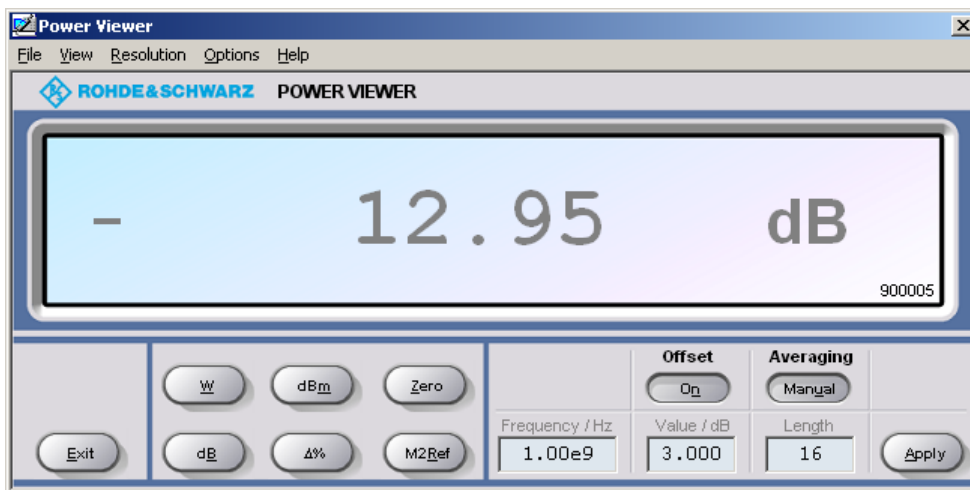


Fig. 2-1 **Power Viewer** – virtual power meter

The result display occupies most of the program window. The result, unit and additional power sensor module status information are displayed. The serial number of the sensor is displayed in the bottom right. The program window also contains animated buttons and entry fields (see Table 2-1 and Table 2-2).

Table 2-1 Virtual power meter keys

Button	Function	Key combination
Exit	Terminates the program. The current settings are saved and recalled the next time the program is started.	Alt + E
W	Selects Watt as the display unit.	Alt + W
dBm	Selects dBm as the display unit.	Alt + M
Zero	Zeroes the power sensor module.	Alt + Z
dB	Selects dB as the display unit. This is the log of the ratio of the measured value to the reference value.	Alt + B
Δ%	Selects % as the display unit. The difference between the measured value and the reference value is expressed as a percentage.	Alt + %
M2Ref	Makes the current measured value the reference value for the relative display units dB and %.	Alt + R
Offset On/Off	Turns the global offset correction for the power sensor module on or off. If the offset correction is Off, the Offset/dB entry field has a grey background.	Alt + N
Averaging Man/Auto	Turns auto-averaging on or off. When auto-averaging is on, the Length entry field has a grey background; the current averaging factor is displayed.	Alt + T
Apply	Accepts edited numerical values in the Frequency/Hz , Value/dB and Length entry fields and transfers them to the sensor.	Alt + A or Enter key

Table 2-2 Virtual power meter entry fields

Entry field	Function
Frequency/Hz	Frequency of the RF carrier in Hertz.
Value/dB	Attenuation in dB of the component connected to the power sensor module. The valid range is –100 to 100. The offset correction must be activated beforehand with the Offset On/Off button if this entry field is to be edited.
Length	Length of the averaging filter (= averaging factor). The valid range is 1 to 65536. Averaging must be set to manual with the Averaging Man/Auto button if this entry field is to be edited.

Scientific notation can also be used for the entry fields. If an invalid entry is made, an error message is output. An edited numerical value will not be transferred to the power sensor module unless you use the **Apply** button or the Enter key to terminate the entry.

Menus

The menu bar can be used to call less frequently used functions.

File **Start Log ...** Opens a file-selection dialog to specify the path and name of the log file. Clicking the **Save** button starts the recording. All displayed values are written line-by-line to the log file with the date (format: YY/MM/DD) and time (format: hh:mm:ss.ms). Example:
-22.51 dBm (03/02/25 15:37:25.310)

Stop Log Ends the log-file recording.

View **Display Refresh Rate** Opens a dialog box to adjust the display refresh rate. The time in milliseconds between two refresh operations is entered. The default setting is 200 ms.

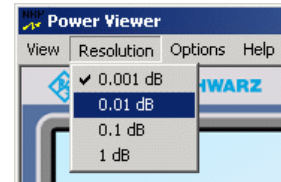


Colours Opens a dialog box to select the background colour for

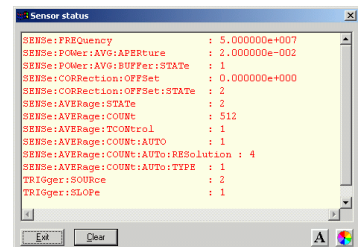
- the result,
- the unit,
- the text in the number fields or
- the key labelling.

**Result
Unit
Edit
Button**

Resolution For setting the result resolution. If auto-averaging has been selected, a higher resolution leads to a greater averaging factor, which means a longer result settling time.

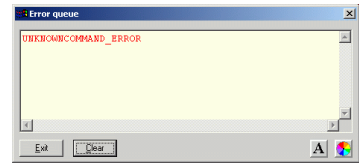


Options **Read Sensor Status ...** Reads the current status of the power sensor module. A parameter list is output.



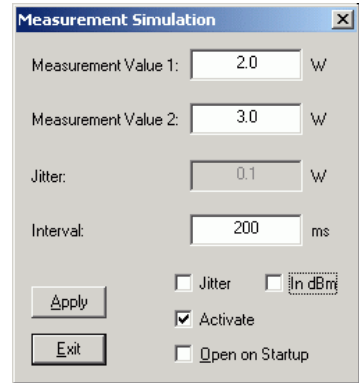
Read Error Queue ...

Reads the error queue. All the error messages that have been issued since the last call are read line-by-line. A tick before this menu entry indicates that an error has occurred.



Simulation ...

Allows you to try out the functions of the virtual power meter even without a power sensor module. The display alternates between **Measurement Value 1** & **Measurement Value 2** with a period given by **Interval**. Simulation can be activated immediately with the **Activate** check box.



Reset Sensor

Initializes the power sensor module. Any previous zeroing remains valid.

Help

Contents

Opens the table of contents for the online-help facility.

About

Displays information about the program version used, etc.

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3 Manual Operation

The previous section describes the Power Viewer program module supplied with the instrument. This module simplifies the most frequently used function of a power meter – measuring the average power of an RF signal. Other program modules are also part of the supplied equipment and can be selected in the Start menu:

- **Power Viewer:** A detailed description of this virtual power meter module is provided in section 2.
- **Terminal:** Program module for sending commands and command sequences to the power sensor module and for displaying measurement results, status information and other data from the sensor
- **Firmware Update:** Program module for updating the firmware in the power sensor module.
- **Update S-Parameters:** Program module for loading an s-parameter table into the sensor. The power splitter integrated in the power sensor module already occupies this data record. Thus, any adapters or attenuators connected ahead of the power sensor modules cannot be taken into consideration via the S-parameter correction function. Since overwriting the existing data record would result in the loss of the functionality of the power sensor module, *Update S-Parameters* is not further described.

Program module "Terminal"

Main control elements

With the USB terminal, commands and command sequences can be sent to the power sensor module in two different ways:

- Commands are entered in the **Input** field (Fig. 3-1). Consecutive commands can be entered as separate lines, one below the other. The buttons associated with the **Input** field are described in Table 3-1.
- Commands or command sequences are stored in *command files*. Command files are created with a text editor, for instance, and then stored. They can be called as often as required (Fig. 3-2). The buttons of the **Command File** field are described in Table 3-2.

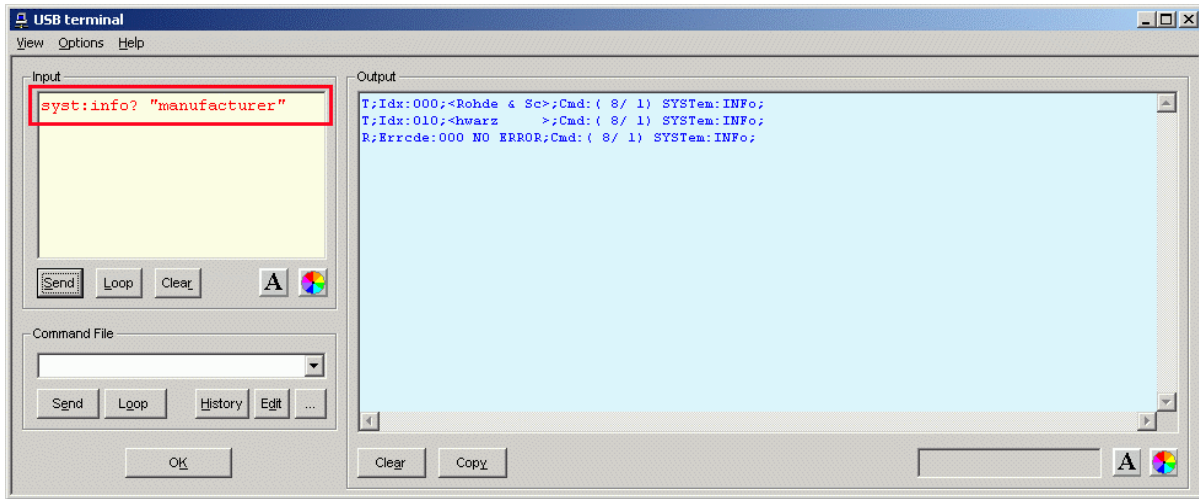


Fig. 3-1 Sending commands using the **Input** field

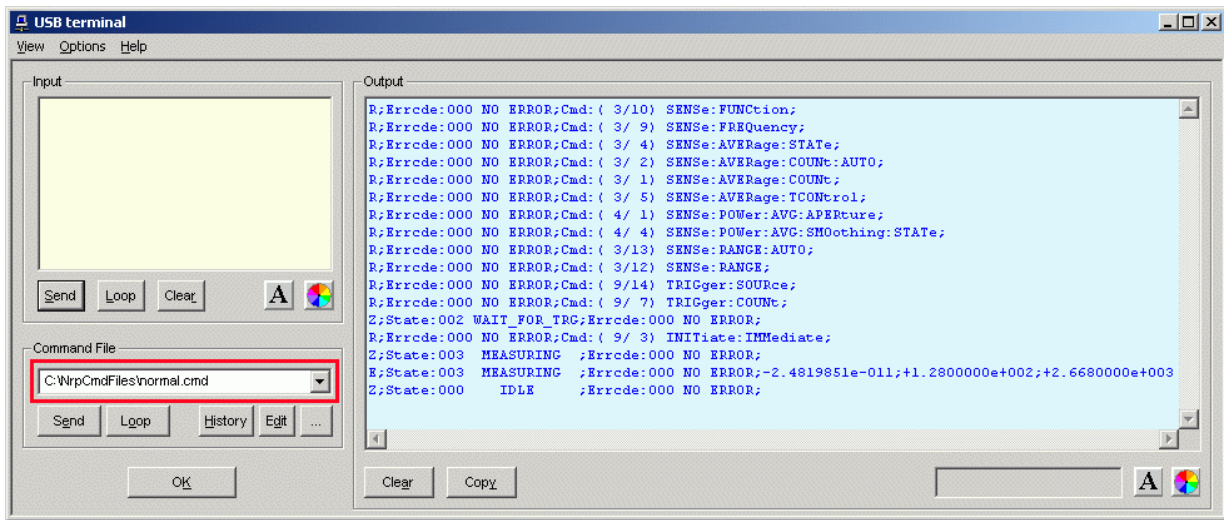


Fig. 3-2 Sending commands using command files

Table 3-1 Buttons assigned to the **Input** field

Button	Function	Key combination
Send	Sends the content of the Input entry field to the power sensor module.	Alt + S
Loop	With Loop the command or command sequence is cyclically sent. Pressing the button again terminates the cyclic transmission. The repetition rate is set in a dialog window that can be opened with View - Loop...	Alt + L
Clear	Clears the content of the Input field.	Alt + R
Font key	Opens a dialog window where the font for the Input field can be selected.	
Colour key	Opens a dialog window where the background colour of the Input field can be selected.	

Table 3-2 Buttons assigned to the **Command File** field

Button	Function	Key combination
Send	Sends the content of the command file to the power sensor module.	Alt + E
Loop	With Loop the command or command sequence is cyclically sent. Pressing the button again terminates the cyclic transmission. The repetition rate is set in a dialog window that can be opened with View - Loop...	Alt + O
History	Opens a window for editing the command file name in the Command File field.	Alt + H
Edit	Opens the selected command file in the Windows™ text editor.	Alt + D
...	Opens a file opening dialog for selecting the command file.	

A command line starting with a tab, a blank or a special character is considered a comment and not forwarded to the power sensor module.

Measurement results, parameters and status information that are returned are displayed in the **Output** field.

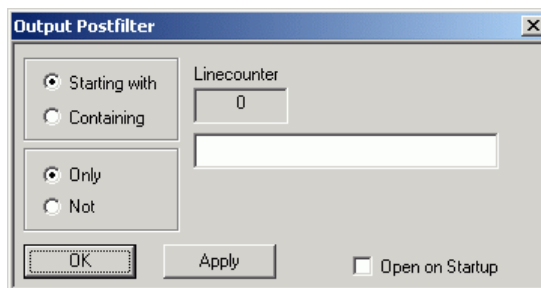
Table 3-3 Buttons assigned to the **Output** field

Button	Function	Key combination
Clear	Clears the content of the Output field	Alt + A
Copy	Copies the content of the Output field to the clipboard. (Another possibility: mark the desired information in the output window with the mouse cursor, press the right mouse key or Ctrl+C and then copy the selected text to the clipboard using the menu item Copy in the opened context menu.)	Alt + Y
Font button	Opens a dialog window where the font for the Output field can be selected.	
Colour button	Opens a dialog window where the background colour of the Output field can be selected.	

Close the USB terminal with OK.

Menus

View Post Filter ... Opens the **Output Postfilter** dialog window where the lines stored in the input buffer can be filtered according to different criteria.



Filter criteria:

Only + Starting with: Only lines starting with the entered character string are displayed.

Not + Starting with: Only lines not starting with the entered character string are displayed.

Only + Containing: Only lines containing the entered character string are displayed.

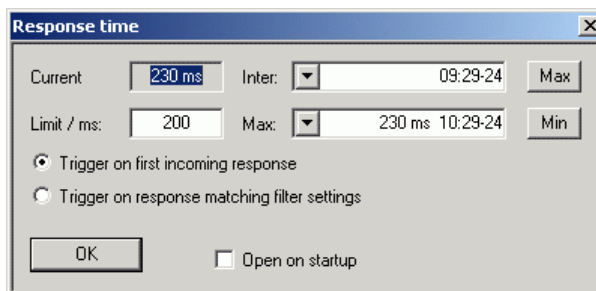
Not + Containing: Only lines not containing the entered character string are displayed.

Lines not matching the specific filter criterion are blanked but not cleared.

Filtering is started with **Apply**. The number of lines matching the filter criterion is displayed in the **Linecounter** field. If **Open on startup** is active, the **Output Postfilter** dialog is automatically opened when the terminal is started. The dialog window is closed with **OK**.

Response Time ...

Opens the **Response time** dialog window where the response time of the power sensor module can be set.



Current indicates the time elapsed between dispatch of the last command and receipt of an acknowledgement from the power sensor module.

When the **Max** button is clicked, the response times exceeding the value in the **limit / ms** field are recorded. When the **Min** button is clicked, the response times within the value in the **limit / ms** field are recorded.

If **Trigger on first incoming response** is active, the time measurement is terminated as soon as the first response arrives after a command is sent. If **Trigger on response matching filter settings** is active, the time measurement is terminated as soon as the first response matching the filter criterion in the **Output Postfilter** dialog window is received.

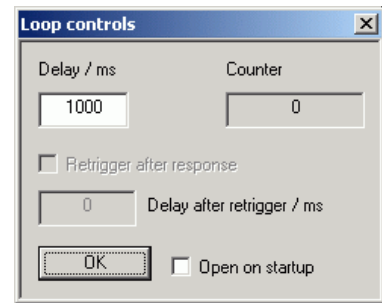
If **Open on startup** is active, the **Response Time** dialog is automatically displayed when the Terminal module is started. The dialog window is closed with **OK**.

Loop ...

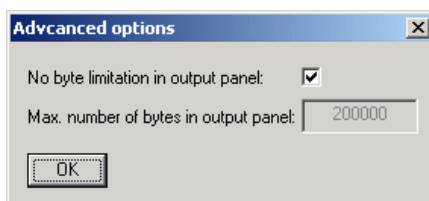
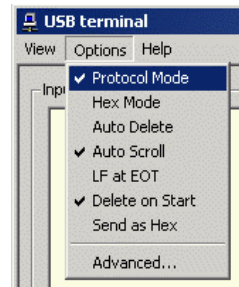
Opens the **Loop controls** dialog window where the cyclic transfer of commands and command sequences can be controlled.

In the **Delay / ms** field, the time interval for the cyclic transfer is specified in milliseconds.

The number of completed transfer cycles is displayed in the **Counter** field. If **Open on startup** is active, the **Response time** dialog is automatically opened when the Terminal module is started. The dialog window is closed with **OK**.



Options	Protocol Mode	In this mode, a time stamp is added to each response block.
	Hex Mode	In this mode, the response blocks from the sensor are displayed in hexadecimal format.
	Auto Delete	With this option active, the Output field is automatically cleared when the Send button is pressed.
	Auto Scroll	With this option active, older items in the Output field are automatically shifted upward and off the display if space is required for new values.
	LF at EOT	With this option active, a line feed is appended to each response block from the sensor.
	Delete on Start	With this option active, the Output field is automatically cleared when the Terminal module is started.
	Send as Hex	With this option active, the text in the Input field is interpreted as a hexadecimal character sequence.
	Advanced ...	Opens a dialog window where the buffer size for the Output field can be set.



Help	Contents	Opens the table of contents for the online help.
	About	Displays information about the program version, etc.

Program module "Firmware Update"

A detailed description of the program module for firmware updates is provided in the Service Manual.

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5 Remote Control – Fundamentals

Rohde & Schwarz recommends to utilize the VXI Plug & Play Driver for the remote control of R&S NRP power sensors and power sensor modules. This driver can be found on the CD-ROM supplied with the sensor or downloaded in its most recent version via the internet (<http://rohde-schwarz.com/>).

The old remote control interface provided by the *Dynamic Link Library NrpControl.dll* is not developed further, but remains on the CD-ROM and can be downloaded via the internet.

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6 Remote Control – Commands

Notation

In the following sections, all commands implemented in the power sensor module are first listed in a table according to command systems and are then described in detail. The notation is largely in line with the SCPI standard.

Command tables For a quick overview of available commands, the commands are listed in a table before they are described. These tables contain the following four columns:

Command:	Commands and their tree structure.
Parameters:	Possible parameters.
Unit:	The basic unit of the physical parameters (must not be sent with parameters).
Remarks:	Identification of all commands <ul style="list-style-type: none"> • that have no query form • that are available as query only

Indentations The various levels of the SCPI command hierarchy are shown in the table by indentations to the right. The lower the level, the greater the indentation to the right. It should be noted that the complete notation of the command includes the higher levels too.

Example:

SENSe:AVERAge:COUNt is represented in the table as follows:

```
SENSe      first level
  :AVERAge  second level
    :COUNt  third level
```

In the individual description, the command is shown in full length. An example of the command is given at the end of the description.

[?]
?

A question mark in square brackets at the end of a command indicates that this command can either be used as a setting command (without question mark) or as a query (with question mark). If the question mark is not in square brackets, the command is a query only.

Example:

SENSe:POWer:AVG:APERture[?]

SENSe:POWer:AVG:APERture 1e-3 sets the length of the sampling window to 1 ms.

SENSe:POWer:AVG:APERture? Returns the currently set length as a response.

**IDN?* Queries the identification string of the power sensor module that of course cannot be changed. For this reason, this command is only available as a query.

Special characters | for parameters

A vertical bar between parameters is used to separate alternative options (OR link).

Example:

NITiate:CONTInuous OFF | ON

The parameter *OFF* or *ON* can be entered.

{numeric expression}

A numeric expression in braces means that it has been rounded to the nearest integral value.

**<parameter>
<variable>**

A parameter or a variable in triangular brackets expresses its current value.

Commands as per IEEE 488.2

The power sensor module supports a subset of the possible setting commands and queries (*Common Commands and Queries*) in line with IEEE 488.2.

*IDN? – Identification Query

*IDN? returns a string with information on the power sensor module's identity (device identification code). In addition, the version number of the installed firmware is indicated. The string for a power sensor module of type R&S NRP-Z27/-Z37 has the following structure:

ROHDE&SCHWARZ,NRP-Zx7,<serial number>,<firmware version>

<serial number>: Serial number in ASCII

<firmware version>: Firmware version number in ASCII

*RST – Reset

*RST sets the power sensor module to the default state, i.e. the default settings for all test parameters are loaded.

*TRG – Trigger

*TRG triggers a measurement. For this purpose, the power sensor module is in the *WAIT_FOR_TRIGGER* state and the source for the trigger event is set to *BUS (TRIGger:SOURce BUS)*.

*TST? – Self Test Query

*TST? starts a selftest and returns 0 (no error found) or 1 (an error has occurred). The selftest comprises the following functions:

- RAM test
- Operating voltages
- Temperature measurement
- Calibration data set
- Noise
- Zero-point offsets.

SCPI Commands

The power sensor module R&S NRP-Z27/-Z37 is controlled via the groups of commands

- CALibration (zeroing)
- SENSE (measurement configurations)
- SYSTem
- TRIGger
- SERVICE.

CALibration

Table 6-1 Commands of the CALibration system

Command	Parameter	Unit	Remarks
CALibration			
:DATA[?]	<calibration data set as definite length block>		
:LENGth?		Bytes	Query only
:ZERO			
:AUTO[?]	OFF ON ONCE		

CALibration:DATA[?] <calibration data set as *definite length block*>

CALibration:DATA is used for writing a calibration data set in the flash memory of the power module sensor.

The query yields the calibration data set currently stored in the flash memory as a *definite length block*.

CALibration:DATA:LENGth?

CALibration:DATA:LENGth? yields the length in bytes of the calibration data set currently stored in the flash memory. Programs that read out the calibration data set can use this information to determine the capacity of the buffer memory required.

CALibration:ZERO:AUTO[?] OFF | ON | ONCE

The commands *CALibration:ZERO:AUTO ON* and *CALibration:ZERO:AUTO ONCE* perform zeroing. For this purpose, the test signal must be deactivated or the power sensor module disconnected from the signal source. The power sensor module automatically detects the presence of any significant power to be measured. This causes zeroing to be aborted and error message *NRPEROR_CALZERO* to be output. The *CALibration:ZERO:AUTO OFF* is ignored. Zeroing takes four seconds at a minimum, but at least as long as the selected averaging filter needs for settling (only fixed-filter mode).

*Repeat zeroing*

- *during warm-up after switching on or connecting the instrument*
- *after a substantial variation of the ambient temperature*
- *after fastening the power sensor module to an RF connector at high temperature*
- *after several hours of operation*
- *when very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.*

For zeroing switch off the test signal and do not remove the power sensor module from the signal source. Apart from keeping the thermal balance, this has the advantage that the noise superimposed on the test signal (e.g. from a broadband amplifier) can be detected on zeroing and does not impair the measurement result.

The query always yields 1 (= OFF).

Default setting

After a power-on reset, the zero offsets determined during the last calibration are used until the first zeroing. Therefore, very slight zero offsets are to be expected with a warmed up power sensor module. Initialization by means of **RST* or *SYSTem:INITialize* has no influence on the current zero offsets.

SENSe (Power Sensor Module Configuration)

The power sensor module is configured by means of the commands of the groups *SENSe* and *TRIGger*.

Table 6-2 Commands of the *SENSe* system

Command	Parameter	Unit	Remarks
SENSe			
:AVERage			
:RESet			No query
:STATe[?]	OFF ON		
:TCONtrol[?]	MOVing REPeat		
:COUNt[?]	1 to 65536		
:AUTO[?]	OFF ON ONCE		
:TYPE[?]	RESolution NSRatio		
:MTIME[?]	1.0 to 999.99	s	
:NSRatio[?]	0.0001 to 1.0	dB	
:RESolution[?]	1 to 4		
:CORRection			
:OFFSet[?]	-200.0 to 200.0	dB	
:STATe[?]	OFF to ON		
:DCYClE[?]	0.001 to 99.999	%	
:STATe[?]	OFF to ON		
:FREQuency[?]	1.0e3 to 18.0e9 (NRP-Z27) or 26.5e9 (NRP-Z37)	Hz	
:FUNction[?]	"POWer:AVG"		
:POWer			
:AVG			
:APERture[?]	0.001 to 0.3	s	
:BUFFer			
:STATe[?]	OFF ON		
:SIZE[?]	1 to 1024		

Command	Parameter	Unit	Remarks
:SMOothing:STATe[?]	OFF ON		
:SGAMma			
:CORRection:STATe[?]	OFF ON		
:MAGNitude[?]	0.0 to 1.0		
:PHASe[?]	-360.0 to 360.0	degree	
:RGAMma			
:MAGNitude[?]	0.0 to 1.0		
:PHASe[?]	-360.0 to 360.0		

SENSe:AVERage:COUNT[?] 1 to 65536

SENSe:AVERage:COUNT sets the number of measured values that have to be averaged for forming the measurement result. The higher this averaging factor, the less the measured values fluctuate and the longer the measurement time lasts. The parameter is rounded off to the nearest power-of-two number.

The query yields the averaging factor used.

NOTICE *The averaging function must be activated with SENSe:AVERage:STATe ON so that the set averaging factor becomes effective.*

Default setting: 4

SENSe:AVERage:COUNT:AUTO[?] OFF | ON | ONCE

SENSe:AVERage:COUNT:AUTO activates (auto-averaging) or deactivates (fixed-filter mode) automatic determination of the averaging factor. If auto-averaging is activated, the averaging factor is continuously determined and set depending on the level of power and other parameters.

SENSe:AVERage:COUNT:AUTO ON activates auto-averaging and *SENSe:AVERage:COUNT:AUTO OFF* deactivates it. On deactivation, the previous, automatically determined averaging factor is used in the fixed-filter mode. The *SENSe:AVERage:COUNT:AUTO ONCE* command ensures that a new averaging factor is determined by the filter automatic function under the current measurement conditions and used in the fixed-filter mode.

The query yields

- 1 for OFF,
- 2 for ON.

Default setting: OFF

SENSe:AVERAge:COUNT:AUTO:MTIME[?] 1.0 to 999.99

SENSe:AVERAge:COUNT:AUTO:MTIME sets the settling time upper limit of the averaging filter in the auto-averaging mode and limits the length of the filter.

The query yields the current settling time upper limit of the averaging filter.

Default setting: 30.0 [s]

SENSe:AVERAge:COUNT:AUTO:NSRatio[?] 0.0001 to 1.0

SENSe:AVERAge:COUNT:AUTO:NSRatio determines the relative noise component in the measurement result if auto-averaging is operated in the corresponding mode (*SENSe:AVERAge:COUNT:AUTO:TYPE NSRatio*). The noise component is defined as the magnitude of the level variation in dB caused by the inherent noise of the power sensor module (two standard deviations).

The query yields the relative noise component in the result.

Default setting: 0.01 [dB]

SENSe:AVERAge:COUNT:AUTO:RESolution[?] 1 to 4

SENSe:AVERAge:COUNT:AUTO:RESolution sets the resolution index for the automatic averaging filter. The resolution index equals the number of decimal places that have to be taken into account for the further processing of the measurement result in dBm, dB μ V or dB. The normal mode is designed in a similar manner as for the predecessors R&S NRVS and R&S NRVD or other commercial power meters. The higher the selected index, the better the measurement result is filtered without the last significant place (0.01 dB with an index of 3) actually being set. The *NSRatio* setting is recommended instead.

The query yields the resolution index.

Default setting: 3

SENSe:AVERAge:COUNT:AUTO:TYPE[?] RESolution | NSRatio

SENSe:AVERAge:COUNT:AUTO:TYPE defines the automatic averaging filter mode. The *RESolution* parameter sets the mode usual for power meters; *NSRatio* predefines the compliance to an exactly defined noise component.

The query yields

- 1 for *RESolution*,
- 2 for *NSRatio*.

Default setting: *RESolution*

SENSe:AVERAge:RESet

SENSe:AVERAge:RESet initializes the averaging filter. This is useful if a high averaging factor is set in the *SENSe:AVERAge:TCONTROL MOVing* filter mode and if the power to be measured has significantly decreased since the previous measurement, e.g. by several powers of ten. In this case, previous measurement results still contained in the averaging filter strongly affect the settling of the display; as a result, the advantage of the *SENSe:AVERAge:TCONTROL MOVing* filter mode, i.e. the ability to detect trends in the measurement result while the measurement is still in progress, is lost. The *SENSe:AVERAge:RESet* command solves this problem by deleting all previous measurement results that the averaging filter contains. After initialization, the filter length gradually increases from 1 to its nominal value *SENSe:AVERAge:COUNT*, so that trends in the measurement result become quickly

apparent. However, this procedure does not shorten the measurement time required in order for the averaging filter to settle completely.

SENSe:AVERage:STATe[?] OFF | ON

SENSe:AVERage:STATe switches on or off the averaging filter.

The query yields

- 1 for *OFF*,
- 2 for *ON*.

Default setting: *ON*

SENSe:AVERage:TCONtrol[?] MOVing | REPeat

SENSe:AVERage:TCONtrol (*terminal control*) defines the behaviour of the averaging filter. As soon as a new measured value is shifted to the FIR filter, a new average value is available at the filter output, which is obtained from the new measured value and the other values stored in the filter.

The *MOVing* parameter defines that each new average value is output as a measurement result. This allows tendencies in the result to be recognized during the measurement procedure.

The *REPeat* parameter defines that a new result is output after the FIR filter has been filled with new measured values. This ensures that no redundant information is output.

The query yields

- 1 for *MOVing*,
- 2 for *REPeat*.

Default setting: *MOVing*

SENSe:CORRection:DCYClE[?] 0.001 to 99.999

SENSe:CORRection:DCYClE sets the duty cycle to a percent value for the correction of pulse-modulated signals. With the correction activated, the power sensor module calculates the signal pulse power from this value and the mean power.

The query yields the current duty cycle in percent.

Default setting: *1.0 [%]*

SENSe:CORRection:DCYClE:STATe[?] OFF | ON

SENSe:CORRection:DCYClE:STATe ON activates the duty cycle correction and thus the pulse-power measurement whereas *SENSe:CORRection:DCYClE:STATe OFF* deactivates it.

The query yields

- 1 for *OFF*,
- 2 for *ON*.

Default setting: *OFF*

SENSe:CORRection:OFFSet[?] -200.0 to 200.0

SENSe:CORRection:OFFSet defines a fixed offset in dB, which is used to correct the measured value. (When a log scale is used, the offset is added to the measured value; this is the reason why the command has this name.)

The attenuation of an attenuator located ahead of the power sensor module or the coupling attenuation of a directional coupler is taken into account with a positive offset, i.e. the power sensor module calculates the power at the input of the attenuator or directional coupler. A negative offset can be used to correct the influence of a gain connected ahead.

The query yields the set offset in dB.

Default setting: *0.0 [dB]*

SENSe:CORRection:OFFSet:STATe[?] OFF | ON

SENSe:CORRection:OFFSet:STATe ON activates the offset correction and *SENSe:CORRection:OFFSet:STATe OFF* deactivates it.

The query yields

- 1 for *OFF*,
- 2 for *ON*.

Default setting: *OFF*

SENSe:FREQuency[?] 10.0e3 to 18.0e9 (R&S NRP-Z27) or 26.5e9 (R&S NRP-Z37)

SENSe:FREQuency transfers the carrier frequency of the RF signal to be measured; this frequency is used for the frequency-response correction of the measurement result. The center frequency is set for broadband signals (*spread-spectrum* signals, multicarrier signals).

The query yields the set carrier frequency in Hz.

Default setting: *50.0e6 [Hz]*

SENSe:FUNcTION[?] <sensor_function>

In contrast to other sensors of the R&S NRP-Z series, the power sensor modules only implement the *Continuous Average* mode. Therefore, the command *SENSe:FUNcTION <sensor_function>* only accepts the parameter *"POWer:AVG"*.

Table 6-3 Measurement mode "POWer:AVG"

<sensor_function>	Description of the measurement mode
"POWer:AVG"	<p>Continuous Average After occurrence of the trigger event, the mean power is measured in a time interval (sampling window) whose width is defined with <i>SENSe:POWer:AVG:APERTure</i>. The single measurements are performed in pairs to obtain a more accurate measurement result by differentiation. With the averaging function activated, this operation is repeated the number of times specified by the averaging factor. With the averaging function activated, the actual measurement time is thus $2 \times \langle \text{SENSe:AVERage:COUNT} \rangle \times \langle \text{SENSe:POWer:AVG:APERTure} \rangle$ and with deactivated averaging function $2 \times \langle \text{SENSe:POWer:AVG:APERTure} \rangle$. Trigger events start one or several measurements in the Continuous Average mode (depending on the <i>TRIGger:COUNT</i> parameter).</p>

The query always yields 1 for *"POWer:AVG"*.

Default setting: *"POWer:AVG"*

SENSe:POWer:AVG:APERTure[?] 0.001 to 0.3

SENSe:POWer:AVG:APERTure defines the time interval (sampling window); measured values are continuously recorded in this interval. In manual operation, the default setting of 20 ms in conjunction with the activated smoothing (see *SENSe:POWer:AVG:SMOothing:STATe*) is sufficient in most cases. Another value, which is normally higher, is required when the measurement result shows variations due to modulation. Especially with low-frequency modulation, it is useful to adapt the size of the sampling window exactly to the modulation period, which yields an optimum stable display.

Table 6-4 Optimum selection of the sampling window size (N = 1, 2, 3, ...)

Smoothing	Optimum sampling window size
OFF	$N \times \text{modulation period} / 2$
ON	$N \times \text{modulation period} \times 2$

The theoretically shortest measurement time can then be obtained only with smoothing deactivated. The situation is somewhat different when the sampling window cannot or should not be exactly adapted to the modulation period. Smoothing should then be activated since even one measurement window length of 5 periods is sufficient to reduce variations due to modulation to an acceptable extent; variations are no longer perceptible with more than 9 periods. With smoothing deactivated, the situation is significantly unfavourable. In this case, 5 instead of 300 periods are required and the variations completely disappear as of 3000 periods.

The query yields the currently set width of the sampling window in seconds.

Default setting: *0.02 [s]*

SENSe:POWer:AVG:BUFFer:SIZE[?] 1 to 1024

SENSe:POWer:AVG:BUFFer:SIZE sets the buffer size for the buffered *Continuous Average* mode.

The query yields the current buffer size for the buffered *Continuous Average* mode.

Default setting: 1

SENSe:POWer:AVG:BUFFer:STATe[?] OFF | ON

The buffered *Continuous Average* mode is activated with *ON* and deactivated with *OFF*. In this mode, the results generated by trigger events are collected in the power sensor module until the buffer is filled. All results are then transferred as block data. The measurement rate obtained is thus higher than in the non-buffered *Continuous Average* mode. The maximum measurement rate is obtained by combining the buffered mode with multiple triggering (see parameter *TRIGger:COUNT*). The size of the result buffer is set with the *SENSe:POWer:AVG:BUFFer:SIZE* command.

The query yields

- 1 for *OFF*,
- 2 for *ON*.

Default setting: *OFF*

SENSe:POWer:AVG:SMOothing:STATe[?] OFF | ON

The *ON* parameter activates a smoothing filter for modulated signals in the *Continuous Average* mode and *OFF* deactivates it. The smoothing filter is a steep-edge digital lowpass filter used to suppress variations of results caused by low-frequency modulation. This parameter should be activated to reduce variations in results due to modulation when the size of the sampling window cannot or should not be exactly adapted to the modulation period. If the selected sampling window is 5 to 9 times larger than a modulation period, the variations in display are normally sufficiently reduced. With smoothing deactivated, 300 to 3000 periods are required to obtain the same effect.

With smoothing deactivated, the sampling values are considered equivalent and averaged in a sampling window, which yields an integrating behaviour of the measuring instrument. As described above, optimum suppression of variations in the result is thus obtained when the size of the sampling window is exactly adapted to the modulation period. Otherwise, the modulation can have a considerable influence, even if the sampling window is much larger than the modulation period. The behaviour can be considerably improved by subjecting sampling values to weighting (raised-von-Hann window), which corresponds to video filtering. This is exactly what happens with activated smoothing.

Since the smoothing filter increases the inherent noise of the power sensor module by approx. 20 %, it should remain deactivated if it is not required.

The query yields

- 1 for *OFF*,
- 2 for *ON*.

Default setting: *ON*

SENSe:SGAMma:CORRection:STATe[?] OFF | ON

SENSe:SGAMma:CORRection:STATe ON activates the correction of the mismatch (gamma correction) between the power sensor module and the source. Gamma correction ensures that the power of the source available at 50 Ω is measured, whereas without correction only the power of the arriving wave is measured. For gamma correction, the complex reflection coefficient of the source is necessary (settings *SENSe:SGAMma:MAGNitude* und *SENSe:SGAMma:PHASe*).

The query yields

- 1 for OFF,
- 2 for ON.

Default setting: OFF

SENSe:SGAMma:MAGNitude[?] 0.0 to 1.0

SENSe:SGAMma:MAGNitude defines the magnitude of the complex reflection coefficient of the source. A value of 0.0 corresponds to an ideal matched source and a value of 1.0 to total reflection.

The query yields the set magnitude.

Default setting: 0.0

SENSe:SGAMma:PHASe[?] -360.0 to 360.0

SENSe:SGAMma:MAGNitude defines the phase angle (in degrees) of the complex reflection coefficient of the source.

The query yields the set phase angle.

Default setting: 0.0 [°]

SENSe:RGAMma:MAGNitude[?] 0.0 to 1.0

With the *SENSe:RGAMma* group of commands, you can compensate the load distortion at the signal output. Such compensation is necessary if the standing wave ratio exceeds a value of 1.05. Otherwise, you cannot comply with the data sheet specifications with regard to absolute accuracy.

For distortion compensation, you have to transfer the magnitude of the reflection coefficient of the load with the setting *SENSe:RGAMma:MAGNitude* and the phase angle with the setting *SENSe:RGAMma:PHASe*. To deactivate distortion compensation, set *SENSe:RGAMma:MAGNitude* to 0. An explicit switch-on/-off command, as is available in mismatch correction, does not exist. Distortion compensation should remain deactivated in the case of questionable measurement values for the reflection coefficient of the load.

The query yields the set magnitude.

Default setting: 0.0

SENSe:RGAMma:PHASe[?] -360.0 ... 360.0

SENSe:RGAMma:PHASe defines the phase angle (in degrees) of the complex reflection factor of the load at the signal output.

The query yields the set phase angle.

Default setting: 0.0 [°]

SYSTEM

With the aid of the *SYSTEM* system, administrative device settings can be defined and queried. This includes detailed information on the power sensor module and its initialization and the transfer of available commands and their parameter limits.

Table 6-5 Commands of the *SYSTEM* system

Command	Parameter	Unit	Remarks
SYSTEM			
:INFO? [Item]			Query only
:INITialize			No query
MINPower?		W	Query only
:TRANsaction			
:BEGIN:			No query
:END			No query

SYSTEM:INFO? [Item]

SYSTEM:INFO? yields a string containing information that is more detailed than the identification string delivered by the power sensor module as a response to **IDN?*. If no *Item* is specified, the response string is a sequence of entries in the form *Item:Information-String* separated by *CR* and *LF* (in C notation: *\r\n*). With the *Item* optionally appended to the command, the entry for the required *Item* can be queried. The response string is zero-terminated, i.e. its end identification is a zero byte (in C notation: *\0*).

Table 6-6 Meaning of *Item* in the *SYSTEM:INFO?* command

Item	Information string	Remarks
"MANUFACTURER"	"Rohde & Schwarz GmbH & Co. KG"	Manufacturer
"TYPE"	"NRP-Z27" for R&S NRP-Z27" "NRP-Z37" for R&S NRP-Z37"	Type designation
"STOCK NUMBER"	"1169.4102.02" for R&S NRP-Z27" "1169.3206.02" for R&S NRP-Z37"	Material number
"SERIAL"	"<serial number>"	6-digit serial number
"HWVERSION"	"000000000"	Hardware version (standard)
"HWVARIANT"	"000000000"	Hardware model (standard)
"SW BUILD"	"<build number>"	Version number of firmware
"TECHNOLOGY"	"Thermal"	Detector technology used

Item	Information string	Remarks
"FUNCTION"	"Power Terminating"	Operating principle of a terminating power sensor.
"MINPOWER"	"<nominal lower test limit in W>"	The nominal lower test limit of power sensor modules is 4 μ W, i.e. with information string "4e-6" as a response to <i>SYSTem:INFo?</i> "MINPOWER".
"MAXPOWER"	"<nominal upper test limit in W>"	The nominal upper test limit of power sensor modules is 400 mW, i.e. with information string "0.4" as a response to <i>SYSTem:INFo?</i> "MAXPOWER".
"MINFREQ"	"<min. measuring frequency in Hz>"	The minimum measuring frequency is 1 kHz, i.e. the power sensor module returns the information string "1e+03" as a response to <i>SYSTem:INFo?</i> "MINFREQ".
"MAXFREQ"	"<max. measuring frequency in Hz>"	The maximum measuring frequency is 18 GHz for the R&S NRP-Z27, or 26.5 GHz for the R&S NRP-Z37, i.e. the power sensor module returns the information string "1.8e+10" or "2.65e+10", respectively, as a response to <i>SYSTem:INFo?</i> "MAXFREQ".
"IMPEDANCE"	"50"	The R&S NRP-Z5x RF input has a nominal input impedance of 50 Ω .
"COUPLING"	" DC"	The RF input of the power sensor modules is DC-coupled.
"CAL. ABS."	"<date>"	Date of absolute calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned with an invalid date entry.
"CAL. REFL."	"<date>"	Date of matching calibration in the format YYYY-MM-DD.
"CAL. S PARA."	"<date>"	Date of s-parameter calibration in the format YYYY-MM-DD. If no S parameter set is loaded, the sensor returns the string "not applicable". "Invalid Calibration Date" is returned with an invalid date entry.
"CAL. MISC."	"<date>"	Date of the calibration of other parameters in the format YYYY-MM-DD. "Invalid Calibration Date" is returned with an invalid date entry.
"SPD MNEMONIC"	"<mnemonic string>"	Clear-text designation of the component connected ahead of the power sensor (e.g. "splitter")

SYSTem:INITialize

SYSTem:INITialize sets the power sensor module to the standard state, i.e. the default settings for all test parameters are loaded in the same way as with **RST*. The power sensor module then outputs a complete list of all supported commands and parameters. With the command, the remote-control software can automatically adapt to the features of different types of sensors with different functionality.

SYSTEM:MINPower?

SYSTEM:MINPower? yields the lower test limit of the power sensor module. This query can be used to determine a useful resolution for the result display near the lower test limit.

SYSTEM:TRANsaction:BEgIn

SYSTEM:TRANsaction:BEgIn marks the beginning of a sequence of setting commands between which the parameter limits must not be checked. This prevents the display of error messages when a setting command causes a conflict that is resolved by a subsequent setting command. See *SYSTEM:TRANsaction:END*.

SYSTEM:TRANsaction:END

SYSTEM:TRANsaction:END marks the end of a sequence of setting commands between which the parameter limits must not be checked. After this command, the parameter limits are checked.

TEST

Table 6-7 Commands of the TEST system

Command	Parameter	Unit	Remarks
TEST:SENSor?			Query only

TEST:SENSor?

TEST:SENSor? triggers a selftest of the power sensor module. In contrast to **TST*, this command yields detailed information, which is useful for troubleshooting.



No signal may be applied to the power sensor module while the selftest is running.

If the selftest is carried out with a signal being present, error messages may erroneously be output for the test steps "Offset Voltages" and/or "Noise Voltages".

TRIGger

Table 6-8 Commands of the TRIGger system

Command	Parameter	Unit	Remarks
ABORt			No query
INITiate			
:CONTInuous[?]	OFF ON		
:IMMediate			No query
TRIGger			
:COUNT[?]	1 to 2×10^9		
:DELay[?]	x to 100.0	s	
:AUTO[?]	OFF ON		
:HOLDoff[?]	0.0 to 10.0	s	
:HYSTeresis[?]	0.0 to 3.0	dB	
:IMMediate			No query
:LEVel[?]	x to y	W	
:SLOPe[?]	POSitive NEGative		
:SOURce[?]	BUS EXTernal HOLD IMMediate INTernal		

ABORt

ABORt interrupts the current measurement and sets the power sensor module to the *IDLE* state (normal case). However, if the power sensor module is in the continuous measurement mode (setting *INITiate:CONTInuous ON*), the *IDLE* state is immediately exited and the power sensor module enters the *WAIT_FOR_TRIGGER* state.

INITiate:CONTInuous[?] OFF | ON

INITiate:CONTInuous ON activates the continuous measurement mode. In this mode, a new measurement is automatically started when a measurement is terminated. The power sensor module first enters the *WAIT_FOR_TRIGGER* state and begins with the measurement as soon as the trigger condition is fulfilled. Once the measurement is completed, the sensor again enters the *WAIT_FOR_TRIGGER* state. The power sensor module will measure continuously assuming continuous trigger events.

In contrast, each measurement cycle must be explicitly started with the *INITiate:IMMediate* command after the *INITiate:CONTInuous OFF* command has been sent. After triggering and completion of the measurement, the power sensor module enters the *IDLE* status and remains in this status until a new measurement is started with the *INITiate:IMMediate* command.

The query yields

- 1 for OFF,
- 2 for ON.

Default setting: OFF

INITiate:IMMEDIATE

INITiate:IMMEDIATE starts a single measurement cycle. The power sensor module first changes from the *IDLE* state to the *WAIT_FOR_TRIGGER* state and begins with the measurement as soon as the trigger condition is fulfilled. Once the measurement is completed, the sensor again enters the *IDLE* state. Since the command is ignored during measurement, it normally has no effect in the continuous mode (setting *INITiate:CONTinuous ON*).

TRIGger:COUNT[?] 1 to 2×10^9

This setting is designed for applications in which several consecutive measurements have to be performed by sending the *INITiate:IMMEDIATE* command only once, e.g. to obtain a higher measurement speed. The gap between a single measurement and the continuous measurement mode is thus closed. The number of measurements is defined with the parameter associated with the *TRIGger:COUNT* command. This number equals the number of results yielded by the power sensor module at the end of the measurement.



The TRIGger:COUNT command does not define the number of trigger events required for performing the entire measurement task. The number may vary depending on the measurement mode.

*A further increase in the measurement speed can be obtained by combining the mode used with the buffered mode. The results are not made available immediately but as a block at the end of the measurement sequence (see group commands *SENSe:POWer:AVG:BUFFer*).*

The query yields the number of measurements performed with the *INIT:IMMEDIATE* command after a measurement start.

Default setting: 1

TRIGger:DELAy[?] 0 to 100.0

TRIGger:DELAy defines the delay (in seconds) between the occurrence of the trigger event and the beginning of the measurement itself.

The query yields the set trigger delay (in seconds).

Default setting: 0.0 [s]

TRIGger:DELAy:AUTO[?] OFF | ON

TRIGger:DELAy:AUTO ON ensures by means of an automatically determined delay that a measurement is only started after the test result has settled. This is important when thermal power sensor modules are used. The automatically determined delay is ignored if a longer period was set with *TRIGger:DELAy*. This does not overwrite the value of *TRIGger:DELAy*. *TRIGger:DELAy:AUTO OFF* deactivates this function.

The query yields

- 1 for *OFF*,
- 2 for *ON*.

Default setting: *ON*

TRIGger:HOlDoff[?] 0.0 to 10.0

TRIGger:HOlDoff suppresses trigger events within the set holdoff time (in s), starting from the time of the last successful triggering.

The query yields the set holdoff time (in s).

Default setting: *0.0 [s]*

TRIGger:HYSteresis[?] 0.0 to 10.0

TRIGger:HYSteresis sets the hysteresis of the internal trigger threshold (parameter *TRIGger:LEVel*). Hysteresis is the magnitude (in dB) by which the trigger signal level falls below the trigger threshold (with positive trigger edge) to enable triggering again. The case is exactly the opposite with a negative trigger edge. The trigger hysteresis setting is only relevant to the *INTernal* trigger source.

The query yields the trigger hysteresis in dB.

Default setting: *0.0 [dB]*

TRIGger:IMMediate

TRIGger:IMMediate triggers a generic trigger event that causes the power sensor module to exit immediately the *WAIT_FOR_TRIGGER* state irrespective of the trigger source and the trigger delay and begin with the measurement. The command is the only means of starting a measurement when the trigger source is set to *HOLD*.

TRIGger:LEVel[?] x to y

TRIGger:LEVel sets the trigger threshold for internal triggering derived from the test signal (in W). This setting is irrelevant to all other trigger sources.

The query yields the trigger threshold in W.

Lower limit x and upper limit y of parameter

SENSe:CORRection:OFFSet:STATe OFF: $x = 25 \times \text{<lower test limit>}$
 $y = \text{<upper test limit >}$

SENSe:CORRection:OFFSet:STATe ON: $x = 25 \times \text{< lower test limit > } \times$
 $10^{(\text{<SENSe:CORRection:OFFSet>} / 10)}$
 $y = \text{< upper test limit > } \times$
 $10^{(\text{<SENSe:CORRection:OFFSet>} / 10)}$

< lower test limit >: 4.0e-6

< upper test limit >: 0.4

Default setting: $10 \times x$

TRIGger:SLOPe[?] POSitive | NEGative

TRIGger:SLOPe defines the edge of the trigger event with internal and external triggering. In this connection, positive means increasing envelope power (with internal triggering) or increasing voltage (with external triggering). This command has no effect in conjunction with trigger sources *BUS*, *HOLD* and *IMMEDIATE*.

The query yields

- 1 for *POSitive*,
- 2 for *NEGative*.

Default setting: *POSitive*

TRIGger:SOURce[?] BUS | EXTernal | HOLD | IMMEDIATE | INTernal

TRIGger:SOURce sets the trigger source.

- *BUS*: Triggering with command **TRG* or *TRIGger:IMMEDIATE*.
- *EXTernal*: Triggering via USB Adapter R&S NRP-Z3. Relevant trigger parameters: *TRIGger:DELay* and *TRIGger:SLOPe*.
- *HOLD*: Triggering only with command *TRIGger:IMMEDIATE*.
- *IMMEDIATE*: Automatic triggering without explicit event.
- *INTernal*: Triggering by the measurement signal. Relevant trigger parameters: *TRIGger:LEVel*, *TRIGger:DELay* and *TRIGger:SLOPe*.

The query yields

- 1 for *BUS*,
- 2 for *EXTernal*,
- 4 for *HOLD*,
- 8 for *IMMEDIATE*,
- 16 for *INTernal*.

Default setting: *IMMEDIATE*

List of Remote-Control Commands

The remote-control commands have a syntax based on standard SCPI 1999.0, but they comply with it only to a limited extent.

Table 6-9 List of remote-control commands

Command	Parameter	Unit	Default setting	Page
* Commands				
*IDN?				6.2
*RST				6.2
*TRG				6.2
*TST?				6.2
CALibration Commands				
CALibration:DATA[?]	<calibration data set as definite length block>			6.3
CALibration:DATA:LENGth?		Bytes		6.3
CALibration:ZERO:AUTO[?]	OFF ON ONCE		OFF (fixed)	6.4
SENSe Commands				
SENSe:AVERage:COUNT[?]	1 to 65536		4	6.6
SENSe:AVERage:COUNT:AUTO[?]	OFF ON ONCE		ON	6.6
SENSe:AVERage:COUNT:AUTO:MTIME[?]	1.0 to 999.99	s	30.0	6.7
SENSe:AVERage:COUNT:AUTO:NSRatio[?]	0.0001 to 1.0	dB	0.01	6.7
SENSe:AVERage:COUNT:AUTO:RESolution[?]	1 to 4		3	6.7
SENSe:AVERage:COUNT:AUTO:TYPE[?]	RESolution NSRatio		RESolution	6.7
SENSe:AVERage:RESet				6.7
SENSe:AVERage:STATe[?]	OFF ON		ON	6.7
SENSe:AVERage:TCONtrol[?]	MOVing REPeat		REPeat	6.8
SENSe:CORRection:DCYCLE[?]	0.001 to 99.999	%	1.0	6.8
SENSe:CORRection:DCYCLE:STATe[?]	OFF ON		OFF	6.8
SENSe:CORRection:OFFSet[?]	-200.0 to 200.0	dB	0.0	6.9

Command	Parameter	Unit	Default setting	Page
SENSe:CORRection:OFFSet:STATe[?]	OFF ON		OFF	6.9
SENSe:CORRection:SPDevice:STATe[?]	OFF ON		OFF (can be modified by the user)	6.9
SENSe:FREQuency[?]	10.0e6 to 18.0e9 (NRP-Z51) or 40.0e9 (NRP-Z55)	Hz	50.0e6	6.9
SENSe:FUNcTION[?]	"POWer:AVG"		"POWer:AVG"	6.10
SENSe:POWer:AVG:APERture[?]	0.001 to 0.3	s	0.02	6.10
SENSe:POWer:AVG:BUFFer:SIZE[?]	1 to 1024		1	6.11
SENSe:POWer:AVG:BUFFer:STATe[?]	OFF ON		OFF	6.11
SENSe:POWer:AVG:SMOothing:STATe[?]	OFF ON		ON	6.11
SENSe:SGAMma:CORRection:STATe[?]	OFF ON		OFF	6.12
SENSe:SGAMma:MAGNitude[?]	0.0 to 1.0		0.0	6.12
SENSe:SGAMma:PHASe[?]	-360.0 to 360.0	degree	0.0	6.12
SYSTem Commands				
SYSTem:INFO? [Item]				6.13
SYSTem:INITialize				6.14
SYSTem:MINPower?		W		6.15
SYSTem:TRANsaction:BEgIn				6.14
SYSTem:TRANsaction:END				6.15
Test Commands				
TEST:SENSor?				6.16
Triggersystem Commands				
ABORt				6.17
INITiate:CONTInuous[?]	OFF ON		OFF	6.17
INITiate:IMMEDIATE				6.18
TRIGger:COUNt[?]	1 to 2×10^9		1	6.18
TRIGger:DELAy[?]	0 to 100.0	s	0.0	6.18
TRIGger:DELAy:AUTO[?]	OFF ON		OFF	6.18
TRIGger:HOLDoff[?]	0.0 to 10.0	s	0.0	6.19

Command	Parameter	Unit	Default setting	Page
TRIGger:HYSTeresis[?]	0.0 to 10.0	dB	0.0	6.19
TRIGger:IMMediate				6.19
TRIGger:LEVel[?]	x to y	W	10 × x	6.19
TRIGger:SLOPe[?]	POSitive NEGative		POSitive	6.20
TRIGger:SOURce[?]	BUS EXTernal HOLD IMMediate INTernal		IMMediate	6.20
SERVICE Commands				
SERVice:CALibration:TEMPerature	ONCE		OFF	
SERVice:CALibration:TEMPerature:DATA?		K	0.0	
SERVice:CALibration:TEST[?]			-1	
SERVice:CALibration:ZERO:NEG0?			1	
SERVice:CALibration:ZERO:POS0?			2	
SERVice:MVCorrection[?]	0 to 63		63	
SERVice:PARAmeter:RTEmp[?]	<float value>	K	0.0	
SERVice:PARAmeter:RNULL0[?]	<float value>	Ω	0.0	
SERVice:PARAmeter:RBAHN[?]	<float value>	Ω	0.0	
SERVice:PARAmeter:NREF[?]	<float value>		0.0	
SERVice:PARAmeter:ATHERM[?]	<float value>	K ⁻¹	0.0	
SERVice:PARAmeter:BTHERM[?]	<float value>	K	0.0	
SERVice:PARAmeter:CTHERM[?]	<float value>	K ⁻¹	0.0	
SERVice:PARAmeter:DTHERM[?]	<float value>	K ⁻¹	0.0	
SERVice:PARAmeter:CJUNC[?]	<float value>	F	0.0	
SERVice:RCount[?]	1 to 32767		0	
SERVice:RESult[?]	0.0 to 1.0e6	W	0.0	
SERVice:SAMPle[?]	0 to 99999999		1000	
SERVice:TDEScriptor?				
SERVice:TDEScriptor:LENGth?		Bytes		
SERVice:UNLock	1234			