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

**Products:**

- R&S®NRP-Z

This application note describes how to connect and use the highly popular R&S®NRP-Z family of USB SMART power sensors with the Android application (app): R&S®Power Viewer Mobile for mobile devices running on Android 4.0 operating systems.

Multi-path diode and wideband power sensors as well as thermal R&S®NRP-Z sensors are supported.

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

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## Introduction

The R&S® Power Viewer Mobile allows to connect R&S®NRP-Z power sensors to your Android 4.0 smartphone and perform basic measurements.

When Rohde & Schwarz introduced its NRP-Z\(^1\) family of power sensors with its Smart Sensor Technology\(^\text{TM}\) 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 v 4.0 and higher of the Android operating system, R&S®NRP-Z 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-Z 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®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, the above sensors can be operated for several hours without the need to recharge the Android host device.

**ATTENTION:** 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.

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\(^1\) The R&S®NRP-Z power sensors are referred to as "NRP-Z" in this document. It would be appropriate to label NRP-Z a family of power meters due to the fact that the sensors deliver calibrated power measurement results and no further corrections are necessary.
2 R&S®Power Viewer Mobile App

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

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

- Continuous power measurement and display of the results in dBm, dB-relative, or W
- Frequency selection
- Automatic and manual averaging,
- Power offset
- Zeroing
- S-parameter activation
- Display Inversion

Note: All screenshots were taken on a 7-inch tablet. The display may be different on other devices!

2.1 Requirements

To be compatible with an NRP-Z sensor, an Android device must meet the following requirements:

- Running Android version 4.0 or higher
- Equipped with a 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.

A device that doesn't meet all three of these above requirements cannot use the R&S®Power Viewer Mobile. 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 4 and USB-OTG. For convenience, this app has been tested successfully on the following devices running Android 4.x:

- Google Nexus 7
- Samsung Galaxy S3
- Sony Xperia P LT22i
- HTC Desire X
This list is neither complete nor guarantees full support of these devices and all firmware versions.

In addition 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) and an USB-OTG adapter or USB-OTG adaptor cable (both easily available as accessory in local retail).

2.1.1 Installation

The app can be downloaded free of charge from the Google Play Store.

2.1.2 Android Permissions

During installation, the R&S®Power Viewer Mobile requires the permissions "Retrieve Running Apps" and "Reorder Running Apps". These are needed to display the system dialogs for the USB permissions correctly. You will be prompted to grant and need to confirm these permissions while installation of R&S®Power Viewer Mobile progresses.

2.1.3 Connecting the R&S®NRP-Z to your device

A generic USB-OTG adapter (sold by your phone’s manufacturer or third party suppliers) and either an R&S®NRP-Z3 (active USB adapter cable with trigger input) or an R&S®NRP-Z4 (passive USB adapter cable) is needed in order to connect an R&S®NRP-Z power sensor to the Android device.

Step by step procedure:

1. Connect the sensor to the NRP-Z3/4
3. Plug the USB-OTG adapter into the Android device. The R&S®Power Viewer Mobile app should start automatically now. This may take several seconds in some cases.
R&S®Power Viewer Mobile App

Requirements

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

5. You must explicitly authorize the R&S®Power Viewer app to access the connected NRP-Z sensor. If you have not given this authorization previously, you will be prompted to confirm access after the R&S®Power Viewer app has started up.

6. To skip this authorization for future uses, check the box "Use by default for this USB device" before clicking OK. In some situations, this dialog box might pop up multiple times. If this happens, click OK each time to grant access.

![Image](image1.png)

Fig. 2-1: R&S®NRP-Z52 thermal power sensor connected via a R&S®NRP-Z4 adapter cable (middle) and an USB-OTG adapter cable (connecting to the Android device).

![Image](image2.png)

Fig. 2-2: R&S®Power Viewer Mobile detects the NRP-Z sensor automatically. Checking “Use by default for this USB device” adds to ease of handling in repeated usage.
2.2 Features and Settings

Once the app has started and found the connected sensor, it will display the measured value in a large and clearly visible font. Information about the averaging mode (NSR), reference level, offset and active s-parameters are displayed at the lower right corner if applicable.

The title bar shows the connected sensor and other important configurable parameters, such as unit and averaging mode if there is enough space available. All further settings and those that do not fit in the title bar can be found in the settings menu.

![R&S®Power Viewer Mobile display with open settings menu](image)

Fig. 2-3: R&S®Power Viewer Mobile display with open settings menu

Manual averaging and other functions like offset, zeroing, etc. are accessible via the 3-dots icon or the physical menu-button near the home-button (e.g. on Samsung devices):

![Settings menu accessible via the 3-dots icon](image)

Fig. 2-4: Settings menu accessible via the 3-dots icon
2.2.1 Unit of Measurement

Measured values can be displayed in Watt, dBm or dB relative to a reference value. To switch to a different unit, tap "Unit" and select the desired display. Selecting "dB relative" sets the current result as the reference value. To set a new reference to refer your measured value to, you can select the menu item "-> Rel" to reassign the reference level.
2.2.2 Frequency

The current frequency of the device under test should be communicated to the sensor so that it can take its internally stored frequency dependent correction values into account to display the correct power measurement results.

To change the frequency, tap the "Frequency" input field. Then use the keypad to type in the value.

Fig. 2-7: Setting the frequency where the main signal component is expected (top right).
2.2.3 Averaging

Two averaging modes are available: automatic and manual:

With 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)

To use automatic averaging, tap "Auto Averaging" and select the desired mode.

With manual averaging, you can specify the number of measurements to be averaged. Select "Manual Average" from the options and then enter the desired number of measurements.

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Fig. 2-8: Menu for selection of the auto average mode.

Fig. 2-9: Menu for the selection of the manual average count.
2.2.4 Offset

This function makes it possible to define an offset. The offset is added to each measured value before the value is displayed. This is normally used to compensate for non-frequency dependent attenuators in front of the power sensor. To define an offset, select "Offset" and then type in the desired value. To remove the offset either set it to 0 dB or tap the “Set to zero” button instead.

![Offset setting](image)

**Fig. 2-10:** Entering a power offset.

2.2.5 S-Parameter correction

When using a sensor that has S-parameters correction data stored, the parameters can be activated or deactivated via the menu. The list of active options at the lower right indicates whether S-parameters are enabled. It is not possible to load a new set of S-parameters, but you can activate (or deactivate) them, once they have been stored on the power sensor.
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 power delivered by the signal source can be calculated precisely by the sensor. For further information on S-parameter correction please refer to your R&S®NRP-Zxx power sensor’s operating manual.

Fig. 2-11: Activating/deactivating S-parameters within the settings menu (accessible via the 3-dots icon).

2.2.6 Zeroing

Before zeroing, ensure that the sensor is not connected to a power source, then select "Zero" from the options. It can take several seconds to complete zeroing.

Fig. 2-12: Confirmation dialog displayed before zeroing.

2.2.7 Sensor Info

The "Sensor Info" menu item reads the sensor information data from the connected NRP-Z and outputs it to the display.
<table>
<thead>
<tr>
<th>Type</th>
<th>NRP-Z52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial</td>
<td>120014</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Rohde &amp; Schwarz</td>
</tr>
<tr>
<td>Stock Number</td>
<td>1138.0505.02</td>
</tr>
<tr>
<td>HWVersion</td>
<td>000000001</td>
</tr>
<tr>
<td>HWVariant</td>
<td>000000010</td>
</tr>
<tr>
<td>SW Build</td>
<td>04.22</td>
</tr>
<tr>
<td>Technology</td>
<td>Thermal</td>
</tr>
<tr>
<td>Function</td>
<td>Power Terminating</td>
</tr>
<tr>
<td>MinPower</td>
<td>3e-07</td>
</tr>
<tr>
<td>MaxPower</td>
<td>0.1</td>
</tr>
<tr>
<td>MinFreq</td>
<td>0</td>
</tr>
<tr>
<td>MaxFreq</td>
<td>3.3e+10</td>
</tr>
<tr>
<td>Impedance</td>
<td>50</td>
</tr>
<tr>
<td>Coupling</td>
<td>DC</td>
</tr>
<tr>
<td>Cal. Abs.</td>
<td>2013-05-10</td>
</tr>
<tr>
<td>Cal. Refl.</td>
<td>2013-05-10</td>
</tr>
<tr>
<td>Cal. S-Par.</td>
<td>not applicable</td>
</tr>
<tr>
<td>Cal. Misc.</td>
<td>2013-05-10</td>
</tr>
<tr>
<td>Cal. Temp.</td>
<td>not applicable</td>
</tr>
<tr>
<td>Cal. Lin.</td>
<td>2013-05-10</td>
</tr>
<tr>
<td>SPD Mnemonic</td>
<td>not available</td>
</tr>
<tr>
<td>TestLimit</td>
<td>0.090 dB</td>
</tr>
<tr>
<td>TestLimit pd</td>
<td>0.090 dB</td>
</tr>
</tbody>
</table>

Fig. 2-43: Display of sensor data. This example shows the data for an NRP-Z52.
2.2.8 Invert Display

Invert the Display from Light Theme to Dark Theme or from Dark Theme to Light Theme.

![Invert Display Example](image)

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

2.2.9 About

Will display additional information about the app and about Rohde & Schwarz.

![About Screen](image)

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

2.2.10 Quit

To fully close the app, use the "Quit" menu item. This also terminates the driver background service for the sensor.
2.3 Battery Life

Using NRP-Z sensors without an external power source (not using an R&S®NRP-Z3 with external power supply) can significantly shorten the battery life for the Android host device. The battery will be drained even without the R&S®Power Viewer Mobile app running, if the sensor is still connected to the device.

Please note: The power consumption of the NRP-Z sensors is not the same for all models. Always carefully monitor the battery status of your Android device especially when using the device with NRP-Z8x peak power sensors.

Please refer to the table below for information regarding power consumption of the various models in the NRP-Z family of power meters.

<table>
<thead>
<tr>
<th>Family</th>
<th>Models</th>
<th>Current drain on USB port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Power Sensors</td>
<td>NRP-Z1x, NRP-Z2x, NRP-Z31</td>
<td>200 mA</td>
</tr>
<tr>
<td>Wideband Power Sensors</td>
<td>NRP-Z8x</td>
<td>500 mA</td>
</tr>
<tr>
<td>Thermal Power Sensors</td>
<td>NRP-Z5x</td>
<td>100 mA</td>
</tr>
<tr>
<td>Average Power Sensors</td>
<td>NRP-Z9x</td>
<td>200 mA</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Values assuming a basic load of 100 mA</th>
<th>Google Nexus 7</th>
<th>Samsung Galaxy S3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Display dimmed (200 mA)</td>
<td>Display bright (400 mA)</td>
</tr>
<tr>
<td>NRP-Z5x (100 mA)</td>
<td>7.8h</td>
<td>7.7h</td>
</tr>
<tr>
<td>NRP-Z11, NRP-Z2x, NRP-Z31 (200 mA)</td>
<td>6.6h</td>
<td>5.0h</td>
</tr>
<tr>
<td>NRP-Z8x (500 mA)</td>
<td>4.5h</td>
<td>3.7h</td>
</tr>
</tbody>
</table>

2.4 De-installation

Use the system settings or the Google Play Store if you need to remove the Power Viewer Mobile application.
3 Appendix

3.1 Literature


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

<table>
<thead>
<tr>
<th>Designation</th>
<th>Type</th>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Universal power sensors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 pW to 200 mW, 10 MHz to 8 GHz</td>
<td>R&amp;S® NRP-Z11</td>
<td>138.3004.02/04</td>
</tr>
<tr>
<td>200 pW to 200 mW, 10 MHz to 18 GHz</td>
<td>R&amp;S® NRP-Z21</td>
<td>1137.6000.02</td>
</tr>
<tr>
<td>200 pW to 200 mW, 10 MHz to 33 GHz</td>
<td>R&amp;S® NRP-Z31</td>
<td>1169.2400.02/04</td>
</tr>
<tr>
<td>1 nW to 100 mW, 10 MHz to 8 GHz</td>
<td>R&amp;S® NRP-Z211</td>
<td>1417.0409.02</td>
</tr>
<tr>
<td>1 nW to 100 mW, 10 MHz to 18 GHz</td>
<td>R&amp;S® NRP-Z21</td>
<td>1137.6000.02</td>
</tr>
<tr>
<td>2 nW to 2 W, 10 MHz to 18 GHz</td>
<td>R&amp;S® NRP-Z22</td>
<td>1137.7506.02</td>
</tr>
<tr>
<td>20 nW to 15 W, 10 MHz to 18 GHz</td>
<td>R&amp;S® NRP-Z23</td>
<td>1137.8002.02</td>
</tr>
<tr>
<td>60 nW to 30 W, 10 MHz to 18 GHz</td>
<td>R&amp;S® NRP-Z24</td>
<td>1137.8502.02</td>
</tr>
<tr>
<td><strong>Wideband power sensors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 nW to 100 mW, 50 MHz to 18 GHz</td>
<td>R&amp;S® NRP-Z81</td>
<td>1137.9009.02</td>
</tr>
<tr>
<td>1 nW to 100 mW, 50 MHz to 40 GHz (2.92 mm)</td>
<td>R&amp;S® NRP-Z85</td>
<td>1411.7501.02</td>
</tr>
<tr>
<td>1 nW to 100 mW, 50 MHz to 40 GHz (2.40 mm)</td>
<td>R&amp;S® NRP-Z86</td>
<td>1417.0109.40</td>
</tr>
<tr>
<td>1 nW to 100 mW, 50 MHz to 44 GHz (2.40 mm)</td>
<td>R&amp;S® NRP-Z86</td>
<td>1417.0109.44</td>
</tr>
<tr>
<td><strong>Thermal power sensors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300 nW to 100 mW, DC to 18 GHz</td>
<td>R&amp;S® NRP-Z51</td>
<td>1138.0005.03</td>
</tr>
<tr>
<td>300 nW to 100 mW, DC to 33 GHz</td>
<td>R&amp;S® NRP-Z52</td>
<td>1138.0505.02</td>
</tr>
<tr>
<td>300 nW to 100 mW, DC to 40 GHz</td>
<td>R&amp;S® NRP-Z55</td>
<td>1138.2008.03</td>
</tr>
<tr>
<td>300 nW to 100 mW, DC to 44 GHz</td>
<td>R&amp;S® NRP-Z55</td>
<td>1138.2008.04</td>
</tr>
<tr>
<td>300 nW to 100 mW, DC to 50 GHz</td>
<td>R&amp;S® NRP-Z56</td>
<td>1171.8201.02</td>
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<tr>
<td>300 nW to 100 mW, DC to 67 GHz</td>
<td>R&amp;S® NRP-Z57</td>
<td>1171.8401.02</td>
</tr>
<tr>
<td>300 nW to 100 mW, DC to 110 GHz</td>
<td>R&amp;S® NRP-Z58</td>
<td>1173.7031.02</td>
</tr>
<tr>
<td><strong>Average power sensors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 pW to 200 mW, 9 kHz to 6 GHz</td>
<td>R&amp;S® NRP-Z91</td>
<td>1168.8004.02/04</td>
</tr>
<tr>
<td>2 nW to 2 W, 9 kHz to 6 GHz</td>
<td>R&amp;S® NRP-Z92</td>
<td>1171.7005.02/42</td>
</tr>
<tr>
<td><strong>Recommended extras</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USB Adapter (active)</td>
<td>R&amp;S® NRP-Z3</td>
<td>1146.7005.02</td>
</tr>
<tr>
<td>USB Adapter (passive, length: 2.0 m)</td>
<td>R&amp;S® NRP-Z4</td>
<td>1146.8001.02</td>
</tr>
<tr>
<td>USB Adapter (passive, length: 0.5 m)</td>
<td>R&amp;S® NRP-Z4</td>
<td>1146.8001.04</td>
</tr>
<tr>
<td>USB Adapter (passive, length: 0.15 m)</td>
<td>R&amp;S® NRP-Z4</td>
<td>1146.8001.06</td>
</tr>
</tbody>
</table>
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 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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Environmental commitment

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

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