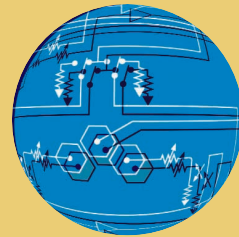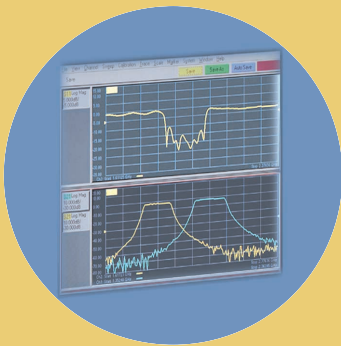# Agilent
Test Solutions for
Multiport and Balanced
Devices

Agilent Technologies

Duplexer test solutions

8753ES option H39/006

During design and final alignment of duplexers, it is often necessary to see both the transmit-antenna and antenna-receive paths together, since tuning the response of one path frequently affects the response of the other path. With an Agilent duplexer test solution both paths can be displayed simultaneously, with a single RF connection to each port. Since design verification and final test and alignment have different requirements, Agilent offers solutions with each in mind.

Design solution

8753ES VNA with opt H39 and opt 006
- 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

Additional literature:
- 8753ES Opt H39 Product Overview (literature number 5988-0596EN)

Production test solution

High performance solution PNA Series network analyzer with Z5623A H03
- Full two-port vector error correction
- Graphical user interface increases productivity by simplifying and speeding instrument calibration setup
- Fully specified performance up to 9 GHz
- Solid state switching for fast, repeatable, and reliable switching between measurement paths
- The multiport application interface enables easy measurement path setup
- Multiport automation interface allows programmers their choice of development environments to design custom test executives
  - Built in LAN interface makes it easy to connect to company Ethernet network
- Test program runs internally on PNA

Additional literature:
- Z5623A Product Overview (literature number 5988-0202EN)

8714ET/ES VNA with 87050E test set
- Available in 4, 8, or 12 test ports to best match your duplexer needs
- Full two port vector error correction
- Test Set Cal easily guides operators through calibration process
- SelfCal automatically recalibrates to test ports
- Calibration and switching controlled from VNA front panel without external PC
- Fully specified performance up to 2.2 GHz
- Solid state switching for fast, repeatable, and reliable switching between measurement path
- Connectivity and automation designed for the production environment
  - IBASIC to easily create custom test applications
  - Built in LAN interface makes it easy to connect to factory Ethernet network

Additional literature:
- 87050E 50 ohm Multiport Test Sets (literature number 5968-4763E)
- 87050E Configuration Guide (literature number 5968-4765E)

RF Front-end module test solutions
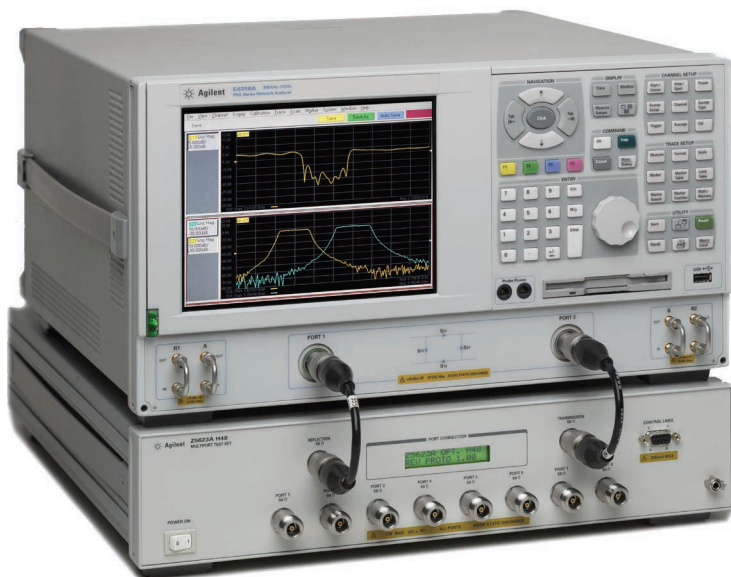
PNA Series network analyzer with Z5623A H48

The never-ending trend to decrease size and cost is leading to many RF front-end passive and active components being integrated in a single compact module. This configuration has new measurement challenges to be considered. Modules designed to use low temperature co-fired ceramics fabrication technology (LTCC) such as switchplexers and multiplexers must be tested exceptionally fast while maintaining high levels of accuracy and high repeatability to achieve high production volumes. Network analyzer sweep speed is only one factor that contributes to the overall throughput that can be achieved in multiport devices with multiple measurement paths. The overall throughput depends on how quickly the system can transition from one measurement path to the next and process that data. These solutions optimize key hardware, firmware, and software features to achieve exceptionally fast measurement speeds.

Design solution

PNA Series network analyzer with Z5623A H48
- Available in eight test ports to best match your design needs
- Full two-port vector error correction
- Graphical user interface simplifies and speeds calibration process
- Fully specified test set performance between all eight ports up to 9 GHz
- Total measurement flexibility between all ports
- Mechanical switching for best RF performance
- Four external control lines on test set for DUT control during testing
- Multiport application interface enables easy measurement path setup
- Built in LAN interface makes it easy to share data over company Ethernet network
- Test program runs internally on PNA

Production test solution

Z5623S S01
System includes:
- E8357A with Option UK6
- E8357A Option H28 –
  128 MB RAM upgrade
- E8357A Option J16 –
  16 channel firmware upgrade
- Z5623A H46 six-port triplexer
  test set
- Z5623A J01 user interface
  software – PNA/test set
  control

- Six port design optimized for dual mode triplexer test
- Full two-port vector error correction
- Graphical user interface increases productivity by simplifying and speeding instrument calibration setup
- Fully specified test set performance up to 6 GHz
- Solid state switching for fast, repeatable, and reliable switching between measurement paths
- Four external control lines on test set for DUT control during testing
- Multiport application interface enables easy measurement path setup
- Multiport automation interface allows programmers their choice of development environments to design custom test executives
- Built in LAN interface makes it easy to connect to company Ethernet network
- Test program runs internally on PNA

Contact your local Agilent Field Engineer for production test solutions for 9 ports and above.

Balanced device test solutions

N4444A

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 balanced-measurement 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.

Devices such as differential filters and amplifiers, baluns, and balanced transmission lines that were once difficult to measure using conventional two-port measuring systems, can now be completely and accurately tested with Agilent's balanced measurement solutions. With one set of connections you can test either single-ended or linear balanced devices across the full RF and microwave frequency range.

RF and microwave design solutions

Common features:
- Full four-port vector error correction
- Solid state switching for fast, repeatable, and reliable switching between measurement paths
- Displays conventional single-ended and mixed-mode S-parameters
- Capable of re-normalization of test data for non 50 ohm devices
- Optional time-domain transforms provide additional insights
- Powerful Windows® based software[1] controls system, applies four-port error correction, and calculates parameters
- Eliminates the use of test baluns for complete, accurate characterization

N4444A RF Balanced[2] Measurement System
- Featuring a PNA Series network analyzer with N4416A S-parameter test set
  - Fully specified performance up to 6 GHz
  - Optional four-port Ecal module makes calibration fast and easy

N4446A Microwave Balanced Measurement System
- Featuring the 8720ES VNA with N4418A S-parameter test set
  - Fully specified performance from 50 MHz to 20 GHz

Additional literature:
- Product Overview, 5988-2186EN

Contact your local Agilent Field Engineer for high speed production testing of balanced devices.
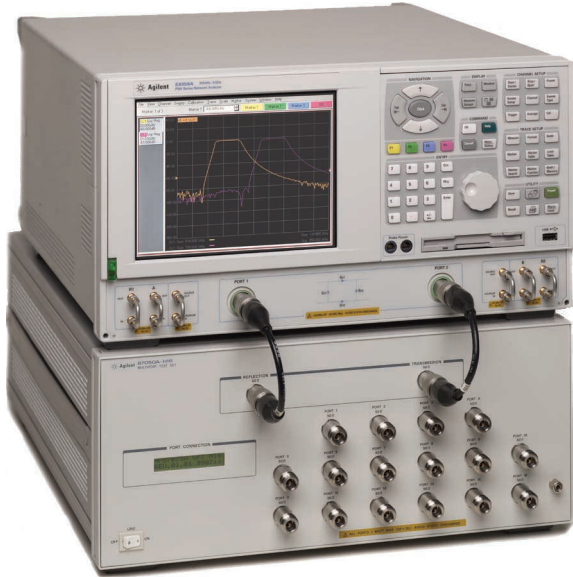
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1   Requires external PC with GPIB card.
2   Solutions based on the 8753ES family are also available. See test sets by family section for more information.

Wireless infrastructure component test solutions

PNA Series network analyzer with 87050A H16

High performance wireless infrastructure components demand the highest performing multiport test solutions available. A range of solutions is available from the simple 3 port duplexers to more complex combiner/divider units (CDU) and multi-carrier power amplifier (MCPA) delay filters. Infrastructure components have a common need for high dynamic range, fast measurement speed and low measurement uncertainty to correctly characterize their performance. Solutions are available that combine the best accuracy with the convenience of multiport connections and electronic calibration.

Custom test solutions

Wireless infrastructure components can vary greatly in design and in the number of connections. Appropriate test solutions need the flexibility to address many different configurations. Custom test solutions are available on a case by case basis when a standard solution does not meet your test requirements. Contact your local Agilent Field Engineer for more details.

Standard test solution

PNA Series network analyzer with Z5623A H03 or H48 test set

Solid state switching available in three port
Mechanical switching available in eight-port

- Full two-port vector error correction
- Fully specified performance up to 6 GHz[1]
- Built in LAN interface makes it easy to connect to company Ethernet network

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1   With E8357 6 GHz Performance Network Analyzer.

Test sets by family

87050A opt H Family of test sets[1]
Designed to work with the 875x family of 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 (871x) (PNA)	6	≥ 25 dB, 30 kHz to 1.3 GHz	≤ 1 dB, 30 kHz to 1.3 GHz	Full crossbar
H12		12	≥ 16 dB, 1.3 to 3.0 GHz	≤ 1.75 dB, 1.3 to 3.0 GHz	
H16		16	≥ 12 dB, 3.0 to 6.0 GHz	≤ 2.5 dB, 3.0 to 6.0 GHz	
H24		24			

87050A opt K Family of test sets[1]
Designed to work with the 872x family of 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)	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 o 12.4 GHz		SCMM[4]
K24		24	≥ 8 dB, 12.4 to 20 GHz		Full crossbar

87050E Family of test sets
Designed to work with the 871x family of 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 2.2 GHz (3 GHz Typ)
Connectors: Type-N (f)
Impedance: 50 ohm

Switch type: Solid state
Switching speed: 60 ms
I/O control: GPIB[5] and Parallel

Option	Designed for:	Ports	System[6] source match	System[6] load match	Test set type
004	871x	4	37 dB, 3 MHz to1.3 GHz	47 dB, 3 MHz to 1.3 GHz	Full crossbar
008		8	35 dB, 1.3 GHz to 2.2 GHz	40 dB, 1.3 GHz to 2.2 GHz	
012		12			

Option	Designed for:	Ports	Raw (uncorrected) return loss	Raw (uncorrected) insertion loss	Test set type
H08	8753D/E/ET/ES[7]	8	≥ 12 dB, 3 MHz to 2.2 GHz	≤ 7.5 dB, 3 MHz to 1.3 GHz	Full crossbar
H12		12		≤ 9.5 dB, 1.3 MHz to 2.2 GHz	

87075C Family of test sets
Designed to work with the 8712 family of 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[5] and Parallel

Option	Designed for: (Works with:)	Ports	Raw (uncorrected) return loss	Raw (uncorrected) insertion loss		Test set type
006	8712ET/ES	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[7]	8				
H12		12				

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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
5   H opts add GPIB interface needed for use with 8753x
6   Specified system performance of 8714 with 87050E test set calibrated with 85032B two-port calibration.
    See data sheet for complete details, literature number 5968-4764E
7   Test Set Cal and SelfCal are not supported.

Z5621A Family of test sets

Designed to work with the 8753 family of network analyzers

Frequency range: 1 MHz to 6 GHz
Connectors: Analyzer: APC-7 Test port: Type-N (f)
Impedance: 50 ohm

Switch type: Solid State
Switching speed: 60 ms
I/O control: Parallel and test set interconnect

Option	Designed for: (Works with:)	Ports	Raw (uncorrected) return loss	Raw (uncorrected) insertion loss	Test set type
H36	8753D/E/ES	3	≥ 18 dB, 1 MHz to 1.3 GHz ≥ 18 dB, 1.3 GHz to 3 GHz ≥ 12.5 dB, 3 GHz to 6 GHz	≤ 3.5 dB, 1 MHz to 1.3 GHz ≤ 3.5 dB, 1.3 GHz to 3 GHz ≤ 5.5 dB, 3 GHz to 6 GHz	Duplexer
H39		3	≥ 18 dB, 1 MHz to 1.3 GHz ≥ 18 dB, 1.3 GHz to 3 GHz ≥ 12.5 dB, 3 GHz to 6 GHz	≤ 7 dB, 1 MHz to 1.3 GHz ≤ 7 dB, 1.3 GHz to 3 GHz ≤ 9 dB, 3 GHz to 6 GHz	Full crossbar

Z5623A Family of 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:[5] 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)[6] return loss	Raw (uncorrected) insertion loss	Test set type
H03	PNA (8753E/S)[2] (871xD/ES)[2]	3	Solid state/11ms	≥ 24 dB, 1.0 MHz to 1.3 GHz ≥ 14 dB, 1.3 GHz to 3.0 GHz ≥ 10 dB, 3.0 GHz to 6.0 GHz ≥ 8.0 dB, 6.0 GHz to 9.0 GHz	≤ 5.0 dB, 1.0 MHz to 1.3 GHz ≤ 6.0 dB, 1.3 GHz to 3.0 GHz ≤ 7.0 dB, 3.0 GHz to 6.0 GHz ≤ 9.0 dB, 6.0 GHz to 9.0 GHz	Duplexer
H46[1]		6	Solid state/11ms	≥ 20 dB, 10 MHz to 1.3 GHz ≥ 14 dB, 1.3 GHz to 3.0 GHz ≥ 10 dB, 3.0 GHz to 6.0 GHz ≥ 7.0 dB, 6.0 GHz to 9.0 GHz	≤ 7.0 dB, 10 MHz to 1.3 GHz ≤ 8.0 dB, 1.3 GHz to 3.0 GHz ≤ 9.5 dB, 3.0 GHz to 6.0 GHz ≤ 11.5 dB, 6.0 GHz to 9.0 GHz	Triplexer
H48[1]		8	Mechanical/50ms	≥ 26 dB, 1.0 MHz to 1.3 GHz ≥ 24 dB, 1.3 GHz to 3.0 GHz ≥ 16 dB, 3.0 GHz to 6.0 GHz ≥ 14 dB, 6.0 GHz to 9.0 GHz	≤ 1.5 dB, 1.0 MHz to 1.3 GHz ≤ 2.0 dB, 1.3 GHz to 3.0 GHz ≤ 2.5 dB, 3.0 GHz to 6.0 GHz ≤ 3.5 dB, 6.0 GHz to 9.0 GHz	Full crossbar

N441x Family of balanced measurement test sets[3]

The included Windows based software controls system, applies four-port error correction, and calculates and displays parameters.

Switch type: Solid state
Impedance: 50 ohms

Model Number	Designed for: (Works with:)	Ports	Frequency range	Connectors Test ports	Analyzer interconnects	Test set type
N4413A	8753ES opt 006,011	4	50 MHz to 6 GHz	3.5 mm (m)	Type-N (f)	
N4414A	8753ES opt 006,011	4	300 kHz to 6 GHz	3.5 mm (m)	Type-N (f)	
N4415A	8753ES opt 006,014	2[4]	30 kHz to 6 GHz	7 mm	Type-N (f)	Full crossbar
N4416A	E8357A opt 015	2[4]	300 kHz to 6 GHz	7 mm	SMA (f)	
N4418A	8720ES opt H32, H42	2[4]	50 MHz to 20 GHz	3.5 mm (m)	SMA (f)	

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1   Test set has four external control lines to enable control of module switching during test
2   Additional adapters and RF cables are needed to connect the test set.
3   N441x family of test sets are controlled by an application running on an external PC
4   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.
5   The Z5623A H46 frequency range is 10 MHz to 9 GHz.
6   Return loss of test set port not used in measurement path.

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.

Additional literature

Network Analyzer Solutions
"Select the Best Network Analyzer
for Your Measurement Needs"
(literature number 5968-5260E)

Key web resources

www.agilent.com/find/component_test
www.agilent.com/find/na

Agilent Technologies' Test and Measurement Support, Services, and Assistance

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