TECHNICAL
OVERVIEW

Vector Network Analyzers

Make linear and nonlinear device characterizations in BOTH frequency and time-domain measurements with confidence. To achieve the most accurate results using Keysight vector network analyzers (VNA). Select from Keysight's broad offering of VNAs for the performance and form-factor that best meet your application needs.









KEYSIGHT TECHNOLOGIES

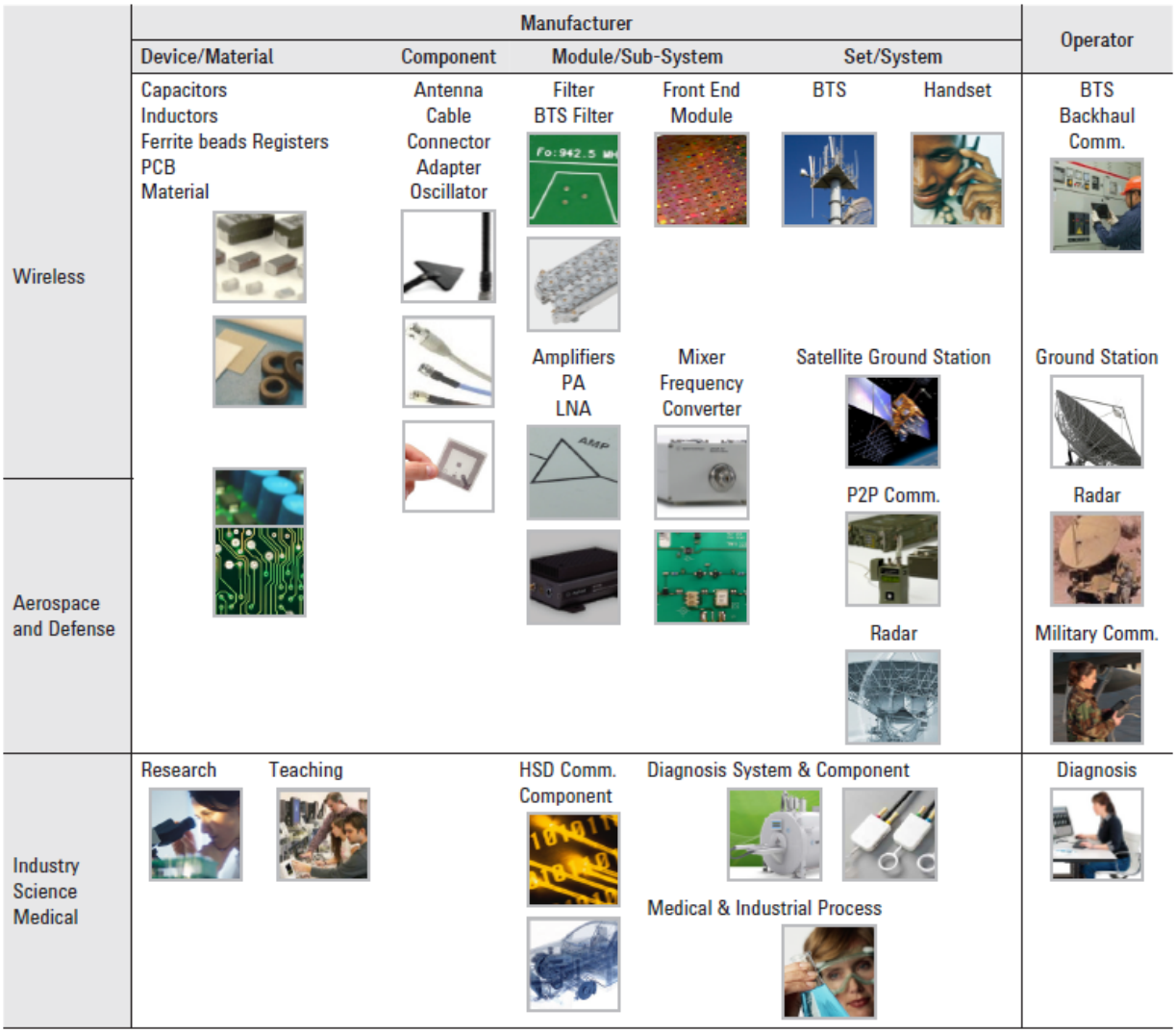
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Gain Deeper Confidence

Whether you're testing active or passive components, the right mix of speed and performance gives you an edge. In R&D, Keysight's vector network analyzers (VNAs) provide a level of measurement integrity that helps you transform deeper understanding into better designs. On the production line, our cost-effective VNAs provide the throughput and repeatability you need to transform parts into competitive components. Every Keysight Technologies, Inc. VNA is the ultimate expression of our expertise in linear and nonlinear device characterization. On the bench, in a rack or in the field, we can help you gain deeper confidence.

Physical measurement ecosystem



Keysight VNA Solutions

Keysight offers a variety of vector network analyzers with frequency, performance, and versatility to meet your measurement needs.

To help you determine which solution is right for you, this selection guide provides an overview and side-by-side comparison of all Keysight network analyzers. In addition, you will find typical network analyzer applications, the measurement needs for those applications, and how Keysight's network analyzers meet those needs.

PNA Family – Reach for unrivaled excellence

Model	Typical applications	Key features
PNA-X Series N524xB		
 • Most advanced, integrated & flexible VNA • 10 MHz to 8.5/13.5/26.5/ 43.5/50/67(70) GHz • Up to 1.5 THz with extenders (Broadband VNA up to 220 GHz)	• Replace an entire rack of equipment with one instrument • Complete linear and nonlinear active device characterization	• Three DDS sources with low spurious and very low phase noise, and 6 GHz arbitrary waveform generation • Sigle-connection multiple measurement • Built-in combiner • Switchable rear-panel jumpers provide the flexibility to add signal-conditioning hardware or route additional test equipment to the DUT without moving test cables • Third source for two-tone frequency converter test • Modulation distortion analysis: EVM, NPR, ACPR • Phase noise, AM noise, and residual noise measurements
PNA Series N522xB		
 • High performance microwave VNA • 10 MHz to 13.5/26.5/ 43.5/50/67(70) GHz • Up to 1.5 THz with extenders (Broadband VNA up to 220 GHz)	• Highest performance passive component analysis up to 70 GHz • Active components characterization • Metrology and cal lab	• Wide dynamic range (> 128 dB at 26.5 GHz, > 112 dB at 67 GHz) • Two DDS sources with low spurious and very low phase noise and 6 GHz arbitrary waveform generation • Integrated VNA with highest RF performance • World's highest accuracy. Metrology option for ultimate S-parameter measurements • Amplifier and converter applications for simple setup, faster measurements, and improved accuracy • Modulation distortion analysis: EVM, NPR, ACPR • Phase noise, AM noise, and residual noise measurements

PNA-L Series N523xB		
 • Economy microwave VNA • 300 kHz to 8.5/13.5/ 20 GHz • 10 MHz to 43.5/50 GHz	• Microwave S-parameter test • Signal integrity • Material measurements	• Basic S-parameters and materials measurements • Flexibility with configurable test set

ENA Series - Drive down the cost of test

Model	Typical applications	Key features
E5081A ENA-X		
 • High-performance ENA-X with configurable test set • 10 MHz to 20/44 GHz	• Active components characterization (ex. power amplifiers, low-noise amplifiers) • High-power device measurements • Noise figure measurements • Manufacturing tests of highly integrated modules (ex. T/R modules)	• Configurable test set on ports 1 and 2 • Low-noise receivers on ports 1 and 2 • Built-in upconverter for wideband modulation distortion analysis (ex. EVM, ACPR, or NPR) with a single connection • Best-in-class measurement performance • Wide variety of measurement applications
E5080B ENA		
 • High-performance ENA • 9 kHz to 4.5/6.5/9/14/ 18/20 GHz • 100 kHz to 26.5/32/44/ 53 GHz	• General purpose RF/microwave component tests • Manufacturing test • Active and passive measurement applications • Enhanced time-domain analysis for signal integrity applications	• RF to microwave frequency ranges with 2 or 4 ports • Best-in-class measurement performance • Integrated hardware capabilities such as DC sources, bias tees and pulse generators/modulators, etc. • Wide range of measurement applications • Two internal sources available on 4-port models • E5071C code compatibility

E5061B ENA		
 • RF VNA and LF-RF VNA with impedance analysis • 5 Hz to 0.5/1.5/3 GHz • 100 kHz to 1.5/3 GHz	• Low-frequency (LF) component/circuit tests down to 5 Hz • Component impedance analysis with supported test fixtures • Power integrity • CATV component tests (75 Ω)	• Economy RF VNA with solid performance • 2-port, 50 Ω or 75 Ω VNA up to 3 GHz • Low frequency coverage down to 5 Hz • Built-in DC bias source • Combines vector network analysis and impedance analysis with a single instrument
E5063A ENA		
 • Low-cost VNA for passive component test • 100 kHz to 0.5/1.5/3/4.5/ 6.5/ 8.5/14/18 GHz	• Passive component tests (i.e., filters, cables, connectors, antennas, etc.) • Wireless power transfer analysis • Material measurements • PC board (PCB) impedance tests	• Entry-model benchtop VNA for simple passive component measurements up to 18 GHz • Optimized between price and performance • PCB impedance analysis with enhanced time domain analysis • Consistent measurement GUI with the E5071C

PXI VNA Family - Drive down the size of test

Model	Typical applications	Key features
M983xA Configurable PXI VNA		
 • PXI VNA with configurable test set • 10 MHz to 20/44 GHz	• Multiport component tests • High-power device measurements • Noise figure measurements • Manufacturing tests of highly integrated modules (ex. T/R modules) • Manufacturing tests for Beamformer IC and front-end module (FEM) for 5G FR2 • Multi-site (parallel) manufacturing tests	• Low-noise receiver per port • Built-in upconverter for wideband modulation distortion analysis (ex. EVM, ACPR, or NPR) with a single connection • Scalable and flexible configurations for multiport DUTs • Best-in-class measurement performance • Wide variety of measurement applications

Model	Typical applications	Key features
M980xA Standard PXI VNA		
 • PXI VNA with standard test set • 9 kHz to 4.5/6.5/9/14/20 GHz • 100 kHz to 26.5/32/44/53 GHz	• Multiport component tests • Manufacturing tests of active and passive components • Multi-site (parallel) manufacturing tests	• Multiport measurements: up to 50 ports (M9800/01/02/03/04A) or up to 34 ports (M9805/06/07/08A) in a single PXI chassis • Best-in-class measurement performance • Fast and easy multiport calibration available with electronic calibration (ECal) modules • Wide variety of measurement applications
M937xA Economy PXI VNA		
 • Economy PXI VNA • 300 kHz to 4/6.5/9/14/20/26.5 GHz	• Passive component tests • Multiport and multi-site (parallel) manufacturing tests	• Multiport measurements available up to 32 ports in a single PXI chassis • Low cost and easy to configure • Enough performance and speed
M981xAS		
 • PXI Vector Component Analyzer • 100 kHz to 26.5/32/44/53 GHz	• Multiport component tests • Manufacturing tests for Beamformer IC and front-end module (FEM) for 5G FR2	• Combines vector network analysis and wideband modulation distortion analysis (ex. EVM, ACPR, or NPR) with a single connection • Excellent accuracy for EVM measurements with vector correction methods

Keysight Streamline Series VNAs - Compact form, zero compromise

Model	Typical applications	Key features
P500xA/B, P502xA/B		
 • High-performance compact VNA • 9 kHz to 4.5/6.5/9/14/ 20 GHz • 100 kHz to 26.5/32/44/ 53 GHz • Thunderbolt 3 interface for faster measurements (B-model only)	• General-purpose component tests (ex. passive components, amplifiers, or mixers/frequency converters, etc.) • A/D applications in secure environments • Manufacturing tests	• Packaged in a compact chassis and controlled by an external computer • Best-in-class performance for compact VNAs • Two internal sources available on 4-port models • Wide variety of measurement applications • Ability to extend the number of test ports by using two VNA instruments (maximum 12-ports up to 20 GHz, or 8-ports up to 53 GHz) • E5071C code compatibility
P937xA/B, P938xB		
 • Entry-model compact 2- or 4-port VNA • 300 kHz to 4.5/6.5/9/14/20/26.5 GHz, 2-port (P937xA) • 9 kHz to 4.5/6.5/9/14/20 GHz, 100 kHz to 26.5/44 GHz, 2-port (P937xB) • 9 kHz to 9/20 GHz, 4-port (P938xB) • Thunderbolt 3 interface (B-model only)	• General-purpose passive components • A/D applications in secure environments	• Packaged in a compact chassis and controlled by an external computer • Affordable VNA with good performance • Ability to extend the number of test ports by using two VNA instruments (maximum 4-ports up to 44 GHz, or 8-ports up to 20 GHz)

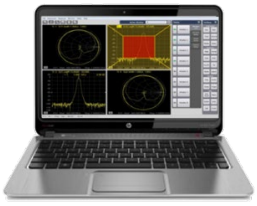
FieldFox Family - Carry precision with you

Model	Typical applications	Key features
Handheld RF and Microwave Analyzers		
 • N991xA, N992xA, N991xB • 30 kHz to 4/6.5/9/14/18/ 26.5 GHz • N995xA • 300 kHz to 32/44/50 GHz	• Wireless installation and maintenance • Interference detection and trouble shooting • RADAR field test • Satellite ground station test • Air traffic control communication • system test	• Advanced capabilities and functions for the latest 5G measurement needs including up to 100 MHz bandwidth and more • Key code enabled to have VNA, SA, RTSA, power meter, noise figure and many other options in one package • Designed for your toughest working environments with MIL-specs • 30% lighter weight than other analyzers • Versatile capabilities, such as cable and antenna analyzer (CAT), a VNA, a spectrum analyzer, and/or an all-in-one combination analyzer

Keysight VNA Simulator

VNA simulator simulate operations of Keysight's latest VNAs (PNA, ENA, PXI VNA, or Streamline Series VNA) on your PC, eliminating the need for a VNA for your test program development and post data processing.

Vector Network Analyzer (VNA) Simulator

Model	Typical applications	Key features
 • S94050B (VNA Simulator – Standard) • S94051B (VNA Simulator – Advanced)	• Test program development for automated test • Post data process without VNA hardware	• Runs on a PC and simulates operation of Keysight's VNAs (PNA/ENA/PXI or Streamline Series VNA) • Eliminates the need for VNA hardware for the VNA operation • The standard version (S94050B) supports operations of standard S-parameter measurement class • The advanced version (S94051B) gives access to advanced software capabilities of the VNA.

Active Component Evaluation and Test

Measurement challenges

Use Keysight vector network analyzers to characterize and test active components, such as amplifiers, mixers, and frequency converters. They can easily measure commonly specified amplifier parameters such as gain, gain and phase compression, isolation, return loss, and group delay. Analysis of harmonic distortion helps to understand an amplifier's nonlinear behavior and requires the receiver to be tuned at a different frequency from the source. Frequency-translating devices, such as mixers and frequency converters present unique measurement challenges because their input and output frequencies are different. Network analyzers used for testing these devices need to have a frequency-offset mode (FOM) to detect output frequencies different from the input.

Using additional instruments and signal conditioning devices for testing for two-tone, higher input and output power, or for other types of measurements including noise figure, EVM and phase noise often results in a more complicated test system that requires multiple stations.

Keysight solutions

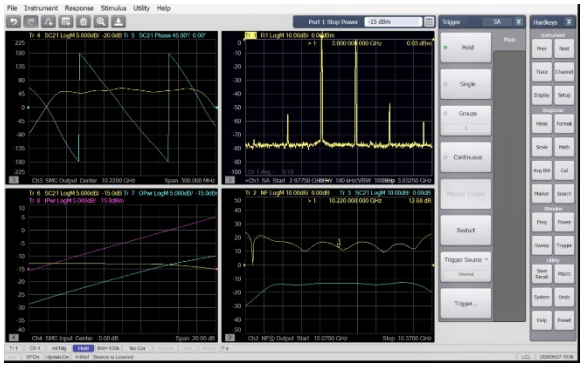
Keysight offers a wide range of flexible and affordable test solutions for vector network analysis of active components. Keysight's VNAs include the ability for linear and nonlinear characterization with the highest accuracy. In addition to high performance, a variety of measurement applications simplify setup, reduce test time, and improve measurement accuracy.

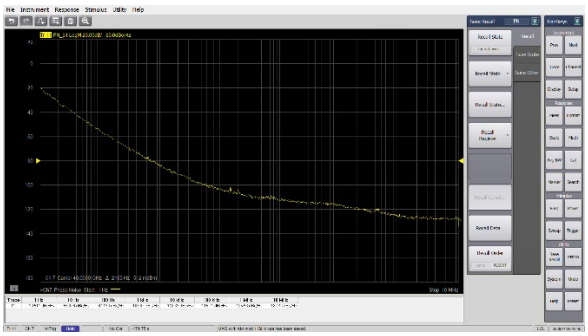
Key features and measurements

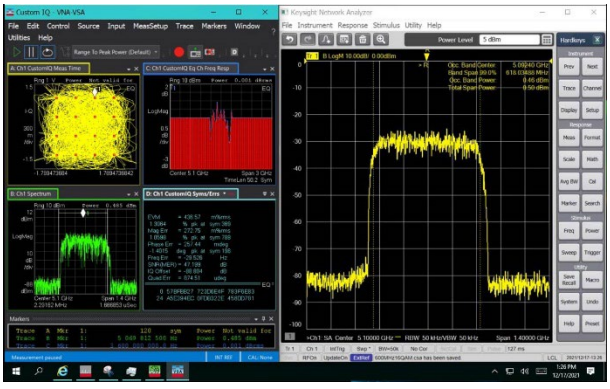


- S-parameter measurements: gain, match and isolation
- Frequency offset measurements (FOM)
- Accurate source power output and absolute power measurements: source and receiver calibration, power-sensor-mismatch correction, receiver leveling
- Gain compression, AM-AM and AM-PM conversion: power sweep, source and receiver calibration
- DC bias: internal DC bias source/DC source control/internal bias-tee
- Power-added efficiency: DC inputs and/or DC meter control
- High power/pulse configurability including configurable test set, high output power, source and receiver attenuators, internal pulse generators, external pulse generator control, internal pulse modulators

- Frequency-converter measurements:
  - Conversion gain/loss/phase/group delay: source and receiver calibration, scalar/vector mixer calibration, magnitude and phase calibration
  - LO drive/measurements: second internal source, external RF source control, 3-port calibration and measurements, LO power calibration, embedded-LO phase noise measurements
  - Mixer topology: swept-RF, swept/fixed- LO (fixed-IF/swept-IF), dual-stage converter, converter with embedded LO
- Harmonic distortion: source and receiver calibration, low source harmonics, receiver attenuator
- Intermodulation distortion (IMD): internal second source or external source control, internal combiner, and swept-IMD
- Phase noise, AM noise and residual noise measurements
- Noise figure measurements
- Spectrum analysis
- Active hot parameters: amplifier test under actual operating condition removing system-to-system correlation problem
- Differential and I/Q device measurements
- EVM, ACPR and NPR measurements with modulated stimulus with vector correction for amplifiers and converters
- DPD and modulation source correction
- 89600 VSA running on VNA
- Internal Arbitrary Waveform Generation
- Nonlinear vector network analysis (NVNA): waveform analysis, X-parameters
- Single-connection multiple measurements







Applications/Features

Applications/Features	PNA-X	PNA	PNA-L	E5081A ENA-X	E5080B ENA	M983xA	M980xA	P50xxA/B	Field Fox
Phase noise, AM noise, residual noise measurement	●	●							
Active load pull with source phase control	●	●		● [1]	● [1]	● [2]	● [2]	● [1, 2]	
True mode stimulus analysis	●	●		● [1]	● [1]	● [2]	● [2]	● [1, 2]	
Real-time measurement uncertainty	●	●	●	●	●	●	●	●	
Embedded-LO frequency converter	●	●		●	●	●	●	●	
Close-in two-tone IMD	●	●							
Fast converter phase and group delay	●	●							
Power meter calibration	●	●	●	●	●	●	●	●	
Swept-frequency gain compression	●	●	●	●	●	●	●	●	
Pulsed measurement	●	●	● [3]	●	●	●	●	●	
FOM, Conversion gain/loss/phase/group delay	●	●	● [4]	●	●	●	●	●	● [5]
Measurement setup assistance (DMX)	●	●	●	●	●	●	●	●	
Swept two-tone IMD	●	● [6]		● [6]	● [6]	● [6]	● [6]	● [6]	
Noise figure	●	● [7]		●	● [7]	●	● [7]	● [7]	●
Differential and I/Q device measurements	●	●		● [1]	● [1]	● [2]	● [2]	● [1, 2]	
Spectrum analysis including classic NPR	●	●	●	●	●	●	●	●	● [8]
NVNA/X-parameters, Active hot parameters	●								
Modulation distortion analysis with vector correction - EVM/NPR/ACPR measurements	● [9]	● [9]		● [9]		● [9]	● [9]		
mmWave modulation distortion analysis	● [10]								
Arbitrary waveform generation	● [11]	● [11]							
DPD, modulation source correction	●	●							
89600 VSA wideband IQ data link	●	●	●						
mmWave broadband VNA (up to 220 GHz)	●	●							

1. Requires a 4-port option with the internal second source.
2. Requires a configuration using multiple modules/instruments with S9x551B software.
3. Requires external pulse generators and modulators.
4. Requires 4-port PNA.
5. Scalar FOM using USB power sensor or spectrum analyzer functionality.
6. With external combiner.
7. Requires an external preamp, band-pass filter, and switches.
8. No NPR measurement available.
9. Requires an external vector source unless the arbitrary waveform generation feature of 4-port PNA-X can't be used
10. 4-port using N5292A
11. 6 GHz maximum bandwidth.

Hardware features

Hardware features	PNA-X	PNA	PNA-L	E5081A ENA-X	E5080B ENA	M983xA	M980xA	P50xxA/ B	Field Fox
High power configuration including configurable test set, high output power, source and receiver attenuator	●	●	● [1]	●	● [4]	●	● [4]	● [4]	
Pulse generators and modulators	●	●		●	●	●	●	●	
DC bias/DC input	●	●			●				● [2]
Built-in DC source				●	●				●
Two internal sources	●	● [3]		● [3]	● [3]	● [5]	● [5]	● [3, 5]	
Third internal source	●								
Low-phase-noise and low-spurious DDS source	●	●							
Enhanced-low phase noise option	●	●							
Dedicated low noise receiver	●			●		●			
Internal combiner/path switches	●								
Rear panel loops for flexible configuration	●								

1. No receiver attenuator available.
2. Built-in DC bias source, no bias tee.
3. Requires 4-port configuration.
4. No configurable test set options. Direct receiver access (DRA) configurations are supported.
5. Two internal sources can be operated with multi-instrument configurations.

Passive Component Evaluation and Test

Measurement challenges

For quality communications systems, high performance passive devices such as filters, combiners, switches, and transmission lines often require low ripple and low insertion loss in the pass band, and high rejection ratios in the stop band. Devices used in balanced circuits have multiple input and output ports that complicate measurement system configurations. For these devices, the key measurement challenge is to easily get accurate data, as fast as possible. Use a wide measurement-frequency range to characterize multi-band operations.

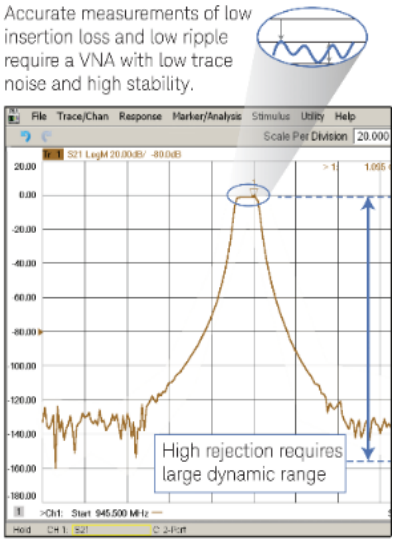
Keysight solutions

Keysight VNAs have a broad frequency range; from 5 Hz to 1.5 THz. Low trace noise, advanced calibration techniques, and good stability help evaluate your passive components with the required accuracy. VNAs with a configurable test set allow direct receiver access, improving system dynamic range for more accurate and faster device measurements. You can display multiple traces in different formats. Various marker searches, including filter parameters and trace-math functions, are available for easy analysis.



Key features

- Wide dynamic range provides fast, accurate filter measurements
- Wide frequency range covers in- and out-of-band characteristics
- Automatic fixture removal to remove fixture effects from non-coaxial device measurements
- Direct receiver access for the widest possible dynamic range
- Low-cost solution provides just enough performance and function for your test
- Low trace noise and high stability for high quality device measurements
- Unknown-thru calibration is easy and accurate non-insertable device measurements
- ECal characterization provides accurate mixed-connector device measurements
- Balanced S-parameter measurements are accurate without balun
- Multi-site configurations with PXI VNA instances to improve throughput with parallel/simultaneous DUT measurements
- Full multiport calibration for mismatch-corrected accurate multiport measurements
- Metrology option provides highest accuracy and stability for metrology-grade component evaluation
- Time domain analysis/gating function for troubleshooting and simple simulation
- Trace analysis functions using marker and trace math



Passive Component Evaluation and Test - Benchtop VNA [1]

Applications/Features	PNA-X	PNA	PNA-L	E5081A ENA-X	E5080B ENA	E5061B	E5063A
Automatic fixture removal	●	●	●	●	●		
Unknown thru cal / ECal characterization	●	●	●	●	●		●
Measurement setup assistance (DMX)	●	●	●	●	●		
Impedance analysis					● [2]	● [3]	
Fast CW for antenna near-field test	●	●					
Min frequency in the series	900 Hz	900 Hz	300 kHz	10 MHz	9 kHz	5 Hz	100 kHz
Max frequency in the series	67 GHz (70 Hz)	67 GHz (70 GHz)	50 GHz	44 GHz	53 GHz	3 GHz	18 GHz
Frequency extension	Up to 1.5 THz	Up to 1.5 THz					
Dynamic range (10 Hz IFBW)	136	137	133	146	140	120	115
Extended dynamic range by direct receiver access	●	●	●	●			
Trace noise at 10 kHz IFBW (dBrms) [4]	0.0063 [4]	0.0063 [4]	0.0063 [4]	0.0015	0.0015	0.0091 [4]	0.0019 [4]
Cycle time (ms. full 2-port cal, 201 points, narrowband)	7	6	7	2	2	21	19
Multiport solutions (N >= 4) / Balanced measurements	●	●	●	●	●		
Max number of ports for full calibrated measurements	> 4 [3]	> 4 [3]	> 4 [3]	4	4	2	2
IF inputs	●	●					
Metrology option		●					

1. Refer to the data sheet of each product for more detailed performance data.
2. Requires 16198A-100 test fixture and 85052DH02 data-based calibration kit.
3. Requires option 3L3/3L4/3L5 and 005.
4. Calculated based on the specification at different IFBW settings at 1 kHz
5. With an external multiport test set.

Passive Component Evaluation and Test - Modular VNA [6]

Applications/Features	M983xA	M980xA	M937xA	P50xxA/B	P937xA/B P938xB	N99xxA	N99xxB
Automatic fixture removal	●	●	●	●	●		
Unknown thru cal / ECal characterization	●	●	●	●	●	●	●
Measurement setup assistance (DMX)	●	●		●	●		
Min frequency in the series	10 MHz	9 kHz	300 kHz	9 kHz	9 kHz	30 kHz	30 kHz
Max frequency in the series	44 GHz	53 GHz	26.5 GHz	53 GHz	44 GHz	50 GHz	26.5 GHz
Frequency extension		Up to 330 GHz (banded)	Up to 170 GHz (banded) [4]	Up to 330 GHz (banded. A-models only) [5]	Up to 170 GHz (banded. P937xA only)		
Dynamic range (10 Hz IFBW)	146	140	115	140	115	95	115
Trace noise at 10 kHz IFBW (dBrms) [1]	0.0015	0.0015	0.003 [1]	0.0015	0.0015	0.004 [3]	0.001 [3]
Cycle time (ms. full 2-port cal, 201 points, narrowband)	2	2	12	22 (A-model) / 2 (B-model)	15	NA	NA
Multiport solutions (N >= 4) / Balanced measurements	●	●	●	●	●		
Max number of ports for full calibrated measurements[7]	4	66 (8)	32 (8)	12 [2] (6)[2]	8 [2] (2)[2]	2	2

1. Calculated based on the specification at different IFBW settings at 1 kHz.
2. Configure a multiport network analyzer with two Streamline Series VNAs.
3. Trace noise at 1 GHz with 300 Hz IFBW.
4. N5252A system is also available for E-band (60-90 GHz).
5. N5253E1/E2/E3 E-band solution bundles are also available.
6. Refer to the data sheet of each product for more detailed performance data.
7. ( ) is for mmWave banded VNA configurations.

General Purpose, Education

Measurement challenges

General-purpose vector network analyzers are essential in education institutions and many other RF labs. Users typically require measurements of S-parameters, power, and sometimes material parameters, for a broad range of passive and active components, with both single-ended and differential inputs and outputs. Devices typically have 2-, 3- and sometimes 4-ports, and must be measured in coaxial, in-fixture, or on-wafer environments. Active devices like amplifiers, mixers, and frequency-converters often require considerable time to measure all necessary parameters. Test equipment is not used every day and is often shared with other groups.

General Purpose, Education – Benchtop VNA

Applications/Features	PNA-X	PNA	PNA-L	E5081A	E5080B	E5061B	E5063A
Sweep type	Linear, Log, Segment, CW, Power, DC source, Phase	Linear, Log, Segment, CW, Power, DC source, Phase	Linear, Log, Segment, CW, Power, DC source	Linear, Log, Segment, CW, Power, DC source, Phase	Linear, Log, Segment, CW, Power, DC source, Phase	Linear, Log, Segment, Power, DC bias	Linear, Log, Segment
4-port test set option	●	●	● [1]	●	●		
Full N-port calibration option for greater than 4 ports	●	●	●				
Configurable test set	●	●	●	●			
Built-in 2nd source option	●	●		●	●		
Receiver attenuator option	●	●					
Built-in DC bias tees option	●	●			●		
Frequency offset mode option	●	●	●	●	●		
Internal pulse generators and modulators option	●	●		●	●		
Noise figure measurement option	●	●		●	●		
Nonlinear vector network analysis application	●						
Built-in combiner	●						
Time domain analysis	●	●	●	●	●	●	●
Enhanced time domain analysis with TDR	●	●	●	●	●		
Frequency extension	●	●					
Impedance analysis					● [2]	● [3]	
Gain-phase ports						● [3]	
75 Ω test set option						●	
Multiport measurements for > 4 ports	● [4]	● [4]	● [4]				
Multi-site measurements for > 4 ports							
Power meter cal	●	●	●	●	●		
EVM, NPR and ACPR	●	●		●			
Spectrum analysis/NPR	●	●	●	●	●		
Phase noise, AM noise, residual noise	●	●					
Active hot parameters	●			●	●		
Arbitrary waveform generation	● [5]	● [5]					
89600 VSA wideband IQ data link	●	●	●				
mmWave broadband VNA	●	●					

1. 13.5 and 20 GHz models only
2. Requires 16198A-100 test fixture and 85052DH02 data-based calibration kit.
3. Requires option 3L3/3L4/3L5.
4. With an external multiport test set.
5. 6 GHz maximum bandwidth

General Purpose, Education – PXI, Streamline Series, and handheld VNA

Applications/Features	M983xA	M980xA	M937xA	P50xxA/B	P937xB, P938xB	N99xxA	N99xxB
Sweep type	Linear, Log, Segment, CW, Power, DC source	Linear, Log, Segment, CW, Power, DC source	Linear, Log, Segment	Linear, Log, Segment, CW, Power, DC source	Linear, Log, Segment, CW, Power, DC Source	Linear	Linear
4-port test set option	● [1]	●	● [1]	●	● [1]		
Full N-port calibration option for greater than 4 ports	●	●	●	●	●		
Configurable test set	●						
Built-in 2nd source option	● [2]	● [2]		● [2]			
Receiver attenuator option							
Built-in DC bias tees option						●	●
Frequency offset mode option	●	●	●	●	●	● [4]	● [4]
Internal pulse generators and modulators option	●	●		●			
Noise figure measurement option	●	●		●		●	●
Nonlinear vector network analysis application							
Built-in combiner option							
Enhanced time domain analysis with TDR		●		●	●		
Frequency extension		●	●	●	●		
Impedance analysis							
Gain-phase ports							
75 Ω test set option						●	●
Multiport measurements for > 4 ports	●	●	●	●	●		
Multisite measurements for > 4 ports	●	●	●	●	●		
Power meter cal	●	●	●	●	●		
EVM, NPR and ACPR	●	●				● [5]	● [5]
Spectrum analysis/NPR	●	●		●		● [5]	● [5]
Active hot parameters	●	●		●			

1. Add additional modules or instruments to configure a multiport network analyzer.
2. Multi-instrument configurations or option 402 (P502xA/B series only) are required.
3. With an external multiport test set.
4. With option 208 or under spectrum analyzer, no phase measurement.
5. Spectrum analyzer function.

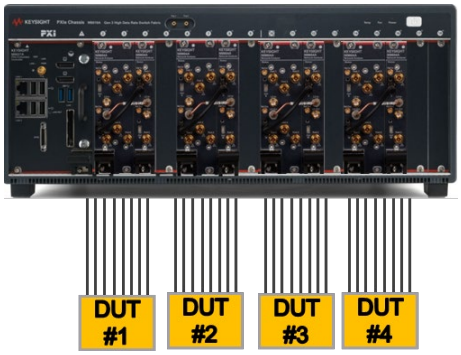
Manufacturing

Measurement challenges



Driving down the cost of test is the key challenge in manufacturing, and there are multiple factors that influence this. One key factor is throughput. You can divide the measurement time of a VNA into several different contributions such as sweep speed, data analysis, display processing, and data transfer. In many cases, the analyzer must send pass/fail results to an automated system. The sweep speed and data-analysis speed are critical for high-volume manufacturing. Being able to minimize the amount of operator intervention, as well as connection and calibration times will also affect measurement throughput. Initial procurement cost, system uptime, maintenance costs, and future performance upgrade costs for test stations also affect total cost of ownership.

Keysight solutions



Keysight offers a broad range of VNAs with very fast data-acquisition speeds and excellent repeatability due to low trace noise and high temperature stability – essential elements to optimize manufacturing test. Many VNAs have a parts-handler interface to achieve fast throughput on an automated production line. Discover the optimal VNA for your manufacturing environment and pay for only for the capabilities you need to minimize your initial procurement costs.

Key features



- Fast processors and wide bandwidths: very fast data acquisition speeds
- Fast data-transfer speeds for maximum throughput
- Segment sweeps: faster testing by tailored stimulus conditions
- Pass/fail limit testing: easy and fast data analysis on the VNA
- Test fixture de-embedding: measure device's true performance
- Internal programming capability: customize VNA operation and data analysis
- ECal modules: simple and fast calibration
- Parts-handler interface: fast handshaking with an ATE system
- Multiport solutions: multiport device test with minimal connections
- Multi-site configurations to improve throughput with parallel/simultaneous DUT measurements
- Upgradable processors: keep your instrument up to date
- Hardware upgrade paths: support your evolving measurement needs

Features	PNA-X	PNA	PNA-L	E5080B	E5061B	E5063A	M983xA, M980xA	P50xx, P93xx
Built-in programming capability					●		● [1]	● [1]
Part handler interface	●	●	●	●	●	●	● [2]	
Multiport solutions	●	●	●	●			●	●
Multiport full calibration with switch matrix products	●	●	●				●	●
Multi-site measurements							●	●
Hardware/software upgrade	●	●	●	●	●	●	●	●

1. Programming capability is available in a host PC used to control the VNA.
2. Requires the M9341A/B PXIe I/O module.

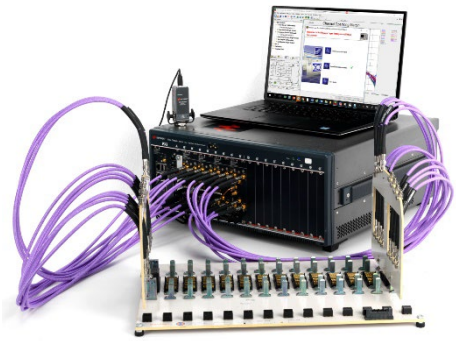
High-Speed Digital Interconnect Analysis

Measurement challenges

As data rates of digital systems increase, signal integrity of interconnects drastically affects system performance. The effects of physical layer components such as printed circuit board traces, connectors, cables, and IC packages require engineer's attention. Fast and accurate analysis of interconnect performance in both time and frequency domains become critical to ensure reliable system performance. Because managing multiple test systems becomes difficult, a single test system that can fully characterize differential high-speed digital devices is a very powerful tool.

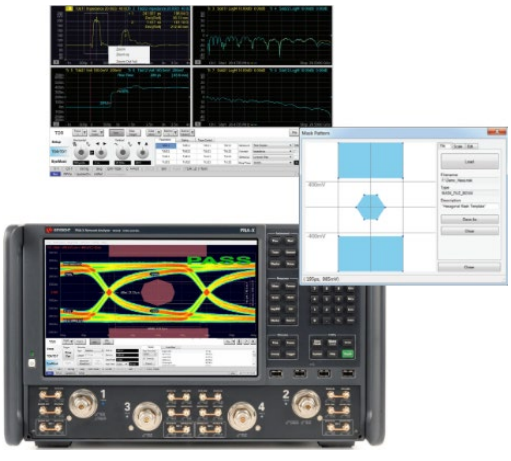
Keysight solutions

N1930xB Physical Layer Test System (PLTS)



- Automatic Fixture Removal (AFR) for accurate, yet simple error correction and de-embedding of unwanted structures inside channel path
- Channel simulator provides user-defined pre-emphasis and equalization settings for real-world channel analysis
- MATLAB interface allows many customizable aspects of testing and automation which typically cut test-plan development time in half
- Characterization report details all critical DUT performance parameters along with specific test-system information to archive important technical test-plan data
- PXI VNA up to 53 GHz, PNA with multiport test set up to 67 GHz

S9x011B Enhanced Time Domain Analysis



- Similar look-and-feel to traditional TDR oscilloscopes, for simple and intuitive operation
- Easily locate source of loss, reflections and crosstalk by simultaneous analysis of both time and frequency domains
- Internal protection circuits inside the instrument provide high robustness against electrostatic discharge (ESD)
- Determine optimal emphasis and equalization settings for your link
- Simulate real-world signals through jitter insertion
- Analyze impedance of active devices under actual operating conditions (Hot TDR) to quantify the multiple reflection effect

Automated Interconnects Compliance Test Solutions

- Cover the latest specifications of interconnect products for high-speed digital standards (ex. S94USBCB for USB Type-C)
- Fully automated compliance tests using 20-port switch matrix
- Setup wizard for quick, setup, calibration, and test selection
- Test fixture de-embedding for accurate measurements
- Comprehensive test report in HTML format



High-speed digital interconnect analysis

Features	PLTS	Enhanced time domain analysis			
Software product number	N1930xB	S93011B (PNA family)	S96011B (E5081A ENA-X and E5080B ENA)	S95011B (M980xA PXI VNA)	S97011B (P93xxB/P50xx Streamline Series VNA)
Supported platform	PNA / ENA / PXI VNA / Streamline Series VNA				
Maximum number of ports	Up to 16	Up to 4	Up to 4	Up to 24	Up to 12
Frequency domain	●	●	●	●	●
Time domain	●	●	●	●	●
Eye diagram	●	●	●	●	●
Stressed eye diagram analysis	●	●	●	●	●
Hot TDR	●	●	●	●	●
Manual compliance test [1,2]		● [3]	●	● [3]	● [3]
Automated compliance test [4]		●	●	●	●
Real-time analysis		●		●	●
Advanced error correction methods [3]	●				

1. PLTS has automated test suite templates that assist R&D engineers with compliance-type testing.
2. Visit http://www.keysight.com/find/ena-tdr_compliance for more details about compliance test solutions.
3. MOI (Methods of Implementation) documents and state files are provided on request basis. Contact your Keysight sales representatives.
4. Requires interconnects compliance test software (ex. S94USBCB), KS8400B PathWave Test Automation, and KS8104B HTML5 Result Listener Plugin.
5. Advanced features: Automatic fixture removal (AFR), differential TRL, multiport crosstalk.

Installation and Maintenance

Measurement challenges

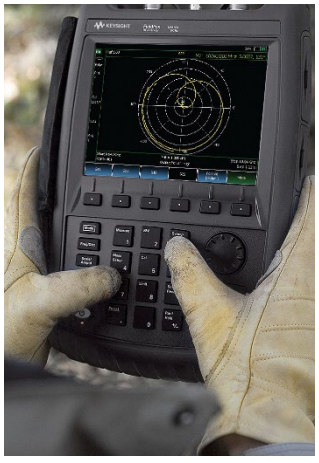


Network analyzer measurements made in the field are fundamentally the same as measurements in the lab, users need to test S-parameters of devices such as cables and filters to determine their performance. The main difference is the requirements placed on the network analyzer hardware. Portability is a big challenge in the field. Carrying benchtop instruments on a cart or trying to fit a benchtop instrument in a tight space like an aircraft is difficult. Locating AC power can also be difficult, so a portable and battery-operated analyzer is often vital for field test.

In addition, while indoor temperatures may be stable, outdoor weather conditions are quite variable. Managing temperature extremes requires specially designed equipment. Use of VNAs outdoors requires a ruggedized structure, as it is moved around often. Finally, the measurements made in the field need to correlate with measurements made in the lab and have similar accuracy.

Keysight solutions

FieldFox analyzer family



- Network analyzer—measure all four S-parameters and perform calibrations such as full 2-port Cal and TRL; unique QuickCal for field calibration; and all Keysight ECal modules
- Optional spectrum analyzer and GPS receiver for interference analysis
- Optional noise figure measurement, real time spectrum analyzer, long distance cable measurement and noise figure measurement
- Can be used together with Keysight N1500A material measurement software
- Designed for field use, battery operated, portable, display viewable in sunlight
- Completely sealed enclosure complaint with MIL-PRF-28800F Class 2 and type tested; meets IEC/EN 60529 requirements for ingress protection
- Large buttons are easy to operate even while wearing gloves

Related Network Analyzer Products and Accessories

Electronic calibration (ECal) modules



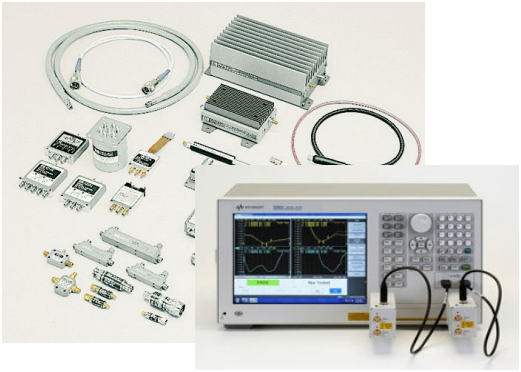
Keysight ECal modules bring calibration to your vector network analyzers with just a single connection from DC up to 67 GHz. The ECal modules are state-of-the-art, solid-state devices with programmable and highly repeatable impedance states which are traceable via National Metrology Institute. Control ECal modules directly from the Keysight network analyzers; does not require an external PC. Electronic calibration replaces traditional mechanical standard calibration and provides consistent calibration and eliminating operator error while bringing convenience and simplicity to your calibration routine.

- www.keysight.com/find/ecal

Microwave test accessories

Keysight provides a complete series of coaxial and waveguide RF and microwave test accessories – everything from adapters, power limiters, DC blocks, attenuators, and couplers, to switches and system amplifiers. These test accessories complete your test solutions by simplifying test setups and maximizing the equipment's full potential to ensure the best possible measurement results.

- www.keysight.com/find/mtacatalog



Two U1810B USB coaxial switches, DC to 18 GHz, SPDT at the ENA test port

Multiport/multi-site solutions

Whether you're measuring differential devices, highly integrated multiport components, or testing many 1-port devices, Keysight offers a variety of multiport/multi-site solutions to suit your measurement needs and dramatically reduce test times.

- www.keysight.com/find/multiport



M980xA PXI VNA up to 66-ports



E5080B ENA with E5092A configurable multiport test set

Millimeter-wave broadband network analyzer solutions

The N5290A/91A millimeter-wave system is a single-sweep solution from 900 Hz to 110/120 GHz with built-in Kelvin bias tees and 2- and 4-port S-parameter measurements. This is a direct replacement for the N5251A with improved performance with N5293AX/5AX smaller size frequency extender heads. A new receiver-leveling function lets you set the source power accurately at the 1.0 mm test port. Keysight allows you to configure 2- or 4-port millimeter-wave broadband network analyzers up to 120 GHz that consist of a PNA or PNA-X network analyzer, an N5292A test set controller, and N5293AX/5AX frequency extenders, and also configure 2-port millimeter-wave broadband network analyzers up to 170 GHz /220 GHz with a 4-port PNA or PNA-X, an N5292A, a pair of N5295AX frequency extenders and a pair of N5262BW05 or 06 frequency extenders.

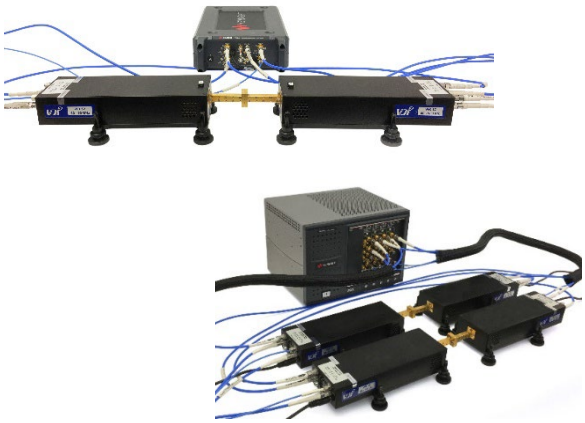


N5290A/91A single sweep solution

- www.keysight.com/find/N5290A
- www.keysight.com/find/N5291A
- Technical Overview, 170 GHz/ 220 GHz Broadband Vector Network Analysis Solution

Millimeter-wave banded network analyzer solutions

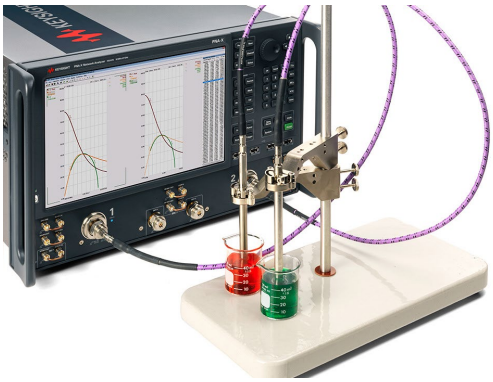
Configure 2- or 4-port millimeter-wave banded network analyzer solutions with a PNA or PNA-X network analyzer and either OML or VDI frequency extenders to measure S-parameters up to 1.5 THz. Keysight also offers affordable 2-port or multiport millimeter-wave banded network analyzers up to 330 GHz (WR3.4 band) with either PXI VNAs or Streamline VNAs, and VDI frequency extenders with or without N5252APXI test set. N5252A and N5253Ex are also available as affordable E-band (60 – 90 GHz) VNA solution bundles. All of these banded VNA solutions allow you to perform the power calibration at test ports with a power sensor.



Banded VNA with Streamline Series VNA / PXI-VNAs

- www.keysight.com/find/ebandvna
- mmWave banded VNA technical overview

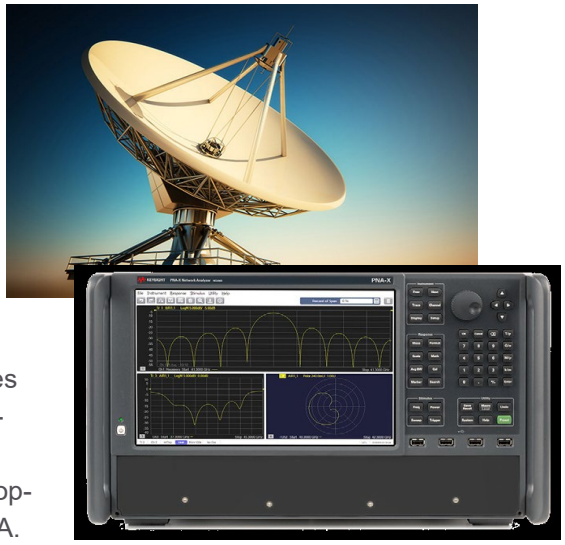
Materials measurement



Trust Keysight to deliver leading-edge techniques for measuring dielectric and magnetic properties of materials. The N1501A dielectric probe kit offers hardware for measuring complex permittivity of liquids and conformable solids from 200 MHz to 50 GHz. The N1500A materials measurement suite automates a variety of techniques across a wide frequency span, including transmission-line, free-space and resonant-cavity methods. The 85072A 10 GHz split-cylinder resonator measures complex permittivity and loss tangent of thin films, un-clad substrates, and other low-loss sheet materials as part of a turnkey solution for IPC standard TM 650 2.5.5.13. Measuring electromagnetic properties of materials is critical in all stages of a products lifecycle: design, incoming inspection, process monitoring and quality assurance. Keysight sets the measurement standard with more than 20 years of experience and innovative new products.

- www.keysight.com/find/materials

Antenna receiver



N5264B PNA-X measurement receiver

Keysight Technologies provides many of the components you need to make accurate antenna and radar cross-section (RCS) measurements. The N5264B PNA-X measurement receiver is a dedicated antenna receiver with 400,000 point-per-second data acquisition on all five measurement channels. The N5264B provides twice as many receivers compared to any other antenna receiver on the market. The N5264B is compatible with MXG or PSG signal generators, the 85309B distributed frequency converter, and 85320A/B mixers. The receiver and an MXG source can completely replace the 8530A and 8360B sources for existing antenna ranges and typically results in a system-speed improvement that is 10 times faster. Additionally, the built-in 8510x/8530A code-emulation software provides a drop-in replacement for existing antenna ranges utilizing an 8530A. Antenna-system integrators such as Microwave Vision Group, Nearfield Systems Inc., ETS-Lindgren, and the System Planning Corporation support the N5264B.

- www.keysight.com/find/antenna

CalPod calibration-refresh modules

Keysight provides a new and unique way to quickly and easily refresh a calibration at the push of a button, without removing the DUT and without the physical connection of standards. CalPods are particularly useful in thermal or thermal-vacuum chambers for removing environmental effects from your measurement results due to temperature changes of cables, connectors, and adaptors, or for removing variations due to cable movements or variations in switch matrices.

- www.keysight.com/find/calpods



85541B 40 GHz temperature characterized CalPod

Key Performance and Functions Comparison – Benchtop VNA

		Performance [2]						
Model	Frequency	Dynamic range (dB) at 3/20 GHz at 10 Hz IFBW		Noise floor (dBm) at 3/20 GHz at 10 Hz IFBW	Max power at 3/20 GHz (dBm)	Best trace noise at 10 kHz [1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201-point [1] sweep, correction off	Dimensions (mm) H x W x D, weight (kg)
		System	Direct receiver access (typ)					
PNA-X								
N5249B N5241B N5242B	900 Hz/10 MHz to 8.5 GHz 900 Hz/10 MHz to 13.5 GHz 900 Hz/10 MHz to 26.5 GHz	126–134/ 126–136	149–158/ 149–158	−114/ −114	+3 to +14/ +4 to +15	0.0063/ 0.047	3.4 ms (600 kHz IFBW)	267 x 426 x 533, 27–37 kg
N5244B N5245B	900 Hz/10 MHz to 43.5 GHz 900 Hz/10 MHz to 50 GHz	125–132/ 126–135	148–155/ 148–156	−110/ −111	+6 to +13/ +6 to +14	0.0063/ 0.063	3.1 ms (600 kHz IFBW)	267 x 426 x 583, 47–49 kg
N5247B	900 Hz/10 MHz to 67 GHz	125–131/ 124–132	147–154/ 147–153	−115/ −118	+7 to +15/ +3 to +12	0.0063/ 0.063	3.2 ms (600 kHz IFBW)	267 x 426 x 583, 47–49 kg
PNA								
N5221B N5222B	900 Hz/10 MHz to 13.5 GHz 900 Hz/10 MHz to 26.5 GHz	132–135/ 127–134	152–156/ 149–156	−114/ −114	+9 to +13/ +8 to +13	0.0063/ 0.047	3.1 ms (600 kHz IFBW)	267 x 426 x 533, 27–37 kg
N5224B N5225B	900 Hz/10 MHz to 43.5 GHz 900 Hz/10 MHz to 50 GHz	126–132/ 125–132	149–155/ 150–153	−114/ −114	+7 to +13/ +8 to +13	0.0095/ 0.063	5.5 ms (600 kHz IFBW)	267 x 426 x 582, 40–42 kg
N5227B	900 Hz/10 MHz to 67 GHz	123–131/ 125–130	146–154/ 148–153	−114/ −116	+6 to +13/ +6 to +11	0.0063/ 0.063	2.6 ms (600 kHz IFBW)	267 x 426 x 583, 43–45 kg
PNA-L								
N5239B N5231B N5232B	300 kHz to 8.5 GHz 300 kHz to 13.5 GHz (Opt. 2xx) 300 kHz to 20 GHz (Opt. 2xx)	131–133/ 111–114	144/124	−120/ −106	+11 to +13/ +5 to +8	0.012/ 0.19	5.75 ms (600 kHz IFBW)	267 x 426 x 446, 24 kg
N5231B N5232B	300 kHz to 13.5 GHz (Opt. 4xx) 300 kHz to 20 GHz (Opt. 4xx)	128/ 101–105	141/114	−120/ −107	+8/ -6 to +2	0.0063/ 0.063	5.75 ms (600 kHz IFBW)	267 x 426 x 446, 24 kg
N5234B N5235B	10 MHz to 43.5 GHz 10 MHz to 50 GHz	110/100	128/117	−110/ −100	0/0	0.019/ 0.19	6 ms (600 kHz IFBW)	267 x 426 x 446, 25 kg

1. Calculated to normalize 10 kHz IFBW equivalent noise.
2. Refer to the data sheet of each product for more detailed performance data.

		Performances						
Model	Frequency	Dynamic range (dB) at 3/20 GHz at 10 Hz IFBW		Noise floor (dBm) at 3/20 GHz at 10 Hz IFBW	Max power at 3/20 GHz (dBm)	Best trace noise at 10 kHz [1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201-point [1] sweep, correction off	Dimensions (mm) H x W x D, weight (kg)
		System	Direct receiver access (typ)					
ENA-X								
E5081A	10 MHz to 20 GHz (Opt. 2K5, 2K6, 4K5, 4K6) 10 MHz to 44 GHz (Opt.2N5, 2N6, 2N7, 4N5, 4N6, 4N7)	137 to 146/ 126 to 133	164/153	−127 to -130/ −122 to -125	+10 to +16/+4 to +10	0.0015/ 0.01	2.5 ms (1 MHz IFBW)	266 x 460 x291, 17 to 18 kg
ENA								
E5080B	9 kHz to 4.5 GHz (Opt. 240, 440, 442) 9 kHz to 6.5 GHz (Opt. 260, 460, 462) 9 kHz to 9 GHz (Opt. 290, 490, 492) 9 kHz to 14 GHz (Opt. 2D0, 4D0, 4D2) 9 kHz to 18 GHz (Opt. 2H0, 4H0, 4H2) 9 kHz to 20 GHz (Opt. 2K0, 4K0, 4K2) without bias tees option (Opt. 120, 140)	140/ 126	NA	−130/ −122	+10/+4	0.0015/ 0.01	1.7 ms (1 MHz IFBW)	266 x 460 x291, 14 kg (2-port) 15 kg (4-port)
	9 kHz to 4.5 GHz (Opt. 240, 440) 9 kHz to 6.5 GHz (Opt. 260, 460) 9 kHz to 9 GHz (Opt. 290, 490) 9 kHz to 14 GHz (Opt. 2D0, 4D0) 9 kHz to 20 GHz (Opt. 2K0, 4K0) with bias tees option (Opt. 120, 140)	138/ 121	NA	−129/ −120	+9/+1.5	0.0015/ 0.02	1.7 ms (1 MHz IFBW)	
	100 kHz to 26.5 GHz (Opt. 2L0, 4L0, 4L2) 100 kHz to 33 GHz (Opt. 2M0, 4M0, 4M2) 100 kHz to 44 GHz (Opt. 2N0, 4N0, 4N2) 100 kHz to 53 GHz (Opt. 2P0, 4P0, 4P2)	140/ 132	NA	−130/ −125	+10/+7	0.0015/ 0.015	2.0 ms (1 MHz IFBW)	

1. Calculated to normalize 10 kHz IFBW equivalent noise.
2. Refer to the data sheet of each product for more detailed performance data.

		Performances						
Model	Frequency	Dynamic range (dB) at 3/20 GHz at 10 Hz IFBW		Noise floor (dBm) at 3/20 GHz at 10 Hz IFBW	Max power at 3/20 GHz (dBm)	Best trace noise at 10 kHz [1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201-point [1] sweep, correction off	Dimensions (mm) H x W x D, weight (kg)
		System	Direct receiver access (typ)					
ENA								
E5061B	5 Hz to 0.5/1.5/3 GHz (LF-RF Opt. 3L3, 3L4, 3L5) 100 kHz to 3 GHz (RF Opt. 135, 235, 137, 237) 100 kHz to 1.5 GHz (RF Opt. 115, 215, 117, 217)	120/–	NA	−110/–	+10/–	0.0091/ 0.055	9 ms (300 kHz IFBW)	215 x 426 x 296, 14 kg
E5063A	100 kHz to 500 MHz (Opt.205) 100 kHz to 1.5 GHz (Opt.215) 100 kHz to 3 GHz (Opt.235) 100 kHz to 4.5 GHz (Opt.245) 100 kHz to 6.5 GHz (Opt.265) 100 kHz to 8.5 GHz (Opt.285) 100 kHz to 14 GHz (Opt.2D5) 100 kHz to 18 GHz (Opt.2H5)	117/–	NA	−117/–	0/–	0.0019/ 0.014	9 ms (300 kHz IFBW)	215 x 426 x 296, 11 kg

1. Calculated to normalize 10 kHz IFBW equivalent noise.
2. Refer to the data sheet of each product for more detailed performance data.

Key Performance and Functions Comparison – PXI VNA

		Performance [2]						
Model	Frequency	Dynamic range (dB) at 3/20 GHz at 10 Hz IFBW		Noise floor (dBm) at 3/20 GHz at 10 Hz IFBW	Max power at 3/20 GHz (dBm)	Best trace noise at 10 kHz [1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201-point [1] sweep, correction off	Dimensions (mm) H x W x D, weight (kg)
		System	Direct receiver access (typ)					
PXI VNA								
M9834A M9837A	10 MHz to 20 GHz 10 MHz to 44 GHz	143/134	164/154	−127/ −123	+16/+11	0.0015/ 0.01	1.4 ms (1 MHz IFBW)	130 x 42 x 210, 1.3 kg (M9834A-205), 130 x 64 x 210, 2.0 kg (M9834A-270, M9837A)
M9800A M9801A M9802A M9803A M9804A	9 kHz to 4.5 GHz 9 kHz to 6.5 GHz 9 kHz to 9 GHz 9 kHz to 14 GHz 9 kHz to 20 GHz	140/126	NA	−130/ −122	+10/+4	0.0015/ 0.01	1.5 ms (1 MHz IFBW)	130 x 22 x 210, 0.54 kg (2-port) 140 x 42 x 210, 1.01 kg (4-port) 1.17 kg (6-port)
M9805A M9806A M9807A M9808A	100 kHz to 26.5 GHz 100 kHz to 32 GHz 100 kHz to 44 GHz 100 kHz to 53 GHz	140/132	NA	−130/ −125	+10/+7	0.0015/ 0.015	1.5 ms (1 MHz IFBW)	130 x 22 x 210, 0.685 kg (2-port)
M9370A M9371A M9372A M9373A M9374A M9375A	300 kHz to 4 GHz 300 kHz to 6.5 GHz 300 kHz to 9 GHz 300 kHz to 14 GHz 300 kHz to 20 GHz 300 kHz to 26.5 GHz	115/110	NA	−108/ -108	+7/+2	0.003/ 0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg

1. Calculated to normalize 10 kHz IFBW equivalent noise.
2. Refer to the data sheet of each product for more detailed performance data.

Key Performance and Functions Comparison – Streamline Series VNA

		Performance [2]						
Model	Frequency	Dynamic range (dB) at 3/20 GHz at 10 Hz IFBW		Noise floor (dBm) at 3/20 GHz at 10 Hz IFBW	Max power at 3/20 GHz (dBm)	Best trace noise at 10 kHz [1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201-point [1] sweep, correction off	Dimensions (mm) H x W x D, weight (kg)
		System	Direct receiver access (typ)					
Streamline Series VNA								
P5000A/B, P5020A/B P5001A/B, P5021A/B P5002A/B, P5022A/B P5003A/B, P5023A/B P5004A/B, P5024A/B	9 kHz to 4.5 GHz 9 kHz to 6.5 GHz 9 kHz to 9 GHz 9 kHz to 14 GHz 9 kHz to 20 GHz	140/126	NA	−130/ −122	+10/+4	0.0015/0.01	13 ms (1 MHz IFBW. A-model) 1.1 ms (1 MHz IFBW, B-model)	48 x 176 x 333, 1.88 kg (2-port) 68 x 176 x 333, 2.82 kg (4-port) 2.98 kg (6-port)
P5005A/B, P5025A/B P5006A/B, P5026A/B P5007A/B, P5027A/B P5008A/B, P5028A/B	100 kHz to 26.5 GHz 100 kHz to 32 GHz 100 kHz to 44 GHz 100 kHz to 53 GHz	140/132	NA	−130/ −125	+10/+7	0.0015/0.015	13 ms (1 MHz IFBW. A-model) 1.3 ms (1 MHz IFBW. B-model)	
P9370A P9371A P9372A P9373A P9374A P9375A	300 kHz to 4.5 GHz 300 kHz to 6.5 GHz 300 kHz to 9 GHz 300 kHz to 14 GHz 300 kHz to 20 GHz 300 kHz to 26.5 GHz	115/110	NA	−108/ −108	+7/+2	0.003/ 0.030	14 ms (600 kHz IFBW)	48 x 176 x 333, 1.90 kg
P9370B P9371B P9372B, P9382B P9373B P9374B, P9384B	9 kHz to 4.5 GHz 9 kHz to 6.5 GHz 9 kHz to 9 GHz 9 kHz to 14 GHz 9 kHz to 20 GHz	115/105	NA	-107/ −107	+8/+4	0.0015/ 0.01	7.7 ms (700 kHz IFBW)	48 x 176 x 333, 1.88 kg (2-port) 68 x 176 x333, 2.82 kg (4-port)
P9375B P9377B	100 kHz to 26.5 GHz 100 kHz to 44 GHz	115/110	NA	−107/ −103	+8/+7	0.0018/0.024	7.9 ms (700 kHz IFBW)	48 x 176 x 333, 1.88 kg (2-port)

1. Calculated to normalize 10 kHz IFBW equivalent noise.
2. Refer to the data sheet of each product for more detailed performance data.

Key Performance and Functions Comparison – Handheld VNA

		Performance [2]						
Model	Frequency	Dynamic range (dB) at 3/20 GHz at 10 Hz IFBW		Noise floor (dBm) at 3/20 GHz at 10 Hz IFBW	Max power at 3/20 GHz (dBm)	Best trace noise at 10 kHz [1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201-point [1] sweep, correction off	Dimensions (mm) H x W x D, weight (kg)
		System	Direct receiver access (typ)					
FieldFox								
N9913B N9914B N9915B N9916B N9917B N9918B	30 kHz to 4 GHz 30 kHz to 6.5 GHz 30 kHz to 9 GHz 30 kHz to 14 GHz 30 kHz to 18 GHz 30 kHz to 26.5 GHz	114/115 (300 Hz IFBW)	NA		Port 1: +8, Port 2: +7/ Port 1: +3, Port 2: +2	0.001/0.005 (300 Hz IFBW)	35 ms (100 kHz IFBW)	292 x 188 x 82, 3.2 kg
N9950A N9951A N9952A	300 kHz to 32 GHz 300 kHz to 44 GHz 300 kHz to 50 GHz	100/102 (300 Hz IFBW)	NA		0.004/0.070 (300 Hz IFBW)	0.004/0.070 (300 Hz IFBW)	180 ms (10 kHz IFBW)	292 x 188 x 82, 3.2 kg

1. Calculated to normalize 10 kHz IFBW equivalent noise.
2. Refer to the data sheet of each product for more detailed performance data.

Migration and Upgrades

Carefully planned instrument migration and modernization can maximize your test-system efficiency, performance, and readiness, while minimizing risk and potential disruptions, keeping you at the leading edge in the competitive marketplace. Keysight PNA, ENA, PXI VNA, Streamline Series VNA, and FieldFox are perfect replacements to their predecessors. Take advantage of the latest VNAs' advanced performance and modern functions when replacing the legacy network analyzers.

To/From:	PNA Reach for unrivalled excellence				ENA Drive down the cost of test			PXI VNA Drive down the size of test	Streamline Series VNA Compact form. Zero compromise	
	PNA-X	PNA	PNA-L	PNA series mmWave	E5080B	E5063A	E5061B	M983xA, M980xA	P50xxA, P50xxB	P937xA/B, P938xB
										
Old PNA Series: E835xA, N338xA, E836xA/B/C, N5230A/C 8719A/B/C/D/E/ET/ES 872xA/B/C/D/E/ET/ES 8510A/B/C system N522xA, N523xA, N524xA	•	•	•	•	•					
Old ENA Series: E5070A/B, E5071A/B/C E5080A					•	•		Multiport applications Multi-site applications		
8753 series, 8753A/B/C/D/E/ET/ES					•	•			Cost Effective Small Footprint	Cost Effective Small Footprint
LF-RF basic VNAs: 8711A/B/C 8712B/C/ES/ET 8713B/C 8714B/C/ES/ET 8752A/B/C E5061A/62A							•			
LF VNA, Impedance analyzer: 3577A/B, 8751A 4192A/94A/95A, 4395A							•			

Upgrades

Keysight offers upgrades for your network analyzer to add more capabilities like new applications and frequency extension for expanding your application needs.

For example, you can add Keysight proprietary low-spurious low-phase DDS source to your N522X/N524X PNA and PNA-X Microwave network analyzer to improve the frequency converter delay/phase measurement speed and close-in two-tone measurements.

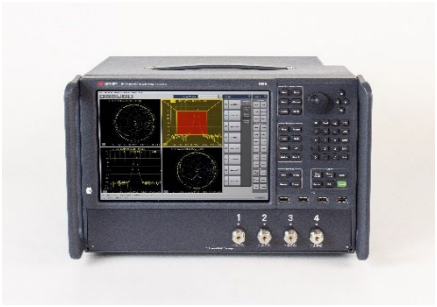
Contact Keysight or visit http://na.support.keysight.com/ for more information available upgrades for your network analyzer.

Premium trade-in solutions

In many countries, Keysight offers a variety of trade-in solutions to give you advanced measurement capabilities, increased throughput, and greater reliability for less than list price. Please contact a Keysight sales representative or visit www.keysight.com/find/savings.



- **Trade-in your legacy network analyzer**
- **Receive credit toward the purchase of a new VNA**



Related Literature

Literature	Number
Keysight PNA and PNA-L Series Microwave Network Analyzers – Brochure	5990-8290EN
Keysight PNA-X Series Microwave Network Analyzers – Brochure	5990-4592EN
N522x/4xB PNA/PNA-X Vector Network Analyzers Enhancement - Technical Overview	3120-1311EN
PNA Family Microwave Network Analyzers – Configuration Guide	5992-1465EN
ENA Vector Network Analyzer Migration – Product Fact Sheet	3121-1316.EN
E5080B ENA Vector Network Analyzer - Data Sheet	5992-3843EN
E5080B ENA and E5081A ENA-X Vector Network Analyzer - Configuration Guide	5992-3842EN
E5061B ENA Vector Network Analyzer – Brochure	5990-6794EN
E5061B ENA Vector Network Analyzer with Impedance Analysis – Data Sheet	5990-7033EN
E5063A ENA Vector Network Analyzer – Brochure	5991-3614EN
M983xA PXIe Vector Network Analyzer – Data Sheet	3122-2129EN
M980xA PXIe Vector Network Analyzer - Data Sheet	5992-3596EN
M980xA and M983xA PXIe Vector Network Analyzer - Configuration Guide	5992-2823EN
M981xAS PXIe Vector Component Analyzer (VCA) - Data Sheet	3120-1346EN
M981xAS PXIe Vector Component Analyzer (VCA) - Configuration Guide	3120-1344EN
M9485A PXIe Multiport Vector Network Analyzer - Configuration Guide	5992-0758EN
M937xA PXIe Vector Network Analyzer – Brochure	5992-0098EN
M937xA PXIe Vector Network Analyzer – Configuration Guide	5991-4885EN
P50xxB and P93xxB Streamline Series Vector Network Analyzer - Data Sheet	3121-1235.EN
P50xxB and P93xxB Streamline Series Vector Network Analyzer - Configuration Guide	3121-1254.EN
P50xxA Streamline Series Vector Network Analyzer - Data Sheet	5992-3606EN
P50xxA and P937xA Streamline Series Vector Network Analyzer - Configuration Guide	5992-2823EN
P937xA Streamline Series Vector Network Analyzer - Data Sheet	5992-2765EN
P937xA Streamline Series Vector Network Analyzer - Brochure	5992-2663EN
FieldFox Handheld Analyzers – Technical Overview	5992-3703EN
FieldFox Handheld Analyzers – Data Sheet	5992-3702EN
FieldFox Handheld Analyzers – Configuration Guide	5992-3701EN
Millimeter Wave Network Analyzers (N5290A/N5291A) – Configuration Guide	5992-2179EN
170 GHz/ 220 GHz Broadband Vector Network Analysis Solution – Technical Overview	3121-1515.EN
Banded Millimeter Wave Network Analysis to 1.5 THz – Technical Overview	5992-2177EN
Measuring Dielectric Properties Using Keysight's Materials Measurement Solutions – Brochure	5991-2171EN
Physical Layer Test System (PLTS) – Technical Overview	5989-6841EN
S93011A Enhanced Time Domain Analysis with TDR - Technical Overview	5992-2715EN
Keysight 855xxA Series Calibration Refresh Modules – Product Fact Sheet	5991-2450EN

Web Resources

Literature	Hyperlink
Keysight Network Analyzer Family	www.keysight.com/find/na
PNA Series Network Analyzers	www.keysight.com/find/pna
ENA Series Network Analyzers	www.keysight.com/find/ena
PXI Vector Network Analyzers	www.keysight.com/find/pxivna
Keysight Streamline Series Network Analyzers	www.keysight.com/find/usb-vna
FieldFox Handheld RF and Microwave Analyzers	www.keysight.com/find/fieldfox
Millimeter-Wave Controllers	www.keysight.com/find/mmwave
Material Test Equipment	www.keysight.com/find/materials
Physical Layer Test System (PLTS) software	www.keysight.com/find/plts
RF & Microwave Test Accessories	www.keysight.com/find/mta
Antenna Measurements	www.keysight.com/find/antenna
Multiport/Multi-site Solutions	www.keysight.com/find/multiport
CalPod Calibration Refresh Module	www.keysight.com/find/calpods
Mechanical and Electronic Calibration Kits	www.keysight.com/find/ecal
PNA-X Nonlinear Vector Network Analyzer	www.keysight.com/find/nvna

Learn more at: www.keysight.com

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KEYSIGHT TECHNOLOGIES

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