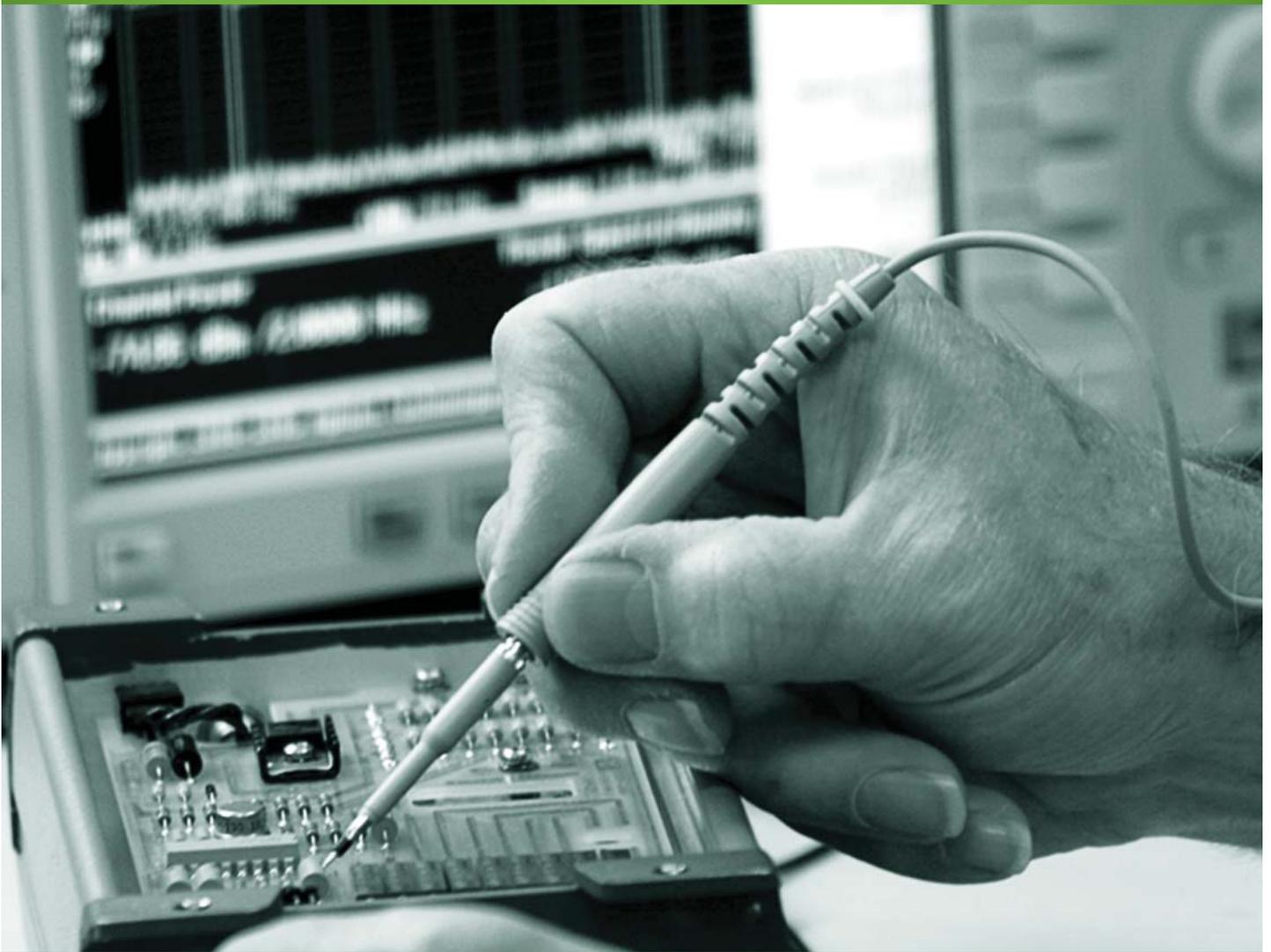


Agilent & Academia

Paving the way for Research and Innovation



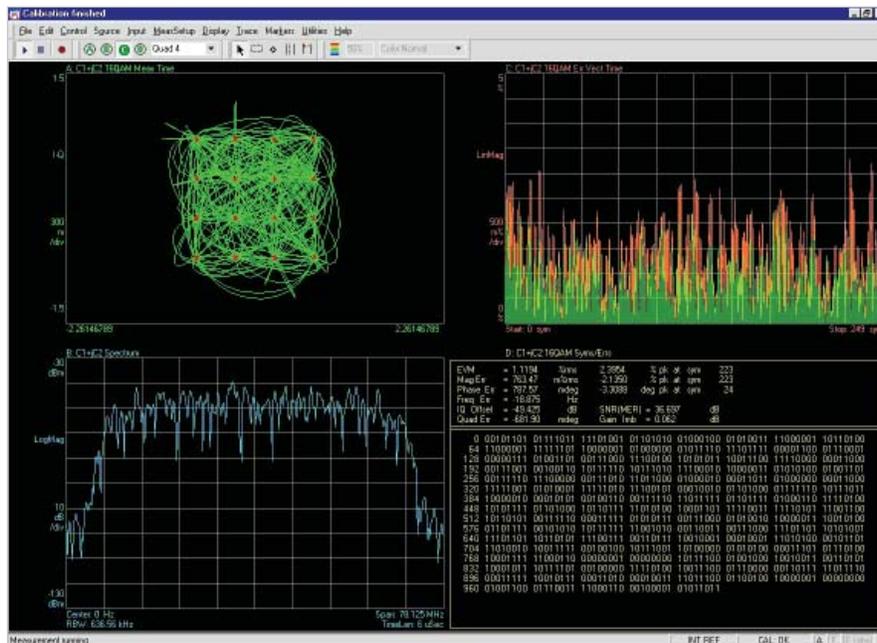
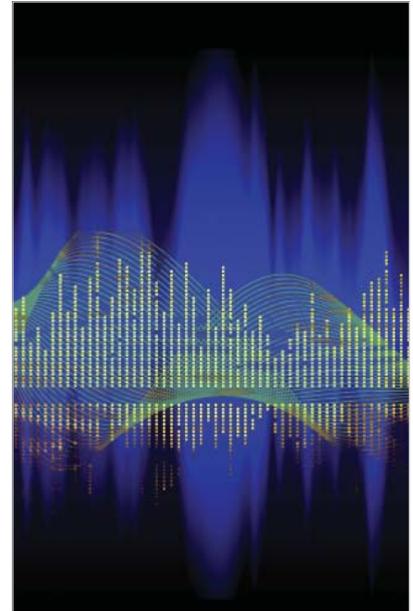
Agilent Technologies

Introduction

At the extremes of science, research often goes beyond “scientific discovery” to become the discovery of new sciences. As you seek to expand the world’s knowledge about phenomena at galactic or nanometer scales — or anything in between — confidence in results is strengthened by dependable measurement solutions that provide exceptional speed and data fidelity. In research laboratories around the world, Agilent instrumentation has become an integral part of advanced experimental systems.

As the world’s premier measurement company, Agilent works in close collaboration with engineers, scientists, and researchers around the globe to meet the communications, electronics, life sciences, material sciences and chemical analysis challenges of today and tomorrow. Agilent is committed to providing innovative measurement solutions that enable our electronics and bio-analytical customers and partners — the leaders in their fields — to deliver the products and services that make a measurable difference in the lives of people everywhere.

This brochure highlights some of the key research areas that Agilent is involved in, and solutions that can help you meet your research and development objectives. Agilent not only offers a full breath of electronic equipment for both teaching and research labs, but also provides solutions for your specific research need.



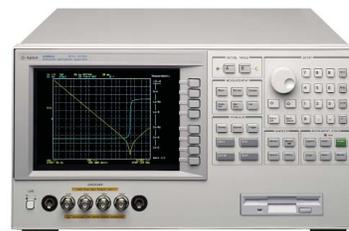
Materials Measurement

University of Washington's Applied Physics Laboratory and Center for Process Analytical Chemistry, are working on new sensors to monitor carbon nano-tube sonication. Utilizing Agilent's PNA Series Network analyzer and the 85070E Dielectric Probe Kit for complex permittivity measurements, researchers have developed a principle component analysis to categorize single and double walled carbon nano-tubes in a solution.

From meta-materials to dielectric substrates, microwave food products to bio-fuels, accurate characterization of electromagnetic properties at RF, microwave and mm-wave frequencies provide scientists with critical information needed for material and circuit design, modeling, research, manufacturing and quality control. Agilent offers a wide variety of instruments and fixtures to meet the most demanding needs.

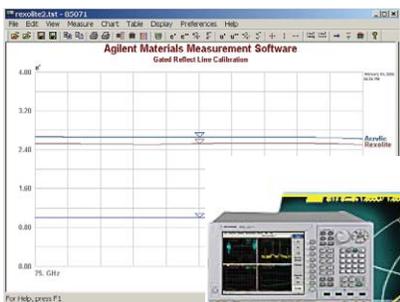
4294A Precision Impedance Analyzer

This is an integrated solution for the measurement and analysis of components and circuits as well as dielectric, magnetic and semiconductor materials. Its equivalent circuit function automatically extracts a circuit model from measured data, letting you analyze the characteristics of your device or material. Additional test fixtures allows for dielectric constant and impedance measurements of liquids.



E4991A Impedance/Material Analyzer, 1MHz to 3GHz

This instrument offers ultimate impedance measurement performance and powerful built-in analysis function. The optional 16453A Dielectric Material Test Fixture enables measurements of dielectric constant and loss tangent of solid materials, while the 16454A Magnetic Material Test fixture offers accurate permeability measurements of toroidal — shaped magnetic materials.



ENA-C, PNA-L, PNA and PNA-X series Network Analyzers

From 10 Hz to 1.05 THz, choose from a growing selection of RF and Microwave network analyzers with the appropriate accessories for your materials measurement needs. Further analysis can be done by adding the 85070E Dielectric Probe Kit to measure complex permittivity of liquids, conformable solids, or smooth flat hard solids. High Temperature, Slim Form and Performance Probes are available. Add the 85071E Materials Measurement Software with appropriate sample holders and test fixtures to measure electromagnetic properties of dielectric and magnetic materials over a broad frequency range.



Device Characterization in TeraHertz

Interest in terahertz is accelerating since many materials exhibit unique terahertz frequency-range properties that provide high contrast for imaging and spectroscopic materials identification. There also is a need for measurement equipment to be expanded into the terahertz region not only to support these applications but also to measure devices that, due to Moore's law, are rapidly pushing up toward 1 THz and beyond. From detecting cancer tumors to inspecting semiconductors, terahertz measurements are gradually increasing.

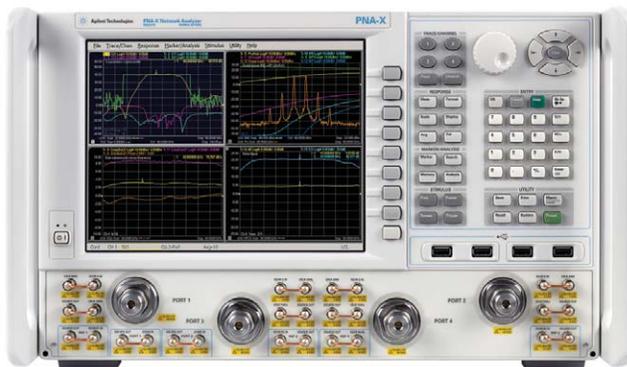
For many years, the University of Leeds Photonics Laboratory has performed some of the world's best research in terahertz. In the past five years its program has expanded to include involvement with most aspects of the terahertz research going on around the world. As a leading provider of microwave, millimeter wave and IR/optical measurement equipment, Agilent Technologies is supporting some of this research with an eye toward expanding our measurement coverage into this area — and exploring new possibilities in measurement, imaging and spectroscopy.

N5247A PNA-X Based Solutions

These solutions connect directly to the front panel of a dual source PNA-X Network Analyzer and do not require a millimeter-wave test set controller. This configuration allows full S-Parameter measurements up to 1.1 THz, and is a fully integrated solution that provides stable and repeatable measurements in the THz frequencies using a PNA-X.

The Key features of this solution are:

- Does not require a test set controller.
- Supports full S-parameter measurements within a waveguide band with a dual source PNA-X network analyzer with either 2- or 4-ports.
- Uses external power supplies that come with the recommended frequency extenders from Virginia Diodes Inc.
- Frequency offset mode of the PNA-X is utilized to drive the frequency extenders.
- Currently supports power calibration and power sweep with the recommended OML frequency extenders.
- Allows use of a higher IF frequency for the test and reference signals and can be driven with either a 26.5, 44, 50 or 67 GHz PNA-X Network Analyzer.
- A downloadable macro is available from Agilent that simplifies the setup of the frequency offset mode.



Millimeter-wave Measurements

Agilent Technologies and the University of Texas at Dallas established a leading millimeter-wave and sub-millimeter-wave electronics characterization facility at the Texas Analog Center of Excellence (TxACE). The facility will be available to industrial and government institutions using an open, collaborative framework. "With a facility of this type in a university environment, critical barriers will be removed for research in this challenging measurement area." Ken O - Director of TxACE and holder of the Texas Instruments Distinguished Chair at UT Dallas.



Millimeter-wave is becoming more common as measurement needs are pushed beyond 110 GHz, to 220 GHz, 325 GHz, and even 1 THz! Applications include on-wafer device characterizations as well as various types of materials measurements. High performance equipment is the essential part for all R&D activity in millimeter wave industry. Agilent provides the following test instruments needed for your millimeter wave labs.

N5250C Single Sweep Solution (10 MHz to 110 GHz)

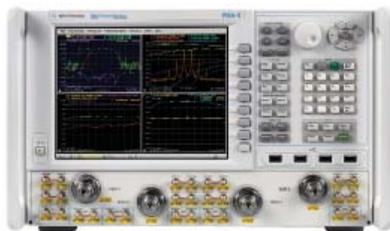
This solution is based on the E8361C PNA with a N5260A millimeter-wave controller and set of Agilent millimeter-wave modules that include a frequency combiner with a bias tees as well as attenuator options.

- Frequency Range: 10MHz to 110 GHz.
- Dynamic Range > 110 dB, without the need for external RF and LO sources.
- Built in Kelvin bias tee on combiners which brings the bias signal close to the device being measured.
- Industry leading stability with less than 1% drift over a 24 hour period.
- Mechanical attenuation of 25 to 30 dB available for above 67 GHz on either port 1 or 2 for high-power device measurements.
- Removing the combiners converts the system to extend W-Band waveguide system for measurements from 67 GHz to 110 GHz.
- Modules fully compatible with CascadeR probe stations and Agilent accessories to easily connect to probes.
- Utilizes Agilent's patented weight least squares calibration method in 1.0 mm for industry leading accuracy.

Millimeter-Wave Controllers N5261A/2A

The N5261/62A millimeter-wave Controller provides the interface between the millimeter-wave modules and PNA-X series network analyzer. The controller, when used in conjunction with the millimeter-wave modules and the PNA-X, provides all of the features and functions of a millimeter-wave vector network analyzer with the frequency range of the millimeter-wave modules used.





N5247A PNA-X Based Single Sweep Solution (10 MHz to 110 GHz)

This configuration of the millimeter network analyzer is based on the N5247A PNA-X network analyzer. It allows both a single sweep measurement solution that starts at 10 MHz up to 110 GHz and full port power level control. This solution is a direct replacement for the 8510XF with improved performance, in particular an added capability to control and use receiver leveling to set the power accurately at the 1.0 mm test port. Architecturally very similar to the existing N5250C system but is configurable as a set of separate components that include the N5247A PNA-X, either a 2- or 4-port millimeter-wave test set controller and the appropriate broadband frequency extenders as needed.

This solution includes all the key features of the N5250C solution plus the following:

- Provides 2- and 4-port S-parameter measurements from 10 MHz to 110 GHz in a single sweep.
- Full power control over the entire frequency range down to at least 50 dBm.
- Receiver leveling to maintain accurate power across the entire frequency range.
- Broad power sweeps across the entire frequency range.
- Supports true differential measurements across frequency range.
- Support for scalar mixer measurements.
- Integrated pulse measurement capability.



Agilent E8257D PSG Microwave Analog Signal Generator

The Agilent E8257D is a fully synthesized signal generator with high output power, low phase noise, and optional ramp sweep capability. Its high output power and superior level accuracy often eliminates the need of an external amplifier for testing high power devices and minimizes test uncertainty to identify errors early in the design process.



Source Modules

Millimeter wave sources are essential instruments for developing almost all millimeter wave systems and for extending the range of microwave systems. The E8257DSxx series of external, high power, frequency banded mm-wave source modules, when paired with the high performance PSG, provide synthesized frequency performance, mm-wave test signals for waveguide bands from 50 to 500 GHz.

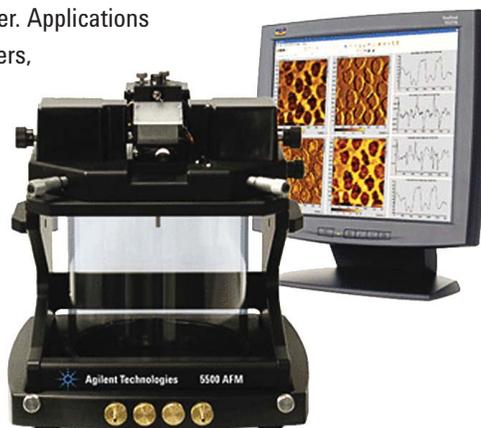
Nanotechnology

The Blakett Laboratory, Department of Physics, Imperial College London utilizes the Agilent 5500 AFM to facilitate research into organic and hybrid semiconductor systems and opto-electronics devices. "We are very excited about the possibilities that the Agilent 5500 AFM system will enable, especially in our research for novel high-performance semiconducting materials and devices," said Dr. Thomas Anthopoulos, a reader in Experimental Solid-State Physics. "The high-spatial-resolution Kelvin force microscopy and current sensing capabilities of the system combined with its excellent environmental control will allow study of the electronic and structural properties of these novel material systems and devices down to nanometer scale."

When your next discovery is within reach, getting there first — and getting a glimpse of what others haven't seen — depends on accurate, efficient nanotech measurement tools. Agilent's nanotech portfolio lets you image, manipulate and characterize a wide variety of nano-scale behaviors — electrical, chemical, biological, molecular, atomic and more. Our growing collection of instruments, accessories, software, services and consumables can reveal the clues you need to understand the nanoscale world.

5500 Atomic Force Microscope/Scanning Probe Microscope (AFM/SPM)

Offers in-situ imaging, top-down scanning and environmental and temperature control. Its universal microscope base permits easy integration with an environmental chamber and inverted optical microscope. This is one of our many application specific AFMs we offer. Applications include material sciences, polymers, electrochemistry, life sciences & nanolithography.



U9320A 8500 Field Emission Scanning Electron Microscope (FE-SEM)

A compact system that has been optimized for low-voltage imaging, extremely high surface contrast, and resolution typically found only in much larger and more expensive field emission microscopes. Applications include polymers, thin films, biomaterials and energy sensitive materials.

U9820A G200 Nano-Indenter

Most accurate, flexible, user-friendly instrument for nanomechanical testing. Electromagnetic actuation allows unparalleled dynamic range in force and displacement and measurement of deformation over six orders of magnitude (from nanometers to millimeters). Applications include semiconductor, thin films, and MEMs (wafer applications); hard coatings and DLC films; composite materials, fibres, and polymers; metals and ceramics; and biomaterials and biology.



B1500A Semiconductor Device Analyzer

Provides accurate, flexible current-voltage (IV) and capacitance-voltage (CV) measurements of devices such as carbon nano-tube transistors and single electron transistors. Its task-oriented interface lets you make a few quick selections regarding the device — and it then chooses the appropriate settings, makes measurements, analyzes the data and displays the results.



4294A Precision Impedance Analyzer

An integrated solution for the measurement and analysis of components and circuits as well as dielectric, magnetic and semiconductor materials. Its equivalent circuit function automatically extracts a circuit model from measured data, letting you analyze the characteristics of your device or material.



34420A 7.5-digit Nano-voltmeter

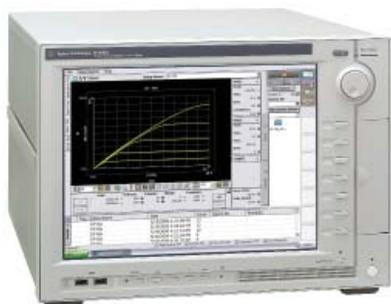
Optimized for low-level measurements. Coupled with free Agilent IntuiLink software, you can easily transfer data to a PC to analyze, interpret, display and document your results.



Renewable Energy – Solar

Agilent Technologies offers a wide variety of power, measurement, and switching products you can use as building blocks for characterizing the electrical properties of solar cells, modules and arrays. Agilent's intent is to provide tools that decrease test costs without sacrificing performance and increase test flexibility to handle a rapidly changing testing environment.

B1505A Power Device Analyzer/Curve Tracer



The Agilent B1505A Power Device Analyzer / Curve Tracer is the only single box solution available today with the capability to characterize high power devices from the sub-picoamp level up to 3000 volts and 40 amps. These capability covers evaluation for new power devices such as SiC or GaN as well as solar cells or solar modules. The B1505A has separate modules that support high-current (HCSMU) and high-voltage (HVSMU). The B1505A also supports a high-power SMU (up to 1 A/200 V) and a multi-frequency capacitance measurement unit (up to 5 MHz). Its ten-slot modular construction lets you configure the B1505A exactly the way you want.

E4360A Solar Array Simulator



The E4360 Modular Solar Array Simulators accurately simulates the I-V curve of different arrays under various environmental conditions such as eclipse, spin, rotation, age and temperature using List Mode with up to 512 sequenced I-V curves. Its small size and high power saves valuable rack space. User interface is simple as you can program I-V curves from the front panel without a need for a controller, or even perform remote programming via GPIB, LAN and USB interfaces with SCPI command set (drivers available). Available as a custom turn-key system or as individual instruments.

U2722A 4-quadrant SMU



The U2722A USB Modular Source Measure Unit is a 3-channel 20V/120mA that can operate in a 4-quadrant operation. The channels could be connected in series or in parallel to achieve up to 60 V/360 mA. It uses the common non-proprietary standard high-speed USB 2.0 interface that provides ease of connectivity — allowing users to set up and configure their tests swiftly with its plug and play feature. The U2722A can function as a standalone module, or as a modular device, allowing expansion and compact solution when used with the other modules in the USB Modular Instruments and DAQ family.

N3300A electronic load

The N3300A electronic load has constant current mode to control the current in the fuel cell. This feature enables you to easily change the current operating point of the fuel cell to explore how the impedances are affected by current density changes. It has built-in synchronized voltage and current digitization capability to digitize its own input voltage and input current waveforms for fuel cell AC impedance measurements. The N3300A also supports remote voltage sensing, allowing users to measure the voltage across two terminals that are located a distance away from the load input terminals.



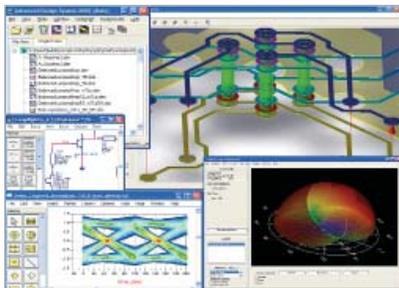
N6700 Series DC sources

The Agilent N6700 modular power system offers speed and accuracy for solar cell dark testing optimization. The modular power system provides up to four outputs in 1U of rack space for high channel count applications. The four outputs are defined by modules that come in different power ranges, speeds, and measurement accuracies. It can connect in series or parallel to meet higher voltage and current needs.



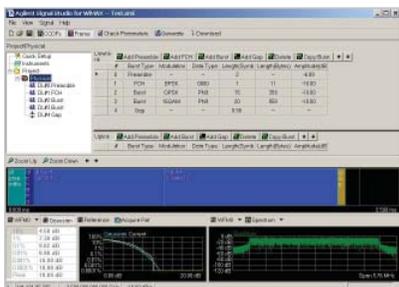
Communications

Enabling the development of devices and networks is the creation of new wireless communication standards and waves of continuous improvement to existing standards. As such, Agilent actively participates in the development of test processes and measurement methods in many of the wireless connectivity standards. We are determined never to let test equipment needs stand in your way of developing innovative products and technology for evolving wireless standards.



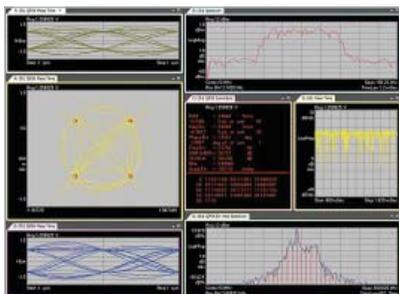
Advanced Design System (ADS) software

- Use PHY layer libraries for both Fixed and Mobile WiMAX.
- Simplify modulation and demodulation simulations and evaluation of output spectrum, error-vector magnitude and bit-error rate with preconfigured setups.
- Support WiMAX Wave 2 capability with 2x2 MIMO and ITU MIMO channel model.



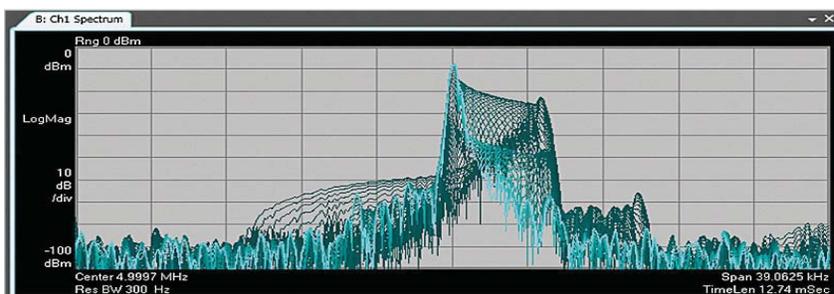
Signal Studio (N7613A and N7615B) with vector signal generators

- Use Signal Studio software to download OFDM or OFDMA waveforms to signal generators.
- Perform WiMAX receiver sensitivity, maximum input level and receiver linearity tests.
- Test receiver frequency and timing requirements with fast switching signal generators.
- Integrates with Agilent's signal generators ESG (E4438C), MXG (N5182A) and PSG (E8267D).



Vector signal analysis software – 89600 Series

- Analyze modulation of Fixed and Mobile WiMAX signals.
- Perform transmitter tests such as output power-level, and rise/fall, spectral flatness, tolerance and relative constellation error (EVM).
- Use with digitizers such as spectrum analyzers, oscilloscopes, test sets, logic analyzers or simulation software for evaluation and troubleshooting from simulation to hardware.



Spectrum analyzers – PSA Series or X-Series (MXA/EXA)

- Measure Fixed and Mobile WiMAX signals.
- Perform transmitter tests such as output power, power rise/fall, spectrum mask, spectral flatness and out of band spurious emission.
- Define limit lines and utilize bandwidth up to 80 MHz.



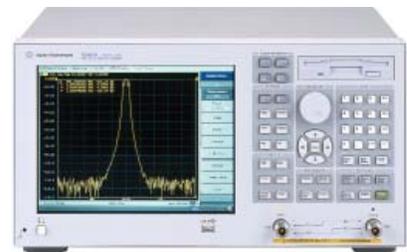
Ultra-high performance Infiniium oscilloscopes – DSO90000A Series

- Capture wide bandwidth of WiMAX with 13 GHz of available bandwidth.
- Capture MIMO signals with two channel inputs.

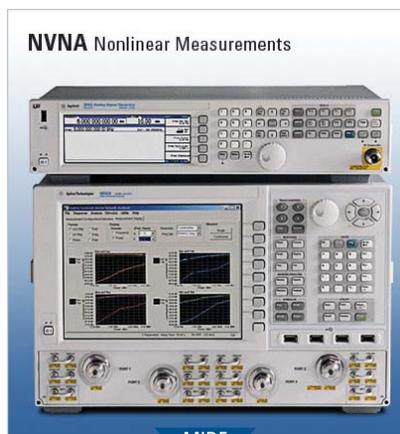


Network analyzers – ENA or PNA-X Series

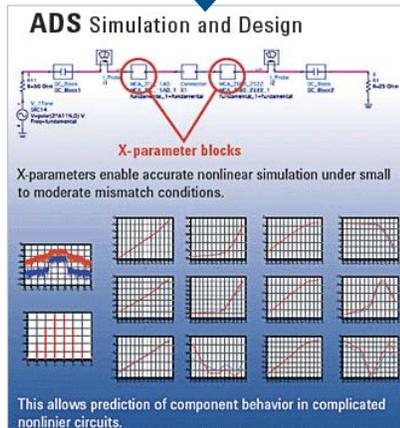
- Perform comprehensive network analysis for WiMAX component needs.
- Integrate measurements for active devices with minimum iterations.
- Attain accurate measurements with fast sweep speeds, wide dynamic range and low trace noise.



Non-linear Waveform Measurements



MIDF
File



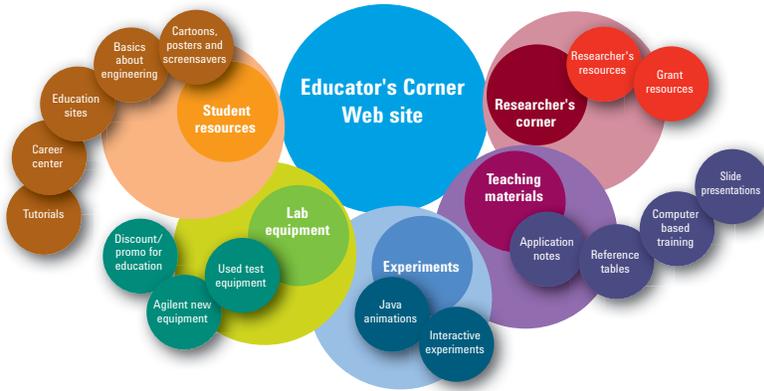
Testing today's high-power devices demands an alternate solution—one that quickly and accurately measures and displays the device's nonlinear behavior under large signal conditions, and provides an accurate behavioral model that can be used for linear and nonlinear circuit simulations.

Since S-parameters assume that all elements in the system are linear, this approach does not work well when attempting to simulate performance when the amplifier is in compression or saturation, as real-world HPAs often are. The errors are particularly apparent when simulating the combined performance of two cascaded devices that exhibit nonlinear behavior. While engineers may live with this inaccuracy, it invariably results in extensive and costly empirical-based iterations of the design, adding substantial time and cost to the design and verification process.

Nonlinear Vector Network Analyzer

- Efficiently and accurately analyze and design active devices and systems under real-world operating conditions, to reduce design cycles by as much as 50%
- Gain valuable insight into device behavior with full nonlinear component characterization
- Display calibrated time-domain waveforms of incident, reflected, and transmitted waves of the DUT in coaxial, in-fixture, or on-wafer environments
- Show the amplitude and phase of all harmonic and distortion spectral products to design optimal matching circuits
- Create user-defined displays such as dynamic load lines
- Measure with full traceability to the National Institute of Science and Technology (NIST)
- Provide fast and powerful measurements of DUT nonlinear behavior using X-parameters
- Extend linear S-parameters into nonlinear operating regions for accurate predictions of cascaded nonlinear device behavior using measurement-based data
- Easily import the NVNA's X-parameters into Agilent's Advanced Design System (ADS) to quickly and accurately simulate and design nonlinear components, modules and systems
- Measure memory effects such as self heating and signal-dependent bias changes
- Capture complete load-dependent nonlinear component behavior with X-parameters and external impedance tuners

Resources, Partnerships and Collaboration



Free resources from Educator's Corner Web portal

Educator's Corner is a dedicated Web site that provides a one-stop education resource to lecturers, researchers and students looking to enhance their higher education curriculum and research capabilities. Various tools and resources can be downloaded for free.

- Teaching tools
- Lab experiments
- Java animations
- Computer based training
- Application notes
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- Journal articles
- Engineering cartoons
- Student resources
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Research partnerships and collaboration

As the world's premier measurement company and a committed global citizen, Agilent takes an active role in supporting higher education and research.

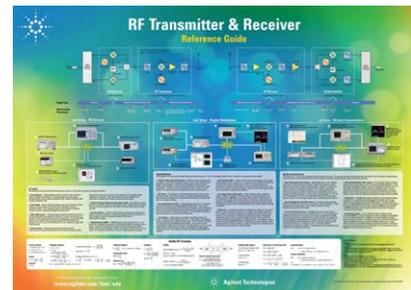
We are committed to furthering science and technology by developing strategic partnerships with universities and research labs worldwide. We work with these universities to develop technology in areas of mutual interest.

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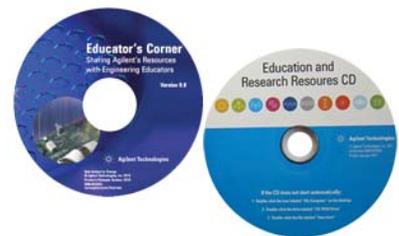
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Agilent Advantage Services is committed to your success throughout your equipment's lifetime. We share measurement and service expertise to help you create the products that change our world. To keep you competitive, we continually invest in tools and processes that speed up calibration and repair, reduce your cost of ownership, and move us ahead of your development curve.

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Revised: October 14, 2010

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Printed in USA, March 30, 2011
5990-7534EN



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