PNA Series RF Network Analyzers Product Overview

Introduction

Every so often, a new product is introduced that is in a class by itself. In 1984, Hewlett-Packard introduced the 8510 vector network analyzer. The 8510 combined the power of microprocessors with the world's most advanced RF hardware, bringing new levels of accuracy and ease-of-use to network analysis. A revolutionary step forward, it instantly became the industry standard for high performance component testing.

Over the past 16 years, the need to characterize RF components has increased dramatically. Due to the worldwide explosion of wireless mobile communications, the need for test equipment to measure component parameters is greater than ever. And once again, it is time for a new standard of excellence. A standard providing the RF performance needed to design and test today's high-performance, high-dynamic-range components. A standard with the speed required for high-volume manufacturing. A standard with flexible automation choices to enhance measurement capability and streamline test processes. A standard with the connectivity tools needed to interface to today's computer networks.

Building on the 50-year tradition of excellence and innovation that Hewlett Packard has brought to component test, Agilent Technologies is proud to introduce the PNA series of RF vector network analyzers. The new world standard for high-performance component measurements. A standard built on a platform designed to grow even more powerful in the years to come. Imagine the possibilities…

Performance

The PNA series provides a solid foundation for high-performance component measurements. Combining lightening-fast sweep speeds, exceptional dynamic range, low trace noise, four measurement receivers with direct access, and 9 GHz frequency coverage, the PNA series gives you the power and flexibility you need for most RF applications.

Let's take a closer look at sweep speeds. With a 35 kHz IF bandwidth, the PNA series can sweep 6 times faster than the industry-leading 8753ES. You can achieve over 80 updates per second. And, compared to other network analyzers on the market, you don't have to sacrifice performance for speed – at 35 kHz, the trace noise is only .004 *(point-zero-zero-four)* dB RMS.

Even if your measurements require high dynamic range, you won't have to compromise measurement speed. Because the inherent dynamic range of the PNA series is much greater than the 8753, measurements with the same dynamic range can be made using wider IF bandwidths on the PNA series, which results in much faster sweeps. For example, measurements requiring 100 dB of instrument dynamic range can use the 35 kHz bandwidth on the PNA series, instead of the 1 kHz bandwidth required by the 8753. This results in sweeps that are 16 times faster. For measurements that require 120 dB of instrument dynamic range, the PNA series is 35 times faster than the 8753. Sweeps that took 43 seconds on the 8753 only take 1.2 seconds on the PNA series.

With a 10 Hz bandwidth, the PNA series achieves over 128 dB of dynamic range at the test set ports, with an incredibly small .0004 *(point-zero-zero-zero-four)* dB RMS of trace noise. This means you get very accurate measurements of low-loss devices. You can also remove the front-panel RF jumpers for direct access to the measurement receivers. This configuration bypasses the internal directional couplers to achieve over 143 dB of dynamic range, letting you see aspects of your component's performance that you've never been able to see before.

PNA series analyzers come in 3, 6, or 9 GHz models, giving you the choice to match your measurement needs, from basic 900 or 1800 MHz insertion and return-loss measurements, to measurements of third-harmonic responses of mobile-communications and wireless-LAN filters. All models use four mixer-based receivers, so you can use true TRL calibration for accurate in-fixture and on-wafer measurements. An optional configurable test set includes additional front-panel RF jumpers for maximum measurement flexibility. This option lets you add your own external amplifiers in the source path to boost the input power to your device. Or, reverse the port-two coupler for high-dynamic-range S-parameter measurements with full two-port calibration.

The time-domain option allows you to locate and remove discontinuities in devices, fixtures or cables. This option also provides a great way to tune cavity-resonator filters. Using this technique, you can save considerable time and get better results compared to tuning in the frequency domain. And, because the time-domain technique is simpler and less recursive than traditional tuning methods, the time required to train operators is much shorter.

As you can see from these examples, the PNA series of network analyzers offers an unsurpassed combination of fast sweep speeds, high dynamic range, low trace noise, and flexible hardware configurations. A combination designed to meet all your component-test challenges.

Ease of Use

Manual operation of the PNA series is both intuitive and flexible, making the analyzers easy to learn and use. You can use a familiar hardkey/softkey interface, or use drop-down-menus driven from a mouse or other standard pointing device like a touchpad or trackball. You may find that a combination of the two methods is optimal when configuring measurements.

The hardkey/softkey method behaves much like a traditional network analyzer, except the PNA series features a simplified softkey structure. Complicated menu trees and sub-menus are eliminated. Just press the hardkey for the function you need, and then select a choice from the active toolbar by pressing one of the four, colored function keys. The active-toolbar changes according to which hardkey is pressed. The selections on the active toolbar let you perform most of the operations required to configure and view measurements. Some advanced settings are available from a dialog box easily accessed by pressing the menu/dialog key and then the hardkey corresponding to the desired function. The front-panel navigation keys let you easily move around the dialog without a mouse.

Using the drop-down menus is ideal if you are comfortable using a Windows-based interface. Intuitive menus appear across the top of the main window, such as Sweep, Calibration, Trace, Scale, Markers, and more. Several toolbars are also available to simplify operation of the instrument. These toolbars provide shortcuts to functions like S-parameter selection, markers and sweep control. When the mouse cursor is placed over an icon in the toolbar for a few seconds, a pop-up “tool tip” appears to describe its function. The mouse-based interface also features right-click selections for quick access to commonly-executed functions like deleting or auto-scaling a trace, setting start and stop frequencies, or simple marker searches. Any USB-compatible keyboard can also be connected for easy entry of file names, screen titles, or other text information.

Both methods of operation handle data-intensive functions like limit lines and segment sweeps by using tables that are simple to configure and edit. You can use a mouse or the navigation keys to easily move between cells in the table.

After configuring your measurement, the Benchlink XL tool provided with the analyzer makes it easy to import trace data and graphics directly into Microsoft Word or Excel, without the need for cumbersome floppy disks.

The PNA series also features a built-in help system that contains the complete documentation set for the analyzer. If you have questions as you work, you can easily access this information to quickly get your answers. You can view information by using the home page, table of contents, or by searching for a specific function or term in the index. Or, if you are in the middle of configuring a measurement and have a question about the available settings, click the Help button in the dialog box. View related information by clicking the "See Also" button. An expansion planned for early 2001 will also allow you to view the help system in Japanese, French, German, or Spanish.

Calibrating your test system has never been easier. The PNA series features a calibration wizard to help guide you through the calibration procedure. The calibration wizard also controls Agilent Technologies’ ECal series of electronic calibration modules. Simply

connect the ECal module to the analyzer with a single USB cable. You no longer need an external PC or module controller to take advantage of quick and easy electronic calibration. Concurrent with the PNA series' introduction, Agilent has added a 9 GHz ECal module to complement the upper frequency range of the PNA series.

With all the effort we've put into making the PNA series easy to learn, use, and calibrate, other network analyzers you may have used will never look or feel the same way again!

Measurement Flexibility

The PNA series offers unprecedented flexibility in configuring and displaying measurements. First of all, measurement channels and traces are separate from the windows in which they appear. Measurement channels are a set of instrument settings needed to make a particular set of measurements. To accommodate multiple measurement setups for a single device-under-test, you can configure up to four independent measurement channels. Each channel can have unique stimulus and response settings such as sweep type, start and stop values, number of trace points, source power level, and IF bandwidth. You can create multiple traces for each of the channels that you set up. Each trace can have unique attributes such as parameter, format, and markers.

Windows are used to view traces from one or more of the measurement channels. You can display up to four windows, each with up to four data traces and four memory traces. Once everything is configured, you can easily resize and move Windows to customize the instrument’s display for your particular viewing requirements. Window sizes and channel and trace definitions are all saved as part of an instrument state.

The trace markers are also very flexible. Up to ten markers can be placed on any trace to extract specific information. You can select both normal and delta markers. Traditional peak-search functions such as maximum, minimum, right, left, bandwidth, or target value are also available. If you already know that the information you are looking for is in particular areas of the device's response, you can define up to nine independent spans and assign markers to operate only within the boundaries of those spans. Marker data can be viewed within a window or in a separate marker table.

The PNA series' combination of independent measurement channels, multiple traces, flexible windows, and adaptable marker functions, provides the flexibility you need to set up and view any measurement, whether simple or complex.

Connectivity

The PNA series achieves levels of connectivity never before seen on a network analyzer. There are many ways to move information to and from the instrument, using a variety of built-in interfaces. The integral Windows 2000 operating system lets you take full advantage of many features you have come to expect from your personal computer. When used with the network analyzer, these features help you achieve a new level of integration for your device-measurement processes.

When you need to save instrument states or measurement data, you have several choices. For local storage, use either the analyzer's internal hard disk drive, the built-in three-and-a half-inch floppy disk drive, or connect an optional USB-compatible CD read/write drive. Use Windows network-drive mapping and the LAN interface to easily save data directly to remote PCs or file servers. This capability makes it easier to develop statistical-process-controlled manufacturing environments. For hardcopies, you can send your measurement results to any Windows-compatible printer with a LAN, USB or parallel interface.

To control other equipment in the test station directly from the network analyzer, such as power meters, signal sources, and spectrum analyzers, use any of the built-in GPIB, LAN, serial, or parallel interfaces. For test software, choose among many programs that run under Windows, such as Visual Basic, LabView, or Agilent VEE.

An external, color VGA monitor can be connected to the analyzer for enhanced viewing of your measurement results. You can place the network analyzer near the devices being measured, while positioning the monitor for optimal viewing by the operator. An external monitor also expands your ability to view on-line information like the embedded help system, or, when using LAN access, to view Agilent Technologies Web pages. And while you are connected to Agilent's Web site, you can download firmware and help-system updates as they become available. This makes it simple for you to obtain the latest features for all your PNA series network analyzers.

The LAN interface also enables remote troubleshooting. You can review measurement results and control the analyzer from anywhere on the network, whether you're on another floor, in another building, or even at a different site. Imagine the time and cost savings of giving advice to production-line technicians or operators without actually being present to push buttons or operate the mouse.

When it comes to connectivity, the combination of the built-in storage devices, standard I/0 interfaces, and the analyzer's Windows 2000 operating system makes it easy to achieve the level of data storage and transfer, measurement control, and operator convenience that will make your test processes run more smoothly and efficiently.

Automation

In manufacturing environments, test automation is essential for high test throughput. For R&D, automated tests can greatly reduce the time spent on repetitious and tedious measurements. The PNA series let you automate your test processes using several powerful automation approaches. You can create programs using familiar SCPI commands and the GPIB or LAN interfaces, or by using COM commands over LAN for fast analyzer access. The analyzer’s firmware provides many programmable objects, or automation "entry points", that respond quickly and directly to COM statements. COM programming makes it easier for you to reuse your test code on multiple hardware or software platforms. It also makes the source code much easier to understand and debug. COM programming can also give you a significant speed advantage. In some instances, COM-based programs execute the same instrument settings and transfer data up to five times faster than using SCPI.

With the analyzer's Windows 2000 operating system, you can run your programs or applications directly on the network analyzer. For example, a group of network analyzers on the production floor can each run test programs to control their individual test stations. The data collected at each test station can be stored locally on the network analyzer, or on a remote file server accessible via the LAN. The expense and space of an external PC is eliminated. In R&D, you can run applications on the analyzer that are tailored for specific measurements, such as amplifier K-factor, or gain compression.

For computation-intensive programs or programs that require considerable memory resources, it may be desirable to run the application on a fast, external computer that can also control the analyzer, using SCPI or COM commands. Or, you can choose to have some data processing performed on the network analyzer, and some done on an external computer.

With the flexibility of using SCPI or COM commands, the speed and re-use advantages of COM-based programs, and the choice of internal or external program execution, you have the options you need to simplify and optimize the testing of your devices for both manufacturing and R&D environments.

Throughput

Decreasing test time is often critical for success in manufacturing environments. It can help you expand your production capacity without adding more lines. The PNA series of network analyzers has many attributes that help you accomplish your throughput goals. To achieve minimal test times, the analyzers offer outstanding RF performance, simplified calibration, a powerful COM-based automation environment, and many features designed to streamline the test process.

The outstanding performance of the analyzers starts with exceptionally fast sweep speeds that take advantage of the high dynamic range and low trace noise inherent in the instrument. Sweeps are anywhere from 6 to 35 times faster than the already fast 8753ES.

You can also reduce device test time by taking advantage of the powerful measurement features found in the PNA series analyzers. If you set up your device measurement with a segmented sweep, the analyzer will measure the device response only at the frequency segments that you define. This means you can skip data you don't need, and have high frequency resolution where you do need it, such as in the passband of your filters. Variable IF bandwidths mean you can use wide bandwidths and fast sweeps in segments that don't require much dynamic range, like in the passband of a filter, and use narrow IF bandwidths only in segments that require high dynamic range, such as in filter stopbands. Control of the source power level is especially helpful when measuring high dynamic range filters using the direct-receiver-access mode, or when measuring filter-LNA combinations. For stopband segments, the source power can be set high to maximize dynamic range. In the passband, the source power can be reduced so that the analyzer's receiver or the LNA is not driven into compression.

You can also improve test throughput for devices that require two to four instrument setups for complete characterization by using up to four separate measurement channels, each with its own stimulus and response parameters. Instead of recalling separate instrument states, you can recall one instrument state that contains all the measurement channels. You might recall only one instrument state for an entire production run, instead of four per device. When these recall time savings are multiplied by a large number of device measurements, overall test throughput can increase dramatically.

Besides improving measurement speed, we've also made it faster and easier to calibrate your test setups, using Agilent's ECal electronic calibration modules. Simply connect the module to your test ports and let the analyzer control and measure all the standards necessary for full two-port calibrations. Using ECal, there is no chance of connecting the wrong standard during calibration, so operators never have to start over. With ECal, you do it right the first time.

Measurement automation is another way to increase test throughput. For the fastest execution of instrument commands, and the fastest data transfer, use the COM programming interface. This chart shows the speed improvement you can obtain by using COM commands instead of SCPI program strings.

The PNA series of network analyzers can help improve your measurement throughput in several ways. Its high dynamic range and low trace noise let you use wider IF bandwidths for faster measurements. Features like segment sweeps, multiple measurement channels,

and electronic calibration help you optimize your device-test processes for speed. And, its COM-enabled remote interface lets you make automated measurements faster than using traditional command-string programming.

Now that you know more about the PNA series of RF network analyzers, imagine how you can use them in your manual and automated test environments to achieve fast, high dynamic range component measurements.