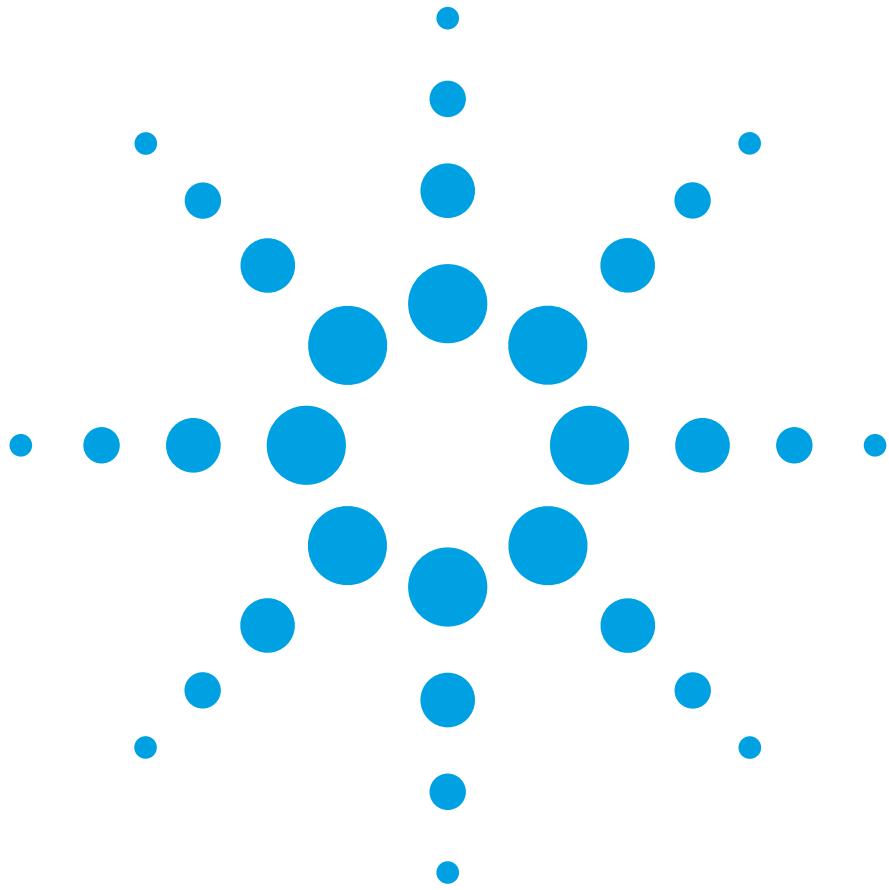


# Agilent

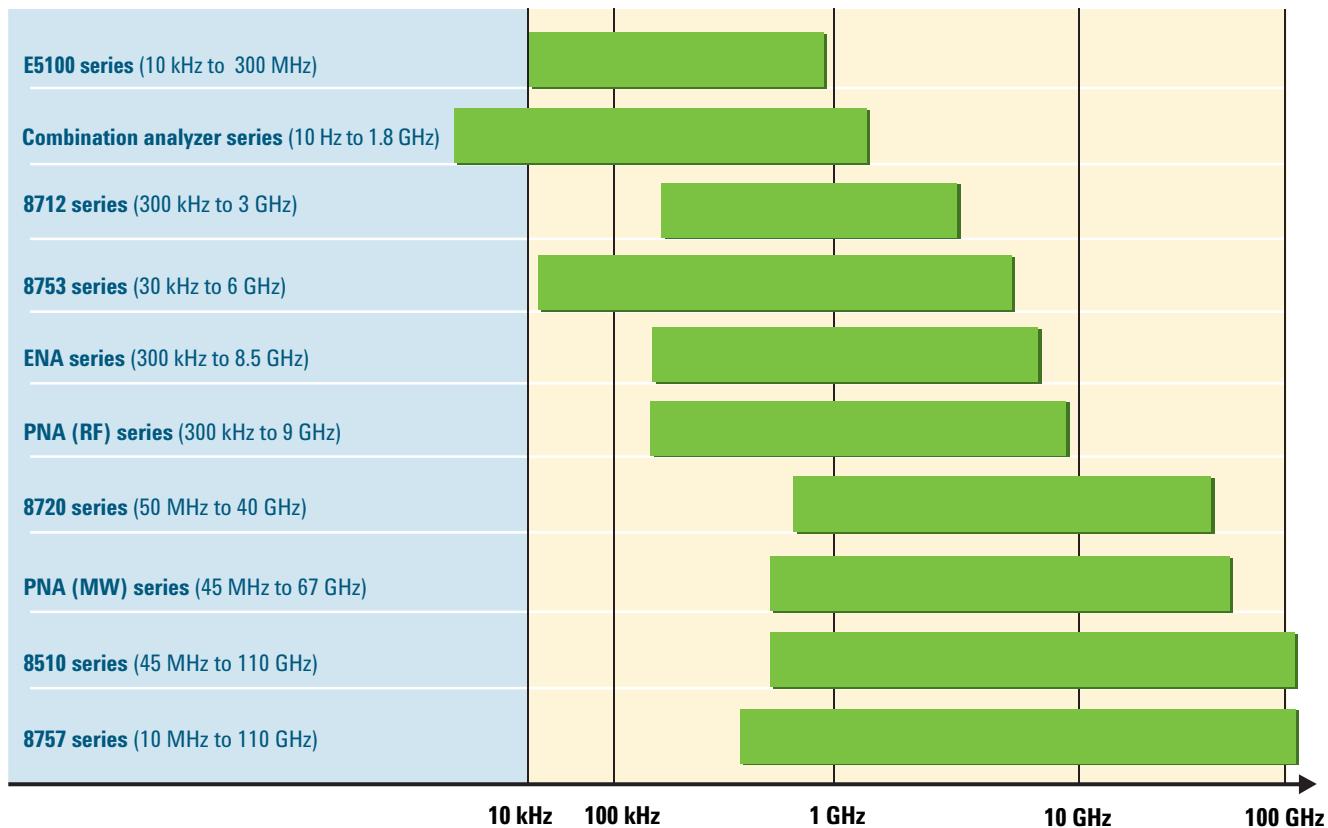
## Network Analyzer Selection Guide



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.*



Frequency coverage for Agilent network analyzers

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## High Throughput for Filter and Resonator Testing

### E5100 series network analyzers

E5100A/B

The Agilent E5100 series network analyzers are 10 kHz to 300 MHz network analyzers best fit for production line testing of crystal/ceramic filters and resonators, as well as other electronic components, where very high test throughput is required.

These analyzers improve manufacturing efficiency by providing exceptionally fast measurement capabilities (up to 0.04 ms/point), built-in waveform analysis commands, and a part-handler interface.

The E5100A provides versatile analysis capabilities to fit your requirements for better yield and higher productivity during final test. The E5100A realizes high quality and high-speed tests with its fine IF bandwidth (IFBW) selection and low-noise circuitry. Convenient analysis and processing functions improve the productivity of final test.

The E5100B, with limited functionality compared to the E5100A, is an economical solution. This model is best suited to in-process testing of filters and resonators. Crystal plating and frequency adjustment are typical application examples.



### Features

- 0.04 ms/point measurement speed
- handler interface for mass-production
- filter and resonator waveform analysis commands

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[www.agilent.com/find/e5100](http://www.agilent.com/find/e5100)

# Network, Spectrum, and Impedance Analyzers in One Box

## Combination analyzer series

4395A, 4396B

The Agilent combination analyzer series merges three analyzer functions into one powerful instrument: a vector network analyzer, a spectrum analyzer, and an optional impedance analyzer. The combination analyzer makes no compromise between vector-network, spectrum, and impedance performance. Use one analyzer for multiple testing needs when you want high speed and accuracy. Save equipment cost and bench space, while avoiding time-consuming, awkward cable hook-up to multiple instruments.

The Agilent 4395A/96B provides excellent LF/RF measurements for lab and production applications. In the lab, evaluate your designs completely and accurately with one instrument. Reduce test time with precise measurements and improved efficiency. On the production line, increase your throughput with the 4395A/96B by quickly and easily switching between different measurement types or tests. The 4395A/96B are breakthroughs in test instruments, delivering outstanding performance at an attractive price.



## Features

- network, spectrum and optional impedance analysis
- fast narrowband spectrum measurement
- time-gated spectrum analysis option

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[www.agilent.com/find/combo](http://www.agilent.com/find/combo)

# Economy Network Analyzer Solutions

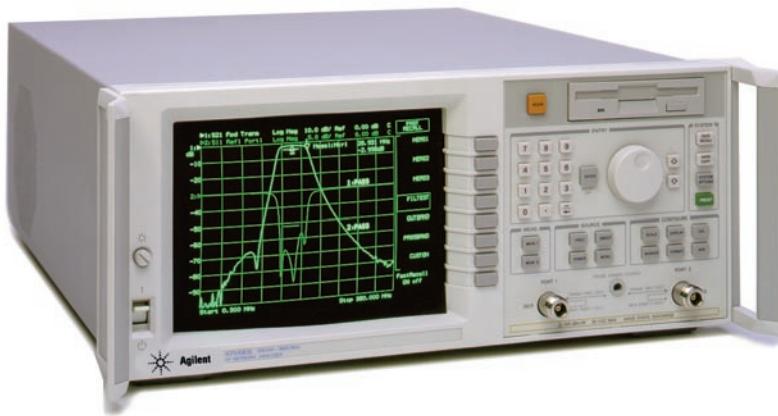
## 8712 series network analyzers

8712ES/ET, 8714ES/ET

The Agilent 8712 series network analyzers provide low-cost solutions for manufacturing test. The series offers four different models with different frequency coverage and test sets (S-parameter or transmission/reflection (T/R)) so you can choose the instrument that meets your measurement needs and budget goals.

Productivity features like automated pass/fail testing, save/recall states, data markers, fast trace update, and IBASIC programming increase throughput and reduce operator errors. In addition, IBASIC can be used as a simple keystroke recorder, or used to develop more complicated test programs that can include custom graphics, softkey labels, and maintain control of other instruments. The built-in LAN interface makes it easy to connect the network analyzer to a factory-wide Ethernet network.

You can add fault-location and structural return loss (SRL) measurement capabilities (option 100) to characterize 50 and 75 ohm cables that are still on spools, or already installed on cellular towers.



## Features

- S-parameter or T/R test set models
- 50 ohm or 75 ohm system impedance available
- optional fault-location and SRL measurements for cable testing

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[www.agilent.com/find/8712](http://www.agilent.com/find/8712)

## Powerful Capabilities for Multi-purpose Requirements

### 8753 series network analyzers

8753ES, 8753ET

The Agilent 8753 series network analyzers offer an unbeatable combination of performance, functionality and ease of use to meet your measurement needs. These analyzers provide you a powerful solution for characterizing the linear and non-linear behavior of active components, as well as a solution for passive component evaluations.

For frequency translating devices like mixers and tuners, the frequency-offset mode allows the network analyzer source to be tuned independently from the receiver. For amplifier measurements, you can add harmonic-measurement capability (option 002) to display swept second- and third-harmonic levels of an amplifier absolutely or in dBc relative to the fundamental. For both mixer and amplifier testing, power meter calibration provides leveled absolute power to devices that are sensitive to absolute input or output levels

Either S-parameter or T/R test set models can be selected depending on your measurement needs. A configurable test set (option 014) provides front panel access to many points in the test set signal paths — enabling you to customize the network analyzer. You can even delete the built-in test set (option 011), which gives you direct access to the R, A, and B receivers.



### Features

- frequency-offset measurement for mixer testing
- harmonic measurement for amplifier testing
- multiple test set configurations

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[www.agilent.com/find/8753](http://www.agilent.com/find/8753)

## Fast Multiport Balanced Testing for Mass Production

### ENA series network analyzers

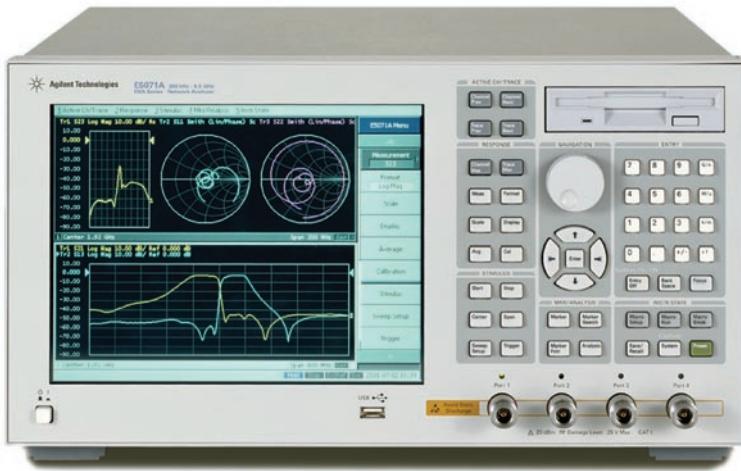
E5070B, E5071B

The Agilent ENA series offers fast, accurate measurements for multiport components such as duplexers and couplers. Built-in test ports, up to four, are available for both the E5070B (3 GHz) and the E5071B (8.5 GHz).

The ENA series offers 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/de-embedding and impedance conversion capabilities.

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

- 2-, 3- or 4-port measurements with full port calibration
- built-in balanced measurement capability
- fixture simulator for balanced component analysis

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[www.agilent.com/find/ena](http://www.agilent.com/find/ena)

## High-performance, Versatile Network Analyzers

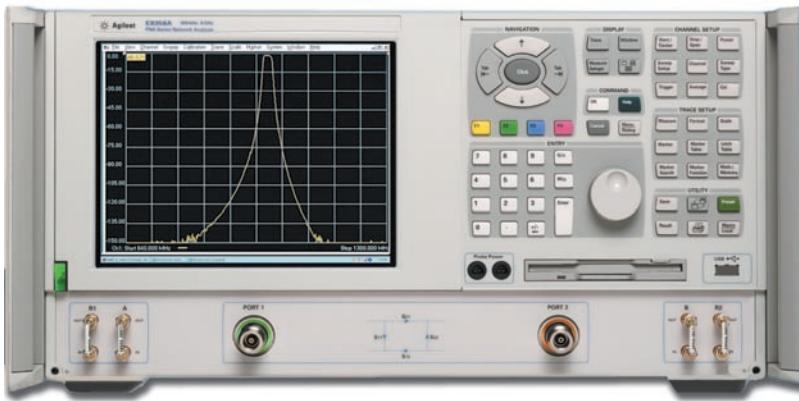
### PNA series network analyzers

E8356/7/8A, E8801/2/3A, N3381/2/3A

The Agilent PNA series offers an unsurpassed combination of performance, speed, and outstanding interconnectivity capabilities to meet the challenges of component testing.

The E8356/7/8A are two-port models (3, 6, or 9 GHz) that provide you the highest performance available from Agilent network analyzers. It offers 128 dB dynamic range at the test ports and 143 dB with direct receiver access. It also provides through-reflect-line (TRL)/ line-reflect-match (LRM) calibration capability for in-fixture and on-wafer devices. Configurable test set options enable you to customize the test set signal path. The E8801/2/3A models are also two-port, but offer three receivers and selectable features of functionality, which provide you the opportunity to configure a more economical instrument that meets your needs. The N3381/2/3A are three-port models with full three-port calibration that enable fast, accurate measurements of all nine S-parameters.

The PNA series offers several functions that can increase your design and test efficiency dramatically. The Windows® 2000 operating system provides the possibility of expanding the instrument's connectivity. From the Windows desktop you can install measurement tools, which reduces 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.



### Features

- 143 dB dynamic range with direct receiver access
- expandability with configurable test set
- advanced connectivity to PC environment

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[www.agilent.com/find/pna](http://www.agilent.com/find/pna)

## **Offering Affordable Prices with Six Different Models**

### **8720 series microwave network analyzers**

8719ES/ET, 8720ES/ET, 8722ES/ET

The 8720 series features six models, in three frequency ranges – 13.5, 20, and 40 GHz – to meet your measurement needs. The ET models offer economical transmission/refection test sets, while the ES models offer S-parameter test sets and a wide selection of configurations for your applications so you can choose the best configuration for your budget. Compact, economical, and easy to use, the 8720 series provides accurate and quick testing of microwave linear and nonlinear devices. The 8720 series analyzers are excellent tools for improving your designs in R&D or maximizing your measurement throughput in manufacturing.

In addition to performing passive component evaluations like those for filters, the 8720 series provides powerful solutions for characterizing active components. For mixer measurements, the frequency-offset option allows the network analyzer source to be tuned independently from the receiver. You can also measure high-power devices up to 20 watts with option 085. A measurement path is made accessible where you can add your own external amplifier to boost the input power to your device. Internally controlled step-attenuators are included in the receiver path to protect the analyzer from high power levels.



### **Features**

- multiple test set choices
- frequency-offset measurement for mixer testing
- high power test set

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[www.agilent.com/find/8720](http://www.agilent.com/find/8720)

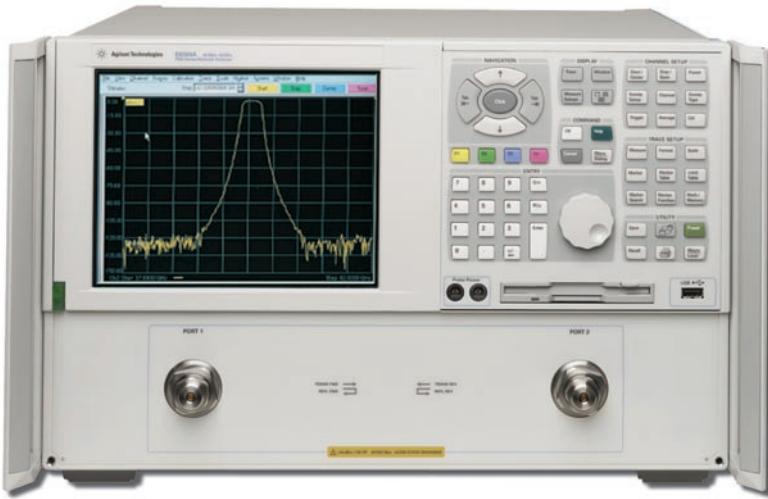
## High performance Microwave Measurements

### PNA series microwave network analyzer

E8362/3/4B, E8361A

The Agilent E8362/3/4B and E8361A 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 series network analyzers cover 20, 40, 50 and 67 GHz frequencies with excellent accuracy. These analyzers are suitable for high-performance microwave components, 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.



### Features

- 136 dB dynamic range with direct receiver access
- expandability with configurable test set
- advanced connectivity to PC environment

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[www.agilent.com/find/pna](http://www.agilent.com/find/pna)

As a part of the PNA family, the user interface and all the analysis capabilities are the same as its RF counterparts. The Windows® 2000 operating system provides the possibility to expand the instrument's connectivity. In addition, from the Windows desktop you can install measurement tools, which reduces 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.

## 110 GHz Modular System for Multiple Applications

### 8510 series microwave network analyzers

(model numbers depend on system configuration)

The Agilent 8510 series provides a complete solution for characterizing microwave devices over the 45 MHz to 110 GHz frequency range. It is the foundation from which you can expand your measurement capability for future applications.

The 8510 series is a modular family of compatible products that can easily be adapted to different measurement requirements without compromising performance – from basic components testing to on-wafer probing, pulsed-device characterization, antenna and radar cross section (RCS) measurements. The 8510 system makes broadband measurements from 45 MHz to 50 GHz in 2.4 mm coax (continuous wave or pulsed), from 45 MHz to 110 GHz in 1.0 mm coax, and from 33 to 110 GHz in waveguide bands.



### Features

- modular configuration to meet future measurement needs
- S-parameter measurements in coax, waveguide, in-fixture or on-wafer
- pulsed-RF, time-domain measurement capability

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[www.agilent.com/find/8510](http://www.agilent.com/find/8510)

## Affordable Scalar Network Analyzers

### 8757 series microwave network analyzer

8757D, 8757xC

The Agilent 8757D is a scalar transmission/reflection network analyzer with three or four detector inputs and four independent color display channels, which can process the signals from detectors and directional bridges. The 8757D offers fast measurement speed, limit testing, and external-disk save/recall. AC detection improves measurement accuracy and provides greater than 76 dB dynamic range. The 8757xC includes a synthesized source and scalar analyzer with the system interconnect cable kit.

You can combine the 8757D with two external sources and use it to measure conversion loss and compression of mixers. For amplifier testing, in addition to measuring gain, flatness, and return loss, the 8757D can measure 1 dB gain compression with near-power-meter accuracy. For characterizing the power accuracy of the 85037 series precision detectors, you can add an internal power calibrator (Option 8757D-002) to the 8757D.

A complete scalar system includes a 8757D, a swept source, a directional bridge or coupler, and detectors. For higher frequencies, Agilent offers millimeter-wave source modules and waveguide accessories.



### Features

- scalar measurements
- three or four detector inputs
- optional power calibrator

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[www.agilent.com/find/8757](http://www.agilent.com/find/8757)

## Network analysis and more

S-parameter is a common measurement parameter 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 cost. 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 these capabilities – providing you with a convenient solution because you won't need to purchase additional instruments to perform these measurements.

## Connector types and calibration accuracy

In an actual measurement environment, your devices might not have co-axial connectors, such as when you perform on-wafer measurements. Or, your devices might not have insertable connector types. In both cases, it is difficult to do accurate calibration, which might affect measurement accuracy. Agilent network analyzers have various calibration functions, like TRL and adapter removal calibration, 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 or our electronic calibration (ECal) modules makes it possible to perform calibration for non-insertable co-axial connectors. These functions will help you produce accurate measurements.

## Expanding your system or using measurement data to write reports

The expandability of an analyzer is critical for doing complex component measurements. Internal and external programming capabilities like IBASIC, 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 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.

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ADS: [www.agilent.com/eesof-eda](http://www.agilent.com/eesof-eda)

VEE: [www.agilent.com/find/vee](http://www.agilent.com/find/vee)

IntuiLink: [www.agilent.com/find/intualink](http://www.agilent.com/find/intualink)

# Measurement Solutions for Your Application

## Research and development

Research and development	E5100 series	Combo series	8712 series	8753 series	ENA series	PNA (RF) series	8720 series	PNA (MW) series	8510 series	8757 series
<b>Basic measurements</b>										
S-parameters	● <sup>1</sup>	● <sup>1</sup>	●	●	●	●	●	●	●	
Transmission and reflection with T/R test set	● <sup>1</sup>	● <sup>1</sup>	●	●			●		●	●
Absolute power	●	●	●	●		●	●	●	●	●
Spectrum analyzer function		●								
Impedance analyzer function	●									
<b>Non-coaxial devices<sup>2</sup></b>										
TRL calibration (on-wafer measurement)					●	●	●	●	●	
TRL* calibration <sup>3</sup>				●			●			
Waveguide measurements				●		●	●	●	●	●
<b>Non-insertable devices<sup>4</sup></b>										
Adapter-removal calibration using mechanical calibration				●	●	●	●	●	●	
Different connector types supported by ECal				●	●	●	●		●	
<b>Time-domain and pulsed-RF measurements</b>										
Time-domain mode/gating				●	●	●	●	●	●	
Swept-frequency pulse testing										●
<b>Programming and connectivity</b>										
Windows-OS					● <sup>5</sup>	● <sup>6</sup>		● <sup>5</sup>		
LAN interface			●		●	●		●		
Internal programming capability <sup>7</sup>	●	●	●		●	● <sup>8</sup>		● <sup>8</sup>		
ADS linkage			● <sup>9</sup>	●	● <sup>9</sup>	●	●	●	●	
VEE linkage		● <sup>10</sup>	●	●		●	●	●	●	
IntuiLink			●	●	●	●	●	●		●

1. Requires an external S-parameter test set or T/R test set.
2. For example, on-wafer, in-fixture, or waveguide applications.
3. TRL\* calibration is a three-receiver version of TRL. TRL calibration provides highly accurate calibration.
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. Closed environment, which does not allow access to a Windows desktop operating system.
6. Open environment, which allows access to a Windows desktop operation system and enables you to install software. Post-measurement analysis can be easily performed on the instrument.
7. Includes IBASIC, Visual Basic, and Visual Basic for Applications.
8. The PNA's open architecture enables you to install any programming software.
9. Saved data files can be used in ADS.
10. Available on the 4395A only.

## High-volume or low-volume manufacturing

Manufacturing can be divided into two segments – high-volume and low-volume. In a high-volume manufacturing environment, the component test time is typically less than 1 second. An automated parts handler system is commonly used to load components and everything is done automatically. On the other hand, low-volume manufacturing means the component test time is longer and measurements are made manually. In both cases, speed is critical. But, depending on the volume you are manufacturing, you may require different capabilities and functions from your test instruments.

## Sweep and data analysis

Total measurement speed can be divided into several different segments, such as sweep, display, data analysis, interface, and data transfer. In low-volume manufacturing, the sweep, data analysis, and display speeds are important. After the measurement, a limit test or a marker function is typically used. On the other hand, in high-volume manufacturing, the sweep, data analysis, and interface 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 automations, Agilent offers various programming capabilities like IBASIC, VBA, and VB. In case you want to transfer all data to an external computer quickly, COM/DCOM provides a seamless environment between our instruments and external computers.

## Communication interfaces

It's becoming more common to have a LAN interface in test and measurement instruments. A LAN is convenient if you need to send data from your manufacturing line to your office, or if you need to monitor measurement status from your office.

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

# Measurement Solutions for Your Application

## Manufacturing test

Manufacturing test	E5100 series	Combo series	8712 series	8753 series	ENA series	PNA (RF) series	8720 series	PNA (MW) series	8510 series	8757 series
<b>Programming</b>										
Internal programming capability <sup>1</sup>	●	●	●		●	● <sup>2</sup>		● <sup>2</sup>		
Test sequencing				●			●			
Fast data transferring <sup>3</sup>						●		●		
<b>Calibration</b>										
Adapter-removal calibration <sup>4</sup>				●	●	●	●	●	●	●
ECal support				●	●	●	●	●	●	●
<b>Measurement and analysis</b>										
Segment sweep <sup>5</sup>	●	●		●	●	●	●	●	●	●
Pass/fail testing	●	●	●	●	●	●	●	●	●	●
Embedding and de-embedding <sup>6</sup>					●					
Waveform analysis command <sup>7</sup>	●				●					
<b>Interface</b>										
LAN			●		●	●		●		
I/O port	●	●	●	●	●	●	●	●	●	
Parts handler interface <sup>8</sup>	●				●	●		●	●	
VGA output	●	●	●	●	●	●	●	●	●	●

1. Includes IBASIC, Visual Basic, and Visual Basic for Applications.

2. The PNA's open architecture enables you to install any programming software.

3. DCOM provides faster data transfer than GPIB.

4. The calibration technique used for non-insertable devices such as those with the same connectors on both sides.

5. Segment sweep includes sweep types that are known as list and fast-swept list.

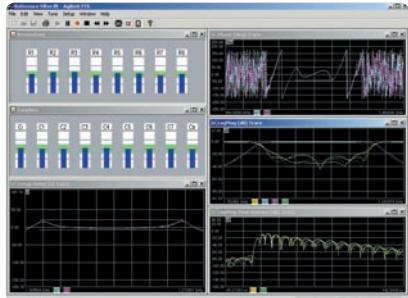
6. Functions to embed or de-embed a fixture's characteristics.

7. Programming commands to quickly retrieve parameters of filters and resonators.

8. The parts handler interface is an I/O-port specialized for communication with automatic a parts handler system.

## Measurement Solutions for Your Application

### Filter and duplexer measurements



#### Filter tuning software for quick multiple-pole filter tuning

N4261A filter tuning software

Agilent's filter tuning software enables you to rapidly tune multiple-pole filters with minimal training. Traditionally, a filter tuner is used to understand the relationship between the frequency or time-domain responses and the filter — a complex and time-consuming process. The N4261A software will speed this process because it is easy to use and does not require you to understand all the filter-tuning measurements. It uses visual tuning indicators to show when the individual resonators and couplers in a filter are tuned to specifications, thus reducing the number of times each element has to be re-tuned before the filter meets specifications.

### Dynamic range, IF bandwidth and sweep time

Dynamic range requirements vary between applications. Agilent offers a variety of network analyzers with different dynamic ranges, so you can choose the best one for your application. For wide dynamic range, Agilent's RF PNA series network analyzers are a good choice. The PNA series offers 128 dB dynamic range at test port and 143 dB with direct receiver access. 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 pass band 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 bandbass 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 20.

[www.agilent.com/find/fts](http://www.agilent.com/find/fts)

# Measurement Solutions for Your Application

## Filter and duplexer measurements

Filter and duplexer measurements	E5100 series	Combo series	8712 series	8753 series	ENA series	PNA (RF) series	8720 series	PNA (MW) series	8510 series	8757 series
<b>Dynamic range</b>										
> 122 dB dynamic range <sup>1</sup>						●				
Wide dynamic range <sup>2</sup>	●	●			●	●	●	●	●	
Direct receiver access to obtain high dynamic range				●		●	●	●	●	
<b>Calibration</b>										
Adapter removal calibration				●	●	●	●	●	●	
Interpolated calibration	●	●	●	●	●	●	●	●	●	
<b>Measurement and analysis</b>										
Segment sweep <sup>3</sup>	●	●		●	●	●	●	●	●	
Four-parameter display	●	●		●	●	●	●	●	●	●
Marker statistics function <sup>4</sup>	●	●	●	●	●	●	●	●		●
<b>Other functions</b>										
Time domain measurement				●	●	●	●	●		●
Filter tuning software				●	●	●	●	●		
Balanced measurement capability <sup>5</sup>				● <sup>6</sup>	●	● <sup>6</sup>	● <sup>6</sup>			
Multi-port measurement capability <sup>5</sup>			● <sup>7</sup>	● <sup>7</sup>	●	● <sup>7</sup>	● <sup>7</sup>			

1. Guaranteed specification.
2. Wide dynamic range is defined as greater than 120 dB for RF analyzers and greater than 90 dB for microwave analyzers.
3. Segment sweep includes sweep types that are known as list and fast swept list.
4. Obtains real-time calculations of device characteristics such as maximum/minimum, center frequency, and 3 dB bandwidth.
5. For more details about balanced and multi-port tests, see page 20.
6. Balanced measurement capability requires an external test set and software.
7. An external test set may be required to achieve these functionalities.

## Measurement Solutions for Your Application

### *Multiport and balanced testing*



#### Balanced measurement system for higher frequency

N4441/2/3/4A balanced measurement system

The ENA series provides a high-speed, integrated balanced measurement solution up to 8.5 GHz. If you require extra capability, such as high frequency coverage the N444xA series will meet your needs. This solution combines a vector network analyzer (VNA) with a S-parameter test set and Windows-based software for differential measurements covering 30 kHz to 20 GHz.

[www.agilent.com/find/multiport](http://www.agilent.com/find/multiport)

## Multiport testing for communication components

Recent module components used in communications have multiple 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. The ENA has built-in three- or four-port measurement capability – enabling fast and accurate multiport measurements.

## Calibration for multiport measurements

When doing multiport measurements, you need to use the proper calibration method to achieve accurate measurements. Agilent offers a three- or four-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.

## Balanced measurements for balanced components

Balanced components are commonly used in communications devices to maintain signal quality in the RF frequency. The ENA series 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.

## External test set for multiport and balanced testing

In order to expand flexibility and capability, Agilent also offers multiport and balanced measurement solutions that use external test sets. For example, several multiport test sets can be used with the PNA series, 8712 series, 8753 series, and 8720 series network analyzers. You can also choose the N444x series balanced measurement system, which is compatible with the PNA series, 8753 series, and 8720 series network analyzers. For details, visit [www.agilent.com/find/multiport](http://www.agilent.com/find/multiport)

# Measurement Solutions for Your Application

## *Multiport and balanced testing*

Multiport and balanced devices	E5100 series	Combo series	8712 series	8753 series	ENA series	PNA (RF) series	8720 series	PNA (MW) series	8510 series	8757 series
<b>Multiport measurements</b>										
Built-in 4-port measurement capability				●						
Built-in 3-port measurement capability				●	●					
Multiport measurement capability with external test set <sup>1</sup>			●	●	●	●	●	●		
<b>Multiport calibration</b>										
Full 4-port calibration				● <sup>2</sup>	●	● <sup>2</sup>	● <sup>2</sup>			
Full 3-port calibration					●	●				
Self-calibration for multiport test set <sup>3</sup>			●							
<b>Balanced measurement</b>										
Built-in balanced measurement capability					●					
Balanced measurement capability with external test set <sup>4</sup>				●		●	●			
Fixture simulation/embedding and de-embedding				● <sup>2</sup>	●	● <sup>2</sup>	● <sup>2</sup>			

1. Agilent 87050A/E, 87075C, Z5621A, Z5623A, E5091A, and N441x families are available as external multi-port test sets. Refer to Test Solutions for Multiport and Balanced Devices (literature number 5988-2461EN) for more details.
2. Available only when used with external test sets and software.
3. Self-calibration of Agilent 87050E and 87075C reduces calibration time and reduces the effects of drift errors.
4. The external test set and software is provided in the Agilent N441x balanced measurement systems. Refer to Test Solutions for Multiport and Balanced Devices (literature number 5988-2461EN) for more details.

# Measurement Solutions for Your Application

## Mixer and amplifier measurements

### Mixer measurements

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 an offset-frequency mode to detect the different frequencies from the input. However, for a more economical solution, there are other types of analyzers that have diode detectors as receivers. In this case however, magnitude-only measurements can be made.

### Amplifier measurements

Agilent network analyzers easily measure commonly specified amplifier parameters like gain, gain compression, isolation, return loss, and group delay. They also offer additional measurements such as power sweep, which is often required to make amplifier measurements, and harmonic distortion, which is often used to understand the amplifier's non-linear behavior. The 8753 series even has the capability to do swept-harmonic 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.

Mixer measurements	E5100 series	Combo series	8712 series	8753 series	ENA series	PNA (RF) series	8720 series	PNA (MW) series	8510 series	8757 series
<b>Measurement and analysis</b>										
Magnitude measurement <sup>1</sup>			●	●		●	●	●	●	
Phase measurement				●		●	●	●	●	
Power sweep	●	●	●	●	●	●	●	●	●	
Internal control of multiple sources							●	●		
<b>Calibration</b>										
Power meter calibration <sup>2</sup>				●	●	●	●	●	●	
<b>Amplifier measurements</b>										
<b>Measurement and analysis</b>										
Power sweep	●	●	●	●	●	●	●	●	●	●
Log sweep		●		●	●	●	●			
Internal bias tee				●	●	●	●	●		
Swept-harmonic option <sup>3</sup>				●						
High-power measurements				●	●	●	●	●	●	
Four-parameter display	●	●		●	●	●	●	●	●	●
Direct receiver access to connect customer-provided high-power test set				●	●	●	●	●		
<b>Calibration</b>										
Power meter calibration <sup>2</sup>				● <sup>4</sup>	● <sup>4</sup>	●	●	●	●	●

1. Frequency-offset modes of the 8753, 8720, and 8510 series let the source and receiver operate at different frequencies. Both magnitude and phase measurements can be made. The 8712 and 8757 series use the diode detection method. Only magnitude measurements can be made.

2. Transfers the accuracy of the power meter to the network analyzer, providing very accurate absolute power measurements.

3. Measures second and third harmonics.

4. Source power meter calibration only.

## Related Network Analyzer Products

### Electronic calibration (ECal) modules

ECal is a precision, single-connection calibration technique for 2- or 4-port Agilent vector network analyzers. Agilent ECal modules are fully traceable and verifiable against electronic impedance standards and can simplify your daily calibration routine. ECal modules are available for Type N-50, N-75, 7 mm, 3.5 mm, Type F, and 7-16 (300 kHz to 9 GHz) connectors. Modules are available in microwave frequency ranging from 10 MHz to 67 GHz for 7 mm, Type N-50, 3.5 mm, 2.92 mm, 2.4 mm and 1.85 mm.

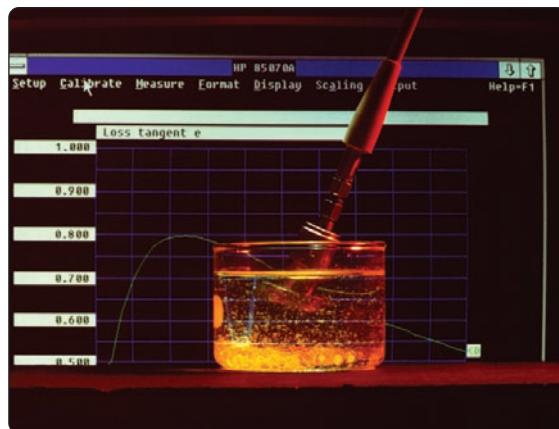


[www.agilent.com/find/ecal](http://www.agilent.com/find/ecal)

### 85070D dielectric probe kit and 85071D materials measurement software

Together, these products enable you to obtain permittivity (dielectric constant) or permeability of material samples from network analysis results.

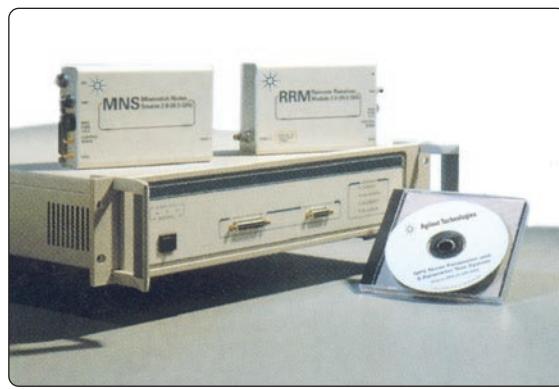
[www.agilent.com/find/materials](http://www.agilent.com/find/materials)



### N4456A/7A noise-parameter measurement system

This system provides solid-state-tuner-based small-signal characterization of RF and microwave semiconductor devices from high-gain, sub-1 dB noise-figure transistors, to millimeter-wave low-noise amplifiers.

[www.agilent.com/find/np](http://www.agilent.com/find/np)



# Specification and Feature Comparison

## RF network analyzers

	E5100 series	Combination analyzer series	8712 series
<b>Model number</b>	E5100A E5100B	4395A 4396B	8712ES/ET 8714ES/ET
<b>Frequency range</b>	E5100A: 10 kHz to 180 MHz/300 MHz E5100B: 10 kHz to 300 MHz	4395A: 10 Hz to 500 MHz 4396B: 100 kHz to 1.8 GHz	8712ES/ET: 300 kHz to 1.3 GHz 8714ES/ET: 300 kHz to 3 GHz
<b>Number of ports<sup>4</sup></b>	2	2	2
<b>Balanced measurements<sup>4</sup></b>	no	no	no
<b>System impedance</b>	50 ohm	50 or 75 ohms	50 or 75 ohms
<b>System dynamic range</b>	120 dB	4395A: 115 dB 4396B: 120 dB	8712ET: 115 dB 8714ET: 114 dB 8712ES: 104 dB 8714ET: 101 dB
<b>Power at test port</b>	–48 dBm to +22 dBm (Opt.001 and 010) –65 dBm to +5 dBm (at RF OUT 2 with Opt.600)	4395A: –50 to +15 dBm 4396B: –60 to +20 dBm	8712ES: –60 to +13 dBm 8712ET: 0 to +16 dBm –60 to +15 dBm (atten. Opt. 1E1) 8714ES: –60 to +9 dBm 8714ET: –5 to +11 dBm –60 to +10 dBm (atten. Opt. 1E1) (75 ohm option reduces max output by 3 dB)
<b>Power sweep range</b>	70 dB (Power Opt. 010)	20 dB	8712ES/ET: 13 dB 8714ES/ET: 15 dB
<b>Sweep type</b>	linear, segment <sup>2</sup> , power	linear, log, segment <sup>2</sup> , power	linear, power
<b>Error correction</b>	Full 2-port Full 3 or 4-port TRL Adapter-removal ECal support	no no no no no	yes (ES model only) no no no no
<b>Measurement channels</b>	2	2	1
<b>Maximum number of data traces</b>	4	4	2
<b>Windows-OS</b>	no	no	no
<b>Internal automation</b>	IBASIC	IBASIC	IBASIC
<b>I/O</b>	GPIB, VGA, parallel, mini-DIN	GPIB, VGA, parallel, mini-DIN	LAN, GPIB, VGA, parallel, RS-232, mini-DIN
<b>ADS linkage</b>	no	no	no
<b>Built-in source attenuator</b>	no	no	yes (ES: standard, ET: option)
<b>DC bias input</b>	no	no	no
<b>Time domain</b>	no	no	no
<b>Corrected specifications<sup>1</sup></b>	do not specify system performance	do not specify system performance	(enhanced response cal, type N, 50 ohms, ES model) Dir 47 to 50 dB SM 36 to 42 dB LM 47 to 50 dB Refl trk $\pm 0.02$ dB Trans trk $\pm 0.04$ to 0.055 dB
<b>Trace noise</b>	0.01 dB rms (1 kHz IFBW) 4396B: 0.002 dB rms (300 Hz IFBW) 0.02 dB rms (broadband)	4395A: 0.005 dB rms (300 Hz IFBW)	0.01 dB rms (narrowband, 250 Hz BW)
<b>Measurement speed<sup>3</sup> (1 sweep, 201 points)</b>	8 ms (1-port cal, ramp-sweep) 64 ms (1-port cal, step-sweep)	165 ms (response cal, gain, 30 kHz BW) 215 ms (response cal, gain and phase, 30 kHz BW)	72 ms (1-port cal, 6.5 kHz BW) 119 ms (1-port cal, 4.0 kHz BW) 240 ms (2-port cal, 4.0 kHz BW, ES model only)

1. Dir = directivity; SM = source match; LM = load match; Refl trk= reflection tracking; Trans trk = transmission tracking

2. Segment includes sweep types that are known as list and fast swept list.

3. Includes system retrace time, but does not include source bandswitch times. Refer to product datasheets for detailed measurement conditions.

4. Table shows the capabilities of the stand-alone instrument. Possible to add capabilities with external test sets. See page 20.

# Specification and Feature Comparison

## RF network analyzers

	8753 series	ENA series	PNA (RF) series
<b>Model number</b>	8753ES/ET 	E5070B E5071B 	E8356/7/8A E8801/2/3A N3381/2/3A 
<b>Frequency range</b>	30 kHz to 3 GHz (ES) 30 kHz to 6 GHz (ES with Opt.006) 300 kHz to 3 GHz (ET) 300 kHz to 6 GHz (ET with Opt.006)	E5070B: 300 kHz to 3 GHz E5071B: 300 kHz to 8.5 GHz	E8356A/E8801A/N3381A: 300 kHz to 3 GHz E8357A/E8802A/N3382A: 300 kHz to 6 GHz E8358A/E8803A/N3383A: 300 kHz to 9 GHz
<b>Number of ports<sup>4</sup></b>	2	2, 3 or 4	2 or 3
<b>Balanced measurements<sup>4</sup></b>	no	yes	no
<b>System impedance</b>	50 ohms 75 ohms (ES model only)	50 ohms	50 ohms
<b>System dynamic range</b>	110 dB (to 3 GHz) 105 dB (to 6 GHz)	120 dB (to 1.5 GHz) 122 dB (to 4 GHz) 118 dB (to 6 GHz) 113 dB (to 7.5 GHz) 106 dB (to 8.5 GHz)	123 dB (to 1 MHz) 128 dB (to 3 GHz) 118 dB (to 6 GHz) 113 dB (to 9 GHz) (Direct receiver access increases dynamic range 15 dB in each frequency range)
<b>Power at test port</b>	ES: -85 dBm to +10 dBm -85 dBm to +8 dBm (Opt.075 or 014) ET: -20 dBm to +5 dBm -85 dBm to +10 dBm (Opt.004 )	-15dBm to 10dBm -50 dBm to 10dBm (with option)	-85 dBm to +10 dBm Available with E8356/7/8A (Opt. UNL)
<b>Power sweep range</b>	25 dB	25 dB	20 to 25 dB
<b>Sweep type</b>	linear, log, segment <sup>2</sup> , power, CW	linear, log, segment <sup>2</sup> , power, CW	linear, log, segment <sup>2</sup> , power, CW
<b>Error correction</b>	Full 2-port Full 3 or 4-port TRL Adapter-removal ECal support	yes (ES model only) no TRL* only (ES model only) yes (ES model only) yes	yes yes yes yes yes
<b>Measurement channels</b>	2	16	32 <sup>5</sup>
<b>Maximum number of data traces</b>	4	81	32
<b>Windows-OS</b>	no	Windows 2000 (Closed) <sup>10</sup>	Windows 2000 (Open) <sup>7</sup>
<b>Internal automation</b>	test sequencing	VBA, SCPI, COM	SCPI, COM/DCOM <sup>8</sup>
<b>I/O</b>	GPIB, VGA, parallel, RS-232, mini-DIN	LAN, USB <sup>9</sup> , GPIB, VGA, parallel, handler, mini-DIN	LAN, USB <sup>6</sup> , GPIB, VGA, parallel, handler, RS-232
<b>ADS linkage</b>	Software driver supported	File format supported	Software driver supported
<b>Built-in source attenuator</b>	yes (ES: standard, ET: option)	yes (with option)	yes (E835xA: standard, other models: option)
<b>DC bias input</b>	yes	no	yes
<b>Time domain</b>	yes (with Opt. 010)	yes (with Opt. 010)	yes (with Opt. 010)
<b>Corrected specifications<sup>1</sup></b>	(2-port cal, type N, 50 ohms, ES model) Dir 47 to 50 dB SM 36 to 49 dB LM 47 to 50 dB Refl trk $\pm 0.005$ to 0.02 dB Trans trk $\pm 0.014$ to 0.026 dB	(2-port cal, type N, 50 ohms) Dir 47 to 52 dB SM 36 to 45 dB LM 39 to 47 dB Refl trk $\pm 0.040$ to 0.070 dB Trans trk $\pm 0.039$ to 0.136 dB	(2-port cal, type N, 50 ohms, E835xA model) Dir 47 to 54 dB SM 36 to 45 dB LM 39 to 47 dB Refl trk $\pm 0.040$ to $\pm 0.070$ dB Trans trk $\pm 0.039$ to $\pm 0.135$ dB
<b>Trace noise</b>	0.006 dB rms (30 kHz to 3 GHz) (3 kHz BW)	0.001 dB rms (3 MHz to 4.25 GHz) (3 kHz BW)	0.002 dB rms (1 kHz BW)
<b>Measurement speed<sup>3</sup> (1 sweep, 201 points)</b>	70 ms (1-port cal) 139 ms (2-port cal, ES model only) (6 kHz BW)	8 ms (2-port cal) (100 kHz BW)	29 ms (2-port cal) (35 kHz BW)

5. For E8356/7/8B, these functions are available with firmware revision A.02.50 or later.

6. The PNA's open architecture allows you to use USB peripherals, such as a keyboard, mouse, and printer.

7. The PNA's open architecture allows you to access the operation system and install software, such as Visual Basic.

8. DCOM enables you to have a seamless programming environment between the instrument and a PC.

9. The ENA's open architecture allows you to use USB peripherals, such as a keyboard, mouse, printer, and ECal.

10. The ENA does not allow you to access a Windows desktop operating system.

# Specification and Feature Comparison

## Microwave network analyzers

	8720 series	PNA (MW) series <sup>8</sup>	8757 series	8510 series	
<b>Model numbers</b>	8719ES/ET 8720ES/ET 8722ES/ET		E8362B E8363B E8364B E8361A	8757D	
<b>Frequency range</b>	8719ES/ET: 50 MHz to 13.5 GHz 8720ES/ET: 50 MHz to 20 GHz 8722ES/ET: 50 MHz to 40 GHz	E8362B 45 MHz to 20 GHz E8363B 45 MHz to 40 GHz E8364B 45 MHz to 50 GHz E8361A <sup>9</sup> 45 MHz to 67 GHz	10 MHz to 110 GHz, depends on configuration	45 MHz to 110 GHz, depends on configuration	
<b>Number of ports<sup>4</sup></b>	2	2	2	2	
<b>Balanced measurements<sup>4</sup></b>	no	no	no	no	
<b>System impedance</b>	50 ohms	50 ohm	50 ohms	50 ohms	
<b>System dynamic range</b>	8719/20ET: 102 to 104 dB 8719/20ES: 77 to 100 dB 8722ET: 84 to 97 dB 8722ES: 67 to 93 dB	94 to 125 dB (max. 136 dB with direct receiver access)	75 dB/70 dB (AC/DC detection modes)	60 to 93 dB, depends on configuration	
<b>Power at test port</b>	8719/20ET: -10 to +10 dBm 8719/20ES: -70 to +5 dBm 8722ET: -15 to 0 dBm (to 20 GHz) -15 to -5 dBm (20 GHz to 40 GHz) (Opt. 004 expands min. power by 55 dB) 8722ES: -75 to -5 dBm (to 20 GHz) -75 to -10 dBm (20 GHz to 40 GHz) (Opt. 007 adds +5 dBm to min/max power level)	-25 to +5dBm at 10GHz (60 dB source attenuator option expands min. power to -82 dBm at 10GHz)	depends on signal source: +10 or +17 dBm (to 26.5 GHz) +6 dBm (to 40 GHz)	depends on system configuration	
<b>Power sweep range</b>	8719/20: 20 dB 8722: 15 dB	31 dB	25 dB	20 dB	
<b>Sweep type</b>	linear, log, power, CW, segment <sup>2</sup>	linear, CW, power, segment <sup>2</sup>	linear, power, CW	linear, power, CW, segment <sup>2</sup>	
<b>Error correction</b>	Full 2-port Full 3 or 4-port TRL Adapter-removal ECal support	yes (ES model only) no optional (TRL*standard, ES model only) yes (ES model only) yes (ES model only)	yes no yes yes yes	no no no no no	yes no yes yes yes <sup>5</sup>
<b>Measurement channels</b>	2	32	2	depends on system configuration	
<b>Visible data traces</b>	4	32	4	4	
<b>Windows-OS</b>	no	Windows 2000 <sup>7</sup>	no	no	
<b>Internal automation</b>	test sequencing	SCPI, D/COM <sup>7</sup>	no	no	
<b>I/O</b>	GPIB, VGA, parallel, RS-232, mini-DIN	LAN, USB <sup>6</sup> , GPIB, VGA, parallel, RS-232	GPIB, VGA	depends on system configuration	
<b>ADS linkage</b>	yes	Software driver supported	no	yes	
<b>Built-in source attenuator</b>	yes (standard for ES model, Opt. 004 for ET model)	yes (with Opt. UNL)	no	depends on system configuration	
<b>DC bias input</b>	yes (ES model only)	yes (with Opt. UNL)	no	yes	
<b>Time domain</b>	yes (with Opt. 010)	yes (with Opt. 010)	no	yes	
<b>Corrected specifications<sup>1</sup></b>	(2-port cal, 3.5 mm) Dir 44 to 48 dB SM 31 to 40 dB LM 44 to 48 dB (ES model) LM 15 to 22 dB (ET model) Refl trk $\pm$ 0.006 to 0.008 dB Trans trk $\pm$ 0.017 to 0.099 dB	(2-port cal, 2.4 mm) Dir 36 to 42 dB SM 31 to 41 dB LM 35 to 42 dB Refl trk $\pm$ 0.001 to 0.027 dB Trans trk $\pm$ 0.014 to 0.200 dB	(coaxial) Dir 40 dB SM source dependent LM 20 dB	(8510E, 2-port cal, 3.5 mm) Dir 44 to 48 dB SM 31 to 40 dB LM 44 to 48 dB Refl trk $\pm$ 0.003 to 0.006 dB Trans trk $\pm$ 0.017 to 0.084 dB	
<b>Trace noise (typical)</b>	0.03 dB rms (to 13.5 GHz) (3 kHz BW)	0.006 dB rms (1 kHz BW)	unspecified	depends on system configuration	
<b>Measurement speed<sup>2</sup> (1 sweep, 201 points)</b>	65 ms (1-port cal) 158 ms (2-port cal, ES model only) (6 kHz BW)	38 ms (2-port cal) (35 kHz BW)	50 ms (1 trace)	470 ms (2-port cal) (10 kHz BW)	

1. Dir = directivity; SM = source match; LM = load match; Refl trk= reflection tracking; Trans trk = transmission tracking

2. Includes system retrace time, but does not include source bandswitch times. The speed of a one-port calibrated measurement is equal to that of enhanced-response and uncorrected.

4. Table shows the capabilities of a stand-alone instrument. Possible to add capabilities with external test set. See page 20.

5. Control software is available.

6. Keyboard and mouse can be attached using USB ports.

7. Windows 2000 is an open environment. You can load any software on the instrument, such as Visual Basic.

8. Typical performance below 45 and above 67 GHz.

9. Specified to 67 GHz, with operation to 70 GHz.

## Information resources

### Online

**Network analyzers:**  
[www.agilent.com/find/na](http://www.agilent.com/find/na)

**Network analyzer accessories:**  
[www.agilent.com/find/accessories](http://www.agilent.com/find/accessories)

**Test and measurement email updates:**  
[www.agilent.com/find/emailupdates](http://www.agilent.com/find/emailupdates)

### Literature

*RF and Microwave Test Accessories Catalog*, literature number 5968-4314EN

*Test Solutions for Multiport and Balanced Devices*, literature number 5988-2461EN

### Application notes

*Advanced Filter Tuning Using Time Domain Transforms*, literature number 5980-2785EN

*Applying Error Correction to Network Analyzer Measurements*, literature number 5965-7709E

*Balanced Measurement Example: Baluns*, literature number 5988-2924EN

*Balanced Measurement Example: Differential Amplifiers*, literature number 5988-2923EN

*Balanced Measurement Example: SAW Filters*, literature number 5988-2922EN

*De-embedding and Embedding S-Parameter Networks Using a Vector Network Analyzer*, literature number 5980-2784EN

*Exploring the Architecture of Network Analyzers*, literature number 5965-7708E

*Improving Network Analyzer Measurements of Frequency-Translating Devices*, literature number 5966-3318E

*Improving Throughput in Network Analyzer Applications*, literature number 5966-3317E

*In-fixture Measurements Using Vector Network Analyzers*, literature number 5968-5329E

*Network Analyzer Measurements: Filter and Amplifier Examples*, literature number 5965-7710E

*Simplified Filter Tuning Using Time Domain*, literature number 5968-5328E

*Understanding and Improving Network Analyzer Dynamic Range*, literature number 5980-2778EN

*Understanding the Fundamental Principles of Vector Network Analysis*, literature number 5965-7707E

*Using a Network Analyzer to Characterize High-Power Components*, literature number 5966-3319E

*10 Hints for Making Better Network Analyzer Measurements*, literature number 5965-8166E

### Product notes

*PNA series, Connectivity Advances for Component Manufacturers*, literature number 5980-2782EN

*PNA series, Introduction to Application Development with the Agilent PNA Series of Network Analyzers*, literature number 5980-2666EN

*PNA series, The 'Need for Speed' in Component Manufacturing Test*, literature number 5980-2783EN

*8510 series, Measuring Non-Insertable Devices*, literature number 5956-4373E

*8510 series, Testing Amplifiers and Active Devices with the Agilent 8510C Network Analyzer*, literature number 5963-2352E

*8510 series, Using Multiple Test Sets with the Agilent 8510C*, literature number 5967-5886E

*8753 series, RF Component Measurements: Amplifier Measurements Using the Agilent 8753 Network Analyzer*, literature number 5956-4361

*8753 series, RF Component Measurements: Mixer Measurements Using the 8753B Network Analyzer*, literature number 5956-4362



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#### Online Assistance:

[www.agilent.com/find/assist](http://www.agilent.com/find/assist)

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