Keysight Technologies
Network Analyzer Selection Guide

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, our 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.
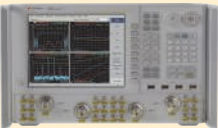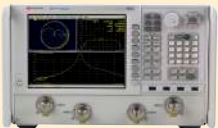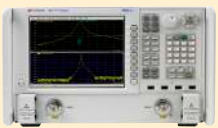
Physical Measurement Ecosystem
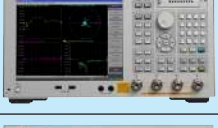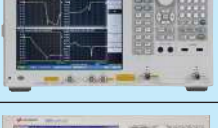
	Manufacturer						Operator
	Device/Material	**Component**	**Module/Sub-System**		**Set/System**		
Wireless	Capacitors Inductors Ferrite beads Registers PCB Material	Antenna Cable Connector Adapter Oscillator	Filter BTS Filter	Front End Module	BTS	Handset	BTS Backhaul Comm.
			Amplifiers PA LNA	Mixer Frequency Converter	Satellite Ground Station		Ground Station
Aerospace and Defense					P2P Comm.		Radar
					Radar		Military Comm.
Industry Science Medical	Research Teaching		HSD Comm. Component	Diagnosis System & Component			Diagnosis
				Medical & Industrial Process			

Introduction

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 our 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.

Keysight VNA solutions

|	Model	Typical application	Frequency range
PNA Family *Reach for unrivaled excellence*	**N524xA PNA-X Series** *Most advanced and flexible VNA*	– Replace an entire rack of equipment with one instrument – Complete linear and nonlinear active device characterization	– 10 MHz to 8.5/13.5/26.5/ 43.5/50/67 GHz – Up to 1.1 THz with extenders
	N522xA PNA Series *High performance microwave VNA*	– Highest performance passive component analysis – Active components characterization – Metrology and cal lab	– 10 MHz to 13.5/26.5/ 43.5/50/67 GHz – Up to 1.1 THz with extenders
	N523xA PNA-L Series *Economy microwave VNA*	– Microwave S-parameter test – Signal integrity – Material measurements	– 300 kHz to 8.5/13.5/20 GHz – 10 MHz to 43.5/50 GHz
ENA *Drive down the cost of test*	**E5072A ENA** *High performance RF VNA with configurable test set*	– RF amplifier test – BTS components – PIM measurements	– 30 kHz to 4.5/8.5 GHz
	E5071C ENA *High performance RF VNA*	– RF component test – Multiport module test – Material measurements – Signal integrity	– 9 kHz to 4.5/6.5/8.5 GHz – 300 kHz to 14/20 GHz
	E5061B ENA *LF-RF VNA with impedance analysis function* *Low cost RF VNA*	– LF component/circuit test – Component Z evaluation – RF component test – CATV component test	– 5 Hz to 3 GHz – 100 kHz to 1.5/3 GHz
	E5063A ENA Low-cost RF VNA for passive component test	– Antenna manufacturing test – RF passive component test – Material measurements – PCB manufacturing test	– 100 kHz to 4.5/8.5/18 GHz
PXI VNA *Drive down the size of test*	**M937xA PXI VNA Series** Full two-port VNA that fits in just one slot	– Antenna manufacturing test – RF component test – Multiport module test – Multi-site test	– 300 kHz to 4/6.5/ 9/14/20/ 26.5 GHz
FieldFox *Carry precision with you*	**N99xxA FieldFox Analyzers** *Handheld combination VNA and spectrum analyzer*	– Field test – S-parameters – Cable and antenna test – Line sweeping – Radio compliance tests – Interference hunting	– 30 kHz to 4/6.5/9/14/ 18/26.5 GHz

Active Component Evaluation and Test

Measurement challenges

Keysight network analyzers can be used 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. Harmonic distortion is often used 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. Additional instruments and signal conditioning devices may be required for testing with two-tone, higher input and output power, or for other types of measurements including noise figure, ACPR, and EVM. As a result, the test system becomes complicated or requires multiple stations.
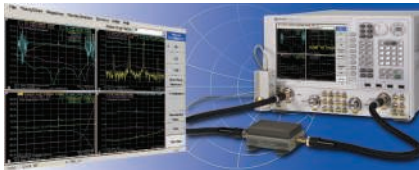
Our solutions

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

Key features

- Amplifier gain, match and isolation: S-parameter measurements
- AM-AM and AM-PM conversion: power sweep, source and receiver calibration
- High power/pulse configurability: configurable test set, high output power, source and receiver attenuators, internal pulse generators, external pulse generator control, internal pulse modulators
- Frequency-converter conversion gain/loss: FOM, source and receiver calibration, scalar mixer calibration
- Frequency-converter conversion phase/group delay: FOM, magnitude and phase calibration, vector mixer calibration
- LO drive/measurements: second internal source, external RF source control, 3-port calibration and measurements, LO power calibration

- Mixer topology: swept-RF, swept/fixed-LO (fixed-IF/swept-IF), dual-stage converter, converter with embedded LO
- Accurate source power output and absolute power measurements: source and receiver calibration, power-sensor-mismatch correction, receiver leveling
- Harmonic distortion: FOM, source and receiver calibration, low source harmonics, receiver attenuator
- Intermodulation-distortion (IMD): FOM, second internal source, external source control, internal combining network, swept-IMD
- Noise figure measurements
- Hot-S22 measurements: FOM, second internal source, internal combining network
- Power-added efficiency: DC inputs and/or DC meter control
- DC bias: internal DC bias source/DC source control/internal bias-tee
- Nonlinear vector network analysis (NVNA): waveform analysis, X-parameters

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Active component evaluation and test

Models	Amplifier gain, match, isolation	Amplifier AM-AM, AM-PM conversion	High-power configure-ability[1]	Pulse	DC bias/ DC input	FOM, conversion gain/loss/ phase/ group delay	Setup wizard/ Quick start	Active measurement applications[2]	Two internal sources	Internal combiner/ path switches	NVNA
PNA-X	●	●	●	●	●	●	●	●	●	●	●
PNA	●	●	●	●	●	●	●	●	●[7]		
PNA-L	●	●	●[3]	●[4]		●[6]	●				
E5072A	●	●	●[3]	●[4]	●	●	●				
E5071C	●	●		●[4]	●	●	●				
E5061B LF	●	●		●[4]	●[5]						
E5061B RF	●	●		●[4]							
FieldFox	●				●[5]						

1. Includes configurable test set, high-output power, source attenuator, and receiver attenuator
2. Includes swept-frequency gain compression, two-tone IMD, pulse, noise figure measurements for amplifiers and frequency converters
3. Receiver attenuator not available
4. Requires external pulse generators and modulators
5. Built-in DC bias source, no bias tee
6. Conversion phase/group delay not available
7. Requires 4-port PNA

Typical solutions

Most integrated and flexible
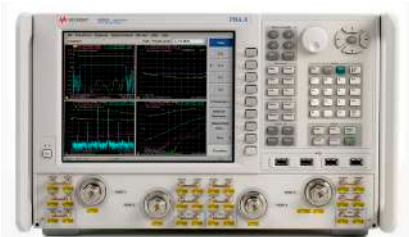
N524xA PNA-X Series microwave network analyzer

– 10 MHz to 8.5/13.5/26.5/43.5/50/67 GHz, 2- or 4-ports
– Two internal sources with low harmonics, combining network, and pulse generators/modulators
– Internal path configuration switches for multiple measurements with a single connection
– Amplifier and converter applications for simple setup, faster measurements and improved accuracy

Highest performance
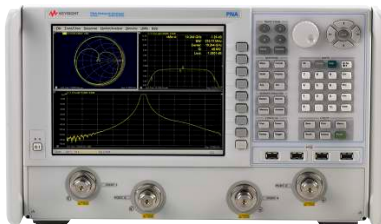
N522xA PNA Series microwave network analyzer

– 10 MHz to 13.5/26.5/43.5/50/67 GHz, 2- or 4-ports
– Two internal sources (4-port only) and pulse generators/modulators
– Highest RF performance and accuracy
– Amplifier and converter applications for simple setup, faster measurements and improved accuracy

RF standard with flexibility
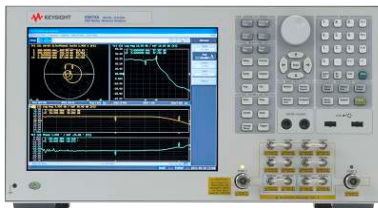
E5072A ENA Series network analyzer

– 30 kHz to 4.5/8.5 GHz, 2-ports
– Configurable test set and source attenuators
– Compatible with 8753ES and E5071C
– Setup Wizard (VBA) for gain compression, K-factor, harmonics and IMD measurements

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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 are sometimes used in balanced circuits and therefore 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. Wide measurement-frequency range is required to characterize multi-band operation.
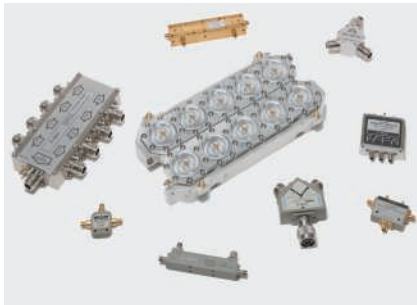
Our solutions

Keysight VNAs have a broad frequency range; from 5 Hz to 1.1 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. Multiple traces can be displayed in different formats, and various marker searches including filter parameters and trace-math functions are available for easy analysis.

Accurate measurements of low insertion loss and low ripple require a VNA with low trace noise and high stability.

High rejection requires large dynamic range
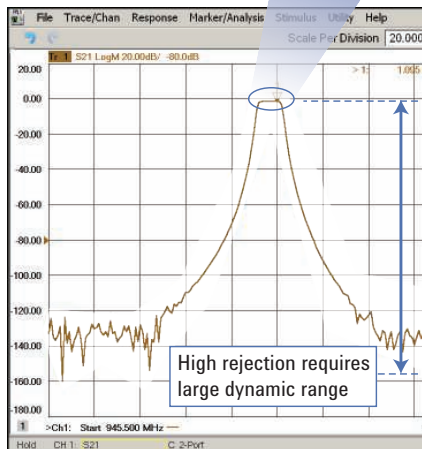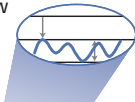
Key features

— Wide dynamic range: fast and accurate filter measurements

— Wide frequency range: covers in- and out-of-band characteristics

— Direct receiver access: obtain widest possible dynamic range

— Low-cost solution: just enough performance and function for your test

— Low trace noise and high stability: high quality device measurements

— Unknown-thru calibration: easy and accurate non-insertable device measurements

— Adapter removal/characterization: accurate mixed-connector device measurements

— Balanced S-parameter measurements: accurate measurements without balun

— Multiport/Multi-site solutions: easy multiport or multiple DUT evaluation

— Full N-port calibration: mismatch-corrected accurate multiport measurements

— Metrology option: highest accuracy and stability for metrology-grade component evaluation

— Time domain analysis/gating function: troubleshooting and simple simulation

— Trace analysis functions using marker and trace math

Passive component evaluation and test

Models	MIN/MAX frequency in the series	Wide dynamic range (dB)	Extended dynamic range by direct receiver access	Affordable cost	Trace noise at 1 kHz IFBW (dB rms)[1]	Unknown thru calibration	Adapter removal/ characterize function	Balanced S-parameters	Multiport solutions	Max # of full-port cal	Metrology option
PNA-X	10 MHz/67 GHz	> 130	●		0.002	●	●	●	●	> 4	
PNA	10 MHz/67 GHz	> 130	●		0.002	●	●	●	●	> 4	●
PNA-L	300 kHz/50 GHz	> 130	●	●	0.004	●	●	●	●	> 4	
E5072A	30 kHz/8.5 GHz	> 120	●		0.0005	●	●			2	
E5071C	9 kHz/20 GHz	> 120		●	0.0004	●	●	●	●	4	
E5061B LF	5 Hz/3 GHz	> 120			0.003		●			2	
E5061B RF	100 kHz/3 GHz	> 120		●	0.003		●			2	
E5063A	100 kHz/18 GHz	> 110		●	0.0006	●	●			2	
PXI VNA	300 kHz / 26.5 GHz	>95		●	0.003	●	●	●	●	Up to 32	
FieldFox	30 kHz/26.5 GHz	> 90		●	0.004	●				2	

1. Calculated based on the specification at different IFBW settings

Typical solutions
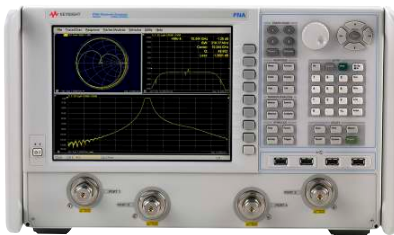
Best accuracy up to microwave frequencies

N522xA PNA Series network analyzer

– 10 MHz to 13.5/26.5/43.5/50/67 GHz, 2- or 4-ports
– Wide dynamic range (> 128 dB at 26.5 GHz, > 112 dB at 67 GHz)
– World's highest accuracy. Metrology option for ultimate S-parameter measurements.
– Full N-port calibration support
– Up to 1.1 THz by using millimeter-wave frequency extenders
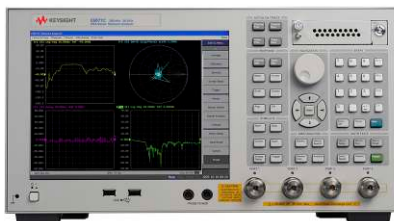
Solid performance for RF frequencies

E5071C ENA Series network analyzer

– 9/100 kHz to 4.5/6.5/8.5 GHz, 300 kHz to 14/20 GHz, 2- or 4-ports
– Wide dynamic range (> 123 dB at 10 MHz to 6 GHz)
– Up to 22-ports using the E5092A
– 0.003 dB rms with 70 kHz IFBW, best-in-class, small trace noise for accurate low-loss device measurements

Best balance between price and performance

E5063A ENA Series network analyzer

– 100 kHz to 4.5/8.5/18 GHz
– > 117 dB dynamic range
– 0.005 dB rms trace noise with 70 kHz IFBW
– PCB test function

Easy to reconfigure based on test needs

M937xA PXI VNA Series

– 300 kHz to 4/ 6.5/ 9/ 14/ 20/ 26.5 GHz
– Best PXI VNA performance on key specifications such as dynamic range, measurement speed, and trace noise
– Up to 16 full 2-port VNA modules in a single chassis
– Full N-port calibration support

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General Purpose, Education
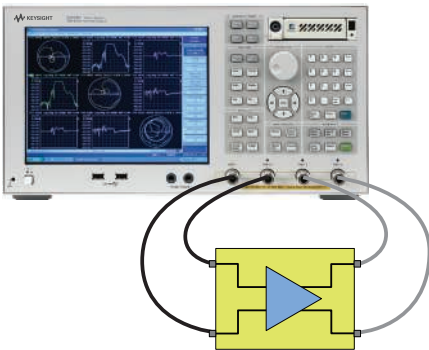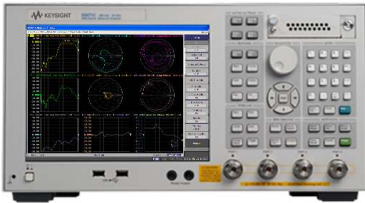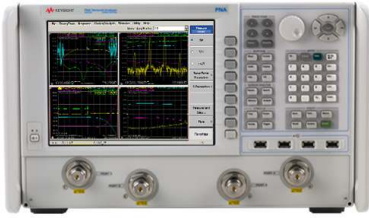
Measurement challenges

General-purpose RF 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.

Our solutions

Keysight has a wide range of general-purpose VNAs, from powerful yet economical bench-top models covering the frequency range of a few GHz up to 100's of GHz, to handheld models that are easily shared and give results on par with their benchtop equivalent.

– ENA and PNA-L benchtop models offer excellent speed and accuracy at affordable prices

– PNA offers the highest S-parameter accuracy and can be used with millimeter-wave extenders up to 1.1 THz

– PXI VNA offers best PXI performance using only a single slot in modular test solutions

– Guided calibration wizards and ECal modules make calibration easy

– FieldFox's portability makes it easy to share among different groups

Key features

– 4-port models make it easy to test couplers, circulators, splitters, and other 3- and 4-port devices, as well as balanced/differential components

– ECal modules replace mechanical calibration kits making calibration fast and easy to perform, and much less prone to operator errors

– Power-meter-based calibration yields accurate measurements of DUT input and output power over a very broad range of powers

– Built-in support for port extensions, port matching, deembedding, and impedance transformations extends coaxial accuracy to on-wafer and in-fixture measurements

– Offsetting the frequency of the source and receivers allows measurements of mixers and frequency converters

– External millimeter-wave modules extend the frequency of operation up to 1.1 THz

– Materials measurement software offers full characterization of dielectric properties using a variety of measurement methods

General purpose, education

Models	Features							
	2-port models	4-port models	ECal support	Power meter cal	Frequency offset mode	Probe, fixture features	Support for mm-wave modules	Spectrum analysis and independent source
PNA-X	●	●	●	●	●	●	●	
PNA	●	●	●	●	●	●	●	
PNA-L	●	●[1]	●	●	●	●		
E5072A	●		●	●	●	●		
E5071C	●	●	●	●	●	●		
E5061B LF	●		●					
E5061B RF	●		●					
E5063A	●		●					
PXI VNA	●	●[2]	●			●		
FieldFox	●		●					●

1. 13.5 and 20 GHz models only
2. Add additional 2-port modules to achieve up to 32-ports in a single chassis

Typical solutions

Best value for microwave S-parameter measurements

N523xA PNA-L Series microwave network analyzer

– 300 kHz to 8.5/13.5/20 GHz, 10 MHz to 43.5/50 GHz, 2-ports
– 300 kHz to 13.5/20 GHz 4-ports
– Basic S-parameters and materials measurements
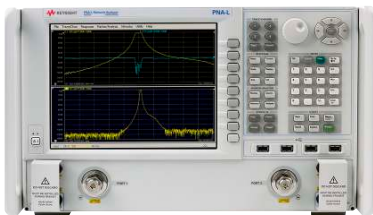
Unsurpassed accuracy in S-parameter measurements

N522xA PNA Series microwave network analyzer

– 10 MHz to 13.5/26.5/43.5/50/67 GHz, 2- or 4-ports
– Wide dynamic range (> 128 dB at 26.5 GHz, > 112 dB at 67 GHz)
– Linear and non-linear measurement options
– Up to 1.1 THz using millimeter-wave frequency extenders
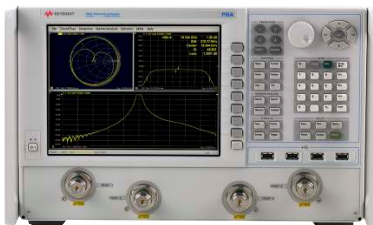
Industry standard for RF measurements

E5071C ENA Series network analyzer

– 9 kHz to 4.5/6.5/8.5 GHz, 300 kHz to 14/20 GHz, 2- or 4-ports
– Wide dynamic range (> 123 dB at 10 MHz to 6 GHz)
– RF and microwave balanced devices
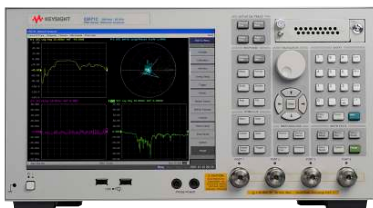
Easy to reconfigure based on test needs

M937xA PXI VNA Series

– 300 kHz to 4/ 6.5/ 9/ 14/ 20/ 26.5 GHz
– Best PXI VNA performance on key specifications such as dynamic range, measurement speed, and trace noise
– RF and microwave balanced devices
– Full N-port calibration support

Easily shared tool for quick evaluations

N991xA FieldFox handheld combination analyzer

– 30 kHz to 4/6.5/9/14/18/26.5 GHz
– T/R (S11/S21) or full 2-port S-parameters
– Spectrum analyzer function
– Independent source and tracking generator

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www.keysight.com/find/pxivna
www.keysight.com/find/fieldfox

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. The measurement time of a VNA can be divided 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.
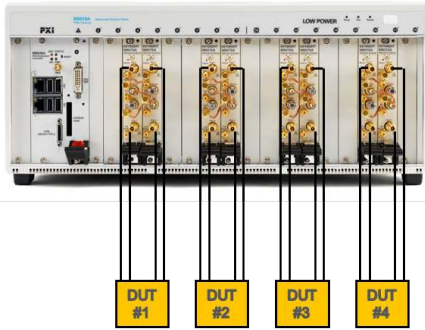
Our solutions

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 are equipped with a parts-handler interface to achieve fast throughput on an automated production line. You can find the optimum VNA for your manufacturing environment, and only pay 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 deembedding: 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/Multi-site solutions: multiple and multiport device test with minimal connections

- Direct-receiver access: obtain widest possible dynamic range

- Upgradable processors: keep your instrument up-to-date

- Hardware upgrade paths: support your evolving measurement needs

Manufacturing

Models	Fast data process & transfer	Segment sweeps	Pass/ fail limit testing	Test fixture deembedding	Built-in programming capability	ECal support	Parts handler interface	Multiport/ Multi-site solutions	Direct receiver access	Hardware upgrade	Processor upgrade
PNA-X	•	•	•	•		•	•	•	•	•	•
PNA	•	•	•	•		•	•	•	•	•	•
PNA-L	•	•	•	•		•	•	•	•	•	•
E5072A	•	•	•	•	•	•	•		•	•	
E5071C	•	•	•	•	•	•	•	•		•	•
E5061B LF	•	•	•		•	•	•				
E5061B RF	•	•	•		•	•	•			•	
E5063A	•	•	•	•		•	•			•	
PXI VNA	•	•	•	•	•[1]	•		•		•	•[2]
FieldFox			•			•					

Typical solutions

The standard in RF/microwave manufacturing test

E5071C ENA Series network analyzer

– 9/100 kHz to 4.5/6.5/8.5 GHz, 300 kHz to 14/20 GHz, 2- or 4-ports
– Fast measurement speed
– 130 dB[3] dynamic range
– 0.003 dB rms with 70 kHz IFBW, best-in-class, small trace noise for accurate low-loss device measurements
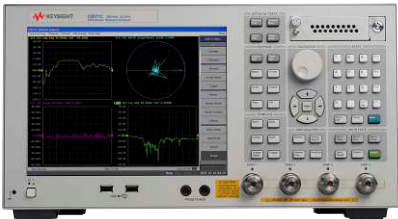
Best balance between price and performance

E5063A ENA Series network analyzer

– 100 kHz to 4.5/8.5/18 GHz
– > 117 dB dynamic range
– 0.006 dB rms trace noise
– PCB test function

Best value for microwave manufacturing

N523xA PNA-L Series microwave network analyzer

– 300 kHz to 8.5/13.5/20 GHz, 10 MHz to 43.5/50 Hz, 2-ports
– 300 kHz to 13.5/20 GHz, 4-ports
– Wide frequency range up to 50 GHz
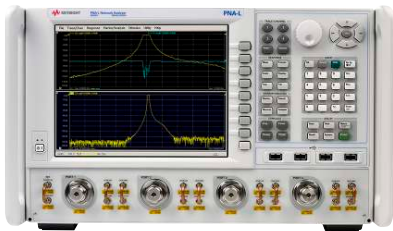
Easy to reconfigure based on test needs

M937xA PXI VNA Series

– 300 kHz to 4/ 6.5/ 9/ 14/ 20/ 26.5 GHz
– Best PXI VNA performance on key specifications such as dynamic range, measurement speed, and trace noise
– Up to 16 full 2-port VNA modules in a single chassis
– Full N-port calibration support

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www.keysight.com/find/pxivna

1. Programming capability is available in the embedded or external controller used to control the PXI VNA module.
2. The central processor for this instrument is the embedded or external controller, which is upgradable.
3. Supplemental performance data

High–Speed Serial 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 can no longer be ignored. 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.

Our solutions

N1930B Physical Layer Test System (PLTS)

– Automatic Fixture Removal (AFR) for accurate, yet simple error correction and deembedding 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 aspects of testing to be customized and automated which typically cuts test-plan development in half
– Characterization report details all critical DUT performance parameters along with specific test-system information to archive important technical test-plan data

E5071C ENA Option TDR

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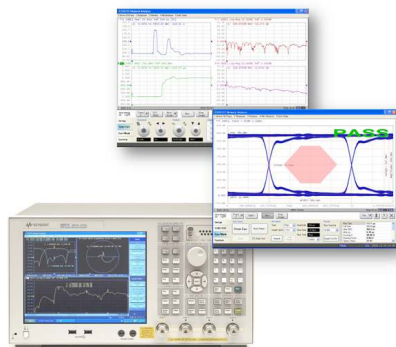– Easily locate source of loss, reflections and crosstalk by simultaneous analysis of both time and frequency domains
– Internal protection circuits inside the instrument provide high robustness against electrostatic discharge (ESD)
– Determine optimal emphasis and equalization settings for your link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

High-speed serial interconnect analysis

Models	Features									
	Maximum bandwidth	Maximum # of ports	Frequency domain	Time domain	Eye diagram	Stressed eye diagram analysis	Hot TDR	Compliance test (MOI) [1]	Real-time analysisz	Advanced error correction methods [2]
PLTS	Up to 67 GHz	Up to 16	●	●	●	●	●			●
ENA Option TDR	Up to 20 GHz	Up to 4	●	●	●	●	●	●	●	

1. PLTS has automated test suite templates that assist R&D engineers with compliance-type testing
2. Advanced features: automatic fixture removal (AFR), differential TRL, multiport crosstalk

www.keysight.com/find/plts
www.keysight.com/find/ena–tdr

Installation and Maintenance

Measurement challenges

Network analyzer measurements made in the field are fundamentally similar to 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 fairly stable, the weather conditions outdoors are quite variable, so the equipment has to be designed to handle these changes. Any VNA used outdoors also has to be rugged, as it is moved around often. Finally, the measurements made in the field need to match the measurements made in the lab, and have similar accuracy.

Our solutions

FieldFox analyzer family

- Designed with field applications in mind, battery operated, portable, display viewable in sunlight
- Sealed enclosure compliant with MIL-PRF-28800F Class 2 and IP53 requirements
- Large buttons are easy to operate even while wearing gloves
- Network analyzer—measure all four S-parameters, and perform calibrations such as SOLT and TRL; unique QuickCal for field calibration
- Optional spectrum analyzer and GPS receiver for interference analysis

M937xA PXI VNA Series

- Best PXI VNA performance on key specifications such as dynamic range, measurement speed, and trace noise
- Full two-port VNA that fits in just one slot
- Full N-port calibration support

E5061B RF ENA Series network analyzer

- Benchtop light weight model up to 3 GHz
- Suitable for measurements that require higher analog performance such as wide dynamic range or fast sweep speed

Installation and maintenance

Models	Features								
	Portability	Battery life	S-parameters	Frequency range	Dynamic range at 3 GHz	SOLT calibration	Time domain	Spectrum analyzer	SCPI programmable
FieldFox	6.6 lbs/ 3 kg	3.5 hours	●	30 kHz to 4/6.5/9/14/18/ 26.5 GHz	95 dB	●	●	●	●
PXI VNA	1.3 lbs / 0.59 kg	N/A	●	300 kHz to 4/6.5/9/ 14/20/26.5 GHz	115	●	●		●
E5061B RF	30 lbs/ 14 kg	N/A	●	100 kHz to 1.5/3 GHz	120 dB	●	●		●

www.keysight.com/find/fieldfox
www.keysight.com/find/ena
www.keysight.com/find/pxivna

Related network analyzer products and accessories

Electronic calibration (ECal) modules

| PNA | ENA | PXI VNA |

Keysight ECal modules provide a precision, single-connection calibration technique for Keysight vector network analyzers. ECal modules are fully traceable and verifiable electronic impedance standards and can simplify your daily calibration routine. RF ECal modules are available for Type N-50, N-75, 7 mm, 3.5 mm, Type F, and 7-16 (300 kHz to 13.5 GHz) connectors. Modules are available in microwave frequency ranges from 300 kHz to 67 GHz for 7 mm, Type N-50, 3.5 mm, 2.92 mm, 2.4 mm and 1.85 mm. 4-port modules are available in 13.5 and 20 GHz frequency ranges.

www.keysight.com/find/ecal

Microwave test accessories

| PNA | ENA | PXI VNA | FieldFox |

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/mta
www.keysight.com/find/mtacatalog

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

Multiport/multi–site solutions

| PNA | ENA | PXI VNA |

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

PXI VNA up to 32-ports, multiport test set

E5071C ENA with E5092A configurable multiport test set

Broadband and millimeter wave

| PNA |

The N5251A millimeter-wave system is a single-sweep solution from 10 MHz to 110 GHz with built-in Kelvin bias tees and 2- and 4-port S-parameter measurements. This is a direct replacement for the 8510XF and N5250C with improved performance. In particular, a new receiver-leveling function lets you set the source power accurately at the 1.0 mm test port. Keysight also offers a variety of banded millimeter-wave solutions that enable the PNA and PNA-X network analyzers to make S-parameter measurements up 1.1 THz.

www.keysight.com/find/N5251A
www.keysight.com/find/mmwave

N5251A 110 GHz single sweep solution

Materials measurement   PNA   ENA   FieldFox

Trust Keysight to deliver leading-edge techniques for measuring dielectric and magnetic properties of materials. The 85070E dielectric probe kit offers hardware and software for measuring complex permittivity of liquids and conformable solids from 200 MHz to 50 GHz. The 85071E materials measurement software 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
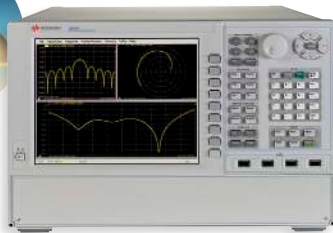
Antenna receiver   PNA

Keysight Technologies provides many of the components you need to make accurate antenna and radar cross-section (RCS) measurements. The N5264A PNA-X measurement receiver is a dedicated antenna receiver with 400,000 point-per-second data acquisition on all five measurement channels. The N5264A provides twice as many receivers compared to any other antenna receiver on the market. The N5264A 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. The N5264A is supported by major antenna-system integrators such as Microwave Vision Group, Nearfield Systems Inc., ETS-Lindgren, and the System Planning Corporation.

www.keysight.com/find/antenna

N5264A PNA-X measurement receiver

CalPod calibration–refresh modules   PNA

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

85541A 40 GHz temperature characterized CalPod

Key Performances and Functions Comparison

Models		Performances							Dimension
		Frequency	Dynamic range at 3 G/20 G at 10 Hz IFBW			Max power at 3 G/20 G (dBm)	Best trace noise at 10 kHz[1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201 point 1sweep, correction off	H (mm) x W (mm) x D (mm), weight (kg)
			System (dB)	Directreceiver access (dB)	Noise floor (dBm/Hz)				
PNA-X	N5249A	10 MHz to 8.5 GHz	124–128/ 124–129	136–140/ 133–141	−114/−114	+8–13/+5–10	0.0063/0.047	5 ms (600 kHz IFBW)	267 x 426 x 533, 27–37 kg
	N5241A N5242A	10 MHz to 13.5 GHz 10 MHz to 26.5 GHz	124–128/ 124–129	136–140/ 133–141	−114/−114	+8–13/ +5–10	0.0063/0.047	5 ms (600 kHz IFBW)	267 x 426 x 533, 27–37 kg
	N5244A N5245A	10 MHz to 43.5 GHz 10 MHz to 50 GHz	118–123/ 121–125	130–135/ 133–137	−110/−111	+8–13/ +10–14	0.0063/0.094	6 ms (600 kHz IFBW)	267 x 426 x 583, 47–49 kg
	N5247A	10 MHz to 67 GHz	124–130/ 125–130	136–142/ 136–140	−115/−118	+9–15/ +7–12	0.0063/0.063	9.7 ms (600 kHz IFBW)	267 x 426 x 583, 47–49 kg
PNA	N5221A N5222A	10 MHz to 13.5 GHz 10 MHz to 26.5 GHz	127/ 124–127	139/ 136–139	−114/−114	+13/ +10–13	0.0063/0.047	5.6 ms (600 kHz IFBW)	267 x 426 x 533, 27–37 kg
	N5224A N5225A	10 MHz to 43.5 GHz 10 MHz to 50 GHz	125–127/ 124–127	137–139/ 136–139	−114/−114	+11–13/ +10–13	0.0095/0.063	4.7 ms (600 kHz IFBW)	267 x 426 x 582, 40–42 kg
	N5227A	10 MHz to 67 GHz	127/ 124–127	138/ 135–138	−114/−116	+9–13/ +8–11	0.0063/0.063	6.3 ms (600 kHz IFBW)	267 x 426 x 583, 43–45 kg
PNA-L	N5239A N5231A N5232A	300 kHz to 8.5 GHz 300 kHz to 13.5 GHz (N5231A Option 2xx) 300 kHz to 20 GHz (N5232A Option 2xx)	131–133/ 111–114	144/124	−120/−106	+11–13/ +5–8	0.012/0.19	5.75 ms (600 kHz IFBW)	267 x 426 x 446, 24 kg
	N5231A N5232A	300 kHz to 13.5 GHz (N5231A Option 4xx) 300 kHz to 20 GHz (N5232A Option 4xx)	128/ 101–105	141/114	−120/−107	+8/ -6 – −2	0.0063/0.063	5.75 ms (600 kHz IFBW)	267 x 426 x 446, 24 kg
	N5234A N5235A	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
ENA	E5072A	30 kHz to 4.5 GHz (Option 245) 30 kHz to 8.5 GHz (Option 285)	123/−	151/−	−107/−	+16/−	0.0015/0.013	3 ms (500 kHz IFBW)	222 x 426 x 496, 20 kg
	E5071C	9 kHz to 4.5 GHz (Option 240, 440)	123/−	− / −	−123/−	+10/−	0.0011/0.013	3 ms (500 kHz IFBW)	222 x 426 x 487, 19–20 kg
		100 kHz to 4.5 GHz (Option 245, 445)							
		9 kHz to 6.5 GHz (Option 260, 460)							
		100 kHz to 6.5 GHz (Option 265, 465)							
		9 kHz to 8.5 GHz (Option 280, 480)							
		100 kHz to 8.5 GHz (Option 285, 485)							
		300 kHz to 14 GHz (Option 2D5, 4D5) 300 kHz to 20 GHz (Option 2K5, 4K5)	123/96	− / −	−123/−106	+10/0	0.0015/0.013	3 ms (500 kHz IFBW)	222 x 426 x 486, 20–22 kg
	E5061B	5 Hz to 3 GHz (LF-RF Option 3L5, S-parameter, port) 100 kHz to 3 GHz (RF Option 135, 235, 137, 237) 100 kHz to 1.5 GHz (RF Option 115, 215, 117, 217)	120/−	− / −	−110/−	+10/−	0.0091/0.055	9 ms (300 kHz IFBW)	215 x 426 x 296, 14 kg
	E5063A	100 kHz to 4.5 GHz (Option 245) 100 kHz to 8.5 GHz (Option 285) 100 kHz to 18 GHz (Option 2H5)	93/−	− / −	−127 /−	0 dBm/−	0.0019/0.014	9 ms (300 kHz IFBW)	215 x 426 x 296, 11 kg

Key Performances and Functions Comparison (continued)

Models		Performances							Dimension
		Frequency	Dynamic range at 3 G/20 G at 10 Hz IFBW			Max power at 3 G/20 G (dBm)	Best trace noise at 10 kHz[1] IFBW Mag (dBrms)/ Phase (degrms)	Best speed at 201 point 1sweep, correction off	H (mm) x W (mm) x D (mm), weight (kg)
			System (dB)	Directreceiver access (dB)	Noise floor (dBm/Hz)				
PXI VNA	M9370A	300 kHz to 4 GHz	115/—	— / —	−108/—	+7/—	0.003/0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg
	M9371A	300 kHz to 6.5 GHz	115/—	— / —	−108/—	+7/—	0.003/0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg
	M9372A	300 kHz to 9 GHz	115/—	— / —	−108/—	+7/—	0.003/0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg
	M9373A	300 kHz to 14 GHz	115/—	— / —	−108/—	+7/—	0.003/0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg
	M9374A	300 kHz to 20 GHz	115/ 110	— / —	−108/−108	+7/+2	0.003/0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg
	M9375A	300 kHz to 26.5 GHz	115/ 110	— / —	−108/−108	+7/+2	0.003/0.030	6 ms (600 kHz IFBW)	128.4 x 19.9 x 212.6, 0.59 kg
FieldFox	N9913A N9914A N9915A N9916A N9917A N9918A	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	95/74 (100 Hz IFBW)	— / —	— / —	−1/−10	0.011/0.08	170 ms (100 kHz IFBW)	292 x 188 x 72, 3 kg

1. Calculated to normalize 10 kHz IFBW equivalent noise

Models		Sweep type	4-port test set option	Full N port cal option	Front jumpers for direct receiver access or high power handling	Built-in 2nd source option	Receiver attenuators option	Built-in bias tees	Frequency offset mode	Internal pulse modulator and generator	Built-in programing environment	Noise figure measurement option	Unique function/ feature
PNA-X	N5249A N5241A N5242A N5244A N5245A N5247A	Linear, Log, Segment, CW, Power, DC source, Phase	●	●	●	●	●	● (Option)	●	●		● (Standard and low-noise receiver)	Nonlinear vector network analyzer option Buillt-in combiner Up to 24 port external test set mm-wave support
PNA	N5221A N5222A N5224A N5225A N5227A		●	●	● (Option)	●	●	● (Option)	●	●		● (Standard receiver)	Metrology option Up to 24 port external test set mm-wave support
PNA-L	N5234A N5235A	Linear, Log, Segment, CW, Power, DC source		●	● (Option)				●				Up to 24 port external test set
	N5239A N5231A N5232A		●[1]	●	● (Option)				●				
ENA	E5072A	Linear, Log, Segment, CW, Power			●			●	●		●		Deep extended dynamic range as 151 dB (SPD)
	E5071C		●					● (Option)	●		●		TDR option Up to 22 port external test set
	E5061B LF-RF option	Linear, Log, Segment, CW, Power, DC bias									●		Gain-phase port (5 Hz to 30 MHz) Impedance analysis (Option 005) Built-in DC bias source
	E5061B RF option	Linear, Log, Segment, CW, Power									●		75 Ω test set option T/R test set option
	E5063A	Linear, Log, Segment, CW											PCB manufacturing test
PXI VNA	M9370A M9371A M9372A M9373A M9374A M9375A	Linear, Log, Segment, CW, Power	●[2]	●							●[3]		Multiport up to 32 ports, multi-site, modular
FieldFox	N9913A N9914A N9915A N9916A N9917A N9918A Microwave combination analyzers	Linear											Handheld Spectrum analysis option T/R test set (Option 210) S-parameter test set (Option 211)

1. N5231A and N5232A only.
2. Add additional modules to increase number of ports.
3. Programming capability is available in the PXIe embedded or external controller.

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, and FieldFox are perfect replacements to their predecessors. Take advantage of the latest VNAs' advanced performance and modern functions when replacing the legacy HP/Keysight network analyzers.

PNA				ENA				PXI VNA	FieldFox
Reach for unrivaled excellence				Drive down the cost of test				Drive down the size of test	Carry precision with you
PNA mmWave	PNA-X	PNA	PNA-L	E5072A/E5071C	E5063A	E5061B LF	E5061B RF	M937xA	N991x/2xA

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	8753A/B/C/D/E/ET/ES E5070A/B, 71A/B	3577A/B 8751A 4192A/94A 4195A/4395A	8711A/B/C 8713B/C 8712B/C/ES/ET 8714B/C/ES/ET 8752A/B/C E5061A/62A

8753A/B/C/D/E/ET/ES 8719A/B/C/D/E/ET/ES 872xA/B/C/D/E/ET/ES E5061A/62A E5070A/B, 71A/B

Migration path

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 an 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
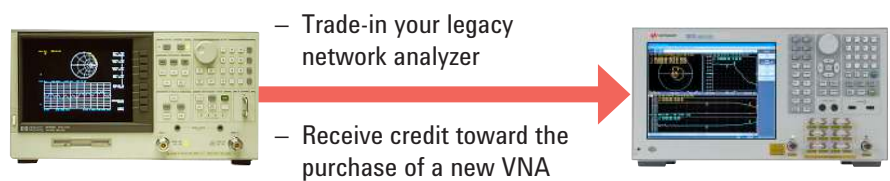
Protect your VNA investment

Keysight offers various VNA hardware and software upgrades to meet your future measurement needs. Keysight's cXL code-translation software can also help you run your legacy 8753, 8720, and 8510 remote programs while controlling the latest VNAs. Contact Keysight or visit www.keysight.com/find/nadisco for more information.

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
PNA Family Microwave Network Analyzers – Configuration Guide	5990-7745EN
E5072A ENA Series Network Analyzer – Technical Overview	5990-8004EN
E5071C ENA Series Network Analyzer – Brochure	5989-5478EN
E5061B ENA Series Network Analyzer – Brochure	5990-6794EN
E5071C ENA Option TDR Enhanced Time Domain Analysis – Technical Overview	5990-5237EN
E5061B-3L5 LF-RF Network Analyzer with Option 005 Impedance Analysis Function – Data Sheet	5990-7033EN
E5063A ENA Series Network Analyzer – Brochure	5991-3614EN
M937xA PXIe VNA – Data Sheet	M9370-90002
M937xA PXIe VNA – Startup Guide	M9370-90001
PXI VNA – Configuration Guide	5991-4885EN
M937xA PXIe VNA – Brochure	5992-0098EN
M937XA PXIe VNA – Flyer	5991-4883EN
FieldFox Combination Analyzers – Technical Overview	5990-9780EN
FieldFox Handheld Analyzers – Data Sheet	5990-9783EN
FieldFox Handheld Analyzers – Configuration Guide	5990-9836EN
Physical Layer Test System (PLTS) – Technical Overview	5989-6841EN
Millimeter-Wave Network Analyzers – Technical Overview	5989-7620EN
Measuring Dielectric Properties Using Keysight's Materials Measurement Solutions – Brochure	5991-2171EN
Keysight 855xxA Series Calibration Refresh Modules – Product Fact Sheet	5991-2450EN

Web Resources

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
FieldFox Handheld RF and Microwave Analyzers	www.keysight.com/find/fieldfox
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Mechanical and Electronic Calibration Kits	www.keysight.com/find/ecal
PNA-X Nonlinear Vector Network Analyzer	www.keysight.com/find/nvna

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