

R&S®NRP Series Power Sensors Getting Started



This manual gives an introduction to the R&S®NRP series power sensors:

- R&S®NRPxxA(N) average power sensors
- R&S®NRPxxS(N) three-path diode power sensors
- R&S®NRP18S-xx high-power three-path diode power sensors
- R&S®NRPxxT(N) thermal power sensors
- R&S®NRPxxTWG thermal waveguide power sensors

The software contained in this product uses several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, for example R&S®NRX is abbreviated as R&S NRX.

Safety Instructions

Instrucciones de seguridad

Sicherheitshinweise

Consignes de sécurité

WARNING

Risk of injury and instrument damage

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury or instrument damage.

- Do not open the instrument casing.
 - Read and observe the "Basic Safety Instructions" delivered as printed brochure with the instrument.
 - Read and observe the safety instructions in the following sections. Note that the data sheet may specify additional operating conditions.
 - Keep the "Basic Safety Instructions" and the product documentation in a safe place and pass them on to the subsequent users.
-

ADVERTENCIA

Riesgo de lesiones y daños en el instrumento

El instrumento se debe usar de manera adecuada para prevenir descargas eléctricas, incendios, lesiones o daños materiales.

- No abrir la carcasa del instrumento.
 - Lea y cumpla las "Instrucciones de seguridad elementales" suministradas con el instrumento como folleto impreso.
 - Lea y cumpla las instrucciones de seguridad incluidas en las siguientes secciones. Se debe tener en cuenta que las especificaciones técnicas pueden contener condiciones adicionales para su uso.
 - Guarde bien las instrucciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.
-

⚠️ WARNUNG**Gefahr von Verletzungen und Schäden am Gerät**

Betreiben Sie das Gerät immer ordnungsgemäß, um elektrischen Schlag, Brand, Verletzungen von Personen oder Geräteschäden zu verhindern.

- Öffnen Sie das Gerätegehäuse nicht.
 - Lesen und beachten Sie die "Grundlegenden Sicherheitshinweise", die als gedruckte Broschüre dem Gerät beiliegen.
 - Lesen und beachten Sie die Sicherheitshinweise in den folgenden Abschnitten; möglicherweise enthält das Datenblatt weitere Hinweise zu speziellen Betriebsbedingungen.
 - Bewahren Sie die "Grundlegenden Sicherheitshinweise" und die Produktdokumentation gut auf und geben Sie diese an weitere Benutzer des Produkts weiter.
-

⚠️ AVERTISSEMENT**Risque de blessures et d'endommagement de l'appareil**

L'appareil doit être utilisé conformément aux prescriptions afin d'éviter les électrocutions, incendies, dommages corporels et matériels.

- N'ouvrez pas le boîtier de l'appareil.
 - Lisez et respectez les "consignes de sécurité fondamentales" fournies avec l'appareil sous forme de brochure imprimée.
 - Lisez et respectez les instructions de sécurité dans les sections suivantes. Il ne faut pas oublier que la fiche technique peut indiquer des conditions d'exploitation supplémentaires.
 - Gardez les consignes de sécurité fondamentales et la documentation produit dans un lieu sûr et transmettez ces documents aux autres utilisateurs.
-

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1 Documentation Overview

This section provides an overview of the R&S NRP series power sensor user documentation. Unless specified otherwise, you find the documents on the R&S NRP series power sensor product page at:

www.rohde-schwarz.com/product/nrp-a-an

www.rohde-schwarz.com/product/nrp_s_sn

www.rohde-schwarz.com/product/nrp18s

www.rohde-schwarz.com/product/nrp-t-tn

www.rohde-schwarz.com/product/nrp-twg

1.1 Getting Started Manual

Introduces the R&S NRP series power sensor and describes how to set up and start working with the product. Includes basic operations and general information, e.g. safety instructions, etc. A printed version is delivered with the power sensor.

1.2 User Manuals

Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance and interfaces. Includes the contents of the getting started manual.

1.3 Tutorials

Tutorials offer guided examples and demonstrations on operating the R&S NRP series power sensor. They are provided on the product page of the internet.

1.4 Instrument Security Procedures

Deals with security issues when working with the R&S NRP series power sensor in secure areas. It is available for download on the Internet.

1.5 Basic Safety Instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

1.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S NRP series power sensor. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

www.rohde-schwarz.com/brochure-datasheet/nrp-a-an

www.rohde-schwarz.com/brochure-datasheet/nrp_s_sn

www.rohde-schwarz.com/brochure-datasheet/nrp18s

www.rohde-schwarz.com/brochure-datasheet/nrp-t-tn

www.rohde-schwarz.com/brochure-datasheet/nrp-twg

1.7 Release Notes and Open Source Acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open source acknowledgment document provides verbatim license texts of the used open source software.

www.rohde-schwarz.com/firmware/nrp-a-an

www.rohde-schwarz.com/firmware/nrp_s_sn

www.rohde-schwarz.com/firmware/nrp18s

www.rohde-schwarz.com/firmware/nrp-t-tn

www.rohde-schwarz.com/firmware/nrp-twg

1.8 Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics.

Application Notes, Application Cards, White Papers, etc.

www.rohde-schwarz.com/application/nrp_s_sn

www.rohde-schwarz.com/application/nrp18s

2 For Your Safety

The R&S NRP series power sensor is designated for use in industrial, administrative, and laboratory environments. Use the R&S NRP series power sensor only for its designated purpose. Observe the safety and usage instructions documented in the user manual, as well as operating conditions and performance limits stated in the data sheet.

The product documentation helps you to use the R&S NRP series power sensor safely and efficiently. Keep the product documentation in a safe place and pass it on to the subsequent users.

Safety information is part of the product documentation. It warns you about the potential dangers and gives instructions how to prevent personal injury or damage caused by dangerous situations. Safety information is provided as follows:

- In the "Basic Safety Instructions", safety issues are grouped according to subjects. For example, one subject is electrical safety. The "Basic Safety Instructions" are delivered with the R&S NRP series power sensor in different languages in print.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation. Always read the safety instructions carefully. Make sure to comply fully with them. Do not take risks and do not underestimate the potential danger of small details such as a damaged power cable.

3 Key Features

The R&S NRP series power sensors are the successors of the established R&S NRP-Z series of RF power sensors.

They provide a high-speed USB interface that constitutes both the communication port and the power supply connection.

Also, most sensors are available with an additional Gigabit Ethernet interface with Power-over-Ethernet (PoE) power supply. The power sensors with networking capabilities, the R&S NRP LAN power sensors, are marked with a trailing N in their names:

- R&S NRPxxSN
- R&S NRPxxAN
- R&S NRPxxTN

The R&S NRP series power sensors are compatible with the R&S NRP-Z power sensors in both the interface (USB) and a common command subset. This compatibility makes the replacement of the old power sensors easy.

For a detailed specification, refer to the data sheet.

4 Preparing for Use

For information on safety, see:

- [Chapter 2, "For Your Safety"](#), on page 8
- [Chapter 4.2, "Operating Conditions"](#), on page 10

4.1 Unpacking and Checking the Power Sensor

Check the equipment for completeness using the delivery note and the accessory lists for the various items. Check the power sensor for any damage. If there is damage, immediately contact the carrier who delivered the power sensor. Make sure not to discard the box and packing material.



Packing material

Retain the original packing material. If the instrument needs to be transported or shipped later, you can use the material to protect the control elements and connectors.

4.2 Operating Conditions

CAUTION

Risk of injury through hot surfaces

Applies only to the R&S NRP18S-xx power sensors.

Under certain conditions, the maximum surface temperatures of the power sensor can exceed the limits defined in EN 61010-1.

Provide protection against unintentional contact and wear appropriate personal protective equipment when touching the sensor.

Specific operating conditions are required to ensure accurate measurements and to avoid damage to the power sensor and connected devices. Before switching on the power sensor, observe the information on appropriate operating conditions provided in the basic safety instructions and the data sheet of the power sensor.

In particular, ensure the following:

- The power sensor is dry and shows no sign of condensation.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are connected correctly and are not overloaded.

4.3 Important Aspects for Test Setup

NOTICE

Handling the R&S NRP33SN-V power sensor

Risk of contamination

Always wear clean protective gloves when handling the R&S NRP33SN-V vacuum power sensors to protect the device and its environment from contamination.

Recommended bake-out procedure

When the sensor is inserted in a vacuum chamber, perform vacuum baking for 100 hours at 85°C at a pressure lower than 10^{-5} mbar.

Preventing electrostatic discharge (ESD)

ESD is most likely to occur when you connect or disconnect a DUT.

- ▶ **NOTICE!** Risk of electrostatic discharge (ESD). Electrostatic discharge (ESD) can damage the electronic components of the power sensor and the device under test (DUT).

Ground yourself to avoid electrostatic discharge (ESD) damage:

- Use a wrist strap and cord, and connect yourself to the ground.
- Use a conductive floor mat and heel strap combination.

EMI impact on measurement results

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated electromagnetic interference (EMI):

- Use suitable shielded cables of high quality. For example, use double-shielded RF and LAN cables.
- Always terminate open cable ends.
- Note the EMC classification in the data sheet.

4.4 Connecting to a DUT

For connecting the power sensor to a DUT, use the RF connector of the power sensor. For details, see [Chapter 5.1, "RF Connector"](#), on page 22.

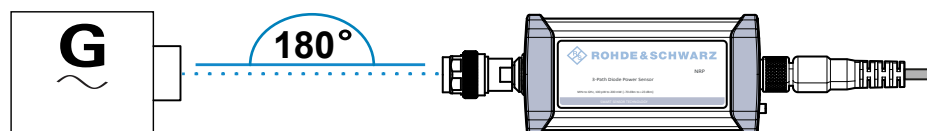
NOTICE**Risk of overloading the sensor**

Using a power sensor at a level above its upper measuring limit can damage the sensor head. To avoid this risk, make sure not to exceed the test limit.

The test limits specified on the type label are valid only for the supplied attenuator. For operation without attenuator, lower test limits apply, as specified in the data sheet.

To connect to the DUT

1. Ensure that the RF connector of your DUT is compatible with the RF connector of the power sensor.
2. Insert the RF connector straight into the RF output of your DUT. Take care not to tilt it.



3. **NOTICE!** Risk of damaging the center pin of the RF connector. Always rotate only the hex nut of the RF connector. Never rotate the power sensor itself.
Tighten the RF connector manually.
4. To ensure maximum measurement accuracy, tighten the RF connector using a torque wrench with the nominal torque recommended in [Chapter 5.1, "RF Connector"](#), on page 22.

To disconnect from the DUT

- ▶ **NOTICE!** Risk of damaging the center pin of the RF connector. Always rotate only the hex nut of the RF connector. Never rotate the power sensor itself.
Carefully loosen the union nut at the front of the RF connector of the sensor and remove the sensor.

4.5 Connecting to a Computer

For operating the power sensor, you can choose from various possibilities. For details, see [Chapter 6, "Operating Concepts"](#), on page 27.

You can establish the connection using one of the following interfaces:

- Host interface

Contents:

- [Setting Up a USB Connection](#)..... 13
- [Setting Up a LAN Connection](#)..... 15

4.5.1 Setting Up a USB Connection

You can connect a R&S NRP series power sensor to a computer using the host interface and control it as described in [Chapter 6, "Operating Concepts"](#), on page 27.

Further information:

- [Chapter 7, "Remote Control Interfaces and Protocols"](#), on page 41

4.5.1.1 Simple USB Connection

All R&S NRP power sensors can be connected to a computer by a USB interface and controlled by a supported software or a remote program.

Required equipment

- R&S NRP power sensor
- R&S NRP-ZKU cable

Setup

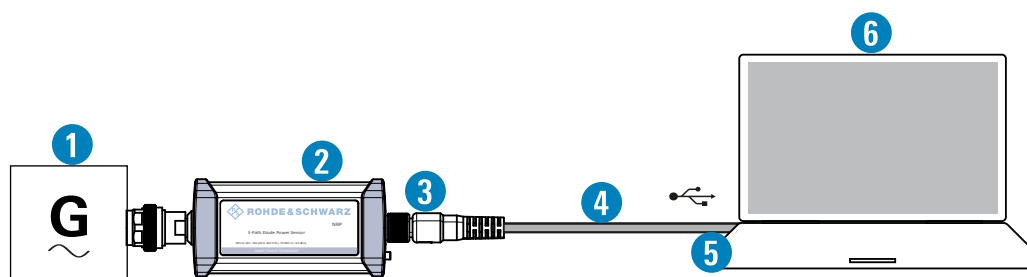


Figure 4-1: Setup with an R&S NRP-ZKU cable

- 1 = Signal source
- 2 = R&S NRP power sensor
- 3 = Host interface connector
- 4 = R&S NRP-ZKU cable
- 5 = USB connector
- 6 = Computer with installed VISA driver or R&S NRP Toolkit



Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

1. Connect the cables as shown in [Figure 4-1](#) :
 - a) Connect the R&S NRP-ZKU cable to the power sensor.
 - b) Connect the R&S NRP-ZKU cable to the computer.
 - c) Connect the power sensor to the signal source.

- On the computer, start a software application to view the measurement results.
See [Chapter 6, "Operating Concepts"](#), on page 27.

4.5.1.2 R&S NRP-Z5 Sensor Hub Setup

The R&S NRP-Z5 sensor hub (high-speed USB 2.0) can host up to four R&S NRP power sensors and provides simultaneous external triggering to all connected sensors.

Required equipment

- 1 to 4 R&S NRP power sensors
- 1 R&S NRP-ZK6 cable per sensor
- R&S NRP-Z5 sensor hub with external power supply unit and USB cable
- BNC cables to connect the trigger input and trigger output signals (optional)

Setup

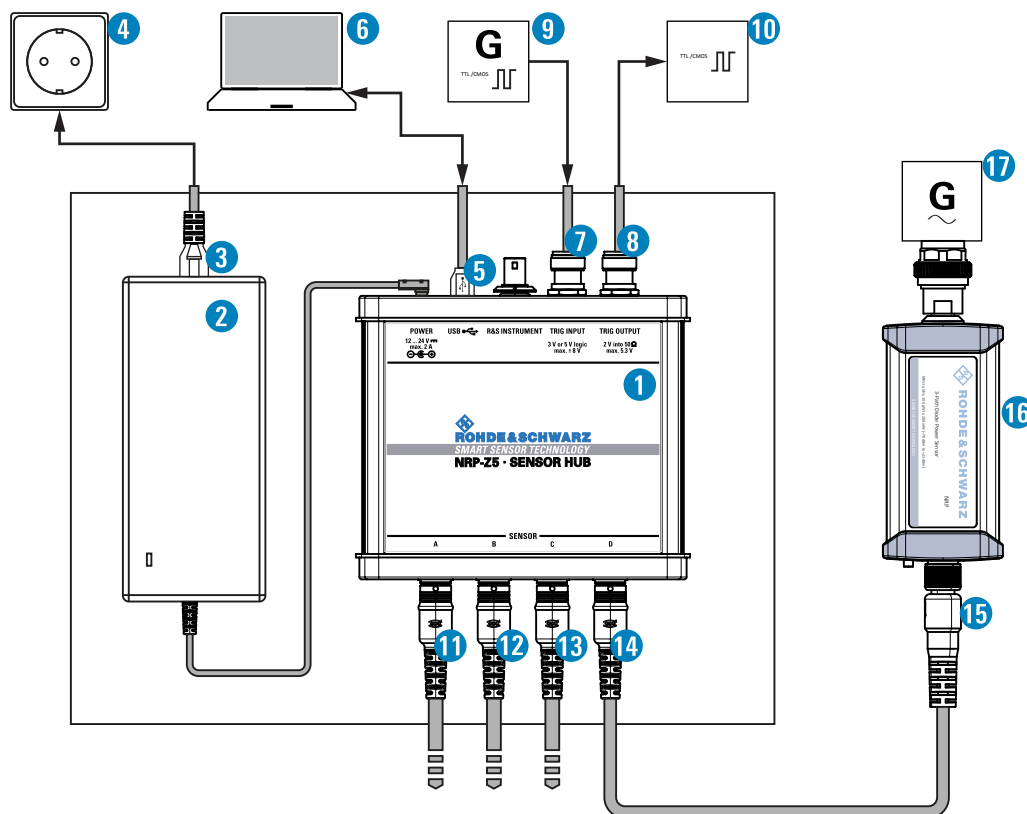


Figure 4-2: Setup with an R&S NRP-Z5 sensor hub

- = R&S NRP-Z5 sensor hub
- = External power supply unit (supplied)
- = Power cable (supplied)
- = AC power supply
- = USB cable (supplied)
- = Computer with USB host interface

- 9 = Trigger source (optional)
- 10 = Triggered device (optional)
- 11-14 = R&S NRP-ZK6 cable
- 15 = Host interface connector
- 16 = R&S NRP power sensor
- 17 = Signal source



Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

1. Connect the cables as shown in [Figure 4-2](#):
 - a) Connect the R&S NRP-ZK6 cable to the power sensor.
 - b) Connect the power sensors to the R&S NRP-Z5 sensor hub. You can connect up to four sensors.
 - c) Connect the R&S NRP-Z5 to the computer.
 - d) Connect the power sensors to the signal source.
 - e) Connect the delivered external power supply unit to the R&S NRP-Z5 and to an AC supply connector.
 - f) Connect the trigger input of the R&S NRP-Z5 with a BNC cable to the trigger source (optional).
 - g) Connect the trigger output of the R&S NRP-Z5 with a BNC cable to the trigger device (optional).
2. On the computer, start a software application to view the measurement results. See [Chapter 6, "Operating Concepts"](#), on page 27.

4.5.2 Setting Up a LAN Connection



Requires power sensors with networking capabilities, the R&S NRP LAN power sensors.

This section describes how to connect the sensor to a LAN network and configure the LAN interface for establishing a connection.



Electromagnetic interference (EMI) can affect the measurement results. To avoid any impact, use category 5 cables or better.

4.5.2.1 Connecting a LAN Power Sensor and a Computer

There are different ways to connect a LAN power sensor to a computer according to the available equipment:

Setup with a PoE Ethernet switch

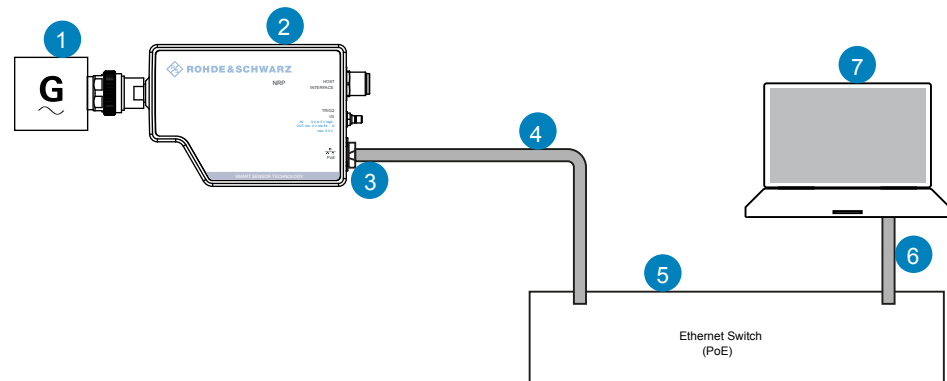


Figure 4-3: Setup with a PoE Ethernet switch

- 1 = Signal source
- 2 = LAN power sensor
- 3 = RJ-45 Ethernet connector
- 4, 6 = RJ-45 Ethernet cable
- 5 = Ethernet switch supporting PoE power delivery, e.g. R&S NRP-ZAP1
- 7 = Computer

1. Connect the [RF] connector of the sensor to the DUT.
2. **NOTICE!** Risk of sensor damage. Use only PoE power sourcing equipment (PSE) according to IEEE standards 802.3af or IEEE 802.3at. Otherwise your power sensor can get damaged.
Connect the RJ-45 Ethernet connector of the sensor to an Ethernet switch that supports PoE power delivery.
3. Connect the computer to the Ethernet switch.
4. Establish a connection between the power sensor and the network.
See [Chapter 4.5.2.2, "Establishing a Connection to the Network"](#), on page 18.

Setup with a PoE injector and a Non-PoE Ethernet switch

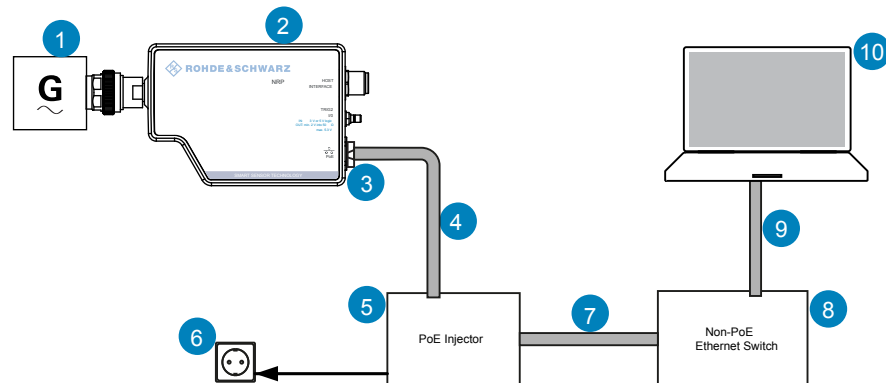


Figure 4-4: Setup with a PoE injector and a Non-PoE Ethernet switch

- 1 = Signal source
- 2 = LAN power sensor
- 3 = RJ-45 Ethernet connector
- 4, 7, 9 = RJ-45 Ethernet cable
- 5 = PoE injector
- 6 = AC supply
- 8 = Non-PoE Ethernet switch
- 10 = Computer

1. Connect the [RF] connector of the sensor to the DUT.
2. **NOTICE!** Risk of sensor damage. Use only PoE power sourcing equipment (PSE) according to IEEE standards 802.3af or IEEE 802.3at. Otherwise your power sensor can get damaged.
Connect the RJ-45 Ethernet connector of the sensor to the output of the PoE injector.
3. Connect the PoE injector to a power supply.
4. Connect the input of the PoE injector to the Non-PoE Ethernet switch.
5. Connect the computer to the Non-PoE Ethernet switch.
6. Establish a connection between the power sensor and the network.
See [Chapter 4.5.2.2, "Establishing a Connection to the Network"](#), on page 18.

Setup with a PoE injector

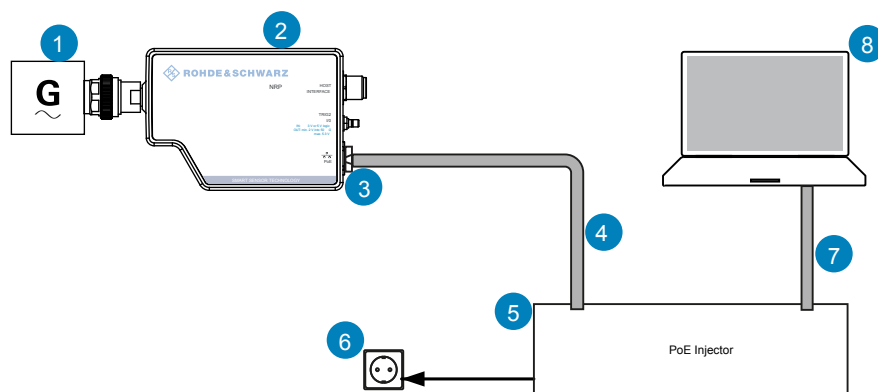


Figure 4-5: Setup with a PoE injector

- 1 = Signal source
- 2 = LAN power sensor
- 3 = RJ-45 Ethernet connector
- 4, 7 = RJ-45 Ethernet cable
- 5 = PoE injector
- 6 = AC supply
- 8 = Computer

1. Connect the [RF] connector of the sensor to the DUT.
2. **NOTICE!** Risk of sensor damage. Use only PoE power sourcing equipment (PSE) according to IEEE standards 802.3af or IEEE 802.3at. Otherwise your power sensor can get damaged.
Connect the RJ-45 Ethernet connector of the sensor to the output of the PoE injector.
3. Connect the PoE injector to a power supply.
4. Connect the computer to the input of the PoE injector.
5. Establish a network connection between the power sensor and the computer.

4.5.2.2 Establishing a Connection to the Network

There are two methods to establish a network connection:

- Power sensor and computer are connected to a common network (infrastructure network).
- Power sensor and computer are connected only over the switch (peer-to-peer network).

In both cases, you can address the LAN power sensor as follows:

- [Chapter 4.5.2.3, "Using Hostnames"](#), on page 19
- [Chapter 4.5.2.4, "Assigning the IP Address"](#), on page 20

To set up a network Ethernet connection

1. Connect the power sensor to the network or to a single computer.
By default, the power sensor is configured to use dynamic TCP/IP configuration (DHCP) and to obtain the address information automatically.
If both LAN status LEDs are illuminated in green color, the power sensor is correctly connected to the network.
Note: Establishing a connection can take up to 2 minutes per device.
2. If the LAN status LEDs show another state, no connection is possible. For possible solutions, see:
 - ["Network status LED"](#) on page 26
 - ["Troubleshooting for peer-to-peer connections"](#) on page 19

Troubleshooting for peer-to-peer connections

1. Allow a waiting time, especially if the computer was used in a network before.
2. Check that only the main network adapter is active on the computer. If the computer has more than one network interfaces, explicitly disable all other network interfaces if you plan to utilize a peer-to-peer connection to the power sensor.
3. Check that the remaining main network adapter has been assigned an IP address starting with 169.254. The IANA (Internet assigned numbers authority) has reserved the range 169.254.0.0 to 169.254.255.255 for the allocation of automatic private IP addresses (APIPA). Addresses from this range are guaranteed to cause no conflicts with any routable IP address.
4. Try to establish a connection to the power sensor with both the default hostname and the hostname extended with `.local`, for example:

```
nrp18sn-101441  
nrp18sn-101441.local
```

4.5.2.3 Using Hostnames

In a LAN that uses a domain name system (DNS) server, each connected computer or instrument can be accessed via an unambiguous hostname instead of an IP address. The DNS server translates the hostname to the IP address. Using the hostname is especially useful when a DHCP server is used, as a new IP address can be assigned each time the instrument is restarted.

Each power sensor is delivered with a default hostname assigned. You can change the default hostname.

Default hostname

The default hostname follows the syntax:

`<device name>-<serial number>`, where:

- `<device name>` is the short name of your sensor.
For example, the `<device name>` of R&S NRP18SN is `nrp18sn`.

- `<serial number>` is the individual serial number of the power sensor. The serial number is printed on the name plate at the rear side of the sensor. It is part of the device ID printed above the barcode:

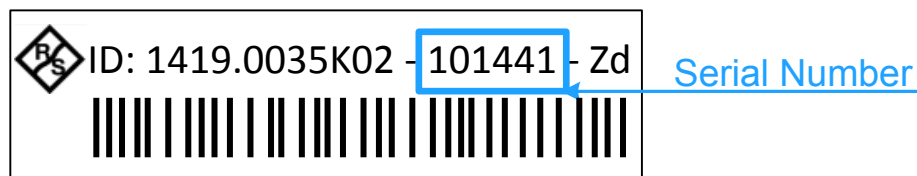


Figure 4-6: Serial number on the name plate

Example:

Serial number of the power sensor: 101441

Default hostname: `nrp18sn-101441`

Hostname in zero configuration networks, including peer-to-peer networks

The power sensor supports zero configuration networking, used in networks without DHCP server, such as peer-to-peer networks. Thus, you can connect the power sensor to a network without setting up services such as dynamic host configuration protocol (DHCP) and domain name system (DNS), or configuring the network settings manually.

For establishing a connection to the power sensor, try the default hostname as well as the hostname extended with `.local` as shown in the example below. All communication for resolving names in the top-level-domain (TLD) `.local` are defined to be executed using dedicated local services and ports if no other DNS (domain name server) is available.

Example:

Default hostname: `nrp18sn-101441`

Extended hostname: `nrp18sn-101441.local`

4.5.2.4 Assigning the IP Address

Depending on the network capabilities, the TCP/IP address information for the LAN power sensor can be obtained in different ways:

- If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), the address information can be assigned automatically.
- If the network does not support DHCP, the LAN power sensor tries to obtain the IP address via the Zeroconf (APIA) protocol. If this attempt does not succeed or if the instrument is set to use alternate TCP/IP configuration, the IP address must be set manually.

For a description on how to set the IP address manually, refer to the user manual.

**Use hostnames to identify the sensor**

In networks using a DHCP server, it is recommended that you address the sensor by its unambiguous hostnames, see [Chapter 4.5.2.3, "Using Hostnames"](#), on page 19.

A *hostname* is a unique identifier of the power sensor that remains permanent as long as it is not explicitly changed. Hence, you can address a power sensor by the same identification, irrespectively if a network or a point-to-point connection is used.

4.6 Connecting to a USB Host

For connecting the power sensor to a USB host, use the host interface of the power sensor. For details, see [Chapter 5.3, "Host Interface"](#), on page 24.

To connect a cable to the host interface of the power sensor

You can use an R&S NRP-ZKU cable or R&S NRP-ZK6 cable.

1. Insert the screw-lock cable connector into the host interface connector of the power sensor.
2. Tighten the union nut manually.

To disconnect the host interface of the R&S NRP power sensors

- ▶ Loosen the union nut of the screw-lock cable connector and remove the cable.

5 R&S NRP Power Sensors Tour

This chapter provides an overview of the available connectors and LEDs of the power sensor.

In [Figure 5-1](#), the USB power sensor is shown on the left, the LAN power sensor is shown on the right.

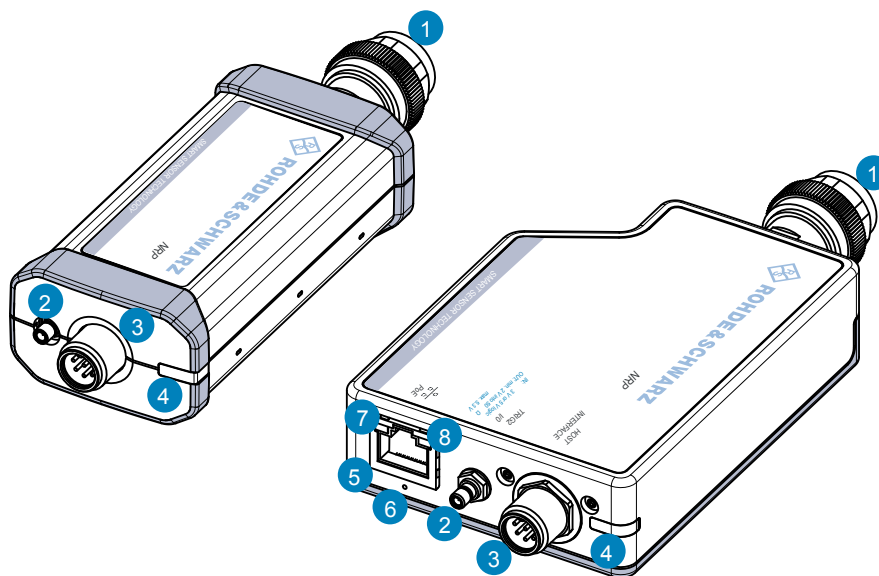


Figure 5-1: R&S NRP series power sensors (example)

- 1 = RF connector, see [Chapter 5.1, "RF Connector"](#), on page 22
- 2 = Trigger I/O connector, see [Chapter 5.2, "Trigger I/O Connector"](#), on page 24
- 3 = Host interface connector, see [Chapter 5.3, "Host Interface"](#), on page 24
- 4 = Status LED, see [Chapter 5.4, "Status LED"](#), on page 25
- 5 = LAN connector, see [Chapter 5.5, "LAN PoE Interface"](#), on page 25
- 6 = LAN reset button, see ["LAN reset button"](#) on page 26
- 7 = Power over Ethernet status LED, see ["Power over Ethernet status LED"](#) on page 26
- 8 = Network status LED, see ["Network status LED"](#) on page 26

5.1 RF Connector

The RF connector is used for connecting the power sensor to a device under test (DUT) or a signal generator.

For maximum measurement accuracy, tighten the RF connector using a torque wrench with a nominal torque as specified in the following table.

Table 5-1: R&S NRPxxA(N) RF connector characteristics

Power sensor	Matching female connector	Male connector	Tightening torque
R&S NRP6A	N	N	1.36 Nm (12" lbs)
R&S NRP6AN			
R&S NRP18A			
R&S NRP18AN			

Table 5-2: R&S NRPxxS(N) RF connector characteristics

Power sensor	Male connector	Matching female connector	Tightening torque
R&S NRP8S	N	N	1.36 Nm (12" lbs)
R&S NRP8SN			
R&S NRP18S			
R&S NRP18SN			
R&S NRP33S	3.50 mm	3.50 mm/ 2.92 mm/ SMA	0.90 Nm (8" lbs)
R&S NRP33SN			
R&S NRP33SN-V			
R&S NRP40S	2.92 mm	3.50 mm/ 2.92 mm/ SMA	
R&S NRP40SN			
R&S NRP50S	2.4 mm	2.4 mm/ 1.85 mm	
R&S NRP50SN			

Table 5-3: R&S NRP18S-xx RF connector characteristics

Power sensor	Male connector	Matching female connector	Tightening torque
R&S NRP18S	N	N	1.36 Nm (12" lbs)

Table 5-4: R&S NRPxxT(N) RF connector characteristics

Power sensor	Male connector	Matching female connector	Tightening torque
R&S NRP18T	N	N	1.36 Nm (12" lbs)
R&S NRP18TN			
R&S NRP33T	3.50 mm	3.50 mm/ 2.92 mm/ SMA	0.90 Nm (8" lbs)
R&S NRP33TN			
R&S NRP40T	2.92 mm		
R&S NRP40TN			
R&S NRP50T	2.4 mm	2.4 mm/ 1.85 mm	

Power sensor	Male connector	Matching female connector	Tightening torque
R&S NRP50TN			
R&S NRP67T	1.85 mm		
R&S NRP67TN			
R&S NRP110T	1.0 mm	1.0 mm	0.23 Nm (2" lbs)

Table 5-5: R&S NRPxxTWG RF connector characteristics

Power sensor	Matching female connector	Male connector	Frequency range	Tightening torque
R&S NRP75TWG	WR-15	WR-15	50 GHz to 75 GHz	0.58 Nm (5" lbs)
R&S NRP90TWG	WR-12	WR-12	60 GHz to 90 GHz	
R&S NRP110TWG	WR-10	WR-10	75 GHz to 110 GHz	
*It is recommended to use the torque wrench of the R&S tool with the part number 1175.2014.02.				

5.2 Trigger I/O Connector

The trigger I/O is a connector of SMB type.

It is used as an input for signals if the trigger source parameter is set to EXTERNAL2. It is used as an output for trigger signals if the sensor is operated in the trigger master mode.

Further information:

- For details on configuration, see the user manual.

5.3 Host Interface









The host interface connector is used for establishing a connection between the power sensors and a USB host or a supported Rohde & Schwarz instrument. For this purpose, an external cable is needed. Two types of cables are available:

- R&S NRP-ZKU cable with a USB connector, for connecting the power sensor to a USB host device (R&S order number 1419.0658.xx).
- R&S NRP-ZK6 cable with a push-pull type connector, for connecting the power sensor to a base unit, R&S NRX or R&S NRP2, or other Rohde & Schwarz products with the round connector (R&S order number 1419.0664.xx).

These cables can be obtained in different lengths up to 5 meters.

5.4 Status LED

The status LED gives information about the state of the power sensor. The following states are defined:

Indication		State
	White	Idle state. The sensor performs no measurement and is ready for use.
	Flashing white	Firmware update is in progress
	Slow flashing white	Sanitizing in progress
	Yellow	Wait for trigger state
	Green	Measuring state
	Turquoise blue	Zeroing is in progress
	Slow flashing red	Static error You can query the error type with <code>SYSTem:SERRor?</code>
	Fast flashing red	Critical static error You can query the error type with <code>SYSTem:SERRor?</code> Note: If this state occurs after a firmware update, the update was not successful. Perform the firmware update again.

5.5 LAN PoE Interface

Available only for LAN power sensor.

An RJ-45 connector is used to connect the Ethernet interface of the power sensors to a Local Area Network (LAN).



Ethernet interface requires PoE (Power over Ethernet)

When using the Ethernet interface of the power sensors, the electrical power has to be provided by Power over Ethernet (PoE). In this case, it is *not* possible to provide the power supply via the USB connector instead.

NOTICE

Risk of sensor damage

Use only PoE power sourcing equipment (PSE) according to IEEE standards 802.3af or IEEE 802.3at.

Otherwise your power sensor can get damaged.

LAN reset button

The LAN reset button is used for resetting the Ethernet connection parameters of the power sensor to their default values.

Power over Ethernet status LED

Available only for LAN power sensor.

The power status LED shows whether the sensor is correctly powered over PoE or not.

Color	State
Green	The sensor is powered over PoE. You can operate it using the Ethernet interface.
No light	No PoE power is present.

Network status LED

Available only for LAN power sensor.

The network status LED shows whether the LAN connection to the network is established properly or not.

Color	State
Green	The power sensor is correctly connected to the network. It has been assigned a valid IP address, either manually or via DHCP.
Red	The power sensor is not connected to the network correctly. Either the connection is erroneous or the sensor has not been assigned a valid IP address yet.

6 Operating Concepts

For operating the power sensor, you can choose from various possibilities:

- [Chapter 6.2, "Browser-Based User Interface"](#), on page 30
- [Chapter 6.3, "Remote Control"](#), on page 32
- [Chapter 6.4, "R&S NRPV"](#), on page 32
- [Chapter 6.5, "R&S Power Viewer"](#), on page 34
- [Chapter 6.6, "R&S Power Viewer Mobile"](#), on page 37
- [Chapter 6.7, "R&S NRX"](#), on page 37
- [Chapter 6.8, "R&S NRP2"](#), on page 38

6.1 R&S NRP Toolkit



Before you start using the power sensor, it is recommended to install the R&S NRP Toolkit.

The R&S NRP Toolkit is the basic software package that supplies low-level drivers and tools for all power sensors. The components of the R&S NRP Toolkit depend on the operating system.

6.1.1 Versions and Downloads

The R&S NRP Toolkit is available for the Microsoft Windows operating systems listed under [Chapter 6.1.2, "System Requirements"](#), on page 27, Linux distributions and MacOSX. Several R&S NRP Toolkit versions are available on your documentation CD-ROM.

The latest version for Windows is available at www.rohde-schwarz.com/software/nrp-toolkit.

To obtain an R&S NRP Toolkit for an operating system other than Microsoft Windows, contact the Rohde & Schwarz customer support: customersupport@rohde-schwarz.com

6.1.2 System Requirements

Hardware requirements:

- Desktop computer or laptop, or an Intel-based Apple Mac
- LAN interface and equipment for setting up a LAN connection.
See [Chapter 4.5.2, "Setting Up a LAN Connection"](#), on page 15.

Supported operating systems:

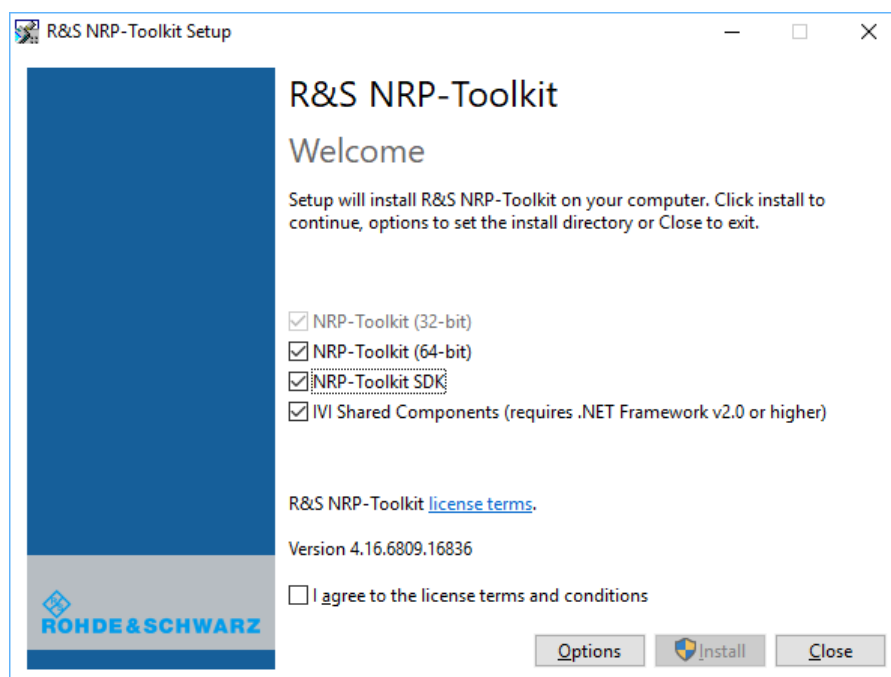
- Microsoft Windows versions
 - Microsoft Windows Vista 32/64-bit
 - Microsoft Windows 7 32/64-bit
 - Microsoft Windows 8/ 8.1 32/64-bit
 - Microsoft Windows 10 32/64-bit
- For information on other operating systems, see [Chapter 6.1.1, "Versions and Downloads"](#), on page 27.

6.1.3 R&S NRP Toolkit for Windows

The R&S NRP Toolkit installer for Windows-based systems contains the components described in the release notes available at www.rohde-schwarz.com/software/nrp-toolkit.

Installing on a computer

1. Start the R&S NRP Toolkit installer on the Windows-based computer.
In the "NRP-Toolkit Setup" dialog, the correct R&S NRP Toolkit version for your operating system, 32-bit or 64-bit, is already selected.
2. Enable the components you want to install.
 - "NRP-Toolkit (SDK)"
The software development kit (SDK) provides programming examples for the R&S power sensors.
 - "IVI Shared Components"
Installs the USBTMC driver. Enabled by default because the installation is recommended.
See also [Table 7-1](#).



3. Accept the license terms to continue with the installation.
4. Click "Next" and complete the installation process.

6.1.3.1 Components of the R&S NRP Toolkit

Access: "Start" > "NRP-Toolkit"

The following tools are part of the R&S NRP Toolkit for Windows.

Configure Network Sensor

Useful if you have troubles establishing a LAN connection with an R&S NRP LAN power sensor. The tool provides the following functions:

- Configuring the network settings by (temporary) connecting the selected sensor to the computer using USB.
- Discovering the sensors that have been configured via the Zeroconf (APIA) protocol.

The tool comes with a guide (PDF) that is also available in the "Start" menu. The guide explains the network setup.

Firmware Update

You can use the Firmware Update for NRP Family program to load new firmware for the power sensors.

For further details, see the user manual.

NRP Version Display

Displays version information of all installed, power measurement-relevant software packages.

R&S NRP-Z Uncertainty Calculator

Determines the expanded measurement uncertainty. The tool comes with a manual (PDF) that is also available in the "Start" menu.

S-Parameter Update Multi

Helps loading an S-parameter table into the power sensor.

For further details, see the user manual.

Terminal

Low-level communication program for sending commands to the power sensor.

6.2 Browser-Based User Interface



Requires a power sensor with networking capabilities, a R&S NRP LAN power sensor.

With the integrated, browser-based graphical user interface of the LAN power sensor, you can easily configure the most common settings and measure in the provided measurement modes.

There is no installation required. The web user interface can be used with all devices and operating systems, including tablets and smart phones that are connected to the same network.

Required equipment

- R&S NRP LAN power sensor
- LAN cables
- PoE Ethernet switch or a non-PoE Ethernet switch and a PoE injector
- Device with a supported web browser installed:
 - Mozilla Firefox 33 or later
 - Google Chrome 36 or later
 - Microsoft Internet Explorer 10 or later
 - Safari 5.1 or later

Setup

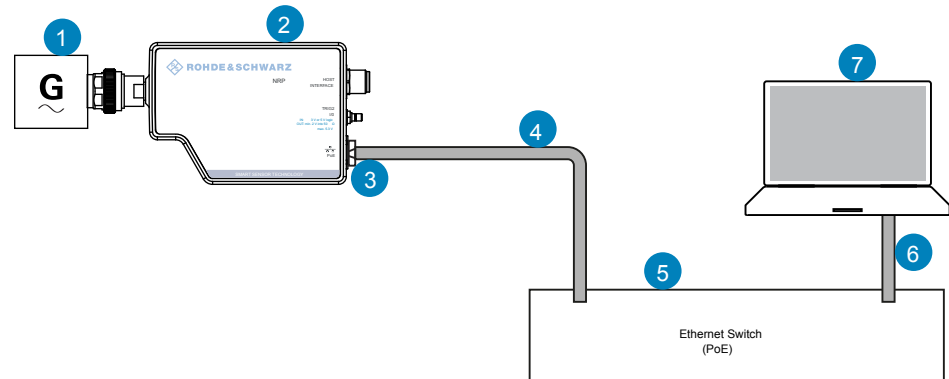


Figure 6-1: Setup with the web user interface

- 1 = Signal source
- 2 = LAN power sensor
- 3 = RJ-45 Ethernet connector
- 4, 6 = RJ-45 Ethernet cable
- 5 = Ethernet switch supporting PoE power delivery
- 7 = Computer with a supported web browser installed

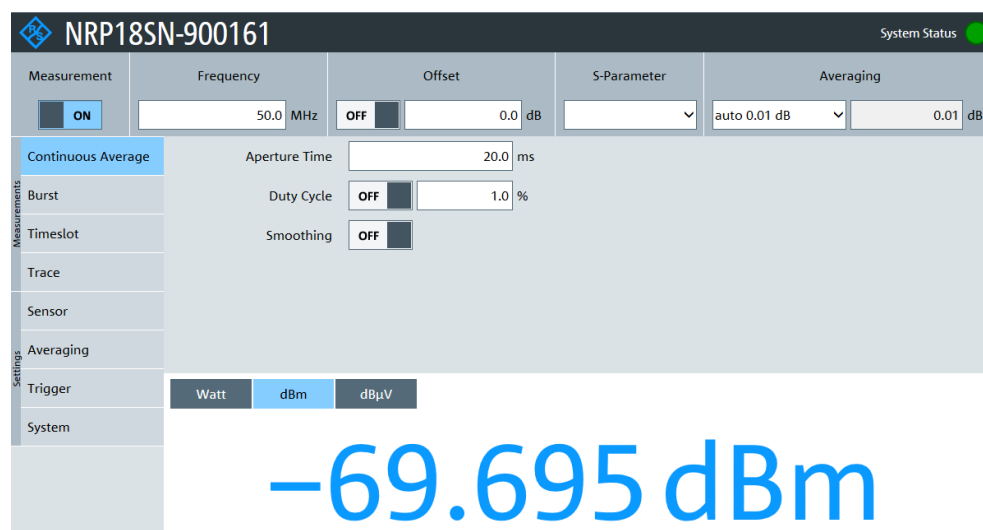


Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

Starting a measurement

1. Connect the cables as shown in [Figure 6-1](#).
For a detailed description, refer to [Chapter 4.5.2, "Setting Up a LAN Connection"](#), on page 15.
2. Open a supported web browser.
3. Enter the instrument name or the IP address of the sensor you want to connect to.
Example: `http://nrp33sn-123456`
For details on how to find out the IP address or hostname, refer to [Chapter 4.5.2.4, "Assigning the IP Address"](#), on page 20 and [Chapter 4.5.2.3, "Using Hostnames"](#), on page 19.



The main dialog of the web user interface opens.

4. Select the "Continuous Average" tab and perform any necessary changes.
5. Press "Measurement > ON" to start the measurement.

For a detailed description of the web user interface, refer to the corresponding chapter in the user manual.

6.3 Remote Control

You can remote control the R&S NRP series power sensor easily. The change to remote control occurs "on the fly" and has no influence on the manual operation.

Further information:

- See the user manual for details.
- [Chapter 7, "Remote Control Interfaces and Protocols"](#), on page 41
- [Chapter 4.5, "Connecting a Computer"](#), on page 12

6.4 R&S NRPV

The R&S NRPV enables you to measure power in all available measurement modes. Also, you can use up to four power sensors simultaneously.

The R&S NRPV is provided on your documentation CD-ROM and on the Rohde & Schwarz website as a separate standalone installation package.

Required equipment

- R&S NRP power sensor

- R&S NRP-ZKU cable or an R&S NRP-Z5 sensor hub and an R&S NRP-ZK6 cable to connect the sensor to the computer
- Windows computer with installed:
 - R&S NRP Toolkit V 4.16 or higher
 - R&S NRPV version 3.2 or higher (refer to the operating manual of the R&S NRPV for a description of the installation process)

Setup

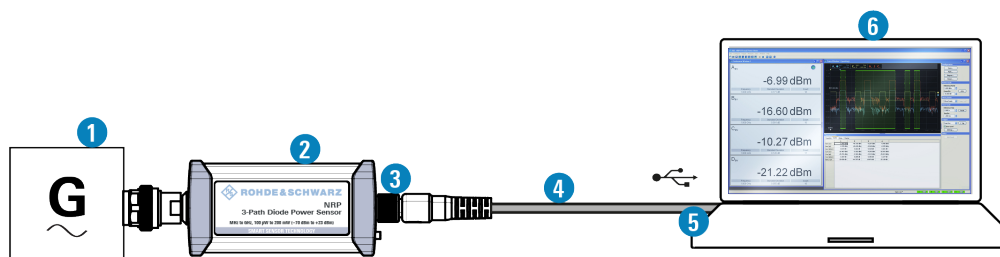


Figure 6-2: Setup with an R&S NRPV

- 1 = Signal source
- 2 = R&S NRP power sensor
- 3 = Host interface connector
- 4 = R&S NRP-ZKU cable
- 5 = USB connector
- 6 = Computer with installed R&S NRPV



Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

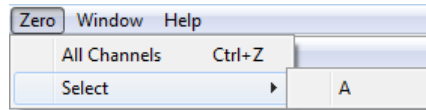
Starting a measurement

1. Connect the power sensor to the computer as shown in [Figure 6-2](#).
For a detailed description, refer to [Chapter 4.5.1.1, "Simple USB Connection"](#), on page 13.
2. Start the R&S NRPV.
3. Execute zeroing:

Note: Turn off all measurement signals before zeroing. An active measurement signal during zeroing causes an error.

 - a) Switch off the measurement signal.

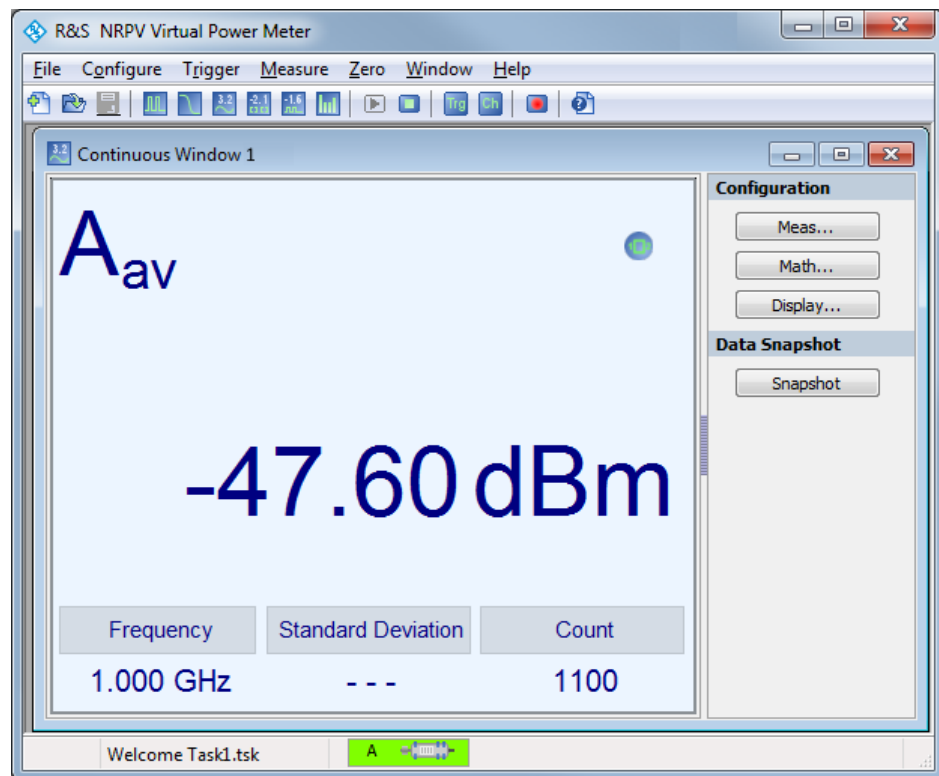
- b) Select "Zero > Select > A" (channel short name).



Zeroing takes several seconds. During zeroing, a message shows the progress. After completion, the message reports either success or an error ("Success" / "Failed").

4. Switch on the test signal of the signal source.
5. To start a continuous measurement, select "Measure > Continuous".

The "Continuous" measurement window appears. It shows the measurement results numerically, and the control panel for accessing further dialogs with parameters for measurement, evaluation and display.



For a detailed description on how to measure in this setup, refer to the operating manual of the R&S NRPV.

6.5 R&S Power Viewer

The R&S Power Viewer is software that simplifies many measurement tasks. It is provided on your documentation CD-ROM and on the Rohde & Schwarz website as a separate standalone installation package.

Required equipment

- R&S NRP power sensor
- R&S NRP-ZKU cable or an R&S NRP-Z5 sensor hub and an R&S NRP-ZK6 cable to connect the sensor to the computer
- Computer with installed:
 - R&S NRP Toolkit V 4.16 or higher
 - R&S Power Viewer version 9.2 or higher (refer to the operating manual of the R&S Power Viewer for a description of the installation process)



If you want to use an android device like a tablet or a smartphone, use the R&S Power Viewer Mobile. For details, see [Chapter 6.6, "R&S Power Viewer Mobile"](#), on page 37.

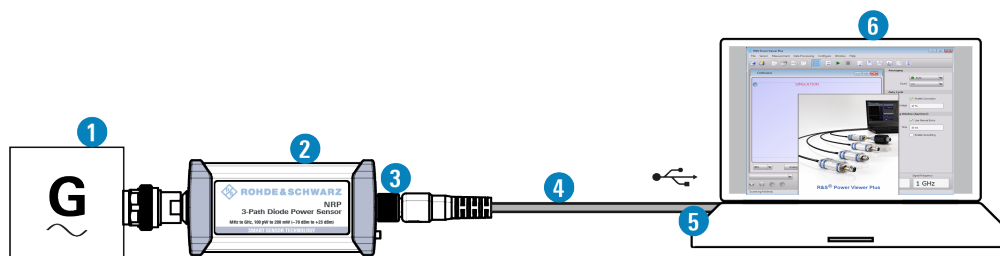
Setup

Figure 6-3: Setup with the R&S Power Viewer

- 1 = Signal source
- 2 = R&S NRP power sensor
- 3 = Host interface connector
- 4 = R&S NRP-ZKU cable
- 5 = USB connector
- 6 = Computer with installed R&S Power Viewer



Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

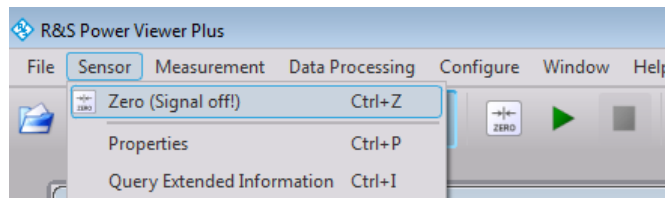
Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

Starting a measurement

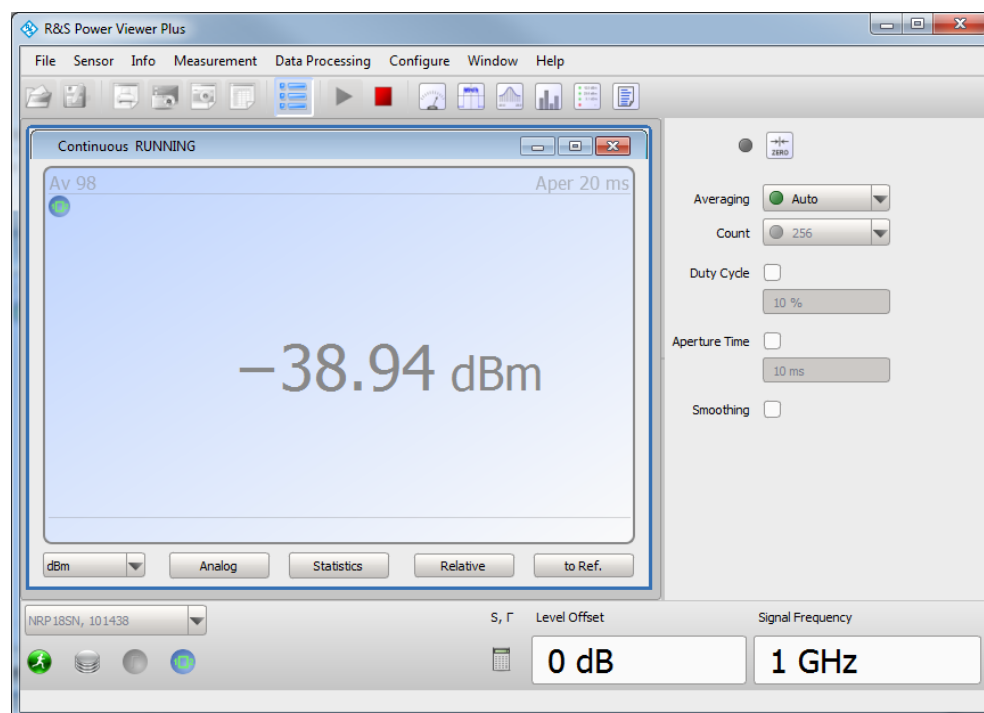
1. Connect the cables as shown in [Figure 6-3](#).
For a detailed description, refer to [Chapter 4.5.1.1, "Simple USB Connection"](#), on page 13.
2. Start the R&S Power Viewer.
3. Execute zeroing:

Note: Turn off all measurement power signals before zeroing. An active measurement signal during zeroing causes an error.

- a) Switch off the measurement signal.
- b) Select "Sensor > Zero (Signal off)".



4. Switch on the test signal of the signal source.
5. For a continuous average measurement, select "Measurement > Continuous".
The "Continuous" measurement window appears. It shows the measurement results numerically and some parameters that can be configured.
6. To start the measurement press "Measurement > Start".
The measurement result is shown in the "Continuous" measurement window.



For a detailed description of how to measure in this setup, refer to the operating manual of your R&S Power Viewer. The manual is installed automatically during the installation of the R&S Power Viewer.

6.6 R&S Power Viewer Mobile

The R&S Power Viewer Mobile extends the functionality of the R&S Power Viewer to Android-based devices, such as a smartphone and tablets.

You can download the R&S Power Viewer Mobile free of charge from the Google Play Store.

The 1MA215 "Using R&S®NRP Series Power Sensors with Android™ Handheld Devices" application note gives a detailed description on installation and features of the R&S Power Viewer Mobile. The application note is provided on the documentation CD-ROM.

6.7 R&S NRX

Using an R&S NRX, you can measure power with up to four power sensors simultaneously. You can use all sensor-dependent measurement functions and display the results in parallel.

Required equipment

- R&S NRP power sensor
- R&S NRP-ZK8 to connect the sensor to the R&S NRX
- R&S NRX

Setup

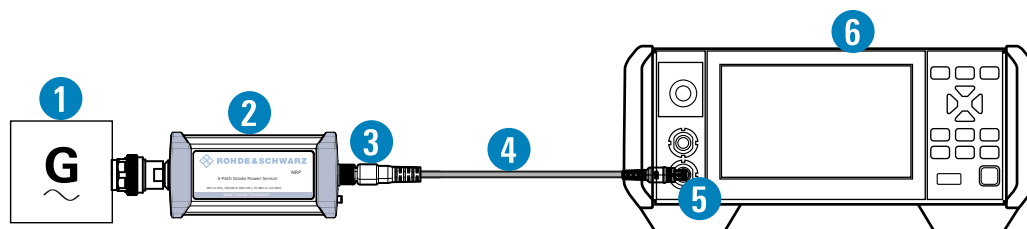


Figure 6-4: Setup with an R&S NRX base unit

- 1 = Signal source
- 2 = R&S NRP power sensor
- 3 = Host interface connector
- 4 = R&S NRP-ZK8
- 5 = Sensor input connector of the R&S NRX
- 6 = R&S NRX base unit



Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

Starting a measurement

1. Preset the R&S NRX and the connected R&S power sensors.
 - a) Press the [Preset] key.
 - b) Tap "Preset".

All parameters are set to their defaults.
2. Execute zeroing:

Note: Turn off all measurement signals before zeroing. An active measurement signal during zeroing causes an error.

 - a) Switch off the power of the signal source.
 - b) Press the [Zero] key of the R&S NRX.
 - c) Tap "Zero All Sensors".
3. Configure the measurement.
 - a) In the "Measurement Settings" dialog, select the "Measurement Type", for example "Continuous Average".
 - b) Tap "Quick Setup" > "Auto Set".
4. Switch on the signal source.

The measurement starts, and the result is displayed in dBm.
5. If necessary, perform further settings.

For a detailed description of how to measure in this setup, refer to the user manual of the R&S NRX.

6.8 R&S NRP2

With the R&S NRP power sensors and an R&S NRP2, you can measure power with up to four power sensors simultaneously. All sensor-dependent measurement functions can be used and the results can be displayed in parallel.

Required equipment

- R&S NRP power sensor
- R&S NRP-ZK6 cable to connect the sensor to the R&S NRP2
- R&S NRP2 base unit with FW version 7.11 or higher

Setup

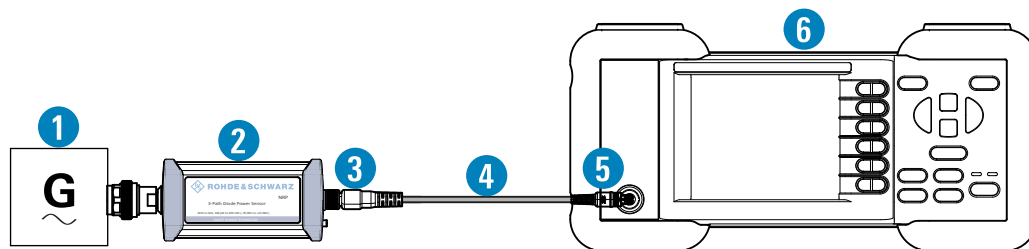


Figure 6-5: Setup with an R&S NRP2 base unit

- 1 = Signal source
- 2 = R&S NRP power sensor
- 3 = Host interface connector
- 4 = R&S NRP-ZK6 cable
- 5 = Sensor input connector of the R&S NRP2
- 6 = R&S NRP2 base unit



Incorrectly connecting/disconnecting the R&S NRP power sensors can damage the power sensors or lead to erroneous results.

Ensure that you connect/disconnect your power sensor as described in [Chapter 4, "Preparing for Use"](#), on page 10.

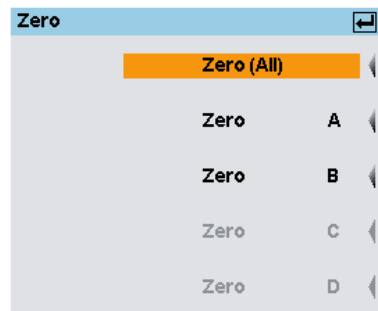
Starting a measurement

1. Connect the cables as shown in [Figure 6-5](#):
 - a) Connect the R&S NRP-ZK6 cable to the host interface connector of the sensor.
 - b) Connect the R&S NRP-ZK6 cable to a sensor input connector of the R&S NRP2.
 - c) Connect the [RF] connector of the power sensor to the signal source.
2. Preset the R&S NRP2.
 - a) Press the [(PRE)SET] hardkey.
The "File" menu appears.
 - b) Press the [(PRE)SET] hardkey again or press the "Preset" softkey.
All parameters are set to their defaults, even when in inactive operating modes.
3. Execute zeroing:

Note: Turn off all measurement signals before zeroing. An active measurement signal during zeroing causes an error.

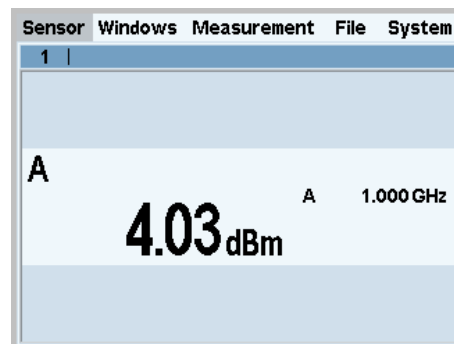
 - a) Switch off the power of the signal source.

- b) Press the [ZERO] hardkey of the R&S NRP2.
The "Zero" dialog box is displayed.



- c) Press the [ZERO] hardkey again to perform zeroing of all connected sensor channels ("Zero (All)") or press the appropriate softkey to select a specific sensor for zeroing.
4. Press the [FREQ] hardkey and enter the carrier frequency of the applied signal if the specified measurement accuracy is to be reached.
5. Switch on the signal source.

The result window indicates the result (in dBm) obtained with sensor A.



6. If necessary, perform further settings.

For a detailed description of how to measure in this setup, refer to the operating manual of your R&S NRP2.

7 Remote Control Interfaces and Protocols

For remote control, communication between the R&S NRP series power sensor power sensors and the controlling host is established based on various interfaces and protocols.

Depending on the sensor type, the power sensors support different interfaces for remote control.

- R&S NRP USB power sensors are always accessed using USB.
- R&S NRP LAN power sensors can be accessed using USB or Ethernet.

Table 7-1 describes the protocols that are supported for each interface.

Table 7-1: Remote control interfaces and protocols

Interface	Supported by	Protocols, VISA ^(*) address string and Library
USB	All power sensors	<ul style="list-style-type: none"> • USBTMC USB::<vendor id="">::<product ID>::<serial number="">::INSTR VISA</serial></vendor> • NRP legacy protocol
Ethernet	R&S NRP LAN power sensors	<ul style="list-style-type: none"> • VXI-11 TCPIP::host address>::LAN device name>::INSTR VISA • HiSLIP High-Speed LAN Instrument Protocol (IVI-6.1) TCPIP::host address>::hislip0>::INSTR VISA • Socket communication (LAN Ethernet) TCPIP::host address>::LAN device name>::<port>::SOCKET

(*) VISA is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite for remote control over USBTMC and LAN (when using VXI-11 or HiSLIP protocol) interfaces.

7.1 USB Interface

For remote control using USB connection, the computer and the power sensors must be connected via the USB interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S power sensors automatically when the USB connection is established. Apart from the USBTMC driver (which comes with the installation of the R&S NRP Toolkit), you do not have to install a separate driver.

USB Test & Measurement Class Specification (USBTMC) is a protocol that is built on top of USB for communication with USB devices. It defines class code information of the sensor, that identifies its functionality to load the respective device driver. Using VISA library, it supports service request, triggers and other operations that are commonly found in GPIB devices.

Besides USBTMC, the NRP legacy protocol is available to ensure the compatibility of the R&S NRP power sensors with the R&S NRP-Z series of power sensors. The usage of this protocol is not recommended for new applications.

The resource string represents an addressing scheme that is used to establish a communication session with the sensor. It is based on the sensor address and some instrument- and vendor-specific information.

USB Resource String

The syntax of the used USB resource string is:

```
USB::<vendor ID>::<product ID>::<serial number>[::INSTR]
```

where:

- <vendor ID> is the vendor ID for Rohde & Schwarz (0x0AAD)
- <product ID> is the product ID for the Rohde & Schwarz sensor
- <serial number> is the individual serial number on the rear of the sensor

Table 7-2: R&S NRPxxA(N) USB product IDs

R&S NRP power sensor	USB product ID
R&S NRP6A	0x0178
R&S NRP6AN	0x0179
R&S NRP18A	0x014E
R&S NRP18AN	0x014F

Table 7-3: R&S NRPxxS(N) USB product IDs

R&S NRP power sensor	USB product ID
R&S NRP8S	0x00E2
R&S NRP8SN	0x0137
R&S NRP18S	0x0138
R&S NRP18SN	0x0139
R&S NRP33S	0x0145
R&S NRP33SN	0x0146
R&S NRP33SN-V	0x0168
R&S NRP40S	0x015F
R&S NRP40SN	0x0160
R&S NRP50S	0x0161
R&S NRP50SN	0x0162

Table 7-4: R&S NRP18S-xx USB product IDs

R&S NRP power sensor	USB product ID
R&S NRP18S-10	0x0148
R&S NRP18S-20	0x014A
R&S NRP18S-25	0x014C

Table 7-5: R&S NRPxxT(N) USB product IDs

R&S NRP power sensor	USB product ID
R&S NRP18T	0x0150
R&S NRP18TN	0x0151
R&S NRP33T	0x0152
R&S NRP33TN	0x0153
R&S NRP40T	0x0154
R&S NRP40TN	0x0155
R&S NRP50T	0x0156
R&S NRP50TN	0x0157
R&S NRP67T	0x0158
R&S NRP67TN	0x0159
R&S NRP110T	0x015A

Table 7-6: R&S NRPxxTWG USB product IDs

R&S NRP power sensor	USB product ID
R&S NRP75TWG	0x01D1
R&S NRP90TWG	0x01D2
R&S NRP110TWG	0x01D3

Example:

```
USB::0x0AAD::0x00E2::100001
```

0x0AAD is the vendor ID for Rohde & Schwarz.

0x00E2 is the product ID for the R&S NRP8S power sensor.

100001 is the serial number of the particular power sensor.

7.2 Ethernet Interface

The Ethernet interface of the R&S NRP LAN power sensors allows you to integrate them in a local area network (LAN).

For remote control via a network, the computer and the power sensor must be connected via the Ethernet interface to a common network with TCP/IP network protocol. The TCP/IP network protocol and the associated network services are preconfigured on the power sensor. Software for device control and the VISA program library must be installed on the computer.

7.2.1 VISA Resource Strings

The VISA resource string is required to establish a communication session between the controller and the power sensor in a LAN. The resource string is a unique identifier, composed of the specific IP address of the sensor and some network and VISA-specific keywords.

TCPIP::*<IP address or hostname>*[:*<LAN device name>*][:INSTR]

- *TCPIP* designates the network protocol used
- *<IP address or hostname>* is the IP address or host name of the device
- [*<LAN device name>*] defines the protocol and the instance number of a subinstrument:
- [*INSTR*] indicates the power sensors resource class (optional)

The IP address or hostname is used by the programs to identify and control the sensor. While the hostname is determined by settings in the sensor, the IP address is assigned by a DHCP server when the sensor requests one. Alternatively the IP address is determined with a procedure called Zeroconf.

You can also assign a *LAN device name* which defines the protocol characteristics of the connection. See the description of the VISA resource string below for the corresponding interface protocols. The string of the *LAN device name* is emphasized in italics.

HiSLIP

TCPIP::*<IP address or hostname>*::*hislip0*[:INSTR]

- *hislip0* is the HiSLIP device name, designates that the interface protocol HiSLIP is used (mandatory)

hislip0 is composed of [*HiSLIP device name*[*HiSLIP port*]] and must be assigned.

For details of the HiSLIP protocol, refer to [Chapter 7.2.3, "HiSLIP Protocol"](#), on page 45 .

VXI-11

TCPIP::*<IP address or hostname>*[:*inst0*][:INSTR]

- *inst0* is the LAN device name, indicating that the VXI-11 protocol is used (optional)

inst0 currently selects the VXI-11 protocol by default and can be omitted.

For details of the VXI-11 protocol, refer to [Chapter 7.2.2, "VXI-11 Protocol"](#), on page 45 .

Socket Communication

TCPIP::*<IP address or hostname>*::*port*::SOCKET

- *port* determines the used port number
- *SOCKET* indicates the raw network socket resource class

Socket communication requires the specification of the port (commonly referred to as port number) and of "SOCKET" to complete the VISA resource string with the associated protocol used.

The default port for socket communication is port 5025.

For details of the socket communication, refer to [Chapter 7.2.4, "Socket Communication"](#), on page 46.

Example:

A power sensor has the IP address *10.111.11.20*; the valid resource string using VXI-11 protocol is:

```
TCPIP::10.111.11.20::INSTR
```

The DNS host name is *nrp18sn-100001*; the valid resource string is:

```
TCPIP::nrp18sn-100001::hislip0 (HiSLIP)
```

```
TCPIP::nrp18sn-100001::inst0 (VXI-11)
```

A raw socket connection can be established using:

```
TCPIP::10.111.11.20::5025::SOCKET
```

```
TCPIP::nrp18sn-100001::5025::SOCKET
```

7.2.2 VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

7.2.3 HiSLIP Protocol

The HiSLIP (high-speed LAN instrument protocol) is the successor protocol for VXI-11 for TCP-based instruments specified by the IVI foundation. The protocol uses two TCP sockets for a single connection - the first for fast data transfer, the second one for non-sequential control commands (e.g. `Device Clear` or `SRQ`).

HiSLIP has the following characteristics:

- High performance as with raw socket network connections
- Compatible IEEE 488.2 support for Message Exchange Protocol, Device Clear, Serial Poll, Remote/Local, Trigger, and Service Request
- Uses a single IANA registered port (4880), which simplifies the configuration of firewalls
- Supports simultaneous access of multiple users by providing versatile locking mechanisms
- Usable for IPv6 or IPv4 networks



The HiSLIP data is sent to the device using the "fire and forget" method with immediate return. Opposed to VXI-11, where each operation is blocked until a VXI-11 device handshake returns. Thus, a successful return of a VISA operation such as `viWrite()` does not guarantee that the sensor has finished (or even started) executing the requested command. It just indicates that the command has been delivered to the TCP/IP buffers.

For more information see also the application note at:

<http://www.rohde-schwarz.com/appnote/1MA208>.

7.2.4 Socket Communication

An alternative way for remote control of the software is to establish a simple TCP/IP connection to the device using the standard network drivers of your operating system. The so-called "socket" on Linux, "winsock" on Windows. The socket communication, also referred to as "raw Ethernet communication", does not necessarily require a VISA installation on the remote controller side.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or hostname of the sensor and the number of the port configured for remote control. The power sensors use port number 5025 for this purpose.

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