Manual

Thermal Power Sensor

R&S® NRP-Z51

DC to 18 GHz / 1 µW to 100 mW

1138.0005.02

R&S® NRP-Z55

DC to 40 GHz / 1 µW to 100 mW

1138.2008.02

Dear Customer,

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Operation of Power Sensor R&S NRP-Z5x from R&S NRP base unit

The power sensor shipped with this manual has firmware revision **01.00** or higher. For operation from an R&S NRP base unit, all software components within the base unit must also be of revision **02.00** or higher.

Revision numbers for the software components installed in the base unit can be displayed under menu item 'System Info', lines 'Main Program', 'Bootloader' and 'Keybd. Ctrl.'. The 'System Info' can be found in the 'File' menu for revision numbers lower than 02.00 and in the 'System' menu otherwise.

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Technical Information

Power Sensors R&S NRP-Z51, -Z55

Thermoelectric accuracy at its best

The new power sensors for the frequency ranges DC to 18 GHz (R&S NRP-Z51) and DC to 40 GHz (R&S NRP-Z55) for the first time combine the thermoelectric test cell with a complete power meter. The sensors feature not only all the advantages of the thermal measuring principle but also a further increase in accuracy since the influence of the base unit is eliminated; they also offer a continuous measurement range from 1 µW to 100 mW without range switching, Γ correction to reduce matching errors and numerous other assets. The DC-coupled thermal test cell of the predecessor models R&S NRV-Z51 and R&S NRV-Z55 was adopted, allowing measurements starting at 0 Hz, plus reference to a low-frequency or DC standard. Like the other sensors of this instrument family, the new sensors can be operated via the R&S NRP base unit or a PC with a USB interface. A virtual user interface is part of the equipment supplied to enable operation from a PC.

Preliminary

ROHDE & SCHWARZ

Power Sensors R&S NRP-Z51, -Z55

Specifications
(data above 18 GHz apply to R&S NRP-Z55 only)

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

Sensor type		Thermoelectric sensor
Measurand		Average power of incident wave average power of source into 50 Ω [1])
Frequency range		DC to 18 GHz (R&S NRP-Z51) DC to 40 GHz (R&S NRP-Z55)
Matching (SWR)	DC to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz > 26.5 GHz to 40.0 GHz	**< 1.10** **< 1.15** **< 1.20** **< 1.25** **< 1.30**
RF connector		N (male) for R&S NRP-Z51 2.92 mm (male) for R&S NRP-Z55
Power measurement range		1 µW to 100 mW (-30 dBm to +20 dBm) cont., without subranges
Max. power	Average Pulse energy	0.3 W (+25 dBm) continuous 10 Wµs
Display noise [14]		< 30 nW (20 nW typ.)
Zero offset [17]		< 50 nW (33 nW typ.)
Zero drift [18]		< 20 nW
Linearity uncertainty *)		**< 0.02 dB**

Calibration uncertainty **)		**R&S NRP-Z51**	**R&S NRP-Z55**
at (20 to 25°C)	10 MHz to < 100 MHz 100 MHz to 4 GHz > 4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 GHz to 18 GHz > 18.0 GHz to 26.5 GHz > 18.0 GHz to 30.0 GHz > 30.0 GHz to 35.0 GHz > 35.0 GHz to 40.0 GHz	*0.047 dB* *0.057 dB* *0.071 dB* *0.076 dB* *0.098 dB*	*0.053 dB* *0.065 dB* *0.077 dB* *0.084 dB* *0.104 dB* *0.086 dB* *0.100 dB* *0.112 dB* *0.105 dB*
Temperature effect		< 0.004 dB/K (0.001 dB/K typ.)	

Uncertainty for absolute power measurements ***) from -13 dBm to 20 dBm	R&S NRP-Z51	20°C to 25°C	15°C to 35°C	0°C to 50°C
	10 MHz to < 100 MHz	0.052 dB	0.057 dB	0.075 dB
	100 MHz to 4 GHz	0.061 dB	0.066 dB	0.082 dB
	> 4 GHz to 8 GHz	0.074 dB	0.078 dB	0.092 dB
	> 8 GHz to 12.4 GHz	0.078 dB	0.082 dB	0.095 dB
	> 12.4 GHz to 18 GHz	0.100 dB	0.102 dB	0.113 dB
	R&S NRP-Z55	20°C to 25°C	15°C to 35°C	0°C to 50°C
	10 MHz to < 100 MHz	0.057 dB	0.062 dB	0.079 dB
	100 MHz to 4 GHz	0.068 dB	0.072 dB	0.087 dB
	> 4 GHz to 8 GHz	0.080 dB	0.083 dB	0.096 dB
	> 8 GHz to 12.4 GHz	0.084 dB	0.087 dB	0.100 dB
	> 12.4 GHz to 18 GHz	0.106 dB	0.108 dB	0.119 dB
	> 18.0 GHz to 26.5 GHz	0.092 dB	0.095 dB	0.106 dB
	> 18.0 GHz to 30.0 GHz	0.102 dB	0.104 dB	0.115 dB
	> 30.0 GHz to 35.0 GHz	0.114 dB	0.116 dB	0.126 dB
	> 35.0 GHz to 40.0 GHz	0.108 dB	0.110 dB	0.1203 dB

Measurement window [7]	Duration	$2 \times$ (1 ms to 300 ms)
	Shape	rectangular (integrating behaviour)
		Von Hann (smoothing filter, for efficient suppression of result variations due to modulation [26])
Measurement time [27]		$N \times$ (duration of measurement window + 0.5 ms) + t_z
		t_z : < 82 ms
Zeroing (duration)	Depends on setting of averaging filter	
	AUTO ON	4 s
	AUTO OFF	
	Integration time [16] < 4 s	4 s
	4 s...16 s	integration time [16]
	> 16 s	16 s
Averaging filter	Modes	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)
	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 1000 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)
Duty cycle correction [8]		0.001 % to 99.999 %

Capacity of measurement buffer [9]		1 to 1024 results
Triggering	Source	Bus, External, Hold, Immediate, Internal
	Slope (external, internal)	pos./neg.
	Level Internal External	 -16 dBm to +20 dBm see specs of R&S NRP and USB Adapter R&S NRP-Z3
	Delay	0 s to +100 s
	Holdoff	0 s to 10 s
	Hysteresis	0 dB to 10 dB
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 ahead of the sensor by loading ist s-parameter data set into the sensor
	Number of frequencies Parameters	1 to 1000 s_{11}, s_{21}, s_{12} and s_{21} (in s2p format)
	Download	with R&S NRP Toolkit (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	100 MHz ($0.1 \times f$ below 1GHz) for specified measurement uncertainty
Interface to host	Power supply	+5 V / 100 mA typ. (USB Low-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 $\times$ H $\times$ L)		48 mm $\times$ 31 mm $\times$ 170 mm length incl. connecting cable: approx. 1.6 m
Weight		< 0.3 kg

[*] For relative measurements referenced to 0 dBm.

[**] Expanded uncertainty (k=2) for absolute power measurements at the calibration level (0 dBm) and the calibration frequencies (10 MHz, 50 MHz, 100 MHz; from 500 MHz to 18 GHz in increments of 500 MHz). Specifications include zero offset and display noise (up to a 2 σ value of 0.004 dB).

[***] Includes the effects of calibration uncertainty, linearity, zero offset, temperature and display noise (up to a value of 0.004 dB). For power levels below -13 dBm the effect of zero set must be calculated separately.

General specifications

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

Accessories and numerical footnotes

see the R&S NRP data sheet (PD 0757.7023.21)

Ordering information

Description	Type	Order No.
Power Sensor 1 µW to 100 mW; DC to 18 GHz	R&S NRP-Z51	1138.0005.02
Power Sensor 1 µW to 100 mW; DC to 40 GHz	R&S NRP-Z55	1138.2008.02

 Before putting the product into operation for the first time, make sure to read the following

S a f e t y   I n s t r u c t i o n s

Rohde & Schwarz makes every effort to keep the safety standard of its products up to date and to offer its customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. This product 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, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, Rohde & Schwarz will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its operating manual and within its performance limits (see data sheet, documentation, the following safety instructions). Using the products requires technical skills and knowledge of English. It is therefore essential that the products be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

Observe operating instructions	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

Supply voltage ON/OFF	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double/reinforced insulation

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in other parts of the documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by Rohde & Schwarz, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a safety hazard with a high potential of risk for the user that can result in death or serious injuries.
WARNING	This tag indicates a safety hazard with a medium potential of risk for the user that can result in death or serious injuries.
CAUTION	This tag indicates a safety hazard with a low potential of risk for the user that can result in slight or minor injuries.
ATTENTION	This tag indicates the possibility of incorrect use that can cause damage to the product.
NOTE	This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist. It is therefore essential to make sure that the tags described here are always used only in connection with the associated documentation and the associated product. The use of tags in connection with unassociated products or unassociated documentation can result in misinterpretations and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude max. 2000 m. 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. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).

3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.

4. If products/components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.

6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.

7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.

8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.

9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.

10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.

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

12. Never use the product if the power cable is damaged. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.

13. The product may be operated only from TN/TT supply networks fused with max. 16 A.

14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise this can result in sparks, fire and/or injuries.

15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.

16. For measurements in circuits with voltages $V_{rms} > 30$ V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.

17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.

18. Never remove the cover or part of the housing while you are operating the product. This will expose circuits and components and can lead to injuries, fire or damage to the product.

19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a skilled electrician.

20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.

21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.

22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.

23. Rohde & Schwarz products are not protected against penetration of water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock or damage to the product, which can also lead to personal injury.

24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.

25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.

26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.

27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries are hazardous waste. Dispose of them only in specially marked containers. Observe local regulations regarding waste disposal. Do not short-circuit batteries or storage batteries.

28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.

29. Please be aware of the weight of the product. Be careful when moving it; otherwise you may injure your back or other parts of your body.

30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).

31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.

32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle; the manufacturer assumes no responsibility for accidents or collisions.

33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.

Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes informaciones de seguridad

Informaciones de seguridad

Es el principio de Rohde & Schwarz de tener a sus productos siempre al día con los estandards de seguridad y de ofrecer a sus clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. Este producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los estandards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, deberá el usuario atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. Rohde&Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto solamente fue elaborado para ser utilizado en la indústria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del maluso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones del correspondiente manual del uso y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso de los productos hace necesarios conocimientos profundos y el conocimiento del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso de los productos a personas péritas o debidamente minuciosamente instruidas con los conocimientos citados. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente.

Símbolos y definiciones de seguridad

Ver manual de instrucciones del uso	Informaciones para maquinaria con uns peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construción con peligro de carga electroestática

potencia EN MARCHA/PARADA	Indicación Stand-by	Corriente continua DC	Corriente alterna AC	Corriente continua/alterna DC/AC	El aparato está protegido en su totalidad por un aislamiento de doble refuerzo

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en otro capítulo de esta documentación y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por Rohde&Schwarz bajo la denominación de „producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO   Indica un punto de peligro con gran potencial de riesgo para el ususario.Punto de peligro que puede llevar hasta la muerte o graves heridas.

ADVERTENCIA   Indica un punto de peligro con un protencial de riesgo mediano para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas .

ATENCIÓN   Indica un punto de peligro con un protencial de riesgo pequeño para el usuario. Punto de peligro que puede llevar hasta heridas leves o pequeñas

CUIDADO   Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.

INFORMACIÓN   Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el ámbito de la comunidad económica europea. Pueden existir definiciones diferentes a esta definición. Por eso se debera tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue: como posición de funcionamiento se define principalmente la posición con el suelo de la caja para abajo , modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar.
A menos que se especifique otra cosa en la hoja de datos, se aplicará una tolerancia de ±10% sobre el voltaje nominal y de ±5% sobre la frecuencia nominal.

2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal périto autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Despues de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de

seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se producieran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.

4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.

5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberan ser tenidas en cuenta las prescipciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescipciones de seguridad especiales en la descripción del producto.

6. Ciertos productos, como por ejemplo las instalaciones de radiación HF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario está comprometido a valorar y señalar areas de trabajo en las que se corra un riesgo de exposición a radiaciones aumentadas de riesgo aumentado para evitar riesgos.

7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.

8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del prodcuto.

9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.

10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto ya que puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.

11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (medida del cable de distribución aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construcciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.

13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A.

14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.

15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.

16. En las mediciones en circuitos de corriente con una tensión de entrada de Ueff > 30 V se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).

17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos de la EC950/EN60950.

18. Nunca abra la tapa o parte de ella si el producto está en funcionamiento. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.

19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.

20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, deberá la toma de corriente estar protegida de manera que los productos o los usuarios estén suficientemente protegidos.

21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir corto circuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.

22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.

23. Los productos R&S no están protegidos contra el agua si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente o de daños en el producto lo cual también puede llevar al peligro de personas.

24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.

25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.

26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención celulas de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Baterías y acumuladores son deshechos problemáticos. Por favor tirenlos en los recipientes especiales para este fín. Por favor tengan en cuenta las prescripciones nacionales de cada país referente al tratamiento de deshechos. Nunca sometan las baterías o acumuladores a un corto circuito.

28. Tengan en consideración de que en caso de un incendio pueden escaparse gases tóxicos del producto, que pueden causar daños a la salud.

29. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.

30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).

31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujecion en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean tenidas en cuenta. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.

32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo y el fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.

33. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.

Certified Quality System

ISO 9001

DQS REG. NO 1954 QM

Certified Environmental System

ISO 14001

DQS REG. NO 1954 UM

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.

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Dear Customer,

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Cher client,

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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-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

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 : 1993 + A2 : 1995
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
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Munich, 2003-11-13   Central Quality Management FS-QZ / Becker

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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.

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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.

The collective designation "R&S NRP-Z5x", where the x stands for any digit, refers to a family of thermal sensors. If formulations apply to all sensors of the family, the collective designation is employed. Yet, if formulations only apply to certain sensors, their exact type designations are employed.

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.) for the N connector of the R&S NRP-Z51, or 0.9 Nm (8" lbs.) for the 2.92 mm connector of the R&S NRP-Z55.

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 has a male N connector (R&S NRP-Z51) or a male 2.92 mm connector (R&S NRP-Z55) on its RF input and so can be connected to any standard female N or 2.92 mm/PC3.5/SMA connector, respectively. Using light pressure, and keeping the male RF connector perpendicular, insert it into the female RF connector and tighten the 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.

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

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

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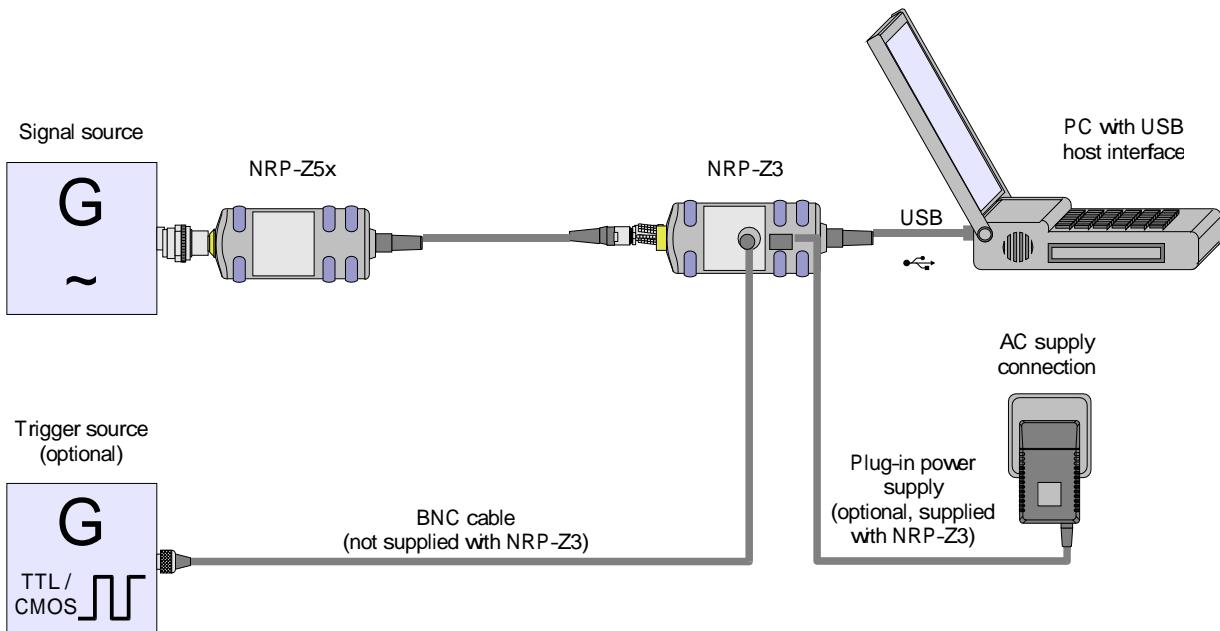
Fig. 1-1   Configuration with Active USB Adapter R&S NRP-Z3

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. 1-2).
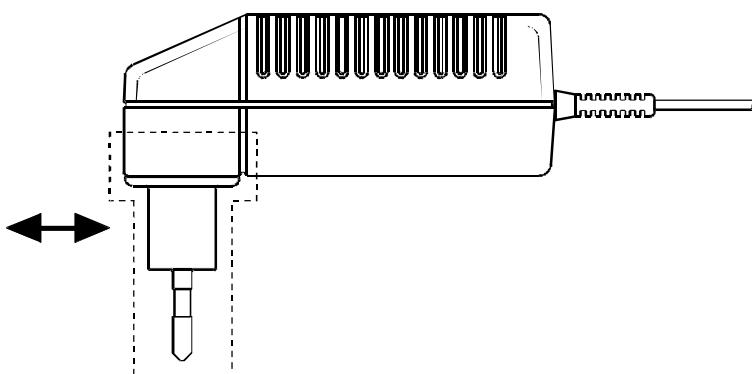
Fig. 1-2   Changing the primary adapter

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. 1-3 is a schematic of the measurement setup. The order in which the cables are connected is not critical.
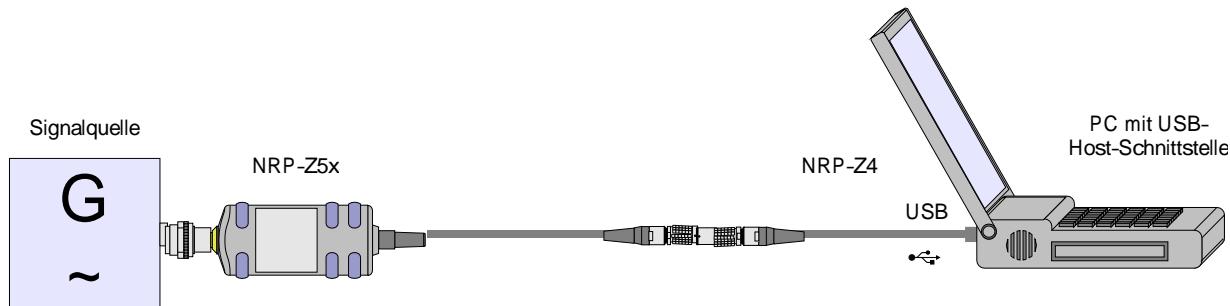
Fig. 1-3   Configuration with Passive USB Adapter R&S NRP-Z4

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.

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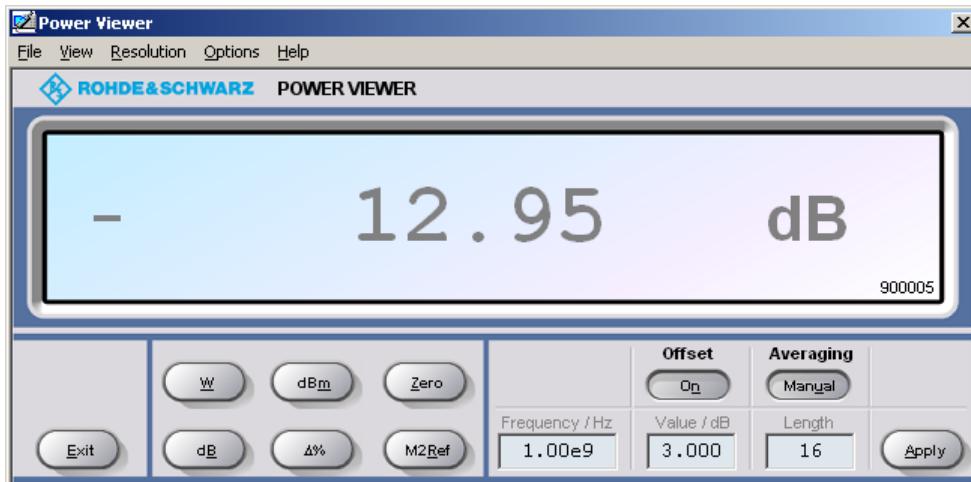
Fig. 2-1   **Power Viewer –** virtual power meter

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	Opens a dialog box to select the background colour for
	Result	• the result,
	Unit	• the unit,
	Edit	• the text in the number fields or
	Button	• 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.
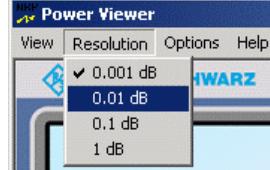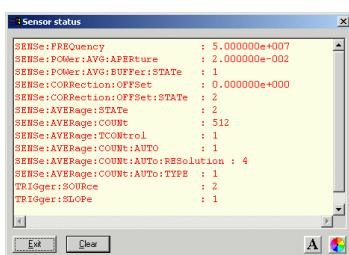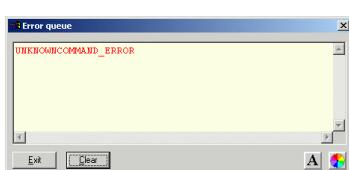
	Simulation …	For trying out the functions of the virtual power meter without actually connecting a sensor. The display alternates between **Measurement Value 1** & **Measurement Value 2** with a period given by **Interval**. Simulation can be activated immediately with the **Activate** check box.
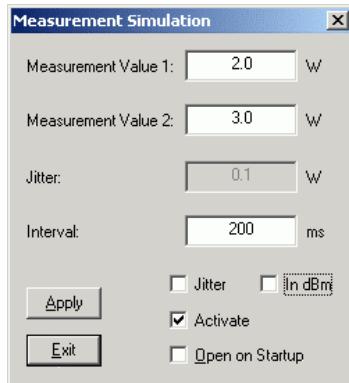
	Reset Sensor	Initializes the sensor. Any previous zeroing remains valid.
Help	**Contents**	Opens the table of contents for the online-help facility.
	About	Displays information about the program version used, etc.

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3 Manual Operation

The previous section describes the Power Viewer program module supplied with the instrument. This module simplifies the most frequently used function of a power meter – measuring the average power of an RF signal 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.
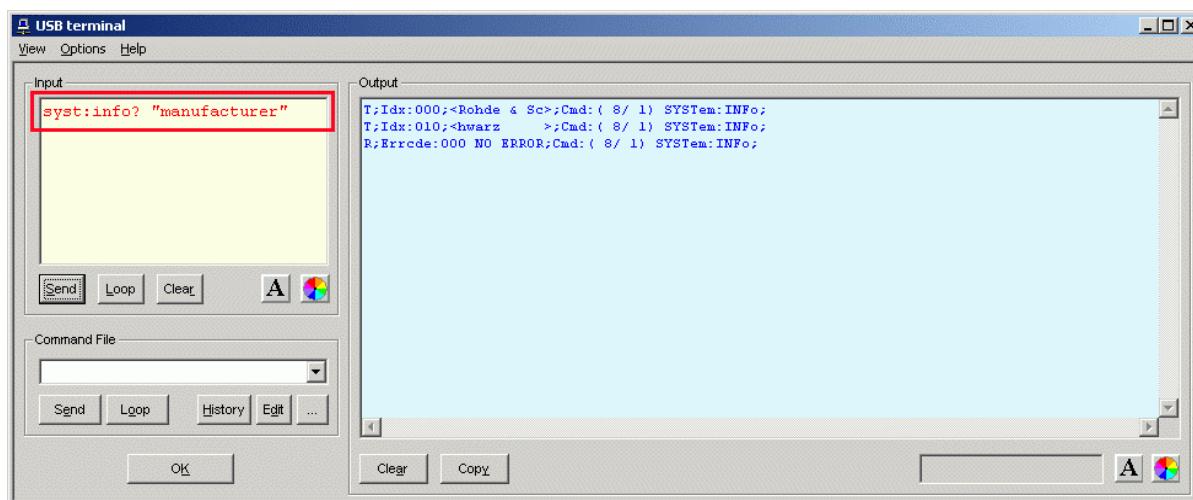

Fig. 3-1   Sending commands using the **Input** field
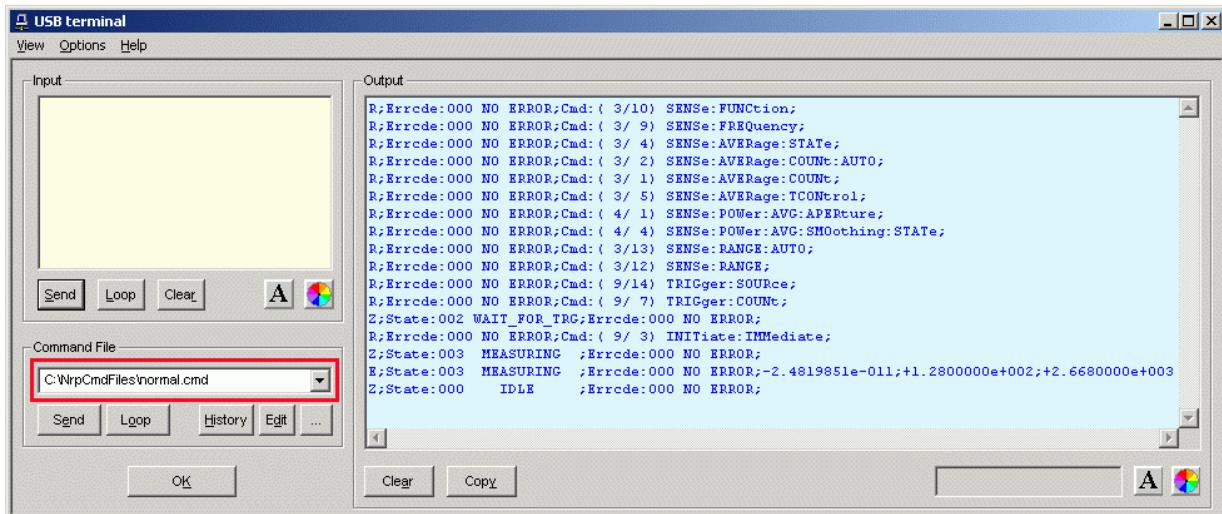
Fig. 3-2   Sending commands using command files

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.
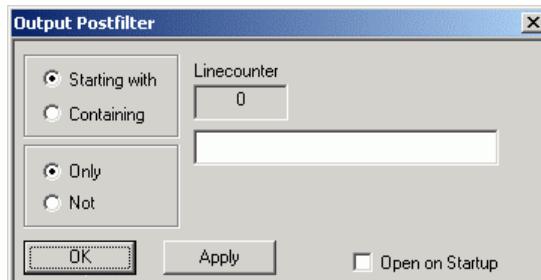
Filter criteria:

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.
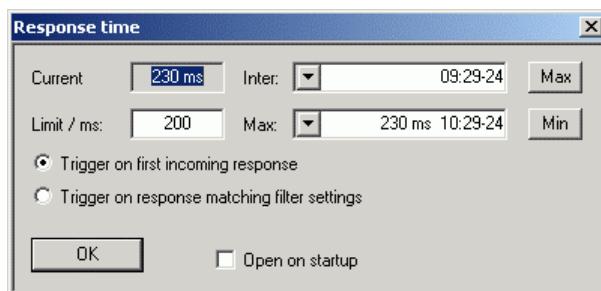
Current indicates the time elapsed between dispatch of the last command and receipt of an acknowledgement from the sensor. When the **Max** button is clicked, the response times exceeding the value in the **limit / ms** field are recorded. When the **Min** button is clicked, the response times within 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**.
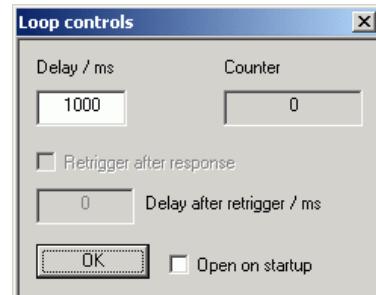
Options	**Protocol Mode**	In this mode, a time stamp is added to each response block.
	Hex Mode	In this mode, the response blocks from the sensor are displayed in hexadecimal format.
	Auto Delete	With this option active, the **Output** field is automatically cleared when the **Send** button is pressed.
	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.
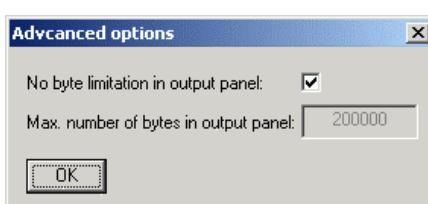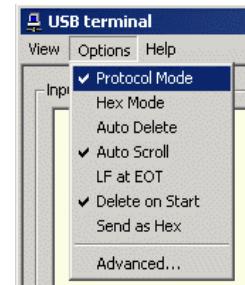
Program module "Firmware Update"

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-Z5x 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-Z5x 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 NrpFlashup program (menu item **Update S-Parameters**) is used for loading an s-parameter table. To ensure compatibility with a great number of network analyzers, NrpFlashup can process measurement data files in S2P format. 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:
   $$f_i \quad s_{11}(f_i) \quad s_{21}(f_i) \quad s_{12}(f_i) \quad s_{22}(f_i),$$
   where $s_{jk}(f_i)$ is the display format as specified in the *option line.*

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

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

   $\mathrm{Re}\left[s_{jk}(f_i) \right] \quad \mathrm{Im}\left[s_{jk}(f_i) \right]$ (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:
$$f_i \quad \text{unc}\left[s_{11}(f_i)\right] \quad \text{unc}\left[s_{21}(f_i)\right] \quad \text{unc}\left[s_{12}(f_i)\right] \quad \text{unc}\left[s_{22}(f_i)\right].$$
> 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, NrpFlashup 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 NrpFlashup.

2. Activate **Update S-Parameters** in the menu. The corresponding dialog window is opened (Fig. 3-3).

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:TRANsmission* 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.)
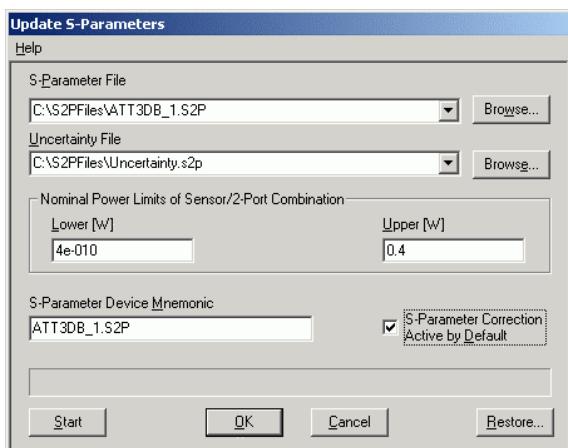

Fig. 3-3   Dialog window for loading an s-parameter table

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:

- Press the **Restore...** button. The **Restore S-Parameters** window is opened (Fig. 3-4).

- 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.

- Press **OK** to start the restore procedure. (With **Cancel** the dialog window is exited without data being restored).
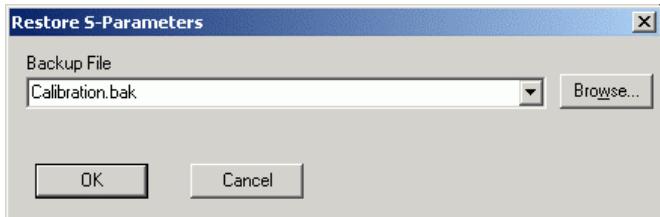
Fig. 3-4   Dialog window for loading the backup file of a calibration data set

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5 Remote Control – Fundamentals

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

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

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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-Z5x 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 *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[?]	10.0e6 to 18.0e9 (NRP-Z51) or 40.0e9 (NRP-Z55)	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 and the normal 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[?]   10.0e6 to 18.0e9 (R&S NRP-Z51) or 40.0e9 (R&S NRP-Z55)

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 only measurement mode controlled by the R&S NRP-Z5x is "Continuous Average". 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-Z51" for R&S NRP-Z51	Type designation
"STOCK NUMBER"	"1138.0005.02" for R&S NRP-Z51 "1138.2008.02" for R&S NRP-Z55	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"	"Thermal"	Detector technology used
"FUNCTION"	"Power Terminating"	The R&S NRP-Z5x 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-Z5x is 1 µW, 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-Z5x is 100 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-Z5x is 10 MHz, i.e. the sensor returns the information string "1e+07" as a response to *SYSTem:INFo? "MINFREQ"*.
"MAXFREQ"	"<max. measuring frequency in Hz>"	The maximum measuring frequency is 18 GHz for the R&S NRP-Z51, or 40 GHz for the R&S NRP-Z55, i.e. the sensor returns the information string "1.8e+10" or "4e+10", respectively, as a response to *SYSTem:INFo? "MAXFREQ"*.
"IMPEDANCE"	"50"	The R&S NRP-Z5x RF input has a nominal input impedance of 50 Ω.
"COUPLING"	" DC"	The RF input of the R&S NRP-Z5x is DC-coupled.
"CAL. ABS."	"<date>"	Date of absolute calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned with an invalid date entry.
"CAL. REFL."	"<date>"	Date of 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.

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 when thermal sensors are used. The automatically determined delay is ignored if a longer period was set with *TRIGger:DELay*. This does not overwrite the value of *TRIGger:DELay*. *TRIGger:DELay:AUTO OFF* deactivates this function.

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

Default setting: *ON*

TRIGger:HOLDoff[?]   0.0 to 10.0

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

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

Default setting: *0.0 [s]*

TRIGger:HYSTeresis[?]   0.0 to 10.0

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

The query yields the trigger hysteresis in dB.

Default setting: *0.0 [dB]*

TRIGger:IMMediate

TRIGger:IMMediate triggers a generic trigger event that causes the 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: $x = 25 \times$ <lower test limit>
                                                         $y =$ <upper test limit >

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

< lower test limit >:   1.0e-6 (with *SENSe:CORRection:SPDevice:STATe OFF*) or entered lower test limit of sensor/twoport combination (with *SENSe:CORRection:SPDevice:STATe ON*)

< upper test limit >:   0.1 (with *SENSe:CORRection:SPDevice:STATe OFF*) or entered upper test limit of sensor/twoport combination (with *SENSe:CORRection:SPDevice:STATe ON*)

Default setting: $10 \times x$

TRIGger:SLOPe[?]   POSitive | NEGative

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

The query yields
- *1* for *POSitive*,
- *2* for *NEGative*.

Default setting: *POSitive*

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

TRIGger:SOURce sets the trigger source.

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

The query yields
- *1* for *BUS*,
- *2* for *EXTernal*,
- *4* for *HOLD*,
- *8* for *IMMediate*,
- *16* for *INTernal*.

Default setting: *IMMediate*

List of Remote-Control Commands

The remote-control commands of the R&S NRP-Z5x 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[?]	10.0e6 to 18.0e9 (NRP-Z51) or 40.0e9 (NRP-Z55)	Hz	50.0e6	6.9
SENSe:FUNCtion[?]	"POWer:AVG"		"POWer:AVG"	6.10
SENSe:POWer:AVG:APERture[?]	0.001 to 0.3	s	0.02	6.10
SENSe:POWer:AVG:BUFFer:SIZE[?]	1 to 1024		1	6.11
SENSe:POWer:AVG:BUFFer:STATe[?]	OFF | ON		OFF	6.11
SENSe:POWer:AVG:SMOothing:STATe[?]	OFF | ON		ON	6.11
SENSe:SGAMma:CORRection:STATe[?]	OFF | ON		OFF	6.12
SENSe:SGAMma:MAGNitude[?]	0.0 to 1.0		0.0	6.12
SENSe:SGAMma:PHASe[?]	−360.0 to 360.0	degree	0.0	6.12
SYSTem Commands				
SYSTem:INFO? [Item]				6.13
SYSTem:INITialize				6.14
SYSTem:MINPower?		W		6.15
SYSTem:TRANsaction:BEGin				6.14
SYSTem:TRANsaction:END				6.15
Test Commands				
TEST:SENSor?				6.16
Triggersystem Commands				
ABORt				6.17
INITiate:CONTinuous[?]	OFF | ON		OFF	6.17
INITiate:IMMediate				6.18
TRIGger:COUNt[?]	1 to 2×10^9		1	6.18
TRIGger:DELay[?]	0 to 100.0	s	0.0	6.18
TRIGger:DELay:AUTO[?]	OFF | ON		OFF	6.18
TRIGger:HOLDoff[?]	0.0 to 10.0	s	0.0	6.19

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

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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-Z5x Firmware

Use the Firmware Update program module to load new firmware for the Power Sensor R&S NRP-Z5x. 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

NRP_Z21_Messkopf_0
1_15.nrp
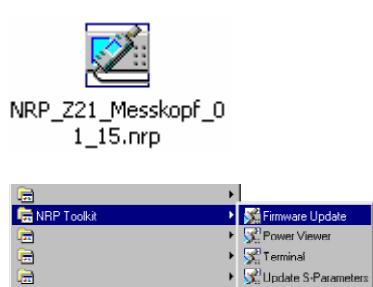
The update can be started as follows:

➢ 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.
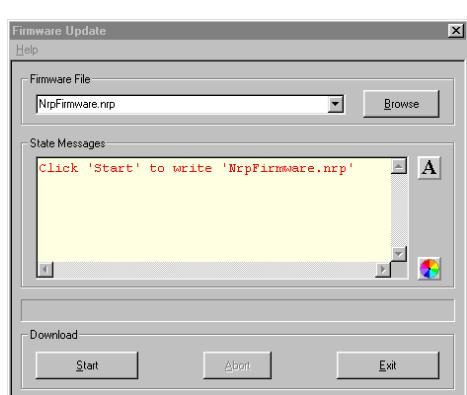
The dialog box on the left is displayed next.

➢ 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.
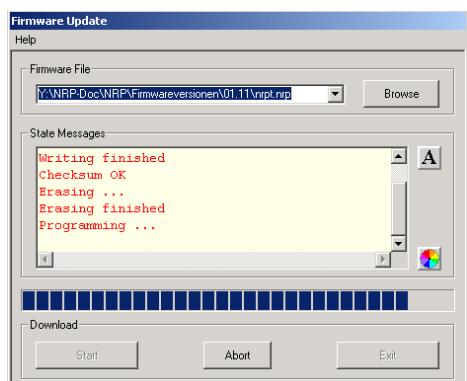
Potential problems

- 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

Bootloader_00_20.
nrp

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.