NRQ
Frequency Selective Power Sensor
Getting Started

1178370502
Version 12

ROHDE&SCHWARZ
Make ideas real

This document describes the following power sensor:

- R&S®NRQ6 (1421.3509K02)

Muehldorfstr. 15, 81671 Muenchen, Germany
Phone: +49 89 41 29 - 0
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

1178.3705.02 | Version 12 | NRQ

Throughout this manual, R&S® is indicated as R&S.

Contents

1 Safety and regulatory information

The product documentation helps you use the product safely and efficiently. Follow the instructions provided here and in the following chapters.

Intended use

The NRQ is intended for precise and fast power measurements in development and for monitoring and maintenance purposes. The supported base units are listed in the data sheet. Observe the operating conditions and performance limits stated in the data sheet.

Target audience

The target audience is developers and technicians. The required skills and experience in power measurements depend on the used operating concept.

Main applications are TX power calibration, band-limited power measurements on multistandard radios (MSR), fast power servoing and calibration of multiple active antenna modules for beamforming.

Where do I find safety information?

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

- In Chapter 1.1, "Safety instructions", on page 7. The same information is provided in many languages as printed "Safety Instructions". The printed "Safety Instructions" are delivered with the product.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

1.1 Safety instructions

Products from the Rohde & Schwarz group of companies are manufactured according to the highest technical standards. To use the products safely, follow the instructions provided here and in the product documentation. Keep the product documentation nearby and offer it to other users.

Use the product only for its intended use and within its performance limits. Intended use and limits are described in the product documentation such as the data sheet, manuals and the printed "Safety Instructions". If you are unsure about the appropriate use, contact Rohde & Schwarz customer service.

Using the product requires specialists or specially trained personnel. These users also need sound knowledge of at least one of the languages in which the user interfaces and the product documentation are available.

Reconfigure or adjust the product only as described in the product documentation or the data sheet. Any other modifications can affect safety and are not permitted.

Never open the casing of the product. Only service personnel authorized by Rohde & Schwarz are allowed to repair the product. If any part of the product is damaged or broken, stop using the product. Contact Rohde & Schwarz customer service at https://www.rohde-schwarz.com/support.

Operating the product

Only use the product indoors. The product casing is not waterproof.

Observe the ambient conditions such as altitude, operating temperature and climatic loads; see the data sheet.

Meaning of safety labels

Safety labels on the product warn against potential hazards.

	Potential hazard Read the product documentation to avoid personal injury or product damage.
	Hot surface Do not touch. Risk of skin burns. Risk of fire.

1.2 Labels on the product

Labels on the product inform about:

- Personal safety
  See "Meaning of safety labels" on page 8.
- Environment safety
  See Table 1-1.

- Identification of the product
  See "Default hostname" on page 23.
- Sensitive components
  See Table 1-2.

Table 1-1: Labels regarding environment safety

	Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its service life. For more information, see the user manual.

Table 1-2: Labels regarding sensitive components

	Electrostatically sensitive components Indicates sensitivity to touch. Follow the instructions in the product documentation to avoid product damage. See "Preventing electrostatic discharge (ESD)" on page 16.

1.3 Warning messages in the documentation

A warning message points out a risk or danger that you need to be aware of. The signal word indicates the severity of the safety hazard and how likely it will occur if you do not follow the safety precautions.

CAUTION

Potentially hazardous situation. Could result in minor or moderate injury if not avoided.

NOTICE

Potential risks of damage. Could result in damage to the supported product or to other property.

2 Welcome

This chapter provides an overview of the user documentation and an introduction to the NRQ.

2.1 Documentation overview

This section provides an overview of the NRQ user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/NRQ6

Further documents are available at:

www.rohde-schwarz.com/product/NRQ6

2.1.1 Getting started manual

Introduces the NRQ and describes how to set up and start working with the product. A printed version is delivered with the product.

2.1.2 User manual

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, instrument interfaces and error messages. Includes the contents of the getting started manual.

The user manual is also available for download or for immediate display on the Internet.

2.1.3 Application sheets

Deal with special tasks and their practical solutions.

2.1.4 CD-ROM

Provides quick access to information. Most of the information is also provided at the R&S internet site, but on different pages. Delivered with the product.

- Links to useful sites on the Rohde & Schwarz website
- Product documentation such as manuals, specifications documents, application notes, security procedures, ...
- Open-source acknowledgment documents

2.1.5 Instrument security procedures

Deals with security issues when working with the NRQ in secure areas. It is available for download on the internet.

2.1.6 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

2.1.7 Specifications documents and product brochures

The specifications document, also called data sheet, contains the technical specifications of the NRQ. 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.

See www.rohde-schwarz.com/brochure-datasheet/NRQ6

2.1.8 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 software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

The open-source acknowledgment document is provided on the user documentation CD-ROM, included in the delivery.

See www.rohde-schwarz.com/firmware/NRQ6

2.1.9 Application notes, application cards, white papers, etc.

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

See www.rohde-schwarz.com/application/NRQ6

2.2 Key features

The NRQ frequency selective power sensor sets standards in RF performance and usability. Outstanding key features are:

- Combines the advantages of a measurement receiver (dynamic range, linearity & video bandwidth) and a conventional diode-based or thermal power sensor (stability, absolute accuracy & source match).
- Easy operation with features such as browser-based user interface, autoset configuration, automatic frequency tracking or spectral preview (signal check).
- Measurements in low RF level ranges that are beyond the range of classical power meters. Faster measurements in the RF level range close to the lower boundary of classical power meters.
- Frequency selective measurements with adjustable bandwidth including a built-in ACLR measurement function

For a detailed specification, refer to the specifications document.

3 Preparing for use

Here, you can find basic information about setting up the product for the first time.

3.1 Unpacking and checking

1. Unpack the product carefully.
2. Retain the original packing material. Use it when transporting or shipping the product later.
3. Using the delivery notes, check the equipment for completeness.
4. Check the equipment for damage.

   If the delivery is incomplete or equipment is damaged, contact Rohde & Schwarz.

3.2 Choosing the operating site

Specific operating conditions ensure proper operation and avoid damage to the product and connected devices. For information on environmental conditions such as ambient temperature and humidity, see the specifications document.

Electromagnetic compatibility classes

The electromagnetic compatibility (EMC) class indicates where you can operate the product. The EMC class of the product is given in the data sheet.

- Class B equipment is suitable for use in:
  - Residential environments

  - Environments that are directly connected to a low-voltage supply network that supplies residential buildings

- Class A equipment is intended for use in industrial environments. It can cause radio disturbances in residential environments due to possible conducted and radiated disturbances. It is therefore not suitable for class B environments.
  If class A equipment causes radio disturbances, take appropriate measures to eliminate them.

3.3 Considerations for test setup

Give particular attention to the following aspects when handling NRQ.

Handling the NRQ

► **CAUTION!** Hot surfaces. Under certain conditions, the maximum surface temperatures of the NRQ can exceed the limits defined in the EN 61010-1 standard, safety requirements for electrical equipment for measurement, control and laboratory use.

Provide protection as follows:

a) Ensure that unintentional contact with the NRQ is impossible.
b) Wear heat-protective gloves when touching the NRQ after operation.

Preventing electrostatic discharge (ESD)

Electrostatic discharge is most likely to occur when you connect or disconnect a device under test (DUT). It can damage the electronic components of the product and the DUT. To prevent electrostatic discharge damage, do not touch the inner conductor of the RF connector.

EMI impact on measurement results

Electromagnetic interference (EMI) can affect the measurement results.

To suppress electromagnetic radiation during operation:

- Use high-quality shielded cables, for example, double-shielded RF and interface cables.
- Always terminate open cable ends.
- Ensure that connected external devices comply with EMC regulations.

Signal input and output levels

Information on signal levels is provided in the specifications document. Keep the signal levels within the specified ranges to avoid damage to the product and connected devices.

Allow sufficient airflow

The NRQ has fan openings at both sides of the casing, as shown in Figure 4-1. If the NRQ runs with insufficient airflow for a longer period, the NRQ overheats. Overheating can disturb the operation, damage the NRQ and lead to wrong measurement results.

When setting up the measurement assembly, be careful to allow sufficient airflow. Make sure of the following:

- All fan openings are unobstructed.
- Airflow perforations are unimpeded.
- Minimum distance between the fan openings and any object is 10 cm.

3.4 Connecting to a DUT

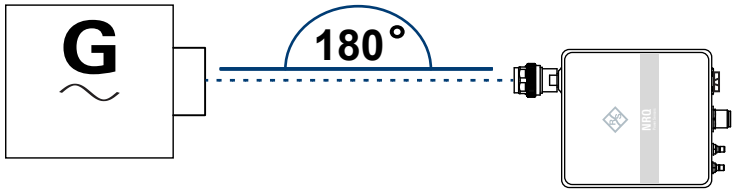
For connecting the NRQ to a DUT, use the RF connector of the NRQ. See Chapter 4.1, "RF connector", on page 32.

To connect to the DUT

1. Ensure that the RF connector of your DUT is compatible with the RF connector of the NRQ.
2. **NOTICE!** Do not touch the inner conductor of the RF connector. See "Preventing electrostatic discharge (ESD)" on page 16.

   Inspect both RF connectors carefully. Look for metal particles, contaminants and defects.

   If one the RF connectors is damaged, do not proceed, because the risk of damaging the mating connector is too high.
3. Insert the RF connector straight into the RF output of your DUT. Take care not to tilt it.



4. **NOTICE!** Risk of damaging the center pin of the RF connector. Only rotate the hex nut of the RF connector. Never rotate the NRQ itself.

   Tighten the RF connector manually.

5. Tighten the RF connector using a torque wrench with the nominal torque of 1.36 Nm (12" lbs) to ensure maximum measurement accuracy.

To disconnect from the DUT

1. **NOTICE!** Risk of damaging the center pin of the RF connector. Only rotate the hex nut of the RF connector. Never rotate the NRQ itself.

   Carefully loosen the union nut at the front of the RF connector of the NRQ.

2. Remove the NRQ.

3.5 Connecting to a power supply

The power for the NRQ is supplied over the LAN PoE+ interface. See also Chapter 4.3, "LAN PoE+ interface", on page 33.

Choose the PoE+ power-sourcing equipment (PSE) with care

Only use PoE+ power-sourcing equipment (PSE) as specified in the IEEE 802.3at standard. Otherwise, the following can happen:

- If too much power is supplied, the NRQ can get overheated and become damaged as a result.
- If the supplied power is not sufficient, the NRQ does not work properly or not at all.

To connect to a LAN PoE+ interface

1. Use a suitable cable as described in Chapter 4.3, "LAN PoE+ interface", on page 33.
2. Connect one end of the cable to the LAN interface of the NRQ.

3. Connect the other end of the cable to one of the following:
   - PoE+ port of a LAN switch:
     See Chapter 3.6.1.1, "Setup with a PoE+ ethernet switch", on page 20.
   - Output of a PoE+ injector:
     See Chapter 3.6.1.2, "Setup with a PoE+ injector and a non-PoE+ ethernet switch", on page 21.
     See Chapter 3.6.1.3, "Setup with a PoE+ injector", on page 22.

3.6 Connecting to a controlling host

For operating the NRQ, you can choose from various possibilities. For details, see Chapter 5, "Operating concepts", on page 37.

The suitable interface depends on the controlling host:

- Computer
  LAN interface
  USB interface
- R&S NRX
  Host interface

Contents:

3.6.1 Computer using a LAN connection

There are different ways to connect the NRQ to a computer according to the available equipment. The power for the NRQ is supplied over the LAN PoE+ interface.

Further information:

- Chapter 3.5, "Connecting to a power supply", on page 18
- Chapter 6, "Remote control interfaces and protocols", on page 47

Contents:

3.6.1.1 Setup with a PoE+ ethernet switch

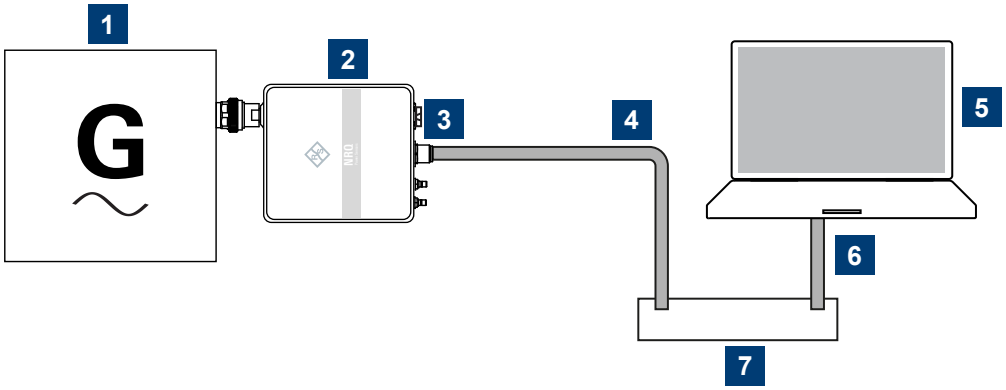


Figure 3-1: Setup with a PoE+ Ethernet switch

1 = Signal source (DUT)
2 = NRQ
3 = RJ.45 Ethernet connector
4, 6 = RJ.45 Ethernet cable
5 = Computer
7 = Ethernet switch supporting PoE+ power delivery

1. Connect the RF connector of the NRQ to the DUT. See Chapter 3.4, "Connecting to a DUT", on page 17.
2. Connect the RJ.45 Ethernet connector of the NRQ to an Ethernet switch that supports PoE+ power delivery.
3. Connect the computer to the Ethernet switch.
4. Establish a connection between the NRQ and the network. See Chapter 3.6.1.4, "Establishing a connection", on page 22.

3.6.1.2 Setup with a PoE+ injector and a non-PoE+ ethernet switch

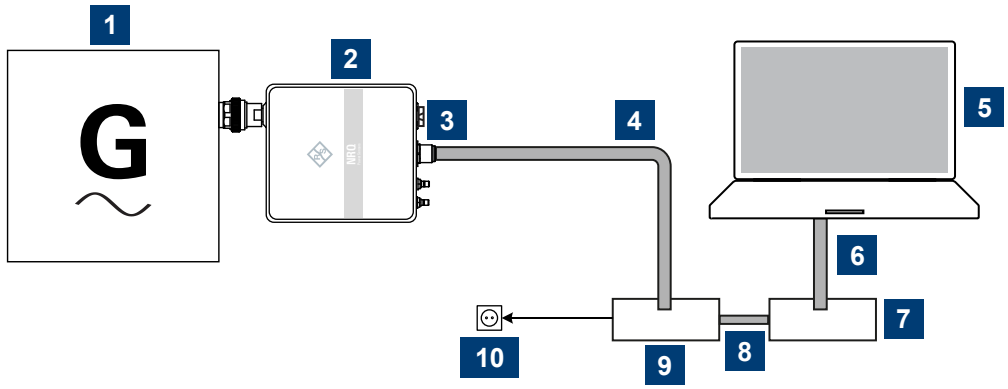


Figure 3-2: Setup with a PoE+ injector and a Non-PoE+ Ethernet switch

1 = Signal source (DUT)
2 = NRQ
3 = RJ.45 Ethernet connector
4, 6, 8 = RJ.45 Ethernet cable
5 = Computer
7 = Non-PoE+ Ethernet switch
9 = PoE+ injector
10 = AC supply

1. Connect the RF connector of the NRQ to the DUT. See Chapter 3.4, "Connecting to a DUT", on page 17.
2. Connect the RJ.45 Ethernet connector of the NRQ 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 NRQ and the network. See Chapter 3.6.1.4, "Establishing a connection", on page 22.

3.6.1.3 Setup with a PoE+ injector

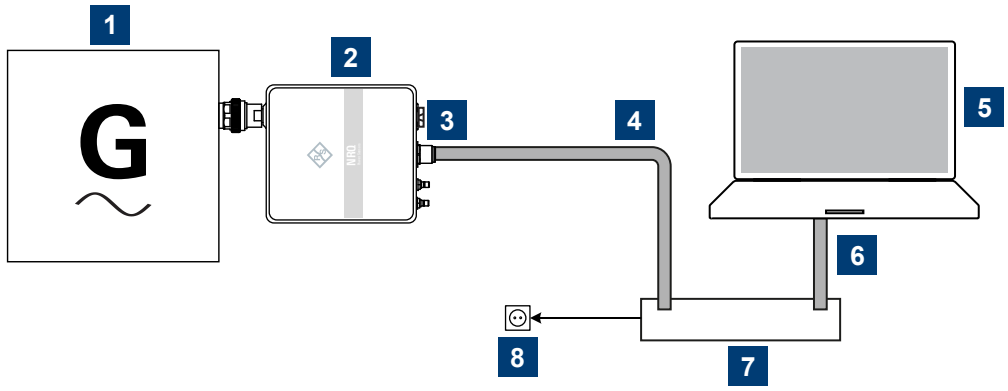


Figure 3-3: Setup with a PoE+ injector

1 = Signal source (DUT)
2 = NRQ
3 = RJ.45 Ethernet connector
4, 6 = RJ.45 Ethernet cable
5 = Computer
7 = PoE+ injector
8 = AC supply

1. Connect the RF connector of the NRQ to the DUT. See Chapter 3.4, "Connecting to a DUT", on page 17.
2. Connect the RJ.45 Ethernet connector of the NRQ 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 connection between the NRQ and the network. See Chapter 3.6.1.4, "Establishing a connection", on page 22.

3.6.1.4 Establishing a connection

There are two methods to establish a network connection:

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

In both cases, you can address the NRQ as follows:

- Chapter 3.6.1.5, "Using hostnames", on page 23
- Chapter 3.6.1.6, "Assigning the IP address", on page 24

To set up a network Ethernet connection

1. Connect the NRQ to the network or to a single computer.

   By default, the NRQ 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 NRQ 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:
   - Chapter 4.3, "LAN PoE+ interface", on page 33

3.6.1.5 Using hostnames

In a LAN that uses a domain name system (DNS) server, you can address each computer or instrument connected in the LAN using its unique hostname instead of the IP address. The DNS server translates the hostname into the IP address. The hostname is especially useful when using a DHCP server, as a new IP address can be assigned each time the instrument is restarted.

The NRQ is delivered with a default hostname that you can change.

Default hostname

The default hostname follows the syntax:

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

- `<device name>` is the short name of your NRQ.
  For example, the `<device name>` of the NRQ is `nrq6`.
- `<serial number>` is the individual serial number of the NRQ. The serial number is printed on the bar code sticker at the rear side of the NRQ. It is the third part of the device ID:

Example:

Serial number of the NRQ: *123456*

Default hostname: `nrq6-123456`

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

The NRQ supports zero configuration networking, used in networks without DHCP server, such as peer-to-peer networks. Thus, you can connect the NRQ 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 NRQ, try the default hostname and 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: `nrq6-123456`

Extended hostname: `nrq6-123456.local`

3.6.1.6 Assigning the IP address

Depending on the network capabilities, the TCP/IP address information for the NRQ is obtained in different ways:

- If the network supports dynamic TCP/IP configuration using the dynamic host configuration protocol (DHCP), the address information is assigned automatically.
- If the network does not support DHCP, the NRQ tries to obtain the IP address via the Zeroconf (APIPA = automatic private IP addressing) protocol. If this attempt does not succeed or if the NRQ is set to use an alternate TCP/IP configuration, you have to set the IP address manually.

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

Identify the NRQ using hostnames

In networks using a DHCP server, it is recommended that you address the NRQ by its unique hostname, see Chapter 3.6.1.5, "Using hostnames", on page 23.

A hostname is a unique identifier of the NRQ that remains permanent as long as it is not explicitly changed. Hence, you can address the NRQ by the same identification, irrespective of whether it is a network or a point-to-point connection.

3.6.2 Computer using a USB connection

You can connect the NRQ to a computer using the host interface and control it as described in Chapter 5, "Operating concepts", on page 37.

Further information:

- Chapter 6, "Remote control interfaces and protocols", on page 47

Contents:

3.6.2.1 Simple USB connection

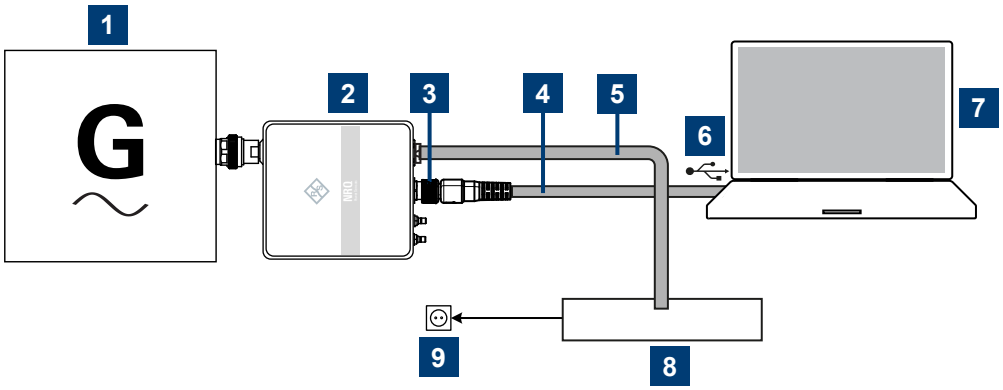


Figure 3-4: Setup with an R&S NRP-ZKU cable

1 = Signal source (DUT)
2 = NRQ
3 = Host interface connector
4 = R&S NRP-ZKU cable
5 = RJ.45 Ethernet cable
6 = USB connector
7 = Computer with installed VISA driver or R&S NRP Toolkit
8 = PoE+ injector
9 = AC supply

1. Connect the NRQ to the signal source (DUT). See Chapter 3.4, "Connecting to a DUT", on page 17.
2. Connect the NRQ to the power supply. See Chapter 3.5, "Connecting to a power supply", on page 18.
3. Connect the R&S NRP-ZKU cable to the host interface connector of the NRQ:
   a) Insert the screw-lock cable connector of the R&S NRP-ZKU cable into the host interface connector. Take care that the guide lug on the left side of the host interface connector fits into the guide gap of the cable connector.

   1 = Guide lug

   b) To minimize the chance of cross-threading, turn the end cap counterclockwise until the threads of the end cap align with the threads of the connector.
   c) Tighten the union nut carefully without using any force.
4. Connect the USB connector of the R&S NRP-ZKU cable to the USB host.

If the computer has a USB-C port, use an R&S NRP-ZKC cable instead of an R&S NRP-ZKU cable.

► If you want to disconnect the cable from the host interface:
   a) Loosen the union nut of the screw-lock cable connector.
   b) Remove the cable.

3.6.2.2 R&S NRP-Z5 sensor hub setup

The R&S NRP-Z5 sensor hub (high-speed USB 2.0) can host up to four NRQ power sensors and provides simultaneous external triggering to all connected sensors. It comes with an external power supply unit, a power cable and a USB cable.

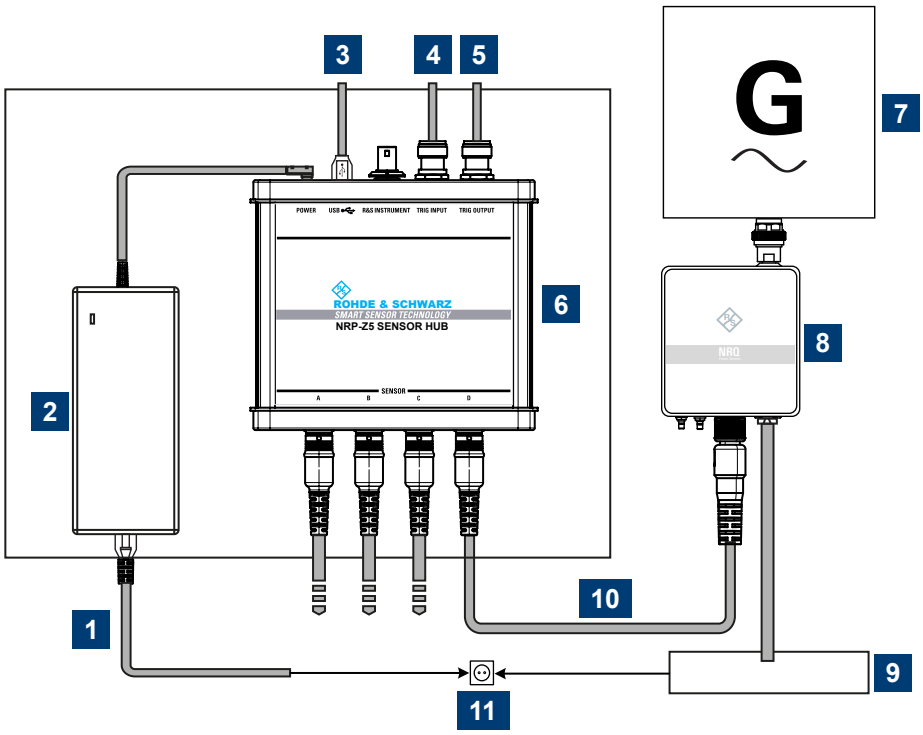


Figure 3-5: Configuration with an R&S NRP-Z5 sensor hub

1 = Connect to AC power supply
2 = External power supply unit
3 = Connect to computer with USB host interface
4 = Optional: Connect to trigger source
5 = Optional: Connect to triggered device
6 = R&S NRP-Z5 sensor hub
7 = Signal source (DUT)
8 = NRQ
9 = PoE+ injector
10 = R&S NRP-ZK6 cable
11 = AC power supply

1. Connect each NRQ to:
   a) Signal source (DUT), see Chapter 3.4, "Connecting to a DUT", on page 17.

b) Power supply, see Chapter 3.5, "Connecting to a power supply", on page 18.
c) R&S NRP-Z5 using a R&S NRP-ZK8 cable.

2. Connect the R&S NRP-Z5 to the computer using a USB cable.
3. Connect the delivered external power supply unit to the R&S NRP-Z5 and to an AC supply connector.
4. If you want to use an external trigger source, connect the trigger input of the R&S NRP-Z5 to the trigger source using a BNC cable.
5. If you want to use the trigger signal externally, connect the trigger output of the R&S NRP-Z5 to the trigger device using a BNC cable.

3.6.3 R&S NRX base unit

You can use an R&S NRX base unit as controlling host. Connect the NRQ to the R&S NRX using the host interface. The R&S NRX supports the configuration of 2 directly connected NRQ, if enhanced accordingly. For details, see the user manual and the specifications document of the R&S NRX.

The R&S NRX supplies an external reference signal that is provided by the LVDS wire pair of the 8-pole sensor connector (M12).

Further information:

- Chapter 5.3, "R&S NRX", on page 45
- R&S NRX user manual

Setup

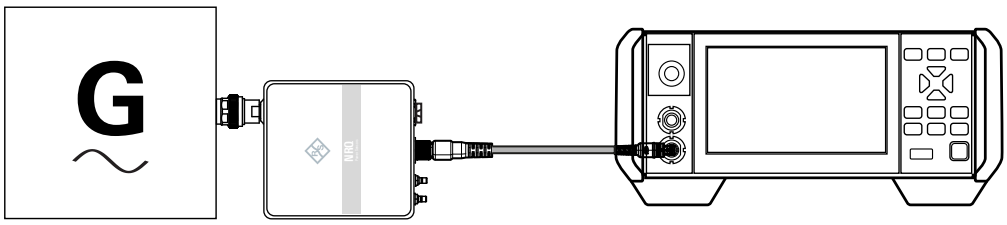


Figure 3-6: Setup with an R&S NRX base unit and one NRQ

1 = Signal source
2 = NRQ
3 = Host interface connector

4 = R&S NRP-ZK8 cable
5 = Sensor input connector of the R&S NRX
6 = R&S NRX base unit

Use an R&S NRP-ZK8 cable.

1. 8-pin female connector of R&S NRP-ZK8 cable:
   a) Insert the screw-lock cable connector into the host interface of the NRQ.
   b) Tighten the union nut manually.
2. 8-pin male connector of R&S NRP-ZK8 cable:
   a) Insert this connector into one of the sensor ports of the R&S NRX.

► If you want to disconnect the cable from the host interface of the NRQ:
   a) Loosen the union nut of the screw-lock cable connector.
   b) Remove the cable.

4 Power sensor tour

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

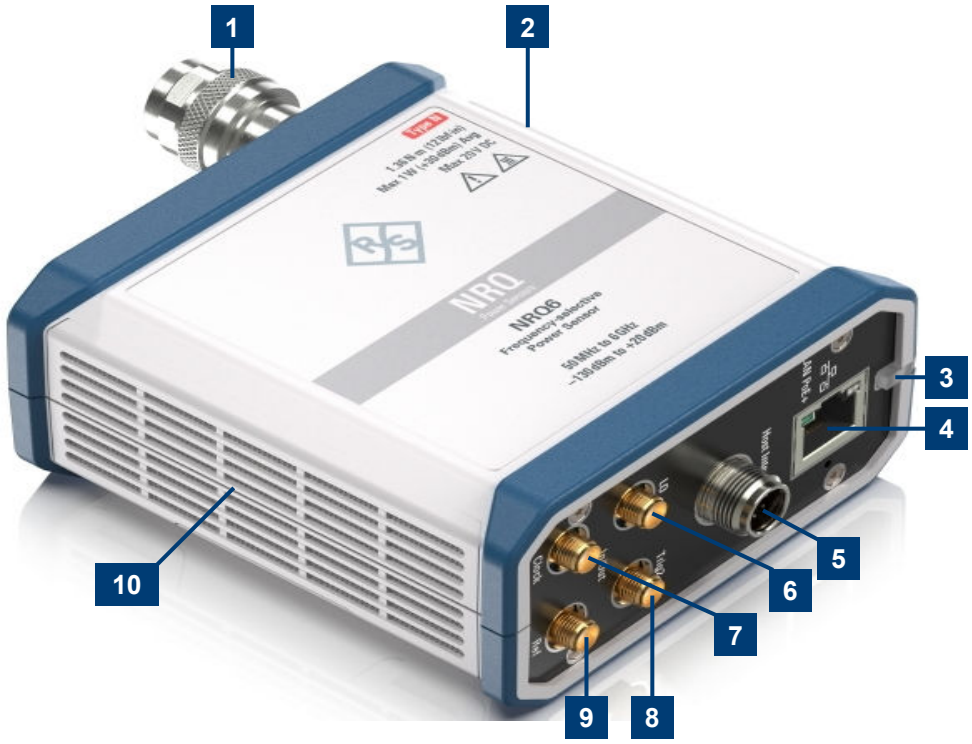


Figure 4-1: NRQ frequency selective power sensor

1 = RF connector, see Chapter 4.1, "RF connector", on page 32
2, 10 = Fan openings, see Chapter 4.9, "Fan openings", on page 36
3 = Status display, see Chapter 4.2, "Status information", on page 32
4 = LAN interface, see Chapter 4.3, "LAN PoE+ interface", on page 33
5 = Host interface, see Chapter 4.4, "Host interface", on page 34
6 = Local oscillator connector, see Chapter 4.8, "Local oscillator I/O (LO)", on page 36
7 = Sampling clock connector, see Chapter 4.7, "Clock I/O (CLK)", on page 35
8 = Trigger connector, see Chapter 4.5, "Trigger 2 I/O (TRIG2)", on page 35
9 = Reference clock, see Chapter 4.6, "Reference I/O (REF)", on page 35

The RF relevant information is printed on the casing. The RF connector information is color-coded.

4.1 RF connector

See (1) in Figure 4-1.

The male N connector is used to connect the NRQ to the device under test (DUT) or a signal generator, see Chapter 3.4, "Connecting to a DUT", on page 17.

For maximum measurement accuracy, tighten the RF connector using a torque wrench with the recommended nominal torque. For details, see "To connect to the DUT" on page 17.

4.2 Status information

See (2) in Figure 4-1.

The status LED shows the state of the sensor by color and blinking frequency.

Table 4-1: Possible states

	Color	Illumination	State
○	White	Steady	Idle The sensor performs no measurement and is ready for use.
☼	White	Fast flashing	Firmware update or reboot is in progress. When the firmware update or reboot is finished, the LED changes to glowing white steadily, indicating the idle state.
●	Yellow	Steady	Waiting for trigger state.
●	Green	Steady	Measurement is running.
●	Turquoise blue	Steady	Zeroing is in progress.
✶	Red	Slow flashing	Static error
☼	Red	Fast flashing	Critical static error **Note:** If this state occurs after a firmware update, the update was not successful. Perform the firmware update again.

Further information:

- Troubleshooting in the user manual.

4.3 LAN PoE+ interface

See (3) in Figure 4-1.

1 Gigabit LAN interface (1000 Base-T). The assignment of the RJ.45 CAT5 connector supports twisted-pair UTP/STP cables in a star configuration (UTP stands for "unshielded twisted pair", and STP for "shielded twisted pair").

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

The power for the NRQ is supplied over the LAN PoE+ interface.

The LAN PoE+ interface also connects the NRQ to a local area network (LAN) for remote control, remote operation and data transfer.

NRQ requires PoE+

The electrical power for the NRQ is provided by PoE+, power over Ethernet. The IEEE 802.3at standard specifies 25.4 W per port. For details, see Chapter 3.5, "Connecting to a power supply", on page 18.

The power delivery at a USB host interface is not sufficient to run the NRQ properly. Therefore, you cannot use it as power supply for the NRQ.

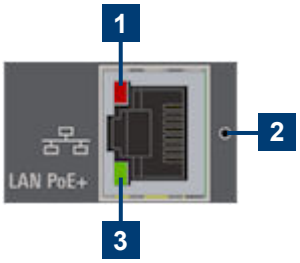


Figure 4-2: LAN [PoE+] interface

1 = Network status LED
2 = LAN reset button
3 = PoE+ status LED

Network status LED

See (1) in Figure 4-2.

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.

PoE+ status LED

See (2) in Figure 4-2.

Shows whether the NRQ 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.

LAN reset button

See (3) in Figure 4-2.

Resets the Ethernet connection parameters of the power sensor to their default values.

After a LAN reset, the Ethernet interface is set DHCP mode where automatic address allocation is attempted.

4.4 Host interface

See (4) in Figure 4-1.

The 8-pole male sensor connector (M12) is used to connect the NRQ to a computer or an R&S NRX base unit.

Further information:

- Chapter 3.6.1, "Computer using a LAN connection", on page 19
- Chapter 3.6.2, "Computer using a USB connection", on page 25
- Chapter 3.6.3, "R&S NRX base unit", on page 28

- Chapter 6, "Remote control interfaces and protocols", on page 47

4.5 Trigger 2 I/O (TRIG2)

See (5) in Figure 4-1.

The female SMA connector is used as an input or output for a trigger signal.

For input and output specifications, read the label on the NRQ casing and the specifications document.

Further information:

- For details on configuration, see the user manual.

4.6 Reference I/O (REF)

See (6) in Figure 4-1.

The female SMA connector is used as an input or output for the reference clock.

By default, the NRQ generates a 10 MHz reference signal and uses it as reference clock. You can use this signal as a reference clock for other devices (output). Also, you can supply an external reference signal and use it as reference clock instead of the internal reference signal (input).

For input and output specifications, read the label on the NRQ casing and the specifications document.

Further information:

- For details on configuration, see the user manual.

4.7 Clock I/O (CLK)

See (7) in Figure 4-1.

The female SMA connector is used as an input or output for the sampling clock. By default, the NRQ generates its sampling clock internally. You can use this signal for other devices (output).

If you supply the local oscillator signal externally, you can use an external signal as sampling clock instead of the internal signal (input).

For input and output specifications, read the label on the NRQ casing and the specifications document.

Further information:

- For details on configuration, see the user manual.

4.8 Local oscillator I/O (LO)

See (8) in Figure 4-1.

The female SMA connector is used as an input or output for the local oscillator (LO) signal.

For input and output specifications, read the label on the NRQ casing and the specifications document.

Further information:

- For details on usage and configuration, see the user manual.

4.9 Fan openings

See (9, 10) in Figure 4-1.

The NRQ has fan openings on the top and on the bottom of the casing. When connecting the NRQ, be careful to allow sufficient airflow as specified in "Allow sufficient airflow" on page 17.

5 Operating concepts

For operating the NRQ, you can choose from the following possibilities:

- Chapter 5.2, "Browser-based user interface", on page 39
- Chapter 5.3, "R&S NRX", on page 45
- Chapter 5.4, "Remote control", on page 46

Also, the NRQ is supported by the R&S Power Viewer. The R&S Power Viewer is a separate standalone installation package. The installation package is provided on the Rohde & Schwarz website at:

www.rohde-schwarz.com/software/nrq6

5.1 R&S NRP Toolkit

Before you start using the power sensor, we recommend installing the latest 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.

5.1.1 Versions and downloads

The R&S NRP Toolkit is available for:

- Microsoft Windows operating systems, as listed in Chapter 5.1.2, "System requirements", on page 38
- macOS

The latest versions for Windows and macOS are available at:

- www.rohde-schwarz.com/software/nrq6

To obtain an R&S NRP Toolkit for other operating systems, contact the Rohde & Schwarz customer support, see Chapter 7, "Contacting customer support", on page 51.

5.1.2 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 3.6.1, "Computer using a LAN connection", on page 19.

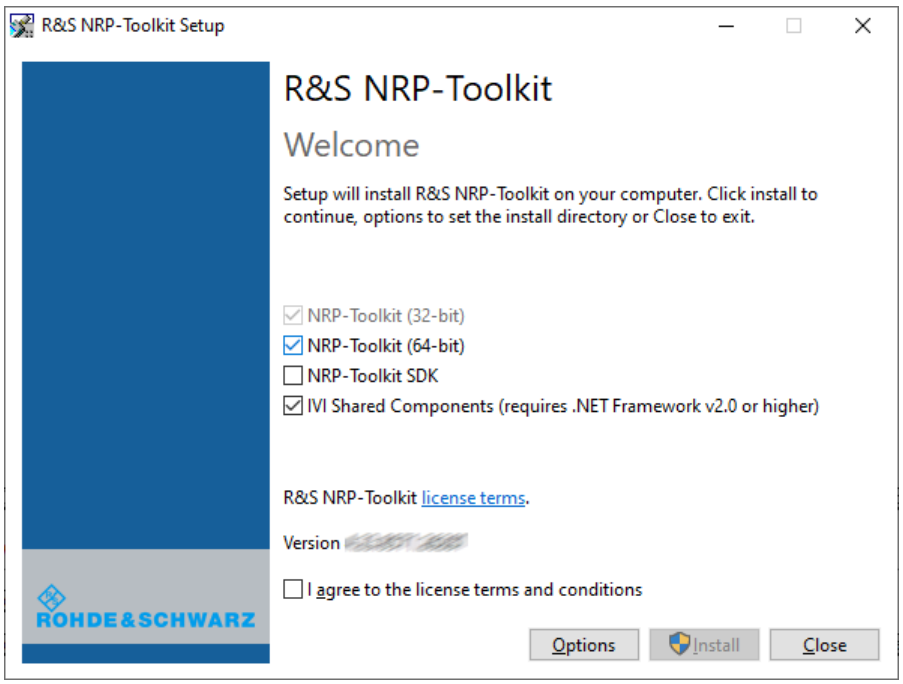
For supported Microsoft Windows versions, see the release notes.

5.1.3 R&S NRP Toolkit for Windows

The R&S NRP Toolkit installer for Windows-based systems contains the components described in the release notes.

To install the R&S NRP Toolkit

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 that 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 6-1.



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

5.1.3.1 Performing a firmware update

The Firmware Update for NRP Family program is part of the R&S NRP Toolkit for Windows. You can use the firmware update progam to update the NRQ firmware.

For further details, refer to the user manual.

5.2 Browser-based user interface

With the integrated, browser-based graphical user interface of the NRQ, you can easily configure the settings and measure in the provided measurement modes. Open a web browser on your controlling host and connect to the NRQ. No extra installation is required.

Requirements

- Controlling host:
  You can use the web user interface with all devices and operating systems, including tablets and smart phones.

- Supported web browser:
  - Mozilla Firefox 56 or later
  - Google Chrome 61 or later
  - Microsoft Internet Explorer 11 or later
  - Microsoft Edge 40

Setup

1. Set up a LAN connection.
   For an example, see Chapter 3.6.1, "Computer using a LAN connection", on page 19.

   Note: Make sure to power the NRQ with PoE+. See "NRQ requires PoE+" on page 33.
2. Connect the NRQ to the DUT as described in Chapter 3.4, "Connecting to a DUT", on page 17.

To display the Web user interface

1. Open a supported web browser.
2. Enter the hostname of the NRQ you want to connect to. See Chapter 3.6.1.5, "Using hostnames", on page 23.
   Example: If the hostname is *nrq6-900045*, enter *http://nrq6-900045*.
   You can also use the IP address, see Chapter 3.6.1.6, "Assigning the IP address", on page 24.

   The main dialog of the web user interface opens. See also Figure 5-1.

Reloading the web browser page

After a firmware update or a reboot, you need to reload the web browser page.

► Press [F5].

Parameter description

The parameters of the web user interface are described together with background information in the user manual.

5.2.1 Layout of the main dialog

The main dialog of the web user interface gives access to all available settings.

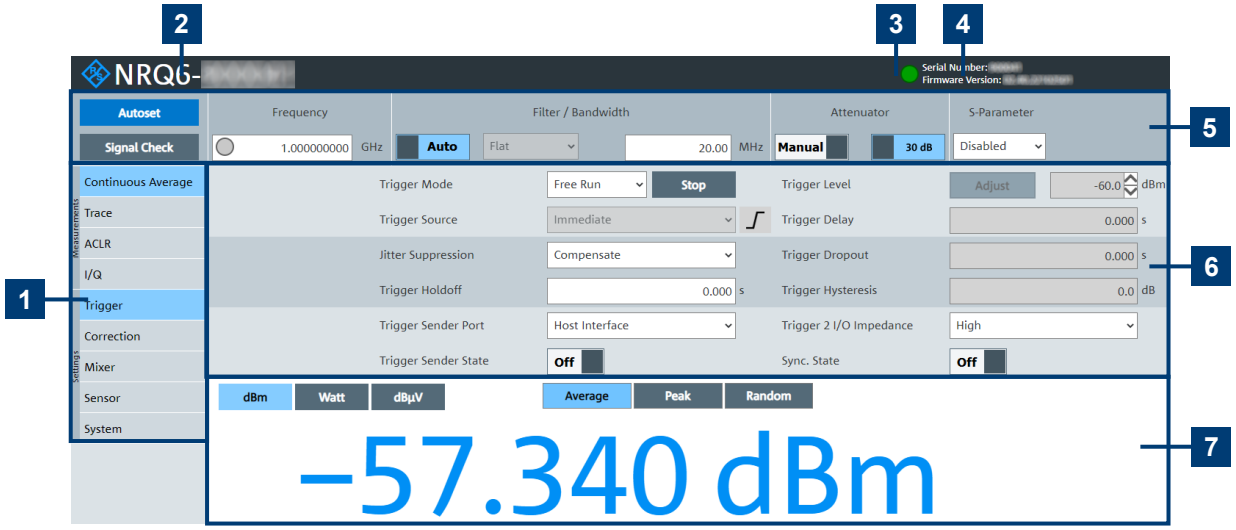


Figure 5-1: Layout of the web user interface

1 = Navigation pane
2 = Sensor name or hostname
3 = Status information
4 = Sensor information
5 = Top pane
6 = Settings pane
7 = Result pane

Sensor name or hostname

(1) in Figure 5-1

If you do not specify a sensor name, the hostname is displayed.

For details, see the user manual.

Status information

(2) in Figure 5-1

Displays the status of the NRQ. The colors are explained in Chapter 4.2, "Status information", on page 32.

You can also display detailed information.

If the NRQ is in remote mode, the status is displayed next to the status LED, see Figure 5-2.

Sensor information

(3) in Figure 5-1

Serial number of the NRQ and installed firmware version

Top pane

(4) in Figure 5-1

Stays always visible.

Navigation pane

(5) in Figure 5-1

For displaying measurement and system settings in the settings pane.

Settings pane

(6) in Figure 5-1

Displays the settings you have selected in the navigation pane.

Result pane

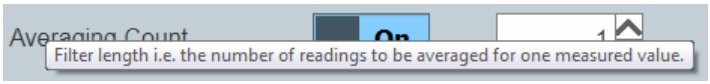
(7) in Figure 5-1

Displays the result for the selected measurement mode.

5.2.2 Tooltips

The web user interface provides tooltips on parameter functions and remote control commands.

If you place the cursor over the name of a parameter field, a short description of the parameter function is displayed.



If you place the cursor over a parameter field, the short form of the corresponding remote control command is displayed.

5.2.3 Toolbar in charts

If you move the mouse into a chart, a toolbar becomes visible in the upper right corner. Use the toolbar to analyze the chart in detail.

Table 5-1: Icons for chart analysis

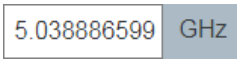
Icon	Description
	Downloads the chart in PNG format.
	Zooms into the selected window.
	Moves the chart in the direction of both axes.
	Resets the axes.

5.2.4 Setting parameters

If a parameter is not grayed, you can change its setting.

To enter quantities with units

The default unit is displayed next to the parameter field, for example:



1. If you enter just a number, the default unit remains.
   Example: *2* + [ENTER] -> 2 GHz
2. If you enter the number with a short form of the unit, the short form overrules the default unit.

   Examples:
   - *123M* + [ENTER] -> 123 MHz
   - *1234M* + [ENTER] -> 1.234 GHz (= 1234 MHz)

   See Table 5-2 for the available short forms of units.

Table 5-2: Short forms of units

Quantity	Short forms *	Corresponding unit
Frequency	*G*	GHz
	M	MHz
* Both capital and small letters are accepted.		

Quantity	Short forms *	Corresponding unit
	K	kHz
	H	Hz
Time	*S*	s
	M	ms
	U	µs
	N	ns
	P	ps
* Both capital and small letters are accepted.		

► If you want to change a number, you can also:

- Use the spinner. One click changes the number by one increment. If you keep the arrow pressed, you can quickly scroll through the possible values.
- Use the right or left arrow key of your keyboard. Select the digit you want to change. Press the key.

To select a parameter value from a list

1. Click ▼ to open the list.
   A list with all available values is displayed.
2. Click a value to select it.
   The change takes effect immediately.

To toggle between two possible values

If only two values are possible, you can toggle between these values. Toggling works for the pairs "Off"/"On", "Auto"/"Manual", "Left"/"Right", etc.

► Click the value to change to the other value.

5.3 R&S NRX

In a measurement, the R&S NRX uses all power sensor-dependent measurement functions and displays the results. Thus, you can configure both the measurement and the power sensor.

Setup

1. Connect the power sensor to the R&S NRX.
   See Chapter 3.6.3, "R&S NRX base unit", on page 28.
2. Connect the power sensor to the signal source.
   See Chapter 3.4, "Connecting to a DUT", on page 17.

Starting a measurement

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

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. If measuring in zero-IF mode (RBW > 40 MHz), consider to zero the power sensor:
   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.

5.4 Remote control

You can remote control the NRQ easily. The change to remote control occurs "on the fly".

Switching to remote control

1. Establish a link between the controller and the NRQ.
2. Send a SCPI command to the NRQ.

   The NRQ changes into remote mode.
   The web user interface is locked and becomes darker. The status is displayed next to the status LED.

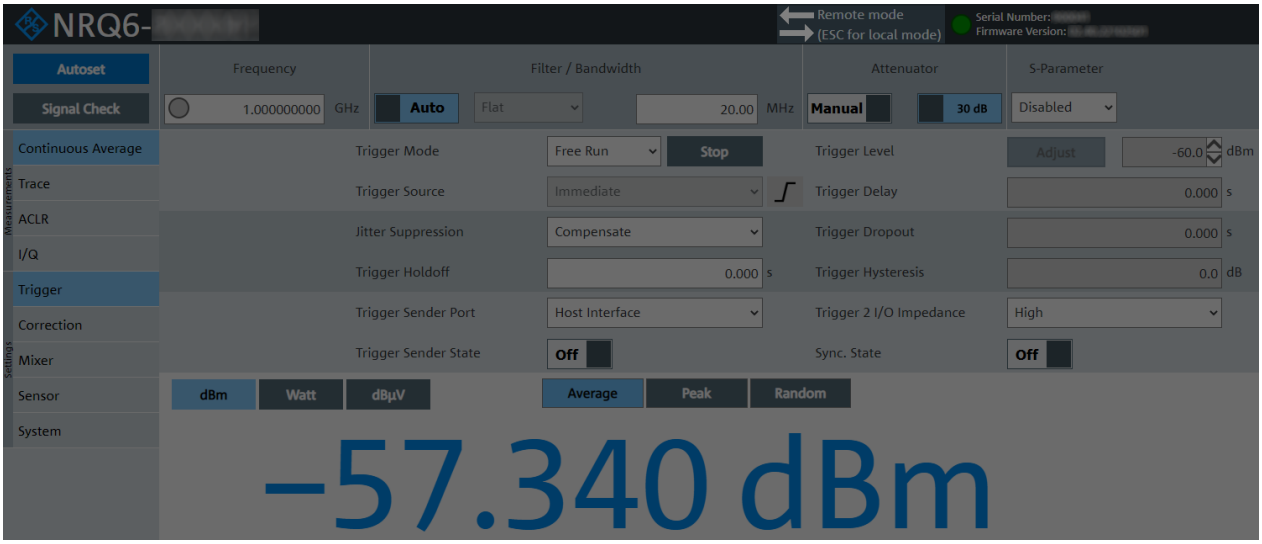


Figure 5-2: Locked web user interface during remote control

Returning to manual operation (local)

► Press [Esc] at the controller keyboard.

The NRQ changes into local mode. The lock of the web user interface is removed.

Further information:

- See the user manual for details.
- Chapter 6, "Remote control interfaces and protocols", on page 47
- Chapter 3.6, "Connecting to a controlling host", on page 19

6 Remote control interfaces and protocols

For remote control, communication between the NRQ and the controlling host is established based on the following interfaces and protocols.

Table 6-1: Supported interfaces and protocols

Interface	Protocol	VISA*) address string	Library
USB	USBTMC	USB::<vendor ID>::<product ID>:: <serial number>[::INSTR]	VISA
Ethernet	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 LAN (when using VXI-11 or HiSLIP protocol) and USBTMC interfaces. See also Chapter 6.2.1, "VISA resource strings", on page 49.		

6.1 USB interface

Computer requirements

- VISA library
  A USB connection requires the VISA library to be installed. VISA detects and configures the NRQ automatically when the USB connection is established.
- USBTMC driver
  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.

Setup

1. Connect the host interface of the NRQ and the USB interface of the computer.

See Chapter 3.6.2, "Computer using a USB connection", on page 25.

2. Make sure that the NRQ is powered by PoE+. For details, see "NRQ requires PoE+" on page 33.

USBTMC protocol

USB Test & Measurement Class Specification (USBTMC) is a protocol that is built on top of USB for communication with USB devices from the test & measurement category. It defines a dedicated class code that identifies a device's functionality. NRQ also uses this class code to identify itself as a member of the test & measurement class. Using a VISA library, such devices support service request, trigger and other operations that are commonly found in GPIB devices.

USB resource string

The VISA resource string for USBTMC device communication represents an addressing scheme that is used to establish a communication session with the power sensor. It is based on the power sensor address and some power sensor- and vendor-specific information. The syntax of the used USB resource string is:

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

- *<vendor ID>* is the vendor ID for Rohde & Schwarz.
- *<product ID>* is the product ID for the NRQ.
- *<serial number>* is the individual serial number of the NRQ, printed on the casing.

Example:

```
USB::0x0AAD::0x015B::100001
```

0x0AAD is the vendor ID for Rohde & Schwarz.

0x015B is the product ID for the NRQ.

100001 is the serial number of the particular NRQ.

6.2 Ethernet interface

The Ethernet interface of the NRQ allows you to integrate it in a local area network (LAN).

Requirements

- TCP/IP network protocol
  The local area network must support the TCP/IP network protocol.
  The TCP/IP network protocol and the associated network services are preconfigured on the NRQ.
- VISA library
  Installed on the computer.
- Software for device control
  Installed on the computer.

Setup

1. Using the Ethernet interface, connect the computer and the NRQ to a local area network. See Chapter 3.6.1, "Computer using a LAN connection", on page 19.
2. Make sure that the NRQ is powered by PoE+. For details, see "NRQ requires PoE+" on page 33.

6.2.1 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 power 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 sensor resource class (optional)

The IP address or hostname is used by the programs to identify and control the power sensor. While the hostname is determined by settings in the power sensor, the IP address is assigned by a DHCP server when the power 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.

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.

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.

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 *nrq6-100001*; the valid resource string is:

TCPIP::nrq6-100001::hislip0 (HiSLIP)

TCPIP::nrq6-100001::inst0 (VXI-11)

A raw socket connection can be established using:

TCPIP::10.111.11.20::5025::SOCKET

TCPIP::nrq6-100001::5025::SOCKET

7 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:

Figure 7-1: QR code to the Rohde & Schwarz support page

Index

T

U

V

W

Z