RadiPower®

Product Manual

RF Power Sensor
With external triggering

Models:
RPR3006C
RPR3006P
RPR3006W

CERTIFIED LR
ISO 9001

Radi*P*ower® Product Manual

This service and operating manual pertains to the Radi*P*ower® RF power sensor.
Models: RPR3006C, RPR3006P, RPR3006W
Made by DARE!! Instruments.

We ask that you read this manual carefully before operating your new product and adhere to any safety instructions it might contain.

A Quick Start Guide has been added to this product for your convenience. This double printed A4 sheet contains the basic start-up steps and the safety warnings for the Radi*P*ower®.

Please keep the Quick Start Guide (and this regular manual) close at hand when you operate your new Radi*P*ower®.

Please contact DARE!! Instruments or your local reseller if you have any questions.

Supplier Information

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Table of Content

WARNINGS & PRECAUTIONS

Read the contents of this manual and become familiar with the safety markings, instructions, operation and handling of the system.

Only qualified service personnel is allowed to carry out adjustments, maintenance or repairs on the equipment.

The RadiPower® contains materials that can be recycled and reused to minimize material waste. At the 'end-of-life', specialized companies can dismantle the discarded system to collect the reusable and recyclable materials. If your product is discarded at its 'end-of-life', please return it to your local reseller for recycling.

1 Introduction

1.1 Product Introduction

An accurate power meter is indispensable to perform reliable EMC measurements. The RadiPower® is a RF power meter especially designed for power measurements during EMC tests. The RadiPower® is an affordable, accurate and extremely fast power meter. It provides accurate measurements over a wide frequency range, which enables effective measurements in accordance with the latest EMC standards.

1.2 Related Products

RadiCentre® system

The RadiCentre® is a modular EMC test system that serves as the user and computer interface for all the RadiCentre® plug-in cards and modules (such as the RadiField® system).
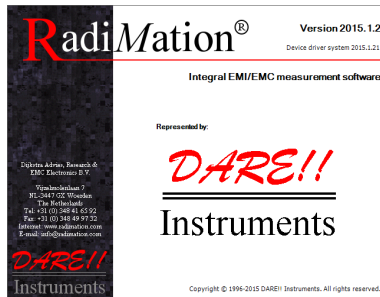
RadiMation® software

RadiMation® is the EMC software package from DARE!! Instruments used for remote control and automated testing of the RadiCentre® plug-in cards and modules (such as the RadiField® system).

Other RadiPower® RF power sensors

RadiPower® 2000 series
Model: RPR2006C, RPR2006P, RPR2018C or RPR2018P.
A RF power sensor to be used together with the RadiPower® plug-in card.

2 The Radi*P*ower®

2.1 Product Characteristics

<u>Fast</u> - EMC immunity measurements are time consuming. This is mainly dependent on the number of frequency points, the dwell time and the speed of the power meter. As the first two parameters are generally prescribed by standards, the only one that can be optimized is the speed of the power meter. The unprecedented detector technology of DARE!! makes extremely fast and accurate power measurements a reality, even at low power levels.

<u>Accurate</u> - Accuracy is another concern in addition to speed, when performing EMC measurements. The Radi*P*ower® allows for high precision EMC measurements with a large dynamic range. Because the Radi*P*ower® has a high accuracy over the complete band, it is suitable for measurements in accordance to automotive, military, telecom and EMC basic standards such as the IEC61000-4-3/6 standards.

<u>Low Measurement Uncertainties</u> - Impedance mismatches contribute to the measurement uncertainty. The Radi*P*ower® has a very low Standing Wave Ratio (SWR) and as a result, measurement uncertainties are low compared to other contributions in the EMC measurement setups.

<u>Easy to Use</u> - With the USB interface the Radi*P*ower® is easy to use. In addition, the Radi*P*ower® can be controlled by both the Radi*M*ation® integral EMC measurement software and any other EMC measurement packages, because all the software codes needed to control the unit are available. For 'stand-alone use' of the Radi*P*ower®, Radi*M*ation® Free measurement software is delivered with the system. By using the USB1004A plug-in card, up to four Radi*P*ower® heads can be connected to a single plug-in card in a Radi*C*entre®.

<u>CW Signals & RF Bursts</u> - To enable the measurement of RF bursts, the Radi*P*ower® can also be delivered as a RF pulse power head. This P-version of the Radi*P*ower® is able to measure RF bursts as short as a few microseconds. The C-version of the Radi*P*ower® only supports RMS-measurements for CW signals.

<u>Simultaneous Power Measurements on Multiple Ports</u> - In combination with Radi*M*ation®, the RPR3006W can be used to perform simultaneous power measurements on multiple ports of MIMO devices in accordance with EN 300 328 or EN 301 893. All necessary parameters are calculated by Radi*M*ation® Free.

The RadiPower® RF power sensor is optimized for EMC measurements, where a high dynamic range, together with fast measurements, are required even at low power levels.

Where most power sensors require long measurement times at low RF levels, the RadiPower® RF power sensor is able to perform accurate power measurements, with a high measurement speed, at power levels close to the noise floor, without the need for zero adjustment!

The RadiPower RF power sensor is mounted in a rugged metal housing to ensure a long life and excellent RF shielding.

The power sensor is equipped with an N-type precision RF input connector and a mini USB-B connector for communication with a computer.

Figure 1: A RadiPower® RF power sensor

2.2   Components

The Radi*P*ower® is delivered with the following items:

Radi*P*ower® RF power sensor
Model: RPR3006C, RPR3006P or RPR3006W.

Shielded USB cable
Model: USB A male to mini USB B male.
To connect the RF power sensor with the plug-in card.

Trigger cable
For measurements on multiple ports.

Supporting documentation in the form of:

- USB stick containing:

  - The (digital) User Manual and Quick Start Guide.

  - The installation of Radi*M*ation® Free software and drivers.

  - Optional - The calibration certificate for the power meter (if a certification was requested).

- Hardcopy of the Quick Start Guide

2.3   Different Models

The Radi*P*ower® RF power sensor is available in 3 models; the RPR3006C, RPR3006P, and RPR3006W. The differences between these models is the measurements that they can perform.

- C-model
  The C-model supports RMS-measurements for CW signals.

- P-model
  The P-model can measure the envelope of RF bursts as short as hundred nanoseconds.

- W-model
  The W-model is dedicated to simultaneous power measurements on wireless devices (WLAN) with single or multiple antenna ports (MIMO) according to EN 300 328 or EN 301 893.

2.4   Functional description

The Radi*P*ower® uses a high speed RMS power detector to measure the RF signal, independent of the crest factor of the input signal waveform. The detected signal is sampled, at high speed, by a high speed ADC and the samples are processed by a powerful DSP. The sophisticated software enables unique functions, such as envelope tracing and burst logging. The table on the following page shows which models support the different measurement modes.

Mode	RPR3006C	RPR3006P	RPR3006W
CW power	√	√	√
Peak power	√	√	√
Envelope tracing		√	
Burst logging			√

2.4.1 CW Mode

The RadiPower® performs RMS power measurements of CW-signals.

In RMS mode the RadiPower® samples the signal at high speed. The RMS value of the power is calculated over the number of samples defined by the filter setting and can be read by a simple command. Due to the high sampling speed the number of readings is high, even at large filter settings.

2.4.2 Peak Mode

The RadiPower® performs peak measurements (max hold) on RF-signals.

In peak mode the RadiPower® keeps track of the highest level that has been measured. This can be done for an infinite time. Once the power level has been read, the maximum value is automatically reset.

2.4.3 Envelope Tracing

The RadiPower® captures the envelope of an RF-signal.

This is a unique feature which enables the possibility to visualize, for example, the inrush phenomena of transmitters or signal generators, without the need for an expensive RF analyzer. Due to the extensive trigger possibilities, almost any RF-signal can be captured in the large buffers of the RadiPower®.

2.4.4 Burst Mode

The RadiPower® logs RF-bursts of a wide variety of RF standards, including LTE, WiMAX, W-CDMA, CDMA2000, TD-SCDMA, and EDGE.

For these complex transmitters, such as WLAN devices, a special burst mode has been implemented. During the observation time, the time and RMS power of each RF-burst is logged into memory. These measurements can be used to perform conducted measurements of RF output power, according to the latest version of the ETSI EN 300 328 or EN 301 389 standard. Parameters such as medium utilization, Tx-gap and Tx- sequence are automatically calculated and displayed on the PC screen by RadiMation® Free software. The RadiPower® is equipped with a trigger in- and output to enable simultaneous measurements on multiple ports of MIMO devices. By daisy chaining the trigger signal of the RPR3006W, multiple power meters can be synchronized using RadiMation® Free software.

2.5   Theory of operation in burst mode

The RPR3006W is especially designed for (MIMO) measurements according to EN 300 328. For this purpose the power meter is equipped with a RMS responding power detector.

The power of the RF signal in an equivalent decibel-scaled value is precisely converted into DC voltage on a linear scale, independent of the crest factor of the input signal waveforms. This DC voltage is translated to a power value in dBm or Watts, based on the frequency of the RF signal. Therefore each sample measured by the RPR3006W represents the RMS power. The sample speed in burst mode can be set to 1 MSps or 5 MSps.

All samples within a RF burst are calculated by the power meter according to:

$$P_{burst} = \frac{1}{m} \sum_{n=1}^{m} P_{sample}(n) \ [W]$$

Where m is the number of RMS power samples within the start and stop time of the RF burst. These times are defined as the points where the power is at least 30 dB below the highest value of the measured samples. This value (threshold level) can be set in Radi$M$ation® software. For each RF burst, the RMS power, start time and stop time is stored in the power meter.

For MIMO measurements using multiple RPR3006W power meters, the total RF power of a burst is calculated using for example Radi$M$ation® software (Chapter 4.2). The burst data of each power meter is gathered by Radi$M$ation® software and calculated to a total power of the RF burst according to:

$$P_{burst,\,total} = \sum_{i=1}^{j} P_{burst}(i) \ [W]$$

Where j is the number of RPR3006W power meters of the MIMO test setup. Corrections like coupler values as well as beamforming gain (Y) and the assembly gain (G) of the DUT can be added in Radi$M$ation® software and will be accounted for in the results of the total power of the bursts.

3 Installation

3.1 Hardware Configuration

Connect the Radi*P*ower® sensor to a Windows computer with a USB 1.1 compatible port.
Use the supplied USB cable to connect the Radi*P*ower® sensor.

The hardware installation for the Radi*P*ower® sensor is now complete. The user can control the Radi*P*ower® using the Radi*M*ation® EMC test software.

3.2 Software Configuration

In order to control the Radi*P*ower® from a computer, one can use either custom made software or the Radi*M*ation® EMC software package from DARE!! Instruments (to be purchased separately).

3.2.1 Radi*M*ation® software

1. Configure the Radi*M*ation® software for a Radi*P*ower® / Radi*C*entre® power meter. Configure a device driver and select the correct communication port and device number.

2. In the 'equipment list' that you are using, select the 'power sensor' device driver.

3. Open a Test Set-up File (TSF) and click on the 'Inputs' button. Select the power sensor(s) to be used.

4. Save the TSF.

Radi*M*ation® is now ready for use with the Radi*P*ower® / Radi*C*entre® power meter.
The Radi*M*ation® software package verifies the power meter at the beginning of each test (if a power sensor is selected).

If you are using the Radi*P*ower® / Radi*C*entre**®** power meter system with any other EMC test software package, we refer you to chapter 5 'Radi*P*ower® Command Set'. These commands can only be used in combination with a set of Windows® DLL's which is available on request.

4   Using the Radi*P*ower®

4.1   'Stand Alone' Use

Connect the Radi*P*ower® sensor to a Windows computer with a USB port for 'stand-alone' use. Use the supplied USB cable to connect the sensor to your computer.

Windows will prompt that new hardware has been found. The USB-driver for the Radi*P*ower® is Windows certified and will be loaded automatically from the Windows update.

If the drivers are not loaded automatically, these can be installed manually from the supplied USB-key. Follow the normal instructions from Windows to install the drivers manually.

Once the drivers are loaded successfully, the Radi*P*ower® will be shown in the device list.
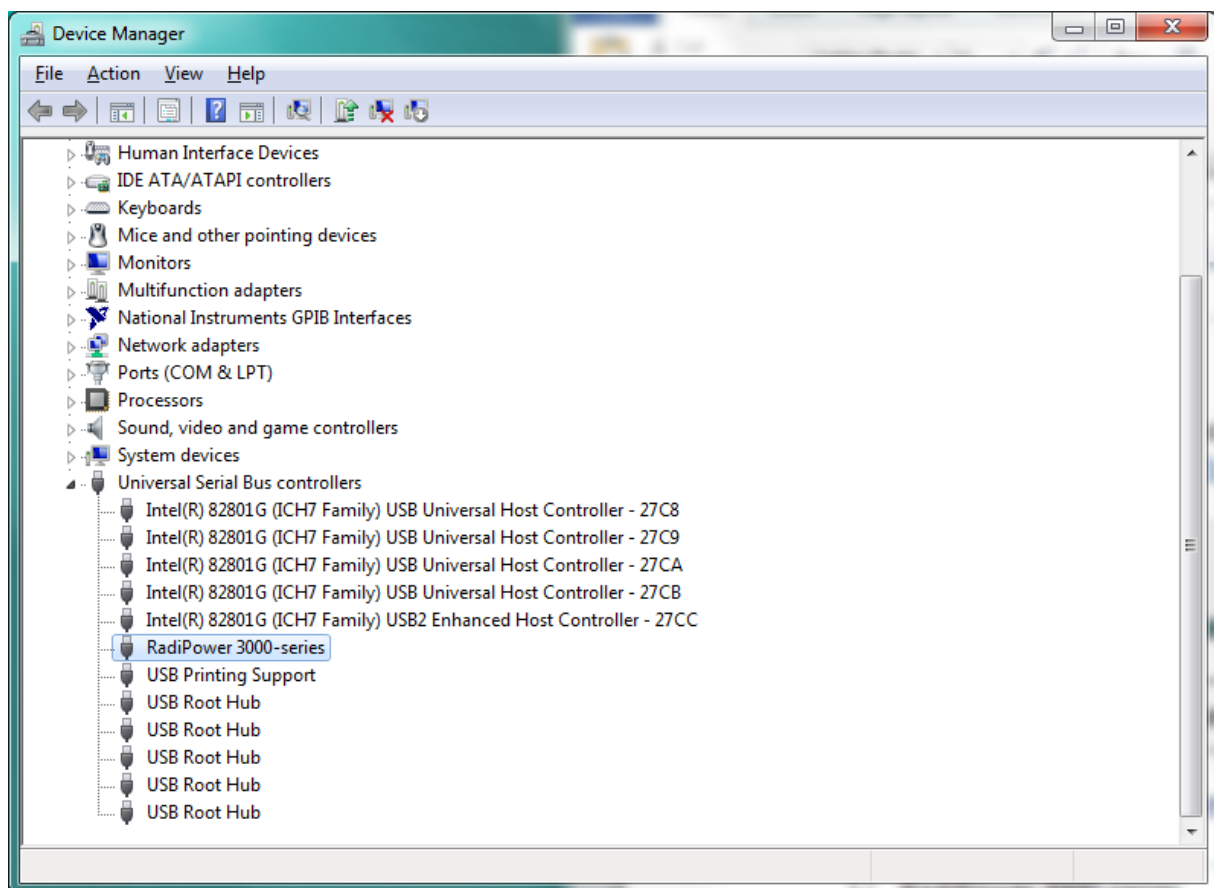
4.2 Setting Up a MIMO Measurement Using RadiMation® Free

Start-up RadiMation® Free[1]. To begin, add the power meters, which will be used for the measurements, in the configuration. From the menu bar select "Configuration" and select "Configuration" again.
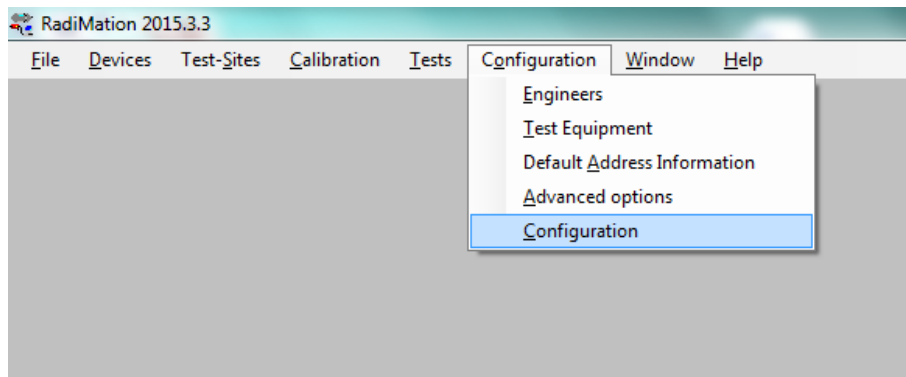
In the configuration window, select the tab "device drivers" and select "power meters" from the drop down box.
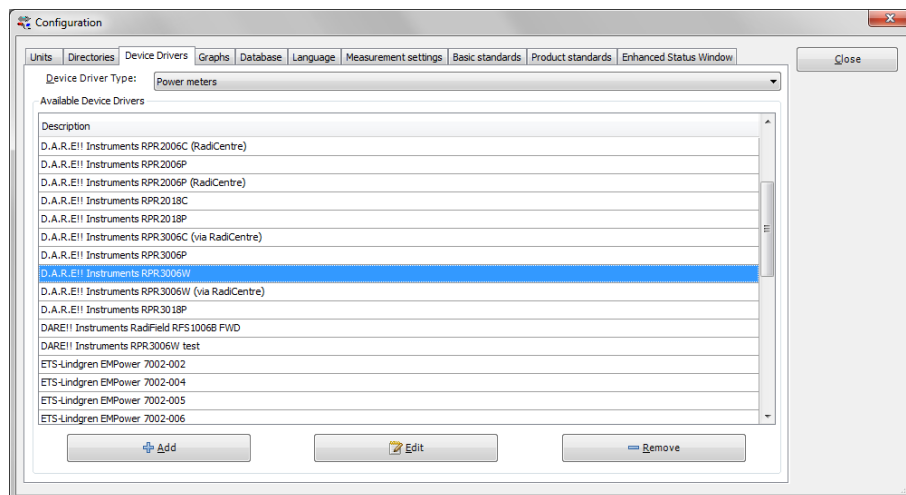
Press the "Add" button. From the list, search for "DARE!! Instruments RPR3006W" and select this power meter.

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[1] Please note that the screenshots presented in this manual may differ from the actual RadiMation® version that is being used.

Enter a unique name for the power meter and press "OK". The power meter is now in the configuration list.
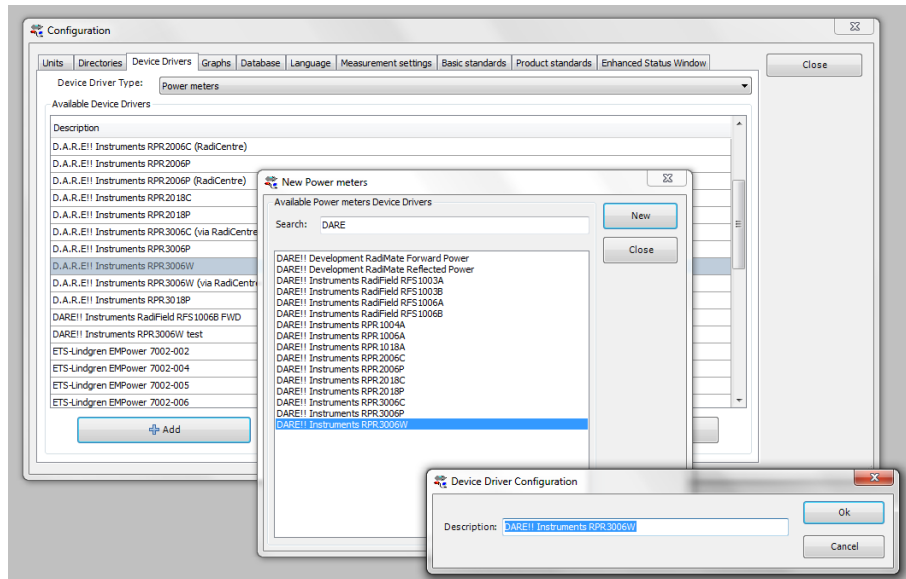
Make sure that the power meter is connected to your PC with the USB port and that the drivers are installed. Check the Windows Device Manager to determine if the Radi*P*ower® USB is loaded correctly.

From the configuration list, select the Radi*P*ower® and press "Edit". A Device Driver Settings window will now appear.

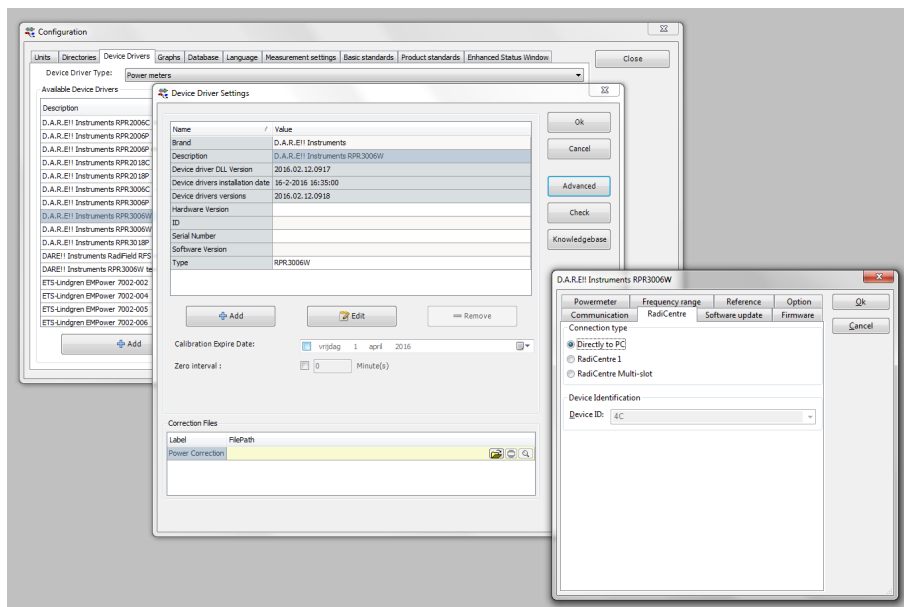- Press the "Advanced" button.

- Select the "Option" tab and set the desired filter for CW measurements, for example: Filter 5.

- Select the "RadiCentre" tab and select "Directly to PC".

- Select the "Communication" tab and select "Detect". Press Configure.

A new window will appear to detect the USB identifier of the Radi*P*ower®. Make sure that only one Radi*P*ower® is connected and press "Detect".
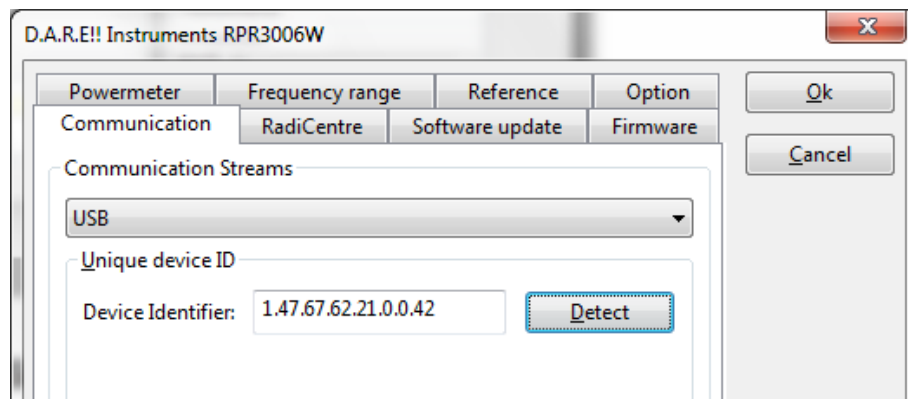
If the Device Identifier is detected, press "OK".
Press "OK" again to return to the Configuration window.

Perform a final check to determine whether the Radi*P*ower® is ready to be used. From the configuration windows press the "Check" button.
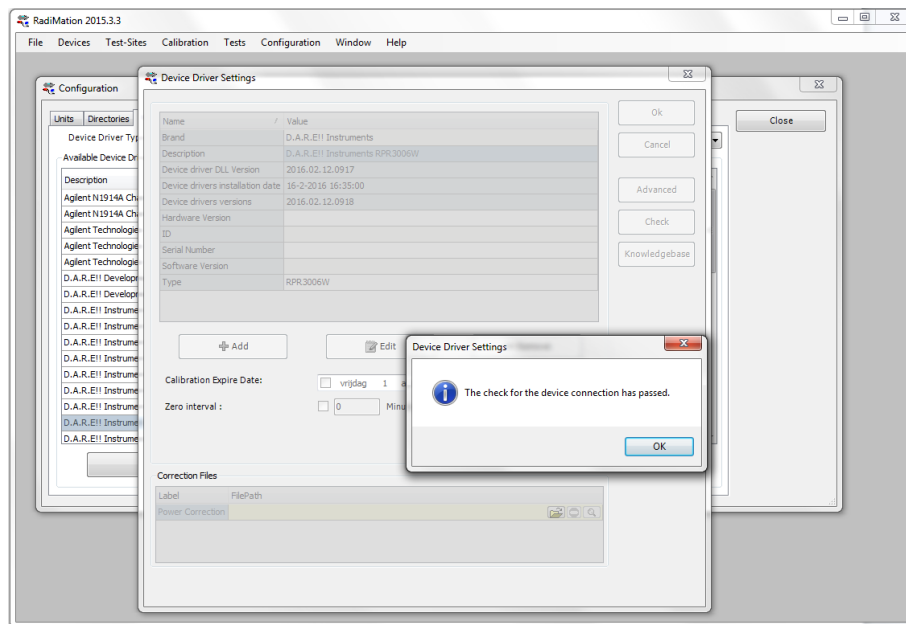
Repeat the procedure to add more Radi*P*ower® heads. Please note that each Radi*P*ower® has to have a unique name.

If all necessary power meters are added in the configuration, the measurement can be setup and all Radi*P*ower® can be connected to the USB ports of the PC.

4.3   Adding coupler values in Radi*M*ation®

In a MIMO test setup, power measurements are often performed using a coupler on the antenna port. Coupling factors can easily be added in Radi*M*ation® using a correction file. If no couplers or additional attenuators are used in the setup, there is no need to create and apply these correction files.

To create a correction file, select "File" – "New" – "Correction" from the menu bar.

Press "Colums/units" to create to columns for Frequency and Attenuation.

To create a constant correction versus frequency:

- Press "Add Row" and enter the lowest frequency with the corresponding attenuation.

- Press "Add Row" again and enter the highest frequency with the corresponding attenuation.
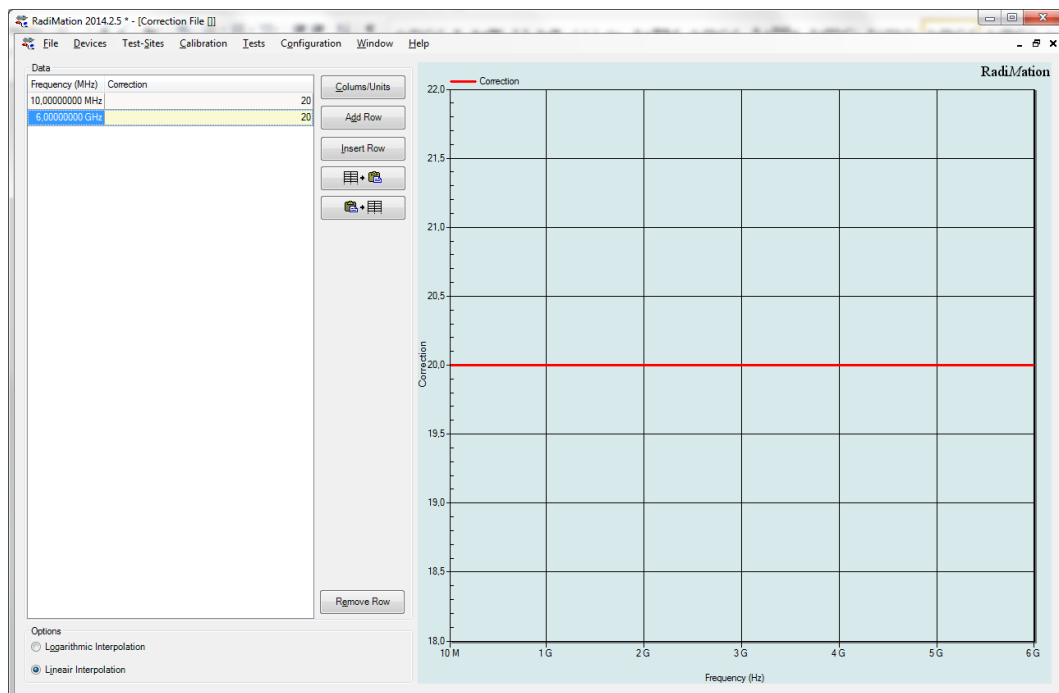
If calibration data of the coupler is available, this data can be used to create an accurate correction for the coupler.

After all data has been entered, select "File" – "Save Correction As" to save the data.

Next, the correction data of the coupler has to be added to the correct power meter. Select "Configuration" and "Configuration" again. In the Configuration window select the "Device drivers" tab and select the power meter for which the correction has to be added. Press "Edit".

Press the "file open"- button in de Correction Files area to select the correction file.
Perform this procedure for each power meter for which a coupler correction has to be added.
Radi*M*ation® will now automatically calculate the power values, including the coupler values.

4.4 Performing a MIMO measurement with RPR3006W and Radi*M*ation® Free

Create a new EUT-file by selecting "File" – "New" – "EUT" from the menu bar. Choose a filename and select "OK". A new EUT-window will now be opened.

From the menu bar select "Test" – "Radiated Emission" – "Burst".
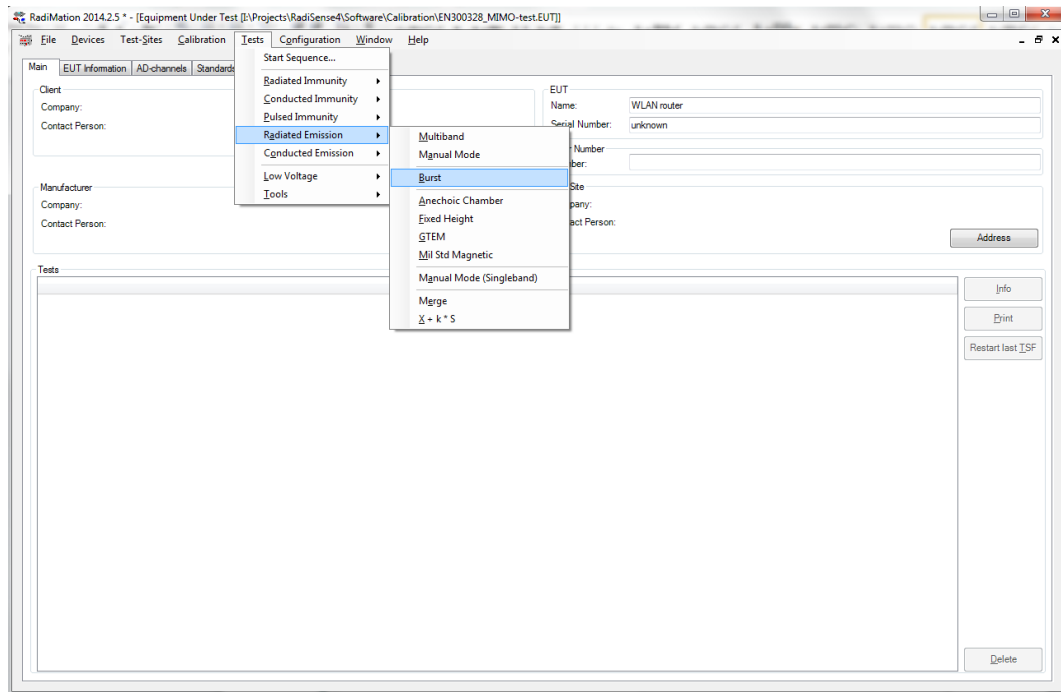
Press "New" to create a new TSF-file (Test Setup).

A new window will be opened in which the test can be configured.

- Press the "+ Add" button to add all the power meters to your test.

- Enter the correct parameters on the right hand side (frequency, trigger level, etc.).
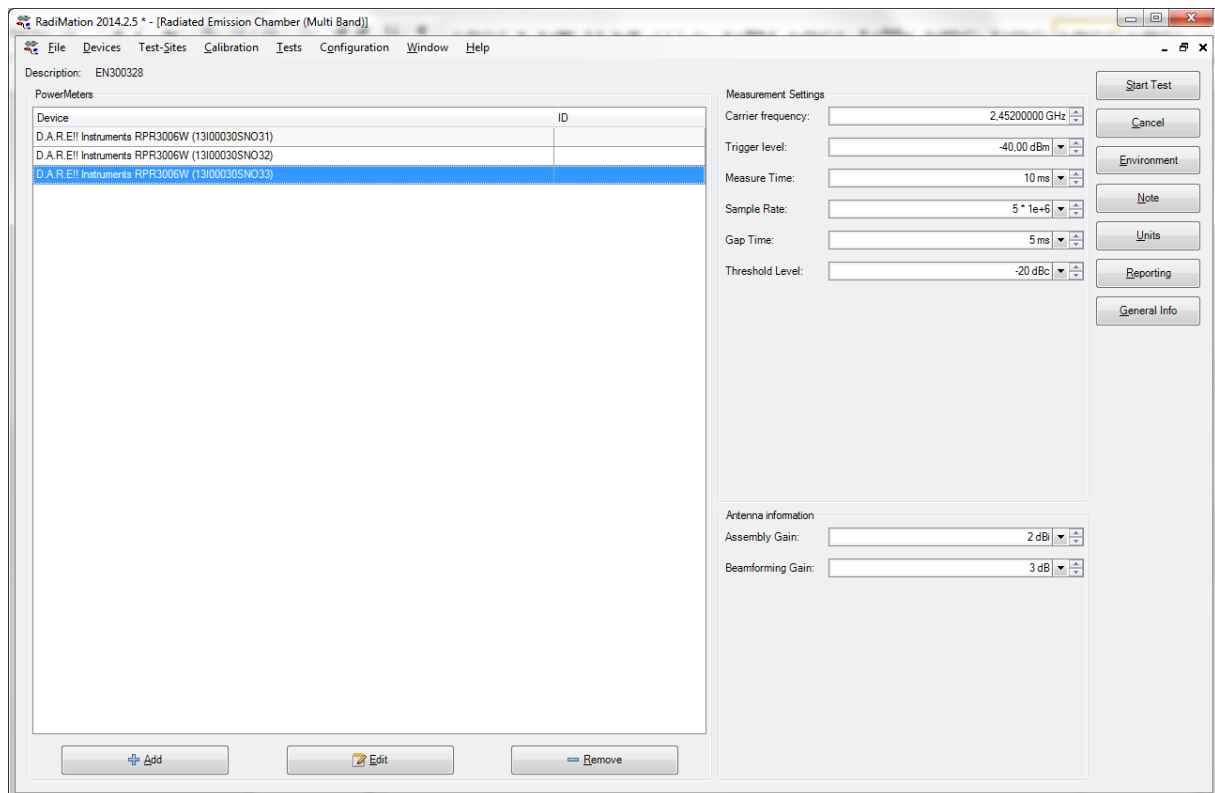
Press "Start Test" to start the conducted power measurement test with multiple power meters. Enter a filename to save the test.

After a measurement has been performed, all parameter such as Max e.i.r.p, medium utilization, Duty cycle, Min Gap time and Max. Sequence time are calculated by Radi*M*ation®.
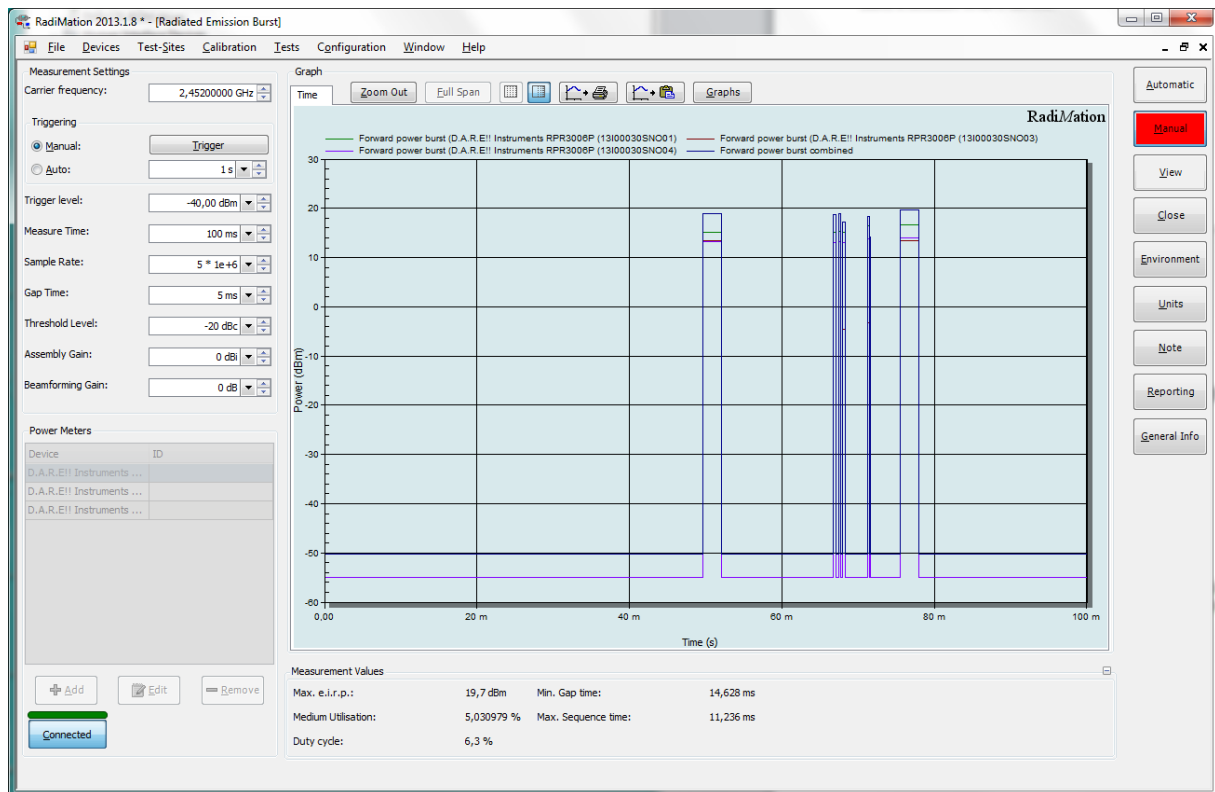
4.5   Firmware update using Radi*M*ation®

If a new firmware version for the Radi*P*ower® is available, this version can be loaded into the power sensor using Radi*M*ation®.

Connect the Radi*P*ower® to your computer, start Radi*M*ation® and load the power meter device. Go to the "Device driver settings" and press "Advanced". Select the "firmware"-tab and browse for the update file (*.upd).
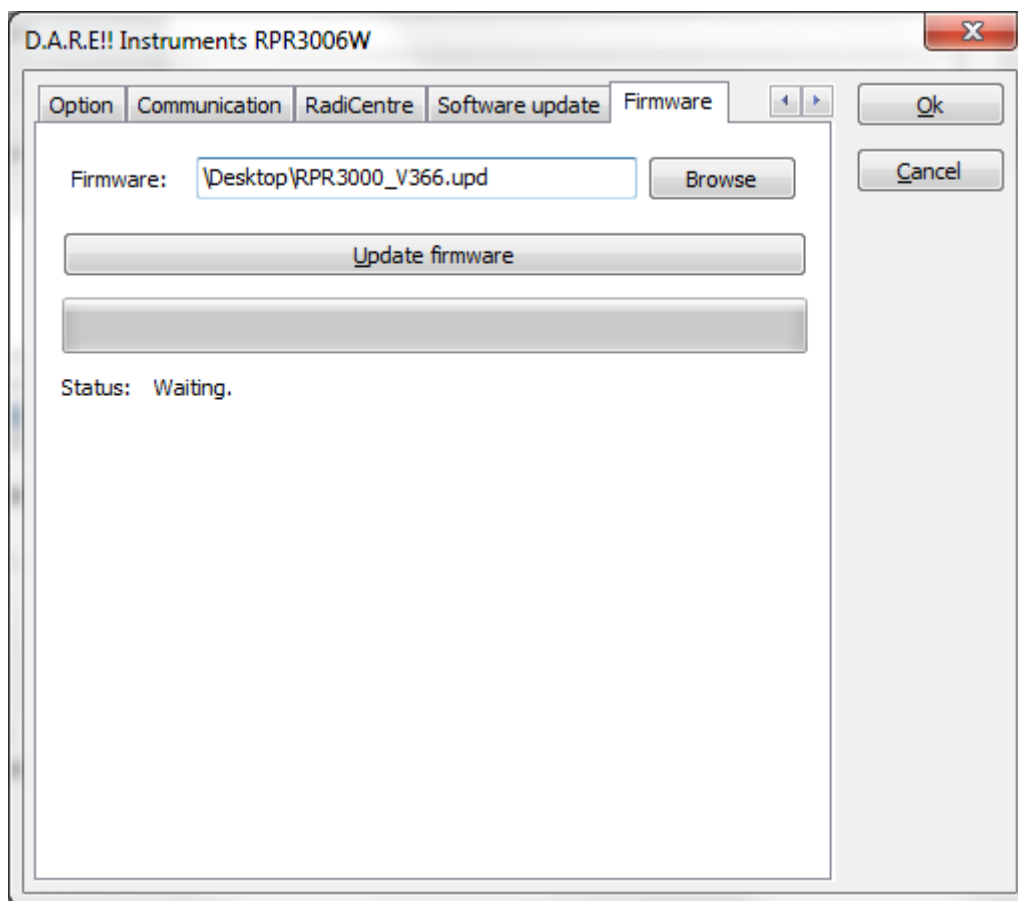
Press "Update firmware" to start the process. The update will not affect any correction data stored in the power sensor.

5   Radi*P*ower® Command Set

5.1   General

The Radi*P*ower® uses a high speed communication protocol that is supported by Radi*M*ation®. This results in short transfer times of the data, even at long observation times or large numbers of samples.

As a result, a simple terminal program cannot be used to communicate with the Radi*P*ower® directly. The Radi*P*ower® uses a USB2.0 FTDI transceiver with a D2XX driver for Windows. For third party software development, programmers can use the API which is provided by DARE!! on request.

5.2   Default Values

The following table shows the default values for the Radi*P*ower®. Use the "RESET" command to return to these factory defaults values:

Command	Default value	Description
MODE	0	RMS power measurement.
AUTO_STORE	0	Parameter changes will not be stored automatically.
FREQUENCY	1300000 kHz	1300 MHz
FILTER	AUTO	Automatic filter setting (related to power level).
POWER_OFFSET	0.00	Sets power offset to 0.00 dB.
POWER_UNIT	0	Sets measurement unit to dBm.
VBW (mode 0) VBW (mode 1, 2 and 3)	1k AUTO	1kHz VBW in RMS mode for CW signals. Automatic VBW setting for all other modes.
ACQ_SPEED	1000	1 MSps
ACQ_LOG_THRESHOLD	-40.0	-40 dBm
ACQ_LOG_TRIG_TYPE	0,1	Internal triggering, rising edge.
ACQ_LOG_TRIG_SET	1,2	2 samples with 2 samples distance for evaluation.
ACQ_AUTO_TRIGGER	0	Single trigger
ACQ_LOG_DELAY	0	No delay time before trigger.
ACQ_LOG_TRIG_HOLDOFF	0	No hold off before trigger.
BM_MEASURE_PERIOD	60000	60000 ms
BM_NOISE_TIMER	10	10 samples
BM_TRIG_LEVEL	-40	-40 dBm

5.3   General Commands (All Modes)

The following table shows the general commands for the RadiPower® RF power sensor. Please note that every command has to be terminated with a carriage return.

Command	Reply	Description
"*IDN?"	"DARE!!, RPR30XXY, version"	Returns the ID of the RadiPower sensor.
"ID_NUMBER?"	"x.x.x.x.x.x.x.x"	Returns the unique id number. For example: 114.80.79.87.20.0.0.225
"VERSION_SW?"	"2.27"	Returns SW version.
"REBOOT SYSTEM"	"OK"	Reboots the system / Restarts embedded software.
"RESET"	"OK"	Resets the RadiPower to default values.
"TEMPERATURE?"	"272"	Returns board temperature in 0.1 degrees. In this example: 27.2°C
"MODE <m>"	"OK"	Sets mode, with: <m> = 0 for RMS mode <m> = 1 for max hold (peak) <m> = 2 for envelope tracing mode <m> = 3 for burst mode
"MODE?"	"0", "1", "2" or "3"	Returns current mode.
"STORE"	"OK"	Stores the current settings in flash memory.
"AUTO_STORE <s>"	"OK"	Sets the auto store mode, with: <s> = 0 (settings will not be automatically stored) <s> = 1 (settings will be stored in flash after each change of the settings)

This table continues on the next page.

General Commands (All Modes), part 2

Command	Reply	Description
"AUTO_STORE?"	"0" or "1"	Returns the current store setting.
"FREQUENCY <f>"	"OK"	Set the frequency <f> in kHz.
"FREQUENCY?"	"1300000 kHz"	Returns the frequency in kHz. In this example: 1.300.000 kHz
"FREQUENCY? MIN"	"9 kHz"	Lowest measurable frequency. In this example: 9 kHz
"FREQUENCY? MAX"	"6000000 kHz"	Highest measurable frequency. In this example: 6 GHz
"FILTER AUTO"	"OK"	Sets the filter to automatic. See specification for setting.
"FILTER <n>"	"OK"	Sets the number of samples used to calculate the RMS power value, with: <n> = 1 (10 samples) <n> = 2 (30 samples) <n> = 3 (100 samples) <n> = 4 (300 samples) <n> = 5 (1000 samples) <n> = 6 (3000 samples) <n> = 7 (5000 samples)
"FILTER?"	"1" to "7" or "AUTO"	Returns the filter setting.
"POWER?" [2]	"-38.81 dBm"	Returns the measured power in dBm. In this example: -38.81 dBm
"POWER_OFFSET <p>"	"OK"	Sets the power offset, with: <p> = -100.00 dBm to +100.00 dBm
"POWER_OFFSET?"	"30.00 dB"	Returns the power offset in dB. In this example: 30 dB
"POWER_UNIT <u>" [3]	"OK"	Sets the power unit, with: <u> = 0 for dBm and 1 for Watts

This table continues on the next page.

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[2] Not supported in Mode 3
[3] Applies only to the "POWER?" command in mode 0 and mode 1

General Commands (All Modes), part 3

Command	Reply	Description
"POWER_UNIT?"	"0" or "1"	Returns the power unit.
"VBW <b>" [4]	"OK"	Sets Video bandwidth (VBW), <b> can be 1k, 10k, 100k, 1M or 10M (Hz). The VBW should be 10 times smaller than the lowest frequency to be measured.
"VBW AUTO" [3]	"OK"	Set the VBW to automatic. The VBW is coupled to the sample speed of the power meter: VBW = 10 MHz at 20 MSps and 40 MSps VBW = 1 MHz at 5 MSps VBW = 100 kHz at 1 MSps and 500 kSps VBW = 10 kHz at 100 kSps VBW = 1 kHz at 10 kSps and 50 kSps
"VBW?" [3]	"1k", "10k", "100k", "1M", "10M" or "AUTO"	Returns the VBW setting
"ACQ_SPEED <s>"	"OK"	Sets ADC sample speed in kSps. <s> can be 10, 50, 100, 500, 1000, 5000, 10000, 20000 or 40000
"ACQ_SPEED?"	"5000"	Returns ADC speed in kSps
"FILTER_BW?	"BW"	Returns the filter bandwidth <BW> in Hz. Sample speed divided by number of averages defined by the filter setting.

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[4] Only for the RPR3006C

5.3.1 Remarks about the general commands

In RMS mode, a new power measurement is started after the "power?"-command has been given. Depending on the filter setting, the Radi*P*ower® performs the required number of measurements and returns the average value of all linear power samples.

Acquisition speed, filter and VBW settings are important to obtain accurate measurements for power measurements of AM modulated signals. In general, the VBW should be 10 times smaller than the RF carrier frequency, but higher than the modulation frequency. For example if an AM modulated signal is measured with a modulation frequency of 1 kHz, the VBW should be set to 10k or higher.

The acquisition speed and filter should be set in such a way that at least one full period of the modulation signal is measured. At 1 Msps, the filter should be set to 5 or higher, which results in 1000 or more samples being averaged. At lower sampling speeds, for example 100 ksps, the filter should be set to 3 or higher to cover at least one full period of the envelope signal.

In formula:

$$Filter\ bandwidth = \frac{Acquisition\ speed}{number\ of\ averages} < modulation\ frequency$$

While:

$$Modulation\ frequency \ll VBW \ll Carrier\ frequency$$

In PEAK mode, the "power?"-command will return the highest value measured, since the previous "power?"-command. After reading the power, the stored value will be cleared.

The filter setting does not apply in peak mode, envelope tracing or burst mode.

The VBW setting can be different for RMS mode and the other modes. If a VBW has been set for RMS mode, this will not affect the VBW setting for the other modes and vice versa. VBW command does not apply for the burst mode (RPR3006W), since this model has no video filter.

Power measurements will be interrupted if a temperature reading is requested.

The STORE command stores all settings in flash memory. All parameters mentioned in the table in chapter 5.2 (default values) are stored

During Envelope tracing, temperature readings are not updated as long as the trigger is armed. While armed, temperature readings are still possible, but the actual values are taken before the measurement is armed. As soon as a trigger occurs, the temperatures are updated in the sensor.

5.4   Commands (Envelope Tracing) - RPR3006P only

Command	Reply	Description
"ACQ_LOG_RESET"	"OK"	Resets (clears) sample buffers.
"ACQ_LOG_STATUS?"	"0" or "1"	0 = waiting for trigger 1 = buffers filled
"ACQ_LOG_BUF_SIZE <m,n>"	"OK"	Sets the buffer size in samples, with: <m> pre trigger buffer size <n> post trigger buffer size The sum of <m> and <n> cannot exceed 100.000 samples.
"ACQ_LOG_BUF_SIZE?"	<m>,<n>	Returns the buffer size of the buffer. <m> is the number of samples pre trigger <n> is the number of samples post trigger
"ACQ_LOG_DATA_ENH? <i>,<j>"	Power values from buffer <i> samples before trigger to <j> samples after trigger.	Returns samples from pre and post buffer (ASCII text dump). The sum of <i> and <j> cannot exceed 100.000 samples. Furthermore <i> cannot be greater than <m> and <j> cannot be greater than <n>.

This table continues on the next page.

Command	Reply	Description
"ACQ_LOG_DATA_ENH_BIN? <i>,<j>"	Power values from buffer <i> samples before trigger to <j> samples after trigger.	Returns samples from pre and post buffer (binary dump, 2 byte integer *100) special code 0x7777 represents data start, 0xAAAA represents data end. The sum of <i> and <j> cannot exceed 100.000 samples. Furthermore <i> cannot be greater than <m> and <j> cannot be greater than <n>.
"ACQ_LOG_THRESHOLD <l>"	"OK"	Sets the trigger level to power level <l> in dBm.
"ACQ_LOG_THRESHOLD?"	"-40"	Returns trigger level, second value is an internal level for debug purposes.
"ACQ_LOG_MAX?"	"-9.97 dBm"	Returns the highest power value in dBm which has been recorded in the buffers. In this example: -9.97 dBm
"ACQ_LOG_DELAY <d>"	"OK"	Sets number of samples that a trigger will be delayed after the measurement is armed. The number of samples <d> can be from 0 to 2.000.000.
"ACQ_LOG_DELAY?"	"0" to "2000000"	Returns number of samples that searching for a trigger will be delayed after the measurement is armed.

Returns the number of samples that searching for a trigger will be delayed with after the measurement is armed

5.5   Commands (Envelope Tracing - Triggering)

Command	Reply	Description
"ACQ_LOG_TRIG_TYPE <a>,<b>"	"OK"	Sets trigger type: <a> = 0 (for Internal triggering) <a> = 1 (for External triggering) <b> = 0 (for Falling edge) <b> = 1 (for Rising edge)
"ACQ_LOG_TRIG_TYPE?"	Returns trigger type <a>,<b>	See command above.
"ACQ_ AUTO_TRIGGER <t>"	"OK"	<t> = "1" for automatic (normal) triggering <t> = "0" for single triggering
"ACQ_ AUTO_TRIGGER?"	"0" or "1"	Returns trigger mode
"ACQ_LOG_TRIG_HOLDOFF <d>"	"OK"	Sets number of samples that a trigger will be held off after first occurring trigger. If a trigger occurs during the hold off period, the counter will be reset. The number of samples <d> can be from 0 to 1.000.000.
"ACQ_LOG_TRIG_HOLDOFF?"	"0" to "1000000"	Returns number of samples that trigger will be held off after first occurring trigger.

If auto trigger mode is set to 1, the power sensor will be automatically armed each time the data has been read from the device.
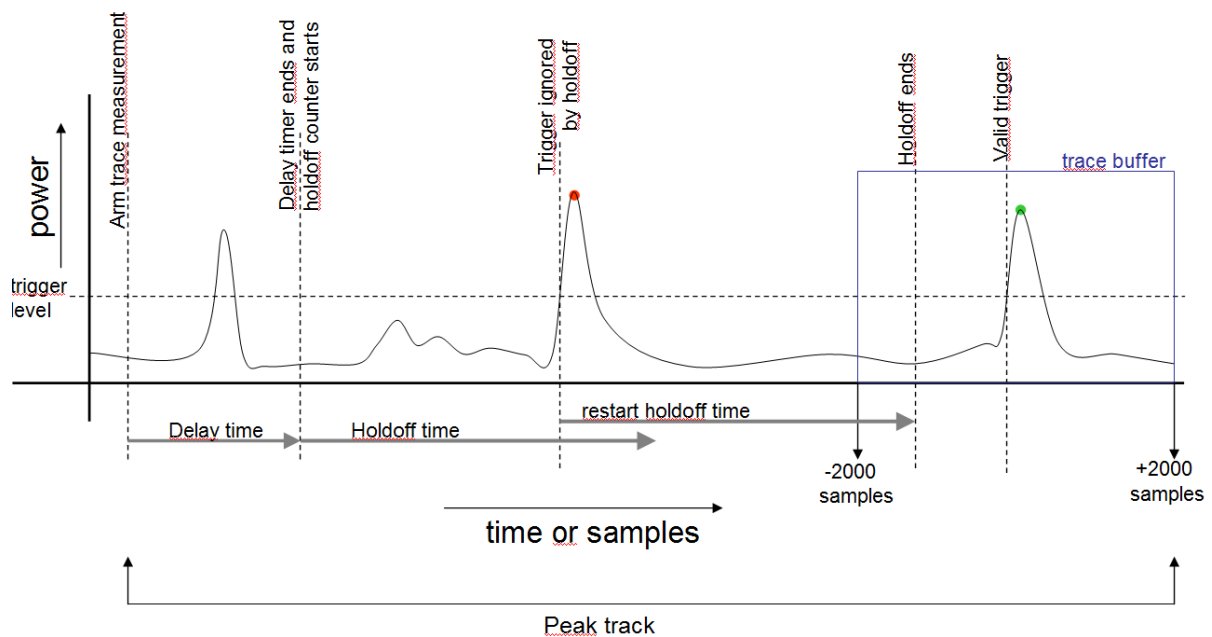
Figure 2: Graphical explanation of trigger mechanism

During envelope tracing mode, the peak value will be tracked and stored in memory from the moment the measurement is armed. The peak value can be read by using the "ACQ_LOG_MAX?" command, which will also reset the peak value once it has been read.

Peak track will stop as soon as a valid trigger has been found and the buffers are ready to be read from the device (ACQ_LOG_STATUS=1).

Please note that a high number of samples for the DELAY or HOLDOFF command at low sampling rates results in long measurement times up to 100 seconds.

5.6   Commands (Burst Mode) – RPR3006W only

Command	Reply	Description
BM_MEASURE_PERIOD <T>	"OK"	Sets the measurement period T (ms), with <T> can be from 1 to 60.000 ms.
BM_MEASURE_PERIOD?	"500"	Returns the measurement period. In this example 500 ms
BM_NOISE_TIMER <n>	"OK"	Sets the number n of samples, which are allowed below the threshold, before a new burst is counted. <n> can be set between 0 and 5000 samples.
BM_NOISE_TIMER?	"10"	Returns the number of samples which are set. In this example 10.
BM_TRIG_LEVEL <l>	"OK"	Sets the trigger level for burst detection. The level <l> can be set between -50 and +10 dBm.
BM_TRIG_LEVEL?	"-40"	Returns the trigger level in dBm. In this example the level is set to -40 dBm.
BM_GO	"OK"	Starts a single burst measurement.
BM_STAT?	"0" or "1"	Returns the status of the burst measurement: 0 if the measurement is not started or in progress. 1 if the measurement is completed and the data is ready to be read.

This table continues on the next page.

Command	Reply	Description
BM_BURST_COUNT?	"252"	Returns the number of bursts found within the set measurement period. The maximum number is 100.000
BM_BURST_DATA?<i>	"x;y;z" or "NO DATA"	Returns for burst with number <i> the start time (x); end time (y); RMS power (z). Final character is a newline.
BM_BURST_DATA_DUMP	"x;y;z" or "NO DATA"	Returns for each burst within the measurement period the start time (x); end time (y); RMS power (z). Final character is a newline.

In burst mode, the Radi*P*ower® can store the information of 100.000 bursts independent of the observation time. For each burst the RMS power and start/stop-times are stored in the buffers. The sample speed can be set to 1 MS/s or 5 MS/s to ensure correct measurements according to the ETSI standard for wideband devices.

In MIMO measurements, using multiple synchronized Radi*P*ower® power meters, Radi*M*ation® captures samples simultaneously and calculates the total power according to the EN 300 328 or EN 301 893 standard.

5.7 Error Codes

The following table shows the error codes for the Radi*P*ower®.

Error code	Description
"ERROR 1"	Wrong command
"ERROR 50"	Wrong argument
"ERROR 51"	Argument too low
"ERROR 52"	Argument too high
"ERROR_601"	Frequency not set
"ERROR_602"	Over range
"ERROR_603"	Under range
"ERROR_604"	No Cal data

6   Radi𝒫ower® Specifications

Model	RPR3006C	RPR3006P	RPR3006W
Electrical specifications			
Detector type	Log detector		RMS detector
Measuring function	RMS CW power, Peak power	RMS CW power, Peak power Envelope tracing	RMS CW power, Peak power Burst mode
Frequency range	9 kHz[5] to 6 GHz		10 MHz tot 6 GHz
Power measuring range	-60 to + 10 dBm		-50 to + 10 dBm
Input damage level	> +20 dBm		
Resolution	0,01 dB		
RF input connector	Precision N-type		
RF input impedance	50 Ohm		
Max SWR: < 100 MHz	1,05		1,10
100 MHz to 1 GHz	1,10		
1 GHz to 6 GHz	1,20		1,15
Frequency response accuracy (at 23º C ± 2º C)	+/- 0,2 dB		
Deviation from CW for signals with high Crest factor	n/a		< 0,2 dB

This table continues on the next page.

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[5] Depends on VBW setting

RadiPower® Specifications, part 2

Model	RPR3006C	RPR3006P	RPR3006W
Linearity error	0,05 dB + 0,005 dB/dB		
Temperature effect	0,15 dB max over full temperature range		
Measuring units	dBm or Watts		
Zero adjustment	Not required		
Frequency response correction	Stored frequency response data is taken into account by numerical entry of the measurement frequency		
Measurement speed	10, 50, 100 kS/s, 1, 5, 10, 20, 33 MS/s		1 and 5 MS/s
Storage capacity	100.000 samples		100.000 bursts
Power consumption			
Supply voltage	+5Vdc from USB port (4,75 V to 5,25 V)		
Current consumption (USB)	Max. 200 mA		

This table continues on the next page.

Filter setting for RMS (Mode 0)	Number of samples used for RMS calculation
Filter 1	10
Filter 2	30
Filter 3	100
Filter 4	300
Filter 5	1000
Filter 6	3000
Filter 7	5000

Auto filter mode	Number of samples used for RMS calculation
+10 to 0 dBm	100 (filter 3)
0 to -10 dBm	100 (filter 3)
-10 to -20 dBm	100 (filter 3)
-20 to -30 dBm	300 (filter 4)
-30 to -40 dBm	1000 (filter 5)
-40 to -50 dBm	3000 (filter 6)
Below -50 dBm	5000 (filter 7)

This table continues on the next page.

Model	RPR3006C	RPR3006P	RPR3006W
Mechanical			
Dimensions of measuring device	124 * 32 * 32 mm		
RF input connector	N type precision		
Data connector (power head side)	USB mini type B		
Trigger input and output	MMCX		
Environmental conditions			
Temperature range (operating)	0° to 40° Celsius		
Temperature range (storage)	-20 to 85º C		
Relative humidity	10 – 90% (non-condensing)		
Interfaces			
Communication	USB 1.0 (drivers supplied for Windows XP and Windows 7)		
RadiCentre	USB1004A plug-in card		
Compliance			
EMC	EN 61326		
Low Voltage	n/a		
Warranty			
Warranty	3 years (misuse excluded)		

WARRANTY CONDITIONS

DARE!! Instruments offers a standard warranty term of three years on their products, starting from the shipping date. This warranty is applicable to all EMC test & measurement products, such as:

- Radi*C*entre® modular / multifunctional EMC test systems
- Radi*C*ontrol® antenna tower/turntable controllers
- Radi*F*ield® Triple A field generators
- Radi*G*en® signal generators
- Radi*P*ower® RF power meters
- Radi*S*ense® laser powered E-field probes
- Radi*S*witch® RF coaxial switches

If a defect occurs within the warranty term, a Return Material Authorization (RMA) 'Warranty Repair' request can be issued using the RMA link at http://rma.dare.eu. The defective product can then be shipped to DARE!! Instrument for repair by our service department.
There will be no charge for repair services (materials or labor) within the warranty term. The customer will need to cover the costs for returning the product to DARE!!, such as shipping and/or any applicable duties and taxes. DARE!! Instruments will arrange the courier and cover the costs for the return shipment.

These warranty terms are not applicable to:

- Fiber optic cables
- Products that have been improperly used
- Products that have been used outside their specified range
- Products that have been improperly installed and/or maintained
- Products that have been modified without approval of DARE!! Instruments
- Calibration and/or re-calibration of the product
- Consumable products such as batteries, ink etc.

Repair services on products that are not covered by the DARE!! warranty will be charged to the customer. If a defect occurs to our product outside the warranty period, a RMA repair and/or re-calibration request must be issued using the RMA link at http://rma.dare.eu.
The repairs (outside the original warranty period) have a warranty limited to six months. Shipping conditions are the same as with repairs within the original warranty period.

EUROPEAN DECLARATION OF CONFORMITY

We, DARE!! Instruments, declare under our sole responsibility that the product;

RadiPower®
Plug-in card model USB1004A, with RF power meter models RPR3006C, RPR3006P and RPR3006W

to which this declaration relates, is in accordance with the following Directives:

        EMC-Directive: 2014/30/EU
        RoHS-Directive: 2011/65/EG

Per the provisions of the applicable requirements of the following harmonized standards:

        Emission: EN 61326-1:2013, Class B
                     Electrical equipment for measurement, control and laboratory use.
        Immunity: EN 61326-1:2013, Industrial level, performance criteria A
                     Electrical equipment for measurement, control and laboratory use.

The Technical Construction Files are maintained at;

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                     P.W.J. Dijkstra

Title of authority: Director