R&S®NRP-Z
Power Sensors
Getting Started

ROHDE & SCHWARZ

This manual gives an introduction to the Rohde & Schwarz NRP-Z sensors. It is valid for all types of power sensors, for the level control sensors and the power sensor modules.

Quality management and environmental management

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde & Schwarz ist unter anderem nach den Managementsystemen ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet

ı Energie-effiziente, RoHS-konforme Produkte
ı Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
ı ISO 14001-zertifiziertes Umweltmanagementsystem

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ı Energy-efficient products
ı Continuous improvement in environmental sustainability
ı ISO 14001-certified environmental management system

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Engagement écologique

ı Produits à efficience énergétique
ı Amélioration continue de la durabilité environnementale
ı Système de management environnemental certifié selon ISO 14001

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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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Contents

1   Welcome to the R&S NRP-Z Power Sensors

Power measurements performed with the R&S NRP-Z power sensors can be evaluated in various ways. This manual gives a short introduction to the solutions offered by Rohde & Schwarz for viewing your power measurement results. Additionally you can find a description of how to set up and perform a basic power measurement with your power sensor.

You can view the results of your measurement on:

● A PC/laptop

● An R&S NRP2 base unit

● A supported Rohde & Schwarz instrument

● An Android 4.x device

Using the R&S NRP-Z power sensors with a PC/laptop

Different software solutions are offered for the use of the power sensors with a PC/laptop:

● **R&S NRP Toolkit** (obligatory)
 The R&S NRP Toolkit is a free software kit, which is provided with the documentation CD-ROM. For viewing your measurement results it contains:
 – **R&S Power Viewer**
 The R&S Power Viewer is a basic tool for viewing the result of a continuous average measurement. It can be used with one power sensor at a time.
 – **R&S Power Viewer Plus**
 The R&S Power Viewer Plus is a free software that supports all measurement modes and can perform mathematical calculations during measurements. It can be used with one power sensor at a time.

● **R&S NRPV virtual power meter** (optional)
 The R&S NRPV is a cost-effective measurement solution that can be used as a replacement for the R&S NRP2 base unit. It supports all measurement modes and can perform different mathematical calculations during measurements. It can be used with up to four power sensors simultaneously.

Using the R&S NRP-Z power sensors with an Android device

Additionally you can connect the power sensors to an Android device and view the results with the free of charge R&S Power Viewer Mobile App, see chapter 8, "Using the Power Sensors with an Android Device", on page 38.

Using the R&S NRP-Z power sensors with an R&S NRP2 or a compatible Rohde & Schwarz instrument

A short overview of the usage of the power sensors with the R&S NRP2 base unit or a compatible Rohde & Schwarz instruments is given in this manual. For more information on this usage, refer to the operating manual of the corresponding Rohde & Schwarz instrument.

Overview of the NRP-Z sensor types

The R&S NRP-Z sensors are highly accurate standalone measuring instruments that offer all the functionality of conventional power meters, and more, within the small housing of a power sensor. With a high dynamic range and automatic error correction the different types of R&S NRP-Z sensors are suitable for nearly every measurement task:

●   The **three-path power sensors** with patented three-path technology can be used in many applications, thanks to their wide dynamic and frequency range. The sensors feature high measurement accuracy independent of the modulation type and speed and offer a wide range of functions.

●   The **two-path power sensors** with slightly modified dynamic range and performance are a cost-effective solution ideal for production applications.

●   The **wideband power sensors** with high video bandwidth that permits accurate time-domain analysis of the envelope power. Analysis is fast and easy thanks to additionally integrated measurement functions such as automatic pulse analysis.

●   The **thermal power sensors** with outstanding measurement accuracy. They are the first choice for power measurements in the frequency range from DC to 110 GHz as performed in calibration labs, where measurement accuracy is the key requirement.

●   The **average power sensors** were specially developed for EMC applications and cover the required frequency range from 9 kHz to 6 GHz.

●   The **level control sensors** with an integrated splitter that can split the signal into two parts of equal power. This allows you to feed power to a device under test (DUT) and monitor the power at the same time.

● The **power sensor modules** were developed for level calibration using the R&S FSMR measuring receiver.

You can find an overview of the available sensors and filter according to your requirements on the Rohde & Schwarz web page:

http://www.rohde-schwarz.com/campaigns/en/power_sensors/.

2   Documentation Overview

You can find additional information about the usage of the R&S NRP-Z power sensors on the Rohde & Schwarz website and on the delivered documentation CD.

The user documentation delivered with the R&S NRP-Z power sensors consists of the following parts:

- Printed Getting Started
- Documentation CD-ROM with:
    - Getting Started
    - Operating manuals of the different power sensor types
    - Data sheet and product brochure
    - A selection of related application notes
    - Links to useful sites on the Rohde & Schwarz website

Getting Started

This manual is delivered with the R&S NRP-Z power sensors in printed form and in PDF format on the documentation CD-ROM. It provides the information required to start working with the power sensors. Basic operation and typical setup examples are described.

Operating Manual

The operating manuals for all types of R&S NRP-Z power sensors are available in PDF format on the documentation CD-ROM delivered with the power sensors. In these manuals, all power sensor type specific functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands.

Internet

On the Rohde & Schwarz website you can find all available documentation for your R&S NRP-Z power sensor. Additionally, there are several application notes available. You can also download the latest version of the available firmware and software.

3   Preparing for Use

This section describes the basic steps to be taken when setting up the R&S
NRP-Z power sensors for the first time.

NOTICE

Risk of instrument damage

Note that the following instructions and the general safety instructions con-
tain information on operating conditions that prevent damage to the instru-
ment. The instrument's data sheet may contain additional operating condi-
tions.

NOTICE

Risk of electrostatic discharge

Protect the work area against electrostatic discharge to avoid damage to
electronic components in the modules. For details, refer to the general
safety instructions.

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can cause damage to the power
sensor and to connected devices. Ensure the following operating condi-
tions:

● The power sensor is dry and shows no sign of condensation.
● The power sensor is connected as described in the following sections.
● 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 correctly connected and are not overloaded.

3.1   EMI Suppression

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated electromagnetic interference:

● Use suitable shielded cables of high quality. For example use double-shielded RF cables.

● Always terminate open cable ends.

● Note the EMC classification in the data sheet.

3.2   Unpacking and Checking the Instrument

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

> **Packing material and transportation**
> Always make sure that sufficient mechanical and electrostatic protection is provided when transporting the power sensors.

3.3   Connectors of the R&S NRP-Z Power Sensors

An R&S NRP-Z power sensor has two connectors, see figure 3-1:

● A host connector of Lemo type (1) for connecting the power sensor to other Rohde & Schwarz products.
You can connect this host connector to the following Rohde & Schwarz products:

  – For a connection to a PC, an R&S NRP-Z3/R&S NRP-Z4 USB adapter and an R&S NRP-Z5 sensor hub

  – An R&S NRP2 power meter base unit

  – A compatible Rohde & Schwarz instrument

- An RF connector (2) for connecting the power sensor to a Device Under Test (DUT) or a signal generator.
  Caused by their different frequency ranges, the R&S NRP-Z power sensors have different RF connectors. Additionally, for maximal measurement accuracy, the RF connector must be tightened using a torque wrench with a specific nominal torque.
  Refer to the operating manual of your R&S NRP-Z power sensor for information on your connector and the allowed nominal torque.

Fig. 3-1: Connectors of an R&S NRP-Z power sensor

1 = Host connector
2 = RF connector

3.4   Connecting the R&S NRP-Z Power Sensors

ℹ️ Additional requirements must be fulfilled when connecting the R&S NRP-Z27/-Z28/-Z37/-Z98 sensors. Refer to the operating manual of the corresponding sensor for a description on how to connect it.
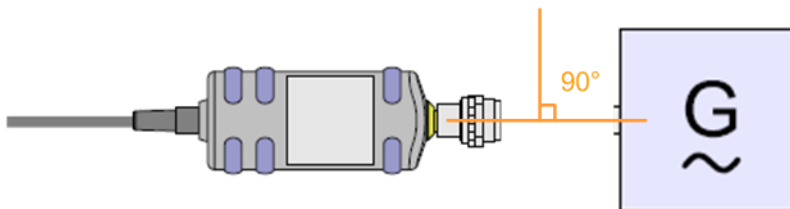
Connecting the RF connector of the R&S NRP-Z power sensors

NOTICE

Risk of damage to the center pin of the RF connector

When connecting the power sensor always rotate only the hex nut of the RF connector. Do not rotate the sensor itself because this may damage the center pin of the connector.

1. Refer to the operating manual of your R&S NRP-Z power sensor to find out what kind of RF connector your sensor has and the recommended nominal torque.

2. Keep the RF connector perpendicular and insert it into the RF output of your DUT.

3. To ensure a maximal measurement accuracy, tighten the RF connector using a torque wrench with the recommended nominal torque (see the operating manual of your power sensor).

Connecting the host connector of the R&S NRP-Z power sensors

To connect the power sensor to an R&S NRP-Z3 or an R&S NRP-Z4 adapter:

► Rotate both cables, so that the red markings on the sleeves of both of them are at the same position and then insert the host connector of your sensor into the connector of your USB adapter.

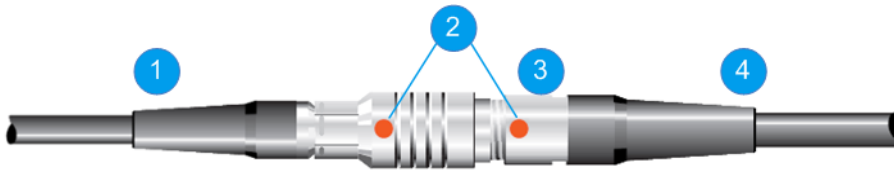*Fig. 3-2: Connecting the host connector*

1 = R&S NRP-Z4 adapter
2 = Red marking
3 = Host connector
4 = R&S NRP-Z power sensor

To connect the power sensor to an Rohde & Schwarz instrument or to an R&S NRP-Z5 sensor hub:

► Insert the host connector, red marking upwards, into the SENSOR connector of your instrument/sensor hub.

3.5   Disconnecting the R&S NRP-Z Power Sensors

Additional requirements must be fulfilled when disconnecting the R&S NRP-Z27/-Z28/-Z37/-Z98 sensors. Refer to the operating manual of the corresponding sensor for a description on how to disconnect it.

Disconnecting the RF connector of the R&S NRP-Z power sensors

NOTICE

Risk of damage to the center pin of the RF connector

When disconnecting the power sensor always rotate only the hex nut of the RF connector. Do not rotate the sensor itself because this may damage the center pin of the connector.

► Carefully loosen the screw at the front of the sensor's RF connector and then remove the sensor.

Disconnecting the host connector of the R&S NRP-Z power sensors

To disconnect the host connector of your power sensor from an R&S NRP-Z3 or an R&S NRP-Z4 adapter:

► Pull at the host connector (figure 3-2 (3)) to disconnect it from the connector of the USB adapter.

To disconnect the host connector of your power sensor from an Rohde & Schwarz instrument or from an R&S NRP-Z5 sensor hub:

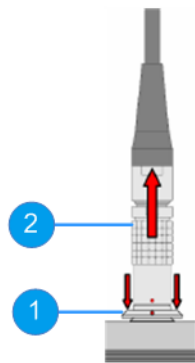► Press down the ring of the built-in plug (1) and pull off the cable sleeve (2) at the same time.

Fig. 3-3: Disconnecting the host connector

1 = Ring of the built-in plug
2 = Cable sleeve

4 Using the Power Sensors with the R&S NRP Toolkit

Depending on the operating system in use you can use your power sensor with different software solutions:

- R&S Power Viewer (Microsoft Windows)
- R&S Power Viewer Plus (Microsoft Windows , Linux and Mac OS X)
- R&S NRPV Virtual Power Meter (Microsoft Windows)

Before you start using the power sensors with a software solution, you have to install the R&S NRP Toolkit. The R&S NRP Toolkit is provided on your documentation CD-ROM and on the Rohde & Schwarz website. The contents of the toolkit depend on your operating system, see chapter 4.1, "Software Installation", on page 15 for more details.

To ensure that your power sensor is recognized properly by your system, first install the R&S NRP Toolkit on your laptop/PC and then connect your power sensor for the first time.

4.1 Software Installation

This section outlines the system requirements and the process of installing the R&S NRP Toolkit on various platforms.

4.1.1 System requirements

Hardware requirements

The following hardware requirements must be fulfilled:

- Desktop PC or laptop, or an Intel-based Apple Mac
- Keyboard and optionally mouse
- USB 1.1 or 2.0 interface
- R&S NRP-Z3 or R&S NRP-Z4 USB adapter or R&S NRP-Z5 sensor hub

Supported operating systems

You can install the R&S NRP Toolkit on the following operating systems:

- Microsoft Windows XP 32-Bit
- Microsoft Windows 7 32/64-Bit
- Microsoft Windows 8 32/64-Bit
- 32/64-Bit Linux distribution with kernel ≥ 2.6.x , e.g. Ubuntu 12.4 LTS x86, SuSe 12.3. Drivers for other distributions may be available on request.
- Mac OS X

Powering the R&S NRP-Z power sensors

The R&S NRP-Z power sensors can be powered in two ways:

- Self-powered from a separate power supply via the active USB adapter R&S NRP-Z3 or the sensor hub R&S NRP-Z5
- Bus-powered from the PC or a USB hub with its own power supply (self-powered hub) via the active USB adapter R&S NRP-Z3 or via the passive USB adapter R&S NRP-Z4
  Requirements for the usage in the bus-powered mode:
  – A laptop/PC with self-powered USB hub **and**
  – Total available current per USB port of 500mA

4.1.2   Installing the R&S NRP Toolkit on a Windows PC

The R&S NRP Toolkit installer version for Windows-based systems contains the following components:

- USB Driver (obligatory)
- R&S NRP Toolkit (optional)
- R&S Power Viewer Plus and its PDF manual (optional)

Additionally the R&S NRP Toolkit contains the following components:

- Power Viewer: virtual power meter
- R&S Power Viewer Plus: program for performing complex measurements with the power sensor
- Terminal: low level communication program for sending commands to the power sensor

● Firmware Update: program module for updating the firmware of the power sensor

● Update S-Parameters: program modules for loading an S-parameter table into the sensor

To install the R&S NRP Toolkit

1. Start the R&S NRP Toolkit installer.

2. Accept the license terms in order to continue with the installation.

3. In the "Choose Components " window, select the components you want to install.
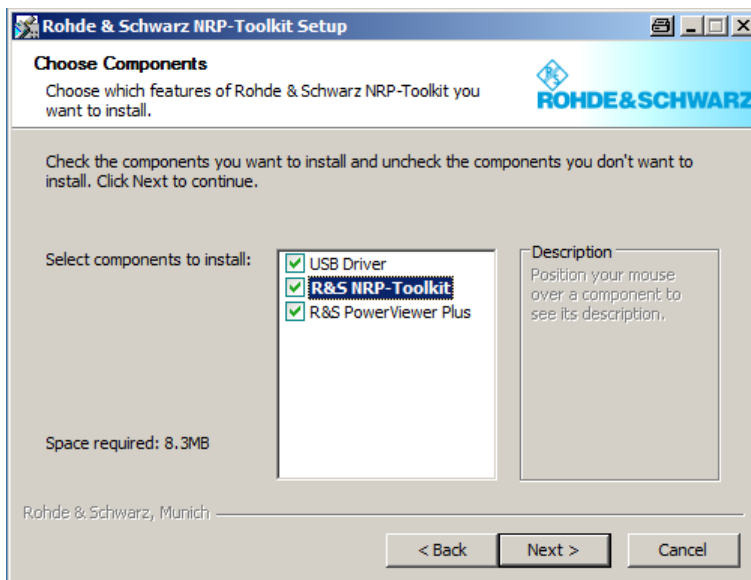
a) If you install the R&S NRP Toolkit for the first time, select the "USB Driver".
If a previous R&S NRP Toolkit installation is found, the installer may offer an option to update the drivers. In case of previous installation problems it is recommended that you enable the USB driver update.
b) Enable the R&S NRP Toolkit (optional).
c) Enable the R&S Power Viewer Plus (optional).

4. Click "Next" and complete the installation process.

The installation process is completed.

4.1.3   Installing the R&S NRP Toolkit on a Linux-Based System

In order to run the R&S NRP Toolkit installer, your Linux-based system must contain the following tools and packages:

● Dialog, base64, tar, gcc
● (On amd64 systems only) ia32-libs
● Kernel modules under `/lib/modules/<version>`
● Kernel headers under `/usr/include/linux`

The R&S NRP Toolkit installer version for Linux contains the following components:

● Kernel module **nrpzmodule**
● Low-level driver **nrplib**
● VXI PnP driver RsNrpZ **rsnrpz**
● HTML help files for the VXI PnP driver
● Power Viewer Plus and its PDF manual
● Example programs for use with VXI PnP driver

To install the R&S NRP Toolkit

1. Run the R&S NRP Toolkit installer with root user permissions:
   `# sudo ./NrpLinuxPckg_<date>.run`

   The self-extracting archive extracts its content to a temporary directory under `/tmp` and then transfers control to the installation script in this directory.
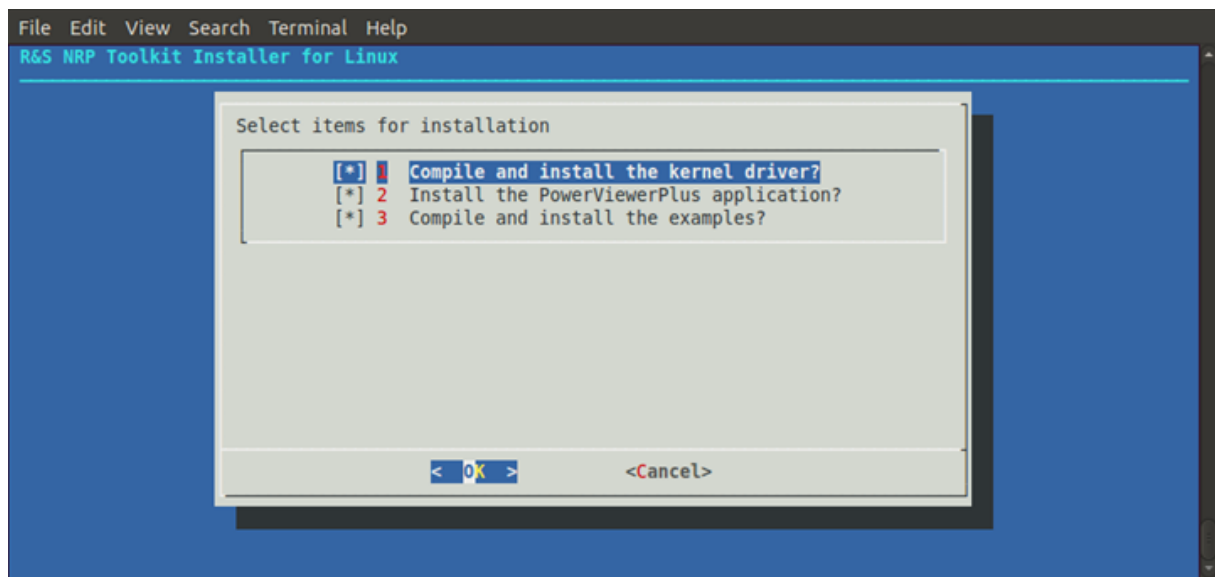
2. Confirm the start of the installation process.
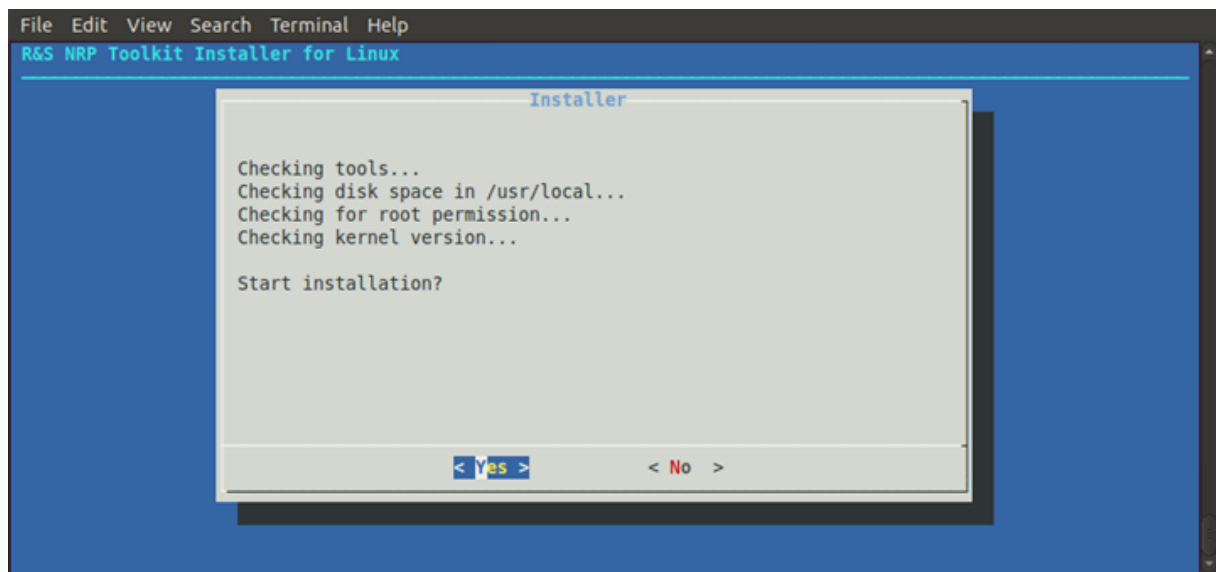
3. Accept the license terms in order to continue with the installation.
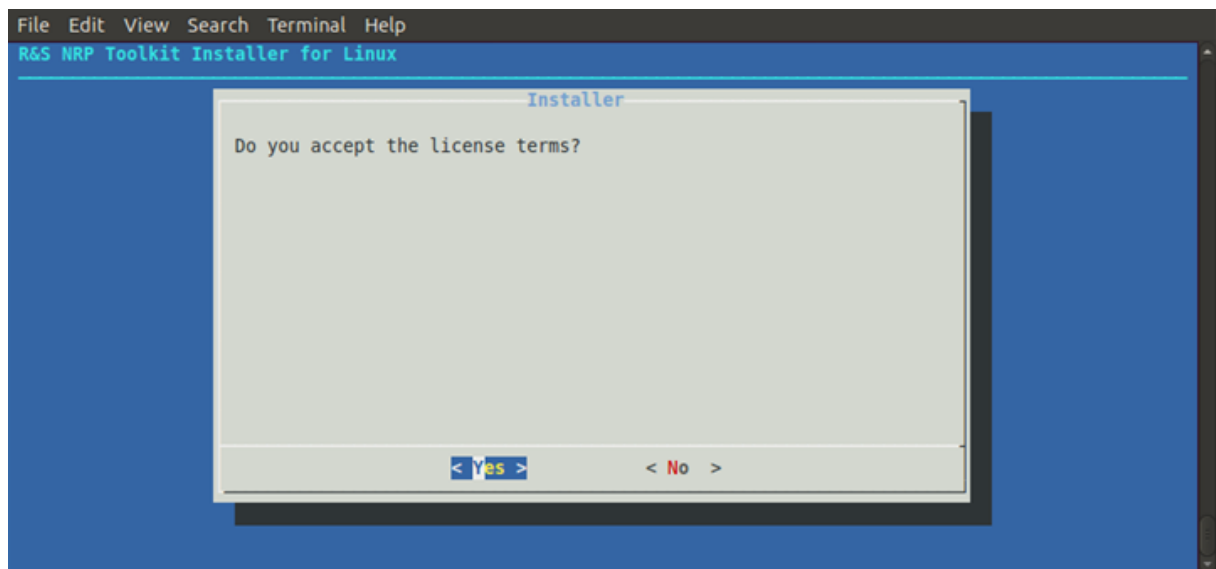
4. Select the components you want to install.

a) Enable "Compile and install the kernel driver".
b) Enable the installation of the R&S Power Viewer Plus (optional)
c) Enable "Compile and install the examples" (optional)

The installation process is completed.
If you install the examples, they will be stored in `/usr/local/src`.

4.1.4   Installing the R&S NRP Toolkit on a Mac OS X

The R&S NRP Toolkit installer version for Mac OS X contains the following components:

● Low-level driver **RsNrpLib.framework**

● VXI PnP driver **RsNrpz.framework**

● HTML help files for the VXI PnP driver

● Power Viewer Plus and its PDF manual

● Example programs for use with VXI PnP driver

To install the R&S NRP Toolkit

1. In the Mac OS X Finder double-click the provided .dmg disk image to mount it.

2. Double-click the NrpToolkit.mpkg installer to start the installation and then follow the instructions.
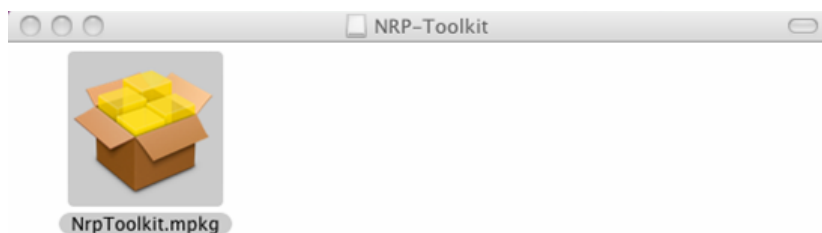
The R&S NRP Toolkit installer opens. The welcome message gives an overview of the packages that are part of the installer and indicates their default installation location.
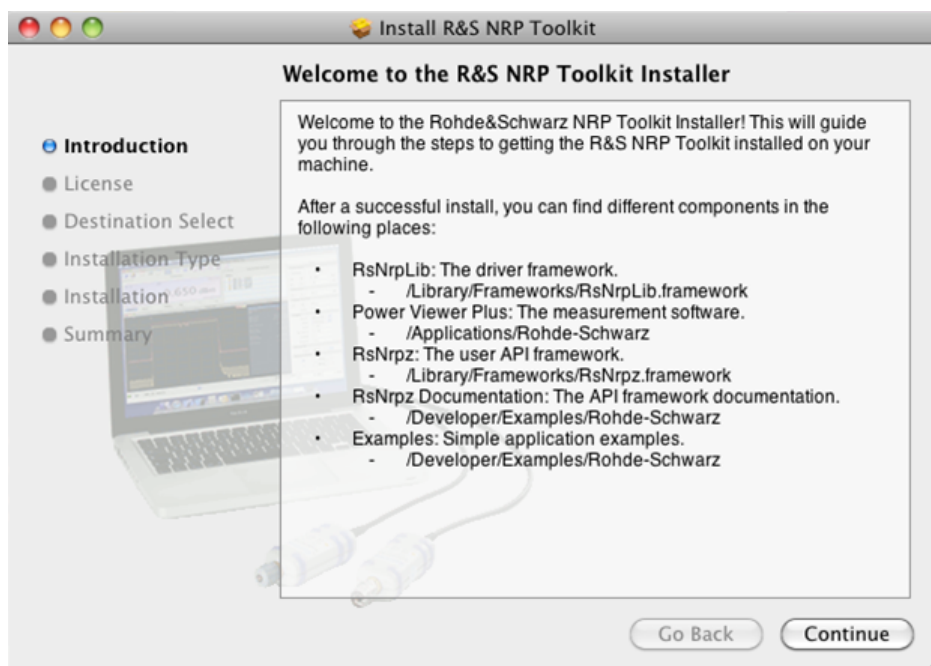
3. Accept the license terms in order to continue with the installation.

4. Select the components you want to install and click "Continue" to complete the installation process.
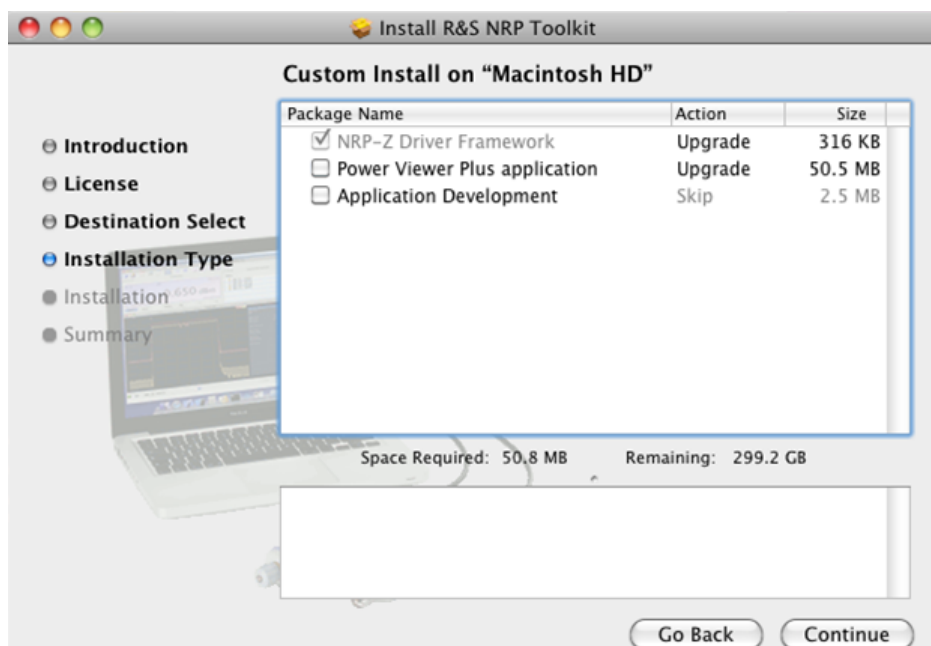
a) NRP-Z Driver Framework (obligatory).

b) Enable the "Power Viewer Plus application" (optional).

c) Enable "Application Development" (optional). You can use this examples as starting points for your own implementations.

5. Click "Continue" and complete the installation process.

After a successful installation, you can start the applications provided with the R&S NRP Toolkit from the `Rohde-Schwarz` folder that was created in the Mac OS X application directory.

4.2   R&S Power Viewer

The R&S Power Viewer is a virtual power meter that uses a subset of the sensor's functions to measure the average power of the signal. It can be used with only one sensor at a time.

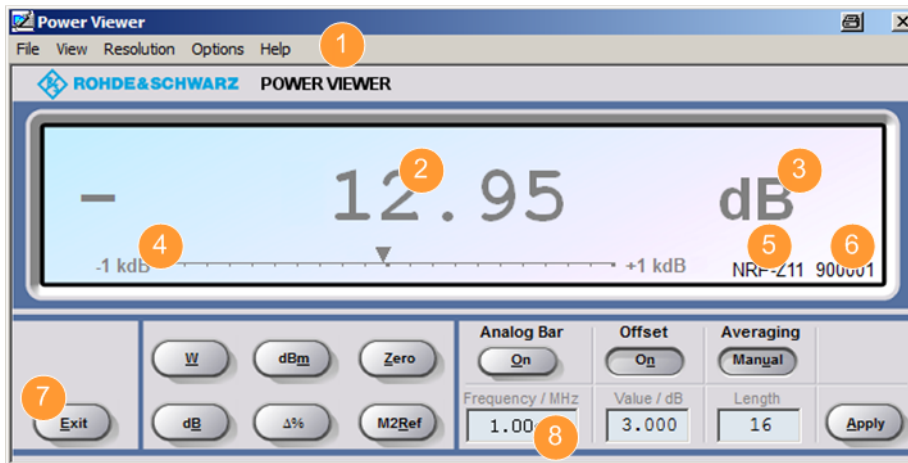The R&S Power Viewer program window is displayed in figure 4-1.

Fig. 4-1: R&S Power Viewer window

1 = Menu bar
2 = Measured value
3 = Unit
4 = Analog bar
5 = Product
6 = Serial number of the R&S NRP-Z power sensor
7 = Button
8 = Entry field

The program window contains a menu bar, a result display window, buttons and entry fields. For an explanation of the functions of the buttons and entry fields refer to table 4-1 and table 4-2.

Table 4-1: R&S Power Viewer buttons

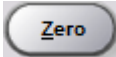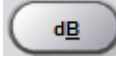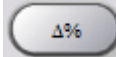| Button	Function	Key Combination
Exit	Terminates the program. The current settings are saved and recalled the next time the program is started.	Alt + E
W	Selects Watt as the display unit.	Alt + W
dBm	Selects dBm as the display unit.	Alt + M
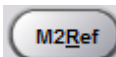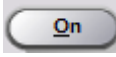
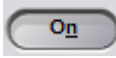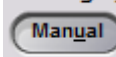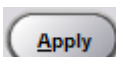| Button	Function	Key Combination
Zero	Zeroes the sensor.	Alt + Z
dB	Selects dB as the display unit. This is the log of the ratio of the measured value to the reference value.	Alt + B
Δ%	Selects % as the display unit. The difference between the measured value and the reference value is expressed as a percentage.	Alt + %
M2Ref	Makes the current measured value the reference value for the relative display units dB and %.	Alt + R
Analog Bar On	Enables/disables the analog bar	Alt + O
Offset On	Turns the offset correction for the sensor on or off. If the offset correction is Off, the "Offset/dB" entry field has a grey background.	Alt + N
Averaging Manual	Turns auto-averaging on or off. When auto-averaging is on, the "Length" entry field has a grey background; the current averaging factor is displayed.	Alt + U
Apply	Accepts edited numerical values in the "Frequency/Hz", "Value/dB "and "Length" entry fields and transfers them to the sensor.	Alt + A or Alt + Enter key

Table 4-2: R&S Power Viewer entry fields

Entry Field	Range	Available for	Description
Frequency/ MHz	-	-	Frequency of the RF carrier in Megahertz (MHz).
Value/dB	-100 to 100	"Offset > On"	Attenuation in dB of a possible two port device connected to the sensor.
Length	1 to 65536	"Averaging > Manual"	Length of the averaging filter (= averaging factor).

For a description of all functions available under the "Menu bar" of the R&S Power Viewer, refer to the operating manual of your R&S NRP-Z power sensor.

4.3   R&S Power Viewer Plus

The R&S Power Viewer Plus is a software that simplifies many measurement tasks. It can be downloaded as part of the R&S NRP Toolkit.

For a detailed description of how to perform different measurements with the R&S Power Viewer Plus refer to its operating manual. The manual is installed automatically during the installation of the R&S Power Viewer Plus.

4.4   Remote Control

The R&S NRP-Z power sensors can be remotely controlled which enables their integration into custom automatic test equipment (ATE) systems. The latest version of the available instrument drivers is available on the Rohde & Schwarz website.

For a detailed description of how to perform different remote measurements refer to the application note "1GP69: R&S®NRP-Z Power Sensor Programming Guide". Additionally you can find a description of the remote SCPI commands in the operating manual of your R&S NRP-Z power sensor.

4.5   Using the Power Sensors with a Passive USB Adapter

The R&S NRP-Z power sensors can be used with the R&S NRP-Z4 for power measurements where no external triggering is required.

Required equipment:

- An R&S NRP-Z power sensor
- An R&S NRP-Z4 passive USB adapter
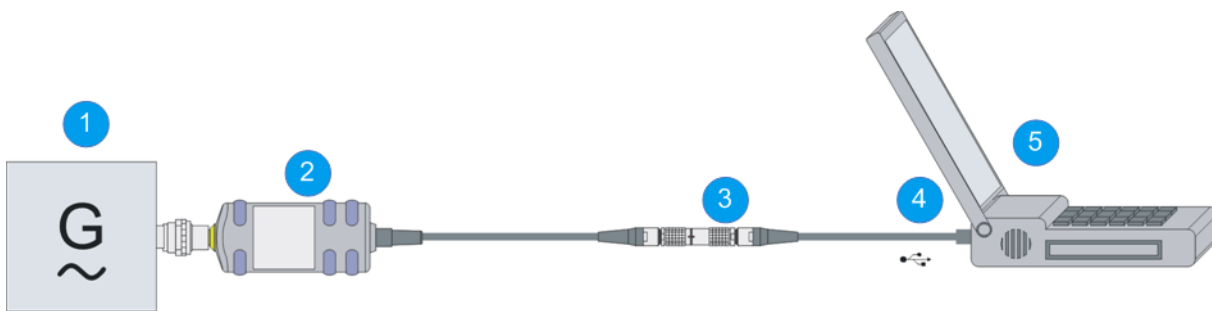- A PC with installed NRP-Toolkit (refer to chapter 4.1, "Software Installation", on page 15)

Fig. 4-2: Configuration with a passive USB adapter

1 = Signal source
2 = R&S NRP-Z power sensor
3 = R&S NRP-Z4
4 = USB connector
5 = PC with a USB interface

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

Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

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1. Connect the cables as shown in figure 4-2:
   a) Connect the R&S NRP-Z4 passive USB adapter to the power sensor.
   b) Connect the power sensor passive USB adapter to the computer.
   c) Connect the power sensor to the signal source.

2. On the computer start the R&S Power Viewer software.

   The result of the measurement is displayed on the screen.

4.6   Using the Power Sensors with an Active USB Adapter

The R&S NRP-Z power sensors can be used with the R&S NRP-Z3 for power measurements where an external power supply or external triggering is required.

Required equipment:

- An R&S NRP-Z power sensor
- An R&S NRP-Z3

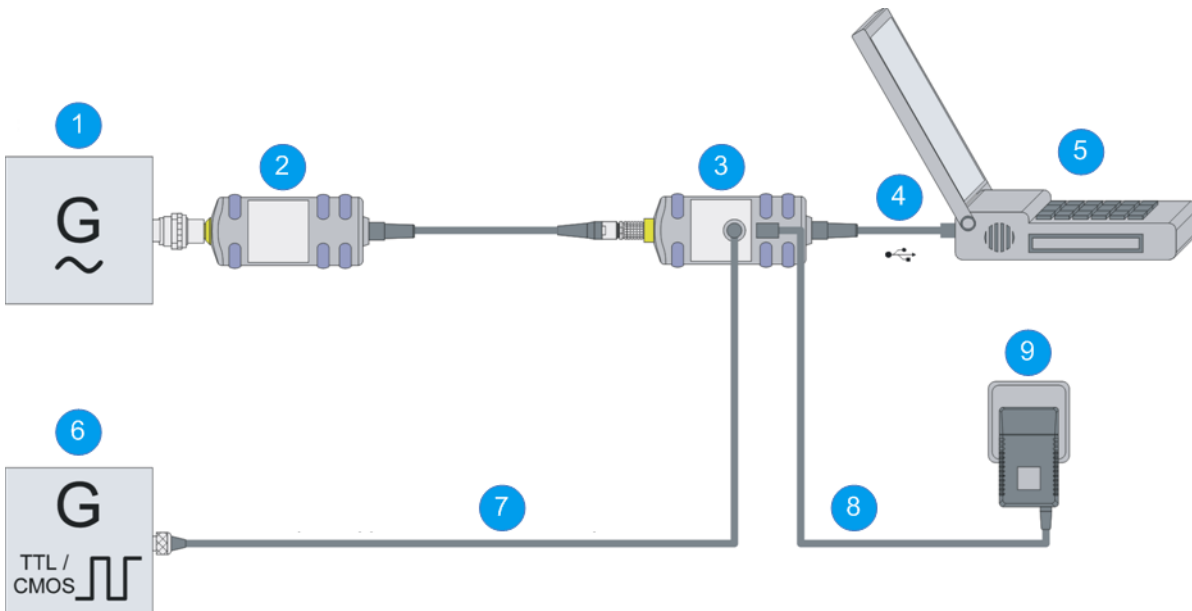● A PC with installed NRP-Toolkit (refer to chapter 4.1, "Software Installation", on page 15)

Fig. 4-3: Configuration with an active USB adapter

1 = Signal source
2 = R&S NRP-Z power sensor
3 = R&S NRP-Z3
4 = USB connector
5 = PC with a USB interface
6 = Trigger source (optional)
7 = BNC cable (optional, not supplied)
8 = Plug-in power supply (optional, supplied)
9 = AC supply connector (optional)

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

Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

1. Connect the cables as shown in figure 4-3:

   a) Connect the R&S NRP-Z3 active USB adapter to the power sensor.
   b) Connect the power sensor passive USB adapter to the computer.
   c) Connect the power sensor to the signal source.

d) Connect the R&S NRP-Z3 with a BNC cable to the trigger source (optional).

e) Connect the delivered plug-in power supply to the R&S NRP-Z3 and to an AC supply connector (optional).

2. On the computer start the R&S Power Viewer software.

The result of the measurement is displayed on the screen.

4.7   Using the Power Sensors with a Sensor Hub

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

Required equipment:

- An R&S NRP-Z power sensor
- An R&S NRP-Z5 sensor hub
- A power supply
- A PC with installed NRP-Toolkit (refer to chapter 4.1, "Software Installation", on page 15)
- A through-wired trigger bus (optional)
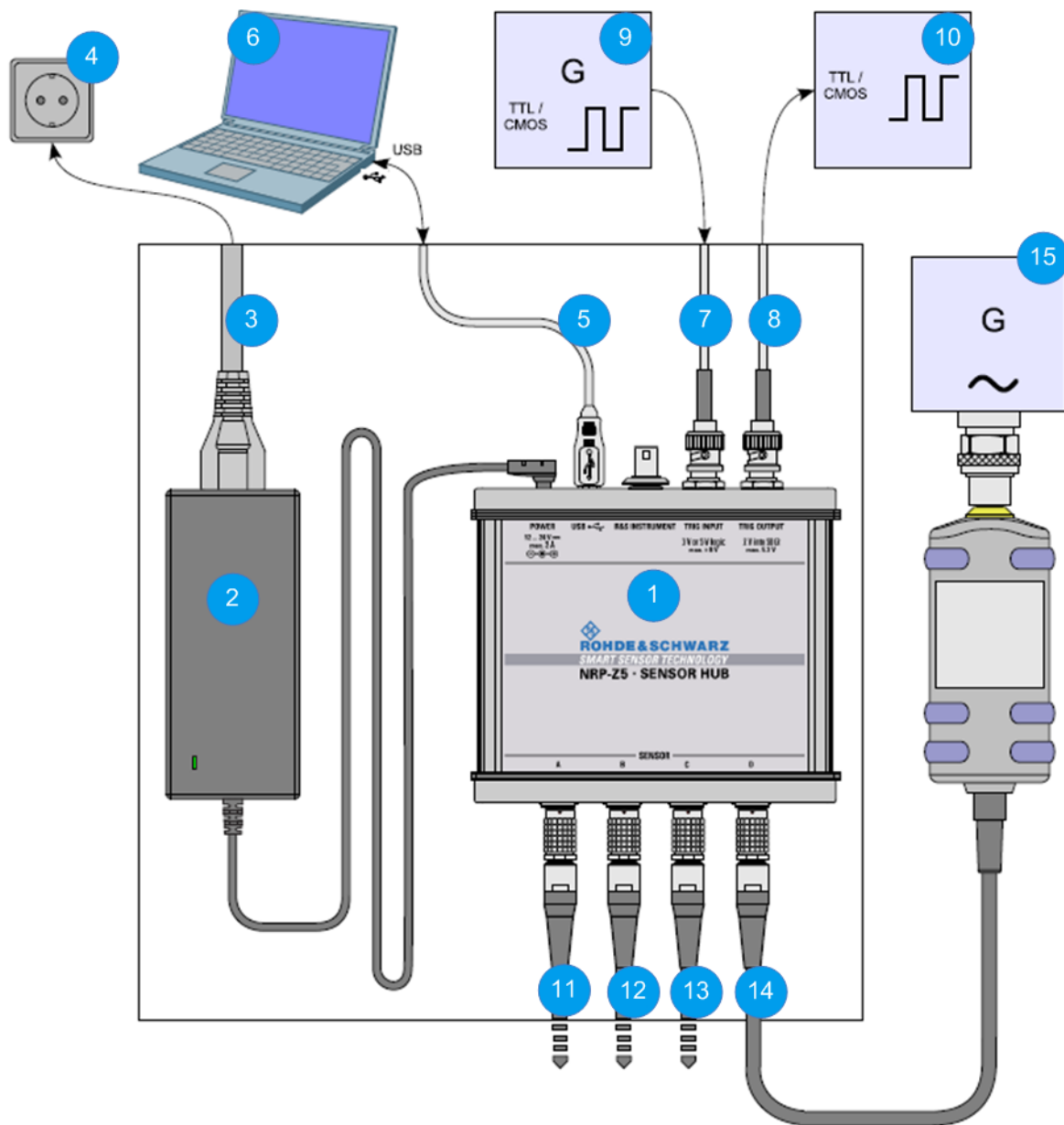- A trigger input and trigger output via BNC sockets (optional)

Fig. 4-4: Configuration with an R&S NRP-Z5 sensor hub

1   = R&S NRP-Z5 sensor hub
2   = External power supply unit (supplied)
3   = Power cable (supplied)
4   = AC power supply
5   = USB cable (supplied)
6   = PC with USB host interface
7,8   = BNC cable (optional, not supplied)
9   = Trigger source (optional)
10   = Triggered device (optional)
11-14 = R&S NRP-Z power sensor
15   = Signal source

> ℹ️ Incorrectly connecting/disconnecting the R&S NRP-Z power sensors may damage the power sensors or lead to erroneous results.
>
> Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

1. Connect the cables as shown in figure 4-4:

   a) Connect the power sensors to the R&S NRP-Z5 sensor hub. You can connect up to four sensors.
   b) Connect the R&S NRP-Z5 to the computer.
   c) Connect the power sensors to the signal source.
   d) Connect the delivered external power supply unit to the R&S NRP-Z5 and to an AC supply connector.
   e) Connect the R&S NRP-Z5 with a BNC cable to the trigger source (optional).
   f) Connect the R&S NRP-Z5 with a BNC cable to the trigger device (optional).

2. On the computer start the R&S Power Viewer software.

   The result of the measurement is displayed on the screen.

5   Using the Power Sensors with the R&S NRPV

With the R&S NRPV you can perform power measurements in all available modes. Additionally you can use up to four power sensors simultaneously.

The R&S NRPV software can be installed on any Windows PC. To make a full use of its functionalities you must activate your R&S NRP-Z power sensor with a license key. Then you can use your power sensor on any laptop/PC with an installed software.

Required equipment:

● An R&S NRP-Z power sensor

● An R&S NRP-Z3, or an R&S NRP-Z4 or an R&S NRP-Z5

● A PC with installed R&S NRPV (refer to the operating manual of the R&S NRPV for a description of the installation process)

● A license key (R&S NRPZ-K1 option) for activating the power measurements for your R&S NRP-Z power sensor
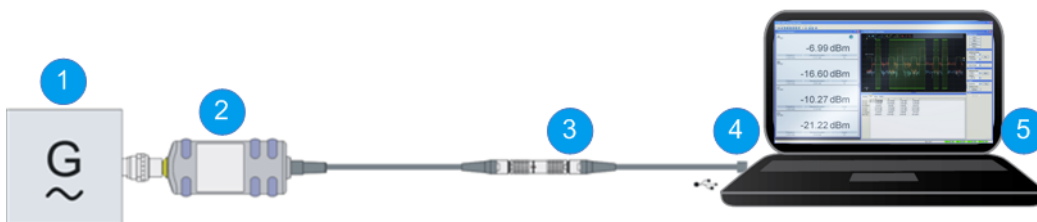

Fig. 5-1: Configuration with an R&S NRP-Z4 and an R&S NRPV

1 = Signal source
2 = R&S NRP-Z power sensor
3 = R&S NRP-Z4
4 = USB connector
5 = PC with installed R&S NRPV

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

Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

1. On the PC start the R&S NRPV software.

2. Connect the power sensor to the PC. For a detailed description, refer to chapter 4, "Using the Power Sensors with the R&S NRP Toolkit", on page 15.

3. If you use the power sensor for the first time with the R&S NRPV software, activate the sensor. You need a license key for the activation.

    a) In the "File" menu, select "File > Licensing".
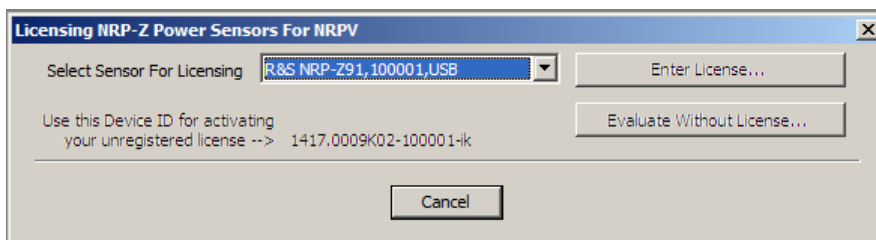   The "Licensing NRP-Z Power Sensors for NRPV" dialog opens.

Fig. 5-2: Licensing R&S NRP-Z power sensor for R&S NRPV dialog

    b) Select your power sensor.
    c) Select "Enter License".
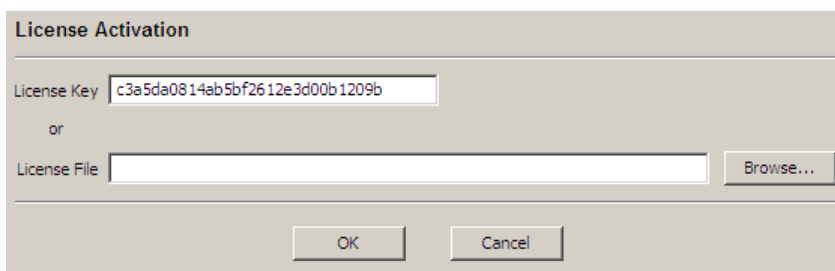   The "License Activation" dialog opens.

Fig. 5-3: License Activation dialog

    d) Enter the license key either manually or with the key code file.
    e) Confirm with "OK" to return to the "Licensing NRP-Z Power Sensors for NRPV" dialog. The dialog indicates all currently connected sensors.

Note: If you want to evaluate the R&S NRPV before buying a license for your power sensor you can activate a sensor for temporary use. To do so click on

"Evaluate Without License" in the "Licensing R&S NRP-Z power sensor for R&S NRPV" dialog (see figure 5-2). For a detailed description, refer to the operating manual of the R&S NRPV.

4. Switch on the test signal of the signal source.

5. To start a continuous measurement, select "Measure > Continuous".

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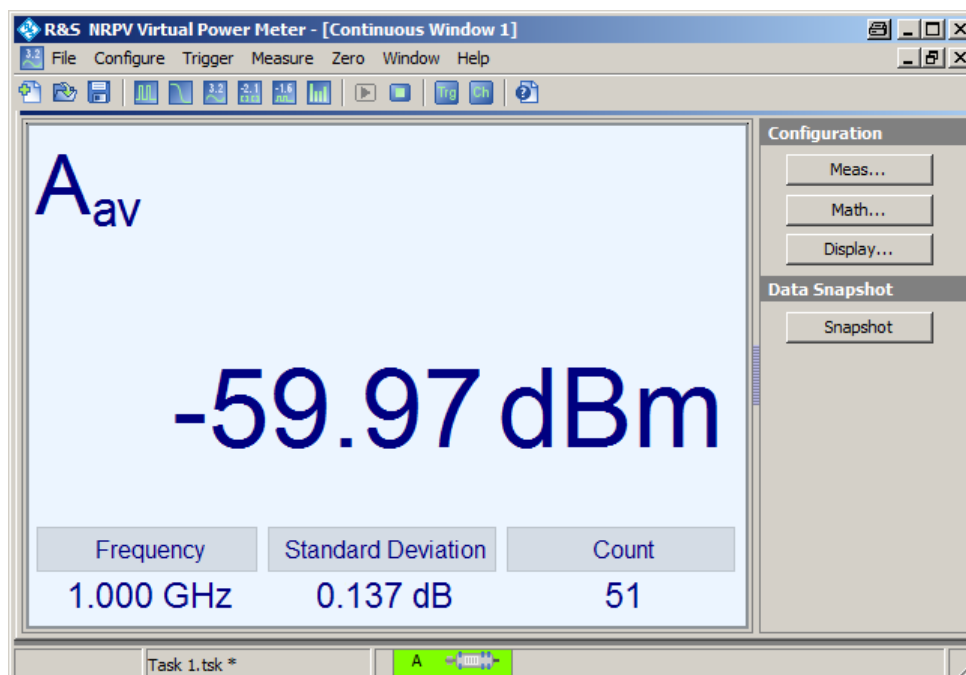

Fig. 5-4: Continuous window

For a detailed description of how to perform different measurements in this setup refer to the operating manual of your R&S NRPV.

6   Using the Power Sensors with an R&S NRP2

With the R&S NRP-Z power sensors and an R&S NRP2 you can perform power measurements which use simultaneously up to four power sensors. All sensor-dependent measurement functions can be used and the results can be displayed in parallel.

Required equipment:

- An R&S NRP-Z power sensor
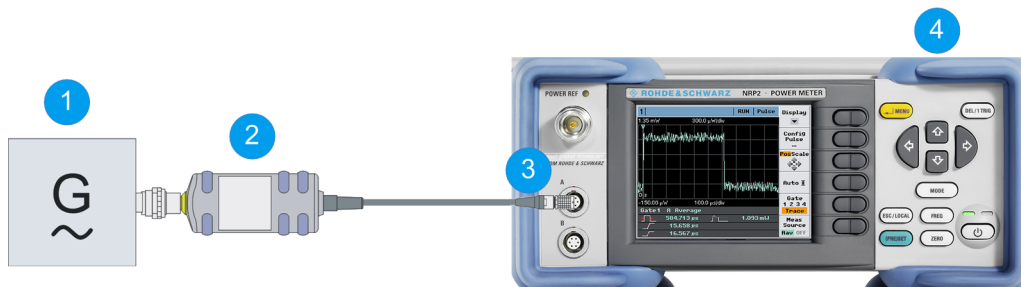- An R&S NRP2 base unit

Fig. 6-1: Configuration with an R&S NRP2 base unit

1 = Signal source
2 = R&S NRP-Z power sensor
3 = SENSOR connector of the R&S NRP2
4 = R&S NRP2 base unit

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

Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

1. Connect the power sensor, to the A SENSOR connector of the R&S NRP2.

2. Preset the R&S NRP2 and execute Zero A.

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

3. Connect the power sensor to the signal source.

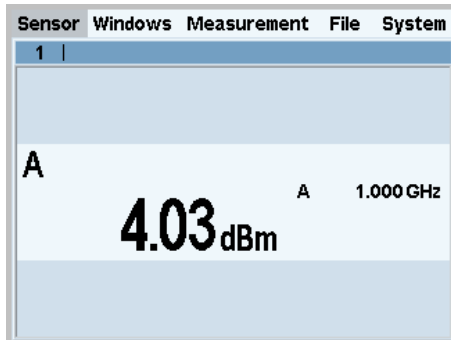The result window indicates the result (in dBm) obtained with sensor A.

Fig. 6-2: Result window (dBm)

4. If required perform further settings.

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

7   Using the Power Sensors with a Compatible Instrument

Many Rohde & Schwarz test instruments allow power measurements using the R&S NRP-Z power sensors. For example, the power sensors can be used with a signal generator to achieve a very stable and accurate RF power, which can be further supplied to your DUT. The power sensors can be directly connected to the R&S NRP-Z SENSOR connector of the instruments. Additionally they can be connected to the USB port of the instrument using the extensions R&S NRP-Z3, R&S NRP-Z4 or R&S NRP-Z5.

Refer to the operating manual of your Rohde & Schwarz instrument to find out if it supports power measurements with the R&S NRP-Z power sensors.

Required equipment:

● An R&S NRP-Z power sensor

● A compatible Rohde & Schwarz instrument

● An R&S NRP-Z3/R&S NRP-Z4 USB adapter or an R&S NRP-Z5 sensor hub (optional)

Fig. 7-1: Configuration with an R&S SMF

1 = R&S SMF
2 = Device under test (DUT)
3 = NRP-Zxx icon
4 = SENSOR connector
5 = R&S NRP-Z Power Sensors
6 = RF output of the DUT
7 = RF OUT connector of the R&S SMF
8 = RF input of the DUT

> ⓘ Incorrectly connecting/disconnecting the R&S NRP-Z power sensors may damage the power sensors or lead to erroneous results.
>
> Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

1. Connect the cables as shown in figure 7-1:
   a) Connect the DUT to the RF OUT connector of the R&S SMF.
   b) Connect the DUT to the RF connector of the power sensor.
   c) Connect the power sensor to the SENSOR connector of the R&S SMF.

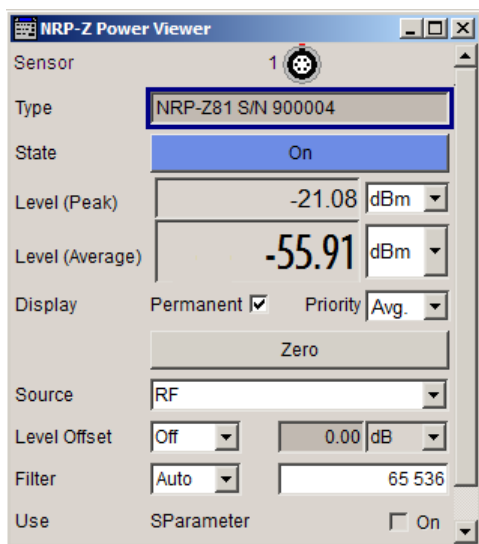2. In the R&S SMF open the "NRP-Z Power Viewer" dialog.

Fig. 7-2: NRP-Z Power Viewer

The dialog shows the result (in dBm) and some additional parameters.

3. If required, perform further settings.

For a detailed description of how to perform different measurements in this setup refer to the operating manual your compatible Rohde & Schwarz instrument.

8 Using the Power Sensors with an Android Device

With an R&S NRP-Z power sensors and an android device you can perform continuous power measurements that require high level of mobility.

Required equipment:

- An R&S NRP-Z power sensor
- An R&S NRP-Z3/R&S NRP-Z4 USB adapter
- An Android device that fulfills the following requirements:
  - Android version 4.0 or higher
  - USB host controller - USB On The Go (USB-OTG)
  - Compatible driver for the USB-OTG hardware. This driver must already be integrated in the device's kernel. Usually it can't be installed separately.
- Installed R&S Power Viewer Mobile app
- A USB-OTG adapter

⚠ **CAUTION**

Risk of impossible critical communication due to battery drain

Always disconnect the sensor from the host device when the sensor is not in use. Leaving the sensor connected to the device will drain the device battery, potentially making critical communications, such as an emergency call, impossible.
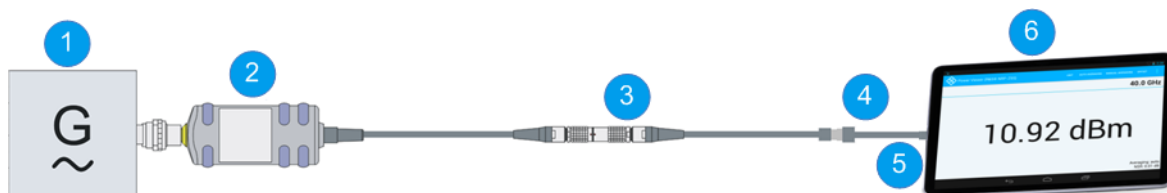

*Fig. 8-1: Configuration with an Android device*

1 = Signal source
2 = R&S NRP-Z power sensor
3 = R&S NRP-Z4
4 = USB-OTG cable
5 = USB socket
6 = Android device

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

Ensure that you connect/disconnect your power sensors as described in chapter 3.4, "Connecting the R&S NRP-Z Power Sensors", on page 12 and chapter 3.5, "Disconnecting the R&S NRP-Z Power Sensors ", on page 13.

1. Connect the cables as shown in figure 8-1:
   a) Connect the power sensor to the R&S NRP-Z3/R&S NRP-Z4 USB adapter.
   b) Connect the USB-OTG adapter to the R&S NRP-Z3/R&S NRP-Z4.
   c) Plug the USB-OTG adapter into the Android device. The R&S Power Viewer Mobile app starts automatically. This may take several seconds.

2. The first time you start the app, you will be asked to accept the Rohde & Schwarz end user license agreement.

3. You must explicitly authorize the R&S Power Viewer Mobile app to access the connected power sensor.

4. To skip this authorization for future uses, enable "Use by default for this USB device" before clicking OK.
   This dialog box might pop up multiple times. If this happens, click OK each time to grant access.
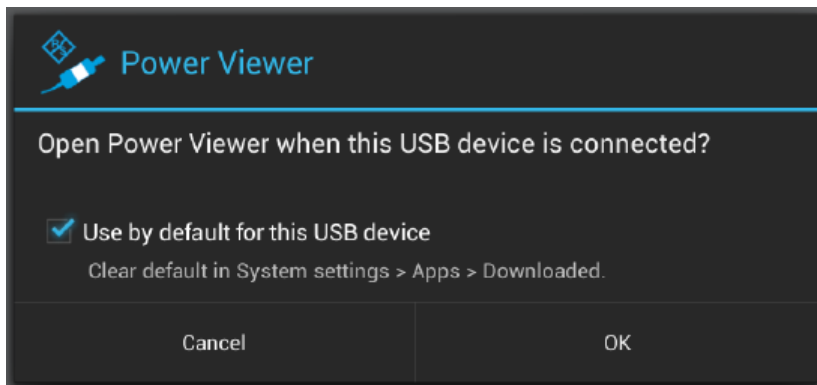
5. After the connected sensor is found, the result of the measurement is displayed on the screen.

For a detailed description of how to perform different measurements in this setup refer to the application note "1MA215: Using R&S®NRP-Z Power Sensors with Android Handheld Devices " provided on the documentation CD-ROM and on the Rohde & Schwarz website.