Agilent
PNA-L
Network Analyzers

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

Advanced capability at an affordable price
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

---

1. 4-port models only.
2. NIST: National Institute of Standards and Technology.
3. Available with Option 551 and firmware A.06.2.
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.
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 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.

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

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.

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)

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.

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

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.

GPIB
DUT
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.

Built-in second source simplifies amplifier measurements. 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.
Differential devices
The PNA-L can easily measure single-ended, balanced, and mixed-mode S-parameters in addition to ratioed and unratioed receiver measurements.

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.

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.

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 “.sn2” 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.

1. Option 551 required for N-port capabilities.
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.

### Series comparisons

#### Key specifications at 20 GHz

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

#### Applications

**Frequency converting devices**
- Basic frequency-offset mode
- Scalar-calibrated converter measurements
- Built-in second source (4-port models only)
- Frequency converter application
  - 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

**Pulsed-RF measurements**
- Triggering for pulse width > 2 or 10 µs

**mm-wave measurements**
- Solutions up to 50 GHz

---

1. Up to 67 GHz.

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.
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...

### Specification summary

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

**Note:** Agilent also offers high-performance 2-port PNA network analyzers. For more information, visit [www.agilent.com/find/pna](http://www.agilent.com/find/pna). For more information about PLTS, go to [www.agilent.com/find/PLTS](http://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)
Configurable test set and extended power range (Option x45)

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.

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

Antenna test
www.agilent.com/find/antenna

Electronic calibration (ECal) modules
www.agilent.com/find/ecal

RF and microwave accessories
www.agilent.com/find/accessories

Remove all doubt
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

www.agilent.com
For more information on Agilent Technologies’ products, applications or services, please contact your local Agilent office. The complete list is available at:
www.agilent.com/find/contactus

Phone or Fax
United States:
(tel) 800 829 4444
(fax) 800 829 4433

Canada:
(tel) 877 894 4414
(fax) 800 746 4866

China:
(tel) 800 810 0189
(fax) 800 820 2816

Europe:
(tel) 31 20 547 2111

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (080) 769 0800
(fax) (080) 769 0900

Latin America:
(tel) (305) 269 7500

Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific
Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042

Email: tm_ap@agilent.com

Windows is a U.S. registered trademark of Microsoft Corporation.