ZNL Vector Network Analyzer
The 3-in-1 allrounder

ZNL Vector Network Analyzer
At a glance

Measurement equipment for RF applications must fulfill high quality standards. Instruments should be easy to use and offer a high versatility. Fast measurements and reliable performance are crucial. With the ZNL, Rohde & Schwarz exceeds these expectations and offers even more: vector network analysis, spectrum analysis and power meter measurements are unified in one single, compact instrument making the ZNL a universal all-rounder.

Offering frequency ranges from 5 kHz to 3 GHz or 6 GHz the ZNL is well suited for various RF component measurement applications in industrial electronics and wireless communications.

Ever changing measurement tasks in research laboratories can be demanding. The ZNL helps to reduce invest-ment costs due to its unique concept of options. The base unit can be extended with a fully integrated spectrum ana-lyzer option [1]. Moreover, the ZNL can be used as a RF power meter [2].

Instead of investing in different instruments, research labs, service centers, universities and production facilities can use one single instrument that offers even higher mea-surement speeds and RF performance than other instru-ments in comparable classes.

Vector network analysis and spectrum analysis measure-ments can be displayed on the 10.1" multitouch screen in parallel. Clear menu structures and numerous wizards help the user to configure the measurement conveniently.

Although the ZNL unifies a variety of different functionalities, it is a very compact instrument with an at-tractive form factor. Weighing only 6 to 8 kg, offering a carrying handle and a battery option, the ZNL is fully portable and can be operated, wherever needed.

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[1] Requires ZNL3-B1 option.
[2] Requires NRP-Zxx external power sensor, FPL1-K9 option and ZNL3-B1 option.

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ZNL Vector Network Analyzer

Benefits and key features

Key features
- Frequency range from 5 kHz to 3 GHz (ZNL3) or 5 kHz to 6 GHz (ZNL6)
- Two-port vector network analyzer for bidirectional measurements
- Universal instrument concept:
  - Vector network analyzer
  - Fully integrated spectrum analyzer option (for ZNL3)
- Display of power meter measurements
- Wide dynamic range of typ. 130 dB
- Output power range from –40 dBm to typ. + 3 dBm
- Measurement bandwidths from 1 Hz to 500 kHz
- Fast measurements, i.e. 16.7 ms for 401 points (100 kHz IFBW, 200 MHz Span, 2-port TOSM (SOLT))
- Compact size and low weight (6 kg to 8 kg)
- Optional battery pack available
- Windows 10® operating system

The 3-in-1 analyzer: compact vector network analyzer
- Solid RF performance
- Versatile features, like calibration unit support, for production and lab
- Time domain and distance to fault
- Compact 3 in 1 instrument
- Remote controllable with LAN and GPIB option
- ▷ page 3

The 3-in-1 analyzer: fully integrated spectrum analyzer
- Integrated hardware for solid RF performance
- Spectrum mode
- Analog demodulation
- Digital demodulation
- ▷ page 3

The 3-in-1 analyzer: RF power meter
- Precise power measurements
- ▷ page 3

User interface with multi-touch screen
- Clear menu structures for efficient operation
- Wide 10.1" display for convenient operation
- Integrated PC
- All-in-one display of different measurement modes with MultiView feature
- ▷ page 3

Fully portable – go anywhere
- Battery and DC supply to power the instrument where needed
- Accessories to prepare the instrument for usage in the field
- ▷ page 3

The 3-in-1 analyzer: compact vector network analyzer

The ZNL combines the functionality of a vector net-work analyzer, a spectrum analyzer and a power meter in a single box. It is an all-in-one test bench and good for use where test requirements are constantly changing such as development, production and service facilities.

Solid RF performance

Vector network analyzers such as the ZNL can characterize electronic networks in the frequency domain, e.g. by measuring the magnitude and phase of S-parameters. Moreover, components can be analyzed in the time domain with the ZNL-K2 option.

High dynamic range

The ZNL features a wide dynamic range of up to 130 dB (typ.; at 10 Hz IFBW) and an output power of typ. 3 dBm. With this, the ZNL can be used for measure-ments on high rejection filters where the demands on wide dynamic range are high.

Low trace noise for high accuracy

The ZNL offers a low trace noise of less than 0.0005 dB (typ.; at 10 Hz IFBW). This allows for stable re-peatable measurements at high accuracies even with larg-er IF bandwidths. Using larger measurement bandwidths, the ZNL can perform faster measurements whilst still maintaining the stability that is normally only available with smaller measurement bandwidths.

Fast measurements for high throughput

With measurement times of 16.7 ms for 401 points (full two port calibration, 200 MHz Span, 100 kHz IFBW), high-speed data processing and fast LAN or IEC/IEEE data transfer, the ZNL is a reliable instrument for applica-tions within the production environment. Throughput can be maximized with the segmented sweep functionality, where the frequency axis is divided into segments. Sweep parameters such as output power, IF bandwidth and num-ber of points can be defined separately for each segment to optimally match the DUT characteristics. This increases measurement speed without any loss in accuracy.

Filter measurement on a high high-rejection bandpass filter using the bandfilter analysis.
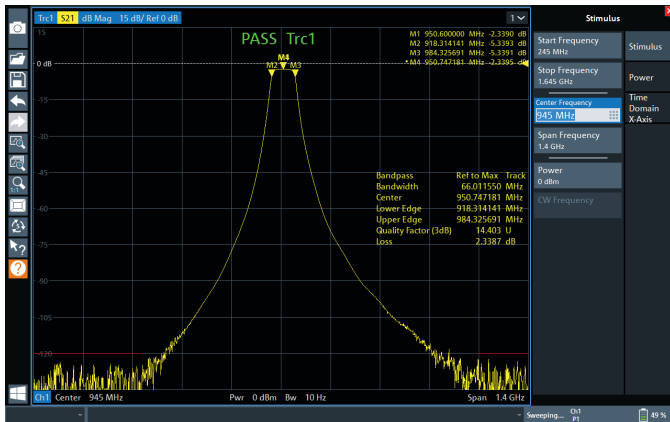
The fixture compensation menu, showing all compensation methods that are available.
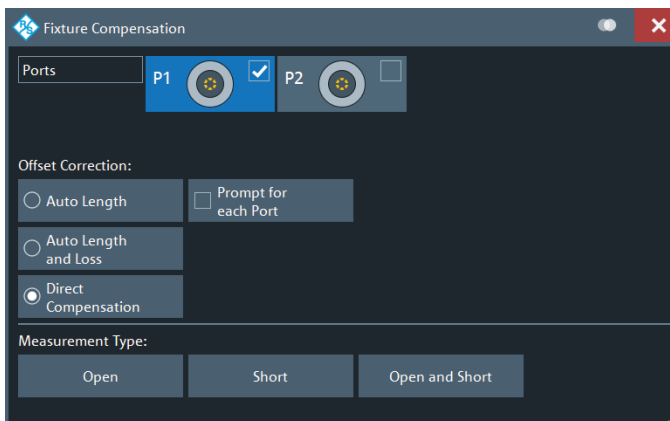
Versatile features, like calibration unit support for production and lab

Versatile calibration features and calibration unit support

The ZNL calibration wizard guides you through the calibration process. Manual calibration kits and automatic calibration units are supported. The use of an automatic calibration unit minimizes the time needed to perform a full system error correction. The calibration unit is ready for use right after it is connected to the ZNL. It only takes a few steps to calibrate the setup. This is especially an advantage in production environments, helping you save time and maximize throughput. With the "Start Auto Cal" button and an automatic calibration unit it is possible to perform a one click calibration.

De-/embedding and fixture compensation

In the production environment, it is often necessary to characterize a single component which is specified together with the networks that match them to the impedance of the surrounding circuit. The ZNL can embed the DUT into virtual matching networks to provide realistic condi-tions by simulating the DUT installed in its operational environment. The ZNL offers a choice of predefined matching network topologies. In addition touchstone files can be read into the ZNL and used for embedding/ deembedding. The fixture compensation feature can be used to correct the measurement results for unwanted effects of a test fixture or adapter placed after the reference plane.

Remote controllable with LAN and GPIB option

The ZNL can be remote controlled via the integrated LAN interface. The optional GPIB interface lets you con-nect a controller to remotely control the ZNL.

Data is transmitted bidirectionally on the 8-bit parallel bus. The data measured during a sweep is transferred to the controller while the next sweep is in progress. As a result, the ZNL has a virtually negligible data transfer time.

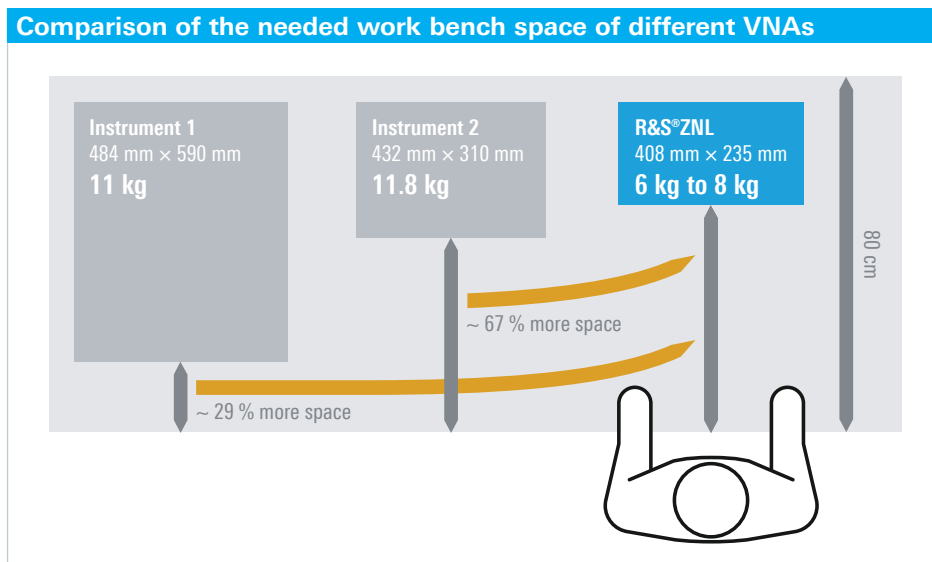## Time domain measurements and distance to fault

The ZNL offers powerful time domain analysis option, ZNL-K2, to measure components such as filters or high-speed digital data cables in the frequency and time domain. With 100 001 points per trace, the ZNL can measure electrically long DUTs such as long cables with-out any limitations.

The ZNL's gating function makes it easy to locate cable faults and analyze them in detail. With the low start frequency of 5 kHz it is possible to get an even more ac-curate measurement for time domain as the gap to DC is reduced and thus the values that need to be estimated are reduced. The ZNL-K3 option allows the detection of cable faults and connectors, which is important for anten-na installation, for example. All common cable types can be selected and are predefined with velocity factor and frequency-dependent attenuation.

Compact 3-in-1 instrument

Featuring an instrument depth of less than 24 cm and weighing only 6 kg to 8 kg, the ZNL is the most com-pact instrument in its class. The user can profit from more space on his work bench than with any other comparable benchtop analyzer.

If the ZNL3-B1 spectrum analyzer option is included even more space is saved as the instrument is still just as compact, but offers the functionality of two, or even three instruments or even three instrumens: network analyzer, spectrum analyzer and power meter.

Comparison of the needed work bench space of different VNAs

Instrument 1
484 mm × 590 mm
11 kg

Instrument 2
432 mm × 310 mm
11.8 kg

R&S®ZNL
408 mm × 235 mm
6 kg to 8 kg

80 cm

~ 67 % more space

~ 29 % more space

The 3-in-1 analyzer: fully integrated spectrum analyzer

Different modes of operation make the ZNL vector network analyzer to a versatile multipurpose instrument. Including the ZNL3-B1 hardware option adds a fully integrated spectrum analyzer on a dedicated hardware board to the base unit. There is no need to reboot the instrument to switch between different modes.

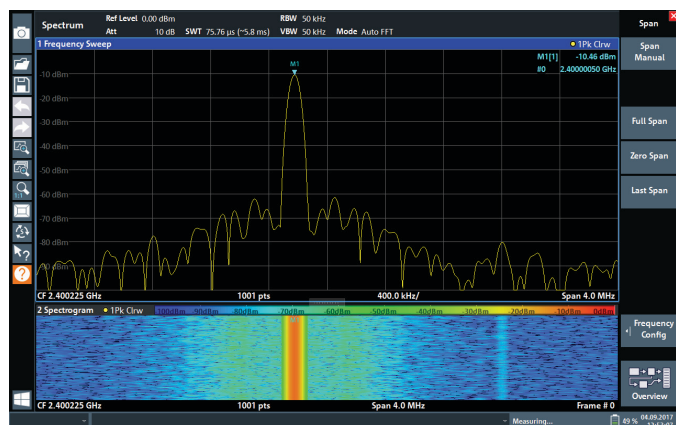## Integrated hardware for solid RF performance

As the ZNL integrates a dedicated hardware board with the ZNL3-B1 option, its performance is com-parable to pure spectrum analyzers in the economy and midrange class. It features a phase noise of typ. –108 dBc (1 Hz) at 10 kHz offset, a third-order intercept point of typ. +20 dBm and typ. –150 dBm displayed average noise level.

Spectrum mode

In the spectrum application the provided functions correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the RF input signal over the selected frequency range with the selected resolution and sweep time. Alternatively, it displays the waveform of the video signal for a fixed frequency. This application requires the ZNL3-B1 spectrum analysis hardware option.

The I/Q analyzer, included in the spectrum analyzer option, is the standard function for digital signal analysis. This application provides measurement and display functions for I/Q Data. It displays the magnitude and phase parameters and the FFT spectrum. The captured IQ data can be transferred to third-party software tools (e.g. Matlab® or Python) for further analysis. This application requires the ZNL3-B1 spectrum analyzer option. With the FPL1-B40 option single-carrier signals with up to 40 MHz bandwidth can be analyzed and demodulated.

Analog demodulation

The FPL1-K7 option converts the ZNL into an analog modulation analyzer for amplitude, frequency and phase modulated signals. It measures the characteristics of the useful modulation and other items such as residual FM or synchronous modulation. Typical applications of the FPL1-K7 include:
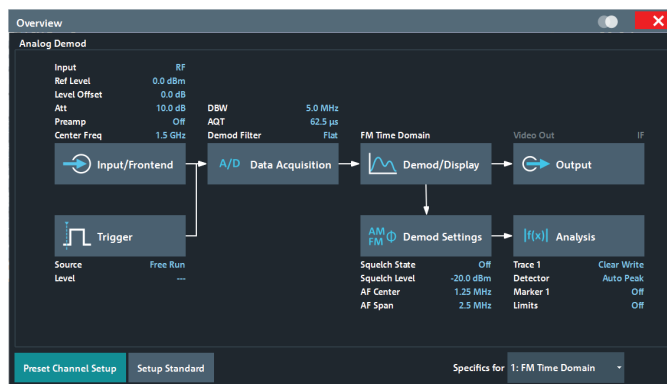
- Transient and settling measurements of oscillators like VCOs and PLLs
- Troubleshooting AM/FM transmitters
- Simple chirp analysis of pulsed or continuous wave signals

Digital demodulation

The ZNL with a ZNL3-B1 option analyzes and demodulates digitally modulated single-carrier signals with up to 40 MHz analysis bandwidth. When analyzing digital modulation signals, ZNL receives and digitizes the signal, which is then analyzed by the VSE vector sig-nal explorer software together with the VSE-K70 or VSE-K106 option. The software runs directly on the ZNL or on an external PC.

The spectrum analyzer mode of the ZNL.
Here the full functionality of a standard spectrum analyzer is utilized.

Overview of the analog demodulation menu.
Here all settings can be done.

The 3-in-1 analyzer: RF power meter

Precise power measurements

The FPL1-K9 option adds the support of NRP power sensors [1] to the ZNL for precise power mea-surements. In order to use a power sensor with the ZNL the ZNL3-B1 spectrum analyzer option is needed as well.

The power sensors can be connected via USB or via the ruggedized power sensor connector, included in FPL1-B5 options.

Up to four power sensors can be connected in parallel. The power sensors can also be used to trigger a measurement at a certain power level.

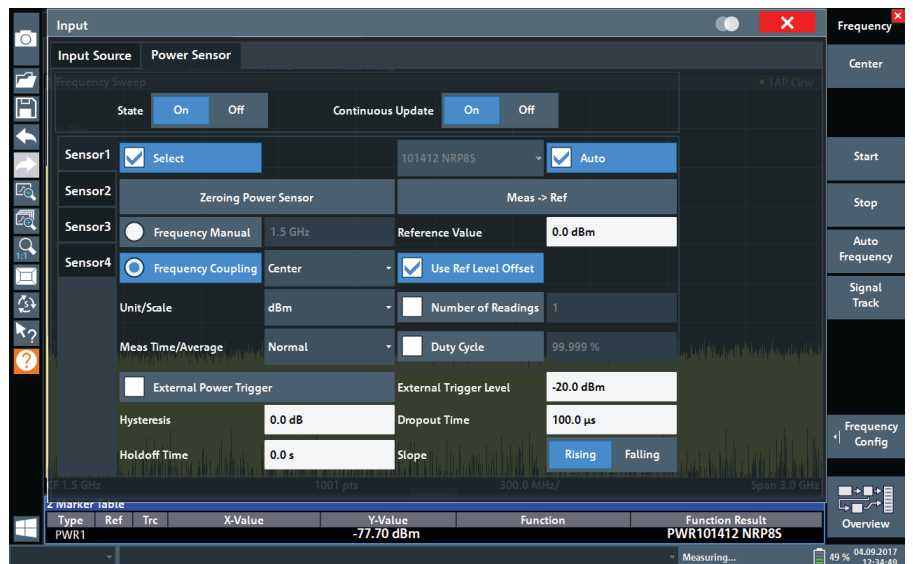[1] Please refer to the datasheet, for a list of supported power sensors.

Example for NRP power sensors. The NRP8SN and the NRP8S.
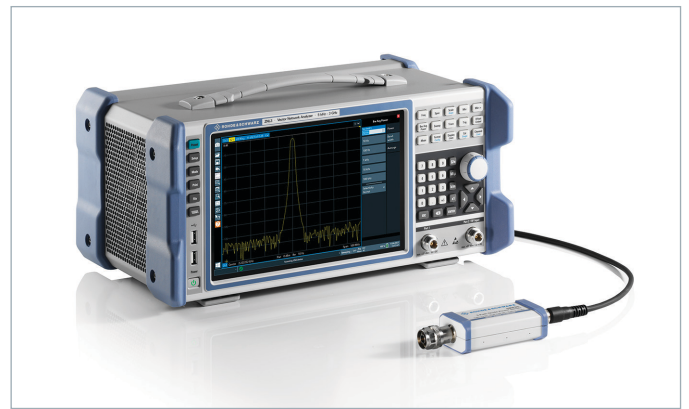
The ZNL can be used for precise power measurements together with a NRP power sensor.

Overview of the power sensor menu. Each sensor is configured in a separate tap.

Front panel overview

10.1" high-resolution display
- 1280 × 800 pixel resolution

Toolbar
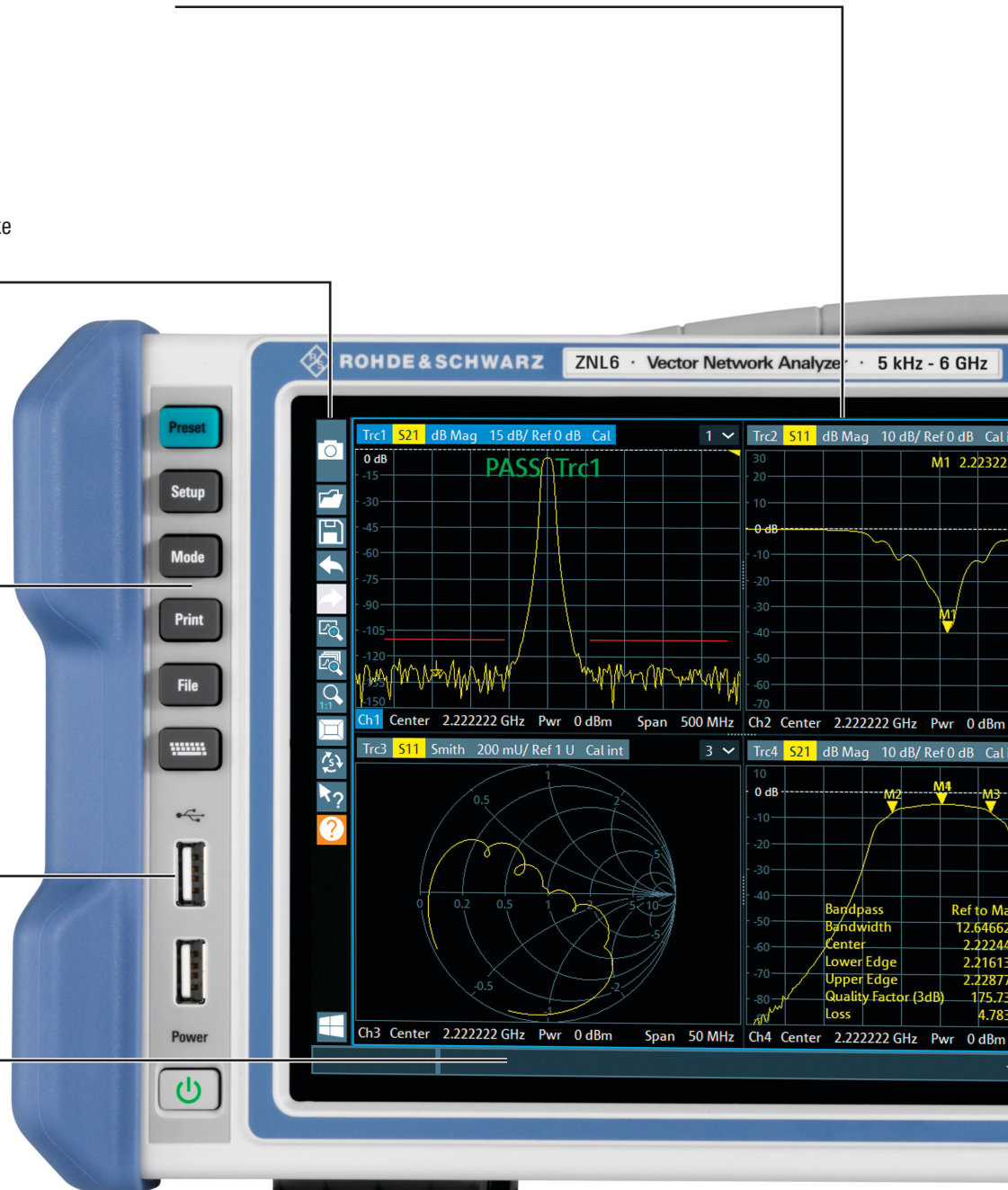- With standard application functions like print, save/open file, undo, redo, help

System keys
- For setup, presets, settings etc.

Two USB 2.0 ports
- For storage media
- For connecting accessories

Instrument status bar

Softkey bar
▮ Quick access to key tools
▮ Hardware settings at a glance

Numerical keypad
▮ With unit keys for frequency and level

Function keys

Control knob

Port 1

Port 2/RF input

User interface with multi-touch screen

Clear menu structures for efficient operation

The ZNL has a user interface, which is well-arranged and clearly structured. Measurements can be configured in just a few steps.

Using the drag-and-drop functionality, traces, channels and diagrams can be arranged to fit the user's needs. Different setups can be saved, reloaded and changing between different setups is possible with minimal effort.

The ZNL offers a variety of marker functions to evalu-ate different properties of the measured trace and help the user to operate the instrument efficiently:
▌ Up to ten markers per trace in different formats such as magnitude, phase, impedance, admittance or VSWR
▌ The format of the marker can be chosen independently of the displayed format of the trace
▌ Markers and traces can be named according to applications
▌ Marker functions as max, min, RMS, peak-to-peak, bandwidth, etc.
▌ Different read-out functions for marker properties

Moreover, the user can define limit-lines to test compli-ance of the devices under test.

Wide 10.1" display for convenient operation

The wide 10.1" multi-touch screen is used to display set-ups and arrange measurement tasks suited to the current application. The layout can be adapted to the user's needs simply by drag-and-drop operation.

Integrated PC

With the ZNL there is no need to supply an external computer controller. With a fully integrated powerful PC platform running the windows 10 operating system the ZNL is a complete standalone analyzer. With the solid state hard disk the ZNL delivers fast boot up time and reli-ability to meet the most demanding applications.

All-in-one display of different measurement modes with MultiView feature

For a full characterization of a device under test, the MultiView display enables the display of an overview of all vector network analysis, spectrum analysis and power me-ter measurements tabs sequentially. All running measure-ment modes are combined and automatically displayed and updated in real time in the MultiView tab, which can be accessed directly by tapping on the desired window.

All configured measurements can be performed sequen-tially by the sequencer in the multiview mode.

In MultiView all tabs can be seen at the same time. In this case one can see a VNA mode measure-ment in parallel to a SA mode measurement.

Fully portable –
go anywhere

Due to its unique hardware concept, the ZNL unifies different functionalities and still offers a compact form factor. Depending on the included options, the ZNL only weighs between 6 and 8 kg.

Battery and DC supply to power the instrument where needed

Equipped with a carrying handle and the optional battery pack FPL1-B31, the ZNL is fully portable allow-ing it to be conveniently transported to the operational site in the field.

Using the FPL1-B30 DC power supply option, the ZNL can be operated with vehicles (12V/24V).

Accessories to prepare the instrument for usage in the field

If the instrument needs to be transported or is to be oper-ated in the field for installation purposes, the carrying bag FPL1-Z2 protects the instrument from damage and dirt. Side vents and the transparent lid allow an operation even if the instrument is safely stored in the bag.

For portable operation, the optional carrying vest holster FPL1-Z3 is available. The powerful benchtop unit ZNL becomes a flexible portable instrument and can conveniently be carried. For outside usage in challenging light conditions, the instrument can be equipped with the anti-glare film option FPL1-Z5. This does not only improve the contrast on the display, but also protects the screen from scratches.

The ZNL can easily be stored and carried around in a robust transport bag.

The rear view of the ZNL, where the batteries are seen, which can be easily accessed.

Specifications in brief

Specifications in brief		
Network analysis		
Frequency range	ZNL3	5 kHz to 3 GHz
	ZNL6	5 kHz to 6 GHz
Dynamic range		>120 dB (spec.); typ. >130 dB
Output power		0 dBm (spec.); typ. + 3 dBm
Trace noise		<0.0035 dB (spec.); typ. < 0.0005 dB
Measurement speed		
Sweep time	401 points, 2-port TOSM, 200 MHz span, 100 kHz IFBW	16.7 ms
Data transfer		
	IEC/IEEE, 201 points	typ. 3 ms
	HiSLIP over 1 Gbit/s LAN	typ. 2.5 ms
Measurement parameters		Sxy; wave quantities, ratios, impedance parameters (Zxy); attmitance parameters (Y); stability factors
Display graphs		dB mag, phase, Smith, polar, SWR, unwr phase, lin. mag, inv. Smith, real, imag, delay
Calibration procedures		reflection normalization open or short, reflection OSM(OSL), enhanced reflection normalization OM or SM; transmission normalization (response calibration), transmission normalization both (response calibration), one path two ports, TOSM (SOLT)
Measurement data points	VNA mode	1 to 100 001
	SA mode	101 to 100 001
IFBW		1 Hz to 500 kHz, in steps of 1/1.5/2/3/5/7
Spectrum analysis		
Frequency range	ZNL3-B1	5 kHz to 3 GHz (resolution 1 Hz)
Displayed average noise level (DANL)	RF attenuation 0 dB	<−140 dBm (spec.); typ. <−150 dBm
Phase noise	1 GHz, 10 kHz offset	<−103 dBc (1 Hz); <−108 dBc (1 Hz)
Max. signal analysis bandwidth	with option FPL1-B40	40 MHz
Intermodulation		
Third-order intercept point (TOI)	300 MHz ≤ fin ≤ 3 GHz	>16 dBm (spec.); typ. >20 dBm
Second harmonic intercept (SHI)	900 MHz ≤ fin ≤ 1.5 GHz	70 dBm (nom.)
General data		
Limit lines	VNA mode	single, segmented, upper limit, lower limit
Channels	within one VNA setup	no limitation
Channel setups		max 14 setups
Traces	VNA mode	no limitation
	SA mode	6
Markers	VNA mode	10 + ref. marker (per trace)
	SA mode	16
Operating system		Windows 10
Display		26.4 cm (10.1"), diagonal WXGA color LCD with touchscreen
Dimensions (W × H × D)		408 mm × 186 mm × 235 mm (16.06 in × 7.32 in × 9.25 in)
Weight	depending on configuration	6 kg to 8 kg (13.23 lb to 17.64 lb)

Ordering information

Designation	Type	Order No.
Base Unit		
Vector Network Analyzer, 5 kHz to 3 GHz, two ports, N(f)	ZNL3	1323.0012.03
Vector Network Analyzer, 5 kHz to 6 GHz, two ports, N(f)	ZNL6	1323.0012.06
Hardware options		
Spectrum Analyzer Function for ZNL3	ZNL3-B1	1323.1802.02
Extended Level Range for ZNL3	ZNL3-B22	1323.1860.02
Extended Level Range for ZNL6	ZNL6-B22	1323.2021.02
Receiver Attenuator, ZNL3 port 1	ZNL3-B31	1323.1848.02
Receiver Attenuator, ZNL3 port 2	ZNL3-B32	1323.1854.02
Receiver Attenuator, ZNL6 port 1	ZNL6-B31	1323.2038.02
Receiver Attenuator, ZNL6 port 2	ZNL6-B32	1323.2044.02
Additional removable HDD	ZNL-B19	1323.2938.02
OCXO Accurate Reference Frequency	FPL1-B4	1323.1902.02
Additional Interfaces	FPL1-B5	1323.1883.02
GPIB Interface	FPL1-B10	1323.1890.02
DC Power Supply for 12/24 V supply	FPL1-B30	1323.1877.02
Li-Ion Battery Pack	FPL1-B31	1323.1725.02
40 MHz Analysis Bandwidth 1)	FPL1-B40	1323.1931.02
Software options		
Time Domain Analysis	ZNL-K2	1323.1819.02
Distance to Fault Measurement	ZNL-K3	1323.1825.02
AM/FM/φM Analog Modulation Analysis 1)	FPL1-K7	1323.1731.02
Measurements with NRP Power Sensors 1)	FPL1-K9	1323.1754.02
Noise Figure Measurements	FPL1-K30	1323.1760.02
License Dongle	FSPC	1310.0002K02
Vector Signal Explorer Base Software	VSE	1320.7500.02
Vector Signal Analysis	VSE-K70	1320.7522.02
EUTRA/LTE NB-IOT	VSE-K106	1320.7900.02
Recommended extras		
Calibration Kit		
Calibration Kit, N, 50 Ω, 0 Hz to 3 GHz	ZCAN	0800.8515.52
Calibration Kit, N (m), 50 Ω, 0 Hz to 9 GHz	ZV-Z170	1317.7683.02
Calibration Kit, N (f), 50 Ω, 0 Hz to 9 GHz	ZV-Z170	1317.7683.03
Calibration Unit		
Calibration Unit, 2 Ports, N(f), 100 kHz to 8.5 GHz	ZN-Z151	1317.9134.72
Calibration Unit, 2 Ports, SMA(f), 100 kHz to 8.5 GHz	ZN-Z151	1317.9134.32
Cables		
N (m)/N (m), 50 Ω, length: 0.6 m/0.9 m, 0 Hz to 18 GHz	ZV-Z191	1306.4507.24/36
N (m)/3.5 mm (m), 50 Ω, length: 0.6 m/0.9 m, 0 Hz to 18 GHz	ZV-Z192	1306.4513.24/36
3.5 mm (f)/3.5 mm (m), 50 Ω, length: 0.6 m/0.9 m, 0 Hz to 26.5 GHz	ZV-Z193	1306.4520.24/36
Others		
Protective Hard Cover	FPL1-Z1	1323.1960.02
Transport Bag, transparent cover	FPL1-Z2	1323.1977.02
Carrying vest holster	FPL1-Z3	1323.1683.02
Spare battery pack	FPL1-Z4	1323.1677.02
Anti-glare film	FPL1-Z5	1323.1690.02
Three-Path Diode Power Sensor, 100 pW to 200 mW, 10 MHz to 8 GHz	NRP8S	1419.0006.02
Three-Path Diode Power Sensor, 100 pW to 200 mW, 10 MHz to 8 GHz, LAN version	NRP8SN	1419.0012.02

Warranty		
Base unit		3 years
All other items 1)		1 year
Options		
Extended Warranty, one or two years	WE1/WE2	Please contact your local Rohde & Schwarz sales office.
Extended Warranty with Calibration Coverage, one or two years	CW1/CW2	
Extended Warranty with Accredited Calibration Coverage, one or two years	AW1/AW2	

1) For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.