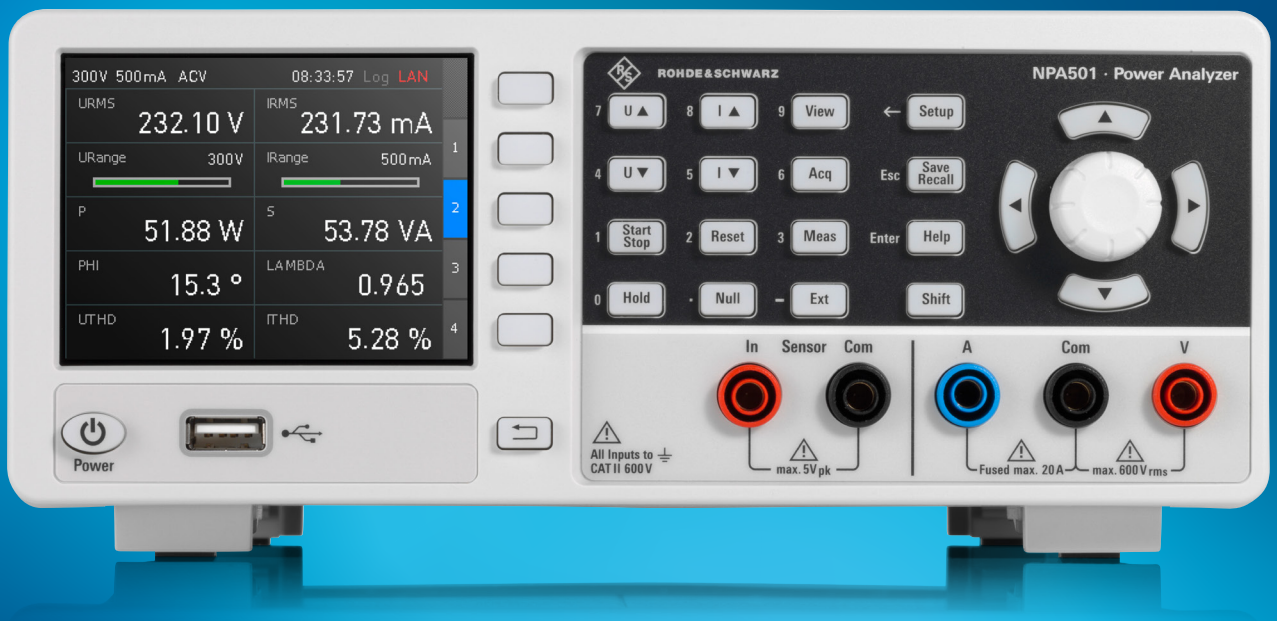
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R&S®ESSENTIALS

R&S®NPA POWER ANALYZERS

All-in-one: the compact class that has it all



Data Sheet
Version 01.01

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The compact testers of the R&S®NPA family enable DC load, AC load and standby current characterization without PC software 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 R&S®NPA101 power meter offers basic measurements of voltage, current, power and total harmonic distortion (THD). The 5 V measurement range provides a previously unattainable level of resolution for power and energy measurements.

Moreover, the R&S®NPA501 power analyzer offers peak value measurements, the graphical display of measured values and the analysis of up to 50 harmonics. The dual-channel trend chart function, which is unique in this instrument class, can be freely configured from 15 measurands. The inrush function captures and graphically displays inrush current and voltage waveforms. The PASS/FAIL function lets users monitor numerous measurands on the screen and externally via an analog and digital output on the rear panel. An additional sensor input for a current probe or shunt expands the instrument's current measurement range as required.

The top-of-the-range model of this family, the R&S®NPA701 compliance tester, that delivers performance and compliance protocols in line with IEC 62301, EN 50564 and EN 61000-3-2.

The power meters of the R&S®NPA family set standards in the documentation of measurement parameters: they simultaneously display up to 10 user-configurable measurands with a refresh rate of 10 measurements per second. A logging function lets users store this data with a timestamp in CSV format for a nearly unlimited period of time. In addition, screen content can be saved to a USB flash drive anytime at the push of a button.

The instrument's standard hardware-based integrator delivers highly precise, seamless power consumption analysis and adds up watt and ampere hours according to polarity.

Three different filters in the voltage and current circuit of the acquisition system can be activated for the measurement task.

All instruments of the R&S®NPA family can be remotely controlled via the Ethernet or USB interface. The virtual COM port and the test and measurement class (TMC) are supported for communications via USB. The remote control commands are completely based on the SCPI standard. Cost-free driver packages for LabVIEW, LabWindows/CVI and IVI.net are also available. They allow the R&S®NPA instruments to be integrated quickly and easily into existing systems.

R&S®NPA501-G and R&S®NPA701-G additionally have an IEEE-488 interface (GPIB).

KEY FACTS

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

BENEFITS

THREE MODEL SERIES

- R&S®NPA101: power meter with basic measurement functions
- R&S®NPA501: power analyzer with enhanced measurement functions and graphics
- R&S®NPA701: compliance tester with additional evaluation functions in line with IEC 62301, EN 50564 and EN 61000-3-2

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
- Up to 26 different measurement and mathematical functions
- Brilliant QVGA color display (320 × 240 pixel)
- Simultaneous display of up to 10 numerical measurement functions
- User-configurable measurement display

PORTS AND REMOTE CONTROL

- Front: 4 mm safety sockets
- Country-specific test adapters as accessories
- USB port (virtual COM port, TMC)
- Ethernet interface (LAN) with integrated web server
- Remote control via SCPI-based commands
- Driver packages for LabVIEW, LabWindows/CVI, IVI.net
- R&S®NPAx-G models: also IEEE-488 (GPIB) interface

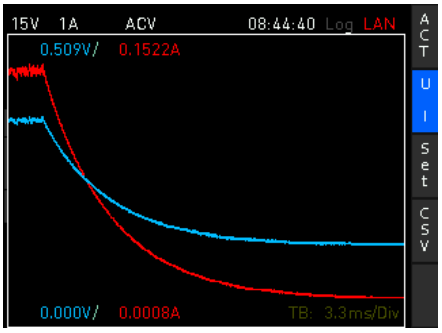
ENHANCED FUNCTIONS FOR R&S®NPA501 AND R&S®NPA701

- Graphical display modes for inrush, harmonic analysis, waveform and trend chart
- Limit testing with PASS/FAIL indication for up to 6 limits selectable from 14 measurands (e.g. U, I, P, S, Q, F)
- Rear: 4 BNC ports for analog and digital inputs and outputs
- Sensor input for a current probe or shunt
- R&S®NPA701 only: compliance test for key standby and harmonic standards

OVERVIEW OF FUNCTIONS

Inrush function

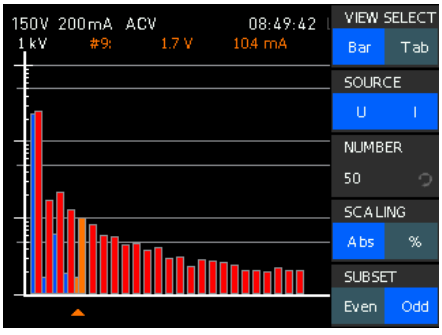
The inrush function makes it possible to graphically display switch-on behavior. Triggering can be either manual or edge-based (pos./neg.) when user-defined voltage or current thresholds are reached. 8192 sample are acquired at all times with a logging period of 16 ms to 67 s.



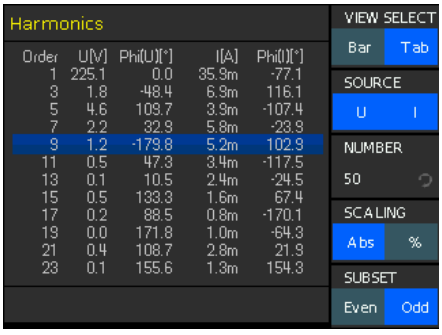
Inrush function

Harmonics 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.



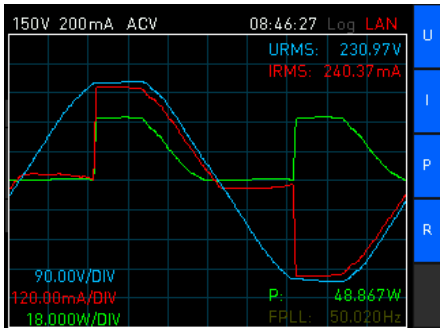
Harmonic analysis bargraph



Harmonic analysis table

Waveform function

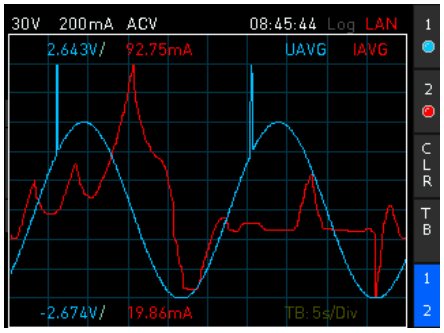
The waveform function shows the voltage, current and power of an input signal period over time.



Waveform function: 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 2 channels. 15 selectable measurands are available, e.g. U, I, P, S, Q and F. The y-axis is scaled in line with progress. The time axis can be varied from 5 s/div to 10 min/div.

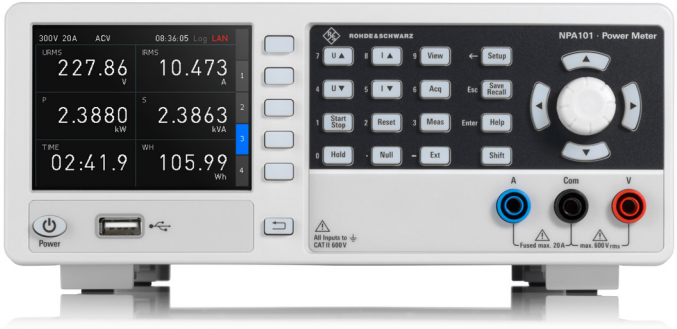


Trend chart function

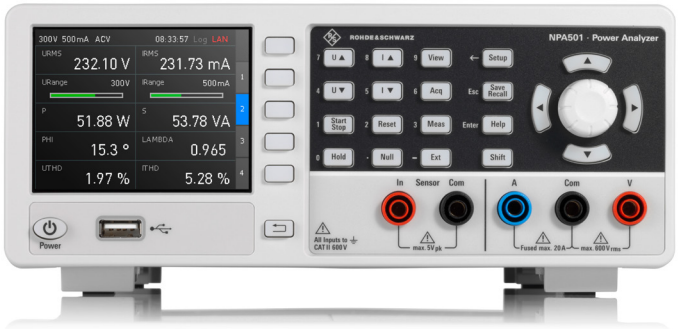
Three model series with different functional range

Function	Description	R&S®NPA101	R&S®NPA501	R&S®NPA701
P	Active power (W)	•	•	•
S	Apparent power (VA)	•	•	•
Q	Reactive power (VAR)	•	•	•
PF	Lambda power factor (λ)	•	•	•
PHI	Phase shift (φ)	•	•	•
FU	Voltage frequency value (Hz)	•	•	•
FI	Current frequency value (Hz)	•	•	•
FPLL	Acquisition frequency (Hz)	•	•	•
URMS	RMS voltage (U RMS)	•	•	•
UAVG	Average voltage (U AVG)	•	•	•
IRMS	RMS current (I RMS)	•	•	•
IAVG	Average current (I AVG)	•	•	•
UTHD	Total harmonic distortion U	•	•	•
ITHD	Total harmonic distortion I	•	•	•
WHM, WHP, WH, AHM, AHP, AH	Energy counter (integrator values)	•	•	•
Logging	Measured value logging (CSV)	•	•	•
UPPeak	Maximum voltage (U PEAK)		•	•
UMPeak	Minimum voltage (U PEAK)		•	•
IPPeak	Maximum current (I PEAK)		•	•
IMPeak	Minimum current (I PEAK)		•	•
PPPeak	Maximum power (P PEAK)		•	•
PMPeak	Minimum power (P PEAK)		•	•
Harmonics	Bargraph of up to 50 harmonics		•	•
Waveform	Waveform display (displays one period of voltage, current or power)		•	•
Trend chart	Current and voltage displayed as a waveform		•	•
Inrush	Triggered display of waveform (single shot)		•	•
Limit / PASS/FAIL	Limit display		•	•
Sensor input	Input for current probe/external shunt		•	•
DIN/AIN	Digital/analog inputs and outputs (BNC)		•	•
IEC 62301	Standby standard			•
EN 50564	Extended standby			•
EN 61000-3-2	Harmonic current for EMC, CE approval			•

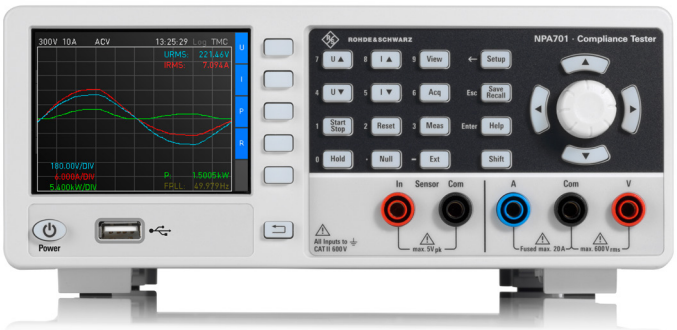
R&S®NPA101



R&S®NPA501



R&S®NPA701



Rear panel of R&S®NPA instruments



PASS/FAIL function

The PASS/FAIL function monitors up to six user-defined (upper or lower) limits, which can be selected from 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 (±5 V).

Digital and analog inputs and outputs

The four BNC sockets can be assigned to different 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 (±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.

Compliance tests with R&S®NPA701

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

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 sensitivity (e.g. mV/A) can be set individually.

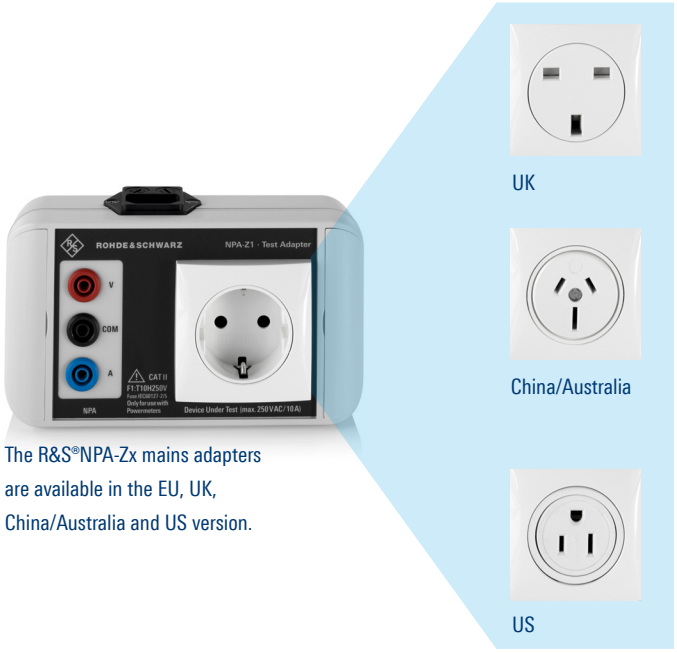
Optional accessories

The R&S®HZC50 (30 A) and R&S®HZC51 (1000 A) AC/DC current probes significantly extend the power measurement range of the R&S®NPA. Current probes are connected to the sensor input using a 4 mm safety connector.

The R&S®NPA-Z1 to R&S®NPA-Z4 mains adapters are used for easy and safe connection of the DUT to the R&S®NPA. The DUT is powered via the appliance coupler on the top of the mains adapter. Four versions cover the most common types of power plug in Europe, UK, USA, China and Australia.



R&S®HZC51 AC/DC current probe



The R&S®NPA-Zx mains adapters are available in the EU, UK, China/Australia and US version.



R&S®NPA701 power analyzer with R&S®NPA-Z1 mains adapter

IDEAL FOR USE IN LABS AND TEST SYSTEMS

Tailored for use in labs and system racks

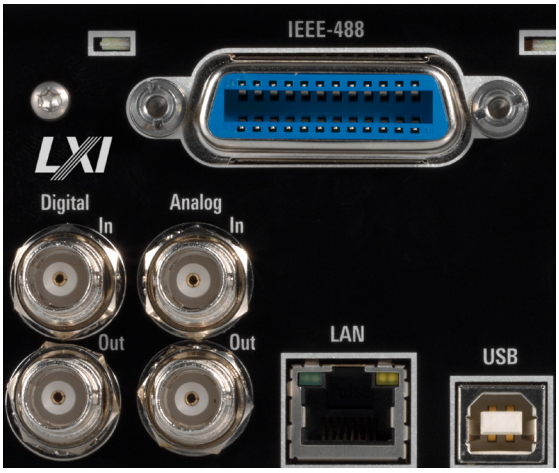
The R&S®NPA measuring instruments have been developed for challenging applications. That is why they are used in R&D labs and integrated into production test systems.

The instruments can be installed in 19" racks using the R&S®HZC95 rack adapter. Thanks to their compact design, two instruments of this type can be installed next to each other.

Full remote capabilities

For use in test systems, all R&S®NPA instruments can be remotely controlled. The Standard Commands for Programmable Instruments (SCPI) syntax is used. The following interfaces are available:

- USB and LAN (Ethernet) interfaces are installed as standard
- IEEE-488 (GPIB) interface: The R&S®NPA501-G and R&S®NPA701-G models additionally have an IEEE-488 (GPIB) interface
  Note: This interface cannot be retrofitted on the standard models.



All remote control interfaces are available on the rear panel of the instrument (example: R&S®NPA501-G with IEEE-488 interface)

Modern architecture: small, compact and quiet

There is never enough space on the bench or in the rack. The measuring instruments of the R&S®NPA family take up very little space thanks to their compact design.

The temperature-controlled fan ensures a quiet working environment.



Two instruments can be installed next to each other in the rack (example: R&S®NPA501 and R&S®NGE103B).

SPECIFICATIONS

Definitions

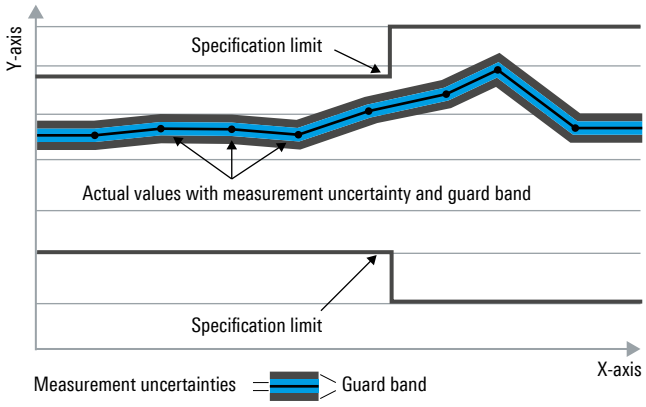
General

Product data applies under the following conditions:

- ► Three hours of storage at ambient temperature followed by 30 minutes of warm-up operation
- ► All data is valid at +23 °C (–3 °C/+7 °C) after 60 minutes of warm-up time.
- ► Specified environmental conditions met
- ► Recommended calibration interval adhered to
- ► All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ± or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design.
Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value, e.g. dimensions or resolution of a setting parameter. Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter. In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: “parameter: value”.

Typical data as well as nominal and measured values are not warranted by Rohde&Schwarz.

In line with the 3GPP standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bit per second (Gbps), million bit per second (Mbps), thousand bit per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

SPECIFICATIONS

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

Basic functions		
Measurement line type		single-phase, 2-wire
Measurement method		simultaneous voltage and current digital sampling, real-time calculation
Measurement functions		active power, apparent power, reactive power, lambda performance factor, phase shift, frequency, voltage (RMS and average), current (RMS and average), total harmonic distortion, energy
Sampling frequency		500 kHz
A/D converter resolution	voltage and current	16 bit
Analog bandwidth		DC to 100 kHz
Input impedance		2 MΩ
Basic accuracy		0.05 % of reading
Frequency measurement range		10 Hz to 100 kHz
Frequency accuracy		0.1 % of reading
Voltage measurement range		1 mV to 600 V
Current measurement range		1 mA to 20 A
Power measurement range		dependent on combination of voltage and current ranges; from 50 µW to 12 kW
PLL synchronization sources		voltage, current, external
Filters		
Analog bandwidth limit		lowpass, 1 kHz, switchable
Digital frequency filter	independent of analog signal filter	lowpass, 500 Hz, switchable
Digital averaging filter	dependent on measurement frequency	adaptive filter for smoothing drifting results

Measurement ranges and accuracy				
Measurement ranges				
	CF1	CF3	CF6	Peak value
Voltage	15 V	5 V	2.5 V	±15 V
	45 V	15 V	7.5 V	±45 V
	90 V	30 V	15 V	±90 V
	180 V	60 V	30 V	±180 V
	450 V	150 V	75 V	±450 V
	900 V	300 V	150 V	±900 V
	1.8 kV	600 V	300 V	±1800 V
Current (500 mΩ)	15 mA	5 mA	2.5 mA	±15 mA
	30 mA	10 mA	5 mA	±30 mA
	60 mA	20 mA	10 mA	±60 mA
	150 mA	50 mA	25 mA	±150 mA
	300 mA	100 mA	50 mA	±300 mA
	600 mA	200 mA	100 mA	±600 mA
Current (10 mΩ)	1.5 A	0.5 A	0.25 A	±1.5 A
	3 A	1 A	0.5 A	±3 A
	6 A	2 A	1 A	±6 A
	15 A	5 A	2.5 A	±15 A
	30 A	10 A	5 A	±30 A
	60 A	20 A	10 A	±60 A
Sensor	0.1 V	0.033 V	0.0165 V	±0.1 V
	1 V	0.33 V	0.165 V	±1 V
	4 V	1.33 V	0.665 V	±4 V

Measurement ranges and accuracy

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 × F) + 0.1	(0.1 + 0.03 × F) + 0.1	(0.1 + 0.07 × F) + 0.1
10 kHz < f ≤ 100 kHz	(0.1 + 0.04 × F) + 0.1	(0.1 + 0.04 × F) + 0.2	(0.1 + 0.07 × 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 voltage range
Temperature coefficient (per °C)	+5 °C to +20 °C and +30 °C to +40 °C		
Voltage			±0.03 % of reading/°C
Current			±0.03 % of reading/°C
Power			±0.03 % of reading/°C

Remote control

Command processing time		≤ 30 ms (nom.)

Protection functions

Type of protection functions		automatic disconnection if there is a possibility of overloading of internal shunt
Fuse		internal fuse 20 A

Special functions

Energy counter		includes current/power values
Start/stop function		manual, span, duration
Maximum integration time		unlimited
Data logging		
Recordable parameters		10 parameters, selectable from 37 measurands
Maximum acquisition rate		10 sample/s
Maximum recording time		unlimited
Memory depth	internal	512 kbyte
	external	USB flash drive (max. 4 Gbyte)
Voltage resolution		100 µV
Current resolution		0.1 µA
Power resolution		1 µW

Special functions for R&S®NPA501, R&S®NPA701		
Additional inputs/outputs		BNC, rear panel
Analog input		±10 V (peak)
Analog input accuracy		0.5 % of reading
Analog output		±5 V (peak)
Digital input	bandwidth	100 kHz
	PWM	1 kHz (max.)
	state	≤ 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
Peak value function		
Measurands		voltage, current, power
Sampling rate		500 ksample/s
Limit testing		PASS/FAIL indication for up to 6 limits, selectable from 14 measurands
Trend chart mode		graphical display over time
Maximum number of channels		2
Displayable parameters		selectable from 15 measurands
Inrush mode		graphical display over time
Number of samples		8192
Recording period		16 ms to 67 s
Harmonics mode		graphical and numerical display versus harmonics
Analysis function		FFT
Maximum number of harmonics		50
Display mode		bar graph or numerical table
Waveform mode		graphical display over time
Maximum number of channels		3
Duration		1 period
Displayable parameters		voltage, current, power

Special functions for R&S®NPA701		
Compliance tests		
Supported standards		IEC 62301, EN 50564, EN 61000-3-2

Display and interfaces		
Display		3.5"/QVGA (color)
Display resolution		5 digits, 10 updates/s
Front panel connections	all models	4 mm safety sockets for voltage/current measurements
	R&S®NPA501, R&S®NPA701	4 mm safety sockets for current probes or shunt
Rear panel connections	R&S®NPA501, R&S®NPA701	BNC ports for analog/digital IN and OUT
Remote control interfaces	all models	USB-TMC, USB-CDC (virtual COM), LAN
	R&S®NPA501-G, R&S®NPA701-G	IEEE-488 (GPIB)

Test adapters	
R&S®NPA-Z1 mains adapter, EU version	
Maximum voltage	250 V
Maximum current	10 A
Fuse	T10H/250 V
Weight	approx. 300 g (0.66 lb)
R&S®NPA-Z2 mains adapter, UK version	
Maximum voltage	250 V
Maximum current	10 A
Fuse	T10H/250 V
Weight	approx. 300 g (0.66 lb)
R&S®NPA-Z3 mains adapter, US version	
Maximum voltage	125 V
Maximum current	10 A
Fuse	T10H/250 V
Weight	approx. 300 g (0.66 lb)
R&S®NPA-Z4 mains adapter, China/Australia version	
Maximum voltage	250 V
Maximum current	10 A
Fuse	T10H/250 V
Weight	approx. 300 g (0.66 lb)

General data		
Environmental conditions		
Temperature	operating temperature range	+5 °C to +40 °C
	storage temperature range	–20 °C to +70 °C
Humidity	noncondensing	5 % to 80 %
Altitude		max. 2000 m above sea level
Power rating		
Mains nominal voltage		100 V to 115 V/230 V
Common mode voltage		CAT II, 600 V (RMS)
Rated frequency		50 Hz to 60 Hz
Rated power		35 W (measured)
Rated current		0.5 A (max.)
Mains fuses	power source: 100 V to 115 V	F630H/250 V
	power source: 230 V	F400H/250 V
Product conformity		
Electromagnetic compatibility	EU: in line with directive 2014/30/EU; UK: in line with Electromagnetic Compatibility Regulations 2016 (S.I. 2016/1091)	applied harmonized standards: ► EN 61326-1 ► EN 5501 (Class A)
	Korea	KC mark
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EU; UK: in line with Electrical Equipment (Safety) Regulations 2016 (S.I. 2016/1101)	applied harmonized standard: EN 61010-1
	USA	UL 61010-1
	Canada	CSA C22.2 No. 61010-1
RoHs	EU: in line with EU directive 2011/65/EU; UK: in line with Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (S.I. 2012/3032)	applied harmonized standard: EN IEC 63000
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, 0.3 mm (peak-to-peak) amplitude const., 55 Hz to 150 Hz, 0.5 g const., in line with EN 60068-2-6
	wideband noise	8 Hz to 500 Hz, 1.2 g (RMS), in all three planes, in line with EN 60068-2-64
Shock		10 Hz to 45 Hz, ramp 6 dB/octave, 45 Hz to 2000 Hz: max. 40 g in line with MIL-STD-810E
Mechanical data		
Dimensions		222 mm × 97 mm × 291 mm (8.74 in × 3.82 in × 11.46 in)
Weight		3.25 kg (7.17 lb)
Rack installation		½ 19", 2 HU
Recommended calibration interval	operation 40 h/week over entire range of specified environmental conditions	1 year

ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
Power meter, DC to 100 kHz	R&S®NPA101	3657.0562.02
Power analyzer, DC to 100 kHz	R&S®NPA501	3657.0562.03
Power analyzer, DC to 100 kHz, incl. IEEE-488 (GPIB) interface	R&S®NPA501-G	3657.0562.05
Compliance tester, DC to 100 kHz	R&S®NPA701	3657.0562.04
Compliance tester, DC to 100 kHz, incl. IEEE-488 (GPIB) interface	R&S®NPA701-G	3657.0562.06
Accessories supplied: set of power cables, quick start guide		
Test adapters and accessories		
Mains adapter, EU version	R&S®NPA-Z1	3657.8911.02
Mains adapter, UK version	R&S®NPA-Z2	3657.8911.03
Mains adapter, US version	R&S®NPA-Z3	3657.8911.04
Mains adapter, CHN/AUS version	R&S®NPA-Z4	3657.8911.05
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
System components		
19" rack adapter, 2 HU, for one or two instruments of R&S®HMC/NGE/NGC/NPA series	R&S®HZC95	5800.2054.02

Warranty		
Base unit		3 years
All other items [1]		1 year
Service options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales representative.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	

[1] All batteries have a 1 year warranty.

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