How to use R&S NRPZ instrument drivers

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July 31, 2018

ROHDE&SCHWARZ

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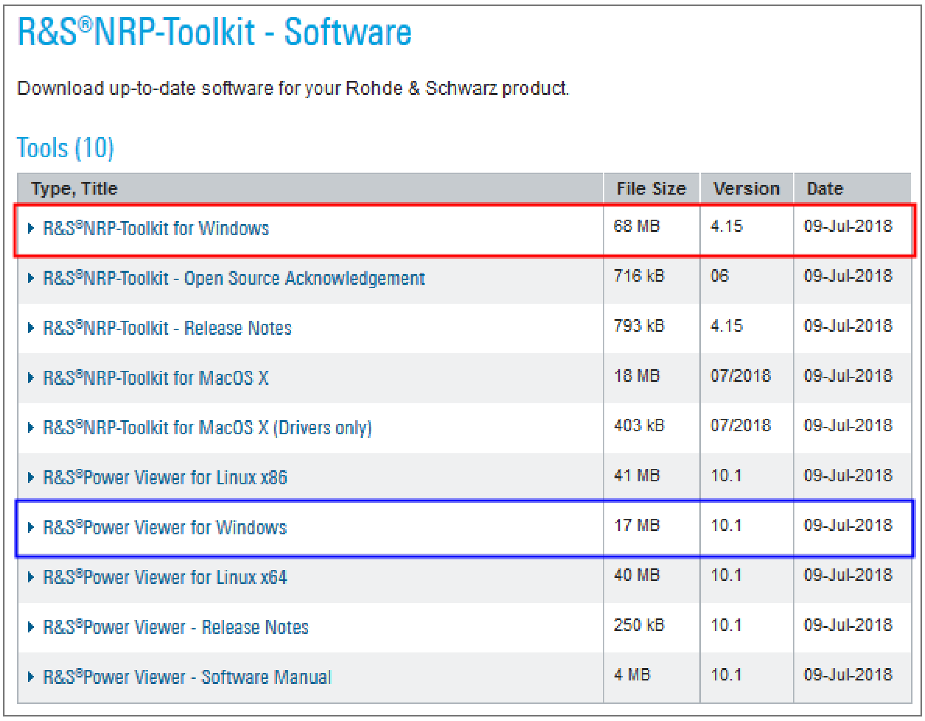
NRP-Z Powersensors system drivers installation

Before using rsnrpz instrument driver, you have to install NRP-Toolkit, available here: https://www.rohde-schwarz.com/software/nrp-toolkit/



R&S®NRP-Toolkit - Software

Download up-to-date software for your Rohde & Schwarz product.

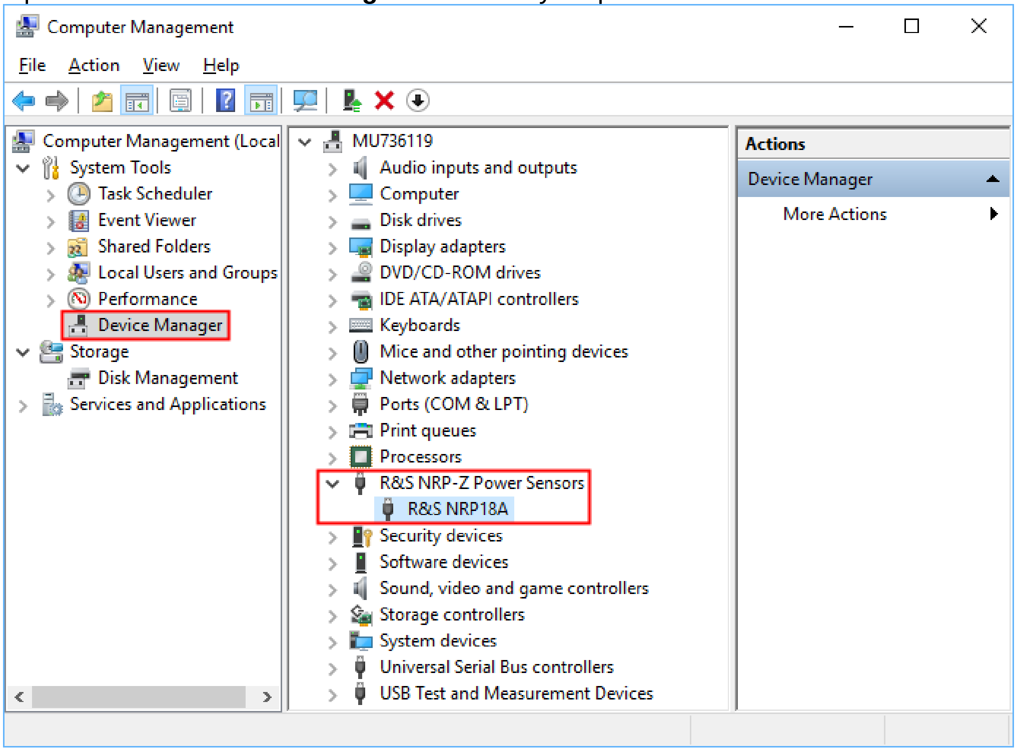
Tools (10)

Type, Title	File Size	Version	Date
R&S®NRP-Toolkit for Windows	68 MB	4.15	09-Jul-2018
R&S®NRP-Toolkit - Open Source Acknowledgement	716 kB	06	09-Jul-2018
R&S®NRP-Toolkit - Release Notes	793 kB	4.15	09-Jul-2018
R&S®NRP-Toolkit for MacOS X	18 MB	07/2018	09-Jul-2018
R&S®NRP-Toolkit for MacOS X (Drivers only)	403 kB	07/2018	09-Jul-2018
R&S®Power Viewer for Linux x86	41 MB	10.1	09-Jul-2018
R&S®Power Viewer for Windows	17 MB	10.1	09-Jul-2018
R&S®Power Viewer for Linux x64	40 MB	10.1	09-Jul-2018
R&S®Power Viewer - Release Notes	250 kB	10.1	09-Jul-2018
R&S®Power Viewer - Software Manual	4 MB	10.1	09-Jul-2018

Power Viewer software installation is not mandatory, but it helps you to verify if your powersensor is working properly before you continue with using instrument driver.

After installation of the NRP-Toolkit, connect your Powersensor to a PC USB port. Powersensor's power supply comes from the USB port. Use the computer USB ports capable of delivering sufficient power or switch to a self-powered USB hub if necessary.

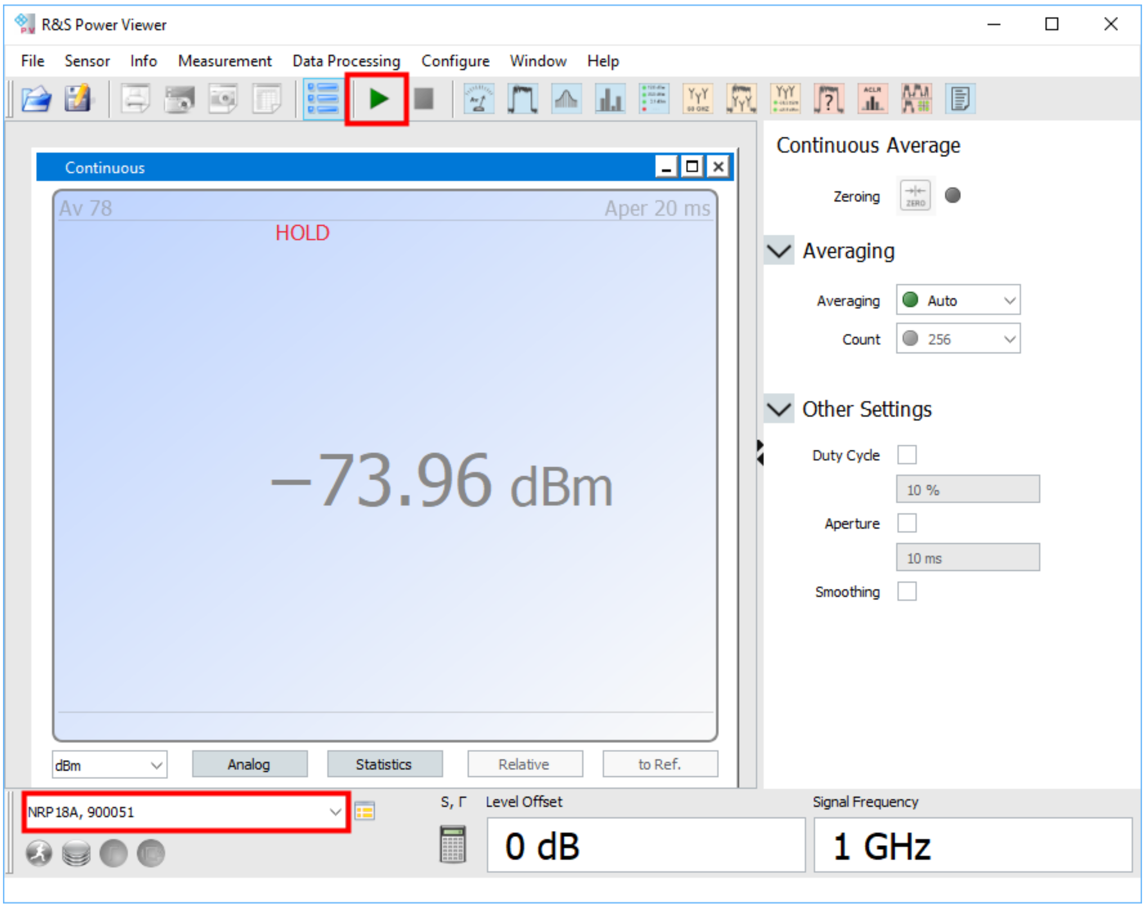
Open **Windows Device Manager** to check if your powersensor is available:



Power Viewer

Power Viewer is a software GUI that provides basic test whether your Powersensor is working properly, as well as great scale of advances features.

Start it from **Windows Start Menu -> R&S Power Viewer -> Power Viewer**:



R&S Power Viewer

Continuous

Av 78 Aper 20 ms

HOLD

−73.96 dBm

Continuous Average

Zeroing

Averaging

Averaging: Auto

Count: 256

Other Settings

Duty Cycle □ 10 %

Aperture □ 10 ms

Smoothing □

NRP18A, 900051

Level Offset: 0 dB

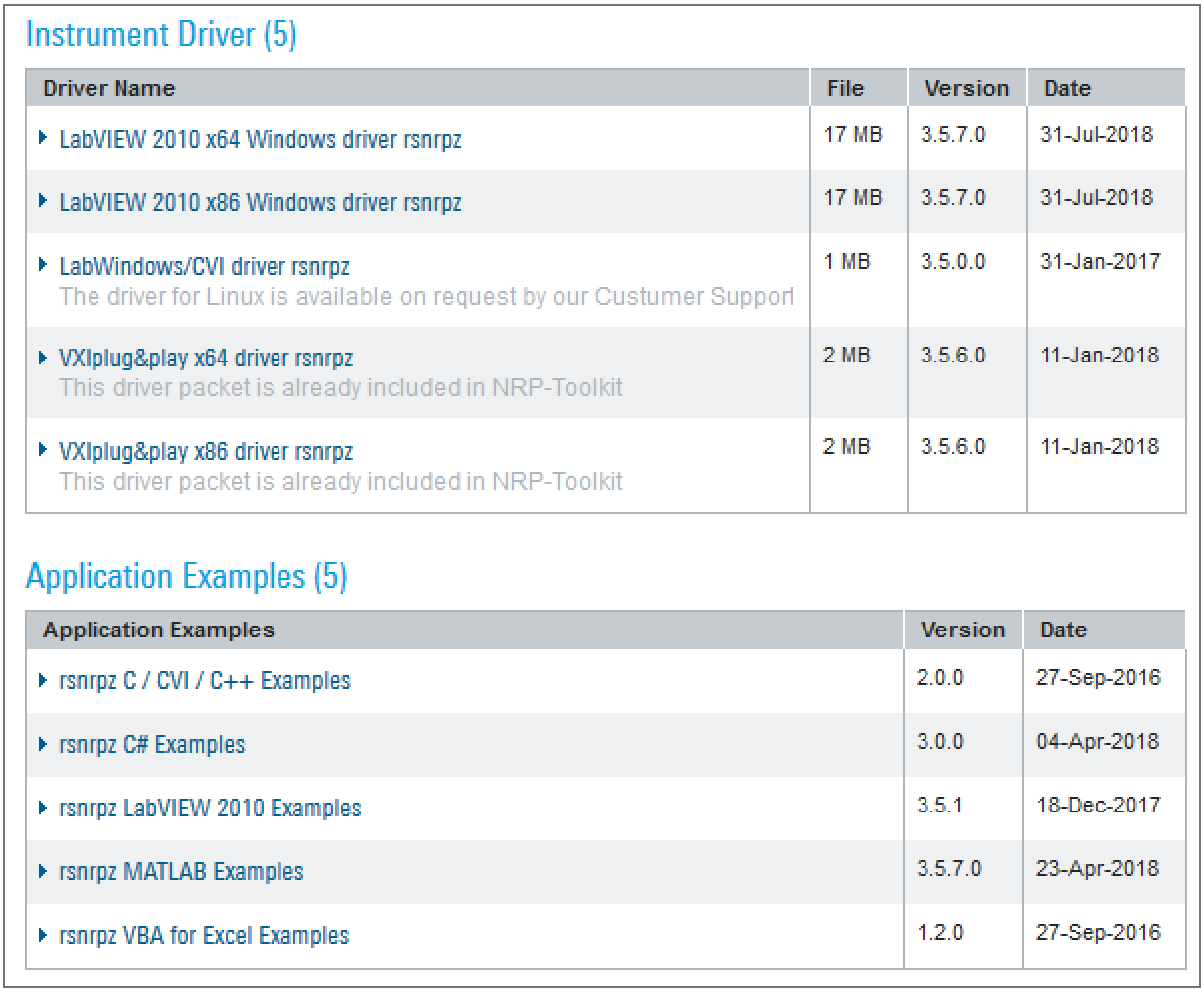
Signal Frequency: 1 GHz

Highlighted are **Start Measurement** button and **Detected Powersensor** indicator.

If your Powersensor is working properly in the Power Viewer, you can continue with the next step, which is instrument driver installation.

NRP-Z Powersensors instrument drivers installation

For all the rsnrpz instrument drivers, follow this link:
https://www.rohde-schwarz.com/driver/nrpz/



Instrument Driver (5)

Driver Name	File	Version	Date
LabVIEW 2010 x64 Windows driver rsnrpz	17 MB	3.5.7.0	31-Jul-2018
LabVIEW 2010 x86 Windows driver rsnrpz	17 MB	3.5.7.0	31-Jul-2018
LabWindows/CVI driver rsnrpz The driver for Linux is available on request by our Custumer Support	1 MB	3.5.0.0	31-Jan-2017
VXIplug&play x64 driver rsnrpz This driver packet is already included in NRP-Toolkit	2 MB	3.5.6.0	11-Jan-2018
VXIplug&play x86 driver rsnrpz This driver packet is already included in NRP-Toolkit	2 MB	3.5.6.0	11-Jan-2018

Application Examples (5)

Application Examples	Version	Date
rsnrpz C / CVI / C++ Examples	2.0.0	27-Sep-2016
rsnrpz C# Examples	3.0.0	04-Apr-2018
rsnrpz LabVIEW 2010 Examples	3.5.1	18-Dec-2017
rsnrpz MATLAB Examples	3.5.7.0	23-Apr-2018
rsnrpz VBA for Excel Examples	1.2.0	27-Sep-2016

LabVIEW instrument driver

You need LabVIEW 2010 or higher to use the R&S rsnrpz LabVIEW driver. Since the LabVIEW driver is only a wrapper over VXIplug&play driver, you need to install the VXIplug&play driver beforehand.

For 64-bit version of LabVIEW:

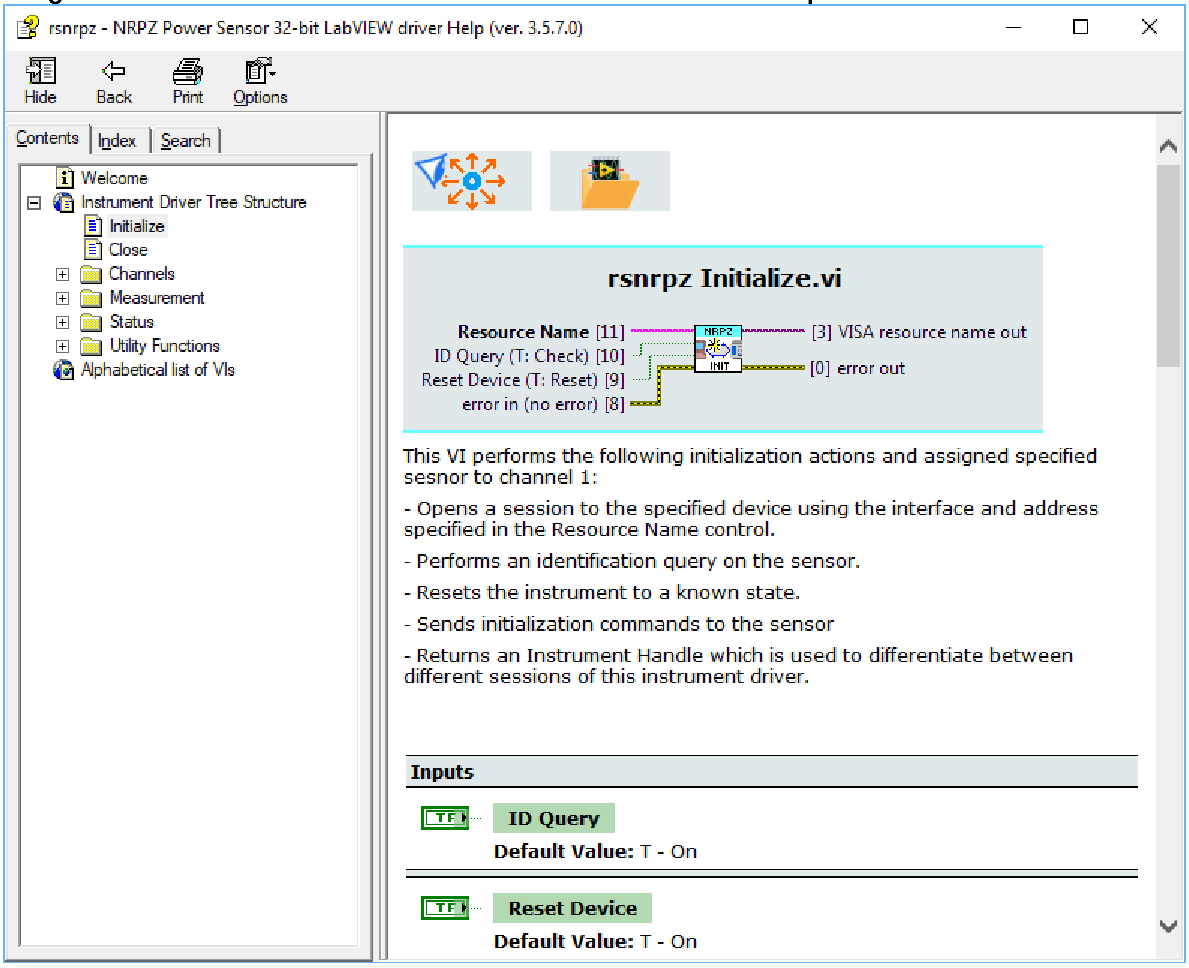
- Download and install **VXIplug&play x64 driver rsnrpz**
- Download and install **LabVIEW 2010 x64 Windows driver rsnrpz**

For 32-bit version of LabVIEW:

- Download and install **VXIplug&play x86 driver rsnrpz**
- Download and install **LabVIEW 2010 x86 Windows driver rsnrpz**

Use the LabVIEW Palette or the **RSNRPZ VI Tree.vi** to access the driver VIs.
The website linked above also contains LabVIEW application examples that help you to start.

For additional information, you can use the driver's help file located here:
Program Files\National Instruments\LabVIEW 2xxx\instr.lib\rsnrpz\RSNRPZ.chm



rsnrpz Initialize.vi

This VI performs the following initialization actions and assigned specified sesnor to channel 1:

- Opens a session to the specified device using the interface and address specified in the Resource Name control.

- Performs an identification query on the sensor.

- Resets the instrument to a known state.

- Sends initialization commands to the sensor

- Returns an Instrument Handle which is used to differentiate between different sessions of this instrument driver.

Inputs

ID Query

Default Value: T - On

Reset Device

Default Value: T - On

LabWindows/CVI instrument driver

LabWindows/CVI rsnrpz instrument driver consists of a ZIP archive containing the driver source files. Out of these source the VXI plug&play instrument drivers are compiled.

Copy the driver source to your CVI project and load the instrument by selecting **rsnrpz.fp**. Header file **NrpControl2.h** is a header file for dynamic link library **NrpControl2.dll** / **NrpControl2_64.dll** that is placed in **c:\Windows\System32** directory.

VXIplug&play instrument driver

This driver is the most universal and can be used in all environments that support calling dynamic or static link library functions.

Paths described in this chapter are default installation paths using Windows 10 64-bit version. For Windows 32-bit version use **Program Files** instead of Program **Files (x86)** directory.

64-bit VXIplug&play driver:

Additional driver files directory:
c:\Program Files\IVI Foundation\VISA\Win64\rsnrpz

Help file:
c:\Program Files\IVI Foundation\VISA\Win64\rsnrpz\rsnrpz_vxi.chm

Driver DLL:
c:\Program Files\IVI Foundation\VISA\Win64\Bin\rsnrpz_64.dll

Driver LLB:
c:\Program Files\IVI Foundation\VISA\Win64\Lib_x64\msc\rsnrpz_64.lib

Header file:
c:\Program Files\IVI Foundation\VISA\Win64\include\rsnrpz.h

C# wrapper:
c:\Program Files\IVI Foundation\VISA\Win64\include\rsnrpz64.cs

Visual Basic .NET wrapper:
c:\Program Files\IVI Foundation\VISA\Win64\include\rsnrpz64.vb

32-bit VXIplug&play driver:

Additional driver files directory:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\rsnrpz

Help file:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\rsnrpz\rsnrpz_vxi.chm

Driver DLL:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\Bin\rsnrpz_32.dll

Driver LLB:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\lib\msc\rsnrpz_32.lib

Header file:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\include\rsnrpz.h

C# wrapper:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\include\rsnrpz.cs

Visual Basic .NET wrapper:
c:\Program Files (x86)\IVI Foundation\VISA\WinNT\include\rsnrpz.vb

Usage of NRP-Z Powersensor instrument drivers

The instrument driver link https://www.rohde-schwarz.com/driver/nrpz/ contains application examples, which you can download to getting started.

Instrument driver structure

Here, we only explain VXIplug&play driver usage. Since the VXIplug&play driver is a compiled LabWindows/CVI driver, they have the same API. For LabVIEW, the dll-wrapper VI names are different from dll-function names. For example, the function `rsnrpz_init()` is in LabVIEW represented by `RSNRPZ Initialize.vi`. However, the structure of both instrument drivers is the same. To find the corresponding function, refer to help files **rsnrpz_vxi.chm** (CVI and VXIpnp) and **RSNRPZ.chm** (LabVIEW).

For backwards compatibility, the following functions are still available, although we do not recommend using them anymore:

```
rsnrpz_AddSensor / RSNRPZ Add Sensor.vi
rsnrpz_CloseSensor / RSNRPZ Close Sensor.vi
```

Powersensor connection initialization

Usage of the instrument driver always starts with Initializing of one or more powersensors. Function prototype:

```
ViStatus rsnrpz_init (ViRsrc resourceName, ViBoolean idQuery,
                  ViBoolean resetDevice, ViSession* instrumentHandle);
```

resourceName is a string with the following format:

USB::<**VendorID**>::<**ProductID**>::<**SerialNumber**>

VendorID is 0xAAD for all Rohde & Schwarz instrument.
ProductID depends on powersensor model:

Powersensor model	ProductID
NRP-Z21	0x0003
NRP-FU	0x0004
FSH-Z1	0x000b
NRP-Z11	0x000c
NRP-Z22	0x0013
NRP-Z23	0x0014
NRP-Z24	0x0015
NRP-Z51	0x0016
NRP-Z52	0x0017
NRP-Z55	0x0018
NRP-Z56	0x0019
FSH-Z18	0x001a
NRP-Z91	0x0021
NRP-Z81	0x0023
NRP-Z31	0x002c
NRP-Z37	0x002d
NRP-Z96	0x002e
NRP-Z27	0x002f
NRP-Z28	0x0051
NRP-Z98	0x0052
NRP-Z92	0x0062
NRP-Z57	0x0070
NRP-Z85	0x0083
NRPC40	0x008f
NRPC50	0x0090
NRP-Z86	0x0095
NRP-Z41	0x0096
NRP-Z61	0x0097
NRP-Z71	0x0098
NRP-Z32	0x009a
NRP-Z211	0x00a6
NRP-Z221	0x00a7

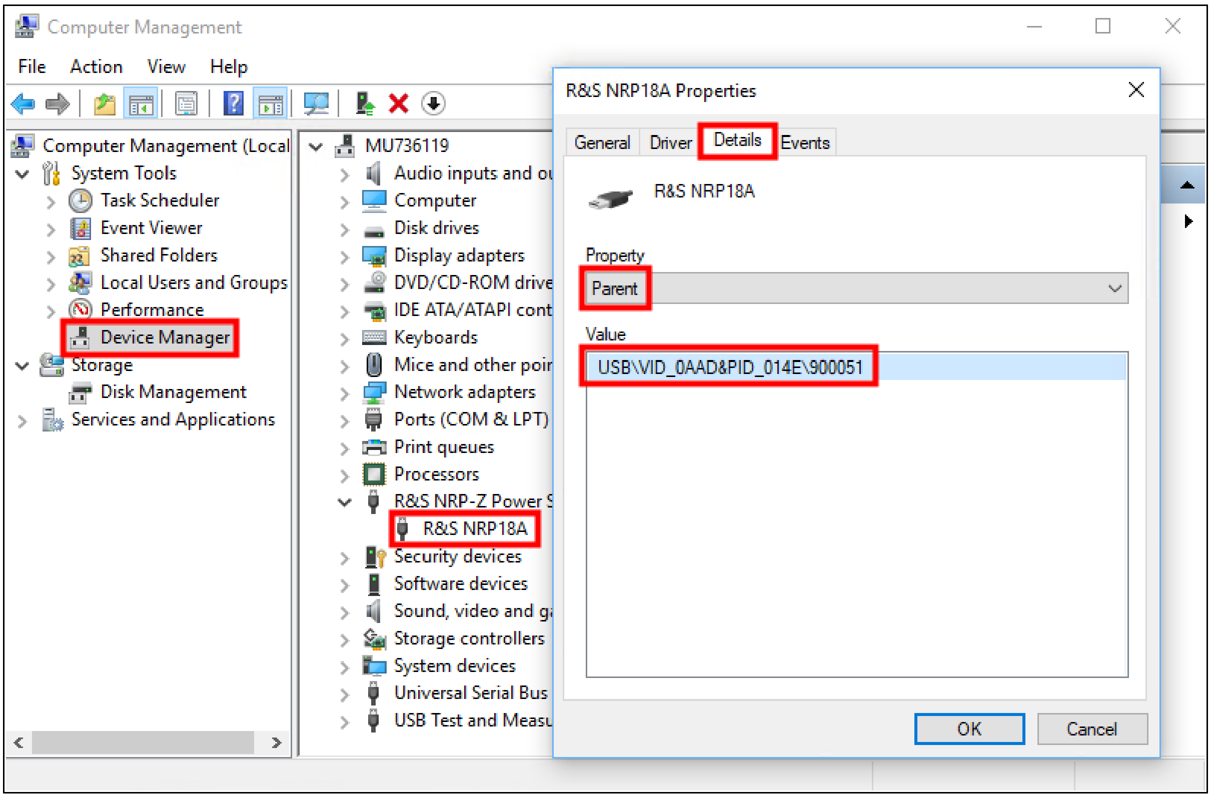
NRP-Z58	0x00a8
NRPC33	0x00b6
NRPC18	0x00bf
NRPC18-B1	0x00c1
NRPC33-B1	0x00c2
NRPC40-B1	0x00c3
NRPC50-B1	0x00c4
NRP8S	0x00e2
NRP8SN	0x0137
NRP18S	0x0138
NRP18SN	0x0139
NRP33S	0x0145
NRP33SN	0x0146
NRP18S-10	0x0148
NRP18SN-10	0x0149
NRP18S-20	0x014a
NRP18SN-20	0x014b
NRP18S-25	0x014c
NRP18SN-25	0x014d
NRP18A	0x014e
NRP18AN	0x014f
NRP18T	0x0150
NRP18TN	0x0151
NRP33T	0x0152
NRP33TN	0x0153
NRP40T	0x0154
NRP40TN	0x0155
NRP50T	0x0156
NRP50TN	0x0157
NRP67T	0x0158
NRP67TN	0x0159
NRP110T	0x015a
NRP40S	0x015f
NRP40SN	0x0160
NRP50S	0x0161
NRP50SN	0x0162
NRP33SN-V	0x0168
NRP6A	0x0178
NRP6AN	0x0179
NRPM3	0x0195
NRP-Z21	0x0003
NRP-FU	0x0004
FSH-Z1	0x000b
NRP-Z11	0x000c
NRP-Z22	0x0013
NRP-Z23	0x0014
NRP-Z24	0x0015
NRP-Z51	0x0016
NRP-Z52	0x0017
NRP-Z55	0x0018

NRP-Z56	0x0019
FSH-Z18	0x001a
NRP-Z91	0x0021
NRP-Z81	0x0023
NRP-Z31	0x002c
NRP-Z37	0x002d
NRP-Z96	0x002e
NRP-Z27	0x002f
NRP-Z28	0x0051
NRP-Z98	0x0052
NRP-Z92	0x0062
NRP-Z57	0x0070
NRP-Z85	0x0083
NRPC40	0x008f
NRPC50	0x0090
NRP-Z86	0x0095
NRP-Z41	0x0096
NRP-Z61	0x0097
NRP-Z71	0x0098
NRP-Z32	0x009a
NRP-Z211	0x00a6
NRP-Z221	0x00a7
NRP-Z58	0x00a8
NRPC33	0x00b6
NRPC18	0x00bf
NRPC18-B1	0x00c1
NRPC33-B1	0x00c2
NRPC40-B1	0x00c3
NRPC50-B1	0x00c4
NRP8S	0x00e2
NRP8SN	0x0137
NRP18S	0x0138
NRP18SN	0x0139
NRP33S	0x0145
NRP33SN	0x0146
NRP18S-10	0x0148
NRP18SN-10	0x0149
NRP18S-20	0x014a
NRP18SN-20	0x014b
NRP18S-25	0x014c
NRP18SN-25	0x014d
NRP18A	0x014e
NRP18AN	0x014f
NRP18T	0x0150
NRP18TN	0x0151
NRP33T	0x0152
NRP33TN	0x0153
NRP40T	0x0154
NRP40TN	0x0155
NRP50T	0x0156

NRP50TN	0x0157
NRP67T	0x0158
NRP67TN	0x0159
NRP110T	0x015a
NRP40S	0x015f
NRP40SN	0x0160
NRP50S	0x0161

NRP50SN	0x0162
NRP33SN-V	0x0168
NRP6A	0x0178
NRP6AN	0x0179
NRPM3	0x0195
NRQ6	0x015B

In case your Powersensor type is missing in the table above, you can find out the Product ID from the **Device Manager** Properties Window. Right-click on the Powersensor, chose **Properties** from the context menu. Switch to tab **Details**, and in **Property** selector choose **Parent:**



R&S NRP18A

Property: Parent

Value: USB\VID_0AAD&PID_014E\900051

In our example, the powersensor has **VID** 0xAAD, **PID** 0x14E and **Serial Number** 900051

Resource name string examples:

USB::0x0aad::0x014E::100001 – NRP-Z11 with Serial Number 100001
USB::0x0aad::0x021::* - first available NRP-Z91 Powersensor
USB::0xaad::* - first available Powersensor

Working with more than 1 powersensor

For legacy reasons, there are two ways how to work with more than one powersensor. We describe them in the following two chapters:

One session, powersensors addressed by channel parameter

This was the original way to communicate with more than one powersensor. That is why almost all functions have parameter `Channel` still as their input parameter. The downside of this solution is the dependency of n-th powersensor on using all n-1 ones. If you want to open powersensor in channel five, you need to open all four powersensors before that. To initialize the first one, you have to call a different function than initializing the further ones. **Although this solution is still supported, we do not recommend using it anymore.**

Here is an ANSI-C example how to initialize access and close more powersensors in this manner:

```
ViStatus iStatus;
ViSession  iHandle;

// Opening of three powersensors
iStatus = rsnrpz_init (“USB::0xAAD::0x000C::100001”, VI_TRUE, VI_TRUE, &iHandle);
iStatus = rsnrpz_AddSensor (iHandle, “USB::0xAAD::0x0021::100011”, 2, VI_TRUE,
VI_TRUE);
iStatus = rsnrpz_AddSensor (iHandle, “USB::0xAAD::0x0003::100010”, 3, VI_TRUE,
VI_TRUE);

// Usage of powersensors (zeroing all of them)
iStatus = rsnrpz_chan_zero (iHandle, 1); //zeroing the 1st powersensor
iStatus = rsnrpz_chan_zero (iHandle, 2); //zeroing the 2nd powersensor
iStatus = rsnrpz_chan_zero (iHandle, 3); //zeroing the 3rd powersensor

// Closing of all three powersensors
iStatus = rsnrpz_CloseSensor (iHandle, 1);
iStatus = rsnrpz_CloseSensor (iHandle, 2);
iStatus = rsnrpz_CloseSensor (iHandle, 3);
```

Unique session for each powersensor

With this approach, every powersensor has its unique handle that are independent. The parameter `Channel` is always set to 1 (in LabVIEW not connected). This is the recommended way of working with more than one powersensor

Same example as in previous chapter using unique sessions approach:

```
ViStatus iStatus;
ViSession  iHandle1, iHandle2, iHandle3;

// Opening of three powersensors
iStatus = rsnrpz_init (“USB::0xAAD::0x000C::100001”, VI_TRUE, VI_TRUE, &iHandle1);
iStatus = rsnrpz_init (“USB::0xAAD::0x0021::100011”, VI_TRUE, VI_TRUE, &iHandle2);
iStatus = rsnrpz_init (“USB::0xAAD::0x0003::100010”, VI_TRUE, VI_TRUE, &iHandle3);

// Usage of powersensors (zeroing all of them)
iStatus = rsnrpz_chan_zero (iHandle1, 1); //zeroing the 1st powersensor
iStatus = rsnrpz_chan_zero (iHandle2, 1); //zeroing the 2nd powersensor
iStatus = rsnrpz_chan_zero (iHandle3, 1); //zeroing the 3rd powersensor

// Closing of all three powersensors
iStatus = rsnrpz_Close (iHandle1); //or iStatus = rsnrpz_CloseSensor (iHandle1, 1);
iStatus = rsnrpz_Close (iHandle2); //or iStatus = rsnrpz_CloseSensor (iHandle2, 1);
iStatus = rsnrpz_Close (iHandle3); //or iStatus = rsnrpz_CloseSensor (iHandle3, 1);
```

Notice that the function `rsnrpz_Close` closes all channels if more than one exist, while `rsnrpz_CloseSensor` only closes the specified channel. For only one powersensor per session, both functions have the same effect.

Examples

All examples are written in LabWindows/CVI with the intention to give user a template about steps and the order of function calls to perform similar measurement tasks in his own programming language. Use the examples from the instrument driver’s website as project templates to insert the following code into.

Simple non-triggered average mode

In this mode, the powersensor measures immediately for defined time (set by rsnrpz_avg_configureAvgManual) and returns the result:

```
ViSession  iHandle;
ViBoolean meas_complete = VI_FALSE;
ViReal64 dResultArray[1];
ViReal dMeasValue = 0.0;
ViInt32 iReadCount;

// Initialization
rsnrpz_init (”USB::0x0aad::0x0021::100001”, 1, 1, & iHandle);

// Configuration of the measurement
rsnrpz_chan_mode (iHandle, 1, 0); //continue average mode
rsnrpz_chan_setCorrectionFrequency (iHandle, 1, 1E9)); //setting corr.
frequency to 1GHz
rsnrpz_trigger_setSource (iHandle, 1, 3); //immediate trigger
rsnrpz_avg_configureAvgManual (iHandle, 1, 5); //manual averaging of 5
values

// Measurement – this section can be repeated to get more measurements
rsnrpz_chans_initiate (iHandle); //start the measurement – from this moment
instrument reacts on trigger event. In case of immediate trigger, it starts
measuring immediately

// Waiting for measurement to finish
do
{
  rsnrpz_chan_isMeasurementComplete(io, 1, &meas_complete)); //check if
measurement is complete
  Delay (0.1); //wait 100ms
 } while (meas_complete == VI_FALSE); //wait until measurement is
completed. Include timeout for this loop to prevent deadlock
rsnrpz_meass_fetchBufferMeasurement(io, 1, 1, &dResultArray, &iReadCount);
dMeasValue = dResultArray[0];
```

Alternatively, for the **//Measurement** section the following code is functionally identical (see the difference between functions:
rsnrpz_meass_readBufferMeasurement
and
rsnrpz_meass_fetchBufferMeasurement

```
rsnrpz_meass_readBufferMeasurement (iHandle, 1, 5000, 1, &dResultArray,
&iReadCount); // Initialize the measurement with timeout of 5000ms, wait
for measurement to finish and read the result
dMeasValue = dResultArray[0];
```

Externally triggered average mode

In this mode, powersensor measurement is triggered by external signal on connector pin, measures for defined time (set by `rsnrpz_avg_configureAvgManual`) and returns the result. The only difference to the previous Simple non-triggered average mode is the following line:

```
rsnrpz_trigger_setSource (iHandle, 1, 1); //external trigger
```

Setting of the Trigger delay in this case is possible with `rsnrpz_trigger_configureExternal`

Internally triggered average mode

In this mode, the powersensor is triggered internally based on incoming signal and configured trigger conditions. After that, it measures for certain time (set by `rsnrpz_avg_configureAvgManual`) and returns the result.

```
ViSession  iHandle;
ViBoolean meas_complete = VI_FALSE;
ViReal64 dResultArray[1];
ViReal dMeasValue = 0.0;
ViInt32 iReadCount;

// Initialization
rsnrpz_init (”USB::0x0aad::0x0021::100001”, 1, 1, & iHandle);

// Configuration of the measurement
rsnrpz_chan_mode (iHandle, 1, 0); //continue average mode
rsnrpz_chan_setCorrectionFrequency (iHandle, 1, 1E9)); //setting corr.
frequency to 1GHz
rsnrpz_trigger_setSource (iHandle, 1, 4); //internal trigger
rsnrpz_trigger_configureInternal (iHandle, 1, 1.0e-6, 0); //trigger level
1uW, positive slope
rsnrpz_avg_configureAvgManual (iHandle, 1, 5); //manual averaging of 5
values

// Measurement - this section can be repeated to get more measurements
rsnrpz_chans_initiate (iHandle); //start the measurement – from this moment
instrument reacts on trigger event.

// Waiting for measurement to finish
do
{
  rsnrpz_chan_isMeasurementComplete(io, 1, &meas_complete)); //check if
measurement is complete
  Delay (0.1); //wait 100ms
 } while (meas_complete == VI_FALSE); //wait until measurement is
completed. Include timeout for this loop to prevent deadlock
rsnrpz_meass_fetchBufferMeasurement(io, 1, 1, &dResultArray, &iReadCount);
dMeasValue = dResultArray[0];
```

Internally triggered timeslot mode

In this mode, the powersensor is triggered internally based on incoming signal and configured trigger conditions. After that, it measures integrated power over defined number of timeslots (set by `rsnrpz_tslot_configureTimeSlot`) and returns the result.

```
ViSession  iHandle;
ViBoolean meas_complete = VI_FALSE;
ViReal64 dResultArray[1];
ViReal dMeasValue = 0.0;
ViInt32 iReadCount;

// Initialization
rsnrpz_init ("USB::0x0aad::0x0021::100001", 1, 1, & iHandle);

// Configuration of the measurement
rsnrpz_chan_mode (iHandle, 1, 2); //timeslot measurement mode
rsnrpz_chan_setCorrectionFrequency (iHandle, 1, 1E9)); //setting corr.
frequency to 1GHz
rsnrpz_trigger_setSource (iHandle, 1, 4); //internal trigger
rsnrpz_trigger_configureInternal (iHandle, 1, 1.0e-6, 0); //trigger level
1uW, positive slope
rsnrpz_tslot_configureTimeSlot (io, 1, 3, 2e-3)); //measurement of 3
timeslots, each of 2ms width

// Measurement - this section can be repeated to get more measurements
rsnrpz_chans_initiate (iHandle); //start the measurement – from this moment
instrument reacts on trigger event.

// Maiting for measurement to finish
do
{
  rsnrpz_chan_isMeasurementComplete(io, 1, &meas_complete)); //check if
measurement is complete
  Delay (0.1); //wait 100ms
 } while (meas_complete == VI_FALSE); //wait until measurement is
completed. Include timeout for this loop to prevent deadlock
rsnrpz_meass_fetchBufferMeasurement(io, 1, 1, &dResultArray, &iReadCount);
dMeasValue = dResultArray[0];
```

About Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, radiomonitoring and radiolocation. Founded more than 80 years ago, this independent company has an extensive sales and service network and is present in more than 70 countries.

The electronics group is among the world market leaders in its established business fields. The company is headquartered in Munich, Germany. It also has regional headquarters in Singapore and Columbia, Maryland, USA, to manage its operations in these regions.

Environmental commitment

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

Certified Quality System
ISO 9001

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