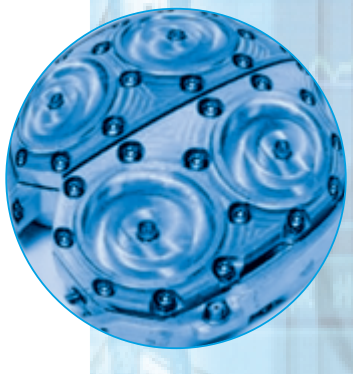
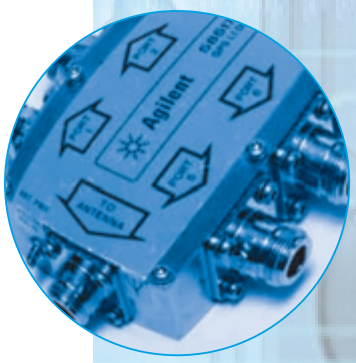
Agilent Test Solutions for Multiport and Balanced Devices





Agilent Technologies

Agilent Vector Network Analyzers for Multiport and Balanced Devices

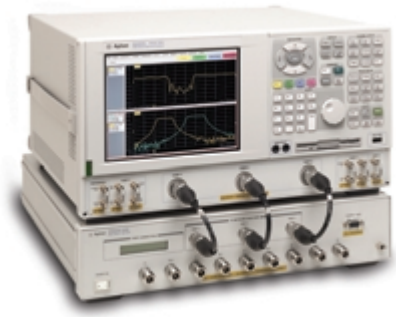
ENA Series

ENA

- One-box integrated solution for three-, four-port, and balanced devices
- Best price performance up to 8.5 GHz
- High measurement speed
- Available dedicated multiport test set for up to nine-port devices

ENA-L

- Lowest cost solution for 75 ohm devices up to 1.3 GHz
- Test set cal and self cal for simplified calibration



PNA Series

- Most flexible solutions with configurable test set, custom multiport test sets, and open Windows® architecture
- Highest performance and accuracy
- Wide frequency coverage up to 50 GHz
- Identical user interface and programming between RF and Microwave models

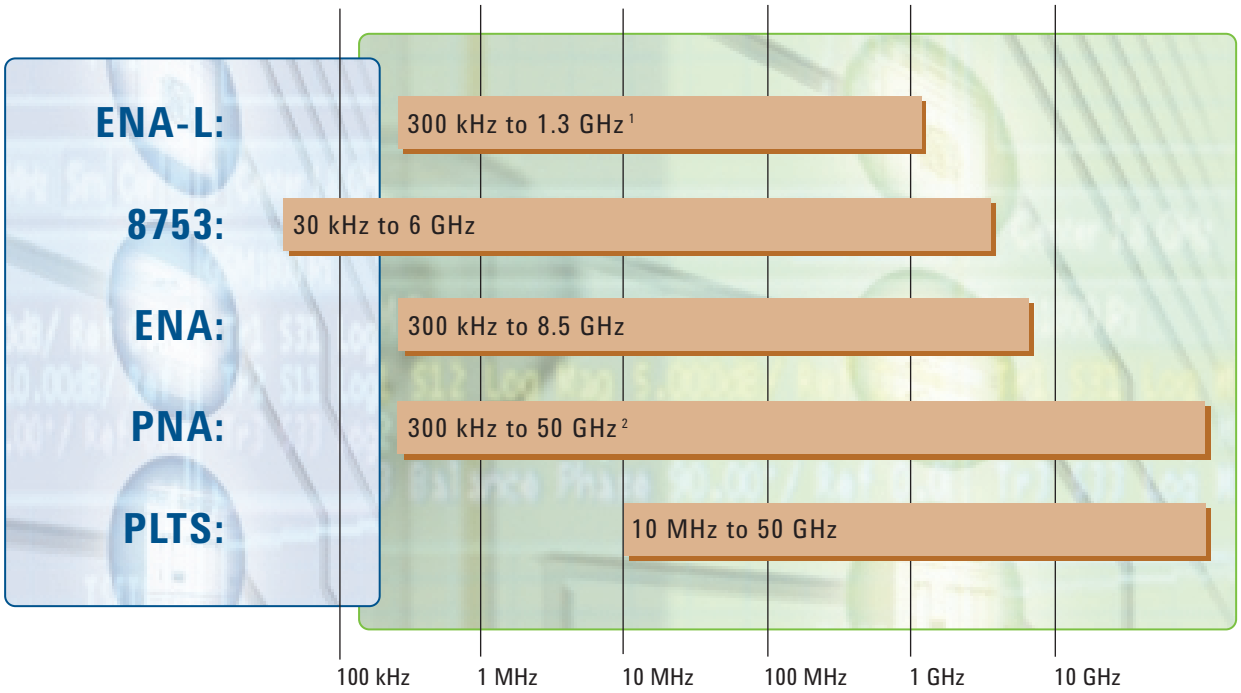
Physical Layer Test Systems (PLTS)

- Premier signal-integrity solution for designing and validating high-speed digital interconnects
- Complete device characterization of single-ended, differential, common-mode and mode-conversion behavior
- Available in 36 ps (20 GHz), 18 ps (40 GHz), and 14.4 ps (50 GHz) systems

8753ES with H39 and Option 006

- Unique solution for frequency transition devices up to 6 GHz
- Available mixer measurements and harmonics measurements functions along with three built-in test ports

Frequency Coverage for Agilent Network Analyzers



1 Available up to 3 GHz for two ports, up to 1. 3 GHz used with 87075C test set.
2 Available up to 110 GHz for two ports, up to 50 GHz for four port configuration.

ENA 2-, 3-, and 4-port RF Network Analyzers

ENA series RF network analyzer with four built-in test ports

New-generation wireless equipment depends on advanced RF components, from duplexers and couplers to differential SAW filters and amplifiers. These components need to be measured efficiently in R&D and production process. Fast and accurate testing is crucial, and Agilent's ENA series network analyzers offer comprehensive measurement capabilities for advanced multiport devices.

Built-in two, three, or four test ports provide simultaneous measurement of all signal paths in components with up to four ports. This advanced architecture minimizes the number of sweeps required for multiport S-parameter measurements and helps increase test throughput.

Built-in balanced measurements, matching-circuit simulation, and port characteristic impedance conversion all enable accurate characterization of most advanced RF components. These test capabilities contribute to shortened time to market and reduced cost of test.

The ENA series holds up to sixteen measurement channels in a single instrument state. Independent frequency list, calibration data, measurement parameters, trace layout, triggering, and limit test are applied in each measurement channel, which acts as if it is an independent network analyzer. This multi-channel capability eliminates recall time for sequencing multiple instrument setup states that are often required for multiport devices used in multi-frequency applications.

E5070B/71B

Features

- Full specified performance from 300 kHz to 3 GHz (E5070B) and 300 kHz to 8.5 GHz (E5071B)
- Built-in 2, 3, and 4 test ports
- Up to Full 4-port calibration
- 122 dB wide dynamic range
- 0.001 dBrms low trace noise
- Fast measurement speed: 9.6 us/point
- Up to 16 measurement channels
- Up to 16 traces per channel
- Real-time balanced measurements
- Flexible matching circuit simulation
- Port characteristic impedance conversion for non-50 ohm device measurements
- Advanced calibration: TRL/LRL cal and mixed-connector cal
- Simulation linkage with Touchstone files (s2p, s3p, and s4p)

The ENA series also accelerates test system development and expands customization capabilities. Built-in Visual Basic® for Applications (VBA) allow you to develop and customize test programs in the ENA series, or import Visual Basic programs from an external PC. A custom user interface using a touch screen (optional) can be created on the 10.4" LCD display.

For more information:
http://www.agilent.com/find/ena

ENA with E5091A Multiport Test Set

ENA RF network analyzer with E5091A multiport test set

Four-port RF ECal with four 3.5 mm connectors

The Agilent E5091A multiport test set, combined with the four-port ENA network analyzer, is a complete solution for multiport device measurements. The multiport test set is available in seven and nine-port configurations. The system is tailored for testing the antenna switch modules for mobile handsets, particularly those modules with balanced ports, although it can be used in a wide range of multiport measurement applications. The system is well suited for both manufacturing and R&D with exceptionally fast measurement speed and various features that facilitate test automation.

The N4431A four-port electronic calibration (ECal) module is available for efficient multiport calibration. ECal is a precision, single-connection calibration technique for your vector network analyzer. It dramatically reduces operation time and number of connections compared to using a mechanical cal kit to perform a full three- or four-port calibration. With ECal, the operator simply connects the ECal module to the network analyzer and the software controls the rest. Easy to use operation of the multiport system minimizes measurement setup time.

ENA with E5091A

Features

- Single connection measurement of up to 9-port devices
- Exceptionally fast measurement speed
- Solid-state switches for fast and reliable measurement
- Built-in balanced measurement to interpret mixed-mode S-parameters
- Easy to use operation with full test set control from ENA series

For more information:
http://www.agilent.com/find/ena

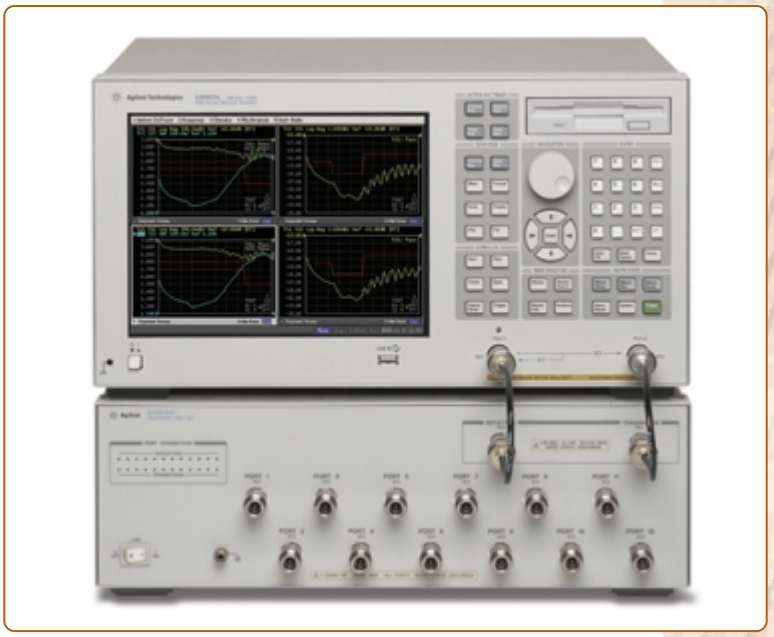
N4431A Four-port RF electronic calibration module

Features

- Fast full 3- or 4-port calibration with a single connection
- NIST traceable accurate calibration
- Reduced connector wear
- USB interface for direct control with PNA and ENA series network analyzers
- Reliable solid-state switching
- Mixed connector option available (3.5 mm, Type-N 50 ohm, and 7-16)

For more information:
http://www.agilent.com/find/ecal

75 ohm Multiport Solution: ENA-L with 87075C Multiport Test Set



ENA-L E5062A with 87075C test set

75 ohm Electonic Calibration (ECal) Module

The Agilent 87075C multiport test set, combined with ENA-L network analyzers, is a complete affordable solution for multiport CATV device measurements. The multiport test set is available in 6 and 12-port configurations. A test set calibration technique eliminates redundant connection of calibration standard, and ECal further simplifies and speeds calibration. Self Cal (an internally automated calibration) reduces the effects of test system drift without connecting an external standard. Full crossbar switching covers a wide variety of CATV device measurements. The system is well suited for both manufacturing and R&D with an easy-to-use user interface and fast measurement speeds.

ENA-L E5061A or E5062A with 87075C test set

Features

- 75 ohm single connection measurement of up to 12-port devices
- Specified performance up to 1.3 GHz
- Test Set Cal and Self Cal drastically reduces calibration time
- Solid state switching for fast and reliable measurements
- Easy-to-use full test set operation from ENA-L

For more information:
http://www.agilent.com/find/ena

75 ohm electronic calibration (ECal) modules: 85096C (Type-N) or 85099C (Type-F)

Features

- Fully automated 2-port calibration with a single connection
- USB interface for direct control with ENA-L
- Reliable solid-state switching

For more information:
http://www.agilent.com/find/ecal

PNA 3-port RF Network Analyzer

PNA series RF network analyzer with built-in third test port

Rapid and continuous changes in RF and microwave technology present a growing challenge for designers and manufacturers. The Agilent PNA Series is a measurement platform that meets the challenge with the right combination of fast sweep speeds, wide dynamic range, low trace noise, and flexible connectivity. Test your high-performance components with a fast and accurate network analyzer that meets your measurement need now and well into the future.

The three-port PNA network analyzer provides frequency coverage from 300 kHz to 3, 6, and 9 GHz, and offers complete characterization of three-port devices quickly and accurately with three-port calibration and an architecture that minimizes the number of sweeps. This three-port analyzer offers the high level of throughput and performances needed to solve today's complex measurement challenges.

RF PNA N3381A/82A/83A

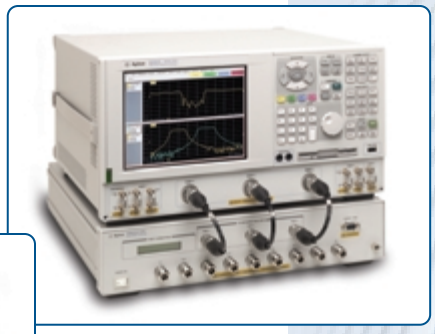
Features

- Full specified performance from 300 kHz to 9 GHz
- Built-in third test port
- Full 3-port calibration
- Advanced calibration including:
  - Guided calibration
  - Electronic calibration (Ecal) provides a precision, single connection, one to four port calibration
  - User defined Ecal
  - Adapter Removal
- De-embedding capability
- Fast measurement speed: 26 µs/point
- 16,001 points per channel
- 32 independent measurement channels
- Wide dynamic range: 143 dB
- Low trace noise: 0.002 dB
- Windows 2000 operating system
- User interface support hardkeys, softkeys, and mouse
- Help system includes full manual, extensive measurement tutorials, and complete programming guide

The PNA series three-port network analyzer offers performance, flexibility, throughput, and connectivity to meet today's measurement requirements and business solutions.

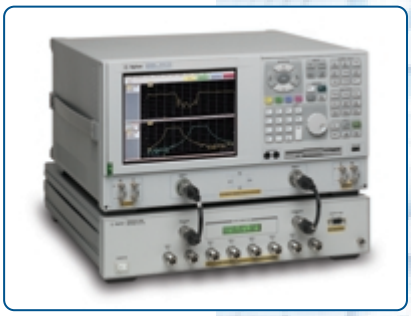
For more information:
http://www.agilent.com/find/pna

PNA and PNA-L Customized Multiport Solutions



PNA series network analyzer with Z5623A H39

PNA series network analyzer with 87050A H16



PNA series network analyzer with Z5623A H48

Many of today's wireless communications and broadband components have three or more ports. These components require multiple connections for complete characterization with a network analyzer. However, time-to-market pressures require that today's components be tested quickly while maintaining high levels of accuracy and high repeatability to achieve production volumes.

Network analyzer sweep speed is only one factor that contributes to the overall throughput that can be achieved in measuring multiport components. The overall throughput depends on how quickly the component can be connected and the system can transition from one measurement path to the next and process that data. Multiport test sets dramatically reduce overall tune and test times because the DUT only needs to be connected once to test multiple signal paths. Minimizing the number of connections also reduces operator fatigue and lowers the chance of connection to the wrong port. In addition, fewer connections means less wear on cables, connectors, fixtures and DUTs. A multiport test set is especially valuable in manufacturing applications where the time required for device connection, handling, and/or configuration is significantly greater than the test time. In these situations, a test set provides a solution that supports operators or part-handlers in increasing throughputs.

Agilent provides the highest performing multiport test solutions to meet the demands of the never-ending trend to decrease size through integration in modules and the pressure to increase throughput and lower test cost. A range of solutions is available for many devices from simple duplexers, for both front-end passive and active and wireless infrastructure components, to more complex integrated modules. These solutions optimize key hardware, firmware, and software features, which provide the best accuracy with the convenience of multiport connections and electronic calibration to achieve exceptionally fast measurement speeds.

PNA series with:
Z5623A Option H39 or Option H48
87050A Option H16

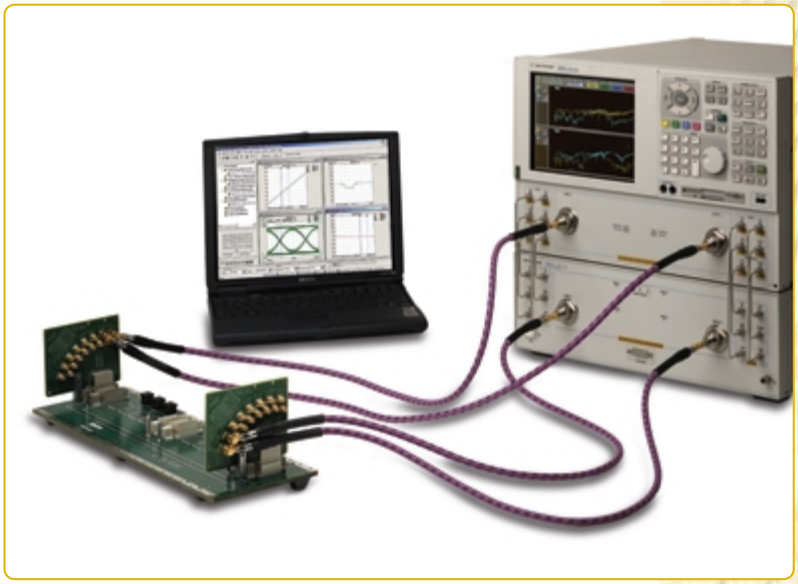
Features

- Multiport configurations optimized for measuring your specific device
- Simple measurement setup and instrument calibration for increased productivity
- Exceptionally fast measurement speed
- Solid-state or mechanical switches available for fast, reliable measurement, and best RF performance
- External control lines on test set for DUT control during testing
- Test program runs internally on PNA
- Automation interface provides programmers with a choice of development environments to design custom test executives
- Built-in LAN interface makes it easy to connect to company network

Agilent multiport test sets can be customized to your measurement application with any number of ports, and a variety of connector types and switching arrangements.

For more information:
Contact your local Agilent Field Engineer for customized multiport test solutions or *http://www.agilent.com/find/assist*

Physical Layer Test Systems (PLTS)



Microwave PNA-based Physical Layer Test System (PLTS)

Physical-layer structures have increasingly become the bottleneck in high-speed digital system performance. As bus speeds, clock speeds, and link speeds all push past the gigabit-per-second mark, digital data no longer looks like simple ones and zeros. In fact, digital data begins to exhibit analog behavior such as reflections from discontinuities, dispersive loss, crosstalk, and EMI radiation and susceptibility. Analog analysis can be the key to solving such digital problems as overshoot, undershoot, ringing, rise-time degradation, pulse droop, ground bounce and eye closure.

While ideal balanced components only respond to or produce differential (out-of-phase) signals, real-world devices also respond to or produce common-mode (in-phase) signals. Agilent's Physical Layer Test Systems perform a series of single-ended stimulus/response measurements on all measurement paths of the device under test, and then calculate and display differential mode, common-mode, and mode conversion S-parameters.

Designing gigabit-per-second devices will require the combination of time-domain and frequency-domain analysis. The Agilent N1900B series Physical Layer Test System is the premier signal integrity solution for designing and validating high-speed differential interconnects. PLTS combines frequency-domain, time-domain, and eye diagram analysis to provide a comprehensive view of device performance. With a single setup to your device, you can measure all transmission and reflection terms for all possible modes of operation, including single-ended, differential, common-mode, and mode-conversion across the full microwave frequency range.

N1957B 14.4 ps (10 MHz to 50 GHz)
E8364B PNA, N4421B Test Set, and N1930A PLTS Software [1]

N1955B 18 ps (10 MHz to 40 GHz)
E8363B PNA, N4420B Test Set, and N1930A PLTS Software [1]

N1953A 36 ps (10 MHz to 20 GHz)
E8362B PNA, N4419B Test Set, and N1930A PLTS Software [1]

Features

- Powerful signal integrity analysis tools include time-domain reflectometry (TDR), time-domain transmission (TDT), frequency-domain, and eye diagram analysis
- Completely characterize the single ended, differential, common mode, and mode conversion behavior of your device
- RLCG parameter extraction allows creation of accurate transmission line models for use in simulation programs such as HSPICE ®
- High dynamic range provides a view into elusive EMI problems that previously may have gone undetected
  - Full four-port vector error correction
  - TRL/LRM/SOLT advanced calibration techniques
  - Port characteristic impedance conversion for non-50 ohm device measurements

Devices such as differential filters, baluns, balanced transmission lines, backplanes, high-speed cables, connectors, and packages that were once difficult to measure using conventional two-port systems, can now be completely and accurately characterized with PLTS.

For more information:
http://www.agilent.com/find/plts

1 Requires external PC with GPIB capability.

8753 Network Analyzer

8753ES option H39/006

If frequency transition devices such as mixers and up/down converters need to be measured along with duplexers or filters, Agilent 8753ES is an appropriate solution. An 8753ES provides mixer measurements and harmonics measurements (Option 002), while Option H39 adds a third test port to a two-port analyzer that enables single connection measurements for all necessary paths of up to three-port devices. Adding a 87050A multiport test set, provides a single-connection multiport measurement solution up to 24 port (Option H24).

8753ES with Option H39 and Option 006

Features

- Three-port solution
- Full two-port vector error correction
- Fully specified performance between all three ports up to 6 GHz
- Fully controllable from familiar 8753 interface
- Solid state switching for fast, repeatable, and reliable switching between measurement paths
- Easily transfer measurement data and images into popular Microsoft® applications with little or no programming using Agilent's IntuiLink connectivity software

For more information:
http://www.agilent.com/find/8753

Test sets (typical performance)

E5091A multiport test set

Designed to work with ENA network analyzers [1]

Frequency range: 50 MHz to 8.5 GHz
Connectors: Type-N (f)
Impedance: 50 ohm
Switch type: Solid state
Switching speed: 3 ms
I/O control: USB

Option	Designed for:	Ports	Raw (uncorrected) return loss [2]	Raw (uncorrected) insertion loss	Test set type
007	ENA	7	**Port A,T2,R1+,R1-,R2+,R2-:** 23 dB, 50 to 300 MHz 25 dB, 300 MHz to 1.3 GHz 19 dB, 1.3 to 3 GHz 12 dB, 3 to 6 GHz 11 dB, 6 to 8.5 GHz **Port T1:** 18 dB, 50 to 300 MHz 20 dB, 300 MHz to 1.3 GHz 16 dB, 1.3 to 3 GHz 12 dB, 3 to 6 GHz 9 dB, 6 to 8.5 GHz	**Port A,T2,R1+,R1-,R2+,R2-:** 3 dB, 50 to 300 MHz 3 dB, 300 MHz to 1.3 GHz 4 dB, 1.3 to 3 GHz 5 dB, 3 to 6 GHz 6 dB, 6 to 8.5 GHz **Port T1:** 5 dB, 50 to 300 MHz 5 dB, 300 MHz to 1.3 GHz 7 dB, 1.3 to 3 GHz 8 dB, 3 to 6 GHz 9.5 dB, 6 to 8.5 GHz	All paths except between R1+ and R2+, and R1- and R2-
009	ENA	9	**Port A,T2,R1+,R1-,R3+,R3-:** 23 dB, 50 to 300 MHz 25 dB, 300 MHz to 1.3 GHz 19 dB, 1.3 to 3 GHz 12 dB, 3 to 6 GHz 11 dB, 6 to 8.5 GHz **Port T1,R2+,R2-:** 18 dB, 50 to 300 MHz 20 dB, 300 MHz to 1.3 GHz 16 dB, 1.3 to 3 GHz 12 dB, 3 to 6 GHz 9 dB, 6 to 8.5 GHz	**Port A,T2,R1+,R1-:** 3 dB, 50 to 300 MHz 3 dB, 300 MHz to 1.3 GHz 4 dB, 1.3 to 3 GHz 5 dB, 3 to 6 GHz 6 dB, 6 to 8.5 GHz **Port T1,R2+,R2-,R3+,R3-:** 5 dB, 50 to 300 MHz 5 dB, 300 MHz to 1.3 GHz 7 dB, 1.3 to 3 GHz 8 dB, 3 to 6 GHz 9.5 dB, 6 to 8.5 GHz	All paths except between R1+, R2+ and R3+, and R1-, R2- and R3-

1 ENA-L does not support a E5091A multiport test set.
2 Return loss of test set port not used in measurement path.

87050A Option H test sets[1]

Designed to work with 875x network analyzers.

Frequency range: 30 kHz to 6 GHz
Connectors: Type-N (f)
Impedance: 50 ohm
Switch type: Mechanical[2]
Switching speed: 60 ms
I/O control: GPIB and Parallel

Option	Designed for:[3] (Works with:)	Ports	Raw (uncorrected) return loss	Raw (uncorrected) insertion loss	Test set type
H06	875x (PNA/PNA-L)	6	≥ 25 dB, 30 kHz to 1.3 GHz ≥ 16 dB, 1.3 to 3.0 GHz ≥ 12 dB, 3.0 to 6.0 GHz	≤ 1 dB, 30 kHz to 1.3 GHz ≤ 1.75 dB, 1.3 to 3.0 GHz ≤ 2.5 dB, 3.0 to 6.0 GHz	Full crossbar
H12		12			
H16		16			
H24		24			

87050A Option K test sets[1]

Designed to work with 872x network analyzers.

Frequency range: 50 MHz to 20 GHz
Connectors: 3.5 mm (f)
Impedance: 50 ohm
Switch type: Mechanical[2]
Switching speed: 60 ms
I/O control: GPIB and Parallel

Option	Designed for:[3] (Works with:)	Ports	Raw (uncorrected) return loss	Raw (uncorrected) insertion loss	Test set type
K06	872x (875x) (PNA/PNA-L)	6	≥ 24 dB, 50 MHz to 1.3 GHz	≤ 2.5 dB, 50 MHz to 6.0 GHz	Full crossbar
K12		12	≥ 20 dB, 1.3 to 3.0 GHz	≤ 3.5 dB, 60 to 12.4 GHz	
K16		16	≥ 14 dB, 3.0 to 6.0 GHz	≤ 4.5 dB, 12.4 to 20 GHz	
K22		22	≥ 12 dB, 6.0 to 12.4 GHz		SCMM[4]
K24		24	≥ 8 dB, 12.4 to 20 GHz		Full crossbar

1 The 87050A family of test sets do not include control interface. Contact your local Agilent Field Engineer for hardware and software control integration solutions.
2 Life time of mechanical switches are specified at 5 million cycles
3 Designed for/(Works with:) Test sets that are used with analyzers, other then the ones that they are designed for, may require extra cabling or custom designed software controls. See data sheets for particular details.
4 Single connection multiple measurements test set

87075C test sets

Designed to work with ENA-L network analyzers.
Special calibration features include Test Set Cal to reduce redundant connections during calibration and SelfCal to reduce the effects of test-system drift.

Frequency range: 3 MHz to 1.3 GHz
Connectors: Type-N (f)
Impedance: 75 ohm
Switch type: Solid state
Switching speed: 60 ms
I/O control: GPIB[1] and Parallel

Option	Designed for: (Works with:)	Ports	Raw (uncorrected) return loss	Raw (uncorrected) insertion loss		Test set type
006	ENA-L	6	≥ 15 dB, 3 MHz to 1.3 GHz	Refl. to Port N ≤6 dB	Port N to Trans. ≤10 dB	Full crossbar
012		12				
H08	8753D/E/ET/ES[2]	8				
H12		12				

1 Hxx options add GPIB interface needed for use with 8753x.
2 Test Set Cal and SelfCal are not supported.

Z5623A test sets

Designed to work with the PNA series of network analyzers.
The graphical multiport application interface is used to set up measurement paths, sequences, and calibration states. The multiport automation interface based on the COM concept is provided allowing external test executive development in a variety of popular languages.

Frequency range:[1] 1 MHz to 9 GHz
Connectors: Type-N (f)
Impedance: 50 ohm **I/O control:** GPIB and parallel

Option	Designed for: (Works with:)	Ports	Switching type/speed	Raw (uncorrected)[2] return loss	Raw (uncorrected) insertion loss	Test set type
H46[3]	PNA Series (8753E/S)[4]	6	Solid state/11ms	≥ 20 dB, 10 MHz to 1.3 GHz ≥ 14 dB, 1.3 to 3.0 GHz ≥ 10 dB, 3.0 to 6.0 GHz ≥ 7.0 dB, 6.0 to 9.0 GHz	≤ 7.0 dB, 10 MHz to 1.3 GHz ≤ 8.0 dB, 1.3 3.0 GHz ≤ 9.5 dB, 3.0 to 6.0 GHz ≤ 11.5 dB, 6.0 9.0 GHz	Triplexer
H48[3]	(871xD/ES)[4]	8	Mechanical/50ms	≥ 26 dB, 1.0 MHz to 1.3 GHz ≥ 24 dB, 1.3 to 3.0 GHz ≥ 16 dB, 3.0 to 6.0 GHz ≥ 14 dB, 6.0 to 9.0 GHz	≤ 1.5 dB, 1.0 MHz to 1.3 GHz ≤ 2.0 dB, 1.3 3.0 GHz ≤ 2.5 dB, 3.0 6.0 GHz ≤ 3.5 dB, 6.0 9.0 GHz	Full crossbar
H39	N3381A/82A/83A	9	Solid state/11ms	> 16 dB, 10 MHz to 1.3 GHz > 14 dB, 1.3 to 3 GHz > 10 dB, 3 to 6 GHz > 13.5 dB, 6 to 9 GHz	> 8 dB, 10MHz to 1.3 GHz > 9 dB, 1.3 to 3 GHz > 10 dB, 3 to 6 GHz > 13.5 dB, 6 to 9 GHz	All paths except between R1+, R2+, and R3+ and R1-, R2-, and R3-

N44xx series PLTS test sets[5]

Requires the N1930A Physical Layer Test System (PLTS) software to control the system, apply four-port error correction, and calculate and display parameters for analysis.

Switch type: Solid state **Impedance:** 50 ohms

Model Number	Designed for: (Works with:)	Ports	Frequency range	Test port connectors	Test set type
N4419B	E8362B Option 014	2[6]	10 MHz to 20 GHz	3.5 mm (m)	Full crossbar
N4420B	E8363B Option 014	2[6]	10 MHz to 40 GHz	2.4 mm (m)	
N4421B	E8364B Option 014	2[6]	10 MHz to 50 GHz	2.4 mm (m)	

1 The Z5623A H46 frequency range is 10 MHz to 9 GHz.
2 Return loss of test set port not used in measurement path.
3 Test set has four external control lines to enable control of module switching during test.
4 Additional adapters and RF cables are needed to connect the test set.
5 N44xx family of test sets are controlled by an application running on an external PC with a GPIB interface.
6 Test sets connect to network analyzer through front panel jumpers. System uses the two ports of the network analyzer and the two test set ports for four system test ports.

Duplexer/Triplexer = Tests normal transmission and receive paths only. Not all port to port path measurements are possible.
Full crossbar = Measurements between all ports are possible.

Key Web Resources

Visit our ENA series Web site for additional literature and product information:
www.agilent.com/find/ena

Visit our PNA series Web site for additional information:
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Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and onsite education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

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