KEYSIGHT



Vector Network Analyzers

From basic network analysis to complex characterization

BUYING GUIDE

Keysight Benchtop Vector Network Analyzers

One family. Three performance grades. 4 classes.



ESSENTIAL

XN3-class

- 1 Maximum number of sources
- 3 GHz to 18 GHz Maximum frequency



EXPERT

XN5, XN7-class

- 2 Maximum number of sources
- 26.5 GHz to 67 GHz Maximum frequency



PRO

XN8-class

- 3 to 4 Maximum number of sources
- 26.5 GHz to 67 GHz Maximum frequency

Introduction

Choosing the right vector network analyzer (VNA) means matching performance to your application. Keysight offers three performance grades of vector network analyzers — Essential, Expert, and Pro. This buying guide compares these grades and their specifications. Whether you're managing routine tests or complex high-frequency measurements, use this guide to find the VNA that fits your technical requirements.

Essential

The XN3-class Essential vector network analyzers include the E5063A and E5061B ENA. Measure S-parameters and characterize passive devices with our Essential vector network analyzer at frequencies up to 18 GHz.

Expert

Expert vector network analyzers come in two classes. The XN5-class includes the ENA-X, PNA-L, and E5080B ENA. The XN7-class includes the PNA and N5264B PNA-X. For labs that need sophisticated features for testing active devices, our metrology-grade Expert vector network analyzer offers vector signal analysis for nonlinear devices with modulated signals, up to two internal sources, and expanded frequency support up to 67 GHz.

Pro

The XN8-class Pro vector network analyzers include the N5241B-N5249B PNA-X and PNA-X Pro. Pro VNAs combine mixers, ultra-low noise floors, and up to four internal sources, along with elevated measurement software, to support the most complex active device R&D applications at frequencies up to 67 GHz.



Step 1. Check the General Specifications

All Keysight vector network analyzers empower engineers with a comprehensive set of measurement capabilities for the design, validation, and optimization stages of product development. Our entire portfolio of VNAs deliver accuracy, exceptional dynamic range, and high measurement speed, providing true insight into the performance of your device under test. Combine this with powerful calibration, de-embedding, and enhanced analysis software, and your lab will be fully equipped to characterize components, troubleshoot designs, validate signal integrity, and ensure compliance with the latest RF and microwave standards. The first part of your VNA selection process will be based on the number of sources, maximum output frequency, and dynamic range.

The table below summarizes the key specifications by product grade — Essential, Advanced, and Pro — to help you select the VNA that is right for your application.

VNA comparison of specifications

Specifications	Essential	Expert	Pro
Class	XN3	XN5, XN7	XN8
Maximum number of sources	1	2	3 to 4
Maximum frequency	3 GHz to 18 GHz	26.5 GHz to 67 GHz	26.5 GHz to 67 GHz
Integrated low-noise receiver	0	0 to 2	1 to 2
Number of built-in ports	2	2, 4	2, 4

EXPLORE ESSENTIAL

EXPLORE EXPERT

EXPLORE PRO

Step 2.
Look at Key Features

Essential

Core Features

- 1 source
- time-domain and impedance analysis

Key Capabilities

Keysight Essential vector network analyzers support passive device measurements, cable and filter testing, and S-parameter analysis for frequencies up to 18 GHz.

Expert

Core Features

- 2 internal sources
- Up to 2 integrated low-noise receivers
- spectrum, error vector magnitude (EVM), and adjacent channel power ratio (ACPR) measurements

Key Capabilities

Measure active devices with metrology-grade performance and direct digital synthesis (DDS) sources for faster phase and group delay measurements at frequencies up to 67 GHz (up to 120 GHz with extenders).



Pro

Core Features

- 3 to 4 internal sources
- configurable architecture with direct receiver access
- wideband active load pull, intermodulation distortion (IMD), and power compression measurements

Key Capabilities

Characterize next-generation designs using the most sophisticated measurement techniques, ideal for complex active device testing. Our Pro models offer the widest range of measurement software and a configurable architecture for precision analysis.

Step 3. Consider Your Use Cases

While specifications and features tell you what a VNA can do — use cases show you how and where it delivers value. Explore the use cases below to see how each performance grade best fits your lab and specific test challenges.

Essential: Fundamental S-parameters and passive device testing

Keysight Essential vector network analyzers leverage Pro model technology, optimized for passive component testing. Get fast insights with automated tests and optional software for impedance and pulsed RF measurements. Our Essential vector network analyzer supports frequencies down to 5 Hz for testing devices like DC-to-DC converters and EMI filters, and frequency options up to 18 GHz.

Designed for essential S-parameter and time-domain tests, our Essential VNA offers a solid foundation for fundamental RF measurements, cable characterization, and passive validation.

Common use cases for Essential VNAs include:

- How to Perform Impedance Analysis
- 10 Hints for Better Network Analyzer Measurements
- Understanding the Fundamental Principles of Vector Network Analysis



Expert: Active devices and modulation analysis

Keysight Expert vector network analyzers expand on Essential model capabilities with active device testing and available metrology-grade performance. With over 120 software options, our Expert vector network analyzers enable fast, accurate characterization of nonlinear devices like RF amplifiers, mixers, and modulators. You can select direct digital synthesis (DDS) sources which deliver up to 10 times faster phase and group delay measurements compared to Essential vector network analyzers.

With a wider frequency range, enhanced dynamic range, and software-enabled features, Expert VNAs are suited for active device characterization and protocol-layer insights.

Common use cases for Expert VNAs include:

- How to Characterize Low-Loss Materials for 5G
- How to Verify TR Module Performance
- How to Verify Frequency Mixer Performance
- How to Test Power Amplifiers with Modulated Signals

Consider Your Use Cases (cont.)

Pro: Complex multiport and high-frequency designs

Keysight Pro vector network analyzers offer our highest benchtop VNA performance, ideal for next-generation designs and complex active device development. Our Pro models expand on our Expert capabilities, offering additional built-in measurements for complete active device test, plus a configurable architecture you can customize for your lab requirements, and up to four integrated sources.

Designed to support multisource testing, enhanced automation, and ultra-low noise for R&D teams working on next-generation RF systems and active circuits.

Common use cases for Pro VNAs include:

- How to Maximize Power Amplifier Efficiency and Linearity
- How to Test SATCOM Mixers
- How to Perform 5G Beamformer IC Test
- How to Measure Frequency Converter Phase Noise
- How to Test Phased Array Antennas



Step 4. Final Key Considerations

As you review basic and elevated features alongside your lab's typical use cases, it's helpful to reconsider how those use cases may drive the requirements for your instrument's features.

Maximum number of sources

Multiple sources enable intermodulation distortion (IMD), gain compression, and wideband tests for active devices.

Choose Essential for one source in passive component tests, Expert for two-source mid-tier setups, and Pro for three to four sources in high-performance, multiport measurements. If you need more than four ports, check out our modular VNAs later in this guide.

Frequency range

Frequency range determines the analyzer's spectrum band capabilities.

Choose Essential (up to 18 GHz) for passive component testing or narrowband RF applications, and Expert or Pro (up to 67 GHz) for broadband, mmWave, or S-parameter testing, including harmonics.

Integrated low-noise receiver

A low-noise receiver ensures accurate measurements of weak signals.

Choose Essential for non-critical tasks like connector or cable loss tests. Use Expert for antenna tuning or filter characterization requiring moderate precision, and Pro for multiport or MIMO testing requiring low-noise, simultaneous signal analysis.

Final Key Considerations (cont.)

Number of built-in ports

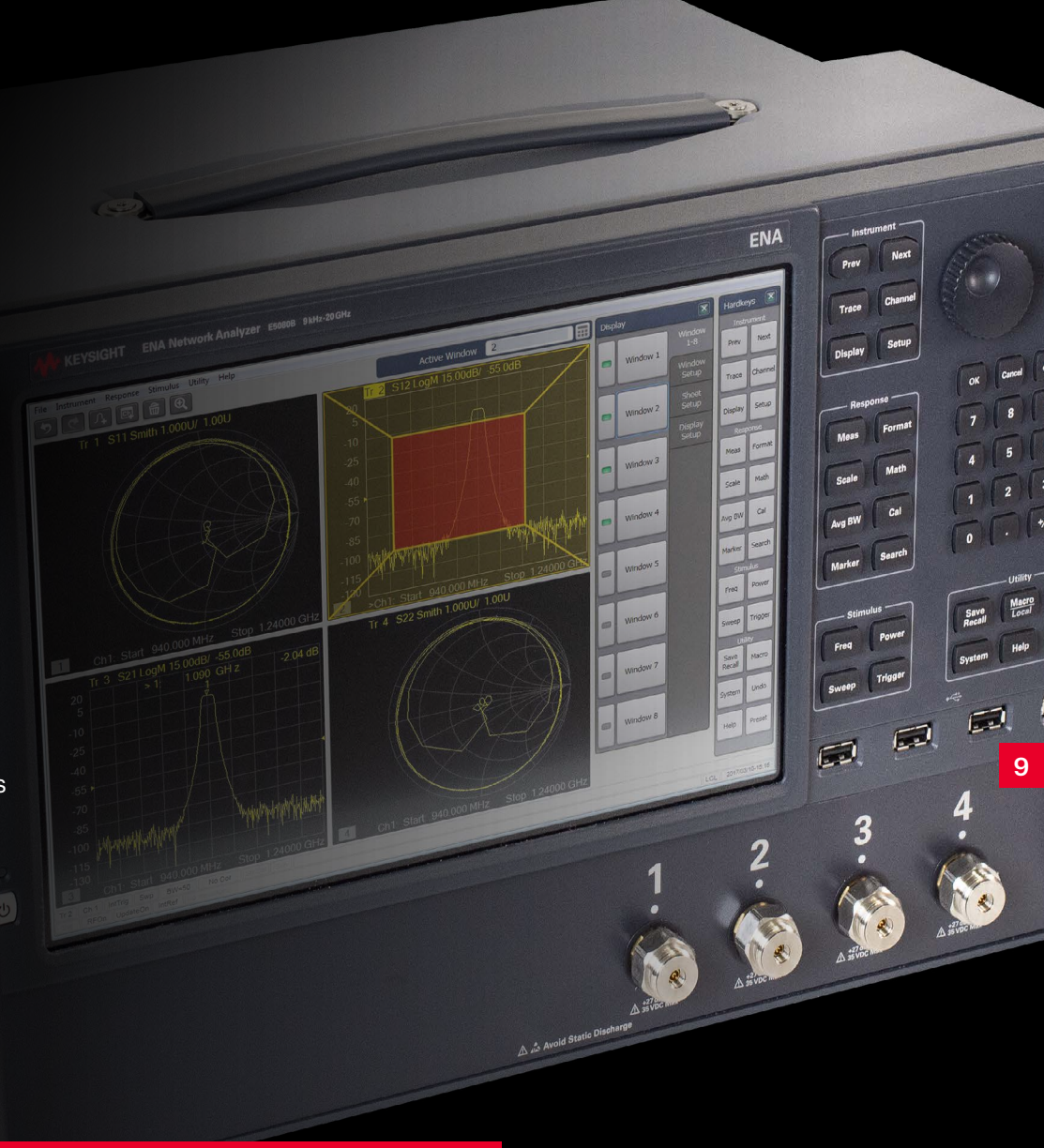
Port configuration impacts accuracy and efficiency, with additional port hardware required for advanced active device measurements.

Choose Essential for simple 2-port configuration S-parameter tests, Expert for flexible 2- to 4-port setups for moderate multiport testing, and Pro for 4-port MIMO, differential, or remote head testing with extended configurability for external equipment support.

How do I choose the right VNA for RF and microwave component testing?

Start with the measurements your components require. For passive devices, prioritize frequency coverage, dynamic range, and S-parameter accuracy. For active devices, confirm support for the tests you need, such as gain compression, intermodulation distortion, noise figure, or modulation analysis.

Match the port count to your device configuration and the number of sources to your test requirements. Check calibration, de-embedding, automation, and measurement speed, then allow room for future frequency and testing needs.



Common mistakes to avoid when selecting a VNA

- Selecting a frequency range that doesn't account for harmonics or future standards.
- Underestimating the importance of dynamic range in filter or amplifier testing.
- Choosing too few ports for multi-port validation or MIMO system requirements.
- Overlooking the need for integrated software to enable automation and modulation analysis.
- Prioritizing portability over performance in applications when accuracy is mission critical.

Modular Vector Network Analyzers

Keysight modular vector network analyzers provide you with Essential benchtop-grade performance in a compact, flexible form factor, helping you scale your multiport and multi-site testing needs. While the dynamic range of conventional switch-based systems limits measurement speed, modular VNAs enable wider intermediate frequency bandwidths to test faster. Our modular VNAs can be configured with up to 50 ports in a single chassis.

With models ranging from 9 kHz to 53 GHz, select the modular vector network analyzer that is right for your application.



Maximum number of sources	1 to 2
Maximum frequency	4.5 GHz to 53 GHz
Dynamic range	115 dB to 146 dB
Configurable test ports	0 to 2

EXPLORE

USB Vector Network Analyzers

Keysight XN4-class USB vector network analyzers include the Streamline Series VNAs. They provide high performance in a lightweight, portable form factor — ideal for labs with limited space. Unlike benchtop network analyzers, which are standalone instruments, USB VNAs connect to a host PC to handle data processing and analysis. Transfer your component characterization from your PC using the same user interface, measurement capabilities, and automation code as our benchtop and modular vector network analyzers.

With models ranging from two to six ports, select the USB vector network analyzer that is right for your application.



Number of built-in ports	2, 4, 6
Maximum output frequency	20 GHz to 53 GHz
Maximum output power	8 dBm to 10 dBm
Maximum number of sources	1

EXPLORE

Handheld Network Analyzers

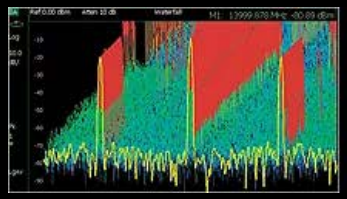
Keysight handheld analyzers combine spectrum analysis, vector network analysis, and power measurements in a rugged, portable unit. Designed for field engineers, they include features like over-the-air testing, USB power sensor compatibility, and pulse signal generation for field-ready performance.



VNA capabilities	Model-dependent
Maximum frequency	4 GHz to 54 GHz
Maximum analysis bandwidth	10 MHz to 120 MHz

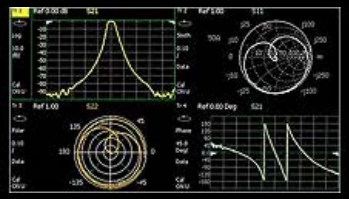
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You can upgrade your analyzer remotely with more than 25 license key-activated software options. Below are some examples. To explore the full range of software, visit our handheld analyzer software page.



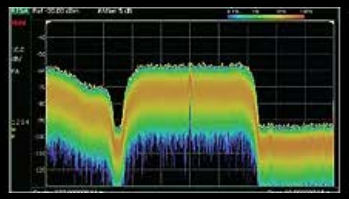
Spectrum Analysis

- real-time spectrum analyzer (RTSA)
- analog demodulation
- interference hunting
- IQ analyzer



Cable and Antenna Testing (CAT)

- vector network analyzer (VNA)
- 2-port S-parameters
- TDR cable measurements



5G / LTE Field Testing

- EMF measurements
- over-the-air (OTA) testing
- channel scanner
- wideband analysis



Power Measurements

- USB power sensor measurements
- built-in power meter
- pulse measurements
- peak power sensor



Utilities

- remote control
- GPS receiver
- indoor / outdoor mapping
- DC bias variable voltage source

VNA Software Functionality

When looking for the right VNA, it is often helpful to understand what types of measurements it can support and to what level. Keysight VNAs support a wide range of measurements. Below are some examples. To explore the full range of VNA software, visit our **instrument measurement software** page.

Measurement software for benchtop VNAs

Network analyzer software

- Real-time S-parameter measurements
- Time domain analysis
- Modulation distortion analysis
- Pulsed-RF measurements
- Active hot parameters
- Noise figure measurements with vector correction
- And more...

Vector signal analysis software

- Wireless connectivity
- Radar analysis
- LTE/LTE-A FDD modulation analysis
- Cellular communication analysis
- Custom modulation analysis
- Cross-correlated EVM analysis
- And more...



Why Choose Keysight?

Keysight vector network analyzers offer exceptional precision, speed, and reliability for accurate and efficient RF and microwave measurements. Here's why engineers choose Keysight:

High accuracy and precision

- Exceptional dynamic range for accurate measurement analysis.
- Integrated low-noise receivers enable accurate detection of weak signals.

Fast insights

- Wide bandwidth analysis enables fast, accurate insights into complex RF testing.
- Real-time analysis enables instant detection of transient signals in wireless testing.

Flexible connectivity

- Supports multiport setups and remote modules, cutting cabling complexity and boosting test efficiency.
- Seamless integration with automation test systems and networks.
- Supports remote access for control, testing, and data retrieval.

Active device characterization

- Enable complex tests beyond S-parameters, including nonlinear device characterization and power amplifier modeling.

Feature	Specification
Internal sources	Up to 4 internal sources
Integrated low-noise receivers	Up to 2 receivers
Frequency coverage	5 Hz to 110+ GHz with extender options
Dynamic range and phase noise	Up to 147 dB dynamic range with low phase noise
Port configurability	2 to 6 ports, with external module and remote head support
Form factor options	USB, benchtop, modular PXIe, and handheld
Calibration and error correction	Automated calibration tools for accurate, repeatable results



Calibration
Ensure your test system performs to specification and meets local and global standards.



Repair
Restore equipment to original functionality and specifications with trained technicians.



KeysightCare
Innovate at speed with curated support plans and prioritized response and turnaround times.



Education
Make measurements quickly with eLearning and in-house, instructor-led training.

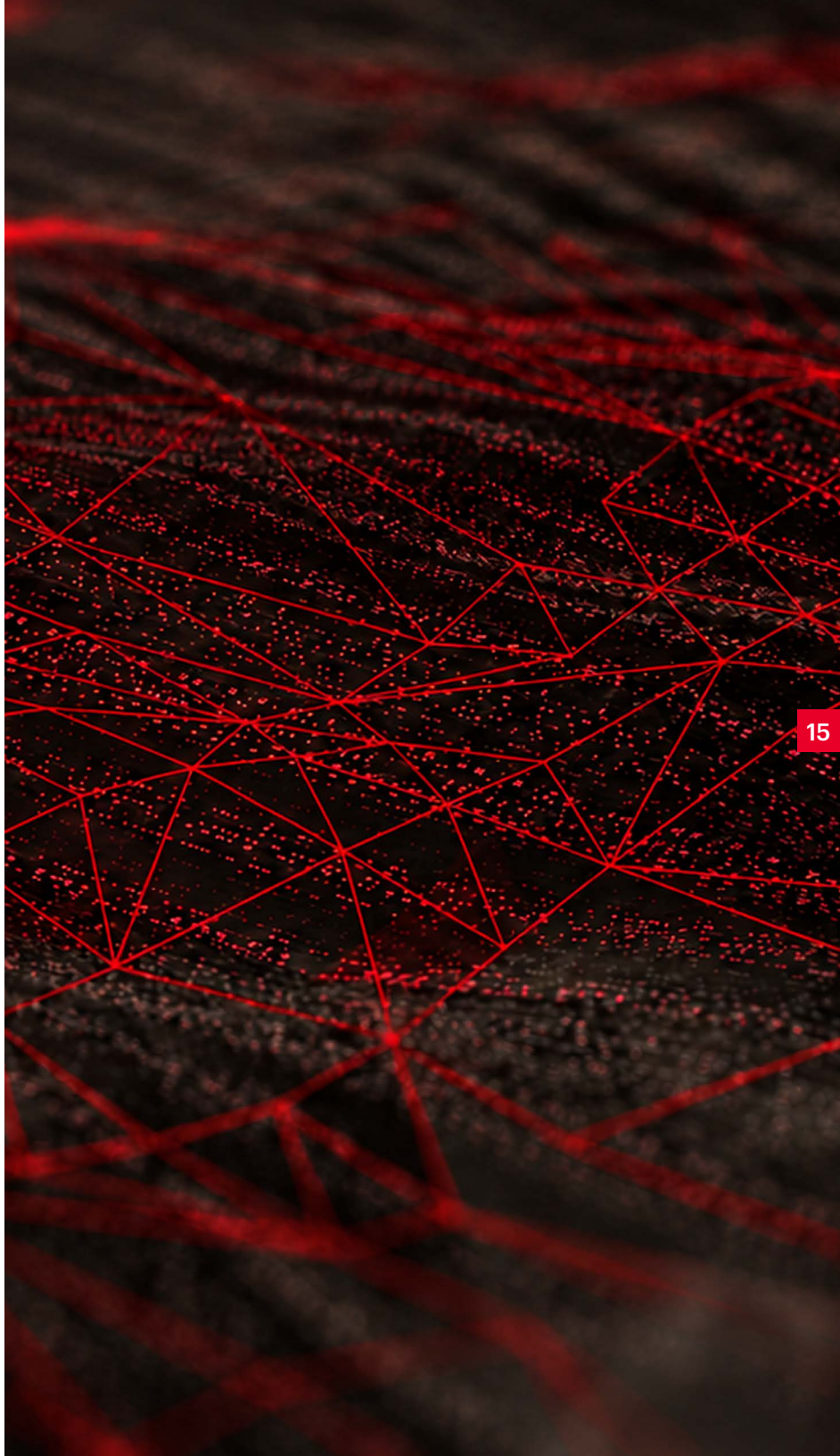


Keysight Support
Get 24x7 access to service requests, case management help, and technical articles.

Select the Network Analyzer That Is Right for You

Should you need more information on Keysight vector network analyzer offerings, visit our extensive **library of resources** to help you select the right network analyzer for your application. Here are some of the resources that can guide you in determining the best network analyzer for your needs:

- Fundamental Principles of Vector Network Analysis
- 5 Essentials to Improve Millimeter-Wave Network Analysis
- Understanding the Vector Network Analyzers Architecture



Once you are ready, visit Keysight vector network analyzers to select one of our popular configurations or build one to meet your specific application.

KEYSIGHT

As a mission-critical design enablement partner, Keysight connects design, emulation, and test so customers can solve the world's most complex engineering challenges. Accelerate innovation at www.keysight.com.

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