Agilent
Network Analyzer Selection Guide
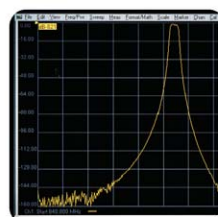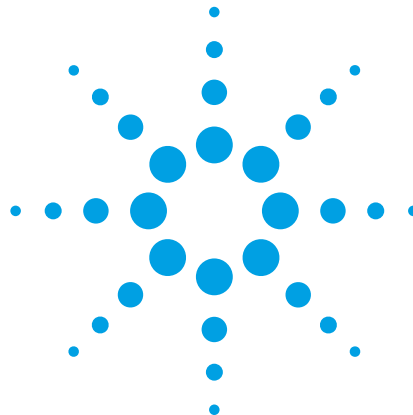
Agilent Technologies

Network Analyzers
to Meet Your Needs

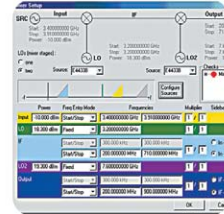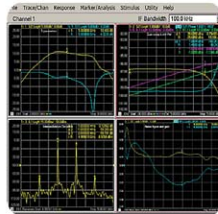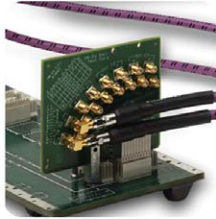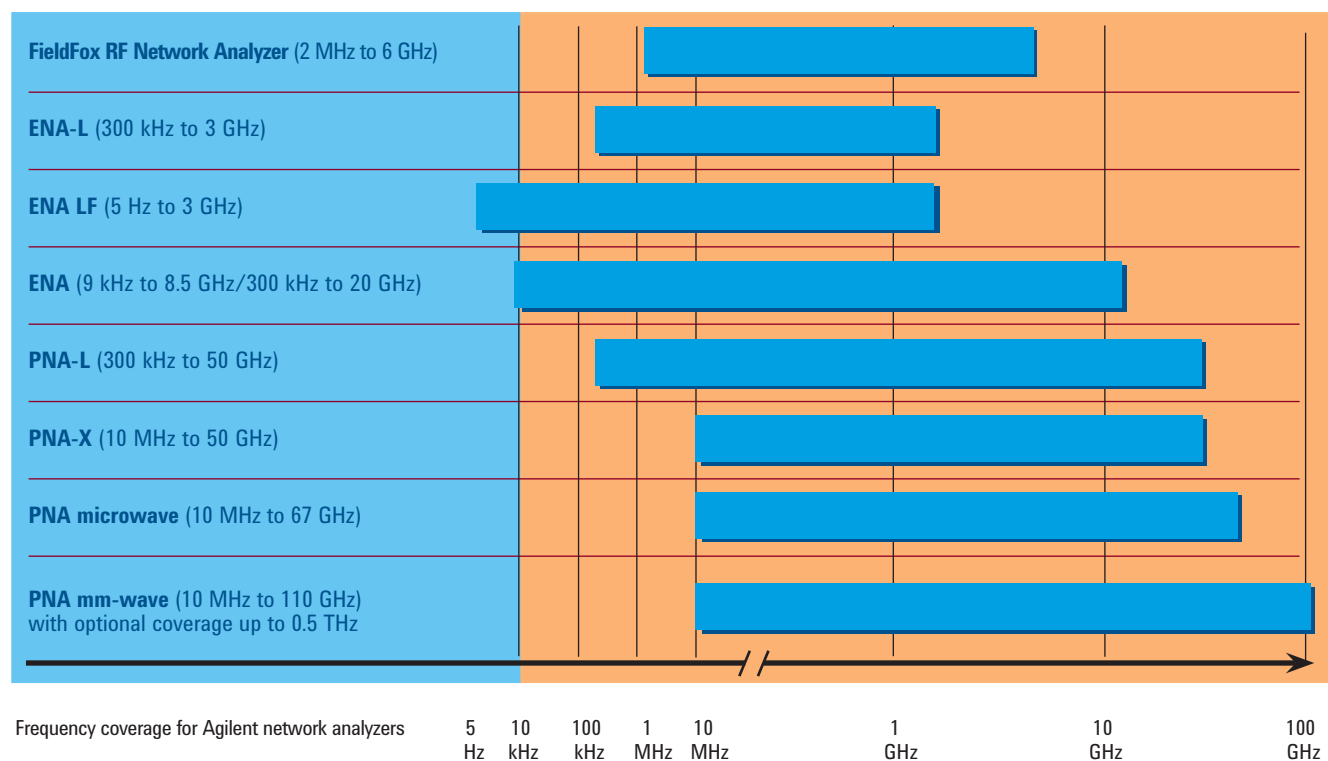*Agilent offers a variety of network analyzers with the frequency, performance, and versatility to meet your measurement needs. To help you determine which network analyzer is right for you, this selection guide provides an overview and side-by-side comparison of all our network analyzers. In addition, you will find a discussion of the typical network analyzer applications, the measurement needs of each, and how Agilent network analyzers meet those needs.*

FieldFox RF Network Analyzer (2 MHz to 6 GHz)

ENA-L (300 kHz to 3 GHz)

ENA LF (5 Hz to 3 GHz)

ENA (9 kHz to 8.5 GHz/300 kHz to 20 GHz)

PNA-L (300 kHz to 50 GHz)

PNA-X (10 MHz to 50 GHz)

PNA microwave (10 MHz to 67 GHz)

PNA mm-wave (10 MHz to 110 GHz)
with optional coverage up to 0.5 THz

Frequency coverage for Agilent network analyzers	5 Hz	10 kHz	100 kHz	1 MHz	10 MHz	1 GHz	10 GHz	100 GHz

NOTE: The 8510, 871x, 8753, 8757, and 872x network analyzers have been discontinued.
Visit **www.agilent.com/find/na** for more information about the latest network analyzer products
and **www.agilent.com/find/nadisco** for discontinued models and migration guides.

Table of Contents

World's Most Integrated Handheld RF Analyzer

FieldFox RF analyzer

N9912A

The FieldFox RF Analyzer is the world's most integrated handheld instrument for wireless network installation and maintenance. It combines cable/antenna analysis, spectrum analysis, interference analysis, power meter measurements, vector network analysis, and a vector voltmeter into one rugged, compact, lightweight and weather-resistant package. Fieldfox is 50 percent faster than traditional handheld instruments and offers superior dynamic range (96 dB) and sensitivity (-148 dBm) in the spectrum analysis mode.

Key measurements

- Cable and antenna test (distance to fault, return loss, etc.)
- Cable loss measurement
- Insertion loss and transmission measurement
- Spectrum analyzer
- Interference analyzer
- Spectogram and waterfall displays
- Channel power, adjacent channel power, and occupied bandwidth
- GSM, WCDMA, LTE, TD-SCDMA, cdma2000® power suite meaurements
- AM/FM tune and listen
- Power meter with USB power sensor
- Vector network analyzer with Smith Chart and polar chart displays
- Vector voltmeter

Features

- Integrated QuickCal calibrates without a calibration kit
- Immediate calibration with CalReady
- Connector covers help keep dust out
- Anti-glare 6.5 inch LCD display with LED backlight
- Convenient side strap makes it easy to hold and carry
- Task-driven keys are grouped to easily and naturally perform standard field measurements
- Portrait design and large buttons for easy operation - even with gloves on
- Dedicated marker keys for quick marker function access
- Backlit keypad
- Easily accessible battery compartment
- LAN port, USB port, and SD flash card slot for data transfer and storage

www.agilent.com/find/fieldfox

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# New Standard for Low-Cost Basic RF Network Analysis

ENA-L RF network analyzers
E5061A, E5062A

Providing the latest in modern technology and flexibility, the Agilent ENA-L network analyzers provide basic vector network analysis in a wide range of industries and applications such as wireless communication, cable TV, automotive, education, and more. Designed to reduce tune and test times, these analyzers provide increased throughput to improve your measurement productivity.

The ENA-L offers all of the critical performance and features needed in R&D, manufacturing, and service to test RF components such as: filters, amplifiers, antennas, cables, CATV taps, and distribution amplifiers.

The affordably priced ENA-L, equipped with the core functions of the industry-standard ENA, includes many easy-to-use features and is optimized for efficient measurements and high reliability.
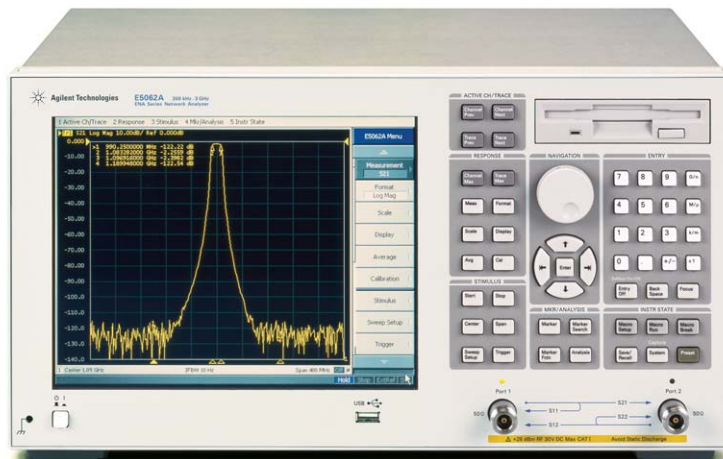
Features

- 120 dB dynamic range and 0.005 dB rms trace noise (3 kHz IFBW)
- S-parameter or T/R test set models
- 50 ohm or 75 ohm system impedance available
- optional fault location and structural return loss measurement
- built-in Visual Basic for Applications (VBA)
- optional electronic calibration (ECal) module simplifies and speeds your calibration process

www.agilent.com/find/ena

Ultimate General-Purpose Network Analyzer

LF-RF network analyzer
E5061B

The Agilent E5061B is the latest addition to the industry-standard ENA Series network analyzers. The option E5061B-3L5 expands the frequency range down to 5 Hz for network analysis, while covering the most frequently-used RF ranges up to 3 GHz.

With its basic and useful S-parameter measurement ability in a wide frequency range, the E5061B can help you in a variety of measurement areas. Meanwhile, the uncompromised performance in a low frequency (LF) range along with the gain-phase test port strongly supports you in designing LF components and circuits.

The broad coverage for low-frequency devices such as DC-DC converters and sensor circuits to RF devices used in the radio systems and wireless interfaces enables you to improve the performance and quality of your end products. The E5061B works as a strong and convenient network analyzer in every lab that needs network analysis.
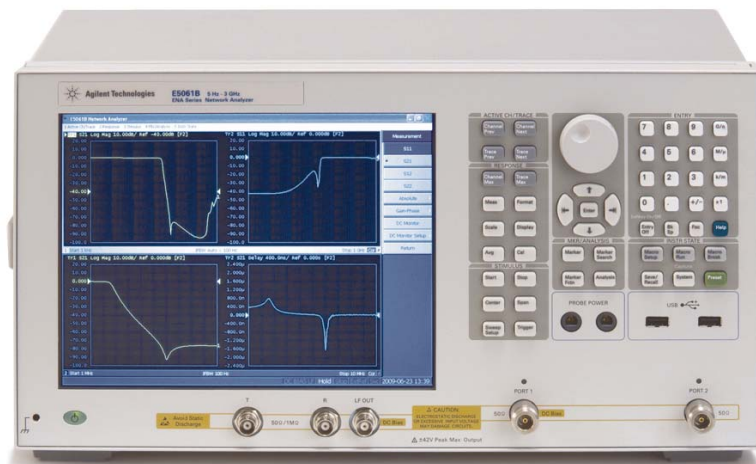
Features

- 5 Hz to 3 GHz frequency
- S-parameter test port (5 Hz to 3 GHz, 50 Ω)
- gain-phase test port (5 Hz to 30 MHz, 1 MΩ/50 Ω)
- excellent dynamic range down to LF
- built-in DC bias source (up to ±40 Vdc)
- compact form factor (254 mm depth)
- built-in Visual Basic for Applications (VBA)

www.agilent.com/find/ena

1. E5061B-3L5 is the only one test set option available as of October 2009.

# Industry Standard for RF Network Analysis

ENA network analyzers

E5071C

The Agilent ENA offers fast, accurate measurements for multiport components such as duplexers and couplers. Up to four built-in test ports are available in the E5071C (4.5, 6.5, 8.5, 14, and 20 GHz).

The ENA offers a built-in balanced measurement capability, which enables you to test advanced handset components such as balanced SAW filters. It provides mixed-mode S-parameter measurements with a fixture simulator function that includes matching circuit embedding, fixture de-embedding and impedance conversion capabilities.

In addition, the ENA provides frequency-offset mode to characterize your mixers and converters accurately.

Efficient measurements can be easily made in manufacturing. Using the built-in Microsoft® Visual Basic for Application (VBA) you can quickly develop test routines or automation programs. In addition, the parts-handler interface makes it easy to integrate the ENA into an automation system and enables fast communication.

These integrated measurement capabilities provide the lowest test cost per component and dramatically improve test throughput of multiport and balanced components.
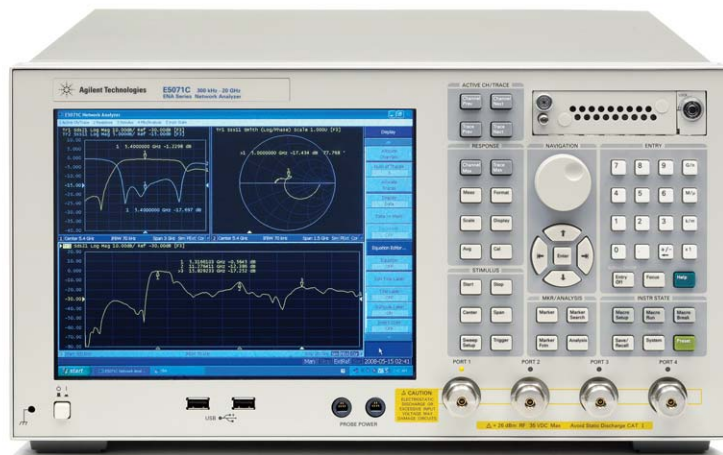
Features

- 123 dB dynamic range and 0.004 dB rms trace noise (70 kHz IFBW)
- 8753x successor for general purpose use
- 2- or 4-port measurements with full port calibration
- built-in balanced measurement capability
- expandable with multiport test sets (E5092A)
- built-in Visual Basic for Applications (VBA)
- optional time-domain and frequency-offset capabilities
- optional removable hard disk drive
- optional electronic calibration (ECal) module simplifies and speeds your calibration process
- hardware and software upgrade paths available

www.agilent.com/find/ena

New Standard for General Purpose Network Analysis
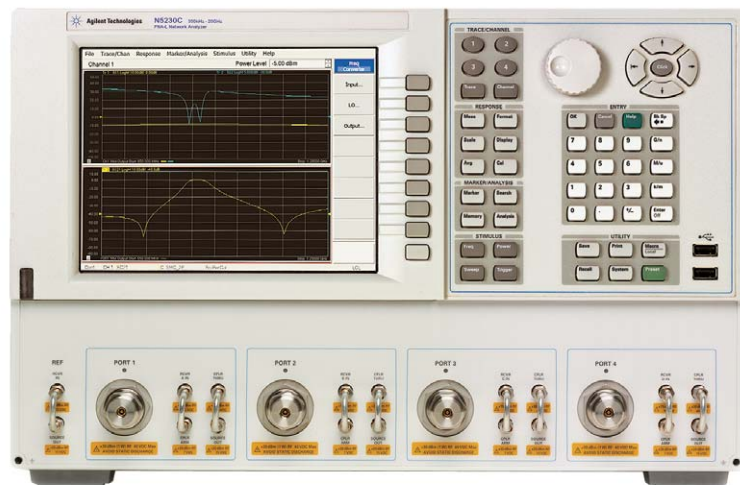
PNA-L network analyzers
N5230C

The PNA-L is designed for your general-purpose network analysis needs and priced for your budget. Advanced features help you work quickly, easily, and accurately. With the same firmware as the PNA, the PNA-L offers the perfect balance of value and performance.

The PNA-L is available with frequency coverage from 300 kHz to 6 and 13.5 GHz, 10 MHz to 20, 40, or 50 GHz and offers capabilities that can dramatically increase your design and test efficiency. 4-port models are also available from 300 kHz to 13.5 or 20 GHz. The Windows® operating system provides the ability to expand the instrument's connectivity and provides tools for maximum flexibility. From the Windows desktop you can install measurement tools, which reduce the need for a dedicated PC. Use embedded Help to quickly refer to programming and user documentation from within the instrument. Furthermore, COM/DCOM programming provides a powerful automation environment.

The enhanced user interface, crisp display with touch screen, and flexible remote interfaces maximize productivity in design and production environments.

PNA-L provides efficiency and flexibility in both manufacturing and R&D applications for industries ranging from Wireless LAN components to Aerospace & Defense.

Features

- measurement speeds as fast as 4 to 9 µs per point
- superior performance and advanced connectivity compared to our 872x network analyzers
- optional built-in second source (4-port models only)
- optional time-domain and frequency-offset capabilities
- optional electronic calibration (ECal) modules allow you to calibrate 10 times faster than mechanical calibration
- up to 32 independent measurements channels

www.agilent.com/find/pnal

High-Performance Microwave Measurements

PNA microwave network analyzer
E8361/2/3/4C

The Agilent E8361/2/3/4C are the microwave frequency models from the PNA series of network analyzers. These models offer an unsurpassed combination of high performance, speed, and outstanding interconnectivity capabilities to meet the challenges of component testing.

The microwave PNA network analyzers cover 10 MHz to 20, 40, 50 and 67 GHz frequency ranges with excellent accuracy. These analyzers are suitable for high-performance microwave devices, such as satellite communication components. They offer 123 dB dynamic range at the test ports and 136 dB with direct receiver access. They also provide TRL/LRM calibration capability for in-fixture and on-wafer devices. In addition, the receiver architecture enables frequency-offset mode to characterize your mixers and converters. The configurable test set allows you to connect external test sets easily and make accurate multiport measurements.

The enhanced user interface, crisp display with touch screen, and flexible remote interfaces maximize productivity in design and production environments.

The Windows operating system provides the ability to expand the instrument's connectivity and provides tools for maximum flexibility. In addition, from the Windows desktop you can install measurement tools, which reduce the need for a dedicated PC, and use on-line Help to quickly refer to programming and user documentation. Furthermore, COM/DCOM provides a powerful automation function. These functions can increase your design and test efficiency dramatically.
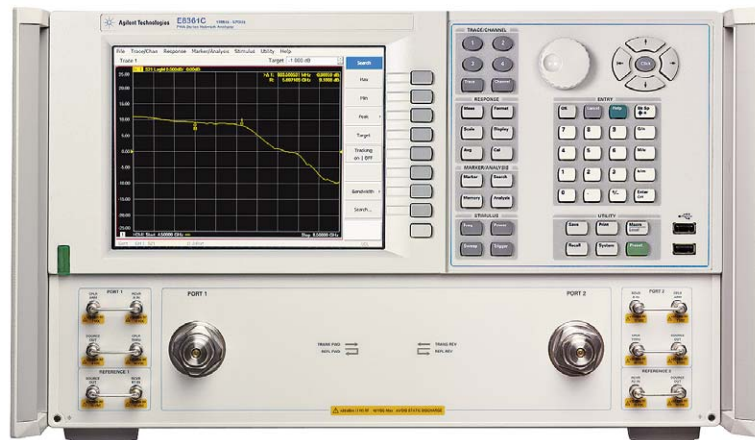
Features
- 136 dB dynamic range with direct receiver access
- expandability with configurable test set
- optional advanced mixer and converter test
- optional electronic calibration (ECal) modules allow you to calibrate 10 times faster than mechanical calibration
- optional antenna and pulsed-RF measurements

www.agilent.com/find/pna

Premier-Performance and Versatility for Active Device Tests

PNA-X microwave network analyzer

N5241A

N5242A

N5244A

N5245A

The Agilent PNA-X premier-performance network analyzers are designed for high performance active device tests that help you minimize design iterations, test system integration, and significantly simplifies test processes. The industry-leading performance and highly integrated, configurable nature of the PNA-X makes it the ideal solution for comprehensive network analysis and tests.

The PNA-X is available with frequency range of 10 MHz to 13.5, 26.5, 43.5, and 50 GHz, and offers 2- or 4-port models. The PNA-X's very low harmonics internal source is ideal for active device characterization, and delivers the highest accuracy. The optional second internal source (standard for 4-port model) together with internal combining network allows fast swept intermodulation distortion measurements for amplifiers. Internal path switches and rear access loops provide maximum flexibility for integrating signal conditioning components or external instruments, and turn the PNA-X into a test hub for a single-connection multiple-measurement (SCMM) solution.

The noise figure measurement option employs an innovative error-correction technique and delivers the most accurate noise figure measurements in the market.

The enhanced user interface, large and crisp display with touch screen, and flexible remote interfaces maximize productivity in design and production environments.

The award winning nonlinear vector network analyzer application provides a critical leap in technology to go beyond S-parameters, allowing you to efficiently and accurately analyze and design active devices under real world operating conditions.
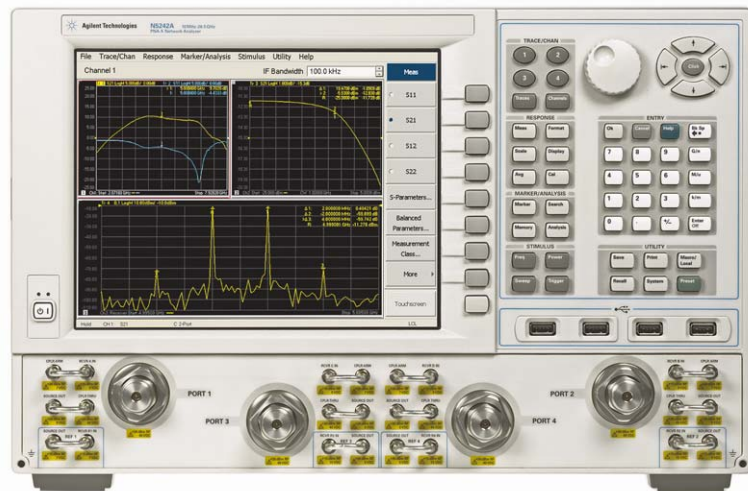
Features

- integrated 2- or 4-port with balanced measurements
- 130 dB dynamic range, 32 channels, 32,001 points
- second internal source (optional for 2-port model)
- optional combining network for two-tone measurements
- optional path switches for SCMM
- optional rear access loops for signal conditioning or external instruments

Application options

- Nonlinear vector network analyzer (NVNA) application including:
  - nonlinear component characterization
  - X-parameters[1]
  - nonlinear pulse envelope domain
- Noise figure
- Gain compression
- Intermodulation and harmonic distortion
- Pulsed RF- wide and narrow pulse width

www.agilent.com/find/pnax

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1. X-parameters is a trademark of Agilent Technologies

Millimeter-wave network analyzers

110 GHz Benchtop System for High-Performance Millimeter-Wave Measurements

PNA mm-wave network analyzers
N5250C

The Agilent N5250C is the millimeter-wave frequency model of the PNA series of network analyzers. This model offers an unsurpassed combination of high performance, speed, and outstanding interconnectivity to meet the challenges of coaxial and on-wafer device testing to 110 GHz. Banded solutions are also available to cover frequencies up to 0.5 THz.

The N5250C allows you to minimize space and maintenance costs with compact test heads and two built-in synthesizers. It provides TRL/LRM calibration capability for in-fixture and on-wafer devices. In addition, optional bias-tees can be added in the combiner assembly very near the device under test, which can greatly improve device stability. The bias-tees have tri-axial connectors for force, sense, and ground. With a single sweep from 10 MHz to 110 GHz, you can maximize your frequency coverage. It offers 123 dB dynamic range at the test ports and can achieve sweep speeds up to 42 times faster than the 8510XF network analyzer.

The enhanced user interface, crisp display with touch screen, and flexible remote interfaces maximize productivity in design and production environments.

If you only need a specific band of millimeter-wave frequency coverage, you can customize the most cost-effective solution. This solution consists of a microwave PNA, N5260A test set controller, and banded test heads from Oleson Microwave.
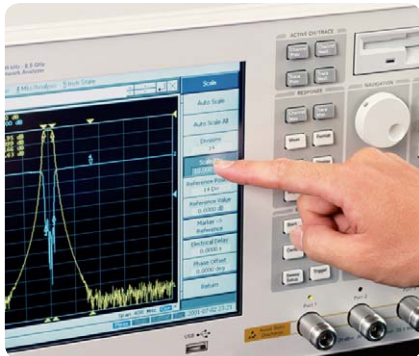
Features
- single sweep from 10 MHz to 110 GHz
- compact test heads and two built-in synthesizers
- 29 IFBW settings, 32 independent channels, and 16,001 points
- optional frequency coverage up to 0.5 THz
- Agilent 8510 to PNA code conversion assistant

www.agilent.com/find/pna

Network analysis and more

S-parameter measurements are the most common measurement parameters for network analysis. However, if you only need to measure transmission or reflection characteristics, you might consider a network analyzer with a T/R test set to help manage costs. In some cases, you might want to make additional types of measurements like absolute power, spectrum, impedance, time-domain and pulsed-RF. Time-domain and pulsed-RF measurements are often used for R&D activities to evaluate filters or high-power devices, respectively. Agilent's network analyzers offer a wide range of capabilities — providing you with convenient and cost-effective solutions tailored to your measurement needs. Nonlinear component analysis and X-parameters, in conjunction with ADS design and simulation tools, minimize design iterations, speed simulation and deterministically model the nonlinear behavior of active components.

Connector types and calibration accuracy

In an actual measurement environment, your devices might not have coaxial connectors, such as when you perform on-wafer measurements, or your devices might not have insertable connector types. In either case, it is difficult to perform an accurate calibration, which will affect measurement accuracy. Agilent network analyzers have various calibration functions, such as TRL, adapter-removal calibration, unknown thru, and embedding/de-embedding to ensure measurement accuracy in these types of situations. TRL enables our network analyzers to perform accurate on-wafer or in-fixture measurements. Adapter-removal calibration, unknown thru, or our electronic calibration (ECal) modules make it possible to perform calibration for non-insertable coaxial connectors. Embedding/de-embedding allows for the mathematical removal of fixtures. These functions will help you produce accurate measurements.

Expanding your system or using measurement data to write reports

Automation capabilities are critical for making complex component measurements. Internal and external programming capabilities like Visual Basic and Agilent VEE make it easier to develop automation programs and even control other instruments as a system.

Another common, time-consuming task for R&D engineers is incorporating analysis data into simulations and reports. Agilent network analyzers provide linkages to design tools such as Advanced Design System (ADS), that let you simulate and analyze a system without hardware — saving you valuable time and money. In addition, many of our network analyzers are compatible with IntuiLink Connectivity Software, which enables you to easily incorporate measurement results into Microsoft applications.

ADS: **www.agilent.com/eesof-eda**
VEE: **www.agilent.com/find/vee**
IntuiLink: **www.agilent.com/find/intuilink**
ECal: **www.agilent.com/find/ecal**
NVNA: **www.agilent.com/find/NVNA**

Measurement Solutions for Your Application
Research and development

Research and development	FieldFox	ENA-L	ENA LF	ENA	PNA-L	PNA-X	PNA MW	PNA mm-wave
Basic measurements								
S-parameters		•	•	•	•	•	•	•
Transmission and reflection with T/R test set	•[11]	•						
Gain-phase test port with 1 Mohm input			•					
X-parameters						•		
Absolute power	•		•[14]	•	•	•	•	•[1]
Spectrum analyzer function						•[2]		
Non-coaxial devices [3]								
TRL calibration (on-wafer measurement)				•	•	•	•	•
Waveguide measurements				•	•	•	•	•
Non-insertable devices [4]								
Adapter-removal calibration using mechanical calibration			•	•	•	•	•	•
SOLR (unknown thru) using mechanical calibration or ECal				•	•	•	•	•
Different connector types supported by ECal		•	•[6]	•	•	•	•	•[1]
Applications								
Gain compression						•		
Intermodulation and harmonic distortion						•		
True mode differential						•		
Nonlinear component characterization						•		
Nonlinear pulse envelope domain						•		
Time-domain mode/gating		•[5]	•	•	•	•	•	•
Frequency-offset mode				•	•	•	•	•
TOI and harmonics					•	•	•	•
Noise figure measurements						•		
Pulsed-RF: wide and narrow pulse width			•	•	•	•	•	•
Frequency conversion application				•		•	•	•[1]
Scalar-calibrated converter measurements				•		•	•	•[1]
Antenna	•	•	•	•		•	•	•
Materials measurement [7]	•[12]			•	•	•	•	•
Signal integrity				•[7]		•	•	•
Automated gain compression						•		
True differential measurements						•		
Programming and connectivity								
Windows-OS		•[8]	•[9]	•[9]	•[9]	•[9]	•[9]	•[9]
LAN interface	•	•	•	•	•	•	•	•
Internal programming capability [11]		•	•	•	•	•	•	•
ADS linkage				•	•	•	•	•
VEE linkage					•	•	•	•
IntuiLink			•	•	•		•	•
LXI compliance			•	•				
Display touch screen		opt	•	•	•	•	•	•
USB for mass storage	•	•	•	•	•	•	•	•

1. Functions up to 67 GHz.
2. Option 087 intermodulation distortion measurements provides spectrum-analyzer-like display for use with IMD measurements.
3. For example, on-wafer, in-fixture, or waveguide applications.
4. A non-insertable device is a device that cannot be inserted in place of a zero-length through. For example, a device that has the same connectors on both ports (type and sex) or different types of connectors on each port (for example, waveguide on one port and coaxial on the another).
5. Time domain gating is not supported.
6. ECal modules do not cover the whole frequency range of the E5061B. Check whether the frequency range of each ECal module meets your measurement needs.
7. For more information, see page 25.

8. Physical Layer Test System (PLTS) 4.5 only supports E5071C-x4x, x8x.
9. Closed environment, which does not allow access to a Windows desktop operating system.
10. Open environment, which allows access to a Windows desktop operating system and enables you to install software and manage data for easy post-measurement analysis.
11. Includes integrated programming language such as Visual Basic for Applications®, and ability of open Windows environments to install programming languages into analyzers.
12. S11 vector and S21 scalar.
13. 85070E Dielectric Probe Kit only.
14. The source and receiver calibrations are not available. For trace normalization, use Data/Memory math function since the response calibration is not applicable to absolute traces.

Optional electronic calibration (ECal) modules for easy, accurate calibration

Unlike the traditional mechanical calibration technique, Agilent's ECal modules only require one set of connections to perform full 2-, 3-, or 4-port calibration. Controlled through the front panel USB port, and requiring only one set of connections, ECal drastically simplifies the calibration process for non-technical operators.

An ENA or PNA controls the ECal module to perform the entire calibration, providing:
·   faster calibration and reduced complexity
·   reduced chance of operator error
·   reduced wear on connectors

Sweep and data analysis

Total measurement speed can be divided into several different components such as sweep speed, display processing, data analysis, and data transfer. In low-volume manufacturing, the data analysis and display speeds are unimportant. After the measurement, a limit test or a marker function is typically used. Conversely, in high-volume manufacturing the sweep speed and data analysis speed are important. In many cases, analysis needs to be done quickly using internal programming capability or waveform analysis commands, and the analyzer must send pass/fail results to an automated system. In both cases, the sweep speed can be maximized using segment sweep. For automation, you can choose from a variety of Windows-compatible programming environments like VBA, VB or Agilent VEE. In case you want to transfer all data to an external computer quickly, COM/DCOM provides a seamless environment between your instruments and external computers.

Communication interfaces

It is becoming more common to have a LAN interface in test and measurement instruments. A LAN is convenient to send data from your manufacturing line to your office, or to monitor measurement status, or have a central data server, or use network printers.

For high-volume automation applications, fast communication with an automated handler system is important. A parts handler interface is commonly used for this purpose. It has a dedicated pin assignment in the I/O interface so that triggers measurement-end status, and limit-test results are communicated quickly between the instrument and the automated handler system.

Measurement Solutions for Your Application
Manufacturing test

Manufacturing test	ENA-L	ENA LF	ENA	PNA-L	PNA-X	PNA MW	PNA mm-wave
Programming							
Internal programming capability [1]	•	•	•	•	•	•	•
Fast data transfer [2]	•	•	•	•	•	•	•
Calibration							
Adapter-removal calibration [3]	•	•	•	•	•	•	•
SOLR (Unknown thru) using mechanical calibration or ECal			•	•	•	•	•
ECal support	•	•[4]	•	•	•	•	•[5]
Measurement and analysis							
Segment sweep [6]	•	•	•	•	•	•	•
Pass/fail testing	•	•	•	•	•	•	•
Embedding and de-embedding [7]			•	•	•	•	•
Waveform analysis command [8]	•	•	•				
Interface							
LAN	•	•	•	•	•	•	•
I/O port	•	•	•	•	•	•	•
Parts handler interface [9]	•	•	•	•	•	•	•
VGA output	•	•	•	•	•	•	•

1. Includes integrated programming language such as Visual Basic for Applications, and ability of open Windows environments to install programming languages into analyzers.
2. COM/DCOM provides faster data transfer than GPIB.
3. The calibration technique used for non-insertable devices such as those with the same connectors on input and output ports.
4. Usable at the frequency range of >300 kHz (2-port ECal modules) or >9 kHz (N4431B 4-port ECal module). ECal user characterization function is not usable for the 4-port ECal module with the ENA LF and other 2-port ENA Series network analyzers.
5. Functions up to 67 GHz.
6. Segment sweep includes sweep types that are known as list and fast-swept list.
7. Functions to embed or de-embed a fixture's characteristics.
8. Programming commands to quickly retrieve parameters of filters and resonators.
9. The parts handler interface is an I/O-port specialized for communication with an automatic parts handler system.

Measurement Solutions for Your Application
Filter and duplexer measurements

Dynamic range, IF bandwidth and sweep time

Dynamic range requirements vary among applications. Agilent offers a variety of network analyzers with different dynamic ranges in different frequency ranges. For wide dynamic range, Agilent's PNA series offers a configurable test set that bypasses the couplers and improves dynamic range by approximately 15 dB. The PNA series offers 122 dB dynamic range at test port. In addition, many analyzers offer segment sweep — a convenient function that manages dynamic range and sweep speed. This function enables you to set different IFBWs for the passband or rejection band, and the sweep speed can be optimized for your measurement needs.

Calibration for filter testing

Agilent network analyzers provide various functions that help you perform efficient, accurate filter evaluations, which can help shorten your design cycles. For instance, the adapter removal calibration functions make it possible to accurately calibrate non-insertable devices. Interpolated calibration is convenient if the measurement frequency is unknown.

Time domain, multiport, and balanced measurement capabilities for advanced devices

Today's wireless devices require test instruments that have advanced measurement functionality. For example, a time-domain function is needed to easily tune coupled-cavity-resonator bandpass filters. Duplexer or front-end modules for handsets often require multiport and balanced measurement capabilities. For more details on multiport and balanced testing, see page 19.

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Measurement Solutions for Your Application
Filter and duplexer measurements

| Filter and duplexer measurements	ENA-L	ENA LF	ENA	PNA-L	PNA-X	PNA	PNA mm-wave
Dynamic range							
Wide dynamic range [1]	•	•	•	•	•	•	•
Direct receiver access to obtain widest possible dynamic range				•	•	•	•
Calibration							
Adapter-removal calibration [3]		•	•	•	•	•	•
SOLR (Unknown thru) using mechanical calibration or ECal			•	•	•	•	•
Interpolated calibration	•	•	•	•	•	•	
Measurement and analysis							
Segment sweep [2]	•	•	•	•	•	•	•
Four-parameter display	•	•	•	•	•	•	•
Marker statistics function [3]	•	•	•	•	•	•	•
Other functions							
Time domain mode/gating	• [4]	•	•	•	•	•	•
Balanced measurement capability [5]			•	•	•	•	•
Multiport measurement capability [5]	• [7]		• [7]	• [7]	•	• [7]	

1. Wide dynamic range is defined as 120 dB or better for RF analyzers and greater than 90 dB for microwave analyzers.
2. Segment sweep includes sweep types that are known as list and fast swept list.
3. Obtains real-time calculations of device characteristics such as maximum/minimum, center frequency, and 3 dB bandwidth.
4. Time gating is not supported.
5. For more details about balanced and multiport tests, see page 19.
6. For 2-port network analyzers, balanced measurement capability requires an external test set and software.
7. An external test set may be required to achieve these functionalities.
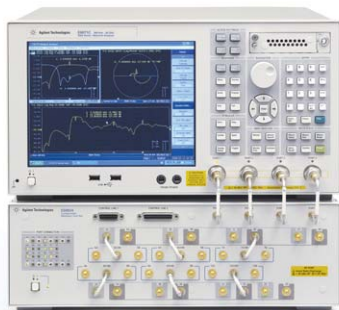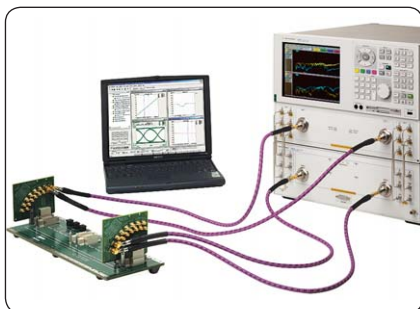
E5071C ENA network analyzer with E5092A configurable multiport test set
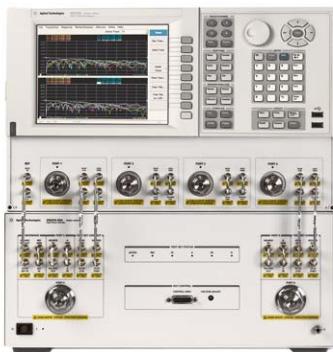
4-port, 20 GHz PNA-L with high-power test set

The Agilent N1957B physical layer test system is used for 4-port, 50 GHz signal integrity measurements

www.agilent.com/find/balanced
www.agilent.com/find/multiport
www.agilent.com/find/plts

Multiport testing for communication components

Many modern components have more than two ports. In order to test these devices efficiently, network analyzers with multiple ports are required. Agilent offers numerous multiport instruments for you to choose from. One example is the Agilent ENA series. ENA, PNA-L and PNA-X have optional built-in four-port measurement capability — enabling fast and accurate multiport measurements from 9 kHz to 26.5 GHz.

Calibration for multiport measurements

When doing multiport measurements, you need to use the proper calibration method to achieve accurate measurements. Agilent offers a three-, four-, or N-port full calibration function together with multiport measurement capability. Four-port ECal modules are available as well, so that calibration can be done easily and quickly. When it is not possible to place coaxial connectors on your design, Agilent provides multiport TRL and LRM calibration techniques, as well as two- and four-port de-embedding to ensure accuracy for balanced or on-wafer measurements.

Balanced measurements for balanced components

Balanced components are commonly used in communications devices to maintain RF signal quality. The ENA has a built-in balanced capability to make fast and easy balanced measurements. It also has a fixture simulation function, including matching circuit embedding/de-embedding and impedance conversion capabilities. These capabilities are also available on the 4-port PNA-L and PNA-X. The 4-port PNA-X provides the most accurate true differential measurements with Option 460. If you require higher frequency coverage, PNA with Option 550 and the N1900B series Physical Layer Test System (PLTS) enable balanced measurements up to 67 GHz.
For more details, visit **www.agilent.com/find/multiport**

Multiport testing for CATV components

Many CATV components, including taps, dividers, and distribution amplifiers, have multiple ports. Network analyzers with multiport test sets drastically increase the test efficiency of these components. The ENA-L network analyzer with the 87075C 75 ohm multiport test set is specifically designed for testing multiport CATV components.

Measurement Solutions for Your Application
Multiport and balanced testing

| Multiport and balanced devices	FieldFox	ENA-L	ENA LF	ENA	PNA-L	PNA-X	PNA	PNA mm-wave
Multiport measurements								
Built-in 4-port measurement capability				•	•	•		
Multiport measurement capability with external test set [1]		•		•	•	•	•	
Multiport calibration								
Full 4-port calibration				•	•	•	•[2]	
Full N-port calibration					•[2]	•[2]	•[2]	
Balanced measurement								
Built-in balanced measurement capability				•	•	•		
Balanced measurement capability with external test set [3]				•	•	•	•	
Fixture simulation/embedding and de-embedding				•	•	•	•	•
True differential measurements						•		

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1. Refer to *Test Solutions for Multiport and Balanced Devices* brochure (literature number 5988-2461EN available on the **www.agilent.com/find/multiport** Web site) for more details.
2. Available only when used with external test sets and Option 550 or 551.
3. The external test set and software are available with either Option 55x or the Physical Layer Test System (PLTS). For more details on PLTS, refer to the Agilent Physical Layer Test Systems Data Sheet (literature number 5988-5288EN) available on the PLTS Web site: **www.agilent.com/find/plts**
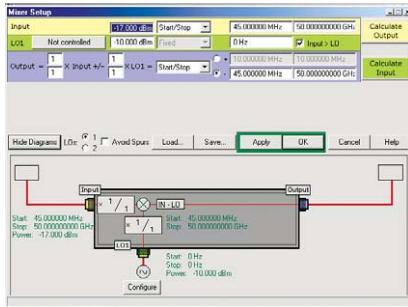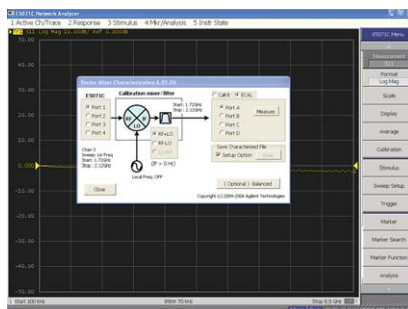
The PNA Frequency Converter Application simplifies set up and calibration for advanced mixer measurements such as absolute phase and group delay.

The PNA-X drives mixers with two internal sources, making multiple measurements with a single connection.

The ENA Frequency-Offset Mode offers vector mixer calibration technique that enables you to perform accurate absolute group delay measurements for frequency-translating devices.

Measurement challenges

Frequency-translation devices such as mixers, converters, and tuners are critical components in most RF and microwave communication systems. They 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 to detect output frequencies different from the input.

Improved accuracy with advanced measurement techniques

Agilent offers the scalar-mixer calibration, which corrects mismatch errors between the analyzer and the device under test, and provides the most accurate conversion loss measurements in the market. This eliminates external pads and minimizes connector ware and tear due to different padding layouts required for different measurements.

The Frequency Converter Application (FCA) is another Agilent unique solution. It includes an easy-to-use graphical user interface and vector-mixer calibration that enables absolute group delay measurements without extensive knowledge. You can accurately measure delay characteristics of your devices and no longer need to rely on a "golden" mixer.

Further more, the Embedded LO Measurements capability works with FCA, and allows the measurement receiver to be tuned at IF frequencies without accessing the LO of the device. With this technique, you can reduce the error significantly from absolute group delay measurements, even though there is no access to the LO or reference clock of your devices.

Comprehensive mixer/converter measurements with PNA-X

The PNA-X offers various advanced capabilities that simplify mixer/converter measurements significantly. The two internal sources drive RF and LO ports without an external signal generator. The built-in combining network combines the two tones internally for IMD measurements [1], and internal path switches allow switching between conversion loss and IMD measurements or even external instruments, without disconnecting the device from the PNA-X's test ports. This dramatically reduces measurement complexity and improves test productivity.

Measurement versatility with ENA

The ENA offers the frequency-offset mode (FOM) that provides frequency-offset sweep, external signal source control, and fixed IF/RF measurement capabilities. The ENA FOM option supports both scalar – and vector – mixer calibrations with inherited mixer measurement techniques from the microwave PNA. These measurement techniques are key to making extremely accurate measurements. Also, this option provides harmonics measurement capabilities for non-linear devices such as amplifies, semiconductor switches, and front-end modules.

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1. Mixer/converter IMD measurements require an external signal source.
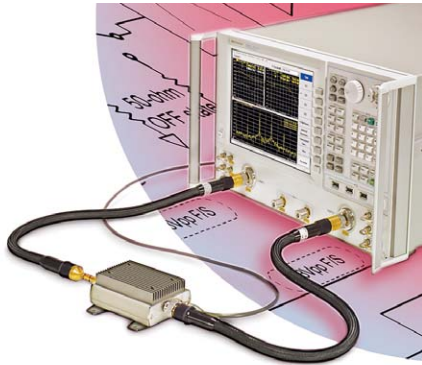
Measurement Solutions for Your Application
Mixer and converter measurements

Mixer measurements	FieldFox	ENA-L	ENA LF	ENA	PNA-L	PNA-X	PNA	PNA mm-wave
Measurement and analysis								
Magnitude measurement [1]				•	•	•	•	• [2]
Phase measurement								
Relative phase					•	•	•	• [2]
Absolute phase				•		•	•	• [2]
3-port measurements [3]				•	•	•	• [4]	
Power sweep				•	•	•	•	• [2]
Embedded LO measurements						•	•	• [2]
Internal dual-source					•	•		
External source control				• [5]	•	•	•	•
Calibration								
Power meter calibration				•	•	•	•	• [2]
3-port calibration				•	•	•	• [4]	
Scalar mixer calibration				•	•	•	•	• [2]
Vector mixer calibration				•		•	•	• [2]

---

1. Frequency-offset modes of the ENA and PNA series let the source and receiver operate at different frequencies. Both magnitude and phase measurements can be made.
2. Funictions available only on a stand-alone PNA, up to 67 GHz. Requires disconnecting mm-wave controller.
3. For LO return loss and LO to RF/IF leak measurements with single connection.
4. Requires an external test set and 4-port measurement option.
5. Supports one external signal source.

The integrated and flexible nature of PNA-X simplifies amplifier measurements.
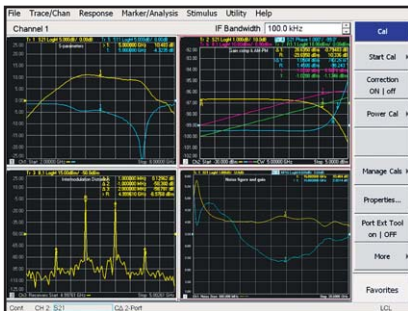
Fully error-corrected amplifier gain (S21), gain and phase compression, IMD, and source-correct noise figure, performed with a single connection between the amplifier and network analyzer.

Measurement challenges

Agilent network analyzers can be used to easily measure commonly specified amplifier parameters such as gain, gain and phase compression, isolation, return loss, and group delay. The power sweep function is often required to make amplifier measurements, and harmonic distortion is commonly used to understand an amplifier's nonlinear behavior. It requires the receiver to be tuned at a different frequency from the source, and the analyzer needs wide frequency coverage. 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, ACP, and EVM. As a result, the test system becomes complicated or requires multiple stations.

Highly integrated, more accurate amplifier measurements with PNA-X

The PNA-X employs very clean signal sources, which minimizes harmonics and IMD measurement errors. The built-in combining network with two internal sources eliminates external components and cable wear, which makes two-tone measurements much faster and simpler. The internal switches and RF access loops maximize the flexibility to add signal conditioning devices and to switch one measurement to another without disconnecting the device from the analyzer.

Agilent's nonlinear vector network analyzer application adds powerful capabilities, X-parameters, nonlinear component characterization, and nonlinear pulse envelope domain.

The integrated pulse generators/modulators with pulse measurement application software increase measurement speed, simplify the test setup, and provide full pulse measurement capabilities such as average pulse, point-in-pulse and pulse-profiling. It can be configured as a uni- or bi-directional pulsed measurement system.

Integrated noise figure measurements with industry-leading accuracy

The PNA-X's unique noise-figure calibration technique uses an ECal module as an impedance tuner to remove the effects of imperfect system source match, providing accurate measurements of 50-ohm noise figure. Measurement accuracy surpasses standalone Y-factor-based noise figure analyzers or spectrum-analyzer-based solutions. With a single connection to the amplifier, the PNA-X network analyzer offers fast, high-accuracy measurements of S-parameters, noise figure, gain and phase compression, IMD, harmonics, and more.

Evolving standard, ENA's enriched versatility

In addition to the highest measurement performance and richest capability in its class, the ENA provides the external test set mode for high power amplifier measurements. Attenuators for high gain amplifiers and other signal conditioning devices can be placed behind the external couplers so that the system is appropriately calibrated. The ENA's DC measurement capability enables power added efficiency (PAE) measurements in parallel with RF measurements.

Power meter calibration

For both mixer and amplifier testing, power meter calibration provides leveled absolute power to devices that are sensitive to absolute input or output levels. This function automatically controls power meters to set the power anywhere in the test setup with power meter accuracy, or to calibrate the network analyzer's receivers for accurate absolute-power measurements.

Measurement Solutions for Your Application
Amplifier measurements

	FieldFox	ENA-L	ENA LF	ENA	PNA-L	PNA-X	PNA	PNA mm-wave
Basic measurements								
Gain, return loss, isolation	•	•	•	•	•	•	•	•
Compression, AM-PM conversion		•	•	•	•	•	•	•
Automated gain compression						•		
High power measurements								
High output power [1]						•		
Source attenuator		•		•	•	•	•	•
Receiver attenuator			•[2]			•	•	•
Connection loop before reference path						•		
Configurable test set				•[3]	•	•	•	•[4]
Harmonic measurements								
Frequency-offset mode				•	•	•	•	•
Analyzer source harmonics [6]						•		
Receiver attenuator						•	•	•
Intermodulation distortion measurements								
Frequency-offset mode				•	•	•	•	•
Second internal source					•	•		
Internal combining network						•		
Simplified swept-IMD setup						•		
Noise figure						•		
Hot-S22					•	•		
DC inputs for power added efficiency				•		•	•	
Internal DC bias source			•					
Internal bias-tee				•		•	•	•
Nonlinear vector network analyzer applications								
X-parameters						•		
nonlinear component characterization						•		
nonlinear pulse envelop domain						•		

1. High output power is defined as greater than +13 dBm for leveled power output.
2. Only the gain-phase test port has the receiver attenuator.
3. Requires Option 44x, 48x or 4K5 to use external test set mode.
4. Available up to 67 GHz.
5. Harmonic and intermodulation distortion can be measured with integrated spectrum analyzer function.
6. 2nd and 3rd harmonics of the internal source are significantly lower than 20 to 30 dBc.

Related Network Analyzer Products

Electronic calibration (ECal) modules

ECal is a precision, single-connection calibration technique for Agilent vector network analyzers. Agilent ECal modules are fully traceable and verifiable against 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.agilent.com/find/ecal

85070E Dielectric Probe Kit
85071E Materials Measurement Software
85072A Split Cylinder Resonator

Trust Agilent to deliver leading-edge techniques for measuring dielectric and magnetic properties of materials. The new 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 turn key solution for IPC standard TM 650 2.5.5.13. The Materials Measurement Software automates a variety of techniques across a wide frequency span, including transmission line, free space, NRL arch and resonant cavity. The Dielectric Probe Kit offers hardware and software for measuring complex permittivity of liquids and conformable solids from 200 GHz to 50 GHz.

Measuring electromagnetic properties of materials is critical in all stages a products lifecycle: design, incoming inspection, process monitoring and quality assurance. Agilent sets the measurement standard with 20 years experience and innovative new products.

www.agilent.com/find/materials

N1900B Physical Layer Test Systems (PLTS)

Agilent's PLTS solutions provide the highest accuracy and most comprehensive tool set for model extraction and characterization of single-ended and differential physical-layer interconnects, or balanced RF and microwave components with frequency coverage up to 67 GHz. These test solutions offer single-ended, balanced, and mixed-mode measurements in both frequency and time domain, and eye-diagram analysis with a simple to use graphical user interface.

www.agilent.com/find/plts

Network analyzers

	FieldFox	ENA-L	ENA LF	ENA
Model number	N9912A	E5061A E5062A	E5061B	E5071C
Frequency range	2 MHz to 4 GHz (option 303, 104) 2 MHz to 6 GHz (option 303, 106)	E5061A: 300 kHz to 1.5 GHz E5062A: 300 kHz to 3 GHz2	5 Hz to 3 GHz (S-param. port) 5 Hz to 30 MHz (gain-phase port)	9 kHz to 4.5 GHz (option 240, 440) 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)
Number of ports	port 1 vector, port 2 scalar	2	2 ports and additional gain-phase port	2 (option 2xx) or 4 (option 4xx)
Balanced measurements	no	no	no	yes
System impedance	50 ohms	50 ohms or 75 ohms	50 ohms	50 ohms
System dynamic range	2 MHz to 2 GHz: 72 dB (typical) >2 GHz to 3 GHz: 67 dB (typical) >3 GHz to 5 GHz: 58 dB (typical) >5 GHz to 6 GHz: 49 dB (typical)	120 dB (1 MHz to 3 GHz)	120 dB (1 MHz to 3 GHz)	97 to 123 dB (Option x4x, x8x)
Power at test port	High power 2 MHz to 4 GHz <+8 dBm, +6 dBm (nominal) > 4 GHz to 6 GHz < +7 dBm, +2 dBm (nominal)	−5 to +10 dBm −45 to +10 dBm (Option 1E1, 250 or 275)	-45 to +10 dBm	−55 to +10 dBm (Option x4x, x8x at 5 GHz)
Power sweep range	N/A	15 dB	55 dB	62 to 65 dB (Option x4x, x8x)
Sweep type	linear	linear, log, segment[4], power, CW	linear, log, segment[2], power, CW	linear, log, CW, power, segment
Error correction Full 2 port Full 4 port TRL Adapter removal SOLR Ecal support	no no no no no internal Quick Cal	yes (S-parameter test sets only) no no no no yes	yes no no yes no yes[1]	yes yes[1] yes yes yes yes
Measurement channels	1	4	4	160
Maximum number of data traces	1, 2 traces with split window view	16	16	1440 (160 channels/9 traces mode)
Windows-OS	yes (closed CE)	yes (closed)	yes	yes
Internal automation	no	VBA, SCPI, COM	VBA, SCPI, COM	VBA, SCPI, COM
I/O	LAN, USB, SD Flash Card	LAN, USB, GPIB, VGA, parallel, handler, mini-DIN	LAN, USB, GPIB, XGA, parallel, handler, mini-DIN	LAN, USB, GPIB, XGA, parallel, handler, mini-DIN
ADS linkage	no	no	no	software driver supported
Built-in source attenuator	no	yes (with Option 1E1, 250 or 275)	no	yes
DC bias input	no	no	yes	yes[5]
Time domain	DTF, x-axis is distance	yes (with Option 100)[4]	no	yes (with Option 010)
Corrected specifications[5]	Dir 42 dB SM 36 dB (option 110 35 dB typical) Refl trk 0.06 (option 110 0.15 dB typical)	(2-port cal, 85032F type-N, 50 ohms) Dir 46 to 49 dB SM 40 to 41 dB LM 46 to 49 dB Refl trk ±0.011 to ±0.021 dB Trans trk ± 0.015 to ±0.018 dB	(2-port cal, 85032F type-N, 50 ohms) Dir 46 to 49 dB[2] SM 40 to 41 dB[2] LM 46 to 49 dB[2] Refl trk ±0.011 to ±0.021 dB[2] Trans trk ± 0.019 to ±0.026 dB[2]	(2-port cal, 85033E 3.5 mm, 50 ohms) Dir 38 to 46 dB SM 36 to 43 dB LM 38 to 46 dB Refl trk ±0.006 to 0.010 dB Trans trk ±0.015 to 0.079 dB
Trace noise	n/a	0.005 dB rms (1 MHz to 3 GHz) (3 kHz BW)	0.005 dB rms (1 MHz to 3 GHz) (3 kHz BW)	0.004 dB rms (10 MHz to 4.38 GHz), (70 kHz BW)
Measurement speed (1 sweep, 201 points, correction off)	return loss 1.5 ms/point (nominal) 1.75 GHz to 3.85 GHz, 1001 points, Cal ON	19 ms (1 GHz to 1.2 GHz, 30 kHz BW)	8 ms[2] (1 GHz to 1.2 GHz, 300 kHz BW)	4.9 ms (1 GHz to 1.2 GHz, 500 kHz BW)

1. ECal modules don't cover the whole frequency range of the E5061B. Check whether the frequency range of each ECal module meets your measurement needs
2. Preliminary data as of August 2009.
3. Only on 4-port models.
4. Segment includes sweep types that are known as list and fast swept list.

5. Option E5071C-xx5 (with bias tees option) is required. Minimum frequency is 100 kHz for Options x45 and x85.
6. Time domain gating is not supported.
7. Dir = directivity; SM = source match; LM = load match; Refl trk = reflection tracking; Trans trk = transmission tracking

Network analyzers

	PNA-L	PNA-X
Model number	N5230C	N5241A
Frequency range	300 kHz to 6 GHz (Option 020, 025) 300 kHz to 13.5 GHz (Option 120, 125, 140, 145, 146)	10 MHz to 13.5 GHz
Number of ports	2 (Option x2x) or 4 (Option 14x)	2 (Option 200), 4 (Option 400)
Balanced measurements	yes (Option 140, 145, 146)	yes (Option 400)
System impedance	50 ohms	50 ohms
System dynamic range	122 dB (Option x20, 10 MHz to 6 GHz) 121 dB (Option x25, 10 MHz to 6 GHz) 120 dB (Option 14x, 10 MHz to 4 GHz)	121 to 130 dB depends on configuration 124 to 141 dB with direct receiver access (typical)
Power at test port	−30 to +2 dBm (Option x20, 300 kHz to 6 GHz) −90 to +1 dBm (Option x25, 300 kHz to 6 GHz) −27 to +8 dBm (Option 140, 10 MHz to 4 GHz) −87 to +8 dBm (Option 145, 146, 10 MHz to 4 GHz)	−25 to +13 dBm (Option 200, 400) −90 to +10 dBm (Option 219, 419) −90 to +15 dBm (Option 224) −90 to +10 dBm (Option 423)
Power sweep range	37 dB (Option x20, 300 kHz to 6 GHz) 36 dB (Option x20, 300 kHz to 6 GHz) 33 dB (Option 14x, 10 MHz to 4 GHz)	27 to 38 dB (Option 200, 400) 24 to 38 dB (Option 219, 419) 23 to 38 dB (Option 224, 423)
Sweep type	linear, log, CW, power, segment	linear, log, CW, power, segment
Error correction Full 2 port Full 4 port Full N-port[2] TRL Adapter removal SOLR Ecal support	 yes yes (also Full N-port) no yes yes yes yes	 yes yes yes yes yes yes yes
Measurement channels	32	32
Maximum number of data traces	unlimited	unlimited
Windows-OS	yes	yes[3]
Internal automation	SCPI, D/COM	SCPI, D/COM
I/O	LAN, USB, GPIB, VGA, parallel, RS-232	LAN, USB, GPIB, VGA, parallel, RS-232
ADS linkage	supported	supported
Built-in source attenuator	yes (Option 025, 145, 146)	yes (with Option 219, 419)
DC bias input	no	yes
Time domain	yes (Option 010)	yes (with Option 010)
Corrected specifications[5]	(2-port cal or 4-port cal, 3.5 mm) Dir 44 to 48 dB SM 31 to 40 dB LM 44 to 48 dB Refl trk ±0.003 to 0.006 dB Trans trk ±0.015 to 0.131 dB	(2-port cal, 3.5 mm) Dir 44 to 48 dB SM 31 to 40 dB LM 44 to 48 dB Refl trk +/-0.003 to 0.006 dB Trans trk +/-0.015 to 0.104 dB
Trace noise	10 MHz to 10.5 GHz 0.004 dB rms (Option x2x) 0.006 dB rms (Option 140) 0.008 dB rms (Option 145) 0.016 dB rms (Option 146)	0.002 dB rms (1 kHz BW)
Measurement speed (1 sweep, 201 points, correction off)	6 ms (600 kHz BW)	6 ms (600 kHz BW)

See back page for footnotes

Network analyzers

	ENA	PNA-L
Model number	E5071C	N5230C
Frequency range	300 kHz to 14 GHz (Option 2D5, 4D5) 300 kHz to 20 GHz (Option 2K5, 4K5)	10 MHz to 20 GHz (Option 220, 225, 240, 245, 246) 10 MHz to 40 GHz (Option 420, 425) 10 MHz to 50 GHz (Option 520, 525)
Number of ports	2 (Option 2D5, 2K5) or 4 (Option 4D5, 4K5)	2 (Option x2x), 4 (Option x4x)
Balanced measurements	yes (Option 4D5, 4K5)	yes (Options 240, 245, 246)
System impedance	50 ohms	50 ohms
System dynamic range	95 dB (300 kHz to 1 MHz) 107 dB (1 to 10 MHz) 136 dB with direct 120 dB (10 to 100 MHz) 123 dB (100 MHz to 6 GHz) 117 dB (6 to 8.5 GHz) 105 dB (8.5 to 10.5 GHz) 100 dB (10.5 to 15 GHz) 96 dB (15 to 20 GHz)	103 dB (Option 240) (at 20 GHz) 98 dB (Option 245, 246) 108 dB (Option x2x) (additional 12 to 16 dB with direct receiver access)
Power at test port	−85 to +10 dBm (at 6 GHz) −85 to +3 dBm (at 15 GHz) −85 to 0 dBm (at 20 GHz)	−27 to −3 dBm (Option 240) (at 20 GHz) −87 to −8 dBm (Option 245, 246) −27 to +3 dBm (Option 220) −87 to +3 dBm (Option 225) −27 to 0 dBm (Optin 420, 520) −87 to 0 dBm (Option 425, 525)
Power sweep range	25 to 35 dB	22 to 33 dB (Option 240) 17 to 33 dB (Option 245, 246) 23 to 25 dB (Option 220, 225) 17 to 25 dB (Option 420, 425) 10 to 25 dB (Option 520, 525)
Sweep type	linear, log, segment[6], power, CW	linear, log, CW, power, segment

Error correction
  Full 2 port
  Full 4 port
  Full N-port[2]
  TRL
  Adapter removal
  SOLR
  Ecal support
	
	yes
	yes[7]
	no
	yes
	yes
	yes
	yes
		
		yes
		yes
		yes
		yes
		yes
		yes
		yes

Measurement channels	160	32
Maximum number of data traces	1440 (160 channels/9 traces mode)	unlimited
Windows-OS	yes	yes[3]
Internal automation	VBA, SCPI, COM	SCPI, D/COM
I/O	LAN, USB, GPIB, XGA, parallel, handler, mini-DIN	LAN, USB, GPIB, VGA, parallel, RS-232
ADS linkage	software driver supported	supported
Built-in source attenuator	yes	yes (with Option 225, 245, 246, 425, 525)
DC bias input	yes	no
Time domain	yes (with Option 010)	yes (with Option 010)
Corrected specifications[5]	(2-port cal, 85052D 3.5 mm, 50 ohms) Dir 36 to 42 dB SM 28 to 37 dB LM 36 to 42 dB Refl trk ±0.003 to 0.008 dB Trans trk ±0.034 to 0.208 dB	(Option 2xx, 2-or 4-port cal, 3.5 mm) Dir 44 to 48 dB SM 31 to 40 dB LM 44 to 48 dB Refl trk ± 0.003 to .006 dB Trans trk ± 0.01 to .125 dB
Trace noise	0.004 dB rms (10 MHz to 4.38 GHz) (70 kHz BW)	0.01 dB rms (Option 240) 0.014 dB rms (Option 245) 0.038 dB rms (Option 246) 0.006 dB rms (Option 22x) 0.01 dB rms (Option 42x, 52x)
Measurement speed **(1 sweep, 201 points, correction off)**	3.2 ms (11 GHz to 12 GHz, 500 kHz BW)	9 ms (250 kHz BW)

See back page for footnotes

Network analyzers

	PNA	PNA-X	PNA-X	PNA-mmwave
Model number	E8361C E8362C E8363C E8364C	N5242A	N5244A N5245A	N5250C
Frequency range	E8362C 10 MHz to 20 GHz E8363C 10 MHz to 40 GHz E8364C 10 MHz to 50 GHz E8361C[1] 10 MHz to 67 GHz	10 MHz to 26.5 GHz	N5244A 10 MHz to 43.5 GHz N5245A 10 MHz to 50 GHz	10 MHz to 110 GHz, and extendable to 0.5 THz
Number of ports	2	2 (Option 200), 4 (Option 400)	2 (Option 200), 4 (Option 400)	2
Balanced measurements	no	yes (Option 400)	yes (Option 400)	no
System impedance	50 ohms	50 ohms	50 ohms	50 ohms
System dynamic range (at 20 GHz)	94 to 125 dB 136 dB with direct receiver access (typical)	121 to 130 dB depends on configuration 124 to 141 dB with direct receiver access (typical)	121 to 125 depends on configuration 133 to 137 with direct receiver access (typical)	111 dB
Power at test port (at 20 GHz)	–25 to +5 dBm at 10 GHz (60 dB source attenuator option expands min. power to –82 dBmat 10 GHz)	–25 to +13 dBm (Option 200, 400) –90 to +10 dBm (Option 219, 419) –90 to +15 dBm (Option 224) –90 to +10 dBm (Option 423)	-25 to +13 dBm (Option 200, 400) -90 to +10 dBm (Option 219, 419) -90 to +10 dBm (Option 224, 423)	–5 dBm
Power sweep range	31 dB	27 to 38 dB (Option 200, 400) 24 to 38 dB (Option 219, 419) 23 to 38 dB (Option 224, 423)	17 to 38 dB (Option 200, 400) 11 to 38 dB (Option 219, 419) 10 to 38 dB (Option 224, 423)	20 dB[4]
Sweep type	linear, log, CW, power, segment	linear, log, CW, power, segment	linear, log, CW, power, segment	linear, log, CW, power, segment
Error correction Full 2 port Full 4 port Full N-port TRL Adapter removal SOLR Ecal support	 yes yes[2] yes yes yes yes yes	 yes yes yes yes yes yes yes	 yes yes yes yes yes yes yes	 yes no no yes yes yes yes[4]
Measurement channels	32	32	32	32
Maximum number of data traces	unlimited	unlimited	unlimited	64
Windows-OS	yes[3]	yes[3]	yes[3]	yes[3]
Internal automation	SCPI, D/COM	SCPI, D/COM	SCPI, D/COM	SCPI, COM,/DCOM
I/O	LAN, USB[4], GPIB, VGA, parallel, RS-232	LAN, USB[4], GPIB, VGA, parallel, RS-232	LAN, USB, GPIB, VGA, parallel, RS-232	LAN, USB, GPIB, VGA, parallel, RS-232
ADS linkage	software driver supported	supported	supported	software driver supported
Built-in source attenuator	yes (with Option UNL)	yes (with Option 010)	yes (with Option 219, 419)	yes
DC bias input	yes (with Option UNL)	no	yes	yes
Time domain	yes (with Option 010)	yes (with Option 100)[4]	yes (with Option 010)	yes (with Option 010)
Corrected specifications[5]	(2-port cal, 2.4 mm) Dir 36 to 42 dB SM 31 to 41 dB LM 35 to 42 dB Refl trk ± 0.001 to 0.027 dB Trans trk ± 0.014 to 0.200 dB	(2-port cal, 3.5 mm) Dir 44 to 48 dB SM 31 to 40 dB LM 44 to 48 dB Refl trk +/-0.003 0.006 dB Trans trk +/-0.015 to 0.104 dB	(2-port cal, 2.4 mm) Dir 36 to 42 dB SM 31 to 41 dB LM 35 to 42 dB Refl trk +/-0.001 to 0.027 dB Trans trk +/-0.020 to 0.182 dB	SM source dependent LM 20 dB
Trace noise	0.006 dB rms (1 kHz BW)	0.002 dB rms (1 kHz BW)	0.002 dB rms (1 kHz BW)	—
Measurement speed (1 sweep, 201 points, correction off)	12 ms (35 kHz BW)	6 ms (600 kHz BW)	6 ms (600 kHz BW)	—

See back page for footnotes

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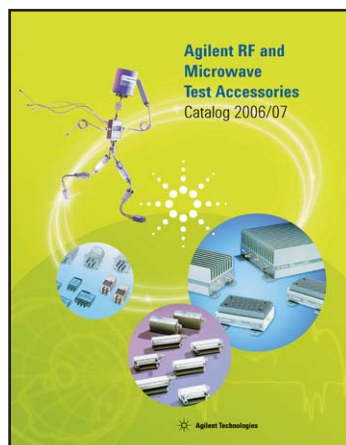
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1. Specified to 67 GHz, with operation to 70 GHz.
2. Available when used with external test sets and software.
3. Open Windows environment. You can load any software on the instrument, such as Visual Basic.
4. Functions up to 67 GHz.
5. Dir = directivity; SM = source match; LM = load match; Refl trk= reflection tracking; Trans trk = transmission tracking
6. Only on 4-port models.
7. Segment includes sweep types that are known as list and fast swept list.

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