

# R&S® HMC8015

## Power Analyzer

All in one: the compact class that has it all



# R&S®HMC8015 Power Analyzer At a glance

The R&S®HMC8015 power analyzer is the first compact tester for AC/DC load and standby current characterization that enables measurements without additional tools such as a computer or remote infrastructure. In addition to a numerical and graphical display with 26 key parameters, the instrument delivers performance and compliance protocols in line with IEC 62301, EN 50564 and EN 61000-3-2.

The power analyzer is the only instrument in its class that graphically displays harmonic analysis up to the 50th harmonic on the logarithmic scale. Its user-configurable, dual-channel trend chart function for U, I, P, S, Q and F etc. is unique as well. The instrument's 5 V measurement range provides embedded developers with a previously unattainable level of resolution for power and energy measurements.

The R&S®HMC8015 also sets standards when it comes to documentation. It simultaneously displays up to 10 user-configurable measurands with a refresh rate of 10 measurements per second. A logging function makes it possible to store this data with a timestamp in CSV format

for a nearly unlimited period of time. Screen content can also be saved to a USB flash drive anytime at the push of a button.

A PASS/FAIL function enables users to monitor numerous measurands either on the instrument's display or externally via an analog/digital output on the rear panel. The inrush function captures and graphically displays inrush current and voltage waveforms.

The instrument's standard hardware-based integrator delivers highly precise, seamless power consumption analysis and adds up watt and ampere hours according to polarity. An additional sensor input for a current probe or shunt expands the tester's current measurement range as required. A three-stage filter in the voltage and current circuit of the acquisition system can be activated, if necessary.

The LXI-Core 1.4-compliant power analyzer can be remotely controlled via an Ethernet, USB or GPIB interface (R&S®HMC8015-G). The commands are based entirely on the SCPI standard. The virtual COM port and the test and measurement class (TMC) are supported for communications via USB. Cost-free driver packages for LabVIEW, LabWindows/CVI, VXI and IVI.net are also available for fast, complication-free integration of the R&S®HMC8015 into existing systems.

## Key facts

- Power measurement range: 50  $\mu$ W to 12 kW
- Analog bandwidth: DC to 100 kHz
- Sampling rate: 500 ksample/s
- 16-bit resolution for current and voltage
- Basic accuracy: 0.05%
- 26 different measurement and mathematical functions



# R&S®HMC8015

## Power Analyzer

### Benefits and key features

#### Clear display of all measured parameters

- Brilliant QVGA color display (320 x 240 pixel)
- Simultaneous display of up to 10 numerical measurement functions
- User-configurable measurement display
- Graphical display modes<sup>1)</sup> for inrush, harmonic analysis, waveform and trend chart

#### Measurement accuracy

- Basic accuracy: 0.05%
- Signal acquisition from DC to 100 kHz at a sampling rate of 500 ksample/s
- Simultaneous display of current and voltage, each with 16-bit resolution
- Three-stage filter system adaptable to the measurement task at hand
- Long-term data logging in CSV format via USB flash drive

#### Everyday measurement functions

- Genuine consumption meter thanks to hardware-based integrator
- 26 different measurement and mathematical functions
- Limit testing with PASS/FAIL indication<sup>2)</sup> for up to six limits selectable from 14 measurands (e.g. U, I, P, S, Q, F)

#### Ports and extensibility

- Front panel: 4 mm safety connectors
- Rear panel: 4 BNC ports<sup>2)</sup> for analog and digital inputs and outputs
- Additional sensor input<sup>2)</sup> for current probe or shunt
- USB port (virtual COM port, TMC)
- Ethernet port (LXI) with integrated web server
- IEEE-488 (GPIB) port (R&S®HMC8015-G)
- Compliance test<sup>3)</sup> for key standby and harmonic standards
- Remote control via SCPI-based commands
- Driver packages for LabVIEW, LabWindows/CVI, VXI, IVI.net

<sup>1)</sup> With R&S®HVC151 advanced analysis option.

<sup>2)</sup> With R&S®HVC152 advanced I/O option.

<sup>3)</sup> With R&S®HVC153 compliance test option.

# Enhanced functions

As seen in the table, up to three options can be added to the base unit. They can be ordered directly from the factory (R&S®HOC15x) or at later time (R&S®HVC15x) as a voucher.

## R&S®HOC151/R&S®HVC151 advanced analysis option

The advanced analysis option complements the base unit's measurands by also displaying peak values for voltage, current and power. These are acquired seamlessly at the

full sampling rate of 500 ksample/s. The following additional graphic functions are available:

### Inrush function

The inrush function makes it possible to graphically display switch-on behavior (see picture on next page). Triggering can be either manual or edge-based (pos./neg.) when user-defined voltage or current thresholds are reached. 8192 samples are acquired at all times with a logging period of 16 ms to 67 s.

Function	Description	Base unit R&S®HMC8015	Opt./voucher R&S®HOC151/ R&S®HVC151	Opt./voucher R&S®HOC152/ R&S®HVC152	Opt./voucher R&S®HOC153/ R&S®HVC153
<b>P</b>	Active power (W)	•			
<b>S</b>	Apparent power (VA)	•			
<b>Q</b>	Reactive power (var)	•			
<b>PF</b>	Lambda power factor ( $\lambda$ )	•			
<b>PHI</b>	Phase shift ( $\varphi$ )	•			
<b>FU</b>	Voltage frequency value (Hz)	•			
<b>FI</b>	Current frequency value (Hz)	•			
<b>FPLL</b>	Acquisition frequency (Hz)	•			
<b>URMS</b>	RMS voltage (U RMS)	•			
<b>UAVG</b>	Average voltage (U AVG)	•			
<b>IRMS</b>	RMS current (I RMS)	•			
<b>Iavg</b>	Average current (I AVG)	•			
<b>UTHD</b>	Total harmonic distortion U	•			
<b>ITHD</b>	Total harmonic distortion I	•			
<b>WHM, WHP, WH, AHM, AHP, AH</b>	Energy counter (integrator values)	•			
<b>Logging</b>	Measured value logging (CSV)	•			
<b>USB, Ethernet (GPIB optional – R&amp;S®HMC8015-G)</b>	Remote control interfaces	•			
<b>UPPeak</b>	Maximum voltage (U PEAK)		•		
<b>UMPeak</b>	Minimum voltage (U PEAK)		•		
<b>IPPeak</b>	Maximum current (I PEAK)		•		
<b>IMPeak</b>	Minimum current (I PEAK)		•		
<b>PPPeak</b>	Maximum power (P PEAK)		•		
<b>PMPeak</b>	Minimum power (P PEAK)		•		
<b>Harmonics</b>	Bargraph of up to 50 harmonics		•		
<b>Waveform</b>	Waveform display (displays one period of voltage, current or power)		•		
<b>Trend chart</b>	Current and voltage displayed as a waveform		•		
<b>Inrush</b>	Triggered display of waveform (single shot)		•		
<b>Sensor input</b>	Input for current probe/external shunt			•	
<b>DIN/AIN</b>	Digital/analog inputs and outputs (BNC)			•	
<b>Limit/PASS-FAIL</b>	Limit display			•	
<b>IEC62301</b>	Standby standard				•
<b>EN50564</b>	Extended standby standard				•
<b>EN61000-3-2</b>	Harmonic current for EMC, CE approval				•

### Harmonic analysis

Harmonic analysis can be displayed in a table or graph or even logarithmically for better readability. The bargraph can optionally show up to the 50th harmonic of voltage and/or current. The bargraph shows the amplitude of the harmonic selected with the cursor.

### Waveform function

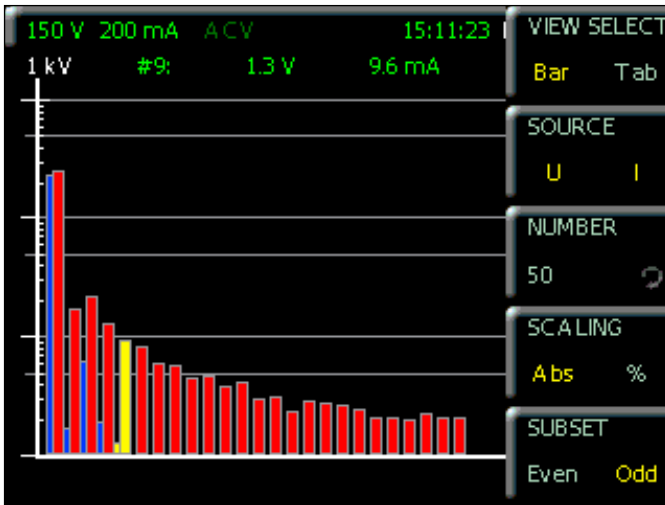
The waveform function shows the voltage, current and power of an input signal period over time. The example shows a load with phase-angle control.

### Trend chart function

The trend chart function makes it possible to observe longer periods of time and can be displayed on up to two channels. 15 selectable measurands are available, e.g. U, I, P, S, Q, F. The y-axis is scaled in line with progress. The time axis can be varied from 5 s/div to 10 min/div.



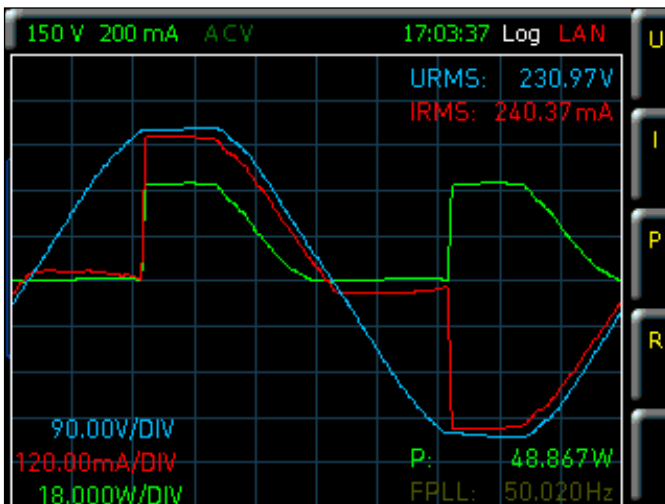
Inrush function



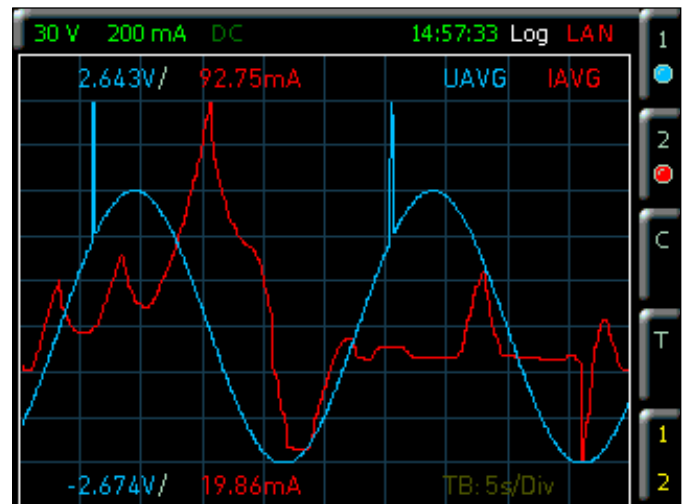
Harmonic analysis: bargraph

Order	U[V]	Phi(U)[°]	I[A]	Phi(I)[°]
1	231.9	-0.0	261.8m	0.6
3	1.7	41.5	15.5m	-141.6
5	6.1	-163.6	21.0m	-172.8
7	2.0	-11.7	11.7m	124.0
9	1.3	-160.2	9.4m	101.6
11	0.3	-122.1	8.0m	48.3
13	0.4	51.6	6.4m	6.2
15	0.7	-173.3	5.1m	-66.2
17	0.2	68.2	4.0m	-115.5
19	0.4	94.8	4.4m	-177.0
21	0.2	-150.2	3.6m	138.9
23	0.2	-4.2	3.9m	78.9

Harmonic analysis: tabular display



Waveform function: load with phase-angle control



Trend chart function

## R&S®HOC152/R&S®HVC152 advanced I/O option

The advanced I/O option activates the following additional functions:

### Sensor input

A current-proportional voltage of 100 mV, 1 V or 4 V (full-scale amplitude) can be applied to the sensor input (4 mm safety connectors) in order to significantly expand the power measurement range. Current probes, current transformers and shunts can be connected to the input. The gradient (e.g. mV/A) can be set individually.

### PASS/FAIL function

The PASS/FAIL function can be used to monitor up to six user-defined (upper or lower) limits, which can be selected from a total of 14 measurands (e.g. U, I, P, S, Q, F). The results appear on the display or are transferred to another device connected via the analog or digital output on the rear panel. The analog output delivers voltage proportional to the limits ( $\pm 5$  V).

Four BNC ports on the rear panel can be assigned to various sources/sinks. The analog output allows users to choose either limits (PASS/FAIL) or measurands U, I or P as a source.

The signal at the analog input ( $\pm 10$  V) can be displayed on the screen with 16-bit resolution as well. The digital output can be assigned to the limit (PASS/FAIL) or the measurement frequency used. The signal at the digital input is available as additional information on the display as status (0/1), frequency (up to 200 kHz) or PWM (0 to 100%). Both inputs are loggable.

### HOC153/HVC153 compliance test option

This option includes wizards for the IEC 62301 (standby), EN 50564 (extended standby) and EN 61000-3-2 (harmonic current for EMC, CE approval) standards, making it possible to carry out autonomous measurements without PC. The results are displayed in a table on the screen and can be saved to a USB flash drive in HTML format.

### Optional accessories

The R&S®HMC8015 (30 A) and R&S®HMC815 (1000 A) AC/DC current probes significantly extend the power measurement range of the R&S®HMC8015. Current probes are connected to the sensor input using a 4 mm safety connector.

The R&S®HMC815 adapter makes it easy and safe to connect a DUT to the R&S®HMC8015. The DUT is powered via the appliance coupler on the top of the adapter.



R&S®HMC815 AC/DC current probe



R&S®HMC8015 power analyzer with the R&S®HMC815 adapter



DE, UK, CHN/AUS and US versions of the R&S®HMC815

# Specifications

Specifications		
Analog bandwidth		DC to 100 kHz
Frequency accuracy		0.1% of reading
A/D converter resolution	voltage and current	16 bit
Basic accuracy		0.05% of reading
Display resolution		5 digits, 10 updates/s
Sampling frequency		500 kHz
Input impedance		2 M $\Omega$
PLL synchronization sources		U, I, external
Filters		
Analog signal filter		1 kHz
Digital filter	depends on measurement frequency	adaptive filter
Frequency filter	independent of analog signal filter	500 Hz
Additional inputs/outputs		
Analog input		$\pm 10$ V (U peak)
Analog input accuracy		0.5% of reading
Analog output		$\pm 5$ V (U peak)
Digital input		
Limits (PASS/FAIL)	bandwidth	100 kHz
	PWM	1 kHz
	state	$\leq 10$ Hz
Signal threshold	logical zero	0 V to 2 V
	logical one	3 V to 24 V
Digital output	up to 100 mA source/sink	5 V, TTL
Display		
		8.9 cm (3.5") TFT (color)
	resolution	320 $\times$ 240 pixel (QVGA)
Network connection	AC	100 V to 115 V/230 V at 50 Hz to 60 Hz
Power consumption		max. 35 W, typ. 15 W
Operating temperature range		+5°C to +40°C
Storage temperature range		-25°C to +60°C
Standards		CAN/CSA-C22.2 NO. 61010-1, UL 61010-1, DIN EN61010-1, DIN EN61326-1, DIN EN55011
Common mode voltage		CAT II, 600 V (U RMS)
Dimensions		222 mm $\times$ 88 mm $\times$ 280 mm (8.74 in $\times$ 3.46 in $\times$ 11.02 in)
Weight		approx. 3.25 kg (7.16 lb)
Warm-up time		60 min

All specifications refer to a sine reference signal, PF = 1, voltage to ground = 0 V, analog filter deactivated, digital filters activated and are valid for measurement values > 1% of measurement range.



Rear panel interfaces (shown here: R&S®HMC8015-G with GPIB interface)

## Measurement ranges and accuracy

### Measurement ranges

	CF3	CF6	Peak value
Voltage	5 V	2.5 V	±15 V
	15 V	7.5 V	±45 V
	30 V	15 V	±90 V
	60 V	30 V	±180 V
	150 V	75 V	±450 V
	300 V	150 V	±900 V
	600 V	300 V	±1800 V
Current (500 mΩ)	5 mA	2.5 mA	±15 mA
	10 mA	5 mA	±30 mA
	20 mA	10 mA	±60 mA
	50 mA	25 mA	±150 mA
	100 mA	50 mA	±300 mA
	200 mA	100 mA	±600 mA
Current (10 mΩ)	0.5 A	0.25 A	±1.5 A
	1 A	0.5 A	±3 A
	2 A	1 A	±6 A
	5 A	2.5 A	±15 A
	10 A	5 A	±30 A
	20 A	10 A	±60 A
Sensor	0.033 V	0.0165 V	±0.1 V
	0.33 V	0.165 V	±1 V
	1.33 V	0.665 V	±4 V

### Measurement accuracy (± displayed in % ± peak value range in %)

Frequency	Voltage	Current/sensor	Active power
DC	0.05 + 0.05	0.05 + 0.05	0.05 + 0.05
f < 45 Hz	0.05 + 0.05	0.05 + 0.05	0.075 + 0.075
45 Hz < f < 66 Hz	0.05 + 0.05	0.05 + 0.05	0.05 + 0.05
66 Hz < f < 1 kHz	0.05 + 0.1	0.05 + 0.1	0.075 + 0.075
1 kHz < f < 10 kHz	$(0.1 + 0.02 \cdot F) + 0.1$	$(0.1 + 0.03 \cdot F) + 0.1$	$(0.1 + 0.07 \cdot F) + 0.1$
10 kHz < f < 100 kHz	$(0.1 + 0.04 \cdot F) + 0.1$	$(0.1 + 0.04 \cdot F) + 0.2$	$(0.1 + 0.07 \cdot F) + 0.1$

Voltage, current: F = frequency in kHz

Sensor input: F = frequency in kHz · 2

### Additional measurement uncertainties

Power factor < 1	–	–	±(0.2 + 0.2 · F) %
Common mode error	±0.01 % of peak value range		

These specifications apply between +20 °C and +30 °C at 80 % relative humidity after 60 min of warm-up time.

# Ordering information

Designation	Type	Order No
<b>Base unit (incl. power cable and manual)</b>		
Power analyzer	R&S®HMC8015	3593.8646.02
Power analyzer, with IEEE-488 (GPIB) interface	R&S®HMC8015-G	3593.8875.02
<b>Software options (firmware)</b>		
Advanced analysis, voucher upgrade	R&S®HVC151	3622.0795.02
Advanced analysis, factory direct order	R&S®HOC151	3622.0789.02
Advanced I/O, voucher upgrade	R&S®HVC152	3622.3788.02
Advanced I/O, factory direct order	R&S®HOC152	3622.3542.02
Compliance test, voucher upgrade	R&S®HVC153	3622.3794.02
Compliance test, factory direct order	R&S®HOC153	3622.3559.02
<b>External accessories (additional equipment, peripherals, etc.)</b>		
Network adapter for R&S®HMC8015, EU connector	R&S®HZC815-EU	3593.8852.02
Network adapter for R&S®HMC8015, GB connector	R&S®HZC815-GB	3622.2246.02
Network adapter for R&S®HMC8015, US connector	R&S®HZC815-US	3622.2252.02
Network adapter for R&S®HMC8015, CHN/AUS connector	R&S®HZC815-CHN	3623.3952.02
19" rackmount kit, 2 HU, for R&S®HMC family	R&S®HZC95	5800.2054.02
AC/DC current probe, 30 A, 4 mm connectors	R&S®HZC50	3622.4690.02
AC/DC current probe, 1000 A, 4 mm connectors	R&S®HZC51	3622.4684.02

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