R&S® Power Viewer Plus

Software Manual

V 1.2.2

ROHDE&SCHWARZ

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Dear Customer,

Contents

1 Overview

The new R&S NRP-Z power sensors from Rohde & Schwarz represent the latest in power measurement technology. They offer all the functionality of conventional power meters, and more, within the small housing of a power sensor. The USB interface on an R&S NRP-Z sensor enables operation with an R&S NRP power meter, or PC running under either Microsoft Windows or Linux.

R&S Power Viewer Plus[1] is an easy-to-use, feature-packed software package that offers capabilities beyond those of a regular power meter. It simplifies measurement tasks such as power average, timeslot average, statistics and trace. In addition, up to four sensors can be utilized for measuring average power simultaneously. Results such as reflection coefficient or gain can be computed from the measured values.

Particularly the use with a desktop PC makes an R&S NRP-Z sensor an ideal and cost-effective solution for lab testing or automated systems. The rugged design is suitable for use in the field, such as servicing antenna systems.

If the sensors are to be controlled by a PC rather than using the R&S NRP base unit, certain prerequisites must be fulfilled:

- The PC must provide a USB 1.1 or 2.0 interface
- The operating system must be either Microsoft Windows XP or Linux with kernel 2.6.x
- The R&S NRP Toolkit package must be installed
- The Power Viewer Plus software supplied in the R&S NRP Toolkit must be installed

This manual describes the installation and use of the Power Viewer Plus software. The application is part of the R&S NRP Toolkit and is available free of charge from the Rohde & Schwarz website.

For the integration of the sensor into custom ATE systems, a versatile and powerful VXI PnP driver exists for Microsoft Windows XP- and Linux-based systems. Documented coding examples are provided in a separate document.

2 Windows and Linux Version

Power Viewer Plus is available for Microsoft Windows XP- and Linux-based systems. Both software packages are available as binary and offer the same feature level. For additional information about the installation and software prerequisites, please refer to the appropriate sections in this document.

[1] R&S Power Viewer Plus is referred to as Power Viewer Plus throughout this manual.

3 Software Installation on Microsoft Windows-Based Systems

The following section describes the installation process for Power Viewer Plus on a Windows XP-based PC.

Installation of the R&S NRP Toolkit

The application is part of the R&S NRP Toolkit. Simply select the “R&S Power Viewer Plus” option during the toolkit installation process.

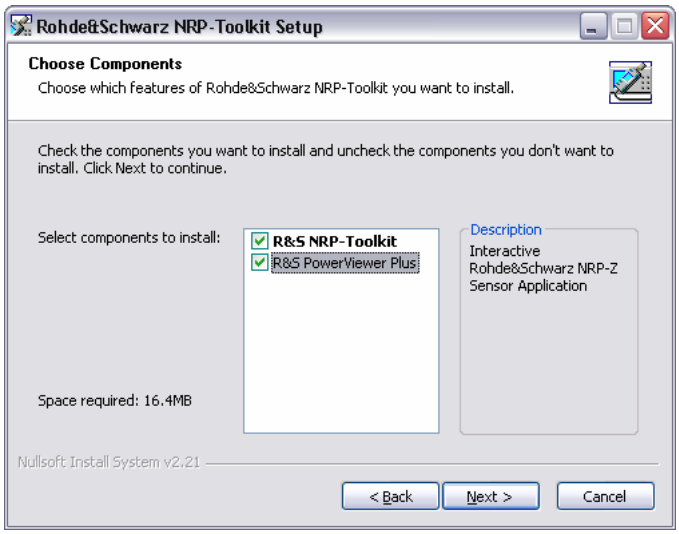


Fig. 3-1 R&S NRP Toolkit Installer

The R&S NRP Toolkit must also be installed if the Power Viewer Plus software option is selected. The basic toolkit installation provides all basic USB device drivers that are required for operating the sensors.

Sensor Firmware Requirements

Power Viewer Plus may require newer firmware versions on certain power sensors. Please see the R&S NRP Toolkit documentation for more details on updating the sensor firmware. The latest firmware files are available free of charge from the Rohde & Schwarz website.

R&S NRP-Z81	**1.16 or later**
R&S NRP-Z5x	**4.08 or later**

Supported Devices

The following table provides an overview of the supported sensors in Power Viewer Plus.

Sensor (R&S)	USB ID	Cont Av	Trace	Timeslot	Statistics
NRP-Z11	0x000c	X	X	X	
NRP-Z21	0x0003	X	X	X	
NRP-Z22	0x0013	X	X	X	
NRP-Z23	0x0014	X	X	X	
NRP-Z24	0x0015	X	X	X	
NRP-Z51	0x0016	X			
NRP-Z52	0x0017	X			
NRP-Z55	0x0018	X			
NRP-Z91	0x0021	X			
NRP-Z81	0x0023	X	X	X	X
NRP-Z27	0x002f	X			
NRP-Z37	0x002d	X			
NRP-Z28	0x0051	X	X	X	
NRP-Z98	0x0052	X			
NRP-Z18	0x001a	X			

If no sensor is detected, Power Viewer Plus automatically activates a simulation mode sensor called R&S NRP-Z00.

4 Software Installation on Linux-Based Systems

The application is statically built using the commercial version of QT 4.3 (www.trolltech.com). There are no dependencies to any external libraries. Please see the installation notes bundled with the Linux package for further information.

5 Known Restrictions

The VXI PnP driver does not support multiple programs accessing the driver simultaneously; only one instance of Power Viewer Plus runs at a time.

At program start, Power Viewer Plus checks if any other instance is already running on the system and, if so, pops up a warning message.

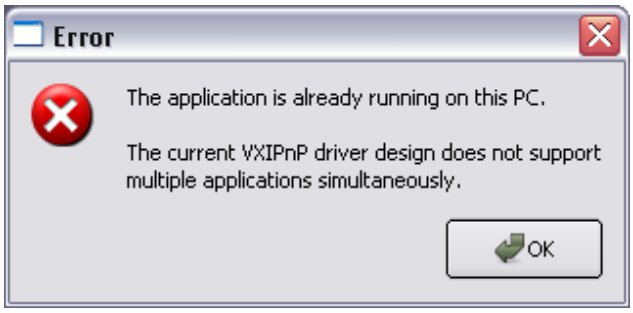


Fig. 5-1 Application single instance warning

However, Power Viewer Plus does not detect if any other application already accesses the VXI PnP driver. It is therefore advisable to close all other R&S NRP-Z-related applications before starting Power Viewer Plus.

6 Software Features

Power Viewer Plus simplifies many measurement tasks:

- Measure average power and view results numerically and as a bar chart.
- View the absolute average power reading or the average power relative to a previously set level.
- Measure the average power of up to four sensors and additionally compute results from the measured values.
- View average power of up to 16 consecutive timeslots as a bar chart.
- Perform statistical CCDF or PDF analysis of envelope power.
- View the RF power envelope down to a resolution of 5 ns/div; measure pulse parameters with markers and within time gates.
- Forward measurements to the data log module and capture results over a period of up to 24 hours.

Please note that some features depend on the R&S NRP-Z hardware used. For example, thermal sensors do not provide statistical signal analysis or trace measurements.

7 Connecting Sensors to a PC

Please see the manual of your R&S NRP-Z power sensor for information on how to put the sensor into operation. Follow these instructions precisely to prevent damage to the sensor, particularly if you are putting it into operation the first time.

The following section provides additional information that is related to the USB interface or to operating multiple sensors simultaneously.

Multiple Sensors

If multiple sensors need to be connected to a single computer, check that the overall current requirement to operate all sensors is available. Each single sensor draws between 300 mA and 500 mA depending on the sensor type.

Example:

The R&S NRP-Z81 sensor is rated at up to 500 mA supply current. Using four sensors simultaneously on one hub requires a total current of at least two amperes. Many consumer hubs cannot provide this current over a long period of time even if rated for this value.

For industrial-grade applications, it is advisable to use USB hubs for DIN rail mount that can provide up to one ampere per USB port and run off a 24 V power supply. The following manufacturers provide such devices:

Beckhoff (www.beckhoff.com) CU8005

Lütze (www.luetze.de) 745581 DIOHUB USB 4

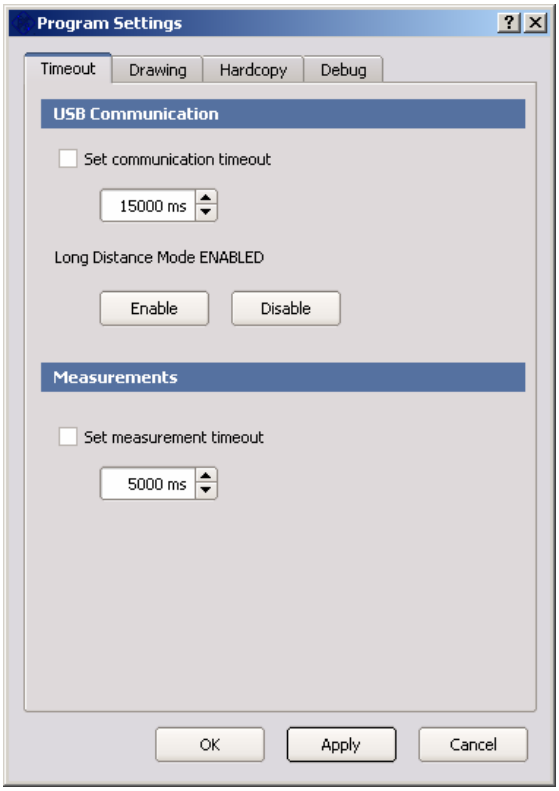
8 Configuring the Application

Power Viewer Plus provides a settings dialog that can be accessed by selecting *Settings -> Configuration* from the main menu.

The dialog is structured using separate tabs for USB communication, drawing operations, hardcopies and debug features.

Timeout-Related Settings

The Timeout tab is shown below and mainly used for connections across USB extenders or USB to LAN interfaces. These devices often introduce large turnaround times that need to be taken care of.



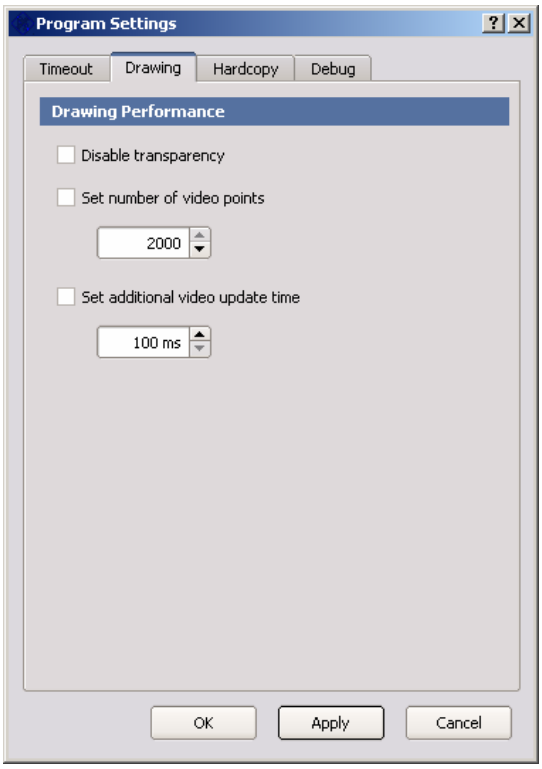
The USB communication timeout is internally set to 5 seconds if it is not otherwise specified. Connections across the Internet (e.g. using the Digi AnywhereUSB® device) may require values of up to 15 seconds.

Long Distance Connection mode is only available for Windows-based operating systems and reduces the number of simultaneous read processes. This lowers USB resource allocation in the operation systems dramatically. AnywhereUSB® connections, for example, require activation of Long Distance Connection mode.

The measurement timeout is internally used between the time a measurement is initiated and the maximum waiting time for a result. Normally the internal time of 5 seconds should be sufficient. However, very slow connections may make it necessary to increase this time.

Drawing Performance

The drawing performance can be adjusted for slow PCs. Activating these features lowers CPU consumption or adds additional idle time.



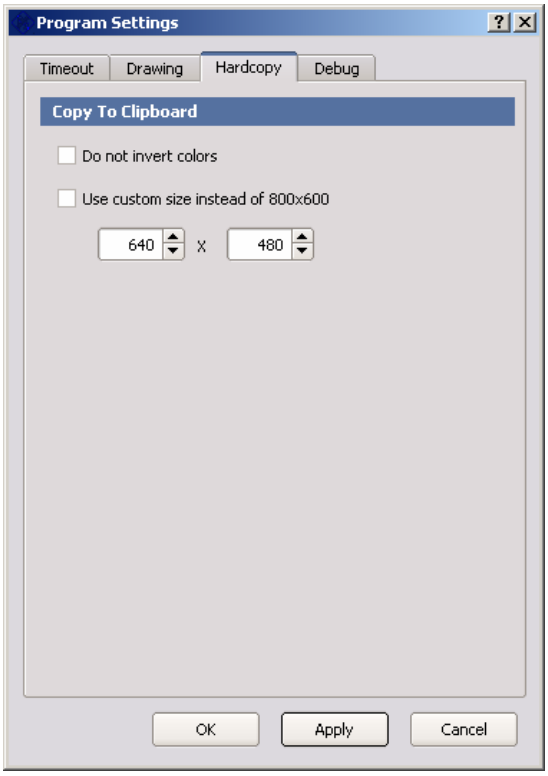
Disable transparency lowers CPU consumption by avoiding semi-transparent drawing operations. Transparent drawing is used, for example, for the grid lines in the trace mode because it makes it possible to see trace points that fall exactly onto a grid line.

The number of video points is set to 500 by default. This number provides a good compromise between measurement speed and resolution. The higher the number of video points, the higher the CPU load and acquisition time. On low-performance PCs it may be desirable to lower this number.

The additional video update time adds idle time between two measurements. This reduces CPU load and provides resources to other applications. The default idle time between two measurements is in the order of 100 ms.

Hardcopy Features

Power Viewer Plus creates print reports or copies measurement results to the system clipboard. This greatly simplifies documentation tasks. Please see section **12 Hardcopy Features** for additional details.



By default the application uses printer-friendly colors when copying data to the clipboard. This feature can be turned off by selecting not to invert the screen colors.

The Copy To Clipboard function always creates a bitmap of a fixed size. This simplifies documentation tasks, since any display resolution may be used and you do not need to specifically rescale captured images.

Debug Options

Debug options are for internal use by Rohde & Schwarz and for debugging purposes. This field should be left blank unless you are instructed otherwise by Rohde & Schwarz.

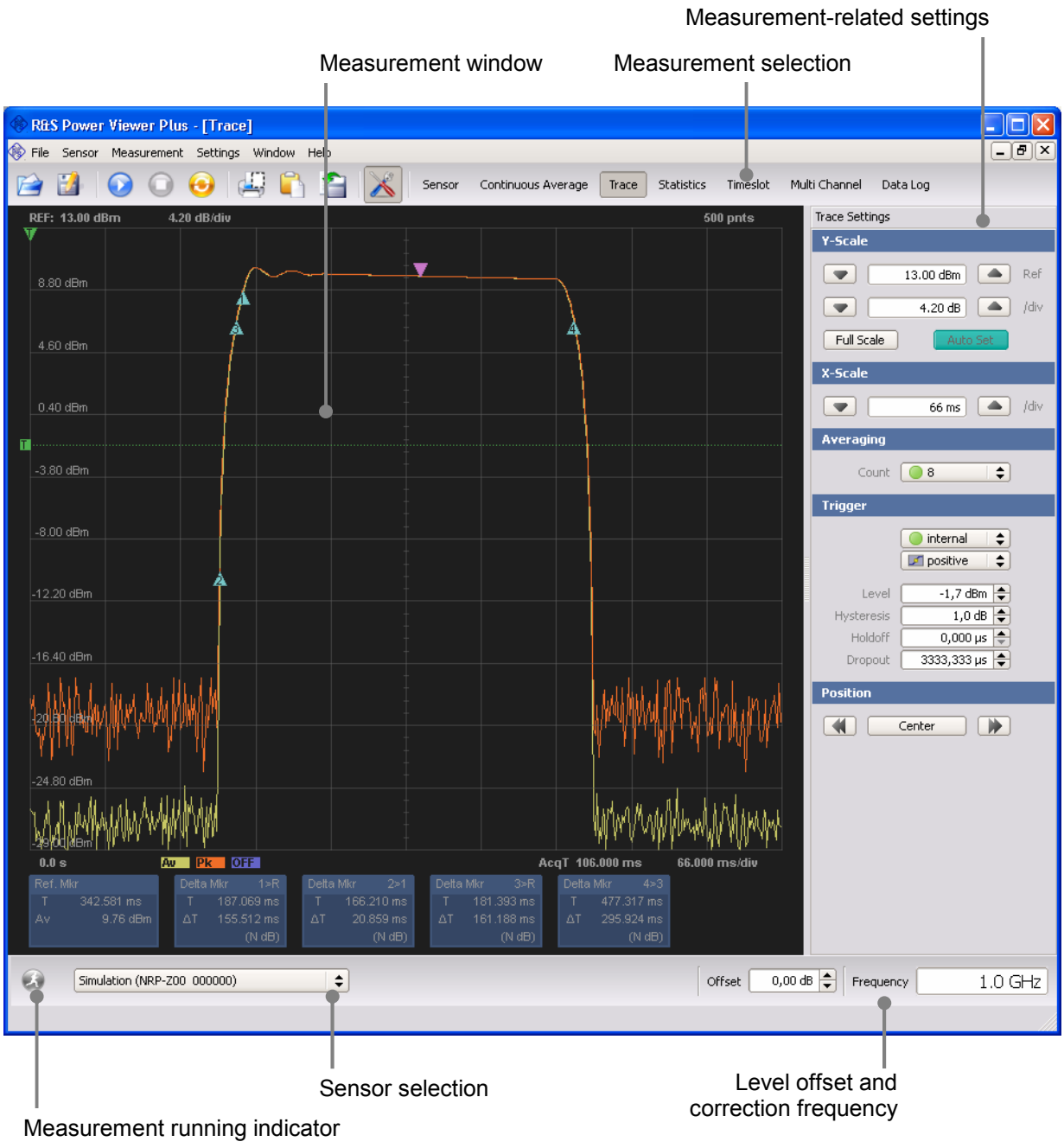
9 The Application Window Layout

The main application window is divided into three major sections:

- The measurement windows
- The settings window
- The two toolbars

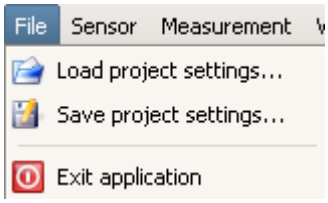
Only one measurement can be active at a time but it is possible to tile multiple measurement windows and switch from one to the other. All measurement windows have the same sensor assigned.

If the settings panel is enabled, it is located on the right side. Its content changes with the currently activated measurement window.



10 Main Menu

File Menu

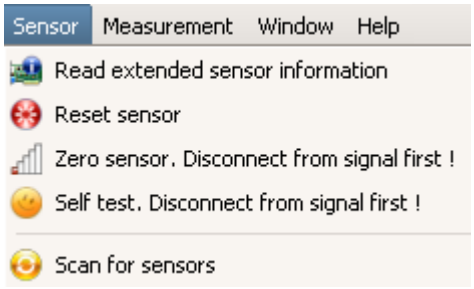


File -> Load project settings loads a previously saved configuration. Settings affect all measurements and fully restore the state of the entire application.

File -> Save project settings saves the configuration of the entire application to a file. The file may later be used to restore a measurement configuration. Measurement data is not part of the settings file.

File -> Exit application aborts all running measurements, disconnects from the power sensor, and subsequently leaves the application.

Sensor Menu



Sensor -> Read extended sensor information reads all available information from the selected sensor. Data returned from the sensor can be viewed on the sensor panel and may be used for debugging purposes. The sensor panel is automatically activated when this menu entry is selected.

Sensor -> Reset sensor initializes the sensor. Any previous zeroing remains valid. It is not necessary to reset the sensor before a measurement is started because measurements always issue this command prior to configuring the sensor.

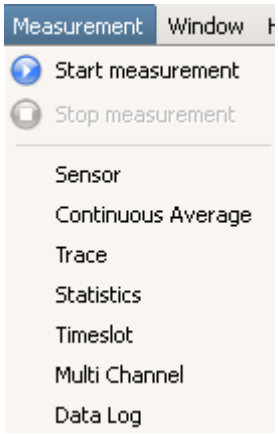
Sensor -> Zero sensor starts the zero adjustment sequence. For this purpose, the test signal must be deactivated or the sensor disconnected from the signal source. The sensor automatically detects the presence of any significant power to be measured. This causes zeroing to be aborted and an error message to be output.

This menu always starts a full zeroing sequence that is valid for all measurement modes and the full frequency range. The process may take up to 8 seconds.

Sensor -> Self test performs a sensor self test and returns the results as text message on the sensor panel. The test signal must be deactivated before the self test is started.

Sensor -> Scan for sensors starts the process of detecting available R&S NRP-Z USB sensors. Activating this menu entry repopulates the sensor selection control. If no sensor is detected, a sensor simulation (R&S NRP-Z00) will be available.

Measurement Menu



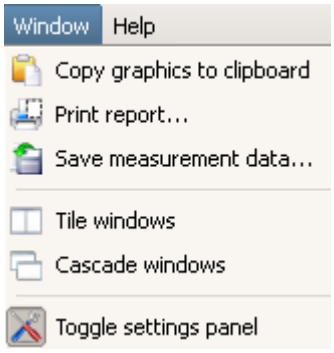
Measurement -> Start measurement starts a measurement in the currently active window. If any other measurement is already running, this button is dimmed. Only one measurement window at a time can be active and run a measurement. Please note that some sensors may not support all measurement modes. In this case, the start button is inactive even if the measurement window is selected.

Measurement -> Stop measurement stops any running measurement, even if the associated window is not currently selected. This menu item is dimmed if no measurement is running.

All further entries in the measurement menu toggle the state of the associated measurement window. If a measurement window is visible, the menu item becomes checked.

The ***Sensor*** panel is not directly used for any specific measurement. It serves as window for informational or error messages, and provides information about the active sensor.

Window Menu

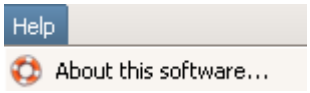


Window -> Copy graphics to clipboard sends the content of the currently activated measurement (graphics only) to the clipboard. This option is only available for measurements that display their result as graphics, such as trace, statistics and timeslot. The option is available for Windows- and Linux-based systems.

Window -> Print report creates a printout of the currently activated measurement. Colors are inverted where necessary to avoid black background. This option is only available for measurements that display their result as graphics, such as trace, statistics and timeslot.

Window -> Save measurement data saves measurement data from the currently active window to a .csv file. The extension stands for comma separated value and lists data in columns that are separated by a single comma. The option is only available for measurements such as trace, statistics or the data log. Comma separated value lists can easily be imported in most applications, such as Microsoft Excel or Linux Open Office.

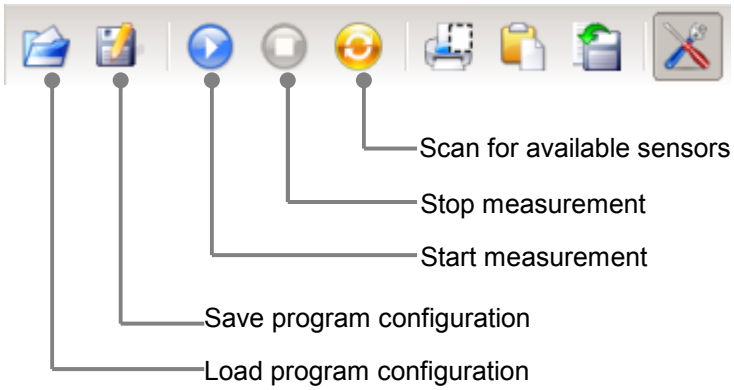
Help Menu

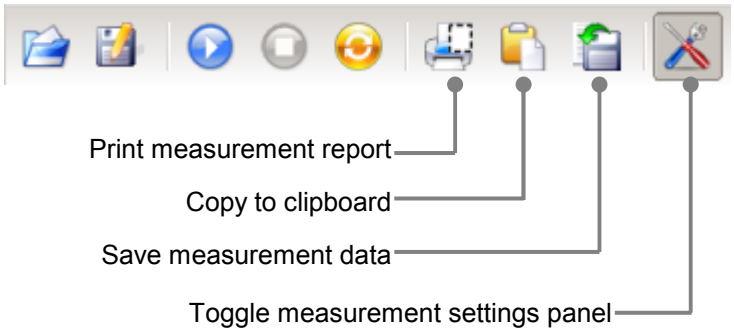


Help -> About this software displays program information such as the software version and licensing information.

11 Toolbars

The application provides two toolbars. The first one is located at the top of the main program window and hosts shortcuts to commonly used functions and measurements. The second toolbar is located at the lower border and used for sensor selection and general settings.

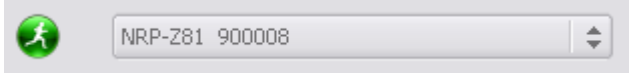




The second toolbar is divided into two sections. The left side provides a running indicator and a control for the sensor selection. If no sensor was detected during the last USB bus scan, a sensor simulation (R&S NRP-Z00) is available to test basic program functionality.

The application remembers the last sensor selection and tries to reuse this device if it was detected during an USB scan. If the last used sensor is not detected anymore, the first of the detected sensors is used instead.

Please note that changing the sensor type may affect measurement settings. Power Viewer Plus double-checks measurement settings before a measurement is started and corrects values if necessary.



The right toolbar section provides two controls for setting up the correction frequency (carrier signal) and an overall level offset.

Both the correction frequency and the level offset value apply to all measurement windows.

This frequency is used for various corrections of the measurement result. It is essential that the current carrier frequency is set. Otherwise, non-linearities or temperature dependencies considerably greater than those stated in the data sheet can occur.

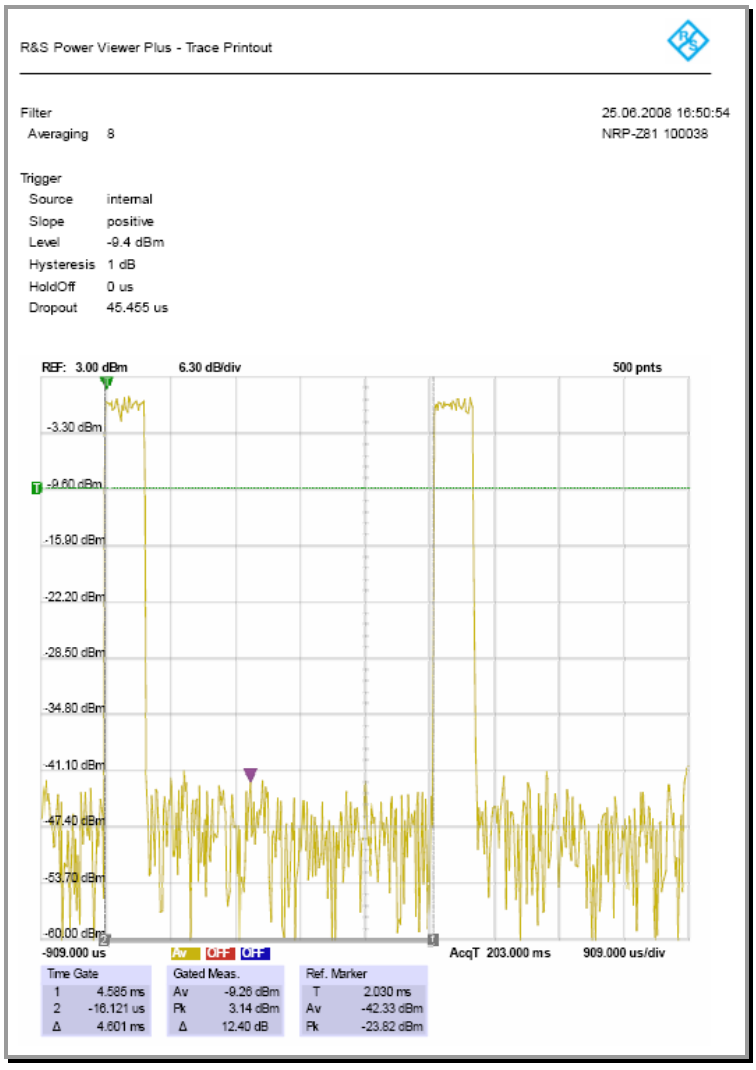
The offset accounts for external losses. If, for example, a 60 dB directional coupler is used to sense power from a DVB-T transmitter, this factor can be provided as offset. Power Viewer Plus sets up the sensor accordingly and in this case would display power results in KW if required.

12 Hardcopy Features

Power Viewer Plus provides two features that greatly simplify documentation tasks. With a simple mouse click it is possible to create a print report for the trace and statistics measurement as well as the data log. Additionally the current graphics can be copied to the system clipboard and pasted into any other application.

Printed Report

The print button in the toolbar automatically creates a one-page measurement report from the current data. Colors are inverted for printer friendliness. The picture below shows an example of the generated form.



The printer selection dialog also offers the option to print directly to a file, in which case a PDF document is directly created without the use of any third-party software.

Copy To Clipboard

The copy to clipboard function creates a bitmap of fixed size from the current measurement and subsequently places the bitmap into the system clipboard.

By default colors are inverted and a resolution of 800 x 600 pixels is used. If this is not acceptable, these parameters can be changed in the settings dialog.

The figure below shows a captured measurement at a resolution of 640 x 480 pixels and inverted colors.

13 Sensor Panel

The sensor panel is not directly used for a measurement. Instead, it provides additional sensor information and lists text messages, warnings and errors that are generated by the application or the USB device driver.

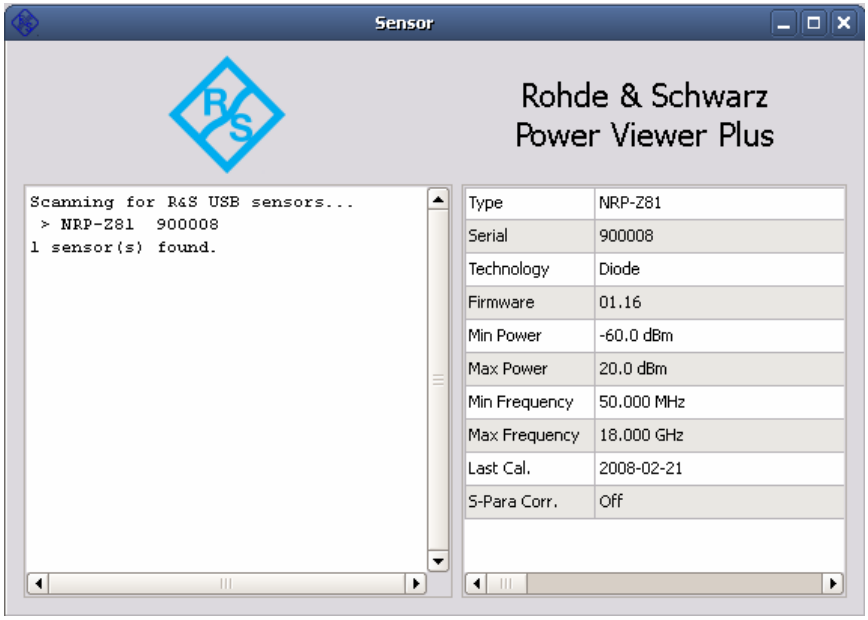


Fig. 13-1 The sensor information panel

The sensor panel is also used to display the output of the extended sensor information query. The following information is important for debugging purposes:

- The sensor type
- The sensor serial number
- The sensor software build number
- The FPGA build number

In case of an unexpected program or sensor behavior, it is advisable to forward a detailed problem description and the above sensor information to the Rohde & Schwarz support center (customersupport@rohde-schwarz.com).

14 Alias Name Assignment

Power Viewer Plus maintains a list of alias names that can be assigned to sensors. Each R&S NRP-Z sensor can have an individual name that is displayed throughout the application as an additional piece of information.

Sensors that are detected during a scan are indicated by illuminated light bulbs whereas unavailable devices appear as gray bulbs.

If no alias name is known for a detected sensor, only its type and serial number is used to identify this device.

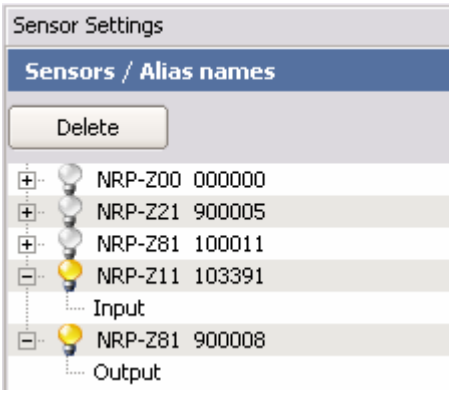


Fig. 14-1 Alias name assignment

The use of alias names simplifies measurement tasks that involve multiple sensors. For example, the measurement of an amplifier gain requires calculating this figure from the incident and output power. Alias names such as “incident” or “output” may be assigned to the sensors connected to these signals. This helps to clearly identify a sensor.

15 Continuous Average Power Measurements

In this mode, the average power of the measurement signal is asynchronously measured within definable time intervals (sampling windows). The width of a sampling window is preset to a length that is optimal for the selected sensor but can be changed to other values. The measurements are performed with chopper stabilization to obtain more accurate results with reduced noise and zero offset. Therefore, a measurement is always performed over two sampling windows, the polarity of the detector output signal being reversed for the second window. By taking the difference of the output signals, the influence of the video path on noise and zero drift is minimized. When the averaging function is activated, the averaging factor determines how often the described measurement cycle is repeated.

Continuous Average Power Settings

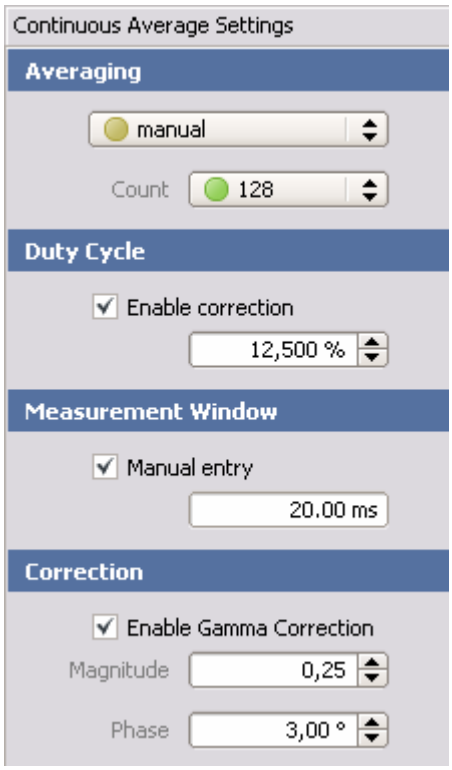


Fig. 15-1 Continuous Average measurement settings

Averaging

The averaging mode can be set to either "auto" or "manual". In manual mode the sensor uses an averaging factor that is set by the user between 1 (no averaging) and 65536. In auto mode the sensor determines the optimum average filter count internally based on the given resolution (0.01 dB).

Average count

This is the number of measured values that have to be averaged to form the measurement result. The greater this averaging factor, the less the measured values fluctuate and the longer the measurement time.

Duty cycle correction

The duty cycle can be set as a percentage when pulse-modulated signals are corrected. With the correction activated, the sensor calculates pulse power from the duty cycle and average power.

Measurement window

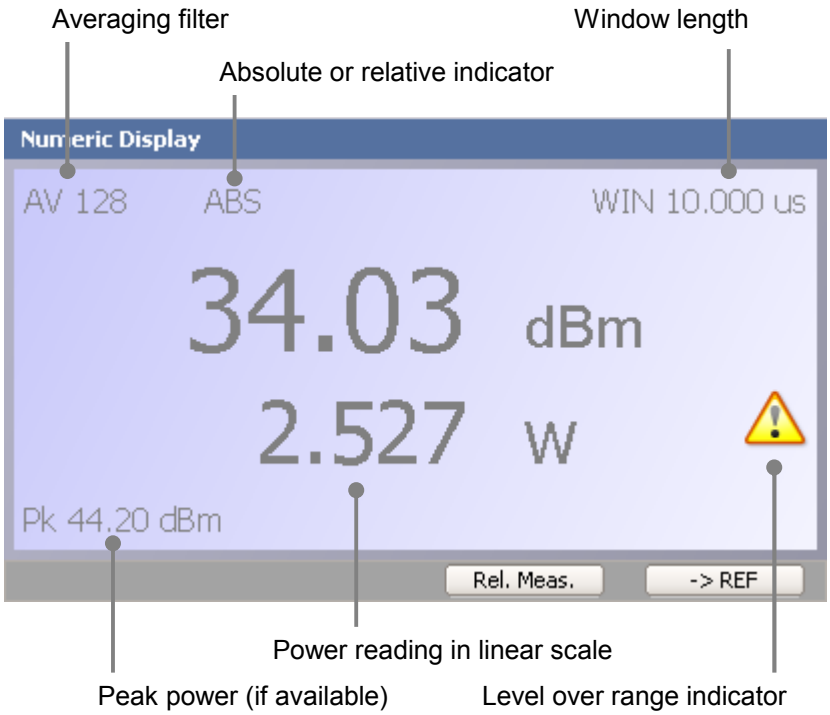
The measurement window is the time period that is used to form one sample. The Power Viewer Software automatically sets a default window that best fits the active sensor. Wider sampling windows may be required if the measurement result exhibits fluctuations due to modulation. In this case, it is beneficial to set the sampling window length to a value equal to the modulation period.

Correction

The gamma correction value sets the complex reflection coefficient of the source. A magnitude value of zero corresponds to an ideally matched source and a value of one to total reflection. The phase angle can be set between −360.0 and +360.0 degrees.

Numerical Data View

Power Viewer Plus displays average power readings in numerical and graphical form. The numerical view always includes the logarithmic and linear representation of the current reading.



The linear scale unit changes between pW, nW, µW, mW, W and KW depending on the current reading.

If a noisy signal is measured close to the zero power reference point (zeroing), negative power readings may occur in the linear scale. The logarithmic scale ignores the polarity and always uses the absolute value of linear power readings. In rare cases the linear scale value may be exactly zero. Since it is impossible to convert zero to a logarithmic scale, a reading of −60 dBm is shown instead.

Both linear and logarithmic power readings are average measurements based on the current average filter setting. If the sensor provides peak power data, this number is displayed in the lower left section.

Please note that peak power readings need to be treated with care regarding accuracy. Chopper stabilization or averaging techniques are not possible for peak measurements and thus the noise level is substantially higher than it is for average measurements. A typical noise level for R&S NRP-Z81 sensor peak readings is around −25 dBm.

Relative measurements

Relative measurements display the current reading relative to a previously set reference power level. This measurement mode is useful when the measurement task requires the analysis of the stability or drift of a power reading.

If the measurement mode is changed to relative, Power Viewer Plus saves the current reading as reference value. Subsequent mode changes do not alter this reference power level anymore and a new level is set using the ->REF button.

Analog Display

Power Viewer Plus also displays power reading graphically as an analog bar graph and trend view. The bar graph shows the average power level as a blue and the peak power level as a red arrow. Each arrow holds the maximum value for a time period of about 5 seconds. Peak readings are indicated by smaller and darker arrows that are located at the tip of the larger arrows.

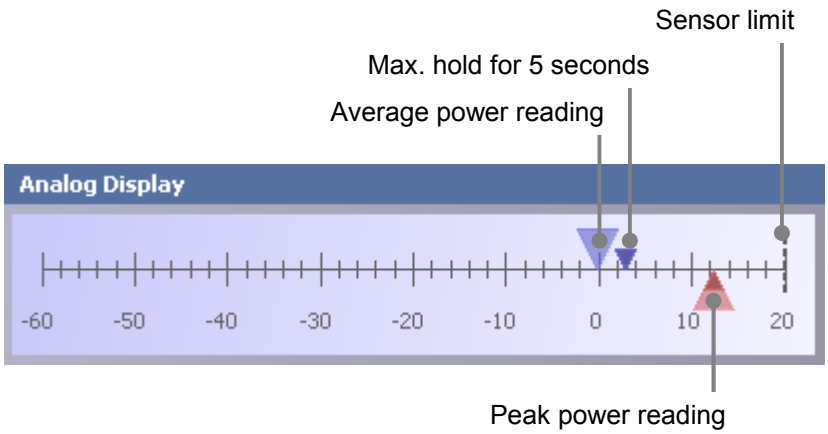


Fig. 15-2 Bar graph in absolute measurement mode for R&S NRP-Z81

In the relative display mode the scale always ranges from −10 dB to +10 dB with minor ticks in increments of 0.2 dB. This scale allows the simple monitoring of a set power level for its deviation or drift. In contrast to the absolute measurement mode the small arrow tips marking peak readings hop back towards 0.0 (center of scale).

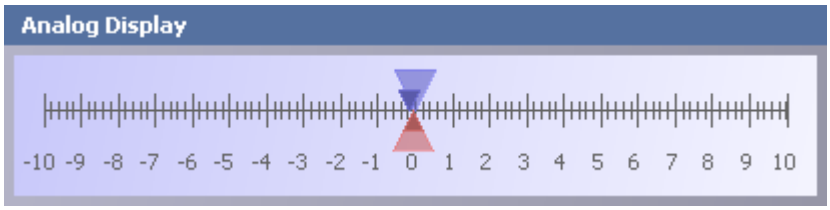


Fig. 15-3 Bar graph in relative measurement mode for R&S NRP-Z81

Please note that not all sensors provide peak power readings. For those sensors the red arrow is omitted.

For the analysis of power readings over time, Power Viewer Plus provides an additional trend chart that shows past power readings. New values are appended on the right side of the chart and move to the left side with time.

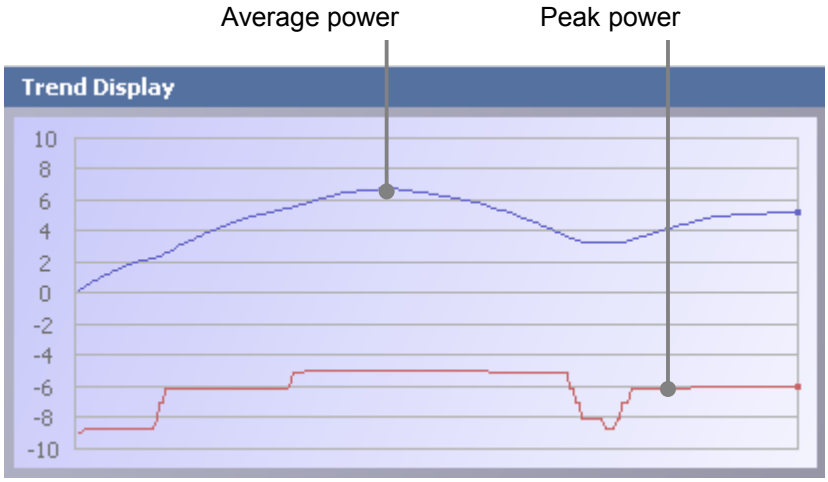


Fig. 15-4 Trend chart in absolute measurement mode

Analogously to the bar chart, the blue trace indicates average power whereas the red trace is used for peak power readings. The trend chart does not provide a time scale because the time varies depending on filter and measurement window settings.

Please note that Power Viewer Plus sets the sensor to use a moving average filter. This ensures constant power readings at a reasonable rate regardless of averaging filter count or window length. However, fast level changes do not appear as a step in the trend display but show a smooth transition from one level to the other.

16 Statistics

In the Statistics mode, either the complementary cumulative distribution function (*CCDF*) or the probability density function (*PDF*) of the envelope power can be measured.

Statistics Settings

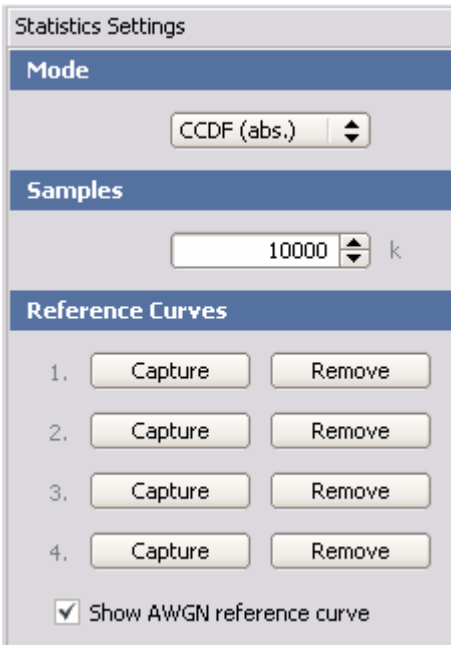


Fig. 16-1 Statistics settings

Mode

Power Viewer Plus supports the absolute and relative CCDF as well as the PDF mode.

The CCDF shows how often a measured power value is above a certain level. For this purpose the X coordinate is scaled in dBm and according to the absolute power level. The Y coordinate is scaled logarithmically and in probabilities from 100 % down to 1e-4 %.

Samples

The number of samples determines the length of the evaluation window. The overall window length is calculated from the sampling rate (80 MHz, 12.5 ns interval) and the sample count.

The default evaluation length is one million samples.

The application uses an unsynchronized measurement mode for the statistics measurement. Thus, a measurement is started without waiting for any trigger event and stopped when the set evaluation period has elapsed.

Reference curves

The current curve can be saved as a reference curve and used for comparison with later measurements. Any reference curve data is only stored locally in the graphics view. It cannot be saved to a file.

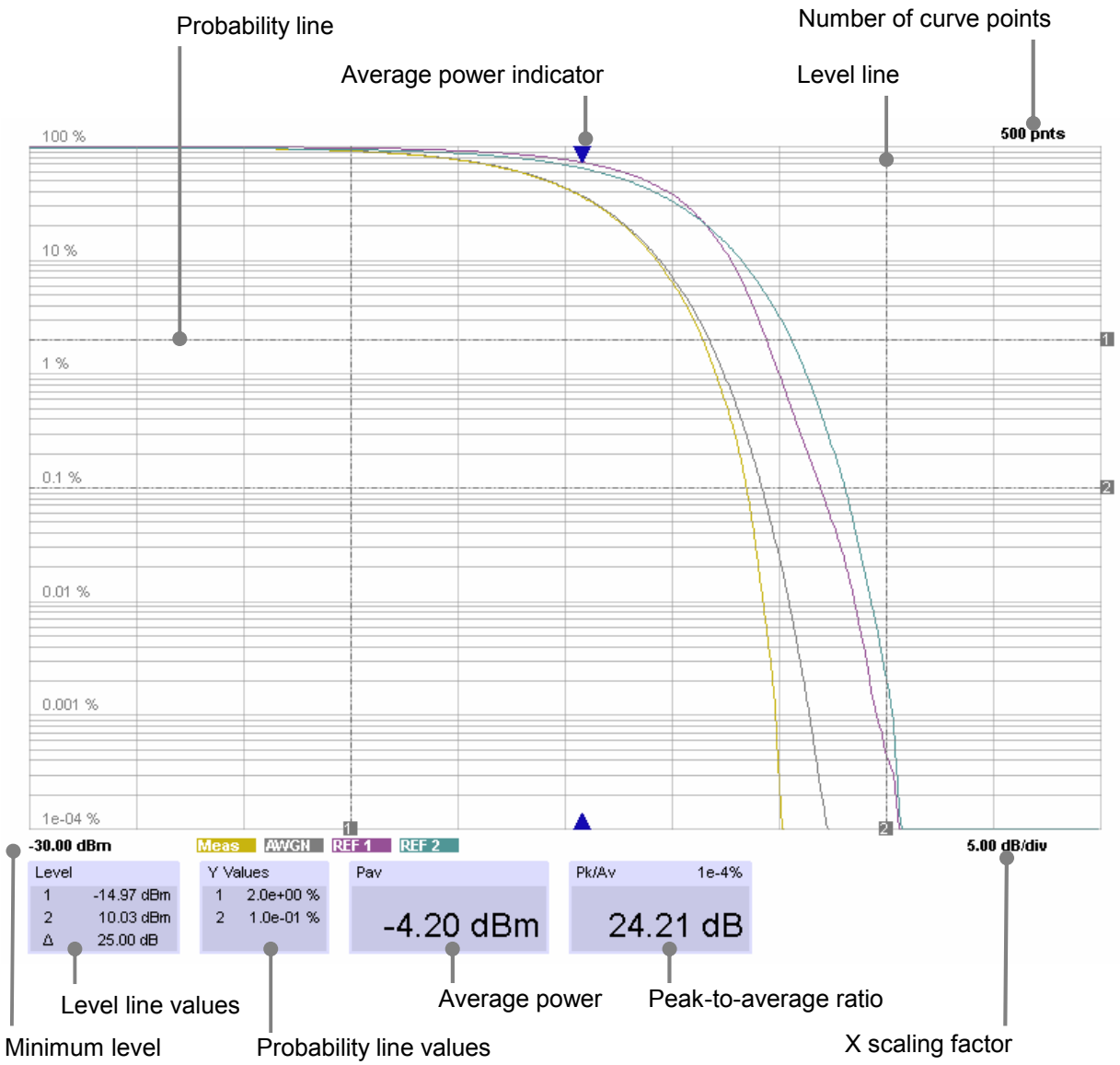
The statistics view supports up to four reference curves in addition to live measurement data.

Show AWGN reference curve

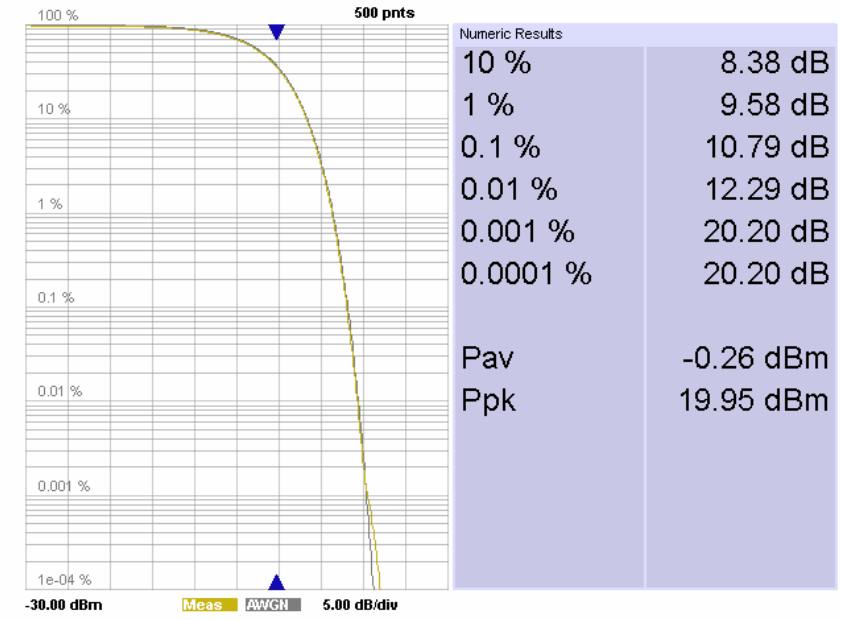
This checkbox adds an ideal AWGN curve as reference to the statistics data display. The reference curve can be used with all statistics modes.

Graphical Data View

The graphical CCDF view may contain the information shown below. Level and probability lines are activated with a right mouse click into the graphics area.



The application supports the absolute or relative CCDF as well as the PDF display. Additionally, the display can be tiled to show a table with numeric results on the right side. The table mode is activated using the context menu (right click into the graphics area).



In the table mode no numeric data is shown below the graphics to save space for the other contents.

17 Timeslot Average

In this mode the average power of a definable number (up to 16) of successive timeslots within a frame structure with equal spacing is measured.

When the averaging function is activated (averaging factor of two or more), measurements are performed with chopper stabilization to obtain more accurate results with reduced noise and zero offset. Chopper stabilization involves reversing the polarity of the detector output signal from frame to frame. By taking the difference of the output signals, the effect of the video path on noise and zero drift is minimized.

Timeslot Average Settings

The timing section sets all parameters that are required to precisely define the timeslot structure of the signal to be analyzed. To obtain stable and reliable results, it is essential that these parameters exactly match the signal.

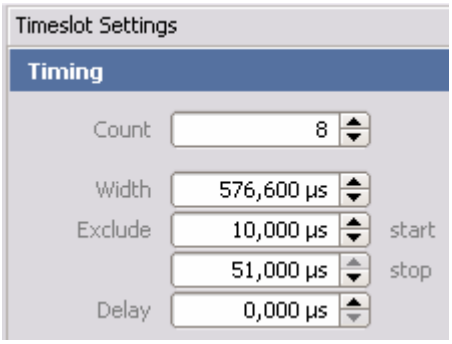


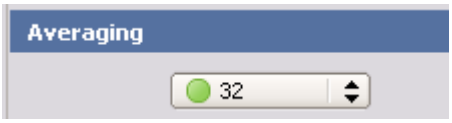
Fig. 17-1 Timing-related settings

Count defines the number of timeslots that belong to a single frame. The permissible range is one to 16.

Width sets the width of a single timeslot within the frame structure. Each timeslot is of exactly the same width.

Exclude is the time gap at the beginning or at the end of a timeslot that is not evaluated for the measurement. This parameter is used to define the spacing between adjacent timeslots.

Delay specifies the time between the trigger point and the start of the entire frame structure.



The average filter reduces the noise level significantly. The filter count sets the number of frames that are to be evaluated to form one measurement result.

Timeslot average measurements require stable and reliable trigger conditions. This is particularly important when average filter techniques are used and data from multiple frames is averaged.

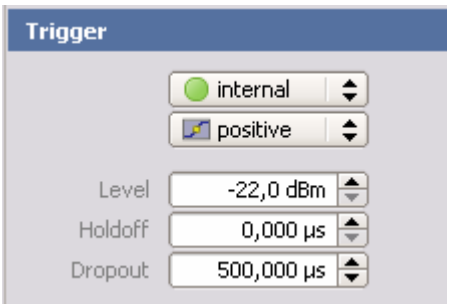


Fig. 17-2 Trigger settings

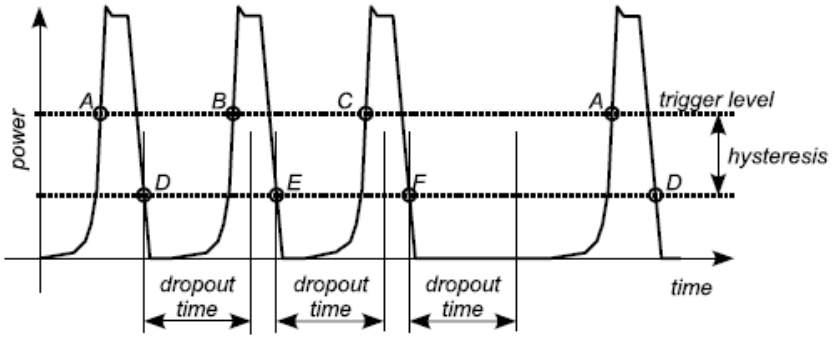
The **trigger source** can be either internal or external. If an external source is used (R&S NRP-Z3 adapter cable), only the settings for polarity and holdoff time are available.

The **trigger polarity** can be set to either positive or negative. This setting is available for all trigger sources.

Level sets the trigger threshold for internal triggering derived from the test signal. This setting is irrelevant to all other trigger sources. In order to achieve stable trigger conditions, a trigger level above −20 dBm is advisable.

Holdoff suppresses trigger events within the set holdoff time (in seconds), starting from the time of the last successful triggering.

Dropout is used to set the dropout time in microseconds. With a positive (negative) trigger slope, the dropout time is the minimum time for which the signal must be below (above) the trigger power level before triggering can occur again. As with the holdoff parameter, unwanted trigger events can be excluded. The set dropout time only affects the internal trigger source.

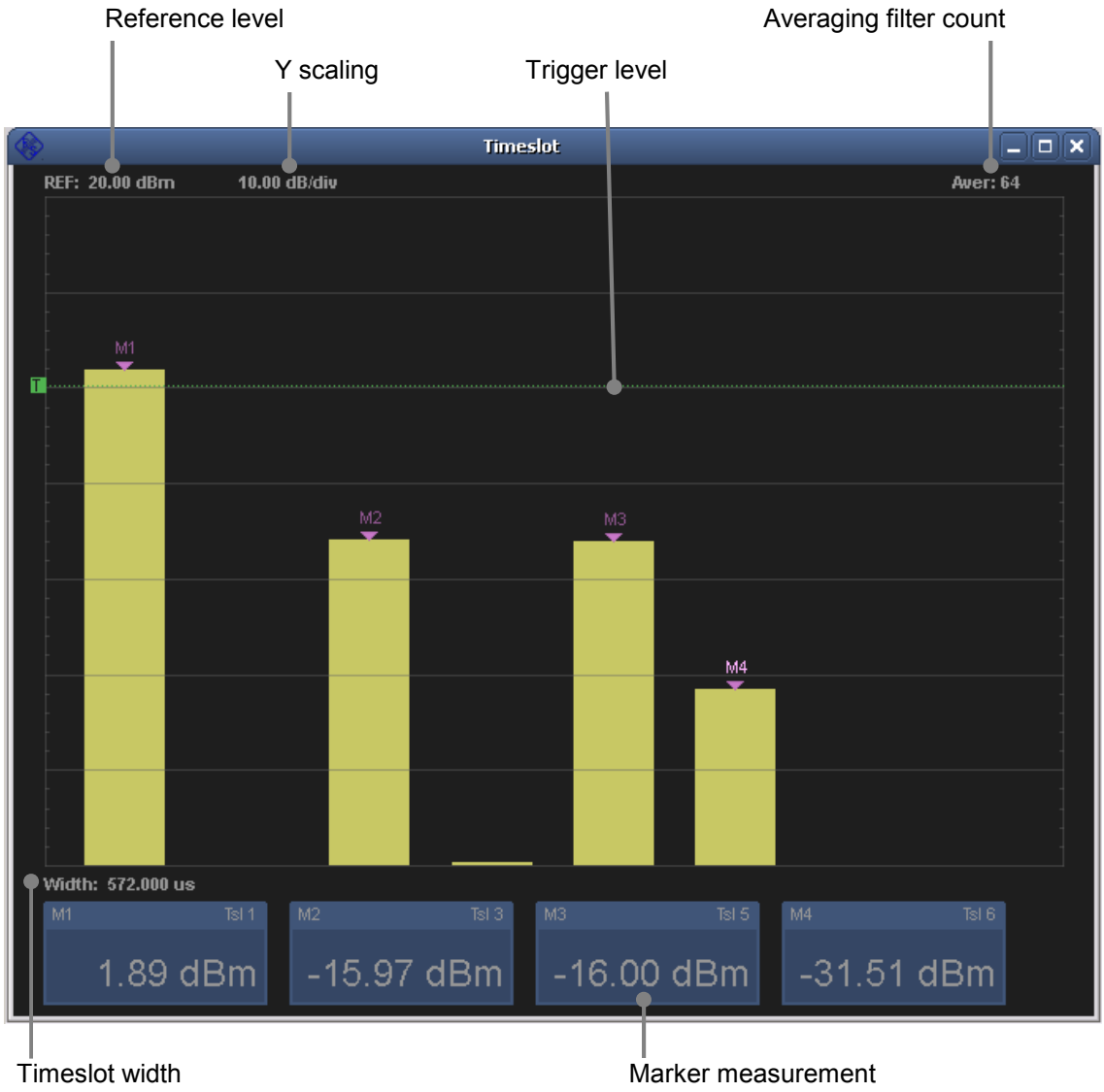


The dropout time parameter is useful when dealing with, for example, GSM signals with several active slots. When performing a measurement in sync with the signal, a trigger event is to be produced at A, but not at B or C. As the RF power between the slots is below the threshold defined by the trigger level, the trigger hysteresis alone cannot prevent triggering at B or at C. This is why the dropout time parameter is selected to be greater than the time elapsed between points E and B

and between F and C, but less than the time elapsed between G and A. This ensures that triggering will take place at A.

Graphical Data View

The graphical timeslot average power view contains the information shown below.



All bars are continuously updated. The update rate depends mainly on the set average filter count. The higher the filter count, the lower the update rate and the noise level.

Markers

Up to four markers can be placed on any of the 16 timeslots for precise average power readings. These readings are displayed below the bar graph area.

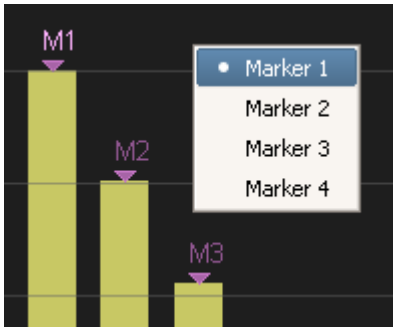
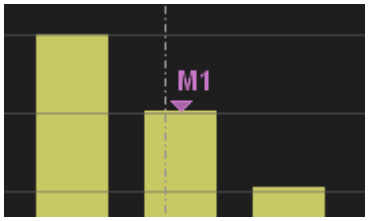


Fig. 17-3 Context menu in timeslot average view

A context menu can be activated within the bar graph view by a right mouse click. The menu selects the active marker from one to four. As a next step, markers can be dragged by holding the left mouse button within the graphics area. A thin line displays the column on which the marker is to be placed.



Moving the mouse to the very left or very right border disables the marker.

Logging data

All marker readings are automatically forwarded to the data log panel and appear as individual traces. The data log functionality is always active even if the associated window is not visible on the screen. Starting a measurement clears all existing data from the data log and restarts capturing.

For additional information regarding the data log feature, please see the section **20 The Data Log Panel**.

18 Trace Measurements

In the Trace mode, the envelope power can be recorded as a function of time. This is done by sampling power over a time interval that can be specified by the user. The power values are assigned to a number of pixels (video points) that each contain data, such as the average power, the maximum power and a randomly sampled value.

When the averaging function is deactivated, measurements are performed without chopper stabilization, i.e. a measurement consists of a single sampling sequence activated by a trigger event. Otherwise, the detector's output-voltage polarity is reversed automatically for alternate sampling sequences. This suppresses low-frequency noise and increases the accuracy with which the average power is measured at each pixel. Averaging has no effect on the randomly selected samples; the largest values for each averaging sequence are output as peak values.

Trace Settings

The Y scale is defined by the two parameters reference level and level step per division. Both values can be changed in steps by means of plus and minus buttons on the settings panel. In addition, values can be entered manually in logarithmic or linear scale.

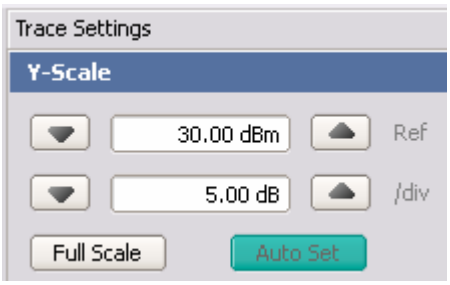


Fig. 18-1 Y scale settings

When entering numeric data, both the value and the unit must be indicated. The application parses the user entry and converts or corrects data as needed. The following units can be used:

d, dB, dBm	dBm
k	10^{3}
m	10^{-3}
u	10^{-6}
n	10^{-9}
p	10^{-12}

Reference Level specifies the upper limit of the trace view area. This setting only affects the graphical data representation in the application and has no influence on the measurement or sensor configuration.

Y/div sets the scaling of the Y-axis. Zooming is always done by keeping the reference level constant and adjusting the lower level accordingly.

Auto Set tries to adjust Y-scaling, trigger level and timing according to the applied signal. All other parameters are set back to defaults. If the auto set process fails, all settings are left untouched.

Power Viewer Plus uses a fixed grid of 10 divisions for the X axis. The time resolution is set per division with the lowest possible value of 5 ns/div.

Please note that not all sensors support the same time resolution. Additional information can be found in the sensor data sheet.

Fig. 18-2 X-scale settings

The two buttons (plus and minus) increase or decrease the time per division value in fixed steps. These steps follow the order 1 -> 2 -> 5 -> 10 or vice versa. The appropriate unit is automatically added to the numeric value.

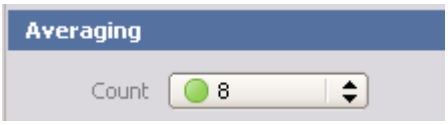


Fig. 18-3 Averaging

The **Averaging** count sets the number of traces to be evaluated to form one measurement result. Averaging reduces the noise level of the average trace but increases measurement time. Changing the averaging count does not have any effect on traces that represent random sampling data. A peak trace representation usually increases in level slightly with an increase in the averaging count.

It should also be noted that using trace averaging requires a stable trigger event. Otherwise, traces with different timing are averaged and the result is erratic.

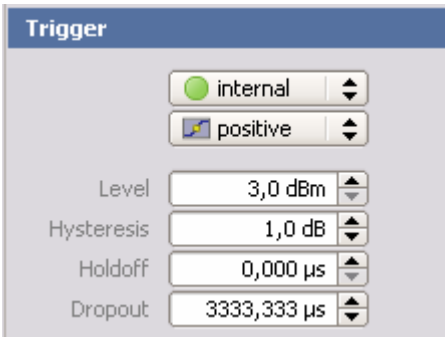


Fig. 18-4 Trigger settings

The trigger sections defines major trigger parameters such as the trigger source, the trigger slope as well as level, holdoff time and dropout time. These parameters are to the same as the ones already described in the section **17 Timeslot Average**.

In contrast to timeslot average mode, the **trigger source** may also be set to free running trigger mode. In this mode a trigger event is immediately issued and makes this setting useful for a very first

inspection of signals with entirely unknown timing and level. Trace averaging cannot be used with free running trigger.

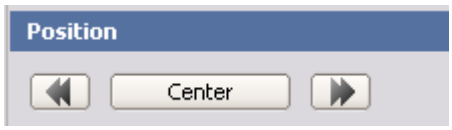


Fig. 18-5 Trace position controls

The **trace position** sets the trigger point position within the trace view area. The arrow buttons move the trace back or forth by one division whereas the **Center** button sets the trigger point to the middle of the trace view area (50 %).

The trace position setting allows the user to view the signal at times before the physical trigger point. Please note that this time interval (pre-trigger) depends on the sensor hardware used. Power Viewer Plus automatically corrects invalid ranges for the current sensor.

Fig. 18-6 Trace context menu

The trace graphics view provides a **context menu** that can be activated by a right mouse click. The context menu contains all functions directly related to the graphical data representation and does not affect sensor settings.

Linear / logarithmic display

Trace data can be viewed in linear scale (Watts) or logarithmic scale (dBm). The menu switches back and forth between these two view modes. However, when switching from linear to log mode, negative Y values are truncated and the lowest dBm level set to −60 dBm.

Traces

Some power sensors (R&S NRP-Z81) return data in the form of three traces that can be selected with the trace submenu. The average, random and peak information is available for each video point of the acquired trace data.

Average power:

The power values of identical measurement points, i.e. points at the same distance from the trigger point, are averaged. This reduces noise, the noise reduction being proportional to the square root of the averaging factor.

Max. values:

The maximum of all samples taken at identical measurement points, i.e. points at the same distance from the trigger point, are found and output.

Random values:

The random values are obtained from the first measurement cycle. Repetition of the measurement cycle has no effect on the result.

View mode

The view mode can be set to either normal or envelope mode. In envelope mode, trace data is accumulated over up to 200 traces and minimum and maximum readings are connected with vertical lines. This mode is very useful for analyzing glitches or jittered signals.

Lines

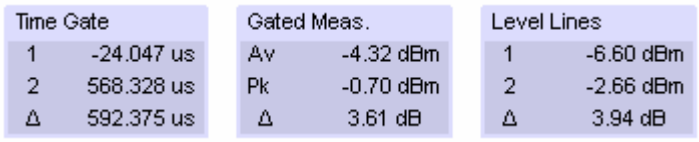


Fig. 18-7 Measurements related to level lines and time gate

Time gate and level lines may be activated for simple measurement tasks. Both line sets can be dragged by holding the left mouse button. Text boxes at the lower border show all related readings such as delta values and power readings within the gated area:

Time Gate

- 1 The position of time gate line 1 relative to the trigger position
- 2 The position of time gate line 2 relative to the trigger position
- Δ The time difference between both time gate lines

Gated Measurement

- Av The average power between the time gate lines
- Pk The peak power between the time gate lines
- Δ The difference between peak and average power

Level Lines

- 1 The level where line 1 is positioned
- 2 The level where line 2 is positioned
- Δ The difference between both level lines

Markers

Markers can be tied to trace points for performing automated measurements. The context menu is used to activate the **Marker Settings** dialog shown below.

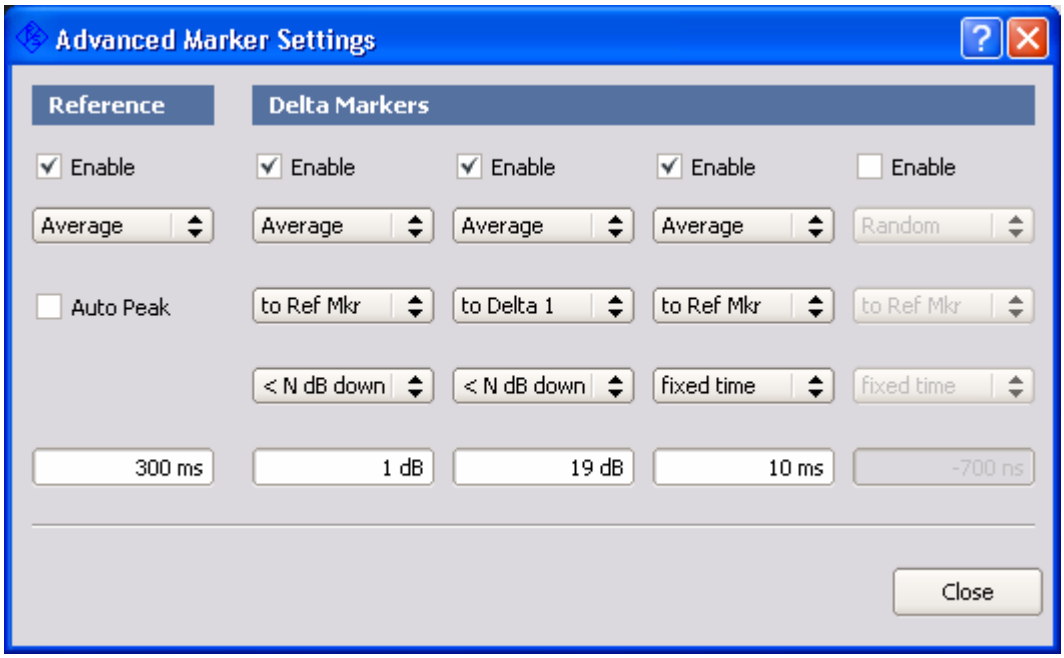


Fig. 18-8 Marker Settings dialog

Power Viewer Plus offers one reference and up to four delta markers.

Each of the markers can be assigned to the average, random or peak trace. This assignment is independent of whether the trace is enabled for viewing or not.

The reference marker is set to a point in time relative to the trigger point. Alternatively it may be set to automatic peak tracking mode, which positions the marker to the maximum power value within the visible trace area.

The reference marker is indicated with a small purple arrow that points downward to the set trace.

Delta markers can be defined relative to the reference marker or relative to other delta markers. This allows the user to build chains of markers and perform measurements between marker points.

Each delta marker is either set to a fixed point in time relative to the marker it depends on, or is used in "N dB down" mode to search for a set level.

Example of a pulse width measurement

An automatic pulse width measurement can be performed using three markers. The reference marker is set to a fixed point in time where its level exactly matches the top pulse power.

The first delta marker is set to operate relative to the reference marker and 3 dB down to the left side. This makes marker one search for the point within the rising edge where the 50 % power level is located.

The second delta marker is set to operate relative to the first delta marker. If "N dB down" search to the right side with zero level difference is used, the marker searches for the same level on the right side.

The result is shown in Fig. 18-9 below.

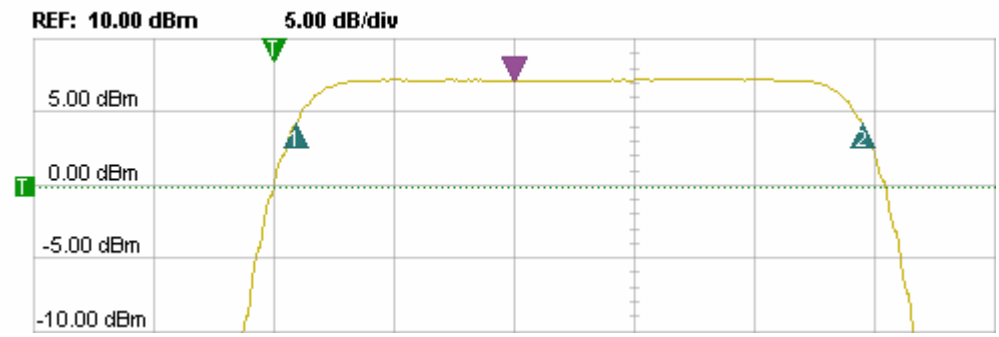


Fig. 18-9 Markers in a pulse width measurement

The pulse width can be read from the ΔT measurement of delta marker two. The starting point of the pulse related to the trigger level is displayed as ΔT measurement of marker one.

Ref. Mkr	
T	2.000 us
Av	7.17 dBm

Delta Mkr	1>R
T	187.3 ns
ΔT	1.813 us
	(N dB)

Delta Mkr	2>1
T	4.901 us
ΔT	4.714 us
	(N dB)

Fig. 18-10 Marker readings

Example of a pulse rise time measurement

The rise or fall time of a pulse can be measured using a set of two delta markers and the reference marker. The reference marker is set to a fixed point in time where its level exactly matches the top pulse power.

The first delta marker is set to operate relative to the reference marker in 1 dB down mode with search to the left side.

The second delta marker is set to operate relative to the first delta marker. The operating mode needs to be 19 dB down with search to the left side.

The result is shown in Fig. 18-11 below:

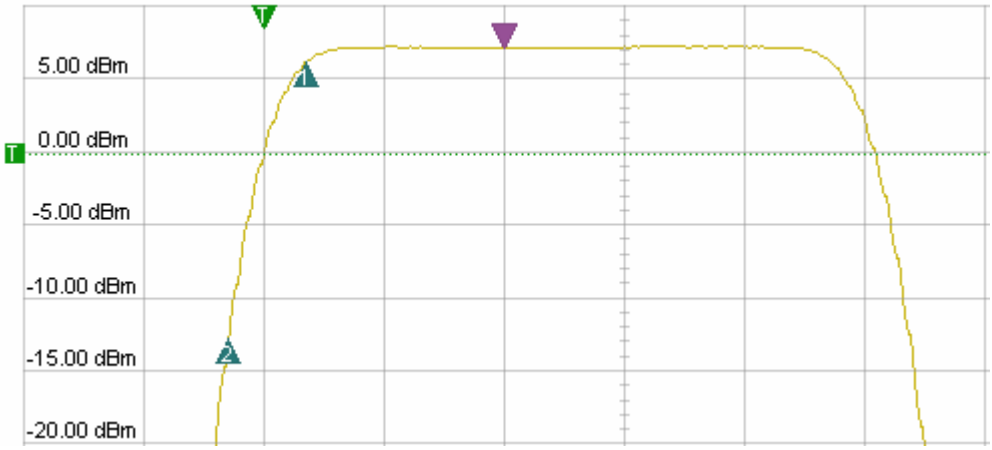


Fig. 18-11 Rise time measurement using markers

The pulse rise time can be read from the ΔT measurement of delta marker two.

Ref. Mkr	
T	2.000 us
Av	7.17 dBm

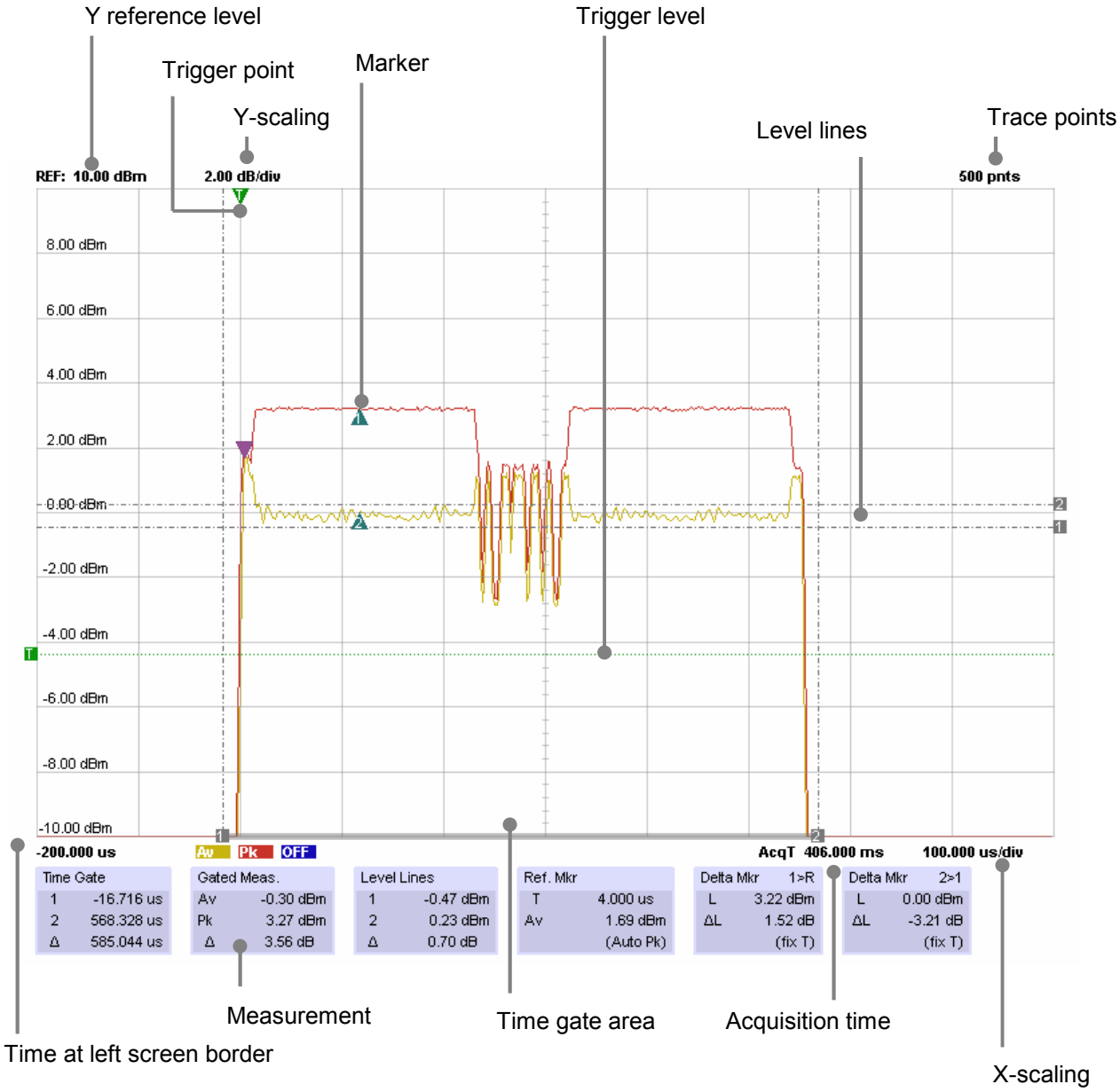
Delta Mkr	1>R
T	350.4 ns
ΔT	1.650 us
	(N dB)

Delta Mkr	2>1
T	-294.7 ns
ΔT	645.1 ns
	(N dB)

Fig. 18-12 Marker readings

Graphical Trace View

The graphical trace view contains the information shown below.



The **AcqT** display may change to "Trig?" if no trigger event occurs over a period of about five seconds. In this case, the display content freezes and the system waits for new trigger events.

Fig. 18-13 Trigger level outside of visible area

If the **trigger level** is outside of the visible area, the green trigger level line disappears. Instead, a little arrow next to the T indicates in which direction the trigger level is located.

Fig. 18-14 Trigger point outside of visible area

If the **trigger** point (in time) is located outside of the display area, the green arrow rotates and indicates in which direction the physical trigger point is located.

Zooming

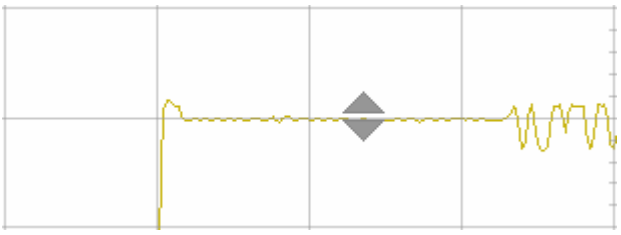
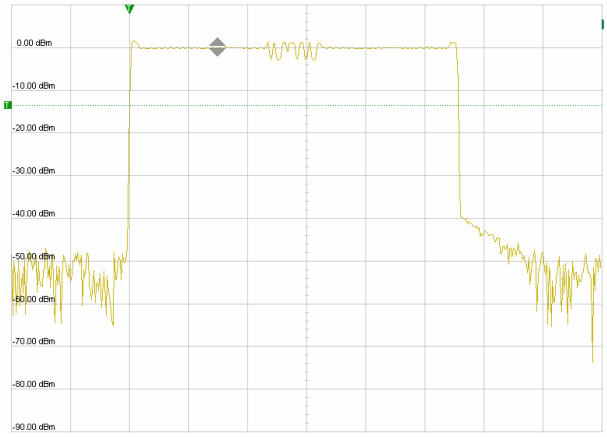


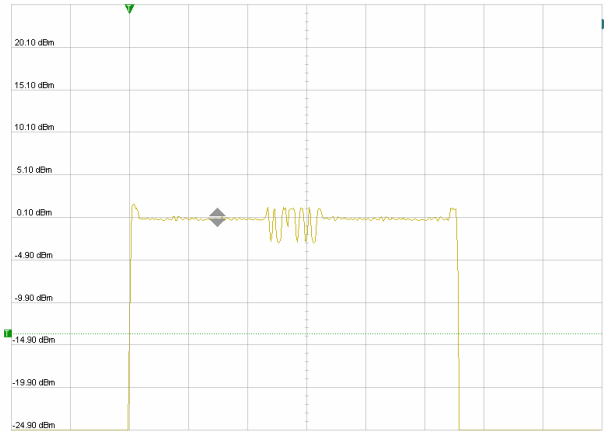
Fig. 18-15 Defining the zoom point

The Y zoom mode can be activated by a left click into the trace view area. This sets the zoom point, which is marked by two little arrows. Subsequently turning the mouse wheel zooms in or out using this point as the center position. The following pictures explain the zooming process:

Step 1: The mouse cursor is positioned at the zoom point, and clicking the left mouse button activates the zoom mode.



Step 2: Turning the mouse wheel away from the user centers the graph vertically and zooms in by a factor of two.

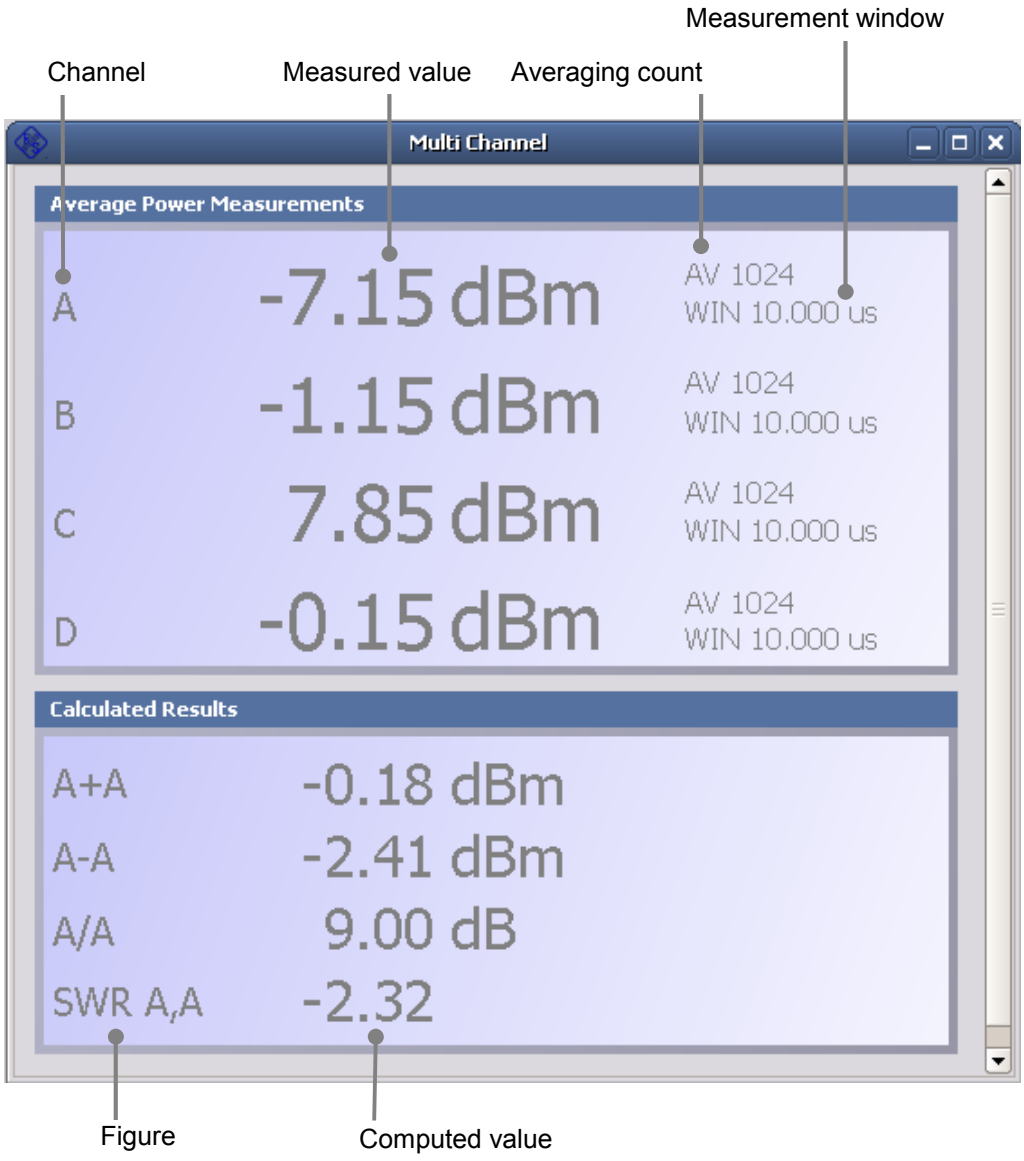


Step 3: Further mouse wheel turns (away from user) magnify the trace in increments of two. Turning the wheel back restores the previous zoom level.

Step 4: Clicking the left mouse button again deactivates the zoom mode and turns off the zoom point indicator.

19 Multichannel Average Power Measurements

Many power measurement tasks require the simultaneous measurement of multiple channels. The Multi Channel measurement panel provides up to four parallel power measurements. In addition, four results can be computed using mathematical expressions.



Each of the four channels can be assigned to the same or to different sensors. If multiple channels use the same sensor, the measurement is only performed once and the result reused for the other channels. Each measurement channel can also be assigned an individual offset to compensate for path losses.

Data logging

All measured values are automatically forwarded to the data log panel and recorded over the set recording time. Starting a new measurement clears all data from the data log and restarts the capturing process.

Multichannel Settings

Measurement settings are similar to the ones available for the continuous power average mode.

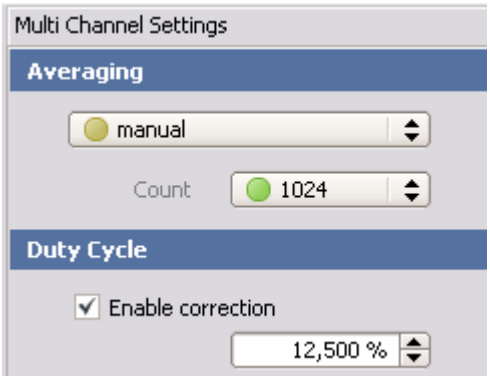


Fig. 19-1 Averaging and duty cycle

The same measurement settings are used for all channels. It is therefore advisable to use sensors of the same or similar type for this measurement mode.

Channel Assignment

Power Viewer Plus measures with up to four sensors simultaneously. These measurements are referred to as channels A, B, C and D. Each channel must be either OFF or assigned to an R&S NRP-Z sensor. An additional offset may be set to compensate for individual losses.

If an alias name was assigned to a sensor, this name is displayed first followed by the sensor type and serial number in parentheses.

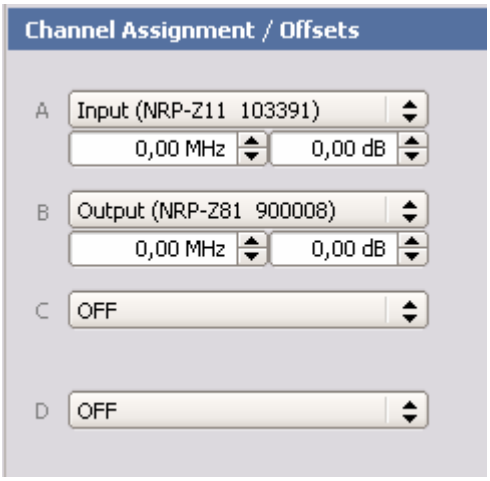
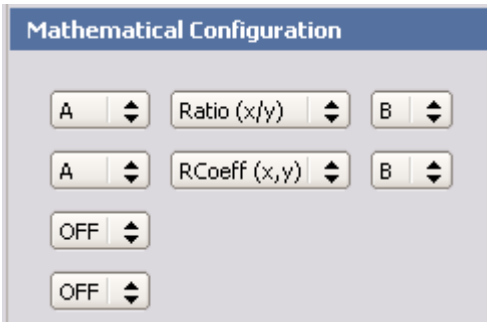


Fig. 19-2 Channel assignment

Each sensor can be assigned to an individual power and frequency offset. This accounts for individual path losses or measurement frequencies within a setup.

Mathematical Expressions

Power Viewer Plus provides a set of most commonly required relations that can be computed from two measured values.



SUM

Two measured values are added in linear scale and then converted to logarithmic scale (dBm).

DIFF

Two measured values are subtracted from each other in linear scale. The result is converted to logarithmic scale (dBm).

RATIO

Two measured values are subtracted from each other in logarithmic scale. The result is displayed in dB.

RCOEFF

The reflection coefficient is computed from two measurements in logarithmic scale using the following equation:

$$RC = 10^{\frac{|P_1 - P_2|}{20}}$$

SWR

The standing wave ratio is computed from two measurements in logarithmic scale using the following equation:

$$SWR = \frac{1 + RC}{1 - RC}$$

20 The Data Log Panel

The Data Log panel captures up to eight scalar measurements over a period of up to 24 hours. A maximum of 10,000 data points is available, and each point can represent the average power, minimum and maximum power reading within the associated time interval.

The Data Log panel is always fed from the active measurement and therefore any existing data is deleted when a new measurement is started.

The following list shows which data is forwarded to the data log panel.

Measurement	Data	Unit
Cont. Average	Average and peak power	dBm
Statistics	Average power	dBm
Timeslot	Marker reading 1/2/3/4	dBm
Multi Channel	Channel measurement 1/2/3/4	dBm

21 Open Source Acknowledgement

This software makes use of valuable open source software packages. The verbatim license texts are provided in the following section.

Package	Link	License
Crystal Icons	www.yellowicons.de	LGPL V2.1
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