Agilent
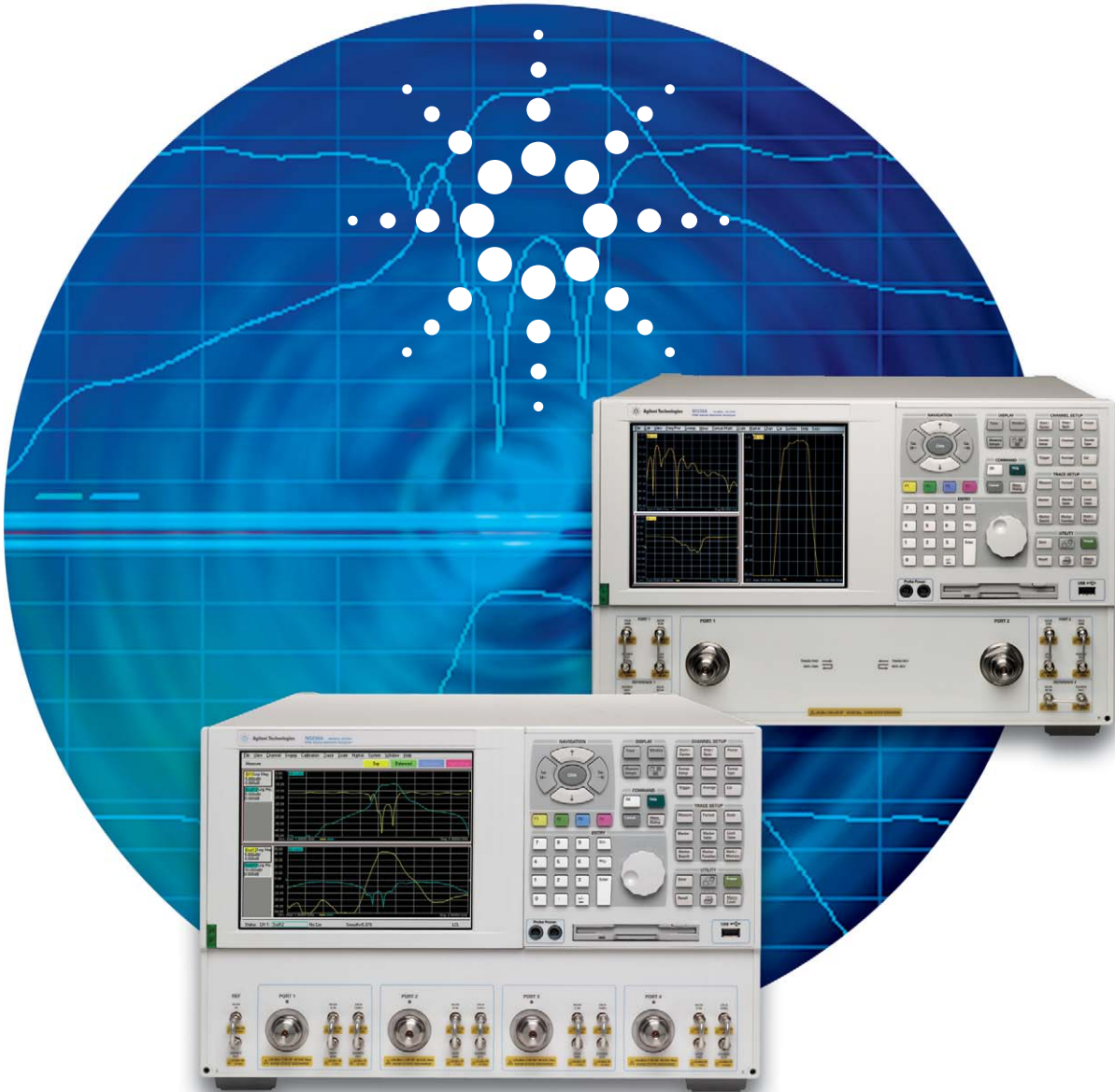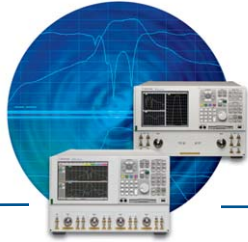# PNA-L
Network Analyzers

Speed and accuracy
you can count on

N5230A
300 kHz to 6, 13.5 or 20 GHz
10 MHz to 20, 40, or 50 GHz

Advanced capability at an affordable price

Agilent Technologies

Introducing the
PNA-L network analyzer

Key features

Unsurpassed performance

- Fast measurements – less than 4 to 9 µs per point

- Low trace noise – as low as 0.004 dB rms at 1 kHz bandwidth

- High dynamic range – up to 108 dB at 20 GHz
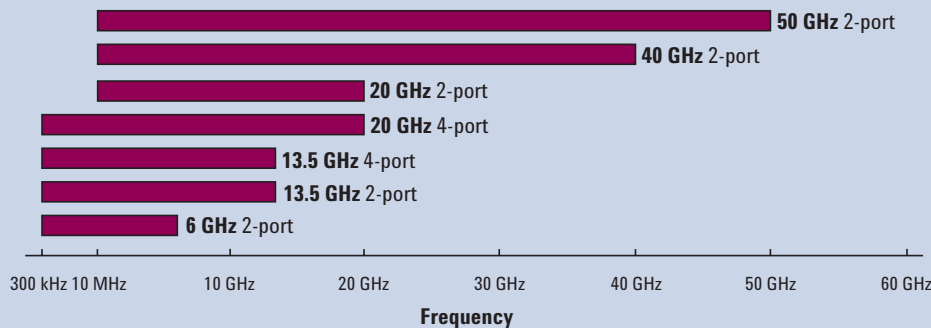
Multi-purpose capabilities

- Configurable test set for applications such as high power measurements with additional test ports

- *Built-in second source* for fixed and swept-LO testing of mixers/converters and intermodulation distortion (IMD) testing of amplifiers[1] (optional)

- Single-ended and balanced measurements[1]

- 4-port network embedding/de-embedding

- 4-port differential matching and port impedance conversion[1]

- Equation editor – calculates and displays non-standard, application-specific results using S-parameter or receiver measurement data

- Time-domain analysis and frequency-offset measurements (optional)

Calibrate with confidence

- Exceptional accuracy with NIST[2]-traceable electronic calibration (ECal) modules (optional)

- User-characterized ECal modules for added flexibility

- Advanced calibrations include TRL and *Unknown Thru*

- *Automatic port extension* – unique feature to easily compensate for fixture loss and electrical delay

- Match-corrected scalar calibration for mixer/converter measurements (optional)

Ease-of-use

- Up to 16,001 points per trace, eight traces per window and an *unlimited*[3] number of windows

- Up to 32 independent measurement channels for easy execution and viewing of complex test plans

- Advanced connectivity with LAN, USB and two GPIB interfaces

50 GHz 2-port
40 GHz 2-port
20 GHz 2-port
20 GHz 4-port
13.5 GHz 4-port
13.5 GHz 2-port
6 GHz 2-port

300 kHz 10 MHz   10 GHz   20 GHz   30 GHz   40 GHz   50 GHz   60 GHz

Frequency

PNA-L 2-port and 4-port frequency range coverage.

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1. 4-port models only.
2. NIST: National Institute of Standards and Technology.
3. Available with Option 551 and firmware A.06.2.
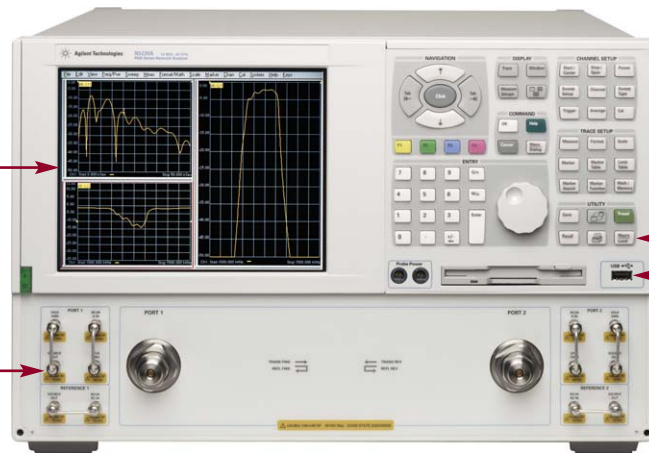
Accelerate time to market and reduce cost of test

The Agilent PNA-L is designed for your general-purpose network analysis needs and priced for your budget. Advanced features help you work quickly, easily, and accurately.

With the same firmware as the PNA, the PNA-L offers the perfect balance of value and performance. PNA-L provides efficiency and flexibility in both manufacturing and R&D applications for industries ranging from wireless LAN component production to Aerospace & Defense.

Simultaneously view multiple windows (10 markers per trace, up to 16,001 points per trace)

One-button macros simplify common measurements

2-port PNA-L

Variety of sweep types: Linear/log/segment, CW, power

Integrated Windows® operating system for maximum flexibility

Trace math and statistical analysis functions are powerful and easy to use
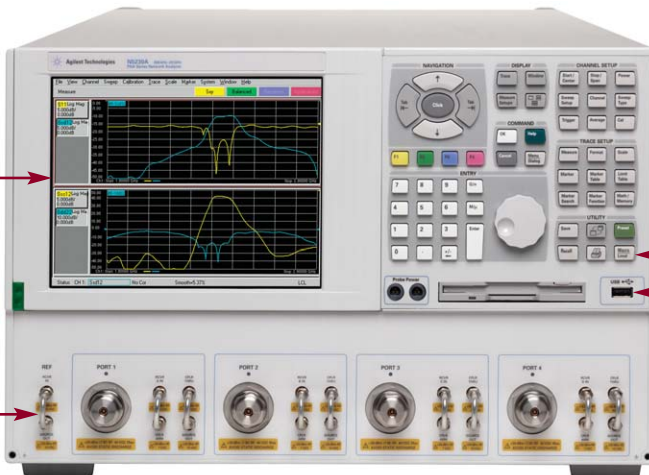
2- and 4-port ECal modules (optional) allow you to calibrate up to 30 times faster than mechanical standard calibration

Configurable test set architecture provides access to signal paths to easily optimize your application

4-port PNA-L
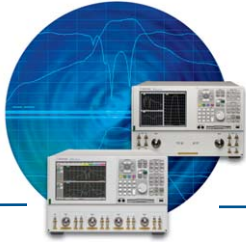
Precise calibrations provide confidence

Removing calibration complexity with ECal

Calibration is crucial for accurate measurements. Agilent offers a variety of NIST-traceable electronic calibration (ECal) modules to speed your calibration process. With ECal modules, you can perform fast, repeatable calibrations that are as accurate as a sliding load mechanical calibration, but less error-prone and more than 30 times faster.

ECal modules in a wide range of frequencies and connectors.

ECal simplifies calibration and reduces operator error.

Two-port ECal modules operating from 300 kHz to 67 GHz are available in a variety of connector types. Two-port ECal modules can be used to perform a full 4-port calibration with only four connections and disconnections (the same as a 4-port ECal module).

For even more convenience and time savings, 4-port ECal modules offer one-step calibrations from 300 kHz to 20 GHz, satisfying the requirements of a wide variety of component test applications.

To make the ECal module even more flexible, the User Characterization feature provides you the ability to create custom module characterizations for use with adapters and fixtures to meet your connector needs.

Use the User Characterization feature to create a custom waveguide calibration module.

Full 4-port calibration to 20 GHz in one single step.

4

# Accurate measurements improve yields
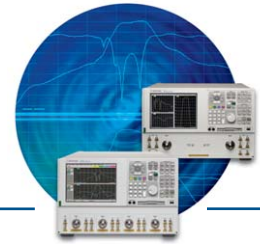
In-fixture measurements

Normal coaxial calibrations do not account for the effects of fixtures on measurements, and resulting errors can become quite significant at microwave frequencies. The PNA-L offers a variety of easy and accurate methods to correct for fixtures.

Port extensions

Traditional port extensions allow the user to enter an electrical delay, correcting for the physical length of the test fixture. However, as test frequencies increase beyond a few GHz the insertion loss of a fixture becomes significant as well. The PNA-L port extension feature allows a user to input an insertion loss value in addition to electrical delay, allowing for much more accurate fixture compensation.

To further simplify fixture compensation, Agilent provides the innovative Automatic Port Extension feature. With a single click, the PNA-L automatically determines a fixture's electrical length and insertion loss and applies the correction to measurements, making in-fixture measurements easy and accurate.
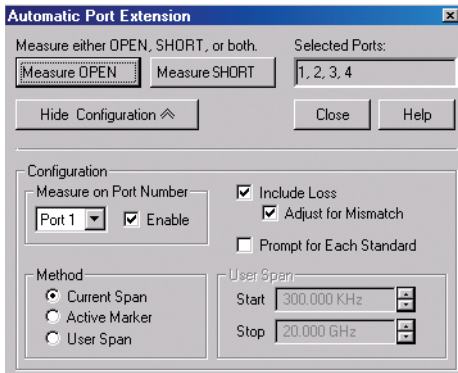
Simple and easy-to-use, Automatic Port Extension is ideal for in-fixture measurements, especially those with multiple ports.
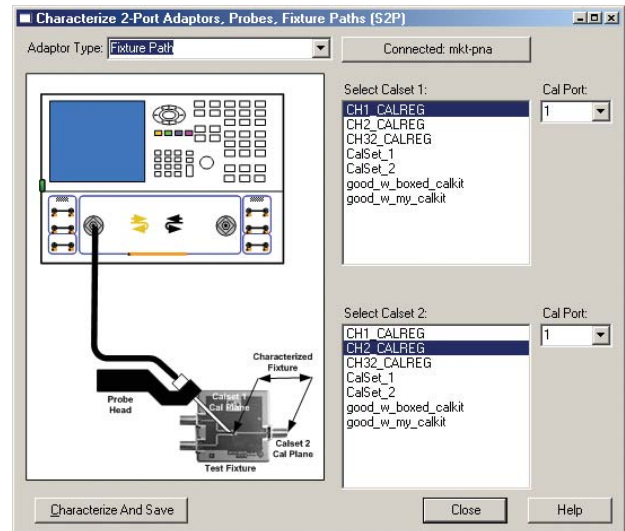
Embedding and de-embedding

The PNA-L offers full embedding and de-embedding of user-supplied S-parameter data files, as well as predefined matching circuit topologies that can be mathematically embedded. Port impedance conversion is available for testing devices that are not 50 ohms.
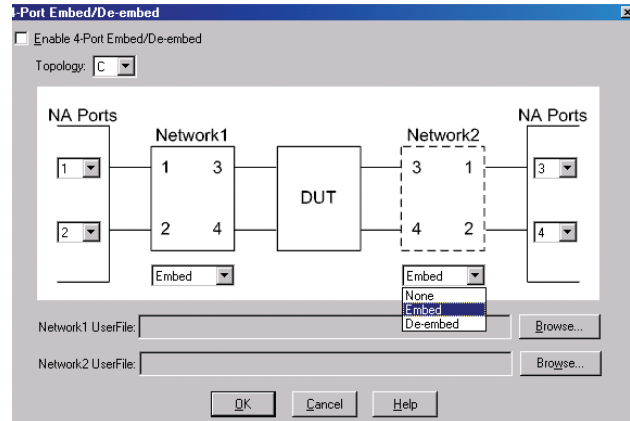

Embedding and de-embedding of 4-port networks, as well as 2-port networks, are available for achieving accurate results.

Adaptor characterization

Embedding (adding) or de-embedding (removing) requires the ".s2p" file of the 2-port device to be embedded or de-embedded. The PNA-L provides a feature for the user to easily create the ".s2p" characterization of the 2-port device (adaptor) and then subsequently apply to S-parameter measurements.

Create ".s2p" files of each path of the fixture using Adaptor Characterization. Apply these files to subsequent S-parameter measurements for de-embedding of the fixture.
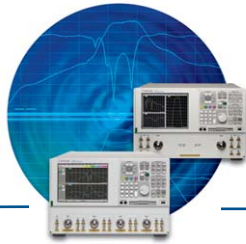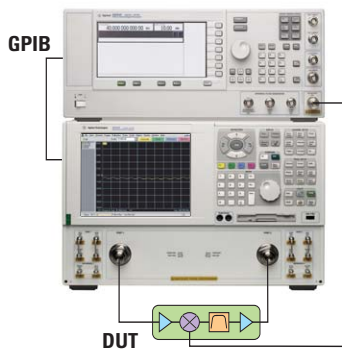
Advanced features
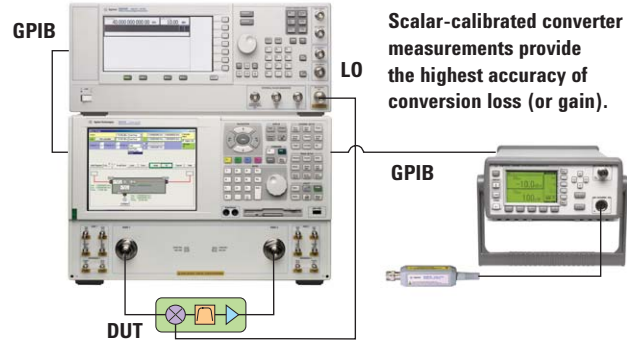# for R&D and manufacturing

Mixer and converter measurements

With frequency-offset mode, the PNA-L Series can set its source and receiver frequencies independently for measuring:

- Mixer conversion loss/gain
- Harmonic and spurious responses
- Intermodulation distortion (IMD)

GPIB

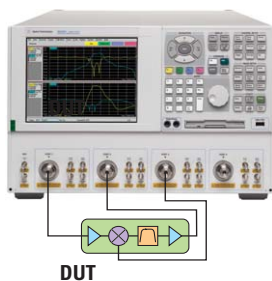Converter measurements using frequency-offset mode of the PNA-L and an external PSG.

DUT

Built-in second source simplifies setups

Available with 4-port models only, an internal second source simplifies setups for testing mixers, converters and amplifiers.

The second source improves sweep speed by at least 20 times compared to using an external source.

Built-in second source simplifies converter measurements. Plus, with the configurable test set, an external booster amplifier can be added to increase the output power of the LO signal.

DUT

Scalar-calibrated converter measurements

To obtain the highest amplitude accuracy possible for your conversion loss/gain measurements, scalar mixer calibration (SMC) combines a short-open-load-through (SOLT) calibration and a power meter calibration to deliver match-corrected amplitude measurements.

GPIB

LO

Scalar-calibrated converter measurements provide the highest accuracy of conversion loss (or gain).

GPIB

DUT

Amplifier measurements

Advanced measurements such as intermodulation distortion (IMD) and hot S22 can easily be performed using the built-in second source of the PNA-L. IMD measurements can be achieved by using the coupler of port 3 as the combiner for signals from source 1 and source 2, so that the signal coming out of port 1 is the two-tone signal needed for IMD measurements. You can perform amplifier measurements easier and in less time because you don't need to setup additional hardware.


DUT   DUT
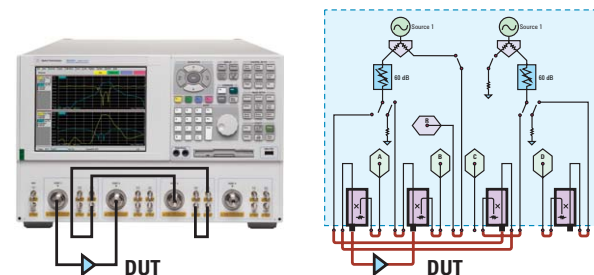
IMD measurements are easy to make using the port 3 coupler as the internal combiner for the two internal sources in order to generate a two-tone signal.

Along with IMD and hot S22 measurements, K-factor is a figure of merit that is often used to characterize amplifiers. With the equation editor, you can now create any equation using either trace data or channel parameter data and the result, such as K-factor, will be displayed on the screen of the PNA-L.
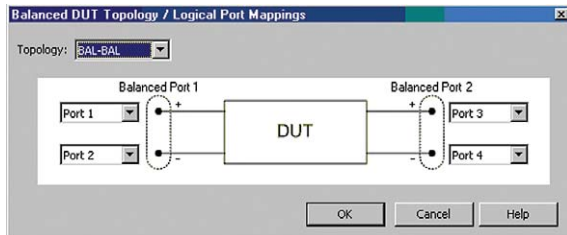
# Simple and easy to measure various devices
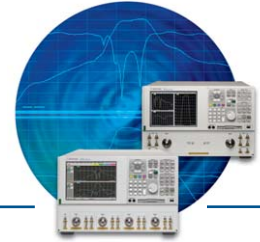
Differential devices

The PNA-L can easily measure single-ended, balanced, and mixed-mode S-parameters in addition to ratioed and unratioed receiver measurements.

Graphical interface makes it easy to set up balanced measurements.

Physical layer test

Use Agilent's Physical Layer Test System (PLTS) software to expand the 4-port PNA-L's measurement capabilities for high-speed differential interconnect design and validation. PLTS software combines frequency-domain, time-domain, and eye-diagram analysis to provide a comprehensive view of your physical layer element. It also controls measurement setup and calibration to provide the most accurate measurements for model extraction, characterization, and validation of your designs.
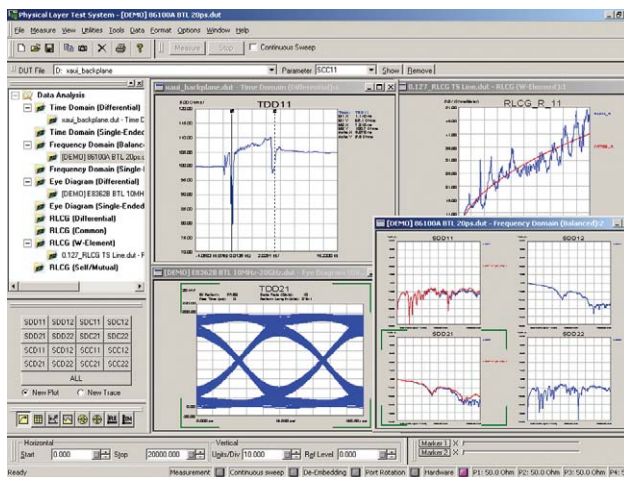
Characterize and validate differential channels with a full suite of analysis tools available in PLTS.

Multiport

For devices with more than four ports, a test set can be added to expand the number of test ports. Different test sets can be added depending on your measurement needs. Control of the test set is done by the PNA-L's firmware, so no extra software is needed.
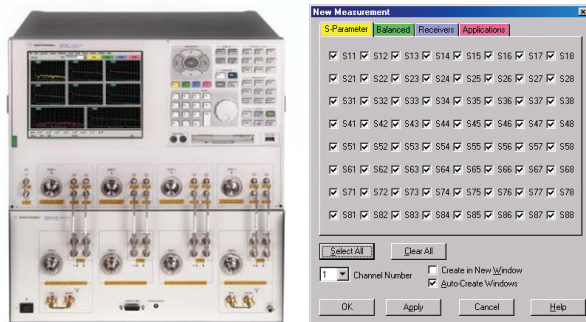

Adding a 4-port test set expands the 4-port PNA-L to an 8-port system with 8-port calibration and measurement capabilities.[1]

Analysis tool

The PNA-L is supported by Agilent's Advanced Design System (ADS), enabling device data to be used in circuit and system simulation. Users can also save 4-port data as ".s4p" files, or ".snp" files for n-port devices which are easily imported into ADS for analysis.

Analysis features such as trace statistics, trace math, and equation editor provide insight into device behavior, while mixed-mode measurements such as common-to-differential mode conversion allow you to discover design flaws early in the design process.
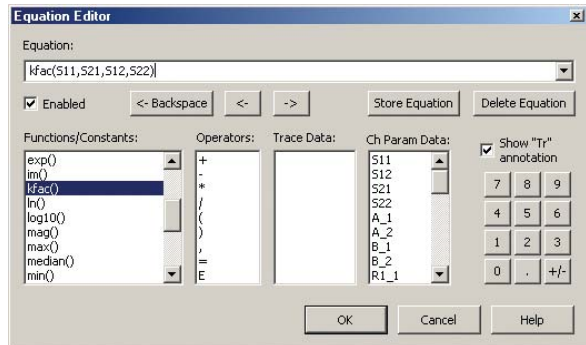
Equation editor allows you to create parameters such as K-factor.

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1. Option 551 required for N-port capabilities.
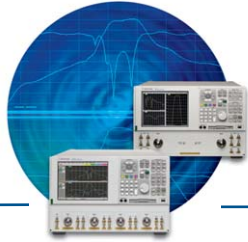
The PNA Series offers a variety of solutions

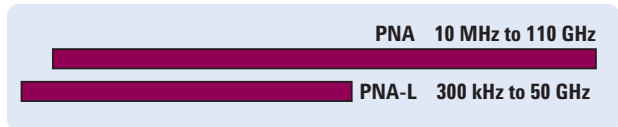The entire family of PNA network analyzers offer reliable, accurate measurements you can count on. Sharing a common architecture, all PNA's have the same user and programming interface, providing familiarity and compatibility across the entire PNA Series.

Agilent's PNA-L is a quality, cost-effective solution designed for general purpose network applications such as S-parameter, filter, basic amplifier, basic mixer, and multiport measurements.

Agilent's higher performance microwave E836x PNA Series provides the world's most advanced performance and is specifically designed for more demanding measurement needs and applications such as antenna, pulsed, and banded mm-wave measurements.

PNA	10 MHz to 110 GHz
PNA-L	300 kHz to 50 GHz

Series comparisons

Key specifications at 20 GHz

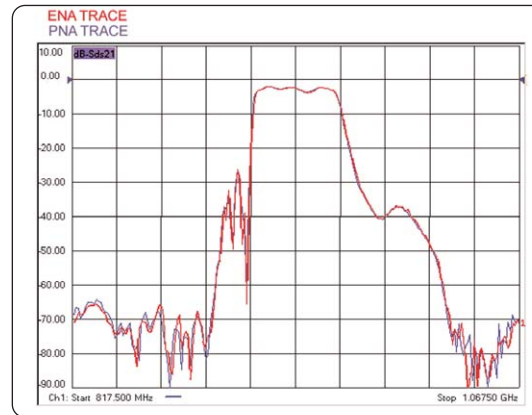| Performance	PNA-L N5230A 4-port, 13.5/20 GHz and 2-port, 6/13.5/20/40/50 GHz	PNA E836x, N5250A 20/40/50/67/110 GHz
Trace noise	0.006 dB rms (Option 220, 225) 0.010 dB rms (Option 420, 425, 520, 525)	0.006 dB rms
Sweep speed	4.5 to 9 µs/pt	26 µs/pt
Maximum output power	+3 dBm (Option 220, 225)	+3 dBm
Dynamic range	108 dB (Option 220, 225) 100 dB (Option 420, 425, 520, 525)	123 dB
Applications		

Frequency converting devices	Basic frequency-offset mode
	Scalar-calibrated converter measurements
	Built-in second source (4-port models only)
		Basic frequency-offset mode
		Scalar-calibrated converter measurements[1]
		Frequency converter application[1]
		  • Graphical user interface
		  • Highest accuracy scalar and vector calibrations
		  • Absolute group delay measurements
		  • Control of external source

Antenna measurements	Optional configurable test set for direct receiver input < 4.5 to 9 µs per point measurement speed	Optional configurable test set for direct receiver input < 30 µs per point measurement speed IF inputs and RF & LO outputs option for use in remote mixing applications Compatible with 85310 distributed frequency converter

Pulsed-RF measurements	Triggering for pulse width > 2 or 10 µs	Triggering for pulse width > 50 µs
		Optional pulsed-RF measurement hardware and software[1]
		  • Average pulse, point-in-pulse measurements
		  • Pulse widths down to 25 ns
		  • Optimizes PNA IF bandwidth and sample rate
		  • Automatic pulse generator control
		  • "Filter nulling" of sidetones for improved speed
		  • Front panel and remote interface

mm-wave measurements	Solutions up to 50 GHz	Solutions up to 110 GHz Extendable to 325 GHz for banded mm-wave measurements

1. Up to 67 GHz.

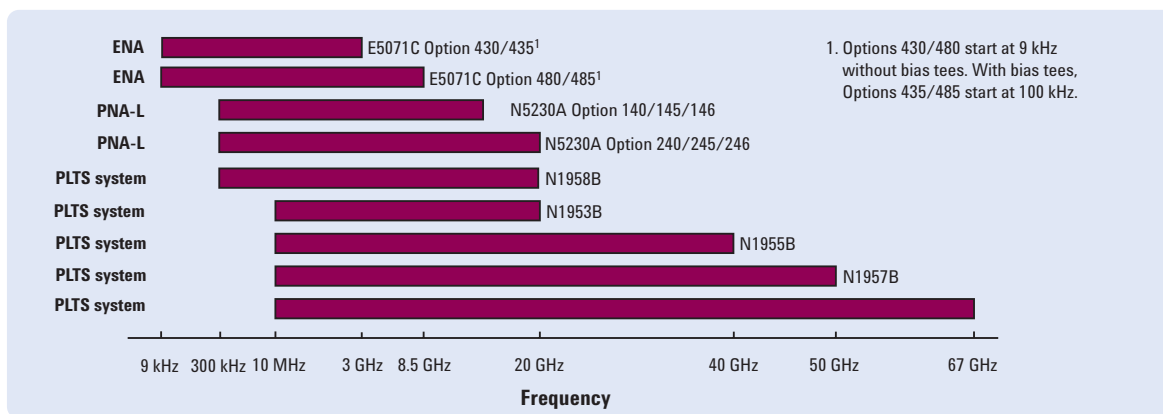# Agilent offers a comprehensive portfolio of 4-port solutions
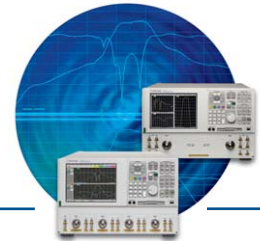
Agilent's ENA and PNA-L network analyzers and Physical Layer Test Systems (PLTS) provide a variety of 4-port and balanced measurement solutions from 300 kHz to 67 GHz to meet your specific application and budget needs.

Since all of these products use common calibration and measurement algorithms, you can be sure no matter which Agilent solution you use, you will get the right answer every time.

Select a specific frequency range that suits your application needs...


Get consistent results with the ENA and PNA-L network analyzers.

1. Options 430/480 start at 9 kHz without bias tees. With bias tees, Options 435/485 start at 100 kHz.

Specification summary

	4-port ENA RF network analyzers	4-port PNA-L network analyzers	Physical Layer Test Systems (PLTS)
Maximum frequency	8.5 GHz	20 GHz	67 GHz
Measurement speed	9.6 µs/point	4 µs/point	26 µs/point
Embedding/de-embedding	Port extensions	Port extensions	Port extensions
	Auto port extension	Auto port extension	–
	Impedance conversion	Impedance conversion	Impedance conversion
	Defined circuit embed	Defined circuit embed	–
	S-parameter file embed/de-embed	S-parameter file embed/de-embed	S-parameter file embed/de-embed
Dynamic range (2, 20 GHz)	122 dB, n/a	120 dB, 103 dB	Depends on system configuration
Maximum power (2, 20 GHz)	+10 dBm, n/a	+8 dBm, -3 dBm	Depends on system configuration
Frequency-offset measurements	Yes, optional	Yes, optional	–
Built-in second source	No	Yes, optional	No
Calibration	SOLT, TRL, LRM	SOLT, TRL, LRM	SOLT, TRL, LRM
Configurable test set	No	Yes, optional	Yes

Note: Agilent also offers high-performance 2-port PNA network analyzers. For more information, visit **www.agilent.com/find/pna** For more information about PLTS, go to **www.agilent.com/find/PLTS**
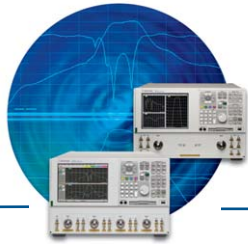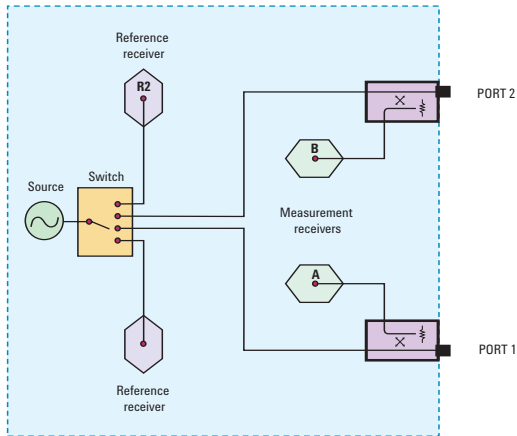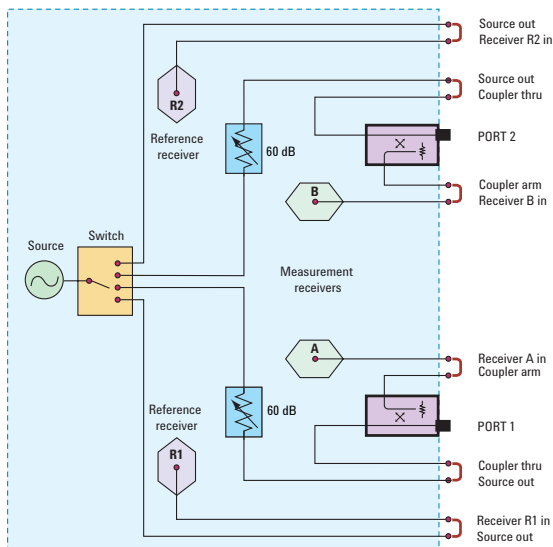
PNA-L test set options

2-port test set options

- **Standard 2-port test set and power range – Option x20**

- **Configurable 2-port test set and extended power range – Option x25**
  Adds six front panel access loops and two 60 dB step attenuators as shown in the figures below. This provides the capability to improve instrument sensitivity for measuring low-level signals, to reverse the directional coupler to achieve even more dynamic range or to add components and other peripheral instruments for a variety of measurement applications.

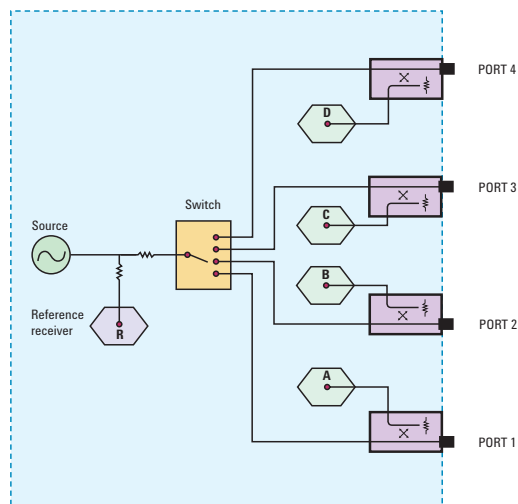## Standard test set (Option x20)

Configurable test set and extended power range (Option x25)


4-port test set options

- **Standard test set and power range – Option x40**

- **Configurable test set and extended power range – Option x45**
  Adds nine front panel access loops and a 60 dB step attenuator. This provides the capability to add external components for high power measurements, improve instrument sensitivity for measuring low-level signals, or to add other peripheral instruments for a variety of measurement applications.

- **Configurable test set, extended power range and internal second source – Option x46**
  Available with 4-port models only, this option adds an internal second source, nine front panel access loops and two 60 dB step attenuators. This provides an additional fixed or swept tone for two-tone third-order-intercept (TOI) and intermodulation testing of amplifiers, or it can be used as a fast swept-LO signal for fixed-IF testing of mixers and converters. In either case, sweep speed is more than 20 times faster than using an external source (Option 080 required).
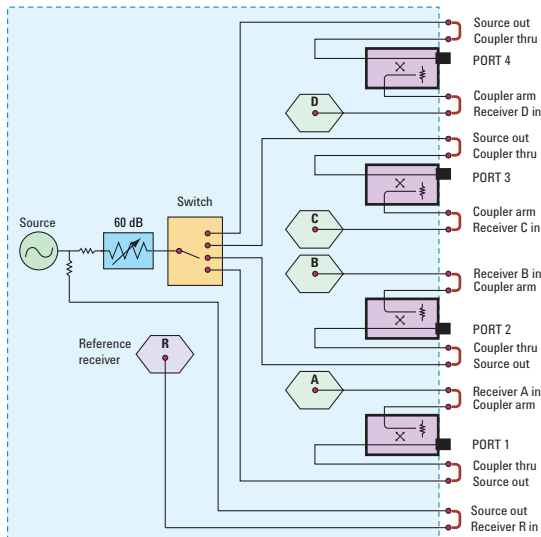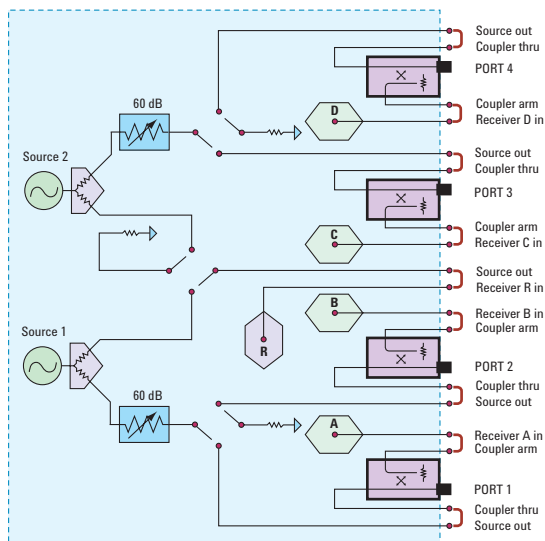
Standard test set (Option x40)

10

PNA-L test set option descriptions
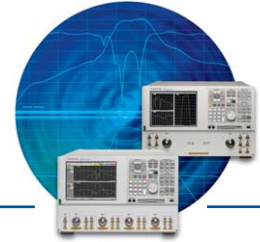
Configurable test set and extended power range (Option x45)

Configurable test set, extended power range and internal second source (Option x46)

For more information visit:
www.agilent.com/find/pnal

Additional options

Time domain – Option 010
This option enables the PNA-L to view reflection and transmission responses in both time or distance domain. Use time domain to tune filters, gate out the response of fixtures and cables, characterize the impedance of transmission and more.

Frequency offset – Option 080
This option enables the PNA-L to set the source frequency independently from where the receivers are tuned. This ability is important for two general classes of devices: mixers (converters) and amplifiers.

Scalar-calibrated converter measurements - Option 082
Using a simple setup, this application provides the highest accuracy of conversion-loss (or gain) measurements by combining one-port and power meter calibrations to remove mismatch errors (Option 080 is required).

4-port measurement application - Option 550
Adds full 4-port error correction and differential measurements on a 2-port network analyzer. An external test set is required.

N-port capabilities - Option 551
Adds full N-port error correction and measurement capabilities to any PNA-L network analyzers. An external test set is required.

Certification options

Commercial calibration certification with test data – Option UK6
Complete set of measurements which tests unit to manufacturer's published specifications. Includes calibration label, calibration certificate, and data report. Conforms to ISO 9001.

ISO 17025 compliant calibration – Option 1A7
Complete set of measurements which tests unit to manufacturer's published specifications. Includes calibration label, ISO17025 calibration certificate, and data report, measurement uncertainties and guard bands on all customer specifications. Conforms to ISO 17025 and ISO 9001.

ANSI Z540 compliant calibration - Option A6J
Complete set of measurements which tests unit to manufacturer's published specifications. Includes pre- and post-adjustment data with measurement uncertainty information compliant to the ANSI/NCSL Z540 standard.

Web resources

Visit our Web sites for additional product information and literature.

PNA-L microwave network analyzers
www.agilent.com/find/pnal

PNA microwave network analyzers
www.agilent.com/find/pna

ENA RF network analyzers
www.agilent.com/find/ena

Physical layer test systems
www.agilent.com/find/plts

Multiport test solutions
www.agilent.com/find/multiport

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Agilent Open simplifies the process of connecting and programming test systems to help engineers design, validate and manufacture electronic products. Agilent offers open connectivity for a broad range of system-ready instruments, open industry software, PC-standard I/O and global support, which are combined to more easily integrate test system development.

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Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Agilent equipment throughout its lifetime. Your equipment will be serviced by Agilent-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements.

Agilent offers a wide range of additional expert test and measurement services for your equipment, including initial start-up assistance, onsite education and training, as well as design, system integration, and project management.

For more information on repair and calibration services, go to

www.agilent.com/find/removealldoubt

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Revised: 09/14/06

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