Using R&S®NRP Series Power Sensors with Android™ Handheld Devices

Products:

- R&S®NRP Series
- R&S®NRP-Zxx Series

This application note describes how to connect and use the highly popular R&S®NRP family of USB smart power sensors with the R&S®Power Viewer Mobile application (app). The app is designed for mobile devices running on the Android operating systems.

Both multi-path diode and wideband power sensors and thermal R&S®NRP sensors are supported.

The R&S®Power Viewer Mobile app is available online.

Application Note
P. Diestelhorst, P. Geltinger
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ROHDE&SCHWARZ

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1 Introduction

The R&S®Power Viewer Mobile allows to connect R&S®NRP power sensors to your Android device, smartphone or tablet, and perform basic measurements.

When Rohde & Schwarz introduced its NRP-Z[1] family of power sensors with its smart Sensor Technology™ ten years ago, this represented a significant step toward a truly mobile power measurement, since it is possible to operate the R&S®NRP-Z power sensors without a power meter base unit (see reference [1]).

With the advent of the smartphone and availability of a USB host mode in Android operating system v 5.0 and higher, R&S®NRP power meters are now able to bring the highest level of accuracy and repeatability in power measurement to super-compact computing devices and the latest generation of tablets.

The R&S®NRP family includes multiple power sensor types capable of mobile use from DC to 110 GHz and with levels ranging from -67 dBm to +45 dBm / 30 W. These are:

- R&S®NRPxxS[N] diode sensors
- R&S®NRPxxT[N] thermal power sensors
- R&S®NRPxxA[N] average power sensors
- R&S®NRP-Z8x wideband power sensors
- R&S®NRP-Z5x thermal power sensors
- R&S®NRP-Z9x average power sensors
- R&S®NRP-Z11, R&S®NRP-Z2x and R&S®NRP-Z31 three-path diode sensors
- R&S®NRP-Z2xx two-path diode sensors

Depending on the power consumption of the sensor being used and on the frequency of use, you can operate the sensors listed above for several hours without the need to recharge the Android host device.

NOTICE

Do not drain the battery of your Android device

Always disconnect the sensor from the host device whenever 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.

[1] The R&S®NRP-Zxx series power sensors are referred to as "NRP-Z" in this document.

2 R&S®Power Viewer Mobile App

The USB interface of the R&S®NRP power sensors makes it very convenient to connect the sensor directly to a mobile PC. This is an attractive alternative to the operation with an R&S®NRP2 base unit. To support Windows-based portable computers such as laptops to display and analyze the data, the R&S®NRP sensors have been shipped with the R&S®Power Viewer program since the first sensor was released. The more advanced R&S®Power Viewer Plus program is also available for download free of charge.

The R&S®Power Viewer Mobile brings the same functionality to Android-based devices, such as a smartphone and tablets. These functions include:

- Continuous power measurement and display of the results in dBm or W
- Trace power measurement and display of the results in dBm or W
- Measurement with up to four sensors
- Frequency selection
- Automatic and manual averaging
- Power offset
- Zeroing
- S-parameter usage
- Support of USB and network sensors

Note: All screenshots were taken on a 9-inch tablet. The display may differ on other devices.

2.1 Requirements

To be compatible with an R&S®NRP sensor, an Android device must meet the following requirements:

- Android version 5.0 or higher
- Android device with USB-OTG support
- USB-OTG adapter cable
- Network connection for using network sensors (if desired)

To use all features of the R&S®Power Viewer Mobile, the Android device must fully support the USB-OTG standard. There is currently no reliable way to find out if a certain device has the required chipset and drivers installed. Please contact the device manufacturer to check if a device supports Android 5 and USB-OTG. For convenience, the R&S®Power Viewer Mobile has been tested successfully on the following devices running Android:

- Google Nexus 7

- Google Nexus 9
- Motorola Moto X Style
- Samsung Galaxy S3 (w/ CyanogenMod Marshmallow)
- Huawei MediaPad T3

This list is neither complete nor guarantees full support of these devices in all firmware versions.

In addition, if you want to use a power sensor from the traditional R&S®NRP-Z series, you need either an R&S®NRP-Z3 (active USB adapter cable with trigger input, external triggering is not supported by this app) or an R&S®NRP-Z4 (passive USB adapter cable). An USB-OTG adapter or USB-OTG adaptor cable is always required for the Android device to provide a standard USB A-type connector. Both, the USB-OTG adapter or the adapter cable, are easily available as accessory in local retail.

2.1.1 Installation

You can download the app free of charge from the Google Play Store.

2.1.2 Android Permissions

During installation, the R&S®Power Viewer Mobile requires the following permissions: "ACCESS_WIFI_STATE", “CHANGE_WIFI_MULTICAST_STATE”, “INTERNET” and "WAKE_LOCK". These permissions are needed to display the system dialogs for the interface permissions correctly.

2.1.3 Connecting the R&S®NRP to Your Device

Step-by-step procedure:

1. Connect the power sensor to the USB-OTG adapter using a suitable USB cable.
2. Plug the USB-OTG adapter into the Android device.
3. If you want to use more than one USB power sensor, connect a powered USB-HUB to the USB-OTG adapter.
4. If a network sensor is used, connect it to a PoE port of your network switch.
5. Ensure that the Android device has a WiFi connection to the same network.
6. Start the R&S®Power Viewer Mobile app.

Fig. 2-1: R&S®Power Viewer Mobile measuring with 4 power sensor

7. If you start the app for the first time, you are asked to accept the Rohde & Schwarz end user license agreement.
8. Explicitly authorize the R&S®Power Viewer Mobile app to access the connected R&S®NRP USB sensor. If you have not given this authorization previously, you are prompted to confirm access after the R&S®Power Viewer Mobile app has started.
9. To skip this authorization for future uses, enable "Use by default for this USB device" before tapping "OK". In some situations, this dialog box might pop up multiple times. If this happens, tap "OK" each time to grant access.

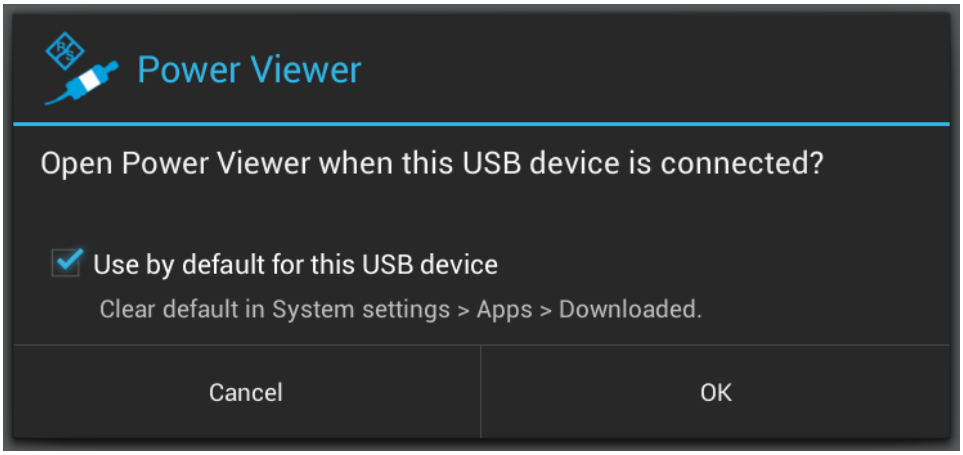


Fig. 2-2: R&S®Power Viewer Mobile detects the R&S®NRP USB sensor automatically

2.2 Program Menu

2.2.1 Selecting Power Sensors for Measurement

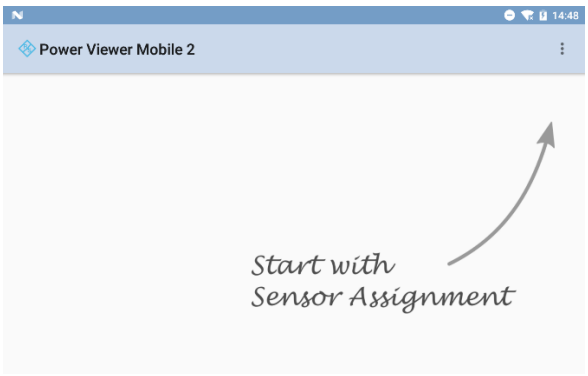


Fig. 2-3: Main Window

To be able to use a power sensor in a measurement, you must activate it in the "Sensor Assignment" dialog first. You can select up to 4 sensors simultaneously.

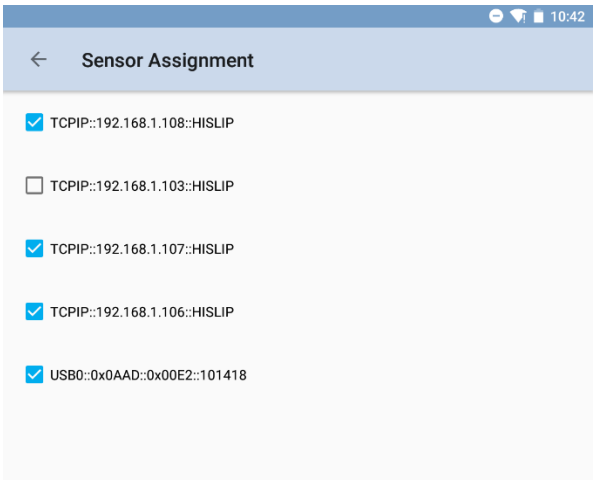


Fig. 2-4: "Sensor Assignment" dialog accessible from more options menu

2.2.2 Inverting Display

You can invert the display from "Light Theme" to "Dark Theme" and vice versa.

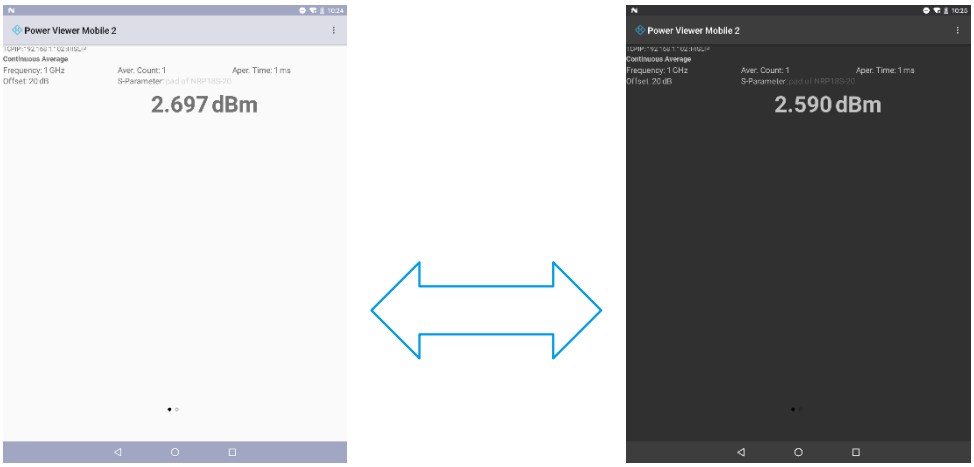


Fig. 2-14: Light Theme (left) and Dark Theme (right)

2.2.3 About the App

Displays additional information about the app and about Rohde & Schwarz.

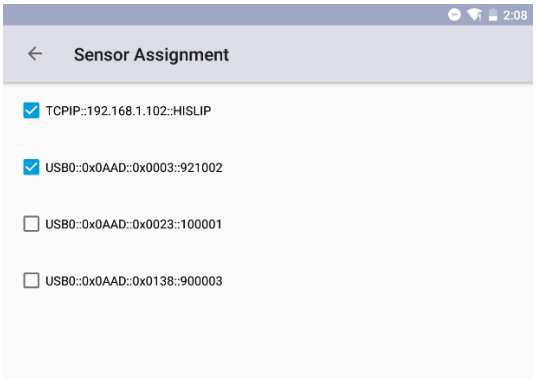
Fig. 2-15: Additional information about the app and access to the R&S homepage via the "About" menu item

2.2.4 Closing the App

To close the app, use the "Quit" menu item.

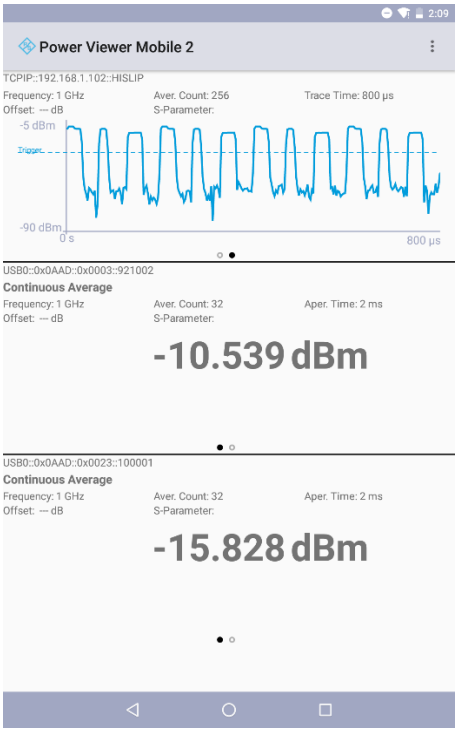
2.3 Selecting Sensors for Measurement

Once the app has started, it automatically searches for connected sensors. All sensors that are found are listed in the "Sensor Assignment" dialog. From there, you can configure up to 4 sensors for the measurement.



► Tap ← to start the measurement with the selected sensors.

In the measurement overview, all assigned sensors are displayed with their main settings and the measured values from the currently selected measurement mode. The application supports both continuous average measurement and power over time, the so-called trace mode.



2.4 Changing the Measurement Mode

The R&S®Power Viewer Mobile supports two major measurement modes. The default mode is the "Continuous Average" mode that is supported by every sensor. In addition, the app supports the trace mode.

► Slide horizontally to change the measurement mode.

If the corresponding sensor does support the trace mode, the new measurement is activated.

Otherwise, the resulting display stays empty.

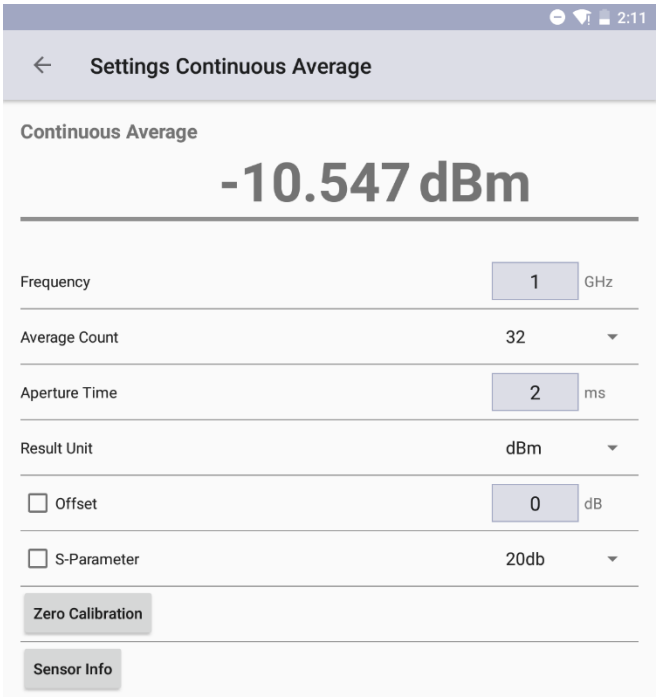
2.5 Configuring the Measurement

► Tap anywhere on the area of the measurement display to configure a measurement.

A dialog appears with the settings of the corresponding measurement mode.

2.5.1 Configuring Continues Average Measurement

In the upper area, the result values are permanently updated and represent each change of the settings. Results are displayed in Watt or dBm.



2.5.1.1 Frequency

Communicate the current frequency of the device under test to the sensor. Thus, the sensor can take its internally stored frequency dependent correction values into account to display the correct power measurement results.

1. Tap the "Frequency" input field to change the frequency.
2. Use the keypad to enter the value.

2.5.1.2 Averaging

Two averaging modes are available: automatic and manual.

Automatic averaging

The app automatically determines the number of measurements to be averaged in order to achieve a defined noise-to-signal ratio (NSR).

Three settings are available for automatic averaging:

- Fast (NSR 0.05 dB)
- Normal (NSR 0.01 dB)
- Precise (NSR 0.001 dB)

► In "Averaging" field, select one of the desired modes.

Manual averaging

► In "Averaging" field, select an explicit average count.

With manual averaging, you can specify the number of measurements to be averaged.

2.5.1.3 Aperture Time

► Tap the edit field of the "Aperture Time" entry to configure the aperture time.

2.5.1.4 Offset

Using this function, you can define an offset. The offset is added to each measured value before the value is displayed. This is used normally to compensate for non-frequency dependent attenuators in front of the power sensor.

To define an offset

1. Enter a value in the text field.
2. Enable the checkbox on the left side.

To remove the offset

► Deactivate the checkbox.

2.5.1.5 S-Parameter Correction

When using a sensor that has S-parameters correction data stored, you can enable or disable the parameters using the menu. The list of available S-parameters in the sensor are grouped in a combo box.

► Enable or disable a selected S-parameter dataset by using the corresponding checkbox on the left side.

An S-parameter data set is required in order to automatically correct the influence of any 2-port, e.g. an adaptor connected between signal source and power sensor. Thus, the sensor can calculated precisely the power delivered by the signal source. For further information on S-parameter correction, refer to the operating manual of the power sensor.

2.5.1.6 Zeroing

1. Before zeroing, ensure that the sensor is not connected to a power source.
2. Tap the "Zero calibration" button.

   It can take several seconds to complete zeroing.

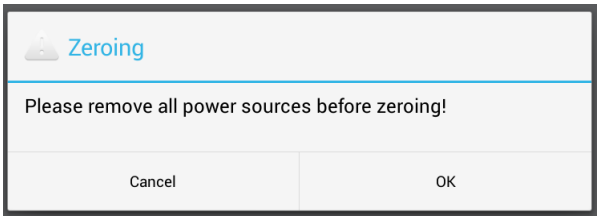
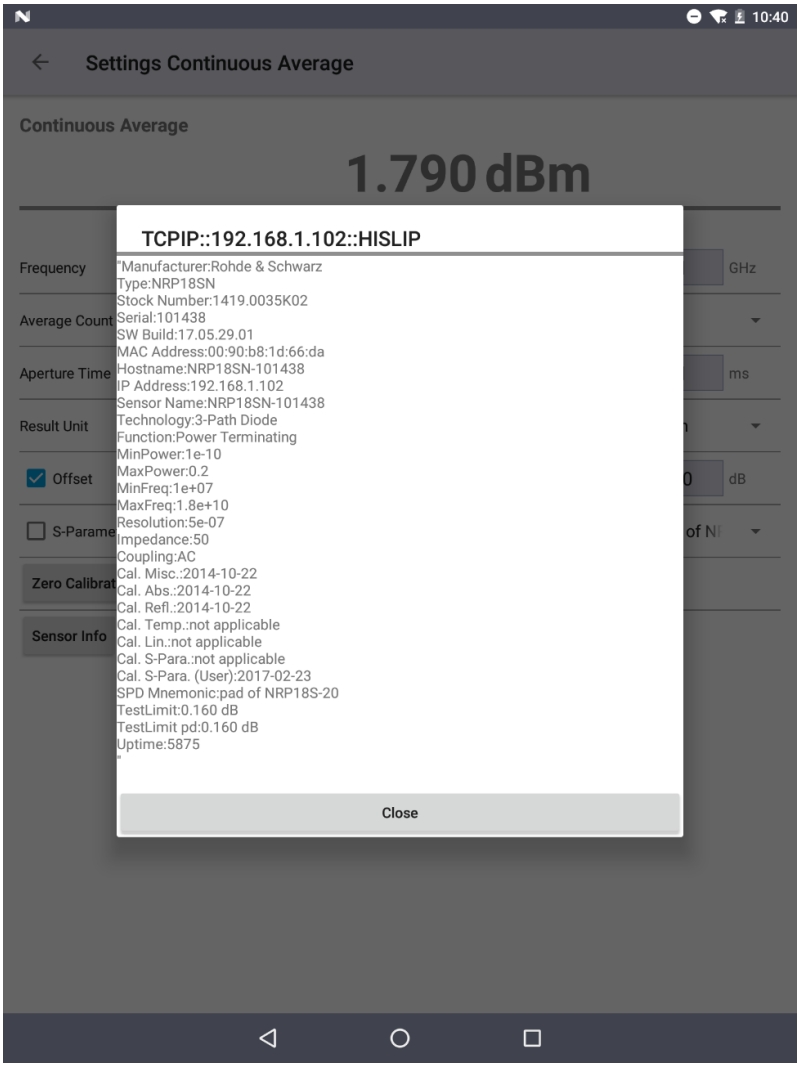


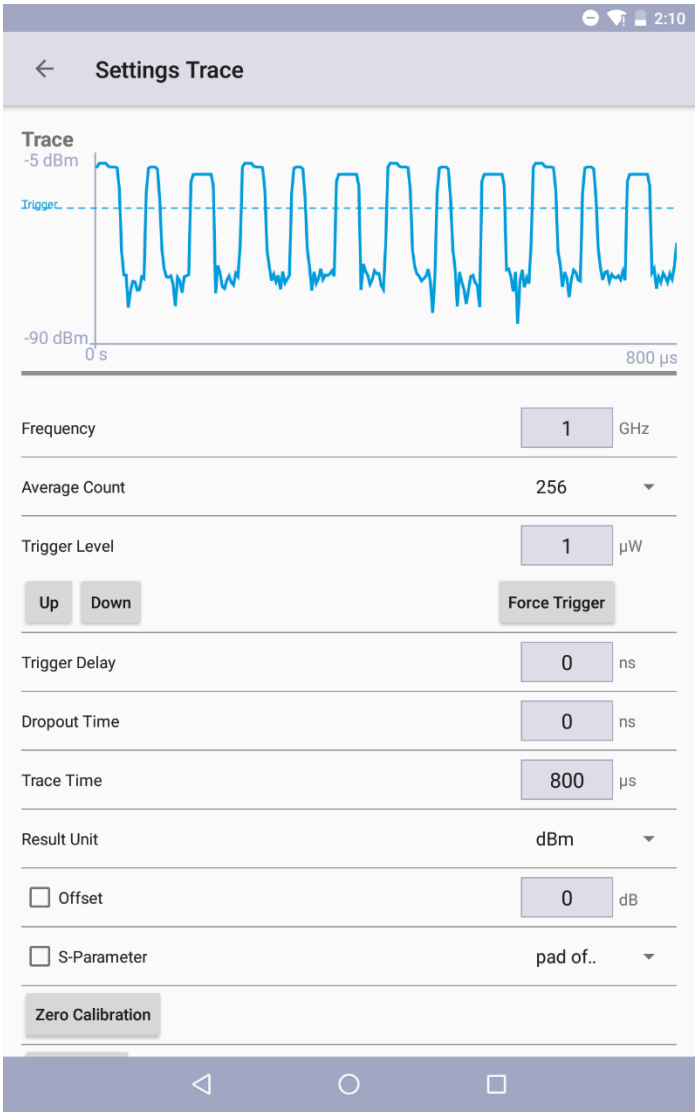
Fig. 2-12: Confirmation dialog displayed before zeroing

2.5.1.7 Sensor Info

Displays the sensor information from the selected sensor.



2.5.2 Configure Trace Measurement



2.5.2.1 Frequency

Communicate the current frequency of the device under test to the sensor. Thus, the sensor can take its internally stored frequency dependent correction values into account to display the correct power measurement results.

1. Tap the "Frequency" input field to change the frequency.
2. Use the keypad to enter the value.

2.5.2.2 Averaging

The average count in "Trace Mode" defines the number of traces that are averaged to a single trace.

To set up the average count

1. Tap on the combo box.
2. Select the value.

2.5.2.3 Trigger Level

The trigger level is the threshold value that causes the triggering of a new measurement.

To change the value

1. Tap in the edit field and
2. Enter the desired value. You can also change the trigger level by the "Up" and "Down" button.

   The currently set value is displayed as a line in the graph.

2.5.2.4 Trigger Delay

The trigger delay defines the time span that is recorded before the measurement gets triggered.

2.5.2.5 Dropout Time

Defines the time that must at least pass before another measurement can be triggered. Using this setting, you can, for example, measure a double pulse without trigger problems.

2.5.2.6 Trace Time

Specifies the length of the trace.

2.5.2.7 Result Unit

Use this setting to change the result unit. Watt and dBm are possible.

2.5.2.8 Offset

Using this function, you can define an offset. The offset is added to each measured value before the value is displayed. This is used normally to compensate for non-frequency dependent attenuators in front of the power sensor.

To define an offset

1. Enter a value in the text field.
2. Enable the checkbox on the left side.

To remove the offset

► Deactivate the checkbox.

2.5.2.9 S-Parameter Correction

When using a sensor that has S-parameters correction data stored, you can enable or disable the parameters using the menu. The list of available S-parameters in the sensor are grouped in a combo box.

► Enable or disable a selected S-parameter dataset by using the corresponding checkbox on the left side.

An S-parameter data set is required in order to automatically correct the influence of any 2-port, e.g. an adaptor connected between signal source and power sensor. Thus, the sensor can calculated precisely the power delivered by the signal source. For further information on S-parameter correction, refer to the operating manual of the power sensor.

2.6 Battery Life

Using R&S®NRP USB sensors without an external power source, not using an R&S®NRP-Z3 with external power supply or a powered USB hub, can significantly shorten the battery life of the Android host device. The battery is drained even without the R&S®Power Viewer Mobile app running, if the sensor is connected to the device.

You can use a USB self-powered hub to relieve the battery of the device. Alternatively, you can use network sensors (Power over Ethernet - PoE).

Note: The power consumption of the R&S®NRP sensors is not the same for all models. Always carefully monitor the battery status of your Android device, especially when using the device with R&S®NRP-Z8x peak power sensors.

Refer to the table below for information regarding power consumption of the various models in the R&S®NRP-Z family of power meters.

Sensor Type / Family	Models	Current drain on USB port
Universal Power Sensors	R&S®NRP-Z1x, R&S®NRP-Z2x, NRP-Z31 R&S®NRPxxS[N]	200 mA 400mA
Wideband Power Sensors	R&S®NRP-Z8x	500 mA
Thermal Power Sensors	R&S®NRP-Z5x R&S®NRPxxT(N)	100 mA 400 mA
Average Power Sensors	R&S®NRP-Z9x R&S®NRPxxA[N]	200 mA 400mA

The following table estimates the working time on a tablet and a smartphone for various exemplary sensors. These are just estimations.

Values assuming a basic load of 100 mA	Google Nexus 7		Samsung Galaxy S3	
	Display dimmed (200 mA)	Display bright (400 mA)	Display dimmed (100 mA)	Display bright (200 mA)
R&S®NRP-Z5x (100 mA)	7.8h	7.7h	4.6h	3.8h
R&S®NRP-Z11, R&S®NRP-Z2x, R&S®NRP-Z31 (200 mA)	6.6h	5.0h	3.8h	3.2h
R&S®NRP-Z8x (500 mA)	4.5h	3.7h	2.4h	2.2h
R&S®NRP8S (400 mA)	5,5h	4h	3h	2,5h

2.7 Uninstalling

Use the system settings or the Google Play Store if you need to remove the R&S®Power Viewer Mobile app.

3 Appendix

3.1 Literature

[1] Evolution in power measurement – intelligent sensor technology, in: News from Rohde & Schwarz No. 174 - 2002/II

[2]: Die bessere Wahl: USB-Leistungssensoren von Rohde & Schwarz in: News from Rohde & Schwarz No. 208 - 2013/II

3.2 Additional Information

Please send your technical queries, comments and suggestions regarding this application note to:

TM-Applications@rohde-schwarz.com

3.3 Ordering Information

Designation	Type	Order No.
Universal power sensors		
100 pW to 200 mW, 10 MHz to 8 GHz	R&S® NRP8S	1419.0006.02
100 pW to 200 mW, 10 MHz to 8 GHz	R&S® NRP8SN	1419.0012.02
100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP18S	1419.0029.02
100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP18SN	1419.0035.02
100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP33S	1419.0064.02
100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP33SN	1419.0070.02
100 pW to 100 mW, 50 MHz to 40 GHz	R&S®NRP40S	1419.0041.02
100 pW to 100 mW, 50 MHz to 40 GHz	R&S®NRP40SN	1419.0058.02
100 pW to 100 mW, 50 MHz to 50 GHz	R&S®NRP50S	1419.0087.02
100 pW to 100 mW, 50 MHz to 50 GHz	R&S®NRP50SN	1419.0093.02
1 nW to 100 mW, 10 MHz to 8 GHz	R&S®NRP-Z211	1417.0409.02
1 nW to 100 mW, 10 MHz to 18 GHz	R&S®NRP-Z221	1417.0309.02
1 nW to 2 W, 10 MHz to 18 GHz	R&S®NRP18S-10	1424.6721.02
10 nW to 15 W, 10 MHz to 18 GHz	R&S®NRP18S-20	1424.6738.02
30 nW to 30 W, 10 MHz to 18 GHz	R&S®NRP18S-25	1424.6744.02
Wideband power sensors		
1 nW to 100 mW, 50 MHz to 18 GHz	R&S®NRP-Z81	1137.9009.02
1 nW to 100 mW, 50 MHz to 40 GHz (2.92 mm)	R&S®NRP-Z85	1411.7501.02
1 nW to 100 mW, 50 MHz to 40 GHz (2.40 mm)	R&S®NRP-Z86	1417.0109.40
1 nW to 100 mW, 50 MHz to 44 GHz (2.40 mm)	R&S®NRP-Z86	1417.0109.44
Thermal power sensors		
300 nW to 100 mW, DC to 18 GHz	R&S®NRP18T	1424.6115.02
300 nW to 100 mW, DC to 18 GHz	R&S®NRP18TN	1424.6121.02
300 nW to 100 mW, DC to 33 GHz	R&S®NRP33T	1424.6138.02
300 nW to 100 mW, DC to 33 GHz	R&S®NRP33TN	1424.6144.02
300 nW to 100 mW, DC to 40 GHz	R&S®NRP40T	1424.6150.02
300 nW to 100 mW, DC to 40 GHz	R&S®NRP40TN	1424.6167.02
300 nW to 100 mW, DC to 50 GHz	R&S®NRP50T	1424.6173.02
300 nW to 100 mW, DC to 50 GHz	R&S®NRP50TN	1424.6180.02
300 nW to 100 mW, DC to 67 GHz	R&S®NRP67T	1424.6196.02
300 nW to 100 mW, DC to 67 GHz	R&S®NRP67TN	1424.6209.02
300 nW to 100 mW, DC to 110 GHz	R&S®NRP110T	1424.6215.02

Designation	Type	Order No.
Average power sensors		
100 pW to 200 mW, 8 kHz to 6 GHz	R&S®NRP6A	1424.6796.02
100 pW to 200 mW, 8 kHz to 6 GHz	R&S®NRP6AN	1424.6809.02
2 nW to 2 W, 9 kHz to 6 GHz	R&S®NRP-Z92	1171.7005.02/42
100 pW to 200 mW, 8 kHz to 18 GHz	R&S®NRP18A	1424.6815.02
100 pW to 200 mW, 8 kHz to 18 GHz	R&S®NRP18AN	1424.6821.02
Recommended extras		
USB Adapter (active)	R&S®NRP-Z3	1146.7005.02
USB Adapter (passive, length: 2.0 m)	R&S®NRP-Z4	1146.8001.02
USB Adapter (passive, length: 0.5 m)	R&S®NRP-Z4	1146.8001.04
USB Adapter (passive, length: 0.15 m)	R&S®NRP-Z4	1146.8001.06

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 80 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Regional contact

Europe, Africa, Middle East
+49 89 4129 12345
customersupport@rohde-schwarz.com

North America
1-888-TEST-RSA (1-888-837-8772)
customer.support@rsa.rohde-schwarz.com

Latin America
+1-410-910-7988
customersupport.la@rohde-schwarz.com

Asia/Pacific
+65 65 13 04 88
customersupport.asia@rohde-schwarz.com

China
+86-800-810-8228 /+86-400-650-5896
customersupport.china@rohde-schwarz.com

Environmental commitment

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

Certified Quality System
ISO 9001

PAD-T-M: 3573.7380.02/02.00/CI/1/EN/

Rohde & Schwarz GmbH & Co. KG
Mühldorfstraße 15 | D - 81671 München
Phone + 49 89 4129 - 0 | Fax + 49 89 4129 – 13777

www.rohde-schwarz.com