R&S®NRQ6
Frequency Selective Power Sensor
User Manual

1178369202

User Manual

Version 07

ROHDE&SCHWARZ

This manual describes the R&S®NRQ6 (1421.3509.02) with firmware version FW 02.20 and later.

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1178.3692.02 | Version 07 | R&S®NRQ6

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®NRQ6 is indicated as R&S NRQ6.

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1 Safety Information

The product documentation helps you use the R&S NRQ6 safely and efficiently. Follow the instructions provided here and in the printed "Basic Safety Instructions". Keep the product documentation nearby and offer it to other users.

Intended use

The R&S NRQ6 is intended for the development, production and verification of electronic components and devices in industrial, administrative, and laboratory environments. Use the R&S NRQ6 only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

Where do I find safety information?

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

- The printed "Basic Safety Instructions" provide safety information in many languages and are delivered with the R&S NRQ6.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

2 Welcome

This chapter provides an overview of the user documentation and an introduction to the R&S NRQ6.

2.1 Documentation Overview

This section provides an overview of the R&S NRQ6 user documentation.

Unless specified otherwise, you find the documents on the R&S NRQ6 product page at:

www.rohde-schwarz.com/manual/NRQ6

2.1.1 Getting Started Manual

Introduces the R&S NRQ6 and describes how to set up and start working with the product. A printed version is delivered with the R&S NRQ6.

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 CD-ROM

Provides quick access to valuable information about the usage of the R&S NRQ6. Delivered with the R&S NRQ6. Most of the information is also provided at the R&S Internet site, but on different pages.

- Useful software for installation, operation and remote control
- Product documentation (including open source acknowledgment document)
- Certificates
- Links to useful sites on the Rohde & Schwarz website

2.1.4 Application Sheets

Deal with special tasks and their practical solution.

2.1.5 Tutorials

Tutorials offer guided examples and demonstrations on operating the R&S NRQ6. They are provided on the product page of the internet.

2.1.6 Instrument Security Procedures

Deals with security issues when working with the R&S NRQ6 in secure areas. It is available for download on the Internet.

2.1.7 Basic Safety Instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the R&S NRQ6.

2.1.8 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S NRQ6. It also lists the options 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

2.1.9 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" is provided on the user documentation CD-ROM, included in the delivery. It contains verbatim license texts of the used open source software.

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

2.1.10 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 R&S NRQ6 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 data sheet.

3 Preparing for Use

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- Considerations for Test Setup....14
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3.1 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 R&S NRQ6 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.

3.1.1 Accessory List

The R&S NRQ6 comes with the following accessories:

- Printed getting started manual
- Multilingual safety brochure
- CD-ROM
- Additive data sheet ref. China ROHS

3.2 Operating Conditions

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 R&S NRQ6.

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.

3.3 Considerations for Test Setup

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 to 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.

3.4 Connecting to a DUT

The R&S NRQ6 has fan openings at both sides of the casing, as shown in Figure 4-1. When connecting the R&S NRQ6 to a DUT and setting up the measurement assembly, be careful to allow sufficient airflow.

NOTICE

Risk of damage due to insufficient airflow

If the R&S NRQ6 is run with insufficient airflow for a longer period, the R&S NRQ6 overheats. Overheating can disturb the operation, even cause damage and lead to wrong measurement results.

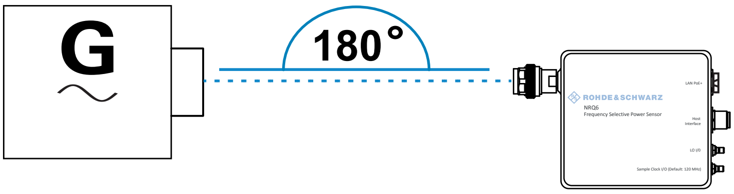
Make sure of the following:

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

To connect to the DUT

For connecting the R&S NRQ6 to a DUT, use the RF connector of the R&S NRQ6. For details, see Chapter 4.1, "RF Connector", on page 26.

1. Ensure that the RF connector of your DUT is compatible with the RF connector of the R&S NRQ6.
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. Only rotate the hex nut of the RF connector. Never rotate the R&S NRQ6 itself.

   Tighten the RF connector manually.
4. 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 R&S NRQ6 itself.

   Carefully loosen the union nut at the front of the RF connector of the R&S NRQ6.
2. Remove the R&S NRQ6.

3.5 Connecting to a Power Supply

The power for the R&S NRQ6 is supplied over the LAN PoE+ interface. See also Chapter 4.3, "LAN PoE+ Interface", on page 27.

NOTICE

Risk of R&S NRQ6 damage

Make sure to use only PoE+ power sourcing equipment (PSE) as specified in the IEEE 802.3at standard. Otherwise, the following consequences can occur:

- If too much power is supplied, the R&S NRQ6 can get overheated which can result in damage.
- If the supplied power is not sufficient, the R&S NRQ6 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 27.
2. Connect one end of the cable to the LAN interface of the R&S NRQ6.
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 17.
   - Output of a PoE+ injector:
     See Chapter 3.6.1.2, "Setup with a PoE+ Injector and a Non-PoE+ Ethernet Switch", on page 18.
     See Chapter 3.6.1.3, "Setup with a PoE+ Injector", on page 19.

3.6 Connecting to a Controlling Host

For operating the R&S NRQ6, you can choose from various possibilities. For details, see Chapter 5, "Operating Concepts", on page 31.

The suitable interface depends on the controlling host:

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

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- R&S NRX Base Unit....24

3.6.1 Computer Using a LAN Connection

There are different ways to connect the R&S NRQ6 to a computer according to the available equipment. The power for the R&S NRQ6 is supplied over the LAN PoE+ interface.

Further information:

- Chapter 3.5, "Connecting to a Power Supply", on page 15
- Chapter 14.1, "Remote Control Interfaces and Protocols", on page 175

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- Setup with a PoE+ Injector and a Non-PoE+ Ethernet Switch....18
- Setup with a PoE+ Injector....19

- Establishing a Connection..19
- Using Hostnames...20
- Assigning the IP Address..21

3.6.1.1 Setup with a PoE+ Ethernet Switch

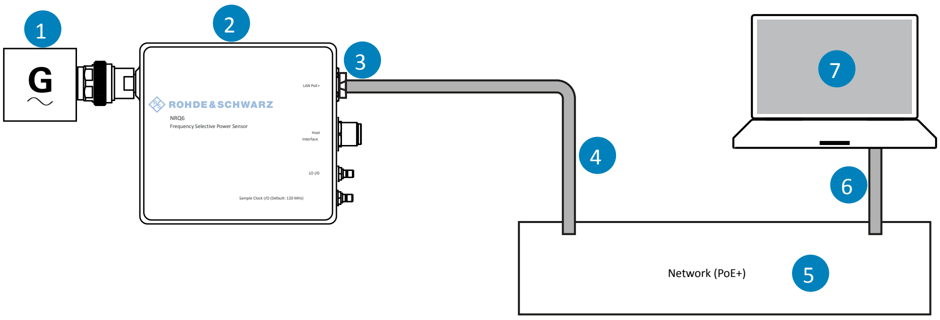


Figure 3-1: Setup with a PoE+ Ethernet switch

1 = Signal source (DUT)
2 = R&S NRQ6
3 = RJ.45 Ethernet connector
4, 6 = RJ.45 Ethernet cable
5 = Ethernet switch supporting PoE+ power delivery
7 = Computer

1. Connect the [RF] connector of the R&S NRQ6 to the DUT, see Chapter 3.4, "Connecting to a DUT", on page 14.
2. Connect the RJ.45 Ethernet connector of the R&S NRQ6 to an Ethernet switch that supports PoE+ power delivery.
3. Connect the computer to the Ethernet switch.
4. Establish a connection between the R&S NRQ6 and the network, see Chapter 3.6.1.4, "Establishing a Connection", on page 19.

3.6.1.2 Setup with a PoE+ Injector and a Non-PoE+ Ethernet Switch

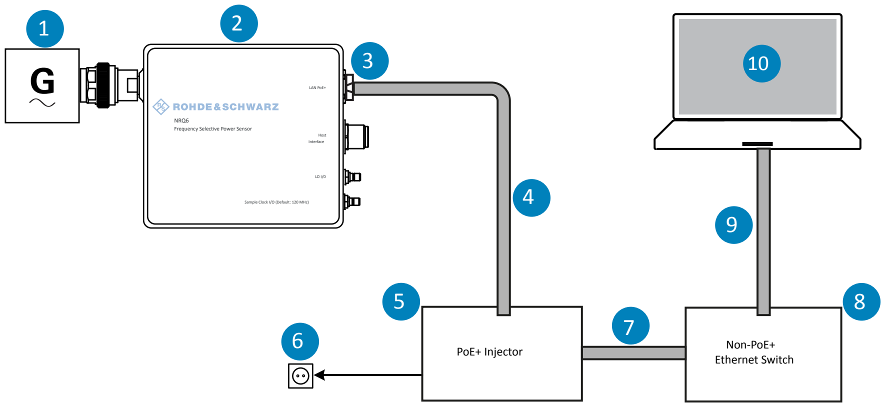


Figure 3-2: Setup with a PoE+ injector and a Non-PoE+ Ethernet switch

1 = Signal source (DUT)
2 = R&S NRQ6
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 R&S NRQ6 to the DUT, see Chapter 3.4, "Connecting to a DUT", on page 14.
2. Connect the RJ.45 Ethernet connector of the R&S NRQ6 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 R&S NRQ6 and the network, see Chapter 3.6.1.4, "Establishing a Connection", on page 19.

3.6.1.3 Setup with a PoE+ Injector

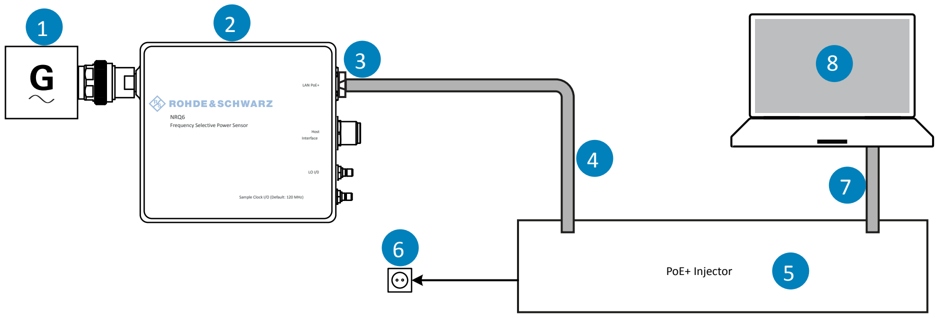


Figure 3-3: Setup with a PoE+ injector

1 = Signal source (DUT)
2 = R&S NRQ6
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 R&S NRQ6 to the DUT, see Chapter 3.4, "Connecting to a DUT", on page 14.
2. Connect the RJ.45 Ethernet connector of the R&S NRQ6 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 R&S NRQ6 and the network, see Chapter 3.6.1.4, "Establishing a Connection", on page 19.

3.6.1.4 Establishing a Connection

There are two methods to establish a network connection:

- R&S NRQ6 and computer are connected to a common network (infrastructure network).
- R&S NRQ6 and computer are connected only over the switch (peer-to-peer network).

In both cases, you can address the R&S NRQ6 as follows:

- Chapter 3.6.1.5, "Using Hostnames", on page 20
- Chapter 3.6.1.6, "Assigning the IP Address", on page 21

To set up a network Ethernet connection

1. Connect the R&S NRQ6 to the network or to a single computer.

By default, the R&S NRQ6 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 R&S NRQ6 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 27
   - Chapter 15.6, "Cannot Establish a LAN Connection", on page 206

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. This is especially useful when using a DHCP server, as a new IP address can be assigned each time the instrument is restarted.

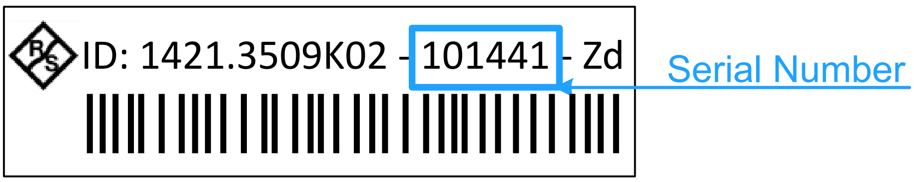
The R&S NRQ6 is delivered with a default hostname that you can change.

Default hostname

The default hostname follows the syntax:

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

- `<device name>` is the short name of your R&S NRQ6.
  For example, the `<device name>` of an R&S NRQ6 is `nrq6`.
- `<serial number>` is the individual serial number of the R&S NRQ6. The serial number is printed on the bar code sticker at the rear side of the R&S NRQ6. It is the third part of the device ID:



Example:

Serial number of the R&S NRQ6: *101441*

Default hostname: `nrq6-101441`

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

The R&S NRQ6 supports zero configuration networking, used in networks without DHCP server, such as peer-to-peer networks. Thus, you can connect the R&S NRQ6 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 R&S NRQ6, 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: `nrq6-101441`

Extended hostname: `nrq6-101441.local`

3.6.1.6 Assigning the IP Address

Depending on the network capabilities, the TCP/IP address information for the R&S NRQ6 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 R&S NRQ6 tries to obtain the IP address via the Zeroconf (APIPA = automatic private IP addressing) protocol. If this attempt does not succeed or if the R&S NRQ6 is set to use alternate TCP/IP configuration, you have to set the IP address manually.
  For a description on how to set the IP address manually, see "IP Address" on page 106.

Identify the R&S NRQ6 using hostnames

In networks using a DHCP server, it is recommended that you address the R&S NRQ6 by its unique hostname, see Chapter 3.6.1.5, "Using Hostnames", on page 20.

A hostname is a unique identifier of the R&S NRQ6 that remains permanent as long as it is not explicitly changed. Hence, you can address an R&S NRQ6 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 an R&S NRQ6 to a computer using the host interface and control it as described in Chapter 5, "Operating Concepts", on page 31.

Further information:

- Chapter 14.1, "Remote Control Interfaces and Protocols", on page 175

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3.6.2.1 Simple USB Connection

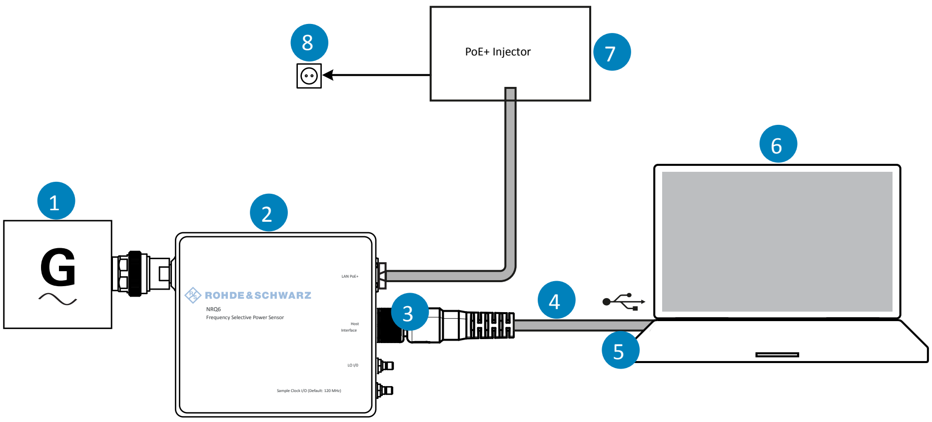


Figure 3-4: Setup with an R&S NRP-ZKU cable cable

1 = Signal source (DUT)
2 = R&S NRQ6
3 = Host interface connector
4 = R&S NRP-ZKU cable cable
5 = USB connector
6 = Computer with installed VISA driver or R&S NRP Toolkit
7 = PoE+ injector
8 = AC supply

1. Connect the R&S NRQ6 to the signal source (DUT), see Chapter 3.4, "Connecting to a DUT", on page 14.
2. Connect the R&S NRQ6 to the power supply, see Chapter 3.5, "Connecting to a Power Supply", on page 15.
3. Connect the R&S NRP-ZKU cable cable to the host interface connector of the R&S NRQ6:
   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 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 R&S NRQ6 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.

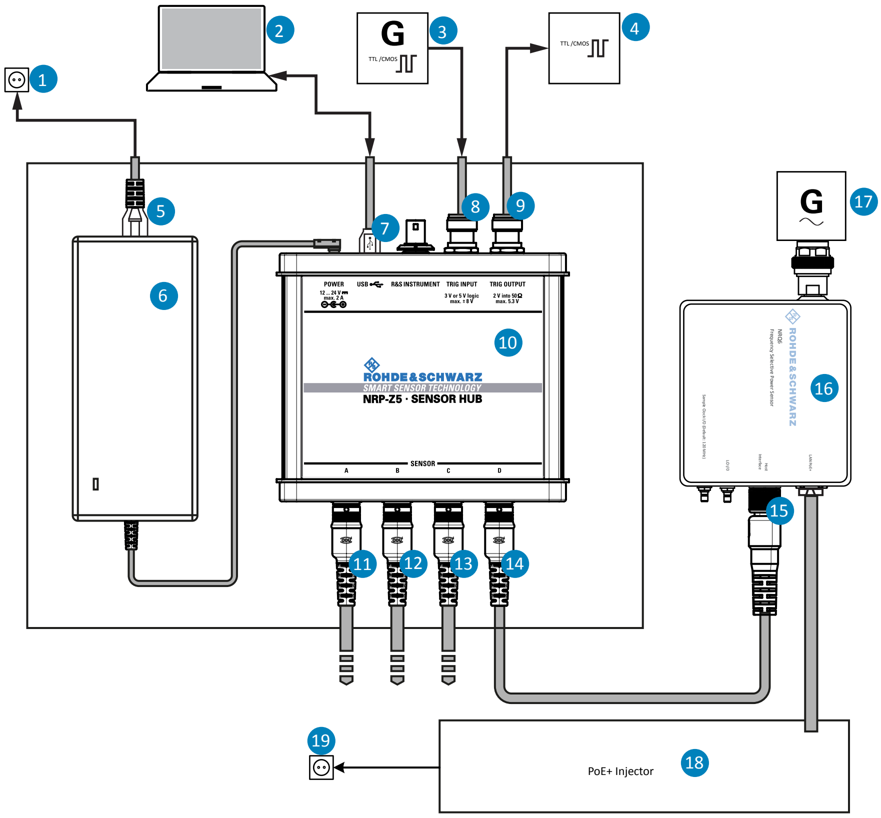


Figure 3-5: Configuration with an R&S NRP-Z5 sensor hub

1 = AC power supply
2 = Computer with USB host interface
3 = Trigger source (optional)
4 = Triggered device (optional)
5 = Power cable
6 = External power supply unit
7 = USB cable
8, 9 = BNC cable (optional)
10 = R&S NRP-Z5 sensor hub
11-14 = R&S NRP-ZK6 cable
15 = Host interface connector
16 = R&S NRQ6
17 = Signal source (DUT)
18 = PoE+ injector
19 = AC supply

1. Connect each R&S NRQ6 to:
   a) Signal source (DUT), see Chapter 3.4, "Connecting to a DUT", on page 14.
   b) Power supply, see Chapter 3.5, "Connecting to a Power Supply", on page 15.
   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 R&S NRQ6 to the R&S NRX using the host interface. The R&S NRX supports the configuration of 2 directly connected R&S NRQ6, if enhanced accordingly. For details, see the user manual and the data sheet 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:
- Table 9-2
- Chapter 5.3, "R&S NRX", on page 38
- R&S NRX user manual

Setup

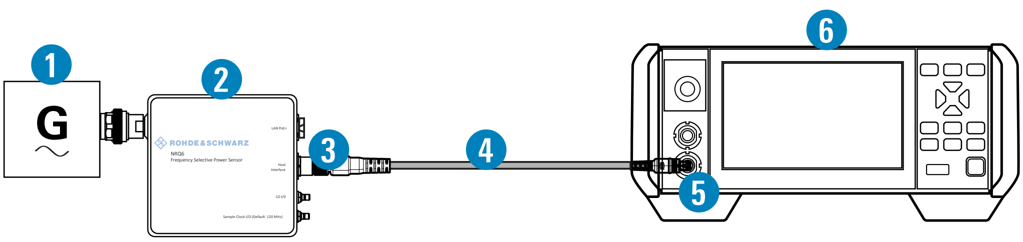


Figure 3-6: Setup with an R&S NRX base unit and one R&S NRQ6

1 = Signal source
2 = R&S NRQ6
3 = Host interface connector
4 = R&S NRP-ZK8
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:
   a) Insert the screw-lock cable connector into the host interface of the R&S NRQ6.
   b) Tighten the union nut manually.
2. 8-pin male connector of R&S NRP-ZK8:
   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 R&S NRQ6:
   a) Loosen the union nut of the screw-lock cable connector.
   b) Remove the cable.

4 R&S NRQ6 Tour

This chapter provides an overview of the available connectors and LEDs of the R&S NRQ6.

Figure 4-1: R&S NRQ6 frequency selective power sensor

1 = RF connector, see Chapter 4.1, "RF Connector", on page 26
2 = Status display, see Chapter 4.2, "Status Information", on page 27
3 = LAN interface, see Chapter 4.3, "LAN PoE+ Interface", on page 27
4 = Host interface, see Chapter 4.4, "Host Interface", on page 29
5 = Trigger connector, see Chapter 4.5, "Trigger 2 I/O (TRIG2)", on page 29
6 = Reference clock, see Chapter 4.6, "Reference I/O (REF)", on page 29
7 = Sampling clock connector, see Chapter 4.7, "Clock I/O (CLK)", on page 30
8 = Local oscillator connector, see Chapter 4.8, "Local Oscillator I/O (LO)", on page 30
9, 10 = Fan openings, see Chapter 4.9, "Fan Openings", on page 30

4.1 RF Connector

See (1) in Figure 4-1.

The male N connector is used to connect the R&S NRQ6 to the device under test (DUT) or a signal generator, see Chapter 3.4, "Connecting to a DUT", on page 14.

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 15.

NOTICE

Risk of overloading the sensor

Using the R&S NRQ6 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.

4.2 Status Information

See (2) in Figure 4-1.

The status LED shows the state of the R&S NRQ6 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	Blinking	Firmware update is in progress.
●	Yellow	Steady	Waiting for trigger state.
●	Green	Steady	Measurement is running.
●	Turquoise blue	Steady	Zeroing is in progress.
●	Red	Slow blinking	Static error
●	Red	Fast blinking	Critical static error **Note:** If this state occurs after a firmware update, the update was not successful. See "Sensor blinks red after firmware update" on page 206.

Further information:

- Chapter 15, "Troubleshooting", on page 200.

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 R&S NRQ6 is supplied over the LAN PoE+ interface.

The LAN PoE+ interface also connects the R&S NRQ6 to a local area network (LAN) for remote control, remote operation and data transfer.

R&S NRQ6 requires PoE+

The electrical power for the R&S NRQ6 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 15.

The power delivery at a USB host interface is not sufficient to run the R&S NRQ6 properly. Therefore, you cannot use it as power supply for the R&S NRQ6.

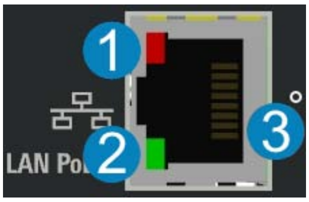


Figure 4-2: LAN [PoE+] interface

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

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 R&S NRQ6 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 R&S NRQ6 to a computer or an R&S NRX base unit.

Further information:

- Chapter 3.6.1, "Computer Using a LAN Connection", on page 16
- Chapter 3.6.2, "Computer Using a USB Connection", on page 21
- Chapter 3.6.3, "R&S NRX Base Unit", on page 24
- Chapter 14.1, "Remote Control Interfaces and Protocols", on page 175

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 R&S NRQ6 casing and the data sheet.

Further information:

- Chapter 9.2, "Trigger Settings", on page 85.

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 R&S NRQ6 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 R&S NRQ6 casing and the data sheet.

Further information:

- Chapter 9.5, "Sensor Settings", on page 101.

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 R&S NRQ6 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 R&S NRQ6 casing and the data sheet.

Further information:

- Chapter 9.5, "Sensor Settings", on page 101.

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 R&S NRQ6 casing and the data sheet.

Further information:

- Chapter 9.4, "Mixer Settings", on page 98.

4.9 Fan Openings

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

The R&S NRQ6 has fan openings on the top and on the bottom of the casing. When connecting the R&S NRQ6, be careful to allow sufficient airflow as specified in Chapter 3.4, "Connecting to a DUT", on page 14.

5 Operating Concepts

For operating the R&S NRQ6, you can choose from the following possibilities:

- Chapter 5.2, "Browser-Based User Interface", on page 33
- Chapter 5.3, "R&S NRX", on page 38
- Chapter 5.4, "Remote Control", on page 39

Also, the R&S NRQ6 is supported by the R&S Power Viewer. The R&S Power Viewer is provided on your documentation CD-ROM and on the Rohde & Schwarz website as a separate standalone installation package.

5.1 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.

5.1.1 Versions and Downloads

The R&S NRP Toolkit is available for the Microsoft Windows operating systems listed under Chapter 5.1.2, "System Requirements", on page 31, 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

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 16.

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 5.1.1, "Versions and Downloads", on page 31.

5.1.3 R&S NRP Toolkit for Windows

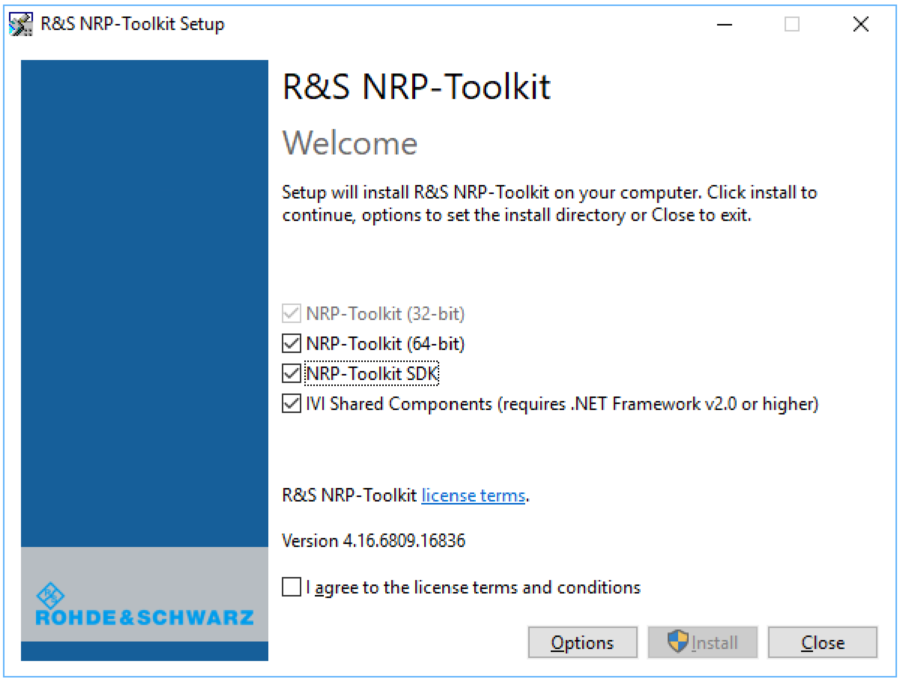
The R&S NRP Toolkit installer for Windows-based systems contains the components described in the release notes available at www.rohde-schwarz.com/software/nrp-toolkit.

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.
     See Chapter 13, "Programming Examples", on page 174.
   - "IVI Shared Components"
     Installs the USBTMC driver. Enabled by default because the installation is recommended.
     See also Table 14-1.



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 for NRP Family program to load new firmware for the power sensors.

For further details, refer to Chapter 11, "Firmware Update", on page 109.

5.2 Browser-Based User Interface

With the integrated, browser-based graphical user interface of the R&S NRQ6, 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 R&S NRQ6. 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 16.
   Note: Make sure to power the R&S NRQ6 with PoE+. See "R&S NRQ6 requires PoE+" on page 28.
2. Connect the R&S NRQ6 to the DUT as described in Chapter 3.4, "Connecting to a DUT", on page 14.

To display the Web user interface

1. Open a supported web browser.
2. Enter the hostname of the R&S NRQ6 you want to connect to. See Chapter 3.6.1.5, "Using Hostnames", on page 20.
   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 21.
   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 following chapters:

- Chapter 7, "Adapting to the Test Signal", on page 49
- Chapter 8, "Measurement Modes and Result Displays", on page 60
- Chapter 9, "Measurement Configuration", on page 79
- Chapter 10, "System Configuration", on page 104

5.2.1 Layout of the Main Dialog

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

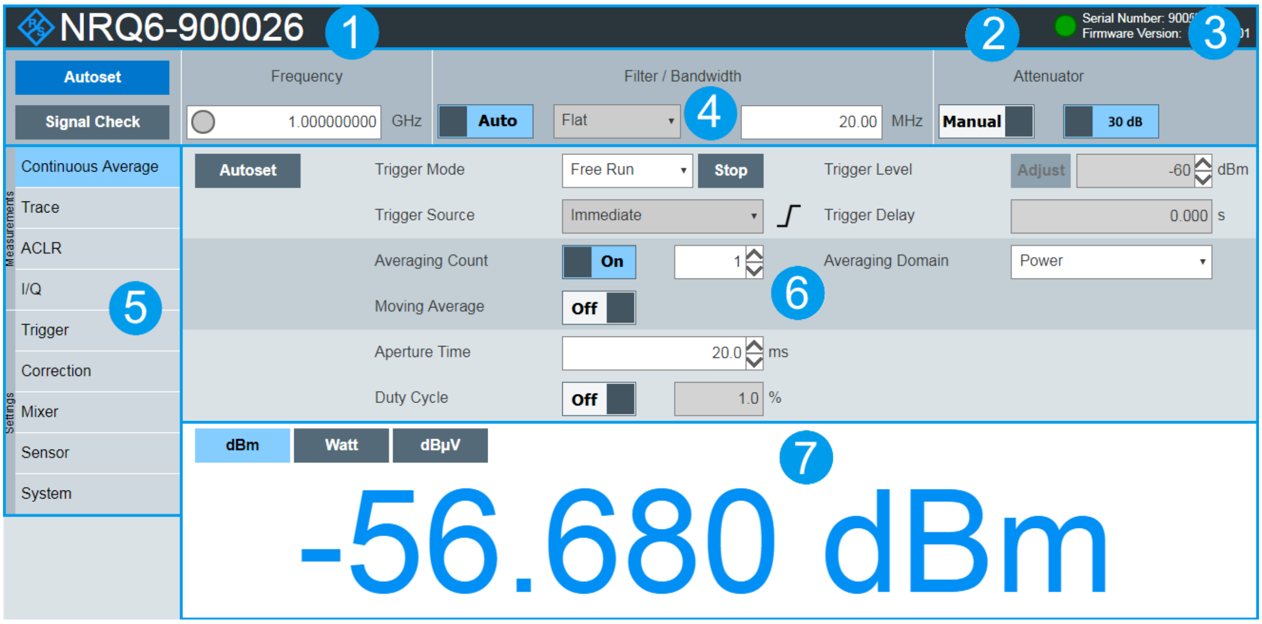


Figure 5-1: Layout of the web user interface

1 = Sensor name or hostname
2 = Status information
3 = Sensor information
4 = Top pane
5 = Navigation 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.

See "Sensor Name" on page 106.

Status information

(2) in Figure 5-1

Displays the status of the R&S NRQ6. The colors are explained in Chapter 4.2, "Status Information", on page 27.

You can also display detailed information.

See Chapter 15.2, "Error Messages", on page 200.

If the R&S NRQ6 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 R&S NRQ6 and installed firmware version

Top pane

(4) in Figure 5-1

Stays always visible.

See Chapter 7, "Adapting to the Test Signal", on page 49.

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

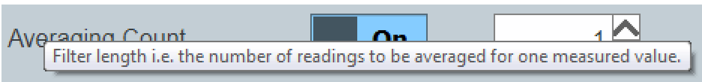
Displays the result for the selected measurement mode.

See Chapter 8, "Measurement Modes and Result Displays", on page 60.

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.
	Enlarges the chart.
	Minimizes the chart.
	Adjusts the y-axis of the chart constantly to the signal. To go back to an optimized setting of the y-axis, click . See also ."Autoscale" on page 67
	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:

5.038886599 GHz

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
	K	kHz
	H	Hz
* Both capital and small letters are accepted.		

Quantity	Short forms *	Corresponding unit
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 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 24.
2. Connect the power sensor to the signal source.
   See Chapter 3.4, "Connecting to a DUT", on page 14.

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. 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.

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

5.4 Remote Control

You can remote control the R&S NRQ6 easily. The change to remote control occurs "on the fly".

Switching to remote control

1. Establish a link between the controller and the R&S NRQ6.
2. Send a SCPI command to the R&S NRQ6.

   The R&S NRQ6 changes into remote mode.
   The web user interface is locked and becomes darker. The status is displayed next to the status LED.

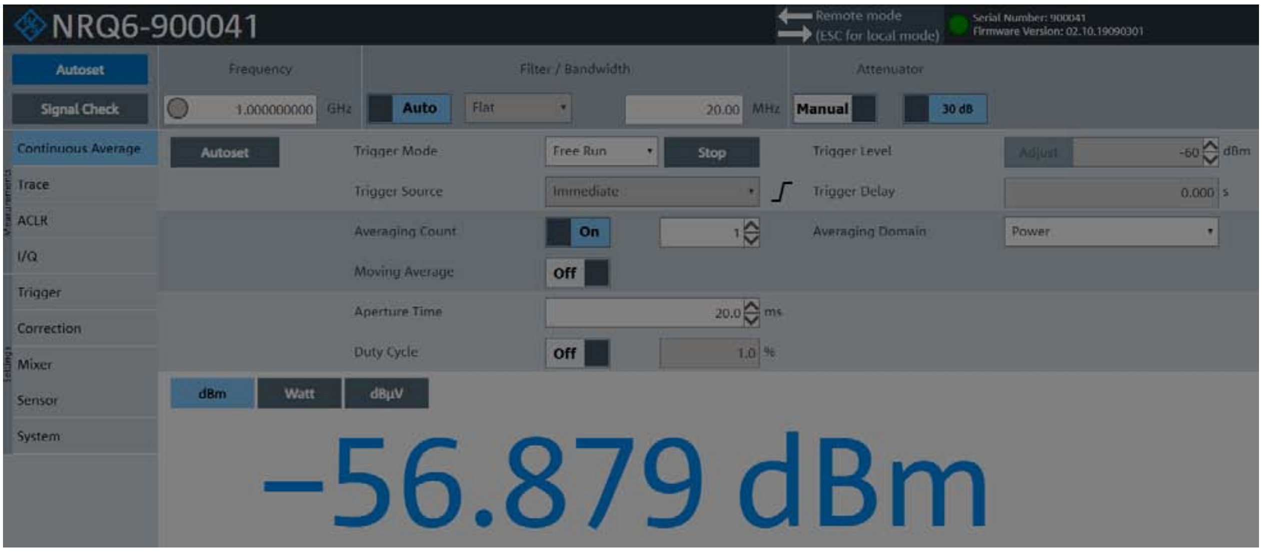


Figure 5-2: Locked web user interface during remote control

Returning to manual operation (local)

► Press [Esc] at the controller keyboard.

The R&S NRQ6 changes into local mode. The lock of the web user interface is removed.

Further information:

- Chapter 12, "Remote Control Commands", on page 115
- Chapter 14, "Remote Control Basics", on page 175
- Chapter 3.6, "Connecting to a Controlling Host", on page 16

6 Measurement Basics

- Functional Principle....41
- Measurement Procedure in Principle....41
- Measurement Duration....42
- Improving Measurement Results....43
- Impact of Measurement Parameters on Noise....43
- Potential Sources of Error....45

6.1 Functional Principle

The R&S NRQ6 is a receiver-based power sensor.

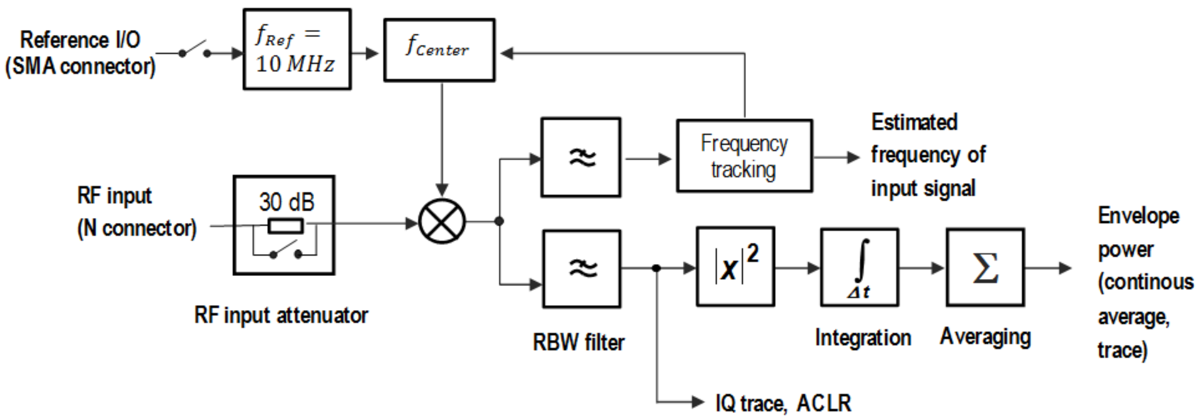


Figure 6-1: Signal flow from the RF input to the result processing

RBW is the resolution bandwidth as known from spectral analysis. If measuring with an RBW > 40 MHz, the R&S NRQ6 works in zero-IF mode.

6.2 Measurement Procedure in Principle

Unlike thermal or diode-based power sensors, the R&S NRQ6 is frequency selective. That means, you go about measuring differently than you are accustomed from the conventional power sensors.

To prepare and start a measurement

1. Take the test signal and its properties into account.
   See Chapter 7, "Adapting to the Test Signal", on page 49.
2. Select the measurement mode.

See Chapter 8, "Measurement Modes and Result Displays", on page 60.

3. Configure the measurement by selecting trigger settings, averaging, aperture time etc.
   See Chapter 8, "Measurement Modes and Result Displays", on page 60 and Chapter 9, "Measurement Configuration", on page 79.
4. For broadband measurements (RBWs > 40 MHz), perform DC zeroing.
   See Chapter 9.3.2.2, "DC Zeroing", on page 95.
5. Start the measurement.

To get measurement results quickly, the R&S NRQ6 offers numerous autoset features. In the web user interface, several settings are bundled together and controlled by an "Autoset" button. In remote control, each automatic setting is executed by a separate command.

To end a measurement

If the "Free Run" trigger mode is set, the measurement runs continuously.

► Next to "Trigger Mode", click "Stopp".

6.3 Measurement Duration

The total measurement time is determined as follows:

Filter settling time + aperture time x averaging = total measurement duration

Filter settling time

Defined by the resolution bandwidth filter. You select this filter by selecting the resolution bandwidth and optionally a filter type if not chosen automatically.

A smaller resolution bandwidth causes a larger filter settling time. The filter type also influences the resulting settling time, see also Chapter 7.3, "Resolution Bandwidth Filters", on page 52.

Aperture time

Available as a measurement parameter. However, the effectively resulting aperture time is always a multiple of the sampling period time interval defined by the resolution bandwidth filter.

If you measure periodic signals, set the aperture time to the signal period. Thus, the power fluctuations are averaged, and the measurement result becomes stable immediately.

Averaging

For non-periodic signals, disable averaging entirely and choose the aperture time according to the desired total measurement duration. This approach is most efficient since it minimizes any waiting or processing times in the sensor.

For periodic signals, the measurement result attains its maximum stability for a fixed aperture time. Thus, adjust the total measurement duration using the averaging count.

6.4 Improving Measurement Results

With the following measures, you can counteract the influencing factors on the measurement results.

How to reduce the measurement noise contributions corresponding to the fluctuations of the measurement result?

► Increase the total measurement duration.

How to reduce noise-like contributions that are caused by spurious and interference signals?

► Reduce the resolution bandwidth.

► Increase the total measurement duration. This measure can help but it does not guarantee any improvement.

How to reduce a measurement bias that is caused by the noise floor or spurious signals in the analysis bandwidth?

► Decrease the resolution bandwidth.

► Use log-power averaging ([SENSe<Sensor>:]AVERage:TYPE VIDeo).

Within the specified measurement uncertainty, measurement offsets of the sensor are always present.

6.5 Impact of Measurement Parameters on Noise

The following parameters mainly determine the fluctuation of measurement results due to noise:

- Measured power level
- Input attenuator state
- Total measurement duration

Note that the selected resolution bandwidth filter does not influence the measurement noise directly. However, the resolution bandwidth must be small enough so that the noise power is sufficiently below the measured value.

Figure 6-2 and Figure 6-3 compare the R&S NRQ6 with a conventional 3-path-diode sensor that has a class leading dynamic range. Unlike the 3-path diode sensor, the R&S NRQ6 has no auto-averaging feature. Therefore, you have to define the measurement time manually when measuring with the R&S NRQ6.

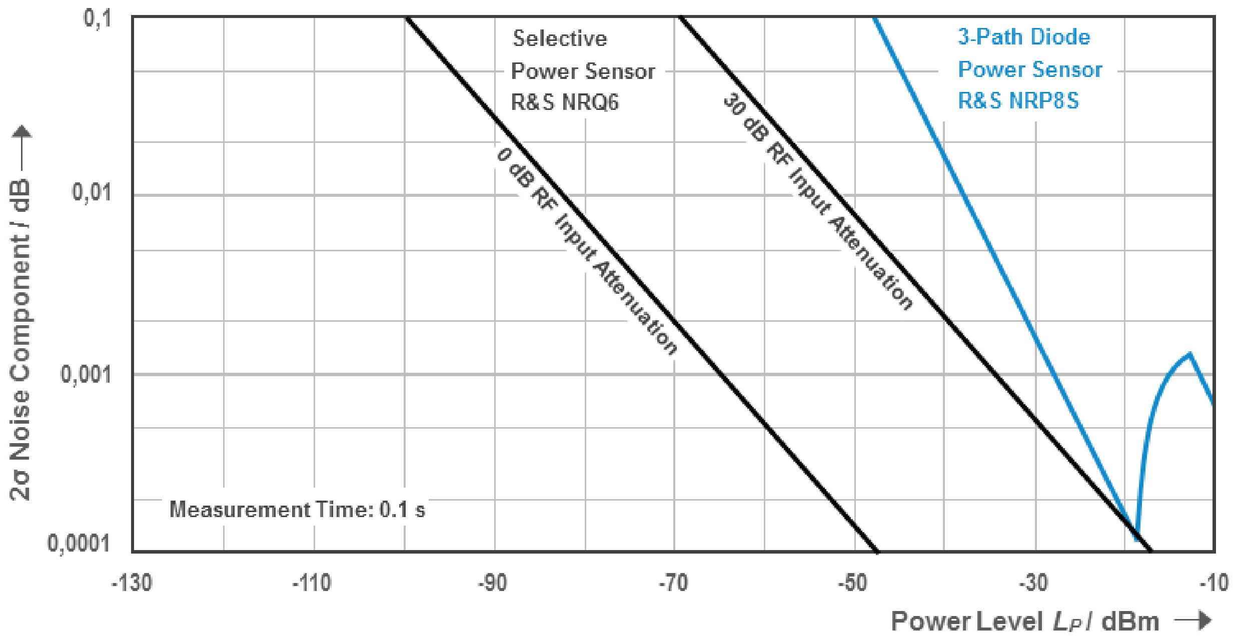


Figure 6-2: Measurement noise

Figure 6-2 shows the resulting noise contribution for a fixed measurement time of 0.1 s, assuming that the filter settling time is far smaller than the integration time and that the noise floor power is much smaller than the power level.

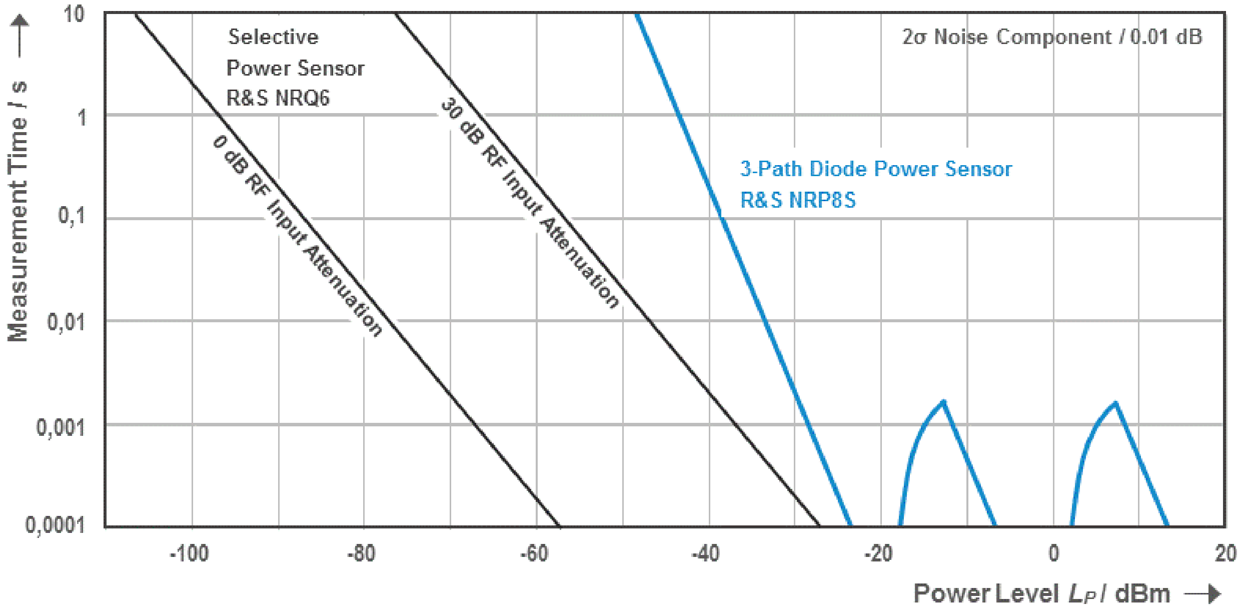


Figure 6-3: Measurement time for CW signal

Figure 6-3 shows the resulting measurement time for a fixed noise contribution of 0.01 dB (2σ), assuming that the filter settling time is far smaller than the integration time and that the noise floor power is much smaller than the power level.

Measurement time = integration time + RBW filter settling time

6.6 Potential Sources of Error

- Spurious Response Frequencies....45
- LO Leakage....46

6.6.1 Spurious Response Frequencies

The hardware design of the R&S NRQ6 differs fundamentally from a spectrum analyzer. Therefore, the R&S NRQ6 cannot provide a similar level of spurious response rejection. For isolated signals with small bandwidths and correctly specified measurement frequencies, that is no problem. It can be assumed that no signal is present at the spurious response frequencies of the sensor. But in the following situations, the measurement result can be corrupted:

- The maximum frequency and the minimum frequency of an input signal are spread by more than a factor of two ($f_{max} > 2 * f_{min}$).
- The measurement frequency is set to a value outside of the signal frequency span

The spurious response frequencies and their corresponding attenuation level vary with the measurement frequency, the resolution bandwidth and the RF input attenuator setting of the R&S NRQ6.

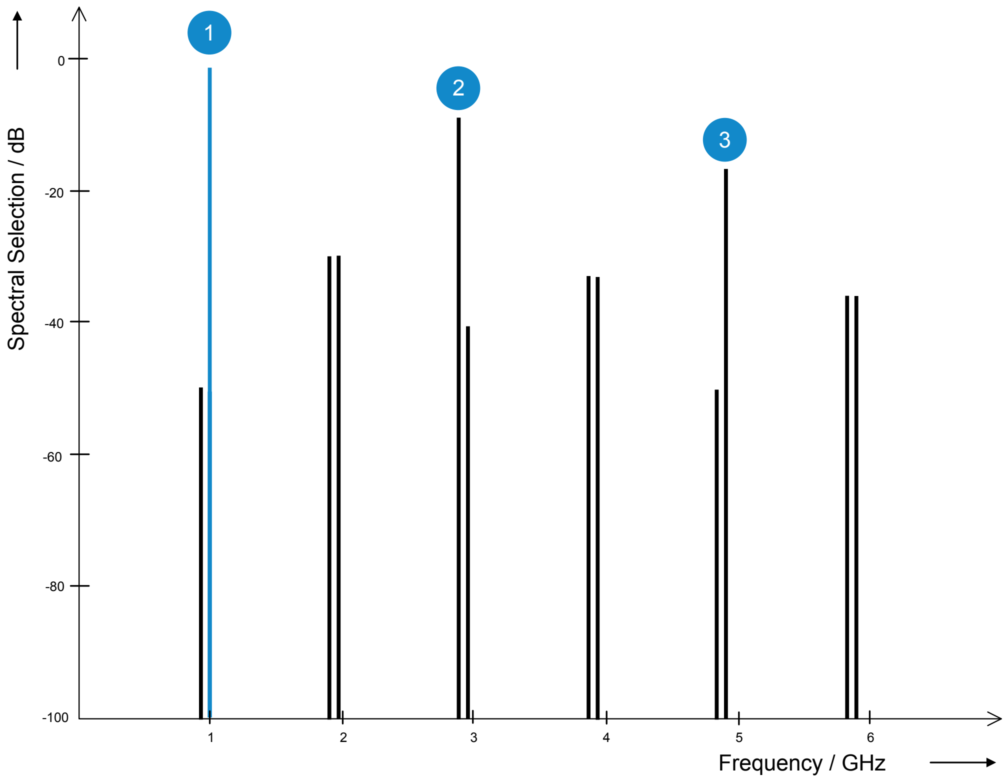


Figure 6-4: Typical spurious response of R&S NRQ6 set at 1 GHz input frequency, 20 MHz resolution bandwidth and right sideband

1 = 1st harmonic (right sideband: 1 GHz)
2 = 3rd harmonic (left sideband: 2.900 GHz)
3 = 5th harmonic (right sideband: 4.900 GHz)

For the 3rd harmonic, the image suppression of the left sideband is about 9.5 dBc. For the 5th harmonic, the image suppression of the right sideband is about 14 dBc. The exact value depends on the frequency response of the R&S NRQ6.

6.6.2 LO Leakage

In a receiver-based power sensor, signal leakage paths can occur. Local oscillator (LO) energy can leak through the mixer stage and the RF connection into DUT. In Figure 6-5, this LO leakage is symbolized by the blue arrow.

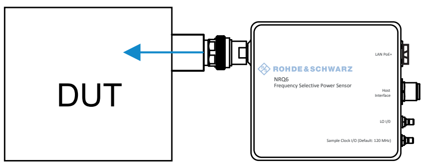


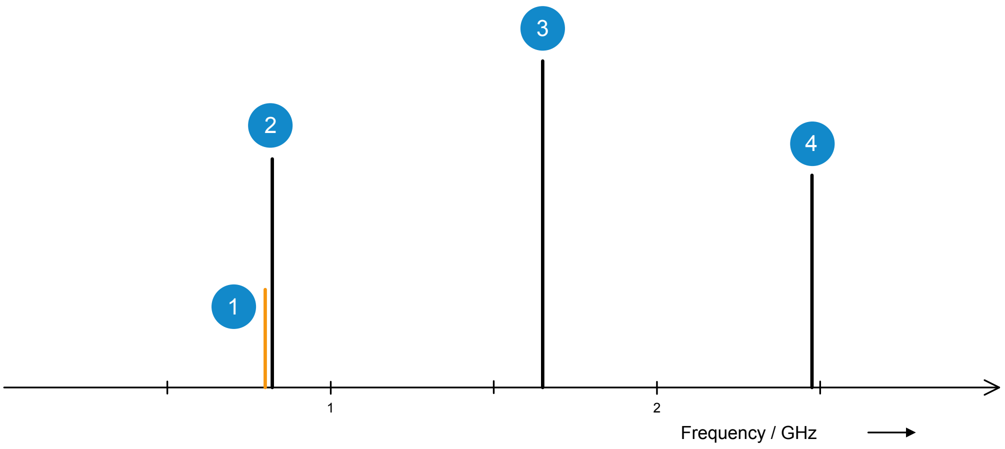
Figure 6-5: LO leakage into the DUT

These emissions have the frequency of the local oscillator or a multiple of it, the harmonics. The emissions can lead to mixing products in the DUT. For example if the DUT is a signal generator with level control, the LO leakage of the R&S NRQ6 can lead to a wrong level setting.

Example: LO frequency and harmonics

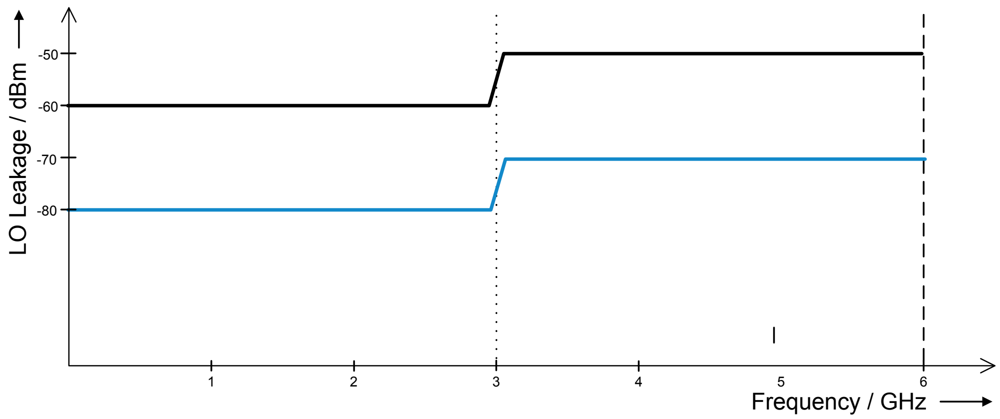
Settings:

- Carrier frequency of the applied signal: 800 MHz
  ([SENSe<Sensor>:]FREQuency[:CENTer])
- LO frequency: 825 MHz
  ([SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO[:CUV]?)
- Distance between carrier frequency and LO frequency: ~25 MHz
  ([SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF[:CUV]?)



1 = Carrier frequency (800 MHz)
2 = LO frequency (825 MHz)
3 = 2nd LO harmonic (1.65 GHz)
4 = 3rd LO harmonic (2.475 GHz)

The LO leakage up to 6 GHz is specified in the data sheet. The diagram below roughly visualizes the specification.



The black line represents the LO leakage at 0 dB RF attenuation. The blue line represents the LO leakage at 30 dB RF attenuation.

7 Adapting to the Test Signal

The R&S NRQ6 is a frequency selective power sensor. Before starting a measurement, you need to take the test signal and its properties into account.

You can do that either automatically by using the autoset function, or by setting the frequency, filter, bandwidth and attenuation manually. With the help of the signal check, you can check whether the signal you want to measure the power of is included in the selected bandwidth. The in-built frequency tracker keeps the focus on the test signal, even when the signal shifts over time. This feature is especially useful for narrowband signals, see Chapter 7.2.2, "Frequency Adjustment for Narrowband Measurements", on page 51.

Further information:

- Chapter 5.2.1, "Layout of the Main Dialog", on page 34

Remote command reference:

- Chapter 12.3, "Adapting to the Test Signal", on page 119

Web user interface:

- Chapter 7.5, "Top Pane Parameters", on page 57

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- Automatic Settings....................49
- Frequency Configuration....................50
- Resolution Bandwidth Filters....................52
- RF Input Attenuation....................56
- Top Pane Parameters....................57

7.1 Automatic Settings

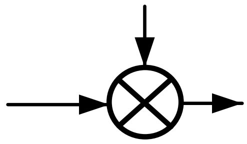
The automatic settings (autoset) function makes the crucial measurement settings for you. Thus, also unknown signals are recognized and their average power can be measured.

The autoset function performs the following actions:

- Automatically adjusts the frequency.
- Optimizes the filter settings. See Chapter 7.3.2, "Automatic Filter Type Selection", on page 53.
- Automatically adjusts the input attenuation.
- If using the web user interface, also the following happens:
  - In trace mode, also performs the auto settings specific for trace mode. See "Autoset" on page 66.
  - Starts the measurement.

You can also adjust the settings manually, see Chapter 7.5, "Top Pane Parameters", on page 57.

7.2 Frequency Configuration



If you do not use the autoset function, the frequency of the test signal is not automatically determined.

The center frequency defines the mixing frequency in the downconversion process. Signals outside of the analysis bandwidth are filtered out. However, the R&S NRQ6 is sensitive to signals at frequencies related to the harmonics of the conversion frequency. These spurious response frequencies are usually attenuated by more than 10 dB compared to the desired measurement frequency. See Chapter 6.6.1, "Spurious Response Frequencies", on page 45.

7.2.1 Frequency Tracker

The R&S NRQ6 offers an in-built frequency tracker. The frequency tracker is available for bandwidths ≤ 10 MHz. The frequency tracker is suitable to correct slow drifts and constant offsets for CW signal levels of 20 dB above the noise floor.

You can enable or disable the frequency tracker using:

- Remote command: `[SENSe<Sensor>:]FREQuency:TRACk` on page 156
- Web user interface: "Switch" on page 101

The frequency tracking range is based on the specified center frequency. The bandwidth of the frequency tracking range is ≤ 30 MHz. It is a multiple of the resolution bandwidth as shown in Table 7-1.

Table 7-1: Correlation of resolution bandwidths

RBW	Tracking range
10 Hz to 100 Hz	30 kHz
200 Hz to 300 Hz	100 kHz
500 Hz to 1 kHz	300 kHz
2 kHz to 3 kHz	1 MHz
5 kHz to 10 kHz	3 MHz
20 kHz to 30 kHz	10 MHz
50 kHz to10 MHz	30 MHz
> 10 MHz	-

The R&S NRP Toolkit provides program examples on this topic.

Further details:

- Chapter 5.1, "R&S NRP Toolkit", on page 31

- Chapter 13, "Programming Examples", on page 174

7.2.2 Frequency Adjustment for Narrowband Measurements

For small resolution bandwidths, oscillator offsets, drifts or phase noise contributions can corrupt the measurement results. Therefore, you have to take additional measures by using one of the following options. The requirements are summarized in Table 7-2.

Synchronizing the reference frequencies - external clock reference

You can synchronize the reference frequencies of the R&S NRQ6 and the signal source. Make sure that center frequency is specified accurately.

Use the REF connector of the R&S NRQ6 to lock the R&S NRQ6 to the reference frequency of the signal source or vice versa.

Further information:

- Table 9-2
- Chapter 4.6, "Reference I/O (REF)", on page 29

Controlling the center frequency - frequency tracker

See Chapter 7.2.1, "Frequency Tracker", on page 50.

Adjusting the frequency settings - autoset function

Applicable if the drifts are:

- Small
  Thus preventing that the signal source and the power sensor reference frequencies diverge too much.
- Slow
  You can perform the autoset repeatedly.

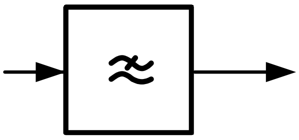
You can use the autoset only if the signal level is high enough. Only CW signal levels above −65 dBm can be identified. For modulated signals, the minimum power must be even larger to discriminate the signal from the noise floor correctly.

Table 7-2: Requirements

	External clock reference	Frequency tracker	Autoset function
Specification of measurement frequency	Accurate value	Approximate value	Automatic setting
Specification of bandwidth	Approximate	Approximate	Automatic setting
DUT must provide reference frequency	Yes	No	No

	External clock reference	Frequency tracker	Autoset function
Compensation of offset and drift	Yes	Yes	No Slow drifts can be handled by calling autoset repeatedly.
Minimum power level at minimum bandwidth	-130 dBm	-120 dBm	−65 dBm

7.3 Resolution Bandwidth Filters



The R&S NRQ6 supports different filter types. Each filter type is optimized for a different goal. Thus, it is possible to adapt the R&S NRQ6 to various measurement situations.

7.3.1 Filter Characteristics

Table 7-3: Characteristics overview

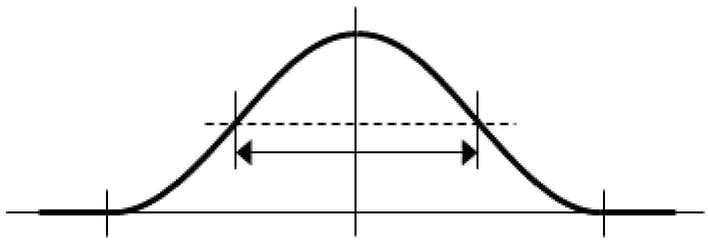
Filter characteristic	Rectangular	Gaussian
Filter type	Flat, LTE, 3GPP	Normal
Optimized for	Flat passband	Short filter response
Overshoot in power domain	Not specified	≤ 5 %
Filter response at ±0.5*RBW	0 dB (flat passband)	-3 dB
Max. RBW setting	100 MHz	400 MHz (rise time ≤ 2 ns)
Min. BW	100 Hz	10 Hz
Filter response	≤ 0.44 s	≤ 0.28 ms

Rectangular filter type

Possesses a flat passband with a nearly linear phase response. If the signal bandwidth does not exceed the passband bandwidth, the signal shape is not affected by the filter. Otherwise, the filter reduces the bandwidth of the signal. In this case, the steep filter edges can easily lead to overshoot features at transitions. For information on available filter bandwidths, see Table 7-4.

Gaussian filter type

Genuine Gaussian filters with various 3 dB bandwidths. Gaussian filters possess a comparably short impulse response, which makes the Gaussian filter advantageous for very short measurement times. The settling time that subtracts from the total measurement time is minimized, and the effective measurement time is maximized. As a side effect, the shortest possible measurement time is decreased. Since the filter is not flat, the power of the input signal decreases away from the center frequency. The spectral components in the middle of the filter are correctly leveled. Furthermore, the filter is smooth both in the frequency and in the time domain. Therefore, no significant overshoot is caused by the filter. For information on available filter bandwidths, see Table 7-4.



7.3.2 Automatic Filter Type Selection

In many situations, it is appropriate to let the R&S NRQ6 automatically choose the filter type for the measurement. The selection process is based on the currently selected measurement mode and, for some modes, also on the resolution bandwidth.

Measurement mode	Filter type	Resolution bandwidth (RBW), see "<Bandwidth>" on page 59	
		Entered value	**Currently used value**
Continuous average Power servoing	"Normal"	value ≤ 7.5 kHz or value ≥ 250 MHz	value < 10 kHz or value = 400 MHz
	"Flat"	7.5 kHz < value < 250 MHz	10 kHz ≤ value ≤ 100 MHz
Trace	"Normal"		
I/Q trace	"Normal"		
ACLR	"LTE"	value > 4.42 MHz	value ≥ 5 MHz
	"3GPP"	value ≤ 4.42 MHz	value < 5 MHz

7.3.3 Choosing the Correct Filter Type

You can choose from a large variety of filters, as listed in Table 7-4. Not every filter type is suitable for every measurement.

For an EVM analysis, use a flat filter type. The LTE and 3GPP filter types are optimized for ACLR measurements.

For trace measurements with long trace length and high resolution bandwidth, you need to give attention to the output sample rate of the filter, given in Table 7-4. For example, when measuring short pulses. If you choose a filter with a high output sample rate, the resulting amount of data can become too huge for the R&S NRQ6 to process. The R&S NRQ6 indicates this condition by a static error due to insufficient memory. Therefore, it is useful to query for static errors after setting all parameters to recognize an insufficient memory condition: `SYSTem:SERRor?`.

Table 7-4 summarizes the following filter characteristics:

- RBW display value
  This nominal value is used to select the desired filter.
- Rise time
  Refers to the time which passes until the signal power rises from 10% to 90% when the filter is exposed to a unit step.
- Settling time
  When measuring, the total measurement time consists of two parts. First, you need to consider the response time of the filter to let the filter attain a steady state. After this settling process, all samples in a predefined measurement interval – usually the aperture time - are used to compute the final measurement value.

Query the information about the currently active filter using `[SENSe<Sensor>:]BANDwidth:INFO?`.

Table 7-4: Filter characteristics at a given bandwidth

Filter type	Entered RBW	Pass BW	3 dB BW	Stop BW	Output sample rate	Rise time	Filter settling time	Equivalent noise BW
Flat	100 MHz	100.0 MHz	106.0 MHz	160.0 MHz	120.0 MHz	11.0 ns	375.0 ns	107.4 MHz
Flat	80 MHz	80.0 MHz	88.9 MHz	97.8 MHz	120.0 MHz	9.9 ns	900.0 ns	88.4 MHz
Flat	40 MHz	40.0 MHz	44.4 MHz	48.9 MHz	60.0 MHz	15.6 ns	1.4 µs	44.1 MHz
Flat	20 MHz	20.0 MHz	22.2 MHz	24.4 MHz	40.0 MHz	32.9 ns	2.0 µs	21.4 MHz
Flat	10 MHz	10.0 MHz	12.5 MHz	15.0 MHz	30.0 MHz	54.4 ns	4.7 µs	12.5 MHz
Flat	5 MHz	5.0 MHz	6.3 MHz	7.5 MHz	15.0 MHz	108.4 ns	9.0 µs	6.2 MHz
Flat	3 MHz	3.0 MHz	3.8 MHz	4.5 MHz	10.0 MHz	180.4 ns	13.3 µs	3.7 MHz
Flat	2 MHz	2.0 MHz	2.5 MHz	3.0 MHz	6.0 MHz	270.4 ns	22.0 µs	2.5 MHz
Flat	1 MHz	1.0 MHz	1.3 MHz	1.5 MHz	3.0 MHz	540.7 ns	43.7 µs	1.2 MHz
Flat	500 kHz	500.0 kHz	625.0 kHz	750.0 kHz	1.5 MHz	1.1 µs	87.0 µs	624.0 kHz
Flat	300 kHz	300.0 kHz	375.0 kHz	450.0 kHz	909.1 kHz	1.8 µs	143.3 µs	374.6 kHz
Flat	200 kHz	200.0 kHz	250.0 kHz	300.0 kHz	600.0 kHz	2.7 µs	217.0 µs	249.6 kHz

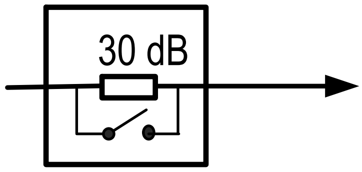
Filter type	Entered RBW	Pass BW	3 dB BW	Stop BW	Output sample rate	Rise time	Filter settling time	Equivalent noise BW
Flat	100 kHz	100.0 kHz	125.0 kHz	150.0 kHz	300.0 kHz	5.4 µs	433.7 µs	124.8 kHz
Flat	50 kHz	50.0 kHz	62.5 kHz	75.0 kHz	150.0 kHz	10.8 µs	867.0 µs	62.4 kHz
Flat	30 kHz	30.0 kHz	37.5 kHz	45.0 kHz	90.1 kHz	18.0 µs	1.4 ms	37.4 kHz
Flat	20 kHz	20.0 kHz	25.0 kHz	30.0 kHz	60.0 kHz	27.0 µs	2.2 ms	25.0 kHz
Flat	10 kHz	10.0 kHz	12.5 kHz	15.0 kHz	30.0 kHz	54.1 µs	4.3 ms	12.5 kHz
Flat	5 kHz	5.0 kHz	6.3 kHz	7.5 kHz	15.0 kHz	108.1 µs	8.7 ms	6.2 kHz
Flat	3 kHz	3.0 kHz	3.8 kHz	4.5 kHz	9.0 kHz	180.2 µs	14.4 ms	3.7 kHz
Flat	2 kHz	2.0 kHz	2.5 kHz	3.0 kHz	6.0 kHz	270.3 µs	21.7 ms	2.5 kHz
Flat	1 kHz	1.0 kHz	1.3 kHz	1.5 kHz	3.0 kHz	540.7 µs	43.3 ms	1.2 kHz
Flat	500 Hz	500.0 Hz	625.0 Hz	750.0 Hz	1.5 kHz	1.1 ms	86.7 ms	624.0 Hz
Flat	300 Hz	300.0 Hz	375.0 Hz	450.0 Hz	900.0 Hz	1.8 ms	144.4 ms	374.4 Hz
Flat	200 Hz	200.0 Hz	250.0 Hz	300.0 Hz	600.0 Hz	2.7 ms	216.7 ms	249.6 Hz
Flat	100 Hz	100.0 Hz	125.0 Hz	150.0 Hz	300.0 Hz	5.4 ms	433.3 ms	124.8 Hz
Normal*	400 MHz	-	400.0 MHz	2.0 GHz	120.0 MHz	2.0 ns	375.0 ns	543.7 MHz
Normal	50 MHz	-	50.0 MHz	100.0 MHz	120.0 MHz	13.3 ns	900.0 ns	50.0 MHz
Normal	25 MHz	-	25.0 MHz	51.7 MHz	120.0 MHz	24.9 ns	900.0 ns	25.1 MHz
Normal	10 MHz	-	10.0 MHz	51.4 MHz	120.0 MHz	56.3 ns	633.3 ns	10.6 MHz
Normal	5 MHz	-	5.0 MHz	25.7 MHz	40.0 MHz	112.3 ns	900.0 ns	5.3 MHz
Normal	3 MHz	-	3.0 MHz	15.4 MHz	24.0 MHz	187.0 ns	1.3 µs	3.2 MHz
Normal	2 MHz	-	2.0 MHz	10.3 MHz	20.0 MHz	280.2 ns	1.7 µs	2.1 MHz
Normal	1 MHz	-	1.0 MHz	5.1 MHz	8.0 MHz	560.5 ns	3.2 µs	1.1 MHz
Normal	500 kHz	-	500.0 kHz	2.6 MHz	5.5 MHz	1.1 µs	6.0 µs	532.9 kHz
Normal	300 kHz	-	300.0 kHz	1.5 MHz	3.2 MHz	1.9 µs	9.8 µs	319.6 kHz
Normal	200 kHz	-	200.0 kHz	1.0 MHz	2.1 MHz	2.8 µs	14.8 µs	213.3 kHz
Normal	100 kHz	-	100.0 kHz	514.5 kHz	1.0 MHz	5.6 µs	29.3 µs	106.6 kHz
Normal	50 kHz	-	50.0 kHz	257.2 kHz	517.2 kHz	11.2 µs	58.3 µs	53.3 kHz
Normal	30 kHz	-	30.0 kHz	154.3 kHz	309.3 kHz	18.7 µs	94.1 µs	32.0 kHz
Normal	20 kHz	-	20.0 kHz	102.9 kHz	206.2 kHz	28.0 µs	141.0 µs	21.3 kHz
Normal	10 kHz	-	10.0 kHz	51.4 kHz	102.9 kHz	56.0 µs	282.1 µs	10.7 kHz
Normal	5 kHz	-	5.0 kHz	25.7 kHz	51.5 kHz	112.1 µs	563.9 µs	5.3 kHz
Normal	3 kHz	-	3.0 kHz	15.4 kHz	30.9 kHz	186.8 µs	939.5 µs	3.2 kHz
Normal	2 kHz	-	2.0 kHz	10.3 kHz	20.6 kHz	280.2 µs	1.4 ms	2.1 kHz

Filter type	Entered RBW	Pass BW	3 dB BW	Stop BW	Output sample rate	Rise time	Filter settling time	Equivalent noise BW
Normal	1 kHz	-	1.0 kHz	5.1 kHz	10.3 kHz	560.4 µs	2.8 ms	1.1 kHz
Normal	500 Hz	-	500.0 Hz	2.6 kHz	5.1 kHz	1.1 ms	5.6 ms	533.2 Hz
Normal	300 Hz	-	300.0 Hz	1.5 kHz	3.1 kHz	1.9 ms	9.4 ms	319.9 Hz
Normal	200 Hz	-	200.0 Hz	1.0 kHz	2.1 kHz	2.8 ms	14.1 ms	213.3 Hz
Normal	100 Hz	-	100.0 Hz	514.5 Hz	1.0 kHz	5.6 ms	28.2 ms	106.6 Hz
Normal	50 Hz	-	50.0 Hz	257.3 Hz	514.5 Hz	11.2 ms	56.4 ms	53.3 Hz
Normal	30 Hz	-	30.0 Hz	154.3 Hz	308.7 Hz	18.7 ms	93.9 ms	32.0 Hz
Normal	20 Hz	-	20.0 Hz	102.9 Hz	205.8 Hz	28.0 ms	140.9 ms	21.3 Hz
Normal	10 Hz	-	10.0 Hz	51.4 Hz	102.9 Hz	56.0 ms	272.1 ms	10.7 Hz
LTE**	5 MHz	4.0 MHz	4.5 MHz	5.0 MHz	10.0 MHz	154.4 ns	13.3 µs	4.5 MHz
LTE**	10 MHz	8.1 MHz	9.0 MHz	9.9 MHz	20.0 MHz	77.3 ns	6.8 µs	9.0 MHz
LTE**	15 MHz	12.2 MHz	13.5 MHz	14.9 MHz	30.0 MHz	51.9 ns	4.7 µs	13.5 MHz
LTE**	20 MHz	16.2 MHz	18.0 MHz	19.8 MHz	30.0 MHz	39.7 ns	2.5 µs	17.5 MHz
3GPP**	3.84 MHz	3.0 MHz	3.84 MHz	4.7 MHz	10.0 MHz	175.4 ns	13.3 µs	3.8 MHz

* only for pulse measurements

** only available filter types for ACLR measurements; for continuous average, trace, I/Q trace mode, all 4 filter types are available.

7.4 RF Input Attenuation



Adjust the input attenuator to prevent that mixers and amplifiers operate close to their compression points. Thus, uncertainties in the measurement result due to nonlinear effects such as intermodulation products and gain compression are decreased. However, as a side effect, the signal-to-noise ratio (SNR) is decreased. The signal-to-noise ratio is the true signal power versus the noise floor power within the relevant RBW.

Decreasing the signal-to-noise ratio causes two effects:

- The measurement uncertainty is increased due to noise.
- The measured power signal includes a bias that depends on the signal-to-noise ratio, see also Chapter 8.1.1, "Averaging Domains", on page 60.

To measure the noise power for the current RBW

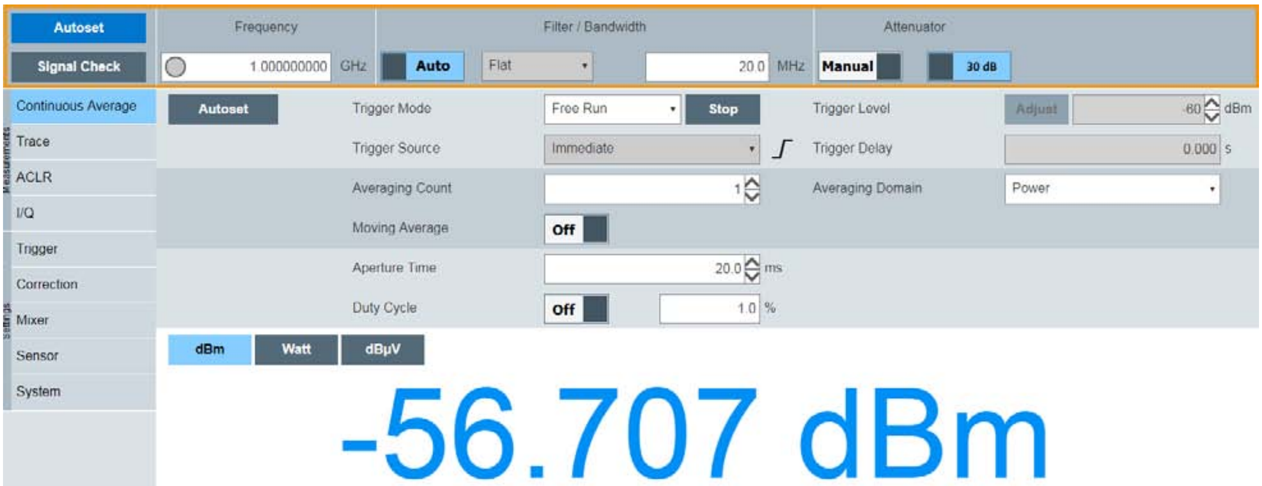
1. Turn off the signal source.

2. Increase the average count until the measurement results are stable.

7.5 Top Pane Parameters

Access: main dialog of the web user interface > top pane

In the web user interface, these settings are grouped in the top pane.



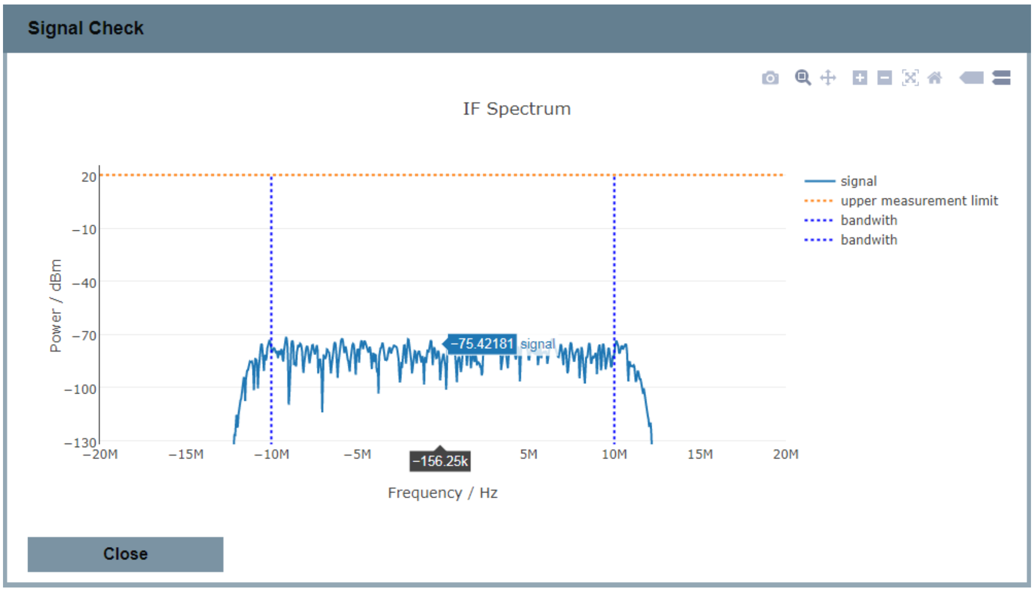
Autoset....57
Signal Check....57
Frequency....58
Filter / Bandwidth....58
└ <State>....58
└ <Filter type>....59
└ <Bandwidth>....59
Attenuator....59
└ <State>....59
└ <Level>....59

Autoset
Performs the automatic settings. See Chapter 7.1, "Automatic Settings", on page 49.

Remote command:

```
[SENSe<Sensor>:]ADJust[:ALL]
[SENSe<Sensor>:]BANDwidth:RESolution:TYPE:AUTO[:STATe]
[SENSe<Sensor>:]INPut:ATTenuation:AUTO
INITiate:CONTinuous
```

Signal Check
Opens the "Signal Check" dialog. It displays the intermediate frequency (IF) spectrum of the test signal and the selected bandwidth.



Within the chart, the cursor becomes a crosshair. The x-position (frequency) of the crosshair is shown on black background, the y-position (power) is shown on blue.

Frequency

Sets the carrier frequency of the applied signal. This value is used for frequency response correction of the measurement result.

Left to the frequency value, the frequency tracker status is displayed, see Table 7-5.

For background information, see Chapter 7.2, "Frequency Configuration", on page 50.

Table 7-5: Frequency tracker status

Color		Status
●	Gray	Disabled.
●	Yellow	Enabled but not locked on the frequency at the RF input.
●	Green	Enabled and locked on the frequency at the RF input. Usual status after autoset.

Remote command:
`[SENSe<Sensor>:]FREQuency[:CENTer]`

Filter / Bandwidth

For background information, see Chapter 7.3, "Resolution Bandwidth Filters", on page 52.

<State> ← Filter / Bandwidth

Enables or disables the automatic filter type selection.

"Manual" Select the filter under "<Filter type>" on page 59.

"Auto" The selection depends on the currently chosen measurement mode and bandwidth.

Remote command:
`[SENSe<Sensor>:]BANDwidth:RESolution:TYPE:AUTO[:STATe]`

<Filter type> ← Filter / Bandwidth
Only available if "Manual" is set under <State>.

Sets the filter type for resolution bandwidth filter. The filter bandwidth is not affected. See also Chapter 7.3.1, "Filter Characteristics", on page 52.

"Flat"	Flat frequency spectrum with steep filter edges.
"Normal"	Gaussian-like filters with less than 5 % overshoot.
"LTE"	Optimized for LTE signal.
"3GPP"	Optimized for 3GPP signal.

Remote command:
`[SENSe<Sensor>:]BANDwidth:RESolution:TYPE`
`[SENSe<Sensor>:]BANDwidth:INFO?`

<Bandwidth> ← Filter / Bandwidth
Sets the resolution bandwidth as floating point value.

<value> in Hz, kHz or MHz. The unit is adopted.

If the resampler is disabled, only discrete steps are available. The entered value is rounded to the next value.

The filter bandwidth refers to the RBW display value in Table 7-4 and its definition varies with the filter type. Each type has its own steps. See also Chapter 7.3.3, "Choosing the Correct Filter Type", on page 54.

Remote command:
`[SENSe<Sensor>:]BANDwidth:RESolution`
`[SENSe<Sensor>:]BANDwidth:RESolution:CUV?`

Attenuator
For background information, see Chapter 7.4, "RF Input Attenuation", on page 56.

<State> ← Attenuator
Enables or disables the automatic setting of the input attenuation.

Remote command:
`[SENSe<Sensor>:]INPut:ATTenuation:AUTO`

<Level> ← Attenuator
Only available if "Manual" is set under <State>.

Sets the input attenuation.

Remote command:
`[SENSe<Sensor>:]INPut:ATTenuation`

8 Measurement Modes and Result Displays

The R&S NRQ6 offers different measurement modes.

Further information:

- Chapter 6.1, "Functional Principle", on page 41
- Chapter 6.2, "Measurement Procedure in Principle", on page 41
- Chapter 9, "Measurement Configuration", on page 79
- Chapter 5.2.1, "Layout of the Main Dialog", on page 34
- "To display the Web user interface" on page 34

Remote command reference:

- Chapter 12.4, "Selecting a Measurement Mode", on page 123
- Chapter 12.5, "Starting and Ending a Measurement", on page 124
- Chapter 12.6, "Measurement Results", on page 125

Web user interface:

- Chapter 8.1.3, "Continuous Average Parameters", on page 62
- Chapter 8.2.1, "Trace Parameters", on page 65
- Chapter 8.3.1, "ACLR Parameters", on page 68
- Chapter 8.4, "I/Q Trace Mode", on page 70

In the web user interface, all measurement modes are grouped in the navigation pane under "Measurements".

8.1 Continuous Average Mode

In this mode, the R&S NRQ6 measures the signal average power asynchronously within a defined time interval, the so-called aperture or sampling window. After a trigger event, the power is integrated over the time interval, see Chapter 8.1.1, "Averaging Domains", on page 60.

Contents:

- Averaging Domains....60
- Measuring Modulated Signals....62
- Continuous Average Parameters....62
- Continuous Average Result Display....64

8.1.1 Averaging Domains

In continuous average and trace mode, the R&S NRQ6 supports three different averaging domains with the following characteristics.

Table 8-1: Averaging domains

	Power averaging	Logarithmic averaging	Amplitude averaging
Command option	"Power"	"Video"	"Linear"
Averaging unit	Watt	dBm	V
Measurement bias caused by noise floor	High	Low	Medium
Measurement uncertainty caused by noise floor	Low	High	Medium
Measurement bias for noise-like signals	0 dB	-2.51 dB	-1.05 dB
Remote command: [SENSe<Sensor>:]AVERage:TYPE on page 139			

Noise-like signals are the noise floor or digitally modulated signals with a flat spectrum, covering the complete RBW.

Measurement bias

Measurement bias means that the measurement value is biased such that the measured value is larger than the true value. When measuring the power of a continuous wave (CW) signal in the presence of noise, the measured power is simply the algebraic sum of the signal and noise powers. When measuring the voltage or logarithmic power of a CW signal in the presence of noise, the calculation of the measurement bias is considerably more complex. For example, for a signal-to-noise ratio of 8 dB, logarithmic averaging results in a measurement bias due to noise of approximately 0.001 dB. For further information, the following article is recommended: NCSLI Measure: The Journal of Measurement Science, December 2012, "Spectrum Analyzer CW Power Measurements and the Effects of Noise".

Measurement noise

The measurement noise quantifies the amount of fluctuation that is to be expected in the measurement result. The measurement uncertainty can be decreased by time averaging. For large signal-to-noise ratios (SNR), the amount of measurement noise is independent of the averaging method. For small signal-to-noise ratios, the amount of measurement noise depends on the averaging method as described in Table 8-1.

Taking the signal type into account

Due to the different behavior described in Table 8-1, select the averaging domain in consideration of the signal type.

Signal type	"Averaging Domain"	Explanation
Continuous wave (CW)	"Video"	No noticeable measurement bias for a signal-to-noise ratio equal to and above 8 dB. Increase in measurement uncertainty is negligible. Can be combined with noise cancellation.
Noise power	"Power"	No measurement bias even if there is colored noise spectrum. Be sure to disable noise cancellation feature.
Broadband communication signal and all other signals	"Power"	No measurement bias due to signal form. Measurement bias due to noise floor can be reduced by noise cancellation feature.

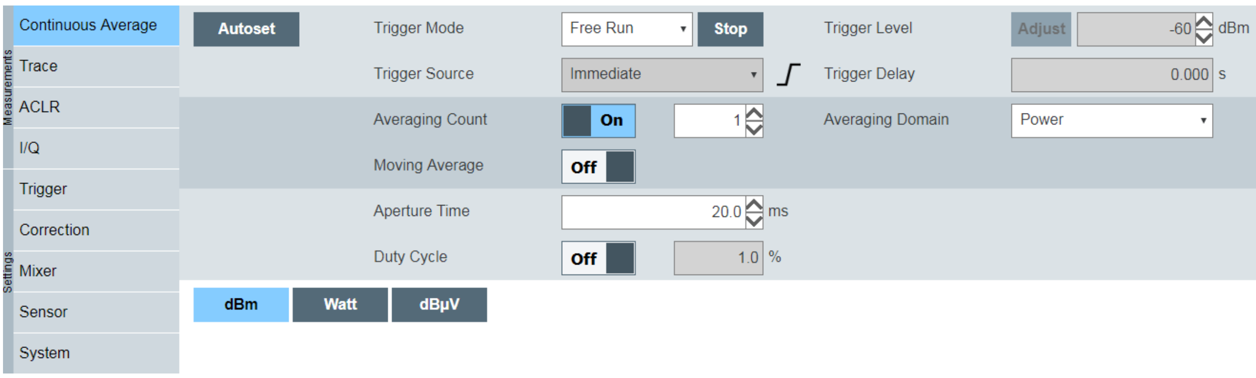
8.1.2 Measuring Modulated Signals

When measuring modulated signals, the measurement can show fluctuation due to the modulation. If that is the case, adapt the size of the sampling window exactly to the modulation period to get an optimally stable display.

If measuring pulse-modulated signals, use the duty cycle correction. The duty cycle correction is only available in the continuous average mode. The duty cycle defines the percentage of one period during which the signal is active.

8.1.3 Continuous Average Parameters

Access: main dialog of the web user interface > navigation pane > "Continuous Average"



Autoset....63
Trigger Mode....63
Trigger Level....63
Trigger Source....63
Trigger Delay....63
Averaging Count....63
└ <State>....63
└ <Count>....63

Averaging Domain....63
Moving Average....64
Aperture Time....64
Duty Cycle....64
dBm / Watt / dBµV....64

Autoset

Starts a continuous measurement.

Remote command:

`TRIGger:SOURce IMMediate`

`INITiate:CONTinuous ON`

Trigger Mode

See "Trigger Mode" on page 89.

Trigger Level

See "Trigger Level" on page 89.

Trigger Source

See "Trigger Source" on page 89.

Trigger Delay

See "Trigger Delay" on page 90.

Averaging Count

Groups the averaging count settings. Average count is often also called averaging factor.

<State> ← Averaging Count

Enables or disables the averaging filter.

Remote command:

`[SENSe<Sensor>:]AVERage[:STATe]`

<Count> ← Averaging Count

Available if "On" is set under <State>.

Sets the number of readings that are averaged for one measured value. The higher the count, the lower the noise, and the longer it takes to obtain a measured value.

Remote command:

`[SENSe<Sensor>:]AVERage:COUNt`

Averaging Domain

Sets the averaging method. For details, see Chapter 8.1.1, "Averaging Domains", on page 60.

"Power"	Power averaging
"Video"	Logarithmic averaging
"Linear"	Voltage averaging

Remote command:
`[SENSe<Sensor>:]AVERage:TYPE`

Moving Average

Defines how the measurement results are output. This is called termination control.

See also Chapter 9.1.1, "Controlling the Measurement Results", on page 79.

"On" Outputs intermediate values to facilitate early detection of changes in the measured quantity. In the settled state, that means when the number of measurements specified by the average count has been performed, a moving average is output.

"Off" Specifies that a measurement result is not output until the entire measurement has been completed. This means that the number of measurement cycle repetitions is equal to the set average count. If the average count is large, the measurement time can be very long.

Remote command:
`[SENSe<Sensor>:]AVERage:TCONtrol`

Aperture Time

Sets the duration of the sampling window. During this unsynchronized time interval, the average signal power is measured.

Remote command:
`[SENSe<Sensor>:][POWer:][AVG:]APERture`

Duty Cycle

Sets the duty cycle for measuring pulse-modulated signals. The duty cycle defines the percentage of one period during which the signal is active. If the duty cycle is enabled, the R&S NRQ6 takes this percentage into account when calculating the signal pulse power from the average power.

Remote command:
`[SENSe<Sensor>:]CORRection:DCYCle:STATe`
`[SENSe<Sensor>:]CORRection:DCYCle`

dBm / Watt / dBµV

Sets the unit of the measured power values (y-axis of the chart).

Remote command:
`UNIT:POWer` on page 132

8.1.4 Continuous Average Result Display

Displays a single scalar value. You can select the unit of the result. See "dBm / Watt / dBµV" on page 64.

8.2 Trace Mode

In this mode, the R&S NRQ6 measures power over time. The number of measurement points and the measurement time is defined. The length of an individual measurement is determined from the ratio of total time and the defined number of measurement points. The entire result is called a "trace". Each trace must be triggered separately.

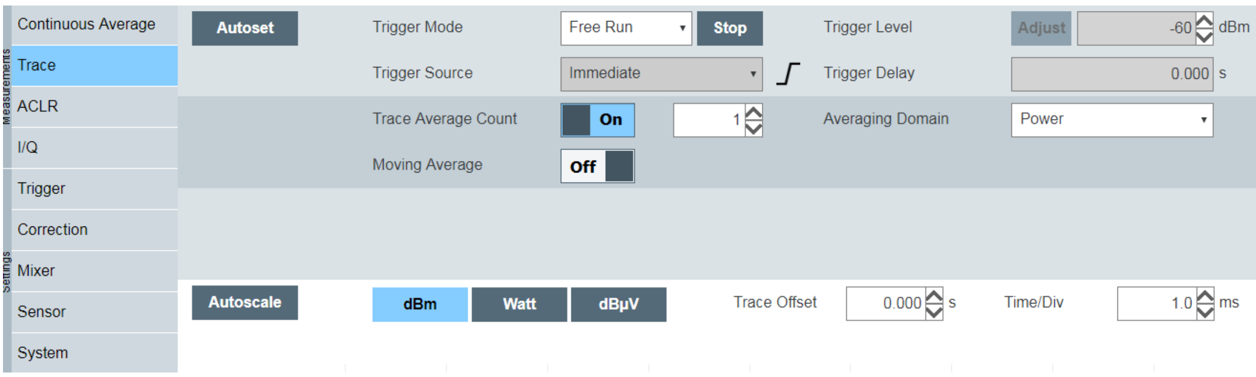
For information on averaging, see Chapter 8.1.1, "Averaging Domains", on page 60.

Contents:

- Trace Parameters.. 65
- Trace Result Display... 67

8.2.1 Trace Parameters

Access: main dialog of the web user interface > navigation pane > "Trace"



Autoset...66
Trigger Mode...66
Trigger Level... 66
Trigger Source...66
Trigger Delay...66
Averaging Count..66
└ <State>... 66
└ <Count>.. 66
Averaging Domain..66
Moving Averaging...67
Autoscale.. 67

dBm / Watt / dBµV 67
Trace Offset 67
Time/Div 67

Autoset

Adjusts the following:

- Adjusts the trace settings to the current signal.
- Optimizes the scaling of the x- and y-axes.
- Sets the trigger to ensure a stable presentation of the test signals.

Remote command:

`TRIGger:LEVel:AUTO ONCE`
`[SENSe<Sensor>:]TRACe:TIME:AUTO ONCE`
`TRIGger:ATRigger[:STATe] ON`
`TRIGger:SOURce INTernal`
`[SENSe<Sensor>:]TRACe:AVERage:COUNt 1`

Trigger Mode

See "Trigger Mode" on page 89.

Trigger Level

See "Trigger Level" on page 89.

Trigger Source

See "Trigger Source" on page 89.

Trigger Delay

See "Trigger Delay" on page 90.

Averaging Count

Groups the averaging count settings. Average count is often also called averaging factor.

<State> ← Averaging Count

Enables or disables the averaging filter.

Remote command:

`[SENSe<Sensor>:]TRACe:AVERage[:STATe]`

<Count> ← Averaging Count

Available if "On" is set under <State>.

Sets the number of readings that are averaged for one measured value. The higher the count, the lower the noise, and the longer it takes to obtain a measured value.

Remote command:

`[SENSe<Sensor>:]TRACe:AVERage:COUNt`

Averaging Domain

See "Averaging Domain" on page 63.

Moving Averaging
See "Moving Average" on page 64.

Remote command:
`[SENSe<Sensor>:]TRACe:AVERage:TCONtrol`

Autoscale
Optimizes the y-axis scaling.

dBm / Watt / dBµV
See "dBm / Watt / dBµV" on page 64.

Trace Offset
Sets the relative position of the trigger event in relation to the trace measurement start:

Trace offset = trace measurement start - trigger delay.

The start of recording relative to the trigger event is set using Trigger Delay.

Remote command:
`[SENSe<Sensor>:]TRACe:OFFSet:TIME`

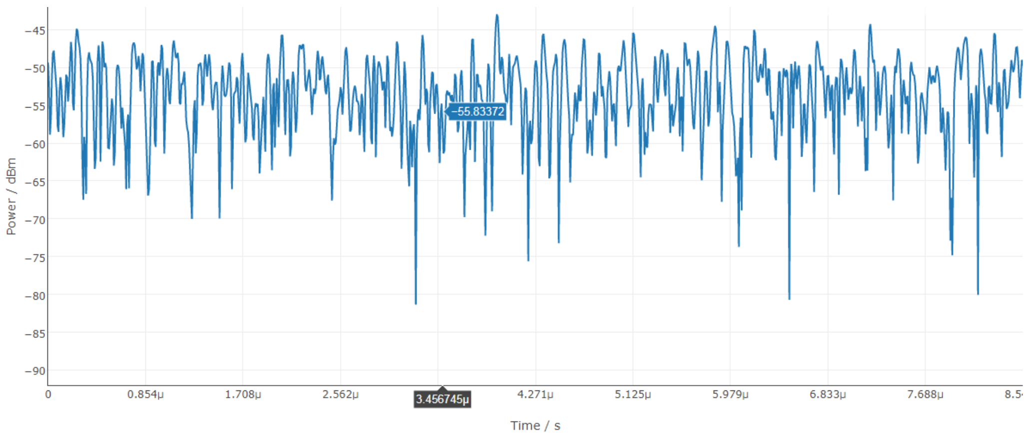
Time/Div
Sets the trace time, the duration of one trace sequence. If you enter the numbers followed by one of the letters, you can change the dimension; s for second, m for ms, n for ns, u for µs.

The available range depends on the RBW. Even for time settings within range, a static error due to insufficient memory can occur if the output sampling rate is too high. See Chapter 7.3.3, "Choosing the Correct Filter Type", on page 54.

Remote command:
`[SENSe<Sensor>:]TRACe:TIME`

8.2.2 Trace Result Display

Displays a trace consisting of an array of scalar values.



Within the chart, the cursor becomes a crosshair. The x-position (frequency) of the crosshair is shown on black background, the y-position (power) is shown on blue.

The trigger level is displayed as an orange, horizontal line.

Using the mouse, you can move the plot in x- and y-direction. Place the mouse over the x-axis. With the left mouse button pressed, drag the x-axis to the right or left. The same works for the y-axis in vertical direction.

For all other actions, use the toolbar in the upper right corner of the chart. See Chapter 5.2.3, "Toolbar in Charts", on page 36.

8.3 ACLR Mode

In this mode, the adjacent channel leakage ratio (ACLR) is displayed. The ACLR is measured by an FFT analysis of a signal wide enough to contain all 5 channels.

4 predefined filters for 3GPP and LTE are available. The set bandwidth defines the filter, see Table 7-4. Only one of the filters is set at a time.

The R&S NRP Toolkit provides program examples on this topic.

Further details:

- Chapter 5.1, "R&S NRP Toolkit", on page 31
- Chapter 13, "Programming Examples", on page 174

Contents:

- ACLR Parameters....................68
- ACLR Result Display....................69
- DC Zeroing in ACLR Mode....................70

8.3.1 ACLR Parameters

Access: main dialog of the web user interface > navigation pane > "ACLR"

Autoset....................69
Trigger Mode....................69
Trigger Level....................69
Trigger Source....................69
Trigger Delay....................69
Aperture Time....................69

Autoset
Starts a continuous measurement.

Remote command:
TRIGger:SOURce IMMediate
INITiate:CONTinuous ON

Trigger Mode
See "Trigger Mode" on page 89.

Trigger Level
See "Trigger Level" on page 89.

Trigger Source
See "Trigger Source" on page 89.

Trigger Delay
Negative trigger delays are not supported.

See "Trigger Delay" on page 90.

Aperture Time
Sets the duration of the sampling window. During this synchronized time interval, the average signal power is measured on all 5 channels.

Remote command:
[SENSe<Sensor>:]ACLR:APERture

8.3.2 ACLR Result Display

Displays an array of scalar values.

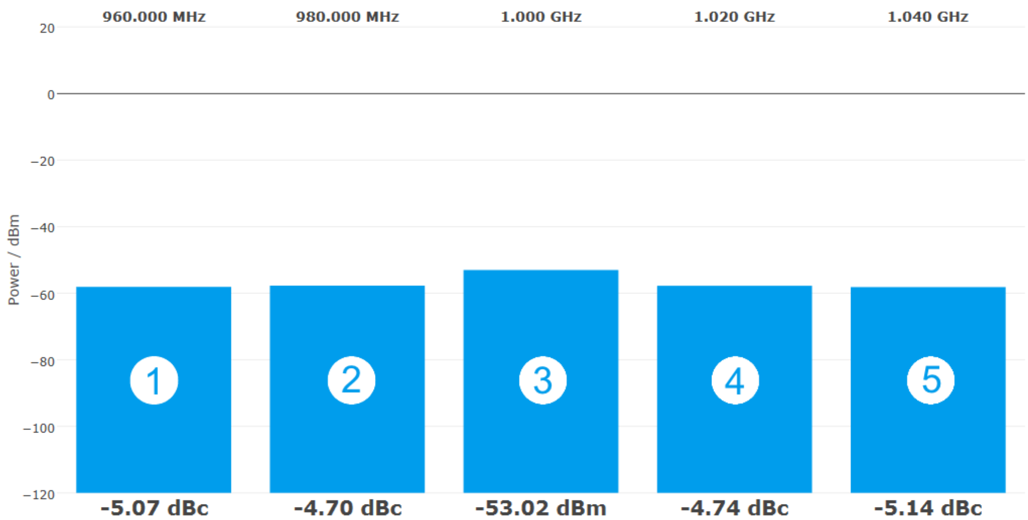


Figure 8-1: Example for LTE

1 = Lower alternate channel
2 = Lower adjacent channel
3 = TX channel
4 = Upper adjacent channel
5 = Upper alternate channel

Using the mouse, you can move the plot in x- and y-direction. Place the mouse over the x-axis. With the left mouse button pressed, drag the x-axis to the right or left. The same works for the y-axis in vertical direction.

For all other actions, use the toolbar in the upper right corner of the chart. See Chapter 5.2.3, "Toolbar in Charts", on page 36.

An application sheet describes how to perform ACLR measurements on LTE advanced/5G signals with a bandwidth of 100 MHz. It has the title "ACLR 100 MHz (Using FFT Filtering)" and is available at:

www.rohde-schwarz.com/manual/NRQ6

8.3.3 DC Zeroing in ACLR Mode

If you use the LTE filter with 10 MHz, 15 MHz or 20 MHz resolution bandwidth, a DC offset can occur. For example with 20 MHz ACLR bandwidth, the R&S NRQ6 measures internally with a total bandwidth of 100 MHz. If you measure signals of low power, the TX channel shows a DC offset. You can correct this offset using the DC offset calibration.

1. Change to another measurement mode, for example the continuous average mode.
2. Set a resolution bandwidth larger than 40 MHz, for example 100 MHz.
3. Perform DC zeroing, see "To calibrate the DC offset" on page 96.
4. Change back to the ACLR mode.

Further information:

- Chapter 9.3.2.2, "DC Zeroing", on page 95

8.4 I/Q Trace Mode

Requires the I/Q data interface (R&S NRQ6-K1). For information on the option management, see Chapter 10.1, "Option Management", on page 104.

In this mode, triggering works as in trace mode. Negative trigger delays are not supported.

You can read out the I/Q data for external signal analysis, for example using the vector signal explorer software (R&S VSE) from Rohde & Schwarz. An application sheet describes the use of the R&S NRQ6 as an I/Q data source for the software R&S VSE vector signal explorer. It has the title "VSE Feed (I/Q Capturing)" and is available at:

www.rohde-schwarz.com/manual/NRQ6

The R&S NRP Toolkit provides program examples on this topic.

Further details:

- Chapter 5.1, "R&S NRP Toolkit", on page 31
- Chapter 13, "Programming Examples", on page 174

8.4.1 Phase Coherent Measurements

Requires the phase coherent measurements option (R&S NRQ6-K3). For information on the option management, see Chapter 10.1, "Option Management", on page 104.

Using two R&S NRQ6, you can measure phase coherence in a multitone analysis. By measuring the relative phase error between calibration port and each antenna port, you can calibrate active antenna modules for beamforming.

For this purpose, two separate measurement steps are performed:

- Calibration
- Measurement

Setup for calibration

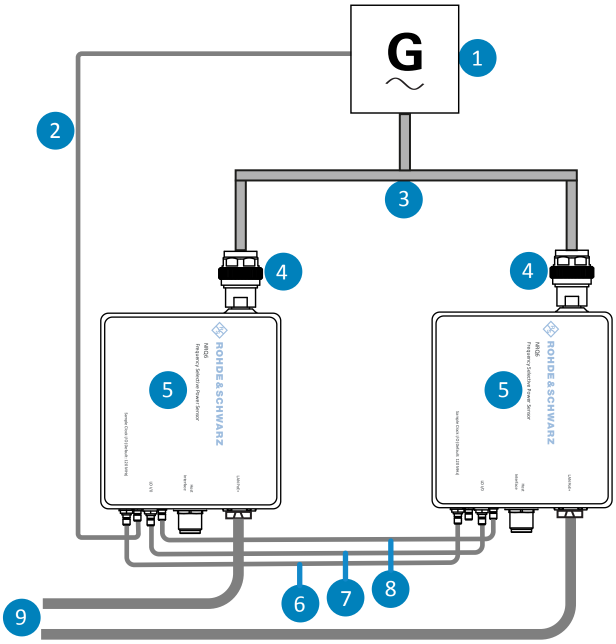


Figure 8-2: Calibrating the system

1 = Signal generator (signal source)
2 = External reference fed into the reference clock of the master R&S NRQ6
3 = Power splitter
4 = RF connector
5 = R&S NRQ6
6 = Sampling clock connection

7 = Local oscillator connection
8 = Trigger connection
9 = LAN connection to controlling host and power supply, see Chapter 3.6.1, "Computer Using a LAN Connection", on page 16.

To calibrate the system accurately, proceed as follows:

1. Use a splitter that is highly symmetrical in the frequency band of interest.
2. Connect the reference output of the signal generator and the reference input of the R&S NRQ6 using a standard coaxial cable.
3. Connect the two R&S NRQ6 using standard SMA cables. Ensure that the cables used for the trigger and sample clock connection are of identical length to ensure a proper eye diagram.
   a) Trigger connection: TRIG2 -> TRIG2
   b) Sampling clock connection: CLK -> CLK
   c) Local oscillator connection: LO -> LO

   See also Figure 4-1.

Configuration for calibration

1. Enable the use of an external reference clock for the R&S NRQ6, to which the external reference is fed.
2. Establish a master/slave relationship for triggering:
   a) Configure the R&S NRQ6 that is fed the external reference as master.
   b) Configure the other R&S NRQ6 as slave.
3. Select the trigger sources for both R&S NRQ6.
4. Configure the two R&S NRQ6 so that the master R&S NRQ6 forwards its sampling clock signal and local oscillator signal to the slave R&S NRQ6.

Main calibration steps

1. Measure the phase difference between the two R&S NRQ6.
2. Save the calibration data.

Setup for measurement

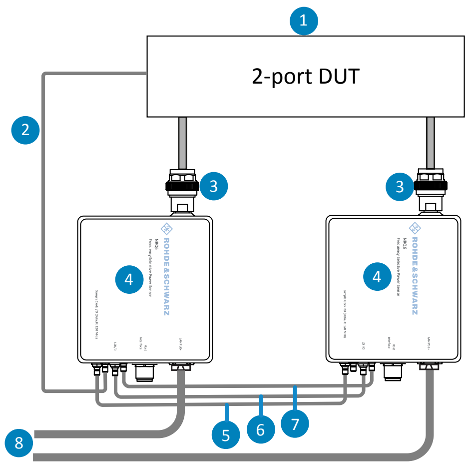


Figure 8-3: Measuring the phase difference

1 = 2-port DUT (signal source)
2 = External reference fed into the reference clock of the master R&S NRQ6.
3 = RF connector
4 = R&S NRQ6
5 = Sampling clock connection
6 = Local oscillator connection
7 = Trigger connection
8 = LAN connection to controlling host and power supply, see Chapter 3.6.1, "Computer Using a LAN Connection", on page 16.

1. Connect the RF port of each R&S NRQ6 to a DUT port.
2. Connect the two R&S NRQ6 as described in step 3.

Configuration for measurement

► Perform the steps as described in "Configuration for calibration" on page 72.

Main measurement steps

1. Measure the phase difference between the two ports of the DUT.
2. Use the calibration data to eliminate the phase difference caused by the R&S NRQ6 and to obtain the relative phase difference between the DUT ports.

An application sheet describes the calibration of active antenna modules for beamforming. It has the title "Phase Coherent Measurements" and is available at:

www.rohde-schwarz.com/manual/NRQ6

A video shows measuring the relative phase difference between two RF signals. It is available at:

https://www.rohde-schwarz.com/product/nrq6

The R&S NRP Toolkit provides program examples on this topic.

Further details:

- Chapter 5.1, "R&S NRP Toolkit", on page 31
- Chapter 13, "Programming Examples", on page 174

In the web user interface, the option-specific parameters are integrated.

8.4.2 Setting the Sample Rate

There are two ways to adjust the sample rate.

To set the sample rate directly

1. Under Specify Bandwidth by, set "Sample Rate".
2. Enter the sample rate in Desired Sample Rate.

   The Used Sample Rate is set accordingly to the closest discrete sample rate.
3. If you want to set exactly the desired sample rate, enable Variable Bandwidth. Works properly only up to 40 MHz sample rate.

   Desired Sample Rate and Used Sample Rate are identical.

To set the sample rate indirectly

1. Under Specify Bandwidth by, set "Resolution Bandwidth".
2. Under Filter / Bandwidth, enter the bandwidth.

   The Used Sample Rate is set accordingly.
   The value in Desired Sample Rate is inconsequential.

8.4.3 I/Q Trace Parameters

Requires the I/Q data interface (R&S NRQ6-K1). If a parameter requires an additional option, the option is listed in the parameter description.

Access: main dialog of the web user interface > navigation pane > "I/Q"

Autoset 75
Trigger Mode 75
Trigger Level 75

Trigger Source....75
Trigger Delay....75
Result Length....75
Specify Bandwidth by....75
Variable Bandwidth....75
Desired Sample Rate....76
Used Sample Rate....76
Sync Mode....76
Captured I/Q Samples....76

Autoset
Adjusts the trace settings to the current signal.

Remote command:
TRIGger:LEVel:AUTO ONCE
[SENSe<Sensor>:]TRACe:TIME:AUTO ONCE
TRIGger:ATRigger[:STATe] ON
TRIGger:SOURce INTernal
[SENSe<Sensor>:]TRACe:AVERage:COUNt 1

Trigger Mode
See "Trigger Mode" on page 89.

Trigger Level
See "Trigger Level" on page 89.

Trigger Source
See "Trigger Source" on page 89.

Trigger Delay
See "Trigger Delay" on page 90.

Result Length
Sets the number of result samples.

Remote command:
[SENSe<Sensor>:]TRACe:IQ:RLENgth

Specify Bandwidth by
Sets how the bandwidth is specified.

"Resolution Bandwidth" By the resolution bandwidth.

"Sample Rate" By the sample rate.

Remote command:
[SENSe<Sensor>:]BANDwidth:TYPE

Variable Bandwidth
Enables the resampler or continuous adjustment. Affects either the sample rate or the resolution bandwidth, depending on the setting under Specify Bandwidth by.

"Off" Selected sample rate or resolution bandwidth is rounded to a discrete value.

"On" Exact value is used up to:

- RBW ≤ 20 MHz with flat filter type
- RBW ≤ 5 MHz with normal filter type
- Sample rate ≤ 40 MHz

If an exact value is set that is out of range, the R&S NRQ6 indicates a static error. See also Chapter 4.2, "Status Information", on page 27.

Remote command:
`[SENSe<Sensor>:]BANDwidth:VARiable` on page 122

Desired Sample Rate
Effective if "Sample Rate" is set under Specify Bandwidth by.

Sets the desired value for the sample rate input. See Chapter 8.4.2, "Setting the Sample Rate", on page 74.

Remote command:
`[SENSe<Sensor>:]BANDwidth:SRATe`

Used Sample Rate
Displays the currently used sample rate. See Chapter 8.4.2, "Setting the Sample Rate", on page 74.

Remote command:
`[SENSe<Sensor>:]BANDwidth:SRATe:CUV?`

Sync Mode
Requires the phase coherent measurements option (R&S NRQ6-K3).

Sets the synchronization for phase coherent measurements.

- "Off"
  No synchronization
- "Master"
  Is synchronized to the signal source by external reference and triggers the slave.
  Select the output port for the trigger signal under Master Port.
- "Slave"
  Is triggered by the master.

See also Chapter 9.2.6, "Trigger Master Usage", on page 88.

Remote command:
`[SENSe<Sensor>:]TRACe:IQ:SYNC:MODE`

Captured I/Q Samples
Available if "Free Run" is set under Trigger Mode.

Click "Download" to export the I/Q sample values in an `*.iq.tar` file. This file is suited for import into the vector signal explorer software, R&S VSE, from Rohde & Schwarz. From version 01.70, the R&S VSE software provides full integration.

Note: The "Download" button is available if Result Length ≤ 262000. For a larger result length, use remote control.

If you are using the R&S VSE software for analysis and it does not work, check whether the Result Length is large enough.

I/Q samples are scaled voltage values that give amplitude and phase information in a Cartesian coordinate system. I/Q data shows the changes in magnitude (or amplitude) and phase of a sine wave.

For more information, visit us at:

- R&S VSE software
- Rohde & Schwarz iq-tar File Format Specification

Remote command:

```
[SENSe<Sensor>:]TRACe:IQ:DATA:FORMat
FORMat[:DATA]
INITiate[:IMMediate]
[SENSe<Sensor>:]TRACe:IQ:DATA?
```

8.5 Power Servoing

Requires the power servoing option (R&S NRQ6-K2). For information on the option management, see Chapter 10.1, "Option Management", on page 104.

For component tests, measurements are performed at a specified DUT output level. Before starting a test, you need to set the DUT output power to a specific value. Because of nonlinearities and temperature effects, the gain of the DUT at the desired operating point can be unknown and needs to be determined iteratively. The traditional approach is to implement a control loop that runs on a computer and to use SCPI commands for querying a power sensor. This procedure can take several 10 ms, which is a long time for automated test applications.

A R&S NRQ6 fitted with the power servoing option, combined with an R&S SGT100A signal generator, offers a much faster solution. The R&S NRQ6 measures continuously and sends the results to the signal generator, using a serial interface. The regulator logic is integrated in the signal generator itself.

Setup

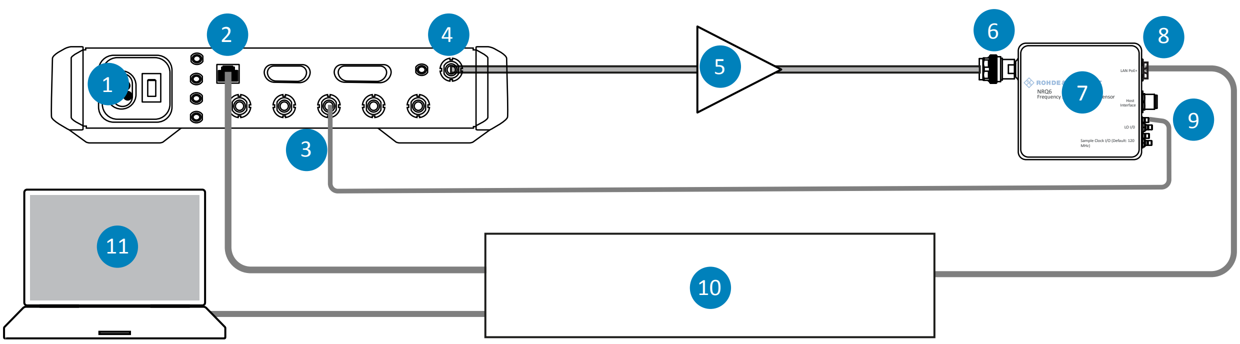


Figure 8-4: Cabling

1 = R&S SGT100A
2 = LAN interface
3 = USER 2 connector
4 = RF 50 Ω connector
5 = DUT
6 = RF connector
7 = R&S NRQ6
8 = LAN PoE+ interface
9 = TRIG2 connector
10 = Ethernet switch supporting PoE+ power delivery, for example. Alternatively, you can use the other set-ups described in Chapter 3.6.1, "Computer Using a LAN Connection", on page 16.
11 = Computer

1. Connect the instruments as shown in Figure 8-4.
2. Make sure to connect the TRIG2 connector of theR&S NRQ6 to the USER 2 connector of the R&S SGT100A.
3. Connect all instruments and the computer to the local network.

An application sheet with the title "Power Servoing" provides information on the measurement and application examples. The application sheet is available at:

www.rohde-schwarz.com/manual/NRQ6

Remote commands

[SENSe<Sensor>:]FUNCtion

SYSTem:COMMunicate:PSERvoing:BCLock

SYSTem:COMMunicate:PSERvoing:TPATtern

9 Measurement Configuration

This chapter describes further settings for measurement configuration. Frequently used settings or settings that are only available in one measurement mode are described with the measurement mode.

Further information:

- Chapter 8, "Measurement Modes and Result Displays", on page 60
- Chapter 10, "System Configuration", on page 104

Remote command reference:

- Chapter 12.9, "Configuring Measurement Settings", on page 136

Web user interface:

- Chapter 9.2.7, "Trigger Parameters", on page 88
- Chapter 9.3.3, "Correction Parameters", on page 96
- Chapter 9.4, "Mixer Settings", on page 98
- Chapter 9.5.2, "Sensor Parameters", on page 102

In the web user interface, these settings are grouped in the navigation under "Settings".

9.1 Controlling the Measurement

The power sensor offers a bunch of possibilities to control the measurement:

- Do you want to start the measurement immediately after the initiate command or do you want to wait for a trigger event?
- Do you want to start a single measurement cycle or a sequence of measurement cycles?
- Do you want to output each new average value as a measurement result or do you want to bundle more measured values into one result?

Further information:

- Chapter 12.5, "Starting and Ending a Measurement", on page 124
- Chapter 9.2, "Trigger Settings", on page 85

9.1.1 Controlling the Measurement Results

The R&S NRQ6 can cope with the wide range of measurement scenarios with the help of the so-called "termination control". Depending on how fast your measurement results change, you can define, how the measurement results are output.

In continuous average mode, use `[SENSe<Sensor>:]AVERage:TCONtrol`.

In trace mode, use `[SENSe<Sensor>:]TRACe:AVERage:TCONtrol`.

Repeating termination control

Outputs a measurement result when the entire measurement has been completed. This means that the number of measurement cycle repetitions is equal to the set average count. If the average count is large, the measurement time can be very long.

Useful if you expect slow changes in the results, and you want to avoid outputting redundant data.

Moving termination control

Outputs intermediate values to facilitate early detection of changes in the measured quantity. This means that for each partial measurement, a new average value is output as a measurement result. Thus, the measurement result is a moving average of the last partial measurements. How many of the partial measurements are averaged is defined by the average count.

Useful if you want to detect trends in the result during the measurement.

9.1.2 Interplay of the Controlling Mechanisms

In the following examples, continuous measurement scenarios are used. But these scenarios apply also to single measurements. The only difference is that a single measurement is not repeated.

9.1.2.1 Continuous Average Mode

General settings for these examples:

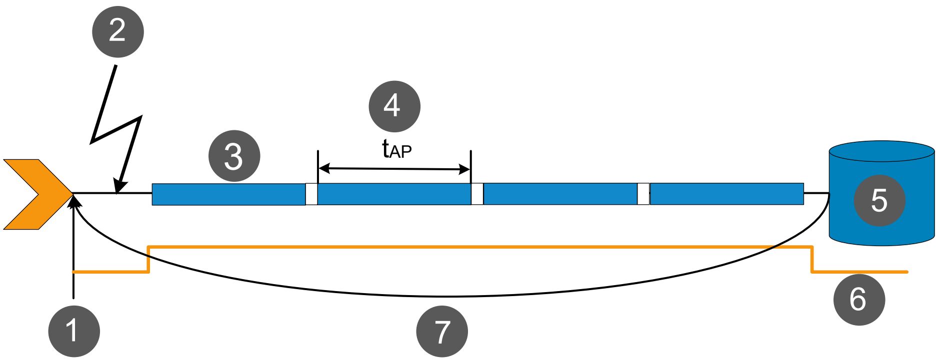
- `INITiate:CONTinuous ON`
- `[SENSe<Sensor>:]AVERage:COUNt 4`

Example: Repeating termination control

Further settings for this example:

- [SENSe<Sensor>:]TRACe:AVERage:TCONtrol REPeat
- [SENSe<Sensor>:]AVERage:COUNt 4

The measurement is started by the trigger event. One measurement lasts as long as the defined aperture time. As defined by the average count, after 4 measurements, the result is averaged and available. During the whole measurement cycle, the trigger synchronization is high (TRIGger:SYNC:STATe ON).



1 = Start of the measurement cycle
2 = Trigger event (only if TRIGger:SOURce ≠ IMMEDiate)
3 = One measurement
4 = Duration of one aperture time
5 = Measurement result
6 = Trigger synchronization
7 = Return to the start of the measurement cycle

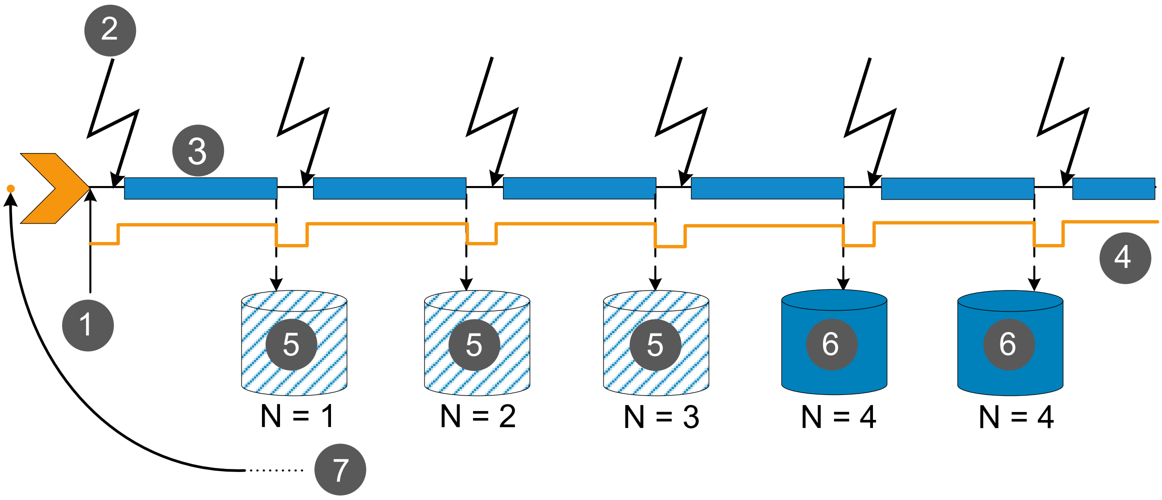
Example: Moving termination control

Further settings for this example:

- [SENSe<Sensor>:]AVERage:TCONtrol MOVing
- [SENSe<Sensor>:]AVERage:COUNt 4
- TRIGger:COUNt 16

Every measurement is started by a trigger event.One measurement lasts as long as the defined aperture time. During each measurement, the trigger synchronization is high (TRIGger:SYNC:STATe ON). Every measurement provides a result. During the settling phase, the amount of the result is already correct, but the noise is higher. After 4 measurements, when the average count is reached, settled data are available.

When the trigger count is reached (TRIGger:COUNt), the R&S NRQ6 returns to the idle state.



1 = Start of the measurement cycle
2 = Trigger event (only if TRIGger:SOURce ≠ IMMEDiate)
3 = One measurement
4 = Trigger synchronization
5 = Measurement result before average count is reached
6 = Averaged measurement result after average count is reached
7 = Return to idle state after trigger count (= 16 in this example) is reached
N = Number of measurements used for result

9.1.2.2 Trace Mode

General settings for the first two examples:

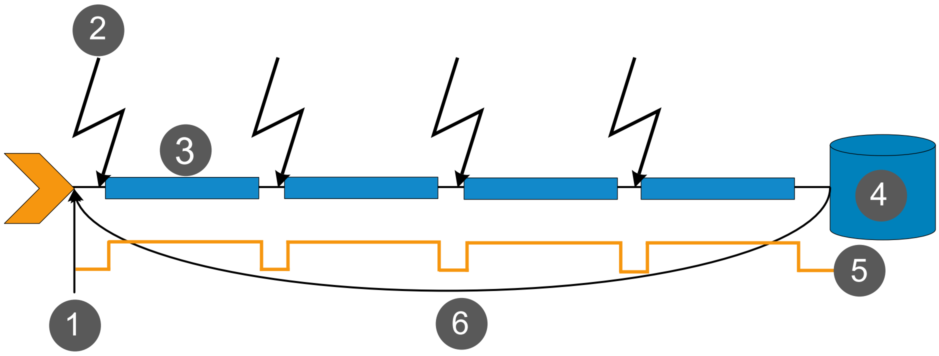
- INITiate:CONTinuous ON
- [SENSe<Sensor>:]AVERage:COUNt 4

Example: Repeating termination control

Further settings for this example:

- [SENSe<Sensor>:]AVERage:TCONtrol REPeat

Every measurement is started by a trigger event and lasts the defined aperture time. During a measurement, the trigger synchronization is high (TRIGger:SYNC:STATe ON). As defined by the average count, after 4 measurements, the result is averaged and available.



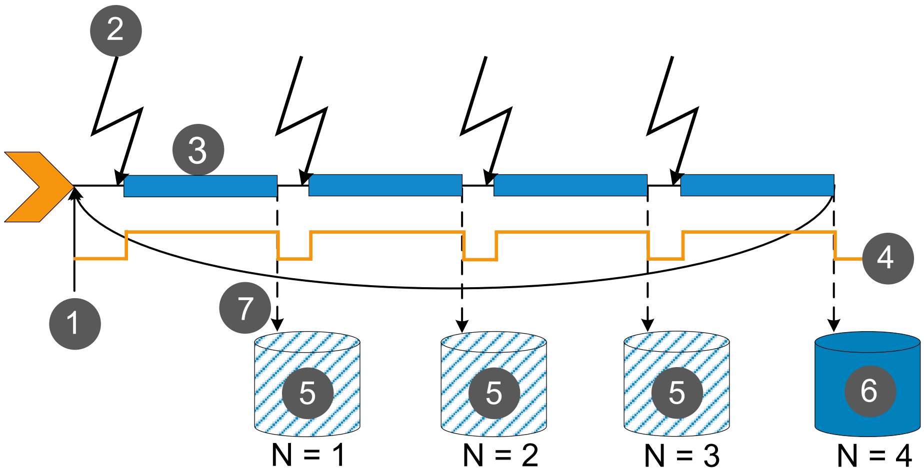
1 = Start of the measurement cycle
2 = Trigger event (only if TRIGger:SOURce ≠ IMMEDiate)
3 = One measurement
4 = Measurement result
5 = Trigger synchronization
6 = Return to the start of the measurement cycle

Example: Moving termination control

Further settings for this example:

- [SENSe<Sensor>:]AVERage:TCONtrol MOVing
- [SENSe<Sensor>:]AVERage:COUNt 4

Every measurement is started by a trigger event and lasts the defined aperture time. During a measurement, the trigger synchronization is high (TRIGger:SYNC:STATe ON). Every measurement provides a result. After 4 measurements, when the average count is reached, settled data are available.

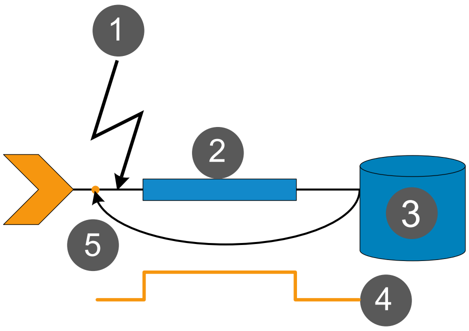


1 = Start of the measurement cycle
2 = Trigger event (only if TRIGger:SOURce ≠ IMMEDiate)
3 = One measurement
4 = Trigger synchronization
5 = Measurement result before average count is reached
6 = Averaged measurement result after average count is reached
7 = Return to the start of the measurement cycle
N = Number of measurements used for result

Example: Average count = 1

[SENSe<Sensor>:]AVERage:COUNt 1

For average count 1, the setting of the termination control has no impact. In both cases, the measurement runs for the duration of one aperture time. Then, settled data are available, and the R&S NRQ6 returns to the idle state.



1 = Trigger event (only if TRIGger:SOURce ≠ IMMEDiate)
2 = One measurement
3 = Measurement result
4 = Trigger synchronization
5 = Return to idle state

9.2 Trigger Settings

Remote command reference:

- Chapter 12.9.5, "Configuring the Trigger", on page 145

Contents:

- Trigger States.....85
- Trigger Sources.....86
- Dropout Time.....86
- Hold-Off Time.....87
- Trigger Jitter.....88
- Trigger Master Usage.....88
- Trigger Parameters.....88

9.2.1 Trigger States

The power sensor has trigger states to define the exact start and stop time of a measurement and the sequence of a measurement cycle. The following states are defined:

- Idle
  The power sensor performs no measurement. After powered on, the power sensor is in the idle state.
- Waiting for trigger
  The power sensor waits for a trigger event that is defined by the trigger source. When the trigger event occurs, the power sensor enters the measuring state.

- Measuring
  The power sensor is measuring data. It remains in this state during the measurement. When the measurement is completed, it exits this state immediately.

9.2.2 Trigger Sources

The possible trigger conditions and the execution of a trigger depend on the selected trigger mode and trigger source.

If the signal power exceeds or falls below a reference level set by the trigger level, the measurement is started after the defined delay time. Waiting for a trigger event can be skipped.

Trigger source	Description	Remote commands to initiate the measurement
"Hold"	Remains in wait state for trigger state infinitely. Provided for SCPI standard compatibility reasons.	-
"Immediate"	Measures immediately, does not wait for trigger condition.	-
"Internal"	Uses the filtered and preprocessed measurement signal as trigger signal.	TRIGger:IMMediate
"Host Interface"	Uses the digital input signal supplied using a differential pair in the 8-pin sensor cable.	TRIGger:IMMediate
"Trigger 2 I/O"	Uses the digital input signal supplied using the SMA connector.	TRIGger:IMMediate
"Bus (*TRG)"	Triggered by the remote command.	*TRG TRIGger:IMMediate

9.2.3 Dropout Time

The dropout time is useful when dealing with signals with several active slots, for example GSM signals, see Figure 9-1. When measuring in sync with the signal, a trigger event is to be produced at A, but not at B or C.

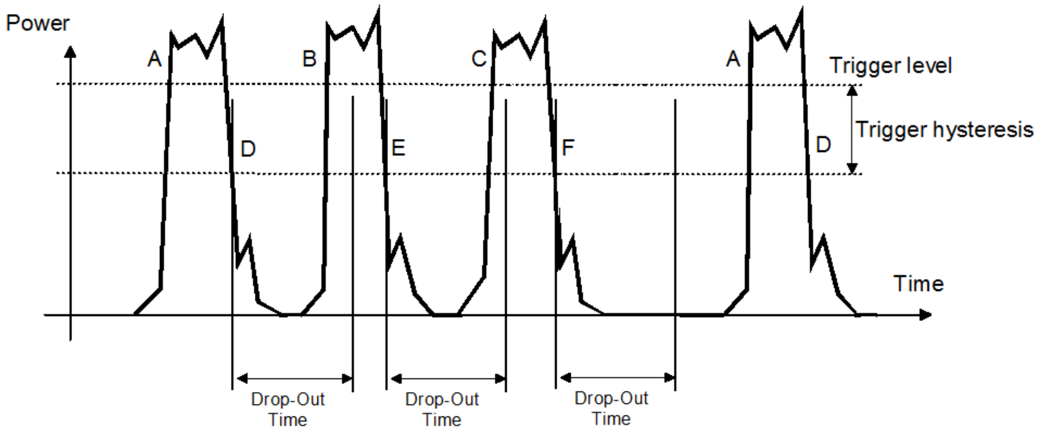


Figure 9-1: Significance of the dropout time

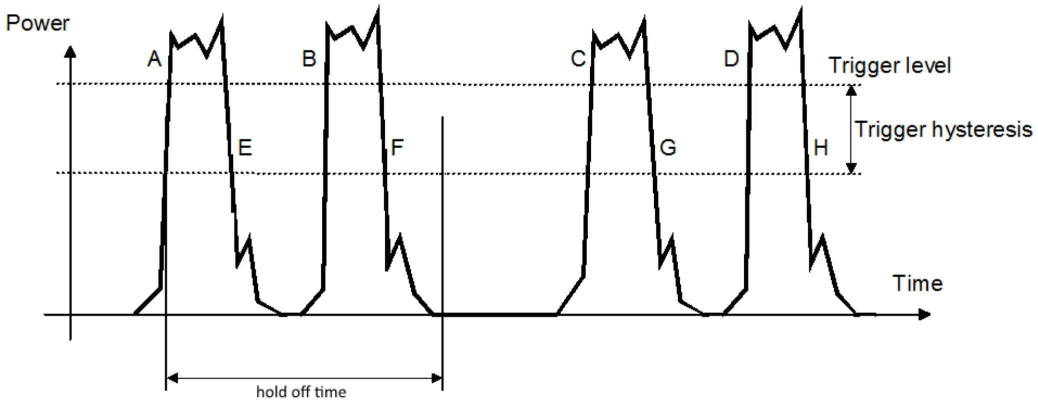
The RF power between the slots is below the threshold defined by the trigger level and the trigger hysteresis. Therefore, the trigger hysteresis alone cannot prevent triggering at B or at C. Therefore, set the dropout time greater than the time elapsed between points D and B and between E and C, but smaller than the time elapsed between F and A. Thus, you ensure that triggering takes place at A.

Because the mechanism associated with the dropout time is reactivated whenever the trigger threshold is crossed, you can obtain also unambiguous triggering for many complex signals.

If you use a hold-off time instead of a dropout time, you can obtain stable triggering conditions - regular triggering at the same point. But you cannot achieve exclusive triggering at A.

9.2.4 Hold-Off Time

During the hold-off time, a period after a trigger event, all trigger events are ignored.



9.2.5 Trigger Jitter

The R&S NRQ6 offers two methods to cope with the deviation from true periodicity.

- Compensate method
  Compensation means resampling of trace result.
  This method is only possible for bandwidths ≤ 80 MHz. Check the current state under <Bandwidth> or use `[SENSe<Sensor>:]BANDwidth:RESolution:CUV?`
  .
- Measure method
  Does not perform resampling, but stores the measured trigger jitter. You can query the measured trigger jitter using `TRIGger:JITTer?`.
  This method is not possible for bandwidths > 80 MHz if using an internal trigger condition. Check the current configuration using `TRIGger:JITTer:METHod:CUV?`. If `MEAS` is returned, this method can be used.

9.2.6 Trigger Master Usage

If the R&S NRQ6 is the trigger master, the R&S NRQ6 outputs a digital trigger signal in sync with its own trigger event. The trigger signal is output at the selected port, "Host Interface" or "Trigger 2 I/O".

Typically, the trigger master uses its internal trigger source. But you can also trigger the trigger master externally, because the R&S NRQ6 has two external trigger connectors. If you trigger the trigger master externally, use "Host Interface" as external trigger input port (trigger source) and "Trigger 2 I/O" as trigger master output port or vice versa.

9.2.7 Trigger Parameters

Access: main dialog of the web user interface > navigation pane > "Trigger"

Here, all available trigger settings are grouped. Some trigger settings are also available as measurement setting for quick access.

Trigger Mode....89
Trigger Level....89
Trigger Source....89
Trigger Delay....90
Jitter Suppression....90

Trigger Dropout....90
Trigger Holdoff....90
Trigger Hysteresis....90
Master Port....91
Trigger 2 I/O Impedance....91
Master State....91
Sync. State....91

Trigger Mode
Controls the trigger execution.

See also Chapter 9.2.2, "Trigger Sources", on page 86.

"Auto" Automatic trigger event each 300 ms if no trigger event has occurred during this time interval.

"Single" Implies separately started measurements that are not triggered internally. Corresponds to the following commands:
- `INITiate:CONTinuous OFF`
- `INITiate[:IMMediate]`
- `TRIGger:SOURce ≠ INTernal`

Click "1 Trig" to enable and trigger the measurement.

"Normal" Implies continuous measurements that are triggered internally. Corresponds to the following commands:
- `INITiate:CONTinuous ON`
- `TRIGger:SOURce INTernal`

Control the trigger event by the Trigger Level or by clicking "Force".

"Free Run" Sets "Immediate" as trigger source and vice versa.
If you want to stop the measurement, click "Stop". Restart the measurement with "Start".

Remote command:
This functionality has no direct remote control equivalent.

Trigger Level
Available if:
- "Auto", "Single" or "Normal" is set under Trigger Mode.
- "Internal" is set under Trigger Source.

Sets the trigger threshold for internal triggering. If Attenuator is set to 0 dB, the trigger level is restricted to ≤ -10 dBm. Values > -10 dBm cause a static error.

Click "Adjust" to adjust the trigger once automatically.

Remote command:
`TRIGger:LEVel`
`TRIGger:LEVel:AUTO`

Trigger Source
Sets the source for the trigger event. See Trigger Sources.

If "Free Run" is set under Trigger Mode, "Immediate" is set as trigger source and cannot be changed.

Remote command:
TRIGger:SOURce

Trigger Delay
Available if:
- "Auto", "Single" or "Normal" is set under Trigger Mode.
- "Internal", "External 1" or "External 2" is set under Trigger Source.

Sets the delay between the trigger event and the beginning of the actual measurement (integration).

Remote command:
TRIGger:DELay

Jitter Suppression
Defines the method how to cope with the misalignment between the trigger event and the sample point.

See Chapter 9.2.5, "Trigger Jitter", on page 88.

Remote command:
TRIGger:JITTer:METHod

Trigger Dropout
Available if:
- "Auto", "Single" or "Normal" is set under Trigger Mode.
- "Internal" is set under Trigger Source.

Sets the dropout time for the internal trigger source. During this time, the signal power must exceed (negative trigger slope) or undercut (positive trigger slope) the level defined by the trigger level and trigger hysteresis. At least, this time must elapse before triggering can occur again.

See Chapter 9.2.3, "Dropout Time", on page 86.

Remote command:
TRIGger:DTIMe

Trigger Holdoff
Sets the hold-off time, a period after a trigger event during which all trigger events are ignored.

See Chapter 9.2.4, "Hold-Off Time", on page 87.

Remote command:
TRIGger:HOLDoff

Trigger Hysteresis
Available if:
- "Auto", "Single" or "Normal" is set under Trigger Mode.
- "Internal" is set under Trigger Source.

Sets the hysteresis. A trigger event occurs, if the trigger level:
- Falls below the set value on a rising slope.
- Rises above the set value on a falling slope.

Thus, you can use this setting to eliminate the effects of noise in the signal for the edge detector of the trigger system.

Remote command:
TRIGger:HYSTeresis

Master Port
Effective only if the R&S NRQ6 is trigger master:
- "On" is set under Master State.
- "Master" is set under Sync Mode.

Selects the port where the R&S NRQ6 outputs a digital trigger signal. See Chapter 9.2.6, "Trigger Master Usage", on page 88.

Remote command:
TRIGger:MASTer:PORT

Trigger 2 I/O Impedance
Effective only if "External2" is set under Trigger Source.

Sets termination resistance of the second external trigger input. Choose the setting that fits the impedance of the trigger source to minimize reflections on the trigger signals.

"High"	~10 kΩ
"Low"	50 kΩ

Remote command:
TRIGger:EXTernal<2...2>:IMPedance

Master State
Enables or disables the trigger master state. See Chapter 9.2.6, "Trigger Master Usage", on page 88.

If enabled, select the output port for the trigger signal under Master Port.

Remote command:
TRIGger:MASTer:STATe

Sync. State
Usually used if "On" is set under Master State.

If enabled, blocks the external trigger bus as long as the sensor remains in the measurement state. Thus, ensures that a new measurement is only started after all sensors have completed their measurements.

The sync port is set by TRIGger:SYNC:PORT.

Make sure that the number of repetitions is the same for all sensors involved in the measurement. Otherwise, the trigger bus is blocked by any sensor that has completed its measurements before the others and has returned to the idle state.

See also Chapter 9.2.1, "Trigger States", on page 85.

Remote command:
TRIGger:SYNC:STATe

9.3 Correction Settings

Remote command reference:

- Chapter 12.7, "Calibrating and Zeroing", on page 133
- Chapter 12.9.6, "Configuring the Corrections", on page 152

Contents:

- Corrections in the RF Path....92
- Corrections in the IF Path.... 93
- Correction Parameters....96

9.3.1 Corrections in the RF Path

You can set parameters that compensate for internal and external influences.

9.3.1.1 Noise Correction

Each electronic system generates inherent noise that is added to the input noise. The *noise figure F* is the quotient of the signal-to-noise ratio at the input and output of an electronic system:

$F = SNR_{output} / SNR_{input}$

Expressed in dB as:

$10 \times \log (SNR_{output} / SNR_{input})$

If you enable the noise correction, the noise figure is subtracted from the measured power. For power measurements close to or in the noise floor, you can use the noise correction in continuous average and trace mode.

The noise figure varies with the frequency. The R&S NRQ6 uses a set of factory noise figures for different bandwidths. Alternatively, you can perform a zero calibration and use the determined noise figure until one of the following happens:

- Reboot
- Value change of:
  - Frequency
    100 MHz frequency grid is used, exactly as in the DC offset correction.
  - Attenuation
    0 dB or 30 dB
  - Resolution bandwidth
  - Resolution bandwidth filter type

In consequence of such changes, the determined noise figure is discarded and the set of factory noise figure values is applied again.

9.3.1.2 Zero Calibration

In a zero calibration, you determine the correction data for your measurement setup. The R&S NRQ6 performs the following steps.

1. Measures the noise using the signal at the RF input. Therefore:
   Turn off all test signals before zeroing. An active test signal during zeroing causes an error.
2. Enables the noise correction by applying the determined noise figure in step 1.
   See Chapter 9.3.1.1, "Noise Correction", on page 92.
3. For measurements in zero-IF mode (RBW > 40 MHz), also performs DC Zeroing.
   See Chapter 9.3.2.2, "DC Zeroing", on page 95.

Perform a new zero calibration if:
- Temperature has varied by more than 5 K.
- No zeroing was performed in the last 24 hours.
- Signals of very low power are to be measured, for instance, if the expected measured value is less than 10 dB above the noise level.

9.3.1.3 Accounting for External Losses

Add a fixed level offset in dB using Level Offset.

If you consider the attenuation of an attenuator located ahead of the R&S NRQ6 or the coupling attenuation of a directional coupler, use a positive offset. That means the R&S NRQ6 displays the power at the input of the attenuator or the directional coupler.

If you want to correct the influence of an amplifier connected ahead, use a negative offset.

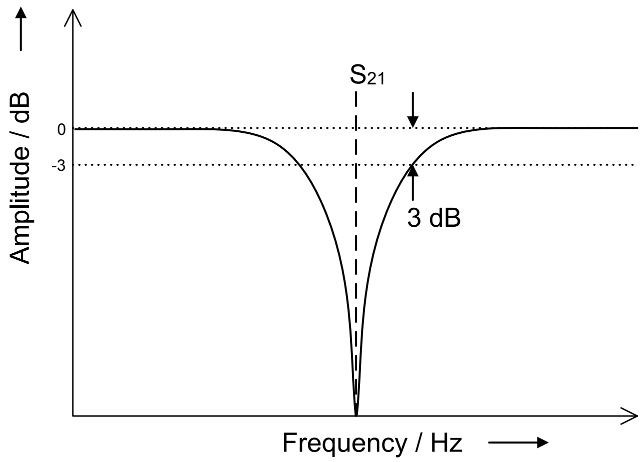
9.3.2 Corrections in the IF Path

These corrections are suitable for measurements in zero-IF mode, with resolution bandwidths > 40 MHz.

9.3.2.1 DC Rejection

Using the DC reject filter, you can suppress an inherent DC offset in the IF path.

The DC reject filter is a notch filter in the IF path. Its frequency response shows a deep notch with high selectivity:



In the following example, the inherent noise spectrum in zero-IF mode is shown, with RBW = 100 MHz and attenuator = 0 dB. Fig.9-2 shows the noise spectrum without corrections. Fig.9-3 shows the noise spectrum with the DC reject filter enabled and the 3 dB frequency set to 1.166 kHz.

For measuring multicarrier signals in zero-IF mode at low signal levels, enable the DC reject filter and set the LO frequency of the R&S NRQ6 in a space between two carriers.

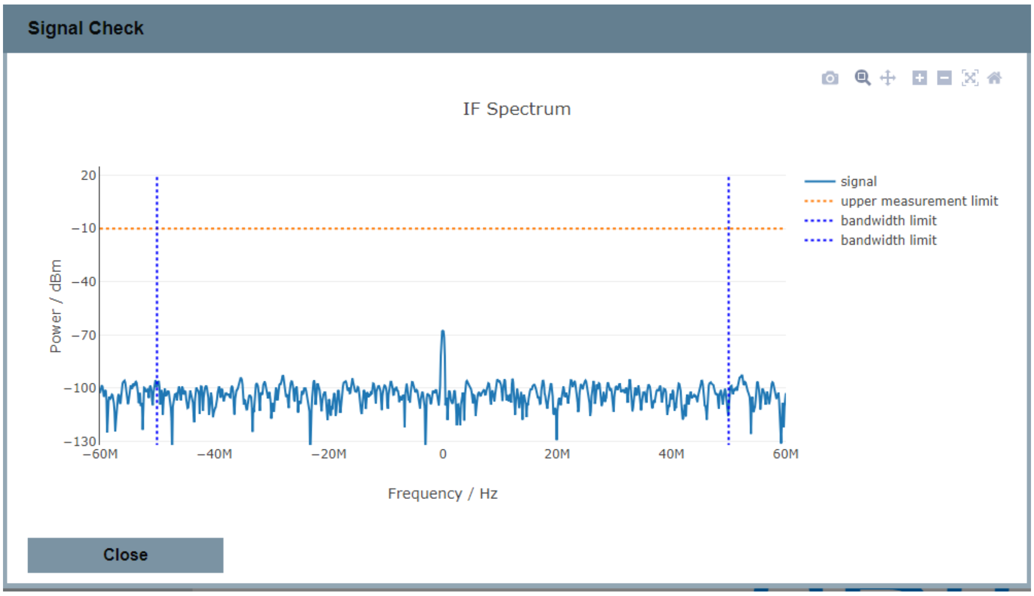


Figure 9-2: Inherent noise spectrum with DC reject filter disabled

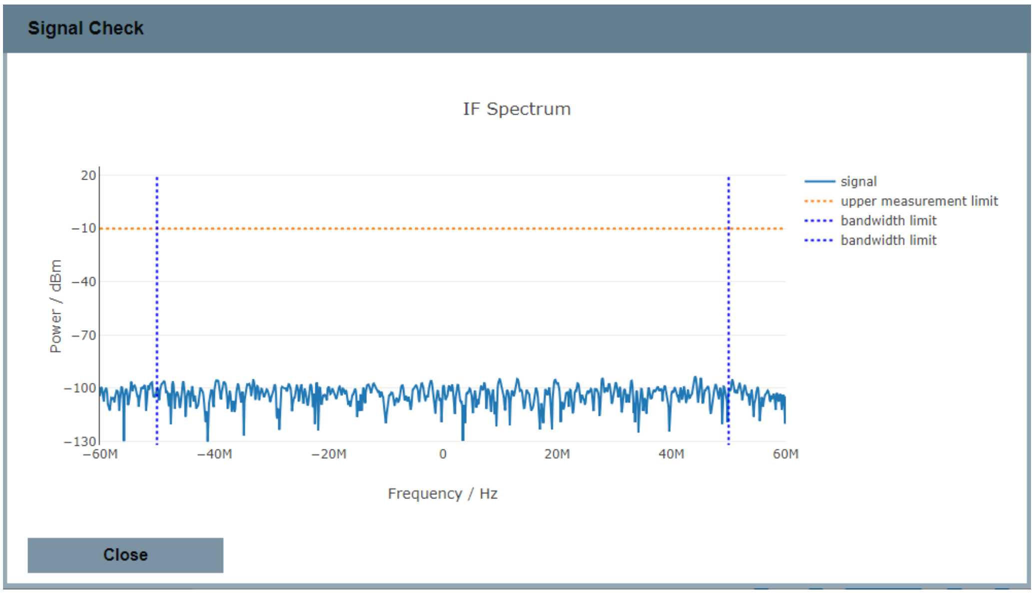


Figure 9-3: Inherent noise spectrum with DC reject filter enabled

9.3.2.2 DC Zeroing

In zero-IF mode (RBW > 40 MHz), the R&S NRQ6 shows a large DC offset. This DC offset is caused by the reflection of the internal LO signal at the RF connector, leading to mixing products. This phenomenon is described in the data sheet as LO leakage at RF input connector. See also Chapter 6.6.2, "LO Leakage", on page 46.

You can correct this offset using the DC offset calibration, so-called DC zeroing. In this calibration, the R&S NRQ6 measures and saves a DC offset value depending on the following parameter settings:

- Attenuator <Level>
  0 dB or 30 dB
- Resolution <Bandwidth>
  Equals 400 MHz or not. All RBWs ≠ 400 MHz count as one setting.
- Center Frequency
  Starting from 50 MHz, the frequency range is divided into a 100 MHz frequency grid. Each 100 MHz range counts as one setting. So if you calibrate for a center frequency of 980 MHz, and then change the center frequency to 1020 MHz, still the same DC offset value applies.

As long as you keep the parameters within range, the R&S NRQ6 applies same DC offset value once it is determined. If you change one parameter out of range, the R&S NRQ6 does not apply the same DC offset value any more. Calibrate for the new parameter settings to acquire a fitting DC offset value.

If you calibrate again for parameter settings for which there already exists a DC offset value, the R&S NRQ6 overwrites the old DC offset value with the new one. You can use the saved DC offset values as long as you do not reboot the R&S NRQ6.

Due to changes in the environmental conditions, it happens that the DC offset value does not fit any more. If you are not sure of the quality, check the intermediate frequency (IF) spectrum using Signal Check. If the DC offset is too large, calibrate again.

To calibrate the DC offset

1. Allow at least 10 minutes warm-up time before starting the DC zeroing.
2. Set up the R&S NRQ6 for the measurement, in all cases ensure that:
   - The DUT is connected to the RF connector as described in Chapter 3.4, "Connecting to a DUT", on page 14. For OTA measurements, ensure that the antenna is connected to the RF connector of the R&S NRQ6.
     In contrast to zero calibration, you do not need to turn off all test signals, as long as the test signals do not have a large DC component in the IF band.
   - The current settings are fitting for the measurement you want to perform.
3. Start DC zeroing.
   Web user interface: "DC Zeroing" on page 98
   Remote control: `CALibration<Channel>:IQOFfset[:AUTO]`

Changing the DUT setup after the DC zeroing can result in a different mismatch, thus making the DC offset calibration invalid.

Further information:

- Chapter 8.3.3, "DC Zeroing in ACLR Mode", on page 70

9.3.3 Correction Parameters

Access: main dialog of the web user interface > navigation pane > "Correction"

RF Path..97
└ Zero Calibration..97
└ Noise Correction..97
└ Level Offset..97
└ <State>..97
└ Normalize..97
└ <Value>..97
IF Path..98

└ DC Reject Filter....98
└ <State>....98
└ Desired 3dB Frequency....98
└ Used 3dB Frequency....98
└ DC Zeroing....98

RF Path
Groups the RF correction settings.

Zero Calibration ← RF Path
Click "Zero" to execute zeroing. See Chapter 9.3.1.2, "Zero Calibration", on page 93.

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

Remote command:
`CALibration<Channel>:ZERO:AUTO`

Noise Correction ← RF Path
For background information, see Chapter 9.3.1.1, "Noise Correction", on page 92.

Enables or disables the noise correction.

Remote command:
`[SENSe<Sensor>:]POWer:NCORrection[:STATe]`

Level Offset ← RF Path
For background information, see Chapter 9.3.1.3, "Accounting for External Losses", on page 93.

<State> ← Level Offset ← RF Path
Enables or disables the offset correction.

Remote command:
`[SENSe<Sensor>:]CORRection:OFFSet:STATe`

Normalize ← Level Offset ← RF Path
Available in continuous average mode.

Click this button to adopt the currently measured value as new level offset. You can use this function as a quick way to set up relative measurements.

<Value> ← Level Offset ← RF Path
Available if "On" is set under <State>.

Sets a fixed offset that is added to the measured value to account for external attenuation or amplification.

"-200.0" to "200.0"
Value in dB.

Remote command:
`[SENSe<Sensor>:]CORRection:OFFSet`

IF Path
Groups the IF correction settings.

DC Reject Filter ← IF Path
For background information, see Chapter 9.3.2.1, "DC Rejection", on page 93.

<State> ← DC Reject Filter ← IF Path
Available for resolution bandwidths > 40 MHz (zero-IF mode).

Enables or disables the DC reject filter. Set the corner (cut-off) frequency points using Desired 3dB Frequency.

Remote command:
`[SENSe<Sensor>:]FILTer:DCReject[:STATe]`

Desired 3dB Frequency ← DC Reject Filter ← IF Path
Enter the corner (cut-off) frequency of the DC reject filter.

"146.0 Hz" to "12.5 MHz"	Frequency range

Remote command:
`[SENSe<Sensor>:]FILTer:DCReject:FCORner`

Used 3dB Frequency ← DC Reject Filter ← IF Path
Displays the currently used corner frequency of the DC reject filter.

Remote command:
`[SENSe<Sensor>:]FILTer:DCReject:FCORner:CUV?`

DC Zeroing ← IF Path
Click "Zero" to compensate for the internal DC voltage offset. Recommended for measurements in zero-IF mode (RBW > 40 MHz). See Chapter 9.3.2.2, "DC Zeroing", on page 95.

Remote command:
`CALibration<Channel>:IQOFfset[:AUTO]`

9.4 Mixer Settings

The mixer is a central part of the R&S NRQ6, as shown in Chapter 6.1, "Functional Principle", on page 41. The center frequency defines the mixing (intermediate) frequency in the downconversion process.

Remote command reference:

- Chapter 12.9.7, "Configuring the Mixer", on page 154

Contents:

- Local Oscillator Signal....................99
- Mixer Parameters....................99

9.4.1 Local Oscillator Signal

By default, the R&S NRQ6 generates its local oscillator (LO) signal internally. You can output the local oscillator signal at the LO connector and use it for other devices. Also, you can input an external signal at the LO connector and use it instead of the internal LO signal. For the frequency range, see Table 9-2.

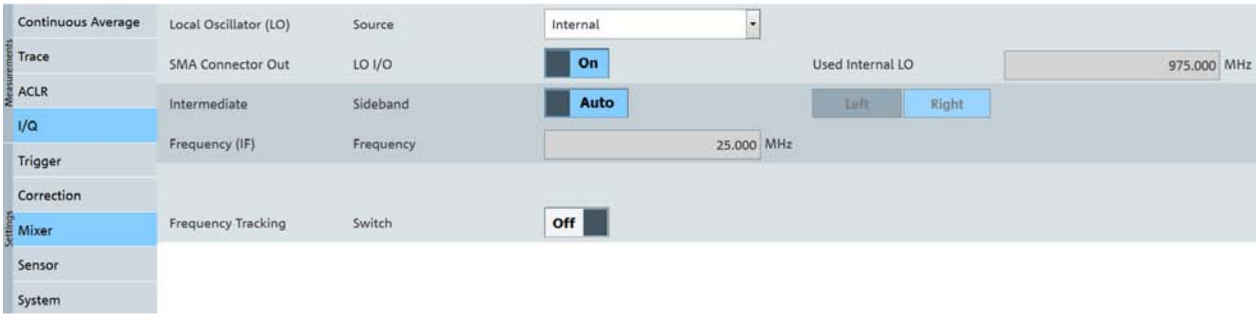
Make sure that you use the LO connector either as input or as output. Contradictory settings cause a static error.

Further information:

- Chapter 7.2, "Frequency Configuration", on page 50
- Chapter 4.8, "Local Oscillator I/O (LO)", on page 30

9.4.2 Mixer Parameters

Access: main dialog of the web user interface > navigation pane > "Mixer"



Local Oscillator (LO) - Source.....99
SMA Connector Out.....100
└ LO I/O.....100
└ Used Internal LO, Expected External LO.....100
Intermediate.....100
└ Sideband.....100
└ Left, Right.....100
Frequency (IF) - Frequency.....100
Frequency Tracking.....100
└ Switch.....101
└ Tracking Frequency.....101

Local Oscillator (LO) - Source

Sets the local oscillator source.

"Internal"	Uses the internal LO signal.
"External"	Uses the external LO signal fed into the LO connector. The internal LO generation is disabled. Enabling LO I/O at the same time causes a static error. The absence of an external LO signal at the LO connector also causes a static error.

Note:

The usage of the external sampling clock requires an external LO signal. To avoid setting conflicts, the following combination is not allowed:

- External sampling clock enabled
- Internal LO source

Remote command:
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:SOURce

SMA Connector Out
Groups the parameters of the local oscillator output.

LO I/O ← SMA Connector Out
Enables or disables the output of the local oscillator signal. See Chapter 9.4.1, "Local Oscillator Signal", on page 99.

"Off"	No signal is output. You can use the LO connector as an input.
"On"	LO signal is output. Setting Local Oscillator (LO) - Source to "External" at the same time causes a static error.

Remote command:
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:OUTPut[:STATe]

Used Internal LO, Expected External LO ← SMA Connector Out
Displays the currently used local oscillator frequency.

Remote command:
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO[:CUV]?

Intermediate
Groups settings of the intermediate frequency sideband.

Sideband ← Intermediate
Enables or disables the automatic setting of the intermediate frequency sideband.

Remote command:
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband:AUTO[:STATe]

Left, Right ← Intermediate
Available if "Manual" is set under "Sideband" on page 100.

Sets the currently used intermediate frequency sideband.

Remote command:
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband

Frequency (IF) - Frequency
Displays the currently used intermediate frequency.

Remote command:
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF[:CUV]?

Frequency Tracking
For background information, see Chapter 7.2.1, "Frequency Tracker", on page 50.

Switch ← Frequency Tracking

Enables or disables the frequency tracker.

Remote command:

`[SENSe<Sensor>:]FREQuency:TRACk`

`[SENSe<Sensor>:]FREQuency:TRACk:CUV[:STATe]?`

Tracking Frequency ← Frequency Tracking

Available if "On" is set under Switch.

Displays the tracking frequency.

Remote command:

`[SENSe<Sensor>:]FREQuency:TRACk:FREQuency?`

9.5 Sensor Settings

Remote command reference:

- Chapter 12.9.8, "Configuring the Sensor", on page 157

Contents:

- Clock Source Configuration.. 101
- Sensor Parameters... 102

9.5.1 Clock Source Configuration

By default, the R&S NRQ6 generates its conversion frequency, sampling clock and reference clock internally. Alternatively, you can use external clock sources, see Table 9-2.

Table 9-1: Internal clock frequencies

Reference clock	10 MHz
Sampling clock	119 MHz to121 MHz
Conversion frequency	70 MHz to 6.03 GHz

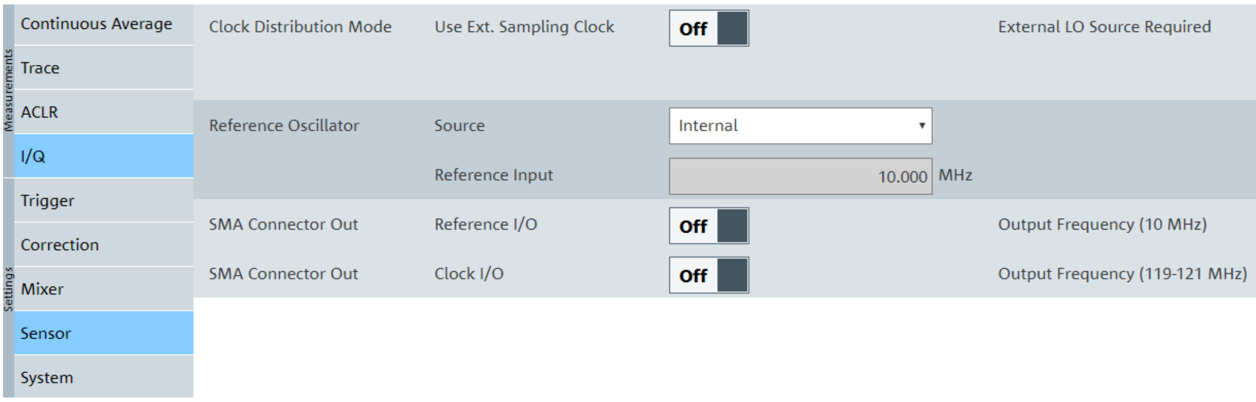
Table 9-2: External clock sources

Used connector	Input frequency range	Output frequency range
Host interface connector (USB host) See Chapter 4.4, "Host Interface", on page 29.	20 MHz	No output
REF connector See Chapter 4.6, "Reference I/O (REF)", on page 29.	10 MHz	10 MHz

Used connector	Input frequency range	Output frequency range
CLK connector See Chapter 4.7, "Clock I/O (CLK)", on page 30.	119 MHz to 121 MHz	119 MHz to 121 MHz
LO connector See Chapter 4.8, "Local Oscillator I/O (LO)", on page 30.	70 MHz to 6.03 GHz	70 MHz to 6.03 GHz

9.5.2 Sensor Parameters

Access: main dialog of the web user interface > navigation pane > "Sensor"



Clock Distribution Mode - Use Ext. Sampling Clock.. 102
Reference Oscillator...103
└ Source...103
└ Reference Input.. 103
SMA Connector Out.. 103
└ Reference I/O..103
└ Clock I/O.. 103

Clock Distribution Mode - Use Ext. Sampling Clock

Requires the phase coherent measurements option (R&S NRQ6-K3).

Configures the usage of the external sampling clock.

Note:

The usage of the external sampling clock requires an external LO signal. To avoid setting conflicts, the following combination is not allowed:

- External sampling clock enabled
- Internal LO source

"Off"	Default setting. Uses the internally generated 10 MHz reference signal to derive the sampling clock signal.
"On"	Enables the use of an external sampling clock supplied at the clock I/O (CLK) connector.

Remote command:

`[SENSe<Sensor>:]ROSCillator:PASSthrough`

Reference Oscillator
Groups the reference oscillator settings.

Source ← Reference Oscillator
Sets the source of the reference oscillator. See Chapter 9.5.1, "Clock Source Configuration", on page 101.

Remote command:
`[SENSe<Sensor>:]ROSCillator:SOURce`

Reference Input ← Reference Oscillator
The behavior depends on the source set under Source.

"Reference I/O"	Sets the frequency of the reference clock signal that is supplied at the REF connector. A value other than 10 MHz is not recommended. See also Table 9-2.
"Internal" or "Host Interface"	The parameter is read-only.

Remote command:
`[SENSe<Sensor>:]ROSCillator:REFio:FREQuency`

SMA Connector Out
Groups the output configuration.

Reference I/O ← SMA Connector Out
Available if "Internal" or "Host Interface" is set under Source.

If the REF connector is used as an output, enables or disables the output signal.

See also Table 9-2.

Remote command:
`[SENSe<Sensor>:]ROSCillator:REFio:OUTPut[:STATe]`

Clock I/O ← SMA Connector Out
If the CLK connector is used as an output, enables or disables the output signal.

See also Table 9-2.

Remote command:
`[SENSe<Sensor>:]SAMPling:CLKio:OUTPut[:STATe]`

10 System Configuration

The settings for the system configuration do not directly affect the measurement.

Remote command reference:

- Chapter 12.10, "Configuring the System", on page 159

10.1 Option Management

Optional features are available as options and are part of the firmware package. If you want to use an optional feature, you buy the option and, in return, receive a license key. Using the license key, you can activate the option as described in Chapter 10.1.1, "Installing a License Key", on page 104.

You can also use the license key to deactivate the option but keep in mind that you cannot use the same license key to activate the option again. If you want to reactivate an option, contact the Rohde & Schwarz service center to request a new license key.

For detailed information on available options, see the data sheet or visit:

www.rohde-schwarz.com/manual/NRQ6

10.1.1 Installing a License Key

Use one of the following methods:

- Entering the license key manually.
  See "To install the license key" on page 104.
- Using an RSI file.
  See "To install the license key" on page 104.
- Using remote control.
  See `SYSTem:LICense:KEY` on page 168 or `SYSTem:LICense:XML` on page 168

To install the license key

1. Make sure that the most recent firmware version is installed.
2. Open the web user interface, see "To display the Web user interface" on page 34.
3. In the navigation pane of the main dialog, select "System".
4. Click "Enter License Key".

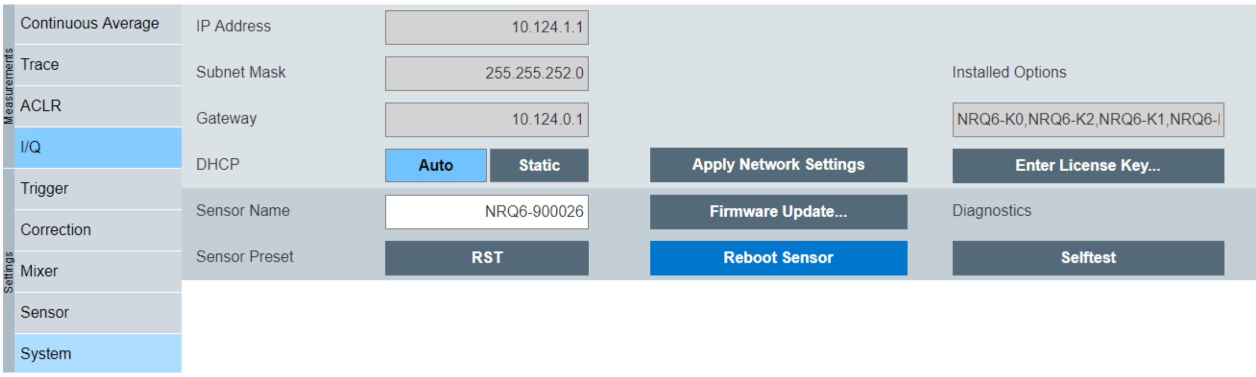
   The "Enter License Key" dialog is displayed.
   See "Enter License Key" on page 107.
5. If you install the license key manually:
   a) Under "License Key", enter the license key from the software option list supplied with the option.

6. If you use an RSI file:
   a) Copy the RSI file delivered with the option into a folder that you can access with your R&S NRQ6.
   b) Click "Browse License File".
   c) Select the RSI file you want to install.
7. Click "Apply".
8. Click "Reboot".

   The R&S NRQ6 performs a reboot.
9. Check whether the option is active. The name of the option is displayed under "Installed Options", for example "NRQ-K1".

10.2 System Parameters

Access: main dialog of the web user interface > navigation pane > "System"



IP Address........106
Subnet Mask........106
Gateway........106
DHCP........106
Apply Network Settings........106
Sensor Name........106
Sensor Preset........106
Firmware Update........107
Reboot Sensor........107
Installed Options........107
Enter License Key........107
└ Device ID........108
└ License Key........108
└ Browse License File........108
└ Apply........108
└ Reboot........108
└ Diagnostics - Selftest........108

IP Address
Sets the IP address of the sensor.

If "Auto" is set under DHCP, the parameter is read-only.

Remote command:
`SYSTem:COMMunicate:NETWork:IPADdress`

Subnet Mask
Sets the subnet mask.

The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

If "Auto" is set under DHCP, the parameter is read-only.

Remote command:
`SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK`

Gateway
Sets the address of the default gateway, that means the router that is used to forward traffic to destinations beyond the local network. This router is on the same network as the power sensor.

If "Auto" is set under DHCP, the parameter is read-only.

Remote command:
`SYSTem:COMMunicate:NETWork:IPADdress:GATeway`

DHCP
Sets how the IP address is assigned.

"Auto" Assigns the IP address automatically, provided the network supports the dynamic host configuration protocol (DHCP).

"Static" Enables assigning the IP address manually.

Remote command:
`SYSTem:COMMunicate:NETWork:IPADdress:MODE`

Apply Network Settings
Applies the changes of the network settings to the sensor.

Sensor Name
Sets the sensor name. The sensor name is displayed in the title bar of the web user interface, see (1) in Figure 5-1.

If you do not specify a sensor name, the hostname is used as default. See also `SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 162.

Remote command:
`SYSTem[:SENSor]:NAME`

Sensor Preset
Click the "RST" button to perform a preset. Use the preset functionality to set the R&S NRQ6 to a well defined state. This allows you to change parameter values from well defined starting point.

Remote command:
`*RST`

Firmware Update
Opens a dialog to start the firmware update. For further information, see Chapter 11.2.1, "Using the Web User Interface", on page 109.

Alternatively, you can the Firmware Update for NRP Family program. See Chapter 11.2.2, "Using the Firmware Update for NRP Family Program", on page 110.

Remote command:
`SYSTem:FWUPdate`
`SYSTem:FWUPdate:STATus?`

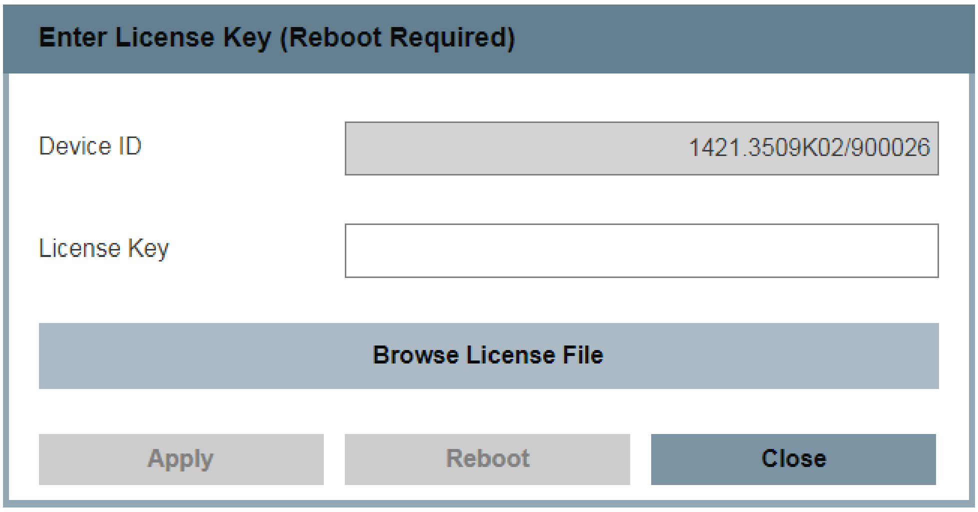
Reboot Sensor
Reboots the R&S NRQ6. When the reboot is completed, press [F5] to reload the web browser page.

Remote command:
`SYSTem:REBoot`

Installed Options
Lists all software options that are activated on the R&S NRQ6. See also Chapter 10.1, "Option Management", on page 104.

Remote command:
`*OPT?`

Enter License Key
Click the "Enter License Key" button to open the corresponding dialog.



Further information:

- Chapter 10.1, "Option Management", on page 104
- Chapter 10.1.1, "Installing a License Key", on page 104

Device ID ← Enter License Key
Displays the identification number that is unique for each R&S NRQ6. The string has the following structure:

1421.3509K02/<serial number>

You need the device ID to order an option.

Remote command:
`SYSTem:INFO?`

License Key ← Enter License Key
Enter the license key for the option.

Remote command:
`SYSTem:LICense:KEY`

Browse License File ← Enter License Key
Opens the file manager to select the license file, an RSI file.

Remote command:
`SYSTem:LICense:XML`

Apply ← Enter License Key
Applies the changes and closes the dialog.

Reboot ← Enter License Key
Reboots the R&S NRQ6 to complete a license key installation.

Remote command:
`SYSTem:REBoot`

Diagnostics - Selftest ← Enter License Key
Click "Selftest" to start a selftest.

Note:
During the selftest, do not apply a signal because this can cause erroneous test results.

After the selftest is completed, the results are displayed. For detailed information, see Chapter 15.4, "Performing a Selftest", on page 203.

Remote command:
`TEST:SENSor?`

11 Firmware Update

- Hardware and Software Requirements....................109
- Updating the Firmware....................109

11.1 Hardware and Software Requirements

For performing a firmware update, the system requirements are as follows:

- Connectors and cables for establishing a connection to the computer
  See Chapter 3.6, "Connecting to a Controlling Host", on page 16.
- Rohde & Schwarz update file (`*.rsu`) for the R&S NRQ6
  Download the most recent firmware version from the Rohde & Schwarz homepage on the Internet, since the CD-ROM accompanying the power sensor contains the firmware dating from the time of delivery. The latest firmware update files are available at: www.rohde-schwarz.com/en/firmware/nrq6/
  If the `*.rsu` file is packed in a `*.zip` archive, extract it before updating.
- If you use the Firmware Update for NRP Family program, further requirements are essential. See "Checking the prerequisites" on page 110.

11.2 Updating the Firmware

NOTICE

Risk of faulty firmware

Disconnecting the power supply while an update is in progress can lead to missing or faulty firmware.

Take special care not to disconnect the power supply while the update is in progress. Interrupting the power supply during the firmware update most likely leads to an unusable power sensor that needs to be sent in for maintenance.

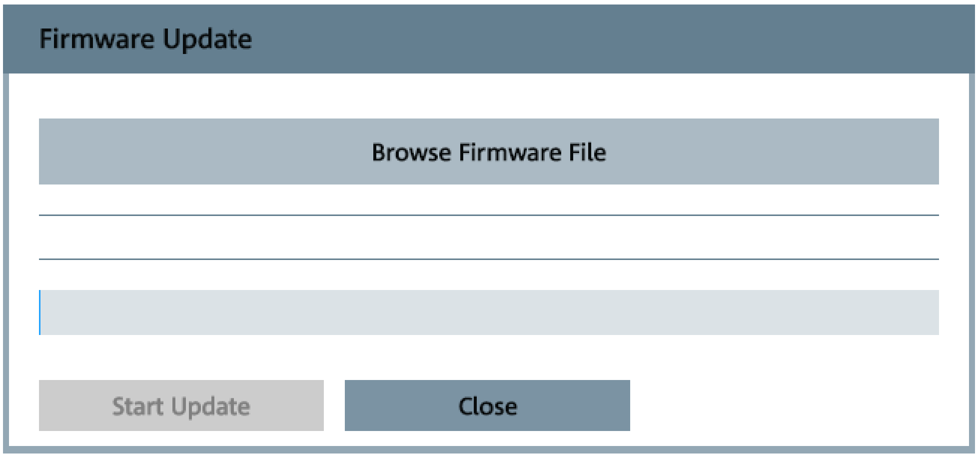
You can use the following methods to update the firmare installed on the R&S NRQ6:

- Using the Web User Interface....................109
- Using the Firmware Update for NRP Family Program....................110
- Using Remote Control....................114

11.2.1 Using the Web User Interface

The operating concept of the web user interface is described in Chapter 5.2, "Browser-Based User Interface", on page 33.

1. Connect the power sensor to the computer as described in "To connect to a LAN PoE+ interface" on page 16.
2. Open the web user interface as described in Chapter 5.2, "Browser-Based User Interface", on page 33.
3. In the navigation pane, select "System".
4. Click "Firmware Update".



5. Click "Browse" to select the `*.rsu` file for upload.

   The selected `*.rsu` is displayed, for example `NRQx_18.02.19.01.rsu`.
6. Click "Start Update".

   During the update process, a progress bar is displayed. When the update is completed, the firmware version displayed in the title bar is the same as in the name of the `*.rsu` file.

11.2.2 Using the Firmware Update for NRP Family Program

The Firmware Update for NRP Family program is part of the R&S NRP Toolkit for Windows. See also Chapter 5.1, "R&S NRP Toolkit", on page 31.

You can perform a firmware update with Firmware Update for NRP Family only if the power sensor is recognized as a VISA device.

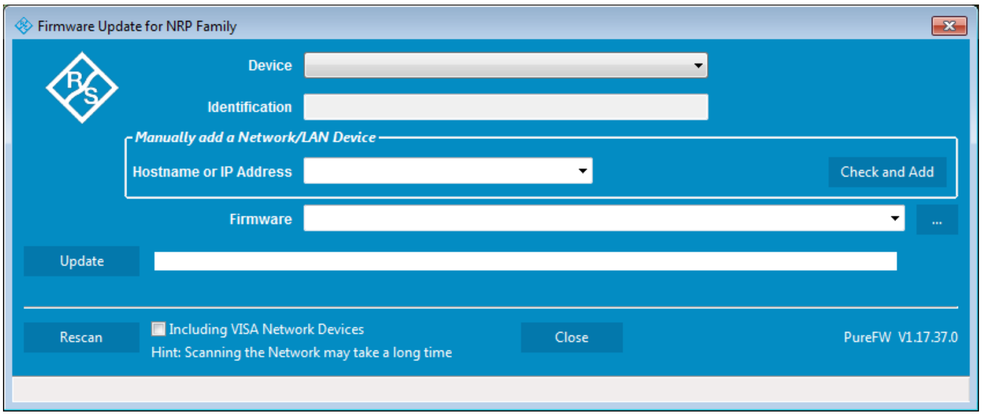
Checking the prerequisites

1. Ensure that a recent VISA software is installed on the computer.
2. Ensure that the R&S NRP Toolkit for Windows is installed on the computer. See Chapter 5.1, "R&S NRP Toolkit", on page 31.

Firmware Update for NRP Family over LAN

1. Check the prerequisites, see "Checking the prerequisites" on page 110.

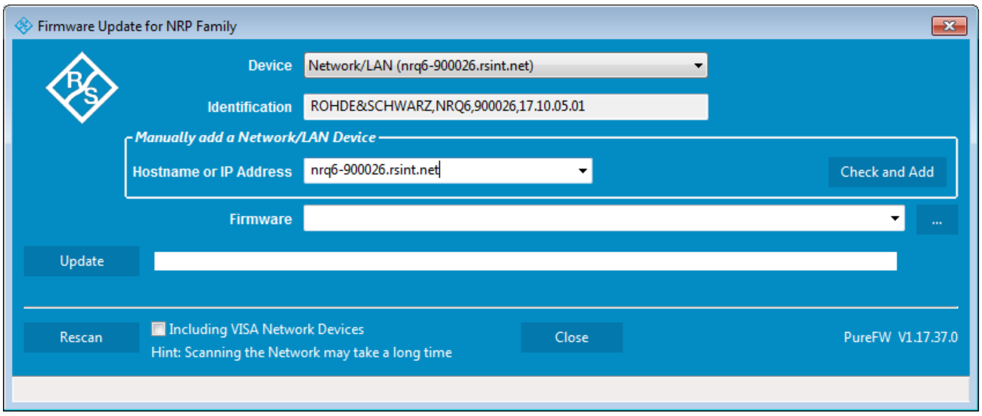
2. Connect the power sensor to the computer as described in Chapter 3.6.1, "Computer Using a LAN Connection", on page 16.
3. Start the Firmware Update for NRP Family program:
"Start" menu > "NRP-Toolkit" > "Firmware Update".



4. Under "Hostname or IP Address", enter the hostname or the IP address of the sensor you want to update.

   If you have updated the firmware on your power sensor before, the hostname or address is displayed.
5. Click "Check and Add".

   Under "Device", the connection type and hostname are displayed.
   Under "Identification", the following information is displayed: manufacturer, sensor type, serial number, firmware version.

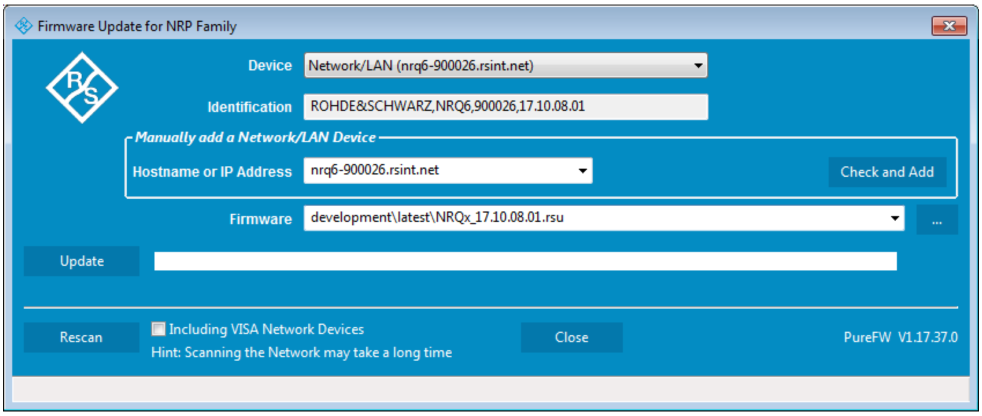


6. In the "Firmware" field, enter the full path and filename of the update file, or press the browse button next to the field and select it.

   If you have updated the firmware on your power sensor before, path and filename are displayed.
   New firmware for the Rohde & Schwarz power sensors generally has an `*.rsu` (Rohde & Schwarz update) extension.
7. Click "Update".

During the update process, a progress bar and status information are displayed.

8. Check if the update was successful. The firmware version in the "Identification" field must match the version you selected in the "Firmware" field.



9. If the update is not successful, check whether all necessary drivers are installed on the computer. For example, if the VISA library is not installed, no VISA power sensor is accessible. For more details, see Chapter 11.1, "Hardware and Software Requirements", on page 109 and "Checking the prerequisites" on page 110.

10. If you use the web user interface to operate the R&S NRQ6, press [F5] to reload the web page.

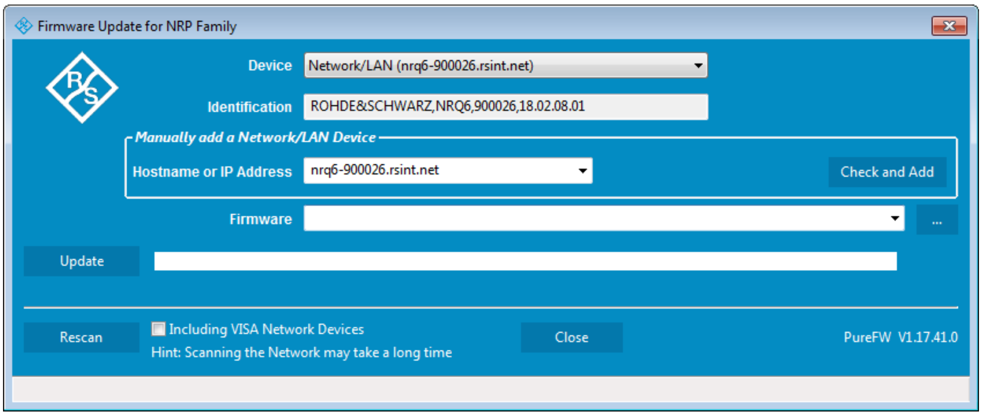
Firmware Update for NRP Family over USB

1. Check the prerequisites, see "Checking the prerequisites" on page 110.

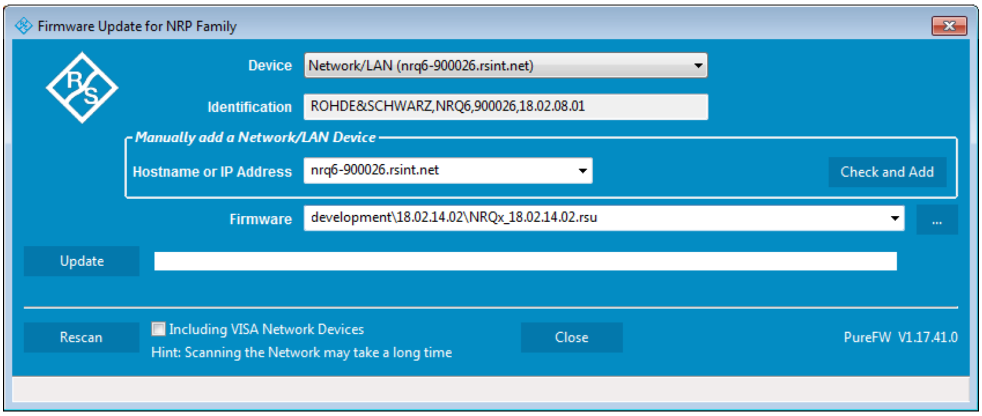
2. Connect the power sensor to the computer as described in Chapter 3.6.2, "Computer Using a USB Connection", on page 21.

3. Start the Firmware Update for NRP Family program:
"Start" menu > "NRP-Toolkit" > "Firmware Update".

   The program automatically starts scanning for Rohde & Schwarz power sensors connected via USB.
   When the scan is completed, all recognized power sensors are listed under "Device".

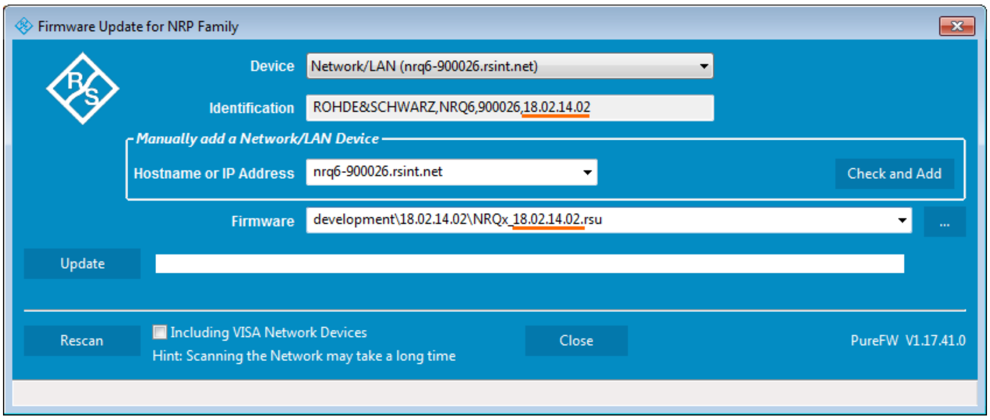


4. If the sensor you want to update is not listed, perform one of the following actions:
   a) Click "Rescan" to search for attached sensors.
   b) Check whether all necessary drivers are installed on the computer.
      For example, if the VISA library is not installed on the computer, no VISA power sensor is accessible.
5. Under "Device", select the sensor you want to update.
   The "Hostname or IP Address" field is not used during this procedure. Therefore, leave it empty.
6. In the "Firmware" field, enter the full path and filename of the update file, or click the browse button ... next to the field. New firmware for the Rohde & Schwarz power sensors generally has an `*.rsu` (Rohde & Schwarz update) extension.



7. Click "Update".
   During the update process, a progress bar is displayed. The update sequence can take a couple of minutes. When the update has been completed, a message is displayed.
8. Confirm the message.

   The firmware version under "Identification" is updated to the version that you have loaded.
9. Ensure that the firmware version displayed in "Identification" matches the version in the RSU filename displayed in"Firmware".



10. If you use the web user interface to operate the R&S NRQ6, press [F5] to reload the web page.

11.2.3 Using Remote Control

If you want to integrate a firmware update function in an application, use SYSTem:FWUPdate on page 164.

Example:

You want to update your R&S NRQ6 with the `NRQx_18.01.22.02.rsu` file. This file has a size of 10242884 bytes.

To send the file to the sensor for updating the firmware, your application has to assemble a memory block containing:

`SYST:FWUP <block_data>`

The `<block_data>` are definite length arbitrary block data as described in SYSTem:FWUPdate on page 164.

The size of the file is 10242884. This number has 8 digits. Thus, the `<block_data>` consist of the following:

- #
- 8
  How many digits follow to specify the file size.
- 10242884
  Number that specifies the file size.
- <file_contents>
  Contents of the `*.rsu` file, byte-by-byte
- 0x0a
  Delimiter

In this example, you write exactly 10242905 bytes to the R&S NRQ6, for example by using a 'viWrite()' function.

The 10242905 bytes result from the values of the list above:

9 + 1 + 1 + 1 + 8 + 10242884 + 1

In a (pseudo) string notation, the memory block looks like this:

`SYST:FWUP #810242884<file_contents>0x0a,`

12 Remote Control Commands

In the following sections, all commands implemented in the sensor are listed according to the command system and then described in detail. For the most part, the notation used complies with SCPI specifications.

The description of each command mainly contains the specifics for remote control. Follow the link under "Manual operation" for detailed information on the values and background information.

Further information:

- Chapter 14.1, "Remote Control Interfaces and Protocols", on page 175
- Chapter 14.2, "SCPI Command Structure", on page 179

12.1 Conventions Used in SCPI Command Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S NRQ6 follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.

For further information on units, see also "Units" on page 182.

12.2 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625–2) standard. The headers of these commands consist of an asterisk * followed by three letters.

*CLS......116
*ESE......116
*ESR?......116
*IDN?......117
*IST?......117
*OPC......117
*OPT?......117
*PRE......118
*RST......118
*SRE......118
*STB?......118
*TRG......118
*TST?......119
*WAI......119

***CLS**

Clear status

Resets the following:

- Status byte (`STB`)
- Standard event register (`ESR`)
- `EVENt` part of the `QUEStionable` and the `OPERation` register
- Error/event queue

The command does not alter the `ENABle` and `TRANsition` parts of the registers.

Usage: Event

***ESE** <register>

Event status enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:

<register> Range: 0 to 255
*RST: 0

***ESR?**

Event status read

Returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

Usage: Query only

***IDN?**

Identification

Returns a string with information on the sensor's identity (device identification code). In addition, the version number of the installed firmware is indicated.

Usage: Query only

***IST?**

Individual status

Note:

Do not apply a signal while sending this command.

Returns the current value of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Usage: Query only

***OPC**

Operation complete

Sets bit 0 in the event status register when all preceding commands have been executed. Send this command at the end of a program message. It is important that the read timeout is set sufficiently long.

The query always returns `1` because the query waits until all previous commands are executed.

`*OPC?` basically functions like `*WAI`, but also returns a response. The response is an advantage, because you can query the execution of commands from a controller program before sending new commands. Thus preventing overflow of the input queue when too many commands are sent that cannot be executed.

***OPT?**

Option identification

Returns a comma-separated list of installed options.

Usage: Query only

Manual operation: See "Installed Options" on page 107

***PRE** <register>

Parallel poll register enable

Sets the parallel poll enable register to the specified value or queries the current value.

Parameters:

<register>	Range:	0 to 255
	*RST:	0

***RST**

Reset

Sets the instrument to a defined default status. The default settings are indicated in the description of commands.

The command corresponds to the `SYSTem:PRESet` on page 169 command.

Usage: Event

Manual operation: See "Sensor Preset" on page 106

***SRE** <register>

Service request enable

Sets the service request enable register to the specified value. This command determines under which conditions a service request is triggered.

Parameters:

<register>	Range:	0 to 255
	*RST:	0

***STB?**

Status byte

Returns the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

Triggers a measurement if the following conditions are met:

- Power sensor is in the waiting for trigger state.
- Trigger source is set to `BUS`.

Usage: Event

***TST?**

Self-test

Triggers a self-test of the R&S NRQ6 and outputs the result. `0` indicates that no errors have occurred.

Usage: Query only

***WAI**

Wait to continue

Prevents the execution of the subsequent commands until all preceding commands have been executed and all signals have settled.

Usage: Event

12.3 Adapting to the Test Signal

These commands are valid for all measurement modes. They take the signal and its properties into account.

Further information:

- Chapter 6, "Measurement Basics", on page 41

Web user interface:

- Chapter 7, "Adapting to the Test Signal", on page 49

Remote commands:

[SENSe<Sensor>:]ADJust[:ALL] ... 119
[SENSe<Sensor>:]BANDwidth:INFO? ... 120
[SENSe<Sensor>:]BANDwidth:RESolution ... 120
[SENSe<Sensor>:]BANDwidth:RESolution:CUV? ... 120
[SENSe<Sensor>:]BANDwidth:RESolution:TYPE ... 121
[SENSe<Sensor>:]BANDwidth:RESolution:TYPE:AUTO[:STATe] ... 121
[SENSe<Sensor>:]BANDwidth:SRATe ... 121
[SENSe<Sensor>:]BANDwidth:SRATe:CUV? ... 122
[SENSe<Sensor>:]BANDwidth:VARiable ... 122
[SENSe<Sensor>:]FREQuency[:CENTer] ... 122
[SENSe<Sensor>:]INPut:ATTenuation ... 122
[SENSe<Sensor>:]INPut:ATTenuation:AUTO ... 123

[SENSe<Sensor>:]ADJust[:ALL] <state>

Adjusts center frequency and bandwidth settings to the test signal. Executed once.

Parameters:

<state> *RST: OFF

Example: ADJ ONCE

Manual operation: See "Autoset" on page 57

[SENSe<Sensor>:]BANDwidth:INFO? [<item>]

Queries information about the currently used resolution bandwidth filter.

Query parameters:

<item> String consisting of:
<Filter Type>,<fPass>,<f3db>,<fStop>

Example:
`BAND:INFO?`
Query
`"Filter Type:FLAT,fPass:2e+07,f3db:2.22222e+07,fStop:2.44444e+07"`
Response

Usage: Query only

Manual operation: See "<Filter type>" on page 59

[SENSe<Sensor>:]BANDwidth:RESolution <bandwidth>

Effective if `[SENSe<Sensor>:]BANDwidth:TYPE` `RESolution` is set.

Sets the resolution bandwidth as floating point value.

Parameters:

<bandwidth> If `[SENSe<Sensor>:]BANDwidth:VARiable` `OFF` is set, only discrete steps are available. The entered value is rounded to the next value.
The filter bandwidth refers to the RBW display value in Table 7-4 and its definition varies with the filter type. Each type has its own steps. See also Chapter 7.3.3, "Choosing the Correct Filter Type", on page 54.

Range: 10 to 400e6
*RST: 25e6
Default unit: HZ

Example: `BAND:RES 40000000`

Manual operation: See "<Bandwidth>" on page 59

[SENSe<Sensor>:]BANDwidth:RESolution:CUV?

Queries the currently used resolution bandwidth.

Example: `BAND:RES:CUV?`

Usage: Query only

Manual operation: See "<Bandwidth>" on page 59

[SENSe<Sensor>:]BANDwidth:RESolution:TYPE <select>

Effective if [SENSe<Sensor>:]BANDwidth:TYPE RESolution is set.

Sets the filter type for resolution bandwidth filter. The filter bandwidth is not affected.

See also Chapter 7.3.1, "Filter Characteristics", on page 52.

If you want to set the filter type automatically, use [SENSe<Sensor>:]BANDwidth:RESolution:TYPE:AUTO[:STATe] on page 121.

Parameters:

<select>	FLAT | NORMal | LTE | W3GPp	
	*RST:	FLAT

Example: `BAND:RES:TYPE FLAT`

Manual operation: See "<Filter type>" on page 59

[SENSe<Sensor>:]BANDwidth:RESolution:TYPE:AUTO[:STATe] <state>

Effective if [SENSe<Sensor>:]BANDwidth:TYPERESolution is set.

If enabled, sets the filter type suitable for the currently chosen measurement mode and bandwidth.

You can query the selected filter type using [SENSe<Sensor>:]BANDwidth:RESolution:TYPE on page 121.

Parameters:

<state>	ON | OFF	
	*RST:	ON

Example: `BAND:RES:TYPE:AUTO ON`

Manual operation: See "Autoset" on page 57
See "<State>" on page 58

[SENSe<Sensor>:]BANDwidth:SRATe <value>

Effective if [SENSe<Sensor>:]BANDwidth:TYPESRATe is set.

Sets the desired value for the sample rate input.

Parameters:

<value>	Range:	50 to 120e6
	*RST:	22.6e6
	Default unit:	HZ

Example: `BAND:SRAT 22600000`

Manual operation: See "Desired Sample Rate" on page 76

[SENSe<Sensor>:]BANDwidth:SRATe:CUV?

Queries the currently used sample rate.

Example: `BAND:SRAT:CUV?`
Query
`2.260000E+07`
Response

Usage: Query only

Manual operation: See "Used Sample Rate" on page 76

[SENSe<Sensor>:]BANDwidth:VARiable <state>

Enables or disables the resampler for a continuous adjustment of the sample rate. If disabled, the selected sample rate is rounded to a discrete value.

Parameters:
<state> *RST: OFF

Example: `BAND:VAR ON`

Manual operation: See "Variable Bandwidth" on page 75

[SENSe<Sensor>:]FREQuency[:CENTer] <frequency>

Sets the carrier frequency of the applied signal. This value is used for frequency response correction of the measurement result.

Parameters:
<frequency> Range: 50e6 to 6e9
*RST: 1e9
Default unit: HZ

Example: `FREQ 10000`

Manual operation: See "Frequency" on page 58

[SENSe<Sensor>:]INPut:ATTenuation <attenuation>

Effective if `[SENSe<Sensor>:]INPut:ATTenuation:AUTO` `OFF` is set.

Sets the input attenuation.

Parameters:
<attenuation> Only two values are possible, 0 dB and 30 dB. The entered value is rounded to the next value.
Range: 0.0 to 30.0
*RST: 30.0
Default unit: dB

Example: `INP:ATT 30`

Manual operation: See "<Level>" on page 59

[SENSe<Sensor>:]INPut:ATTenuation:AUTO <att_mode>

Configures the automatic setting of the input attenuation.

It is not possible to enable the result buffer and the automatic input attenuation simultaneously. This combination causes a settings conflict and a static error.

Parameters:

<att_mode> ON | OFF

ONCE
Adjusts the input attenuation one time, then disables the automatic setting.

*RST: OFF

Example: `INP:ATT:AUTO OFF`

Manual operation: See "Autoset" on page 57
See "<State>" on page 59

12.4 Selecting a Measurement Mode

Web user interface:

- Chapter 8, "Measurement Modes and Result Displays", on page 60

[SENSe<Sensor>:]FUNCtion <function>

Sets the measurement mode.

Parameters:

<function>

"POW:ACLR:AVG"
Adjacent channel leakage ratio (ALCR) mode, see Chapter 8.3, "ACLR Mode", on page 68.

"POWer:AVG"
Continuous average mode, see Chapter 8.1, "Continuous Average Mode", on page 60.

"POW:SERV"
Power servoing mode, see Chapter 8.5, "Power Servoing", on page 77.
Requires the power servoing option (R&S NRQ6-K2).

"POW:SERV:TEST"
Power servoing test mode, see Chapter 8.5, "Power Servoing", on page 77.
Requires the power servoing option (R&S NRQ6-K2).

"XTIMe:POWer"
Trace mode, see Chapter 8.2, "Trace Mode", on page 65.

"XTIMe:VOLT:IQ"
I/Q trace mode, see Chapter 8.4, "I/Q Trace Mode", on page 70.
Requires the I/Q data interface (R&S NRQ6-K1).

*RST: "POWer:AVG"

Example: FUNC "POWer:AVG"

12.5 Starting and Ending a Measurement

In a basic continuous measurement, the measurement is started immediately after the continuous measurement mode is enabled. If you want to start the measurement only if a specific condition is fulfilled, for example if a signal level is exceeded or in certain time intervals, define a trigger.

Further information:

- Chapter 12.9.5, "Configuring the Trigger", on page 145
- Chapter 9.2.1, "Trigger States", on page 85

Web user interface:

- "To display the Web user interface" on page 34
- Chapter 6.2, "Measurement Procedure in Principle", on page 41

Remote commands:

ABORt.. 124
INITiate:CONTinuous.. 124
INITiate:ALL.. 125
INITiate[:IMMediate].. 125

ABORt

Immediately interrupts the current measurement.

If the measurement has been started as a single measurement (INITiate[:IMMediate] on page 125), the R&S NRQ6 goes into the idle state.

If a continuous measurement is in progress (INITiate:CONTinuous on page 124 ON), the R&S NRQ6 waits for triggering and, if the trigger condition is met, starts a new measurement immediately.

See also Chapter 9.2.1, "Trigger States", on page 85.

Example: ABOR

Usage: Event

INITiate:CONTinuous <state>

Enables or disables the continuous measurement mode. In continuous measurement mode, the R&S NRQ6 does not reach the idle state after a measurement has been completed, but immediately executes another measurement cycle.

If measuring in zero-IF mode (RBW > 40 MHz), consider to zero the power sensor (CALibration<Channel>:ZERO:AUTOONCE; *OPC?).

Parameters:

<state> See also Chapter 9.2.1, "Trigger States", on page 85.

ON
Measures continuously. If a measurement is completed, the R&S NRQ6 does not return to idle state but waits for triggering again.

OFF
Ends the continuous measurement mode. The R&S NRQ6 goes into the idle state.

*RST: OFF

Example: `INIT:CONT OFF`

Manual operation: See "Autoset" on page 57
See "Autoset" on page 63
See "Autoset" on page 69
See "Trigger Mode" on page 89

INITiate:ALL
INITiate[:IMMediate]

Starts a single measurement cycle. The R&S NRQ6 changes from idle to waiting for trigger and begins the measurement when the trigger condition is fulfilled. Depending on the number of trigger events that are required, e.g. for averaging, the R&S NRQ6 can enter the waiting for trigger state several times. Once the entire measurement is completed, a measurement result is available, and the R&S NRQ6 enters the idle state again.

Use this command only after disabling the continuous measurement mode (see `INITiate:CONTinuous` on page 124).

If measuring in zero-IF mode (RBW > 40 MHz), consider to zero the power sensor (`CALibration<Channel>:ZERO:AUTO ONCE; *OPC?`).

See also Chapter 9.2.1, "Trigger States", on page 85.

Example: `INIT`

Usage: Event

Manual operation: See "Captured I/Q Samples" on page 76
See "Trigger Mode" on page 89

12.6 Measurement Results

- Results of All Kind....126
- Retrieving Continuous Average Results....126
- Retrieving Trace Results....128
- Retrieving ACLR Results....130
- Retrieving I/Q Results....130
- Configuring Results....130

12.6.1 Results of All Kind

FETCh<Sensor>[:SCALar][:POWer][:AVG]?

Queries the last valid measurement result.

You can configure the unit using UNIT:POWer on page 132.

Example: FETC?
Query
Results of the continuous average measurement
Single scalar value.
2.454005E-05
Results of the trace measurement
List of trace points.
2.989667E-12,3.014341E-12,2.749163E-12,
2.930418E-12,...,2.698201E-1
Results of the ACLR measurement
Channel power list:
<TX channel>, <lower adjacent channel>, <upper adjacent channel>, <lower alternate channel>, <upper alternate channel>
6.024564E-09,4.457427E-12,4.475155E-12,
4.086455E-12,4.144877E-12
Results of the I/Q trace measurement
The format of the results is defined by [SENSe<Sensor>:]TRACe:IQ:DATA:FORMat.

Usage: Query only

12.6.2 Retrieving Continuous Average Results

Further information:

- Chapter 8.1, "Continuous Average Mode", on page 60

Web user interface:

- Chapter 8.1.4, "Continuous Average Result Display", on page 64

Remote commands:

FETCh<Sensor>[:SCALar][:POWer][:AVG]? on page 126

FETCh<Sensor>:ARRay[:POWer][:AVG]? 126
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:CLEar 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:COUNt? 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:DATA? 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:SIZE 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:STATe 127

FETCh<Sensor>:ARRay[:POWer][:AVG]?

Queries the last valid measurement result of a measurement with enabled result buffer.

You can enable the buffer using [SENSe<Sensor>:][POWer:][AVG:]BUFFer:STATe.

Usage: Query only

[SENSe<Sensor>:][POWer:][AVG:]BUFFer:CLEar

Clears the contents of the result buffer in continuous average mode.

Example: `BUFF:CLE`

Usage: Event

[SENSe<Sensor>:][POWer:][AVG:]BUFFer:COUNt?

Queries the number of results that are currently stored in the result buffer. Available in continuous average mode.

Example: `BUFF:COUN?`

Usage: Query only

[SENSe<Sensor>:][POWer:][AVG:]BUFFer:DATA?

Queries the result buffer and returns the results, even if the buffer is not full. Available in continuous average mode.

In contrast, FETCh<Sensor>[:SCALar][:POWer][:AVG]? returns only a valid measurement result, that means only if the buffer is full.

Example: `BUFF:DATA?`

Usage: Query only

[SENSe<Sensor>:][POWer:][AVG:]BUFFer:SIZE <count>

Sets the size of the result buffer in continuous average mode.

You can enable the buffer using [SENSe<Sensor>:][POWer:][AVG:]BUFFer:STATe.

Parameters:

<count> Range: 1 to 131072
*RST: 1

Example: `BUFF:SIZE 1`

[SENSe<Sensor>:][POWer:][AVG:]BUFFer:STATe <state>

Enables or disables the result buffer in continuous average mode. If enabled, all results generated by trigger events are collected in the buffer until it is full.

It is not possible to enable the result buffer and the automatic input attenuation simultaneously. This combination causes a settings conflict and a static error.

You can set the size of the buffer using `[SENSe<Sensor>:][POWer:][AVG:]BUFFer:SIZE`.

Parameters:
<state> *RST: OFF

Example: `BUFF:STAT OFF`

12.6.3 Retrieving Trace Results

Further information:
- Chapter 8.2, "Trace Mode", on page 65

Web user interface:
- Chapter 8.2.2, "Trace Result Display", on page 67

Remote commands:

`FETCh<Sensor>[:SCALar][:POWer][:AVG]?` on page 126
[SENSe<Sensor>:]TRACe:DATA?... 128

[SENSe<Sensor>:]TRACe:DATA?

Returns the measured trace data in a well-defined format.

Command response

In principle, the response has the format as shown in Figure 12-1:

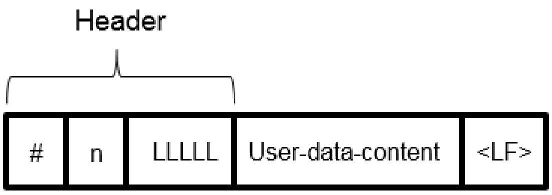


Figure 12-1: Response format

- Header consisting of:
  – Character #
  – Single digit ('n') which tells the number of following digits that is taken as the size of the content.
  – Number consisting of as many digits as 'n' specified ('LLLLL'). This number gives the size of the content
- Content ('user data content'), see also Figure 12-2. As many bytes as 'LLLLL' specified.
- Single-line feed character (symbolically shown as <LF>)

Example

The arbitrary block response data for a user data that contains 45182 bytes is:

`#545182xxxxxx.......xxxxxx <LF>`

The arbitrary block response data for a user data content `'THIS IS A TEST'` is:

`#214THIS IS A TEST<LF>`

Explanation: `'THIS IS A TEST'` has 14 bytes, and '14' has 2 digits, hence the `#214`

User data content

The previous paragraphs described how to separate the "user data content" from the header. We keep the designator "user data content" in the further description for denoting the totality of the contained measurement results.

The further description deals with the user data content and shows what is embedded in it. There are similar mechanisms as with arbitrary block response data in the user data content. As indicated above, the user data content can have 1 or more sections with trace measurement results, depending on the selection of auxiliary measurands. Each section is composed of:

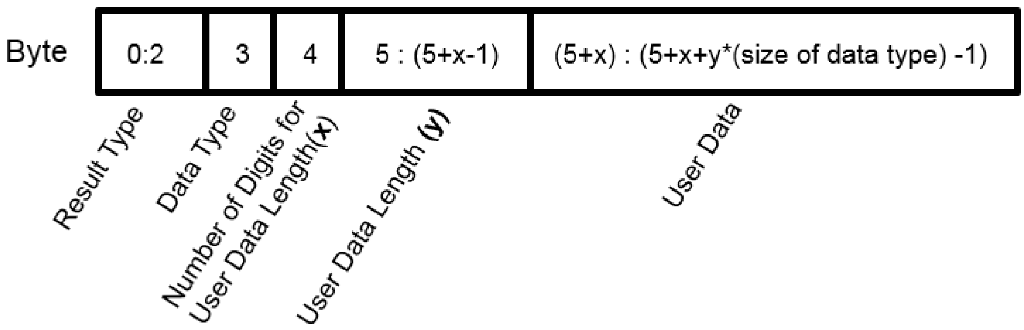


Figure 12-2: User data content format

y = Number of values which follow the header
x = Number of digits of y

- Result type (always 3 bytes, one of 'AVG', 'MIN', 'MAX' or 'RND')
- Designator for the contained data type with the size of 1 byte
  Currently, the only possible designator is 'f' for 4-byte IEEE754 float data type, little endian
- Single digit which tells the number of following digits that are taken as the number of contained float values
- As many digits as the number of digits for user data specified ('x'). These digits are interpreted as the number of values ('y') (not number of bytes) which follow the header
- Measurement result values in the format that is described by the data type (currently IEEE754 float only)

Usage: Query only

12.6.4 Retrieving ACLR Results

Further information:

- Chapter 8.3, "ACLR Mode", on page 68

Web user interface:

- Chapter 8.3.2, "ACLR Result Display", on page 69

Remote commands:

FETCh<Sensor>[:SCALar][:POWer][:AVG]? on page 126

12.6.5 Retrieving I/Q Results

Further information:

- Chapter 8.4, "I/Q Trace Mode", on page 70

Web user interface:

- Chapter 8.4.3, "I/Q Trace Parameters", on page 74

Remote commands:

FETCh<Sensor>[:SCALar][:POWer][:AVG]? on page 126

[SENSe<Sensor>:]TRACe:IQ:DATA?... 130

[SENSe<Sensor>:]TRACe:IQ:DATA?

Effective if [SENSe<Sensor>:]FUNCtion is set to XTIMe:VOLT:IQ.

Queries the IQ trace results. The format of the results is defined by [SENSe<Sensor>:]TRACe:IQ:DATA:FORMat.

Alternative command: FETCh<Sensor>[:SCALar][:POWer][:AVG]?

Usage: Query only

Manual operation: See "Captured I/Q Samples" on page 76

12.6.6 Configuring Results

FORMat:BORDer...130
FORMat[:DATA]...131
FORMat:SREGister...132
[SENSe<Sensor>:]TRACe:IQ:DATA:FORMat...132
UNIT:POWer...132

FORMat:BORDer <border>

Selects the order of bytes in 32-bit or 64-bit binary data.

Parameters:

<border> NORMal | SWAPped

NORMal
The 1st byte is the least significant byte, the 4th/8th byte the most significant byte.
Fulfills the Little Endian (little end comes first) convention, used by x86/x64 CPUs, for example.

SWAPped
The 1st byte is the most significant byte, the 4th/8th byte the least significant byte.
Fulfills the Big Endian (big end comes first) convention.

*RST: NORMal

Example: `FORM:BORD NORM`

FORMat[:DATA] <data[,length]>

Specifies how the R&S NRQ6 sends the acquired I/Q data to the controlling host/computer.

In the R&S NRQ6, the acquired I/Q data is natively represented as pairs of I/Q samples, stored as IEEE754 single precision (32-bit) float values.

Note: If you select an output format other than the native one, `FORMat:DATA REAL,32`, the R&S NRQ6 has to recode the acquired data into the selected output format before sending it out. Depending on the size of the acquired data, the result length, recoding can require significant processing time and a lot of additional internal memory. As long as the chosen result length is relatively small, this step is negligible. But the maximum result length can come up to 15000000 I/Q pairs. Then, the internal block of measured data would be 2 * 15000000 * 4 = 120 Mbyte. Thus leaving 'only' 50 Mbyte as remaining free internal memory, which is not enough to recode the results into another output format.

So if you apply a high result length, select the native output format, `FORMat:DATA REAL,32`.

Parameters:

<data,length> <REAL,32 | 64>

REAL
Block of binary values, 32-bit or 64-bit each; so-called "SCPI definite length block"

32 | 64
32-bit or 64-bit
If you omit the length, the R&S NRQ6 sets the last used length.
Example for `REAL,32` format:
`#6768000....<binary float values>....`
Example for `REAL,64` format:
`#71536000....<binary float values>....`

<data[,length]> <ASCii[,0 to 12]>

ASCii
List of comma separated, readable values.

[,0 to 12]
Defines the number of decimal places.
The reset value 0 does not restrict the number of decimal places.
Example for `ASCii,4` format:
`1.2938e-06, -4.7269e-11, ...`

*RST: ASCii,0

Manual operation: See "Captured I/Q Samples" on page 76

FORMat:SREGister <sregister>

Specifies which format is used for the return value of `*STB?`.

Parameters:

<sregister> ASCii | HEXadecimal | OCTal | BINary

*RST: ASCii

Example: `FORM:SREG ASC`

[SENSe<Sensor>:]TRACe:IQ:DATA:FORMat <format>

Defines the format of the I/Q trace results.

Parameters:

<format> COMPatible | IQBLock | IQPair

COMPatible
512k I data samples, 512k Q data samples, 512k I data ...

IQBLock
I data block, Q data block

IQPair
I data sample, Q data sample, I data sample, Q data sample, I data ...

*RST: IQBLock

Manual operation: See "Captured I/Q Samples" on page 76

UNIT:POWer <unit>

Sets the output unit for the measured power values.

Parameters:

<unit> DBM | W | DBUV

*RST: W

Example: `UNIT:POW DBM`

Manual operation: See "dBm / Watt / dBµV" on page 64

12.7 Calibrating and Zeroing

Further information:

- Chapter 9.3.1, "Corrections in the RF Path", on page 92
- Chapter 9.3.2, "Corrections in the IF Path", on page 93

Web user interface:

- "Zero Calibration" on page 97
- "DC Zeroing" on page 98

If the factory calibration data is not suitable for your measurement, you can import measurement data files to create your own calibration data set. Four different measurement data files can be imported in total; for absolute calibration, for the reflection factor, both for 0 dB and 30 dB attenuation. Proceed as follows:

1. Import all measurement data files or just a part of them, using `CALibration:DATA:PATH<Path>:ABSolute` and `CALibration:DATA:PATH<Path>:REFLection`.
   The import order does not matter.
2. Start the recalculation of the new calibration data set, using `CALibration:RECalculate`.
3. Check the protocol of the new normalized calibration factors, using `CALibration:PROTocol?`.

Remote commands:

CALibration:DATA ... 133
CALibration:DATA:LENGth? ... 133
CALibration:DATA:PATH<Path>:ABSolute ... 134
CALibration:DATA:PATH<Path>:REFLection ... 134
CALibration<Channel>:IQOFfset[:AUTO] ... 134
CALibration:PROTocol? ... 135
CALibration:RECalculate ... 135
CALibration<Channel>:ZERO:AUTO ... 135

CALibration:DATA <caldata>

Writes a binary calibration data set in the memory of the sensor.

Parameters:

<caldata> <block_data>

CALibration:DATA:LENGth?

Queries the length in bytes of the calibration data set currently stored in the flash memory. Programs that read out the calibration data set can use this information to determine the capacity of the buffer memory required.

Example: `CAL:DATA:LENG?`
Query
`57392`
Response

Usage: Query only

CALibration:DATA:PATH<Path>:ABSolute <blockdata>

Imports the measurement data files for absolute calibration. There is a separate file for each attenuation setting.

Suffix:

<Path> 1 to 2
Attenuation; 1 = 0 dB, 2 30 dB

Setting parameters:

<blockdata> <block_data>
Block of binary values, the so-called "SCPI definite length block".

Usage: Setting only

CALibration:DATA:PATH<Path>:REFLection <blockdata>

Imports the measurement data files for the reflection factor. There is a separate file for each attenuation setting.

Suffix:

<Path> 1 to 2
Attenuation; 1 = 0 dB, 2 30 dB

Setting parameters:

<blockdata> <block_data>
Block of binary values, the so-called "SCPI definite length block".

Usage: Setting only

CALibration<Channel>:IQOFfset[:AUTO] <state>

Compensates for the internal DC voltage offset. Recommended for measurements in zero-IF mode (RBW > 40 MHz). See also Chapter 9.3.2.2, "DC Zeroing", on page 95.

Suffix:

<Channel> 1 to 4
Measurement channel if more than one channel is available.

Parameters:

<state> **ONCE | ON**
Performs DC zeroing once. After completion, zeroing is switched off.

0
Return value if no zeroing is in progress.

*RST: OFF

Example: `CAL1:IQOF ONCE`
Performs DC zeroing.

Manual operation: See "DC Zeroing" on page 98

CALibration:PROTocol?

Reads the protocol containing the normalized calibration factors.

Usage: Query only

CALibration:RECalculate

Recalculates the calibration data set using the imported measurement data.

Usage: Event

CALibration<Channel>:ZERO:AUTO <state>

Performs zero calibration. For measurements in zero-IF mode (RBW > 40 MHz), also performs DC zeroing (`CALibration<Channel>:IQOFfset[:AUTO] ONCE`). See also Chapter 9.3.1.2, "Zero Calibration", on page 93.

Turn off all test signals before zeroing. An active test signal during zeroing causes an error.

While zero calibration is in progress, no queries or other setting commands are allowed, since the command is synchronous. Any communication attempt can run into a timeout.

After zero calibration, query the static error queue using `SYSTem:SERRor?`. The following responses are possible:

- `0`
  No error, zero calibration was successful.
- `-240`
  Warning, zero calibration failed.

Suffix:
<Channel> 1 to 4
Measurement channel if more than one channel is available.

Parameters:
<state> **ONCE | ON**
Performs zero calibration once. After completion, zeroing is switched off.

0
Return value if no zeroing is in progress.

*RST: OFF

Example:
```
*CLS
CAL1:ZERO:AUTO ONCE
```
Performs zero calibration.

Manual operation: See "Zero Calibration" on page 97

12.8 Running a Selftest

The selftest allows a test of the internal circuitry of the sensor.

Further information:

- Chapter 15.4, "Performing a Selftest", on page 203
- Chapter 9.3.1, "Corrections in the RF Path", on page 92

Web user interface:

- "Diagnostics - Selftest" on page 108

TEST:SENSor?

Starts a selftest.

Note:

During the selftest, do not apply a signal because this can cause erroneous test results.

In contrast to `*TST?`, this command returns detailed information that you can use for troubleshooting. If one test step or a part of it fails, the overall result is FAIL.

See also Chapter 15.4, "Performing a Selftest", on page 203.

Example:
```
TEST:SENS?
```
Query
```
"Power Applied: PASS Operating Voltages:
PASS Temperatures: PASS Test Generator: Error:
Test Generator has no calibration! FAIL LO Level:
PASS DC Offset:
PASS Displayed Average Noise Level (DANL):
PASS Dither: PASS ADC Interface:
PASS DDS DAC Interface: PASS "
```
Response

Usage: Query only

Manual operation: See "Diagnostics - Selftest" on page 108

12.9 Configuring Measurement Settings

This chapter describes the measurement settings for all measurement modes.

Further information:

- Chapter 8, "Measurement Modes and Result Displays", on page 60
- Chapter 9, "Measurement Configuration", on page 79
- Chapter 10, "System Configuration", on page 104

Contents:

- Configuring a Continuous Average Measurement.. 137
- Configuring a Trace Measurement...140
- Configuring an ACLR Measurement... 143
- Configuring an I/Q Trace Mode...144
- Configuring the Trigger.. 145
- Configuring the Corrections.. 152
- Configuring the Mixer...154
- Configuring the Sensor.. 157

12.9.1 Configuring a Continuous Average Measurement

Further information:

- Chapter 8.1, "Continuous Average Mode", on page 60

Web user interface:

- Chapter 8.1.3, "Continuous Average Parameters", on page 62

Remote commands:

[SENSe<Sensor>:]AVERage:COUNt..137
[SENSe<Sensor>:]AVERage:RESet..138
[SENSe<Sensor>:]AVERage[:STATe].. 138
[SENSe<Sensor>:]AVERage:TCONtrol... 138
[SENSe<Sensor>:]AVERage:TYPE..139
[SENSe<Sensor>:]BANDwidth:TYPE... 139
[SENSe<Sensor>:]CORRection:DCYCle... 139
[SENSe<Sensor>:]CORRection:DCYCle:STATe...140
[SENSe<Sensor>:][POWer:][AVG:]APERture..140

[SENSe<Sensor>:]AVERage:COUNt <count>

Effective if `[SENSe<Sensor>:]AVERage[:STATe] ON` is set.

Sets the number of readings that are averaged for one measured value. The higher the count, the lower the noise, and the longer it takes to obtain a measured value.

Parameters:

<count>	Range:	1 to 65536
	*RST:	1

Example: `AVER:COUN 1`

Manual operation: See "<Count>" on page 63

[SENSe<Sensor>:]AVERage:RESet

Deletes all previous measurement results that the averaging filter contains and initializes the averaging filter. The filter length gradually increases from 1 to the set averaging factor. Thus, trends in the measurement result become quickly apparent. Note that the measurement time required for the averaging filter to settle completely remains unchanged.

Use this command if:

- High averaging factor is set.
  `[SENSe<Sensor>:]AVERage:COUNt`
- Intermediate values are output as measurement results.
  `[SENSe<Sensor>:]AVERage:TCONtrol MOVing`
- Power has significantly decreased since the previous measurement, for example by several powers of 10.

In this situation, previous measurement results, which are still contained in the averaging filter, strongly affect the settling of the display. As a result, the advantage of detecting trends in the measurement result while the measurement is still in progress is lost.

Example: `AVER:RES`

Usage: Event

[SENSe<Sensor>:]AVERage[:STATe] <state>

Enables or disables the averaging filter.

Parameters:

<state> *RST: ON

Manual operation: See "<State>" on page 63

[SENSe<Sensor>:]AVERage:TCONtrol <mode>

Defines how the measurement results are output. This is called termination control. See also Chapter 9.1.1, "Controlling the Measurement Results", on page 79.

Parameters:

<mode> MOVing | REPeat

MOVing
Outputs intermediate values to facilitate early detection of changes in the measured quantity. In the settled state, that means when the number of measurements specified by the average count has been performed, a moving average is output.

REPeat
Specifies that a measurement result is not output until the entire measurement has been completed. This means that the number of measurement cycle repetitions is equal to the set average count. If the average count is large, the measurement time can be very long.
The average count is set using `[SENSe<Sensor>:]AVERage:COUNt`.

*RST: REPeat

Example: `AVER:TCON REP`

Manual operation: See "Moving Average" on page 64

[SENSe<Sensor>:]AVERage:TYPE <type>

Sets the averaging domain. For details, see Chapter 8.1.1, "Averaging Domains", on page 60.

Parameters:

<type> POWer | VIDeo | LINear

*RST: POWer

Example: `AVER:TYPE POW`

Manual operation: See "Averaging Domain" on page 63

[SENSe<Sensor>:]BANDwidth:TYPE <type>

Sets how the bandwidth is specified.

Parameters:

<type> RESolution | SRATe

RESolution
By the resolution bandwidth. See `[SENSe<Sensor>:]BANDwidth:RESolution` on page 120.

SRATe
By the desired sample rate. See `[SENSe<Sensor>:]BANDwidth:SRATe` on page 121.

*RST: RESolution

Example: `BAND:TYPE RES`

Manual operation: See "Specify Bandwidth by" on page 75

[SENSe<Sensor>:]CORRection:DCYCle <duty_cycle>

Sets the duty cycle for measuring pulse-modulated signals. The duty cycle defines the percentage of one period during which the signal is active. If the duty cycle is enabled, the R&S NRQ6 takes this percentage into account when calculating the signal pulse power from the average power.

Parameters:

<duty_cycle>	Range: 0.001 to 100.00 *RST: 1.00 Default unit: Percent

Example: `CORR:DCYC 1`

Manual operation: See "Duty Cycle" on page 64

[SENSe<Sensor>:]CORRection:DCYCle:STATe <state>

Enables or disables the duty cycle correction for the measured value.

Parameters:

<state>	*RST: OFF

Example: `CORR:DCYC:STAT ON`

Manual operation: See "Duty Cycle" on page 64

[SENSe<Sensor>:][POWer:][AVG:]APERture <integration_time>

Sets the duration of the sampling window in the continuous average mode. During this time interval, the average signal power is measured.

Parameters:

<integration_time>	Range: 8.30E-09 to 30.0 *RST: 0.02 Default unit: Seconds

Example: `APER 0.02`

Manual operation: See "Aperture Time" on page 64

12.9.2 Configuring a Trace Measurement

Further information:

- Chapter 8.2, "Trace Mode", on page 65

Web user interface:

- Chapter 8.2.1, "Trace Parameters", on page 65

Remote commands:

`[SENSe<Sensor>:]AVERage:TYPE` on page 139

`[SENSe<Sensor>:]BANDwidth:TYPE` on page 139

[SENSe<Sensor>:]TRACe:AVERage:COUNt......141
[SENSe<Sensor>:]TRACe:AVERage[:STATe]......141
[SENSe<Sensor>:]TRACe:AVERage:TCONtrol......141
[SENSe<Sensor>:]TRACe:OFFSet:TIME......142
[SENSe<Sensor>:]TRACe:RLENgth[:CUV]?......142

[SENSe<Sensor>:]TRACe:POINts......142
[SENSe<Sensor>:]TRACe:TIME......142
[SENSe<Sensor>:]TRACe:TIME:AUTO......143

[SENSe<Sensor>:]TRACe:AVERage:COUNt <count>

Sets the number of readings that are averaged for one measured value. The higher the count, the lower the noise, and the longer it takes to obtain a measured value.

Averaging is only effective, if `[SENSe<Sensor>:]TRACe:AVERage[:STATe] ON` is set.

Parameters:

<count> Range: 1 to 65536
*RST: 1

Manual operation: See "Autoset" on page 66
See "<Count>" on page 66
See "Autoset" on page 75

[SENSe<Sensor>:]TRACe:AVERage[:STATe] <state>

Enables or disables the averaging filter.

Parameters:

<state> *RST: ON

Manual operation: See "<State>" on page 66

[SENSe<Sensor>:]TRACe:AVERage:TCONtrol <mode>

Defines how the measurement results are output. This is called termination control. See also Chapter 9.1.1, "Controlling the Measurement Results", on page 79.

Parameters:

<mode> MOVing | REPeat

MOVing
Outputs intermediate values to facilitate early detection of changes in the measured quantity. In the settled state, that means when the number of measurements specified by the average count has been performed, a moving average is output.

REPeat
Specifies that a measurement result is not output until the entire measurement has been completed. This means that the number of measurement cycle repetitions is equal to the set average count. If the average count is large, the measurement time can be very long.
The average count is set using `[SENSe<Sensor>:]AVERage:COUNt`.

*RST: REPeat

Example: `TRAC:AVER:TCON REP`

Manual operation: See "Moving Averaging" on page 67

[SENSe<Sensor>:]TRACe:OFFSet:TIME <time>

Sets the relative position of the trigger event in relation to the trace measurement start:

Trace offset = trace measurement start - trigger delay.

The start of recording relative to the trigger event is set using `TRIGger:DELay`.

Parameters:

<time> Range: -15.0 to 15.0
*RST: 0.0
Default unit: Seconds

Example: `TRAC:OFFS:TIME 1.0`

Manual operation: See "Trace Offset" on page 67

[SENSe<Sensor>:]TRACe:RLENgth[:CUV]?

The behavior of this query depends on the measurement mode.

- I/Q trace mode (R&S NRQ6-K1)
  Queries the number of samples in the current trace.
- Trace mode
  Queries the number of real result samples before they are reduced or interpolated to the number of trace points defined by `[SENSe<Sensor>:]TRACe:POINts`. If you want to see the all result samples in the result trace, set the number of trace points to this value.

Usage: Query only

[SENSe<Sensor>:]TRACe:POINts <points>

Sets the number of pixels per trace sequence. In the result display of the web user interface, the maximum resolution is restricted by the number of measured values, sampled by the output sample rate. In remote control, no such restriction applies. If you set more pixels than there are measured values, the R&S NRQ6 duplicates measured values to fill up the gaps.

The query returns the number of samples after the trace has been decimated by the display detector.

Parameters:

<points> Range: 1 to 1048576
*RST: 1024

Example: `TRAC:POIN 1024`

[SENSe<Sensor>:]TRACe:TIME <time>

Sets the trace time, the duration of one trace sequence.

Parameters:

<time> The available range depends on the RBW. Even for time settings within range, a static error due to insufficient memory can occur if the output sampling rate is too high. See Chapter 7.3.3, "Choosing the Correct Filter Type", on page 54.

Range: 8.30E-09 to 30.0
*RST: 0.01
Default unit: Seconds

Example: `TRAC:TIME 0.01`

Manual operation: See "Time/Div" on page 67

[SENSe<Sensor>:]TRACe:TIME:AUTO <state>

Sets the trace time automatically.

Performs an FFT to calculate the power spectrum and sets the trace time to five times the larges peak of the spectrum, which is a good indication for the dominant period of the signal.

This calculation is performed for any signal without checking the signal-to-noise ratio.

Parameters:

<state> *RST: OFF

Example: `TRAC:TIME:AUTO OFF`

Manual operation: See "Autoset" on page 66
See "Autoset" on page 75

12.9.3 Configuring an ACLR Measurement

Further information:

- Chapter 8.3, "ACLR Mode", on page 68

Web user interface:

- Chapter 8.3.1, "ACLR Parameters", on page 68

Remote commands:

[SENSe<Sensor>:]ACLR:ACHannel:SPACing[:ACHannel]?..143
[SENSe<Sensor>:]ACLR:APERture..144

[SENSe<Sensor>:]ACLR:ACHannel:SPACing[:ACHannel]?

Queries the distance from transmission channel to adjacent channel. The return value depends on the transmission standard selected by the resolution bandwidth setting.

Example: `ACLR:ACH:SPAC?`
Query
`5.000000E+06`
Response for 3GPP

Usage: Query only

[SENSe<Sensor>:]ACLR:APERture <integration_time>

Sets the duration of the sampling window. During this synchronized time interval, the average signal power is measured on all 5 channels.

Parameters:

<integration_time> Range: 1e-3 to 40e-3
*RST: 10e-3
Default unit: Seconds

Example: `ACLR:APER 0.001`

Manual operation: See "Aperture Time" on page 69

12.9.4 Configuring an I/Q Trace Mode

Requires the I/Q data interface (R&S NRQ6-K1).

Further information:

- Chapter 8.4, "I/Q Trace Mode", on page 70

Web user interface:

- Chapter 8.4.3, "I/Q Trace Parameters", on page 74

Remote commands:

`[SENSe<Sensor>:]BANDwidth:TYPE` on page 139

[SENSe<Sensor>:]TRACe:IQ:RLENgth....................144
[SENSe<Sensor>:]TRACe:SRATe[:CUV]?....................144
[SENSe<Sensor>:]TRACe:IQ:SYNC:MODE....................145

[SENSe<Sensor>:]TRACe:IQ:RLENgth <value>

Requires the I/Q data interface (R&S NRQ6-K1).

Sets the number of result samples.

Parameters:

<value> Range: 1 to 15000000
*RST: 1024

Example: `TRAC:IQ:RLEN 2000`

Manual operation: See "Result Length" on page 75

[SENSe<Sensor>:]TRACe:SRATe[:CUV]?

See `[SENSe<Sensor>:]BANDwidth:SRATe:CUV?` on page 122.

Usage: Query only

[SENSe<Sensor>:]TRACe:IQ:SYNC:MODE <mode>

Requires the following options:

- I/Q data interface (R&S NRQ6-K1)
- phase coherent measurements (R&S NRQ6-K3)

Sets the synchronization for phase coherent measurements. The master is synchronized to the signal source by external reference and triggers the slave. Select the output port for the trigger signal using `TRIGger:MASTer:PORT` on page 150.

See also Chapter 9.2.6, "Trigger Master Usage", on page 88.

Parameters:

<mode> OFF | MASTer | SLAVe

*RST: OFF

Example: `TRACe:IQ:SYNC:MODE MAST`
Configures the R&S NRQ6 as master.

Manual operation: See "Sync Mode" on page 76

12.9.5 Configuring the Trigger

Further information:

- Chapter 9.2.1, "Trigger States", on page 85
- Chapter 12.9, "Configuring Measurement Settings", on page 136

Web user interface:

- Chapter 9.2.7, "Trigger Parameters", on page 88

Remote commands:

TRIGger:ATRigger:DELay....146
TRIGger:ATRigger:EXECuted?....146
TRIGger:ATRigger[:STATe]....146
TRIGger:COUNt....146
TRIGger:DELay....147
TRIGger:DTIMe....147
TRIGger:EXTernal<2...2>:IMPedance....147
TRIGger:HOLDoff....148
TRIGger:HYSTeresis....148
TRIGger:IMMediate....148
TRIGger:JITTer?....148
TRIGger:JITTer:METHod....149
TRIGger:JITTer:METHod:CUV?....149
TRIGger:LEVel....149
TRIGger:LEVel:AUTO....150
TRIGger:LEVel:UNIT....150
TRIGger:MASTer:PORT....150
TRIGger:MASTer:STATe....151
TRIGger:SLOPe....151

TRIGger:SOURce........151
TRIGger:SYNC:PORT........152
TRIGger:SYNC:STATe........152

TRIGger:ATRigger:DELay <delay>

Effective only if `TRIGger:ATRigger[:STATe]` on page 146 is set to `ON`.

Sets the delay between the artificial trigger event and the beginning of the actual measurement

Parameters:

<delay>	Range:	0.1 to 5.0
	*RST:	0.3
	Default unit:	Seconds

TRIGger:ATRigger:EXECuted?

Queries the number of measurements that were triggered automatically since `TRIGger:ATRigger[:STATe]` on page 146 was set to `ON`.

In normal scalar measurements, this number can only be 0 or 1. If a buffered measurement was executed, this number indicates how many results in the returned array of measurement data were executed without a real trigger event.

Usage: Query only

TRIGger:ATRigger[:STATe] <state>

Controls the automatic trigger function. If enabled, an artificial trigger is generated if the delay time has elapsed after the measurement start and no trigger event has occurred. The delay time is set using `TRIGger:ATRigger:DELay` on page 146.

The command is only effective in the trace mode and, irrespective of the set averaging factor, only one trace is recorded.

Parameters:

<state>	*RST:	OFF

Manual operation: See "Autoset" on page 66
See "Autoset" on page 75

TRIGger:COUNt <count>

Sets the number of measurement cycles to be performed when the measurement is started using `INITiate[:IMMediate]` on page 125.

This number equals the number of results that can be obtained from the sensor after a single measurement. As long as the defined number of measurements is not executed, the sensor automatically initiates another measurement internally when the current result is available.

This command is particularly useful in conjunction with buffered measurements. For example, to fill a buffer with a predefined size with measurements that have been triggered externally or by *TRG without having to start the measurement multiple times.

Parameters:

<count>	Range:	1 to 131072
	*RST:	1

TRIGger:DELay <delay>

Sets the delay between the trigger event and the beginning of the actual measurement (integration).

Parameters:

<delay>	Range:	-5.0 to 10.0
	*RST:	0.0
	Default unit:	Seconds

Manual operation: See "Trigger Delay" on page 90

TRIGger:DTIMe <dropout_time>

Sets the dropout time for the internal trigger source. During this time, the signal power must exceed (negative trigger slope) or undercut (positive trigger slope) the level defined by the trigger level and trigger hysteresis. At least, this time must elapse before triggering can occur again.

See Chapter 9.2.3, "Dropout Time", on page 86.

Parameters:

<dropout_time>	Range:	0.00 to 10.00
	*RST:	0.00
	Default unit:	Seconds

Manual operation: See "Trigger Dropout" on page 90

TRIGger:EXTernal<2...2>:IMPedance <impedance>

Effective only if `TRIGger:SOURce EXTernal2` is set.

Sets termination resistance of the second external trigger input. Choose the setting that fits the impedance of the trigger source to minimize reflections on the trigger signals.

Suffix:

<2...2> 2...2

Parameters:

<impedance> HIGH | LOW

HIGH
~10 kΩ

LOW
50 Ω

*RST: HIGH

Manual operation: See "Trigger 2 I/O Impedance" on page 91

TRIGger:HOLDoff <holdoff>

Sets the hold-off time, a period after a trigger event during which all trigger events are ignored.

See Chapter 9.2.4, "Hold-Off Time", on page 87.

Parameters:

<holdoff> Range: 0.00 to 10.00
*RST: 0.00
Default unit: Seconds

Manual operation: See "Trigger Holdoff" on page 90

TRIGger:HYSTeresis <hysteresis>

Sets the hysteresis. A trigger event occurs, if the trigger level:

- Falls below the set value on a rising slope.
- Rises above the set value on a falling slope.

Thus, you can use this setting to eliminate the effects of noise in the signal for the edge detector of the trigger system.

Parameters:

<hysteresis> Range: 0.00 to 10.00
*RST: 0.00
Default unit: DB

Manual operation: See "Trigger Hysteresis" on page 90

TRIGger:IMMediate

Causes a generic trigger event. The R&S NRQ6 leaves the waiting for trigger state immediately, irrespective of the trigger source and the trigger delay, and starts the measurement.

This command is the only way to start a measurement if the trigger source is set to hold (`TRIGger:SOURce HOLD`). Only one measurement cycle is executed, irrespective of the averaging factor.

Usage: Event

TRIGger:JITTer?

Available in trace mode.

Queries the known trigger offset.

Example: `TRIG:JITT?`
Query
`0.000000E+00`
Result

Usage: Query only

TRIGger:JITTer:METHod <methode>

Available in trace mode.

Defines the method how to cope with the misalignment between the trigger event and the sample point.

Parameters:

<methode> COMPensate | MEASure | NONE

COMPensate | MEASure
See Chapter 9.2.5, "Trigger Jitter", on page 88.

NONE
Neither measures nor corrects or compensates the trigger jitter.

*RST: COMPensate

Example: `TRIG:JITT:METH COMP`

Manual operation: See "Jitter Suppression" on page 90

TRIGger:JITTer:METHod:CUV?

Available in trace mode.

Queries the currently used value.

Example: `TRIG:JITT:METH:CUV?`
Query
`NONE`
Result

Usage: Query only

TRIGger:LEVel <level>

Effective only if `TRIGger:SOURce` is set to `INTernal`.

Sets the trigger threshold for internal triggering.

If you enter a value without unit, the unit is defined by `TRIGger:LEVel:UNIT`.

Parameters:

<level> If [SENSe<Sensor>:]INPut:ATTenuation is set to 0 dB, the trigger level is restricted to ≤ 100 µW. Values > 100 µW cause a static error.
If no offset is set ([SENSe<Sensor>:]CORRection:OFFSet) and enabled ([SENSe<Sensor>:]CORRection:OFFSet:STATe ON), the following range applies.

Range: 1e-14 to 0.1
*RST: 1.0e-9
Default unit: Watts

Manual operation: See "Trigger Level" on page 89

TRIGger:LEVel:AUTO <val>

Sets the trigger level automatically. Performs a measurement and uses the mean value between the maximum and minimum sample of the trace that has not been decimated by the display detector.

Parameters:

<val> *RST: OFF

Example: `TRIG:LEV:AUTO OFF`

Manual operation: See "Autoset" on page 66
See "Autoset" on page 75
See "Trigger Level" on page 89

TRIGger:LEVel:UNIT <unit>

Sets the unit of the trigger level if this value is entered without a unit.

See also TRIGger:LEVel on page 149.

Parameters:

<unit> DBM | W | DBUV

*RST: W

TRIGger:MASTer:PORT <master_port>

Effective only if the R&S NRQ6 is trigger master:

- TRIGger:MASTer:STATe ON
- [SENSe<Sensor>:]TRACe:IQ:SYNC:MODE MAST

Selects the port where the R&S NRQ6 outputs a digital trigger signal. See Chapter 9.2.6, "Trigger Master Usage", on page 88.

Parameters:

<master_port> EXT1 | EXTernal1 | EXT2 | EXTernal2

*RST: EXT1

Example:
```
TRIG:MAST:PORT EXT1
TRIG:SOUR EXT2
TRIG:MAST:STAT ON
```

Example:
```
TRIG:MAST:PORT EXT2
TRIG:SOUR EXT1
TRIG:MAST:STAT ON
```

Manual operation: See "Master Port" on page 91

TRIGger:MASTer:STATe <state>

Enables or disables the trigger master state. See Chapter 9.2.6, "Trigger Master Usage", on page 88.

If enabled, select the output port for the trigger signal using `TRIGger:MASTer:PORT` on page 150.

Parameters:
<state> *RST: OFF

Example: `TRIG:MAST:STAT ON`

Manual operation: See "Master State" on page 91

TRIGger:SLOPe <slope>

Effective only if `TRIGger:SOURce` is set to `INTernal` or `EXTernal`.

Determines which edge of the envelope power, with internal triggering, or increasing voltage, with external triggering, is used for triggering.

Parameters:
<slope> POSitive | NEGative

POSitive
Rising edge

NEGative
Falling edge

*RST: POSitive

TRIGger:SOURce <source>

Selects the source for the trigger event.

Parameters:
<source> HOLD | IMMediate | INTernal | BUS | EXTernal | EXT1 | EXTernal1 | EXT2 | EXTernal2

See Chapter 9.2.2, "Trigger Sources", on page 86.

*RST: IMMediate

Example: `TRIG:SOUR IMM`

Manual operation: See "Autoset" on page 63
See "Autoset" on page 66
See "Autoset" on page 69
See "Autoset" on page 75
See "Trigger Mode" on page 89
See "Trigger Source" on page 89

TRIGger:SYNC:PORT <sync_port>

Selects the external connection for the sync output of the sensor. For more information, see `TRIGger:SYNC:STATe` on page 152.

Parameters:

<sync_port> EXT1 | EXTernal1 | EXT2 | EXTernal2
*RST: EXT1

Manual operation: See "Sync. State" on page 91

TRIGger:SYNC:STATe <state>

Usually used if `TRIGger:MASTer:STATe` on page 151 is set to `ON`.

If enabled, blocks the external trigger bus as long as the sensor remains in the measurement state. Thus, ensures that a new measurement is only started after all sensors have completed their measurements.

Make sure that the number of repetitions is the same for all the sensors involved in the measurement. Otherwise, the trigger bus is blocked by any sensor that has completed its measurements before the others and has returned to the idle state.

See also Chapter 9.2.1, "Trigger States", on page 85.

Parameters:

<state> *RST: OFF

Manual operation: See "Sync. State" on page 91

12.9.6 Configuring the Corrections

Further information:

- Chapter 9.3, "Correction Settings", on page 92
- Chapter 12.7, "Calibrating and Zeroing", on page 133
- Chapter 12.9, "Configuring Measurement Settings", on page 136

Web user interface:

- Chapter 9.3.3, "Correction Parameters", on page 96

Remote commands:

[SENSe<Sensor>:]CORRection:OFFSet 153
[SENSe<Sensor>:]CORRection:OFFSet:STATe 153
[SENSe<Sensor>:]FILTer:DCReject:FCORner 153

[SENSe<Sensor>:]FILTer:DCReject:FCORner:CUV?..153
[SENSe<Sensor>:]FILTer:DCReject[:STATe]..154
[SENSe<Sensor>:]POWer:NCORrection[:STATe]...154

[SENSe<Sensor>:]CORRection:OFFSet <offset>

Sets a fixed offset that is added to the measured value to account for external attenuation or amplification. See also Chapter 9.3.1.3, "Accounting for External Losses", on page 93.

Parameters:

<offset> Range: -200.0 to 200.0
*RST: 0
Default unit: dB

Example: `CORR:OFFS 0`

Manual operation: See "<Value>" on page 97

[SENSe<Sensor>:]CORRection:OFFSet:STATe <state>

Enables or disables the offset correction. See also Chapter 9.3.1.3, "Accounting for External Losses", on page 93.

Parameters:

<state> *RST: OFF

Example: `CORR:OFFS:STAT ON`

Manual operation: See "<State>" on page 97

[SENSe<Sensor>:]FILTer:DCReject:FCORner <frequency>

Sets the corner (cut-off) frequency of the DC reject filter. See also Chapter 9.3.2.1, "DC Rejection", on page 93.

Parameters:

<frequency> Range: 146.0 to 12.5e6
*RST: 1166.0
Default unit: HZ

Manual operation: See "Desired 3dB Frequency" on page 98

[SENSe<Sensor>:]FILTer:DCReject:FCORner:CUV?

Queries the currently used corner frequency of the DC reject filter.

Usage: Query only

Manual operation: See "Used 3dB Frequency" on page 98

[SENSe<Sensor>:]FILTer:DCReject[:STATe] <state>

Available for resolution bandwidths > 40 MHz (zero-IF mode).

Enables or disables the DC reject filter. Set the corner (cut-off) frequency points using `[SENSe<Sensor>:]FILTer:DCReject:FCORner`. See also Chapter 9.3.2.1, "DC Rejection", on page 93.

Parameters:

<state> *RST: OFF

Manual operation: See "<State>" on page 98

[SENSe<Sensor>:]POWer:NCORrection[:STATe] <state>

Enables or disables the noise cancellation. See also Chapter 9.3.1.1, "Noise Correction", on page 92.

Parameters:

<state> *RST: OFF

Example: `POW:NCOR OFF`

Manual operation: See "Noise Correction" on page 97

12.9.7 Configuring the Mixer

Further information:

- Chapter 12.9, "Configuring Measurement Settings", on page 136

Web user interface:

- Chapter 9.4, "Mixer Settings", on page 98

Remote commands:

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF[:CUV]?....154
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband....155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband:AUTO[:STATe]....155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO[:CUV]?....155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:OUTPut[:STATe]....155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:SOURce....156
[SENSe<Sensor>:]FREQuency:TRACk....156
[SENSe<Sensor>:]FREQuency:TRACk:CUV[:STATe]?....156
[SENSe<Sensor>:]FREQuency:TRACk:FREQuency?....157

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF[:CUV]?

Queries the currently used intermediate frequency.

Example: `FREQ:IF?`
Query
`-2.500000E+07`
Result in Hz

Usage: Query only

Manual operation: See "Frequency (IF) - Frequency" on page 100

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband <select>

Sets the currently used intermediate frequency sideband.

Parameters:

<select> LEFT | RIGHt

*RST: LEFT

Example: `FREQ:CONV:MIX:IF:SID RIGH`
Sets the right sideband.

Manual operation: See "Left, Right" on page 100

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband:AUTO[:STATe] <state>

Enables or disables the automatic setting of the intermediate frequency sideband.

Parameters:

<state> *RST: ON

Example: `FREQ:IF:SID:AUTO ON`

Manual operation: See "Sideband" on page 100

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO[:CUV]?

Queries the currently used local oscillator (LO) frequency.

Example: `FREQ:LO?`
Query
`1.025000E+09`
Result in Hz

Usage: Query only

Manual operation: See "Used Internal LO, Expected External LO" on page 100

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:OUTPut[:STATe] <state>

Enables or disables the output of the local oscillator signal. See Chapter 9.4.1, "Local Oscillator Signal", on page 99.

Parameters:

<state> **OFF**
No signal is output. You can use the LO I/O connector as an input.

ON
LO signal is output.
Setting [SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:SOURce EXTernal at the same time causes a static error.

*RST: OFF

Example: FREQ:CONV:MIX:LO:OUTP OFF

Manual operation: See "LO I/O" on page 100

[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:SOURce <source>

Sets the local oscillator source.

The usage of the external sampling clock requires an external LO signal. To avoid setting conflicts, the following combination is not allowed:

- External sampling clock enabled
- Internal LO source

Parameters:

<source> INTernal | EXTernal

INTernal
Uses the internal LO signal.

EXTernal
Uses the external LO signal fed into the LO connector. The internal LO generation is disabled.
Setting [SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:OUTPut[:STATe] ON at the same time causes a static error.

*RST: INTernal

Example: FREQ:CONV:MIX:LO:SOUR EXT

Manual operation: See "Local Oscillator (LO) - Source" on page 99

[SENSe<Sensor>:]FREQuency:TRACk <state>

Enables or disables the frequency tracker. See Chapter 7.2.1, "Frequency Tracker", on page 50.

Parameters:

<state> *RST: OFF

Example: FREQ:TRAC OFF

Manual operation: See "Switch" on page 101

[SENSe<Sensor>:]FREQuency:TRACk:CUV[:STATe]?

Queries the current state of the frequency tracker.

Example: `FREQ:TRAC:CUV?`
Query
`0`
Result

Usage: Query only

Manual operation: See "Switch" on page 101

[SENSe<Sensor>:]FREQuency:TRACk:FREQuency?

Queries the tracking frequency. See Chapter 7.2.1, "Frequency Tracker", on page 50.

Usage: Query only

Manual operation: See "Tracking Frequency" on page 101

12.9.8 Configuring the Sensor

Further information:

- Chapter 12.9, "Configuring Measurement Settings", on page 136

Web user interface:

- Chapter 9.5.2, "Sensor Parameters", on page 102

Remote commands:

[SENSe<Sensor>:]ROSCillator:PASSthrough....... 157
[SENSe<Sensor>:]ROSCillator:REFio:FREQuency....... 158
[SENSe<Sensor>:]ROSCillator:REFio:OUTPut[:STATe]....... 158
[SENSe<Sensor>:]ROSCillator:SOURce....... 158
[SENSe<Sensor>:]SAMPling:CLKio:OUTPut[:STATe]....... 158

[SENSe<Sensor>:]ROSCillator:PASSthrough <state>

Requires the phase coherent measurements option (R&S NRQ6-K3).

Configures the usage of the external sampling clock.

The usage of the external sampling clock requires an external LO signal. To avoid setting conflicts, the following combination is not allowed:

- External sampling clock enabled
- Internal LO source

Parameters:

<state>

OFF
Uses the internally generated 10 MHz reference signal to derive the sampling clock signal.

ON
Enables the use of an external sampling clock supplied at the clock I/O (CLK) connector.

*RST: OFF

Manual operation: See "Clock Distribution Mode - Use Ext. Sampling Clock" on page 102

[SENSe<Sensor>:]ROSCillator:REFio:FREQuency <freq>

Only effective for `[SENSe<Sensor>:]ROSCillator:SOURceREFio`.

Sets the frequency of the reference clock signal that is supplied at the REF connector.

See Table 9-2.

Parameters:

<freq> Keep the reset value. A value other than 10 MHz is not recommended.

Range: 10e6 to 120e6
Increment: 10e6
*RST: 10e6
Default unit: HZ

Example: `ROSC:REF:FREQ 10000000`

Manual operation: See "Reference Input" on page 103

[SENSe<Sensor>:]ROSCillator:REFio:OUTPut[:STATe] <state>

If the REF connector is used as an output, enables or disables the output signal.

See also Table 9-2.

Parameters:

<state> *RST: OFF

Example: `ROSC:REF:OUTP OFF`

Manual operation: See "Reference I/O" on page 103

[SENSe<Sensor>:]ROSCillator:SOURce <source>

Sets the source of the reference oscillator.

Parameters:

<source> INTernal | HOST | REFio

See Chapter 9.5.1, "Clock Source Configuration", on page 101.

*RST: INTernal

Example: `ROSC:SOUR INT`

Manual operation: See "Source" on page 103

[SENSe<Sensor>:]SAMPling:CLKio:OUTPut[:STATe] <state>

If the CLK connector is used as an output, enables or disables the output signal.

See also Table 9-2.

Parameters:

<state> *RST: OFF

Example: `SAMP:CLK:OUTP OFF`

Manual operation: See "Clock I/O" on page 103

12.10 Configuring the System

The `SYSTem` subsystem contains a series of commands for general functions that do not directly affect the measurement.

Web user interface:

- Chapter 10.2, "System Parameters", on page 105

Remote commands:

SYSTem:COMMunicate:NETWork:IPADdress ... 160
SYSTem:COMMunicate:NETWork:IPADdress:GATeway ... 160
SYSTem:COMMunicate:NETWork:IPADdress:INFO? ... 160
SYSTem:COMMunicate:NETWork:IPADdress:MODE ... 160
SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK ... 161
SYSTem:COMMunicate:NETWork:RESTart ... 161
SYSTem:COMMunicate:NETWork:RESet ... 161
SYSTem:COMMunicate:NETWork:STATus? ... 161
SYSTem:COMMunicate:NETWork[:COMMon]:DOMain ... 162
SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname ... 162
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SYSTem:COMMunicate:NETWork:IPADdress <ipaddress>

Effective only if `SYSTem:COMMunicate:NETWork:IPADdress:MODE` is set to `STATic`.

Sets the IP address of the R&S NRQ6.

Parameters:
<ipaddress>

Example: `SYST:COMM:NETW:IPAD '192.168.10.29'`
Sets *192.168.10.29* as IP address.

Manual operation: See "IP Address" on page 106

SYSTem:COMMunicate:NETWork:IPADdress:GATeway <gateway>

Effective only if `SYSTem:COMMunicate:NETWork:IPADdress:MODE` is set to `STATic`.

Sets the address of the default gateway, that means the router that is used to forward traffic to destinations beyond the local network. This router is on the same network as the power sensor.

Parameters:
<gateway>

Example: `SYST:COMM:NETW:IPAD:GAT '192.168.10.254'`
Sets *192.168.10.254* as IP address of the default gateway.

Manual operation: See "Gateway" on page 106

SYSTem:COMMunicate:NETWork:IPADdress:INFO?

Queries the network status information.

Usage: Query only

SYSTem:COMMunicate:NETWork:IPADdress:MODE <mode>

Sets how the IP address is assigned.

Parameters:
<mode> AUTO | STATic

AUTO
Assigns the IP address automatically, provided the network supports the dynamic host configuration protocol (DHCP).

STATic
Enables assigning the IP address manually.

*RST: AUTO

Example: `SYST:COMM:NETW:IPAD:MODE AUTO`
The IP address is assigned automatically.

Manual operation: See "DHCP" on page 106

SYSTem:COMMunicate:NETWork:IPADdress:SUBNet:MASK <netmask>

Effective only if `SYSTem:COMMunicate:NETWork:IPADdress:MODE` is set to `STATic`.

Sets the subnet mask.

Parameters:

<netmask> The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

Example: `SYST:COMM:NETW:IPAD:SUBN:MASK '255.255.255.0'`
Sets *255.255.255.0* as subnet mask.

Manual operation: See "Subnet Mask" on page 106

SYSTem:COMMunicate:NETWork:RESTart

Restarts the network connection to the DUT, that means terminates the connection and sets it up again.

Example: `SYST:COMM:NETW:REST`

Usage: Event

SYSTem:COMMunicate:NETWork:RESet

Resets the LAN network settings to the default values.

Usage: Event

SYSTem:COMMunicate:NETWork:STATus?

Queries the network configuration state.

Example: `SYST:COMM:NETW:STAT?`
Query
`UP`
Response: The network is active.

Usage: Query only

SYSTem:COMMunicate:NETWork[:COMMon]:DOMain <domain>

Sets the domain of the network.

Parameters:
<domain>

Example: `SYST:COMM:NETW:COMM:DOM 'ABC.DE'`
Sets *ABC.DE* as domain of the network.

SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <hostname>

Sets the individual hostname of the sensor.

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

The R&S NRQ6 performs the change of the hostname immediately after the command is sent. For this purpose, the R&S NRQ6 restarts its connection to the network, which can take several seconds. During this time, you cannot address the R&S NRQ6. After the restart, you can only address the R&S NRQ6 using the newly set hostname.

Note: It is recommended that you do not change the default hostname to avoid problems with the network connection. However, if you change the hostname, be sure to use a unique name.

Parameters:
<hostname>

Example: `SYST:COMM:NETW:COMM:HOST 'powersensor-2nd-floor'`
Sets *powersensor-2nd-floor* as new hostname.

Manual operation: See "Sensor Name" on page 106

SYSTem:COMMunicate:PSERvoing:BCLock <value>

Requires the power servoing option (R&S NRQ6-K2).

Used for internal communication between the R&S SGT100A and the R&S NRQ6. Sets the clock rate of the serial interface.

Parameters:

<value>	Range:	1e6 to 100e6
	*RST:	10e6
	Default unit:	HZ

SYSTem:COMMunicate:PSERvoing:TPATtern <value>

Requires the power servoing option (R&S NRQ6-K2).

Used for internal communication between the R&S SGT100A and the R&S NRQ6. Sets the bit pattern for the connection test of the serial interface.

Parameters:

<value> Range: std::numeric_limits<int>::min() to std::numeric_limits<int>::max()

*RST: 0

SYSTem:DFPRint<Channel>?

Reads the footprint file of the sensor.

Suffix:

<Channel> 1 to 4

Measurement channel if more than one channel is available.

Usage: Query only

SYSTem:ERRor:ALL?

Queries all unread entries in the error/event queue and removes them from the queue.

The response is a comma-separated list in first out order, each entry consisting of the error number and a short description of the error.

Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Example: `SYST:ERR:ALL?`

Query

`0,"No error"`

Response

Usage: Query only

SYSTem:ERRor:CODE:ALL?

Queries all unread entries in the error/event queue and removes them from the queue. Only the error numbers are returned.

Example: `SYST:ERR:CODE:ALL?`

Query

`0`

Response: No errors have occurred since the error queue was last read out.

Usage: Query only

SYSTem:ERRor:CODE[:NEXT]?

Queries the oldest entry in the error queue and then deletes it. Only the error number is returned.

Example: `SYST:ERR:CODE?`
Query
`0`
Response: No errors have occurred since the error queue was last read out.

Usage: Query only

SYSTem:ERRor:COUNt?

Queries the number of entries in the error queue.

Example: `SYST:ERR:COUN?`
Query
`1`
Response: One error has occurred since the error queue was last read out.

Usage: Query only

SYSTem:ERRor[:NEXT]?

Queries the error/event queue for the oldest entry and removes it from the queue. The response consists of an error number and a short description of the error.

See also "Querying errors (remote control)" on page 200.

Example: `SYST:ERR?`
Query
`0, 'no error'`
Response: No errors have occurred since the error queue was last read out.

Usage: Query only

SYSTem:FWUPdate <fwudata>

Loads new operating firmware into the R&S NRQ6. Rohde & Schwarz provides the update file. For further details, see Chapter 11, "Firmware Update", on page 109.

If you want to integrate a firmware update function in an application, see the example given in Chapter 11.2.3, "Using Remote Control", on page 114.

Setting parameters:
<fwudata> <block_data>

Definite length arbitrary block data containing the direct copy of the binary `*.rsu` file in the following format:
#
Single digit indicating how many digits follow to specify the size of the binary file.
Number that specifies the size of the binary file.
Binary data

0x0a as appended delimiter for line feed

Usage: Setting only

Manual operation: See "Firmware Update" on page 107

SYSTem:FWUPdate:STATus?

Reads the result of the firmware update performed using `SYSTem:FWUPdate`.

While a firmware update is in progress, the LED of the sensor flashes in bright white color. When the firmware update is completed, you can read the result.

The result of the query is a readable string.

Example: `SYST:FWUP:STAT?`
Query
`"Success"`
Response

Usage: Query only

Manual operation: See "Firmware Update" on page 107

SYSTem:HELP:HEADers? [<Item>]

Returns a list of all SCPI commands supported by the sensor.

Query parameters:
<Item> <block_data>

Usage: Query only

SYSTem:HELP:SYNTax? [<Item>]

Queries the relevant parameter information for the specified SCPI command.

Query parameters:
<Item>

Example: `SYST:HELP:SYNT? 'sens:aver:coun'`

Usage: Query only

SYSTem:HELP:SYNTax:ALL?

Queries the implemented SCPI commands and their parameters. Returns the result as a block data.

Usage: Query only

SYSTem:INFO? [<item>]

Queries information about the system.

If queried without parameters, the command returns all available information in the form of a list of strings separated by commas.

If you want to query specific information, add a query parameter:

```
SYST:INFO? "<string>"
```

Query parameters:

<item> "<string>" with the following values:

Manufacturer

Type

Stock Number

Serial

SW Build

MAC Address

Hostname

IP Address

Sensor Name

Technology

Function

MinPower

MaxPower

MinFreq

MaxFreq

Resolution

Impedance

Coupling

Cal Due Date

TestLimit

Uptime

Example:

```
SYST:INFO?
```

Query

```
"Manufacturer:Rohde & Schwarz Type:
NRQ6 Stock Number:1421.3509K02 Serial:
900041 SW Build:02.10.19090301 MAC Address:
00:90:b8:1e:
57:19 Hostname:nrq6-900041 IP Address:
10.111.0.157 Sensor Name:
NRQ6-900041 Technology:
Frequency Selective Function:
Power Terminating MinPower:1e-17 MaxPower:
0.1 MinFreq:5e+07 MaxFreq:6e+09 Resolution:
8.33333e-09 Impedance:
50 Coupling:AC Cal. Due Date:2018-12 TestLimit:
0.160 dB Uptime:24 "
```

Response

Usage: Query only

Manual operation: See "Device ID" on page 108

SYSTem:INITialize

Sets the sensor to the standard state.

The sensor loads the default settings for all test parameters in the same way as when using *RST. The sensor outputs a complete list of all supported commands and parameters. The remote-control software can automatically adapt to the features of different types of sensors with different functionality.

Usage: Event

SYSTem:LANGuage <language>

Selects an emulation of a different command set.

Parameters:

<language> SCPI

*RST: SCPI

SYSTem:LED:COLor <color>

Sets the color and the flash code of the system status LED, if the operating mode of the LED is set to `USER` (`SYSTem:LED:MODE` on page 168 `USER`).

Parameters:

<color> Hexadecimal code described as
0x0krrggbb
with
k = 0: steady on; k = 1: slowly flashing; k = 2: fast flashing
rr = red
gg = green
bb = blue

Range: 0 to 0x0FFFFFFF
*RST: 0x00A0A0A0

Example:

```
SYST:LED:MODE USER
```
Sets the system status LED operating mode to user.

```
SYST:LED:COL #H01a00000
```
The LED flashes slowly in red.

```
SYSTem:LED:MODE SENSor
```
Sets the system status LED operating mode back to the sensor internal settings.

SYSTem:LED:MODE <mode>

Selects whether the color of the system status LED is controlled by the sensor firmware or by the user settings.

For more information, see `SYSTem:LED:COLor` on page 167.

Parameters:

<mode>	USER | SENSor
	*RST: SENSor

SYSTem:LICense:KEY <key>

Installs the license key for the option key management. To make the new option available, reboot the sensor using `SYSTem:REBoot`.

Check the installed options using `*OPT?` on page 117.

Setting parameters:

<key>	The <key> string contains the license key from the software option list supplied with the option.
Usage:	Setting only
Manual operation:	See "License Key" on page 108

SYSTem:LICense:XML <xmlfile>

Installs the license key for the option key management. To make the new option available, reboot the sensor using `SYSTem:REBoot`.

Check the installed options using `*OPT?` on page 117.

Setting parameters:

<xmlfile>	<block_data> Definite length arbitrary block data containing the direct copy of the binary `*.xml` file in the following format: # Single digit indicating how many digits follow to specify the size of the binary file. Number that specifies the size of the binary file. Binary data 0x0a as appended delimiter for line feed See also Chapter 11.2.3, "Using Remote Control", on page 114.
Usage:	Setting only
Manual operation:	See "Browse License File" on page 108

SYSTem:MINPower?

Queries the lower power measurement limit.

Use this query to determine a useful resolution for the result display near the lower measurement limit.

Usage: Query only

SYSTem:PARameters?

Lists all commands with default values, limits and ranges.

Usage: Query only

SYSTem:PARameters:DELTa?

Lists all commands that differ from the defined default status set by `*RST` on page 118.

The commands are output with default values, limits and ranges.

Usage: Query only

SYSTem:PRESet

Triggers a sensor reset.

The command essentially corresponds to the `*RST` command, with the exception that the settings of the following commands are persistently held:

`INITiate:CONTinuous` on page 124

`[SENSe<Sensor>:]AVERage:TCONtrol` on page 138

`[SENSe<Sensor>:]TRACe:AVERage:TCONtrol` on page 141

Usage: Event

SYSTem:REBoot

Reboots the R&S NRQ6.

Usage: Event

Manual operation: See "Reboot Sensor" on page 107
See "Reboot" on page 108

SYSTem:RESTart

Restarts the firmware of the R&S NRQ6.

Usage: Event

SYSTem[:SENSor]:NAME <sensorname>

Sets the sensor name. The sensor name is displayed in the title bar of the web user interface, see (1) in Figure 5-1.

If you do not specify a sensor name, the hostname is used as default. See also SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname on page 162.

Parameters:
<sensorname>

Example: `SYST:NAME "InputModule-X5"`

Manual operation: See "Sensor Name" on page 106

SYSTem:SERRor?

Queries all static errors that are currently present.

See also "Querying errors (remote control)" on page 200.

Usage: Query only

SYSTem:SERRor:LIST:ALL?

Returns a list of all static errors that have occurred but have already been resolved. For example, an overload of a short duration.

Example: `SYST:SERR:LIST:ALL?`
Response: `0,"reported at uptime:2942; notice; auto-averaging exceeded maximum time; Notification",0,"removed at uptime:2944; notice; auto-averaging exceeded maximum time; Notification".`

Usage: Query only

SYSTem:SERRor:LIST[:NEXT]?

Queries the list of all static errors that have occurred but have already been resolved for the oldest entry and removes it from the queue. The response consists of an error number and a short description of the error.

Example: `SYST:SERR:LIST?`
Query
`0,"reported at uptime:2942; notice; auto-averaging exceeded maximum time; Notification"`
Response

Usage: Query only

SYSTem:VERSion?

Queries the SCPI version that the command set of the sensor complies with.

Example: `SYST:VERS?`
Query
`1999.0`
Response: SCPI version from 1999.

Usage: Query only

12.11 Using the Status Register

Further information:

- Chapter 14.3, "Status Reporting System", on page 186

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12.11.1 General Status Register Commands

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STATus:PRESet

Resets the edge detectors and `ENABle` parts of all registers to a defined value.

Usage: Event

STATus:QUEue[:NEXT]?

Queries the most recent error queue entry and deletes it.

Positive error numbers indicate sensor specific errors. Negative error numbers are error messages defined by SCPI.

If the error queue is empty, the error number 0, "No error", is returned.

Usage: Query only

12.11.2 Reading Out the CONDition Part

Further information:

- Chapter 14.3.2, "Structure of a SCPI Status Register", on page 187

STATus:DEVice:CONDition?
STATus:OPERation:CALibrating:CONDition?
STATus:OPERation:CONDition?
STATus:OPERation:LLFail:CONDition?
STATus:OPERation:MEASuring:CONDition?
STATus:OPERation:SENSe:CONDition?
STATus:OPERation:TRIGger:CONDition?
STATus:OPERation:ULFail:CONDition?
STATus:QUEStionable:CALibration:CONDition?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:POWer:CONDition?
STATus:QUEStionable:WINDow:CONDition?

Usage: Query only

12.11.3 Reading Out the EVENt Part

Further information:

- Chapter 14.3.2, "Structure of a SCPI Status Register", on page 187

STATus:DEVice[:EVENt]?
STATus:OPERation:CALibrating[:SUMMary][:EVENt]?
STATus:OPERation[:EVENt]?
STATus:OPERation:LLFail[:SUMMary][:EVENt]?
STATus:OPERation:MEASuring[:SUMMary][:EVENt]?
STATus:OPERation:SENSe[:SUMMary][:EVENt]?
STATus:OPERation:TRIGger[:SUMMary][:EVENt]?
STATus:OPERation:ULFail[:SUMMary][:EVENt]?
STATus:QUEStionable:CALibration[:SUMMary][:EVENt]?
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:POWer[:SUMMary][:EVENt]?
STATus:QUEStionable:WINDow[:SUMMary][:EVENt]?

Usage: Query only

12.11.4 Controlling the ENABle Part

Further information:

- Chapter 14.3.2, "Structure of a SCPI Status Register", on page 187

STATus:DEVice:ENABle <value>
STATus:OPERation:CALibrating:ENABle <value>
STATus:OPERation:ENABle <value>
STATus:OPERation:LLFail:ENABle <value>
STATus:OPERation:MEASuring:ENABle <value>
STATus:OPERation:SENSe:ENABle <value>
STATus:OPERation:TRIGger:ENABle <value>
STATus:OPERation:ULFail:ENABle <value>
STATus:QUEStionable:CALibration:ENABle <value>

STATus:QUEStionable:ENABle <value>
STATus:QUEStionable:POWer:ENABle <value>
STATus:QUEStionable:WINDow:ENABle <value>
Parameters:
<value> *RST: 0

12.11.5 Controlling the Negative Transition Part

Further information:

- Chapter 14.3.2, "Structure of a SCPI Status Register", on page 187

STATus:DEVice:NTRansition <value>
STATus:OPERation:CALibrating:NTRansition <value>
STATus:OPERation:NTRansition <value>
STATus:OPERation:LLFail:NTRansition <value>
STATus:OPERation:MEASuring:NTRansition <value>
STATus:OPERation:SENSe:NTRansition <value>
STATus:OPERation:TRIGger:NTRansition <value>
STATus:OPERation:ULFail:NTRansition <value>
STATus:QUEStionable:CALibration:NTRansition <value>
STATus:QUEStionable:NTRansition <value>
STATus:QUEStionable:POWer:NTRansition <value>
STATus:QUEStionable:WINDow:NTRansition <value>
Parameters:
<value> *RST: 0

12.11.6 Controlling the Positive Transition Part

Further information:

- Chapter 14.3.2, "Structure of a SCPI Status Register", on page 187

STATus:DEVice:PTRansition <value>
STATus:OPERation:CALibrating:PTRansition <value>
STATus:OPERation:PTRansition <value>
STATus:OPERation:LLFail:PTRansition <value>
STATus:OPERation:MEASuring:PTRansition <value>
STATus:OPERation:SENSe:PTRansition <value>
STATus:OPERation:TRIGger:PTRansition <value>
STATus:OPERation:ULFail:PTRansition <value>
STATus:QUEStionable:CALibration:PTRansition <value>
STATus:QUEStionable:PTRansition <value>
STATus:QUEStionable:POWer:PTRansition <value>
STATus:QUEStionable:WINDow:PTRansition <value>
Parameters:
<value> *RST: 65535

13 Programming Examples

If you install the optional software development kit (SDK) of the R&S NRP Toolkit, programming examples are provided. See Chapter 5.1.3, "R&S NRP Toolkit for Windows", on page 32.

Under Windows, these examples are installed under:

`C:\ProgramData\Rohde-Schwarz\NRP-Toolkit-SDK\examples\NRQ`

The following programming examples are available for the R&S NRQ6:

- ACLR measurement
- Don't miss a pulse
- Using the frequency tracker
- Measuring at low levels
- Feed for Vector Signal Explorer (VSE)
  Writes the measured I/Q data into a `*.csv` file. Requires the I/Q data interface (R&S NRQ6-K1).
- Phase analysis
  Requires the I/Q data interface (R&S NRQ6-K1) and the phase coherent measurements (R&S NRQ6-K3).

14 Remote Control Basics

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14.1 Remote Control Interfaces and Protocols

For remote control, communication between the R&S NRQ6 and the controlling host is established based on the following interfaces and protocols.

Table 14-1: Supported interfaces and protocols

Interface	Protocol	VISA*) address string	Library	Further information
USB	USBTMC	USB::<vendor ID>::<product ID>:: <serial number>[::INSTR]	VISA	Chapter 14.1.1, "USB Interface", on page 175
Ethernet	VXI-11	TCPIP::host address[::LAN device name][::INSTR]	VISA	Chapter 14.1.2.2, "VXI-11 Protocol", on page 178
	HiSLIP High-speed LAN instrument protocol (IVI-6.1)	TCPIP::host address::hislip0[::INSTR]	VISA	Chapter 14.1.2.3, "HiSLIP Protocol", on page 178
	Socket communication (LAN Ethernet)	TCPIP::host address[::LAN device name]::<port>::SOCKET		Chapter 14.1.2.4, "Socket Communication", on page 179
	*) 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 14.1.2.1, "VISA Resource Strings", on page 177.			

14.1.1 USB Interface

Computer requirements

- VISA library
  A USB connection requires the VISA library to be installed. VISA detects and configures the R&S NRQ6 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 R&S NRQ6 and the USB interface of the computer, see Chapter 3.6.2, "Computer Using a USB Connection", on page 21.

2. Make sure that the R&S NRQ6 is powered by PoE+. For details, see "R&S NRQ6 requires PoE+" on page 28.

USBTMC protocol

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. R&S NRQ6 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 sensor. It is based on the sensor address and some instrument- 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 R&S NRQ6.
- *<serial number>* is the individual serial number of the , printed on the casing.

Example:

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

0x0AAD is the vendor ID for Rohde & Schwarz.

0x015B is the product ID for the R&S NRQ6.

100001 is the serial number of the particular R&S NRQ6.

14.1.2 Ethernet Interface

The Ethernet interface of the R&S NRQ6 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 R&S NRQ6.
- 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 R&S NRQ6 to a local area network, see Chapter 3.6.1, "Computer Using a LAN Connection", on page 16.
2. Make sure that the R&S NRQ6 is powered by PoE+. For details, see "R&S NRQ6 requires PoE+" on page 28.

14.1.2.1 VISA Resource Strings

The VISA resource string for network device communication 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 hostname 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.

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 further details, see Chapter 14.1.2.2, "VXI-11 Protocol", on page 178.

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 further details, see Chapter 14.1.2.3, "HiSLIP Protocol", on page 178 .

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 further details, see Chapter 14.1.2.4, "Socket Communication", on page 179.

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 hostname 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

14.1.2.2 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.

14.1.2.3 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.

14.1.2.4 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.

14.2 SCPI Command Structure

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The power sensor supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers.

SCPI commands consist of a so-called header and, usually, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers can consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

14.2.1 Syntax for Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk (*) and possibly one or more parameters.

Examples:

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

14.2.2 Syntax for Device-Specific Commands

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters here, to distinguish it from the long form, which constitutes the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`INITiate:CONTinuous` is equivalent to `INIT:CONT` or `init:cont`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Different numbering in remote control

For remote control, the suffix can differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `INITiate[:IMMediate]`

Command: `INIT:IMM` is equivalent to `INIT`

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma.

For a description of the parameter types, refer to Chapter 14.2.3, "SCPI Parameters", on page 181.

Special characters

|	**Parameters** A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
[ ]	Mnemonics in square brackets are optional and can be inserted into the header or omitted. **Example**: `INITiate[:IMMediate]` `INIT:IMM` is equivalent to `INIT`
{ }	Parameters in curly brackets are optional and can be inserted once or several times, or omitted.

14.2.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa can comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed.

Units

For physical quantities, you can enter the unit. Only basic units are allowed and recognized, see Table 14-2. If you omit the unit, the basic unit is used.

Table 14-2: Units

Basic unit	Also noted as
Hz	Frequency or HZ
s	Seconds
W	Watts
degrees	Angle
PCT	Percent
dB	DB
dBm	DBM
dBuV	DBUV

Special numeric values

The texts listed below are interpreted as special numeric values. For a query, the numeric value is provided.

- **MIN/MAX**
  `MINimum` and `MAXimum` denote the minimum and maximum value.
- **DEF**
  `DEFault` denotes a preset value which has been stored in the non-variable memory. This value conforms to the default setting, as it is called by the *RST command.
- **UP/DOWN**
  `UP`, `DOWN` increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.
- **INF/NINF**
  `INFinity`, `Negative INFinity (NINF)` represent the numeric values 9.9E37 or -9.9E37, respectively. `INF` and `NINF` are only sent as instrument responses.
- **NAN**
  Not a number (NAN) represents the value 9.91E37. NAN is only sent as an instrument response. This value is not defined. Possible causes are the division by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `SENSe:AVERage:COUNt:AUTO ON`

Query: `SENSe:AVERage:COUNt:AUTO?`

Response: `1`

Text parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. For a query, the short form of the text is provided.

Example:

Setting command: `TRIGger:SLOPe POSitive`

Query: `TRIG:SLOP?`

Response: `POS`

Character strings

Enter strings always in quotation marks (' or ").

Example:

Setting command: `SENSe:FUNCtion "POWer:AVG"`

Query: `SENS:FUNC?`

Response: `"POWer:AVG"`

Block data

Block data is a format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

`SYSTem:HELP:SYNTax:ALL?`

`Response: #45168xxxxxxxx`

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example, the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

14.2.4 Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line, the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*****	The asterisk marks a common command.
' **"**	Quotation marks introduce a string and terminate it (both single and double quotation marks are possible).
#	The hash symbol introduces binary, octal, hexadecimal and block data. ● Binary: #B10110 ● Octal: #O7612 ● Hex: #HF3A7 ● Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

14.2.5 Structure of a Command Line

A command line can consist of one or several commands. It is terminated by one of the following:

- a <New Line>
- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

`TRIG:LEV 0.1mW;TRIG:DEL 3E-3`

This command line contains two commands. Both commands are part of the `TRIG` command system, i.e. they have one level in common.

When abbreviating the command line, the second command begins with the level below `TRIG`. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

`TRIG:LEV 0.1E-3;DEL 3E-3`

A new command line always begins with the complete path.

Example:

`TRIG:LEV 0.1E-3`

`TRIG:DEL 3E-3`

14.2.6 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.
  Example: `TRIG:SOUR?`, response: `INT`
- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the `Unit` command. The response `3.5E9` for example stands for 3.5 GHz.
- Truth values (Boolean values) are returned as `0` (for `OFF`) and `1` (for `ON`).
  Example:
  Setting command: `SENS:AVER:COUN:AUTO ON`
  Query: `SENS:AVER:COUN:AUTO?`
  Response: `1`
- Text (character data) is returned in a short form.
  Example:
  Setting command: `TRIGger:SOURce INTernal`
  Query: `TRIG:SOUR?`

Response: `INT`

14.3 Status Reporting System

The status reporting system stores all information on the current operating state of the sensor, and on errors which have occurred. This information is stored in the status registers and in the error queue. You can query both with the commands of the `STATus` subsystem.

14.3.1 Hierarchy of the Status Registers

Fig.14-1 shows the hierarchical structure of information in the status registers.

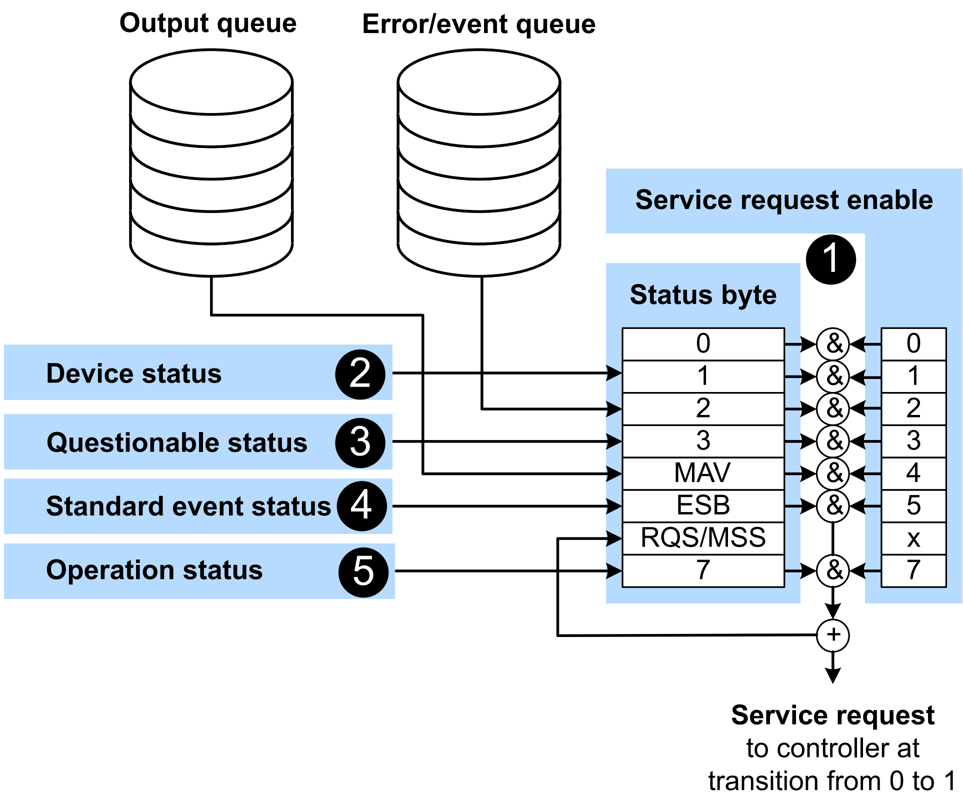


Figure 14-1: Status registers overview

1 = Chapter 14.3.3, "Status Byte (STB) and Service Request Enable Register (SRE)", on page 188
2 = Chapter 14.3.5, "Device Status Register", on page 190
3 = Chapter 14.3.6, "Questionable Status Register", on page 191
4 = Chapter 14.3.7, "Standard Event Status and Enable Register (ESR, ESE)", on page 194
5 = Chapter 14.3.8, "Operation Status Register", on page 195

The highest level is formed by the status byte register (STB) and the associated service request enable (SRE) register.

The status byte register (STB) receives its information from:

- Standard event status register (ESR)
- Associated standard event status enable register (ESE)
- SCPI-defined operation status register
- Questionable status register, which contains detailed information on the device.

14.3.2 Structure of a SCPI Status Register

Each SCPI register consists of five 16-bit registers that have different functions, see Figure 14-2. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is the same for all five registers. Bit 15, the most-significant bit, is set to 0 in all registers, thus preventing problems some controllers have with the processing of unsigned integers.

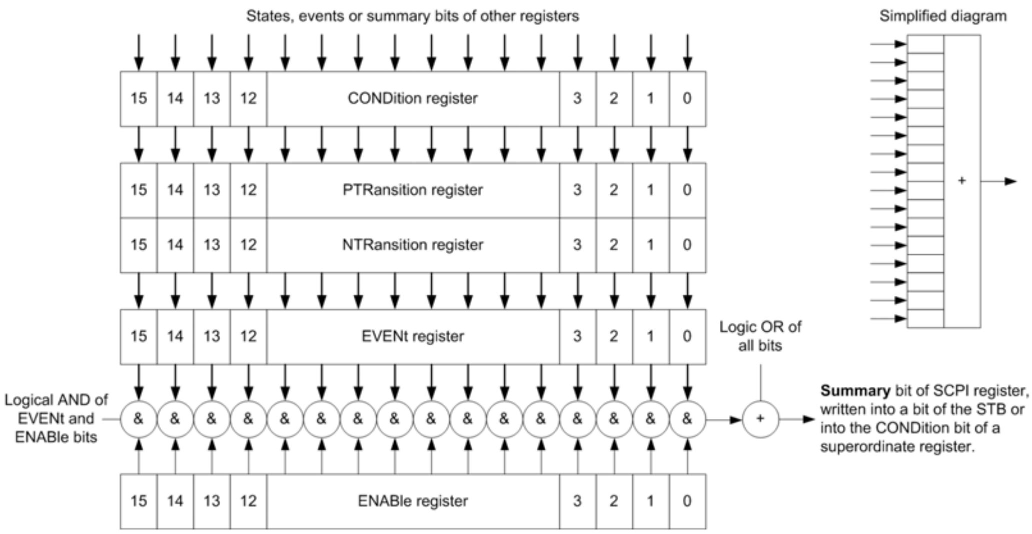


Figure 14-2: Standard SCPI status register

CONDition status register part

The five parts of a SCPI register have different properties and functions:

The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.

PTRansition / NTRansition status register part

The two transition register parts define which state transition of the `CONDition` part (none, 0 to 1, 1 to 0 or both) is stored in the `EVENt` part.

The *Positive TRansition* part acts as a transition filter. When a bit of the `CONDition` part is changed from 0 to 1, the associated `PTR` bit decides whether the `EVENt` bit is set to 1.

- `PTR` bit = 1: The `EVENt` bit is set.
- `PTR` bit = 0: The `EVENt` bit is not set.

This part can be written into and read as required. Its contents are not affected by reading.

The *Negative TRansition* part also acts as a transition filter. When a bit of the `CONDition` part is changed from 1 to 0, the associated `NTR` bit decides whether the `EVENt` bit is set to 1.

- `NTR` bit = 1: The `EVENt` bit is set.
- `NTR` bit = 0: The `EVENt` bit is not set.

This part can be written into and read as required. Its contents are not affected by reading.

EVENt status register part

The `EVENt` part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument.

You can only read this part. Reading the register clears it. This part is often equated with the entire register.

ENABle status register part

The `ENABle` part determines whether the associated `EVENt` bit contributes to the sum bit (see below). Each bit of the `EVENt` part is "ANDed" with the associated `ENABle` bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an "OR" function (symbol '+').

`ENABle` bit = 0: The associated `EVENt` bit does not contribute to the sum bit.

`ENABle` bit = 1: If the associated `EVENt` bit is 1, the sum bit is set to 1 as well.

You can read and write as required. Its contents are not affected by reading.

Sum bit

The sum bit is obtained from the `EVENt` and `ENABle` part for each register. The result is then entered into a bit of the `CONDition` part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event can lead to a service request throughout all levels of the hierarchy.

14.3.3 Status Byte (STB) and Service Request Enable Register (SRE)

The status byte register is already defined in IEEE 488.2. It gives a rough overview of the sensor status, collecting information from the lower-level registers. It is comparable with the CONDition register of a SCPI defined register and is at the highest level of the SCPI hierarchy. Its special feature is that bit 6 acts as the summary bit of all other bits of the status byte register.

The status byte register is read by *STB? or a serial poll. The service request enable register is associated with the status byte register. The function of the service request enable register corresponds to that of the ENABle register of the SCPI registers. Each bit of the status byte register is assigned a bit in the service request enable register. Bit 6 of the service request enable register is ignored. If a bit is set in the service request enable register and the associated bit in the status byte register changes from 0 to 1, a service request (SRQ) is generated on the IEC/IEEE bus. This service request triggers an interrupt in the controller configured for this purpose, and can be further processed by the controller.

Set and read the service request enable register using *SRE.

See Figure 14-1.

Table 14-3: Used status byte bits and their meaning

Bit no.	Short description	Bit is set if
1	Device status register summary	A sensor is connected or disconnected or when an error has occurred in a sensor, depending on the configuration of the sensor status register. Chapter 14.3.5, "Device Status Register", on page 190.
2	Error queue not empty	The error queue has an entry. If this bit is enabled by the service request enable register, each entry of the error queue generates a service request. An error can thus be recognized and specified in detail by querying the error queue. The query yields a conclusive error message. This procedure is recommended since it considerably reduces the problems of IEC/IEEE-bus control.
3	Questionable status register summary	An EVENt bit is set in the QUEStionable status register and the associated ENABLe bit is set to 1. A set bit denotes a questionable device status which can be specified in greater detail by querying the questionable status register. Chapter 14.3.6, "Questionable Status Register", on page 191.
4	MAV Message available	A readable message is in the output queue. This bit can be used to automate reading of data from the sensor into the controller.
5	ESB Standard event status register summary	One of the bits in the standard event status register is set and enabled in the event status enable register. Setting this bit denotes a serious error which can be specified in greater detail by querying the standard event status register. Chapter 14.3.7, "Standard Event Status and Enable Register (ESR, ESE)", on page 194.

Bit no.	Short description	Bit is set if
6	MSS Master status summary	The sensor triggers a service request, which happens if one of the other bits of this register is set together with its enable bit in the service request enable register (SRE).
7	Operation status register summary	An EVENt bit is set in the operation status register and the associated ENABLe bit is set to 1. A set bit denotes that an action is being performed by the sensor. Information on the type of action can be obtained by querying the operation status register. Chapter 14.3.8, "Operation Status Register", on page 195.

14.3.4 IST Flag and Parallel Poll Enable Register (PPE)

Similar to the service request (SRQ), the IST flag combines the complete status information in a single bit. It can be queried by a parallel poll or by *IST?.

The parallel poll enable register (PPE) determines which bits of the STB affect the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE; bit 6 is also used, in contrast to the service request enable register. The IST flag is obtained by ORing all results together.

Set and read the parallel poll enable register using *PRE.

14.3.5 Device Status Register

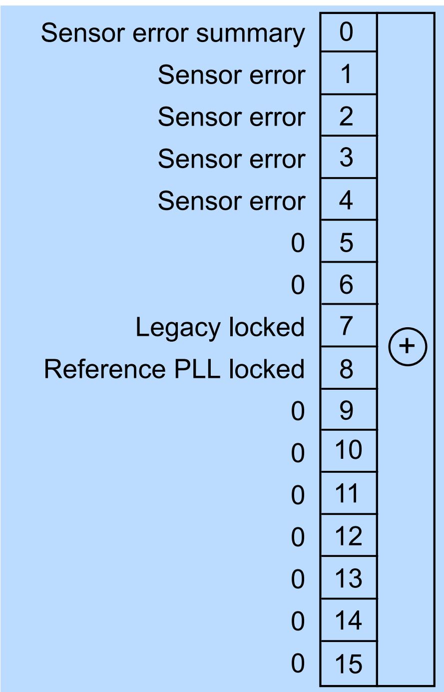


Figure 14-3: Device status register

Querying the register:

- STATus:DEVice:CONDition?
- STATus:DEVice[:EVENt]?

Querying the static errors:

- SYSTem:SERRor?

Table 14-4: Used device status bits and their meaning

Bit no.	Short description	Bit is set if
0	Sum of SERR bits	Sum/combination of SERR bits 1 to 4.
1	SERR measurement not possible	
2	SERR erroneous results	Static error exists. The measurement result is possibly incorrect.
3	SERR warning	Static error exists. Status LED of the power sensor is slowly flashing red.
4	SERR critical	Critical static error exists. Status LED of the power sensor is fast flashing red.
8	Reference PLL locked state	PLL for the clock reference is synchronized. The bit is useful when selecting an external clock source.

14.3.6 Questionable Status Register

Contains information on questionable sensor states that occur if the power sensor is not operated in compliance with its specifications.

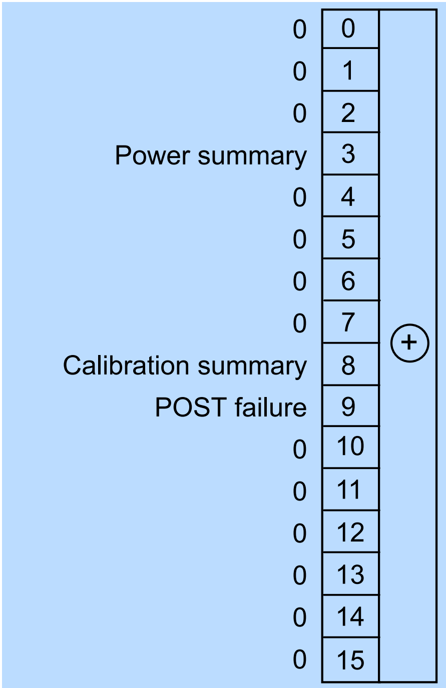


Figure 14-4: Questionable status register

Querying the register:

- `STATus:QUEStionable:CONDition?`
- `STATus:QUEStionable[:EVENt]?`

Table 14-5: Used questionable status bits and their meaning

Bit no.	Short description	Bit is set if
3	Power summary	Summary of Questionable Power Status Register exists.
8	Calibration summary	Summary of Questionable Calibration Status Register exists.
9	POST failure	Built-in test of the R&S NRQ6 that is carried out automatically upon power-up has generated an error.

14.3.6.1 Questionable Power Status Register

Contains information whether the measured power values are questionable.

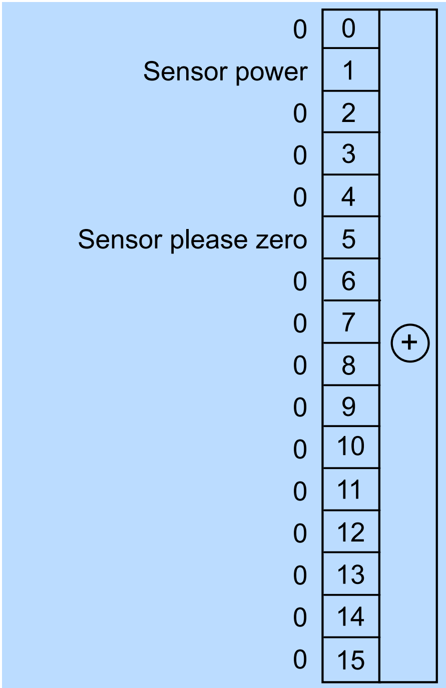


Figure 14-5: Questionable power status register

Querying the register:

- `STATus:QUEStionable:POWer:CONDition?`
- `STATus:QUEStionable:POWer[:SUMMary][:EVENt]?`

Table 14-6: Used questionable power status bits and their meaning

Bit no.	Short description	Bit is set if
1	Sensor power	Measurement data of the power sensor is corrupt.
5	Sensor please zero	Zero correction for the power sensor is no longer correct. Perform a zero correction.

14.3.6.2 Questionable Calibration Status Register

Contains information whether the zeroing of the power sensor was successful.

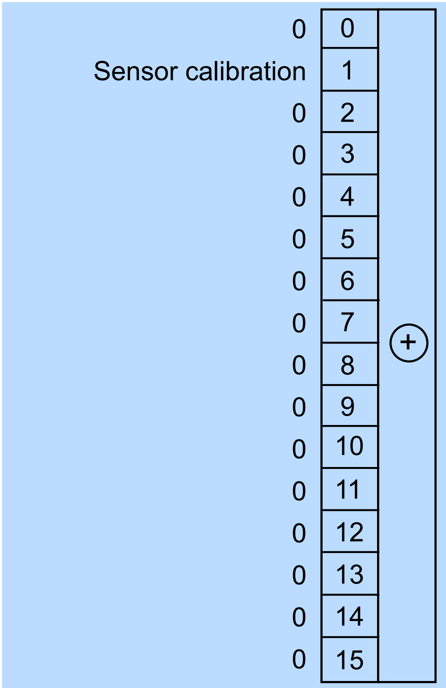


Figure 14-6: Questionable calibration status register

Querying the register:

- `STATus:QUEStionable:CALibration:CONDition?`
- `STATus:QUEStionable:CALibration[:SUMMary][:EVENt]?`

Table 14-7: Used questionable calibration status bits and their meaning

Bit no.	Short description	Bit is set if
1	Sensor calibration	Zeroing of the power sensor was not successful.

14.3.7 Standard Event Status and Enable Register (ESR, ESE)

The `ESR` is already defined in the IEEE 488.2 standard. It is comparable to the `EVENt` register of a SCPI register. The standard event status register can be read out by `*ESR?`.

The `ESE` forms the associated `ENABle` register. It can be set and read by `*ESE`.

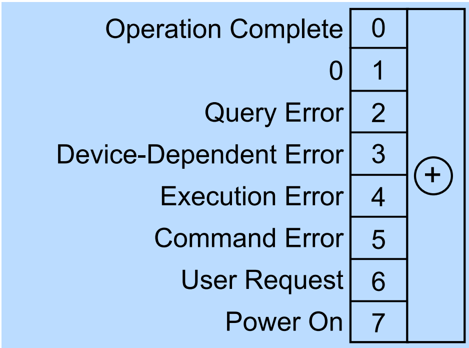


Figure 14-7: Standard event status register (ESR)

Table 14-8: Used standard event status bits and their meaning

Bit no.	Short description	Bit is set if
0	Operation complete	All previous commands have been executed and *OPC is received.
2	Query error	The controller wants to read data from the sensor but has not sent a query, or it sends new commands to the sensor before it retrieves existing requested data. A frequent cause is a faulty query which cannot be executed.
3	Device-dependent error	A sensor-dependent error occurs. An error message with a number between -300 and -399 or a positive error number denoting the error in greater detail is entered in the error queue.
4	Execution error	The syntax of a received command is correct but the command cannot be executed due to various marginal conditions. An error message with a number between -200 and -300 denoting the error in greater detail is entered in the error queue.
5	Command error	An undefined command or a command with incorrect syntax is received. An error message with a number between -100 and -200 denoting the error in greater detail is entered in the error queue.
6	User request	The sensor is switched over to manual control.
7	Power on	The sensor is switched on.

14.3.8 Operation Status Register

Contains information on current operations, CONDition register, or operations performed since the last query, EVENt register.

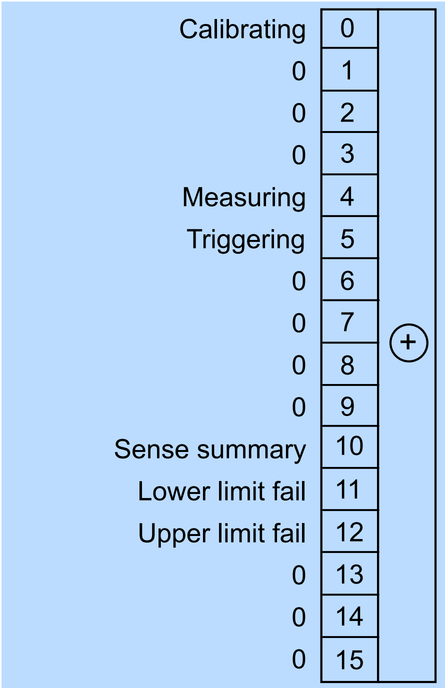


Figure 14-8: Operation status register

Querying the register:

- `STATus:OPERation:CONDition?`
- `STATus:OPERation[:EVENt]?`

Table 14-9: Used operation status bits and their meaning

Bit no.	Short description	Bit is set if
0	Calibrating	Summary of Operation Calibrating Status Register exists.
4	Measuring	Summary of Operation Measuring Status Register exists.
5	Triggering	Summary of Operation Trigger Status Register exists.

14.3.8.1 Operation Calibrating Status Register

The `CONDition` register contains information whether a power sensor is being calibrated. The `EVENt` register contains information whether a calibration was started or completed since the last query.

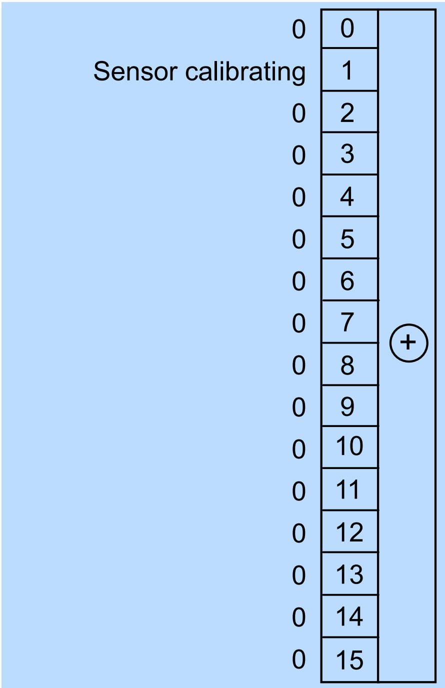


Figure 14-9: Operation calibrating status register

Querying the register:

- STATus:OPERation:CALibrating:CONDition?
- STATus:OPERation:CALibrating[:SUMMary][:EVENt]?

Table 14-10: Used operation calibrating status bits and their meaning

Bit no.	Short description	Bit is set if
1	Sensor calibrating	Sensor is being calibrated.

14.3.8.2 Operation Measuring Status Register

The CONDition register contains information whether a power sensor is measuring. The EVENt register contains information whether a measurement was started or completed since the last query.

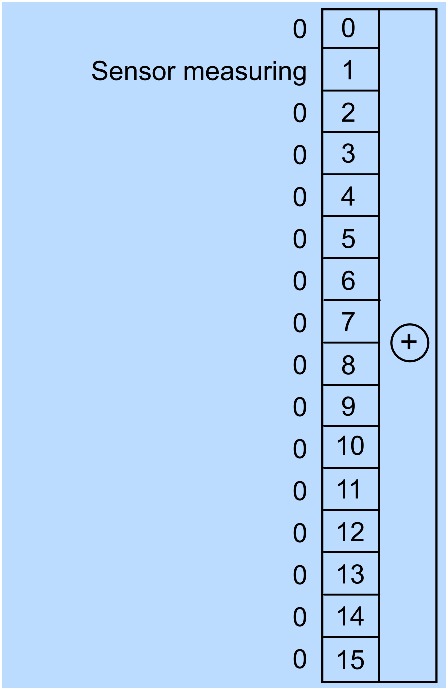


Figure 14-10: Operation measuring status register

Querying the register:

- `STATus:OPERation:MEASuring:CONDition?`
- `STATus:OPERation:MEASuring[:SUMMary][:EVENt]?`

Table 14-11: Used operation measuring status bits and their meaning

Bit no.	Short description	Bit is set if
1	Sensor measuring	Sensor is measuring.

14.3.8.3 Operation Trigger Status Register

The `CONDition` register contains information whether a power sensor is waiting for a trigger event. The `EVENt` register contains information whether the power sensor has been waiting for a trigger event since the last query.

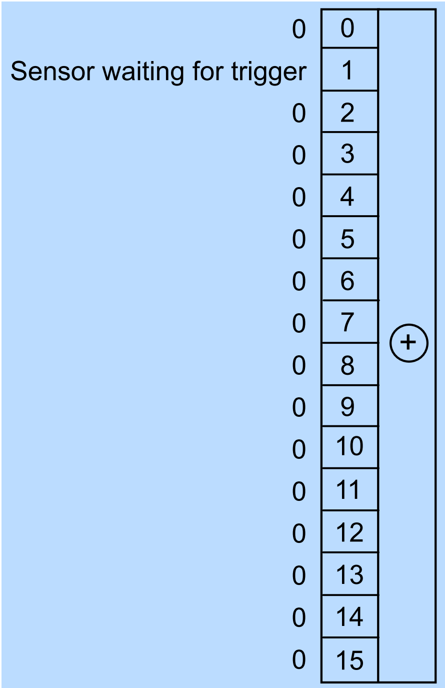


Figure 14-11: Operation trigger status register

Querying the register:

- STATus:OPERation:TRIGger:CONDition?
- STATus:OPERation:TRIGger[:SUMMary][:EVENt]?

Table 14-12: Used operation trigger status bits and their meaning

Bit no.	Short description	Bit is set if
1	Sensor waiting for trigger	Sensor is waiting for a trigger event. When the trigger event occurs, the sensor changes into the measuring state.

15 Troubleshooting

Further information:

- Chapter 6.6, "Potential Sources of Error", on page 45

- Displaying Status Information....200
- Error Messages....200
- Implausible Measurement Results....202
- Performing a Selftest....203
- Problems during a Firmware Update....206
- Cannot Establish a LAN Connection....206
- Contacting Customer Support....207

15.1 Displaying Status Information

Status information is available in several ways.

Status LED of the R&S NRQ6

The position of the status LED is indicated in Figure 4-1.

The meaning of the different colors and blinking frequencies is explained in Chapter 4.2, "Status Information", on page 27.

Title bar of the web user interface

The position of the status icon is indicated in Figure 5-1. The colors are explained in Chapter 4.2, "Status Information", on page 27.

15.2 Error Messages

The meaning of error messages is described in Chapter 15.2.1, "Interpreting the Error Messages", on page 201.

Displaying error messages (web user interface)

► In the web user interface, click the status icon in right corner of the title bar.

In the "Sensor Status Information" dialog, all static and normal errors are listed. Identical errors are displayed only once.

Querying errors (remote control)

In remote control, the commands querying errors are part of `SYSTem`, see Chapter 12.10, "Configuring the System", on page 159.

The severity of the error is distinguished:

- Normal error

Results from, for example, unknown commands or syntax errors and generally affect a single parameter or setting.

- Static error
More severe than a normal error. Prevents the execution of normal measurements.

Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

You can query the error queue using:

- `SYSTem:ERRor:ALL?`
- `SYSTem:ERRor:COUNt?`
- `SYSTem:ERRor[:NEXT]?`

If you want to look only at static errors, use:

- `SYSTem:SERRor?`
- `SYSTem:SERRor:LIST[:NEXT]?`

15.2.1 Interpreting the Error Messages

In the following, important error messages and their meaning are explained. For all other errors, execute a selftest to find out whether it is a hardware or software problem, and report the problem to the R&S customer support. See Chapter 15.4, "Performing a Selftest", on page 203.

Current settings exceed specified operating range....201
LO level out of range....201
Current settings exceed calibration range....201
Insufficient memory....202
ADC overrange....202
Ref PLL not locked....202
Sensor overload....202

Current settings exceed specified operating range
Setting conflict.

Reason: For frequencies below 400 MHz, zero-IF bandwidths above 40 MHz are not supported.

LO level out of range
Can occur when supplying an external local oscillator signal.

Reason: The power of the external local oscillator is too high or too low. Or the frequency is not correct.

Current settings exceed calibration range
For the current settings, not all calibration values are found.

Solution: Check whether the R&S NRQ6 operates out of specification, that means exceeding a resolution bandwidth of 40 MHz at 50 MHz RF frequency.

Insufficient memory
Not enough memory for the current settings.

Solution: Decrease the measurement time or the resolution bandwidth. See also Chapter 7.3.3, "Choosing the Correct Filter Type", on page 54.

ADC overrange
The last acquired measurement contains samples where the ADC range was exceeded and clamped.

Solution: Use 30 dB input attenuation, or reduce the power at the input.

Ref PLL not locked
Locking to the external frequency reference signal failed.

Solution: Adjust the input frequency or REF power level. Or tune the external frequency so that it is inside the permissible range.

Sensor overload
The RF input power exceeds the measurement range by far.

Solution: Reduce the power to prevent permanent damage.

15.3 Implausible Measurement Results

Implausible trace result

Possible solutions:

- Try using "Autoset".
- Try reducing the trace time.
- Check also the subsequent conditions described in the following topics.

Implausible triggering

Observation: It seems that the signal does not reach the trigger level, but the R&S NRQ6 is triggering.

Reason: The samples that are triggering the R&S NRQ6 are not shown in the display because the display decimation averages out short peaks.

Solution: Reduce the trace time (`[SENSe<Sensor>:]TRACe:TIME`) until the trace output (`[SENSe<Sensor>:]TRACe:RLENgth[:CUV]?`) corresponds directly to the samples (`[SENSe<Sensor>:]TRACe:POINts`) used in the trigger.

Implausible results in zero-IF mode

If RBW > 40 MHz.

Observations:

- Large zero offset without input power is applied.
- Constant power level causes oscillation in the trace result.

Reason: DC offset corrupts the result.

Solution: Every time you alter the configuration, before you start the measurement, perform DC zeroing. See also Chapter 9.3.2.2, "DC Zeroing", on page 95.

- Send `CALibration<Channel>:ZERO:AUTO ONCE`.
- If you use the web user interface: On the "Correction" tab, click DC Zeroing.

15.4 Performing a Selftest

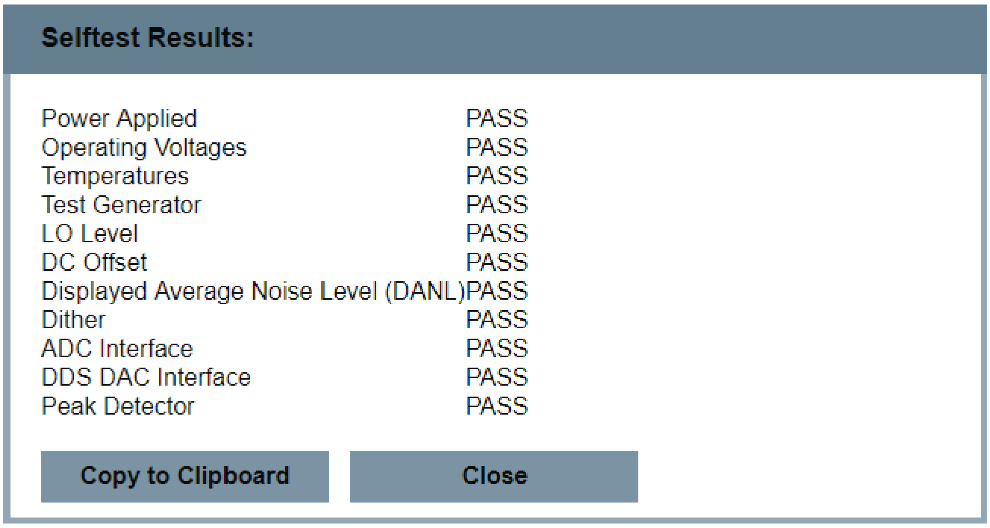
The selftest gives you detailed information that you can use for troubleshooting.

During the selftest, do not apply a signal because this can cause erroneous test results.

Using the web user interface

1. In the navigation pane of the main dialog, select "System".
2. Under "Diagnostics", click "Selftest".

   For each test step, PASS or FAIL is listed. If you need more detailed information, use remote control.



Using remote control

► For a quick check, send `TEST:SENSor?`.

For each test step, PASS or FAIL is listed.

15.4.1 Interpreting the Test Results

If all test steps or parts pass, the overall result is PASS. If one test step or a part of it fails, the overall result is FAIL. What you need to do in this case is described in the following.

Power Applied

Checks whether power (signal) is applied at the input.

If the test fails

► Disconnect the signal source at the input during the selftest.

Operating Voltages

Checks the operating voltages.

If the test fails

1. Disconnect all signal sources and connectors except LAN or USB.
2. Perform the selftest again.

   If it fails again, a hardware defect is probable. Contact the service.

Temperatures

Checks the temperature at several measurement points whether they are plausible and whether the limits are met.

Is the ambient temperature OK?

► Check whether the ambient temperature lies within the range rated in the data sheet of the R&S NRQ6.

  If the ambient temperature is higher or lower, adjust the air conditioning of the room or move the test setup into a room with a fitting temperature.

Are the fan openings obstructed?

1. Check whether the fan opening is obstructed.

   If they are obstructed, clean them with a vacuum cleaner.
2. Ensure that the pollution degree of the environment does not exceed 2.
3. Ensure that the minimum distance between the fan openings and any object is 10 cm.

Is the fan running?

► Check whether the fan is running.

  If it does not run, contact the service.

Test Generator

The R&S NRQ6 has an integrated signal source to verify the absolute calibration.

If the test fails

1. Check whether a signal is applied at the input. See also "Power Applied" on page 204.
2. If no signal is applied or if the test step fails again, contact the service.

LO Level

The R&S NRQ6 has mixer-based concept to detect power. It achieves its high stability by controlling the level of the local oscillator (LO) precisely.

If the test fails

► The uncertainties rated in the data sheet are not granted any more. Contact the service.

DC Offset

Checks the DC offsets of the intermediate frequency (IF) stage.

If the test fails

1. Check whether a signal is applied. An applied signal can influence the accuracy of the measurement.
2. If no signal is applied or if the test step fails again, contact the service.

Displayed Average Noise Level (DANL)

Checks the specified inherent noise of the R&S NRQ6.

If the test fails

1. Check whether a signal is applied.
2. If no signal is applied or if the test step fails again, contact the service.

Dither

The R&S NRQ6 is a highly linear power sensor. To optimize the linearity of the A/D converter, a dither signal is used in certain operating modes. This test step checks whether the dither source works properly.

If the test fails

1. Check whether a signal is applied.
2. If no signal is applied or if the test step fails again, the uncertainties rated in the data sheet are not granted any more. Contact the service.

ADC Interface

Checks the data interface of the A/D converter.

If the test fails

► Contact the service. This error is a critical.

DDS DAC Interface

Checks the data interface of the A/D converter in the signal synthesis of the local oscillator (LO).

If the test fails

► Contact the service. This error is a critical.

15.5 Problems during a Firmware Update

Sensor blinks red after firmware update

The firmware update is described in Chapter 11, "Firmware Update", on page 109.

Firmware update was interrupted

If, for example, a power cut happened during the firmware update, problems can occur.

1. Perform the firmware update again. Sometimes, a further update fixes the problems.
2. If the R&S NRQ6 is not accessible any more, contact the service.

15.6 Cannot Establish a LAN Connection

If you have problems to establish a peer-to-peer connection as described in Chapter 3.6.1.4, "Establishing a Connection", on page 19, try the following measures:

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 R&S NRQ6.
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 R&S NRQ6 with both the default hostname and the hostname extended with `.local`, for example:
   `nrq6-101441`
   `nrq6-101441.local`

15.7 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 15-1: QR code to the Rohde & Schwarz support page

List of Commands

[SENSe<Sensor>:][POWer:][AVG:]APERture 140
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:CLEar 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:COUNt? 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:DATA? 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:SIZE 127
[SENSe<Sensor>:][POWer:][AVG:]BUFFer:STATe 127
[SENSe<Sensor>:]ACLR:ACHannel:SPACing[:ACHannel]? 143
[SENSe<Sensor>:]ACLR:APERture 144
[SENSe<Sensor>:]ADJust[:ALL] 119
[SENSe<Sensor>:]AVERage:COUNt 137
[SENSe<Sensor>:]AVERage:RESet 138
[SENSe<Sensor>:]AVERage:TCONtrol 138
[SENSe<Sensor>:]AVERage:TYPE 139
[SENSe<Sensor>:]AVERage[:STATe] 138
[SENSe<Sensor>:]BANDwidth:INFO? 120
[SENSe<Sensor>:]BANDwidth:RESolution 120
[SENSe<Sensor>:]BANDwidth:RESolution:CUV? 120
[SENSe<Sensor>:]BANDwidth:RESolution:TYPE 121
[SENSe<Sensor>:]BANDwidth:RESolution:TYPE:AUTO[:STATe] 121
[SENSe<Sensor>:]BANDwidth:SRATe 121
[SENSe<Sensor>:]BANDwidth:SRATe:CUV? 122
[SENSe<Sensor>:]BANDwidth:TYPE 139
[SENSe<Sensor>:]BANDwidth:VARiable 122
[SENSe<Sensor>:]CORRection:DCYCle 139
[SENSe<Sensor>:]CORRection:DCYCle:STATe 140
[SENSe<Sensor>:]CORRection:OFFSet 153
[SENSe<Sensor>:]CORRection:OFFSet:STATe 153
[SENSe<Sensor>:]FILTer:DCReject:FCORner 153
[SENSe<Sensor>:]FILTer:DCReject:FCORner:CUV? 153
[SENSe<Sensor>:]FILTer:DCReject[:STATe] 154
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband 155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF:SIDeband:AUTO[:STATe] 155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:IF[:CUV]? 154
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:OUTPut[:STATe] 155
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO:SOURce 156
[SENSe<Sensor>:]FREQuency:CONVersion:MIXer:LO[:CUV]? 155
[SENSe<Sensor>:]FREQuency:TRACk 156
[SENSe<Sensor>:]FREQuency:TRACk:CUV[:STATe]? 156
[SENSe<Sensor>:]FREQuency:TRACk:FREQuency? 157
[SENSe<Sensor>:]FREQuency[:CENTer] 122
[SENSe<Sensor>:]FUNCtion 123
[SENSe<Sensor>:]INPut:ATTenuation 122
[SENSe<Sensor>:]INPut:ATTenuation:AUTO 123
[SENSe<Sensor>:]POWer:NCORrection[:STATe] 154
[SENSe<Sensor>:]ROSCillator:PASSthrough 157
[SENSe<Sensor>:]ROSCillator:REFio:FREQuency 158
[SENSe<Sensor>:]ROSCillator:REFio:OUTPut[:STATe] 158

[SENSe<Sensor>:]ROSCillator:SOURce....158
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[SENSe<Sensor>:]TRACe:DATA?....128
[SENSe<Sensor>:]TRACe:IQ:DATA:FORMat....132
[SENSe<Sensor>:]TRACe:IQ:DATA?....130
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[SENSe<Sensor>:]TRACe:POINts....142
[SENSe<Sensor>:]TRACe:RLENgth[:CUV]?....142
[SENSe<Sensor>:]TRACe:SRATe[:CUV]?....144
[SENSe<Sensor>:]TRACe:TIME....142
[SENSe<Sensor>:]TRACe:TIME:AUTO....143
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*ESE....116
*ESR?....116
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*OPC....117
*OPT?....117
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*SRE....118
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*TRG....118
*TST?....119
*WAI....119
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CALibration:DATA....133
CALibration:DATA:LENGth?....133
CALibration:DATA:PATH<Path>:ABSolute....134
CALibration:DATA:PATH<Path>:REFLection....134
CALibration:PROTocol?....135
CALibration:RECalculate....135
CALibration<Channel>:IQOFfset[:AUTO]....134
CALibration<Channel>:ZERO:AUTO....135
FETCh<Sensor>:ARRay[:POWer][:AVG]?....126
FETCh<Sensor>[:SCALar][:POWer][:AVG]?....126
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FORMat[:DATA]....131
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INITiate:CONTinuous....124
INITiate[:IMMediate]....125
STATus:DEVice:CONDition?....172
STATus:DEVice:ENABle....172
STATus:DEVice:NTRansition....173

STATus:DEVice:PTRansition......173
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STATus:OPERation:CALibrating:CONDition?......172
STATus:OPERation:CALibrating:ENABle......172
STATus:OPERation:CALibrating:NTRansition......173
STATus:OPERation:CALibrating:PTRansition......173
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