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RadiPower®

Product Manual

RF Power Sensor

Plug-in Card and Power Sensor for the RadiCentre®

Card Model:

USB1004A

Sensor Models:

RPR2006C RPR2006P
RPR2018C RPR2018P

RadiPower® Product Manual

This service and operating manual pertains to the RadiPower® plug-in card and the RadiPower® RF power sensor.
Card model: USB1004A.
Sensor models: RPR2006C, RPR2006P, RPR2018C and RPR2018P.
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 RadiPower®.

Please keep the Quick Start guide (and this regular manual) close at hand when you operate your new RadiPower®.

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

Supplier Information

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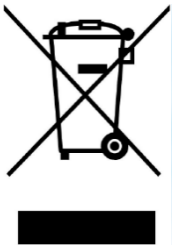
WARNINGS & PRECAUTIONS

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

Become familiar with the contents of the manual for the Radi*C*entre® system.

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

This equipment is designed to be used as a plug-in card for the Radi*C*entre®. Do not use this card in combination with any other main frame.



The Radi*P*ower® 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.

The Radi*P*ower® contains no hazardous substances as described in the RoHS-directive.

1. Introduction

This manual contains information about two Radi*P*ower® products, namely the plug-in card and the power sensor. Please read this manual carefully and make sure to pay special attention to the chapters regarding your new product(s).

1.1 Product Introduction

1.1.1 Radi*P*ower® RF power sensor

An accurate power meter is indispensable to perform reliable EMC measurements. The Radi*P*ower® is a RF power meter especially designed for power measurements during EMC tests. The Radi*P*ower® 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.

1.1.2 Radi*P*ower® plug-in card

The Radi*P*ower® plug-in card for the Radi*C*entre® can control up to 4 power sensors at the same time. One Radi*C*entre® can contain up to 7 Radi*P*ower® Plug-in cards, resulting in a maximum of 28 Power sensors per Radi*C*entre®.

Figure 1: Radi*P*ower® plug-in card in a Radi*C*entre (left) and power meters RPR2006C, RPR2006P, RPR2018C and RPR2018P.

1.2 Related Products

Radi*C*entre® system

The Radi*C*entre® is a modular EMC test system that serves as the user and computer interface for all the Radi*C*entre® plug-in cards and modules (such as the Radi*F*ield® system).

Radi*M*ation® software

Radi*M*ation® is the EMC software package from DARE!! Instruments used for remote control and automated testing of the Radi*C*entre® plug-in cards and modules (such as the Radi*F*ield® system).

Other Radi*P*ower® RF power sensors

Radi*P*ower® 3000 series
Model: RPR3006W.
A RF power sensor with external triggering.

2. The RadiPower®

1.2 Product Characteristics

Fast - 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.

Accurate - Accuracy is another concern (in addition to speed), when performing EMC measurements. The RadiPower® allows for high precision EMC measurements with a large dynamic range. Because the RadiPower® 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.

Low Measurement Uncertainties - Impedance mismatches contribute to the measurement uncertainty. The RadiPower® 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.

Easy to Use - With the USB interface the RadiPower® is easy to use. In addition, the RadiPower® can be controlled by both the RadiMation® 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 RadiPower®, RadiMation® Free measurement software is delivered with the system. By using the USB1004A plug-in card, up to four RadiPower® heads can be connected to a single plug-in card in a RadiCentre®.

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

1.3 Components

The Radi*P*ower® plug-in card is delivered with the following items:

Radi*P*ower® plug-in card
Model: USB1004A.
A RF power sensor plug-in card to be used in the Radi*C*entre® system.

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

Radi*P*ower® RF power sensor
Model: RPR2006C, RPR2006P, RPR2018C or RPR2018P.
A RF power sensor to be used together with a Radi*P*ower® plug-in card.

Shielded USB cable
Model: USB A male to USB mini B5 male.
To connect the RF power sensor with the plug-in card.

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

1.4 RadiPower® RF Power Sensor

The RadiPower RF power sensor is mounted in a rugged metal housing in order to ensure long life and excellent RF shielding. The power sensor is equipped with an N-type precision input connector and a standard USB data connector.

Figure 2: RadiPower® RPR2006C, RPR2006P, RPR2018C, RPR2018P

1.4.1 Different Models

The RadiPower® RF power sensor is available in 4 models; the RPR2006C, RPR2006P, RPR2018C and RPR2018P. The differences between these models is the frequency range that they cover and the measurements that they can perform.

- C- vs P-models

  The C-models support measurements for CW signals.
  The P-models can measure RF bursts as short as a few microseconds.

- 2006 vs 2018 models

RPR2006:	9 kHz	to	6 GHz,	-55 dBm	to	+10 dBm
RPR2018:	80 MHz	to	18 GHz,	-45 dBm	to	+10 dBm

- Option2 for 2006 models

  #010 4 kHz extension (-40 dBm to +10 dBm from 4 to 9 kHz)

1.4.2 Functional description

The RadiPower® uses a high-performance demodulating logarithmic amplifier to detect the RF signal. The demodulated signal is sampled at high speed by a powerful DSP, which processes all samples. The sophisticated software enables unique functions, such as envelope tracing. The Pulse-version of the RadiPower® supports all different modes of operation:

mode 0:	RMS power:	to perform RMS power measurements of CW-signals
mode 1:	Peak power:	to perform peak measurements on RF-signals
mode 2:	Envelope tracing:	to capture the envelope of an RF-signal

Mode 0 - In RMS mode the RadiPower® samples the demodulated signal at high speed up to a maximum of 10Msps[1]. 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.

Mode 1 - In peak mode the RadiPower® keeps track of the highest level detected. This can be done for an infinite time. Once the power level has been read, the maximum value is automatically reset.

Mode 2 - Envelope tracing is a unique feature which enables the possibility to visualize, for example, the inrush phenomena of transmitters or signal generators, without the need of an expensive RF analyzer. Due to the extensive trigger possibilities, almost any RF-signal can be captured in the buffers of the RadiPower®. This mode 2 is only applicable when using the RadiPower® directly connected to the PC USB interface (stand-alone use).

[1] Only in RMS mode a sampling speed of 10 Msps can be used for RadiPower models RPR2006C and RPR2018C with firmware version 2.7.0 or higher. The maximum sampling speed for firmware versions < 2.7.0 and all other modes is 1 Msps.

3. Installation

3.1 Hardware Configuration

3.1.1 For stand-alone use

1. Connect the RadiPower® sensor to a Windows computer with a USB 1.1 compatible port. Use the supplied USB cable to connect the RadiPower® sensor.

3.1.2 For use in combination with a RadiCentre®

The hardware configuration is carried out in the following 7 steps[2]:

1. Choose the slot of the RadiCentre® system in which you want to install the plug-in card.

2. Remove the blind panel from this slot by removing the four screws of the panel (two on top and two at the bottom). See Figure 3.

3. Gently insert the plug-in card into the slot of the RadiCentre® and reinsert the four screws. See Figure 3.

Figure 3: Example of a (RadiSupply® LPS1001A) plug-in card installation

**Steps 4 to 7of the hardware configuration are visible on the next page.*

[2] These are the basic steps in a plug-in card installation, the exact installation of your plug-in card may vary.

4. Switch on the RadiCentre® system. The new plug-in card will automatically be detected and initialized by the RadiCentre®.

5. Connect the plug-in card to the desired device(s).

   The RadiCentre® will automatically detect the power sensor when it is plugged into one of the 4 USB slots of the USB1004A plug-in card. Please note that for correct auto detection of power heads, one must wait at least 10 seconds between un-plugging and/or re-connecting any individual power sensor. Not taking the above-mentioned measures into account may result in incorrect power sensor detection. Please re-start the RadiCentre® system in order to re-detect all connected sensors in this situation.

6. Connect the RadiCentre® system to your PC using any of the available interfaces of the RadiCentre® system; USB, RS232, Ethernet or IEEE-488 (optional).

7. Place the interlock plug into the interlock connector of the RadiCentre®. Some cards are equipped with a local interlock system. For these plug-in cards a separate interlock plug is supplied.

The hardware installation for the plug-in card is now complete.

The user can control the plug-in card either through the touchscreen on the RadiCentre® system (only available for the 2 and 7-slot versions, not for the 1-slot version), or by using the control commands in combination with an external software package such as the RadiMation® 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).
If the Radi*P*ower® is operated manually, this chapter can be skipped.
If Radi*M*ation® software is used; select the required device driver for the Radi*P*ower®.

3.2.1 Radi*M*ation® software

1. Configure the Radi*M*ation® software for a Radi*P*ower® / Radi*C*entre® power sensor. 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 sensor.

The Radi*M*ation® software package verifies the power sensor at the beginning of each test (if a power sensor is selected).

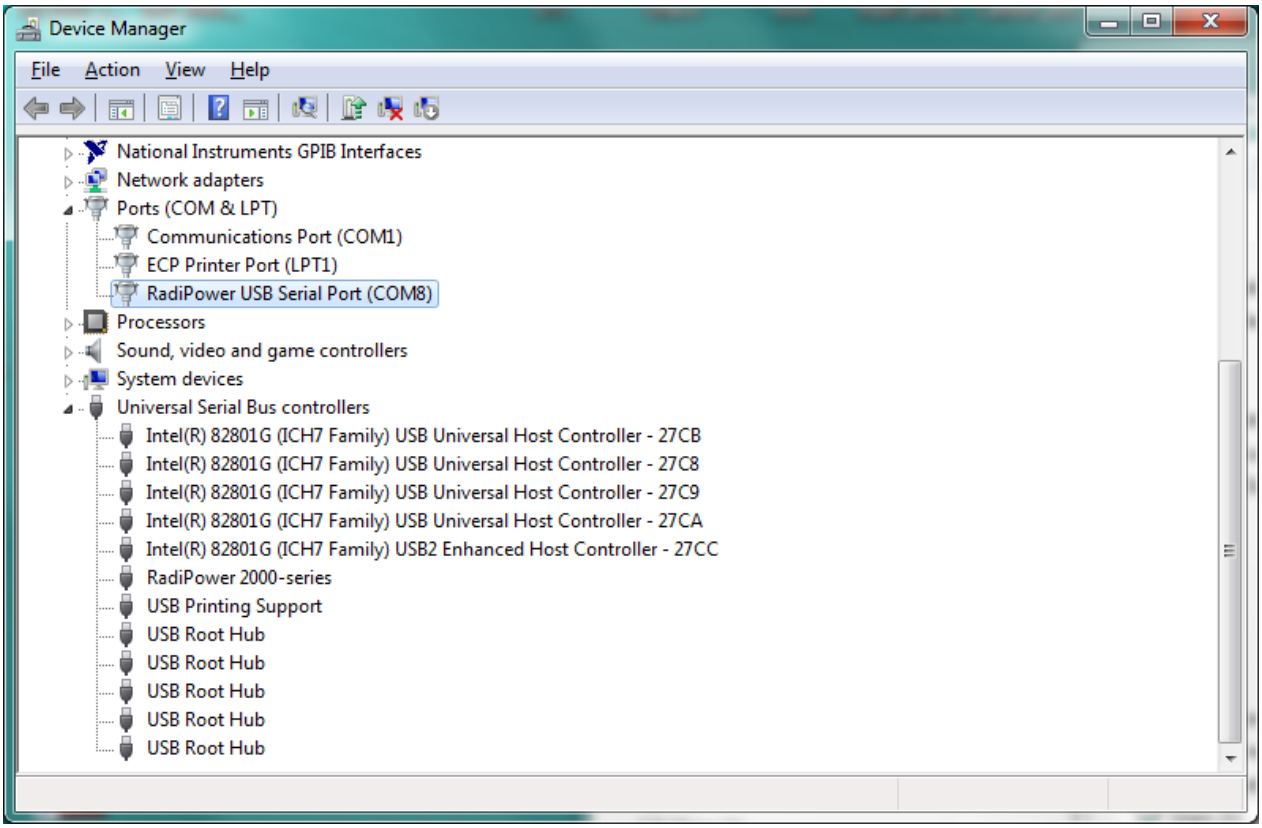
If you are using the Radi*P*ower® / Radi*C*entre® power sensor system with any other EMC test software package, we refer you to chapter 5 'Radi*P*ower® Command Set'.

4. Using the RadiPower®

4.1 'Stand Alone' Use

Connect the RadiPower® 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 RadiPower® 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 RadiPower® will be shown in the device list.



A virtual COM-port (VCP) will be present in the list of Ports. This COM-port can be used to communicate with the RadiPower® using any terminal program.

4.2 Manual Control

Once the Radi*C*entre® is switched on, the Radi*P*ower® can be activated from the 'main'- screen[3] on the Radi*C*entre® touchscreen. Readings from the sensor can be taken directly from the TFT screen, with the Radi*M*ation® EMC software or any other (custom made) software package.

4.2.1 Sensor configuration

The large 'status' button in the 'main' screen of the Radi*C*entre® will display the detected Radi*P*ower® plug-in card and sensor measurements (see Figure 4). To monitor the measured power level(s), one can go to the 'control' screen (see Figure 5) by pressing the Radi*P*ower® 'status' button.

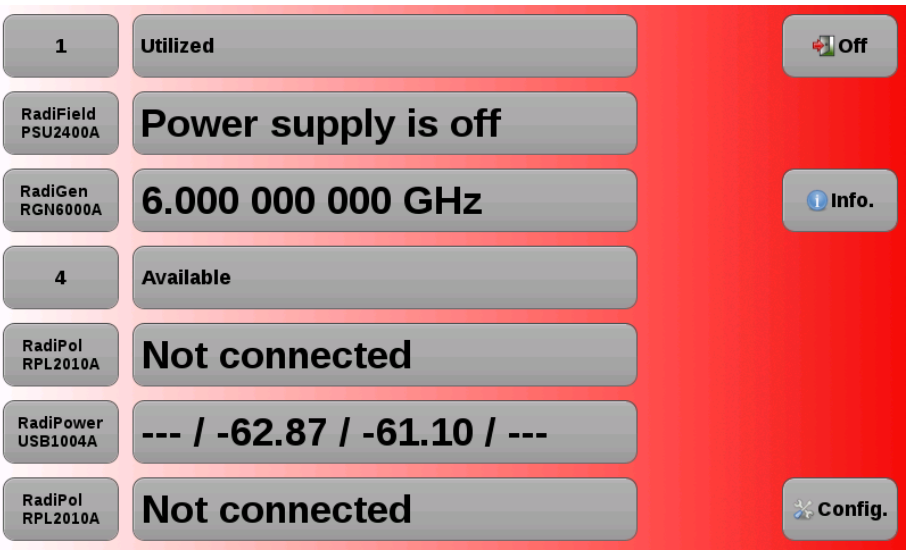


Figure 4: Example of the Radi*P*ower® status button in the 'main' screen

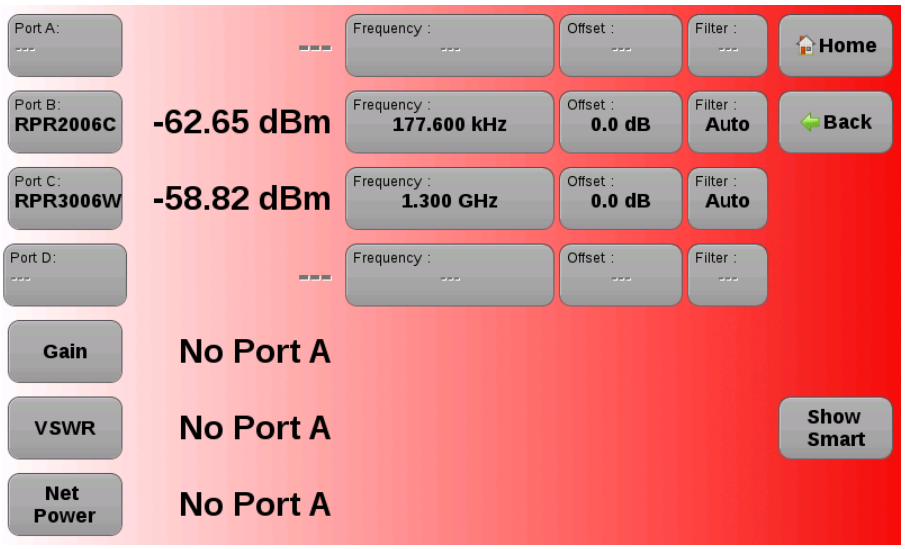


Figure 5: Example of the Radi*P*ower® control screen

[3] Please note that the screenshots shown in this manual are related to Radi*C*entre® firmware v3.3.x. Other version may look different and support other functions.

In order to obtain the correct absolute power level, the user can enter the measurement frequency in the frequency window (see Figure 6). This window will appear after pressing the frequency button next to the power sensor data.

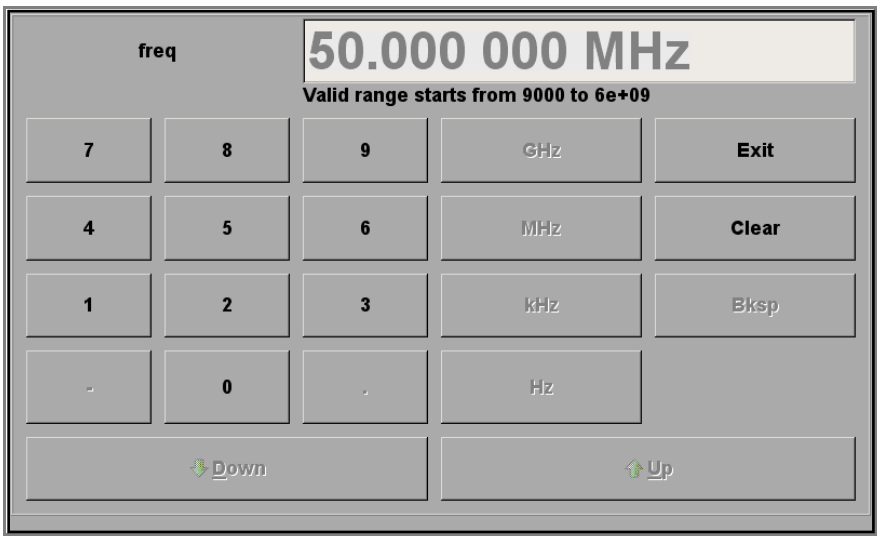


Figure 6: Example of the frequency window

Remark: When the user does not enter the correct measurement frequency, the power sensor will not display the correct absolute power level.

The user can also enter the filter setting (see Figure 7), to select a 'filter time constant'. For more information, see chapter 6, 'Radi*P*ower® Specifications'.

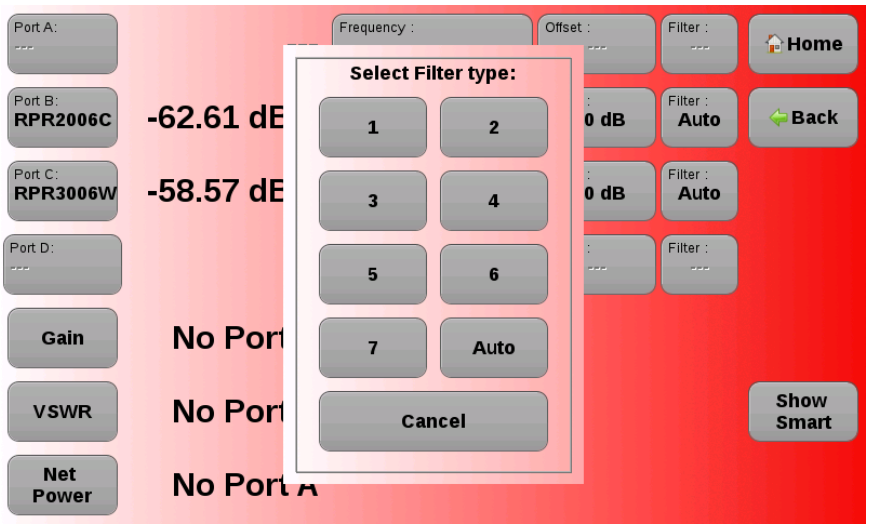


Figure 7: Example of the filter window

Another function that is available for the Radi*P*ower® is the 'Offset' function. The Offset value can be used to 'compensate' for a fixed – known value, for example 20 dB attenuation. The offset value defined in dB will be subtracted from the measured value of the Radi*P*ower®.

The user can enter the 'Offset' value by pressing the 'Offset' button on the RadiPower® screen, where a new window will open in which the value can be entered. Please refer to figure 8 below where as an example an offset of 20 dB has been entered. The displayed value on Port B will now be the measured value minus the offset value (20 dB lower).

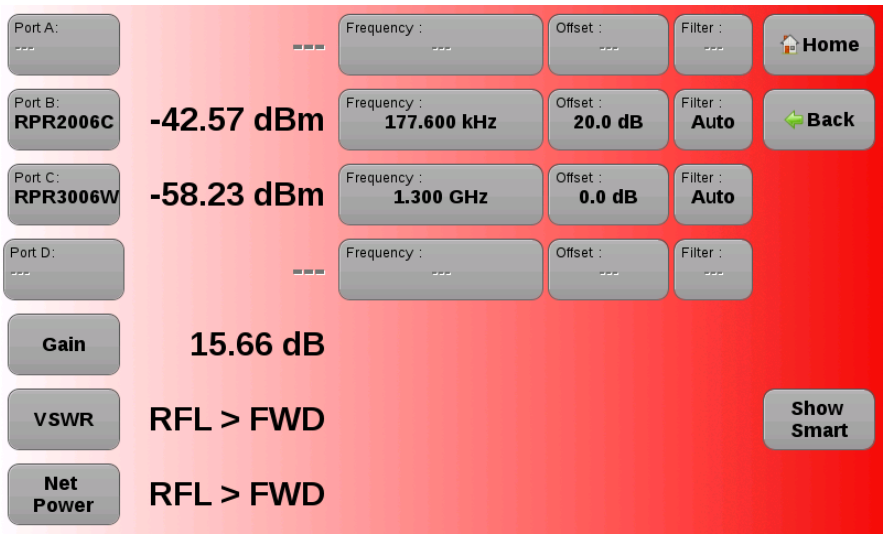


Figure 8: Example of the filter window

In situations where multiple RadiPower® USB power heads are connected to the USB1004A plug-in card, the operator can use pre-defined calculations on the main screen to calculate between two different power meter measurements. This function is only applicable for mode 0.

Gain function

The 'Gain' function as shown as an example in figure 9 will calculate the difference in dBm between the measured power on port B (dBm) and the measured power on port C (dBm).

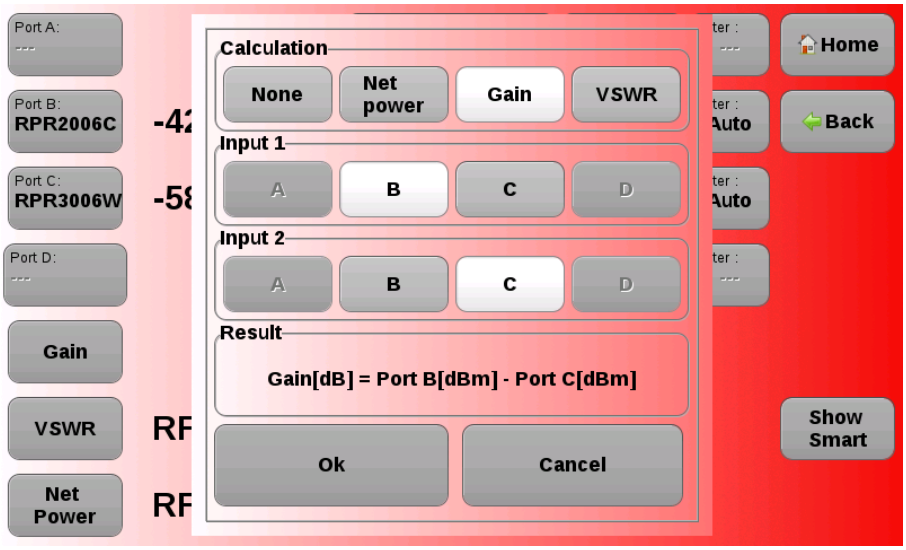


Figure 9: Example of the 'gain' calculation window

VSWR function

The ‘VSWR’ function as shown as an example in figure 10 will calculate the VSWR based on the measured forward power on port A divided by the measured reflected power on port C.

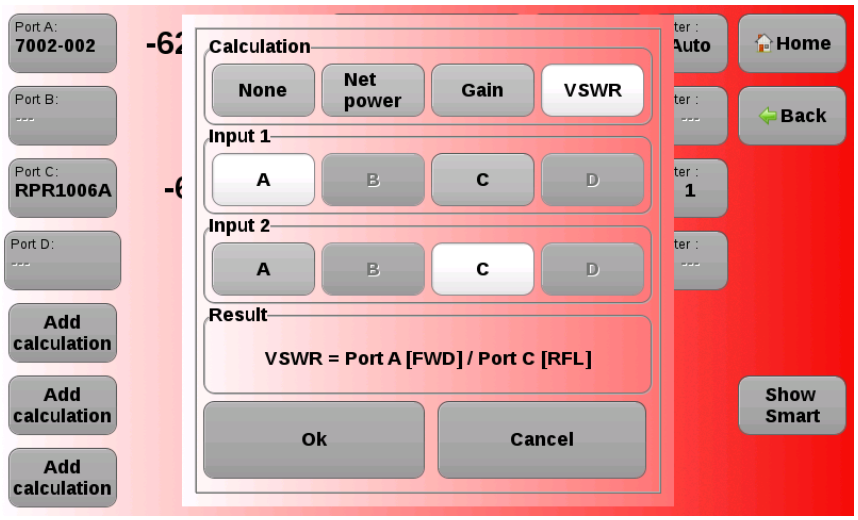


Figure 10: Example of the ‘VSWR’ calculation window

Net Power function

The ‘Net power’ function as shown as an example in figure 11 will calculate the logarithmic difference in dBm between the measured power on port C (W) and the measured power on port B (W).

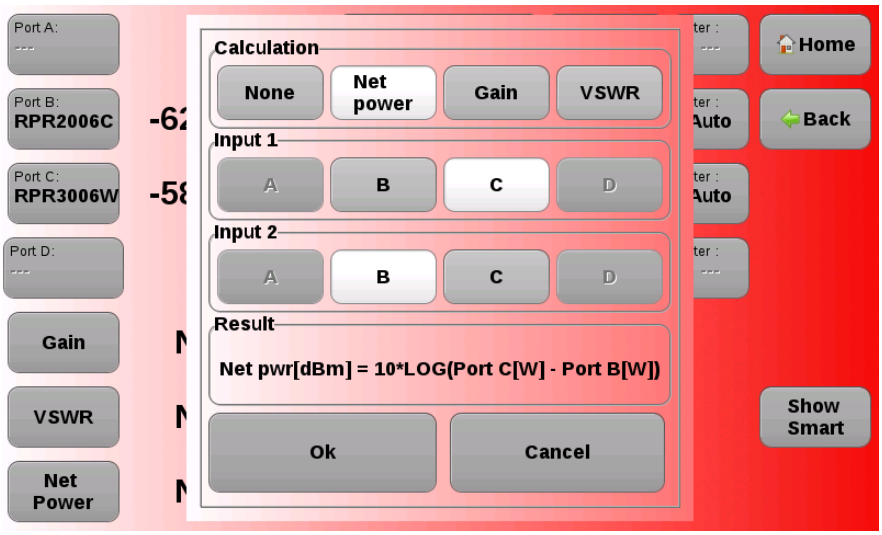


Figure 11: Example of the ‘Net power’ calculation window

4.3 Remote Control

The RadiPower® can be controlled remotely through the interfaces of the RadiCentre®. The exact communication protocol can be found in the RadiCentre® manual. The specific commands for the RadiPower® are shown in chapter 5 'RadiPower® Command Set'.

5. RadiPower® Command Set

5.1 General

The table in chapter 5.2 shows all available commands for the plug-in card of the RadiPower® sensor. Please note that all these commands must have the prefix of the 'Device number' in front of the specific command if the RadiPower® is to be used in the RadiCentre®. When the RadiPower® is directly plugged in a USB connector of a PC, a prefix is not necessary.

Refer to the RadiCentre® manual, for more information on the 'Device number' of a module.

The RadiPower® consists of two parts:

- RadiPower® plug-in card for the RadiCentre®
- RadiPower® RF power sensor (which must be connected to the plug-in card)

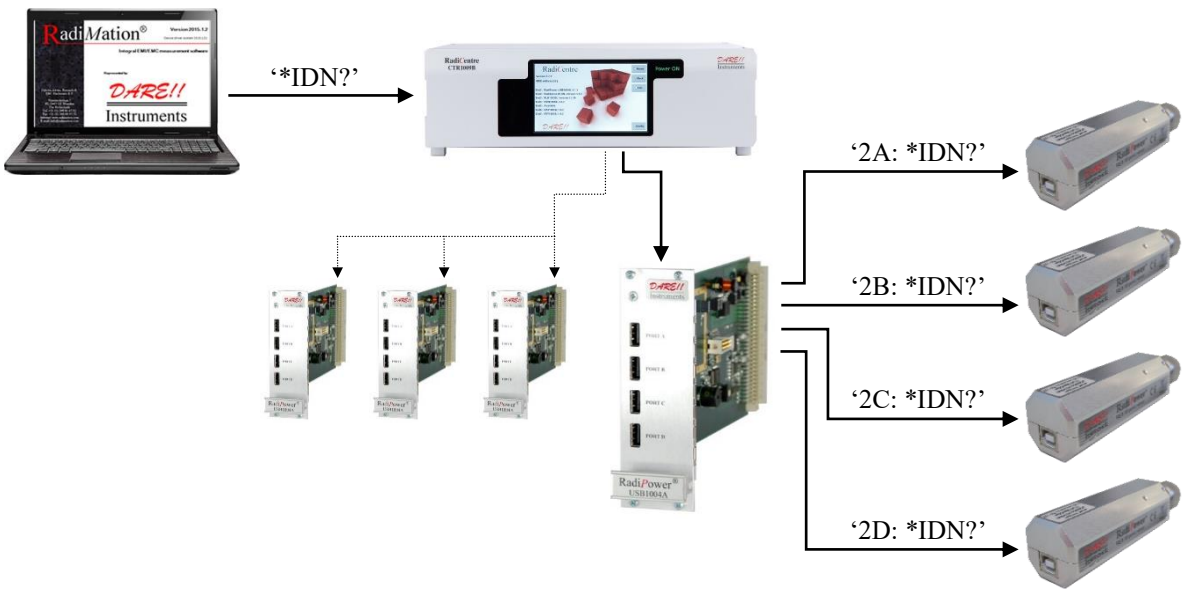


Figure 12: RadiPower® module, within the RadiCentre® system, controlled with the RadiMation® software

Device number message example:

- "2A:POWER?"
  Get the power level of the RadiPower® Head which is connected to port A of the RadiPower® plug-in card in slot 2.

- "2B:FILTER?"
  Get the filter setting of the RadiPower® Head which is connected to port B of the RadiPower® plug-in card in slot 2.

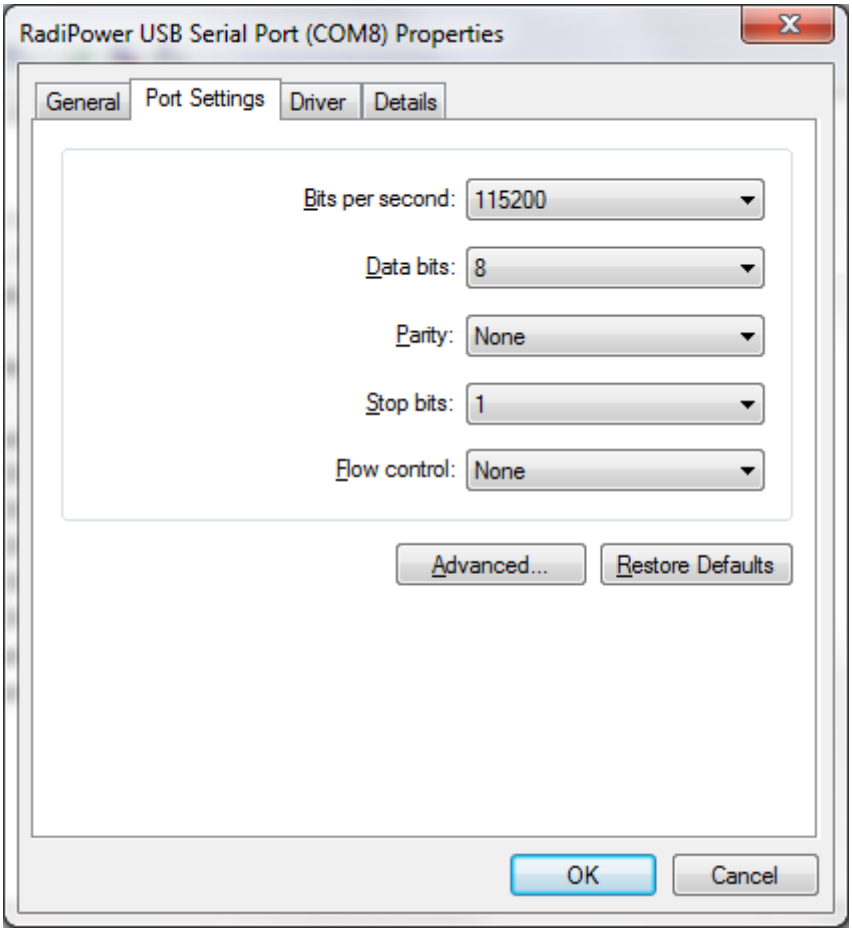
- "3B:FILTER?"
  Get the filter setting of the RadiPower® Head which is connected to port B of the RadiPower® plug-in card in slot 3.

  "2" = '*board-number*' of the RadiPower® plug-in card
  "A" & "B" = ports of the RadiPower® RF power sensor
  "FILTER?" = message to the RadiPower® RF power sensor

The RadiPower® sensor can also be connected directly to a PC

Figure 13: RadiPower® sensor, controlled with the RadiMation® software

Communication with the RadiPower® sensor is possible using a virtual COM-port (VCP)
See: [Start] > [Settings] > [Control Panel] > [System] > [Hardware] > [Device Manager]



The COM-port settings are:

- Baud rate: 115K2
- Data bits: 8
- Parity: None
- Stop Bits: 1
- Flow control: None

5.2 Commands Plug-In Card

The following table shows the general commands for the RadiPower® plug-in card.

Command	Reply	Description
“*IDN?”	“USB1004A, Version 4.1.0”	Returns the model and version of the device.
"ID_NUMBER?"	“d.d.d.d.d.d.d.d”	Returns the unique identifier number of the RadiPower®.
“POWER?”	“-12.34 dBm”	Get measure power level in dBm.
“BURST? <NUM>”	“-12.34 -12.35 dBm”	Get multi measure power level in dBm. The number of measurements is requested in <NUM>.
"FREQUENCY?"	<NUM> Hz	Get the frequency in Hz.
"FREQUENCY <NUM> Hz"	“OK” or error code.	Set the frequency in Hz.
"FREQUENCY? MIN"	“9000 Hz”	Get the minimal frequency.
"FREQUENCY? MAX"	“6000000000 Hz”	Get the maximum frequency.
"FILTER?"	“1”, “2”, “3”, “4”, “5”, “6”, “7” or “AUTO”	Get Filter.
"FILTER <NUM>"	“OK”	Set Filter to 1,2,3,4,5,6 or 7.
"FILTER AUTO"	“OK”	Set Filter to auto.

- IEEE command for Interface Clear or Clear are not supported.
- IEEE Status flags in either serial or parallel poll, or as a service request, are not supported.
- When IEEE communication is used, the first command/request should be the "*IDN?\r" command.

5.3 Error Codes Plug-In Card

The following table shows the error codes for the RadiPower® plug-in card.
These error codes apply for serial (RS232) as well as IEEE communication.

Error code	Description
“ERROR 1”	Unknown command
“ERROR_50”	Argument error
“ERROR_51”	Argument to high error
“ERROR_52”	Argument to low error
“ERROR_601”	Error frequency not set
“ERROR_602”	Error over range
“ERROR_603”	Error under range
“ERROR_604”	No Cal data

5.4 Default Values Power Sensor

The following table shows the default values for the RadiPower® RF power sensor.

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 dB	Sets power offset to 0 dB.
POWER_UNIT	0	Sets measurement unit to dBm.
VBW (mode 0) VBW (mode 1 and 2)	3 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_TRIGGER	0;1;2	Rising edge triggering, 2 samples 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.

5.5 General Commands (All Modes) Power Sensor

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. The default communication setting of the serial USB port is 115200,8,N,1.

Command	Reply	Description
"*IDN?"	"DARE!!, RPR20XXY, version"	Returns the ID of the RadiPower® sensor.
"*OPT?"[4]	"0" or "010"	Returns the options installed. "0" is returned if no options are installed.
"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?"	"2.30"	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
"BAUD <n>"	"OK"	Sets the baud rate, with: <n> = 0 (for 57600 bps) <n> = 1 (for 115200 bps, default) <n> = 2 (for 230400 bps) <n> = 3 (for 460800 bps)
"BAUD?"	"0", "1" or "2"	Returns the current baud rate.
"MODE <m>"	"OK"	Sets mode, with: <m> = 0 (for RMS mode) <m> = 1 (for max hold, peak) <m> = 2 (for envelope tracing mode) *Remark: Only for models RPR2006P and RPR2018P*
"MODE?"	"0", "1" or "2"	Returns current mode. *Remark: Only for models RPR2006P and RPR2018P*

**This table continues on the next page.*

[4] The option command is only present in firmware version 2.4.x or higher

General Commands (All Modes) Power Sensor, part 2

Command	Reply	Description
"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)
"AUTO_STORE?"	"0" or "1"	Returns the current store setting.
"FREQUENCY <f>"[5]	"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: 9kHz
"FREQUENCY? MAX"	"6000000 kHz"	Highest measurable frequency. In this example: 6GHz
"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.

**This table continues on the next page.*

[5] The frequency can be set with a resolution of 0,1 kHz from firmware version 2.4.x or higher

General Commands (All Modes) Power Sensor, part 3

Command	Reply	Description
"POWER?"	"-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>" [6]	"OK"	Sets the power unit, with: <u> = 0 (for dBm) or 1 (for Watts)
"POWER_UNIT?"	"0" or "1"	Returns the power unit.
"VBW <n>" [7]	"OK"	Sets Video bandwidth (VBW), with: <n> = 0 for 10MHz <n> = 1 for 1MHz <n> = 2 for 200kHz <n> = 3 for 1kHz The VBW should be 10 times smaller than the lowest frequency to be measured.
"VBW AUTO" [7]	"OK"	Set the VBW to automatic. The VBW is coupled to the sample speed of the power meter: VBW = 10MHz at 1MSps VBW = 1MHz at 100kSps VBW = 200kHz at 20kSps
"VBW?" [7]	"0", "1", "2", "3" or "AUTO"	Returns the VBW setting.
"ACQ_SPEED <s>" [8]	"OK"	Sets ADC sample speed in kSps. <s> can be 20, 100, 1000 or 10000.
"ACQ_SPEED?" [8]	"20", "100", "1000" or "10000"	Returns ADC speed in kSps.

[6] Applies only for the POWER? command in mode 0 and mode 1.
[7] Only for the RPR2006C and RPR2006P, does not apply for the RPR2018 models.
[8] 10 MSps only available in the RPR2006C and RPR2018C with firmware version 2.7.0 or higher.

5.5.1 Remarks about the general commands

In mode 0 (RMS mode), a new power measurement is started after the “power?” command has been given. Depending on the filter setting, the RadiPower® performs the required number of measurements and returns the RMS value of all samples taken.

The RadiPower® uses a point (.) as decimal separator.

Acquisition speed, filter and VBW settings are important to obtain accurate measurements for power measurements of AM modulated signals. For example, if an AM modulated signal is to be measured with a modulation frequency of 1 kHz, the VBW should be set to 0, 1, 2 or AUTO. In general the VBW should be 10 times smaller than the RF carrier frequency, but higher than the modulation frequency.
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. At lower sampling speeds, for example 100 ksps, the filter should be set to 3 or higher to measure at least one full period of the envelope signal.

In mode 1 (max hold), 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 mode 1 or 2.

The VBW setting can be different for mode 0 and the other two modes 1 and 2. If a VBW has been set for mode 0, this will not affect the VBW setting for mode 1 or 2 and vice versa.

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 5.4 (default values) are stored, including the BAUD setting.

In mode 2 (envelope tracing), temperature readings are not updated as long as the triggering 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.

5.6 Commands (Mode 2 - Envelope Tracing) Power Sensor

Command	Reply	Description
“ACQ_LOG_RESET”	“OK”	Resets (clears) the sample buffers. Also arms the envelope trace measurement, waiting for the next valid trigger.
“ACQ_LOG_STATUS?”	“0” or “1”	0 = waiting for trigger 1 = buffers filled
“ACQ_LOG_DATA?”	Power values from buffer samples 0 to 1000	Returns log power values from buffer in dBm (ASCII text dump, values are separated by a “;”).
“ACQ_LOG_DATA_ENH? <i>,<j>”	Power values from buffer <i> samples before trigger to <j> samples after trigger.	Returns log data from pre and or post trigger buffer (text dump). Buffer sizes <i> and <j> can be 0 to 2000
“ACQ_LOG_DATA_ENH_BIN? <i>,<j>”	Power values from buffer <i> samples before trigger to <j> samples after trigger.	Returns log data from pre and/or post trigger buffer (binary dump, 2 byte integer *100) special code 0x7777 represents data start, 0xAAAA represents data end.
“ACQ_LOG_THRESHOLD <l>”	“OK”	Sets the trigger level to power level <l> in dBm.
“ACQ_LOG_THRESHOLD?”	“-40.00”	Returns trigger level.
“ACQ_LOG_TRIGGER <a>,<b>,<c>”	“OK”	Sets trigger mode: <a> = 0 (for Edge triggering) <a> = 1 (for Level triggering) <b> = 0 (for Falling edge) <b> = 1 (for Rising edge) <c> = 2 to 10 (for number of samples used to evaluate edge or level trigger) During edge trigger the distance between two samples is 10, during level trigger the distance between to samples is 1.
“ACQ_LOG_TRIGGER?”	Returns trigger settings <a>;<b>;<c>	<a> = mode <b> = rising/falling edge <c> = trigger filter

**This table continues on the next page.*

Commands (Mode 2 – Envelope Tracing) Power Sensor, part 2

Command	Reply	Description
“ACQ_LOG_MAX?”	“-9.97 dBm”	Returns the highest power value in dBm which has been recorded since the “ACG_LOG_RESET” command. In this example: -9.97 dBm
“ACQ_ AUTO_TRIGGER <t>”	“OK”	Sets the trigger mode that should be used: <t> = 1 (for automatic (normal) triggering) <t> = 0 (for single triggering)
“ACQ_ AUTO_TRIGGER?”	“0” of “1”	Returns trigger mode.
“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 2000000.
“ACQ_LOG_DELAY?”	“0” to “2000000”	Returns number of samples that searching for a trigger will be delayed after the measurement is armed.
“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 1000000.
“ACQ_LOG_TRIG_HOLDOFF?”	“0” to “1000000”	Returns number of samples that trigger will be held off after first occurring trigger.

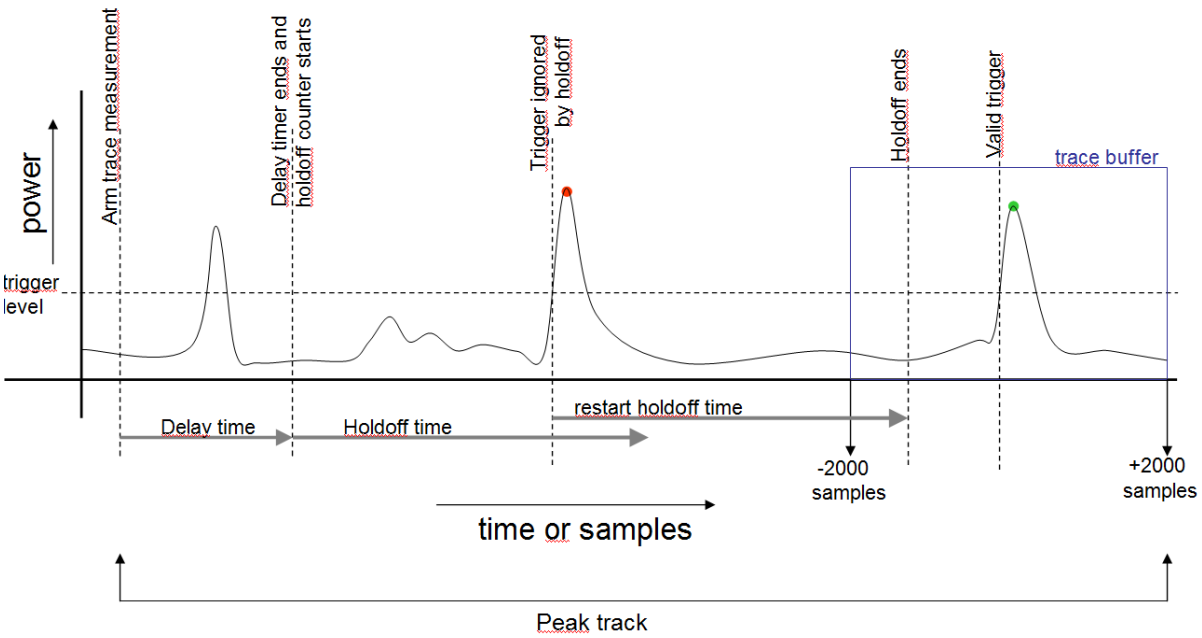


Figure 8: Graphical explanation of the trigger mechanism

During tracing mode, the peak value will be tracked and stored in memory from the moment the measurement is armed. The peak value (represented as the RED dot in figure 10) will 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 ACQ_LOG_DELAY or ACQ_LOG_TRIG_HOLDOFF command at low sampling rates results in long measurement times up to 100 seconds.

5.7 Response Times for Data Readout (Mode 2 - Envelope Tracing) Power Sensor

In mode 2, several commands can be used to read the data from the buffers of the RadiPower®. The following table shows the approximate time for the data transfer at 115200 bps.

Command	Description	Time
"ACQ_LOG_DATA?"	Read power values from buffer samples 0 to 1000 in ASCII text.	720ms
"ACQ_LOG_DATA_ENH? <i>,<j>"	Read power values from buffer <i> samples before trigger to <j> samples after trigger in ASCII text.	720ms for i=j=500 1425ms for i=j=1000 2850ms for i=j=2000
"ACQ_LOG_DATA_ENH_BIN? <i>,<j>"	Read power values from buffer <i> samples before trigger to <j> samples after trigger in binary format.	180ms for i=j=500 360ms for i=j=1000 720ms for i=j=2000

5.8 Error Codes Power Sensor

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® Plug-In Card Specifications

Model	USB1004A	
Power consumption		
Supply voltage	Through USB port	
Current consumption (USB)	100 mA max.	
Mechanical		
Dimensions of measuring device	100 * 40 * 40 mm	
Dimensions of the power sensor	110 * 250 * 320 mm (h * b * d)	2U * 84TE * 250,4mm
RF input connector	N type precision	
Data connector (power head side)	USB type B	
Data connector (Plug in card side)	USB type A	
Number of power sensors per card	4 max.	
Environmental conditions		
Temperature range (operating)	0° to 40° Celsius	
Temperature range (storage)	-20 to 85° C	
Relative humidity	10 – 90% (non-condensing)	
Interfaces		
Communication	USB 1.1	
Compliance		
EMC	EN 61326	
Low Voltage	n/a	
Warranty		
Warranty	3 years (misuse excluded)	

7. RadiPower® RF Power Sensor Specifications

Model	RPR2006	RPR2018
Electrical specifications		
Detector type	Log detector	
Measuring function	RMS CW power, Peak power (max hold) Envelope tracing	
Frequency range	(4 kHz)[8] 9 kHz to 6 GHz	80 MHz to 18 GHz
Power measuring range	-55 dBm[9] to + 10 dBm (Usable to -60 dBm)	-45 dBm to + 10 dBm (Usable to -50 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	1,20
100 MHz to 2 GHz	1,15	
2 GHz to 6 GHz	1,35	
6 GHz to 18 GHz	n/a	1,35
Frequency response accuracy (at 23° C ± 2° C)	+/- 0,25 dB	+/- 0,25 dB (≤ 10 GHz) +/- 0,50 dB (> 10 GHz)

*This table continues on the next page.

[8] If option #010 is installed, the lowest frequency is 4 kHz, otherwise 9 kHz

[9] If option #010 is installed, the dynamic range is -40 dBm to +10 dBm for the frequency range from 4 to 9 kHz

Radi*P*ower® RF Power Sensor Specifications, part 2

Model	RPR2006	RPR2018
Linearity error	0,05 dB + 0,005 dB/dB (-50 dBm to +10 dBm)	0,25 dB / 10 dB (-40 dBm to +10 dBm)
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	20 kSps, 100 kSps, 1 MSps or 10 MSps (*)	
Minimum RF burst width	2µs	
Power consumption		
Supply voltage	+5Vdc from USB port (4,75 V to 5,25 V)	
Current consumption (USB)	120 mA	160 mA

(*) 10 MSps only available in the RPR2006C and RPR2018C with firmware version 2.7.0 or higher

**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.

RadiPower® RF Power Sensor Specifications, part 4

Model	RPR2006	RPR2018
Mechanical		
Dimensions of measuring device	124 * 32 * 32 mm	152 * 32 * 32 mm
RF input connector	N type precision	
Data connector (power head side)	USB type B	
Environmental conditions		
Temperature range (operating)	0° to 40° Celsius	
Temperature range (storage)	-20 to 85° 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 RPR2006C, RPR2006P,
RPR2018C and RPR2018P

to which this declaration relates, is in accordance with the following Directive(s):

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

According to the provisions of the applicable requirements of the following 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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Title of authority: Director

CERTIFIED ISO 9001