ROHDE&SCHWARZ

Test and Measurement
Division

Manual

Average Power Sensor

R&S® NRP-Z91

9 kHz to 6 GHz / 200 pW to 200 mW

1168.8004.02

Printed in the Federal
Republic of Germany

Dear Customer,

Tabbed Divider Overview

Data Sheet

Safety Instructions
Certificate of Quality
EU Certificate of Conformity
List of R&S Representatives

Tabbed Divider

Technical Information

Power Sensor R&S NRP-Z91

Universal power measurement from 9 kHz to 6 GHz

The Power Sensor R&S NRP-Z91 is designed for measuring average power in a very wide frequency range. In particular, it covers the frequency bands relevant for terrestrial radio-communication. It is thus ideal not only for EMC applications but also as a truly universal power sensor.

The sensor can be operated on the R&S NRP base unit and also as a standalone device on a PC or a PC-based measuring instrument.

- 90 dB dynamic range
- Able to handle signals with any type of modulation
- Very low measurement uncertainty
- Excellent matching
- Low sensitivity to harmonics
- Operable on a PC without power meter base unit

ROHDE&SCHWARZ

Preliminary

Specifications

Bold: Parameter 100% tested

Italics: Uncertainties calculated from the test assembly specifications and the modelled behaviour of the sensor.

Normal: Compliance with specifications is ensured by the design or derived from the measurement of related parameters

Power Sensor R&S NRP-Z91

Frequency range		9 kHz to 6 GHz
Matching (SWR) Level-dependent matching change [2)]	9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz 9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz	< 1.13 (**1.11**) values in ( ) for < 1.20 (**1.18**) temperature range 15°C to 35°C < 0.05 (0.02) < 0.08 (0.05)
Power measurement range		200 pW to 200 mW (-67 dBm to +23 dBm)
Max. power	Average Peak envelope power	0.4 W (+26 dBm) continuous 1 W (+30 dBm) for max. 10 µs
Measurement subranges	Path 1 Path 2 Path 3	-67 dBm to - 14 dBm -47 dBm to + 6 dBm -27 dBm to +23 dBm
Transition ranges	With automatic path selection, user def'd crossover[5]) set to 0 dB	(-19±1) dBm to (-13±1) dBm (+ 1±1) dBm to (+7±1) dBm
Display noise[14)]	15°C to 35°C Path 1 2 3 0°C to 50°C Path 1 2 3	< 60 pW (40 pW typ.) < 5.6 nW (3.6 nW typ.) < 0.56 µW (0.36 µW typ.) < 65 pW < 6.3 nW < 0.63 µW
Display noise, relative [15)]	Measurement window 2 × 1 ms, without averaging Measurement window 2 × 20 ms, averaging factor 32 (measurement time approx. 1 s)	< 0.05 dB (0.03 dB typ.) < 0.002 dB (0.001 dB typ.)
Zero offset[17)]	15°C to 35°C Path 1 2 3 0°C to 50°C Path 1 2 3	< 96 pW (64 pW typ.) < 9.0 nW (5.8 nW typ.) < 0.90 µW (0.58 µW typ.) < 104 pW < 10.0 nW < 1.00 µW
Zero drift[18)]	Path 1 Path 2 Path 3	< 35 pW < 3 nW < 0.3 µW
Triggering	Source Slope (external, internal) Level Internal External Delay Holdoff Hysteresis	Bus, External, Hold, Immediate, Internal pos./neg. -40 dBm to +23 dBm See specs for R&S NRP and USB Adapter R&S NRP-Z3 -5 ms to +100 s 0 s to 10 s 0 dB to 10 dB

Uncertainty for absolute power measurements[31)] in dB

9 kHz to < 20 kHz

0.174	0.175	0.175	(0...50) °C
0.075	0.070	0.071	(15...35) °C
0.056	0.047	0.048	(20...25) °C

-40[37)] to -19 to +1 to +23 dBm

20 kHz to < 100 MHz

0.147	0.159	0.159	(0...50) °C
0.072	0.069	0.069	(15...35) °C
0.056	0.047	0.048	(20...25) °C

-40[37)] to -19 to +1 to +23 dBm

100 MHz to 4 GHz

0.150	0.162	0.164	(0...50) °C
0.081	0.077	0.081	(15...35) °C
0.066	0.058	0.063	(20...25) °C

-40[37)] to -19 to +1 to +23 dBm

> 4 GHz to 6 GHz

0.160	0.170	0.174	(0...50) °C
0.096	0.089	0.097	(15...35) °C
0.083	0.072	0.082	(20...25) °C

-40[37)] to -19 to +1 to +23 dBm

Uncertainty for relative power measurements [32), 33), 36)] in dB

9 kHz to < 20 kHz

dBm	-40[37)]	-19 / -13	±0 / +8	+23
+23	0.226 0.084 0.046	0.229 0.080 0.044	0.027 0.022 0.022	
+7 / +1	0.226 0.083 0.045	0.027 0.022 0.022	0.229 0.080 0.044	
-13 / -19	0.023 0.022 0.022	0.226 0.083 0.045	0.226 0.084 0.046	

20 kHz to < 100 MHz

dBm	-40[37)]	-19 / -13	±0 / +8	+23	
+23	0.206 0.082 0.046	0.215 0.078 **0.044**	0.027 0.022 0.022		(0...50) °C (15...35) °C (20...25) °C
+7 / +1	0.205 0.081 **0.044**	0.027 0.022 **0.022**	0.215 0.078 **0.044**		(0...50) °C (15...35) °C (20...25) °C
-13 / -19	0.023 0.022 0.022	0.205 0.081 **0.044**	0.206 0.082 0.046		(0...50) °C (15...35) °C (20...25) °C

100 MHz to 4 GHz

dBm	-40[37)]	-19 / -13	±0 / +8	+23
+23	0.209 0.088 0.055	0.218 0.085 0.047	0.038 0.032 0.031	
+7 / +1	0.206 0.083 0.048	0.028 0.022 0.022	0.218 0.085 0.047	
-13 / -19	0.023 0.022 0.022	0.206 0.083 0.048	0.209 0.088 0.055	

> 4 GHz to 6 GHz

dBm	-40[37)]	-19 / -13	±0 / +8	+23	
+23	0.215 0.097 0.066	0.223 0.093 0.059	0.049 0.044 0.043		(0...50) °C (15...35) °C (20...25) °C
+7 / +1	0.210 0.088 0.054	0.030 0.022 0.022	0.223 0.093 0.059		(0...50) °C (15...35) °C (20...25) °C
-13 / -19	0.024 0.022 0.022	0.210 0.088 0.054	0.215 0.097 0.066		(0...50) °C (15...35) °C (20...25) °C

Additional characteristics of R&S NRP-Z91

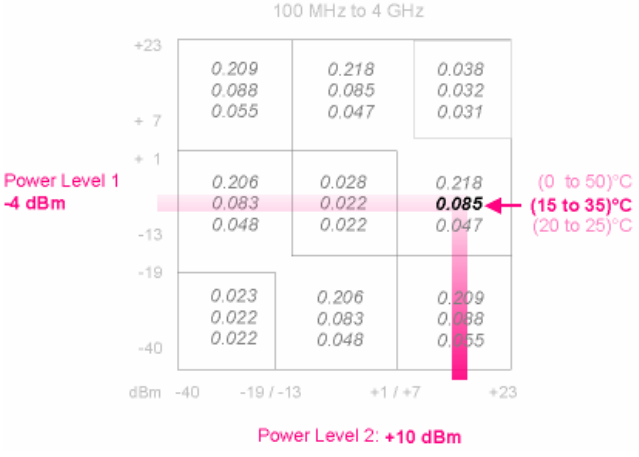
Sensor type		3-path diode sensor		
Measurand		average power of incident wave average power of source into 50 Ω[1])		
RF connector		N (male)		
Calibration uncertainty[30)] in dB (20 to 25) °C		Path 1	Path 2	Path 3
	9 kHz to < 100 MHz	*0.056*	*0.047*	*0.048*
	0.1 GHz to 4.0 GHz	*0.066*	*0.057*	*0.057*
	> 4 GHz to 6 GHz	*0.083*	*0.071*	*0.072*
Measurement function		Continuous Average		
	Measurement window[7)]	2 × (1 ms to 300 ms)		
	Duty cycle correction[8)] Smoothing	0.001% to 100.00% See under Measurement window		
Dynamic behaviour of video path	Rise time 10% / 90%	< 5 ms		
Sampling frequency		133.358 kHz		
Zeroing (duration)	Depends on setting of averaging filter			
	AUTO ON	4 s		
	AUTO OFF			
	Integration time[16]) < 4 s	4 s		
	4 s to 16 s	Integration time[16])		
	>16 s	16 s		
Measurement error due to harmonics $n \times f_0$ of carrier frequency[19)] values in [ ]: typ. standard uncertainty	N = 3, 5, 7, ... [20]) -30 dBc	<0.003 dB [0.0015 dB]		
	-20 dBc	<0.010 dB [0.005 dB]		
	-10 dBc	<0.040 dB [0.015 dB]		
	N = 2, 4, 6, ... [20]) -30 dBc	<0.001 dB [0.0003 dB]		
	-20 dBc	<0.002 dB [0.001 dB]		
	-10 dBc	<0.010 dB [0.003 dB]		
Modulation influence[21)] values in [ ]: User def'd crossover ≤ -6 dB	General	measurement errors in subranges are proportional to power and depend on CCDF and modulation bandwidth of test signal		
	WCDMA (3-GPP Test Model 1-64) AM (80 %)			
	Worst case	-0.02 dB to +0.07 dB [-0.02 dB to +0.02 dB]		
	Typical	-0.01 dB to +0.03 dB [-0.01 dB to +0.01 dB]		
Measurement window	Duration	as specified for the measurement function		
	Shape	rectangular (integrating behaviour)		
		Von Hann (smoothing filter, for efficient suppression of result variations due to modulation[26)]		
Measurement times[27)]		N × (duration of meas. window[7)]+10ms) -3.4 ms+ t_d		
		t_d must be considered with activated auto delay (1ms to 20 ms dependent from temperature)		
Auto delay		If activated, the beginning of a measurement is delayed so, that settled readings for a power step up to ±10 dB are obtained (to ±0.005 dB) .		

Averaging filter	Modes	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)
	AUTO mode Normal operating mode[23)]	setting of filter depends on power to be measured and resolution
	Resolution	1 (1 dB), 2 (0.1 dB), 3 (0.01 dB), 4 (0.001 dB)
	Fixed Noise operating mode	filter set to specified noise content
	Noise content Max. measurement time[24)]	0.0001 dB to 1 dB 0.01 s to 999 s
	Averaging factor N	1 to 2^{16} (number of averaged measurement windows)
	Result output Moving Average	continuous with every newly evaluated measurement window (e.g. in case of manual operation via R&S NRP)
	Repeat	only final result (e.g. in case of remote control of R&S NRP)
Attenuation correction	Function	correcting the measurement result by means of a fixed factor (dB offset)
	Range	-100.000 dB to +100.000 dB
S-parameter correction	Function	Taking into account a component connected to the sensor input by loading its s-parameter data set into the sensor
	Number of frequencies Parameters	1 to 1000 s_{11}, s_{21}, s_{12} and s_{22} (in s2p format)
	Download	With R&S NRP tool kit (supplied with sensor) via USB Adapter R&S NRP-Z3 or R&S NRP-Z4
Γ correction	Function	Reducing the influence of mismatched sources[29)]
	Parameters	Magnitude and phase of reflection coefficient of source
	Download	see under S-parameter correction
Frequency response correction	Function	taking into account the calibration factors relevant for the test frequency
	Parameter	carrier frequency (center frequency)
	Permissible deviation from actual value	50 MHz (0.05 × f below 1 GHz) for specified measurement uncertainty
Interface to host	Power supply	+5 V / 200 mA typ. (USB high-power device)
	Remote control	As a USB device (function) in full-speed mode, compatible with USB 1.0/1.1/2.0 specifications
	Trigger input	differential (0 / +3.3 V)
Dimensions	W x H x L	48 mm × 31 mm × 170 mm Length incl. connecting cable: approx. 1.6 m
Weight		< 0.3 kg

Footnotes

Please refer to the R&S NRP data sheet for footnotes not mentioned below.

[33]) Reading the uncertainty for relative power measurements. The example shows a level step of approx. 14 dB (-4 dBm → +10 dBm) at 1.9 GHz and an ambient temperature of 28°C.



[37]) For measurements at even lower levels the influence of zero offset and zero drift must be added to the specifications on an RSS basis. The same applies to noise exceeding a two-sigma value of 0.01 dB.

General specifications

See the R&S NRP data sheet (PD 0757.7023.21), sensors R&S NRP-Z11/-Z21.

Accessories

See the R&S NRP data sheet (PD 0757.7023.21).

Ordering information

Description	Type	Order No.
Average Power Sensor 200 pW to 200 mW; 9 kHz to 6 GHz	R&S NRP-Z91	1168.8004.02

ROHDE & SCHWARZ GmbH & Co. KG · Mühldorfstraße 15 · 81671 München
Telefon +49 89 4129-0 ·Telefax +49 89 4129 121 64 · Internet: http://www.rohde-schwarz.com

ROHDE&SCHWARZ

EC Certificate of Conformity

CE

Certificate No.: 2002-36

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
NRP-Z3	1146.7005.02	USB Adapter
NRP-Z4	1146.8001.02	USB Adapter
NRP-Z11	1138.3004.02	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-Z51	1138.0005.02	Thermal Power Sensor
NRP-Z55	1138.2008.02	Thermal Power Sensor
NRP-Z91	1168.8004.02	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)

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12
EN55011 : 1998 + A1 : 1999
EN61326 : 1997 + A1 : 1998 + A2 : 2001

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

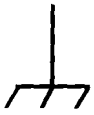
Munich, 2004-03-29 Central Quality Management FS-QZ / Becker

Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

							
Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground	Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, pollution severity 2 overvoltage category 2, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO 9001 und ISO 14001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde & Schwarz quality management system is certified according to standards such as ISO 9001 and ISO 14001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde & Schwarz a été homologué, entre autres, conformément aux normes ISO 9001 et ISO 14001.

ROHDE&SCHWARZ

Support Center

Telefon / Telephone: **+49 (0)180 512 42 42**

Fax: **+49 89 41 29 137 77**

E-mail: **CustomerSupport@rohde-schwarz.com**

Für technische Fragen zu diesem Rohde & Schwarz-Gerät steht Ihnen die Hotline der Rohde & Schwarz Vertriebs-GmbH, Support Center, zur Verfügung.

Unser Team bespricht mit Ihnen Ihre Fragen und sucht Lösungen für Ihre Probleme.

Die Hotline ist Montag bis Freitag von 8.00 bis 17.00 Uhr MEZ besetzt.

Bei Anfragen außerhalb der Geschäftszeiten hinterlassen Sie bitte eine Nachricht oder senden Sie eine Notiz per Fax oder E-Mail. Wir setzen uns dann baldmöglichst mit Ihnen in Verbindung.

Um Ihr Gerät stets auf dem neuesten Stand zu halten, abonnieren Sie bitte Ihren persönlichen Newsletter unter

http://www.rohde-schwarz.com/www/response.nsf/newsletterpreselection.

Sie erhalten dann regelmäßig Informationen über Rohde & Schwarz-Produkte Ihrer Wahl, über Firmware-Erweiterungen, neue Teiber und Applikationsschriften.

Should you have any technical questions concerning this Rohde & Schwarz product, please contact the hotline of Rohde & Schwarz Vertriebs-GmbH, Support Center.

Our hotline team will answer your questions and find solutions to your problems.

You can reach the hotline Monday through Friday from 8:00 until 17:00 CET.

If you need assistance outside office hours, please leave a message or send us a fax or e-mail. We will contact you as soon as possible.

To keep your instrument always up to date, please subscribe to your personal newsletter at

http://www.rohde-schwarz.com/www/response.nsf/newsletterpreselection.

As a subscriber, you will receive information about your selection of Rohde & Schwarz products, about firmware extensions, new drivers and application notes on a regular basis.

ROHDE&SCHWARZ

Adressen/Addresses

FIRMENSITZ/HEADQUARTERS

Phone
Fax
E-mail

Rohde & Schwarz GmbH & Co. KG
Mühldorfstraße 15 · D-81671 München
Postfach 80 14 69 · D-81614 München
+49 (89) 41 29-0
+49 89 4129-121 64
-

WERKE/PLANTS

Rohde & Schwarz Messgerätebau GmbH
Riedbachstraße 58 · D-87700 Memmingen
Postfach 1652 · D-87686 Memmingen
+49 (8331) 108-0
+49 (8331) 108-11 24
-

Rohde & Schwarz GmbH & Co. KG
Werk Teisnach
Kaikenrieder Straße 27 · D-94244 Teisnach
Postfach 1149 · D-94240 Teisnach
+49 (9923) 857-0
+49 (9923) 857-11 74
-

Rohde & Schwarz GmbH & Co. KG
Dienstleistungszentrum Köln
Graf-Zeppelin-Straße 18 · D-51147 Köln
Postfach 98 02 60 · D-51130 Köln
+49 (2203) 49-0
+49 (2203) 49 51-308
info@rsdc.rohde-schwarz.com
service@rsdc.rohde-schwarz.com

TOCHTERUNTERNEHMEN/SUBSIDIARIES

Rohde & Schwarz Vertriebs-GmbH
Mühldorfstraße 15 · D-81671 München
Postfach 80 14 69 · D-81614 München
+49 (89) 41 29-137 74
+49 (89) 41 29-137 77
-

Rohde & Schwarz International GmbH
Mühldorfstraße 15 · D-81671 München
Postfach 80 14 60 · D-81614 München
+49 (89) 41 29-129 84
+49 (89) 41 29-120 50
-

Rohde & Schwarz Engineering and Sales GmbH
Mühldorfstraße 15 · D-81671 München
Postfach 80 14 29 · D-81614 München
+49 (89) 41 29-137 11
+49 (89) 41 29-137 23
-

R&S BICK Mobilfunk GmbH
Fritz-Hahne-Str. 7 · D-31848 Bad Münder
Postfach 2062 · D-31844 Bad Münder
+49 (5042) 998-0
+49 (5042) 998-105
-

Rohde & Schwarz FTK GmbH
Wendenschlossstraße 168, Haus 28
D-12557 Berlin
+49 (30) 658 91-122
+49 (30) 655 50-221
-

Rohde & Schwarz SIT GmbH
Agastraße 3
D-12489 Berlin
+49 (30) 658 84-0
+49 (30) 658 84-183

ADRESSEN DEUTSCHLAND/ADDRESSES GERMANY

Rohde & Schwarz Vertriebs-GmbH
Mühldorfstraße 15 · D-81671 München
Postfach 80 14 69 · D-81614 München
+49 89 4129-133 74
+4989 4129-133 77
-

Zweigniederlassungen der Rohde & Schwarz Vertriebs-GmbH/Branch offices of Rohde & Schwarz Vertriebs-GmbH

Zweigniederlassung Nord, Geschäftsstelle Berlin
Ernst-Reuter-Platz 10 · D-10587 Berlin
Postfach 100620 · D-10566 Berlin
+49 (30) 34 79 48-0
+49 (30) 34 79 48 48
-

Zweigniederlassung Büro Bonn
Josef-Wirmer-Straße 1-3 · D-53123 Bonn
Postfach 140264 · D-53057 Bonn
+49 (228) 918 90-0
+49 (228) 25 50 87
-

Zweigniederlassung Nord, Geschäftsstelle Hamburg
Steilshooper Alle 47 · D-22309 Hamburg
Postfach 60 22 40 · D-22232 Hamburg
+49 (40) 63 29 00-0
+49 (40) 630 78 70
-

Zweigniederlassung Mitte, Geschäftsstelle Köln
Niederkasseler Straße 33 · D-51147 Köln
Postfach 900 149 · D-51111 Köln
+49 (2203) 807-0
+49 (2203) 807-650
-

Zweigniederlassung Süd, Geschäftsstelle München
Mühldorfstraße 15 · D-81671 München
Postfach 80 14 69 · D-81614 München
+49 (89) 41 86 95-0
+49 (89) 40 47 64
-

Zweigniederlassung Süd, Geschäftsstelle Nürnberg
Donaustraße 36
D-90451 Nürnberg
+49 (911) 642 03-0
+49 (911) 642 03-33
-

Zweigniederlassung Mitte, Geschäftsstelle Neu-Isenburg
Siemensstraße 20
D-63263 Neu-Isenburg
+49 (6102) 20 07-0
+49 (6102) 20 07 12
-

ADRESSEN WELTWEIT/ADDRESSES WORLDWIDE

Albania siehe / see Austria

Algeria
ROHDE & SCHWARZ
Bureau d'Alger
5B Place de Laperrine
16035 Hydra-Alger
+213 (21) 48 20 18
+213 (21) 69 46 08

Argentina
PRECISION ELECTRONICA S.R.L.
Av. Pde Julio A. Roca 710 - 6° Piso
(C1067ABP) Buenos Aires
+541 (14) 331 41 99
+541 (14) 334 51 11
alberto_lombardi@prec-elec.com.ar

Australia
ROHDE & SCHWARZ (AUSTRALIA) Pty. Ltd.
Sales Support
Unit 6
2-8 South Street
Rydalmere, N.S.W. 2116
+61 (2) 88 45 41 00
+61 (2) 96 38 39 88
lyndell.james@rsaus.rohde-schwarz.com

Austria
ROHDE & SCHWARZ-ÖSTERREICH Ges.m.b.H.
Am Euro Platz 3
Gebäude B
1120 Wien
+43 (1) 602 61 41-0
+43 (1) 602 61 41-14
office@rsoe.rohde-schwarz.com

Azerbaijan
ROHDE & SCHWARZ Azerbaijan
Liaison Office Baku
ISR Plaza
340 Nizami Str.
370000 Baku
+994 (12) 93 31 38
+994 (12) 93 03 14
RS-Azerbaijan@RUS.Rohde-Schwarz.com

Baltic Countries siehe / see Denmark

Bangladesh
BIL Consortium Ltd.
Corporation Office
House No: 95/A, Block - 'F'
Road No. 4, Banani
Dhaka-1213
+880 (2) 881 06 53
+880 (2) 882 82 91

Belgium
ROHDE & SCHWARZ BELGIUM N.V.
Excelsiorlaan 31 Bus 1
1930 Zaventem
+32 (2) 721 50 02
+32 (2) 725 09 36
info@rsb.rohde-schwarz.com

Brasil
ROHDE & SCHWARZ DO BRASIL LTDA.
Av. Alfredo Egidio de Souza Aranha n° 177,
1° andar - Santo Amaro
04726-170 Sao Paulo - SP
+55 (11) 56 44 86 11 (general)
+55 (11) 56 44 86 25 (sales)
+55 (11) 56 44 86 36
sales-brazil@rsdb.rohde-schwarz.com

Brunei
GKL Equipment PTE. Ltd.
Jurong Point Post Office
P.O.Box 141
Singapore 916405
+65 (6) 276 06 26
+65 (6) 276 06 29
gkleqpt@singnet.com.sg

Bulgaria
ROHDE & SCHWARZ ÖSTERREICH
Representation Office Bulgaria
39, Fridtjof Nansen Blvd.
1000 Sofia
+359 (2) 963 43 34
+359 (2) 963 21 97
rohdebg@rsoe.rohde-schwarz.com

Bosnia-Herzegovina siehe / see Slovenia

Adressen/Addresses

Canada
ROHDE & SCHWARZ CANADA Inc.
555 March Rd.
Kanata, Ontario K2K 2M5
+1 (613) 592 80 00
+1 (613) 592 80 09
cgirwarnauth@rscanada.ca

Canada
TEKTRONIX CANADA Inc.
Test and Measurement
4929 Place Olivia
Saint-Laurent, Pq

Montreal H4R 2V6
+1 (514) 331 43 34
+1 (514) 331 59 91

Chile
DYMEQ Ltda.
Av. Larrain 6666
Santiago
+56 (2) 339 20 00
+56 (2) 339 20 10
dnussbaum@dymeq.com

China
ROHDE & SCHWARZ China Ltd.
Representative Office Shanghai
Central Plaza
227 Huangpi North Road
RM 807/809
Shanghai 200003
+86 (21) 63 75 00 18
+86 (21) 63 75 91 70

China
ROHDE & SCHWARZ China Ltd.
Representative Office Beijing
Room 602, Parkview Center
2 Jiangtai Road
Chao Yang District
Beijing 100016
+86 (10) 64 31 28 28
+86 (10) 64 37 98 88
info.rschina@rsbp.rohde-schwarz.com

China
ROHDE & SCHWARZ China Ltd.
Representative Office Guangzhou
Room 2903, Metro Plaza
183 Tianhe North Road
Guangzhou 510075
+86 (20) 87 55 47 58
+86 (20) 87 55 47 59

China
ROHDE & SCHWARZ China Ltd.
Representative Office Chengdu
Unit G, 28/F, First City Plaza
308 Shuncheng Avenue
Chengdu 610017
+86 (28) 86 52 76 05 to 09
+86 (28) 86 52 76 10
rsbpc@mail.sc.cninfo.net

China
ROHDE & SCHWARZ China Ltd.
Unit 3115
31/F Entertainment Building
30 Queen's Road Central
Hongkong
+85 (2) 21 68 06 70
+85 (2) 21 68 08 99

China
ROHDE & SCHWARZ China Ltd.
Representative Office Xi'an
Room 10125, Jianguo Hotel Xi'an
No. 2, Huzhu Road
Xi'an 710048
+86 (29) 321 82 33
+86 (29) 329 60 15
sherry.yu@rsbp.rohde-schwarz.com

China
Shanghai ROHDE & SCHWARZ
Communication Technology Co.Ltd.
Central Plaza, Unit 809
227 Huangpi North Road
Shanghai 200003

China
Beijing ROHDE & SCHWARZ Communication
Technology Co.Ltd.
Room 106, Parkview Centre
No. 2, Jiangtai Road
Chao Yang District
Beijing 100016
+86 (10) 64 38 80 80
+86 (10) 64 38 97 06

Croatia
siehe / see Slovenia

Cyprus
HINIS TELECAST LTD.
Agiou Thoma 18
Kiti

Larnaca 7550
+357 (24) 42 51 78
+357 (24) 42 46 21
hinis@logos.cy.net

Czech Republic
ROHDE & SCHWARZ - Praha s.r.o.
Hadovka Office Park
Evropská 33c
16000 Praha 6
+420 (2) 24 31 12 32
+420 (2) 24 31 70 43
office@rscz.rohde-schwarz.com

Denmark
ROHDE & SCHWARZ DANMARK A/S
Ejby Industrivej 40
2600 Glostrup
+45 (43) 43 66 99
+45 (43) 43 77 44

Ecuador
REPRESENTACIONES MANFRED WEINZIERL
Vía Láctea No. 4 y Via Sta. Inés
P.O.Box 17-22-20309
1722 Cumbayá-Quito
+593 (22) 89 65 97
+593 (22) 89 65 97
mweinzierl@accessinter.net

Egypt
U.A.S. Universal Advanced Systems
31 Manshiet El-Bakry Street
Heliopolis
11341 Cairo
+20 (2) 455 67 44
+20 (2) 256 17 40
an_uas@link.net

El Salvador
siehe / see Mexico

Estonia
ROHDE & SCHWARZ DANMARK A/S
Estonian Branch Office
Narva mnt. 13
10151 Tallinn
+372 (6) 14 31 23
+372 (6) 14 31 21
margo.fingling@rsdk.rohde-schwarz.com

Finland
Orbis Oy
P.O.Box 15
00421 Helsinski 42
+358 (9) 47 88 30
+358 (9) 53 16 04
info@orbis.fi

France
ROHDE & SCHWARZ FRANCE
Immeuble "Le Newton"
9-11, rue Jeanne Braconnier
92366 Meudon La Forêt Cédex
+33 (1) 41 36 10 00
+33 (1) 41 36 11 73

France
Niederlassung/Subsidiary Rennes
37 Rue du Bignon
Bât. A
F-35510 Cesson Sevigne
+33 (0) 299 51 97 00
+33 (0) 299 51 98 77
-

France
Niederlassung/Subsidiary Toulouse
Technoparc 3
B.P. 501
F-31674 Labège Cédex
+33 (0) 561 39 10 69
+33 (0) 561 39 99 10
-

France
Aix-en-Provence
+33 (0) 494 07 39 94
+33 (0) 494 07 55 11
-

France
Office Lyon
+33 (0) 478 29 88 10
+33 (0) 478 79 18 57

France
Office Nancy
+33 (0) 383 54 51 29
+33 (0) 383 54 82 09

Ghana
KOP Engineering Ltd.
P.O. Box 11012
3rd Floor Akai House, Osu
Accra North
+233 (21) 77 89 13
+233 (21) 701 06 20

Greece
MERCURY S.A.
6, Loukianou Str.
10675 Athens
+302 (10) 722 92 13
+302 (10) 721 51 98
mercury@hol.gr

Guatemala
siehe / see Mexico

Honduras
siehe / see Mexico

Hongkong
Electronic Scientific Engineering
36/F Dorset House, Taikoo Place
979 King's Road
Quarry Bay
Hong Kong
+852 (25) 07 03 33
+852 (25) 07 09 25
stephenchau@ese.com.hk

Hungary
ROHDE & SCHWARZ
Budapesti Iroda
Váci út 169
1138 Budapest
+36 (1) 412 44 60
+36 (1) 412 44 61
rohdehu@rsoe.rohde-schwarz.com

Iceland
siehe / see Denmark

Adressen/Addresses

India
ROHDE & SCHWARZ India Pvt. Ltd.
Bangalore Office
No. 24, Service Road, Domlur
2nd Stage Extension
Bangalore - 560 071
+91 (80) 535 23 62
+91 (80) 535 03 61
rsindiab@rsnl.net

India
ROHDE & SCHWARZ India Pvt. Ltd.
Hyderabad Office
302 & 303, Millenium Centre
6-3-1099/1100, Somajiguda
Hyderabad - 500 016
+91 (40) 23 32 24 16
+91 (40) 23 32 27 32
rsindiah@nd2.dot.net.in

India
ROHDE & SCHWARZ India Pvt. Ltd.
244, Okhla Industrial Estate, Phase-III
New Delhi 110020
+91 (11) 26 32 63 81
+91 (11) 26 32 63 73
sales@rsindia.rohde-schwarz
services@rsindia.rohde-schwarz.com

India
ROHDE & SCHWARZ India Pvt. Ltd.
RS India Mumbai Office
B-603, Remi Bizcourt, Shah Industrial
Estate, Off Veera Desai Road
Mumbai - 400 058
+91 (22) 26 30 18 10
+91 (22) 26 32 63 73
rsindiam@rsnl.net

Indonesia
PT ROHDE & SCHWARZ Indonesia
Graha Paramita 5th Floor
Jln. Denpasar Raya Blok D-2
Jakarta 12940
+62 (21) 252 36 08
+62 (21) 252 36 07
sales@rsbj.rohde-schwarz.com
services@rsbj.rohde-schwarz.com

Iran
ROHDE & SCHWARZ IRAN
Groundfloor No. 1, 14th Street
Khaled Eslamboli (Vozara) Ave.
15117 Tehran
+98 (21) 872 42 96
+98 (21) 871 90 12
rs-tehran@neda.net

Ireland siehe / see United Kingdom

Israel
EASTRONICS LTD.
Messtechnik / T&M Equipment
11 Rozanis St.
P.O.Box 39300
Tel Aviv 61392
+972 (3) 645 87 77
+972 (3) 645 86 66
david_hasky@easx.co.il

Israel
J.M. Moss (Engineering) Ltd.
Kommunikationstechnik/ Communications
Equipment
9 Oded Street
P.O.Box 967
52109 Ramat Gan
+972 (3) 631 20 57
+972 (3) 631 40 58
jmmoss@zahav.net.il

Italy
ROHDE & SCHWARZ ITALIA S.p.a.
Centro Direzionale Lombardo
Via Roma 108
20060 Cassina de Pecchi (MI)
+39 (02) 95 70 42 03
+39 (02) 95 30 27 72
ornella.crippa@rsi.rohde-schwarz.com

Italy
ROHDE & SCHWARZ ITALIA S.p.a.
Via Tiburtina 1182
00156 Roma
+39 (06) 41 59 82 18
+39 (06) 41 59 82 70

Japan
ADVANTEST Corporation
RS Sales Department
1-32-1, Asahi-cho
Nerima-ku
Tokyo 179-0071
+81 (3) 39 30 41 90
+81 (3) 39 30 41 86
RSSales@advantest.co.jp

Jordan
Jordan Crown Engineering & Trading Co.
Jabal Amman, Second Circle
Youssef Ezzideen Street
P.O.Box 830414
Amman, 11183
+962 (6) 462 17 29
+962 (6) 465 96 72
jocrown@go.com.jo

Kazakhstan
ROHDE & SCHWARZ Kazakhstan
Representative Office Almaty
Pl. Respubliki 15
480013 Almaty
+7 (32) 72 63 55 55
+7 (32) 72 63 46 33
RS-Kazakhstan@RUS-Rohde-Schwarz.com

Kenya
Excel Enterprises Ltd
Dunga Road
P.O.Box 42 788
Nairobi
+254 (2) 55 80 88
+254 (2) 54 46 79

Korea
ROHDE & SCHWARZ Korea Ltd.
83-29 Nonhyun-Dong, Kangnam-Ku
Seoul 135-010
+82 (2) 514 45 46
+82 (2) 514 45 49
sales@rskor.rohde-schwarz.com
service@rskor.rohde-schwarz.com

Kuwait
Group Five Trading & Contracting Co.
Mezanine Floor
Al-Bana Towers
Ahmad Al Jaber Street
Sharq
+965 (244) 91 72/73/74
+965 (244) 95 28
jk_agarwal@yahoo.com

Latvia
ROHDE & SCHWARZ DANMARK A/S
Latvian Branch Office
Merkela iela 21-301
1050 Riga
+371 (7) 50 23 55
+371 (7) 50 23 60
rsdk@rsdk.rohde-schwarz.com

Lebanon
ROHDE & SCHWARZ Liaison Office
c/o Haji Abdullah Alireza Co. Ltd.
P.O.Box 361
Riyadh 11411
+966 (1) 465 64 28 Ext. 303
+966 (1) 465 64 28 Ext. 229
chris.porzky@rsd.rohde-schwarz.com

Lebanon Netcom

Liechtenstein siehe / see Switzerland

Lithuania
ROHDE & SCHWARZ DANMARK A/S
Lithuanian Office
Lukiskiu 5-228
2600 Vilnius
+370 (5) 239 50 10
+370 (5) 239 50 11

Luxembourg siehe / see Belgium

Macedonia siehe / see Slovenia

Malaysia
DAGANG TEKNIK SDN. BHD.
No. 9, Jalan SS 4D/2
Selangor Darul Ehsan
47301 Petaling Jaya
+60 (3) 27 03 55 68
+60 (3) 27 03 34 39
mey.nara@danik.com.my

Malta
ITEC International Technology Ltd
B'Kara Road
San Gwann SGN 08
+356 (21) 37 43 00 or 37 43 29
+356 (21) 37 43 53
sales@itec.com.mt

Mexico
Rohde & Schwarz de Mexico (RSMX)
S. de R.L. de C.V.
German Centre Oficina 4-2-2
Av. Santa Fé 170
Col. Lomas de Santa Fé
01210 Mexico D.F.
+52 (55) 85 03 99 13
+52 (55) 85 03 99 16
latinoamerica@rsd.rohde-schwarz.com

Mexico
Rohde & Schwarz de Mexico (RSMX)
Av. Prol. Americas No. 1600, 2° Piso
Col. Country Club
Guadalajara, Jal.
Mexico CP, 44610
+52 (33) 36 78 91 70
+52 (33) 36 78 92 00

Moldavia siehe / see Romania

Netherlands
ROHDE & SCHWARZ NEDERLAND B.V.
Perkinsbaan 1
3439 ND Nieuwegein
+31 (30) 600 17 00
+31 (30) 600 17 99
info@rsn.rohde-schwarz.com

New Zealand
Nichecom
1 Lincoln Ave.
Tawa, Wellington
+64 (4) 232 32 33
+64 (4) 232 32 30
rob@nichecom.co.nz

Nicaragua siehe / see Mexico

Nigeria
Ferrostaal Abuja
Plot 3323, Barada Close
P.O.Box 8513, Wuse
Off Amazon Street
Maitama, Abuja
+234 (9) 413 52 51
+234 (9) 413 52 50
fsabuja@rosecom.net

Adressen/Addresses

Norway
ROHDE & SCHWARZ NORGE AS
Enebakkveien 302 B
1188 Oslo
+47 (23) 38 66 00
+47 (23) 38 66 01

Oman
Mustafa Sultan Science & Industry Co.LLC.
For Test & Measurement ONLY
Way No. 3503
Building No. 241
Postal Code 112
Al Khuwair, Muscat
+968 636 000
+968 607 066
m-aziz@mustafasultan.com

Pakistan
Siemens Pakistan
23, West Jinnah Avenue
Islamabad
+92 (51) 227 22 00
+92 (51) 227 54 98
reza.bokhary@siemens.com.pk

Panama
siehe / see Mexico

Papua-New Guinea
siehe / see Australia

Philippines
MARCOM INDUSTRIAL EQUIPMENT, Inc.
6-L Vernida I Condominium
120 Amorsolo St.
Legaspi Village
Makati City/ Philippines 1229
+63 (2) 813 29 31
+63 (2) 810 58 07
marcom@i-next.net

Poland
ROHDE & SCHWARZ Österreich SP.z o.o.
Przedstawicielstwo w Polsce
ul. Stawki 2, Pietro 28
00-193 Warszawa
+48 (22) 860 64 94
+48 (22) 860 64 99
rohdepl@rsoe.rohde-schwarz.com

Portugal
Rohde & Schwarz Portugal, Lda.
Alameda Antonio Sergio, n° 7
R/C, Sala A
2795-023 Linda-a-Velha
+351 (21) 415 57 00
+351 (21) 415 57 10
telerus@mail.telepac.pt

Romania
ROHDE & SCHWARZ
Representation Office Bucharest
Str. Uranus 98
Sc. 2, Et. 5, Ap. 36
76102 Bucuresti, Sector 5
+40 (21) 410 68 46
+40 (21) 411 20 13
rohdero@rsoe.rohde-schwarz.com

Russian Federation
ROHDE & SCHWARZ
Representative Office Moscow
119180, Yakimanskaya nab., 2
Moscow
+7 (095) 745 88 50 to 53
+7 (095) 745 88 54
rs-russia@rsru.rohde-schwarz.com

Saudi Arabia
Mr. Chris Porzky
ROHDE & SCHWARZ International GmbH
c/o Haji Abdullah Alireza Co. Ltd.
P.O.Box 361
Riyadh 11411
+966 (1) 465 64 28 Ext. 303
+966 (1) 465 6428 Ext. 229
chris.porzky@rsd.rohde-schwarz.com

Saudi Arabia
GENTEC

Serbia-Montenegro
Representative Office Belgrade
Tose Jovanovica 7
11030 Beograd
+381 (11) 305 50 25
+381 (11) 305 50 24

Slovak Republic
Specialne systemy a software, a.s.
Svrcia ul.
841 04 Bratislava
+421 (2) 65 42 24 88
+421 (2) 65 42 07 68
stefan.lozek@special.sk

Slovenia
ROHDE & SCHWARZ
Representation Ljubljana
Tbilisijska 89
1000 Ljubljana
+386 (1) 423 46 51
+386 (1) 423 46 11
rohdesi@rsoe.rohde-schwarz.com

South Africa
Protea Data Systems (Pty.) Ltd.
Communications and Measurement Division
Private Bag X19
Bramley 2018
+27 (11) 719 57 00
+27 (11) 786 58 91
unicm@protea.co.za

South Africa
Protea Data Systems (Pty.) Ltd.
Cape Town Branch
Unit G9, Centurion Business Park
Bosmandam Road
Milnerton
Cape Town, 7441
+27 (21) 555 36 32
+27 (21) 555 42 67
unicm@protea.co.za

Spain
ROHDE & SCHWARZ ESPANA S.A.
Salcedo, 11
28034 Madrid
+34 (91) 334 10 70
+34 (91) 329 05 06
rses@rses-rohde-schwarz.com

Sri Lanka
LANKA AVIONICS
658/1/1, Negombo Road
Mattumagala
Ragama
+94 (1) 95 66 78
+94 (1) 95 83 11
lankavio@sltnet.lk

Sudan
SolarMan Co. Ltd.
P.O.Box 11 545
North of Fraouq Cementry 6/7/9 Bldg. 16
Karthoum
+249 (11) 47 31 08
+249 (11) 47 31 38
solarman29@hotmail.com

Sweden
ROHDE & SCHWARZ SVERIGE AB
Marketing Div.
Flygfältsgatan 15
128 30 Skarpnäck
+46 (8) 605 19 00
+46 (8) 605 19 80
info@rss.se

Switzerland
Roschi Rohde & Schwarz AG
Mühlestr. 7
3063 Ittigen
+41 (31) 922 15 22
+41 (31) 921 81 01
sales@roschi.rohde-schwarz.com

Syria
Electro Scientific Office
Baghdad Street
Dawara Clinical Lab. Bldg
P.O.Box 8162
Damascus
+963 (11) 231 59 74
+963 (11) 231 88 75
memo@hamshointl.com

Taiwan
Lancer Communication Co. Ltd.
for Div. 1 and 7
16F, No. 30, Pei-Ping East Road
Taipei
+886 (2) 23 91 10 02
+886 (2) 23 95 82 82
info@lancercomm.com.tw

Taiwan
System Communication Co. Ltd.
for Div. 2 and 8
16F, No. 30, Pei-Ping East Road
Taipei
+886 (2) 23 91 10 02
+886 (2) 23 95 82 82
info@lancercomm.com.tw

Tanzania
SSTL Group
P.O. Box 7512
Dunga Street Plot 343/345
Dar es Salaam
+255 (22) 276 00 37
+255 (22) 276 02 93
sstl@twiga.com

Thailand
Schmidt Electronics (Thailand) Ltd.
63 Government Housing Bank Bldg.
Tower II, 19th floor, Rama 9 Rd.
Huaykwang, Bangkapi
Bangkok 10320
+66 (2) 643 13 30 to 39
+66 (2) 643 13 40
kamthoninthuyot@schmidtthailand.com

Thailand
TPP Operation Co., Ltd.
41/5 Mooban Tarinee
Boromrajchonnee Road
Talingchan, Bangkok 10170
+66 (2) 880 93 47
+66 (2) 880 93 47
thipsukon@tpp-operation.com

Trinidad &Tobago
siehe / see Mexico

Tunisia
TELETEK
71, Rue Alain Savary
Residence Alain Savary (C64)
1003 Tunis

Turkey
ROHDE & SCHWARZ International GmbH
Liaison Office Istanbul
Bagdad Cad. 191/3, Arda Apt. B-Blok
81030 Selamicesme-Istanbul
+90 (216) 385 19 17
+90 (216) 385 19 18
rsturk@superonline.com

Ukraine
ROHDE & SCHWARZ
Representative Office Kiev
4, Patris Loumoumba ul
01042 Kiev
+38 (044) 268 60 55
+38 (044) 268 83 64
rohdeukr@rsoe.rohde-schwarz.com

United Arab Emirates
ROHDE & SCHWARZ International GmbH
Liaison Office Abu Dhabi
P.O. Box 31156
Abu Dhabi
+971 (2) 633 56 70
+971 (2) 633 56 71
michael.rogler@rsd.rohde-schwarz.com

Adressen/Addresses

United Arab Emirates	ROHDE & SCHWARZ Bick Mobile Communication P.O.Box 17466 Dubai	+971 (4) 883 71 35 +971 (4) 883 71 36 www.rsbick.de
United Arab Emirates	ROHDE & SCHWARZ Emirates L.L.C. Ahmed Al Nasri Building, Mezzanine Floor, P.O.Box 31156 Off old Airport Road Behind new GEMACO Furniture Abu Dhabi	+971 (2) 631 20 40 +971 (2) 631 30 40 rsuaeam@emirates.net.ae
United Kingdom	ROHDE & SCHWARZ UK Ltd. Ancells Business Park Fleet Hampshire GU 51 2UZ England	+44 (1252) 81 88 88 (sales) +44 (1252) 81 88 18 (service) +44 (1252) 81 14 47 sales@rsuk.rohde-schwarz.com
Uruguay	AEROMARINE S.A. Cerro Largo 1497 11200 Montevideo	+598 (2) 400 39 62 +598 (2) 401 85 97 mjn@aeromarine.com.uy
USA	ROHDE & SCHWARZ, Inc. Broadcast & Comm. Equipment (US Headquarters) 7150-K Riverwood Drive Columbia, MD 21046	+1 (410) 910 78 00 +1 (410) 910 78 01 rsatv@rsa.rohde-schwarz.com rsacomms@rsa.rohde-schwarz.com
USA	Rohde & Schwarz Inc. Marketing & Support Center / T&M Equipment 2540 SW Alan Blumlein Way M/S 58-925 Beaverton, OR 97077-0001	+1 (503) 627 26 84 +1 (503) 627 25 65 info@rsa.rohde-schwarz.com
USA	Rohde & Schwarz Inc. Systems & EMI Products 8080 Tristar Drive Suite 120 Irving, Texas 75063	+1 (469) 713 53 00 +1 (469) 713 53 01 info@rsa.rohde-schwarz.com
Venezuela	EQUILAB TELECOM C.A. Centro Seguros La Paz Piso 6, Local E-61 Ava. Francisco de Miranda Boleita, Caracas 1070	+58 (2) 12 34 46 26 +58 (2) 122 39 52 05 r_ramirez@equilabtelecom.com
Venezuela	REPRESENTACIONES BOPIC S.A. Calle C-4 Qta. San Jose Urb. Caurimare Caracas 1061	+58 (2) 129 85 21 29 +58 (2) 129 85 39 94 incotr@cantv.net
Vietnam	Schmidt Vietnam Co., (H.K.) Ltd., Representative Office in Hanoi Intern. Technology Centre 8/F, HITC Building 239 Xuan Thuy Road Cau Giay, Tu Liem Hanoi	+84 (4) 834 61 86 +84 (4) 834 61 88 svnhn@schmidtgroup.com
West Indies	siehe / see Mexico	
	GEDIS GmbH Sophienblatt 100 Postfach 22 01 24021 Kiel	+49 (431) 600 51-0 +49 (431) 600 51-11 sales@gedis-online.de

Table of Contents

Figs.

1 Putting into Operation

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

Unpacking the sensor

Remove the sensor 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 sensor is to be shipped or transported at a later date.

The sensor 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 sensor.

Connecting the sensor

To prevent EMI, the sensor 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 sensor.

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.).

Operation with the R&S NRP basic unit

Connecting the sensor to the R&S NRP basic unit

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

Connecting the sensor to the DUT

The sensor R&S NRP-Z91 has a male N connector and so can be connected to any standard female N connector. Using light pressure, and keeping the male N connector perpendicular, insert it into the female N connector and tighten the N connector locking nut (right-hand thread).

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.

As the sensor is a *high-power device*, there is no guarantee that it can be powered from all types of laptop or notebook in the *bus-powered* mode. To be sure, you should determine the current at the USB connectors beforehand:

- *In the Windows™ start menu, select **Settings – Control Panel***
- *Select the **System** icon*
- *Select the **Hardware** tab*
- *By clicking on the button with that name, start the **Device Manager***
- *Open **USB Controller** (all USB controllers, hubs and USB devices are listed here)*
- *Double-click on **USB Root Hub** or select **Properties*** in the context menu *(use the right-hand mouse button)*
- *Select the **Power** tab (Fig. 1-1). If the hub is self-powered and the total power available is, as indicated by **Hub Information,** 500 mA per port, high-power devices can be connected.*

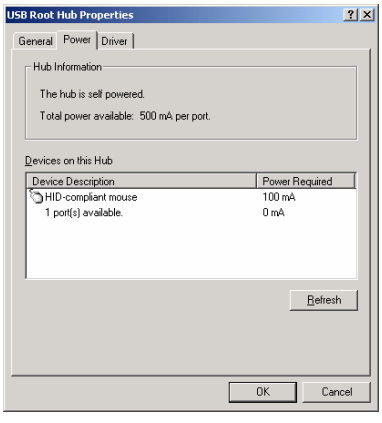


Fig. 1-1 Displaying the total available power of a USB port

If you have any doubts, ask the manufacturer if the USB port on your laptop or notebook can handle *high-power devices*.

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

Fig. 1-2 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.

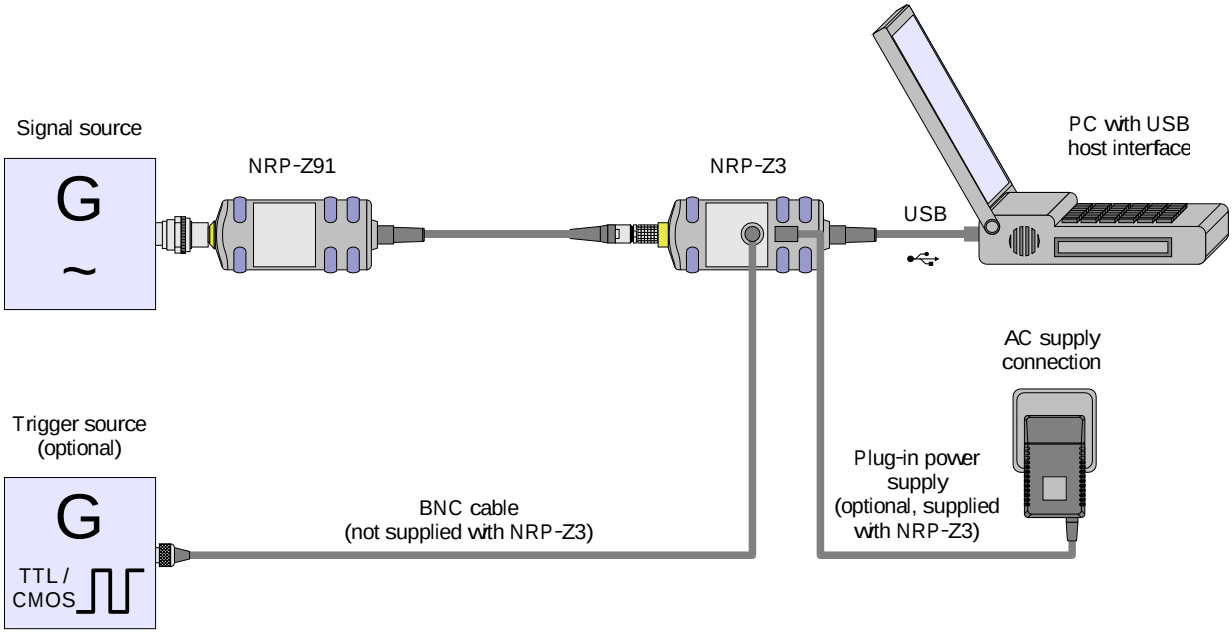


Fig. 1-2 Configuration with Active USB Adapter R&S NRP-Z3

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 autosets 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. 1-3).

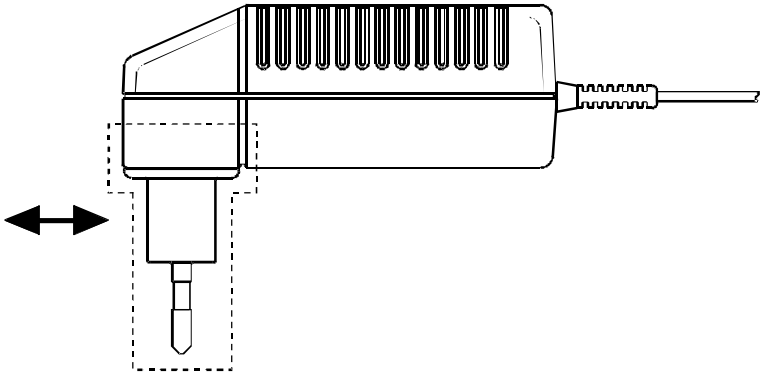


Fig. 1-3 Changing the primary adapter

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.

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. 1-4 is a schematic of the measurement setup. The order in which the cables are connected is not critical.

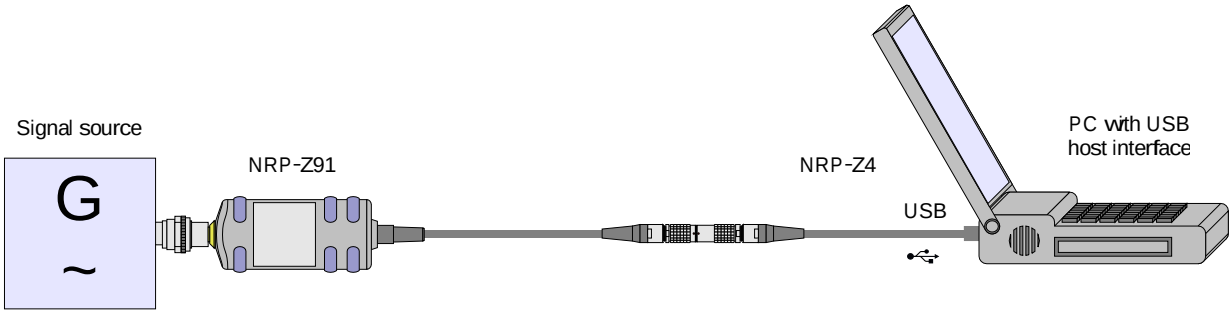


Fig. 1-4 Configuration with Passive USB Adapter R&S NRP-Z4

Connecting the sensor to the DUT

See the section “Operation with the R&S NRP” for information on how to connect the sensor to the DUT.

Table of Contents

Figs.

Tables

2 Virtual Power Meter

You will find the **NrpFlashup** program for controlling sensors with a PC under Windows™ on the CD-ROM that accompanies the sensor. 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, the user can measure the average power of modulated signals.

The other modules in **NrpFlashup** are described in Chapter 3 of the operating manual (**Terminal** and **Update S-Parameters** modules) 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).

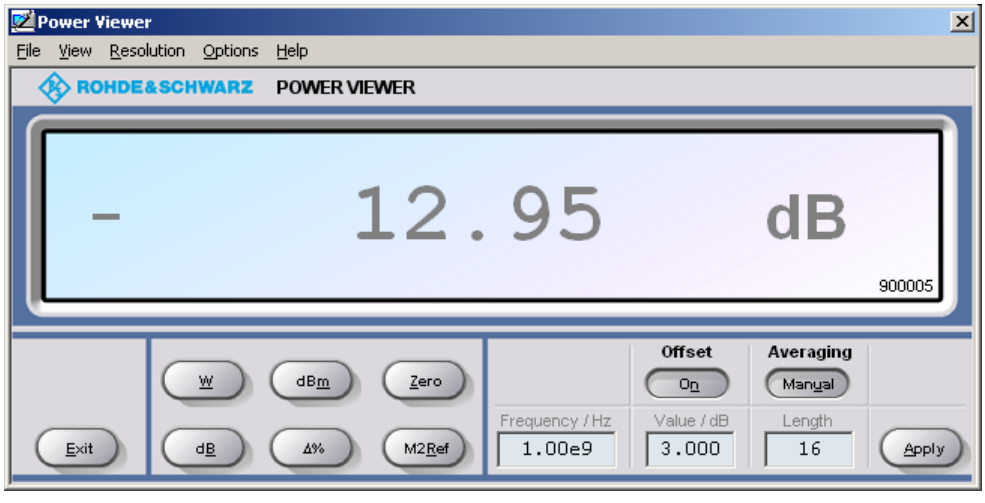


Fig. 2-1 **Power Viewer –** virtual power meter

The result display occupies most of the program window. The result, unit and additional sensor 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 sensor.	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 offset correction for the sensor 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 twoport connected to the sensor. 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 sensor 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)`

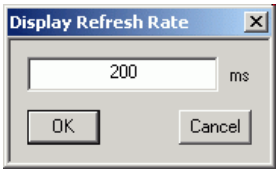
Stop Log

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

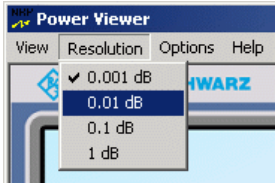
Result
Unit
Edit
Button

Opens a dialog box to select the background colour for

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

Resolution

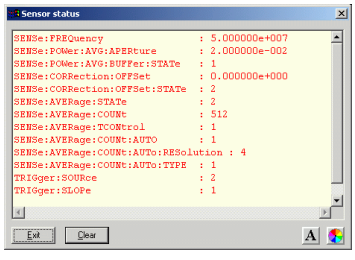
For setting the result resolution. If auto-averaging has been selected, a higher resolution leads to a greater averaging factor, which means a longer result settling time.



Options

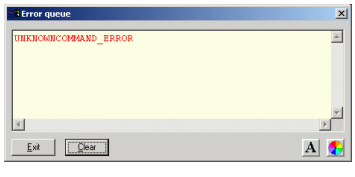
Read Sensor Status ...

Reads the current sensor status. 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 ...	For trying out the functions of the virtual power meter without actually connecting a sensor. 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 sensor. 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.

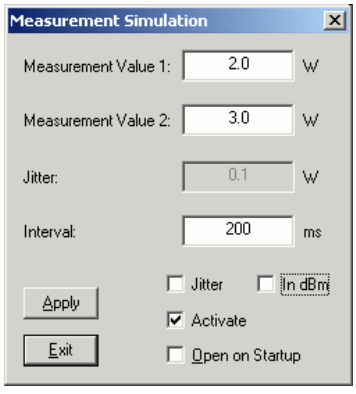


Table of Contents

Figs.

Tables

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 of almost any modulation. 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 sensor and for displaying measurement results, status information and other data from the sensor
- **Firmware Update**: Program module for updating the sensor firmware
- **Update S-Parameters**: Program module for loading an s-parameter table into the sensor

Program module “Terminal”

Main control elements

With the USB terminal, commands and command sequences can be sent to the sensor 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.

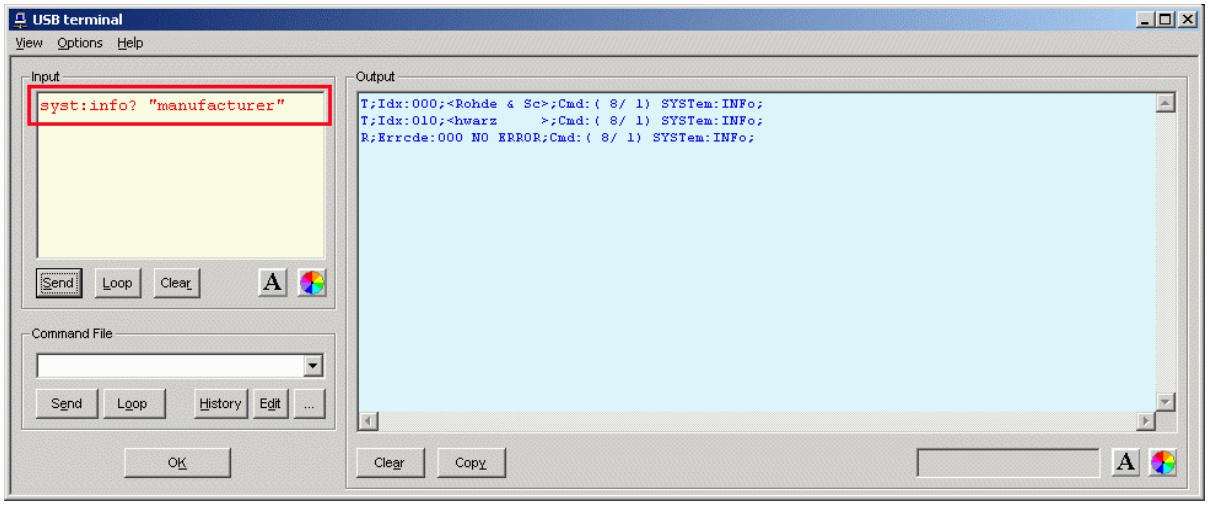


Fig. 3-1 Sending commands using the **Input** field

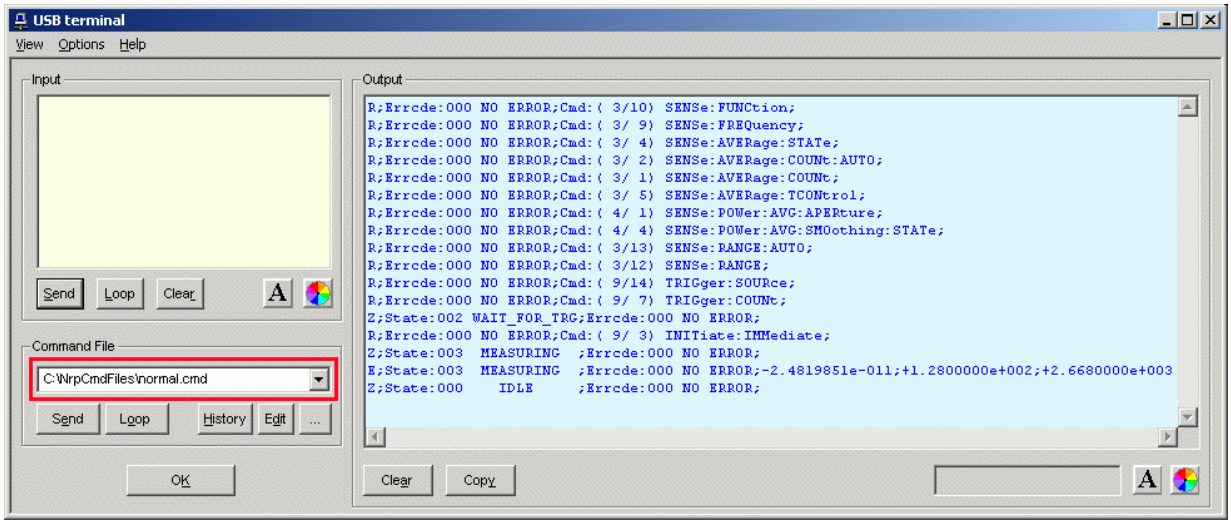


Fig. 3-2 Sending commands using command files

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

Button	**Function**	**Key combination**
Send	Sends the content of the **Input** entry field to the sensor.	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 sensor.	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 sensor.

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

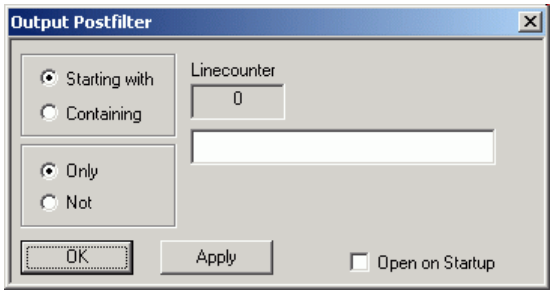
Table 3-3 Buttons assigned to the **Output** field

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 possiblity: 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.

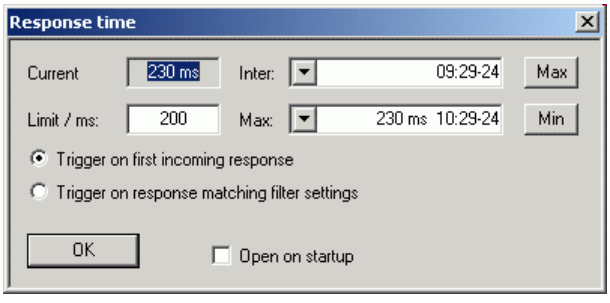
Not + **Containing**: Only lines not containing the entered character string are displayed.

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 sensor can be set.



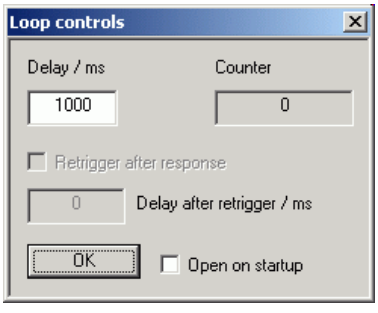
Current indicates the time elapsed between dispatch of the last command and receipt of an acknowledgement from the sensor. When the **Max** button is clicked, the response times exceeding the value in the **limit / ms** field are recorded. When the **Min** button is clicked, the response times within 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.

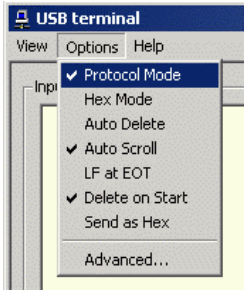
Auto Delete With this option active, the **Output** field is automatically cleared when the **Send** button is pressed.

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.

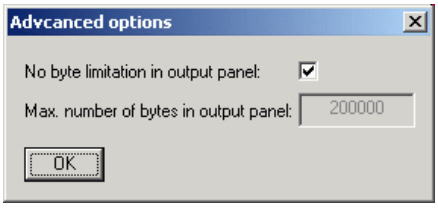
LF at EOT With this option active, a line feed is appended to each response block from the sensor.

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.

Program module "Update S-Parameters"

Fundamentals

With the sensor R&S NRP-Z91 the influence of any twoport connected to the input on the measurement result can be corrected by way of calculation. A precondition is that a complete set of s-parameters of the twoport is available in the frequency range in question. The set of calibration data in the R&S NRP-Z91 therefore includes an s-parameter table with up to 1000 measurement frequencies. The real and the imaginary part of each frequency as well as the uncertainty of s-parameters s_{11}, s_{12}, s_{21} and s_{22} can be stored. Since the measurement frequencies in the s-parameter table are independent of the calibration frequencies, they can be set so that the twoport frequency range of interest is optimally covered. The real and the imaginary parts between these measurement frequencies are linearly interpolated, while the more substantial measurement uncertainty at the two neighbouring frequency points is used for calculating the uncertainty of the measurement result. Below the first and above the last measurement frequency, the values of the first and the last measurement frequency are used, respectively.

The program module "Update S-Parameters" is used for loading an s-parameter table. To ensure compatibility with a great number of network analyzers, measurement data files in S2P format can be processed. All standard frequency units (Hz, kHz, MHz, GHz) and display formats (real and imaginary part, linear magnitude and phase, magnitude in dB and phase) are supported. The only restriction is that a reference impedance of 50 Ω must be used for the s-parameters. Other noise parameters in the measurement data file are not evaluated.

Structure of the S2P measurement data file:

1. The *option line* has the following format:
   # [<frequency unit>] [<parameter>] [<format>] [<R n>]
   # identifies the *option line*.
   The <frequency unit> may be Hz, kHz, MHz or GHz. If a frequency unit is not specified, GHz is implicitly assumed.
   If a parameter is specified, S must be used in <parameter> for s-parameter files. If a parameter is not specified, S is implicitly assumed.
   The <format> may be MA (linear magnitude and phase in degree), DB (magnitude in dB, phase in degree) or RI (real and imaginary part). If a format is not specified, MA is implicitly assumed.
   R is optional and followed by the reference impedance in Ω. If an entry is made for R, R50 must be specified. If no entry is made, R50 is implicitly assumed.
   The *option line* should therefore read:
   # [HZ | KHZ | MHZ | GHZ] [S] [MA | DB | RI] [R 50]

2. The measurement frequencies in ascending order are specified as follows:
   $f_i \;\; s_{11}(f_i) \;\; s_{21}(f_i) \;\; s_{12}(f_i) \;\; s_{22}(f_i)$,
   where $s_{jk}(f_i)$ is the display format as specified in the *option line.*

   $|s_{jk}(f_i)| \;\; \arg s_{jk}(f_i)$ (display format for linear magnitude and phase in degree) or

   $20 \cdot \lg|s_{jk}(f_i)| \;\; \arg s_{jk}(f_i)$ (display format for magnitude in dB and phase in degree)

   $\mathrm{Re}\lfloor s_{jk}(f_i)\rfloor \;\; \mathrm{Im}\lfloor s_{jk}(f_i)\rfloor$ (display format for real and imaginary part)

3. Comments: Any line starting with an exclamation mark (!) is interpreted as a comment line.

To characterize the measurement uncertainty of the s-parameter test system, another data file can optionally be created. Without this file, the measurement uncertainty cannot be correctly calculated in the sensor. The syntax of the uncertainty data file is similar to that of the S2P data file but U is specified as <Parameter> in the *option line* so that the *option line* reads # Hz U for frequencies in Hz.
The measurement frequencies must not be identical to those of the S2P measurement data files. In most cases a few entries will be sufficient to characterize the measurement uncertainty of the s-parameter test system. An s-parameter uncertainty as high as that of the neighbouring measurement frequencies of the uncertainty data file is then selected. If different values are available, the higher one is chosen. This is illustrated in the example below:

Table 3-4 Uncertainties of the s-parameter test system (example)

***f* in GHz**	**unc [$s_{ik}(f)$]**
0.1	0.01
1.0	0.01
1.1	0.005
10.0	0.005
10.1	0.01
40.0	0.01

Table 3-5 Interpolated uncertainties of measurement frequencies for s-parameters (example)

***f* in GHz**	**unc [$s_{ik}(f)$]**
0.9	0.01
0.95	0.01
1.0	0.01
1.05	0.01
1.1	0.005
1.15	0.005
1.2	0.005

At 1.05 GHz, the higher uncertainty of the two adjacent 1.0 GHz and 1.1 GHz measurement frequencies is entered in the s-parameter table. If an uncertainty of 0.005 is desired for all frequencies above 1.0 GHz, the first measurement frequency in the uncertainty data file must above 1.0 GHz, e.g. 1.000001 GHz.

Structure of the uncertainty data file:

1. The *option line* has the following format:
   # [<frequency unit>] <parameter> [<format>] [<R n>]
   # identifies the *option line*.
   The <frequency unit> may be Hz, kHz, MHz or GHz. If a frequency unit is not specified, GHz is implicitly assumed.
   U must be specified for <parameter> in uncertainty data files. If a parameter is not specified, S is implicitly assumed and as a result an error message is triggered.
   <format> is ignored in uncertainty measurement files; the entry is therefore irrelevant.
   R is optional and followed by the reference impedance in Ω. If an entry is made for R, R50 must be specified. If no entry is made, R50 is implicitly assumed.
   The *option line* should therefore read:
   # [HZ | KHZ | MHZ | GHZ] U [MA | DB | RI] [R 50]

2. Measurement frequencies in ascending order are specified in the following form:
   $f_i \;\; \mathrm{unc}\left[s_{11}(f_i)\right] \;\; \mathrm{unc}\left[s_{21}(f_i)\right] \;\; \mathrm{unc}\left[s_{12}(f_i)\right] \;\; \mathrm{unc}\left[s_{22}(f_i)\right].$
   The s-parameters uncertainties are forwarded as follows:
   - as extended absolute uncertainties ($k = 2$) for the magnitude of reflection parameters s_{11} and s_{22}, for instance 0.015,
   - as extended uncertainties ($k = 2$) in dB for the magnitude of transmission parameters s_{21} and s_{12}, for instance 0.015.

3. Comments: Any line starting with an exclamation mark (!) is interpreted as a comment line.

Two additional values must be specified when the s-parameters are loaded: the lower and the upper nominal measurement limit of the sensor-twoport combination. If s-parameter correction is active, these values are transferred by the sensor in response to SYSTem:INFO? The values cannot always be derived from the lower or upper measurement limit of the sensor alone and from the loss or gain of the preconnected twoport. The upper measurement limit of the sensor-twoport combination may also be limited by the twoport's maximum power-handling capacity. Furthermore, the lower measurement limit may be raised not only by the loss but also by the inherent noise of the twoport. For this reason, the program module "Update S-Parameters" allows these values to be entered.

The upper nominal measurement limit of the sensor-twoport combination entered when loading the s-parameters should be carefully specified, as automatic test systems may evaluate it and an incorrect value may cause the sensor and/or the twoport to be overloaded.

Procedure

To load an s-parameter table into the calibration set of the sensor, proceed as follows:

1. Connect the sensor to the USB port of the PC and start the program module **Update S-Parameters**. The corresponding dialog window is opened (Fig. 3-3).
2. Make sure **Keep Current S-Parameter Data** is deactivated.
3. Under **S-Parameter File** enter the search path and the name of the S2P file containing the parameters. Press the **Browse**... button to open a file-opening dialog where the S2P measurement data file can be easily selected.
4. Under **Uncertainty File** enter the search path and the name of the measurement uncertainty file containing the measurement uncertainty of the s-parameter test system. Press the **Browse**... button to open a file-opening dialog where the measurement uncertainty file can be easily selected.
5. Enter the upper and lower nominal measurement limit of the sensor-twoport combination in the **Lower Power Limit** and **Upper Power Limit** fields**.**
6. Enter a name for the loaded s-parameter set in the **S-Parameter Device Mnemonic** field. This name can later be queried with *SYSTem:INFO? "SPD Mnemonic"* and is displayed on the NRP basic unit when s-parameter correction is switched on.
7. Activate **S-Parameter Correction on by Default** if the *SENSe:CORRection:SPDevice:STATe* switch should be automatically set to *ON* when the sensor is put into operation.
8. Press **Start** for loading. (The dialog is closed with **OK** and the set parameters are retained. When the dialog is exited with **Cancel**, all parameter modifications are ignored.)

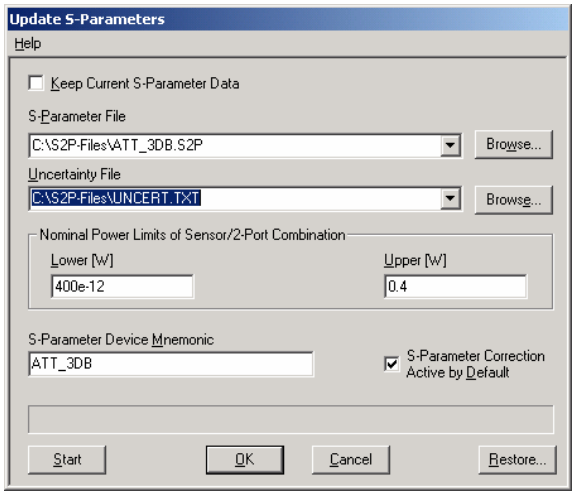


Fig. 3-3 Dialog window for loading an s-parameter table

During loading, the current calibration data set of the sensor is overwritten. To be on the safe side, a backup copy of the current calibration data set is therefore automatically stored before s-parameters are loaded. The names of the backup files have the structure <batch number>_<date><time>.bak, where <batch number> is the batch number of the sensor, <date> the date of the s-parameter update in yymmdd format and <time> the time of the s-parameter update in the format hhmmss.

Store the automatically created backup files on a separate data medium (e.g. diskette, CD-ROM or network drive) and, if required, assign a meaningful name to them to simplify reloading. With the aid of these files, a previously used calibration data set of the sensor can be restored.

To reload the backup file of a calibration data set into the sensor, proceed as follows:

1. Press the **Restore...** button. The **Restore S-Parameters** window is opened (Fig. 3-4).
2. Enter the search path and the name of the backup file in the **Backup File** field. Press the **Browse**... button to open a dialog where the backup file can be easily selected.
3. Press **OK** to start the restore procedure. (With **Cancel** the dialog window is exited without data being restored).

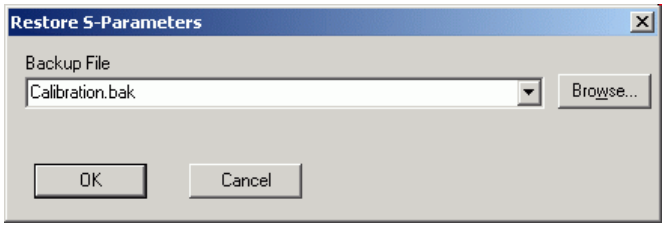


Fig. 3-4 Dialog window for loading the backup file of a calibration data set

To be able to determine if the s-parameter correction is active after plugging in or resetting the sensor, proceed as follows:

1. Connect the sensor to the USB port of the PC and start the program module **Update S-Parameters**.
2. Make sure **Keep Current S-Parameter Data** is activated (Fig. 3-5).
3. Activate **S-Parameter Correction on by Default** if the *SENSe:CORRection:SPDevice:STATe* switch should be automatically set to *ON* when the sensor is put into operation, otherwise deactivate it.
4. Press **Start** for loading.

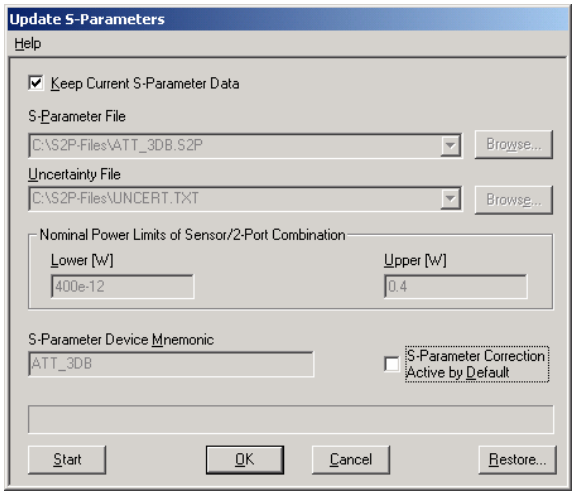


Fig. 3-5 Subsequently changing the default behaviour of the s-parameter correction

Table of Contents

5 Remote Control – Fundamentals

Rohde & Schwarz recommends to utilize the VXI Plug & Play Driver for the remote control of R&S NRP power sensors. 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.

Table of Contents

Tables

6 Remote Control – Commands

Notation

In the following sections, all commands implemented in the sensor 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
- 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 sensor identification string 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 sensor 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 sensor's identity (device identification code). In addition, the version number of the installed firmware is indicated. The string for a sensor of type R&S NRP-Z51 has the following structure:

ROHDE&SCHWARZ,NRP-Z51,<serial number>,<firmware version>

<*serial number*>: Serial number in ASCII
<*firmware version*>: Firmware version number in ASCII

*RST – Reset

**RST* sets the sensor 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 sensor 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 sensor R&S NRP-Z91 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 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* zeroes the three measurement paths of the sensor. For this purpose, the test signal must be deactivated or the sensor disconnected from the signal source. The sensor automatically detects the presence of any significant power to be measured. This causes zeroing to be aborted and error message *NRPERROR_CALZERO* to be output. The command *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 sensor 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 sensor 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 sensor. Initialization by means of **RST* or *SYSTem:INITialize* has no influence on the current zero offsets.

SENSe (Sensor Configuration)

The sensor 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		
:SPDevice:STATe[?]	OFF to ON		
:FREQuency[?]	9.0e3 to 6.0e9	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	

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.

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 sensor (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, dBµV 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 sensor calculates the signal pulse power from this value and the mean power. Since the duty cycle is only useful in the *Continuous Average* mode, it is evaluated only there.

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 sensor or the coupling attenuation of a directional coupler is taken into account with a positive offset, i.e. the sensor 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:CORRection:SPDev:STATe[?] OFF | ON

SENSe:CORRection:SPDevice:STATe ON activates the s-parameter data set for a component (attenuator, directional coupler) connected ahead of the sensor. Parameter *OFF* deactivates it.

The use of s-parameters instead of a fixed offset (see group of commands *SENSe:CORRection :OFFSet*) allows more precise measurements, since the interactions between the sensor, the source and components connected between them can be taken into account. (For detailed information on loading s-parameter data sets, refer to section 3.) The sensor has no factory-set s-parameter data set. In this state, the *SENSe:CORRection:SPDevice:STATe ON* command generates an error message.

The query yields
- *1* for *OFF,*
- *2* for *ON.*

Default setting:
The factory-set default setting of the sensor is *OFF*. On loading an s-parameter table, the default setting can be redefined (see section 3).

SENSe:FREQuency[?] 9.0e3 to 6.0e9

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, the R&S NRP-Z91 only implements 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"	**Continuous Average** After occurrence of the trigger event, the mean power is measured in a time interval (sampling window) whose width is defined with SENSe:POWer:AVG:APERture. 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 × <SENSe:AVERage:COUNt> × <SENSe:POWer:AVG:APERture> and with deactivated averaging function 2 × <SENSe:POWer:AVG:APERture>. Trigger events start one or several measurements in the Continuous Average mode (depending on the TRIGger:COUNt parameter).

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 × modulation period / 2
ON	N × modulation period × 2

The theoretically shortest measurement time can then be obtained only with smoothing deactivated. As the number of modulation periods that fit into a sampling window increases, the issue of whether N is an integer becomes more critical. With smoothing activated, approx. 5 periods are 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 sensor 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 sensor 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 initiates the use of the complex reflection coefficient of the source defined with *SENSe:SGAMma:MAGNitude* and *SENSe:SGAMma:PHASe* for the correction of interactions between the sensor, the source and the components connected between them (*see SENSe:CORRection:SPDevice:STATe*). This compensates for the source mismatch, which often largely contributes to measurement uncertainty.

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 [°]*

SYSTem

With the aid of the *SYSTem* system, administrative device settings can be defined and queried. This includes detailed information on the sensor 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 sensor 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-Z91"	Type designation
"STOCK NUMBER"	"1168.8004.02"	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 sensor firmware
"TECHNOLOGY"	"3 Path Diode"	Detector technology used
"FUNCTION"	"Power Terminating"	The R&S NRP-Z91 is a terminating power sensor.

Item	Information string	Remarks
"MINPOWER"	"<nominal lower test limit in W>"	The nominal lower test limit of the R&S NRP-Z91 is 200 pW, i.e. with s-parameter correction deactivated, the sensor returns the information string "2e-10" as a response to *SYSTem:INFo? "MINPOWER"*. With s-parameter correction activated, the information string depends on the nominal lower limit of the sensor/twoport combination.
"MAXPOWER"	"<nominal upper test limit in W>"	The nominal upper test limit of the R&S NRP-Z91 is 200 mW, i.e. with s-parameter correction deactivated, the sensor returns the information string "0.2" as a response to *SYSTem:INFo? "MAXPOWER"*. With s-parameter correction activated, the information string depends on the nominal upper limit of the sensor/twoport combination.
"MINFREQ"	"<min. measuring frequency in Hz>"	The minimum measuring frequency of the R&S NRP-Z91 is 9 kHz, i.e. the sensor returns the information string "9000" as a response to *SYSTem:INFo? "MINFREQ"*.
"MAXFREQ"	"<max. measuring frequency in Hz>"	The maximum measuring frequency is 6 GHz for the R&S NRP-Z91, i.e. the sensor returns the information string "6e+10" as a response to *SYSTem:INFo? "MAXFREQ"*.
"IMPEDANCE"	"50"	The R&S NRP-Z91 RF input has a nominal input impedance of 50 Ω.
"COUPLING"	"AC/DC"	The RF input of the R&S NRP-Z91 is DC-coupled, but DC voltages superimposed on the RF signal are suppressed by the measurement amplifier.
"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 reflection-coefficient calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned with an invalid date entry.
"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 components connected ahead of the sensor.

SYSTem:INITialize

SYSTem:INITialize sets the sensor to the standard state, i.e. the default settings for all test parameters are loaded in the same way as with **RST*. The sensor 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 sensor or the combination comprising the sensor and components connected ahead of it, if the *SENSe:CORRection:SPDevice* parameter has the *ON* value. 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 sensor. In contrast to **TST*, this command yields detailed information, which is useful for troubleshooting.

No signal may be applied to the sensor 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 sensor to the *IDLE* state (normal case). However, if the sensor is in the continuous measurement mode (setting *INITiate:CONTinuous ON*), the *IDLE* state is immediately exited and the sensor 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 sensor 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 sensor 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 sensor 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 sensor 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 sensor 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 sensor has settled. This is important primarily with this sensor and thermal sensors. 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 auto-delay function takes delays within the sensor into account, so long as the level change is not greater than 10 dB. In the case of greater level changes, particularly abrupt jumps from high to low powers immediately before the trigger point, the *TRIGger:DELay* function must be used to provide a longer delay so that the specified accuracy can be attained.

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 sensor 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 = 500 × <lower test limit>
y = <upper test limit >

SENSe:CORRection:OFFSet:STATe ON: x = 500 × <lower test limit> × 10^(<*SENSe:CORRection:OFFSet*> / 10)
y = < upper test limit > × 10^(<*SENSe:CORRection:OFFSet*> / 10)

<lower test limit>: 200.0e-12 (with *SENSe:CORRection:SPDevice:STATe OFF*) or entered lower test limit of sensor/twoport combination (with *SENSe:CORRection:SPDevice:STATe ON*)

<upper test limit>: 0.2 (with *SENSe:CORRection:SPDevice:STATe OFF*) or entered upper test limit of sensor/twoport combination (with *SENSe:CORRection:SPDevice:STATe ON*)

Default setting: 10 × 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 of the R&S NRP-Z91 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:SPDev:STATe[?]	OFF | ON		OFF (can be modified by the user)	6.9
SENSe:FREQuency[?]	9.0e3 to 6.0e9	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	6.20
TRIGger:SLOPe[?]	POSitive | NEGative		POSitive	6.20
TRIGger:SOURce[?]	BUS | EXTernal | HOLD | IMMediate | INTernal		IMMediate	6.20
SERVice Commands				
SERVice:CALibration:DITHer	ONCE		OFF	
SERVice:CALibration:DITHer:DATA?			0	
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:CALibration:ZERO:NEG1?			3	
SERVice:CALibration:ZERO:POS1?			4	
SERVice:CALibration:ZERO:NEG2?			5	
SERVice:CALibration:ZERO:POS2?			6	
SERVice:MVCorrection[?]	0 to 63		63	
SERVice:PARameter:RTEMp[?]	<float value>	K	0.0	
SERVice:PARameter:RNULL0[?]	<float value>	Ω	0.0	
SERVice:PARameter:RNULL1[?]	<float value>	Ω	0.0	
SERVice:PARameter:RNULL2[?]	<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	

Command	Parameter	Unit	Default setting	Page
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			

ROHDE&SCHWARZ

Test and Measurement
Division

Service Instructions R&S NRP-Z91

1168.8604.82

Table of Contents

4 Firmware Update

Chapter 4 provides information on the firmware update. Descriptions enclosed with the firmware update can be filed here.

Installation of New R&S NRP-Z91 Firmware

Use the Firmware Update program module to load new firmware for the Power Sensor R&S NRP-Z91. The module is part of the R&S NRP Toolkit that is supplied on a CD-ROM together with the power sensors and enables you to update the boot loader and the application firmware.

The current firmware versions can be downloaded from the R&S homepage on the Internet, since the CD-ROM accompanying the power sensors contains the firmware status at the time of delivery.

Hardware and software requirements

The system requirements for a firmware update are the same as for the operation of the power sensor on a PC (an update via the power meter is not possible):

- PC with free USB port.
- USB Interface Adapter R&S NRP-Z3 or R&S NRP-Z4.
- Operating system Windows™ 98, Windows™ ME, Windows™ 2000, or Windows™ XP.
- **The R&S NRP Toolkit software must already be installed on your PC.**
- One of the following files must be selected (depending on the software component to be updated):
  - `<Type>_Sensor<Version Number>.nrp` Application
  - `Bootloader_<Version Number>.nrp`, Boot loader

  The files are available in the \software\firmware\sensors directory of the CD-ROM.

Preparation

- Connect the R&S NRP power sensor to the PC using one of the two USB interface adapters.
- If a second R&S NRP-Z power sensor or an R&S NRP is connected to the PC, unplug these devices from the PC.
- Shortly afterwards, the PC should have identified the new USB hardware and assigned the appropriate driver from the **R&S NRP Toolkit** to the power sensor (brief message in a small window).

If you forgot to install the R&S NRP Toolkit beforehand, Windows will try in vain to find a USB driver for the power sensor. If this happens, the R&S NRP-Zxx is highlighted by a yellow exclamation mark in the Windows device manager. In this case, proceed as follows:

- *Abort the dialog for driver installation.*
- *Install the R&S NRP Toolkit from the CD-ROM.*
  Then manually assign the USB driver from the toolkit to the power sensor.
- *Go to Control Panel – Add/Remove Hardware and start the hardware assistant to search for new components.*
- *Mark the R&S NRP-Zxx in the list of hardware components and complete the driver installation.*
- *Unplug the power sensor and reconnect it.*

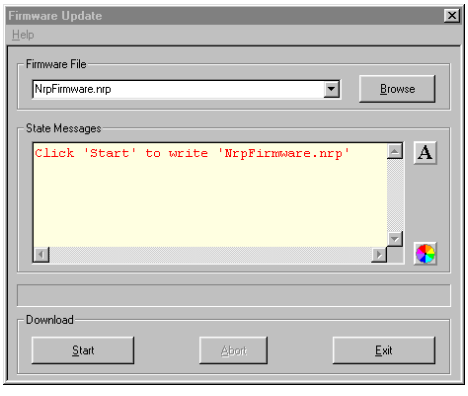
Updating the application firmware

The update can be started as follows:

➢ Either double-click the icon of the update file named `<Type>_Messkopf_<Version Number>.nrp`

➢ Or start **NRP Toolkit – Firmware Update** from the Windows Start menu.

The dialog box on the left is displayed next.

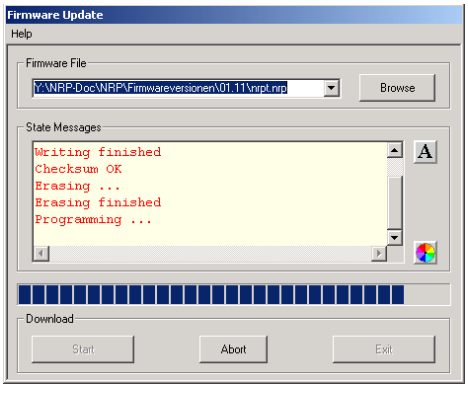


➢ If the update was started via the Windows Start menu, enter the file name of the application firmware in the **Firmware File** box (or search for the name by using the **Browse** button).

➢ Click the **Start** button to start the file transfer, which is performed automatically.

➢ Observe the following:

- *Do not disconnect the power sensor from the PC.*
- *Neither connect nor disconnect the power supply for the R&S NRP-Z3 adapter.*
- *Exit the Firmware Update program only after it has been completely executed.*



➢ During the update, the State Messages box informs you of the progress. The update has been completed successfully if the message `'Device <Type Designation><Serial Number> is active'` appears.

➢ You can then use the power sensor for measuring.

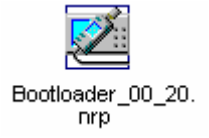
Potential problems

- Error in the compatibility and consistency checks.

  In this case, the update is aborted and an error message is output.

➢ Unplug the power sensor, reconnect it and start the update again.

Updating the boot loader



The boot loader update is similar to the update of the application firmware (see above).

➢ Instead of the application, however, you must load the new boot loader named

`Bootloader_<Version Number>.nrp`

Strictly observe the warnings under "Updating the application firmware", since the destruction of the boot loader will generally require a repair of the power sensor.

Potential problems

- The power sensor cannot be accessed after the update (error message).

➢ Exit the Firmware Update program, unplug the power sensor from the PC and reconnect it. The power sensor is now ready for operation.