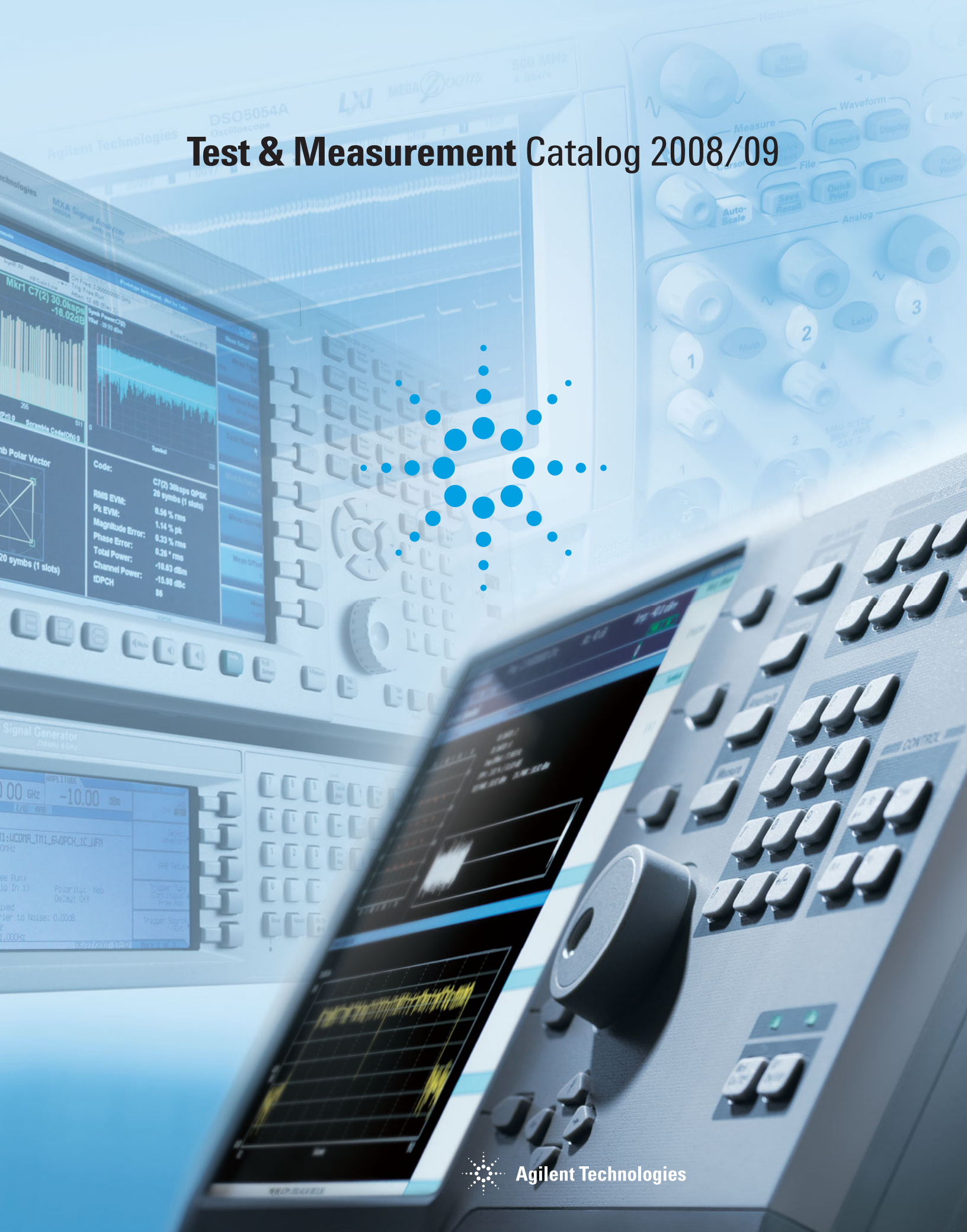
Test & Measurement Catalog 2008/09



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Welcome to
Agilent Technologies

Dear Valued Customer,

I'm pleased to present the 2008/09 edition of the Agilent Test and Measurement Catalog. As you look through it, you will find unmatched depth and breadth of products, solutions and services to help you improve your business results.

As the world's premier measurement company, Agilent Technologies Electronic Measurements Group is firmly committed to being a measurement solutions partner to every engineer and scientist in the electronics markets.

Agilent people around the world value strong customer relationships. We count on your feedback to ensure that we continue to meet your needs. We hope you'll always look to Agilent for innovative products and solutions to help you achieve your business results.

Sincerely,

Saleem Odeh
Vice President and General Manager
Agilent Technologies, Inc.
Electronic Measurements Group
Sales, Service and Support

A Singular Focus on Measurement

Today's world runs on electronics from the cell phones in people's pockets to anytime-anywhere internet access. For advancing these and other essential applications and products, one company stands at the forefront: Agilent, the leader in electronic measurement.

Agilent's Electronic Measurement business provides standard and customized solutions that are used in the design, development, manufacture, installation, deployment and operation of electronic equipment and systems and communications networks and services. These solutions include test and measurement instruments and systems, automated test equipment, communications network monitoring, management and optimization tools and software design tools and associated services.

The company's 19,000 employees serve customers in more than 110 countries. These customers include many of the world's leading high-technology firms, which rely on Agilent's products and services to increase profitability and competitiveness, from research and development through manufacturing, installation and maintenance. Agilent enables its customers to speed their time to market and achieve volume production and high-quality precision manufacturing.

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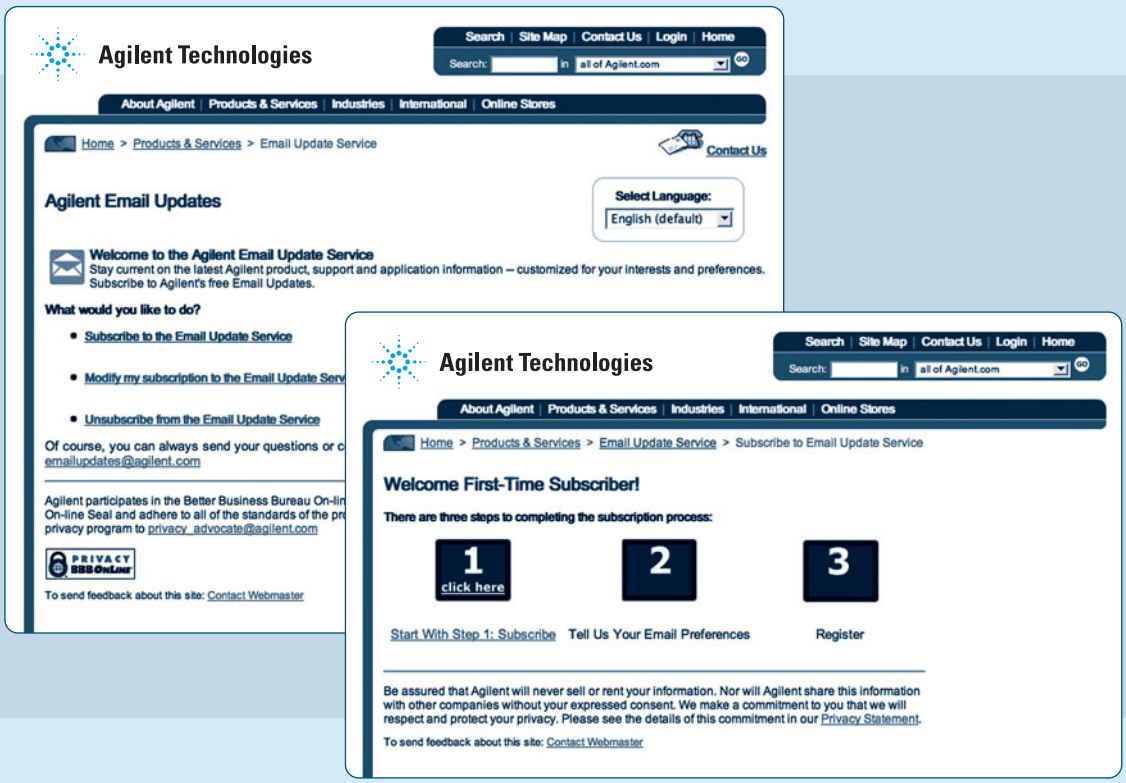

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Agilent E6832A W-CDMA Cal Application - Measurement Screen
File Window Screens View Measurements Utility Help
Summary SEM ACLR Mean Pow RRC Pow
In-Channel Power -13.05 dBm/3.84 MHz
Frequency (MHz)
Range (MHz) Pass/Fail Level (dBc) Margin (dB)
10 Pass -57.88 14.88
-5 Pass -56.65 23.65
5 Pass -56.90 23.90
10 Pass -56.21 13.21
Timeslot: - Continuous
Spectrum Monitor Results
Summary Graphic
Graph Control
Center: Auto
Span: Auto
Ref Level: Auto
dB/Div: Auto
Markers
Frequency
Mode
Frequency: Relative
Markers: Normal
Peak Track:
More (1 of 2)
Delete All
Define Wafer
Wafer size 200 mm
Wafer shape notch
Notch Location Top Left Right Bottom
Map Origin
Wafer name ASUR
Die X Step(um) 20000
Die Y Step(um) 20000
Ctr X Index 3
Ctr Y Index 5
X Offset(um) 0
Y Offset(um) 0
Align Die X 4
Align Die Y 7
Align Module X 0
Align Module Y 0
Apply Reset
Load Save Clear All Select Whole Done Cancel

NEW PRODUCTS & APPLICATIONS

5000 Series Oscilloscopes

See what you've been missing with your current bench scope.

- **See more time at a higher resolution with 1 M points MegaZoom III memory**
- **See the most elusive signal details with up to 100,000 waveforms per second update rate and high-resolution display**
- **Have more connectivity options with LXI class C compatibility and standard USB/LAN/GPIB ports**

Users of general-purpose portable oscilloscopes have, until now, had to work through everyday debug tasks using oscilloscope technology from the 1990s. Engineers need tools capable of handling today's design challenges. The new 5000 Series oscilloscopes tackle these needs with:

- Deep memory
- Fast update rates
- A high-resolution XGA display system
- Up to 12 bits of vertical resolution in both repetitive and single-shot modes

The 5000 Series is also LXI compatible with USB, LAN, and GPIB ports all standard (as well as XGA out).

See what you've been missing with traditional bench scopes. Ask for a DSO5000 Series demo today.

►See page 56
www.agilent.com/find/dso5000

6000L Series Low Profile Oscilloscopes

The 6000L Series scope is the highest performance and lowest cost automated test oscilloscope in its class.

- **4 channel scope in only 1U (43.6 mm space)**
- **Up to 1 GHz bandwidth, 4 GSa/s sample rates and up to 8 M memory**
- **Built in web browser for control with standard USB, LAN, GPIB interfaces, XGA out and LXI class C compliance**

The Agilent 6000L Series oscilloscopes give you just the right performance in a compact (1U) package. This family of oscilloscopes consists of three 4-channel models for automated test applications. They provide unbeatable performance in this price range, with measurement capabilities ideal for functional and qualification testing.

The three digital storage oscilloscopes (DSOs) combine the best in signal viewing with patented MegaZoom III technology and 2 Mpt standard MegaZoom deep memory allowing you to capture long, non-repeating signals, while maintaining high sample rates and good timing resolution. With standard USB, LAN, GPIB connectivity interfaces, XGA out and LXI class C compliance these oscilloscopes are easily integrated into your new or existing automated test system.

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www.agilent.com/find/6000L

N2780A Series AC/DC Current Probes

N2780A Series current probes and N2779A power supply.

- **Various bandwidths: DC to 2 MHz, 10 MHz, 50 MHz, and 100 MHz**
- **Superior 1% accuracy, flat frequency response and high signal-to-noise ratio**
- **Direct connection to high-impedance 1 MΩ BNC input of oscilloscope**

Compatible with any oscilloscope with a high-impedance BNC input, the new N2780A Series current probes offer accurate and reliable solution for measuring DC and AC currents.

Using hybrid technology that includes a Hall-effect sensor and an AC current transformer, the probes provide accurate measurement of DC or AC currents up to 500 Arms (for model N2780A) or DC – 100 MHz (for model N2783A), without breaking into the circuit.

The current probes feature broad measurement ranges that make the probes ideal for measuring steady state or transient current of motor drives, switching power supplies, and flat-panel displays. External power supply (model N2779A) lets you connect up to three N2780A Series current probes to a single power supply.

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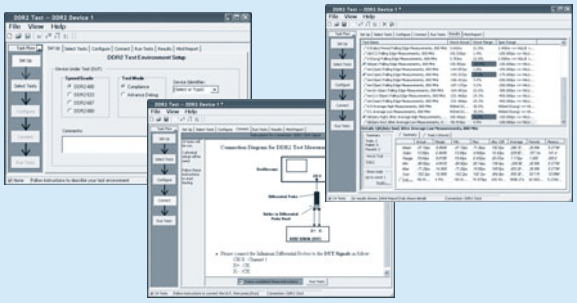
www.agilent.com/find/N2780A

N5413A DDR2 Compliance Test Application



- **Easy operation reduces test time**
- **Powerful analysis and debug**
- **Thorough performance reporting**

With Agilent Technologies' DDR2 compliance test application, you can perform automated testing and margin analysis based on the JEDEC specifications. The application automatically configures the oscilloscope for each test and provides informative results. It includes margin analysis indicating how close your device comes to passing or failing.

The demand of signal integrity performance for DDR2 measurement is critical to achieve accurate and repeatable measurements. Agilent's Infiniium 80000 Series oscilloscope, the winner of Test and Measurement World's 2007 Best-In-Test Product of the Year offers industry's lowest noise floor, lowest trigger jitter and flattest frequency response. It is an excellent tool for DDR2 characterization.

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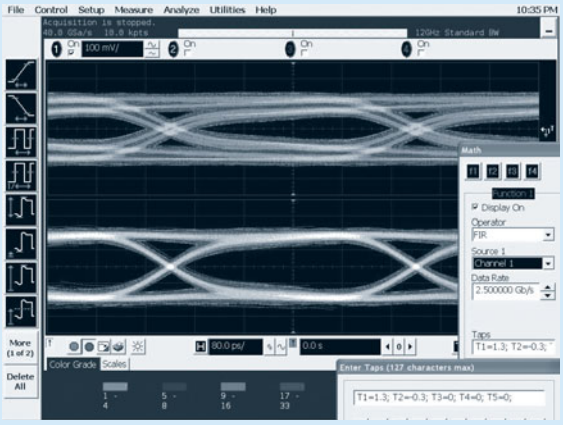
www.agilent.com/find/n5413a

N5430A User Defined Function Software



The top is a live signal eye pattern with an ISI (inter symbol interference) effect from its transmission line. The bottom is an equalized eye pattern after applying 5 tap FIR filter through N5430A User Defined Function.

- **Enhance your Infiniium oscilloscope with the analysis power of MATLAB®**
- **Develop custom analysis functions directly on Infiniium oscilloscopes**
- **Live waveform update from a seamless gateway to the MATLAB**

The Agilent N5430A Infiniium User Defined Function software allows you to create and execute your own custom math and analysis functions using the power of MATLAB software environment from The MathWorks.

With a seamless integration to MATLAB, Agilent Infiniium oscilloscopes allow you to display your math and analysis functions created in MATLAB live on the oscilloscope screen, just like any of the other scope's standard functions. Or, you can interactively analyze and visualize your results in the MATLAB environment, such as graphically plotting results or auto generating reports.

The User Defined Function comes with standard example functions like "5 TAP FIR equalization filter", "Butterworth low pass filter", "Linear Feedforward Equalization" and more.

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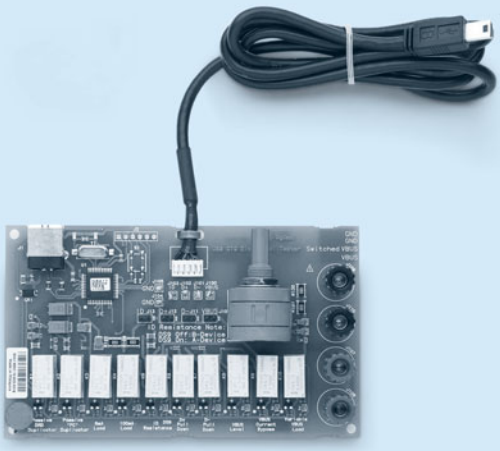
www.agilent.com/find/udf

N5417A USB OET (On-the-go Electrical Test Fixture)



USB On-the-go (OTG) Electrical Test Fixture.

- **Automated through Infiniium oscilloscope running N5416A USB 2.0 automated test software**
- **N5417A USB OET (On-The-Go Electrical Test Fixture) verifies USB On-The-Go electrical test**
- **USB-IF recognized automated USB OTG compliance test fixture**

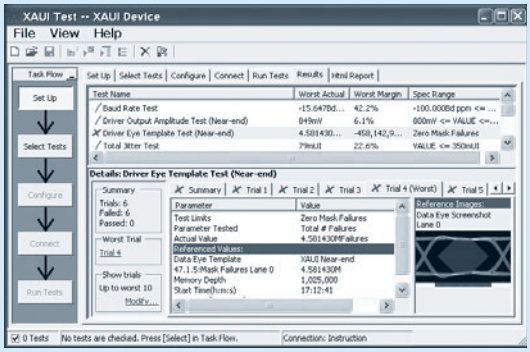
USB On-the-go is the latest addition to USB, the most popular interconnect for PC and CE interfaces. USB OTG allows dynamic role switching between host and device. This can be done without the need of the standard PC host to improve portability.

Agilent now offers N5417A USB on-the-go electrical tester as part of the complete USB electrical compliance test solution that supports USB 1.1, USB 2.0 and USB OTG. The N5417A USB OET (On-the-Go Electrical) verifies USB OTG specific electrical test in the USB OTG compliance test.

The N5417A OTG electrical fixture requires the DSO80000B-Series oscilloscope, N5416A USB compliance test software, 34401 DMM and E3631A power supply to support USB-OTG fully automated electrical compliance tests.

▶Visit www.agilent.com/find/n5417a

N5431A XAUI Electrical Validation Application



Improve your efficiency with the powerful reporting capabilities of the N5431A which provides fast and accurate XAUI validation.

- **The industry's only XAUI & 10GBASE-CX4 automated test solution**
- **Fast and accurate XAUI validation with advanced test control and debug**
- **Superior probing system with unmatched flexibility**

The N5431A XAUI electrical validation application is the industry's only XAUI automated test solution that helps you improve your efficiency by providing fast and accurate XAUI validation.

With the superior signal integrity and probing provided by the Agilent 80000 Series oscilloscopes, you will have confidence that devices which pass testing with the N5431A are in conformance to the XAUI specifications as described in IEEE 802.3-2005.

The application also provides support for the XAUI-derived 10GBASE-CX4 specification, as well as bit-rates and masks for the CPRI, OBSAI; and Serial RapidIO specifications. Easily set up, configure and test your XAUI devices with an intuitive task flow which automatically generates reports you can share with your managers, colleagues, and customers.

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www.agilent.com/find/n5431a

U2000 Series USB Power Sensors

Setup is as easy as plugging a U2000 sensor's USB cable into your PC, and you can start your measurements right away with the Power Analysis Manager.

- **Performs power measurements without a power meter**
- **Frequency range: 9 kHz to 24 GHz**
- **Power range: –60 dBm to +20 dBm (Higher range up to +44 dBm will be available early 2008)**

The Agilent U2000 Series of standalone USB-based power sensors enable simpler and more affordable power measurements – without a power meter.

These sensors make fast, accurate average power measurements at up to 1000 readings/s*, and with plug-and-play USB setup. Measurement results are displayed on a PC or other selected Agilent instrument, such as the signal source, spectrum analyzer or network analyzer. Because these sensors are USB-powered and provide built-in triggering, they don't require external power adapters and triggering modules for synchronization with external instruments or events.

Each sensor's capabilities are extended with the feature-packed N1918A Power Analysis Manager software, for better monitoring and troubleshooting.

Other benefits include its portability for field applications and zeroing without disconnecting from the device-under-test.

** When operating at buffered mode*

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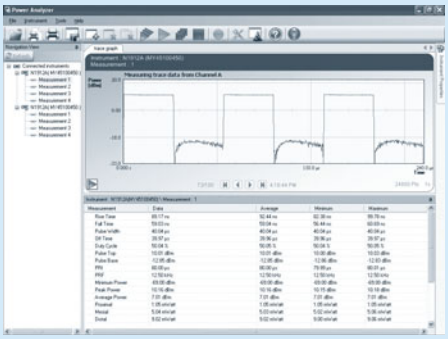
www.agilent.com/find/usbsensor

N1918A Power Analysis Manager

Adopt versatile viewing all on one screen with multiple display formats – and even multiple tabs.



Analyze pulses easily with N1918A's complete pulse characterization capability.

- **Various display formats: numerical, analog, strip chart, trace graph and multi-list view (>10 channels)**
- **15-point parameter display for complete pulse characterization**
- **Limit and alert settings for easy deviation monitoring**

The Agilent N1918A Power Analysis Manager software extends the capabilities of the U2000 Series USB power sensors, P-Series power meters and P-Series modular power meter. This feature-packed software not only enables performance monitoring and data collection, but also simplifies post-data analysis and speeds up troubleshooting. Other features of the N1918A include the following:

- Overlay of traces
- Channel mathematics
- Waveform mathematics
- Recording and playback – of up to 7 days of data – for easy analysis and troubleshooting
- PDF, CDF or CCDF statistical computations in graph and tabular formats

The N1918A is available in two versions: the basic Power Panel and the advanced Power Analyzer – for full access to its features and capabilities. Power Panel can be accessed immediately upon installation, while Power Analyzer's license (N1918A-100) is available for purchase separately.

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www.agilent.com/find/N1918A

N8262A P-Series Modular Power Meter

The compact LXI-based solution for power measurements.

- **Slim, compact build (1U half-rack size) for easy deployment**
- **LXI C compliant for seamless integration into an ATE system**
- **Online web browser for real-time remote operation**

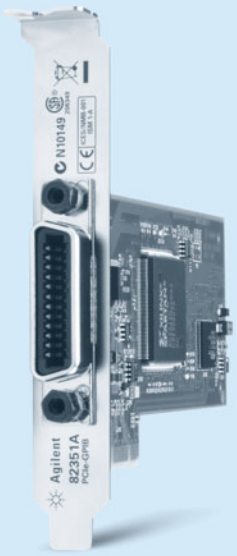
The Agilent N8262A P-Series modular power meter enables LAN-based automated measurements of peak, peak-to-average ratio and average power. Its slim build enables fast, efficient, and cost-effective creation of your ATE system. The N8262A offers seamless interoperability with existing assets in the system – where minimal programming and re-configuration are required.

The N8262A contributes to a lower cost of ownership with its LAN interface, much unlike PXI or VXI-based interfaces. Other features include its 30 MHz wide video bandwidth and its code-compatibility with P-Series power meters.

By helping you build greater assurance in system readiness, the N8262A frees you to focus where it counts most.

►**www.agilent.com/find/N8262A**

82351A PCIe™-GPIB Interface Card



Leveraging from PCIe™ – the new standard for high-speed internal devices.

- **Half-height card (68.9 mm)**
- **High transfer rate of 1.4 MB/s**
- **Highly flexible via up-plugging (into x4 and x8 slots)**

The 82351A is a half-height PCIe™-GPIB interface card that is designed for integration into next generation PCIe™-based PCs or workstations with smaller form factors. PCIe™ (PCI Express) is an evolutionary version of PCI that offers a higher transfer rate across a low number of wires, hence increasing the bandwidth to execute applications faster.

►www.agilent.com/find/82351A

2

N6705A DC Power Analyzer

N6705A DC Power Analyzer.

- **Integrates capabilities of power supply, DMM, scope, arbitrary waveform generator and datalogger**
- **Easy to use R&D tool for sourcing and measuring DC voltage and current into the DUT**
- **Connections and controls color-coded to the display**
- **Intuitive, dedicated physical controls for common functions**
- **Access all capabilities without programming**

The Agilent N6705A DC power analyzer provides unrivaled productivity gains when sourcing and measuring DC voltage and current into a device under test (DUT). This tool, which R&D engineers can use to gain insights into the DUT's power consumption in minutes without writing a single line of code, represents an entirely new instrument category for R&D engineers.

The Agilent N6705A DC Power Analyzer is a highly integrated instrument that combines up to four advanced DC power supplies, DMM, oscilloscope, arbitrary waveform generator and datalogger. It provides an easy-to-use interface, with all sourcing and measuring functions available from the front panel.

►See page 375
www.agilent.com/find/N6705

L4411A Low Profile 6½ digit Enhanced Performance DMM

L4411A 6½ digit enhanced performance DMM.

- **Fastest reading rates with 1 M reading memory**
- **Expanded measurement ranges and functions**
- **USB, GPIB, and LAN standard – LXI class C compliant**

The newest 6½ digit enhanced performance digital multimeter has all the capability of the 34411A in a smaller compact package. The built-in web interface allows the user to very quickly connect to the instrument and start taking measurements.

If this instrument is replacing the E1412A or 34401A in a system, use the compatibility mode to ensure the easiest transition to the new hardware while you take advantage of faster test throughput. Measurement ranges have been expanded, and capacitance and temperature measurements are included!

►See page 226
www.agilent.com/find/L4411A

E8663B Analog Signal Generator

The E8663B replaces the 8663A as the performance leader in RF signal generation.

- **High output power**
- **Excellent phase noise performance**
- **100 kHz to 9 GHz frequency coverage**

The E8663B analog generator for LO substitution and component test applications offers high output power, ultra-low phase noise from 1 MHz to 9 GHz, superior level accuracy, and code compatibility with other Agilent microwave signal generators such as the 8662A/8663A family.

The E8663B is also an excellent tool for advanced communication testing of receiver quality, transmitter sensitivity and selectivity, offering low harmonics, low spurious, ultra-low phase noise, flexible analog modulation formats: AM, FM, ΦM and pulse, internal modulation with sine, square, triangular, ramp, and noise waveforms, and narrow pulse modulation (20 ns) down to 10 MHz.

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www.agilent.com/find/E8663B

MXG Signal Generators

Agilent MXG signal generators provide fast switching speeds, industry-best ACPR, and simplified self-maintenance.

- **Frequency range from 100 kHz to 1, 3, or 6 GHz**
- **≤1.2 ms switching speed, –76 dBc ACLR performance, and designed for reliability and easy self-maintenance**
- **Signal Studio software includes W-CDMA, cdma2000®, WLAN, mobile WiMAX™ and more**

The MXG analog and vector signal generators provide better value for your investment by increasing throughput, reducing measurement uncertainty, maximizing uptime, and saving rack space. The innovative hardware design offers high reliability and simplified self-maintenance – all in two rack units (2RU).

The Agilent MXG's fast frequency, amplitude and waveform switching, is ideal for high-volume manufacturing of components used in cellular and wireless connectivity systems. And with scalable capability and outstanding signal quality, including industry-leading ACPR and EVM performance, the Agilent MXG is a cost effective solution that provides accurate and repeatable reference signals for:

- LO/clock substitution
- CW and AM, FM, ΦM, pulse, ASK, FSK, PSK modulated interferers
- Testing PA/MCPAs, filters, modulators, transmitters, receivers, etc.

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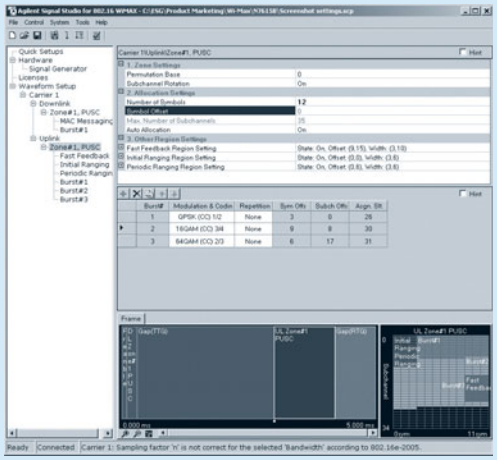
www.agilent.com/find/mxg

N7615B Signal Studio for 802.16 WiMAX (mobile)



Build WiMAX and WiBro waveforms with N7615B Signal Studio for 802.16 WiMAX.

- **Single- and multi-carrier 802.16 mobile WiMAX and WiBRO**
- **Flexible downlink and uplink (or both) frame configuration: zones, bursts, and MAC PDUs**
- **Support for matrix A (STC), matrix B (2x2 MIMO), and uplink collaborative spatial multiplexing**

N7615B Signal Studio for 802.16 WiMAX enables you to easily create waveforms that comply with WirelessMAN-OFDMA PHY in the IEEE 802.16-2004 and 802.16e-2005 standards. The software's intuitive graphical user interface provides convenient access to the physical and basic MAC layer parameters, including bandwidth, cyclic prefix ratio (G), and frame length, providing the versatility you need to configure waveforms for both component and receiver design verification and testing. Download WiMAX waveform files to N5182A MXG, E4438C ESG, and E8267D PSG vector signal generators for instant playback.

Optional capabilities provide application-specific customization with basic capabilities targeted for component design and test or advanced capabilities for receiver design and test. The flexible licensing product structure allows for fixed or transportable and perpetual or time-based licenses.

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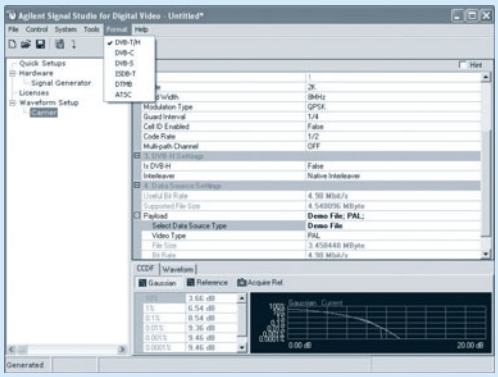
www.agilent.com/find/signalstudio

N7623B Signal Studio for Digital Video



N7623B Signal Studio for Digital Video.

- **Create standard-compliant DVB-T/H/C/S, ISDB-T, ATSC, and DTMB reference signals for component and receiver test**
- **Compatible with E8267D PSG, N5182A MXG, and E4438C ESG vector signal generators**
- **Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more**

With N7623B Signal Studio, easily create DVB-T/H/C/S, ISDB-T, ATSC and DTMB waveforms. Play back waveforms using the N5182A MXG or E4438C ESG high-performance vector signal generators that support a wide range of applications including cellular and wireless connectivity communications.

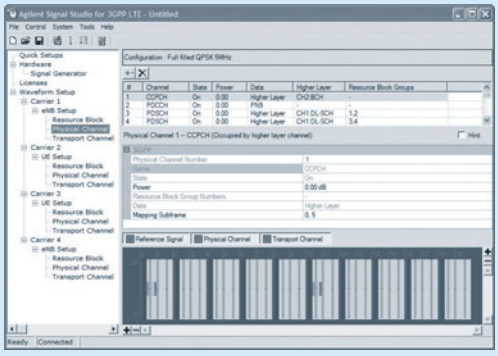
From a simple graphical user interface, specify channel coding and modulation parameters, OFDM frame structure, and seamless TS stream to create video signals that meet your specific receiver and component test needs.

- Support DVB-T/H/C/S, ISDB-T, ATSC and DTMB digital video formats
- Trimming and editing input Transport Stream (TS) files for seamless video file playback
- Low cost with good mod quality and spectral purity for video component test (Amplifiers, mixers, etc.)

Free upgrades provide equivalent DVB-T/H/C/S functionality for N7623A.

▶See page 331
www.agilent.com/find/signalstudio

Signal Studio for 3GPP LTE



Signal Studio for 3GPP LTE user interface showing the resource block configuration of a downlink signal.

- **Create single- and multi-carrier 3GPP LTE signals**
- **Configure uplink and downlink channel parameters**
- **Generate physical and transport layer coded signals for component test and receiver test**

Agilent-validated and performance-optimized 3GPP LTE reference signals
The N7624B Signal Studio for 3GPP LTE is a powerful software tool that simplifies the creation of standards-based 3GPP LTE signals. Modify transport and physical layer parameters for component testing applications. Easily generate complex 3GPP LTE reference signals which are validated and optimized for baseband/RF performance. Create your own user-defined signals with the use of an intuitive graphical interface (GUI).

▶See page 316
www.agilent.com/find/signalstudio

N9310A RF Signal Generator, 9 kHz to 3 GHz

N9310A RF signal generator provides superior quality, significantly reduces cost of test.

- **Professional performance compact size with an affordable price**
- **Easily generate CW, AM/FM/phase modulation, pulse and IQ modulated signals from one instrument**
- **Save operation time with easy-to-use RF stimulus and multi-language user interface**

The Agilent N9310A RF signal generator is the first in this new entry level of RF basic instruments. It is ideal for electronic manufacturing test for modern consumer products like cordless phones, digital radios, GPS modules, RFIDs and wireless LAN devices, base station installation and maintenance, education teaching labs, as well as low cost research and development.

N9310A generates common RF signals from 9 kHz to 3 GHz. With its built-in analog modulation capabilities, it can generate modulated AM, FM, ΦM and pulse signal easily. By adding the optional analog IQ input capability, it can generate complex IQ modulated signals such as GSM, cdma and OFDM signals from custom IQ inputs. Multi-language UI and USB connectivity make it easy to operate and store data.

▶See page 275
www.agilent.com/find/n9310a

X-Series Signal Analyzers

The highest performance in a midrange signal analyzer with the industry's fastest signal and spectrum analysis.

The Agilent EXA Economy Signal Analyzer offers unprecedented speed, accuracy, and application coverage for an economy class instrument.

Whether you're focused on time-to-market or cost of test, your signal analyzer should help you save both time and money. The X-Series Signal Analyzers accomplish this and are the newest addition to Agilent's Spectrum Analyzer portfolio. The X-Series will be able to share code seamlessly, except where hardware options differ, and provide customers with an enhanced feature set. For example, control these instruments from across the room or around the world through the Open Windows XP operating system via GPIB, 100Based-T LAN or one of 7 USB ports. Move seamlessly from development into manufacturing with common X-Series advanced measurement applications on the MXA and EXA signal analyzers.

The common features include:

- **Fastest Signal Analysis – Measurements 30% to 300% faster than other analyzers**
- **Broadest set of applications – Optional built-in Mobile WiMAX, W-CDMA, HSDPA/HSUPA, GSM/Edge, phase noise, noise figure and analog demodulation**
- **Over 50 demodulation formats with the unmatched 89601A vector signal analysis software internal to the instrument**
- **Control of instrument from across the room or around the world with Open Windows XP operating system**
- **World-class connectivity standard with 7 USB ports, GPIB or 100Based-T LAN interface**
- **Analyze your signals with 12 independent markers, 6 different traces, and trace math**

N9020A MXA Signal Analyzer

The Agilent MXA signal analyzer drives signal and spectrum analysis to the next level by offering the highest performance in a midrange analyzer for development engineers.

Features offered only on the N9020A MXA Signal Analyzer:

- Analyze low level signals on the only midrange analyzer to offer a choice of fully calibrated internal preamplifiers up to 26.5 GHz
- Frequency ranges: 20 Hz to 3.6, 8.4, 13.6, or 26.5 GHz
- Make measurements of mobile or fixed WiMAX, multi-carrier W-CDMA, and other wideband signals using optional 25 MHz analysis bandwidth

MXA performance:

- 0.3 db absolute amplitude accuracy
- +15 dBm third order intercept (TOI)
- –163 dBm/Hz displayed average noise level (DANL)
- –103 dBc/Hz Phase Noise, 10 kHz offset
- 78 dB W-CDMA ACLR dynamic range (with noise correction on)

►See page 115
www.agilent.com/find/mxa

N9010A EXA Signal Analyzer

The Agilent EXA economy-class signal analyzer is the next-generation replacement for your current economy-class instrument.

Features offered on the N9010A EXA Signal Analyzer:

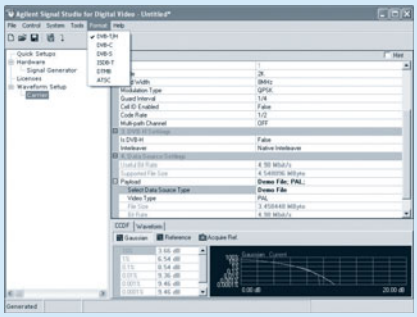
- Frequency ranges: 9 kHz to 3.6, 7.0, 13.6, or 26.5 GHz
- 10 MHz standard analysis bandwidth
- Zoom in on your signals with optional 2 dB fine step attenuator or 1 dB electronic attenuator (also on available on the MXA)

EXA performance:

- 0.4 db absolute amplitude accuracy
- +13 dBm third order intercept (TOI)
- –160 dBm/Hz displayed average noise level (DANL)
- –98 dBc/Hz Phase Noise, 10 kHz offset

► See page 121
www.agilent.com/find/exa

Dig Deeper into your Signals with the 89600 Series VSA



Now with RFID analysis.

- **Powerful new MB-OFDM and RFID modulation analysis**
- **A new link to Simulink simulation results**
- **89600 software runs in the new signal analyzers: MXA and EXA**

Use the powerful measurements and displays of the 89600 to troubleshoot RFID systems. Analyze the forward (interrogator) and return (tag) signals of the most popular standards. Troubleshoot multi-band OFDM PHY layer signals, such as certified wireless USB, with the industry's most complete set of easy-to-use measurement tools. Team the software with the Agilent DSO80000 Series oscilloscopes for ultra-wideband signal capture and analysis.

Apply the power of the 89600 VSA software measurements and displays to Simulink-based designs. This new capability provides a VSA block set designed to work with Simulink tool sets and block sets.

The MXA/EXA signal analyzers take signal and spectrum analysis to the next generation, offering the highest performance in a midrange signal analyzer with the industry's fastest signal and spectrum analysis. The 89600 VSA software now runs on the MXA/EXA's internal PC offering full functionality.

►See page 124
www.agilent.com/find/89600

N9330A Handheld Cable and Antenna Tester, 25 MHz to 4 GHz

N9330A cable and antenna tester boosts your troubleshooting and testing speed with optimized usability at competitive price.

- **With 4 hours battery operating time, N9330A enhances field test effectiveness**
- **N9330A supports USB connectivity for both memory stick and PC connection to offer the user most efficient way to manage test data**
- **The optional electronic calibrator fulfills calibration with one connection very quickly and enhances the field test efficiency**

N9330A is a basic handheld cable and antenna tester with optimized usability and fast test speed at a competitive price. It is an ideal choice for installation and maintenance of wireless service (GSM/CDMA/3G/PHS/wireless LAN), military communications, broadcasting and radio links.

N9330A offers fast scan speed which enables one time multi-frequency scan completed in 1.6 seconds. The trace resolution can be up to 521 points. It also provides trace resolution of 261 and 131. The N9330A is able to store 200 traces and 15 setups, and supports USB memory stick for data and screen saving. The N9330A's usability is optimized for field use with four-hour battery operating time, USB connectivity for both memory stick and PC connection, 11-language UI, 7.2" sunlight-viewable LCD, smart electronic calibrator, and powerful post analysis PC software.

The compact, light weight (approximately 2.6 kg) and portable design, together with the standard soft carrying case make the N9330A an ideal tester for field installation and maintenance tasks.

►www.agilent.com/find/n9330a

N1996A CSA Spectrum Analyzer

CSA Portable Spectrum Analyzer.

- **Frequency range: 100 kHz to 3 or 6 GHz**
- **Stimulus/response suite 10 MHz to 3 or 6 GHz**
- **Optional AM/FM Tune and Listen and optional AM/FM modulation analysis**

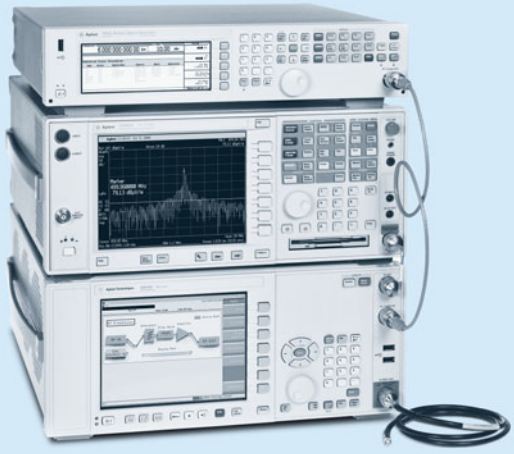
The compact design of the CSA features a small foot print and light weight while offering a bright, 21 cm, XCA display. The battery life is 2 hours (typical). The CSA is a great measurement tool for the field as well as the R&D bench top. The CSA's modern connectivity makes it an excellent low cost solution for automated testing.

This compact spectrum analyzer offers impressive specifications:
- DANL of –146 dBm with preamplifier on
- Phase noise of –124 dBc at 1 MHz offset
- Resolution bandwidth of 10 Hz to 200 kHz in 10% steps, 250 kHz, 1, 3, 5 MHz
- Amplitude accuracy of ±0.5 dB at 1 GHz (95% Confidence)

There is a wide range of accessories including a stimulus/response calibration kit, soft carrying case and transit case.

▶See page 135
www.agilent.com/find/CSA

EMI Measurement Receiver and RF Preselector N9039A



EMI Measurement Receiver.

- **RF Preselection from 9 kHz to 1 GHz**
- **CISPR bandwidths and Detectors**
- **CISPR 16-1-1 compliant**

Combine the world-class performance of the E4440A PSA Series spectrum analyzer and the new N9039A RF preselector and the result is an accurate, fast EMI measurement receiver to 50 GHz.

Measurement accuracy and repeatability:
- Radiated emissions bands sensitivity to 1 GHz is –152 dBm
- Absolute amplitude accuracy ±1.0 dB, 9 kHz to 1 GHz
- Input VSWR 1.2:1
- Preselected TOI is +11 dBm
- Span accuracy at 100 MHz 20 kHz typical

▶See page 141
www.agilent.com/find/emi

N9320A RF Spectrum Analyzer; 9 kHz to 3 GHz

N9320A spectrum analyzer packs full functions with competitive price/performance.

- **Fast measurement speed – best for mass production manufacturing tests, service and repair tasks**
- **Light weight and portable – good for field installation and maintenance tasks**
- **Full function spectrum analyzer with an affordable price – fits your tight budget and helps you reduce cost**

The new economy N9320A RF spectrum analyzer offers fast swept speed (9.2 ms), lowest displayed average noise level (–148 dBm), narrowest resolution bandwidth (10 Hz), third order intercept (+13 dBm) at a very attractive price. It is best choice for quality-conscious and cost-sensitive customers.

As an entry-level spectrum analyzer, Agilent armed N9320A with enhanced usability designs to convenient end users. Multi-language user interface helps you to recognize the software menu faster and easier, accelerating front panel operations. Adequate logical hard keys and interface, USB connectivity, and SCPI compatible make either front panel operation or remote control easy to start-up.

Now, with the exceptionally price/performance of the N9320A RF spectrum analyzer, you can afford to own Agilent test equipment you always wanted.

▶See page 136
www.agilent.com/find/n9320a

N9340A Handheld RF Spectrum Analyzer, 100 kHz to 3 GHz

N9340A handheld spectrum analyzer offers best-in-class performance and usability for variety of industry applications.

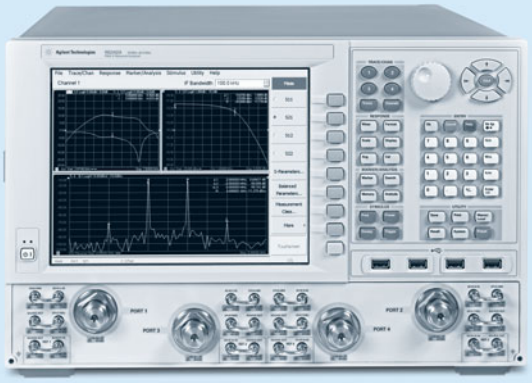
- **Truly understand all the signals in your spectrum**
- **Quickly locate and identify elusive, transient interference signals**
- **Easily operate in direct sunlight for a full 4 hours per battery**

The Agilent N9340A handheld RF spectrum analyzer provides exceptional performance and optimized usability for installation & maintenance tasks in the field, such as interference test, spectrum monitoring, and on-site repair. N9340A offers:

- Exceptional performance. The unrivaled sweep time (10 ms at non-zero span) dramatically reduce field time and enhance productivity. Narrow RBW (30 Hz minimum) helps to resolve close-in signals. Low DANL (–144 dBm with preamp on) allows you to detect low level signals such as spurious and noise. Low SSB phase noise helps to detect low signals close to the carrier
- Usability optimized for field use. The USB connectivity easy PC control and data transfer; four-hour battery life enables extended field time; 7.2 inch sunlight-viewable LCD; multi-language UI makes operating easier
- Light weight, rugged and portable. At 3.5 kg (with battery) the N9340A is specifically designed for field installation and maintenance tasks for military, wireless service providers (WSP), TV & broadcasting, and spectrum management authority

▶See page 137
www.agilent.com/find/n9340a

N5242A PNA-X – The Premier-Performance Microwave Network Analyzer



4-port PNA-X network analyzer – the ideal solution for your amplifier test needs.

- **10 MHz to 26.5 GHz, 2 or 4-ports**
- **IMD, hot-S_{22} and mixer test using the internal combiner and built-in 2nd source**
- **Built-in pulse generators and modulators for fast pulse measurements**

The premier-performance PNA-X network analyzer offers a unique single-connection solution for two-tone and swept LO measurements, featuring an integrated second source and signal-combining network. The PNA-X also can be configured with internal pulse modulators and generators for fast and simplified pulse measurements.

The new signal routing architecture transforms it from a pure network analyzer to an RF measurement solution for amplifiers and frequency converters. With two internal signal sources – each with high output power (+13 dBm), low harmonics (–60 dBc), a wide power sweep range (38 dB), and a built-in pulse modulator and signal combiner, the PNA-X can easily perform amplifier intermodulation distortion, hot-S_{22}, traditional S-parameter and pulsed-S-parameter measurements along with harmonic and compression measurements.

▶See page 156
www.agilent.com/find/pna-x

E5071C RF Network Analyzer, 9 kHz to 8.5 GHz

The standard in RF network analysis.

- **Wide dynamic range: >123 dB**
- **Low trace noise: <0.004 dB rms at 70 kHz IFBW**
- **Fast measurement speed: 39 ms at full 2-port cal, 1601 points**

Featuring an integrated 2- or 4-port, the highest performance, extended lower frequency range, and fastest speed in its class, the Agilent E5071C ENA Series RF network analyzer is the ideal solution for manufacturing and R&D engineers evaluating RF components and circuits from 9 kHz to 8.5 GHz. The ENA Series significantly reduces engineers' cost of test through its ability to cover such a wide frequency range with a single instrument. The Agilent ENA Series addresses a broad array of component and circuit tests including EMC-related applications and automotive, wireless communications, aerospace and defense, education, and medical applications.

▶See page 153
www.agilent.com/find/ena

E5052B Signal Source Analyzer, 10 MHz to 7 GHz

Get a 10X Increase in Measurement Throughput.

- **World's fastest throughput and best usability in low phase noise evaluation**
- **Phase noise and jitter measurements with 100 MHz offset range and fs resolution**
- **X100 memory and enhanced triggers make transient measurements much easier**

The new E5052B features a number of enhanced characteristics. 100 MHz offset range, 16 dB improved close-in residual phase noise @1 Hz offset and 100 times longer data memory are designed to increase its versatility.

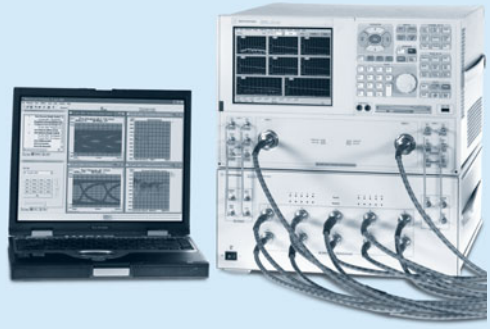
The E5052B's frequency range can be extended up to 26.5 GHz with the E5053A, and up to 110 GHz with the E5053A plus Agilent 11970 Series mixers, along with a cross-correlation method.

Newly added AM noise and baseband noise measurement modes provide more comprehensive real-time analysis of noise sources. An optional precision clock jitter analysis capability enables better usability with utilizing femto-second resolution.

The E5052B is suitable for use in a wide range of applications including RF/uW/mmW oscillators, VCOs, system reference clocks, LAN modules, high-speed timing modules, SerDes chips and high-speed data converter.

▶See page 268
www.agilent.com/find/ssa

Physical Layer Test System 4.0/PLTS Studio



- **12-port VNA implementation for multiple aggressor differential crosstalk analysis**
- **Advanced file import for building .s12p files from .s4p files quickly**
- **Low-cost analysis package for post-measurement characterization of interconnects**

Featuring new multiport enhancements, PLTS 4.0 is a robust calibration, measurement and analysis platform that is ideal for signal integrity engineers doing high-speed digital design and encountering microwave transmission line effects in their printed circuit boards, cables, IC packages and backplanes.

Included in PLTS 4.0 is Agilent's PLTS Studio software package for data analysis. Economically priced, PLTS Studio enables budget-minded engineers to fully correlate measurement-based interconnect models in a digital-friendly user environment. Designed to simplify signal integrity characterization with powerful analysis tools, it features the same multiport analysis enhancements now available with PLTS 4.0. The PLTS Studio analysis engine provides valuable insight that helps the engineer fix signal integrity problems faster.

▶See page 554
www.agilent.com/find/plts

L Series EM Coaxial Switches

L7104C/L7106C multiport switches and L7222C transfer switch.

- **Guaranteed 0.03 dB insertion loss repeatability up to 2 million cycles (5 million cycles typical)**
- **Unmatched Isolation, 90 dB minimum at 12 GHz**
- **Economically priced**

Agilent's economically-priced L Series electromechanical (EM) switches provide the long life cycle, repeatability and reliability required to achieve higher performance in automated test and measurement, signal monitoring and routing applications. These high-performance switches reduce measurement uncertainty for 2 million cycles with a guaranteed 0.03 dB insertion loss repeatability and unmatched isolation. This not only minimizes measurement uncertainty, but also reduces the downtime for recalibration and improves testing efficiency.

The L Series offers a full selection of switch configurations: terminated and un-terminated, SP4T and SP6T multiport and a transfer, from DC to 26.5 GHz. These switches deliver the required functionality over their life expectancy while providing the flexibility to deal with the most complex switch matrix and automatic test equipment applications.

►See page 651
www.agilent.com/find/lswitches

High-performance FET Solid State Switches, 8 to 18 GHz

U9397A/C FET solid state switches.

- **Low video leakage, <10 mVpp**
- **Industry leading settling time, 350 µs**
- **Exceptionally high isolation, 100 dB**

Agilent U9397A/C FET solid state switches, SPDT provide superior performance in terms of video leakage, isolation, settling time, and insertion loss across a broad frequency range. The U9397A/C are particularly suitable for measuring sensitive devices and components, where video leakage may cause damage or reliability issues. High isolation minimizes crosstalk between measurements, ensuring accurate testing and improving yields.

The U9397A/C switches incorporate a patented design which reduces the settling time to <350 µs, measured to 0.01 dB of the final value, making them ideal for high-speed RF and microwave SPDT switching applications in instrumentation, communications, radar, and other test systems.

►See page 646
www.agilent.com/find/mta

Synthetic Instruments

Typical synthetic instrument system.

- **Small, flexible, and easily reconfigured**
- **Provides the longest future support life architecture**
- **Lowers the total cost of ownership**

Agilent's new synthetic instrument modules provide a new measurement methodology for automated test systems. This new concept maximizes the flexibility of a measurement system, provides greater system longevity, while also minimizing the cost of the system over its lifetime.

The synthetic instrument concept breaks the measurement instrumentation into its most basic functional components, which consist of a frequency converter, data converter, and numeric processor. Using these basic functional modules as building blocks, a wide variety of different types of measurements can be synthesized.

To meet the needs of this new measurement methodology, Agilent has introduced several new synthetic instrument modules. Agilent's frequency converter modules consist of a downconverter and two upconverters. For data converter modules, a variety of new arbitrary waveform generators and digitizers are available.

►See page 420
www.agilent.com/find/synthetic

16800 Series Portable Logic Analyzer, Built-in Pattern Generator

Portable logic analyzers with performance you can use, priced to fit your budget.

- **15-inch (38.1 cm) color display (touch screen available) allows you to see more data and gain insight quickly**
- **Up to 32 M memory depth enables you to identify the root cause of a problem widely separated in time from the symptom**
- **Models with a built-in 48-channel pattern generator provide stimulus and response in a single instrument**

The Agilent 16800 Series portable logic analyzer delivers an exclusive combination of logic analysis, pattern generation, application software and innovative probing... all at a price that will fit your budget. Select from a variety of configurations that range from 34 to 204 channels. Models with a built-in pattern generator allow you to verify operation across a variety of test conditions. Upgradeable memory depth and state speed enable you to purchase the capability you need now, then upgrade as your needs evolve.

►See page 183
www.agilent.com/find/16800

16901A 2-slot Modular Logic Analyzer Mainframe

Modularity provides configuration flexibility to meet your measurement needs – now and in the future.

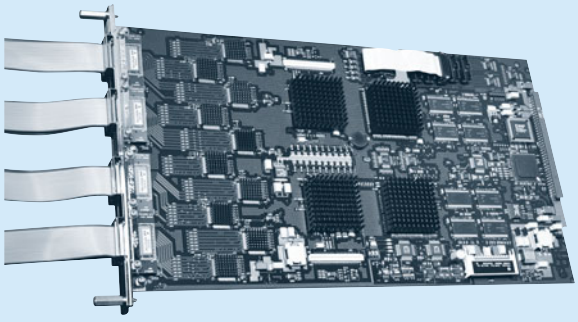
- **2-slot modular logic analyzer mainframe supports multiple timing/state logic analyzer and pattern generator modules**
- **15-inch (38.1 cm) color touch screen display**
- **Intuitive user interface and the familiarity of Windows®**

The 16901A 2-slot modular logic analyzer provides high-performance, system-level debugging of digital designs. Expandability is the key to the system's long-term value.

Customize your modular logic analyzer for your specific needs with innovative probing, high-performance measurement modules, and application specific analysis tools. Agilent provides a wide variety of FPGA, bus, protocol, processor and analysis solutions for use with your logic analyzer system. In addition, View Scope seamlessly integrates your scope and logic analyzer waveforms into a single, time-correlated display.

▶See page 180
www.agilent.com/find/16900

16950B/16951B Logic Analyzer Modules with the Industry's Deepest Memory



Combine multiple acquisition modules when you need to make measurements across many channels.

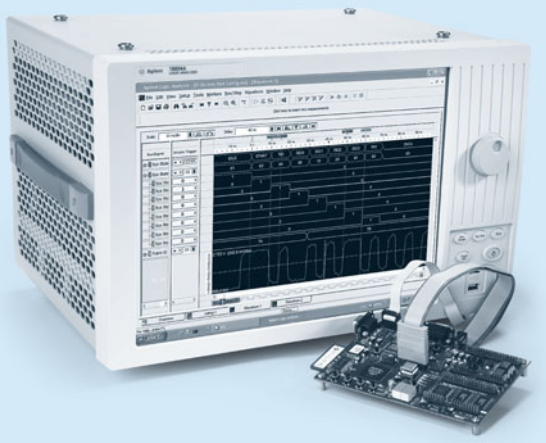
- **4 GHz (250 ps) timing zoom with 64 K memory, 1.2 GHz/600 MHz timing with deep memory (half/full channel)**
- **State clock rates up to 667 MHz and data rates up to 1066 Mb/s (Dual Sample)**
- **Memory depths up to 256 M (512 M in half-channel timing mode)**

The 16950B and 16951B state and timing modules for the Agilent 16900 Series logic analysis systems deliver the performance and capabilities needed to debug and validate today's high-speed applications. The module's automated threshold/sample position setup provides accurate measurements on high-speed buses.

Simultaneous eye diagrams on all channels identify problem signals quickly. Deep memory allows you to maximize the time covered by your measurement, helping you to identify the root cause of a problem widely separated in time from the symptom.

▶See page 181
www.agilent.com/find/logic

B4656A FPGA Dynamic Probe for Altera FPGAs



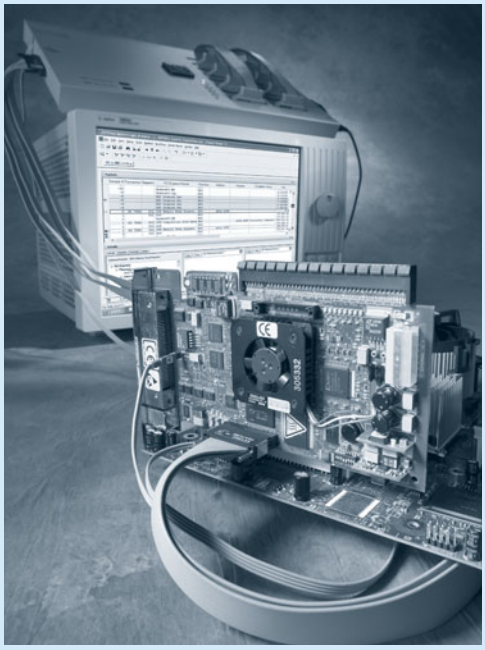
Save days to weeks when debugging your Altera FPGA-based designs with unprecedented insight into internal FPGA activity.

- **Quickly access internal Altera FPGA signals**
- **Make new measurements in seconds without changing design timing**
- **Access up to 256 internal signals for each FPGA pin dedicated to debug**

You rely on the insight a logic analyzer provides to understand the behavior of your Altera FPGA in the context of the surrounding system. The Agilent FPGA dynamic probe, used in conjunction with an Agilent logic analyzer, provides the most effective solution for simple through complex debugging of systems incorporating Altera FPGAs. Supported Altera FPGAs: Stratix Series, Cyclone Series, MAX Series, APEX Series, and Excalibur Series.

▶See page 185
www.agilent.com/find/fpga

FSI-60112 PCI Express Packet Analysis Probe



Non-intrusively probe PCI Express slots and chip-to-chip links with Agilent's FSI-60112 PCI Express Packet Analysis Probe.

- **Non-intrusive probing of PCI Express slots and chip-to-chip links (link widths: x4, x2, x1)**
- **Supports PCI Express at full frequency (2.5+ GT/s) and ALL PCI Express Modes: Squelch, Link training, TLP, DLLP, 10b/8b**
- **Trigger on and decode a PCI Express bus at the packet level**

The FSI-60112 packet analysis probe, provides packet-based trigger and display for a PCI Express bus. With this probe you can capture and view data traveling across PCI Express in high-level format on the 16800 Series portable logic analyzer. The tool decodes the PCI Express data to present a packet-based listing and packet view format.

Packet viewer and Transaction Viewer software provides viewing of transmit and receive path in the same window. The FSI-60112 PCI Express analysis probe decodes a number of pre-defined PCI Express packets and also allows for user-defined packet setup.

▶See page 188
www.agilent.com/find/pciexpress

N4850A DigRF v3 Digital Acquisition Probe and N4860A DigRF v3 Digital Stimulus Probe

Rapidly deploy your DigRF v3-based designs using Agilent logic analyzer and RF tools for stimulus and analysis in the digital and RF domains.

- **Validate and troubleshoot devices incorporating the DigRF v3 digital serial bus across a wide variety of 2.5G and 3GPP over-air standards**
- **Simultaneously acquires Tx/Rx bidirectional traffic, displaying control and data packets at the protocol level**
- **Provides continuous DigRF v3 stimulus to replace a missing BB-IC or RF-IC**

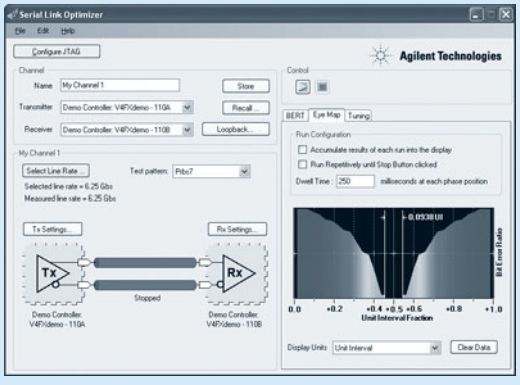
In many mobile wireless device designs, the traditional analog interface between the BB-IC and RF-IC is being replaced by the DigRF v3 digital serial bus to enable interoperability between different vendors, reduce costs and extend battery life. Spectrum analyzers and signal generators that were traditionally used to measure and stimulate the BB-IC and RF-IC interface are incapable of making the measurements on the new digital serial bus.

Agilent's N4850A acquisition probe and N4860A stimulus probe operate in conjunction with Agilent 16800 and 16900 Series logic analyzers to provide the digital serial acquisition and stimulus capabilities required for DigRF v3 based IC evaluation and integration.

The integration of DigRF v3 logic analysis tools with the Agilent RF portfolio provides the cross-domain solutions that will help you rapidly deploy your DigRF v3-based designs.

▶See page 189
www.agilent.com/find/digRF

E5910A Serial Link Optimizer for Xilinx FPGAs



Automatically tune Xilinx MGT-based serial links for optimal performance.

- **Graphical margin analysis with eye mapping**
- **Automatic optimization of your serial link's BER**
- **On-chip measurement via JTAG means no external instrumentation**
- **Available from Xilinx worldwide distributors Avnet and Nu Horizons**

Agilent's E5910A Serial Link Optimizer is a software tool that extends the Xilinx ChipScope Pro Serial IO Toolkit and provides easy-to-use BERT, eye mapping, and automatic channel tuning for optimal bit error ratio on your gigabit serial bus implemented with Xilinx FPGAs.

The Serial Link Optimizer is used together with the internal bit error ratio tester (IBERT) core from the Xilinx ChipScope Pro Serial IO Toolkit. This extended analysis and automatic optimization capability saves you considerable time and expense in optimizing the BER of your serial link.

▶See page 185
www.agilent.com/find/serial_IO

E2960B Series for PCI Express 2.0

E2960B Series Analyzer for PCIe 1 & 2.

- **Non-Intrusive analyzer provides authentic system view with genuine and unaltered signal characteristics**
- **LTSSM (Link Training Status State Machine) exerciser for effective link negotiation testing, isolates failures for expedited troubleshooting**
- **Protocol to Logic Gateway (P2L Gateway) for correlation to the Agilent Logic Analyzers, enabling broad visibility into all parts of the system**

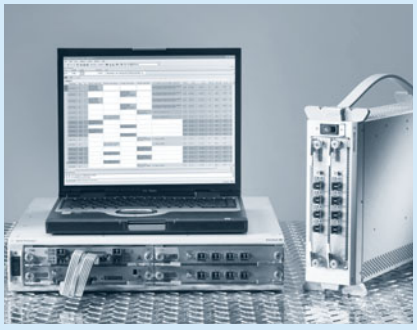
Building on the success of its test equipment for PCI Express 1.0, Agilent is first with a complete, transaction and link layer test solution for PCI Express 2.0. This consists of a protocol analyzer, a full-featured LTSSM exerciser, including probing solutions that draw on Agilent's extensive experience in probing.

The E2960B helps you resolve demanding test situations from the physical layer through to the transaction domain. The modules continue to use Agilent's well-known N2X multi-services test solution chassis, and you can use these cost effective components independently, to ensure the highest use of test assets.

The protocol analyzer works together with Agilent's logic analysis system providing tight integration between the two test solutions. Full system viewing is facilitated using the Protocol to Logic gateway (P2L gateway), enabling time correlated cross bus measurements with cross triggering.

▶See page 192
www.agilent.com/find/pcie2

1736 1, 2, 4 and 8G Fibre Channel Test Solution



1736B Fibre Channel Test Platform.

- **1, 2, 4 & 8 Gb/s Fibre Channel test platform**
- **One system multiple applications – Protocol analysis, traffic generation or device emulation**
- **Fully featured and intuitive tool with easy error duplication and sophisticated traffic generation capabilities**
- **Modular and expandable hardware to suit specific test configurations**

The Agilent SAN test system provides an efficient way for network equipment manufacturers, storage solution integrators and semiconductor manufacturers to introduce high-quality products to the market. The SAN Tester accelerates the configuration, validation, characterization and debugging of Fibre Channel SAN devices, while Protocol Analysis helps identify and resolve the root-cause issues faster.

A traditional Fibre Channel test environment includes active test tools that generate traffic conditions needed to test all of the fabric and equipment capabilities, together with passive protocol analyzers to transparently monitor traffic information within the network. Significant challenges are related to the integration of heterogeneous test tools and various APIs in a common test environment. The Agilent modular, scalable test solution combines Fibre Channel Protocol Analysis, Traffic Generation and Fabric Performance Measurement in a common versatile, multi-user N2X chassis, helping you get instant insights into your system with multiple applications and analysis tools.

▶See page 200
www.agilent.com/find/8Gig

N4903A J-BERT Pattern Generator

Quick and accurate receiver stress test with the N4903A pattern generator with built-in jitter sources.

- **Simplifies worst-case jitter tolerance testing with built-in and calibrated jitter sources for random jitter (RJ), periodic jitter (PJ) and bounded uncorrelated jitter (BUJ), inter-symbol interference (ISI) and amplitude noise. Optional spread spectrum clocking**
- **Covers all popular data rates between 150 Mb/s to 12.5 Gb/s**
- **Accurate results with excellent output signal performance with 20 ps transition times and 9 ps pp jitter**

The Agilent J-BERT N4903A 7 Gb/s and 12.5 Gb/s pattern generator options offer complete built-in jitter injection capabilities. Serial gigabit device ports can be stimulated with pattern streams with and without all types of jitter modulation, enabling higher-quality characterization of device performance.

The J-BERT pattern generators can be used in combination with oscilloscopes, built-in error ratio test (BIST) or other analyzers. The jitter injection capabilities include RJ, PJ, BUJ, ISI for eye closures >0.5 UI. In addition built-in sinusoidal interference can be used for vertical eye closures. The pattern sequencer, spread spectrum (SSC) option and the flexible sub-rate clocking significantly simplifies stimulating serial computer bus ports, such as PCI Express, SATA, fully-buffered DIMM and Display Port.

▶See page 206
www.agilent.com/find/n4903

N4916A De-Emphasis Signal Converter

- **Inject a de-emphasized signal with variable post-cursor for accurate receiver characterization and stress test**
- **Covers data rates up to 13.5 Gb/s**
- **Convenient operation via the user interfaces of Agilent J-BERT N4903A and 81141/42A serial pulse data generator**
- **Robust receiver and board designs by injecting de-emphasized signals with N4916A**

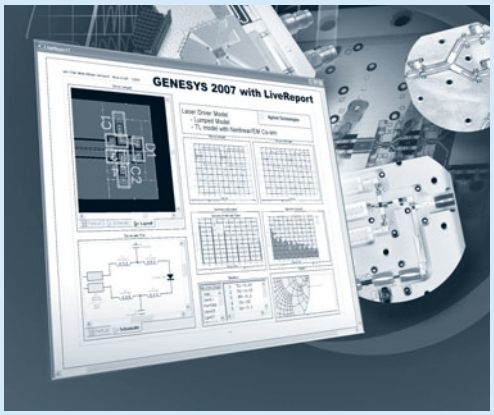
The Agilent N4916A is the industry's first de-emphasis signal converter. It enables design and test engineers to accurately and conveniently characterize gigabit-speed ports and channels that operate with de-emphasized signals.

De-emphasis is a commonly used technique for transmitting electrical signals at gigabit rates over a PC board trace.

The new N4916A de-emphasis signal converter allows characterizing high-speed devices by injecting de-emphasized signals. The receiver's behavior can be analyzed including the channel effects of a real-word PC board environment under various de-emphasis level and signal conditions. It is operated via the user interfaces of the Agilent J-BERT N4903A or the 81141/42A serial pulse data generator.

▶See page 210
www.agilent.com/find/N4916

GENESYS 2007



- **Integrated, easy-to-use EDA environment optimized for RF & microwave component designers**
- **Save RF board turns and achieve first-pass RF design success up to 50 GHz with accurate new EM capabilities**
- **Configurations start at just US$3995, buy online at www.agilent.com/find/eesof-genesys-core**

Genesys is an integrated electronic design automation (EDA) environment for independent workgroups doing traditional RF board and microwave component design. From initial system architecture through final documentation, Genesys provides state-of-the-art performance in a single easy-to-use design environment that is fast, powerful, and affordable. Revision 2007 is now available, and includes:

- LiveReport: A living notebook page that collects live views of schematics, graphs, equations, notes, and tables into a single page
- Updated vendors parts libraries, with over 30,000 commercial parts
- New localized user interface in 5 languages: Russian, Japanese, Korean, Chinese (simplified), and Chinese (traditional)

▶See page 529
www.agilent.com/find/eesof-genesys-evaluation

E6651A Mobile WiMAX Test Set

- **Base station emulation supporting network entry, traffic connection and functional test**
- **Logging and analysis tools for protocol verification, expandable to protocol conformance test (PCT)**
- **Physical layer RF test suite, and optional test automation software**

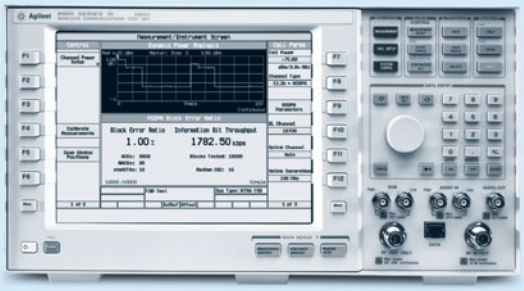
The E6651A represents a significant breakthrough in Mobile WiMAX testing enabling 802.16e-2005 subscriber station designers and manufacturers to rapidly move from development to volume production, and improve the integrity and quality of their products while reducing cost.

The Agilent E6651A is a WiMAX base-station emulator providing a test environment for verifying network entry and basic data connection. It includes a suite of RF measurements for PHY testing of WiMAX transmitters and receivers. Multi-profile support is provided using flexible RF signal generation and signal analysis up to 6 GHz.

A number of software applications are available, which significantly enhance the capabilities of the test set and make it an indispensable tool for: Repeated RF testing, end-to-end application testing, protocol logging & analysis and protocol conformance test (PCT) using TTCN-3 protocol scripting.

▶See page 505
www.agilent.com/find/E6651A

E6720A Lab Application Annual Contract

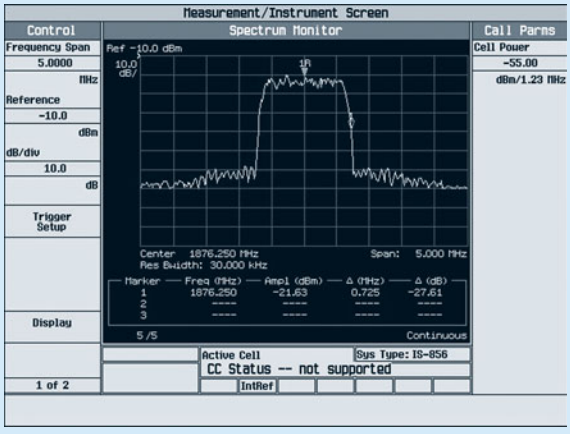


- **Provides individualized early notification and access to pre-release revisions of lab application product updates and enhancements during the term of the contract for no additional charge**
- **New firmware and licenses (if required) are delivered electronically on demand via the web**
- **Order Option 001 for E6701E, Option 003 for E6703D, and Option 006 for E6706A**

With rapidly evolving standards and the continuing stream of new product features, the E6720A lab application annual contract offers an edge for getting reliable products to market quickly. By ordering an annual contract, you get all new releases coming out in the next year for Agilent's powerful lab applications. The E6720A optimizes your ability to quickly isolate and resolve product faults and incompatibility issues, and prevent manufacturing delays.

▶See page 483
www.agilent.com/find/E6720A

1xEV-DO FTM Test Application



- **E5515C generates forward link physical channels**
- **No call processing to bring up connection, automation through Qualcomm Serial Interface Command Set**
- **Independent receiver measurements on phone's transmitted signal**

The Agilent E1976A 1xEV-DO Factory Test Mode Test Application is the subset of the E1966A 1xEV-DO Mobile Test Application for Release 0 and Release A. It is also the first one-box test set solution to support 1xEV-DO Rel A Factory Test Mode supported by Qualcomm® allowing engineers to test the terminal's physical channel performance through test mode, rather than call processing. The test requires external serial port control of mobile device. Order the E1976A-102 to receive the Release A Factory Test Mode functionality.

The E1976A meets the needs of mobile manufacturers, developers and designers of leading edge 1xEV-DO wireless access terminals. Designed for use with Agilent's 8960, it ensures efficient test times, accuracy, and repeatability in 1xEV-DO test processes.

▶See page 491
www.agilent.com/find/E1976A

E6601A Wireless Communications Test Set

E6601A is the next generation of mobile phone manufacturing test.

- **Reduce the cost of test for high volume mobile phone manufacturing with the E6601A 3.5G ready Wireless Communications Test Set**
- **Mobile phone technology specific software applications optimized for high volume manufacturing test**
- **Advanced fast calibration techniques provide state of the art test speeds**

The Agilent E6601A is the next-generation solution for 2G, 2.5G, 3G, and 3.5G mobile phone/cell phone calibration and non-signaling test. Combining industry-leading measurement speed and integrity, buy only what you need architecture, and an integrated Windows® PC, the E6601A helps you achieve the lowest cost of test in wireless device manufacturing.

E6601A non-signaling test performance complements the industry-leading full call processing performance of the 8960 Wireless Communications Test Set which is continually evolving to meet mobile test needs in R&D, manufacturing, and repair.

▶See page 497
www.agilent.com/find/E6601A

E6890A General Purpose Application for the E6601A

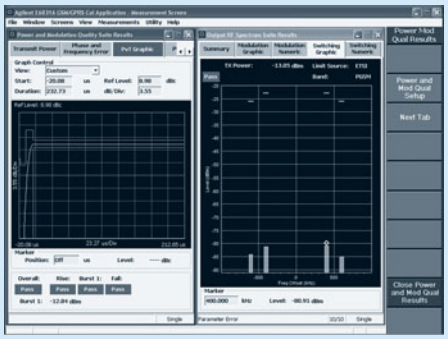
- **CW/AM/FM/DSB-SC source**
- **High-speed TX Measurements: channel power, settable fixed channels from 1 kHz to 5 MHz, frequency error, power vs time (zero span spectrum monitor)**
- **High-performance spectrum monitor (spectral analysis in a Windows interface) and optional IQ capture for waveform sampling**

The Agilent E6890A general purpose application for the E6601A test set provides a calibrated source and receiver for wireless device test. This general purpose application, designed for non-signaling test in re-work and troubleshooting stations, and development can play an important role in meeting your time-to-market goals and reducing your cost of test.

This general purpose test solution is based on the new, next-generation, high-performance E6601A test set. With an application focused on basic RF generation and measurement, flexible connectivity (LAN, GP-IB, USB) and access via Windows Remote Desktop, the next-generation capabilities of this test set offers a general purpose solution that can increase your efficiency and reduce your test costs.

▶See page 498
www.agilent.com/find/E6890A

E6831A GSM/GPRS/EGPRS Cal Application for the E6601A



- **GSM/GPRS ARB source for flexible phone receiver (RSSI) testing**
- **Full set of high-speed transmitter measurements support all GSM/GPRS chipset calibration**
- **Dynamic Power provides fast series of power measurements for high-speed amplitude characterization (requires chipset support) and optional Phase and Amplitude versus Time measurement for high-speed characterization of phase-varying amplifiers (requires chipset support)**

The Agilent E6831A GSM/GPRS/EGPRS cal application for the E6601A test set provides all the necessary capabilities to calibrate your GSM, GPRS and EGPRS mobile devices. This cal application, designed for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for GSM, GPRS and EGPRS wireless devices.

This GSM/GPRS/EPGRS test solution is based on the new, next-generation, high-performance E6601A test set. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a UMTS calibration solution that can increase your throughput and reduce your test costs.

►See page 499
www.agilent.com/find/E6831A

E6832A W-CDMA Cal Application for the E6601A

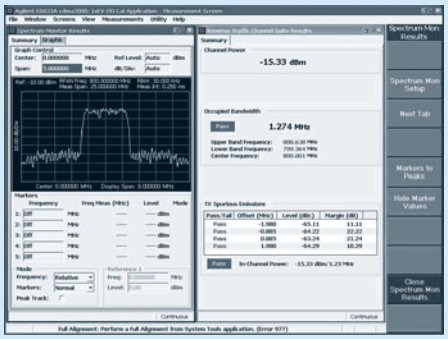
- **W-CDMA ARB source for flexible phone receiver (RSSI) testing**
- **Full set of high-speed transmitter measurements support all W-CDMA chipset calibration**
- **Dynamic Power provides fast series of power measurements for high-speed amplitude characterization (requires chipset support) and optional Fast Device Tune capability combines dynamic power, frequency hopping and simultaneous source (RSSI) for high-speed transmitter and receiver characterization of supported chipsets**

The Agilent E6832A W-CDMA cal application for the E6601A test set provides all the necessary capabilities to calibrate your W-CDMA and HSDPA mobile devices. This cal application, designed for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for W-CDMA and HSDPA wireless devices.

This W-CDMA/HSDPA test solution is based on the new, next-generation, high-performance E6601A test set. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a UMTS calibration solution that can increase your throughput and reduce your test costs.

►See page 500
www.agilent.com/find/E6832A

E6833A cdma2000/1xEV-DO Cal Application for the E6601A



- **cdma2000/1xEV-DO ARB source for flexible phone receiver (RSSI) testing**
- **High-speed transmitter measurements support cdma2000/1xEV-DO chipset calibration**
- **Dynamic Power provides fast series of power measurements for high-speed amplitude characterization (requires chipset support) and optional Fast Device Tune capability combines dynamic power, frequency hopping and simultaneous source (RSSI) for high-speed transmitter and receiver characterization of supported chipsets**

The Agilent E6833A cdma2000/1xEV-DO cal application for the E6601A test set provides all the necessary capabilities to calibrate your cdma2000 and 1xEV-DO mobile devices. This cal application, design for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for cdma2000 and 1xEV-DO wireless devices.

This cdma2000/1xEV-DO test solution is based on the new, next-generation, high-performance E6601A test set. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a UMTS calibration solution that can increase your throughput and reduce your test costs.

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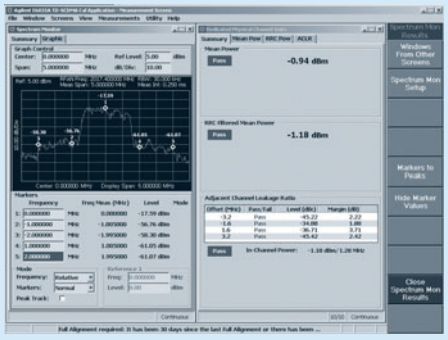
www.agilent.com/find/E6833A

E6835A TD-SCDMA Cal Application for the E6601A



- **TD-SCDMA ARB source for flexible phone receiver (RSSI) testing**
- **High-speed transmitter measurements support TD-SCDMA chipset calibration**

The Agilent E6835A TD-SCDMA cal application for the E6601A test set provides all the necessary capabilities to calibrate your TD-SCDMA mobile devices. This cal application, designed for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for TD-SCDMA wireless devices.

This TD-SCDMA test solution is based on the new, next-generation, high-performance E6601A test set. You gain the benefits of industry leading measurement speed, optional time-based and portable licensing, and an integrated open Windows PC. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a TD-SCDMA calibration solution that can increase your throughput and reduce your test costs.

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www.agilent.com/find/E6835A

MXZ-1000 WiMAX Manufacturing Test System

- **High performance – Based on the MXA signal analyzer which offers the industry's fastest signal and spectrum analysis, MXG signal generator provides the fastest switching speeds in its class**
- **Beceem's chipset certified – The MXZ-1000 is the first WiMAX manufacturing test system in industry that is certified with Beceem's chipset library. It is optimized to communicate Beceem MS120 baseband and RF chipset and the WiMAX modem software thus enabling the highest possible measurement throughput. Beceem will certify Agilent's test systems for use by manufacturers that are developing mobile WiMAX products based on the MS120 chipset**
- **Supports fixed and mobile WiMAX – Enables both fixed (802.16-2004) and mobile (802.16 OFDMA) "last mile" broadband wireless access (BWA) systems using a point-to-point or point-to-multipoint architecture**

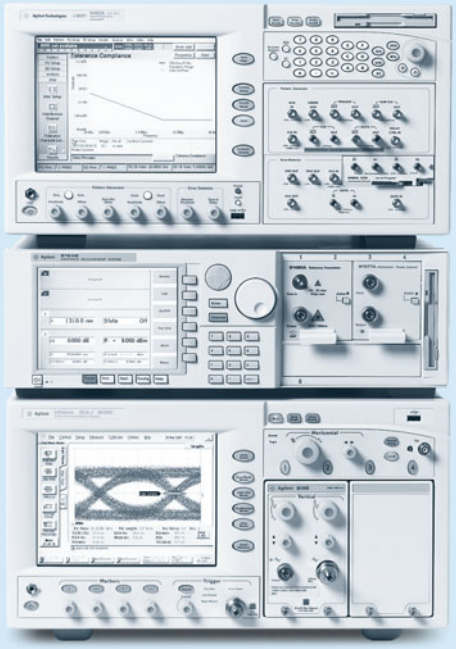
The Agilent MXZ-1000 is a fully integrated WiMAX calibration and tuning test solution offering exceptional test speed, superior measurement performance and capability, a user-friendly GUI environment, and world-wide global delivery and support.

Agilent MXZ-1000 is the industry's first WiMAX manufacturing test system offering a library of proprietary chipset communication and calibration profiles for WiMAX manufacturers seeking a WiMAX calibration solution optimized for high-volume environments.
The MXZ-1000 is ideal for:

- Reference designers and contract manufacturers for modules
- Original equipment manufacturer (OEM) for consumer products like PC/PDA/handset
- Access point (AP) manufacturers and reference design houses (RDH) using OEM reference chipsets

►www.agilent.com/find/mxz1000

N4917A Optical Receiver Stress Test Set



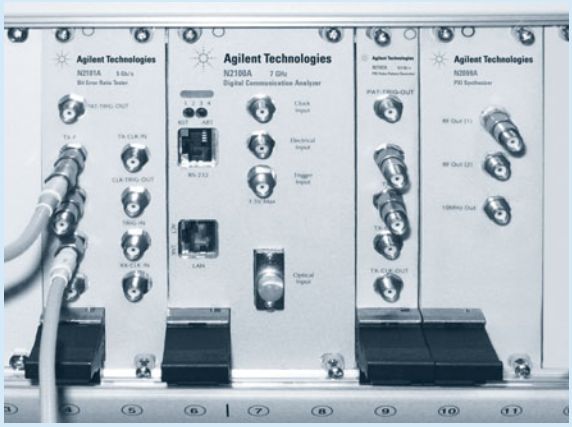
Complete optical receiver stress test with the N4917A.

- **Calibrated injection of extinction ratio (ER), optical modulation amplitude (OMA) and vertical eye closure penalty (VECP)**
- **One reference transmitter for 1310 nm and 1550 nm single mode**
- **Targets 10 Gb Ethernet and Fibre Channel**

The Agilent N4917A is a complete optical receiver test set. It allows repeatable and calibrated characterization and standard compliance test of optical transceivers and ROSAs (receiver optical sub-assemblies) operating at data rates up to 12.5 Gb/s. Calibrated injection of ER, VECP and OMA is now easy. A calibration and automation software controls all instruments and allows the user to inject compliant and custom stress to the receiver under test. Together with the accessory kits measurements are now reproducible across different test sites. The reference transmitter supports 1310 nm and 1550 nm single mode fibers, reducing the amount of test equipment needed when testing devices for multiple standards.

►**www.agilent.com/find/optical_stress**

PXIT Modular Transceiver Test Platform



Cost-effective manufacturing optimization with the PXIT Modular Transceiver Test Platform.

- **Cost-effective transceiver test solution including BER and eye diagram measurement solutions**
- **Large selection of instruments and modules**
- **Small, compact, rugged form factor**

The PXIT family of products are high performance optical and electrical PXI modules used to test a wide range of photonic components in the telecommunications and data communications industry. Products include a 10.7 Gb/s Bit Error Ratio Tester, 8.5 Gb/s Digital Communication Analyzer (DCA), 11.1 Gb/s Pulse Pattern Generator, and a PXI Synthesizer.

PXI is a modular instrumentation platform designed specifically for measurement and automation applications. This new instrument set provides easy automation through Microsoft® DLL and Active X support and has a straightforward user interface allowing measurements to be configured quickly from the start.

►See page 212
www.agilent.com/find/pxit

83496B Clock Recovery Module with Phase Noise Analysis

Easy clock recovery, even in the presence of spread spectrum clocking (SSC).

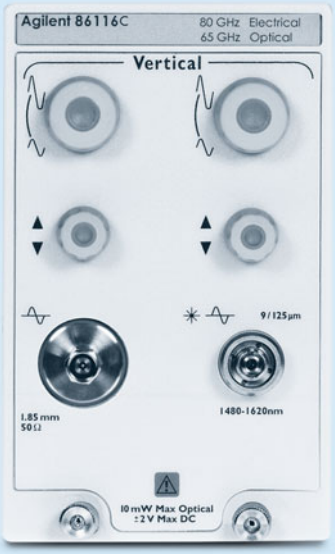
- **Provides a standards compliant trigger for waveform measurements, even in the presence of spread spectrum clocking**
- **Accurate phase noise analysis provides insight into jitter performance of clock and data signals**
- **Continuous, unbanded tuning from 50 Mb/s to 13.5 Gb/s**
- **Ultra low residual jitter: <300 femtoseconds rms**

The 83496B clock recovery module provides ideal performance for waveform analysis with the 86100C Infiniium DCA-J Digital Communications Analyzer. It can derive a clock from NRZ signals with rates as low as 50 Mb/s, as high as 13.5 Gb/s, and any rate between, providing the ultimate in flexibility. At less than 300 femtoseconds rms, the residual jitter of the output clock is virtually negligible, allowing accurate measurements of very low levels of signal jitter.

The 83496B and phase noise application software reveal root causes of jitter through frequency domain analysis – an effective and easy method of detecting jitter sources. Also, this solution can perform the analysis on both clock and data signals, so the causes of data jitter can be related to system clocks.

▶See page 72
www.agilent.com/find/83496B

86116C 65 GHz Optical and 80 GHz Electrical Plug-in Module



Accurate analysis of both optical and electrical 40 Gb/s waveforms.

- **The widest optical and electrical bandwidths available in one module**
- **Well designed frequency response for precision waveforms**
- **Switchable 39.8 and 43.0 Gb/s optical reference receivers**

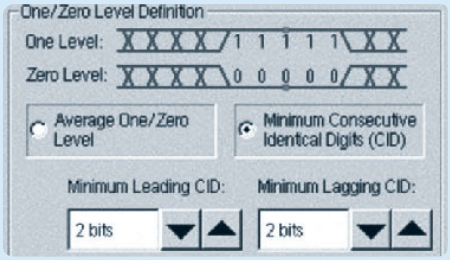
The 86116C Optical and Electrical Module represents one of the fastest solutions available for measuring high-speed communications signals. With 65 GHz optical and well over 80 GHz electrical bandwidth, the 86116C when paired with the 86107A Precision Timebase becomes the ideal solution for ultra high-speed waveform analysis.

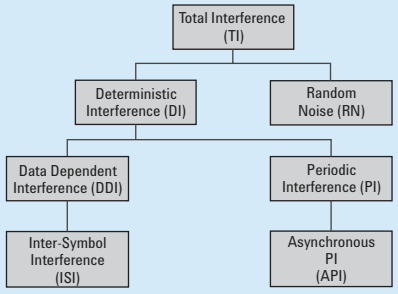
The 65 GHz bandwidth setting provides the best pulse fidelity mode for measurement and display of very high-speed waveforms and provides a fast full-width, half-max (FWHM) of 7.4 ps. User selectable bandwidth settings can reduce noise when observing low amplitude signals.

The electrical channel features well over 80 GHz of bandwidth. This yields a 4.4 ps system risetime. Just as important as bandwidth, the channel has a well controlled frequency response to minimize waveform distortion. User selectable bandwidth settings of 55 and 30 GHz can be used for reduced instrumentation noise.

▶See page 72
www.agilent.com/find/86116C

86100C Infiniium DCA-J Option 300 Amplitude Analysis





Easy Relative Intensity Noise (RIN) measurements and complete eye characterization with interference decomposition of high speed digital signals.

- **Advanced technique for determining signal amplitude and its constituent components**
- **Measure RIN on industry-standard PRBS patterns**
- **Complete compliance verification in one instrument**

The Agilent 86100C Infiniium DCA-J option 300 provides an advanced technique for determining signal amplitude. Users can isolate specific bit sequences to compose a signal amplitude measurement. The impact of various data patterns can be examined. Standards based optical modulation amplitude test, usually requiring a square wave pattern can now be derived from virtually any data pattern.

Option 300 provides the same industry-accepted analysis now translated into the amplitude domain. This enables capabilities such as Relative Intensity Noise (RIN) measurement, a common specification for optical transmitters. In the past, RIN measurements have required expensive or complicated test equipment. Now, with this software, eye-mask test and RIN measurements can be performed quickly and accurately using the same equipment and at the same time. Option 300 also allows separation of interference parameters to extremely low probabilities, providing an accurate measurement of Q-factor, commonly used to estimate bit error ratio.

▶See page 72
www.agilent.com/find/dcaj

N4373B 67 GHz Lightwave Component Analyzer

67 GHz Lightwave Component Analyzer (LCA) to characterize high speed electro-optical components with fast and accurate turn-key solution.

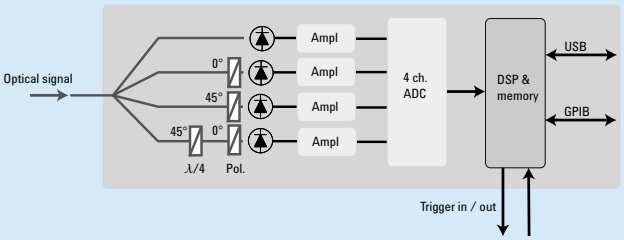
- **Excellent accuracy of absolute and relative responsivity measurements**
- **Fast time to market with turn-key solution**
- **Easy and fast measurement setup**

Agilent's N4373B Lightwave Component Analyzer (LCA) is the instrument of choice to test the most advanced 40 Gb/s electro-optical components. With 67 GHz modulation bandwidth it supports also S21 performance test for real 100 Gb/s electro-optical components. The N4373B is the successor of the already discontinued 86030 LCA.

Key benefits:
- High absolute and relative accuracy measurements improve the yield of development and production processes. With the excellent accuracy and reproducibility, measurement results can be compared among test locations world wide
- High confidence and fast time-to-market with a NIST-traceable turn-key solution
- Significantly increased productivity using the fast and easy measurement setup with a unique new calibration process leads to lower cost of ownership

▶See page 598
www.agilent.com\find\LCA

N7781A Polarization Analyzer



N7781A polarization analyzer operation diagram.

- **Measurement of Stokes Parameters (SOP)**
- **Measurement of degree of polarization (DOP)**
- **High-speed operation (>1 M samples per seconds)**

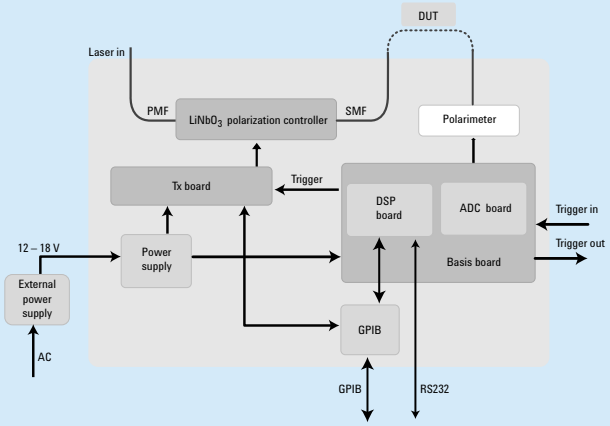
The Agilent N7781A is a compact high-speed polarization analyzer which provides comprehensive capabilities for analyzing polarization properties of optical signals. This includes representation of the State of Polarization (SOP) on the Poincare Sphere (Stokes Parameter). The on-board algorithms together with the on-board calibration data ensure highly accurate operation across a broad wavelength range.

Due to its real time measurement capability (1 M samples/s) the instrument is well suited for analyzing disturbed and fluctuating signals as well as for control applications requiring real time feedback of polarization information.

Analogue data output ports are provided, for example for support of control loops in automated manufacturing test systems.

►See page 594
www.agilent.com/find/pol

N7788A Optical Component Analyzer



N7788A operation diagram.

- **Highest accuracy in a single sweep: no averaging over multiple sweeps required**
- **Complete measurement across C/L-band in ess than 10 seconds**
- **Robustness against fiber movement/vibration and drift**

Agilent Technologies pushes the limits of component measurements with the N7788A Component Analyzer. Its proprietary technology is comparable with the well-known Jones-Matrix-Eigenanalysis (JME) which is the standard method for measuring Polarization Mode Dispersion (PMD) or differential group delay (DGD) of optical devices. Compared to the JME, Agilent's new single scan technology offers a range of advantages:
A complete set of parameters:
- DGD/PMD/PDL/2nd order PMD
- Power/Loss
- TE/TM-Loss
- Principal States of Polarization (PSPs)
- Jones and Mueller Matrices

►See page 594
www.agilent.com/find/pol

J8115A LIN Tester

The J8115A LIN Tester is a very flexible analysis and emulation tool used for the testing and validation of LIN communication systems.

- **Full master and slave emulation capability**
- **Accurate timing measurements with 10 µs resolution**
- **LIN Go editor to connect signals to graphical objects in the PC environment**
- **Extensive online and offline protocol analysis capabilities**

The Agilent J8115A LIN Tester is the "Complete Test in a Single Tool" solution for LIN. The efficient analysis and emulation capabilities in real time on the compact hardware, in durable housing, make the LIN Tester the foremost LIN test tool.

The complete analysis of protocol data, the precise analysis of the protocol timing parameter with a resolution of 10 µs and flexible triggering make the analysis and error tracing in LIN networks fast and effective.

The real time emulation implemented on the LIN Tester hardware permits precise communication timing, the flexible programming of protocol timing errors and the dynamic changes between operational mode and timing schedules.

Through the use of a LIN Tester, the development of robust LIN networks becomes possible with only one tool.

▶See page 441
www.agilent.com/find/lintester

J8120A VPT501 Vehicle Protocol Tester Series 500

J8120A VPT501 is your indispensable tool for identifying and solving network related communication faults, that otherwise may be unidentifiable through traditional testing methods.

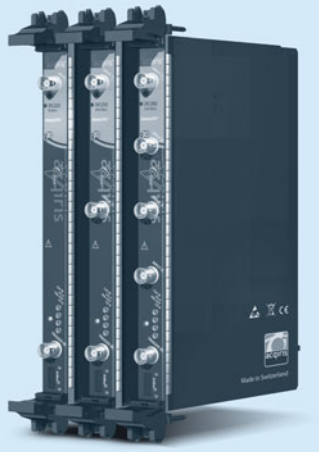
- **2 CAN, 2 LIN interfaces**
- **Integrated transceivers for high speed and fault tolerant CAN**
- **8 configurable digital I/O**
- **Standalone data logger mode**

Engineered on innovation, the Vehicle Protocol Tester series 500 (VPT501) ensures effective network testing results by providing: a truly efficient configuration process, expansive testing methodologies, and highly reliable measurement data.

VPT501 efficiently enables reuse of existing communication system databases by fully supporting import of standard database formats (.dbc, .ldf, .mcf), while being expandable to include more detailed timing parameters critical to system testing. As a result of the complete database definition, the VPT501 is efficiently configured for rest bus emulation and testing without requiring any custom developed code. The highly configurable and flexible test environment automatically identifies communication patterns which are not in accordance with specifications, enabling the identification and insight required for solving complex communication problems related to data throughput timing, gateway delays, data synchronization, error frames, and missing data.

▶See page 442
www.agilent.com/find/vpt501

U1065A Acqiris DC282, DC252, DC222 High-Speed 10-bit PXI/CompactPCI® Digitizers



- **Quad-, dual- and single-channel models**
- **Up to 8 GS/s sampling rate with 10-bit ADC resolution**
- **Choice of mezzanine front ends with input protection**
- **Standard input option, 2 GHz bandwidth, 50 Ω, DC or AC-coupled, with internal DC calibration**
- **High-frequency input option, 3 GHz bandwidth, 50 Ω, DC-coupled**
- **High-impedance input option, 1 GHz bandwidth, 50 Ω/1 MΩ, DC or AC-coupled with internal DC calibration**

The Agilent U1065A Acqiris DC282, DC252 and DC222 PXI/CompactPCI 10-bit digitizers can each achieve a dazzling single channel sampling rate of 8 GS/s, and offer a choice of front-end input mezzanines providing up to 3 GHz input bandwidth or switchable high impedance input coupling. This front-end flexibility, coupled with astounding data conversion performance, makes these digitizers ideal for implementation in applications such as high-resolution radar, lidar, and ultrasound, as well as semiconductor test and large scale physics research experiments.

▶See page 470
www.agilent.com/find/acqiris

U1071A Acqiris DP1400 Dual-Channel PCI Digitizer Card

- **Dual-channel, 8-bit digitizer**
- **1 GS/s real-time sampling rate on each channel, up to 2 GS/s in single-channel mode**
- **1 GHz bandwidth guaranteed over 50 mV to 5 V full scale ranges**
- **Power requirements <15 W**
- **Auto-synchronous bus system for trigger and clock signal distribution to multiple modules (up to 3 modules)**

The Agilent Acqiris DP1400 high-speed digitizer is designed to provide optimized data conversion performance and maximum data throughput. It offers a very high level of integration, and features exceptional low power consumption in a compact package. The digitizers' front-end includes both signal conditioning and a high-speed analog to digital converter (ADC) components.

▶See page 471
www.agilent.com/find/acqiris

U1056A AcqirisMAQS Multichannel Data Acquisition

- **A turnkey solution for measurements and analysis of up to 28 high-speed signals**
- **Multi-waveform display on a large high resolution screen**
- **Complete overview of your system hardware**
- **Parameter measurements and analysis**
- **Compact and low power for portable applications**

The Agilent U1056A Acqiris MAQbox delivers essential multichannel oscilloscope capabilities in a compact package. It offers a benchtop standalone solution to multichannel data acquisition and eliminates the need for extensive software development. MAQBox is a modular instrument providing a wide range of capabilities. Its scope-like GUI has been optimized for the set-up of multiple digitizers. MAQbox incorporates innovative features to easily display, compare, store and analyze large numbers of waveforms.

▶See page 472
www.agilent.com/find/acqiris

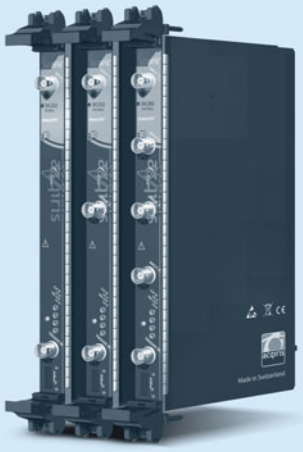
U1051A Acqiris TC890 High Resolution Multi-start, Multi-stop Time-to-Digital Converter

- **6 channel multi-stop time-to-digital converter (TDC) with multi-start acquisition mode**
- **50 ps timing resolution**
- **Ideal for measurement in time-of-flight applications including mass spectrometry and LIDAR and for various pulse-timing measurements**
- **Large internal memory buffer, with up to 4 million events**
- **Low jitter (<3 ps rms) stable (±2 ppm) internal clock source**

The Agilent Acqiris TC890 features six independent stopwatches for precise timing measurements from a common start event to multiple stop events at a high resolution. The TC890 is ideal for time measurement applications including LIDAR for 3D mapping and navigation, fluorescence lifetime spectrometry and ion counting in time-of-flight mass spectrometry (TOFMS). Many pulse timing measurements, such as period, frequency and time interval analysis (TIA), also benefit from the new TDC's precise measurement technology.

▶See page 473
www.agilent.com/find/acqiris

U1062A Acqiris DC152 and DC 122 High-Speed 10-bit 3U PXI/CompactPCI® Digitizers



- **Dual- and single-channel models**
- **Up to 4 GS/s sampling rate with 10-bit ADC resolution**
- **Dual-channel 50 Ω front end (DC152 only), with 2 GHz bandwidth, software selectable interleaved single-channel mode, on either input**
- **Choice of single-channel front-end mezzanines (DC122 only)**
- **Standard input option, with 2 GHz bandwidth, 50 Ω, DC or AC-coupled, with internal DC calibration**
- **High-frequency input option, with 3 GHz bandwidth, 50 Ω, DC-coupled**

The Agilent U1062A Acqiris dual-channel DC152 and single-channel DC122 digitizers significantly increase data acquisition and testing rates, each achieving a dazzling single-channel sampling rate of 4 GS/s. The digitizers are ideal for high-speed applications such as telecommunications, ATE, and semiconductor testing, where test time should be limited only by the speed limits of the device under test (DUT).

▶See page 474
www.agilent.com/find/acqiris

4080 Series of Parametric Testers

Fast and efficient production test of current and next-generation semiconductor processes, including support for parallel test, flash cell test, and RF test.

- **Decrease test times by up to 50% via Virtual Multiple Testhead Technology that supports both synchronous and asynchronous parallel test**
- **Meet the characterization demands of advanced Flash memory cell technologies with ±40 V output capability, 20 ns rise/fall times, and 3-level output capability**
- **Improve throughput and increase flexibility of RF production testing via an 8 x 10 RF matrix with 20 GHz capability**

Agilent 4080 Series is a new production parametric test platform that provides unprecedented throughput and performance for advanced and next-generation processes. The 4080 Series is available in three models.

1. The 4082A Parametric Test System, which provides greatly enhanced measurement throughput via architecture enhancements and parallel test capabilities.
2. The 4082F Flash Memory Cell Parametric Test System, which supports new pulse generator units optimized for performing advanced Flash memory cell evaluation.
3. The 4083A DC/RF Parametric Test System, which provides RF S-parameter characterization to 20 GHz and offers an optional 8 x 10 20 GHz RF matrix for additional measurement flexibility.

These modular and expandable production test platforms have the capabilities to meet all of the parametric characterization challenges posed by the most advanced semiconductor processes.

▶See page 614
www.agilent.com/see/4080

B1500A Semiconductor Device Analyzer

A complete CV/IV parametric characterization solution, including support for quasi-static CV, medium-frequency CV (to 5 MHz), and high-voltage pulsed applications such as flash cell test.

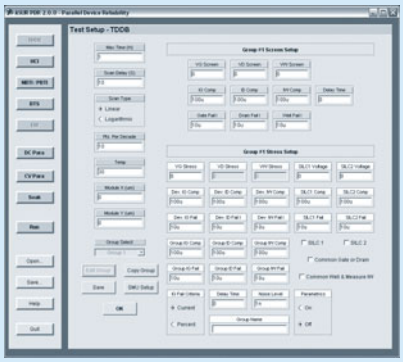
- **The PC-based B1500A comes with Agilent's innovative EasyEXPERT software, which makes every user into a parametric test expert. The intuitive GUI-based EasyEXPERT interface makes setting up a measurement quick and easy even for a novice user, and the over 180 furnished application tests help to reduce the start-up time. EasyEXPERT software is also available in a stand-alone desktop version, which enables an external PC to control the B1500A, the 4155B/C, and the 4156B/C**
- **The B1500A is a complete, single-box CV/IV parametric measurement solution. The B1500A can measure current and voltage with 0.1 femtoamp and 0.5 microvolt resolution. It also has quasi-static CV measurement capability and supports a capacitance measurement unit that can measure capacitance up to 5 MHz**
- **The B1500A supports a semiconductor pulse generator unit (SPGU) module for non-volatile memory test. The high-voltage SPGU (HV-SPGU) has ±40 V output and tri-level pulse capability to meet the most demanding test challenges posed by non-volatile memory testing**

The Agilent B1500A is a complete parametric test solution. It supports all aspects of parametric test, from basic manual measurements to test automation across a wafer in conjunction with a semiautomatic wafer prober. The B1500A utilizes the Microsoft Windows XP Professional operating system, making it easy to integrate into your PC-based work environment. The B1500A's modular configuration, with ten available module slots, makes it easy to configure the B1500A exactly the way you want.

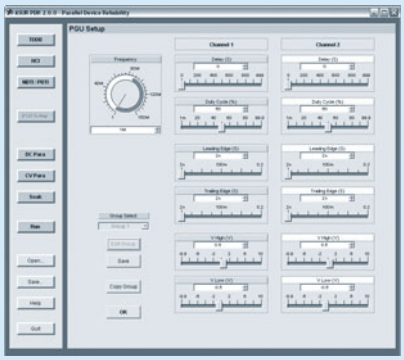
Currently available modules include several types of source/monitor units (SMUs), a multi-frequency capacitance measurement unit (MFCMU), and a high-voltage semiconductor pulse generator unit (SPGU). The integrated B1500A solution eliminates many of the common measurement errors associated with using rack-and-stack instruments and provides improved measurement performance.

►See page 622
www.agilent.com/see/b1500a

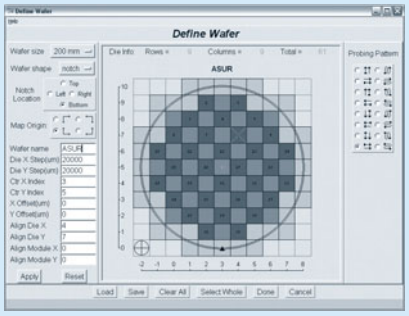
C1280A ASUR Parallel Device Reliability (ASUR PDR)



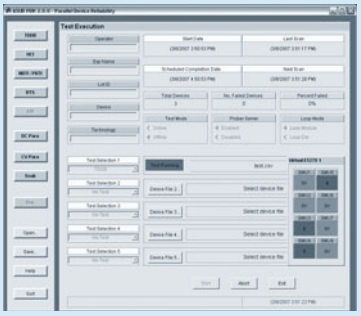
Example of PDR DC TDDB Test Module.



Example of PDR AC Test Module.



ASUR PDR Prober Server for semi or fully automated probers.



ASUR PDR Off-line Test Development and Test Verification.

- **ASUR PDR is a topology scalable parallel multi-device and multi-site on wafer DC and AC reliability tool for accelerated to long-term tests. Those tests include device conditioning, pre- and post-test programless parametric, and JEDEC compliant [J|V] TDDB with SILC, VRAMP, BTS, [N|P] BTI, HCI, EM, etc.**
- **The scalability of PDR provides seamless expansion beyond fast E5270, E5260 or B1500 SMU mainframes and E5250 or B2200 switching matrix units, where multiple mainframes can be used for high-pin count tests. In addition, various type of resources such as multi-channel PGU can be added to the topology to expand the solutions into AC reliability**
- **The PDR test modules do not require programming and each having especial value added features included but not limited to non-relaxation techniques, fast microsecond measurements, device conditioning to simulate actual circuit stress conditions, pre- and post-stress electrical tests, compensation for over- and under-shoot due to cable and systems parasitics, on-the-fly techniques, etc.**

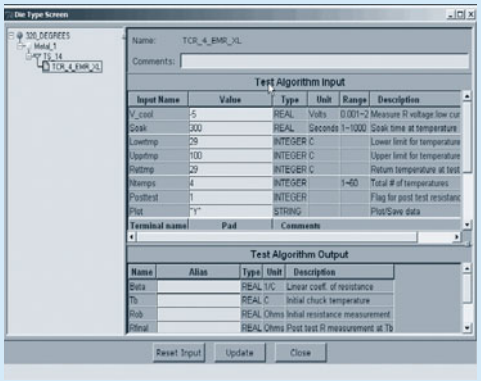
ASUR PDR provides parallel, multi-site, on-wafer DC and AC (Pulsed) TDDB, BTS, HCI, N|P BTI and EM accelerated to long-term reliability tests. Advanced features allow detection of novel effects found in advanced materials such as high-k and low-k dielectrics, copper and transition silicide barrier metallization.

ASUR PDR builds upon and extends the popular PDQ-WLR® algorithms to cover reliability studies from accelerated to long-term stress allowing users to selectively test devices whether individually (per-pin), in sets (groups) or a combination of those (quasi-per-pin) at different stresses, polarities, etc. with no relaxation.

ASUR PDR architecture supports Kelvin, Pseudomorphic Kelvin and non-Kelvin wiring configurations for different operating regimes of devices, test techniques, instrumentation, etc.

▶See page 631
www.agilent.com/see/reliability

C1281A ASUR Single Device Reliability (ASUR SDR)



Example of ASUR SDR Algorithm and Test Plan Development.

- **ASUR SDR is a high-performance, low-cost, accelerated reliability and pre- and post-stress parametric for single-site device testing that incorporates the proven accelerated techniques of PDQ-WLR using instruments-based solutions**
- **The Interactive Measurement Tool (IMT) is used to perform device or parameter exploration for rapid turnaround or as the basis for the industry's most advanced programless user-assisted custom algorithm builder**
- **ASUR SDR provides the flexibility to standardize and expand test cells and methodologies with different instruments. It is mission ready; same testing capabilities and structure as industry standard 4070 PDQ-WLR**

ASUR SDR is a high-performance, low-cost, accelerated reliability and pre- and post-stress parametric for single-site device testing that incorporates the proven accelerated techniques of PDQ-WLR using instruments-based solutions. Methods, including microsecond on-the-fly techniques where appropriate, are provided for reliability testing of gate oxides, bias-temperature stress (BTI), hot-carrier injection (HCI), electromigration, etc. User custom algorithms are supported via BASIC, C or automatically generated from the programless graphical Interactive Measurement Tool (IMT).

All user interfaces in ASUR SDR are designed with the SPECS user in mind. The same test plan hierarchy is observed and simplified for the instrument environment. The application program interface follows the standard TIS and the algorithm builders extend the user's capability to add templates for connectivity.

ASUR SDR architecture supports Kelvin, Pseudomorphic Kelvin and non-Kelvin wiring configurations for different operating regimes of devices, test techniques, instrumentation, etc.

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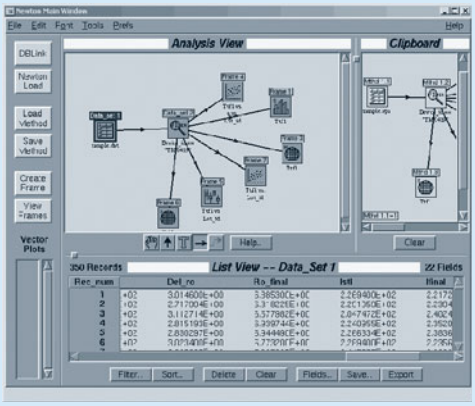
www.agilent.com/see/reliability

C1282A ASUR Reliability Data Analyzer (ASUR RDA)



ASUR RDA Main Window.

Example of ASUR RDA Data Plots.

- **ASUR RDA is post-test statistical and physical analysis software. It aids in the analysis of production, development or qualification test data taken by the Agilent ASUR test software**
- **ASUR RDA provides powerful, built-in EM, HCI and dielectric statistical distribution plotting and lifetime extraction and automatic parameter extraction (APEX)**
- **ASUR RDA includes standard statistical analysis graphical tools such as Log-Normal Cumulative Distribution Function (CDF) plots with Least Squares Fit (LSF)**

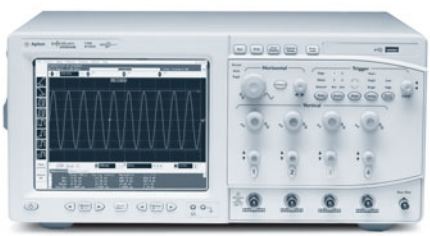
ASUR RDA provides powerful, built-in EM, HCI and dielectric statistical distribution plotting and lifetime extraction. Advanced filtering, macro data manipulation and plotting capabilities are tailored for semiconductor reliability test and analysis. Filtering allows large datasets to be pared down to specific analysis datasets and tasks. Macros can be applied to both scalar and vector data over time. Plotting includes wafer mapping and reliability statistical plots. Data tunneling allows outliers and novel points to be traced back to specific wafer die locations, lots and tests facilitating process optimization and failure analysis based on reliability. ASUR RDA includes Automatic Parameter Extraction (APEX) built-in to allow users change failure criteria during post-test analysis.

▶See page 633
www.agilent.com/see/reliability

Service Provider Standardizes on Agilent HDMI Equipment

E5071C

86100C



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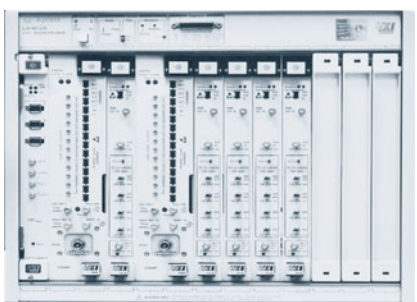


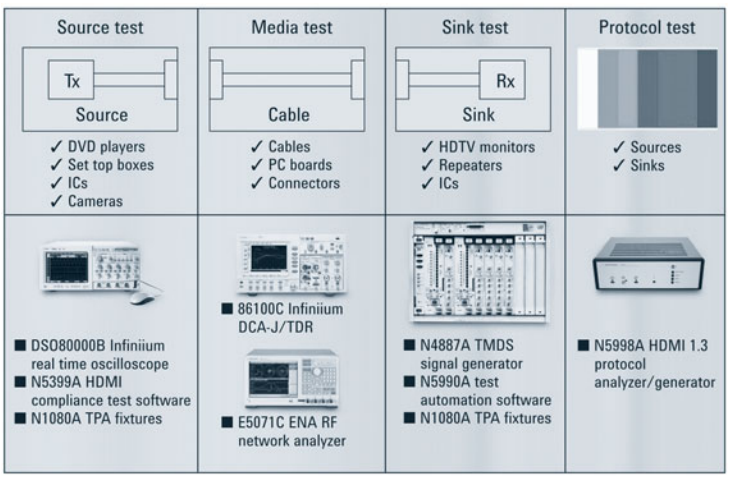
81250A

N5998A

Agilent's HDMI 1.3 solution is now shipping to five HDMI Authorized Test Centers worldwide and has been selected as recommended test equipment in the HDMI Compliance Test Specification (CTS) version 1.3 b – HDMI.org's highest endorsement for test equipment. The Authorized Test Centers confirmed their acceptance of Agilent's solution because of its completeness as a solution for HDMI compliance tests in Source, Media and Sink testing, its performance, and its dedication in offering industry-leading serial data generation and analysis test capabilities to speed up HDMI 1.3 tests, and beyond.

High Definition Multimedia Interface (HDMI) is the new digital video interface for consumer electronics applications. It builds upon the electrical specifications of the Digital Visual Interface (DVI) standard (video only) by including audio, uses a smaller connector plug, and supports a bigger distance range.

HDMI uses 4 parallel lanes with differential signaling. Three lanes are data lanes for red, green and blue that can operate from 250 Mb/s to 1.65 Gb/s. The fourth lane is a clock lane, which runs at one-tenth the rate. HDMI version 1.3 extends the data rate up to 3.4 Gb/s and introduced deep-color support. Future versions plan higher data rates. Designers need wide bandwidth measurement tools and quality probing to characterize HDMI designs.



HDMI Solutions by Agilent

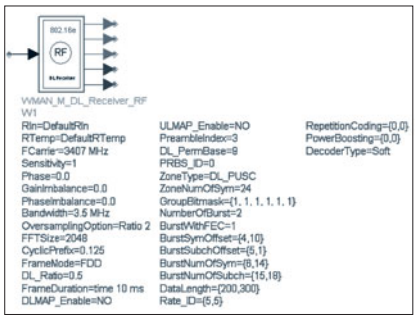
For more information, *www.agilent.com/find/HDMI*

DSO80000B Infiniium oscilloscopes, see page 69
N5399A HDMI compliance test software, see page 71
N1080A TPA fixtures, see page 81
86100C Infiniium DCA-J/TDR, see page 72
E5071C ENA RF network analyzer, see page 153
N4887A TMDS signal generator
N5990A test automation software, see page 413
N5998A HDMI 1.3 protocol analyzer/generator

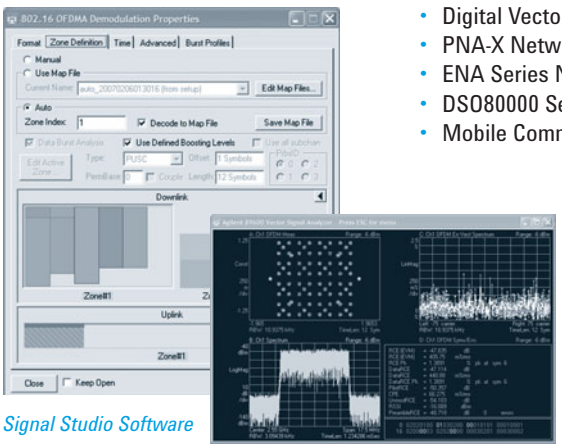
Application – WiMAX

You move WiMAX forward. Agilent clears the way

As a world leader in test and measurement solutions, Agilent Technologies continues to be at the forefront of this emerging market, offering WiMAX design and test solutions that span the entire technology lifecycle – R&D, design verification & pre-conformance, conformance, manufacturing and installation & maintenance.
www.agilent.com/find/WiMAX



Advanced Design System Software



Signal Studio Software

89600 Series Vector Signal Analysis Software

Research and Development

Whether you are working on fixed or mobile WiMAX designs, Agilent can help you get your designs from concept to customer – faster. Only Agilent delivers a complete, integrated R&D design and test environment, including simulation, characterization and evaluation tools.

Agilent's R&D solutions for WiMAX:

- Advanced Design System Software
- E6651A Mobile WiMAX Test Set
- Signal Studio Software with the Agilent MXG and ESG Vector Signal Generators
- 89600 Series Vector Signal Analysis Software
- EXA/MXA Spectrum Analyzer
- PSA Series Spectrum Analyzer
- Digital Vector Signal Analysis (DVSA) with a Logic Analyzer
- PNA-X Network Analyzer
- ENA Series Network Analyzer
- DSO80000 Series Ultra High Performance Oscilloscopes
- Mobile Communications DC Source with Device Characterization Software

E6651A Mobile WiMAX Test Set

Design Verification & Pre-Conformance

Once your design is complete, you need to ensure it conforms to the 802.16-2004 and 802.16e-2005 standards. Agilent's test solutions let you check your new products against RF PHY requirements called for in the WiMAX Forum's RCT documents and IEEE 802.16 specifications. So you can determine if your product will be allowed to operate in the defined geographic region.

Agilent's Design Verification & Pre-Conformance Solutions for WiMAX:

- E6651A Mobile WiMAX Test Set
- Signal Studio Software with the Agilent MXG and ESG Vector Signal Generators
- 89600 Series Vector Signal Analysis Software
- EXA/MXA Spectrum Analyzer
- PSA Series Spectrum Analyzer
- Digital Vector Signal Analysis (DVSA) with a Logic Analyzer
- ENA Series Network Analyzer
- DSO80000 Series Ultra High Performance Oscilloscopes
- Mobile Communications DC Source with Device Characterization Software
- WiMAX Design Verification System

AT4 Wireless MINT T2110 RCT System

Conformance Test

Conformance test ensures interoperability with other WiMAX equipment and a positive end user experience for your customers.

Radio Conformance Test (RCT)

Agilent's range of WiMAX test products incorporate the latest industry-required measurements and are found in the AT4 Wireless MINT RCT System.

AT4 Wireless MINT T2110 combines AT4 systems technology with Agilent's industry-leading E4440A PSA Series high-performance signal analyzer, 89601A Option B7S/B7Y WiMAX demodulation software, and the E4438C ESG vector signal generator. MINT T2110 covers the transmitter and receiver test cases for base stations and subscriber stations according to the WiMAX CS 103 001 test specification.

Protocol Conformance Test (PCT)

Agilent's IEEE 802.16e 2005 Protocol Conformance Test (PCT) Solution is based on the new Agilent E6651A Mobile WiMAX Test Set. When equipped with the PCT capability, Agilent's E6651A Mobile WiMAX Test Set allows equipment developers and test houses to run validated protocol test cases to verify that their implementations conform to WiMAX standards.

The N8300A is a one-box RF parametric test set targeting manufacturing engineers who need a standard-compliant 802.16e – 2005 physical layer (PHY) test tool for mobile WiMAX™ Tx and Rx applications.

Manufacturing

In the manufacturing environment you feel intense time-to-market pressures, especially for new technologies such as WiMAX. You need to get your products to market ahead of your competitors, while protecting your profit potential and ensuring the shortest testing time.

Agilent's Manufacturing Solutions for WiMAX:

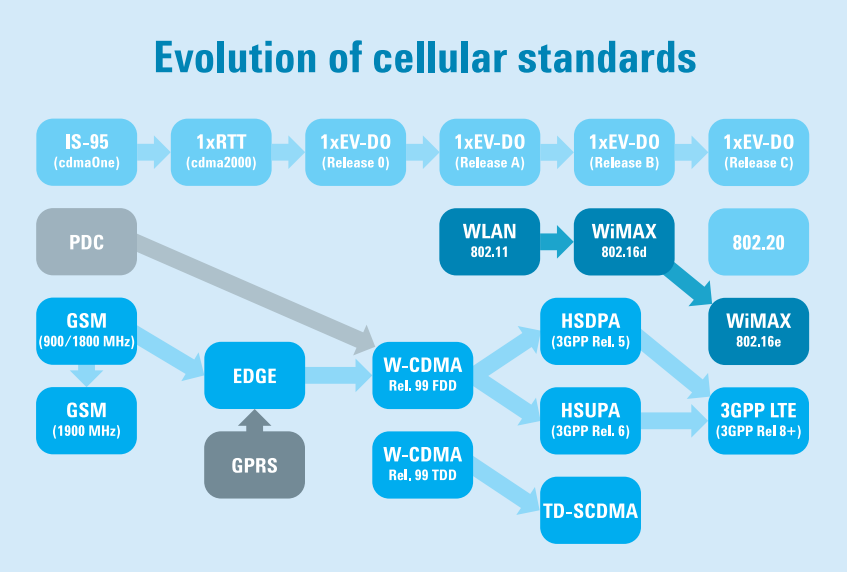
- N8300A Wireless Networking Test Set
- E6651A Mobile WiMAX Test Set
- EXA/MXA Spectrum Analyzer
- Signal Studio Software with the Agilent MXG Vector Signal Generator
- 89600 Series Vector Signal Analysis Software
- ENA Series Network Analyzer
- Multifunction RF Switch/Measurement Unit
- Agilent MXZ-1000 WiMAX Manufacturing Test System

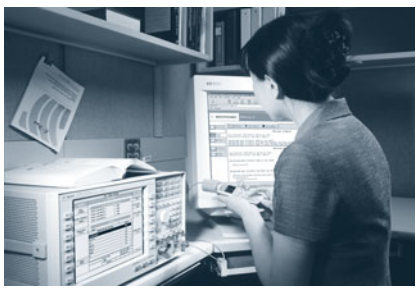
Installation & Maintenance

Agilent's market leading Agilent E6474A Drive Test solution encompasses all the key measurements you need to optimize and troubleshoot your WiMAX networks. WiMAX devices based on the Beceem MS120 chipset are supported, together with Agilent's industry leading measurement receiver technology giving you the ultimate toolkit to solve your WiMAX network problems.

- Beceem chipset based devices
- Up to 4 handsets supported on a single PC
- Industry leading data test support
- Open architecture for post processing
- Fast, accurate receiver measurements
- Fully scalable solution from Receiver or Phone to full combo

Move forward to what's possible in high-speed cellular





Agilent Technologies, the world's premier measurement company, offers a full range of design, test, and management solutions that span the range of cellular technologies – from legacy 2G systems through 3G systems to HSPA, 3GPP Long Term Evolution (LTE) and Revision A of 1xEV-DO. Agilent products cover the lifecycle from early design and development, through volume manufacturing, to network deployment and service assurance.
www.agilent.com/find/comms

From design and development...

Agilent is an active participant in the development of test processes and measurement methods in both 3GPP and 3GPP2 standards organizations. We are determined never to let test equipment needs stand in your way of developing innovative products for emerging communications standards.

To manufacturing...

As technologies move into manufacturing, Agilent extends its expertise to offer stand alone products and system solutions to help get your designs to market faster and more efficiently. And, we will continue refining our offering of design and test tools as technologies mature and cost-of-test issues drive manufacturing efficiency.

To network deployment...

Emerging cellular technologies bring a complexity to managing services never before experienced by operators. Agilent provides end-to-end network, service, and customer assurance from network deployment through service growth and maturity. With Agilent tools, you can gain an accurate understanding of a subscriber's experience, and quickly fix problems to restore service and generate revenues.

Worldwide engineering expertise

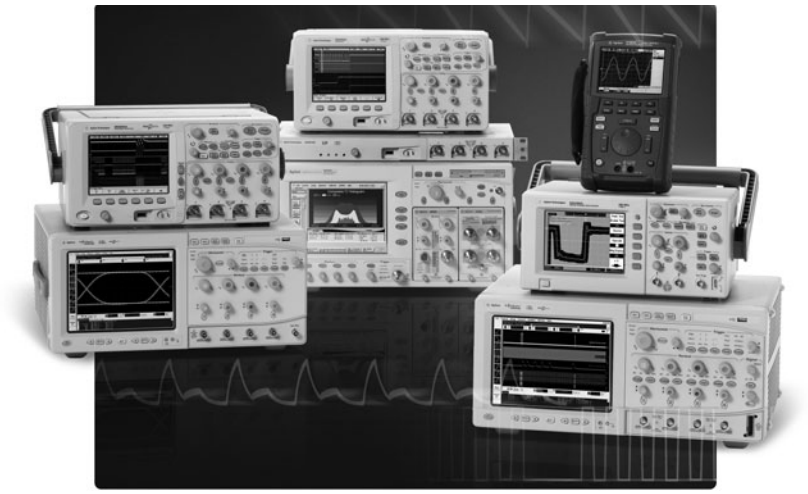
Agilent engineers – experts in test and measurement – have dedicated their careers to understanding the intricacies of these evolving technologies to provide you with the solutions you need, when you need them. So, as you take cellular forward, Agilent clears the way.

Agilent's Solutions for High-speed Cellular

	LTE	HSPA	W-CDMA	(E)GPRS	GSM	1xEV-DO Rev A	1xEV-DO	cdma2000®	cdmaOne	TD-SCDMA	Page
Advanced Design System software	■	■	■	■	■	■	■	■	■	■	528
89600 Series vector signal analysis software	■	■	■	■	■	■	■	■	■	■	124
DSO80000B Series ultra high performance oscilloscopes	■	■	■	■	■	■	■	■	■	■	69
8000 Series Infiniium oscilloscopes	■	■	■	■	■	■	■	■	■	■	65
16900 Series logic analyzer	■	■	■	■	■	■	■	■	■	■	180
GS-8800 RF design verification system	■	■	■	■	■	■	■	■	■		510
Anite development and conformance test systems	■	■	■	■	■						503
ENA Series network analyzer	●	●	●	●	●	●	●	●	●	●	153
PNA-X network analyzer	●	●	●	●	●	●	●	●	●	●	157
ESG vector signal generator family	●	●	●	●	●	●	●	●	●	●	298
MXG vector signal generator family	●	●	●	●	●	●	●	●	●	●	293
EXA/MXA signal analyzer	●	●	●	●	●	●	●	●	●	●	95
PSA Series spectrum analyzer	●	●	●	●	●	●	●	●	●	●	98
E5515C wireless communications test set	●	●	●	●	●	●	●	●	●		476
6000 Series high performance portable oscilloscopes	●	●	●	●	●	●	●	●	●	●	60
5000 Series portable oscilloscopes	●	●	●	●	●	●	●	●	●	●	56
E6601A wireless communications test set		◆	◆	◆	◆		◆	◆		◆	497
14565B and 66319D battery drain analysis tools			◆	◆	◆		◆	◆	◆		367
GS-8000 mobile manufacturing test system	◆	◆	◆	◆	◆	◆	◆	◆	◆		516
66300 Series mobile communications power supplies	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	367
acceSS7 surveillance and troubleshooting system		▲	▲	▲	▲		▲	▲	▲		550
Session trace QoS analyzer		▲	▲	▲	▲		▲	▲	▲		550
Roaming management system		▲	▲	▲	▲		▲	▲	▲		550
Business/service analytics		▲	▲	▲	▲		▲	▲	▲		550
NgN analysis system		▲	▲	▲	▲		▲	▲	▲		550
J6900A triple play analyzer		▲	▲	▲	▲		▲	▲	▲		545
J7830A signaling analyzer		▲	▲	▲	▲		▲	▲	▲		542
J6801B distributed network analyzer		▲	▲	▲	▲		▲	▲	▲		543
J6840A network analyzer		▲	▲	▲	▲		▲	▲	▲		544
E6474A wireless network optimization platform	▲	▲	▲	▲	▲	▲	▲	▲	▲		524
E7495B wireless base station test set	▲	▲	▲	▲	▲	▲	▲	▲	▲		521

■ *Design and development*
● *Design and development, and manufacturing*
◆ *Manufacturing*
▲ *Network deployment and service assurance*

OSCILLOSCOPES, ANALYZERS, METERS



Accelerate Your Troubleshooting

Agilent oscilloscopes are designed to help you accelerate the troubleshooting process. Based on input from customers around the world, Agilent has engineered features and unique capabilities that will enable you to keep pace with the rapid changes in technology, yet are easier to use than most competitive products. The result is you spend more time troubleshooting your design and less time fighting your oscilloscope.

- Real-time oscilloscopes with bandwidths from 20 MHz to 13 GHz
- Sampling oscilloscopes with bandwidths up to 80 GHz
- Unique mixed signal scopes with integrated oscilloscope and logic analysis features
- Mega*Zoom* technology for fast and deep memory all the time

Agilent Offers a Wide Range of Oscilloscopes

Model	Bandwidth	Sample Rate	Analog Channels	Digital Channels	Memory Depth
Handheld U1600A Series	20 – 40 MHz	200 MSa/s	2	—	125 Kpts
Economy DSO3000 Series	60 – 200 MHz	500 M – 1 GSa/s	2	—	4 Kpts
Portable DSO5000 Series	100 – 500 MHz	2 – 4 GSa/s	2 or 4	—	1 Mpts standard
High Performance Portable MSO/DSO6000 Series	100 MHz – 1 GHz	2 – 4 GSa/s	2 or 4	16 optional	Up to 8 Mpts (2 Mpts standard)
Low Profile Scope DSO 6000L Series	100 MHz – 1 GHz	2 – 4 GSa/s	4	16 optional	2 Mpts standard
Mainstream Lab Infiniium 8000 Series	600 MHz – 1 GHz	2 – 4 GSa/s	4	16 optional	Up to 128 Mpts (8 Mpts standard)
High Performance Lab Infiniium DSO80000B Series	2 GHz – 13 GHz	20 – 40 GSa/s	4	—	Up to 2 Mpts at 20 G – 40 GSa/s
High Bandwidth Sampling 86100C Infiniium DCA-J Series	3 GHz – 80 GHz	40 kS (sequential)	4	—	Configurable

- **3-in-1 solution: 2-channel oscilloscope, true RMS DMM, data logger**
- **Large 4.5-inch LCD color display**
- **Up to 200 MSa/s real time sampling rate**
- **125 KB/channel memory depth**
- **Zoom and Dual Waveform Math functions (includes FFT function for U1604A)**

U1602A

U1604A

The Agilent U1600A Series digital handheld oscilloscopes include two models: the U1602A with 20 MHz bandwidth and U1604A with 40 MHz bandwidth. The U1600A Series is designed to address portability in multi-industrial automation, process control, facility maintenance and automotive-service industries. Bringing value and high performance, it was voted the No. 1 Product of the Year by readers of Elektronik, one of Europe's key electronics magazines.

Clearly Distinguish your Waveforms

Clearly distinguish the waveforms between channels with U1600A's large 4.5-inch, 320x240 resolution LCD color display.

Effective Capture and Precise Isolation of Signals

With real-time sampling rates up to 200 MSa/s, you can achieve effective capture of signal anomalies, deviations and glitches. The U1600A Series deep memory of 125 KB enables capture of non-repeating signals over long time spans, and zooming into the segment of interest to uncover even the most subtle details of the signal. Advanced triggering types such as edge, pulse width, pattern and video, further enable quick isolation of critical events.

Quick Waveform Analysis with FFT and Dual Waveform Math Functions

Add and subtract multiple channel signals with U1600A's Dual Waveform Math function. With the U1604A's Fast Fourier Transform (FFT) function, you can view waveforms in four windowing techniques: Rectangular, Hanning, Hamming, and Blackman-Harris.

22 Automatic Measurements

Make and display four different measurements simultaneously with up to 22 automatic measurements.

Save and Recall Waveform and Setup Memories

Save/recall up to 10 waveforms and configuration setups at anytime so you can save test time. As an option, you can also store your waveforms and setups onto a USB flash drive through the instrument's USB host port.

Built-in DMM Functions

The U1600A Series can function as a 6000 count resolution, true RMS digital multimeter (DMM) with a broad range of measurement functions – including voltage, resistance, capacitance, diode, continuity test and temperature measurements.

Built-in Data Logger Function

The U1600A Series comes with a standard USB 2.0 full speed interface. This, together with the bundled PC Link application software, enables remote control and data transfer to PC. With the PC Link application software, you can also perform storing, retrieval and documentation of your data.

Multi-language Quick Help Support

The built-in Quick Help menu is designed to give you instant assistance, and is available in English, German, Italian, Spanish, Portuguese, French, Korean, Traditional Chinese, Simplified Chinese, and Japanese.

Scope Specifications[1]

Vertical System: Scope Channels

Bandwidth (–3 dB)
U1602A: DC to 20 MHz
U1604A: DC to 40 MHz

Scope Characteristics[2]

Acquisition : Scope Channels

Maximum Sample Rate
U1602A: 200 MSa/s interleaved, 100 MSa/s each channel (50 s/div to 125 ns/div)
U1604A: 200 MSa/s interleaved, 100 MSa/s each channel (50 s/div to 250 ns/div)
Equivalent Sample Rate
U1604A: 2.5 GSa/s (125 ns/div to 10 ns/div)
Vertical Resolution
8 bits
Maximum Memory Depth
125 kilobytes/channel
Peak Detection
5 ns
Average
Selectable in average number of 2, 4, 8, 16, 32, 64, 128, 256

Vertical System: Scope Channels

Analog Channels
Channel 1 and Channel 2 simultaneous acquisition
Rise Time
U1602A: <17.5 ns
U1604A: <8.8 ns
Vertical Sensitivity
5 mV/div to 100 V/div (1:1 scope probe)
50 mV/div to 1 kV/div (10:1 scope probe)
500 mV/div to 10 kV/div (100:1 scope probe)
Maximum Input
CAT III 300 V_{rms} (up to 400 Hz) from terminal to ground
Offset/Dynamic Range
± 5 div
Input Impedance
1 MW || <20 pF
Coupling
AC, DC, GND
Maximum Probe Input
1x CAT III 300 VAC 10x, 100x CAT III 600 VAC
Noise Peak-to-peak
3% of full scale or 5 mV, whichever is greater
DC Vertical Offset Accuracy
±0.2 div ±2 mV ±0.5% offset value
Single Cursor Accuracy
4% full scale
Dual Cursor Accuracy
4% full scale

[1] All specifications are warranted. Specifications are valid after a 30-minute warm-up period and within ±10°C from firmware calibration temperature.
[2] All characteristics are typical performance values and are not warranted. Characteristics are valid after a 30-minute warm-up period and within ±10°C from firmware calibration temperature.

U1602A
U1604A

Horizontal System
Range
U1602A: 50 ns to 50 s/div
U1604A: 10 ns to 50 s/div
Resolution
U1602A: 2 ns
U1604A: 400 ps
Delay Range (pre-trigger)
15 divisions
Delay Range (post-trigger)
1000 divisions
Analog Δt Accuracy
±3% reading ± 0.4% screen
Modes
Main, XY, Roll
RMS Jitter
5% of horizontal scale or 5 ns whichever is higher

Trigger System
Source
Channel 1 and Channel 2
Modes
Auto, normal, single
Selections
Edge, pulse width, pattern, video
- Edge: Trigger on a rising or falling edge of any source
- Pattern: Trigger at the beginning of a pattern of high, low levels and rising or falling edge established conditions of AND, OR, NOR and NAND between the channels
- Pulse width: 200 ns to 10 s. Trigger when a positive or negative pulse width of any source larger than, less than, equal to or not equal to duration
- Video: Video trigger sensitivity: 0.7 division trigger level. Available to both Channel 1 and Channel 2. Analog progressive and interlaced video standards including NTSC, PAL and SECAM. Positive or negative sync pulse polarity. Modes – all fields, even fields, odd fields or line 5 – 263 within a field

Range
±4 divisions from center screen
Level Accuracy
±0.5 divisions
Trigger Sensitivity
DC to 5 MHz: 0.5 divisions
U1602A: 5 MHz to 20 MHz – 1 division
U1604A: 5 MHz to 40 MHz – 1 division
Coupling
DC, AC (<1 Hz), HF reject (>50 kHz), LF reject (<30 kHz), Noise reject

Measurement System
Autoscale
Finds and displays all active scope channels, sets edge trigger mode on highest numbered channel, sets vertical sensitivity on scope channel. Requires voltage >20 mVp-p, 0.5% duty cycle and frequency >100 Hz
Automatic Measurement
Measurements continuously updated
Voltage
Peak-to-peak, maximum, minimum, amplitude, top, base, +overshoot, –overshoot, preshoot, RMS, mean and one cycle mean
Time
Frequency, period, +width, –width and +duty cycle and –duty cycle on any channel
Rise time, fall time, delay and phase shift
Cursors
Manually place readout of horizontal (X, ΔX) and vertical (Y, ΔY)
Waveform Math
CH1 + CH2, CH1 – CH2, CH2 – CH1

FFT[1]
Window
Rectangular, Hamming, Hanning, Blackman-Harris
Amplitude Display
Selectable in amplitude display of 1 dB, 2 dB, 5 dB, 10 dB

Digital Multimeter Specifications[2] ± (% of reading + % of range)

DC Voltage
Up to 600 V
AC Voltage
Up to 600 V
AC + DC Voltage
Up to 600 V
Resistance
Up to 60 MΩ
Capacitance
Up to 300 µF
Diode
Up to 1 V

Measurement Characteristics
Full Scale Reading
6000 count
DC Voltage, True RMS AC Voltage
Maximum input voltage, 600 V_{rms} CAT II, 300 V_{rms} CAT III
DC coupled input coupling
Continuity
Beeper <60 Ω in 600 W range

Data Logger
Source
Digital multimeter measurements
Range
10 divisions
Record Size
250 points
Time Span
Auto range 150 seconds to 20 days
Time Reference
Time from start
Record Method
Selectable minimum, maximum and average

Display System
Display
4.5-inch diagonal color CSTN LCD
Resolution
320 x 240 pixels
Control
Contrast control, infinite persistence on/off
Built-in Help System
Functional help displayed by pressing help button
Real Time Clock
Time and date (user adjustable)

Storage
Save/Recall (non-volatile)
Up to 10 setups and traces

Key Literature & Web Link

Data Sheet, p/n 5989-5576EN

For more information on U1600A Series **www.agilent.com/find/U1600A**
To watch U1600A Series interactive product showcase
www.agilent.com/find/U1600A_showcase

Ordering Information

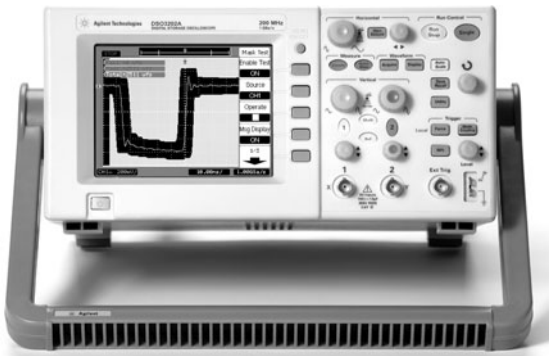
U1602A 20 MHz Digital Handheld Oscilloscope
U1604A 40 MHz Digital Handheld Oscilloscope

Includes U1560A Scope Probe (1:1), U1561A Scope Probe (10:1), U1571A Ni-MH Battery Pack 7.2 V, 4500 mA, U1580A DMM Test Lead, Ground Alligator Clip, Medium Jaw Alligator Clip, Hook Clip, USB Cable, Power Cord and AC Adapter, Quick Start Guide, Product Reference CD-ROM (includes User's and Service Guide, Quick Start Guide and PC Link Application software), Certificate of Calibration, Test Report

Accessories
U1560A Scope Probe (1:1) CAT III 300 V
U1561A Scope Probe (10:1) CAT III 600 V
U1571A Ni-MH Battery Pack 7.2 V, 4500 mA
U1580A DMM Test Lead
U1590A Soft Casing
U1562A Scope Probe (100:1) CAT III 600 V with ground alligator clip
Option 001 USB Host Capability

[1] FFT function is only available for U1604A model.
[2] For temperature between 0°C to 18°C and 28°C to 50°C , add 0.1% of reading + 0.02% of range for every degree Celsius.

- **Large 15-cm (5.9-in) color display**
- **Up to 1 GSa/s sample rate and 4 k points of memory**
- **Advanced triggering including edge, pulse-width, and line-selectable video**
- **20 automatic measurements and 4 math functions with FFTs**
- **USB connectivity and Scope Connect software, standard**
- **GPIB and RS232 connectivity available**
- **Mask test standard**



Full-featured Oscilloscopes for the Smallest Budgets

Agilent's 3000 Series oscilloscopes give you an affordable way to see what's happening in your designs. Developed with the features you need to make your job easier.

Need flexibility? Choose from four models with bandwidths ranging from 60 MHz to 200 MHz. To give you the debugging power you need, each oscilloscope comes standard with advanced features including sophisticated triggering, automatic measurements, digital filtering, sequence mode acquisition, math functions (including FFTs), stored setups and waveforms, mask testing and much more.

See your Signals More Clearly

All 3000 Series models have color displays to allow you to quickly identify your signals, and the large size – 15 cm (5.9 in) with 320 x 240 resolution – makes it easier for you to see more information.

The 3000 Series' delayed sweep also lets you see more details in your design. You can view a long record, then window in on the section of the signal of interest.

All the Features you Need

All 3000 Series scopes include the standard features you need to get your job done easier and faster:

Autoscale – Autoscale lets you quickly display any active signals, automatically setting the vertical, horizontal and trigger controls for the best signal display.

Advanced Triggering – Includes edge, pulse width and line-selectable video, to help you isolate the signals you want to see.

Waveform Math with FFTs – Analysis functions include addition, subtraction, multiplication, and Fast Fourier Transforms with four windows (Hanning, Hamming, Blackman-Harris and rectangular).

Auto Calibration – Automatically calibrates the oscilloscope's vertical and horizontal systems.

Multi-language Interface – Operate the oscilloscope in the language of your choice. Language support includes simplified and traditional Chinese, Japanese, Korean, French, German, Italian, Portuguese, Russian, Spanish and English.

Digital Filtering – Digital filtering selections include low pass, high pass, band pass, and band reject filters. Limits are selectable between 1 kHz and the bandwidth of your oscilloscope model.

Ten Waveform and Setup Memories – Store waveforms or commonly used setups for future reference and use.

Mask Testing – Automatically compares incoming signals with a predefined mask, clearly highlighting signal changes.

Sequence Mode – Frame an area of interest on your signal and record up to 1,000 frames for playback.

3-year Warranty – All 3000 Series scopes include a full 1-year warranty with optional 3-year warranty coverage.

Easy to Set Up and Use – Dedicated, color-coded knobs for vertical sensitivity, offset, and time base settings make it easy to set up and use. Front-panel keys for triggering functions are also grouped to make your job easier.

Specifications

Bandwidth
DSO3062A: 60 MHz
DSO3102A: 100 MHz
DSO3152A: 150 MHz
DSO3202A: 200 MHz

Real Time Sample Rate
2 channels interleaved: 1 GSa/s
Each channel 500 MSa/s

Channels
2

Display
Color, 320 x 240 1/4 VGA LCD; H: 88 mm, W: 116 mm

Memory
4 kpoints per channel

Vertical Resolution
8 bits

Vertical Sensitivity
2 mV/div to 5 V/div

DC Gain Accuracy
±3% for 10 mV/div to 5 V/div; ±4% for 2 mV/div to 5 mV/div

Vertical Zoom
Vertical expand

Maximum Input Voltage
300 V_{rms} CAT II; derated at 20 dB/decade above 100 kHz to 13 V p-p AC at 3 MHz and above

Time Base Range
2 ns/div to 50 s/div (5 ns/div to 50 s/div in DSO 3062A)

BW Limit
~ 20 MHz

Input Coupling
DC, AC, Ground

Input Impedance
1 MΩ: ≈13 pF

Time Base Accuracy
100 ppm

Acquisition Modes
Normal: Displays sampled data directly to the screen in real time
Averaging: Selectable from 2, 4, 8, 16, 32, 64, 128 or 256
Peak detect: Captures high-frequency glitches as narrow as 10 ns when viewing signals at slower sweep speeds (slower than 5 µs/div)

Sweep Modes
Auto, Normal

Trigger Coupling
AC, DC, LF reject, HF reject

Trigger Modes
Force: Triggers immediately when front-panel button is pushed
Edge: Triggers on the positive or negative slope on any channel
Video: Triggers on one of three standard television waveforms: NTSC, PAL, SECAM
Pulse triggering: Triggers on a pulse width greater than, equal to, or less than a specified time limit, with time limits ranging from 20 ns to 10 s

Trigger Source
Ch 1, 2, Ext, Ext/5, Line (edge mode only)

Cursors
Modes: Manual, auto, track
Type: Time and voltage
Measurements: ΔT, ΔV, frequency

Automatic Measurements
20 plus 5-digit hardware counter
Voltage: Peak-to-peak, maximum, minimum, average, amplitude, top, base, V_{rms}, overshoot, preshoot
Time: Frequency, period, +width, –width, +duty cycle, –duty cycle, rise time, fall time, delay, phase

Math Functions
Add, subtract, multiply, FFT

DSO3062A
DSO3102A
DSO3152A
DSO3202A
N2860A
N2861A
N2862A
N2863A
10073C
N2774A
N2775A
10076A
N2771A

3

DSO3062A
DSO3102A
DSO3152A
DSO3202A
N2860A
N2861A
N2862A
N2863A
10073C
N2774A
N2775A
10076A
N2771A

FFT
Window modes: Hanning, Hamming, Blackman-Harris, rectangular
Sample size: 1024 points
Autoscale
Single button automatic setup of all channels
Display
1/4 VGA (320 x 240), passive color LCD with adjustable brightness
Interpolation
Sin(x)/x
Display Types
Dots and vectors
Persistence
Off, infinite
Format
YT and XY
I/O
Optional ports: GPIB, RS-232
Maximum data transfer rates: GPIB: 500 kbytes/sec
Physical Size
30 cm wide x 15 cm high x 29 cm deep (without handle)
34.6 cm wide x 18.2 cm high x 29 cm deep (with handle)
Weight Net
4.8 kgs (10.5 lbs)
Shipping
7 kgs (15 lbs)

Accessories

Accessories Included
Quick Start manual, CD-ROM with User's Guide (French, German, Japanese, Korean, Russian, Simplified Chinese, and English) and Programmer's Manual, power cord, accessory pouch, two passive probes, Scope Connect Software

Additional Probes
N2862A 10:1, 150 MHz passive probe
N2863A 10:1, 300 MHz passive probe
10070C 1:1, 20 MHz passive probe
N2774A 50 MHz current probe, ac/dc
N2775A Power supply for N2774A
10076A 100:1, 4 kV, 250 MHz high-voltage probe
N2771A 1000:1, 15 kV, 50 MHz high-voltage probe

Optional Accessories
N2861A Communications Module
Provides GPIB and RS-232 connectivity and pass/fail output for automatic testing.

Warranty Options
All models include a standard 1-year warranty. Contact your local sales office for prices of extended warranty options.
R-51B-001-3C: 1-year return-to-Agilent warranty, extended to 3-years

Key Literature & Web Link

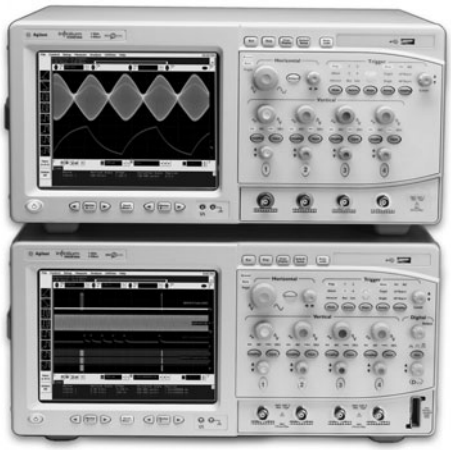
3000 Series Oscilloscopes Data Sheet, p/n 5989-2235EN

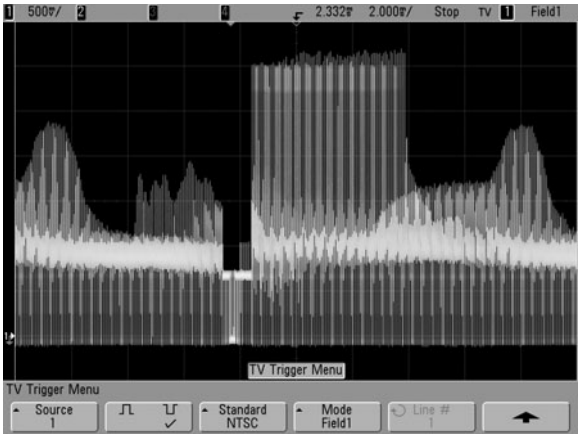
www.agilent.com/find/DSO3000

Ordering Information

DSO3062A 60 MHz, 2 Channel Oscilloscope
DSO3102A 100 MHz, 2 Channel Oscilloscope
DSO3152A 150 MHz, 2 Channel Oscilloscope
DSO3202A 200 MHz, 2 Channel Oscilloscope
N2860A 3000 Series Connect Software
N2861A Communications Module
N2862A 150 MHz Passive Probe
N2863A 300 MHz Passive Probe
10070C 1:1, 20 MHz Passive Probe
N2864A Rack Mount Kit
N2774A 50 MHz Current Probe, ac/dc
N2775A Power Supply for N2774A
10076A 100:1, 4 kV, 250 MHz High-voltage Probe
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
N2865A USB Host Modules (standard with purchase)

- **Analog signal viewing with fast and responsive Mega*Zoom* memory**
- **Digital signal triggering and analysis**
- **Serial triggering and decode for I²C, SPI, CAN, LIN, Flex Ray and more**





Analog: Up to 4 Channels with 4 GaS/s Sample Rate and 1 GHz Bandwidth

Mega*Zoom* Technology

Mega*Zoom* deep memory captures long, non-repeating signals and maintains high sample rates, allowing you to quickly zoom in on areas of interest. Sample rate and memory depth go hand-in-hand. Deep memory in oscilloscopes sustains a high sample rate over longer time spans. Mega*Zoom* also supports a high-resolution XGA display system and maps the deep memory to 256 levels of color intensity grades, delivering unmatched real-time insight into signal details.

Signal Integrity – Probing

Probing high-frequency signals becomes more challenging as the variety of test points and the frequencies of the signals continue to grow. Probes need to be lightweight, small, affordable, and offer the accessories and probe tips you require to get your job done easily. Agilent has a wide range to meet your needs.

Digital: 16 Digital Timing Channels and Mixed Signal Triggering

With many of today's designs containing a mix of signal types and speeds, it's often critical to capture and compare multiple cycles of digital signals along with slower analog signals. But doing so often requires an instrument that can deliver more resolution and memory than a traditional DSO can provide.

Easily See Complex Interactions with an MSO

Mixed signal oscilloscopes (MSOs) with 2 or 4 scope channels plus 16 logic channels combine the detailed signal analysis of a scope with the multi-channel timing measurements of a logic analyzer.

Full-width Pattern Triggering

Flexible triggering capabilities across all scope and logic channels so you can easily isolate and analyze complex signals in your mixed analog and digital designs.

View Scope – Logic and Scope Correlation

Easily make time-correlated measurements between an Agilent logic analyzer and an Agilent 5000, 6000, 8000 or 80000 Series Scope. Easily view and analyze time-correlated logic and scope waveforms integrated into a single logic analyzer waveform display. Global markers track between two instruments.

Serial: Hardware-accelerated Decode and Trigger for I²C, SPI, CAN, LIN and Flex Ray

As more and more component interfaces move from parallel to serial on both low- and high-speed buses, Agilent is offering more serial triggering and decode options on oscilloscopes.

Serial Bus Triggering and Decoding

Trigger on the industry's most popular serial bus standards including I²C, SPI, CAN, LIN, FlexRay and USB. Decode options display responsive, on-screen decode of serial bus traffic. Select from a suite of hardware triggers for the ability to isolate specific events with pin-point accuracy, then enable decode to validate serial bus activity in real-time.

Hijack Infrequent Errors

Fast acquisition speed combined with hardware-accelerated decoding increases your probability of capturing elusive events. Agilent oscilloscopes can help you catch that intermittent problem before it becomes an intermittent customer complaint or quality concern.

Oscilloscopes, 100 MHz to 500 MHz 5000 Series Oscilloscopes

MegaZoom
DSO5012A
DSO5014A
DSO5032A
DSO5034A
DSO5052A
DSO5054A

- **1Mpts deep memory – High sustained high sample rates means that you don't lose signal resolution – even when acquiring long periods of time**
- **100,000 waveforms/sec update rate – Fast waveform update rates provide you with unsurpassed ability to capture and view infrequent and intermittent problems**
- **XGA display with 256 levels of intensity – A high-definition display system improves your ability to view small signal anomalies**
- **Full connectivity, including USB: USB, LAN, GPIB, and XGA video-out are all included standard**
- **LXI class C compatible**

Users of general-purpose portable oscilloscopes have, until now, had to work through everyday debug tasks using oscilloscope technology from the 1990s. Engineers need tools capable of handling today's design challenges. The new 5000 Series oscilloscopes tackle these needs with responsive deep memory, a high-definition display system, and a superior ability to capture signal transients. Traditional bench scopes are great for characterizing things that you know about. Agilent's patented deep memory and fast waveform update rate help you find the bugs that you don't know about.

MegaZoom III Deep Memory

Based on the same technology that powers Agilent's market leading high end oscilloscopes the deep memory that is available in the 5000 oscilloscope is based on MegaZoom technology. 1 Mpt of MegaZoom deep memory comes standard so you can capture long, non-repeating signals, while maintaining high sample rates and good timing resolution.

Don't Take our Word for It

Compare the 5000 Series with your current bench scope.
View an on-line product demonstration or schedule a hands-on evaluation by visiting our web site at: **www.agilent.com/find/5000ct2**
This memory updates up to 100,000 times per second, so you can capture intermitted glitches with confidence.

Specifications

	DSO5012A	DSO5014A	DSO5032A	DSO5034A	DSO5052A	DSO5054A
Bandwidth	100 MHz	100 MHz	300 MHz	300 MHz	500 MHz	500 MHz
Sample Rate	2 GSa/s each channel	2 GSa/s each channel	2 GSa/s each channel	2 GSa/s each channel	2 GSa/s each channel, 4 GSa/s max	2 GSa/s each channel, 4 GSa/s max
Channels	2	4	2	4	2	4
Display	Color, 1024 x 768 6.3" XGA LCD with 265 intensity levels					
Memory	1 Mpts max, 500 kpts each channel					
Update Rate	Up to 100,000 waveforms per second					
Vertical Sensitivity	2 mV/div to 5 V/div					
Maximum Input Voltage	CAT I 300 V_{rms}, 400 Vpk; transient overvoltage 1.6 kVpk ; CAT II 100 V_{rms}, 400 Vpk					
Input Impedance	1 MW ± 1% || 12 pF or 50 W ± 1.5% selectable					
Timebase Accuracy	25 ppm up to 40°C; 40 ppm at 55°C					
Display Mode	Main, delayed, XY and roll					
Triggering	Edge, Pulse width, Pattern, TV (Composite and HDTV/EDTV), Duration					
Dimensions	38.5 cm W x 18.8 cm H x 17.4 cm D (with handle)					
Weight	4.1 kg					

Accessories

Options

SEC Secure Environment Mode
E2690B Oscilloscope Tools (US/Can)
N5385B Oscilloscope Tools (Int'l)
N2916B Rackmount Kit for 6000 and 5000 Series Oscilloscopes
N2917B Transit Case for 6000 and 5000 Series Oscilloscopes
N2760A Soft Carrying Case for 5000 Series Oscilloscopes

Probes

10073C 10:1, 500 MHz Passive Probe (shipped with DSO605xA)
N2863A 10:1, 300 MHz Passive Probe (shipped with DSO501xA, 503xA)
10070C 1:1, 20 MHz Passive Probe
1130A 1.5 GHz InfiniiMax Differential Probe Amplifier (accessories sold separately)
N2774A 50 MHz Current Probe, AC/DC (requires N2775A power supply)
1146A 100 kHz Current Probe, AC/DC
1147A 50 MHz Current Probe, AC/DC
10076A 100:1, 4 kV, 250 MHz High-voltage Probe
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
1141A 200 MHz Differential Probe (requires 1142A power supply)
N2772A 600 V CAT III, 20 MHz Differential Probe (requires 9 V battery or N2773A power supply)

Key Literature & Web link

Visit **www.agilent.com/find/5000ct2** to download the following additional information:
5000 Series Portable Oscilloscopes Brochure, p/n 5989-6385EN
5000 Series Portable Oscilloscopes Data Sheet, p/n 5989-6390EN
5000 and 6000 Series Probes and Accessories Data Sheet, p/n 5968-8153EN

Features

	General Purpose	High Performance	
	DSO5000	**DSO6000**	**MSO6000**
Channel	Channel count 2 or 4 analog		
Sample Rate	Maximum sample rate 4 GSa/s		
Display	XGA display, 256 intensity levels, update rate 100,000 wps		
Accessories	Extensive selection of probes and accessories		
Connectivity	USB, LAN, GPIB connectivity, XGA out, LXI Class C compliant		
Bandwidth			
100 MHz	•	•	•
300 MHz	•	•	•
500 MHz	•	•	•
1 GHz		•	•
Mega*Zoom* Deep Memory			
1 Mpts – standard	•		
2 Mpts – standard		•	
8 Mpts – upgrade		•[1]	•[1]
Triggering			
Triggering (Edge, Pattern, Pulse, Width, TV, HDTV)	•	•	•
I²C, SPI and USB serial bus triggering		•	•
CAN, LIN and FlexRay serial bus triggering		•[1]	•[1]
Mixed signal triggering across both analog and digital content		•[1]	•
Digital Timing Channel			
16 digital timing channels with mixed signal triggering and bus display mode		•[1]	•
Xilinx and Altera FPGA dynamic probe application options		•[1]	•[1]
Serial Decode			
I²C/SPI/CAN/LIN/FlexRay serial bus decode		•[1]	•[1]
Options			
Battery option		•[1]	•[1]

[1] Upgrade or pay option available; advanced serial triggering and decode available on 4 channel models.

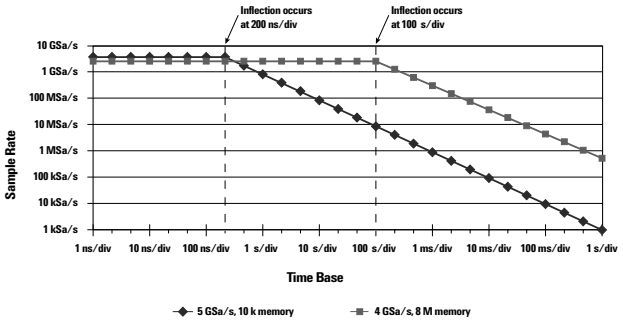
Probe Scope Selection Guide

	GP Portable	High Performance Portable	
	DSO5000	**DSO6000**	**MSO6000**
Channel	Channel 2 or 4 analog		
Sample Rate	Max Sample rate – 4 GSa/s		
Display	XGA resolution, up to 100,000 waveforms/sec and 256 levels of intensity scale		
Accessories	Extensive selection of probes and accessories		
Connectivity	Standard USB, LAN, GPIB connectivity, XGA out, LXI class C compliant		
Bandwidth			
100 MHz	•	•	•
300 MHz	•	•	•
500 MHz	•	•	•
1 GHz		•	•
Mega*Zoom* Deep Memory			
1 Mpts – standard	•		
2 Mpts – standard		•	
8 Mpts – upgrade		•[1]	•[1]
Triggering			
Triggering (Edge, Pattern, Pulse, Width, TV, HDTV)	•	•	•
I²C, SPI and USB serial bus triggering		•	•
CAN, LIN and FlexRay serial bus triggering		•[1]	•[1]
Mixed signal trigger on both analog and digital content		•[1]	•
Digital Timing Channel			
16 digital timing channels with mixed signal trigger and bus mode		•[1]	•
Xilinx and Altera FPGA dynamic probe application option		•[1]	•[1]
Serial Decode			
I²C/SPI/CAN/LIN/FlexRay serial bus decode		•[1]	•[1]
Options			
Battery option		•[1]	•[1]

[1] There is either an upgrade or for pay option available; advanced serial triggering and decode available on 4 or 4+16 – channel models only.

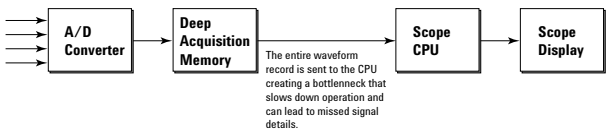
DSO8000
MSO8000

- **Instant response to control signals – with up to 128 Mpts of deep memory**
- **Zoom in quickly on critical signals**
- **Easily and quickly find infrequent and unpredictable events**

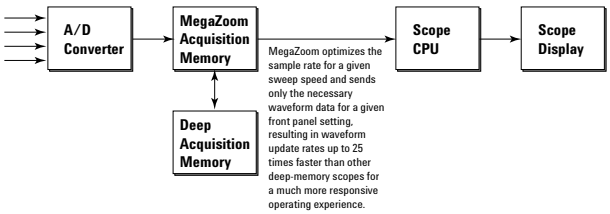


Scope memory affects sample rate.

Conventional Deep-Memory Scope Architecture



MegaZoom Deep-Memory Scope Architecture



Agilent Mega*Zoom* delivers fast, responsive operation through a custom, integrated circuit that optimizes data acquisition and processing.

Always On and Always Fast

With many of today's designs containing a mix of signal types and speeds, it's often critical to capture and compare multiple cycles of digital signals along with slower analog signals. But doing so often requires an instrument that can deliver more resolution and memory than a traditional DSO can provide. Mega*Zoom* gives you memory that is simultaneously fast and deep all the time, unlike deep-memory options on alternative scopes. With Agilent oscilloscopes, you have up to 128 Mpts of Mega*Zoom* deep memory, enabling you to correlate high-speed digital control signals with slower analog signals, capture infrequent events and then quickly zoom in on the details to narrow in on problems. Unlike deep-memory options on alternative scopes, Agilent Mega*Zoom* is not a special mode with sluggish response. It's always on, always fast, and always there to help you capture the most critical signals with maximized sample rates.

Patented Technology

Mega*Zoom* technology is based on a custom processor that controls the flow of data into acquisition memory and rapid post-processing for display and measurements. The Mega*Zoom* processor operates at the full speed of the scope's A/D. Processing the data with Mega*Zoom* technology greatly reduces the amount of data transferred to the scope's CPU for post-processing. Mega*Zoom* substantially increases the waveform update rate and front-panel responsiveness of Agilent's deep memory scopes, making these scopes better suited to working on today's complex digital-based designs. Responsiveness and waveform update rate slow down dramatically on traditional deep memory oscilloscopes making them difficult, sluggish and frustrating to use. Agilents oscilloscopes feature patented Mega*Zoom* technology that provides the fastest waveform update rates – uncompromised. Agilent oscilloscopes also feature best-in-class waveform viewing powered by Mega*Zoom* technology.

Deep Memory Provides Sustained High Sample Rates

Besides bandwidth, one of the most fundamental specifications in a digital storage oscilloscope (DSO) is its specified maximum sample rate. However, a DSO's sample rate is actually based on the scope's time base setting. At the faster time base settings, all oscilloscopes will capture waveforms using their specified maximum sample rates. But as you adjust the time base setting to slower ranges in order to capture longer waveforms, all scopes will automatically reduce their sample rates because of their limited memory depths. Deeper memory in an oscilloscope means that the scope can sustain its maximum sample rate on more time base settings, enabling you to see more details of your signals.

MSO6000A
MSO8000A

- **Mixed signal oscilloscopes – 16 digital channels time-correlated with traditional scope analog channels**
- **Oscilloscope interface and ease of use with logic analyzer insight, timing and measurements**
- **Precise analog measurements timed with exact digital content, all in one box**

Agilent pioneered the mixed signal oscilloscope in the mid 1990s and has continued to modify and improve upon the original idea since then. You can now choose from a large selection of bandwidths, memory depths and sample rates to meet your needs.

What is an MSO?

Increasing digital content brought about by the wide use of microcontrollers, DSPs, and microprocessors has added to the challenges of design verification and debug. And the proliferation of low-cost serial buses makes it more difficult to trigger on and interpret the interaction of information as it flows through a system. To trace the path between initial symptom and root cause of a problem with a traditional 2- or 4-channel oscilloscope, you have to take multiple acquisitions to capture all the signals of interest. Each acquisition only gives you a narrow view of system behavior.

Agilent's mixed signal oscilloscopes (MSOs) tightly correlate 2 or 4 analog channels with 16 logic timing channels. MSOs combine all of the measurement capabilities of a digital storage oscilloscope (DSO) with some of the measurement capabilities of a logic analyzer, along with serial protocol analysis — in a single instrument. With an MSO, you are able to see multiple time-aligned analog, parallel, digital, and serially decoded waveforms on the same display. MSOs allow you to trigger on any combination of analog and digital signals – and on many popular serial bus protocols. You can do all of this with a single, easy-to-use oscilloscope interface.

More Channels, More Memory, More Triggering

With the increasing digital content in today's designs, it is often difficult to capture enough channels simultaneously with a traditional 2 or 4 channel scope. To further complicate matters, the analog and digital sides are often operating at drastically different speeds. The seamless integration of scope and logic timing channels in the MSO gives you an instrument with unprecedented capabilities. With the MSO you can trigger on any combination of its scope and logic channels with the low jitter performance you expect from an oscilloscope. Now you can capture, display, and analyze a variety of signals in one acquisition on one instrument screen, helping you narrow in more quickly on tough design problems. With mixed signal scopes, a 16-channel timing analyzer is seamlessly integrated into a full-featured scope. It's now easy to measure a combination of signal types and speeds all at once, including slow analog slow analog, fast digital, or baseband RF.

- **Choose from Bandwidths ranging from 100 MHz to 1 GHz**
- **100,000 Waveforms/sec update rate**
- **Up to 8 Mpts deep memory – Responsive Mega*Zoom* III deep memory**
- **Pick the model that best fits your budget**

Performance Packed at a Budget Price

These oscilloscopes are ideally suited for testing circuits that are taking advantages of the use of onboard serial data. With bandwidths ranging from 100 MHz to 1 GHz, Mega*Zoom* III deep memory technology, advanced triggering, a high definition display, the look and ease of use of an analog scope, and built-in help, Agilent's 6000 Series oscilloscopes give you a view into your system performance that is unmatched by any other portable oscilloscopes at a price that fits within your budget.

Responsive Deep Memory

Mega*Zoom* technology gives you higher sampling speeds where you need them to observe the wide range of signals in your system, rather than just the faster few sweep speeds. Mega*Zoom* is available at all times and does not require a special operating mode. Measurement data are mapped into a high-resolution XGA color display with 256 levels of intensity and 1000 points resolution, twice the display resolution of other oscilloscopes.

Powerful Triggering

Because of increased digital content in today's electronic circuits, traditional level and slope scope triggering is no longer enough. Agilent's 6000 Series portable oscilloscopes offer a rich triggering feature set that lets you easily isolate and analyze complex signals and fault conditions. Triggers include:

- Pulse width
- TV
- I^2C
- SPI
- USB
- LIN*
- CAN*
- FlexRay*

Mega*Zoom* III Technology

The 6000 Series oscilloscopes are based on the third generation of Mega*Zoom* technology. This third generation of Mega*Zoom* enhances the responsiveness of this deep memory technology while maintaining its mode free operation. Mega*Zoom* III provides:

- The most responsive deep memory available
- The highest definition color display available
- Fastest update rate, uncompromised

Available Applications and Options

The 6000 Series oscilloscopes are not only a powerful portable oscilloscope standard in their off the shelf configuration but they also offer a selection of additional options to enhance debugging and decoding of your specific application. From analog signal analysis of vectors and Jitter to digital signal FPGA debugging to serial triggering a decoding of CAN, LIN and FlexRay the 6000 Series oscilloscopes can help you get your job done faster.

Agilent 6000 Series Oscilloscope Selection Guide

	601xA		603xA		605xA		610xA	
	DSO6012A	DSO6014A	DSO6032A	DSO6034A	DSO6052A	DSO6054A	DSO6102A	DSO6104A
	MSO6012A	MSO6014A	MSO6032A	MSO6034A	MSO6052A	MSO6054A	MSO6102A	MSO6104A
Bandwidth	100 MHz		300 MHz		500 MHz		1 GHz	
Channels Scopes	2 or 2 + 16	4 or 4 + 16	2 or 2 + 16	4 or 4+16	2 or 2 + 16	4 or 4 + 16	2 or 2 + 16	4 or 4 + 16
Sample Rate	2 GSa/s		2 GSa/s		4 GSa/s		4 GSa/s	
Maximum Memory	8 Mpts		8 Mpts		8 Mpts		8 Mpts	
Standard Memory	2 Mpts		2 Mpts		2 Mpts		2 Mpts	
Special Features	All of the 6000 Series are supplied with Mega*Zoom* III technology and MSO models incorporate the seamless integration of 16 logic timing channels. All models can be upgraded with additional memory at any time after purchase and all DSO models can be upgraded to an MSO configuration in your lab as an after purchase product.							

* available with purchase of option.

Agilent Portable Oscilloscope Specifications

	601xA	603xA	605xA	610xA
Channels	2 (DSO6012A) 4 (DSO6014A) 2 + 16 (MSO6012A) 4 + 16 (MSO6014A)	2 (DSO6032A) 4 (DSO6034A) 2 + 16 (MSO6032A) 4 + 16 (MSO6034A)	2 (DSO6052A) 4 (DSO6054A) 2 + 16 (MSO6052A) 4 + 16 (MSO6054A)	2 (DSO6102A) 4 (DSO6104A) 2 + 16 (MSO6102A) 4+ 16 (MSO6104A)
Scope Channels				
Bandwidth	100 MHz	300 MHz	500 MHz	1 GHz
Max Sample Rate	2 GSa/s	2 GSa/s	4 GSa/s	4 GSa/s
Max Input	400 V dc + peak ac	400 V dc + peak ac	400 V dc + peak ac	400 V dc + peak ac
Resolution	8 bits	8 bits	8 bits	8 bits
High Resolution Mode	12 bits of resolution when ≥10 µs/div @ 4 GSa/s or ≥20 20 µs/div @ 2 GSa/s			
Vertical Range	1 mV/div to 5 V/div (1 MΩ input)	2 mV/div to 5 V/div (1 MΩ or 50 Ω input)	2 mV/div to 5 V/div (1 MΩ or 50 Ω input)	2 mV/div to 5 V/div (1 MΩ input), 2 mV/div to 1 V/div (50 Ω input)
Max Memory	8 Mpts (optional) 2 Mpts standard	8 Mpts (optional) 2 Mpts standard	8 Mpts (optional) 2 Mpts standard	8 Mpts (optional) 2 Mpts standard
Time Base Range	5 nsec/div to 50/div	2 nsec/div to 50/div	1 nsec/div to 50/div	500 psec/div to 50/div
Peak Detection	1 ns peak detect	500 ps peak detect	250 ps peak detect	250 ps peak detect
Triggering				
Source	Internal selection of CH1, CH2, (CH3, CH4) Line and Ext			
Modes	Edge, Pattern, Pulse Width, TV, Sequence, Duration Nth edge and Serial Protocols of I^2C, SPI, USB, CAN, LIN (advanced CAN, LIN and FlexRay available through add-on optional applications)			
Display				
Type	High Definition color LCD			
Resolution	XGA – 1024 horizontal x 768 vertical, 256 levels of intensity scale			
Measurements				
Automatic	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, undershoot, RMS standard duration (AC RMS), frequency, period, +width, –width, duty cycle, time at max, time at min, phase, and delay			
Counter	Built-in 5 digit frequency counter on any channel, counts up to the scope's bandwidth The counter resolution can be increased to 8 digits with an external 10 MHz reference			
Cursors	Manually or automatically placed readout of Horizontal (X, deltaX, 1/deltaX) and Vertical (Y, deltaY)			
Math Functions	CH1 – CH2, 1*2, FFT, Differentiate, Integrate, sqrt			
Storage				
Type	USB 1.1 ports on front and rear panels			
Format	Waveform images as BMP or PNG and waveform data as CSV, ASCII XY pair or binary			
Connectivity	USB 2.0 device, 2x USB 1.1 host, 10/100 Base T LAN, GPIB and Video output			
Built-in Help	Key specific help in 6 languages			
Warranty	1 year, option increase to 5			
Size	35.4 cm W x 18.8 cm H x 28.2 cm D (without handle)			
Net Weight	4.9 kg (10.8 lbs)			

Ordering Information

	601xA		603xA		605xA		610xA	
	DSO6012A	**DSO6014A**	**DSO6032A**	**DSO6034A**	**DSO6052A**	**DSO6054A**	**DSO6102A**	**DSO6104A**
	MSO6012A	**MSO6014A**	**MSO6032A**	**MSO6034A**	**MSO6052A**	**MSO6054A**	**MSO6102A**	**MSO6104A**
Bandwidth	100 MHz		300 MHz		500 MHz		1 GHz	
Channels Scopes	2 analog or 2 analog + 16 digital	2 analog or 2 analog + 16 digital	2 analog or 2 analog + 16 digital	4 analog or 4 analog + 16 digital	2 analog or 2 analog + 16 digital	4 analog or 4 analog + 16 digital	2 analog or 2 analog + 16 digital	4 analog or 4 analog + 16 digital
Sample Rate	2 GSa/s		2 GSa/s		4 GSa/s		4 GSa/s	
Maximum Memory	8 Mpts		8 Mpts		8 Mpts		8 Mpts	
Standard Memory	2 Mpts		2 Mpts		2 Mpts		2 Mpts	
Included Accessories	10:1 passive probe per scope (analog) channel, MSO includes a 54620-68701 (2 x 8) logic cable, user guide, service manual, programmer's manual, power cord, accessories storage, front panel cover, one-year warranty, Agilent IO libraries version 14.2 CD							

Memory and MSO Options

Option Number on New Units – Factory Installed	Option Number After Purchase – User Installed	Description	601xA/603xA	605xA/610xA
8ML	N2911A	8 Mpts half channel, 4 Mpts each channel	•	
8MH	N2913A	8 Mpts half channel, 4 Mpts each channel		•
Order MSO model	N2914A	MSO upgrade kit for DSO models (user installed)	•	
Order MSO model	N2915A	MSO upgrade kit for DSO models (user installed)		•

Probe and Accessory Options
1146A 100 kHz/100 A Current Probe, AC/DC
N2772A 20 MHz Differential Probe (Requires N2773A power supply)
10070C 1:1 Passive Probe with ID
10076A 100:1, 4 kV, 250 MHz Probe with ID
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
N2780A 2 MHz/500 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2781A 10 MHz/150 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2782A 50 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2783A 100 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
1147A 50 MHz Current Probe, AC/DC with AutoProbe Interface
1141A 200 MHz Differential Probe (Requires 1142A probe control and power module)
1156A 1.5 GHz Active Probe with AutoProbe Interface
1130A 1.5 GHz InfiniiMax Differential Probe Amplifier with AutoProbe Interface (Requires one or more InfiniiMax probe head – E2675A, E2668A, E2669A)
1144A 800 MHz Active Probe (Requires 1142A power supply)
N2916B Rackmount Kit for 5000/6000 Series Scope
N2917B Transit Case for 5000/6000 Series Scope
1180CZ Testmobile Scope Cart
N2919A Testmobile Bracket for 1180CZ and 6000 Series Scope
N2918A Oscilloscope Evaluation Kit for 6000 Series Scope

Application Options

Digital Analysis
N5406A FPGA Dynamic Probing Xilinx
N5434A FPGA Dynamic Probing Altera

Serial Data Analysis
N5423A I^2C/SPI Serial Decode Option (for 4/4 + 16 Ch models only)
N5424A AMS CAN + LIN Automotive Triggering and Decode (4/4 + 16 Ch models only)
N5432A FlexRay Automotive Trigger + Decode FRS

Additional Options
BAT Battery option – operate scope without line power
SEC Secure environment mode option

- **4 channel scope in only 1U (43.6 mm space)**
- **Up to 1 GHz bandwidth, 4 GSa/s sample rates and 8 M memory**
- **Built in web browser for control**
- **Standard USB, LAN, GPIB interfaces and XGA out**
- **100% compatible with 6000A Series portable oscilloscopes**
- **Optimized for automated and manufacturing test**
- **LXI class C compliant**

The Agilent 6014L Series digital storage oscilloscopes (DSOs) offer four channels of measurements in a compact, rack-mountable 1U-high form factor, giving engineers a space-efficient way to integrate oscilloscopes into their test systems.

Powerful Acquisition with Mega*Zoom* III Deep Memory

Consistent with other Agilent oscilloscopes the deep memory that is available in the 6000L Series Low Profile oscilloscope is based on Mega*Zoom* technology. 2 Mpt of Mega*Zoom* deep memory comes standard so you can capture long, non-repeating signals, while maintaining high sample rates and good timing resolution.

Mixed Signal Analysis Option

If you work with both analog and digital circuitry, the Agilent 6000L Series oscilloscope can help you see more signal activity in your designs. You can upgrade the 6000L Series oscilloscope to a 4 scope + 16 logic timing channel mixed signal oscilloscope (MSO). Agilent's mixed signal oscilloscopes (MSOs) tightly correlate 4 analog channels with 16 logic timing channels. With an MSO, you are able to see multiple time-aligned analog, parallel, digital, and serially decoded waveforms on the same display.

Easy System Integration

Rack mount brackets and rack rails are standard with every unit and because the units have side and rear air vents (no top or bottom air vents) other instruments can be mounted directly above or below them. There is built-in web server to provide remote access and control of the instrument via a standard Java-enabled web browser on your computer. There is also a no-cost optional secure environment mode that provides the highest level of security by ensuring that internal memory is clear of all setup and trace settings. Because the 6000L Series Oscilloscope is LXI class C compliant and is 100% compatible with 6000A Series Oscilloscope it enables an easy transition from development to manufacturing. Engineers can use the LXI class C compliant 6000A Series portable oscilloscope during the R&D phase, using the display, keypad and knobs. When your product moves to manufacturing, you can use a system-optimized 6000L Series LXI oscilloscope without a display.

Specifications

	DSO6014L	DSO6054L	DSO6104L
Channels	4 scope channels (16 logic channels available as option)	4 scope channels (16 logic channels available as option)	4 scope channels (16 logic channels available as option)
Scope Channels			
Bandwidth	100 MHz	500 MHz	1 GHz
Max Sample Rate	2 GSa/s	4 GSa/s	4 GSa/s
Max Input	400 V dc + peak ac	400 V dc + peak ac	400 V dc + peak ac
Vertical Resolution	8 bits	8 bits	8 bits
High Resolution Mode (Time Base & Bits of Resolution)	<100 nsec/div, 8 bits 500 nsec/div, 9 bits 2 µsec/div, 10 bits 10 µsec/div, 11 bits ≥50 µsec/div, 12 bits	<100 nsec/div, 8 bits 500 nsec/div, 9 bits 2 µsec/div, 10 bits 10 µsec/div, 11 bits ≥50 µsec/div, 12 bits	<100 nsec/div, 8 bits 500 nsec/div, 9 bits 2 µsec/div, 10 bits 10 µsec/div, 11 bits ≥50 µsec/div, 12 bits
Standard Memory	2 Mpts on 2 channels, 1 Mpts on 4 channels		
Time Base Range	5 nsec/div to 50 sec/div	1 nsec/div to 50 sec/div	500 psec/div to 50 sec/div
Peak Detection	1 ns peak detect	250 ps peak detect	250 ps detect
Triggering			
Source	DSO6xx4L: Ch 1, 2, 3, 4, line, ext and D0 – D15 for MSO enabled DSO		
Modes	Edge, Pattern, Pulse Width, TV, Sequence, Duration, Nth edge burst and Serial Protocols of I²C, SPI, USB (CAN, LIN and FlexRay available through add-on optional applications)		
Display	—	—	—
Measurements			
Automatic	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, preshoot, RMS, standard deviation (AC RMS), frequency, period, +width, –width, duty cycle, time at max, time at min, time at max, phase, and delay		
Counter	Built-in 5 digit frequency counter on any channel, counts up to the scope's bandwidth The counter resolution can be increased to 8 digits with an external 10 MHz reference		
Math Functions	CH1 – CH2, CH1 + CH2, 1*2, FFT, Differentiate, Integrate		
Connectivity	USB 2.0 device, 2 x USB 1.1 host, 10/100 Base T LAN, GPIB and XGA Video output		
Warranty	1 year, option increase to 3		
Size	43.5 cm W x 27 cm D x 4.2 cm H (without brackets)		
Net Weight	Net: 2.45 kg (5.4 lbs.) Shipping: 6.2 kg (13.6 lbs.)		

Key Literature & Web link

Agilent Technologies 6000L Low Profile Oscilloscopes Data Sheet, p/n 5989-5470EN
Agilent Oscilloscope Probes and Accessories Selection Guide, p/n 5989-6162EN
Agilent 6000 Series Oscilloscopes Data Sheet, p/n 5989-2000EN/EUS
Agilent 5000 and 6000 Series Oscilloscope Probes and Accessories Data Sheet, p/n 5968-8153EN
Option SEC N5427A Secure Environment Mode Option Data Sheet, p/n 5968-5558EN
Next-Generation Test Systems Application Note, p/n 5989-2802EN
LXI: Going Beyond GPIB, PXI and VXI Application Note, p/n 5989-4371EN
Optimizing Test Systems for Highest Throughput Lowest Cost and Ease of Integration with LXI Instruments Application Note, p/n 5989-4886EN
Open the Door to Simpler System Creation Brochure, p/n 5989-2042EN

Ordering Information

6000L Series Low-profile Oscilloscopes

	DSO6014L	DSO6034L	DSO6104L
Bandwidth	100 MHz	500 MHz	1 GHz
Channels Scopes	4 scope	4 scope	4 scope
Sample Rate	2 GSa/s	4 GSa/s	4 GSa/s
Standard Memory	2 Mpts	2 Mpts	2 Mpts

The above models include: user's guide, service guide, programmers guide, power code, 10:1 divider passive probe per scope channel, Agilent IO Libraries Suite 14.2, 1 year warranty, GPIB extender, LAN crossover cable, rack mount hardware

Standard Probes Included

	Passive Probes	Logic Cable Kit – Comes with MSO Upgrade Kit
DSO6014L	10074C 10:1 passive probe (qty 4)	54826-68701 MSO logic cable kit (qty 1)
DSO6034L	10073C 10:1 passive probe (qty 4)	54826-68701 MSO logic cable kit (qty 1)
DSO6104L	10073C 10:1 passive probe (qty 4)	54826-68701 MSO logic cable kit (qty 1)

Available Options

		DSO6014L	DSO6054L/ DSO6104L
N2914A	MSO upgrade kit for DSO6014L	•	
N2915A	MSO upgrade kit for DSO6054L/DSO6104L		•
-SEC	Secure environment mode (factory installed option)	•	•
N5423A LSS	I^2C/SPI decode option	•	•
N5424A AMS	CAN, LIN and FlexRay decode option	•	•
N5432/FRS	Flex Ray decode option	•	•

Probe Options

10070C 1:1, 1 MΩ Passive Probe*
1147A 50 MHz, 50 A AC/DC Current Probe
10076A 100:1, 4 kV, 250 MHz High Voltage Probe
1144A 800 MHz Active Probe – order 1142A Power Supply
1145A 2 Channel 750 MHz Active Probe – order 1142A Power Supply
1156A 1.5 GHz Active Probe with AutoProbe Interface (power supply not required)
1130A 1.5 GHz InfiniiMax Probe Amplifier – no probe heads included**

Memory Upgrade

8ML – 100 MHz
8MH – 500 MHz + 1 GHz

* fine-pitch and IC probing kits available (10072, 10075A).
** for a complete probing solution, also order a connectivity kit or individual probe head(s) (E2675A, E2668A, E2669A).

- **Choose 600 MHz or 1 GHz bandwidth**
- **4 GSa/s sample rate**
- **Up to 128 Mpts memory**
- **Open Windows XP Pro based with touch screen drag and drop measurements**
- **Extensive application software suite**
- **Mega*Zoom* Technology powered deep memory, display and viewing system**
- **Unrivaled InfiniiMax active probes and accessories**

Agilent's Infiniium oscilloscopes combine ease of use and the right specifications with a broad feature set to help you get your job done faster. If you are tired of spending 80 percent of your lab time fighting your instrumentation and only 20 percent making meaningful measurements, Infiniium is the scope for you.

Industry-Leading Mega*Zoom* Deep Memory

Mega*Zoom* is Agilent's unique, patented technology that gives you the advantages of deep memory without the usual drawbacks. Mega*Zoom* deep memory lets you capture a full cycle of your system's operation and responsively zoom in on specific areas of interest. Mega*Zoom* deep memory captures long records with fast waveform updates, minimizing dead-time between acquisitions.

Signal Integrity

If you are concerned about accurate reproduction of your signals as they appear on your device under test, you need the best end-to-end measurement system starting at the probe tip. The 1156A 1.5 GHz single-ended active probe is uniquely designed for a flat frequency response over the entire probe bandwidth, eliminating the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance. The InfiniiMax 1130A 1.5 GHz differential/single-ended active probe system builds on this technology by providing a variety of flexible probe heads to gain access to the most difficult to access test points.

Open Windows XP Pro Interface

Infiniium's intuitive Windows-based graphical user interface (GUI), coupled with its analog-like control knobs, puts the scopes' powerful measurements, waveform math functions, advanced analysis capabilities, and triggering at your fingertips. Infiniium's open Windows XP Professional architecture is a robust environment for installing third-party or custom analysis software applications inside the oscilloscope for the most expansive one-box test solution. The open architecture enables all the standard PC connectivity you are familiar with, making it easy to share your work and communicate your results. Infiniium features an email-ontrigger function that will send an email with date and time stamp in addition to an attached screen image to any email account in the world once a trigger event occurs. Use a Java™ – Venabled Web browser to share access with team members working remotely from their very own PC.

Available Add On Application-specific Solutions

The PC platform of the Infiniium enables it to be the perfect place to run your software application right on the instrument. Agilent has created a wide selection of applications, available as add on options (either before or after purchase) to help take advantage of that PC power and get you further down the road to your end product.

Agilent Infiniium 8000 Series Selection Guide

	8064A		8104A	
	DSO8064A	**MSO8064A**	**DSO8104A**	**MSO8104A**
Bandwidth	600 MHz		1 GHz	
Channels Scopes	4 analog	4 analog + 16 digital logic	4 analog	4 analog + 16 digital logic
Sample Rate	4 GSa/s		4 GSa/s	
Maximum Memory	128 Mpts		128 Mpts	
Standard Memory	8 Mpts		8 Mpts	
Special Features	Advanced measurement suite with touch screen drag-and-drop capability. Extensive built-in waveform analysis with histograms, mask testing, and measurement statistics for full signal characterization. Segmented memory acquisition mode for efficient capture of bursting signals. Extensive Application suite available			

Specifications

	DSO8064A	MSO8064A	DSO8104A	MSO8104A
Bandwidth	600 MHz	600 MHz	1 GHz	1 GHz
Channels Scopes	4 analog	4 analog + 16 digital logic	4 analog	4 analog + 16 digital logic
Scope Channels				
Maximum Sample Rate	4 GSa/s	4 GSa/s	4 GSa/s	4 GSa/s
Maximum Memory	128 Mpts	128 Mpts	128 Mpts	128 Mpts
Standard Memory	8 Mpts	8 Mpts	8 Mpts	8 Mpts
Sampling Modes	Real time, equivalent time, peak detect, high resolution, averaging and segmented			
Max input, High Z	150 V RMS or dc, CAT I; ±250 V (dc + ac) in AC coupling			
Max input, 50 Ohms	5 V RMS, CAT I			
Vertical Resolution	8 bits, >12 bits with averaging or high resolution modes			
Dynamic Range	±8 div from center screen (1 MΩ) and ±12 div from center screen (50 Ω)			
Logic Channels (MSO models only)				
Maximum Sample Rate	1 GSa/s	1 GSa/s	1 GSa/s	1 GSa/s
Maximum Memory	32 Mpts	32 Mpts	32 Mpts	32 Mpts
Input Level	500 mV p-p minimum, ±40 V Maximum			
Threshold	±8 V in 10 mV increments	±8 V in 10 mV increments	±8 V in 10 mV increments	±8 V in 10 mV increments
Glitch Detection	2.5 ns minimum	2.5 ns minimum	2.5 ns minimum	2.5 ns minimum
Timebase				
Range	500 ps/div to 20 s/div	500 ps/div to 20 s/div	200 ps/div to 20 s/div	200 ps/div to 20 s/div
Resolution	4 ps	4 ps	4 ps	4 ps
Accuracy	15 ppm (±0.0015%)	15 ppm (±0.0015%)	15 ppm (±0.0015%)	15 ppm (±0.0015%)
Jitter Measurement Floor				
– time internal error	7 ps rms	7 ps rms	5ps rms	5ps rms
– period jitter	10 ps rms	10 ps rms	7 ps rms	7 ps rms
– N-cycle, Cycle-Cycle Jitter	15 ps rms	15 ps rms	11 ps rms	11 ps rms
Triggering				
Source	All Channels (Scope Channels 1 – 4 and Logic Channels D0 – D15) & External			
Modes	Edge, glitch, line, pattern, state, delay by time, delay by events, TV & violation triggers (pulse width, setup/hold, and transition)			
Jitter	8 ps ± 0.05 ppm x | delay setting | rms			
Display	8.4 inch diagonal color TFT-LCD; Maximum waveforms/second >8,800			
Waveform Measurements				
Voltage	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower, Area			
Time	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, Rise Time, Fall Time, Tmin, Tmax, Channel-to-Channel Phase			
Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, FFT Phase			
Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion, Statistics, Histograms, Mask Testing			
Jitter clock (scope only)	Cycle-cycle jitter, N-cycle jitter, cycle-cycle +width, cycle-cycle –width, cycle-cycle duty cycle (all with EZJIT)			
Jitter data (scope only)	Time interval error (TIE), data rate, unit interval (all with EZJIT)			
Math Functions	Four functions f1 – f4. Select from add, average, common mode, differentiate, divide, FFT magnitude, FFT phase, high pass filter, integrate, invert, low pass filter, magnify, min, max, multiply, smoothing, subtract, versus			
Drives	≥40 GB internal hard drive (optional removable hard drive) CD-ROM drive on rear panel			
IO ports	LAN, GPIB, RS-232, Parallel, PS/2, USB 2.0,video output, auxiliary output, TTL trigger output			
Warranty	1 year standard, option increase to 3 years			
Size	216 mm H x 437 mm W x 440 mm D (8.5 in x 17.19 in x 17.34 in)			
Net Weight	Net: 13.4 kg (29.5 lbs.); Shipping: 16.4 kg (36.1 lbs.)			

Accessories

Extensive Application Software

The Agilent 8000 Series Infiniium Oscilloscope offers a broad portfolio of add-on applications that enable you to customize your oscilloscope. Agilent engineers have worked with industry experts to create software for the oscilloscope that will offer application specific insight and ultimately save you time. These options are available as add on options either before or after purchase.

Application Area	Application Name	Product Number/Option Number	Publication Number	Description
Digital Debug	FPGA dynamic probing Xilinx	N5397A	5989-1848EN	• Quickly and easily access your FPGA troubleshooting pins • Save time with easy signal identification • Enable measurement of a wide range of signals on our design without reprogramming your FPGA
	FPGA dynamic probing Altera	N5433A	5989-5940EN	• Quickly and easily access your FPGA troubleshooting pins • Save time with easy signal identification • Enable measurement of a wide range of signals on our design without reprogramming your FPGA
Serial Data Analysis	Low-speed serial data analysis for I^2c or SPI serial communication buses	N5391A	5989-1250EN	• Save time with automatic decode • Easily sort through data with click and zoom • Find the data you are looking for quickly with search functions for a particular packet
	CAN serial data analysis software	N5402A	5989-3632EN	• View both protocol and physical layer information directly on the Infiniium • Save time with automatic decode • Easily sort through data with click and zoom
	High-speed serial data analysis software	N5384A	5989-0108EN	• Effectively validate signal integrity • Recover embedded clock signals then display and make TIE Jitter measurements relative to them • Build and recover eye diagrams
Jitter Analysis	EZJIT Jitter Analysis	E2681A	5989-0109EN	• Access the measurements you need the most for Jitter; cycle-cycle jitter, N-cycle jitter, period jitter, time interval error, setup and hold time, measurement histograms, measurement trending and jitter spectrum • Save time with set-up wizard
Compliance Testing	Ethernet performance validation and compliance software	N5392A N5395B (Ethernet test fixture) N5396A (Gigabit Ethernet Jitter test cable)	5989-1527EN	• Quickly and easily verify and debug 1000Base-T, 1000base-TX, 10base-T Ethernet designs • Automatically execute Ethernet physical-layer electrical tests
	USB 2.0 performance validation and compliance software	N5416A E2646A (SQiDD test fixture)	5989-4044EN	• Fast and reliable way to verify SUB electrical specification compliance for USB 2.0 devices • Execute MATLAB USB-IF scripts inside the Infiniium
Vector Signal Analysis	VSA software for Infiniium	89601A	5989-0947EN	• Enables flexible signal analysis and demodulation up to 1 GHz bandwidth for troubleshooting wideband modulated signals in radar and communications applications

Accessories

Application Area	Application Name	Product Number/Option Number	Publication Number	Description
Usability Enhancements	My Infiniium	E2699A	5988-9934EN	• Launch your application directly from the oscilloscope front panel
	Communication Mast Test Kit	E2652A	5989-0372EN	• Ensure your design meets industry communication standards. Comes with a set of electrical communication adapters to ensure convenient, reliable, and accurate connections to your device under test
	VoiceControl software	E2682A		• Speak into the collar-mounted microphone to operate your Infiniium's front-panel controls without using your hands
	Logic Analyzer/ Oscilloscope time correlation	E5805A		• Easily make time correlated measurements between an Agilent 16900 Series logic analysis system or Agilent 1680/90 Series benchtop logic analyzer and an Infiniium oscilloscope without a correlation fixture
	User Defined Function	N5430A	5989-5632EN	• Develop your own custom math functions or filters using MATLAB® and its Signal Processing Toolbox and display them on your oscilloscope along side the other standard functions*
	Infiniiscan	N5415A	5989-4605EN	• Quickly and easily identify signal integrity issues with InfiniiScan. Isolate anomalous signal behavior with application scans through thousand of acquired waveforms. Capture anomalies that hardware-based solutions can't find

* User must purchase MATLAB® from The MathWorks separately.

Active Probes

Probing high-frequency signals becomes more challenging as the variety of test points and the frequencies of the signals continue to grow. Probes need to be lightweight, small, affordable, and offer the accessories and probe tips you require to get your job done easily. For high-speed differential signal measurements, the 1130A InfiniiMax differential probe amp, with its variety of probe heads, is a perfect compliment to the Infiniium 8000 Series oscilloscopes. Its 1.5 GHz bandwidth, extremely low input capacitance, high common mode rejection and the patented resistor probe tip technology provide ultra-low loading of the DUT and superior signal fidelity. The 1156A active probe is a small, low-mass, active probe also with 1.5 GHz bandwidth. The probe offers a flat frequency response across the entire probe bandwidth, even with a variety of accessories attached, giving you accurate insight into your high-speed measurement. Agilent offers a variety of probe tips to help you probe any test point.

Model	Probe Bandwidth	System Bandwidth	Single-ended/ Differential
1156A	1.5 GHz	1 GHz with MSO8104A and DSO8104A 600 MHz with MSO8064A and DSO8064A	single-ended
1130A	1.5 GHz	1 GHz with MSO8104A and DSO8104A	both[1,2]

[1] Depending on probe head used.
[2] For a complete probing solution, also order a connectivity kit or individual probe head(s).

Key Literature & Web Link

Infiniium 8000 Series Oscilloscopes Data Sheet, p/n 5989-4271EN
Infiniium Probes, Accessories and Options Data Sheet, p/n 5989-7141EN
Agilent Oscilloscope Probes and Accessories Selection Guide, p/n 5989-6162EN
Agilent 8000 Series Oscilloscopes Brochure, p/n 5989-5806EN

Ordering Information

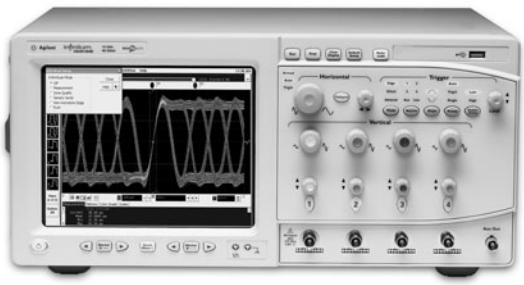
Standard Probes Included
DSO8064A 10073C 10:1 Passive Probe (qty 4)
MSO8064A 10073C 10:1 Passive Probe (qty 4), 54826-68701 MSO Logic Cable Kit (qty 1)
DSO8104A 10073C 10:1 Passive Probe (qty 4)
MSO8104A 10073C 10:1 Passive Probe (qty 4), 54826-68701 MSO Logic Cable Kit (qty 1)

Memory Options
N5407A-080 16 Mpts on 2 Channels, 8 Mpts on 4 Channels
N5407A-160 32 Mpts on 2 Channels, 16 Mpts on 4 Channels
N5407A-320 64 Mpts on 2 Channels, 32 Mpts on 4 Channels
N5407A-640 128 Mpts on 2 Channels, 64 Mpts on 4 Channels

Probe and Accessory Options
1146A 100 kHz/100 A Current Probe, AC/DC
N2772A 20 MHz Differential Probe (Requires N2773A power supply)
10070C 1:1 Passive Probe with ID
10076A 100:1, 4 kV, 250 MHz Probe with ID
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
N2780A 2 MHz/500 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2781A 10 MHz/150 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2782A 50 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2783A 100 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
1147A 50 MHz Current Probe, AC/DC with AutoProbe Interface
1141A 200 MHz Differential Probe (Requires 1142A probe control and power module)
1153A 200 MHz Differential Probe
1155A 750 MHz, 2-channel, Low-mass Active Probe
1156A 1.5 GHz Active Probe with AutoProbe Interface
1130A 1.5 GHz InfiniiMax Differential Probe Amplifier with AutoProbe Interface (Requires one or more InfiniiMax probe head – E2675A, E2668A, E2669A)
1144A 800 MHz Active Probe (Requires 1142A power supply)
N2916B Rackmount Kit for 5000/6000 Series Scope
N2917B Transit Case for 5000/6000 Series Scope
1180CZ Testmobile Scope Cart
N2919A Testmobile Bracket for 1180CZ and 6000 Series Scope
N2918A Oscilloscope Evaluation Kit for 6000 Series Scope
E5396A Half-size (17 channel) Soft Touch Connectorless Logic Probe for MSO Models

Miscellaneous Options
017 (factory installed) ≥40 GB Removable Hard Disk Drive. Replaces ≥40 GB Internal Hard Disk with a ≥40 GB Removable Hard Disk. Order the N5422A for Additional Hard Disk Drive Cartridges that contain the Full Windows Operating System and Oscilloscope Application.
1181BZ Testmobile System Cart
1184A Testmobile with Keyboard/Mouse Tray and Drawer for Accessories
E2609B Rackmount Kit
A6J ANSI Z540-compliant Calibration
R-51B-001-3C 1 Year Return-to-Agilent warranty extended to 3 Years

- **Industry's lowest noise floor for both oscilloscopes and probes**
- **Industry's lowest jitter measurement floor**
- **Industry's lowest trigger jitter – less than 500 fs rms**
- **Industry's flattest frequency response**
- **Industry's only bandwidth upgradeable series from 2 GHz to 13 GHz**
- **Industry's largest selection of application software packages**
- **Industry's only full bandwidth economical lead-free solder-in probe solution**
- **Industry's first software event finder "InfiniiScan" (option)**
- **Now LXI functional class C compliant**



Superior Signal Integrity and Probing for Your Application

The superior signal integrity, probing and application software selection of Agilent Technologies' Infiniium DSO/DSA80000B Series and InfiniiMax II probing system will lead to improved measurements and increased design margins.

The signal integrity advantages of Agilent's Infiniium 80000B Series Scopes and InfiniiMax Probing System include the industry's lowest noise floor, lowest jitter measurement floor, lowest trigger jitter and flattest frequency response. These foundational capabilities are crucial for achieving accurate and repeatable measurements. These superior signal integrity capabilities come from Agilent's RFdesign experience, proprietary packaging technologies and unique CMOS ADC architecture. Superior signal integrity maximizes engineer's design margins by not wasting any measurement accuracy due to the poor noise, jitter or frequency response of the scope or probing system.

Agilent Infiniium DSO/DSA80000B Series Oscilloscopes Selection Guide

	DSO/DSA81304B	DSO/DSA81204B	DSO/DSA81004B	DSO/DSA80804B	DSO/DSA80604B	DSO/DSA80404B	DSO/DSA80304B	DSO/DSA80204B
Bandwidth	13 GHz	12 GHz	10 GHz	8 GHz	6 GHz	4 GHz	3 GHz	2 GHz
Channels	4	4	4	4	4	4	4	4
Sampling Rate	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s
Standard Memory	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M
Max Memory (Option 001, standard on DSA Models)				1 – 2 M (64 M at 4 GSa/s)				
Rise Time/Fall Time								
(20 – 80%)	23 ps	25 ps	30 ps	38 ps	48 ps	91 ps	108 ps	152 ps
(10 – 90%)	33 ps	36 ps	42 ps	54 ps	70 ps	105 ps	108 ps	152 ps
Noise (rms at 100 mV/div)	3.3 mV	2.7 mV	2.3 mV	2.1 mV	1.8 mV	1.4 mV	1.2 mV	1.0 mV
Hardware Sensitivity (SW Expansion to 1 mV/div)	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div
Timebase Range	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div
Popular Scope Options	EZJIT Jitter Analysis Software (Option 002, Standard on DSA models) High Speed Serial Data Analysis Software (Option 003, Standard on DSA models) EZJIT Plus Advanced Jitter Analysis Software (Option 004, Standard on DSA models) Noise Reduction Software (Option 005, Standard on DSO/DSA81304B) My Infiniium Customization Software (Option 006) InfiniiScan Event Identification Software (Option 009) User Defined Function Software (Option 010)							

Infiniimax Probing System – Probe Amplifiers

	1169A	1168A	1134A	1132A	1131A	1130A
BW Spec	12 – 13 GHz	10 GHz	7 GHz	5 GHz	3.5 GHz	1.5 GHz
Recommended Oscilloscope	DSO81304B DSO81204B	DSO81004B DSO80804B	DSO80604B	DSO80404B	DSO80304B DSO80204B	DSO80204B
Attenuation	3.45:1	3.45:1	10:1	10:1	10:1	10:1
Dynamic Range	3.3 Vp-p	3.3 Vp-p	5 Vp-p	5 Vp-p	5 Vp-p	5 Vp-p
Noise Referred to Input	2.5 mV rms	2.5 mV rms	3.0 mV rms	3.0 mV rms	3.0 mV rms	3.0 mV rms

Infiniimax Probing Systems – Probe Heads

	N5380A	N5381A	N5382A	N5425A/ N5426A	E2675A	E2676A	E2677A	E2678A	E2679A	E2695A
Typ BW	13 GHz	13 GHz	13 GHz	13 GHz	6 GHz	6 GHz	12 GHz	12 GHz	6 GHz	8 GHz
Description	Hi-BW Differential SMA	Hi-BW Differential Solder-in	Hi-BW Differential Browser	Hi-BW Differential ZIF Solder-in	Differential Browser	Single-Ended Browser	Differential Solder-in	Differential Socket	Single-Ended Solder-in	Differential SMA
Diff Capacitance	—	0.21 pF	0.21 pF	0.33 pF	0.32 pF	0.67 pF	0.27 pF	0.34 pF	0.50 pF	—

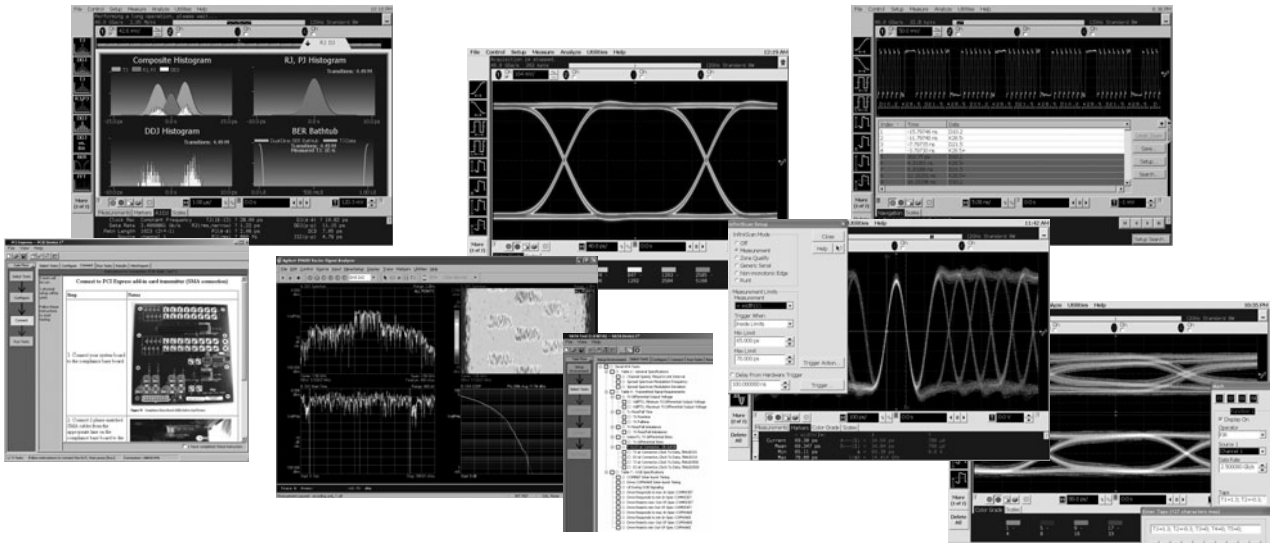
Infiniimax Probing Systems – Connectivity Kits and Misc

	E2669A	E2668A	E2697A
Description	Differential Kit	Single-Ended Kit	1 Mohm High Impedance Adapter
Includes	E2675A, E2677A x4, E2678A	E2676A, E2679A, E2678A	500 MHz Passive Probe

InfiniiMax Extreme Temperature Cable Extension

A SMP microwave extension cable from Gore (W. L. Gore & Associates, Inc.) is available for extending the reach of InfiniiMax probes into tight environments or into test chambers (Part number PRP042105-01). Please contact Gore at 1-800-311-3060 or look up international contacts at **www.gore.com**

Operating Temperature Range: 0 to 105°C

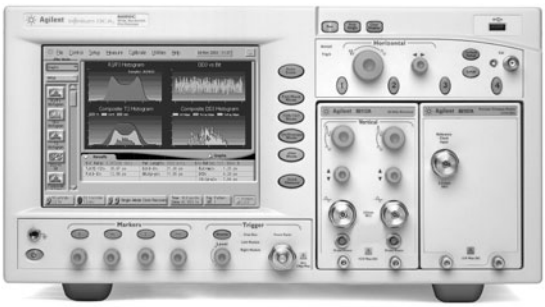


Infiniium Software Applications

Area	Part Number	Name	Description
Jitter	E2681A	EZJIT Jitter Analysis (Option 002)	Wizard based – measurements, histograms, measurement trending, jitter frequency spectrum
	N5400A	EZJIT Plus Jitter Analysis (Option 004)	Adds jitter separation into components and bit error rate projections. Same UI as 86100C Infiniium DCA-J
	E2690B	M1 Jitter Analysis (3rd Party)	Most advanced and flexible jitter analysis package. Supports offline analysis as well.
Serial Analysis	E2688A	High Speed SDA Serial Data Analysis (Option 003)	Wizard based – clock recovery, mask testing, real-time eyes with unfolding, 8b/10b decode, listing, and trigger
Compliance	N5393A	PCI Express 1.0/1.1 Compliance	Wizard based framework – test selection, configuration, connection, execution, results. Requires SDA
	N5392A	Ethernet Compliance (10/100BaseTX, Gigabit)	Wizard based framework – test selection, configuration, connection, execution, results
	N5394A	DVI Compliance	Wizard based framework – test selection, configuration, connection, execution, results
	N5399A	HDMI Compliance	Wizard based framework solution, supporting the latest HDMI 1.3. Listed in CTS 1.3.
	N5409A	Fully Buffered DIMM Compliance	Wizard based framework solution supporting FBD1/AMB1
	N5410A	Fiber Channel Compliance	Wizard based framework. Industry's only Fiber Channel compliance solution
	N5411A	Serial ATA Compliance	Wizard based framework, supporting both SATA gen 1 and gen 2
	N5412A	SAS Compliance	Wizard based framework for Serial Attached SCSI
	N5413A	DDR2 Full Compliance	Wizard based framework solution for both clock and data characterization
	N5416A	USB 2.0 Compliance	Wizard based framework based on USB-IF developed MATLAB script
	N5431A	XAUI Compliance	Wizard based framework for Industry's only XAUI compliance solution
	N5402A	CAN Serial Data Analysis	For CAN data analysis and decoding
	Serial ATA	Serial ATA Compliance	Free SATA I compliance solution from compliance body
	Fire-Wire	Fire-Wire Compliance (3rd Party)	FW compliance solution from 3rd party partner
Frequency Analysis	89601A	Vector Signal Analysis	Ultra-wide-band, multi-port vector signal analysis
	N5403A	Noise Reduction (Option 005)	DSP noise reduction feature at 10, 8, 6, 4, 2 and 1 GHz (DSO81204A/81004A/80804A Only)
Utilities	N5420A-G	After Burner II Bandwidth Upgrades	Upgrade any 80000 Series model to a higher bandwidth model
	N5391A	Low Speed Serial Data Analysis (Opt 21)	Decode I^2C and SPI low speed serial bus protocols
	N5414A	InfiniiScan Event Identification Software	Industry's first software triggering solution including the "Zone Trigger" feature
	N5430A	User Defined Function	Build your own analysis function through a seamless link to MATLAB
	E2625A	Communications Mask Test Kit	Low speed electrical mask testing for ANSI and ITU standards
	E2699A	My Infiniium Integration Package (Opt 6)	Customize Infiniium user interface to launch user-created or 3rd party executable programs
	E2682A	Voice Control Option	Hands free operation of the Infiniium Oscilloscope

86100C Infiniium DCA-J

- **Modular platform for testing electrical and optical waveforms to 40 Gb/s and beyond**
- **Automated jitter and interference decomposition**
- **Internally generated pattern trigger**
- **Broadest coverage of data rates**
- **RIN measurements on PRBS signals**
- **Jitter spectrum of clock or data signals**



Meeting Your Growing Need for More Bandwidth

Today's high data-rate signals have significant frequency content well beyond a real-time oscilloscope's 3 dB bandwidth. A high bandwidth scope does not alone guarantee an accurate representation of your waveform. Careful design of the DCA-J equivalent time sampling oscilloscope's frequency response (both amplitude and phase) minimizes distortion such as overshoot and ringing allowing the most precise signal analysis available from 50 Mb/s to over 40 Gb/s.

Four Instruments in One

The 86100C Infiniium DCA-J can be viewed as four high-powered instruments in one:

- A general-purpose wide-bandwidth sampling oscilloscope; the new PatternLock triggering significantly enhances the usability as a general purpose scope
- A digital communications analyzer; the new Eyeline Mode feature adds a powerful new tool to eye diagram analysis
- A time domain reflectometer
- A jitter and amplitude interference analyzer

In addition the 86100C Infiniium DCA-J can measure:

- Relative Intensity Noise (RIN) of lasers modulated with industry-standard PRBS signals
- Characterize the jitter spectrum of clock or data signals found in many computer architectures
- Lock its clock recovery onto Source Spectrum Clocking (SSC) signals

Configurable to Meet Your Needs

The 86100C supports a wide range of modules for testing both optical and electrical signals. Select modules to get the specific bandwidth and sensitivity you need.

Signal Integrity Analysis

The unique combination of wide bandwidth and low noise makes the DCA-J the most precise signal integrity analyzer available. Accurate eye-diagram analysis is essential for characterizing the quality of transmitters used from 50 Mb/s to 40 Gb/s and the DCA-J is designed specifically for the complex task of analyzing digital waveforms. Compliance mask and parametric testing can be performed with the touch of a single button.

Jitter and Amplitude Interference Analysis

Extremely wide bandwidth, low intrinsic jitter, and advanced analysis algorithms yield the highest accuracy in jitter measurements. As data rates increase in both electrical and optical applications, decomposition of jitter and amplitude interference into its constituent components is becoming more critical. It provides critical insight for jitter and amplitude budgeting and performance optimization in device and system designs. Many emerging standards require jitter decomposition for compliance. The DCA-J provides simple, one button setup and execution of advanced waveform analysis. Jitter Mode decomposes jitter and amplitude interference into its constituent components and presents jitter data in various insightful displays. Jitter Mode operates at all data rates the DCA-J supports. The 86100C brings several key attributes to jitter analysis:

- Very low intrinsic jitter (both random and deterministic) translates to the lowest jitter noise floor available providing unmatched jitter measurement sensitivity
- Wide bandwidth measurement channels with very low intrinsic jitter allow jitter and interference analysis on all data rates to 40 Gb/s and beyond
- Optimized frequency response (magnitude and phase) results in more accurate waveform representation

Internal Triggering Through Clock Recovery

Typically an external timing reference is used to trigger an equivalent time sampling oscilloscope to the test signal. In cases where a trigger signal is not available, clock recovery modules with adjustable PLL loop bandwidth are used to derive a timing reference directly from the waveform and provide golden PLL functionality for testing to industry standards.

PatternLock Triggering

The Enhanced Trigger Option (Option 001) enables the DCA-J to generate a trigger at the repetition of the input data pattern – a pattern trigger. PatternLock automatically detects the pattern length, data rate and clock rate enabling the 86100C to behave more like a real-time oscilloscope in terms of user experience. Users that are familiar with real-time oscilloscopes, but perhaps less so with equivalent time sampling scopes will be able to ramp up quickly.

Time Domain Reflectometry/Time Domain Transmission (TDR/TDT)

High-speed design starts with the physical structure. The transmission and reflection properties of electrical channels and components must be characterized to ensure sufficient signal integrity.

Use TDR and TDT to optimize microstrip lines, PC board traces, SMA edge launchers and coaxial cables.

Calibration techniques, unique to the DCA-J, provide the highest precision by removing cabling and fixturing effects from the measurement results. Translation of TDR data to complete single-ended, differential, and mixed mode S-parameters are available through the N1930A Physical Layer Test System software.

For specifications and ordering information refer to pages 76-79.

- **Essential tools for the high speed digital designer**
- **Wide bandwidth oscilloscope**
- **Communications analyzer**
- **Signal integrity analyzer**
- **Interference and jitter analyzer**
- **RIN measurements on PRBS signals**
- **Jitter spectrum of clock and data signals**

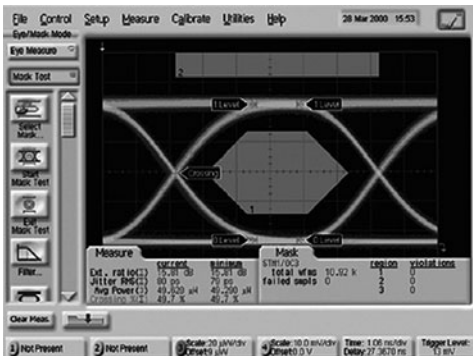
The ultimate flexible tool – the 86100C Infiniium DCA-J with advanced jitter analysis. Four instruments in one – a digital communications analyzer with automated eye measurements; a full-function time domain reflectometer (TDR) for impedance analysis; a full function oscilloscope with bandwidth in excess of 80 GHz; an innovative and accurate jitter analyzer for electrical and optical signals. With the ability to accept plug-in modules that you already own from the 83480A/54750A and 86100A/B, the DCA-J also protects your investment.

Capabilities

- Broadest coverage – receivers and clock recovery modules cover widest range of data rates and wavelengths
- Pattern lock – internally generates pattern trigger from an ordinary clock
- Eyeline mode – isolates specific bit sequences, creates an averaged eye diagram
- Interference and jitter mode – one-button RJ/DJ, RN/DI separation; accurate, stable, in-depth interference and jitter analysis at any rate-even beyond 40 Gb/s
- Jitter analysis with the 86107A precision timebase – achieve the most accurate jitter measurements with the lowest jitter intrinsics of any enterprise jitter solution to measure ultra high performance components
- TDR/TDT – accurately analyzes single-ended and differential devices; built-in calibration removes cabling/fixture effects
- S-parameters – one button push shows you reflection and transmission parameters – Option 202 and TDR
- Open operating system – Windows® XP Pro allows external applications to be installed

Eye Diagram Mask Testing

The DCA-J provides efficient, high-throughput waveform compliance testing with a suite of standards based eye-diagram masks. The test process has been streamlined into a minimum number of keystrokes for testing at industry standard data rates.

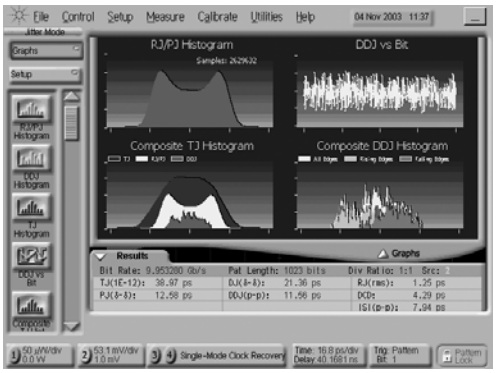


Standard Masks

	Rate (Mb/s)
• 1X Gigabit Ethernet	1250
• 2X Gigabit Ethernet	2500
• 10 Gigabit Ethernet	9953.28
• 10 Gigabit Ethernet	10312.5
• 10X Gigabit Ethernet FEC	11095.7
• Fibre Channel	1062.5
• 2X Fibre Channel	2125
• 4X Fibre Channel	4250
• 8X Fibre Channel	8500
• 10X Fibre Channel	10518.75
• 10X Fibre Channel FEC	11317
• STM0/OC1	51.84
• STM1/OC3	155.52
• STM4/OC12	622.08
• STM16/OC48	2488.3
• STM16/OC48 FEC	2666
• Infiniband	2500
• 10 Gigabit Ethernet LX4	3125
• STM64/OC192	9953.28
• STM64/OC192 FEC	10664.2
• STM64/OC192 FEC	10709
• STM64/OC192 Super FEC	12500
• STM256/OC768	39813
• STS1 EYE	51.84
• STS3 EYE	155.52

Other eye-diagram masks are easily created through scaling. In addition, mask editing allows for new masks either by editing existing masks, or creating new masks from scratch. A new mask can also be created or modified on an external PC using a text editor such as Notepad, then can be transferred to the instrument's hard drive using LAN, Flash drive, or USB devices.

Perform these mask conformance tests with convenient user-definable measurement conditions, such as mask margins for guardband testing, number of waveforms tested, and stop/limit actions.



Jitter Mode

Jitter Mode decomposes jitter and amplitude interference into its constituent components and presents jitter data in various insightful displays. Jitter Mode operates at all data rates the DCA-J supports, removing the traditional data rate limitations from complex jitter analysis. The DCA-J brings several key attributes to jitter analysis:

- Very low intrinsic jitter (both random and deterministic) translates to a very low jitter noise floor which provides unmatched jitter measurement sensitivity
- Wide bandwidth measurement channels deliver very low intrinsic data dependent jitter and allow analysis of jitter on all data rates to 40 Gb/s and beyond
- PatternLock triggering technology provides sampling efficiency that makes jitter measurements very fast

Analysis functionality is segmented into three software package options. Option 200 is the enhanced jitter analysis software, and Option 201 is the advanced waveform analysis software. Option 300 provides amplitude analysis and RIN. Option 200 includes:

- Decomposition of jitter into Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ), Periodic Jitter (PJ), Data Dependent Jitter (DDJ), Duty Cycle Distortion (DCD), and Jitter induced by Intersymbol Interference (ISI)
- Various graphical and tabular displays of jitter data
- Export of jitter data to convenient delimited text format
- Save/recall of jitter database
- Jitter frequency spectrum
- Isolation and analysis of Sub-Rate Jitter (SRJ), that is, periodic jitter that is at an integer sub-rate of the bitrate
- Bathtub curve display
- Adjustable total jitter probability

As bit rates increase, channel effects cause significant eye closure. Many new devices and systems are employing equalization and pre/de-emphasis to compensate for channel effects. Option 201 Advanced Waveform Analysis will provide key tools to enable design and test of devices and systems that must deal with difficult channel effects:

- Capture of long single valued waveforms. PatternLock triggering and the waveform append capability of Option 201 enable very accurate pulse train data sets up to 2×10^{23} bits long
- Equalization. The DCA-J can take a long single valued waveform and route it through an equalizer algorithm (default or user defined) and display the resultant equalized waveform in real time. The user can simultaneously view the input (distorted) and output (equalized) waveforms
- Interface to MatLab® analysis capability

Option 300 includes:

- Decomposition of amplitude interference into total interference (TI), deterministic interference (DI), random noise (RN), data dependent interference (DDI), inter-symbol interference (ISI), and periodic interference (PI)
- Various graphical and tabular displays of interference measurements
- Relative Intensity Noise (RIN 1 level or RIN OMA) using square-wave or industry-standard PRBS patterns
- Q-factor measurement

Option 300 requires options 200 (enhanced jitter software) and 001 (enhanced trigger hardware).

Internal Triggering Through Clock Recovery

Typically an external timing reference is used to synchronize the oscilloscope to the test signal. In cases where a trigger signal is not available, clock recovery modules are available to derive a timing reference directly from the waveform to be measured.

The 83496B provides the highest performance/flexibility as it is capable of operation at any data rate from 50 Mb/s to 13.5 Gb/s, on single-ended and differential electrical signals, single mode (1250 to 1620 nm) and multimode (780 to 1330 nm) optical signals, with extremely low residual jitter. PLL loop bandwidth is adjustable to provide optimal jitter filtering according to industry test standards.

Stimulus Response Testing Using the Agilent N490xA/B Bit Error Ratio Tester

Error performance analysis represents an essential part of digital transmission test. The DCA-J and Agilent N490xA/B Bit Error Ratio Tester error performance analyzer come together to create a powerful test solution where two instruments together can perform measurements that would otherwise be impossible.

Transitioning from the Agilent 83480A or 86100A/B to the Infiniium DCA-J

The 86100C Infiniium DCA-J has been designed to be a virtual drop-in replacement for the Agilent 83480A digital communications analyzer and Agilent 54750A wide-bandwidth oscilloscope. All modules used in the Agilent 83480A, 54750A, and 86100A/B can also be used in the 86100C Infiniium DCA-J. Some newer modules (such as the 86116C and the 83496B) work only in the 86100C Infiniium DCA-J.

Eyeline Mode

Eyeline Mode is a new feature only available in the DCA-J that provides insight into the effects of specific bit transitions within a data pattern. The unique view assists diagnosis of device or system failures do to specific transitions or sets of transitions within a pattern. When combined with mask limit tests, Eyeline Mode can quickly isolate the specific bit that caused a mask violation.

Traditional triggering methods on an equivalent time sampling scope are quite effective at generating eye diagrams. However, these eye diagrams are made up of samples whose timing relationship to the data pattern is effectively random, so a given eye will be made up of samples from many different bits in the pattern taken with no specific timing order. The result is that amplitude versus time trajectories of specific bits in the pattern are not visible. Also, averaging of the eye diagram is not valid, as the randomly related samples will effectively average to zero.

Eyeline Mode uses PatternLock triggering to build up an eye diagram from samples taken sequentially through the data pattern. This maintains a specific timing relationship between samples and allows Eyeline Mode to draw the eye based on specific bit trajectories. Effects of specific bit transitions can be investigated, and averaging can be used with the eye diagram.

Measurements

The following measurements are available from the tool bar, as well as the pull down menus. The available measurements depend on the DCA-J operating mode.

Jitter Mode

Jitter Mode requires Option 001 Enhanced Trigger hardware.
There are three analysis software packages for the DCA-J. Option 200 is the enhanced jitter analysis software, Option 201 is the advanced waveform analysis software, and option 300 is the advanced amplitude analysis software.

Measurements (Option 200 Jitter Analysis)
Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ), Periodic Jitter (PJ), Data Dependent Jitter (DDJ), Duty Cycle Distortion (DCD), Intersymbol Interference (ISI), Sib-Rate Jitter (SRJ)

Data Displays (Option 200 Jitter Analysis)
TJ histogram, RJ/PJ histogram, DDJ histogram, Composite histogram, DDJ versus Bit position, Composite DDJ, Bathtub curve, PJ Analysis, SRJ analysis, Aliased Spectrum, PJ Waveforms
Measurements (Option 201 Advanced Waveform Analysis)
Pattern waveform
Data Displays (Option 201 Advanced Waveform Analysis)
Equalized waveform
Measurements (Option 300 Advanced Amplitude Analysis)
Total Interference (TI), Deterministic Interference (DI), Random Noise (RN), Data Dependent Interference (DDI), Inter-Symbol Interference (ISI), Periodic Interference (PI)
Data Displays (Option 300 Advanced Amplitude Analysis)
TI histogram, RI/PI histogram, DDI histogram, Composite histogram, DDI versus Bit position

Oscilloscope Mode

Time
Rise Time, Fall Time, Jitter RMS, Jitter p-p, Period, Frequency, + Pulse Width, – Pulse Width, Duty Cycle, Delta Time, [Tmax, Tmin, Tedge – remote commands only]
Amplitude
Overshoot, Average Power, V amptd, V p-p, V rms, V top, V base, V max, V min, V avg, Optional Modulation Amplitude (OMA)

Eye/Mask Mode

NRZ Eye Measurements
Extinction Ratio, Jitter RMS, Jitter p-p, Average Power, Crossing Percentage, Rise Time, Fall Time, One Level, Zero Level, Eye Height, Eye Width, Signal to Noise (Q-Factor), Duty Cycle Distortion, Bit Rate, Eye Amplitude
RZ Eye Measurements
Extinction Ratio, Jitter RMS, Jitter p-p, Average Power, Rise Time, Fall Time, One Level, Zero Level, Eye Height, Eye Amplitude, Opening Factor, Eye Width, Pulse Width, Signal to Noise (Q-Factor), Duty Cycle, Bit Rate, Contrast Ratio

Mask Test

Open Mask, Start Mask Test, Exit Mask Test, Filter, Mask Test Margins, Mask Test Scaling, Create NRZ Mask

TDR/TDT Mode (requires TDR module)

Quick TDR, TDR/TDT Setup, Normalize, Response, Rise Time, Fall Time, Δ Time

Modules for the Agilent 86100C Infiniium DCA-J

The Infiniium DCA has a large family of plug-in modules designed for a broad range of data rates for optical and electrical waveforms. The DCA-J can hold up to 2 modules for a total of 4 measurement channels.

3

86100C Family Plug-in Module Matrix

Module	Option	Number of Optical Channels	Number of Electrical Channels	Wavelength Range (nm)	Unfiltered Optical Bandwidth (GHz)	Electrical Bandwidth (GHz)	Fiber Input (µm)	Mask Test Sensitivity (dBm)	Probe Power[1]	Filtered Data Rates																						
										Mb/s						Gb/s																
										155	622	1063	1244/1250	2125	2488/2500	2.666	3.125	4.25	5.00	6.25	8.500	9.953	10.3125	10.51875	10.664	10.709	11.096	11.317	39.813	43.018
Optical/Electrical																																
86105B	**111**	1	1	1000 – 1600	15	20	9	–12														•	•	•	•	•	•	•		
	112	1	1	1000 – 1600	15	20	9	–12		•	•				•	•						•	•	•	•	•	•	•		
	113	1	1	1000 – 1600	15	20	9	–12				•	•	•	•							•	•	•	•	•	•	•		
86105C	**100**[2]	1	1	750 – 1650	8.5	20	62.5	–20		•	•	•	•	•	•	•	•	•	•	•	•									
	200	1	1	750 – 1650	8.5	20	62.5	–16														•	•	•	•	•	•	•		
	300[2]	1	1	750 – 1650	8.5	20	62.5	–16		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
86106B		1	1	1000 – 1600	28	40	9	–7	•													•								
	410	1	1	1000 – 1600	28	40	9	–7	•													•	•	•	•	•				
86116A		1	1	1000 – 1600	53	63	9	—	•																					
86116B		1	1	1480 – 1620	65	80	9	—																						
86116C[1,3]		1	1	1480 – 1620	65	80	9	–3																					•	•
Dual/Electrical																														
54754A		0	2	—	—	18	—	—	•																					
86112A		0	2	—	—	20	—	—	•																					
86117A		0	2	—	—	50	—	—																						
86118A		0	2	—	—	70	—	—																						

[1] Module has receptacle to supply power for external probe. For modules without a probe power receptacle, use the 1143A Probe Power Supply.
[2] Pick any 4 rates (155 Mb/s to 8.5 Gb/s).
[3] This module is not compatible with the 86100A and 86100B Digital Communication Analyzer (DCA) mainframes. If you would like to upgrade older DCAs contact Agilent Technologies and ask for current trade-in deals.

Module Specifications: 86106B, 86116A/B/C

High Bandwidth, Single-mode Optical/ Electrical Modules	86106B	86116A[1]	86116B[1]	86116C[1]
Optical Channel Specifications				
Optical Channel Unfiltered Bandwidth	28 GHz	53 GHz	65 GHz (best pulse fidelity)	65 GHz
Wavelength Range	1000 to 1600 nm		1480 to 1620 nm	1480 to 1620 nm
Calibrated Wavelengths	1310/1550 nm		1550 nm	1550 nm
Optical Sensitivity[3]	–7 dBm			–3 dBm
Transition Time (10% to 90%, calculated from TR = 0.48/BW optical)	18 ps	9.0 ps (FWHM)[2]	7.4 ps (FWHM)[2]	7.4 ps (FWHM)[2]
RMS Noise				
Characteristic	13 µW (Filtered) 23 µW (Unfiltered)	60 µW (50 GHz) 190 µW (53 GHz)	50 µW (55 GHz) 140 µW (65 GHz)	36 µW (39.8, 43.0 Gb/s filters) 125 µW (65 GHz)
Maximum	15 µW (Filtered) 30 µW (Unfiltered)	90 µW (50 GHz) 260 µW (53 GHz)	85 µW (55 GHz) 250 µW (65 GHz)	68 µW (39.8, 43.0 Gb/s filters) 200 µW (65 GHz)
Scale Factor				
Minimum	20 µW/division	200 µW/division	200 µW/division	200 µW/division
Maximum	500 µW/division	2.5 mW/division	5 mW/division	5 mW/division
CW Accuracy (single marker, referenced to average power monitor)	±50 µW ± 4% of (reading-channel offset)	±150 µW ± 4% of (reading-channel offset)	±150 µW ± 4% of (reading-channel offset)	±150 µW ± 4% of (reading-channel offset)
CW Offset Range (referenced two divisions from screen bottom)	+1 mW to –3 mW	+5 mW to –15mW	+8 to –12 mW	+8 to –12 mW
Average Power Monitor (specified operating range)	–27 dBm to +3 dBm	–23 dBm to +9 dBm	–23 dBm to +9 dBm	–23 dBm to +9 dBm
Factory Calibrated Accuracy	±5% ± 100 nW ± connector uncertainty, 20°C to 30°C			
User Calibrated Accuracy	±2% ± 100 nW ± power meter uncertainty, <5°C change			
Maximum Input Power				
Maximum non-destruct average	2 mW (+3 dBm)	10 mW (+10 dBm)	10 mW (+10 dBm)	10 mW (+10 dBm)
Maximum non-destruct peak	10 mW (+10 dBm)	50 mW (+17 dBm)	50 mW (+17 dBm)	50 mW (+17 dBm)
Fiber Input	9/125 µm, user selectable connector			
Input Return Loss (HMS-10 connector fully filled fiber)	30 dB	30 dB	20 dB	20 dB
Electrical Channel Specifications				
Electrical Channel Bandwidth	18 and 40 GHz	43 and 63 GHz	80, 55 and 30 GHz	80, 55 and 30 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	19.5 ps (18 GHz) 9 ps (40 GHz)	8.1 ps (43 GHz) 5.6 ps (63 GHz)	6.4 ps (55 GHz) 4.4 ps (80 GHz)	6.4 ps (55 GHz) 4.4 ps (80 GHz)
RMS Noise				
Characteristic	0.25 mV (18 GHz) 0.5 mV (40 GHz)	0.6 mV (43 GHz) 1.7 mV (63 GHz)	0.6 mV (55 GHz) 1.1 mV (80 GHz)	0.5 mV (30 GHz) 1.1 mV (80 GHz)
Maximum	0.5 m V (18 GHz) 1.0 mV (40 GHz)	0.9 mV (43 GHz) 2.5 mV (63 GHz)	1.1 mV (55 GHz) 2.2 mV (80 GHz)	0.8 mV (30 GHz) 2.2 mV (80 GHz)
Scale Factor				
Minimum	1 mV/division	2 mV/division	2 mV/division	2 mV/division
Maximum	100 mV/division	100 mV/division	100 mV/division	100 mV/division
DC Accuracy (single marker)	±0.4% of full scale ±2 mV ± 1.5% of (reading-channel offset), 18 GHz ±0.4% of full scale ±2 mV ± 3% of (reading-channel offset), 40 GHz	±0.8% of full scale ±2 mV ± 1.5% of (reading-channel offset), 43 GHz ±2.5% of full scale ±2 mV ± 2% of (reading-channel offset), 63 GHz	±0.4% of full scale ±3 mV ± 2% of (reading-channel offset), ± 2% of offset (all bandwidths)	±0.4% of full scale ±3 mV ± 2% of (reading-channel offset), ± 2% of offset (all bandwidths)
DC Offset Range (referenced to center of screen)	±500 mV	±500 mV	±500 mV	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV	±400 mV	±400 mV	±400 mV
Maximum Input Signal	±2 V (+16 dBm)	±2 V (+16 dBm)	±2 V (+16 dBm)	±2 V (+16 dBm)
Nominal Impedance	50 Ω	50 Ω	50 Ω	50 Ω
Reflections (for 20 ps rise time)	5%	5%	10% (DC to 70 GHz) 20% (70 to 100 GHz)	10% (DC to 70 GHz) 20% (70 to 100 GHz)
Electrical Input	2.4 mm (male)	1.85 mm (male)	1.85 mm (male)	1.85 mm (male)

[1] 86116A and 86116B require the 86100 software revision A.3.0 or above. 86116C requires an 86100C mainframe and software revision 7.0.
[2] FWHM (Full Width Half Max) as measured from optical pulse with 700 fs FWHM, 5 MHz repetition rate and 10 mW peak power.
[3] Smallest average optical power required for mask test. Values represent typical sensitivity of NRZ eye diagrams. Assumes mask test with compliance filter switched in.

Module Specifications: Single-mode & Multimode Optical/Electrical

Multimode and Single-mode Optical/Electrical Modules	86105B	86105C
Optical Channel Specifications		
Optical Channel Unfiltered Bandwidth	15 GHz	8.5 GHz (9 GHz)
Wavelength Range	1000 to 1600 nm	750 to 1650 nm
Calibrated Wavelengths	1310 nm/1550 nm	850 nm/1310 nm/1550 nm (±20 nm)
Optical Sensitivity[1]	–12 dBm	850 nm ≤2.666 Gb/s, –20 dBm >2.666 Gb/s to ≤4.25 Gb/s, –19 dBm >4.5 Gb/s to 11.3 Gb/s, –16 dBm 1310 nm/1550 nm ≤2.666 Gb/s, –21 dBm >2.666 Gb/s to ≤4.25 Gb/s, –20 dBm >4.25 Gb/s to 11.3 Gb/s, –17 dBm
Transition Time (10% to 90% calculated from TR=0.48/BW optical)	32 ps	56 ps
RMS Noise Characteristic	5 µW, (10 GHz) 12 µW, (15 GHz)	850 nm ≤2.666 Gb/s, 1.3 µW >2.666 Gb/s to ≤4.25 Gb/s, 1.5 µW >4.25 Gb/s to 11.3 Gb/s, 2.5 µW 1310 nm/1550 nm ≤2.666 Gb/s, 0.8 µW >2.666 Gb/s to ≤4.25 Gb/s, 1.0 µW >4.25 Gb/s to 11.3 Gb/s, 1.4 µW
Maximum	8 µW, (10 GHz) 15 µW, (15 GHz)	850 nm ≤2.666 Gb/s, 2.0 µW >2.666 Gb/s to ≤4.25 Gb/s, 2.5 µW >4.25 Gb/s to 11.3 Gb/s, 4.0 µW 1310 nm/1550 nm ≤2.666 Gb/s, 1.3 µW >2.666 Gb/s to ≤4.25 Gb/s, 1.5 µW >4.25 Gb/s to 11.3 Gb/s, 2.5 µW
Scale Factor (per division) Minimum	20 µW	2 µW
Maximum	500 µW	100 µW
CW Accuracy (single marker, referenced to average power monitor)	±25 µW ± 2% (10 GHz) ±25 µW ± 4% (15 GHz)	±25 µW ± 3% ±25 µW ± 10%
CW Offset Range (referenced two divisions from screen bottom)	+1 µW to –3 µW	+0.2 µW to –0.6 µW
Average Power Monitor (specified operating range)	–30 dBm to +3 dBm	–30 dBm to 0 dBm
Average Power Monitor Accuracy Single-mode	±5% ± 100 nW ± connector uncertainty (20°C to 30°C)	±5% ± 200 nW ± connector uncertainty
Multimode (characteristic)	—	±10% ± 200 nW ± connector uncertainty
User Calibrated Accuracy Single-mode	±2% ± 100 nW ± power meter uncertainty, <5°C change	±3% ± 200 nW ± power meter uncertainty, <5°C change
Multimode (characteristic)	—	±10% ± 200 nW ± power meter uncertainty, <5°C change
Maximum Input Power Maximum Non-destruct Average	2 µW (+3 dBm)	0.5 µW (–3 dBm)
Maximum Non-destruct Peak	10 µW (+10 dBm)	5 µW (+7 dBm)
Fiber Input	9/125 µm user selectable connector	62.5/125 µm
Input Return Loss (HMS-10 connector fully filled fiber)	33 dB	850 nm >13 dB , 1310 nm/1550 nm >24 dB

[1] Smallest average optical power required for mask test. Values represent typical sensitivity of NRZ eye diagrams. Assumes mask test with compliance filter switched in.

Module Specifications: Single-mode & Multimode Optical/Electrical

Multimode and Single-Mode Optical/Electrical Modules	86105B/C
Electrical Channel Specifications	
Electrical Channel Bandwidth	12.4 and 20 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	28.2 ps (12.4 GHz) 17.5 ps (20 GHz)
RMS Noise	
Characteristic	0.25 mV (12.4 GHz) 0.5 mV (20 GHz)
Maximum	0.5 mV (12.4 GHz) 1 mV (20 GHz)
Scale Factor	
Minimum	1 mV/division
Maximum	100 mV/division
DC Accuracy (single marker)	±0.4% of full scale ± 2 mV ± 1.5% of (reading-channel offset), 12.4 GHz ±0.4% of full scale ± 2 mV ± 3% of (reading-channel offset), 20 GHz
DC Offset Range (referenced to center of screen)	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV
Maximum Input Signal	±2 V (+16 dBm)
Nominal Impedance	50 Ω
Reflections (for 30 ps rise time)	5%
Electrical Input	3.5 mm (male)

54754A
86112A
86117A
86118A

Module Specifications: Dual Electrical

Dual Electrical Channel Modules	86112A	54754A
Electrical Channel Bandwidth	12.4 and 20 GHz	12.4 and 18 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	28.2 ps (12.4 GHz); 17.5 ps (20 GHz)	28.2 ps (12.4 GHz); 19.4 ps (18 GHz)
RMS Noise		
Characteristic	0.25 mV (12.4 GHz); 0.5 mV (20 GHz)	0.25 mV (12.4 GHz); 0.5 mV (18 GHz)
Maximum	0.5 mV (12.4 GHz); 1 mV (20 GHz)	0.5 mV (12.4 GHz); 1 mV (18 GHz)
Scale Factor		
Minimum	1 mV/division	1 mV/division
Maximum	100 mV/division	100 mV/division
DC Accuracy (single marker)	±0.4% of full scale ±2 mV ± 1.5% of (reading-channel offset), 12.4 GHz ±0.4% of full scale ±2 mV ± 3% of (reading-channel offset), 20 GHz	±0.4% of full scale ±2mV ± 0.6% of (reading-channel offset), 12.4 GHz ±0.4% of full scale or marker reading (whichever is greater) ±2 mV ± 1.2% of (reading-channel offset), 18 GHz
CW Offset Range (referenced from center of screen)	±500 mV	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV	±400 mV
Maximum Input Signal	±2 V (+16 dBm)	±2 V (+16 dBm)
Nominal Impedance	50 Ω	50 Ω
Reflections (for 30 ps rise time)	5%	5%
Electrical Input	3.5 mm (male)	3.5 mm (male)

TDR Module	54754A
TDR Step Rise Time	
Oscilloscope/TDR Performance	40 ps nominal
Normalized Characteristics	Adjustable from larger of 10 ps or 0.08 x time/division. Maximum: 5 x time/division
TDR Step Flatness	
Oscilloscope/TDR Performance	≤±1% after 1 ns from edge; ≤±5% less than 1 ns from edge
Normalized Characteristics	≤0.1%
Low Level	0.00 V ± 2 mV
High Level	+200 mV ± 2 mV

Dual Electrical Channel Modules	86117A	86118A
Electrical Channel Bandwidth	30 and 50 GHz	50 and 70 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	11.7 ps (30 GHz) 7 ps (50 GHz)	—
RMS Noise		
Characteristic	0.4 mV (30 GHz) 0.6 mV (50 GHz)	0.7 mV (50 GHz) 1.3 mV (70 GHz)
Maximum	0.7 mV (30 GHz) 1.0 mV (50 GHz)	1.8 mV (50 GHz) 2.5 mV (70 GHz)
Scale Factor		
Minimum	1 mV/division	1 mV/division
Maximum	100 mV/division	100 mV/division
DC Accuracy (single marker)	±0.4% of full scale ±2 mV ± 1.2% of (reading-channel offset) (30 GHz) ±0.4% of full scale ±2 mV ± 2% of (reading-channel offset) (50 GHz)	±0.4% of full scale ±2 mV ± 2% of (reading-channel offset) (50 GHz) ±0.4% of full scale ±2 mV ± 4% of (reading-channel offset) (70 GHz)
CW Offset Range (referenced from center of screen)	±500 mV	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV	±400 mV
Maximum Input Signal	±2 V (+16 dBm)	±2 V (+16 dBm)
Nominal Impedance	50 Ω	—
Reflections (for 30 ps rise time)	5%	20%
Electrical Input	2.4 mm (male)	1.85 mm (female)

Suggested Configurations for Common Applications

86100C Infiniium DCA-J Mainframe (option 1)				
Electrical 1 to 12 Gb/s	**Electrical** 20, 40 Gb/s	**Optical** 1 to 12 Gb/s	**Optical** 20, 40 Gb/s	**TDR**
86112A Dual channels >20 GHz each **83496B** Electrical clock recovery (#100, 200, 300)	**86118A** Dual remote heads 70 GHz each **86107A** Precision timebase (#040)	**86105C** 9 GHz optical channel 20 GHz electrical channel **83496B** Optical clock recovery (#101, 200, 300)	**86116C** 65 GHz optical channel 80 GHz electrical channel **86107A** Precision timebase (#040)	**54754A** Differential TDR/ Dual 18 GHz channels

Note: Other modules and options available. See the Technical Specifications, p/n 5989-0278EN or **www.agilent.com** for configuration details.

Ordering Information

86100C Infiniium DCA-J Mainframe
- **86100C-001** Enhanced Trigger
- **86100CS-001** Enhanced Trigger Upgrade Kit
- **86100C-701** Standard Trigger (default)
- **86100C-090** Removable Hard Drive
- **86100C-092** Internal Hard Drive (default)
- **86100C-200** Jitter Analysis Software
- **86100CU-200** Enhanced Jitter Analysis Software Upgrade
- **86100C-201** Advanced Waveform Analysis Software
- **86100CU-201** Advanced Waveform Analysis Software Upgrade
- **86100C-202** Enhanced Impedance and S-parameter Software
- **86100CU-202** Enhanced Impedance and S-parameter Software Upgrade
- **86100C-300** Amplitude Analysis/RIN/Q-factor
- **86100CU-300** Amplitude Analysis/RIN/Q-factor Upgrade
- **86100C-AFP** Module Slot Filler Panel
- **86100C-AX4** Rack Mount Flange Kit
- **86100C-AXE** Rack Mount Flange Kit with Handles
- **86100C-UK6** Commercial Cal Certificate with Test Data

N4688A External CD-RW Drive

Optical/Electrical Modules

86105B 15 GHz Optical Channel; Single-mode, Unamplified (1000 to 1600 nm), 20 GHz Electrical Channel
- **86105B-111** 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.096, 11.317 Gb/s
- **86105B-112** 155, 622 Mb/s, 2.488, 2.5, 2.666, 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.096, 11.317 Gb/s
- **86105B-113** 1.063, 1.250, 2.125, 2.488, 2.5, 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.096, 11.317 Gb/s

86105C 9 GHz Optical Channel; Single-mode and Multimode, Amplified (750 to 1650 nm), 20 GHz Electrical Channel
- **86105C-100** 155 Mb/s through 8.5 Gb/s (choose 4 data rates)
- **86105C-110** 155 Mb/s
- **86105C-120** 622 Mb/s
- **86105C-130** 1.063 Gb/s
- **86105C-140** 1.244/1.250 Gb/s
- **86105C-150** 2.125 Gb/s
- **86105C-160** 2.488, 2.500 Gb/s
- **86105C-170** 2.666 Gb/s
- **86105C-180** 3.125 Gb/s
- **86105C-190** 4.250 Gb/s
- **86105C-193** 5.0 Gb/s
- **86105C-195** 6.250 Gb/s
- **86105C-197** 8.500 Gb/s
- **86105C-200** 9.953, 10.3125, 10.519, 10.664, 10.709, 11.096, 11.317 Gb/s
- **86105C-300** Combination of Rates Available in 86105C-100 and 86105C-200

86106B 28 GHz Optical Channel; Single-mode, Unamplified (1000 to 1600 nm) 9.953 Gb/s, 40 GHz Electrical Channel
- **86106B-410** 9.953, 10.3125, 10.664, 10.709 Gb/s

86116C 65 GHz optical channel; single-mode, unamplified (1480 to 1620 nm), 80 GHz electrical channel. This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies to discuss current trade-in deals.

All optical modules have FC/PC connectors installed on each optical port. Other connector adapters available as options are: Diamond HMS-10, DIN, ST and SC.

Dual Electrical Channel Modules

86112A Dual 20 GHz Electrical Channels
86117A Dual 50 GHz Electrical Channels
86118A Dual 70 GHz Electrical Remote Sampling Channels
86118A-H01 Differential De-Skew

TDR/TDT Modules

Included with each of these TDR Modules is a TDR demo board, programmers guide, two 50 Ω SMA Terminations and one SMA short.
54754A Differential TDR Module with Dual 18 GHz TDR/Electrical Channels
N1020A 6 GHz TDR Probe Kit
N1024A TDR Calibration Kit

Trigger Module

86107A Precision Timebase Reference Module
- **86107A-010** 2.5 and 10 GHz Clock Input Capability
- **86107A-020** 10 and 20 GHz Clock Input Capability
- **86107A-040** 10, 20 and 40 GHz Clock Input Capability

Clock Recovery Modules

The following modules provide a recovered clock from the data signal for triggering at indicated data rates:

83496A 50 Mb/s to 7.1 Gb/s Clock Recovery Module
- **83496A-100** Single-ended and Differential Electrical with Integrated Signal Taps
- **83496A-101** Single-mode (1250 to 1620 nm) and Multimode (780 to 1330 nm) Optical. Integrated Signal Taps. Single-ended or Differential Electrical Inputs (no signal taps)
- **83496A-200** Increase Operating Range to 50 Mb/s to 13.5 Gb/s
- **83496AU-200** Upgrade Data Rate 0.05 Gb/s to 13.5 Gb/s
- **83496A-300** Add Tunable Loop Bandwidth "golden PLL" Capability
- **83496AU-300** Upgrade Adjustable Loop Bandwidth

83496B 50 Mb/s to 7.1 Gb/s clock recovery module. This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies and ask for current trade-in deals.
- **83496B-100** Single-ended and Differential Electrical with Integrated Signal Taps
- **83496B-101** Single-mode (1250 to 1620 nm) and Multimode (780 to 1330 nm) Optical. Integrated Signal Taps. Single-ended or Differential Electrical Inputs (no signal taps)
- **83496B-200** Increase Operating Range to 50 Mb/s to 13.5 Gb/s
- **83496BU-200** Upgrade Data Rate 0.05 Gb/s to 13.5 Gb/s
- **83496B-201** Shift Operating Range to 7.1 to 13.5 Gb/s
- **83496BU-201** Upgrade Shift Operating Range to 7.1 to 13.5 Gb/s
- **83496B-300** Add Tunable Loop Bandwidth "golden PLL" Capability
- **83496BU-300** Upgrade Adjustable Loop Bandwidth

Warranty Options (for all products)

R1280A Customer Return Repair Service
R1282A Customer Return Calibration Service

Accessories

86101-60005 Filler Panel
0960-2427 USB Keyboard (included with 86100C)
1150-7799 USB Mouse (included with 86100C)

Note: 86100C-200 and 86100C-201 require Option 001 (enhanced trigger). 86100C-300 requires Options 200 and 001.

Optical Connector Adapters
Optical modules come standard with one FC/PC connector adapter
81000 AI Diamond HMS-10 Connector
81000 FI FC/PC Connector Adapter
81000 SI DIN Connector Adapter
81000 VI ST Connector Adapter
81000 KI SC Connector Adapter

RF/Microwave Accessories
11667B Power Splitter, DC to 26.5 GHz, APC 3.5 mm
11667C Power Splitter, DC to 50 GHz, 2.4 mm
11742A 45 MHz to 26.5 GHz DC Blocking Capacitor
11742A-K01 50 GHz DC Blocking Capacitor
8490D-020 2.4 mm 20 dB Attenuator
11900B 2.4 mm (f-f) Adapter
11901B 2.4 mm (f) to 3.5 mm (f) Adapter
11901C 2.4 mm (m) to 3.5 mm (f) Adapter
11901D 2.4 mm (f) to 3.5 mm (m) Adapter
5061-5311 3.5 mm (f-f) Adapter
1250-1158 SMA (f-f) Adapter
1810-0118 3.5 mm Termination

Passive Probe
54006A 6 GHz Passive Probe

InfiniiMax I Active Probes (1.5 to 7 GHz)
The N1022A probe adapter is required to use these probes with the DCA-J

InfiniiMax I Probe Amplifiers
Order 1 or more InfiniiMax I probe head or connectivity kit for each amplifier
1130A 1.5 GHz Probe Amplifier
1131A 3.5 GHz Probe Amplifier
1132A 5 GHz Iprobe Amplifier
1134A 7 GHz Probe Amplifier

InfiniiMax I Probe Heads
E2675A InfiniiMax Differential Browser Probe Head and Accessories. Includes 20 Replaceable Tips and Ergonomic Handle. Order E2658A for Replacement Accessories
E2676A InfiniiMax Single-ended Browser Probe Head and Accessories. Includes 2 Ground Collar Assemblies, 10 Replaceable Tips, a Ground Lead Socket and Ergonomic Browser Handle. Order E2663A for Replacement Accessories
E2677A InfiniiMax Differential Solder-in Probe Head and Accessories. Includes 20 Full Bandwidth and 10 Medium Bandwidth Damping Resistors. Order E2670A for Replacement Accessories
E2678A InfiniiMax Single-ended/Differential Socketed Probe Head and Accessories. Includes 48 Full Bandwidth Damping Resistors, 6 Damped Wire Accessories, 4 Square Pin Sockets and Socket Heatshrink. Order E2671A for Replacement Accessories
E2679A InfiniiMax Single-ended Solder-in Probe Head and Accessories. Includes 16 Full Bandwidth and 8 Medium Bandwidth Damping Resistors and 24 Zero Ohm Ground Resistors. Order E2672A for Replacement Accessories

InfiniiMax I Connectivity Kits (popular collections of the above probe heads)
E2669A InfiniiMax Connectivity Kit for Differential Measurements
E2668A InfiniiMax Connectivity Kit for Single-ended Measurements

InfiniiMax II Active Probes (10 to 13 GHz)
The N1022A probe adapter is required to use these probes with the DCA-J

InfiniiMax II Probe Amplifiers
Order 1 or more InfiniiMax II probe heads for each amplifier. Infiniimax I probe heads and connectivity kits can also be used but will have limited bandwidth
1168A 10 Ghz Probe Amplifier
1169A 13 Ghz Probe Amplifier

InfiniiMax II Probe Heads
N5380A InfiniiMax II 12 GHz Differential SMA Adapter
N5381A InfiniiMax II 12 GHz Solder-in Probe Head
N5382A InfiniiMax II 12 GHz Differential Browser

Probe Adapters
N1022A Adapts 113x/115x/116x Active Probes to DCA-J

Connectivity Solutions
HDMI
N1080A H01 High Performance Coax Based HDMI Fixture with Plug (TPA-P)
N1080A H02 High Performance Coax Based HDMI Fixture with Receptacle (TPA-R)
N1080A H03 HDMI Low Frequency Board

SATA
iSATA Plug to SMA – COMAX P/N H303000104
iSATA Receptacle to SMA – COMAX P/N H303000204
These are available from COMAX Technology, see **www.comaxtech.com**

ATCA
Advanced TCA Tx/Rx Signal Blade™
Advanced TCA Tx/Rx Bench Blade™
These are available from F9 Systems, see **www.f9-systems.com**

Call Agilent for connectivity and probing solutions not listed above.

Firmware and Software
Firmware and Software Upgrades are available through the web or your local sales office. **www.agilent.com/find/dcaj**

Upgrade Services
86100CS-001 Enhanced Trigger Hardware Upgrade
86100CU-200 Enhanced Jitter Analysis SW Upgrade
86100CU-201 Advanced Waveform Analysis SW Upgrade
86100CU-202 Enhanced Impedance and S-parameter Software Upgrade
86100CU-300 Advanced Amplitude Analysis SW Upgrade
83496A – 83496B Performance Upgrade Contact your local Agilent Service Center and request Service Note 83496A-02
86100A/B to 86100C Upgrade Contact Agilent Technologies for current trade-in deals

Recommended Oscilloscope/Probe Compatibility Chart

	General Purpose Passive Probes									
Oscilloscope	**10:1**	**100:1**	**1000:1**	**1:1**	**Low Mass 10:1**	**Low Z**	**50 Ohm**	**Active Single Ended**	**Active Differential**	**Current**
DS03000A	N2862A, N2863A	10076A	N2771A	10070C	—	—	—	—	1141A[3], N2772A	1146A, N2780/1/2/3A[7]
DS05000A	N2863A, 10073C	10076A	N2771A	10070C	—	—	—	1156A, 1144A[3], 1145A[3]	1130A[6], 1141A[3], N2772A	1146A, 1147A, N2780/1/2/3A[7]
Infiniium 54810/15/20/25A	1160A 1164A	10440B[2], 10076A	N2771A	1162A	—	1163A	10437B	1152A, 1155A, 1156A	1153A[2]	1146A, 1147A, N2780/1/2/3A
Infiniium 54830/31/32/33B/D, 8000 Series	10073C, 1165A	10440B[2], 10076A	N2771A	1162A	1171A	1163A	10437B	1156A, 1155A,	1153A[2], 1154A, 1159A, 1130A[6]	1146A, 1147A, N2780/1/2/3A[7]
Infiniium 54835A, 54845A/B, 54846A/B	1161A	10440B[2], 10076A	N2771A	1162A	—	1163A	10437B	1152A[2], 1155A[2], 1156A	1153A[2], 1154A, 1159A, 1130/32A[6]	1146A, 1147A, N2780/1/2/3A
54751/52A/B	—	—	—	—	—	54006A	—	54701A[2,4]	1141A[3]	—
54711/12/21/22A	—	—	—	—	—	54006A	—	54701A[4]	1141A[3]	—
54714/15A/13B	10441B, 10073C	10440B, 10076A	N2771A	10439B, 10070C	1170A[1]	10442B, 1163A[1]	10437B	1144A[3], 1145A[3], 54701A[4]	1141A[3]	—
MSO/DSO6000 (300 MHz – 1 GHz)	10073C	10076A	N2771A	10070C	—	—	—	1156A, 1144A[3], 1145A[3]	1130[6], 1141A[3], N2772A	1146A, 1147A N2780/1/2/3A[7]
MSO/DSO6000 (100 MHz)	10074C	10076A	N2771A	10070C	—	—	—	—	1141A[2,3], N2772A	1146A, N2780/1/2/3A[7]
54645A/D	10074C	10440B, 10076A	N2771A	10070C	1171A[1]	—	—	1144A[2,3], 1145A[2,3]	1141A[2,3], N2772A	1146A, N2780/1/2/3A[7]
54621A/D 54622A/D/24A	10074C	10440B, 10076A	N2771A	10070C, 10439B	1171A[1]	—	—	—	1141A[2,3]	1146A, N2774A[5]
54641A/D, 54642A/D	10073C	10440B, 10076A	N2771A	10070C	1171A[1]	—	—	1144A[3], 1145A[3]	1141A[3]	1146A, N2780/1/2/3A[7]
54615/16B/16C	10073C	10440B, 10076A	N2771A	10070C, 10439B	—	1163A[1], 10442B	10437B	1144A[3], 1145A[3]	1141A[3], N2772A	1146A, N2780/1/2/3A[7]
54610A/B	10073C	10440B, 10076A	N2771A	10070C, 10439B	—	1163A[1], 10442B	10437B	1144A[3], 1145A[3]	1141A[3], N2772A	1146A, N2780/1/2/3A[7]
54600/01/02/03A/B	10074C	10440B, 10076A	N2771A	10070C, 10439B	1171A[1]	—	—	1144A[2,3], 1145A[2,3]	1141A[2,3], N2772A	1146A, N2780/1/2/3A[7]

[1] Must remove pogo pin and configure scope for probe manually.
[2] User with 50 ohm termination adapter.
[3] Requires the 1142A probe power supply.
[4] Requires the 1143A probe offset and power module.
[5] Requires N2775A power supply.
[6] Requires one or more InfiniiMax probe heads or connectivity kit per amplifier.
[7] Requires N2779A power supply.

10070 Passive Divider Probe Series.

10070 Passive Divider Probe Family

The 10070 family of rugged, general purpose probes are designed to operate with the 6000 and 54600 family of oscilloscopes. This family provides a range of high-quality probing solutions at very reasonable prices.

These reliable probes come with one retractable hook tip, eight color identification tags, one ground bayonet, one IC Tip, one adjustment tool, and one ground lead.

See page 87 for compatible SMT probing kit.

Model	Length	Division Ratio	Circuit Loading (1 MΩ scope input)	Typical Scope Bandwidth	Compensates Oscilloscope Input
10070C	1.5 m	1:1	1 MΩ; 70 pF	20 MHz	High Impedance
10073C	1.5 m	10:1	2.2 MΩ; 12 pF	500 MHz	1 MΩ; 6 to 15 pF
10074C[1]	1.5 m	10:1	10 MΩ; 15 pF	150 MHz	1 MΩ; 9 to 17 pF
10076A	1.8 m	100:1	66.7 MΩ; 3 pF	250 MHz	1 MΩ; 7 to 20 pF

[1] Probe ID pin.

Other 10070 Series Probe Accessories

Accessory	p/n
Probe tip to BNC (m) adapter	5081-7705
Replacement parts accessory kit	5081-7690
SMT probe accessory kit	10072A
0.5 mm IC probing kit	10075A
Retractable hook tip, qty 2	N2769A
Alligator ground lead, qty 2	N2770A

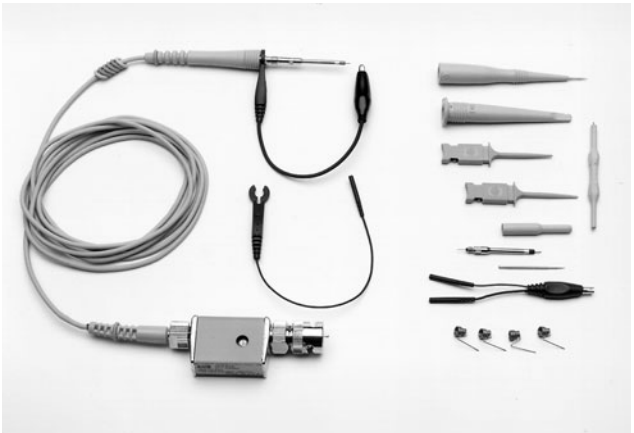
Other Accessories

Accessory	p/n
BNC 50 Ω feedthrough	10100C
BNC 75 Ω feedthrough	11094B
BNC AC blocking capacitor	10240B

N2862/63A Low-cost Passive Probe Family

The Agilent N2862A and N2863A low-cost passive probes provide a 10:1 attenuation and features a high input resistance of 10 Mohm. The probes can be adjusted for low-frequency compensation and high-frequency compensation. The probes are compatible with wide range of oscilloscopes and provide a high quality probing solution at affordable prices.

Model	Length	Division Ratio	Circuit Loading (1 MΩ scope input)	Bandwidth	Scope Compensation
N2862A	1.2 m	10:1	10 MΩ; 12 pF	150 MHz	5 – 30 pF
N2863A	1.2 m	10:1	10 MΩ; 12 pF	300 MHz	5 – 30 pF



10400B Passive Divider Probe Series.

10400B Passive Divider Probe Family

The 10400B probe family are reliable general-purpose high performance passive probes that replace the 10400A family of probes. These probes include a no-slip browser. The crown point of the browser digs in to solder and won't slip while the pogo pin allows small hand movements without losing contact.

The 10400B family of probes also comes complete with a range of accessories. For grounding, there's an alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements and a socketed ground lead. The accessories also include 2 IC clips for probing 50 mil SMDs and a dual-lead adapter so that both the probe tip and ground can easily be connected to surface mount devices.

The miniature probe has a narrow, sharp tip that is good for probing SMDs. The handle of the probe can be unscrewed and pulled back on the cable to reduce the probe's mass and size. This makes attaching to fine pitch ICs and small devices easier. For connection to fine pitch ICs order the Wedge probe adapter or the 0.5 mm IC clips.

The 10400 family of probes are built and tested for high reliability. The cable has a Kevlar strengthener for added pull strength and the general purpose retractable hook tip is made from durable music wire. The probe tips are replaceable.

See page 87 for compatible SMT probing solutions.

Model	Length	Division Ratio	Circuit Loading	Typical Scope Bandwidth	Compensates Oscilloscope Input
10437B	2 m	1:1	50 Ohm	—	50 Ohm
10439B[1]	1.5 m	1:1	65 pF	—	High Z
10433B	2 m	10:1	10 MOhm; 10 pF	300 MHz	1 MOhm; 10 – 16 pF
10436B	2 m	10:1	10 MOhm; 11 pF	100 MHz	1 MOhm; 18 – 22 pF
10441B	1.8 m	10:1	10 MOhm; 9 pF	500 MHz	1 MOhm; 6 – 9 pF
10442B	2 m	10:1	500 Ohm; 1.2 pF	1 GHz	50 Ohm
10440B	2 m	100:1	10 MOhm; 2.5 pF	300 MHz	1 MOhm; 6 – 14 pF

[1] This probe can be used with many oscilloscopes, but because of the relatively high capacitance, there will be bandwidth degradation.

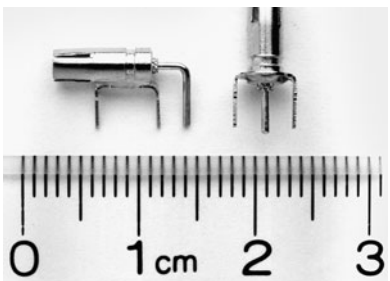
10400B Family Replacement Parts

p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD clips	5
01160-68701	Accessory Kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	 4 4 4 1
5063-2167	10433B probe tip	5
5063-2168	10436B probe tip	5
5063-2138	10437B probe tip	5
5063-2138	10439B probe tip	5
5063-2171	10440B probe tip	5
5063-2172	10441B probe tip	5
5063-2139	10442B probe tip	5

Fine Pitch IC Probing Accessories

p/n	Description	Qty
E2613B	Wedge probe adapter, 0.5 mm, 3-signal	2
E2614A	Wedge probe adapter, 0.5 mm, 8-signal	1
E2615B	Wedge probe adapter, 0.65 mm, 3-signal	2
E2616A	Wedge probe adapter, 0.65 mm, 8-signal	1
E2643A	Wedge probe adapter, 0.5 mm, 16-signal	1
E2644A	Wedge probe adapter, 0.65 mm, 16-signal	1
10467-68701	0.5 mm IC clips for surface SMT parts with lead spacings of 0.5 mm (0.020 in) to 0.8 mm (0.32 in)	4

PC Board Mini-Probe Sockets



The PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the probe tip and the circuit under test. These probe sockets are designed for use with the 1160A-family and 10400B-family of passive probes.

Ordering Information

N2766A Horizontal Mini-Probe Socket, qty 25
N2768A Vertical Mini-Probe Socket, qty 25

1160A Miniature Passive Probe Series.

1160A Family Miniature Passive Probes

The 1160 family of miniature probes are reliable general-purpose probes for use with Infiniium Oscilloscopes . The 1160 family probes include a no-slip browser with a crown point that digs in to solder, and won't slip. The pogo pin allows hand movement without losing contact.

A variety of grounding accessories are included. An alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements, a socketed ground lead and 2 SMD IC clips for probing 50 mil SMD. Also included is a dual lead adapter so that both the probe tip and ground can be connected to SMD devices. For connection to 0.5 mm – 0.8 mm devices, order the 10467-68701 0.5 mm IC clips.

The 1160 family probes are built and tested for high reliability. The cable has a kevlar strengthener for added pull strength. The general-purpose retractable hook tip has a durable music wire hook. And probe tips are replaceable.

The miniature probe has a narrow, sharp tip that is good for probing SMD. To fully miniaturize the probe, unscrew the handle and pull it back on the cable. The 1160 family probes are compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.

Model	Type of Probe	Length	Division Ratio	Circuit Loading	System Bandwidth (Scope and Probe)	Oscilloscope Input
1160A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 9 pF	500 MHz[1]	1 MOhm, 6 – 9 pF
1161A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	500 MHz[2]	1 MOhm,12 – 14 pF
1162A	High Impedance, Passive	1.5 m	1:1	1 MOhm, 50 pF + scope input	25 MHz[3]	1 MOhm
1163A	500 Ohm Resistive Divider	1.5 m	10:1	500 Ohm, 1.5 pF	1.5 GHz[2]	50 Ohm
1164A	High Impedance, Passive	2.0 m	10:1	10 MOhm, 10 pF	500 MHz[1]	1 MOhm, 6 – 9 pF
1165A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	600 MHz[4]	1 MOhm, 12 – 14 pF

[1] System bandwidth with 54810A/15A/20A/25A.
[2] System bandwidth with 54845A.
[3] System bandwidth with all Infiniium scopes.
[4] System bandwidth with 54830B/31B/32B/30D/31D/32D/33A/33D, DSO/MSO8064A and DSO/MSO8104A.

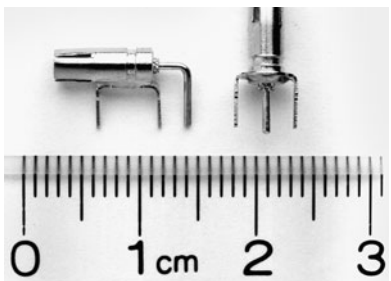
1160 Family Replacement Parts

p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD IC clips	5
01160-68701	Accessory kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	 4 4 4 1
5063-2136	1160A probe tip	5
5063-2137	1161A/65A probe tip	5
5063-2138	1162A probe tip	5
5063-2139	1163A probe tip	5
5063-2151	1164A probe tip	5

Fine Pitch IC Probing Accessories

p/n	Description	Qty
E2613B	Wedge probe adapter, 0.5 mm, 3-signal	2
E2614A	Wedge probe adapter, 0.5 mm, 8-signal	1
E2615B	Wedge probe adapter, 0.65 mm, 3-signal	2
E2616A	Wedge probe adapter, 0.65 mm, 8-signal	1
E2643A	Wedge probe adapter, 0.5 mm, 16-signal	1
E2644A	Wedge probe adapter, 0.65 mm, 16-signal	1
10467-68701	0.5 mm IC clips for surface SMT parts with lead spacings of 0.5 mm (0.020 in) to 0.8 mm (0.32 in)	4

PC Board Mini-Probe Sockets

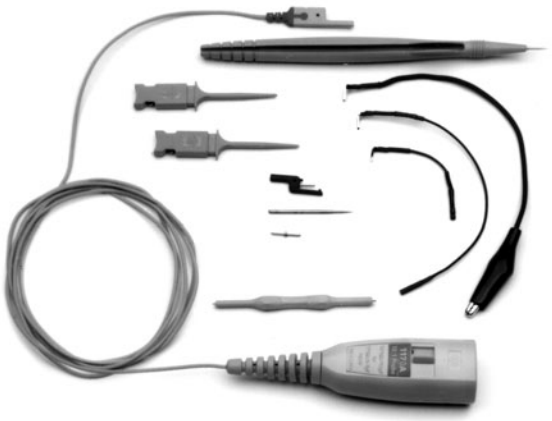


The PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the probe tip and the circuit under test. These probe sockets are designed for use with the 1160A-family and 10400B-family of passive probes.

Ordering Information

N2766A Horizontal Mini-Probe Socket, qty 25
N2768A Vertical Mini-Probe Socket, qty 25

1171A
10467-68701
E2613A
E2613B
E2614A
E2615A
E2615B
E2616A

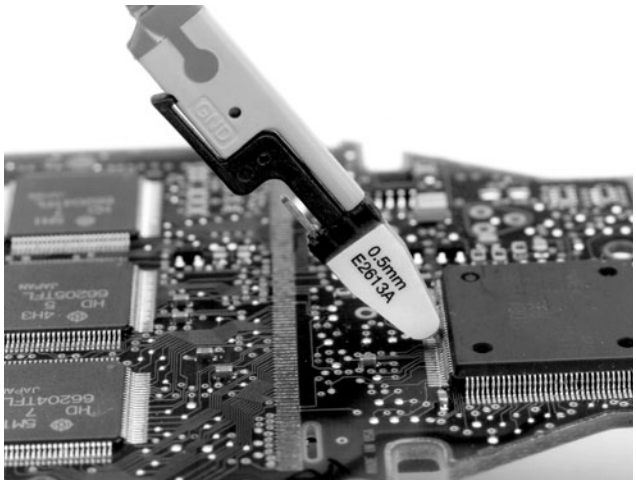


The 117x Low Mass Passive Probe.

The 117x family of low mass high performance passive probes for the Infiniium Oscilloscopes is designed specifically to make the probing of fine pitch ICs and dense circuit boards easier. The probe tip is exceptionally small and light, weighing less than 1 gram, so it is easier to attach to those small devices and surface mount ICs. Even though small and light, these probes are designed for high performance and the ruggedness required for general purpose use. The cable is re-enforced with Kevlar for added pull strength.

The probe also includes a no-slip browser for precise and safe browsing. The crown point of the browser digs in to solder and won't slip and the pogo pin allows small movements without loosing contact.

The 117xA family of probes will connect directly to the Wedge probe adapter for an easy hands-free solution for probing 0.5 and 0.65 mm IC packages. See page 87 for more information.



Easy hands-free connection to fine pitch ICs using the Wedge and 117x probe.

All probes come complete with a range of accessories for both general purpose probing and the probing of fine pitch ICs and dense circuit boards.

The 117x family of probes is compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.

Model	Length	Division Ratio	Circuit Loading	System Bandwidth (Scope and Probe)	Oscilloscope Input
1171A	1.4 m	10:1	10 MOhm; 10 pF	500 MHz	1 MOhm; 12 – 14 pF

117x Family Replacement Parts

Ordering Information

Fine Pitch IC Probing Accessories
E2613A Wedge probe adapter, 0.5 mm, 3-signal, qty1
E2613B Wedge probe adapter, 0.5 mm, 3-signal, qty2
E2614A Wedge probe adapter, 0.5 mm, 8-signal, qty1
E2615A Wedge probe adapter, 0.65 mm, 3-signal qty1
E2615B Wedge probe adapter, 0.65 mm, 3-signal, qty2
E2616A Wedge probe adapter, 0.65 mm, 8-signal, qty1
E2643A Wedge probe adapter, 0.5 mm, 16-signal, qty1
E2644A Wedge probe adapter, 0.65 mm, 16-signal, qty1
10467-68701 0.5 mm IC clips for surface SMT parts with leg spacing of 0.5 mm (0.020 in) to 0.8 mm (0.32 in), qty 4

Other Accessories
E9638A Probe tip to BNC adapter

Fine-Pitch Probing Kits

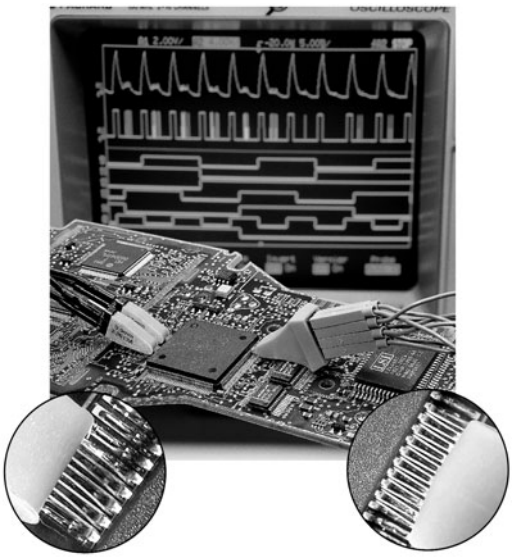
A Complete Solution at a Bargain Price

These fine-pitch probing kits take the 117x family of probes and add the most useful accessories to give you a versatile and complete probing solution. Each kit includes 2 117x-family probes (20:1 models) and related accessories, 2 of the 0.5 mm Wedge probe adapter, 4 of our 0.5 mm IC clips and 10 standard IC clips. All for a price substantially less than the individual parts.

Ordering Information

E2652A Fine-Pitch Probing Kit for the Infiniium Oscilloscopes
E2653A Fine-Pitch Probing Kit for Infiniium Oscilloscopes

- **Easy connection to 0.5 mm, 0.65 mm TQFP and PQFP packages**
- **Reliable contact with little chance of shorting to adjacent pins**
- **Mechanically noninvasive**
- **Can be inserted while the board is active**
- **3, 8, and 16-signal versions**



At one end, Wedge conductor segments are inserted into the space between IC pins; at the other end, they easily connect to scopes and logic analyzers.

Wedge Probe Adapter

Precise Problem-free Probing

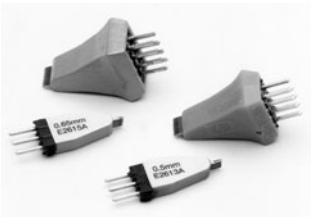
The Agilent Wedge probe adapter solves the problem of connecting your scope or logic analyzer to fine pitch thin quad flat pack (TQFP) and plastic quad flat pack (PQFP) surface mount ICs. It provides accurate, mechanically noninvasive and reliable electrical contact to 0.5 and 0.65 mm IC packages, with little chance of shorting. It is available in 3-, 8-, and 16-signal versions.

Easy to Insert, Then Stays Put

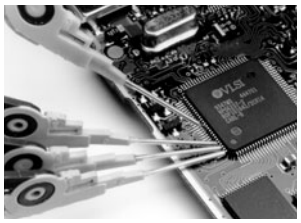
It works by inserting compressible dual conductors between adjacent IC pins. The flexible conductors conform to the size and shape of each leg to ensure tight contact. It's then a simple matter to connect your scope or logic analyzer to the Agilent Wedge.

Electrical Reliability

The Wedge's unique design delivers secure redundant contact on each pin, with little chance of shorting to adjacent pins. The redundant physical connection created by two contact points on each pin of the IC and its short electrical length dramatically increases the reliability of the electrical connection. Since the Agilent Wedge doesn't latch directly onto the IC and doesn't require expansion beforehand (as a clip does), it can be inserted while the board is active. Plus, it's mechanically noninvasive so it won't damage your device under test.



3- and 8-signal versions for 0.5 and 0.65 mm IC Packages.



10467-68701 0.5 mm IC Clips.

0.5 mm IC Clips

These IC clips are the smallest in the industry to date and are suitable for connecting to PQFP and SOIC SMT packages from 0.5 – 0.8 mm pitch. The thin body allows clips to be mounted side by side for probing adjacent IC pins. They are suitable for use with all Agilent oscilloscope probes and logic analyzers and have a maximum input voltage of ±40 V (dc + peak ac).

10467-68701 0.5 mm IC Clips.

10075A and 10467-68701 0.5 mm IC Clip Accessory Kit

The 10075A includes four 0.5 mm IC clips (10467-68701) and two dual-lead adapters for use with passive probes. Plug the probe tip into one end of the adapter and connect the IC clip to the other end.

The 10075A is compatible with the 10070A family of passive probes. The 10467-68701 is compatible with the 10400A family of passive probes. The 1160A and 10400B family of probes include a dual-lead adapter as a standard accessory. For these probes the accessory kit is not required.

Ordering Information

E2613A Wedge probe adapter, 0.5 mm 3-signal, qty 1
E2613B Wedge probe adapter, 0.5 mm 3-signal, qty 2
E2614A Wedge probe adapter, 0.5 mm 8-signal, qty 1
E2615A Wedge probe adapter, 0.65 mm 3-signal, qty 1
E2615B Wedge probe adapter, 0.65 mm 3-signal, qty 2
E2616A Wedge probe adapter, 0.65 mm 8-signal, qty 1
E2643A Wedge probe adapter, 0.5 mm 16-signal, qty 1
E2644A Wedge probe adapter, 0.65 mm 16-signal, qty 1
10467-68701 0.5 mm IC Clips, qty 4
10072A SMT Probe Accessory Kit

10072A SMT Probe Accessory Kit

The 10072A includes 10 SMT lead clips that adapt the 10070A family of low-cost probes to fine-pitch devices.

1141A Differential Probe with 1142A Power Supply

The 1141A is a 1X FET differential probe with 200 MHz bandwidth and a 3000:1 CMRR (Common Mode Rejection Ratio). The probe has a high-input resistance and low-input capacitance of 7 pF to minimize circuit loading. The 1141A must be used with the 1142A probe control and power module, which controls input coupling modes dc, dc with variable offset, and dc reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ±30 V.

1153A 200 MHz Differential Probe

The 1153A is a 200 MHz Differential Probe for use with Agilent Infiniium Oscilloscopes. It is a 1X FET differential probe with 200 MHz bandwidth and 3000:1 CMRR (Common Mode Rejection Ratio). The probe has high-input resistance of 1 MOhm and low-input capacitance of 7 pF to minimize circuit loading. The 1153A is compatible with the AutoProbe Interface, which provides power and completely configures the Infiniium Oscilloscope for the probe.

Input coupling modes include dc, dc with variable offset, and l f reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ±30 V.

N2772A Differential Probe with N2773A Power Supply

The N2772A is an active differential probe compatible with any oscilloscope with a high-impedance BNC input. With 20 MHz bandwidth and switchable attenuation of 20:1 and 200:1, N2772A provides the versatility for a broad range of applications including high-voltage circuits, motor speed controls, power supply design, electronic high-power converters, and numerous other situations where signals are floating above earth ground.

The N2772A differential probe has an input impedance of 10 MOhm and the CMRR is >50 dB at 1 MHz.

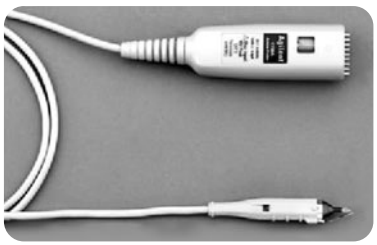
The probe requires a 9 V dc battery or N2773A power supply. The power supply has selectable ac frequency settings for 115 V and 230 Vac at 50 Hz, 60 Hz, and 400 Hz.

Ordering Information

1141A 200 MHz Differential Probe
1142A Power Supply for 1141A/1144A/1145A
1153A 200 MHz Differential Probe
N2772A 20 MHz Differential Probe
N2773A Power Supply for N2772A

1155A Low Mass Active Probe for Surface-Mount Devices

The two-channel 1155A low mass active probe for Infiniium oscilloscopes has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF), and high input resistance (1 MOhm). A versatile set of accessories are provided, including an Agilent browser with a crown point that digs deep in to solder and a spring loaded tip that helps absorb small movements. When used in conjunction with the Agilent Wedge, the 1155A provides a hands-free solution for probing 0.5 mm and 0.65 mm IC packages. See page 87 for more information.



1156A/57A/58A Active Probe, 1.5/2.5/4.0 GHz

The Agilent 1156A, 1157A, and 1158A family of active probes offers R & D engineers the performance they need to probe small geometries in hard-to-reach areas on the DUT. These probes were designed specifically for the Infiniium or 6000 Series oscilloscopes.

As the speeds in your design increase, you may notice more overshoot, ringing, and other perturbations when connecting an oscilloscope probe. Probes form a resonant circuit where they connect to the device. If this resonance is within the bandwidth of the oscilloscope probe you are using, it will be difficult to determine if the measurement perturbations are due to your circuit or the probe.

Agilent is the only company that has overcome the resonance formed by the connection of a probe to a device. The Agilent 1156/57/58A probes optimize performance to make your job easier.

1144A 800 MHz Active Probe

The 1144A features 800-MHz bandwidth, 1 MΩ input resistance, 2 pF input capacitance, 10:1 attenuation, and ±40 Vdc + peak ac maximum-input voltage. The 1144A can access power directly from the 54520 and 54540 series and the 54615B and 54616B oscilloscopes. These oscilloscopes provide power for two channels of active probing. If four channels of probing are needed, a special one-input, two-output adapter is available (p/n 01144-61604). Two adapters are needed for four channels of probing. If the 1144A is used with any scope not listed above, then the 1142A power supply is required. The 01144-61604 adapter can be used with this power supply to provide power for two channels of active probing.

InfiniiMax 113xA Probing System

InfiniiMax High-Performance Active Probe System

The innovative InfiniiMax probing system provides either differential or single-ended probing solutions for the most demanding mechanical requirements, without sacrificing performance. A flat frequency response over the entire probe bandwidth eliminates the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance.

Agilent 1130 Series InfiniiMax Probing Selection Guide

	1134A	1132A	1131A	1130A	1168A	1169A	E2669A	E2667A
Bandwidth	7 GHz	5 GHz	3.5 GHz	1.5 GHz	10 GHz	12 GHz (13 GHz typical)	Differential kit	Single-ended kit
Description	Probe amplifier, order one or both of the connectivity kits per probe amplifier				Probe amplifier, order one or both of the connectivity kits per probe amplifier		Connectivity kit, includes browser, solder-in and socket probe heads supporting the measurement type	
Oscilloscope Compatibility	54855A	54854A	54845B/ 54846B/ 54853A	5483xB/D, 6000 Series, 8000 Series	DSO80804B, DSO81004B	DSO81204B, DSO81304B	—	—
Notes	Probe amplifier specifications: dynamic range = ±2.5 V DC, offset range = ±12 V				Probe amplifier specifications dynamic range = ±1.65 V differential, 3.3 V single ended		Probe amplifier specifications: dynamic range = ±2.5 V DC, offset range = ±12 V	

1145A Low Mass Active Probe for Surface-Mount Devices

The two-channel 1145A low mass active probe has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF) and high input resistance (1 MOhm). A versatile set of accessories are provided and when used in conjunction with the Wedge, the 1145A provides a hands-free solution for probing 0.5 mm and 0.65 mm IC packages. See page 87 for more information.

This probe can access power directly from the 54520/40 series and 54615/16B oscilloscopes. The 1142A power supply is required for all other instruments. This configuration requires 50 Ohm inputs.

Ordering Information

1130A 1.5 GHz InfiniiMax Active Probe System
1131A 3.5 GHz Infiniimax Active Probe System
1132A 5 GHz Infiniimax Active Probe System
1133A 7 GHz Infiniimax Active Probe System
1142A Power Supply for 1144A and 1145A
1143A Probe Offset and Power Module for 54701A
1144A 800 MHz Active Probe
1145A 2-Channel, 750 MHz Active Probe
1155A 2-Channel, 750 MHz Active Probe with Auto Probe Interface
1156A 1.5 GHz Active Probe
1157A 2.5 GHz Active Probe
1158A 4 GHz Active Probe
1168A 10 GHz InfiniiMax II Active Probe System
1169A 12 GHz InfiniiMax II Active Probe System

10076A 100:1 High-Voltage Probe

The 10076A 4 kV 100:1 passive probe gives you the voltage and bandwidth you need for making high-voltage measurements. Its compact design makes it easier to probe today's small power electronics components and its rugged construction means it can withstand rough handling without breaking. You can measure dc voltages up to 4 kV peak. The 250 MHz probe bandwidth enables you to capture fast, high-voltage signals. The 10077A accessory kit can be used with this high voltage probe for wider range of application.

54006A 6-GHz Passive Divider Probe

The low 0.25 pF input capacitance and sophisticated ground design of the 54006A probe lets you probe multi-GHz systems with minimal loading of the circuit under test. The small size of this probe also allows you to access very small components. The 54006A is supplied with 10:1, 500 Ω, and 20:1, 1 kΩ resistive dividers.

N2771A 1000:1 High-Voltage Probe

The N2771A is a new 1000:1 high voltage probe for the measurement of fast high voltage signals, up to 30 kV dc + peak ac, 10 kV_{rms} and 50 MHz probe bandwidth.

The probe's large size and rugged construction provides superior protection. The ground lead is fed through the body of the probe and protrudes behind the safety barrier, keeping the ground connection away from the high voltage.

1146A Oscilloscope AC/DC Current Probe

This ac/dc current probe expands oscilloscope applications into industrial, automotive or power environments, and is ideal for analysis and measurement of distorted current waveforms and harmonics. This probe permits accurate display and measurement of currents from 100 mA to 100 A rms, dc to 100 kHz without breaking into the circuit. The 1146A uses Hall-effect technology to measure ac and dc signals. Compatible with any scope or voltage measuring instrument with BNC input, 0.2 to 0.5 V/div, and a minimum input impedance of 1 MOhm. 1 mV/100 mA Range; Output Signal: 10 mV/A ac/dc. 1mV/10 mA Range; Output Signal: 100 mV/A ac/dc. Working Voltage: 660 V max., Battery: 9 V alkaline.

High-Voltage, Resistive Divider and Current Probes (cont.)

1146A
1147A
10076A
10077A
54006A
N2771A
N2779A
N2780A
N2781A
N2782A
N2783A

- **Various bandwidths: DC to 2 MHz, 10 MHz, 50 MHz, 100 MHz**
- **DC and AC measurements**
- **Superior 1% accuracy and high signal-to-noise ratio**
- **Overload-protect function prevents probe damage from excessive input**
- **Direct connection to high-impedance 1 MΩ BNC input of oscilloscope**
- **"Demagnetize" button to remove any residual magnetism that builds up in the magnetic core**
- **External power supply (N2779A) lets you connect up to three N278xA current probes to a single power supply**

Compatible with any oscilloscope with a high-impedance BNC input, the new N2780A Series current probes offer accurate and reliable solution for measuring DC and AC currents.

Hybrid Technology for AC and DC Measurements

Using hybrid technology that includes a Hall-effect sensor and an AC current transformer, the probes provide accurate measurement of DC or AC currents up to 500 Arms peak (for model N2780A) or DC – 100 MHz (for model N2783A), without breaking into the circuit. Using split core construction, the probe easily clips on and off of a conductor.

Wide Range of Applications

The current probes feature broad measurement ranges (up to 500 A), flat frequency response, low noise and low insertion loss that make the probes ideal for current measurements in areas such as measuring steady state or transient current of motor drives, switching power supplies, inverters, controllers, sensors, disk drives, LCD displays, electronic ballasts and amplifiers. The high signal-to-noise ratio of the N2782A and N2783A makes them ideal for making low-level current measurements in milliamphere ranges.

Accurate Current Measurement

A built-in DEMAG (demagnetize) function allows the removal of any residual magnetism that has built up in the magnetic core due to power on/off switching or excessive input current. In addition, voltage offset or temperature drift on the probe can be easily corrected by using the zero adjustment control.

Key Literature & Web Link

www.agilent.com/find/N2780A

Ordering Information

N2780A 2 MHz/500 A AC/DC Current Probe
N2781A 10 MHz/150 A AC/DC Current Probe
N2782A 50 MHz/50 A AC/DC Current Probe
N2783A 100 MHz/50 A AC/DC Current Probe
N2779A 3-channel Power Supply for N2780A Series Current Probes

1147A 50 MHz Current Probe

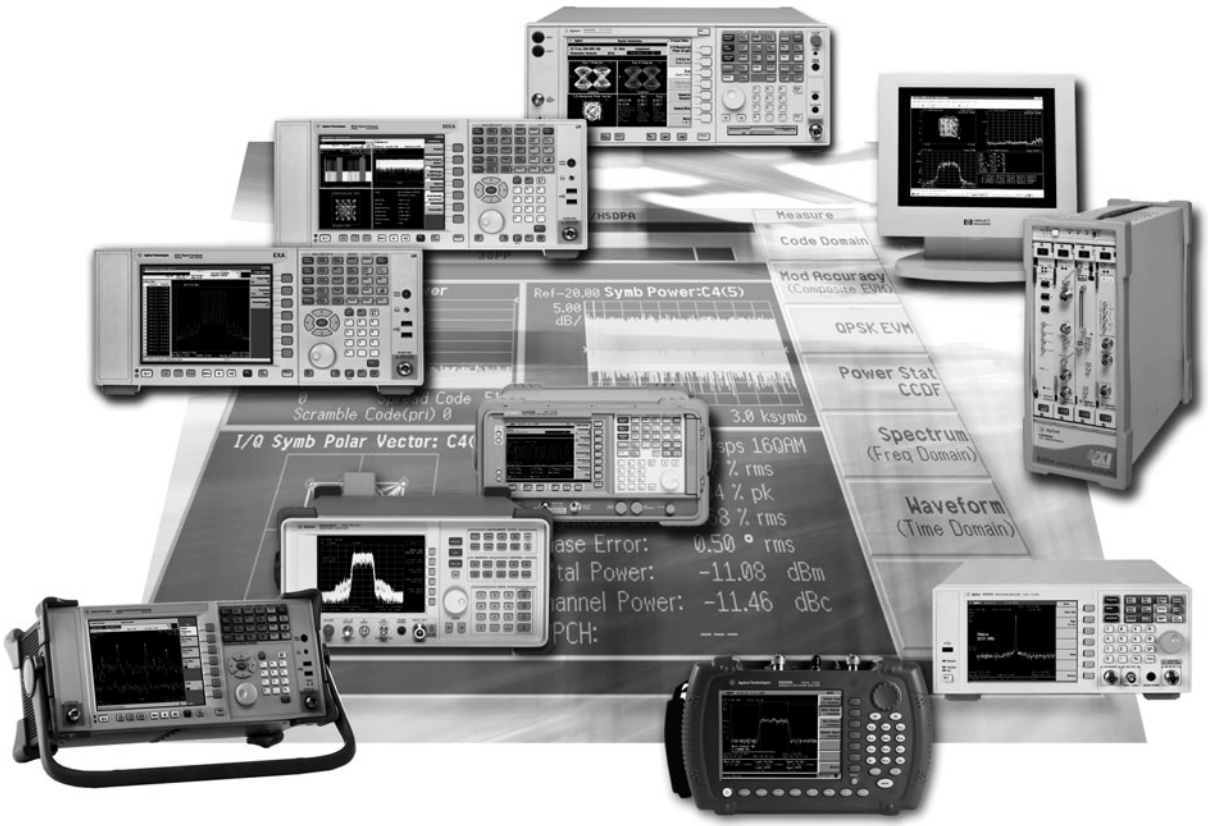
The Agilent 1147A is a wide bandwidth, active current probe for 8000 Series Infiniium oscilloscopes or the 5000/6000 Series oscilloscopes with AutoProbe interface. The probe features flat bandwidth (DC – 50 MHz), low noise (<2.5 mA rms) and low circuit insertion loss. The 1147A is ideal for capturing transient current signals such as those found in motor controllers, in switching power supplies, inverters and current amplifiers driving inductive loads.

Related Literature

Publication Title	Publication Type	Publication Number
Agilent Oscilloscope Probes and Accessories	Selection Guide	5989-6162EN
Agilent 3000 Series Oscilloscopes	Data Sheet	5989-2235EN
Agilent 5000 Series Portable Oscilloscopes	Data Sheet	5989-6110EN
Agilent Technologies 6000 Series Oscilloscopes	Data Sheet	5968-8152EN
Agilent Technologies Infiniium 8000 Series Oscilloscopes	Brochure	5988-3788EN
Infiniium DSO80000B Series Oscilloscopes and InfiniiMax Probes	Data Sheet	5989-4604EN
Infiniium 86100B DCA: Modular Platform for Fast, Accurate Waveform Testing Up to 40 Gb/s	Brochure	5988-5235EN
The following literature provides useful information on using oscilloscopes for specific applications.		
Optimizing Oscilloscope Measurement Accuracy on High-Performance Systems with Agilent Active Probes	Application Note 1385	5988-5021EN
Ten Things to Consider When Selecting your Next Oscilloscope	Application Note	5989-0552EN
Five Applications to Help you Decide	Application Note	5989-0526EN
Finding Hidden Problems Using Agilent's Deep-Memory Oscilloscope: How IBM Solved a Mystery	Customer Success Story	5988-5655EN
The Truth About the Fidelity of High-Bandwidth Voltage Probes	Application Note 1404	5988-6515EN
The Next Generation in Automated Oscilloscope Test	Application Note	5989-5989EN
Evaluating Oscilloscope Sample Rates vs. Sampling Fidelity: Accurate Digital Measurements	Application Note	5989-5732EN
Improve your Ability to Capture Elusive Events	Application Note	5989-2002EN
Deep Memory Oscilloscopes: The New Tools of Choice	Application Note	5989-9106EN
Using Scope's Segmented Memory to Capture Signals More Efficiently	Application Note	5989-4932EN
Debugging Serial Bus Systems with a Mixed-Signal Oscilloscope	Application Note 1395	5988-5997EN
Agilent Infiniium Oscilloscopes Performance Guide Using 89601A Vector Signal Analyzer Software	Product Note	5988-4096EN

Ordering Information

1146A 100-kHz AC/DC Current Probe
10076A 100:1 High Voltage Probe
10077A Accessory Kit for 10076A
54006A 6-GHz Passive Divider Probe
N2771A 1000:1 High Voltage Probe



Agilent Technologies offers a complete line of analyzers to provide frequency, time, order, angle, and modulation-domain measurement capability. The following section is devoted primarily to the frequency domain.

Signal/Spectrum Analyzers

Modern day analyzers offer both swept-tuned and FFT architectures. In addition they also offer high frequency range, wide dynamic range, and excellent overall RF characteristics. Many offer measurement personalities and applications to demodulate signals based on standards, and can be configured with easy to use one-button pass/fail testing capabilities. The following are just some of the measurements that can be made with signal/spectrum analyzers: absolute and relative frequency, absolute and relative amplitude, noise, spurious and distortion products, AM, FM, pulsed modulation, and digital modulation.

Dynamic Signal (Fourier) Analyzers

Fourier analyzers offer fast, high-resolution spectrum and network analysis. Unlike conventional swept analyzers, Fourier-based analyzers can measure dynamic signals because they measure all frequencies simultaneously, not one at a time. Fourier analyzers are especially useful on low-frequency signals (<100 kHz) or where very fast measurements are desired. Applications include acoustic, modal, vibration, or rotating machine analysis.

Vector Signal Analyzers

VSAs provide capabilities throughout the RF range. They offer fast, high-resolution spectrum measurements, demodulation, and advanced time-domain analysis. They are especially useful for characterizing complex signals such as burst, transient, or modulated signals used in communications, video, broadcast, sonar, and ultrasound imaging applications. The vector signal analyzer is also capable of in-depth modulation analysis as it captures signal phase along with magnitude.

EMC/EMI Solutions

Based on a spectrum analyzer platform the E7400A series EMC analyzer provides the tools required for pre-compliance EMI measurements to 26.5 GHz for conducted and radiated emissions.

Using any of the PSA Series spectrum analyzers as the measurement engine, the EMI Measurement Receiver adds the N9039A RF Pre-selector for full CISPR 16-1-1 compliance measurement capability.

Overview

Below you will find a condensed comparison guide of Agilent Signal/Spectrum Analyzers. For the full signal/spectrum analyzer capabilities, please see their individual web pages at **www.agilent.com** or their respective sections in this catalog.

	PSA	MXA	856x	EXA	ESA-E	ESA-L	CSA	Low Cost	Handheld
	E444xA	N9020A		N9010A	E440xB	E44xxB	N1996A	N9320A	N9340A
Price/Performance	*****	****	****	***	***	**	**	**	**
Frequency Range	3 Hz – 50 GHz	20 Hz – 26.5 GHz	30 Hz – 50 GHz	9 kHz – 26.5 GHz	100 Hz[1] – 26.5 GHz	9 kHz – 26.5 GHz	100 kHz – 6 GHz	9 kHz – 3 GHz	100 kHz – 3 GHz
Minimum RF Sweep Time	1 ms	1 ms	50 ms	1 ms	1ms	4 ms	180 ms	9.2 ms	10 ms
Warm-Up Time	30 mins	30 mins	5 mins	30 mins	5 mins	5 mins	5 mins	45 mins	30 mins
Phase Noise at 1GHz (10 kHz Offset)	–116 dBc/Hz	–103 dBc/Hz	–113 dBc/Hz	–99 dBc/Hz	–98 dBc/Hz	–90 dBc/Hz	–85 dBc/Hz	–88 dBc/Hz	–87 dBc/Hz
Maximum Third Order Dynamic Range, 1 GHz	113 dB	110 dB	108 dB	106 dB	108 dB	88 dB	96 dB	93 dB	89 dB
Displayed Average Noise at 1 GHz	–168 dBm[2]	–163 dBm[2]	–151 dBm[1]	–160 dBm[2]	–166 dBm[2,3]	–125 dBm[1]	–146 dBm[2,3]	–148 dBm[2]	–144 dBm[2]
Standard Attenuator Range/Step	70 dB 2 dB	70 dB 2 dB	70 dB 10 dB	60 dB 10 dB	75 dB 5 dB	65 dB 5 dB	40 dB 1 dB	70 dB 1 dB	51 dB 1 dB
Overall Amplitude Accuracy	±.62 dB	±.78 dB	±1.9 dB	±.95 dB	±1.0 dB	±1.1 dB	±1.5 dB	±2.0 dB	±1.5 dB
Resolution Bandwidth	1 Hz – 8 MHz	1 Hz – 8 MHz	1 Hz – 2 MHz	1 Hz – 8 MHz	1 Hz – 5 MHz	100 Hz – 5 MHz	10 Hz – 5 MHz	10 Hz – 1 MHz	30 Hz – 1 MHz
Standard Analysis Bandwidth	10 MHz	10 MHz		10 MHz	10 MHz		5 MHz		1 MHz
Optional Analysis Bandwidth	40 MHz 80 MHz	25 MHz							
Battery					•[1]	•[1]	•[1]		standard

[1] Optional.
[2] With optional built-in preamp.
[3] Typical.

Power Suite One-button Measurements

	PSA	MXA	856x	EXA	ESA-E	ESA-L	CSA	N9320A	N9340A
Channel Power	•	•	•	•	•	•	•[2]	•	•
Occupied Bandwidth	•	•	•	•	•	•	•	•	•
Multicarrier, Multi-offset ACP	•	•	•[1]	•	•	•	•	•	•
Multicarrier Power	•	•	•[1]	•	•	•			
CCDF	•	•		•	•				
Harmonic Distortion	•	•[2]		•[2]	•	•			
Burst Power	•	•		•	•	•			
Intermod (TOI)	•	•[2]		•[2]	•	•		•	
Spurious Emissions	•	•		•	•	•			
Spectrum Emission Mask	•	•		•	•	•		•	

[1] Option.
[2] Future Option.

Measurement Applications and Personalities

Below is a short comparison of measurement applications and personalities on our Spectrum/Signal Analyzers. Please see the individual listings in subsequent chapters for a complete list of capabilities that each analyzer offers.

	PSA	MXA	856xEC	EXA	ESA-E	ESA-L	CSA	N9320A	N9340A
Cable TV						•			
Cable Fault Location					•		•		
cdma2000	•	•[2]		•[2]					
EMI Precompliance	•								
External Source Control	•	•[2]		•[2]					
Flexible Digital Mod Analysis	•	•[2]		•[2]	•				
GSM/EDGE	•	•[2]		•[2]	•				
Noise Figure	•	•[2]		•[2]	•				
Phase Noise	•	•	•	•	•				
TD-SCDMA	•	•[2]		•[2]					
W-CDMA HSDPA/HSUPA	•	•		•					
WiMAX Mobile	•[3]	•		•					
WiMAX Fixed	•[3]	•[3]		•[3]					
AM/FM Tune and Listen		•[2]		•[2]			•		•
WLAN	•	•[3]		•[3]					
1xEV-DO	•	•[2]		•[2]					
856x, 859x Programming Code Compatibility Suite	•	•[2]		•[2]					
Stimulus Response							•		
89601A Link	•	•		•	•				

Connectivity

Remote Interface									
RS-232					•[1]	•[1]			
GPIB	•	•	•	•	•	•			
LAN	10	100		100			100		
USB	2.0[4]	2.0		2.0			1.1	1.1	1.1
Removable storage	3.5" floppy	USB	Memory card	USB	3.5" floppy	3.5" floppy	USB	USB	USB
LXI		B[2], C		B[2], C					

[1] Option.
[2] Future Option.
[3] With 89601A VSA software.
[4] Device-side only.

For complementary signal creation software, see Signal Generators – Signal Studio Software on page 311.

Dynamic Signal Analyzers

Frequency Range	Channel Match	Frequency Resolution in Lines	Real-time Bandwidth	Dynamic Range	Amplitude Accuracy* (±)	Model Number	Page
0.000122 Hz to 102.4 kHz	±0.04 dB, ±0.5°	100 to 1600	25.6 kHz	80 dB (90 dB typical)	0.15 dB	35670A	270

*Relative accuracy = relative frequency response + lesser of either scale fidelity or IF gain accuracy.

Vector Signal Analyzers

Frequency Range	Maximum Analysis Bandwidth	Sensitivity (displayed average noise level)	Dynamic Range (3rd order IMD)	Modulation Analysis	Signal Capture Memory	Model Number	Page
3 Hz to 50 GHz*	Up to 13 GHz*	–168 dBm/Hz* (at 1 GHz)	–75 dBc*	PC software linked to ESA, PSA, MXA, EXA analyzers or Infiniium series oscilloscopes. Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups.	Up to 1.2 GB (384 Msa, complex)	89601A	124
dc to 40 MHz	39 MHz	–151 dBm/Hz	–70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89610S	126
52 to 88 MHz (or frequency range of external tuner)	36 MHz	–159 dBm/Hz	–70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89611S	126
dc to 2.7 GHz	36 MHz	–158 dBm/Hz (at 1 GHz)	–70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89640S	126
dc to 6 GHz	36 MHz	–157 dBm/Hz (at 1 GHz)	–70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89641S	126
3 Hz to 6.7, 13.2, 26.5 GHz	40, 80 MHz	–152 dBm/Hz	<–78 dBc, typical	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	512 MB (128 Msa, complex)	89650S	125

* Depends on analyzers or oscilloscopes linked to 89601A PC software.

** 2 tones at 6 dB below full scale (–31 dBm at input).

Signal Source Analyzer/Phase Noise Measurement Solutions

Frequency Range	Phase Noise Sensitivity (depends on offset frequency)	Functions Available	Model Number	Page
10 MHz to 7 GHz/ 26.5 GHz*/110 GHz**	–135 dBc/Hz @1 kHz offset to –178 dBc/Hz @10 MHz offset (@1 GHz, SPD)	Phase noise, frequency, RF power, DC current, frequency/phase/power transient, AM noise, Baseband noise	E5052B	268
50 kHz to 110 GHz[2]	–180 dBc/Hz @>10 kHz offset (typical)	Phase noise, AM noise, residual noise, low level spurious signals: 0.01 Hz to 100 MHz offsets	E5505A	553

* with E5053A

** with external mixers

Measuring Receiver – Signal Generator and Attenuator Calibration

Frequency Range	Maximum Amplitude Measurement Range	Functions Available	Model Number	Page
100 kHz to 50 GHz	+30 dBm to –140 dBm	Frequency counter, absolute RF power, tuned RF level, AM depth, FM/PM deviation, modulation rate, modulation distortion, and audio signal analysis (optional)	N5531S	108

EMC Analyzers

Frequency Range	Maximum Sensitivity (displayed average noise level)	Maximum Dynamic Range 3rd order	Amplitude Accuracy (±)	Resolution Bandwidth Range	Model Number	Page
100 Hz to 3.0 GHz	≤–150 dBm[2]	+12.5 dBm TOI	1.0 dB	1 Hz to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7402A	142
100 Hz to 26.5 GHz	≤–150 dBm[2]	+12.5 dBm TOI	1.0 dB	1 Hz to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7405A	142

[1] With standard built-in pre-amplifier.

[2] To 110 GHz with external mixing.

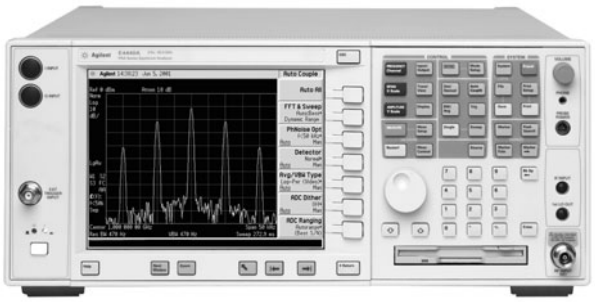
EMI Measurement Receiver

Frequency Range	Amplitude Accuracy	Frequency Accuracy	Functions Available	Model Number	Page
3 Hz to 6.7, 13.2, 26.5, 44, or 50 GHz	<1.0 dB (9 kHz to 1 GHz)	<0.2% Typical <0.02%	CISPR 16 & Mil Std 461 detectors and bandwidths. Limit lines, amplitude corrections, zoom display, measure at marker	N9039A[1]	141

[1] When used with PSA series spectrum analyzer and PSA option 239 EMI Receiver measurement personality.

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

- **All-digital IF gives industry-leading accuracy and linearity**
- **Exceptionally fast low-level spur search**
- **One-button RF power measurements with format-based setups**
- **Over 16 optional built-in measurement personalities for phase noise, noise figure and 2G through 3.5G digital modulation formats**
- **Optional 80 MHz analysis bandwidth with unsurpassed dynamic range and flatness**



PSA Series Spectrum Analyzer

PSA Series High-Performance Spectrum Analyzer

The Agilent PSA series offers high-performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, and a leading-edge combination of flexibility, speed, accuracy, bandwidth and dynamic range.

Measurement Accuracy

The PSA Series' modern instrument architecture features an all-digital IF section, a highly accurate internal reference signal, and automatic internal alignment processes to achieve unsurpassed industry-leading accuracy, guaranteed by Agilent's high standards for meeting our published specifications.

Measurement Speed and Dynamic Range

The PSA Series spectrum analyzer is designed to optimize measurements for speed and dynamic range. With a 2-dB step attenuator and 160 resolution bandwidth settings (in 10% steps), you can customize each of your measurements to achieve the best combination of speed and dynamic range. Decrease adjacent channel power ratio measurement time with the industry's fastest ACPR measurement.

Swept Tuned or FFT Analysis

With the all-digital IF, the PSA can perform both swept or FFT measurements. FFT capability can significantly reduce the sweep time in narrow span measurements and low-level spur searches.

Analysis Bandwidth

For center frequencies up to 26.5 GHz, use PSA option 122 (80 MHz BW Digitizer) to analyze signals up to 80 MHz wide and with 78 dB of image-free dynamic range. Analysis of digitally modulated signals is enhanced by the superb digital IF performance, which produces residual EVM of <1%. Capture up to 1.28 seconds of signal data at 80 MHz bandwidth, or record longer capture times at narrower spans. For signals up to 40 MHz wide, use the PSA Option 140 (40 MHz BW Digitizer). For measurements above 3 GHz, PSA Option 123 (Switchable MW Preselector Bypass), allows for superb frequency response and phase linearity in the microwave bands.

Phase Noise Optimization

Increase the dynamic range of your close-to-carrier measurements with the phase noise optimization feature of the PSA Series. Depending on how close to or far from the carrier you are measuring, the PSA has different LO phase lock loop configurations to reduce phase noise and therefore increase the dynamic range of your measurement.

Gated Sweep

Analyze time varying signals such as pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated with gated sweep capability. This type of time gating makes fast spectrum measurements on burst signals without interference from switching the carrier on and off.

EMC

Use the PSA to make conducted and radiated emissions measurements. Now available in every PSA are built-in CISPR and MIL-STD compliant EMI detectors and bandwidths.

One-Button Power Measurements

The PSA Series offers a standard suite of flexible, one-button RF and microwave power measurements with format based setups. With Power Suite, measurements that were once difficult and tedious to make are now executed with a single button press and provide easy-to-read results.

One-button measurements include:
- channel power
- occupied bandwidth
- adjacent channel power (ACP), fast ACP
- multi-carrier ACP
- power statistics (CCDF)
- harmonic distortion
- burst power
- third order intercept (TOI)
- spurious emissions
- spectrum emission mask

Format-based setups for:
- IS-95A
- IS-95C
- 3GPP W-CDMA
- NADC
- *Bluetooth*
- W-LAN (802.11a/b/g)
- DVB-T
- J-STD-008
- GSM/EDGE
- cdma2000
- PDC
- TETRA
- W-LAN HiperLAN/2
- UWB
- S-DMB
- FCC Part 15 Subpart F

Measurements Beyond Spectrum Analysis

The PSA Series offers a variety of optional measurement personalities to expand measurement capability. A measurement personality is a downloadable software program that can transform the spectrum analyzer into another type of test instrument, essentially giving it another "personality". You can make the most challenging measurements very easily and with the same instrument you use for spectrum analysis. Choose from over 16 measurement personalities to make phase noise measurements for oscillator tests, measure the noise figure of your amplifier, execute scalar network analysis, or even perform modulation analysis on your 2G, 2.5G, 3G or 3.5G signal. If you have a proprietary modulated signal that you want to test, you can use internal flexible digital modulation analysis personality or you can link the PSA to the 89601A vector signal analysis software for flexible demodulation and analysis.

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

Connectivity

The PSA Series has built-in capability to network with PCs, printers, software programs, and test systems. Features include IVI-COM drivers for developing measurement routines and collecting results, IntuiLink connectivity software to transfer measurement results and screen captures directly into Microsoft® Excel and Word, a floppy disk drive to store results and display data, and GPIB and 10 baseT LAN for SCPI programming. Additionally, a USB 2.0 device-side I/O interface is available for the high throughput data transfer. You can also operate the analyzer remotely, anywhere in the world, using our BenchLink Web Remote control software (Option 230).

Upgrade from the HP8566A/B or HP8568A/B Analyzer

The PSA Series spectrum analyzers offer programming code compatibility with the Agilent 856x, 895x, and HP 8566A/B, 8568A/B legacy spectrum analyzers. Option 266 allows users with those legacy instruments to upgrade their automated test equipment (ATE) systems with modern and supportable ESA-E or PSA Series spectrum analyzers as the HP 8566A/B, 8568A/B instruments reach the end of their formal support lives. Additionally, PSA Option 124 provides 8566A/B, 8568A/B analog Y-axis video out capability.

Measurements Beyond 50 GHz

With optional external mixing capability (Option AYZ) along with harmonic mixers, the Agilent PSA (E4440A/46A/47A/48A) can measure signals up to 325 GHz. The PSA Option AYZ will support Agilent 11970 Series millimeter harmonic mixers, Agilent 11974 Series preselected millimeter harmonic mixers as well as third party mixers. The PSA Option AYZ offers patented signal identification methods to help you identify true signals to be test more efficiently, and amplitude correction to compensate for conversion loss incurred in external mixers. It also supplies bias voltage with adjustable current for third-party mixers requiring biasing to maximize signal conversion.

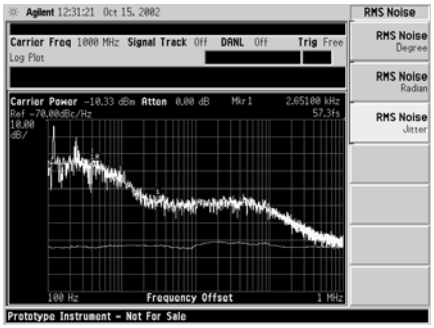
Gated Sweep

Analyze time-varying signals such as pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated signals with gated sweep capability that is now a standard feature of all the PSA Series spectrum analyzers. The gated sweep capability enables the PSA to perform fast and accurate spectrum measurements on burst signals without interference from switching the carrier on and off. The gate length can be easily adjusted between 10 µs and 500 ms, and the gate delay from 0 to 500 ms. Users can choose between external TTL trigger, variable level trigger, or burst trigger to start the PSA gated sweep according to the nature of time-varying signals under test.

External Source Control (Option 215)

The external source control measurement personality, available on all the PSA Series models (E4440A/43A/45A/46A/47A/48A), enables these high-performance spectrum analyzers to control Agilent PSG or ESG signal generators for scalar network analysis up to 50 GHz. A variety of controlled sweep modes, including standard sweep, harmonic sweep, offset sweep, and power sweep, provides the optimal test tools for characterizing different components. Wide dynamic range (up to and beyond 109 dB) allows accurate measurements for a component with the presence of high and low power levels at the same time. One-button normalization and open/short calibration help to remove the systemic frequency response errors incurred in the transmission and return loss measurements, respectively, to further improve the measurement accuracy.

Measurement Personalities

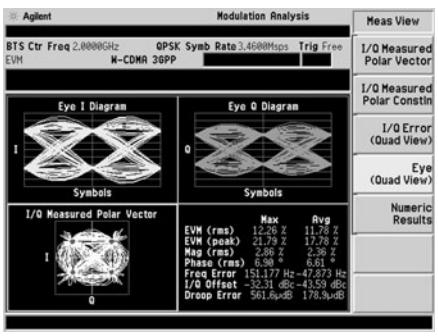


Phase Noise (Option 226)

This optional, built-in measurement personality consolidates advanced spectrum analysis capability and phase noise measurements into a single oscillator test. This flexible tool can quickly and easily generate plots of phase noise in dBc/Hz versus log offset frequency or measure jitter or make continuous real-time spot frequency phase noise measurements. An intuitive user-interface provides easily adjustable parameters without the need to resort to cumbersome tables.

Noise Figure (Option 219)

The noise figure measurement personality provides fast, one-button noise figure and gain measurements from 200 kHz up to 26.5 GHz. DUT setup menus help guide you easily through amplifier and mixer measurements, and a built-in measurement uncertainty calculator makes it easy to qualify your measurement system. An optional internal preamplifier (Option 1DS) improves instrument uncertainty to ±0.05 dB for frequencies up to 3 GHz, so you can conveniently and accurately measure devices with low noise figure. A 50 GHz internal preamplifier (Option 110) enables nominal performance to the highest frequency of the PSA.



Flexible Digital Modulation Analysis (Option 241)

The flexible digital modulation analysis measurement personality allows you to measure error vector magnitude (EVM), and troubleshooting digital communication systems. This option makes PSA as a single analyzer for spectrum and modulation analysis with a variety of digital modulation formats including industry standard formats such as: IS-95 (cdmaOne), cdma2000, W-CDMA, EDGE/GSM, NADC, PDC, PHS, *Bluetooth*, TETRA, ZigBee, APCO25 Phase1, and VDL mode3. If you are working with customized or unique formats different from existing standards, you can easily set up your own custom demodulation formats (MSK, PSK, FSK, QAM, etc.) and parameters to suit your application.

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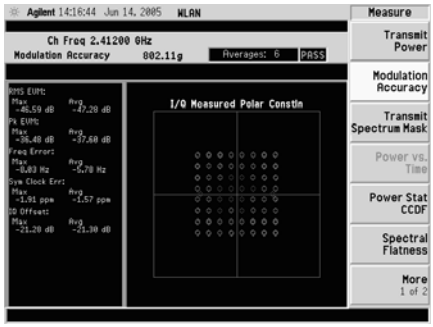
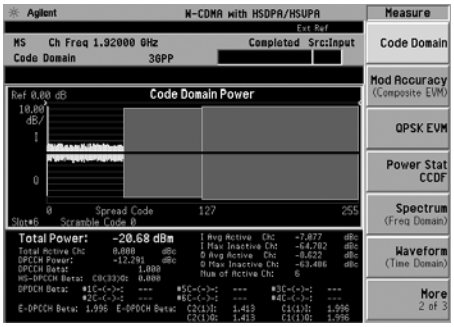
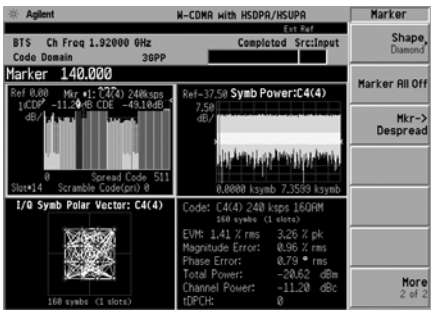




WLAN (Option 217)

Analyze WLAN 802.11a, 802.11b, and 802.11g signals, including DSSS, CCK, PBCC, and OFDM signals, with an easy-to-use and intuitive interface. Test IEEE-based standard conformance, or set a customized pass/fail limit. Perform signal impairment analysis using built-in modulation accuracy measurement tools. Measurements included in this option are:

- error vector magnitude
- transmit power
- spectrum emission mask
- CCDF
- spectral flatness
- power ramp up and ramp down (802.11b only)
- center frequency leakage
- frequency and symbol clock error



W-CDMA (Option BAF)

The complexity of W-CDMA demands flexibility for 3GPP conformance test and depth of modulation analysis capability provided by this measurement personality. Perform the following standards-based measurements on the both uplink or downlink signals:

- code domain analysis
- QPSK EVM
- modulation accuracy (composite EVM)
- channel power
- adjacent channel power leakage ratio (ACLR)
- intermodulation distortion
- multi-carrier power
- spectrum emission mask
- occupied bandwidth
- CCDF
- power control (PRACH power, slot power and slot phase for UE phase discontinuity)
- power versus time

HSDPA/HSUPA (Option 210)

To follow the 3GPP standard evolving in release 5 and 6, High Speed Downlink Packed Access (HSDPA) and High Speed Uplink Packet Access (HSUPA) are added over W-CDMA 3GPP to increase the data rate for both downlink and uplink. Option 210 provides more modulation analysis capabilities like analysis for HS-PDSCH in 16QAM and HS-DPCCH for HSDPA. As for HSUPA, E-DPCCH and E-DPDCH can be demodulated for EVM and code domain analysis.

GSM with EDGE (Option 202)

This option includes both Global System for Mobile Communications (GSM) and Enhanced Data Rates for GSM Evolution (EDGE) measurements based on the latest standards. The following measurements are quick, easy to make, and standards-based:

- transmit power
- GMSK power versus time (PvT)
- GMSK phase and frequency error
- GMSK output RF spectrum (ORFS)
- GMSK transmitter band spurious
- EDGE PvT
- EDGE EVM
- EDGE ORFS
- EDGE transmitter band spurious

cdma2000 (Option B78)

The cdma2000 measurement personality offers the logical upgrade path from IS-95 to IS-2000 testing. Measurements supported in both the forward and reverse links include:

- code domain analysis
- QPSK EVM
- modulation accuracy (composite rho and EVM)
- channel power
- adjacent channel power ratio
- intermodulation distortion
- spectrum emission mask
- occupied bandwidth
- CCDF

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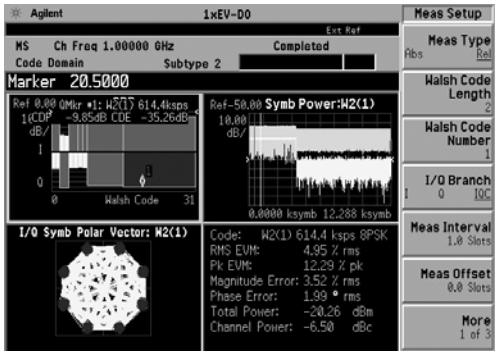

1xEV-DV (Option 214)

For the higher data rates provided by 1xEV-DV in cdma2000 forward link, the 1xEV-DV measurement personality supports 8PSK and 16QAM modulation analysis. This option provides the following necessary measurements:

- code domain analysis
- modulation accuracy (composite rho and EVM)

1xEV-DO (Option 204)

The evolution to cdma2000 with 1xEV-DO Rev.O and A introduces unique measurement challenges. Based on 3GPP2 Technical Specification Group cdma2000 (TSG-C) standards (C.S0032, C.S0033 and C.S0024-A), these challenges are met with the following measurements:

- code domain power
- modulation accuracy (composite rho)
- QPSK EVM
- power versus time (PvT)
- channel power
- intermodulation distortion
- spurious emissions and ACP
- occupied bandwidth
- CCDF

TD-SCDMA (Options 211/212/213)

Perform measurements on uplink and downlink TD-SCDMA signals. The measurement personalities, based on the 3GPP TD-SCDMA standard UTRA TDD 1.28 Mcps option, provide power and modulation-domain measurements, including HSDPA/8PSK signals, with pass/fail indication for conformance verification. These limits can be user-defined to meet custom pass/fail requirements.

PSA Option 211 TD-SCDMA measurement personality easily makes power measurements such as transmit power, power versus time, occupied bandwidth, adjacent channel power, spectrum emission mask, and more.

PSA Option 212 performs modulation analysis measurements. By quickly quantifying modulation quality, engineers can troubleshoot designs and find the root cause of error. Composite EVM, constellation diagram, code domain power, code domain error, and other results are available.

PSA Option 213 adds HSDPA/8PSK capability to Option 212, allowing troubleshooting of HS-PDSCH and associated channels.

cdmaOne (Option BAC)

Built on Agilent's pioneering efforts in CDMA measurement techniques, this personality provides quick and easy measurement setups for ACPR and SpurClose with TIA/EIA/IS-95A, J-STD-008, and IS-97D/98D standards and following measurements:

- modulation accuracy (rho)
- code domain analysis
- channel power
- adjacent channel power ratio
- close-in spurious

NADC/PDC (Option BAE)

Both the North American Digital Cellular (NADC) and Personal Digital Cellular (PDC) measurement personalities are included in this option. The NADC measurements are structured according to the IS-136 TDMA standard. Measurements included in this option are:

- adjacent channel power (ACP)
- error vector magnitude (EVM)
- occupied bandwidth (available for PDC only)

Built-in Measuring Receiver Personality (Option 233)

This option is the key component that converts the general-purpose PSA Series high-performance spectrum analyzer into the flexible N5531S measuring receiver. The PSA-based measuring receiver is an ideal tool for signal generator/attenuator calibrations up to 50 GHz, with special functions including:

- Frequency counter
- Absolute RF power
- Tuned RF level
- AM depth, FM/PM deviation
- Modulation distortion
- Audio analysis (optional)

See page 108 for details about the PSA-based measuring receiver.

N9039A RF Preselector Control for EMI Receiver (Option 239)

Option 239 for the PSA is the personality enabling it to be used in conjunction with Agilent's N9039A RF Preselector to be configured as a CISPR 16-1-1 compliant EMI receiver. This personality controls the preselector during measurements and enables the alignment of the preselector to the PSA using an Agilent approved source. The personality allows the PSA to control settings within the preselector like attenuation and gain from within the PSA and minimize the need for user interaction with the preselector. The personality also provides measurements unique to the capability of the receiver like "zoom display" and "measure at marker" which allow the user to view and measure the noise characteristics of frequency suspects while in a large span.

See page 141 for details about the PSA-based EMI measurement receiver.

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

Frequency Specifications

Frequency Range

E4443A	(DC coupled) 3 Hz to 6.7 GHz
	(AC coupled) 20 MHz to 6.7 GHz
E4445A	(DC coupled) 3 Hz to 13.2 GHz
	(AC coupled) 20 MHz to 13.2 GHz
E4440A	(DC coupled) 3 Hz to 26.5 GHz
	(AC coupled) 20 MHz to 26.5 GHz
E4447A	(DC coupled) 3 Hz to 42.98 GHz
E4446A	(DC coupled) 3 Hz to 44 GHz
E4448A	(DC coupled) 3 Hz to 50 GHz

Band	Harmonic Mixing Mode (N)	
0	1–	3 Hz to 3 GHz
1	1–	2.85 GHz to 6.6 GHz
2	2–	6.2 GHz to 13.2 GHz
3	4–	12.8 GHz to 19.2 GHz
4	4–	18.7 GHz to 26.8 GHz
5	4+	26.4 GHz to 31.15 GHz
6	8–	31.0 GHz to 50.0 GHz

Frequency Reference

Accuracy	±[(time since last adjustment x aging rate) + temperature stability + calibration accuracy]
Aging rate	$\pm 1 \times 10^{-7}$/year
Temperature stability	$\pm 1 \times 10^{-8}$ (20°C to 30°C)
	$\pm 5 \times 10^{-8}$ (0°C to 55°C)
Calibration accuracy	$\pm 7 \times 10^{-8}$

Frequency Readout Accuracy (start, stop, center, marker)
±(marker frequency x frequency reference accuracy + 0.25 percent x span + 5 percent x RBW + 2 Hz + 0.5 x horizontal resolution*)
*Horizontal resolution is span/(sweep points –1)

Marker Frequency Counter

Accuracy	±(marker frequency x frequency reference accuracy + 0.100 Hz)
Delta counter accuracy	±(delta frequency x frequency reference accuracy + 0.141 Hz)
Counter resolution	0.001 Hz

Frequency Span (FFT and swept mode)

Range	0 Hz (zero span), 10 Hz to maximum frequency of model
Resolution	2 Hz
Accuracy	±[0.2 percent x span + span/(sweep points –1)]

Sweep Time and Triggering

Range	
Span = 0 Hz	1 µs to 6000 s
Span ≥10 Hz	1 ms to 2000 s
Accuracy	
Span ≥10 Hz, sweep	±0.01 % nominal
Span ≥10 Hz, FFT	±40 % nominal
Span = 0 Hz	±0.01 % nominal
Trigger	Free run, line, video, RF burst, external front, external rear
Trigger delay	
Span = 0 Hz, or FFT	–150 ms to +500 ms
Span ≥10 Hz, swept	1 µs to 500 ms
Resolution	0.1 µs

Sweep (trace) Point Range

Span = 0 Hz	2 to 8192
Span ≥10 Hz	101 to 8192

Gated FFT

Maximum span	10 MHz
Delay range	–150 to +500 ms
Delay resolution	100 ns or 4 digits whichever is more
Gate duration	1.83/RBW ±2 % nominal

Gated Sweep

Span range	Any span
Gate length range	10.0 µs to 500.0 ms
Gate Delay range	0 to 500.0 ms

Resolution Bandwidth (RBW)

Range (–3.01 dB bandwidth)	1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz
Bandwidth accuracy (power):	
RBW range:	
1 Hz to 51 kHz	±0.5 % (±0.022 dB)
56 kHz to 100 kHz	±1.0 % (±0.044 dB)
110 kHz to 240 kHz	±0.5 % (±0.022 dB)
270 kHz to 1.1 MHz (<3 GHz CF)	±1.5 % (±0.044 dB)
1.2 MHz to 2.0 MHz (<3 GHz CF)	±0.07 dB nominal
2.2 MHz to 6.0 MHz (<3 GHz CF)	±0.02 dB nominal
Bandwidth accuracy (–3.01 dB):	
RBW range 8 MHz (<3 GHz CF)	±15 % nominal
Selectivity (–60 dB/–3 dB)	4.1:1 nominal

EMI Resolution Bandwidths

CISPR family	200 Hz, 9 kHz, 120 kHz, 1 MHz
MIL STD family	10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

Analysis Bandwidths

Maximum FFT width	10 MHz 80 MHz, 14 bit ADC (E444xA-122), 40 MHz, 14 bit ADC (E444xA-140)
I/Q waveform digital output bandwidth	10 MHz (E444xA-B7J) 80 MHz, 14 bit ADC (E444xA-122), 80 MHz, 14 bit ADC (E444xA-140)
321.4 MHz IF output	(except E4447A)
–1 dB bandwidth	20 to 30 MHz nominal
–3 dB bandwidth	30 to 100 MHz nominal
70 MHz IF output (Option E444xA-H70)	(except E4447A)
–1 dB bandwidth	20 to 30 MHz nominal
–3 dB bandwidth	30 to 100 MHz nominal

Video Bandwidth (VBW)

Range	1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz and wide open
Accuracy	±6 % nominal

Stability

Noise sidebands (20°C to 30°C, CF = 1 GHz)

Offset	Specification	Typical
100 Hz	–91 dBc/Hz	–96 dBc/Hz
1 kHz	–103 dBc/Hz	–108 dBc/Hz
10 kHz	–116 dBc/Hz	–118 dBc/Hz
30 kHz	–116 dBc/Hz	–118 dBc/Hz
100 kHz	–122 dBc/Hz	–124 dBc/Hz
1 MHz	–145 dBc/Hz	–147 dBc/Hz
6 MHz	–154 dBc/Hz	–156 dBc/Hz
10 MHz	–156 dBc/Hz	–157.5 dBc/Hz

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Amplitude Specifications

Amplitude Range

Measurement range	Displayed average noise level (DANL) to maximum safe input level
Input attenuator range	0 to 70 dB in 2 dB steps

Maximum Safe Input Level

Average total power	+30 dBm (1 W)
Preamp	
Option E444xA-1DS	+30 dBm
Option E444xA-110	+25 dBm
Peak pulse power	
<10 µs pulse width, <1 % duty cycle and input attenuation ≥30 dB	+50 dBm (100 W)
DC volts:	
DC coupled	<±0.2 Vdc
AC coupled (E4443A, E4445A, E4440A only)	±100 Vdc

1 dB Gain Compression (Two-Tone)

	Total Power at Input Mixer
20 MHz to 200 MHz	0 dBm
	+3 dBm nominal
200 MHz to 3 GHz	+3 dBm
	+7 dBm nominal
3 GHz to 6.6 GHz	+3 dBm
	+4 dBm nominal
6.6 GHz to 26.5 GHz	–2 dBm
	0 dBm nominal
26.5 GHz to 50 GHz	0 dBm nominal

Typical Gain Compression (Two-Tone)

	Mixer Level	Typical Compression
20 MHz to 200 MHz	0 dBm	<0.5 dB
200 MHz to 6.6 GHz	+3 dBm	<0.5 dB
6.6 GHz to 26.5 GHz	–2 dBm	<0.4 dB

Preamp Gain Compression (Option E444xA-1 DS)

10 MHz to 200 MHz	–30 dBm nominal
200 MHz to 3 GHz	–25 dBm nominal

Preamp Gain Compression (Option E444xA-110)

10 MHz to 200 MHz	–24 dBm nominal
200 MHz to 3 GHz	–20 dBm nominal
3 to 6.6 GHz	–23 dBm nominal
6.6 to 30 GHz	–27 dBm nominal
30 to 50 GHz	–24 dBm nominal

Displayed Average Noise Level (DANL)

(Input terminated, sample or average detector, averaging type = Log, 20 to 30°C, zero span, swept normalized to 1 Hz RBW, 0 dB attenuation)

	Specification	Typical
E4443A/E4445A/E4440A		
3 Hz to 1 kHz	—	–110 dBm nominal
1 kHz to 10 kHz	—	–130 dBm nominal
10 kHz to 100 kHz	–137 dBm	–141 dBm
100 kHz to 1 MHz	–145 dBm	–149 dBm
1 MHz to 10 MHz	–150 dBm	–153 dBm
10 MHz to 1.2 GHz	–154 dBm	–155 dBm
1.2 GHz to 2.1 GHz	–153 dBm	–154 dBm
2.1 GHz to 3.0 GHz	–152 dBm	–153 dBm
3 GHz to 6.6 GHz	–152 dBm	–153 dBm
6.6 GHz to 13.2 GHz	–150 dBm	–152 dBm
13.2 GHz to 20 GHz	–147 dBm	–149 dBm
20 GHz to 26.5 GHz	–143 dBm	–145 dBm
Preamp On (Option E4443/45/40A-1DS)		
100 kHz to 200 kHz	–159 dBm	–162 dBm
200 kHz to 500 kHz	–159 dBm	–162 dBm
500 kHz to 1 MHz	–163 dBm	–165 dBm
1 MHz to 10 MHz	–166 dBm	–168 dBm
10 MHz to 500 MHz	–169 dBm	–170 dBm
500 MHz to 1.1 GHz	–168 dBm	–169 dBm
1.1 GHz to 2.1 GHz	–167 dBm	–168 dBm
2.1 GHz to 3.0 GHz	–165 dBm	–166 dBm
Preamp On (Option E4443/45/40A-110)		
10 to 50 MHz	–148 dBm	–154 dBm
50 to 500 MHz	–153 dBm	–164 dBm
500 MHz to 3 GHz	–166 dBm	–168 dBm
3 to 6.6 GHz	–165 dBm	–166 dBm
6.6 to 13.2 GHz	–163 dBm	–165 dBm
13.2 to 16 GHz	–162 dBm	–165 dBm
16 to 19 GHz	–162 dBm	–164 dBm
19 to 26.5 GHz	–159 dBm	–161 dBm
E4447A/E4446A/E4448A		
3 Hz to 1 kHz	—	–110 dBm nominal
1 kHz to 10 kHz	—	–130 dBm nominal
10 kHz to 100 kHz	–137 dBm	–141 dBm
100 kHz to 1 MHz	–145 dBm	–150 dBm
1 MHz to 10 MHz	–150 dBm	–155 dBm
10 MHz to 1.2 GHz	–153 dBm	–154 dBm
1.2 GHz to 2.1 GHz	–152 dBm	–153 dBm
2.1 GHz to 3 GHz	–151 dBm	–152 dBm
3 GHz to 6.6 GHz	–151 dBm	–152 dBm
6.6 GHz to 13.2 GHz	–146 dBm	–149 dBm
13.2 GHz to 20 GHz	–144 dBm	–146 dBm
20 GHz to 22.5 GHz	–143 dBm	–146 dBm
22.5 GHz to 26.8 GHz	–140 dBm	–144 dBm
26.8 GHz to 31.15 GHz	–142 dBm	–145 dBm
31.15 GHz to 35 GHz	–134 dBm	–136 dBm
35 GHz to 38 GHz	–129 dBm	–132 dBm
38 GHz to 44 GHz	–131 dBm	–134 dBm
44 GHz to 49 GHz	–128 dBm	–131 dBm
49 GHz to 50 GHz	–127 dBm	–130 dBm
Preamp On (Option E4447/46/48A-1DS)		
100 kHz to 200 kHz	–158 dBm	–162 dBm
200 kHz to 500 kHz	–158 dBm	–162 dBm
500 kHz to 10 MHz	–161 dBm	–165 dBm
1 MHz to 10 MHz	–167 dBm	–169 dBm
10 MHz to 500 MHz	–167 dBm	–169 dBm
500 MHz to 1.2 GHz	–166 dBm	–168 dBm
1.2 GHz to 2.1 GHz	–165 dBm	–167 dBm
2.1 GHz to 3.0 GHz	–163 dBm	–165 dBm
Preamp On (Option E4447/46/48A-110)		
10 to 50 MHz	–148 dBm	–158 dBm
50 to 500 MHz	–153 dBm	–164 dBm
500 MHz to 2.1 GHz	–165 dBm	–168 dBm
2.1 to 6.6 GHz	–165 dBm	–167 dBm
6.6 to 13.2 GHz	–162 dBm	–165 dBm
13.2 to 19 GHz	–161 dBm	–163 dBm
19 to 22.5 GHz	–161 dBm	–162 dBm
22.5 to 26.8 GHz	–155 dBm	–160 dBm
26.8 to 31.15 GHz	–157 dBm	–161 dBm
31.15 to 35 GHz	–152 dBm	–156 dBm
35 to 44 GHz	–146 dBm	–150 dBm
44 to 45 GHz	–143 dBm	–150 dBm
45 to 49 GHz	–143 dBm	–146 dBm
49 to 50 GHz	–140 dBm	–145 dBm

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Display Range

Log scale	0.1 to 1 dB/division in 0.1 dB steps 1 to 20 dB/division in 1 dB steps (10 display divisions)
Linear scale	10 divisions
Scale units	dBm, dBmV, dBuV, V, and W

Frequency Response

(10 dB input attenuation, 20 to 30°C, preselector centering applied)

E4443A/E4445A/E4440A		**Typical**
3 Hz to 3 GHz	±0.38 dB	±0.11 dB
3 GHz to 6.6 GHz	±1.50 dB	±0.6 dB
6.6 GHz to 22 GHz	±2.00 dB	±1.0 dB
22 GHz to 26.5 GHz	±2.50 dB	±1.3 dB
E4447A/E4446A/E4448A		
3 Hz to 3 GHz	±0.38 dB	±0.15 dB
3 GHz to 6.6 GHz	±1.50 dB	±0.6 dB
6.6 GHz to 22 GHz	±2.00 dB	±1.2 dB
22 GHz to 26.8 GHz	±2.50 dB	±1.3 dB
26.4 GHz to 31.15 GHz	±1.75 dB	±0.6 dB
31.15 GHz to 50 GHz	±2.50 dB	±1.0 dB
Frequency Response at Attenuation ≠ 10 dB		
(Atten = 20, 30, or 40 dB)		
10 MHz to 2.2 GHz	±0.53 dB	
2.2 GHz to 3 GHz	±0.69 dB	
Preamp On (Option E444xA-1DS), (for all models)		
100 kHz to 3 GHz	±0.70 dB	<(±0.30 dB typical)
Preamp On (Option E4443/45/40A-110, 0 dB input attenuation)		
10 MHz to 3.0 GHz	±1.0 dB	(±0.35 dB typical)
3.0 to 6.6 GHz	±1.75 dB	(±0.8 dB typical)
6.6 to 13.2 GHz	±3.0 dB	(±1.0 dB typical)
13.2 to 19 GHz	±3.0 dB	(±1.2 dB typical)
19 to 26.5 GHz	±4.0 dB	(±2.0 dB typical)
Preamp On (Option E4447/46/48A-110, 0 dB input attenuation)		
10 MHz to 3.0 GHz	±1.3 dB	(±0.5 dB typical)
3.0 to 6.6 GHz	±2.5 dB	(±1.0 dB typical)
6.6 to 13.2 GHz	±2.5 dB	(±1.2 dB typical)
13.2 to 19 GHz	±3.0 dB	(±1.5 dB typical)
19 to 26.5 GHz	±4.0 dB	(±2.0 dB typical)
26.5 to 31.15 GHz	±3.0 dB	(±1.2 dB typical)
31.15 to 50 GHz	±3.5 dB	(±1.6 dB typical)

Input Attenuation Switching Uncertainty

(Attenuator setting ≥2 dB)

At 50 MHz	±0.18 dB (±0.053 dB typical)
3 Hz to 3 GHz	±0.3 dB nominal
3 GHz to 13.2 GHz	±0.5 dB nominal
13.2 GHz to 26.5 GHz	±0.6 dB nominal
26.5 GHz to 50 GHz	±1.0 dB nominal

Absolute Amplitude Accuracy

(10 dB input attenuation, 20 to 30°C, 10 Hz ≤RBW ≤1 MHz, input signal –10 to –50 dBm, all settings auto-coupled except Auto Swp Time = Accy, any reference level, any scale)

At 50 MHz	±0.24 dB (±0.06 dB typical)
At all frequencies	±(0.24 dB + frequency response) ±(0.06 dB + frequency response) typical
3 Hz to 3 GHz (95% confidence)	±0.19 dB
Preamp on (Option E444xA-1DS)	±(0.36 dB + frequency response) ±(0.09 dB + frequency response) typical
Preamp on (Option E444xA-110)	±(0.40 dB + frequency response) ±(0.15 dB + frequency response) typical

Input Voltage Standing Wave Ratio (VSWR)

(≥8 dB input attenuation)

50 MHz to 3 GHz	<1.2:1 nominal
3 GHz to 18 GHz	<1.6:1 nominal
18 GHz to 26.5 GHz	<1.9:1 nominal
26.5 GHz to 50 GHz	<1.6:1 nominal
Preamp on (50 MHz to 3 GHz) (≥10 dB attenuation)	<1.2:1 nominal

Resolution Bandwidth Switching Uncertainty

(referenced to 30 kHz RBW)

1 Hz to 1 MHz RBW	±0.03 dB
1.1 MHz to 3 MHz RBW	±0.05 dB
4, 5, 6, 8 MHz RBW	±1.0 dB

Reference Level

Range:

Log scale	–170 dBm to +30 dBm in 0.01 dB steps
Linear scale	707 pV to 7.07 V in 0.1 % steps
Accuracy	0 dB

Display Scale Switching Uncertainty

Switching between linear and log	0 dB
Log scale/div switching	0 dB

Display Scale Fidelity

≤–20 dBm input mixer level	±0.07 dB total
–20 dBm<mixer level≤–10 dBm	±0.13 dB total

Spurious Response (mixer level = –40 dBm)

General spurious:

f <10 MHz from carrier	(–73 + 20 log N) dBc
f ≥10 MHz from carrier	(–80 + 20 log N) dBc (–90 + 20 log N) dBc typical

See frequency range for N

Second Harmonic Distortion (SHI)

E4443A, E4445A, E4440A	**Distortion (dBc)**	**SHI (dBm)**
10 MHz to 460 MHz (–40 dBm mixer level)	–82	+42
460 MHz to 1.18 GHz (–40 dBm mixer level)	–92	+52
1.18 GHz to 1.5 GHz (–40 dBm mixer level)	–82	+42
1.5 GHz to 2.0 GHz (–10 dBm mixer level)	–90	+80
2.0 GHz to 13.25 GHz (–10 dBm mixer level)	–100	+90
E4447A, E4446A, E4448A	**Distortion (dBc)**	**SHI (dBm)**
10 MHz to 460 MHz (–40 dBm mixer level)	–82	+42
460 MHz to 1.18 GHz (–40 dBm mixer level)	–92	+51
1.18 GHz to 1.5 GHz (–40 dBm mixer level)	–82	+41
1.5 GHz to 2.0 GHz (–10 dBm mixer level)	–90	+80
2.0 GHz to 3.25 GHz (–10 dBm mixer level)	–94	+84
3.25 GHz to 13.25 GHz (–10 dBm mixer level)	–96	+86
13.25 GHz to 25 GHz (–10 dBm mixer level)	–100 nominal	+90 nominal
Preamp On (Option E444xA-1DS, for all models, input preamp level = –45 dBm)		
10 MHz to 1.5 GHz	–60 nominal	+15 nominal
Preamp On (Option E444xA-110, input preamp level = –45 dBm)		
10 MHz to 25 GHz	–45 nominal	+10 nominal

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Third-Order Intermodulation Distortion (TOI)

(two –30 dBm tones at input mixer with tone separation >15 kHz, 20 to 30°C)

E4443A/E4445A/E4440A	**Distortion (dBc)**	**TOI (dBm)**
10 MHz to 100 MHz	–88	+14 (+17 typical)
100 MHz to 400 MHz	–90	+15 (+18 typical)
400 MHz to 1.7 GHz	–92	+16 (+19 typical)
1.7 GHz to 2.7 GHz	–94	+17 (+19 typical)
2.7 GHz to 3.0 GHz	–94	+17 (+20 typical)
3.0 GHz to 6.0 GHz	–90	+15 (+18 typical)
6.0 GHz to 16 GHz	–76	+8 (+11 typical)
16 GHz to 26.5 GHz	–84	+12 (+14 typical)
E4447A/E4446A/E4448A	**Distortion (dBc)**	**TOI (dBm)**
10 MHz to 100 MHz	–90	+15 (+20 typical)
100 MHz to 400 MHz	–92	+16 (+21 typical)
400 MHz to 1.7 GHz	–94	+17 (+20 typical)
1.7 GHz to 2.7 GHz	–96	+18 (+21 typical)
2.7 GHz to 3.0 GHz	–96	+18 (+21 typical)
3.0 GHz to 6.0 GHz	–92	+16 (+21 typical)
6.0 GHz to 16.0 GHz	–84	+12 (+15 typical)
16.0 GHz to 26.5 GHz	–84	+12 (+15 typical)
26.5 GHz to 50.0 GHz	–85	+12.5 nominal
Preamp on (Option E444xA-1DS, for all models, two –45 dBm tones at preamp input)		
10 MHz to 500 MHz		–15 nominal
500 MHz to 3 GHz		–13 nominal
Preamp on (Option E444xA-110, two –45 dBm tones at preamp input)		
10 MHz to 3.0 GHz		–15 dB nominal
3.0 to 6.6 GHz		–21 dB nominal
6.6 to 13.2 GHz		–23 dB nominal
13.2 to 19 GHz		–23 dB nominal
19 to 26.5 GHz		–25 dB nominal

Residual Responses

Input terminated and 0 dB attenuation

200 kHz to 6.6 GHz	–100 dBm
6.6 GHz to 26.8 GHz	–100 dBm nominal
26.8 GHz to 50 GHz	–90 dBm nominal

Trace Detectors

Normal, peak, sample, negative peak, log power average, RMS average, voltage average, quasi-peak, EMI average, MIL-peak and EMI peak

Option E444xA-1DS, Preamplifier

Frequency range	100 kHz to 3 GHz
Gain	28 dB nominal
Noise figure	7 dB nominal

Option E444xA-110, Preamplifier

Frequency range	10 MHz to 50 GHz	
Gain	10 MHz to 30 GHz	27 dB (nominal)
	30 to 50 GHz	24 dB (nominal)
Noise figure	10 to 30 MHz	12.5 dB (nominal)
	30 MHz to 3 GHz	7.8 dB (nominal)
	3 to 30 GHz	10.3 dB (nominal)
	30 to 50 GHz	21.8 dB (nominal)

Option E444xA-123, Switchable MW Preselector Bypass

DANL	–153 dB typical
Frequency response	±0.2 dB typical

Measurement Speed

Local measurement and display update rate	≥50/s nominal
Remote measurement and GPIB transfer rate	
101 sweep points	≥45/s nominal
401 sweep points	≥30/s nominal
601 sweep points	≥25/s nominal

Power Suite Measurement Specifications

Channel Power

Amplitude accuracy, W-CDMA or IS95
(20 to 30 °C, mixer level <–20 dBm) ±0.68 dB (±0.18 dB typical)

Occupied Bandwidth

Frequency accuracy ± [span/600] nominal

Adjacent Channel Power

Accuracy, W-CDMA (ACLR) (at specific mixer levels and ACLR ranges):

	Adjacent	**Alternate**
MS	±0.12 dB	±0.17 dB
BTS	±0.22 dB	±0.22 dB
Dynamic range (typical):		
w/o noise correction	–74.5 dB	–82 dB
w/noise correction	–81 dB	–88 dB
Offset channel pairs measured	1 to 6	

Multi-Carrier Power and ACP

Fast ACP speed	<30 ms (std dev 0.2 dB, nominal)
ACPR dynamic range, W-CDMA (5 MHz offset, RRC weighted, 3.84 MHz noise bandwidth):	
Two carriers	–70 dB nominal
Four carriers	–68 dB nominal
ACPR accuracy (two carriers, 5 MHz offset, –48 dBc ACPR)	±0.38 dB nominal
Multiple number of carriers measured	Up to 12

Power Statistics CCDF

Histogram resolution 0.1 dB

Harmonic Distortion

Maximum harmonic number	10th
Results	Fundamental power (dBm), relative harmonics power (dBc), total harmonic distortion in percent

Intermod (TOI)

Measure the third-order products and intercepts from two tones

Burst Power

Methods	Power above threshold, power within burst width
Results	Output power, average output power, single burst maximum power, minimum power within burst, burst width

Spurious Emission

cdma2000 or W-CDMA (1980 MHz region, 1.2 MHz RBW)
Table driven spurious signals; search across regions.

Relative dynamic range	80.6 dB (82.4 dB typical)
Absolute sensitivity	–89.7 dBm (–91.7 dBm typical)

Spectrum Emission Mask (SEM)

cdma2000 (750 kHz offset):	
Relative dynamic range (30 kHz RBW)	85.3 dB (88.3 dB typical)
Absolute sensitivity	–105.7 dBm (–107 dBm typical)
Relative accuracy	±0.09 dB
3GPP W-CDMA (2.515 MHz offset):	
Relative dynamic range (30 kHz RBW)	87.3 dB (89.5 dB typical)
Absolute sensitivity	–105.7 dBm (–107.7 dBm typical)
Relative accuracy	±0.10 dB

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General Specifications

Temperature Range

Operating	0°C to +55°C
Storage	–40°C to +75°C

EMI Compatibility

Radiated and conducted emission is in compliance with CISPR Pub.11/1996 Class A and B
Complies with radiated electromagnetic field immunity requirement in IEC/EN 61326 using performance criterion B

Audio Noise

ISO 7779	LNPE <5.0 BELS at 25°C

Military Specification

Type tested to environmental specifications MIL-PRF-28800F Class 3

Power Requirements

Voltage and frequency:
100 to 132 V_{rms}, 47 to 66 Hz/360 to 440 Hz
195 to 250 V_{rms}, 47 to 66 Hz
Power consumption:

On	<260 watts, no options (<450 watts, all options)
Standby	<20 watts

Weight (without options)

E4443A, E4445A, E4440A

Net	23 kg (50 lbs) nominal
Shipping	33 kg (73 lbs) nominal

E4447A, E4446A, E4448A

Net	24 kg (53 lbs) nominal
Shipping	34 kg (76 lbs) nominal

Dimensions

Height	177 mm (7.0 in)
Width	426 mm (16.8 in)
Length	483 mm (19 in)

Warranty

The E4440A, E4443A, E4445A, E4446A, E4447A and E4448A are supplied with a one-year standard warranty.

Calibration Cycle

The recommended calibration cycle is one year. Calibration services are available through Agilent service centers.

Input and Outputs

Front Panel

RF Input

Connector:	
E4443A/E4445A	Type-N female, 50 Ω
E4440A	Type-N female, 50 Ω
E4440A-BAB	APC 3.5 male
E4447A/E4446A/E4448A	2.4 mm male, 50 Ω

Probe Power

Voltage/current (nominal)	+15 Vdc, ±7 % at 150 mA max –12.6 Vdc, ±10 % at 150 mA max GND

Ext Trigger Input

Connector	BNC female
Impedance	10 kΩ nominal
Trigger level	5 V TTL nominal

Option AYZ External Mixing

IF Input

Connector	SMA, female
Center frequency	321.4 MHz
3 dB bandwidth	60 MHz nominal
Maximum safe input level	+10 dBm
Absolute amplitude accuracy	±1.2 dB

Mixer Bias Current

Range	±10 mA
Output impedance	77 Ω nominal
Mixer bias voltage	±3.7 V (measured in an open circuit)

LO Output

Connector	SMA, female
Impedance	50 Ω nominal
Frequency range	3.05 to 6.89 GHz
VSWR	<2.0:1 (nominal)

LO Power Out

E4440A	+13.5 to +18.5 dBm
E4447A, E4446A, E4448A	+14.5 to +18.8 dBm

Rear Panel

10 MHz OUT (switched)

Connector	BNC female, 50 Ω
Output amplitude	≥0 dBm nominal
Frequency accuracy	10 MHz ±(10 MHz x frequency reference accuracy)

Ext Ref In

Connector	BNC female, 50 Ω
Input amplitude range	–5 to +10 dBm nominal
Input frequency	1 to 30 MHz nominal
Frequency lock range	±5 x 10-6 of specified external reference input frequency

Trigger In

Connector	BNC female
External trigger input:	
Impedance	>10 kΩ nominal
Trigger level	5 V TTL

Trigger 1 and Trigger 2 Outputs

Connector	BNC female
Trigger 1 output:	HSWP (high = sweeping)
Impedance	50 Ω nominal
Level	5 V TTL
Trigger 2 output	Reserved for future applications

Monitor Output

Connector	VGA compatible, 15-pin mini D-SUB
Format	VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 X 480

Noise Source Drive Output

Connector	BNC female
Output voltage	
On	28.0 ±0.1 V (60 mA maximum)
Off	<1 V

Remote Programming

GPIB interface:	
Connector	IEEE-488 bus connector
GPIB codes	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3, and C28, DT1, L4, C0
Serial interface connector	9-pin D-SUB male (factory use only)
LAN TCP/IP interface	RJ45 Ethertwist
USB interface	USB 2.0 device side I/O interface

Parallel Printer Interface Connector

25-pin D-SUB female

321.4 MHz IF Output (except E4447A)

Connector	SMA female, 50 Ω nominal
Frequency	321.4 MHz nominal
Conversion gain	+2 to +4 dB nominal

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

Key Literature & Web Link

Select the Right Signal Analyzer for Your Needs Selection Guide, p/n 5968-3413E
PSA Series Brochure, p/n 5980-1283E
PSA Series Data Sheet, p/n 5980-1284E
PSA Series Configuration Guide, p/n 5989-2773EN
Self-Guided Demonstration for Spectrum Analysis Product Note, p/n 5988-0735EN
Phase Noise Measurement Personality Technical Overview, p/n 5988-3698EN
Noise Figure Measurement Personality Technical Overview, p/n 5988-7884EN
External Source Control Measurement Personality Technical Overview, p/n 5989-2240EN
Flexible Digital Modulation Analysis Measurement Personality Technical Overview, p/n 5989-1119EN
W-CDMA and HSDPA Measurement Personalities Technical Overview, p/n 5988-2388EN
GSM with EDGE Measurement Personality Technical Overview, p/n 5988-2389EN
cdma2000 and 1xEV-DV Measurement Personalities Technical Overview, p/n 5988-3694EN
1xEV-DO Measurement Personality Technical Overview, p/n 5988-4828EN
cdmaOne Measurement Personality Technical Overview, p/n 5988-3695EN
WLAN Measurement Personality Technical Overview, p/n 5989-2781EN
NADC/PDC Measurement Personality Technical Overview, p/n 5988-3697EN
TD-SDCMA Measurement Personality Technical Overview, p/n 5989-0056EN
Built-in Measuring Receiver Personality/Agilent N5531S Measuring Receiver Technical Overview, p/n 5989-4795EN
BenchLink Web Remote Control Software Product Overview, p/n 5988-2610EN
IntuiLink Software Data Sheet, p/n 5980-3115EN
Programming Code Compatibility Suite Technical Overview, p/n 5989-1111EN
40/80 MHz Bandwidth Digitizers Technical Overview, p/n 5989-1115EN
Vector Signal Analysis Basics Application Note 150-15, p/n 5989-1121EN
using Extended Calibration Software for Wide Bandwidth Measurements, PSA Option 122 & 89600 VSA Application Note 1443, p/n 5988-7814EN
PSA Series Spectrum Analyzer Performance Guide using 89601A Vector Signal Analysis Software Product Note, p/n 5988-5015EN
89650S Wideband VSA System with High Performance Spectrum Analysis Technical Overview, p/n 5989-0671E
PSA Series Spectrum Analyzer Video Output (Option 124) Technical Overview, p/n 5989-1118EN
PSA Series Spectrum Analyzers, Option H70, 70 MHs IF Output Product Overview, p/n 5986-5261EN
8 Hints for Millimeter Wave Spectrum Measurement Application Note, p/n 5988-5680EN
Spectrum Analyzer Basics Application Note 150, p/n 5952-0292
Making Precompliance Conducted and Radiated Emissions Measurements with the PSA, (AN 150-10) Application Note 150-10, p/n 5989-1550EN
External Waveguide Mixing and Millimeter Wave Measurements with Agilent PSA Spectrum Analyzers Application Note 1485, p/n 5988-9414EN
Agilent PSA series Optimizing Dynamic Range Product Note, p/n 5980-3079EN
PSA Series Amplitude Accuracy Product Note, p/n 5980-3080EN
Performance Spectrum Analyzer Series Swept and FFT Analysis Application Note, p/n 5980-3081EN
PSA Series Measurement Innovations and Benefits Product Note, p/n 5980-3082EN

For more information on the PSA Series, please visit:
www.agilent.com/find/psa

Ordering Information

PSA Series Spectrum Analyzer
E4443A 3 Hz to 6.7 GHz
E4445A 3 Hz to 13.2 GHz
E4440A 3 Hz to 26.5 GHz
E4447A 3 Hz to 42.98 GHz
E4446A 3 Hz to 44 GHz
E4448A 3 Hz to 50 GHz

Options
To Add Options to a Product, Use the Following Ordering Scheme:
Model: E444xA (x = 0, 3, 5, 6, 7 or 8)
Example Options: E4440A-B7J, E4448A-1DS
Digital Demodulation Hardware
E444xA-B7J: Digital Demodulation Hardware (required for digital demodulation measurement personalities)

Digital Wireless Communication Measurements
E444xA-BAF W-CDMA Measurement Personality
E444xA-210 HSDPA/HSUPA Measurement Personality
E444xA-202 GSM w/EDGE Measurement Personality
E444xA-B78 cdma2000 Measurement Personality
E444xA-204 1xEV-DO Measurement Personality
E444xA-214 1xEV-DV Measurement Personality
E444xA-BAC cdmaOne Measurement Personality
E444xA-BAE NADC, PDC Measurement Personality
E444xA-241 Flexible Digital Modulation Analysis Personality
E444xA-211 TD-SCDMA Power Measurement Personality
E444xA-212 TD-SCDMA Modulation Analysis Measurement Personality
E444xA-213 HSDPA/8PSK for TD-SCMA Analysis (requires option 212)
E444xA-217 WLAN Measurement Personality (requires option 122 or 140)

Other Measurements and Controls
E444xA-226 Phase Noise Measurement Personality
E444xA-219 Noise Figure Measurement Personality
E444xA-215 External Source Control Measurement Personality
E444xA-233 Built-in Measuring Receiver Personality
E444xA-23A AM/FM/PM Triggering for Measuring Receiver (requires option 233)
E444xA-23B CCITT Filter for Audio Measurements (requires options 233/107)
E444xA-117 Secure Memory Erase
E444xA-239 N9039A RF Preselector Control

Hardware Options
E444xA-AYZ External Mixing
E444xA-122 80 MHz Bandwidth Digitizer (E4443A, E4445A, E4440A only)
E444xA-140 40 MHz Bandwidth Digitizer (E4443A, E4445A, E4440A only)
E444xA-1DS 100 kHz to 3 GHz Built-in Preamplifier
E444xA-110 Built-in Preamp Covering 10 MHz to Max Frequency of PSA
E4440A-107 Audio Input 100 kohm (requires option 233)

Inputs and Outputs
E4440A-BAB Replaces Type "N" Input Connector with APC 3.5 Connector

Connectivity Software
E444xA-230 BenchLink Web Remote Control Software

Code Compatibility
E444xA-266 HP 8566B/8568B Code Compatibility Measurement Personality

Accessories
E444xA-1CM Rackmount Kit
E444xA-1CN Front Handle Kit
E444xA-1CP Rackmount with Handles
E444xA-1CR Rack Slide Kit
E444xA-045 Millimeter Wave Accessory Kit
E444xA-0B1 Extra Manual Set Including CD ROM

Warranty and Service
Standard warranty is 1 year
R-51B-001-3C 1 Year Return-to-Agilent warranty extended to 3 years

Calibration[1]
R-50C-001 Standard Calibration
R-50C-002 Standards Compliant Calibration
E444xA-OBW Service Manual, Assembly Level
E444xA-UK6 Commercial Calibration Certificate with Test Data
R-52A Calibration Software and Licensing (ordered with PSA)
N7810A PSA Calibration and Licensing (ordered stand-alone)

[1] Options not available in all countries

N5531S
N5532A

- **Absolute RF power: Accuracy of a modern digital power meter combined with a specially designed sensor module using 848x thermal-couple power sensor**
- **Tuned RF level (TRFL): measurement sensitivity of as low as –140 dBm[1] with level accuracy exceeding source/attenuator calibration requirements**
- **Frequency counter: 0.001 Hz frequency resolution and up to –100 dBm sensitivity (manual mode)**
- **Analog modulation analysis: AM, FM, and ΦM to verify correct source modulation index and distortion**
- **Optional audio analysis capabilities with high-impedance audio input**
- **N5532A sensor modules with single input connection up to 50 GHz for accuracy, productivity, and repeatability**
- **Remote control through SCPI commands**

N5531S Measuring Receiver

The Agilent N5531S measuring receiver is comprised of a PSA high-performance spectrum analyzer with Option 233 (Built-in measuring receiver personality), a P-series precision power meter (N1911A/12A), and an N5532A sensor module. It combines multiple precision measurement functions into one compact, integrated system that set the new standards for metrology grade of RF, microwave, and millimeter-wave signal measurement up to 50 GHz. The available key measurements include: frequency counter, absolute RF power, TRFL, AM depth, FM deviation, ΦM deviation, modulation rate, and modulation distortion. Additionally, audio measurements are also available (with Option 107 being installed to the PSA), which include audio frequency counter, audio level, and audio distortion/SINAD measurements.

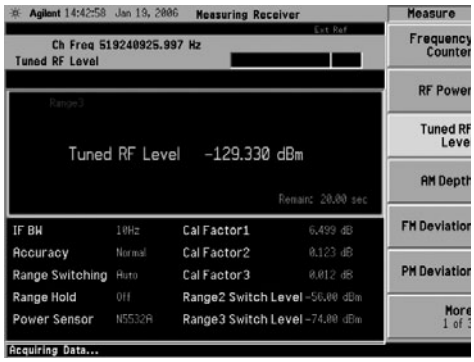
Metrology and Calibration Applications

The N5531S is a successor to the legacy 8902A measuring receiver and extends the frequency coverage to 50 GHz. The N5531S offers superior accuracy, exceedingly wide dynamic range, repeatability, and traceability mandated by metrology and calibration labs. By placing the receiver measurements and controls directly into the PSA, the need for an external computer is eliminated – providing a more compact measuring receiver system.

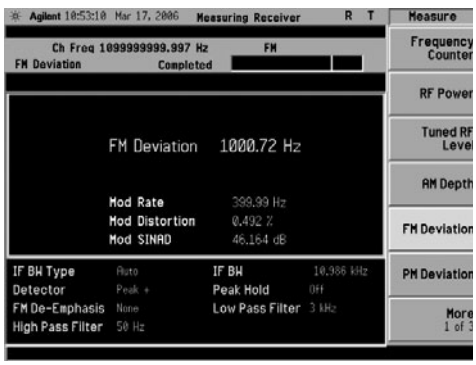
The built-in measuring receiver personality (Option 233) installed in the PSA enables users to set the measurement parameters and to initiate the measurement via the PSA's front panel. One button pressing can switch between the measuring receiver mode to other modes, such as spectrum analysis, easily and quickly. Measurement results are shown on the PSA's display.

Combining with P-Series power meter's accuracy and the PSA's outstanding linearity, the N5531S provides superior absolute RF amplitude specifications to meet or exceed the most challenging requirements for calibrating the signal sources. The excellent sensitivity of the N5531S in tuned RF level (TRFL) measurements allows the users to calibrate step attenuators with the widest dynamic range within the demanded measurement uncertainty and speed.

As the input signal level to the measurement receiver decreases, the signal-to-noise ratio (SNR) will have increasingly significant contribution to the measurement uncertainty. Taking the SNR into account, the N5531S provides comprehensive TRFL level accuracy specifications across the entire measurement range, which offers realistic confidence for your measurement results.



The N5531S offers superb analog modulation analysis capabilities that enable the users to quantify their signal sources' modulation accuracy at the metrology-grade level for the carrier signal frequency as high as 50 GHz. The measurement parameters, such as filter bandwidth and the number of averages, can be manually set by pressing the PSA front panel keys to optimize the modulation analysis. Different speed settings also allow the users for the best compromise between the measurement speed and accuracy.



The optional audio analysis capability of the N5531S (PSA Option 107), based on the latest digital signal processing technologies, provides ideal tool to characterize audio signals. A large set of preconditioning filters, including the CCITT filter (PSA Option 23B), helps users to achieve the best possible audio analysis and to measure their audio signals against the regulations.

[1] Refer to the PSA Measuring Receiver Personality Specifications Guide (Literature Number: E4440-90333) for more details.

Signal Characterization

The N5531S is also an excellent research and development lab tool for accurately characterizing signals from 100 kHz to 50 GHz. Level measurements down to –140 dBm with superb accuracy and linearity makes the N5531S ideal for testing various RF, microwave, and millimeter devices.

As the N5531S measuring receiver consists of a PSA high-performance spectrum analyzer and a P-Series power meter, its users can gain full benefits from the stand-alone instruments. With other optional measurement personalities, the PSA can help you to analyze complex digitally modulated signals used in the modern wireless communications, such as W-CDMA, HSDPA/HSUPA, cdma2000, TD-SCDMA, and GSM/EDGE, or to conduct one-button tests for phase noise and noise figure.

N5532A Sensor Modules with Single Input Connection

Four types of sensor modules were designed specifically for use with the N5531S measuring receiver to cover different frequency bands: N5532A-504 (100 kHz to 4.2 GHz), N5532A-518 (10 MHz to 18 GHz), N5532A-526 (30 MHz to 26.5 GHz), and N5532A-550 (30 MHz to 50 GHz). With these sensor modules, you can characterize the absolute amplitudes of a signal without switching back and forth between the power meter and PSA's RF input, which helps to ensure your measurement integrity. While the N5532A sensor module have exactly same form factor as those used for the 8902A (11722A or 11792A), they have been mechanically and electronically improved for better reliability, sensibility, and repeatability.

Each N5532A sensor module is shipped with its specific calibration factor data file that will be loaded and saved to the PSA to ensure the highest possible measurement accuracy.

N5531S Key Specifications[1]

RF Power (with power meter and N5532A sensor module)
- Range: +30 dBm (1 W) to –10 dBm (100 µW)
- Frequency: 100 kHz to 50 GHz
- Linearity: ±0.02 dB
- Input SWR:
  - <1.10:1 (100 kHz to 2 GHz)
  - <1.28:1 (2 to 18 GHz)
  - <1.40:1 (18 to 26.5 GHz)
  - <1.55:1 (26.5 to 33 GHz)
  - <1.70:1 (33 to 40 GHz)
  - <1.75:1 (40 to 50 GHz)

Tuned RF Level
- Maximum measurable level: +30 dBm
- Minimum measurable level: to –140 dBm (at defaulted 10 Hz RBW with preamp options 1DS or 110, depending on the frequency band)
- Frequency range: 100 kHz to 50 GHz
- Linearity: ±(0.009 dB + 0.005 dB/10 dB step)
- Relative measurement accuracy:
  - ±(0.015 dB + 0.005 dB/10 dB step) (nominal) between the residual noise threshold[2] to the maximum measurable level
  - Range change uncertainty: ±0.031 dB

RF Frequency
- Range: 100 kHz to 50 GHz
- Maximum resolution: 0.001 Hz

Amplitude Modulation
- Rates: 20 Hz to 100 kHz
- Depth: 5 to 99%
- Accuracy: ±0.5% of reading, for 10 MHz to 3 GHz frequency range, 50 Hz to 100 kHz rates, and 20 to 99% depth

Frequency Modulation
- Rates: 20 Hz to 200 kHz
- Maximum peak deviation: 400 kHz
- Accuracy: ±1.5% of reading, for 10 MHz to 6.6 GHz frequency range, 50 Hz to 200 kHz rates, 250 to 400 kHz peak deviation, and ß[3] >0.2

Phase Modulation
- Rates: 200 Hz to 20 kHz
- Maximum peak deviation: 12,499 radians, in "Auto" mode for carrier frequency ≥10 MHz
- Accuracy: ±1% of reading, for 100 kHz to 6.6 GHz frequency range, and phase deviations >0.7 radians

Audio Measurements
- Audio level accuracy: 1% of reading, 100 mV to 3 V (rms)
- Audio frequency range: 20 Hz to 250 kHz
- Audio frequency display resolution: 0.01 Hz (8 digits)
- Audio distortion accuracy: ±1 dB of reading, 20 Hz to 250 kHz

Ordering Information

PSA Series Spectrum Analyzer (select one)
E4443A 3 Hz to 6.7 GHz
E4445A 3 Hz to 13.2 GHz
E4440A 3 Hz to 26.5 GHz
E4447A 3 Hz to 42.98 GHz
E4446A 3 Hz to 44 GHz
E4448A 3 Hz to 50 GHz

PSA Options (x=0, 3, 5, 6, 7, or 8)
E444xA-233 Built-in Measuring Receiver Personality
E444xA-123 µW Preselector Bypass
(Required for TRFL measurements above 3 GHz)
E444xA-1DS RF Internal Preamplifier (Required for the higher sensitivity TRFL measurement below 3 GHz, mutually exclusive with Option 110)
E444xA-110 RF/µW Internal Preamplifier
(Required for the higher sensitivity TRFL measurement from 10 MHz up to the maximum frequency of the PSA, mutually exclusive with Option 1DS)
E444xA-107 Audio Input 100 kohm (Required for audio analysis)
E444xA-23A AM/FM/PM Triggering for Measuring Receiver
(Requires Option 233 to operate)
E444xA-23B CCITT Filter for Audio Measurements
(Requires Options 233 and 107 to operate)

P-Series Power Meter (select one)
N1911A P-Series Single Channel Power Meter
N1912A P-Series Dual Channel Power Meter

N5532A Sensor Modules
N5532A-504 100 kHz to 4.2 GHz, type N(m) Input Connector
N5532A-518 10 MHz to 18 GHz, type N(m) Input Connector
N5532A-526 30 MHz to 26.5 GHz, APC 3.5 mm (m) Input Connector
N5532A-550 30 MHz to 50 GHz, 2.4 mm (m) Input Connector
N5532A-019 Adaptor to N191xA Power Meter
(Required when the N191xA power meter is used)

For more information on the N5531S, please visit:
www.agilent.com/find/N5531S

[1] Refer to the PSA Measuring Receiver Personality Specifications Guide (Literature Number: E4440-90333) for more details.
[2] The "residual noise threshold" is at 30 dB above the minimum measurable level.
[3] ß is the ratio of frequency deviation to modulation rate (deviation/rate).

- **Continuous 30 Hz to 2.9, 13.2, 26.5, 40, or 50 GHz sweeps**
- **Resolution bandwidths of 1 Hz to 100 Hz digitally implemented for measurement speed**
- **Best-in-class performance in phase noise and dynamic range**
- **Precision timebase and 1 Hz counter resolution**
- **Adjacent channel power, channel power, carrier power and gated video measurements standard**
- **Class 3 MIL-rugged**
- **Color screen**
- **VGA output**

8560EC

8560EC Series Spectrum Analyzers

The 8560EC series portable spectrum analyzers offer the measurement capabilities and performance traditionally found only in larger, more expensive benchtop analyzers. These spectrum analyzers combine outstanding phase noise, sensitivity, 1 Hz resolution bandwidths and wide dynamic range in a Class 3 MIL-rugged package built to withstand harsh environmental conditions.

Capabilities for RF Communications

The ability to measure adjacent channel power (ACP) on wireless telephones, pagers and other transmitters is critical in both R&D and manufacturing. The 8560EC series spectrum analyzers offer a complete solution for ACP testing of burst carrier signals using digital modulation such as is used in NADC-TDMA, GSM, DECT, CT2-CAI, PDC and PHS systems. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate and easy-to-use ACP measurement capability. Measure W-CDMA adjacent channel power ratio (ACPR) with a dynamic range of at least 70 dB using the 8563E-K35 ACPR test set.

Another standard feature is the ability to measure from 0.10 to 99.99 percent occupied bandwidth.

Additionally, the carrier power and channel power measurements for both continuous and burst signals are also available as the standard features of the 8560EC Series spectrum analyzers.

Time-gated signal analysis is another standard feature that allows you to easily measure time-varying signals such as pulsed RF, time-division multiple access (TDMA), interleaved and burst-modulated. The 85902A burst carrier trigger can supply a TTL trigger signal.

8560EC series specifications have been enhanced. Now, you can get better phase noise, sensitivity, dynamic range and frequency response from this midrange performance portable spectrum analyzer family.

The 8562EC spectrum analyzer provides a 13.2 GHz frequency range with increased dynamic range and third-order intercept (TOI) capability. This allows wireless communications engineers to test high-performance components in burst operation systems.

With the 85672A spurious response measurements utility, you can use 8560EC series spectrum analyzers to make fast and easy spurious response tests.

For more information on RF communications measurement capabilities, refer to page 114.

Fast Digital Resolution Bandwidths

Digitally-implemented resolution bandwidths of 1, 3, 10, 30 and 100 Hz allow the 8560EC series spectrum analyzers to sweep from 3 to 600 times faster than is possible with comparable analog filters. A narrow 5:1 shape factor allows you to view close-in, low-level signals easily. Digital bandwidths also provide the spectrum analyzer with a full 100 dB on-screen calibrated display.

PC Software for 8560EC Series

The Agilent BenchLink Spectrum Analyzer PC software provides an easy-to-use communications link between your PC and the 8560EC series spectrum analyzers. Taking full advantage of the Windows interface, you can easily transfer screen images or trace data via the GPIB interface, thereby making it easy to capture, analyze and document measurement results in your PC. Order Option B70 or E4444A for this PC software.

Precision Frequency and Amplitude

Measure frequencies accurately using the built-in frequency counter. A standard precision frequency reference, with an aging rate of 1 x 10^{-7} per year, and 1 Hz counter resolution provide confidence in measurement accuracy. At 1 GHz, frequency accuracy of ±135 Hz after a 15-minute warmup is achieved.

Amplitude measurement uncertainty can be reduced using the amplitude correction (AMPCOR) feature. AMPCOR allows you to enter up to 200 amplitude correction points to compensate for sources of amplitude uncertainty, such as cable losses, preamplifier gain and spectrum analyzer frequency response. After developing a table of correction data, amplitudes that have been referenced to a power meter can be read directly on the spectrum analyzer display.

Digitized, Fast Time-Domain Sweeps

Digitized fast time-domain (zero span) sweeps use markers, trace math, trace storage and get hardcopy output, for measurements such as rise/fall times, pulse widths and time between events.

8560EC RF Spectrum Analyzer

The 8560EC offers excellent performance for RF design, manufacturing and service applications. The 8560EC has a frequency range of 30 Hz to 2.9 GHz. It has synthesized tuning for drift-free accurate measurements.

8562EC RF Spectrum Analyzer

The 8562EC is a midrange performance spectrum analyzer that provides the frequency and dynamic range needed for high-speed digital wireless communication applications. It allows manufacturing and R&D engineers to test network components with state-of-the-art performance. The 8562EC has a frequency range of 30 Hz to 13.2 GHz, which covers the spur-search ranges specified by leading standards organizations in Europe and in the United States.

8563EC Microwave Spectrum Analyzer

The 8563EC extends the outstanding features and capabilities of the 8560EC Series RF spectrum analyzers into the microwave frequency range. The 8563EC has a standard frequency range of 9 kHz to 26.5 GHz (preselected from 2.75 GHz to 26.5 GHz), with optional low-end frequency coverage to 30 Hz. The image-enhanced, double-balanced harmonic mixer of the 8563EC achieves noise-figure performance similar to that of a fundamentally-mixed front end.

8564EC and 8565EC Millimeter-Wave Spectrum Analyzers

Whether you want to measure the third harmonic of a 15 GHz oscillator or the noise sidebands of a 38 GHz carrier, the 8564EC and 8565EC make spectrum analysis easier than ever before. A single coaxial connection is all you need to measure signals from 30 Hz to 50 GHz. Preselection minimizes images and multiple responses at higher frequencies.

The 8564EC has a frequency range of 9 kHz to 40 GHz, the 8565EC of 9 kHz to 50 GHz. Both have optional low-end coverage to 30 Hz and are preselected above 2.75 GHz.

8563E-K35 Adjacent Channel Power Ratio Test Set

Use this special option with the 8562EC/63EC/64EC/65EC spectrum analyzers to increase the dynamic range of ACP measurements. 8563E-K35 uses an alternate first converter mixer with custom filtering to increase the spectrum analyzer's ACPR measurement dynamic range. The dynamic range becomes at least 70 dB for systems with a guard band between channels of 900 kHz or greater. This meets the needs of W-CDMA specifications. Control menus are integrated into the spectrum analyzer softkeys making the test set easy to use.

11970 Series and 11974 Series Millimeter-Wave Mixers

For millimeter-wave measurements[1], preselection can be extended to 75 GHz using the 11974 mixers. Unpreselected frequency range can be extended to 110 GHz using the 11970 series mixers, and to 325 GHz using mixers from other manufacturers.

85620A Mass Memory Module

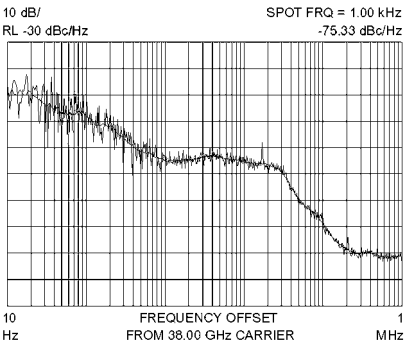
This standard plug-in module adds measurement personality capability, enough memory to store 100 traces, memory-card capability and computer capability, without an external controller. Create complex measurement routines and save them as single-key measurements stored on memory cards or in the module's 128 KB of battery-backed RAM. A clock/calendar and automatic save and execute functions let you configure the spectrum analyzer for unattended, automatic measurements.

85629B Test and Adjustment Module

This accessory for the 8560EC/61EC/63EC (limited use on 8562EC/64EC) makes it easier to service your spectrum analyzer. The module plugs into the rear panel of the instrument and automates high-level diagnostics, self tests and adjustment procedures. It performs more than 1,000 troubleshooting adjustments. Readjustments are fast and accurate because the module controls internal analyzer settings as well as external test equipment.

85671A Phase Noise Measurement Utility

This downloadable program transforms your 8560EC Series spectrum analyzer into a phase noise tester. It eliminates the task of hand-drawing phase noise plots. To measure oscillator phase noise, you can generate graphs of phase noise (dBc/Hz) versus log offset frequency without having to manually tune to multiple frequency offsets. Other productivity features include direct phase noise readout, variable filtering (for controlling trade-offs between measurement repeatability and speed), calculation of RMS noise (displayed in radians and degrees), spot-frequency measurements (phase noise measurements at a single offset frequency) and digitized hardcopy and storage.



Use the 85671A phase noise utility to easily characterize noise sidebands of an oscillator.

85672A Spurious Response Measurements Utility

The 85672A is a downloadable program on a card that inserts directly into any 8560EC Series spectrum analyzer. This test utility provides fast and easy spurious response test capability for all of 8560EC Series spectrum analyzers. Test setup time can be drastically reduced for manufacturing and R&D engineers with this one-button solution. 85672A offers five preprogrammed tests: third-order intermodulation product/third order intercept (TOI), harmonics and total-harmonic distortion (THD), discrete sideband spurs, general-spur search and mixing products.

Scalar Network Analysis Capability

The 85640A tracking generator used with the 8560EC covers 300 kHz to 2.9 GHz, providing 8560EC Series spectrum analyzers with scalar measurement capability.

Specifications

Frequency

Frequency Range (internal mixing)
8560EC: 30 Hz to 2.9 GHz
8562EC: 30 Hz to 13.2 GHz
8563EC: 9 kHz to 26.5 GHz; 30 Hz to 26.5 GHz (Option 006)
8564EC: 9 kHz to 40 GHz; 30 Hz to 40 GHz (Option 006)
8565EC: 9 kHz to 50 GHz; 30 Hz to 50 GHz (Option 006)

Frequency Range (external mixing): 18 GHz to 325 GHz in 12 wave-guide bands

Frequency Reference Accuracy	
Temperature Stability	$\pm 1 \times 10^{-8}$
Aging (per year)	$\pm 1 \times 10^{-7}$
Settability	$\pm 1 \times 10^{-8}$

Warmup (nominal), 5 minute $\pm 1 \times 10^{-7}$; 15 minute $\pm 1 \times 10^{-8}$
Frequency Readout Accuracy (N = LO Harmonic)
Span >2 MHz x N: ± (freq. readout x freq. ref. accuracy + 5% x span + 15% x RBW +10 Hz)
Span ≤2 MHz x N: ± (freq. readout x freq. ref. accuracy + 1% x span + 15% x RBW +10 Hz)

For more information, visit our web site:
www.agilent.com/find/8560

[1] Millimeter-wave coverage is not available with Option 002 on the 8560EC.

Marker Count Accuracy (S/N ≥25 dB): ±(marker freq. x freq. ref. accuracy +2 Hz x N +1 LSD)
Counter Resolution: Selectable from 1 Hz to 1 MHz
Frequency Span
- Range: 0 Hz, 100 Hz to maximum frequency

Sweep Time
- Range
  - Span = 0 Hz: 50 µs to 6,000 s
  - Span ≥100 Hz: 50 ms to 100 ks

Accuracy (span = 0 Hz)
- Sweep Time >30 ms: ±1% digital
- Sweep Time <30 ms: ±10% analog; ±0.1% digital

Sweep Trigger: Delayed, free run, single, line, video, external
Resolution Bandwidth:
- Range (–3 dB): 1 Hz to 1 MHz in a 1, 3, 10 sequence and 2 MHz
- Accuracy
  - 1 Hz to 300 kHz: ±10%; 1 MHz: ±25%; 2 MHz: +50%, –25%
- Selectivity (–60 dB/–3 dB)
  - RBW ≥300 Hz: <15:1; RBW ≤100 Hz: <5:1

Video Bandwidth Range: 1 Hz to 3 MHz in a 1, 3, 10 sequence

Noise Sidebands (center frequency ≤1 GHz)
- Offset
  - 100 Hz: <–88 dBc/Hz
  - 1 kHz: <–97 dBc/Hz
  - 10 kHz: <–113 dBc/Hz
  - 100 kHz: <–117 dBc/Hz

Residual FM (zero span): <1 Hz p-p in 20 ms; <0.25 Hz p-p in 20 ms (nominal); <10 Hz p-p in 20 µs (Option 103)

Amplitude

Range: Displayed average noise level to +30 dBm
Maximum Safe Input Level
- Average Continuous Power: +30 dBm (1W, input atten. ≥10 dB)
- Peak Pulse Power (<10 µs pulse width and <1% duty cycle): +50 dBm (100 W, input atten. ≥30 dB)
- DC Volts: <±0.2 V (dc-coupled); <±50 V (ac-coupled, 8560EC and 8562EC only)

1 dB Gain Compression
- 10 MHz to 2.9 GHz: mixer level ≤–5 dBm
- 2.9 to 6.5 GHz (8562EC/63EC/64EC/65EC): mixer level ≤0 dBm
- >6.5 GHz: ≤–3 dBm (8562EC/63EC); ≤0 dBm (8564EC/65EC)

Displayed Average Noise Level (0 dB input atten., 1 Hz RBW)

Frequency	8560EC	8562EC	8563EC	8564EC/65EC
30 Hz	–90 dBm	–90 dBm	–90 dBm	–90 dBm
1 kHz	–105 dBm	–105 dBm	–105 dBm	–105 dBm
10 kHz	–120 dBm	–120 dBm	–120 dBm	–120 dBm
100 kHz	–120 dBm	–120 dBm	–120 dBm	–120 dBm
1 to 10 MHz	–140 dBm	–140 dBm	–140 dBm	–140 dBm
10 MHz to 2.9 GHz	–149 dBm	–149 dBm	–149 dBm	–145 dBm
2.9 to 6.5 GHz	—	–148 dBm	–148 dBm	–147 dBm
6.5 to 13.2 GHz	—	–145 dBm	–145 dBm	–143 dBm
13.2 to 22.0 GHz	—	—	–140 dBm	–140 dBm
22.0 to 26.5 GHz	—	—	–139 dBm	–136 dBm
26.5 to 31.15 GHz	—	—	—	–139 dBm
31.15 to 40.0 GHz	—	—	—	–130 dBm
40.0 to 50.0 GHz	—	—	—	–127 dBm[1]

Spurious Responses	Mixer Level	Distortion
General Spurious	–40 dBm	<(–75+20 log N) dBc
Second Harmonic Dist.		
20 MHz to 1.45 GHz	–40 dBm	<–79 dBc
1 MHz to 1.45 GHz	–40 dBm	<–72 dBc
1.45 GHz to 3.25 GHz	–20 dBm	<–72 dBc
1.45 GHz to 2.0 GHz[2]	–10 dBm	<–85 dBc
2 GHz to 6.6 GHz	–10 dBm	<–100 dBc
2.0 GHz to 13.25 GHz[3]	–10 dBm	<–100 dBc
2.0 GHz to 20 GHz[4]	–10 dBm	<–90 dBc
20 GHz to 25 GHz[3]	–10 dBm	<–90 dBc

Spurious Responses	Mixer Level	Distortion
3rd Order Intermodulation[5]		
20 MHz to 2.9 GHz	–30 dBm	<–82 dBc
1 MHz to 2.9 GHz	–30 dBm	<–78 dBc
2.9 GHz to 6.5 GHz	–30 dBm	<–90 dBc
6.5 GHz to 26.5 GHz	–30 dBm	<–75 dBc
26.5 GHz to 40 GHz[4]	–30 dBm	<–85 dBc (nominal)
40 GHz to 50 GHz[1]	–30 dBm	≤–85 dBc (nominal)
Images		
10 MHz to 26.5 GHz	–10 dBm	<–80 dBc
26.5 GHz to 50 GHz	–30 dBm	<–60 dBc
Multiples and Out-of-Band Responses		
10 MHz to 26.5 GHz	–10 dBm	<–80 dBc
26.5 GHz to 50 GHz	–30 dBm	<–55 dBc

Residual Responses (>200 kHz, N=1): <–90 dBm
Display
- Viewing area: Approx. 7 cm (V) x 9 cm (H)
- Scale calibration: 10 x 10 divisions
- Log scale: 10, 5, 2, 1 dB per division
- Linear scale: 10% of ref. level per division

Display Scale Fidelity
- Log: ±0.1 dB/dB to a maximum of ±0.85 dB, 0 to –90 dB; maximum of ±1.5 dB, 0 to –100 dB (RBW ≤100 Hz)
- Linear: ±3 % of reference level

Reference Level Range: Log = –120 to +30 dBm in 0.1 dB steps;
- Linear = 2.2 µV to 7.07 V in 1% steps

Frequency Response, Relative (10 dB input atten.)

Frequency	8560EC	8562EC	8563EC	8564EC/65EC
100 MHz to 2.0 GHz	±0.7 dB	±0.9 dB	±1.0 dB	±0.9 dB
30 Hz to 2.9 GHz	±1.0 dB	±1.25 dB	±1.25 dB	±1.0 dB
2.9 GHz to 6.5 GHz	—	±1.5 dB	±1.5 dB	±1.7 dB
6.5 GHz to 13.2 GHz	—	±2.2 dB	±2.2 dB	±2.6 dB
13.2 GHz to 22.0 GHz	—	—	±2.5 dB	±2.5 dB
22.0 GHz to 26.5 GHz	—	—	±3.3 dB	±3.3 dB
26.5 GHz to 31.15 GHz	—	—	—	±3.1 dB
31.15 GHz to 40.0 GHz	—	—	—	±2.6 dB
40.0 GHz to 50.0 GHz	—	—	—	±3.2 dB[1]

Calibrator Output: 300 MHz x (1 ±freq. ref. acc'y), –10 dBm: <±0.3 dB
Input Attenuator
- Range
  - 8560EC/62EC/63EC: 0 to 70 dB in 10 dB steps
  - 8564EC/65EC: 0 to 60 dB in 10 dB steps
- Switching Uncertainty (ref. to 10 dB, 30 Hz to 2.9 GHz): <±0.6 dB/10 dB step, ±1.8 dB max.
- Repeatability: ±0.1 dB (nominal)

IF Gain Uncertainty (10 dB atten., 0 to –80 dBm ref. level): <±1 dB
Resolution Bandwidth Switching Uncertainty: <±0.5 dB
Pulse Digitization Uncertainty (pulse response mode, PRF ≥720/sweep time, RBW ≤1 MHz): <1.25 dB pk-pk (Log); <4 % of reference level pk-pk (Linear)

Time-Gated Spectrum Analysis

Gate Delay	Edge Mode	Level Mode
Range	3 µs to 65.535 ms	≤0.5 µs
Resolution	1 µs	

Accuracy (from gate trigger input to pos. edge of gate output): <±1 µs

Gate Length
Range: 1 µs to 65.535 ms
Resolution: 1 µs
Accuracy (from pos. edge to neg. edge of gate output): <±1 µs

[1] 8565EC only.
[2] 8563EC/64EC/65EC only.
[3] 8563EC only.
[4] 8564EC/65EC only.
[5] TOI reference to single tone.

Delayed Sweep

Trigger Modes: Free run, line, external, video
Range: 2 µs to 65.535 µs; Option 007, Sweeptime <30 µs;
–9.9 µs to +65.535 µs; Sweeptime ≥30 µs, +2 µs to +65.535 µs
Resolution: 1 µs
Accuracy: ±1 µs

Demodulation (Spectrum)

Modulation Type: AM and FM
Audio Output: Speaker and phone jack with volume control

Inputs and Outputs (All values nominal)

Front-Panel Connectors

RF Input (50 Ω)
8560EC/62EC/63EC, Type-N female
8563EC Option 026, APC-3.5 male
8564EC/65EC, 2.4-mm male
VSWR (≥10 dB atten.): <1.5:1 below 2.9 GHz; <2.3:1, ≥2.9 GHz
LO Emission Level (average with 10 dB atten.): <– 80 dBm
Second IF Input (SMA female, 50 Ω)
- Frequency: 310.7 MHz
- Full Screen Level: –30 dBm
- Gain Compression: –20 dBm

First LO Output (SMA female, 50 Ω)
- Frequency: 3.0 to 6.8107 GHz
- Amplitude: 16.5 dBm ±2 dB; +14.5 dBm ±3 dB (Option 002)

Cal Output: BNC female, 50 Ω
Probe Power: +15 Vdc, –12.6 Vdc, and GND (150 mA maximum each)

Rear Panel Connectors

10 MHz Reference In/Out (shared BNC female, 50 Ω)
- Output Freq. Accuracy: 10 MHz ± (10 x MHz freq. ref. acc'y)
- Output Amplitude: 0 dBm
- Input Amplitude: –2 to +10 dBm

Video Output (BNC, 50 Ω)
- Amplitude (RBW ≥300 Hz): 0 to +1 V full scale

LO Sweep I FAV Output (shared BNC female, 2 kΩ)
- Amplitude (LO sweep): 0 to 10 V, no load

Blanking/Gate Output: Shared BNC female, 50 Ω, TTL output
External/Gate Trigger Input (shared BNC female, >10 kΩ): settable to high TTL or low TTL
GPIB (IEEE-488 bus connector)
Interface Functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C1, C28, E1
Interface Functions (For 8562EC): SH1, AH1, T6, LE0, RL1, PP1, DC1, DT1, C1, C28, TE0, SR1

General Specifications

Environmental
- Military Specs: Class 3 MIL-rugged
- Calibration Interval: Two years (8560EC/61EC/62EC/63EC); One year (8564EC/65EC)
- Warmup Time: 5 minutes in ambient conditions
- Temperature: 0° to +55°C (operating); –40° to +71°C (not operating)
- Humidity: 95% at 40°C for five days
- Rain Resistance: Drip-proof at 16 liters/hour/sq. ft.
- Altitude: 15,000 ft. (operating); 50,000 ft. (not operating)
- Pulse Shock (half sine): 30 g for 11 ms duration
- Transit Drop: 8-inch drop on six faces and eight corners

Electromagnetic Compatibility: Conducted and radiated interference in compliance with CISPR Pub. 11 (1990). Meets MIL-STD-461C, part 4, with certain exceptions.
Power Requirements
- 115 Vac Operation: 90 to 140 V rms, 3.2 A rms max., 47 to 440 Hz
- 230 Vac Operation: 180 to 250 V rms, 1.8 A rms max., 47 to 66 Hz

Maximum Power Dissipation: 180 W (8560EC/62EC/63EC); 260 W (8564EC/65EC)
Audible Noise (nominal)**:** <5.0 Bels power at room temp. (ISO DP7779)
Dimensions (w/o handle, feet, cover)**:** 187 mm H x 337 mm W x 461 mm D (7.48 in x 13.34 in x 18.44 in)
Weight (carrying, nominal)
- Agilent 8560EC/62EC/63EC: 16.3 kg (36 lbs)
- Agilent 8564EC/65EC: 17.3 kg (38 lbs)

Key Literature & Web Link

8560EC Series Configuration Guide, p/n 5968-8155E
8560EC Series Brochure, p/n 5968-9328E
8563E-K35 Product Overview, p/n 5966-2913E
8560EC Series Technical Specifications, p/n 5968-8156E
85671A Product Overview, p/n 5091-7089E
85672A Product Overview, p/n 5965-1337E
85710A Technical Data, p/n 5952-1452

For more information on compatible printers, visit our web site:
www.agilent.com/find/pcg

Ordering Information

8560EC Spectrum Analyzer, 30 Hz to 2.9 GHz
8562EC Spectrum Analyzer, 30 Hz to 13.2 GHz
8563EC Spectrum Analyzer, 9 kHz to 26.5 GHz
8564EC Spectrum Analyzer, 9 kHz to 40 GHz
8565EC Spectrum Analyzer, 9 kHz to 50 GHz

Options
To add options to a product, use the following ordering scheme:
Model: 856xEC (x = 0, 2, 3, 4 or 5)
Example options: 8563EC-006, 8560EC-002

856xEC-001 Add Second IF Output (310.7 MHz); Rear Panel Connector
856xEC-005 Add Alternate Sweep Out (cannot be used with Opt 002)
856xEC-006 Low End Range to 30 Hz (8563EC/64EC/65EC)
856xEC-008 Add Signal Identification
856xEC-026 APC-3.5 mm Input Connector (8563EC)
856xEC-042 Gray Spectrum Analyzer Backpack
856xEC-044 Yellow Spectrum Analyzer Backpack
856xEC-104 Do Not Include Mass Memory Module
856xEC-B70 BenchLink Spectrum Analyzer Software
856xEC-908 Rackmount Kit without Handles
856xEC-909 Rackmount Kit with Handles
856xEC-910 Extra Manual Set
856xEC-915 Service Guide
856xEC-916 Extra Quick Reference Guide (English)
856xEC-1BP MIL-STD-45662A Calibration with test data
856xEC-UK6 Commercial Calibration (with data)
856xE-K35 ACPR Test Set (8562EC/63EC/64EC/65EC)

Accessories
85629B Test and Adjustment Module
85640A Tracking Generator (300 kHz to 2.9 GHz)
8449B 1 to 26.5 GHz Preamplifier
85700A 32 KB RAM Memory Card
85671A Phase Noise Measurements Utility
85672A Spurious Response Measurements Utility
85902A Burst Carrier Trigger

- **Accurate, automated ACP measurements on TDMA and TDD signals**
- **Measure according to NADC-TDMA, PDC, PHS, and other standards**
- **Measurement accelerators speed up ACP testing**
- **Carrier on/off power**
- **Total channel power, percent occupied bandwidth**
- **Burst-timing measurements**

Accurate and Easy-to-Use Power Measurements Using the 8560EC Series Spectrum Analyzers

Many wireless communications systems employ burst-carrier techniques such as time division multiple access (TDMA) and time division duplex (TDD) to maximize system capacity. The 8560EC series spectrum analyzers offer power measurements for both continuous and burst signals that are accurate, and easy to make. Measurement capability includes adjacent channel power (ACP), carrier power, channel power, and occupied bandwidth. These analyzers provide the greatest measurement flexibility and RF performance, making them powerful tools for R&D designers working with current wireless standards, or on systems with standards still under development.

The 8562EC Spectrum Analyzer

The 8562EC Spectrum Analyzer was designed specifically for digital communications. Its frequency coverage of 13.2 GHz means that now you can use the same analyzer for harmonic and spurious testing both in- and out-of-band. The increased dynamic range and third-order intercept (TOI) capability allows wireless communications engineers to test high-performance components in burst operation systems. See page 111 for details.

Measurement Utility Increases Speed and Repeatability

The 85672A Spurious Response Measurements Utility makes measurements fast and easy with the touch of a button. Works on all 8560EC series spectrum analyzers. See page 111 for details.

Adjacent Channel Power

The ability to measure ACP on wireless telephones, pagers, and other transmitters is critical in R&D, manufacturing and in the field. The 8560EC series spectrum analyzers provide ACP measurements for a variety of wireless communication systems, including support for NADC-TDMA, PDC, and PHS digital formats. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate, and easy-to-use ACP measurements. Use an 8560EC series spectrum analyzer with the 8563EC-K35 APCR test set to meet the needs of the W-CDMA specifications.

In addition to the standard analog method for making ACP measurements (used for FM mobile telephones and continuous digital formats), the analyzers support four other methods used for burst-carrier measurements of TDMA and TDD signals:

- Peak (for PDC and PHS)
- Two-bandwidth (for PDC)
- Time-gated (for NADC-TDMA)
- Burst-power (an Agilent proprietary method)

The burst-power method overcomes many of the problems of the other standards, and is suitable for all formats. These methods can easily be adapted to measure other transmitters besides those used for cellular or cordless telephones. Configuration parameters that can be set by the user include channel spacing and bandwidth, number of alternate channels, burst period and width, and values for root-raised-cosine frequency weighting. Measurement results can be displayed in both graphic and tabular formats for ease of data interpretation and documentation. Measurement accelerators are available that give ACP results in just a few seconds, allowing real-time transmitter adjustments.

Carrier Power

The carrier power feature provides the user with a quick means of measuring the average “on” and “off” power of the burst carrier. This measurement is performed in the time domain, using zero span.

Channel Power

The channel power feature quickly provides the user with information on total power within a specified channel bandwidth, as well as power density within the channel. This feature greatly simplifies this common measurement, as the spectrum analyzer automatically performs the necessary integration across the desired frequency band.

Occupied Bandwidth

Occupied bandwidth is a way of determining the spectral spread of a signal. It is defined as the bandwidth which contains the specified percent of the total transmitted power. The user may specify the percentage to be anywhere from 0.1 to 99.99 percent.

Burst Timing

Complete timing measurements can be made on the burst-carrier signal using digitized, fast time-domain (zero span) sweeps. Using sweep times as fast as 50 µs, edge times, burst width, and time between bursts can easily be measured.

More Information

More information about the 8560EC series spectrum analyzers, including ordering information, can be found on page 110.

- **30 to 300% faster than other analyzers**
- **Optional 25 MHz analysis bandwidth**
- **+15 dBm TOI, –154 dBm/Hz DANL**
- **0.3 dB absolute amplitude accuracy**
- **78 dB W-CDMA ACLR dynamic range**
- **Built in one-button measurement applications for Mobile WiMAX™, W-CDMA, HSDPA/HSUPA, phase noise, and more**
- **World-leading 89601A vector signal analysis software runs inside**

Eliminating the Compromise Between Speed and Performance

The MXA signal analyzer drives signal and spectrum analysis to the next level by offering the highest performance in a midrange analyzer and the industry's fastest signal and spectrum analysis.

Fastest Signal Analysis

Design validation and manufacturing floor engineers and managers agree that measurement speed is most critical in achieving their test goals. With this in mind, Agilent continues to compare the MXA's measurement speed against other signal and spectrum analyzers in the industry. The measurement results reveal that the MXA is 30 to 300% faster than other signal or spectrum analyzer regardless of the frequency range. Following are some key benchmark results.

- <14 ms W-CDMA ACLR fast mode measurement speed (σ = 0.2 dB)
- <5 ms marker peak search
- <51 ms tune, measure, and transfer over GPIB
- <75 ms measurement/mode switching speed for seamless switching between mobile WiMAX, W-CDMA, HSDPA/HSUPA, phase noise, and 89601A VSA (vector signal analysis) software

Highest Performance in a Midrange Signal Analyzer

Fast measurement speed doesn't mean compromising dynamic range. The MXA has the best-in-class dynamic range:

- +15 dBm third-order intercept (TOI)
- –154 dBm/Hz displayed average noise level (DANL)
- 78 dB W-CDMA ACLR dynamic range

With a 2 dB step mechanical attenuator or optional 1 dB step electrical attenuator and 160 resolution bandwidth settings (in 10% incremental steps), the MXA provides you with the best combination of speed and dynamic range.

Electronic Attenuator

The optional 3 GHz electronic attenuator is able to withstand millions of switches. The combination of exceptional measurement speed, user-definable pass/fail capability, and excellent repeatability, due to an all digital IF technology, make the MXA ideal for high-volume, low-cost manufacturing.

25 MHz Analysis Bandwidth

Activate optional 25 MHz analysis bandwidth to make measurements for Mobile WiMAX, multi-carrier W-CDMA, and other wideband signals using:

- 802.16 OFDMA and W-CDMA measurement applications
- 89601A VSA software
- CCDF measurements up to 25 MHz that covers four carrier W-CDMA signal
- 90 Msamples/sec, 14 bit ADC

Fully Calibrated Preamplifiers up to 26.5 GHz

Analyze low level signals on the only midrange analyzer to offer a choice of fully calibrated internal preamplifiers up to 26.5 GHz. You can select preamp frequency up to the maximum frequency of the instrument:

- Four different preamp frequencies are available: 100 kHz to 3.6, 8.4, 13.6 or 26.5 GHz
- Gain +20 dB from 100 kHz to 3.6 GHz and +35 dB from 3.6 to 26.5 GHz

Time Gating

Analyze time varying signals such as WiMAX, pulsed RF, time division multiple access (TDMA), and interleaved and burst-modulated signals with time gating capability. The Agilent MXA offers three types of time gating – gated LO (or gated sweep), gated video, and gated FFT:

- Gated LO offers the fastest time gating measurement for a full span of frequency
- Gated FFT offers the fastest time gating measurement within the span of analysis bandwidth (8 MHz standard, 25 MHz optional)
- Gated video offers the backward compatibility with Agilent ESA, 856x and 859x series spectrum analyzers

List Sweep

Save measurement time by programming the MXA analyzer for fast power measurements using the list sweep feature. Remotely extract amplitude values at known frequencies by making a list of single-point measurements in advance. The MXA can also run through the measurements without requiring you to reset the analyzer for each iteration of a measurement cycle. You can:

- Make multiple zero span measurements at multiple frequencies
- Choose different resolution bandwidths, video bandwidths, detector types, and sweep times at different sweep points
- Obtain peak and average power measurement result

89601A Vector Signal Analysis (VSA) Software Runs in the Instrument

The MXA is the first signal analyzer that has the world's best-selling VSA software running in it. It offers a convenient access to analysis of complex, time-varying signals using the advanced modulation analysis algorithms to help you develop, troubleshoot, and verify the physical layer performance of your radio system. Easily navigate the 89601A VSA user interface using a keyboard and mouse. A 14-day trial version of the 89601A VSA software is included in every MXA signal analyzer. Evaluate the software for free and access the in-depth help file to learn more about the software. See page 124 (where the VSA is described) for further information of VSA.

MATLAB®

MXA officially supports MATLAB. You can run MATLAB and 89601A VSA, the two most popular software products for system designers in the wireless communication industry, in a single instrument. MATLAB support allows you to create custom measurement programs for the MXA. In addition, Agilent provides plenty of sample programs – visit **www.agilent.com/find/matlab_sa** for drivers, sample programs, and more information.

One-button Power Measurements: Power Suite

The spectrum analysis capability in the MXA provides both standards-based power measurements and enhanced traditional spectrum analysis. Power Suite, a subset of the spectrum analyzer capability, provides a comprehensive set of flexible, one-button RF and microwave power measurements. Wireless standards-based setups include: 2G/3G, WLAN, Bluetooth®, UWB, and S-DMB. Use the more than 75 quick setups or use custom settings for specific power measurements that are not already preconfigured. The Power Suite includes:

- Adjacent channel power (ACP)
- Channel power
- Occupied bandwidth (OBW)
- Spectrum emission mask (SEM)
- Complementary cumulative distribution function (CCDF)
- Burst power
- Spurious emissions

Visit **www.agilent.com/find/mxa** for the latest set of available measurements and presets for standards.

Auto Tune

Save set-up time with the Auto Tune feature. At the press of a button, a mathematical algorithm is executed that automatically changes the analyzer's center frequency to the strongest signal in the tunable span of the analyzer. It also adjusts the span to three times the occupied bandwidth of the signal, sets the resolution and video bandwidth, optimizes the reference level, performs a peak search, sets a maker on the peak, and displays the measurement result.

Advanced Markers and Traces

Determine the precise value at each trace point quickly with MXA's advanced marker capability. Twelve markers, either frequency or position based, are available. Any marker can be a reference for other markers. Band marker enables easy setup for power ratio measurements such as adjacent channel power (ACP) and noise power ratio (NPR). You can view all readings of the markers on the marker table. You can also display up to six traces, such as a carrier plus up to five harmonics, in the same display window. In addition, you can choose one of detectors (Normal, Average/RMS, Positive peak, Negative peak) to each trace independently.

Built-in Help

Instead of storing and scouring through hundreds of pages of manuals, just press the Help key to evoke a comprehensive context-sensitive help system inside the MXA – any key, any menu, anytime. Use keys on the MXA's front panel to view the rich manual content which also includes handy SCPI programming commands.

Agilent Open

Modern Connectivity

Take advantage of the modern connectivity as well as the legacy connectivity and backward compatibility:

- Connect your MXA to a LAN and control the MXA remotely – view signals and acquire and analyze waveform data from anywhere in the world using either the embedded web server or Windows Remote Desktop software
- Connect the MXA to the LAN to share files and print to networked computers
- Use IVI-COM drivers for Agilent VEE
- Save time by reusing test code with the MXA's backward code compatibility to the ESA and PSA as well as code written for EXA
- Chose the best connection for your requirements:
  - USB 2.0 – six type A, one type B
  - LAN – 100 based-T
  - GPIB

LXI™

LXI class C Compliant (Class-B mid 2008)

LXI (LAN eXtensions for Instruments), the test-system architecture based on proven, widely used standards such as Ethernet, enables fast, efficient, and cost-effective creation – and reconfiguration – of test systems. The MXA is an LXI class C compliant signal analyzer that can help you and your team open new possibilities in testing. For more information, visit **www.agilent.com/find/lxi**

Open Windows® XP Professional Operating System

- Manage files easily and quickly using Windows Explorer
- Run MATLAB and the 89601A vector signal analysis software inside the MXA
- Trouble shoot and control the MXA via Windows Remote Desktop software or with them embedded web server (LXI class C compliant)

Frequency and Time Specifications

Frequency Range

	DC Coupled	AC Coupled
Option 503	20 Hz to 3.6 GHz	10 MHz to 3.6 GHz
Option 508	20 Hz to 8.4 GHz	10 MHz to 8.4 GHz
Option 513	20 Hz to 13.6 GHz	10 MHz to 13.6 GHz
Option 526	20 Hz to 26.5 GHz	10 MHz to 26.5 GHz

Band	LO Multiple (N)	
0	1	20 Hz to 3.6 GHz
1	1	3.5 to 8.4 GHz
2	2	8.3 to 13.6 GHz
3	2	13.5 to 17.1 GHz
4	4	17 to 26.5 GHz

Frequency Reference

Accuracy	±[(time since last adjustment x aging rate) + temperature stability + calibration accuracy]	
Aging rate	Option PFR	Standard
	$\pm 1 \times 10^{-7}$/year	$\pm 1 \times 10^{-6}$/year
	$\pm 1.5 \times 10^{-7}$/2 years	
Temperature stability	Option PFR	Standard
20 to 30°C	$\pm 1.5 \times 10^{-8}$	$\pm 2 \times 10^{-6}$
5 to 50°C	$\pm 5 \times 10^{-8}$	$\pm 2 \times 10^{-6}$
Achievable initial calibration accuracy	Option PFR	Standard
	$\pm 4 \times 10^{-8}$	$\pm 1.4 \times 10^{-6}$
Residual FM		
Option PFR	≤(0.25 Hz x N) p-p in 20 ms nominal	
Standard	≤(10 Hz x N) p-p in 20 ms nominal See band table above for N (LO Multiple)	

Frequency Readout Accuracy (start, stop, center, marker)
± (marker frequency x frequency reference accuracy + 0.25% x span + 5% x RBW + 2 Hz + 0.5 x horizontal resolution*)

Marker Frequency Counter

Accuracy	±(marker frequency x frequency reference accuracy + 0.100 Hz)
Delta counter accuracy	±(delta frequency x frequency reference accuracy + 0.141 Hz)
Counter resolution	0.001 Hz

Frequency Span (FFT and swept mode)

Range	0 Hz (zero span), 10 Hz to maximum frequency of instrument
Resolution	2 Hz
Accuracy	
Swept	±(0.25% x span + horizontal resolution)
FFT	±(0.10% x span + horizontal resolution)

Sweep Time and Triggering

Range	
Span = 0 Hz	1 us to 6000 s
Span ≥10 Hz	1 ms to 4000 s
Accuracy	
Span ≥10 Hz, swept	±0.01% nominal
Span ≥10 Hz, FFT	±40% nominal
Span = 0 Hz	±0.01% nominal
Trigger	
Free run, line, video, external 1, external 2, RF burst, periodic timer	
Trigger delay	
Span = 0 Hz or FFT	–150 to +500 ms
Span ≥10 Hz, swept	1 us to 500 ms
Resolution	0.1 us

Sweep (trace) Point Range

All spans	1 to 20001

Time Gating

Gate method	Gated LO; Gated video; Gated FFT
Gate length (except method:FFT)	100 ns to 5 s
Gate delay range	0 to 100 s
Gate delay jitter	33.3 ns p-p (nominal)

Resolution Bandwidth (RBW)

Range (–3.01 dB bandwidth)	1 Hz to 3 MHz (10% steps), 4, 5, 6, 8 MHz
Bandwidth accuracy (power)	
RBW range:	
1 Hz to 750 kHz	±1.0% (±0.044 dB)
820 kHz to 1.2 MHz (<3.6 GHz CF)	±2.0% (±0.088 dB)
1.3 to 2.0 MHz (<3.6 GHz CF)	± 0.07 dB nominal
2.2 to 3 MHz (<3.6 GHz CF)	± 0.15 dB nominal
4 to 8 MHz (<3.6 GHz CF)	± 0.25 dB nominal
Bandwidth accuracy (–3.01 dB)	
RBW range (1 Hz to 1.3 MHz)	±2% nominal
Selectivity (–60 dB/–3 dB)	4.1:1 nominal

Analysis Bandwidth

Maximum bandwidth	
Option B25	25 MHz
Standard	10 MHz

Video Bandwidth (VBW)

Range	1 Hz to 3 MHz (10% steps), 4, 5, 6, 8 MHz and wide open (labeled 50 MHz)
Accuracy	±6% nominal

Stability

See Phase noise under Dynamic Range Specification

Measurement Speed

Local measurement and display update rate	Sweep points = 1001 11 ms (90/s) nominal
Remote measurement and LAN transfer rate	Sweep points = 1001 4 ms (250/s) nominal
Marker peak search	5 ms nominal
Center frequency tune and transfer (RF)	51 ms nominal
Center frequency tune and transfer (µW)	86 ms nominal
Measurement/ mode switching	75 ms nominal

Amplitude Accuracy and Range Specifications

Amplitude Range

Measurement range	Displayed average noise level (DANL) to maximum safe input level
Input attenuator range (20 Hz to 26.5 GHz)	0 to 70 dB in 2 dB steps

Electronic Attenuator (Option EA3)

Frequency range	20 Hz to 3.6 GHz
Attenuation range	
Electronic attenuator range	0 to 24 dB, 1 dB steps
Full attenuation range (mechanical + electronic)	0 to 94 dB, 1 dB steps

Maximum Safe Input Level

Average total power	+30 dBm (1 W)
Preamp (Option P03, P08, P13, P26)	+25 dBm
Peak pulse power	<10 us pulse width, <1% duty cycle and +50 dBm (100 W) input attenuation ≥30 dB
DC volts	
DC coupled	±0.2 Vdc
AC coupled	±70 Vdc

Display Range

Log scale	0.1 to 1 dB/division in 0.1 dB steps 1 to 20 dB/division in 1 dB steps (10 display divisions)
Linear scale	10 divisions
Scale units	dBm, dBmV, dBµV, dBmA, dBµA, V, W, A

* Horizontal resolution is span/(sweep points –1)

N9020A

Frequency Response

(10 dB input attenuation, 20 to 30°C, preselector centering applied, σ = nominal standard deviation)

	Specification	95th Percentile (≈ 2 σ)
20 Hz to 10 MHz	±0.6 dB	±0.28 dB
10 MHz to 3.6 GHz	±0.45 dB	±0.17 dB
3.5 to 8.4 GHz	±1.5 dB	±0.48 dB
8.3 to 13.6 GHz	±2.0 dB	±0.47 dB
13.5 to 22.0 GHz	±2.0 dB	±0.52 dB
22.0 to 26.5 GHz	±2.5 dB	±0.71 dB
Preamp on (Option P03, P08, P13, P26, 0 dB attenuation)		
100 kHz to 3.6 GHz	±0.75 dB	±0.28 dB
3.5 to 8.4 GHz	±2.0 dB	±0.53 dB
8.3 to 13.6 GHz	±2.3 dB	±0.60 dB
13.5 to 17.1 GHz	±2.5 dB	±0.81 dB
17.0 to 22.0 GHz	±2.5 dB	±0.81 dB
22.0 to 26.5 GHz	±3.5 dB	±1.25 dB

Input Attenuation Switching Uncertainty

50 MHz (reference frequency) attenuation >2 dB	±0.20 dB (±0.08 dB typical)
20 Hz to 3.6 GHz	±0.3 dB nominal
3.5 to 8.4 GHz	±0.5 dB nominal
8.3 to 13.6 GHz	±0.7 dB nominal
13.5 to 26.5 GHz	±0.7 dB nominal

Total Absolute Amplitude Accuracy

(10 dB attenuation, 20 to 30°C, 1 Hz ≤RBW ≤1 MHz, input signal –10 to –50 dBm, all settings auto-coupled except Auto Swp Time = Accy, any reference level, any scale, σ = nominal standard deviation)

At 50 MHz	±0.33 dB
At all frequencies	±(0.33 dB + frequency response)
20 Hz to 3.6 GHz	±0.24 dB (95th Percentile ≈ 2 σ)
Preamp On (Option P03, P08, P13, P26)	
At all frequencies	±(0.39 dB + frequency response)

Input Voltage Standing Wave Ratio (VSWR)

(≥10 dB input attenuation)

10 MHz to 3.6 GHz	<1.2:1 nominal
3.6 to 8.4 GHz	<1.5:1 nominal
8.4 to 13.6 GHz	<1.6:1 nominal
13.6 to 26.5 GHz	<1.9:1 nominal
Preamp On (Option P03, P08, P13, P26, 0 dB attenuation)	
10 MHz to 3.6 GHz	<1.7:1 nominal
3.6 to 8.4 GHz	<1.8:1 nominal
8.4 to 13.6 GHz	<2.0:1 nominal
13.6 to 26.5 GHz	<2.0:1 nominal

Resolution Bandwidth Switching Uncertainty

(referenced to 30 kHz RBW)

1 Hz to 1.5 MHz RBW	±0.05 dB
1.6 MHz to 3 MHz RBW	±0.10 dB
4, 5, 6, 8 MHz RBW	±1.0 dB

Reference Level

Range:	
Log scale	–170 to +30 dBm in 0.01 dB steps
Linear scale	Same as Log (707 pV to 7.07 V)
Accuracy	0 dB

Display Scale Switching Uncertainty

Switching between linear and log	0 dB
Log scale/div switching	0 dB

Display Scale Fidelity

Between –10 dBm and –80 dBm input mixer level	±0.10 dB total

Trace Detectors

Normal, peak, sample, negative peak, log power average, RMS average, and voltage average

Preamplifier

Frequency Range	
Option P03	100 kHz to 3.6 GHz
Option P08	100 kHz to 8.4 GHz
Option P13	100 kHz to 13.6 GHz
Option P26	100 kHz to 26.5 GHz
Gain	
100 kHz to 3.6 GHz	+20 dB nominal
3.6 to 26.5 GHz	+35 dB nominal
Noise Figure	
100 kHz to 3.6 GHz	11 dB nominal
3.6 to 8.4 GHz	9 dB nominal
8.4 to 13.6 GHz	10 dB nominal
13.6 to 26.5 GHz	15 dB nominal

Dynamic Range Specifications

1 dB Gain Compression (two-tone)

	Total Power at Input Mixer	
20 to 500 MHz	0 dBm	+3 dBm typical
500 MHz to 3.6 GHz	+3 dBm	+7 dBm typical
3.6 GHz to 26.5 GHz	0 dBm	+4 dBm typical
Preamp On (Option P03, P08, P13, P26)		
10 MHz to 3.6 GHz		–10 dBm nominal
3.6 to 26.5 GHz		
Tone spacing 100 kHz to 20 MHz		–26 dBm nominal
Tone spacing >70 MHz		–16 dBm nominal

Displayed Average Noise Level (DANL)

(Input terminated, sample or averaging type = Log, 0 dB input attenuation, IF Gain = High, 20 to 30°C.)

Preamp Off	Specification	Typical
9 kHz to 1 MHz		–125 dBm
1 to 10 MHz	–150 dBm	–153 dBm
10 MHz to 2.1 GHz	–151 dBm	–154 dBm
2.1 to 3.6 GHz	–149 dBm	–152 dBm
3.6 to 8.4 GHz	–149 dBm	–153 dBm
8.4 to 13.6 GHz	–148 dBm	–151 dBm
13.6 to 17.1 GHz	–144 dBm	–147 dBm
17.1 to 20.0 GHz	–143 dBm	–146 dBm
20.0 to 26.5 GHz	–136 dBm	–142 dBm
Preamp On (Option P03, P08, P13, P26)		
100 kHz to 1 MHz		–149 dBm
1 to 10 MHz	–161 dBm	–163 dBm
10 MHz to 2.1 GHz	–163 dBm	–166 dBm
2.1 to 3.6 GHz	–162 dBm	–164 dBm
3.6 to 8.4 GHz	–162 dBm	–166 dBm
8.4 to 13.6 GHz	–162 dBm	–165 dBm
13.6 to 17.1 GHz	–159 dBm	–163 dBm
17.1 to 20.0 GHz	–157 dBm	–161 dBm
20.0 to 26.5 GHz	–152 dBm	–157 dBm

Spurious Responses

Residual Responses	
(Input terminated and 0 dB attenuation)	
200 kHz to 8.4 GHz (swept)	–100 dBm
Zero span or FFT or other frequencies	–100 dBm nominal
Image Responses	
10 MHz to 3.6 GHz	–80 dBc (–107 dBc typical)
3.6 to 13.6 GHz	–78 dBc (–88 dBc typical)
13.6 to 17.1 GHz	–74 dBc (–85 dBc typical)
17.1 to 22 GHz	–70 dBc (–82 dBc typical)
22 to 26.5 GHz	–68 dBc (–78 dBc typical)
LO Related Spurious	
(f >600 MHz from carrier)	
10 MHz to 3.6 GHz	–90 dBc typical
Other spurious f ≥10 MHz from carrier	–80 dBc

Second Harmonics Distortion (SHI)

	Mixer level	Distortion	SHI
10 MHz to 1.8 GHz	–15 dBm	–60 dBc	+45 dBm
1.8 to 7.0 GHz	–15 dBm	–80 dBc	+65 dBm
7.0 to 11.0 GHz	–15 dBm	–70 dBc	+55 dBm
11.0 to 13.25 GHz	–15 dBm	–65 dBc	+50 dBm

Preamp On (Option P03, P08, P13, P26)

	Preamp level	Distortion	SHI
10 MHz to 1.8 GHz	–45 dBm	–78 dBc nominal	+33 dBm nominal
1.8 to 13.25 GHz	–50 dBm	–60 dBc nominal	+10 dBm nominal

Third-order Intermodulation Distortion (TOI)

(two –30 dBm tones at input mixer with tone separation >5 times IF prefilter bandwidth, 20 to 30°C, see Specifications Guide for IF prefilter bandwidths)

	Distortion	TOI	Typical
10 to 100 MHz	–84 dBc	+12 dBm	+17 dBm
100 to 400 MHz	–88 dBc	+14 dBm	+18 dBm
400 MHz to 1.7 GHz	–90 dBc	+15 dBm	+19 dBm
1.7 to 3.6 GHz	–92 dBc	+16 dBm	+19 dBm
3.6 to 8.4 GHz	–90 dBc	+15 dBm	+18 dBm
8.4 to 13.6 GHz	–90 dBc	+15 dBm	+18 dBm
13.6 to 26.5 GHz	–80 dBc	+10 dBm	+14 dBm

Preamp on (Option P03, P08, P13, P26)

(two –45 dBm tones at preamp input)

10 to 500 MHz	+4 dBm nominal
500 MHz to 3.6 GHz	+5 dBm nominal
3.6 to 26.5 GHz	–15 dBm nominal

Phase Noise

Noise sidebands (20 to 30°C, CF = 1 GHz)

Offset	Specification	Typical
100 Hz	–84 dBc/Hz	–88 dBc/Hz
1 kHz		–100 dBc/Hz nominal
10 kHz	–103 dBc/Hz	–106 dBc/Hz
100 kHz	–115 dBc/Hz	–117 dBc/Hz
1 MHz	–133 dBc/Hz	–137 dBc/Hz
10 MHz		–148 dBc/Hz nominal

Power Suite Measurement Specifications

Channel Power

Amplitude accuracy, W-CDMA or IS-95 (20 to 30°C, attenuation = 10 dB): ±0.80 dB (±0.30 dB 95th percentile)

Occupied Bandwidth (OBW)

Frequency accuracy ±[span/1000] nominal

Adjacent Channel Power (ACP)

Accuracy, W-CDMA (ACLR)

(at specific mixer levels and ACLR ranges)	Adjacent	Alternate
MS	±0.14 dB	±0.21 dB
BTS	±0.49 dB	±0.44 dB
Dynamic range (typical)		
Without noise correction	–73 dB	–79 dB
With noise correction	–78 dB	–82 dB
Offset channel pairs measured	1 to 6	

ACP speed (fast method). Data measurement and transfer time: 14 ms nominal (σ = 0.2 dB)

ACPR dynamic range, W-CDMA (5 MHz offset, RRC weighted, 3.84 MHz noise bandwidth)

Two carriers	–70 dB nominal
Four carriers	–64 dB nominal
With noise correction	–72 dB nominal

ACPR accuracy (two carriers, 5 MHz offset, –48 dBc ACPR): ±0.42 dB nominal

Multiple number of carriers measured: Up to 12

Power Statistics CCDF

Histogram resolution 0.01 dB

Spurious Emission

W-CDMA (1 to 3.6 GHz)

Table driven spurious signals; search across regions.

Dynamic range	95.3 dB (100.3 dB typical)
Absolute sensitivity	–84.4 dBm (–89.4 dBm typical)

Spectrum Emission Mask (SEM)

cdma2000 (750 kHz offset)	
Relative dynamic range (30 kHz RBW)	78.9 dB (85.0 dB typical)
Absolute sensitivity	–99.7 dBm (–104.7 dBm typical)
Relative accuracy	±0.11 dB
3GPP W-CDMA (2.515 MHz offset)	
Relative dynamic range (30 kHz RBW)	81.9 dB (88.2 dB typical)
Absolute sensitivity	–99.7 dBm (–104.7 dBm typical)
Relative accuracy	±0.12 dB

General Specifications

Temperature Range

Operating	5 to +50°C
Storage	–40 to +65°C

EMC

Complies with European EMC Directive 89/336/EEC, amended by 93/68/EEC

- IEC/EN 61326
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11:2002
- ICES/NMB-001

Safety

Complies with European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC

- IEC/EN 61010-1
- Canada:CSA C22.2 No.61010-1
- USA:UL 61010-1

Audio Noise

Acoustic noise emission	Geraeuschemission
LpA <70 dB	LpA <70 dB
Operator position	Am Arbeitsplatz
Normal position	Normaler Betrieb
Per ISO 7779	Nach DIN 45635 t.19

Environmental Stress

Samples of this product have been type tested in accordance with the Agilent Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation and end-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-2800F Class 3.

Power Requirements

Voltage and frequency (nominal)	100/120 V, 50/60 Hz 220/240 V, 50/60 Hz

Power Consumption

On	< 260 watts
Standby	< 20 watts

Data Storage

Internal	40 GB nominal
External	Supports USB 2.0 compatible memory devices

Weight (without options)

Net	16 kg (35 lbs) nominal
Shipping	28 kg (62 lbs) nominal

Dimensions

Height	177 mm (7.0 in)
Width	426 mm (16.8 in)
Length	368 mm (14.5 in)

Warranty

The MXA signal analyzer is supplied with a one-year warranty.

Calibration Cycle

The recommended calibration cycle is one year: Calibration services are available through Agilent service centers.

Input and Outputs

Front Panel

RF input	
Connector	Type-N female, 50 ohm nominal
Probe power	
Voltage/current	+15 Vdc, ±7% at 150 mA max nominal –12.6 Vdc, ±10% at 150 mA max nominal
USB 2.0 ports	
Master (2 ports)	
Standard	Compatible with USB 2.0
Connector	USB Type-A female
Output current	0.5 A nominal

Rear Panel

10 MHz out	
Connector	BNC female, 50 ohm nominal
Output amplitude	≥0 dBm nominal
Frequency	10 MHz ±(10 MHz x frequency reference accuracy)
Ext Ref in	
Connector	BNC female, 50 ohm nominal
Input amplitude range	–5 to +10 dBm nominal
Input frequency	1 to 50 MHz nominal
Frequency lock range	$\pm 5 \times 10^{-6}$ of specified external reference input frequency
Trigger 1 and trigger 2 inputs	
Connector	BNC female
Impedance	>10 kOhm nominal
Trigger level range	–5 to +5 V
Trigger 1 and trigger 2 outputs	
Connector	BNC female
Impedance	50 Ohm nominal
Level	5 V TTL nominal
Sync (reserved for future use)	
Connector	BNC female
Monitor output	
Connector	VGA compatible, 15-pin mini D-SUB
Format	XGA (60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	1024 x 768
Noise source drive +28 V (pulsed) (reserved for future use)	
Connector	BNC female
SNS series noise source (reserved for future use)	
Digital bus (reserved for future use)	
Connector	MDR-80
Analog out (reserved for future use)	
Connector	BNC female
USB 2.0 ports	
Master (4 ports)	
Standard	Compatible with USB 2.0
Connector	USB Type-A female
Output current	0.5 A nominal
Slave (1 port)	
Standard	Compatible with USB 2.0
Connector	USB Type-B female
Output current	0.5 A nominal
GPIB interface	
Connector	IEEE-488 bus connector
GPIB code	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3, C28, DT1, L4, C0
LAN TCP/IP interface	
Standard	100BaseT
Connector	RJ45 Ethertwist

Accessories

Additional accessories provide more protection for your MXA signal analyzer in tough environments.

N9020A-HTC MXA Hard Transit Case
Ultra-durable wheeled carrying case offers maximum protection and portability. This transit case comes with retractable handle, edge casters, and bumpers. A custom cut polyethylene foam insert provides additional protection for your MXA signal analyzer.

N9020A-PRC MXA Portable Configuration
Add a convenient pivoting carrying handle and rubber protective corner and end guards. This configuration is intended for applications requiring more rugged packaging, such as in the field. Front panel protective cover is included in both the standard and portable configurations.

Key Literature & Web Link

Agilent MXA Signal Analyzer Data Sheet, p/n 5898-4942EN
Agilent MXA Signal Analyzer Configuration Guide, p/n 5989-4943EN
Agilent MXA Signal Analyzer Photo Card, p/n 5989-4940EN
Agilent MXA Brochure, p/n 5989-5047EN
Agilent MXA Demonstration Guide, p/n 5989-6126EN
Select the Right Agilent Signal Analyzer for Your Needs, Selection Guide, p/n 5968-3413E
Spectrum Analysis Basics Application Note 150, p/n 5952-0292
Vector Signal Analysis Basics Application Note 150-15, p/n 5989-1121EN
89600 Series Vector Signal Analysis Software Technical Overview, p/n 5989-1679
Using the Agilent MXA Signal Analyzer for Measuring and Troubleshooting Digitally Modulated Signals Application Note, p/n 5989-4944EN
Using MXA Preselector Tuning for Amplitude Accuracy in Microwave Spectrum Analysis Application Note, p/n 5989-4946EN
Maximizing Measurement Speed with the Agilent MXA Signal Analyzer Application Note, p/n 5989-4947EN

For more information on MXA please visit:
www.agilent.com/find/mxa

Ordering Information

For further information, refer to MXA Signal Analyzer Configuration Guide (5989-4943EN)

Hardware

N9020A MXA Signal Analyzer
- **N9020A-503** Frequency Range, 20 Hz to 3.6 GHz
- **N9020A-508** Frequency Range, 20 Hz to 8.4 GHz
- **N9020A-513** Frequency Range, 20 Hz to 13.6 GHz
- **N9020A-526** Frequency Range, 20 Hz to 26.5 GHz
- **N9020A-B25** Analysis Bandwidth, 25 MHz
- **N9020A-PFR** Precision Frequency Reference (variable)
- **N9020A-EA3** Electronic Attenuator, 3.6 GHz
- **N9020A-P03** Preamplifier, 3.6 GHz
- **N9020A-P08** Preamplifier, 8.4 GHz
- **N9020A-P13** Preamplifier, 13.6 GHz
- **N9020A-P26** Preamplifier, 26.5 GHz
- **N9020A-ESC** External Source Control (available 2008)
- **N9020A-CPU** Instrument security, additional CPU/HDD

Accessories
- **N9020A-MSE** Mouse
- **N9020A-KYB** Keyboard
- **N9020A-EFM** USB Flash Drive, 512 MB
- **N9020A-DVR** USB DVD-ROM/CD-R/RW Drive
- **N9020A-MLP** Minimum Loss Pad, 50 to 75 ohm
- **N9020A-PRC** Portable Configuration
- **N9020AK-CVR** Front Panel Cover, additional
- **N9020A-1CP** Rack Mount and Handle Kit
- **N9020A-1CM** Rack Mount Kit
- **N9020A-1CN** Front Handle Kit
- **N9020A-1CR** Rack Slide Kit
- **N9020A-HTC** Hard Transit Case

Applications
See page 123 X-series measurement application section

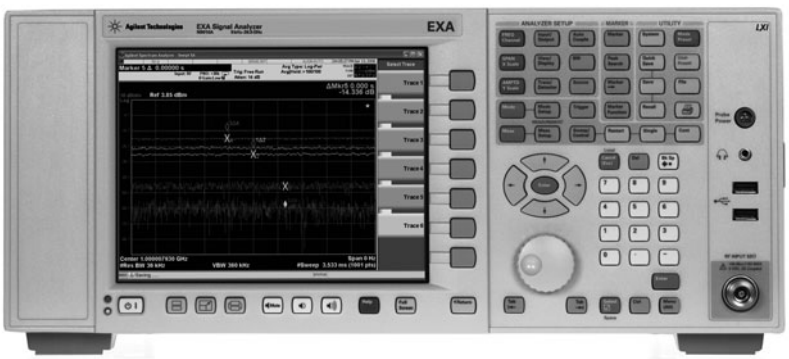
Documentation
- **N9020A-1A7** ISO17025 Compliant Calibration
- **N9020A-A6J** ANSI Z540 Compliant Calibration
- **N9020A-AB1** Getting Started Korean
- **N9020A-ABJ** Getting Started Japanese
- **N9020A-ABD** Getting Started German
- **N9020A-ABF** Getting Started French
- **N9020A-AKT** Getting Started Russian

Warranty and Service
Standard warranty is one year
R-51B-001-3C 1 year return-to-Agilent warranty extended to 3 years

Calibration (Options not available in all countries)
R-50C-011-3 Inclusive calibration plan, 3 year coverage
R-50C-013-3 Inclusive calibration plan and cal data, 3 year coverage

N9010A

- **Make affordable, highly accurate general-purpose measurements with –160 dBm/Hz DANL using the 3.6 GHz preamplifier option**
- **Advanced troubleshooting with capabilities formerly found only on high-end signal analyzers such as: fast mode switching, 4-ms peak search, six independent traces, 12 markers, band power markers, and extensive peak table**
- **Utilize the broadest application coverage available in an economy-class signal analyzer with shared applications common to EXA and MXA signal analyzers including phase noise, noise figure, and analog demodulation**
- **Analyze modulated signals with Agilent's leading 89601A vector signal analysis software running inside the EXA on an open Windows platform**
- **Choose and use the connectivity you need with included GPIB, 100BASE-T LAN and USB 2.0 ports – now LXI class C compliant**



The Agilent EXA Economy Signal Analyzer offers unprecedented speed, accuracy, and application coverage for an economy class instrument.

Make Every Millisecond Count

From product design to the production line, every device demands decisions that require tradeoffs in your goals – product specifications, throughput and yield. Whether you're focused on time-to-market, time-to-volume or cost of test, your choice of economy-class signal analyzer should help you save both time and money. The Agilent EXA signal analyzer makes this possible by eliminating the compromise between speed and price. In addition, the outstanding accuracy of the EXA lets you accelerate the transition from design into manufacturing and helps reduce your overall cost of test. When you need speed without compromise, the Agilent EXA signal analyzer lets you make every millisecond count.

Enhance Yield and Throughput with Excellent Speed and Accuracy

- Improve test-system throughput with capabilities such as fast (10-ms) remote sweep and trace transfer
- Make highly accurate general-purpose measurements – affordably
- Characterize signal quality with a suite of fast, one-button RF power measurements
- Build on the familiarity of ESA Series – the world's most popular economy spectrum analyzer – and the benefits of ESA/EXA code compatibility

Highest Performance in an Economy Class Signal Analyzer

Fast measurement speed doesn't mean compromising dynamic range. With optional 2 dB step mechanical attenuator or 1 dB step electrical attenuator and 160 resolution bandwidth settings (in 10% incremental steps), the EXA provides you with the best combination of speed and dynamic range. EXA's electronic attenuator is able to withstand millions of switches – making it ideal for high speed manufacturing.

89601A Vector Signal Analysis (VSA) Software Runs in the Instrument

The EXA has the world's best-selling VSA software running in it. It offers a convenient access to analysis of complex, time-varying signals using the advanced modulation analysis algorithms to help you develop, troubleshoot, and verify the physical layer performance of your radio system. Easily navigate the 89601A VSA user interface using a keyboard and mouse. A 14-day trial version of the 89601A VSA software is included in every EXA signal analyzer. Evaluate the software for free and access the in-depth help file to learn more about the software. See page 124 for further information of VSA software.

Simplify Manual Testing with An Advanced – Yet Familiar – User Interface

- Save time and effort with capabilities such as fast mode switching, 4-ms peak search, six independent traces, 12 markers, band power markers and a peak table
- Transfer test results quickly and easily via built-in 100BASE-T LAN and USB 2.0 ports
- Ensure easy operation and connectivity through the familiarity and openness of Windows®

Reach New Insights Faster with Versatile Measurement Capabilities

- Confidently pinpoint signal quality issues with accurate measurements
- Perform advanced troubleshooting with capabilities formerly found only on high-end signal analyzers
- Utilize the broadest application coverage available in an economy-class signal analyzer including the 89600 vector signal analysis software, phase noise, analog demodulation and noise figure
- Enhance the EXA with easy updates as test needs and budgets evolve
- Address the latest standards – W-CDMA/HSDPA/HSUPA, GSM/EDGE, cdma2000, Mobile WiMAX – with specific measurement applications and a suite of fast, one-button RF power measurements
- Run applications such as MATLAB inside the EXA

Enhanced Standard Features

Auto Tune
At the press of a button, the analyzers center frequency adjusts to the strongest signal in the tunable span of the analyzer, changes the span to three times the occupied bandwidth of the signal, sets the resolution and video bandwidth, optimizes the reference level, performs a peak search, sets a maker on the peak, and displays the measurement result. This is a patented Agilent exclusive feature.

Advanced Markers and Traces
Determine the precise value at each trace point quickly with the advance marker capability. Twelve independent markers, based on frequency or position, can be set as a reference for any other marker. Band marker enables easy setup for power ratio measurements and results can be viewed on the marker table. Display up to six traces, in the same display window, each with independent detectors.

Built in Help
Instead of searching through hundreds of pages in a manual, just press Help key to evoke comprehensive help system inside the EXA – any key, any menu, anytime. This includes handy SCPI programming commands.

Time Gating
Analyze time varying signals such as WiMAX, pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated with time gating capability. The Agilent EXA offers three types of Time Gating: Gated LO (or Gated sweep), Gated Video and Gated FFT.

- Gated LO offers the fastest Time Gating measurement for full span of frequency
- Gated FFT offers the fastest Time Gating measurement within the span of analysis bandwidth (10 MHz)
- Gated Video offers the backward compatibility with Agilent ESA, 856x and 859x series spectrum analyzers

List Sweep
Save measurement time by programming the EXA analyzer for fast power measurements using the list sweep feature. Remotely extract amplitude values at known frequencies by making a list of single-point measurements in advance. The EXA can run through the measurements without requiring you to reset the analyzer for any iteration of a measurement cycle.

MATLAB
Agilent supports MATLAB driver officially allowing you to run MATLAB and 89601A VSA, which are the two most popular software products for system designers in the wireless communication industry. Agilent also provides sample programs at:
www.agilent.com/find/matlab_sa

Advanced Measurement Applications
Please see the measurement application section on page 123 for standards based, one-button measurement applications such as: phase noise, noise figure, analog demodulation, WiMAX, GSM/Edge, cdma2000, and W-CDMA. These advanced measurements applications can be used on the economy class EXA or our mid range MXA.

Specifications
For full specification information please see **www.agilent.com/find/exa**

Key Literature & Web Link
www.agilent.com/find/exa

Ordering Information

Instrument
N9010A MXA Signal Analyzer
(includes spectrum analyzer measurement application)
- **N9010A-503** Frequency Range, 9 kHz to 3.6 GHz, non-upgradeable
- **N9010A-507** Frequency Range, 9 kHz to 7.0 GHz, non-upgradeable
- **N9010A-513** Frequency Range, 9 kHz to 13.6 GHz, non-upgradeable
- **N9010A-526** Frequency Range, 9 kHz to 26.5 GHz, non-upgradeable
- **N9010A-PRC** Portable configuration, upgradeable

Performance Options
- **N9010A-PFR** Precision Frequency Reference, upgradeable
- **N9010A-EA3** Electronic Attenuator, 3.6 GHz, upgradeable
- **N9010A-FSA** Fine Step Attenuator, upgradeable
- **N9010A-P03** Preamplifier, 3.6 GHz, upgradeable

Accessories
- **N9010A-EFM** USB Flash Drive, 512 MB, upgradeable
- **N9010A-DVR** USB DVD-ROM/CD-R/RW Drive, upgradeable
- **N9010A-MSE** Mouse, USB Interface, upgradeable
- **N9010A-KYB** Keyboard, USB Interface, upgradeable
- **N9010A-MLP** Minimum Loss Pad, 50 to 75 ohms (Type N to BNC), upgradeable
- **N9010A-CVR** Front Panel Protective Cover, upgradeable
- **N9010A-HTC** Hard Transit Case, upgradeable
- **N9010A-1CP** Rack Mount Kit with Handles, upgradeable
- **N9010A-1CN** Front Handle Kit, upgradeable
- **N9010A-1CM** Rack Mount Kit, upgradeable
- **N9010A-1CR** Rack Slide Kit, upgradeable

Measurement Applications
(can also be used on the MXA midrange signal analyzer)
N9075A WiMAX 802.16-OFDMA Measurement Application, upgradeable
N9073A-1FP W-CDMA Measurement Application, upgradeable
N9073A-2FP HSDPA/HSUPA Measurement Application (requires 1FP), upgradeable
N9068A Phase Noise Measurement Application, upgradeable
89601A 89601A Vector Signal Analysis (VSA) Software, upgradeable

Warranty and Service
Standard warranty is one year
R-51B-001-3C 1 year return-to-Agilent warranty extended to 3 years

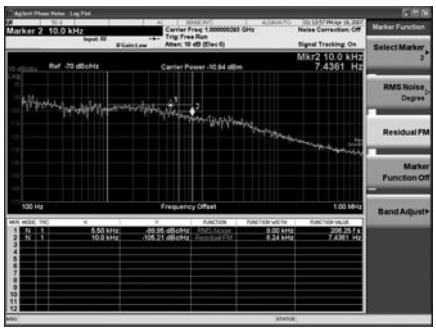
Calibration (Options not available in all countries)
R-50C-011-3 Inclusive calibration plan, 3 year coverage
R-50C-013-3 Inclusive calibration plan and cal data, 3 year coverage

A growing list of X-Series advanced measurement applications available for the MXA and EXA signal analyzers increase the capability and functionality of the analyzers to speed your time to insight. These software measurement applications provide essential measurements for specific tasks. For example, use the W-CDMA measurement application to quickly perform 3GPP standard-based modulation, spectrum, and power tests with confidence.

The application software is identical for MXA and EXA including the same functionality, measurements, and user interface. The only difference is the level of performance achieved by the instrument hardware selected. Choose the level of performance necessary for the application and have full assurance the calculations and algorithms are the same across your MXA and EXA signal analyzers, from the development lab and into manufacturing.

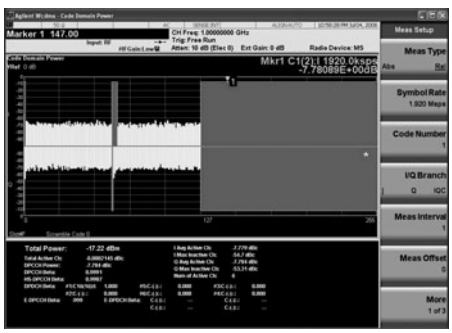
Phase Noise Measurement Application (N9068A)

The Agilent N9068A phase noise measurement application provides plots, traces, and tabular results and has pass/fail tests for clear indication of test results. Features include a customizable range table, log plot, and spot frequency results.



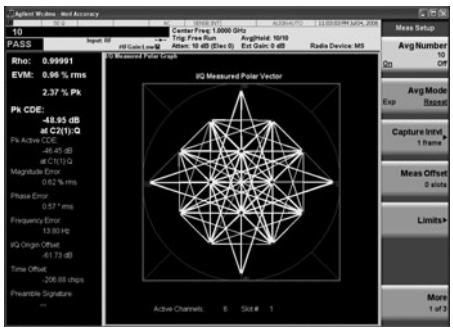
W-CDMA Measurement Application (N9073A-1FP)

For 3GPP W-CDMA Release 99 through Release 6, the W-CDMA measurement application provides simple one-button power measurements, and in-depth modulation analysis for conformance test requirements. Available measurements include modulation analysis such as composite EVM and code domain analysis, and RF measurements such as channel power, ACP, SEM, and more. The application supports BTS and MS measurements.



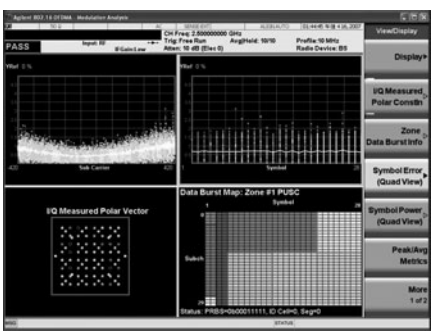
HSDPA/HSUPA Measurement Application (N9073A-2FP)

High speed packet access (HSPA) signals can be analyzed using the HSDPA/HSUPA measurement application. On HSDPA signals, 16-QAM HS-PDSCH is automatically detected for code domain and modulation accuracy measurements. On HSUPA signals, channels like E-DPCCH and E-DPDCH in SF2 can be demodulated. Adaptive Modulation and Coding (AMC) is supported, as well as Discontinuous Transmission (DTX). The HSDPA/HSUPA measurement application requires WCDMA application (N9073A-1FP).



802.16 OFDMA Measurement Application (N9075A)

The Agilent N9075A 802.16 OFDMA measurement application provides one-button standard-based pass/fail testing of IEEE 802.16-2005 (Mobile WiMAX) compliant signals. It offers automatic zone map decoding, SCPI programmability, familiar front panel local operation, and superior measurement speed. Power, spectrum, and modulation measurements such as RCE, spectral flatness, and SEM are included, all with adjustable pass/fail limit indicators.



89601A Vector Signal Analysis Software

For more information please refer to page 124.

Additional Measurement Applications

The following additional measurement applications will be available for order beginning on December 1, 2007.

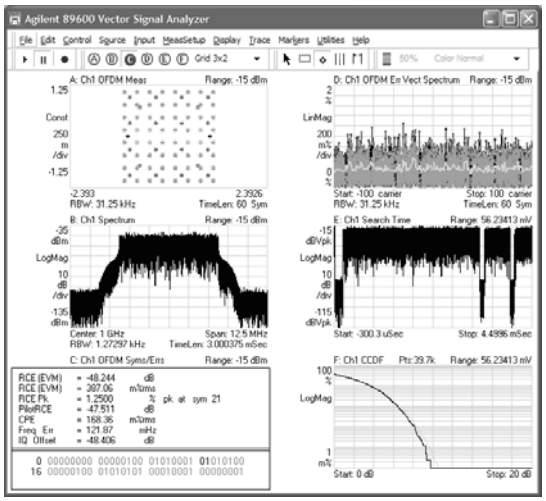
Analog demodulation measurement application (N9063A)
Noise figure measurement application (N9069A)
GSM/EDGE measurement application (N9071A)
TD-SCDMA measurement application (N9079A-1FP)
HSDPA / 8PSK measurement application (N9079A-2FP)
89601X VSA application
1xEV-DO measurement application (N9076A)*
cdma2000/cdmaOne measurement application (N9072A)

Consult the Agilent website for the latest listing of available measurement applications for both EXA and MXA:
www.agilent/find/exa_apps
www.agilent/find/mxa_apps

* available for order mid-2008

89601A/
89601AN/
89601N12
Vector
Signal
Analysis
Software

- **Flexible modulation analysis and troubleshooting tools**
- **Powerful 3GPP/WLAN/802.16 analysis options**
- **Advanced analysis tools for wideband satellite and radar signals**
- **Multi-channel ready**
- **PC-based, ESA/PSA/MXA/EXA/Scope/Logic Analyzer compatible**



The Agilent 89600 series vector signal analysis software characterizes complex modulated, time varying signals with detailed and simultaneous spectrum, modulation and time waveform analysis tools. Use these tools to uncover signal anomalies you couldn't see before.

Measurements include: time, gated time, spectrum, power spectral density, CCDF and CDF, auto-correlation and more. These tools help you easily troubleshoot pulsed and hopping signals.

The 89600 VSA software offers markers which display current location, calculate offset (delta) values, provide frequency counter capability, integrate between two lines to determine bandpower, calculate occupied bandwidth (OBW), let you set up zones to calculate adjacent channel power (ACPR), and conduct limit tests. Markers can be coupled across displays (up to six simultaneously), allowing you to "walk" through your signal and see its behavior in multiple domains — a very powerful and useful feature.

Characterize intentionally and unintentionally-modulated AM/PM/FM signals in both the frequency and time domains. Check phase, amplitude and frequency trajectories of pulsed signals, make phase noise measurements, uncover interference and more.

The 89600 VSA software lets you capture your digitized signal in your measurement hardware. Then, link it to a supported Agilent signal generator for signal stimulus. Record the signal at one frequency, and using the zoom mode feature, transfer the signal to the generator at a different frequency. Control key features of the signal generator from the 89600 VSA software front panel.

The 89600 VSA software comes fully equipped to control and process two base band or two RF channels. Powerful and sophisticated trace data provide you with the basic capabilities to perform MIMO-analysis. Use these tools to develop and analyze complex multi-antenna, radar, or signal surveillance systems. Check hardware specifications to determine which hardware platform configurations support multiple channels (literature #5989-1753EN.)

Take advantage of Agilent's flexible licensing capability for the 89600 VSA software. A software license is the key that unlocks the powerful measurement capability of the 89600 software on your PC. Floating (89601AN), node-locked (89601A), and limited term (89601N12) licenses are available, depending on your need.

View constellation diagrams, make I/Q quality measurements (imbalance, quadrature error, offset) and more. The Agilent 89600 VSA software offers sophisticated error analysis that lets you see both RF and DSP problems. The key is the EVM measurement. EVM compares the phase and magnitude of the input signal with an ideal reference signal stream. The average error over time is displayed as a single percent, or the error can be viewed on a symbol-by-symbol basis. Use the FFT of the EVM error signal to identify systematic impairments you couldn't otherwise see. Identify spurs coupling from other parts of the system by looking at the EVM spectrum for peaks.

Powerful Modulation Analysis Options

Flexible Modulation Analysis (Option AYA)

Option AYA demodulates a wide range of standard communication formats, such as EDGE and GSM. But it also offers a wide range of general purpose demodulators for FSK, BPSK, QPSK, offset QPSK, QAM, and VSB, all with user-settable symbol clock rate, bandwidth, filter type and alpha. You can even apply your own proprietary filtering by providing the filter's impulse or frequency response.

3G Modulation Analysis (Option B7N)

Evaluate and troubleshoot your 3G modulated wireless communications signals with Option B7N. Whether your signal is cdma2000 or W-CDMA, TD-SCDMA or 1xEV-DO, HSDPA or 1xEV-DV, the tools and analysis flexibility in Option B7N help you test your signal to its standard and troubleshoot the problem if the signal fails to meet its standard. You can purchase the modulation types separately as option B7T (cdma2000/1xEV-DV), option B7U (WCDMA/HSDPA), option B7X (TD-SCDMA), or option B7W (1x-EVDO).

WLAN Modulation Analysis (Option B7R)

Agilent is an industry leader in WLAN signal analysis. The WLAN analysis option available with the 89600 VSA software offers:

- 802.11a OFDM modulation analysis
- 802.11b DSSS/CCK/PBCC modulation analysis
- 802.11g modulation analysis
- 802.11a/b/g standards-based testing

IEEE 802.11n MIMO Modulation Analysis (Option B7Z)

Analyzing an IEEE 802.11n MIMO signal is extraordinarily challenging because it is made up of multiple OFDM signals that transmit on the same frequency at the same time. The advanced troubleshooting and evaluation tool set provided by Agilent's IEEE 802.11n MIMO modulation analysis option is specifically designed to handle this challenge and more.

IEEE 802.16-2004 OFDM Analysis (Option B7S)

Analyzing OFDM signals requires developers to think in the time and frequency domains simultaneously. You need OFDM-specific signal analysis tools to help you manipulate and break down the signal in order to effectively troubleshoot the situation. The IEEE 802.16 OFDM analysis software helps you do this quickly and efficiently.

Option B7S provides comprehensive coverage of the IEEE 802.16-2004 standard:

- All IEEE 802.16-2004 modulation formats, including BPSK, QPSK, 16QAM, and 64QAM
- TDD, FDD, and H-FDD
- Uplink and downlink
- Bursted and continuous
- All frame lengths, guard intervals, and sampling factors
- Demodulation down to the raw bit level

MB-OFDM ultra-wideband modulation analysis (Option BHB)

Troubleshoot your WiMedia-based multi-band OFDM ultra-wideband PHY layer signals, such as those in certified wireless USB, with the industry's most complete set of easy-to-use measurement tools, providing you with an unparalleled view into your PHY layer signals. Use Option BHB running on the high performance Agilent DSO80000 Series oscilloscopes to help you identify the root causes of problems, sooner.

RFID Modulation Analysis (Option BHC)

Use the powerful measurements and displays of the 89600 software to troubleshoot RFID systems. Analyze both the forward (interrogator) and return (tag) signals. Use the built-in pre-sets for some of the RFID standards or manually set the demodulation format, line coding, and bit rate or tari.

IEEE 802.16e OFDMA Analysis (Option B7Y)

Analyze your IEEE 802.16e OFDMA signal with the advanced troubleshooting tools offered in option B7Y. Evaluate modulation performance by logical sub-channel, by burst and by zone. Analyze uplink and downlink burst formats, TDD and FDD and more.

Connectivity

Add world-class modulation analysis to your Agilent spectrum analyzer, oscilloscope, and more. Link the 89600 VSA software to any one of a variety of Agilent instruments to sample your signal. Connection to the instruments is via GPIB, FireWire® (IEEE-1394), USB or LAN. The software supports the following platforms.

ESA-E Series Spectrum Analyzers

The ESA-E Series general-purpose, portable spectrum analyzers offer a wide range of performance, features, and flexibility with up to 26.5 GHz tuning range and 10 MHz of analysis bandwidth. Measurement control is via GPIB LAN/GPIB gateway, USB/GPIB gateway.

PSA Series High-Performance Spectrum Analyzers

The Agilent PSA Series offers high performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, a leading- edge combination of flexibility, speed, accuracy, dynamic range, and up to 80 MHz of analysis bandwidth. Measurement control is via LAN or GPIB.

MXA Series Mid-Performance Spectrum Analyzers

The MXA signal analyzer takes signal and spectrum analysis to the next generation, offering the highest performance in a midrange signal analyzer with the industry's fastest signal and spectrum analysis, eliminating the compromise between speed and performance. With a broad set of applications and demodulation capabilities, an intuitive user interface, outstanding connectivity and powerful one-button measurements, the MXA is ideal for both R&D and manufacturing engineers working on cellular, emerging wireless communications, general purpose, aerospace and defense applications. The software can run in the MXA or on an external PC.

Infiniium Scopes

Combine the 89600 VSA software with Agilent's Infiniium oscilloscopes (many models) to analyze super wide bandwidth signals. The oscilloscopes provide up to 13 GHz of analysis bandwidth and are well suited to digitizing down-converted satellite, LMDS, and MMDS signals. The software can run in the scope (many models) or on an external PC.

Logic Analyzers

Analyze your digital baseband and zero IF signals without having to convert them to analog signals first. Monitor the results of FPGA and ASIC-based DSP algorithms directly. Use the Agilent 16900 or 1680/1690 series logic analyzers to connect to and capture the data and the 89600 VSA software to evaluate and troubleshoot the performance of the vector modulation the data represents. View the constellation, measure I/Q parameters, see EVM behavior over time and frequency, and more directly in the logic analyzer or via connection to an external PC.

Modular VXI Analysis Hardware

Used as part of Agilent's 89600S Series vector signal analyzer family, this versatile combination of modules offers 36 MHz of analysis bandwidth, up to 6 GHz tuning range in a compact 4-slot VXI mainframe and coherent 2-channel MIMO analysis. Measurement control is via FireWire.

Two Channel Operation

For use when you need cross channel or I + jQ results, the software supports two channel configurations based on the VXI modular hardware and Agilent Infiniium or 6000 Series multi-channel scope models. 2-channel operation is also supported with the PSA Series spectrum analyzers for use with the 89604A/N distortion test suite application.

Agilent Connected Solutions (Option 105)

The powerful, PC-based 89600 VSA software offers tight, interactive integration with Agilent EEsof's Advanced Design System to analyze computational data from a simulation. Dynamically link the 89600 software to any point in the digital model to analyze data by simply dragging the VSA icon to the desired spot in the schematic.

Link to The MathWorks Simulink Model-Based Design Software (Option 106)

Gain the power of the 89600 VSA measurements and displays for Simulink-based designs with Option 106. This option provides a VSA block set designed to work with Simulink tool sets and block sets. Use the VSA sink to accept data from the simulation, then process and display it using the wealth of features and functionality in the 89600 VSA software. The VSA source allows you to accept measured data from Agilent test equipment, and feed it into the Simulink design.

Key Literature & Web Link

89600 Demonstration Software CD, p/n 5980-1989E
89600 Software Technical Overview, p/n 5989-1679EN
89600 Software Data Sheet, p/n 5989-1786EN
Using Infiniium Scopes with 89600 SW, p/n 5988-4096EN
Making Digital Baseband Measurements with Logic Analyzers and the 89600 SW, p/n 5989-2384EN
Making WiMAX Measurements with 89600 SW, p/n 5989-2029
89600 Measurement Platforms Data Sheet, p/n 5989-1753EN
89650S Wideband VSA Technical Overview, p/n 5989-0871EN
89604A/AN Distortion Test Suite Technical Overview, p/n 5988-7812EN
89607A WLAN Test Suite Technical Overview, p/n 5988-9574EN

See **www.agilent.com/find/89600** for more information

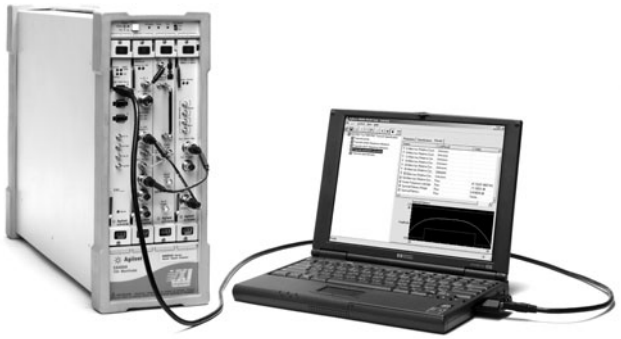
Ordering Information

89601A/AN VSA software
- **-200** Basic Vector Signal Analysis
- **-300** Hardware Connectivity
- **-105** ADS Connectivity
- **-106** Simulink Connectivity
- **-AYA** Flexible Modulation Analysis
- **-B7R** WLAN Modulation Analysis (802.11a/b/g)
- **-B7Z** 802.11n MIMO Modulation Analysis
- **-B7S** IEEE 802.16-2004 OFDM Modulation Analysis
- **-B7Y** IEEE 802.16 OFDMA Modulation Analysis
- **-B7T** cdma2000/1xEV-DV Modulation Analysis
- **-B7U** W-CDMA/HSDPA Modulation Analysis
- **-B7W** 1xEV-DO Modulation Analysis
- **-B7X** TD-SCDMA Modulation Analysis
- **-B7N** 3GPP Analysis Bundle (includes B7T, B7U, B7W, B7X)
- **-BHA** TEDS Modulation and Test
- **-BHB** MB-OFDM Ultra-wideband Modulation Analysis
- **-BHC** RFID Modulation Analysis

89601N12 VSA Software, 12 Month License
89601AS Additional Software Update Subscription Service, (node-locked license)
89601ASN Software Update Subscription Service for 1 Server (floating license)

89610S
89611S
89640S
89641S

- **Frequency range: DC to 6 GHz**
- **At least 36 MHz analysis bandwidth**
- **Baseband I&Q inputs available**
- **Flexible digital demodulators with settable center frequency, symbol rate, filter type and alpha/BT**
- **Standards based measurement setups include GSM (EDGE), cdma2000, W-CDMA, PHP, 1xEV-D0, TD-SCDMA, 802.11a/b/g (WLAN), 802.16 OFDM and OFDMA and more**
- **Up to 1.2 GB of signal capture and playback memory**
- **PC-based analysis software also works with PSA/ESA spectrum analyzers, many Infiniium scopes, logic analyzers, Agilent's Advanced Design System (ADS)**



89640S 2.7 GHz VXI-based VSA.

89600S VXI-based Vector Signal Analyzers

The Agilent 89600S family of VXI-based vector signal analyzers measures the RF and modulation quality of wideband modulated signals. They offer FFT based spectrum analysis, wideband flexible demodulation, and scope-like measurements on RF signals.

Along with wide IF bandwidths (36 to 39 MHz), the 89600S VSAs offer traditional RF spectrum displays, baseband (I/Q) analysis, signal capture memory, RF and IF triggering, a wide variety of analog and digital demodulators, and an extensive set of time, frequency and modulation analysis tools. These capabilities make 89600S VSAs ideal for evaluating narrowband and wideband signals.

Analyze a wide variety of standard and non-standard signal formats using the popular 89600 vector signal analysis software. Standard-signal presets cover GSM, GSM (EDGE), CDMAOne, cdma2000/1xEV-DV, W-CDMA/HSDPA, 802.11a/b/g, 1xEV-D0, TD-SCDMA, 802.16-2004 and more. For emerging standards, the 89600 analyzers offer numerous digital demodulators with variable center frequency, symbol rate, filter type and alpha/BT. A user-adjustable adaptive equalizer is also provided.

89610S Baseband Vector Signal Analyzer

Targeted at baseband measurements this is a DC-40MHz VSA with 39 MHz bandwidth. A second channel can be added giving I and Q baseband measurements and 78 MHz effective bandwidth for I+jQ measurements.

89611S IF Vector Signal Analyzer

Designed to team with tuners having 70 MHz IF center frequencies this is a 52 – 88 MHz VSA with 36 MHz analysis bandwidth. A second channel can be added for baseband I&Q analysis.

89640S RF Vector Signal Analyzer

The versatile 89640S is designed to measure the RF and modulation quality of signals up to 2.7 GHz. Baseband I and Q inputs are available. Coherent 2-channel RF measurements up to 2.7 GHz are available for MIMO analysis.

89641S RF Vector Signal Analyzer

This flexible modular system is designed to measure signals up to 6.0 GHz. Baseband I and Q inputs are available. Coherent 2-channel RF measurements up to 2.7 GHz are available for MIMO analysis.

89600 Series Vector Signal Analysis Software

The 89600 Series vector signal analysis software is a PC based package designed to measure the RF and modulation quality of most digitally modulated signals. Its large array of demodulators, filters, displays, and analysis tools make it ideally suited to evaluating and troubleshooting modulated signals in the R&D lab and can be directly linked to a wide range of Agilent spectrum analyzers, digital oscilloscopes and modular VXI systems. This software is provided as part of the 89610S, 89611S, 89640S and 89641S vector signal analyzers.

Choose either node-locked (89601A), floating (89601AN), or limited-term (89601N12) licensed software. One year of software update subscription service is included with the node-locked license.

89604A Distortion Test Suite Software

The 89604A distortion test suite software accurately measures AM/AM and AM/PM distortion. The wideband product is compatible with complex modulated stimulus signals with bandwidths as high as 36 MHz. This wideband measurement technique helps assure that even subtle distortion mechanisms like memory effects and local heating are stimulated and measured. Use the complete graphic and data summary tables to characterize the performance of your MCPA.

Specifications

	89610S	89611S	89640S	89641S
Frequency Range	DC to 40 MHz	52 to 88 MHz (or frequency range of external tuner)	DC to 2700 MHz	DC to 6000 MHz
Maximum Analysis Bandwidth	39 MHz	36 MHz	36 MHz	36 MHz
Sensitivity Displayed Average Noise Level at 1 GHz at Max Frequency	<–151 dBm/Hz	<–159 dBm/Hz	<–158 dBm/Hz <–156 dBm/Hz	<–157 dBm/Hz <–153 dBm/Hz
Dynamic Range (3rd IMD)	<–70 dBc[1]	<–70 dBc[1]	<–70 dBc[1]	<–70 dBc[1]
Amplitude Accuracy (20-30°C)	±0.8 dB	±0.8 dB	±2.0 dB	±2.0 dB
Signal Capture Memory		Up to 1.2 GB (384 MSa, complex)		
I&Q Inputs	Option	Option	Option	Option
2 RF Channel Support			✓	✓

[1] tones @ 6 dB below full scale (–31 dBm at input)

Key Literature & Web Link

89600 Demonstration Software CD, p/n 5980-1989E
89600 VXI Configuration Guide, p/n 5968-9350E
89600 Software Technical Overview, p/n 5989-1679EN
89600 Software Data Sheet, p/n 5989-1786EN
89600 Measurement Platforms Data Sheet, p/n 5989-1753EN
89650S Wideband VSA Technical Overview, p/n 5989-0871EN
89650S Wideband VSA Configuration Guide, p/n 5989-1435EN
89607A WLAN Test Suite Technical Overview, p/n 5988-9574EN
89604A Distortion Test Suite Technical Overview, p/n 5988-7812EN

See **www.agilent.com/find/89600** for more information

Ordering Information

89600S Vector Signal Analyzer

89610S/89611S/89640S/89641S
144 MB/288 MB/1.2 GB signal capture memory option
Add a second IF/baseband channel option
Add a second RF channel option (89640/41 only)
Choice of VXI-mainframe size: 4, 6, 13-slot (not all configurations fit all units)
Choice of PC interface: desktop, laptop; also, laptop PC with software installed

89600 Series VSA Software
Choice of node-locked (89601A), floating (89601AN) or limited-term license (89601N12)
(Basic VSA and Hardware Connectivity options included)
Flexible vector modulation analysis option
3G modulation analysis options
WLAN modulation analysis option
IEEE 802.16 OFDM WiMAX modulation analysis option
IEEE 802.16e OFDMA modulation analysis option
Dynamic Link to ADS

Also Available
89604A/AN Distortion Test Suite
89607A WLAN Test Suite
89601AS Software Update Subscription Service (node-locked license)
89601ASN Software Update Subscription Service (floating license)

E4411B
E4403B
E4408B
E4402B
E4404B
E4405B
E4407B

ESA Series Spectrum Analyzers

- **±1.0 dB amplitude accuracy**
- **5 minute warm up to guaranteed performance**
- **Wide set of built-in power measurements**
- **Integrated measurements for noise figure and phase noise (opt)**
- **RMS, quasi-peak, peak detectors and EMI bandwidths are available**
- **Built-in help**

ESA Series Spectrum Analyzers

ESA Express Analyzers Provide Ordering Ease, Fast Delivery, and Best Value

The ESA analyzer is available in three "express option" choices. Express Analyzer options are based on the most frequently ordered ESA configurations and most popular options. The express analyzer options simplify the ordering process while maintaining the flexibility of the ESA platform. Just select the ESA express analyzer that meets your needs and budget. Express analyzers are favorably priced and provide faster delivery. For unique requirements, the ESA analyzer may be custom configured from the complete set of available options.

ESA Basic Analyzer (Option BAS or BTG)

For basic, quality, spectrum analysis on RF or microwave signals at an affordable price. The basic analyzer provides general spectrum analysis with the speed, accuracy and dynamic range to give you confidence in your measurement results.

- 1.5 GHz, 3.0 GHz, and 26.5 GHz Frequency range
- 1.1 dB overall amplitude accuracy
- 100 Hz RBW (optional)
- +7.5 dBm TOI
- 5 minute warm-up to guaranteed measurement accuracy
- Rugged design, weather resistant, snap on battery pack
- Multiformat RF power measurement suite

ESA Standard Analyzer (Option STD or STG)

The standard analyzer includes a wide set of built-in functions and features while maintaining the flexibility to add the most popular ESA options.

- 0.4 dB amplitude accuracy (95% confidence level)
- 10 Hz RBW (1 Hz with option)
- +16 dBm TOI
- FM demodulation
- Expandable platform

ESA Communication Test Analyzer (Option COM)

Expand on the leading performance and functionality of the standard analyzer with the addition of built-in demodulation hardware. When combined with the communication focused measurement personalities or the Agilent 89601 VSA software, this express analyzer makes a powerful tool for communications device development.

- 0.4 dB amplitude accuracy (95% confidence level)
- 1 Hz RBW
- +16 dBm TOI
- Precision frequency reference
- 10 MHz demodulation bandwidth
- Optional communications focused applications such as flexible modulation analysis, GSM/EDGE, and cdmaOne
- Link to the popular Agilent 89601A vector signal analysis software for fully flexible demodulation analysis and in depth trouble shooting tools

Performance

Amplitude Accuracy

The ESA offers performance in accuracy with a guaranteed overall amplitude accuracy of less than 1.0 dB error (<3 GHz) based on traceable and warranted specifications. Other economy-class analyzers may specify only typical performance levels. The ESA excels in overall amplitude accuracy whether comparing guaranteed specifications or expected levels of performance.

Frequency Accuracy

The ESA provides a warranted internal frequency reference that may not be available in other economy-class analyzers. Further, the ESA has excellent frequency readout accuracy, a function of the frequency reference error as well as the span error coefficient, RBW, center frequency, and number of sweep points.

Measuring Low Level Signals such as Spurs

The ESA offers top performance thanks to its optional built in low noise, high gain preamplifier. Achieving a Displayed Average Noise Level (DANL) of better than –167 dBm.

Measuring Lower Level Signals Next to Higher Power Signals

A spectrum analyzers dynamic range is a function of both its displayed average noise level (DANL) performance and its intermodulation distortion performance. The ESA third order intermodulation distortion performance is +16 dBm third order intercept (TOI) (+7.5 for basic analyzer configurations). In addition, the ESA features a standard 5 dB step attenuator making it easy to optimize the spectrum analyzer's mixer level settings to achieve the best dynamic range.

5 Minute Warm Up Time

Most spectrum analyzers take 15 minutes to 1 hour to warm up before the specifications in the data sheet are valid. Not with the ESA. The ESA takes only 5 minutes to warm-up so technicians and engineers spend little time waiting for instrument stabilization.

Automatic Background Alignment

The automatic, internal background alignment feature gives consistently accurate results over varying temperatures. This is especially beneficial when operating the ESA outdoors or in varying temperature conditions. Further, the ESA provides guaranteed performance specifications over a wide temperature range of 0 to 55 degrees centigrade.

Wide Selection of Detectors

The ESA has a wide selection of detectors to meet all of your test needs; including averaging (RMS), peak, negative peak, sample, and quasi-peak (optional). Notably, the ESA's RMS averaging detector improves your measurement repeatability and efficiency when testing noise like signals such as today's 2G and 3G formats. In addition the RMS detector provides RMS results as required by several standards. The ESA's optional quasi-peak detector enables you to verify your EMI performance of your DUT, making the ESA a flexible tool for all types of design and verification testing. For a dedicated EMI instrument with established measurement routines and EMI software, the E7400A Series EMC precompliance analyzer may be more appropriate.

Narrow Resolution Bandwidth Filters

Achieve the maximum frequency resolution with the ESA spectrum analyzer's optional narrow resolution bandwidths. The flexibility of the ESA allows you to select the resolution that you need. The base performance of the ESA includes a 1 kHz RBW. Add the narrow resolution bandwidth option (1DR) to get 10 Hz minimum RBW's (100 Hz on the basic analyzer). Or, for the maximum performance, order the high stability timebase option (1D5) in addition to the narrow resolution bandwidth option to get 1 Hz RBW's.

Measurements Made Easy

PowerSuite – Absolute Confidence in Making Power Measurements in 3 Easy Steps

The ESA simplifies the task of making common power measurements through its built-in power measurements. These measurement functions are easy to use.

Step 1

Press the measurement button on the front panel.

Step 2

Select the desired standards-based format or customize your test setup.

The ESA includes a wide selection of standards-based test setups including the following formats:

- cdmaOne (IS-95A/C)
- cdmaOne (J-STD-008)
- NADC
- GSM/GPRS and EDGE
- 3GPP W-CDMA TS 21.141 spurious emissions test
- W-CDMA 3GPP
- cdma2000 SR1
- cdma2000 SR3-MC
- cdma2000 SR3-DS
- PDC
- *Bluetooth*
- TETRA
- WLAN 802.11a, b, g
- HiperLAN/2
- DVB-T

Step 3

Select the desired measurement functions.

The ESA offers the widest selection of built-in power measurements available in a mid-range instrument:

- Channel power
- Occupied bandwidth
- Adjacent channel power (ACP)
- Multi-carrier ACP
- Power statistics (CCDF) (not available on the basic analyzer)
- Harmonic distortion
- Burst power
- Intermodulation distortion (TOI)
- Spurious emissions
- Spectrum

Agilent's IO Libraries Suite

Agilent's IO Libraries Suite ships with the ESA series spectrum analyzers to help you quickly establish an error-free connection between your PC and instruments – regardless of the vendor. It provides robust instrument control and works with the software development environment you choose. For additional description of Agilent's IO Libraries Suite features and installation requirements, please go to **www.agilent.com/find/iosuite/data-sheet**

IntuiLink PC Software

With IntuiLink software you can conveniently save and document your results by linking the ESA to MS Word or Excel applications. In addition, the IntuiLink software provides a simple programming interface to the ESA spectrum analyzer allowing you to easily write macros or functions within windows applications to control the ESA spectrum analyzer. IntuiLink is included free of charge with every ESA.

Remotely Control and Monitor the ESA over the Internet

BenchLink web remote control (Option 230) enables you to remotely control your instrument over the internet or intranet. The software operates on a locally-networked computer connected to the ESA by GPIB. The ESA can then be controlled remotely from any client computer on the internet or intranet with a standard web browser.

Segmented Sweep

Segmented sweep allows you to view up to 32 discontinuous segments of the spectrum with varying levels of resolution at the same time. This feature allows you to view problem spots at the same time and save time while doing so by eliminating the need to retune or make long sweeps (standard and communication test analyzers only).

Log Sweep

The log sweep function on the ESA makes it very easy to set up limit lines and view the spectrum in log scale. This is useful for meeting test requirements, such as CISPR, that specify requirements on a log scale (standard and communication test analyzers only).

Amplitude Corrections

Making amplitude corrections for cables, antennas, external mixers or other peripherals used with the ESA is simple using the ESA's built-in amplitude correction tables. Simply populate the ESA's amplitude correction table with correction factors and then turn the corrections on. Up to 4 correction tables may be loaded and applied at any one time. Add correction factors for cables, antennas, or other devices.

Application Focused Solutions

Noise Figure

Option 219 (measurement personality) provides one-button noise figure and gain measurements via a user-friendly interface. Smart noise source (SNS) support, DUT setup menus, limit lines with pass/fail functionality, and context sensitive help are just some of the features that simplify noise figure measurements.

Phase Noise

Option 226 (measurement personality) provides a log plot of phase noise in dBc/Hz versus offset frequency. Examine phase noise at a single offset frequency, or make phase jitter measurements utilizing an intuitive user interface.

Modulation Analysis

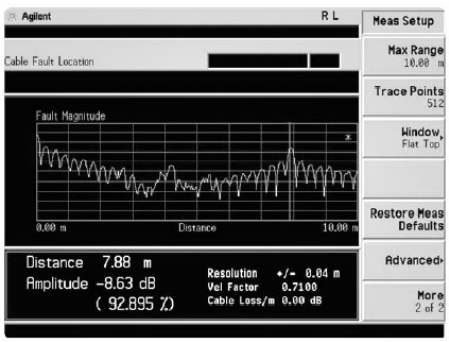
Options 229 (measurement personality) and COM (communication test analyzer) combine to enable you to measure EVM and other related metrics for all major 2G/3G formats. Constellation and eye diagrams are provided to help verify modulation quality.

89601A VSA Link

Option 231 (ESA to 89601A Vector Signal Analysis software link utility) adds vector signal analysis capabilities of the 89601A software to the ESA Communication Test analyzer (Option COM). The 89601A software provides vector signal analysis features such as displaying phase information, time selective frequency domain measurements, time-data displays, spectrogram displays, and more.

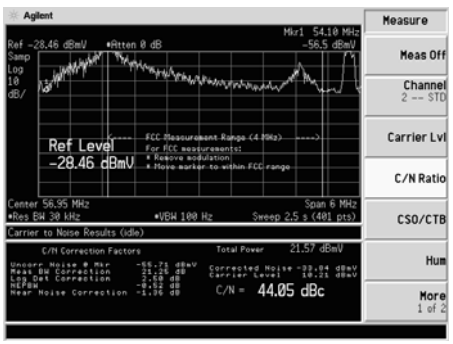
Cable Fault Location

Options 225 (measurement personality), 1DN or STG (tracking generator) and B7K (measurement kit) combine to identify distance to cable discontinuities for fault location and troubleshooting of cable installation and maintenance.



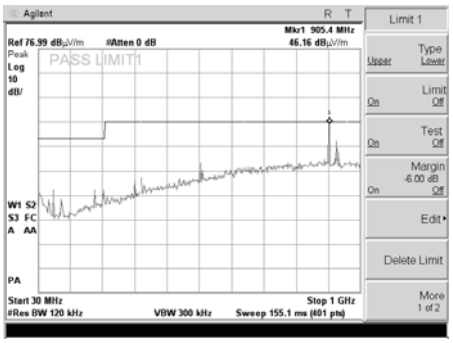
Cable TV Field Service and Analog Broadcast

Option 227 (measurement personality) provides cable TV operators fast, accurate and rugged spectrum analysis for field installation, ingress evaluation and troubleshooting. Perform digital TV measurements by adding Option COM and using the 89601A vector signal analysis software.



Basic EMI Capability

Avoid costly redesign by measuring the radiated and conducted emissions of your design early in the development process. Perform basic EMI measurements by using the ESA's EMI detectors. Additionally, the following EMI bandwidths are available: 200 Hz, 9 kHz, & 120 kHz.



GSM/GPRS/EDGE

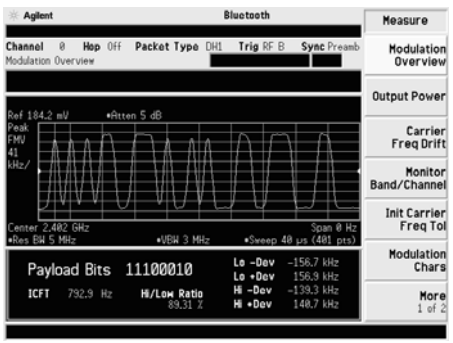
Options BAH and 252 (measurement personalities) and COM (communication test analyzer) combine to provide all the GSM 450/900, DCS1800, PCS1900 tests required to verify the performance of GSM/GPRS/EDGE mobile and BTS transmitters.

cdmaOne

Options BAC (measurement personality) and COM communication test analyzer) combine to make the cdmaOne standard tests that are required to verify the performance of cdmaOne transmitters. Measurements include code domain power, ACPR, Rho, spurious, and more.

Bluetooth™

Option 304 (measurement personality and digital demodulation hardware) provides one-button standards-based *Bluetooth* transmitter measurements, including modulation characteristics and ACP.



Key Specifications and Features Summary

See the ESA data sheet for more specifications and details. (**http://cp.literature.agilent.com/litweb/pdf/5968-3386E.pdf**)

0.4 dB Overall Amplitude Accuracy	For maximum measurement confidence based on 95% specification. 1.0 dB accuracy guaranteed.
Guaranteed Frequency Readout Accuracy	Based on internal frequency reference.
Wide Dynamic Range with 16 dBm TOI	(Third order intercept) giving the ESA the widest dynamic range of any analyzer in its class.
–167 dBm DANL with Built-in Pre-amplifier	High-gain, low-noise, fully calibrated pre-amplifier increases sensitivity (optional).
Wide Offset Phase Noise	Performance of –150 dBc Hz at 1 MHz offset (optional).
1-ms RF Sweep Time	Combined with >45 measurements per second, provides virtual real-time updates. Responsive display makes circuit adjustment easier, while increasing the probability of intercepting intermittent signals.
Five-minute Warm-up	Provides full measurement accuracy after just 5 minutes.
Data Transfer (GPIB)	>45 measurements and transfers per second reduces measurement times in ATE environments.
Variable Sweep (trace) Points	Ranging from 101 to 8192, optimizes measurements for frequency resolution and accuracy versus speed.
Narrow Digital RBW Filters	Adds 1, 3, 10, 30, 100, 200, and 300 Hz resolution bandwidth filters (optional). The 200 Hz bandwidth enables you to perform EMI tests. The 9 kHz and 120 kHz bandwidths come standard.
Time-domain Sweeps	Sweeps 2.5 ns per division in zero span.
Amplitude Correction	Calibrates out frequency-related amplitude effects with built-in amplitude correction factor table. Common EMI correction factors are available for EMC measurements.
Automatic Background Alignment	Continuously calibrates the analyzer. Guarantees accuracy over changing temperatures.
85 to 120 dB Calibrated Display Range	Displays large and small signals simultaneously.
Optional Built-in Tracking Generator	Combines spectrum and scalar test capability in a single instrument. One-button normalize function quickly calibrates the test setup.
5 dB Step Attenuator	Optimizes distortion-free dynamic range.
Wide Selection of Detectors	Including peak, RMS, video averaging, negative peak, sample and optional quasi-peak detector.
Temperature Range	Guaranteed specifications provided over a wide temperature range of 0 to 55°C.

Measurements Made Easy

One-button Power Measurements with Standards-based Setups	Quick setup and measurement time with one-button RF power measurements for all major 2G/3G, WLAN, and digital video formats.
Optimize Reference Level	Button included with the built in power measurements simplifies the setting up of your measurement by automatically adjusting the reference level and attenuator based on signal level.
Segmented Sweep	Saves measurement and setup time by viewing in one sweep only the frequency spans of interest. Paste together up to 32 discontinuous frequency or zero spans in one sweep. Eliminate multiple setups and sweeping through unwanted frequencies.
Log Sweep	Display swept measurements on a logarithmic scale of the frequency domain.
Zoom Windows	Split screen display shows wide spans while zooming in on signals of interest.
Marker Functions	Provides digital resolution of measurement details through peak search, continuous peak search, delta markers, marker table, and carrier-to-noise ratio. Signal track keeps unstable signals centered on the screen while band power calculates total power between user-defined limits.
Frequency Counter	With 1 Hz resolution, minimizes the need for an external frequency counter.
Softkey/Hardkey Interface	Provides a simple user interface while retaining access to sophisticated features.
Built-in Help Button	Eliminates carrying manuals into the field to determine softkey/hardkey functions and remote SCPI commands.
Limit Lines	Built-in limit lines and pass/fail messages simplify testing. EMI limit lines are available.
Built-in Clock/Calendar	Provides time stamps on both stored and printed data.
Automatic Overload Protection	Protects RF input from overly large signals (E4411B).
Automatic Printer Setup	Identifies connected most Hewlett-Packard printer models automatically.
IntuiLink Software	PC software provides easy transfer of measurement results into Microsoft® Excel and Microsoft Word. Download from **www.agilent.com/find/intuilink**
SCPI Programming Interface	Allows full remote control and programming of the ESA spectrum analyzer.
IVI COM Drivers	Provides interface for programming in many environments, including Visual Studio®, LabVIEW, and Agilent VEE. Drivers may be found at: **www.agilent.com/find/drivers**

Instrument Design, Express Analyzer Features and Performance Summary

Large, Color VGA Display with Output	16.8 cm, high-resolution color display makes detailed observations easy. Includes 15-pin color VGA rear output connector for external color monitor.
Fully Synthesized Design	Provides continuously phase-locked precision throughout the entire sweep. Assures frequency accuracy, stability, and measurement repeatability, eliminating drift.
Snap-on Battery	Eliminates the restrictions of power cords.
Rubber-encased Front and Rear Frames	Provides impact protection in the field.
Rain-resistant Front Panel	Combined with louvered air vents, allows operation in diverse weather conditions.
12 Vdc Power Cable	Allows direct operation from automotive and truck batteries.
Parallel Port	Supports output to the most popular Hewlett-Packard printers.
Floppy Disk Drive	Move measurement results files to your PC quick and easy.
8.0 MB Data Storage	Provides internal storage of measurement data and setups for future analysis or comparison.

Express Analyzer Features and Performance Summary

See the ESA data sheet for more specifications and details. (**http://cp.literature.agilent.com/litweb/pdf/5968-3386E.pdf**)

	Basic Analyzer (Option BAS/BTG)	**Standard Analyzer (Option STD/STG)**	**Communication Test Analyzer (Option COM)**	**ESA Optional Performance with Custom Configuration**
Frequency Range	9 kHz to 1.5, 3.0, 26.5 GHz	9 kHz to 3.0, 6.7, 13.2, 26.5 GHz	9 kHz to 3.0, 6.7, 13.2, 26.5 GHz	30 Hz to 3.0, 6.7, 13.2, 26.5 GHz (Option UKB)
Speed				
Sweep Time (<3 GHz)	4 ms to 4000 s	1 ms to 4000 s	1 ms to 4000 s	1 ms to 4000 s (Option 1D5)
Zero Span Sweep	4 ms to 4000 s	50 ns to 4000 s	25 ns to 4000 s	25 ns to 4000 s (Option B7D/B7E)
Remote Trace Transfer	30/sec	45/sec	45/sec	45/sec
Warm Up Time	5 mins	5 mins	5 mins	5 mins
Dynamic Range				
Resolution Bandwidth	100 Hz to 5 MHz with Option	10 Hz to 5 MHz 1Hz with Option 1D5/1DR	1 Hz to 5 MHz	1 Hz to 5 MHz (Option 1DR and 1D5)
Phase Noise 10 kHz	–93 dBc/Hz + 20 LogN	–101 dBc/Hz[1] + 20 LogN	–101 dBc/Hz[1] + 20 LogN	–101 dBc/Hz[1] + 20 LogN (Option 120)
Measurement Range (Option 1DR)	–130 dBm to +30 dBm	–140 dBm[2] to +30 dBm –156 dBm[2] with Option 1DS	–150 dBm to +30 dBm –167 dBm with Option 1DS	–167 dBm to +30 dBm (Options 1DR, 1D5, 1DS)
TOI (for Spurious Free Dynamic Range (SFDR))	+7.5 dBm	+16 dBm	+16 dBm	+16 dBm
Accuracy				
Frequency Accuracy	±101 Hz	±101 Hz	±101 Hz	±101 Hz
Span Accuracy	±0.5%	±0.5%	±0.5%	±0.5%
Amplitude Accuracy	±1.1 dB	±0.4 dB	±0.4 dB	±0.4 dB
Measurement Capability				
Sample of Available Features	PowerSuite one button measurements, IntuiLink connectivity to MS Office, amplitude corrections	Basic features plus: log sweep, segmented sweep, optional preamp, CCDF function, FM demodulation, variable sweep points	Basic and standard features plus: digital demodulation capability	Basic, standard, and communication test features plus: 75 ohm (1DP), quasi-peak detection (AYQ), external mixing (AYZ), Class B emissions (060), and wide offset phase noise (120)
Available Measurement Applications	Cable TV	Noise figure, phase noise, cable fault, cable TV	Flexible demodulation with 89601A software, modulation analysis, GSM/EDGE, cdmaOne, noise figure, phase noise	Basic, standard, and communication test applications plus *Bluetooth* (304)
Future Upgrades	Limited	Available	Available	Available

[1] With Options 1DS and 1DR.
[2] Enhanced performance is available with different option configurations. Up to –167 dBm performance is available with Options 1DR, 1D5, and 1DS.

Ordering Information – Custom Configurations

Equivalent Options and Bundles

Option	Equivalent Option(s)	Comments
ESA-L Series		
BAS – Basic analyzer	A4J	Order BAS or BTG to get best delivery and price
BTG – Basic analyzer with TG	A4J, 1DN	Order BAS or BTG to get best delivery and price
ESA-E Series		
STD – Standard analyzer	AYX, BAA	Order STD, STG, or COM to get best delivery and price
STG – Standard analyzer with TG	AYX, BAA, 1DN	Order STD, STG, or COM to get best delivery and price
COM – Communication test analyzer	B7D, B7E, 1D5, 1DR, BAA, 231	Order STD, STG, or COM to get best delivery and price
B75 – Performance bundle	1DR, 1DS, 1D5	Only available on the Standard Analyzers (Express Option STD or STG)
304 – *Bluetooth* premium bundle	228, 106, B7D, B7E, 1DS, 1D5	Options 106 and 228 are not available outside of the Option 304 bundle

ESA-L Series Custom Analyzer

All custom ESA-L series include a 75 Ω input port

Available Models		
E4411B (9 kHz to 1.5 GHz)		Custom configuration not available for E4403B or E4408B
Included Options		**Comments**
GPIB connection	A4H	Standard on every instrument unless 1AX is ordered; Occupies 1 expansion slot
IntuiLink PC connectivity software	Included	Connects to Microsoft® Word and Excel; download for free from **www.agilent.com/find/intuilink**
Available Options		**Comments**
75 ohm impedance	1DP	
Replace GPIB connection (A4H) with serial port	1AX	Not compatible with Option A4H; Occupies 1 expansion slot
IF sweep, and video output ports	A4J	Occupies 1 expansion slot
Narrow resolution bandwidths	1DR	100 Hz minimum on ESA-L Series
75 ohm tracking generator (1 MHz to 1.5 GHz)	1DQ	Requires Option 1DP
8590-Series programming code compatibility	290	Free download from **www.agilent.com/find/esa**; no license required
Future Upgrades		**Comments**
Limited upgrades are available		For more details about upgrades, go to: **www.agilent.com/find/saupgrades**

Key Literature & Web Link for ESA

Agilent ESA Series Spectrum Analyzer Data Sheet, p/n 5968-3386E
Agilent ESA/EMC Spectrum Analyzer Configuration Guide, p/n 5968-3412E
Agilent ESA Series Spectrum Analyzer Brochure, p/n 5968-3278E

www.agilent.com/find/esa

ESA Accessories

Option	Description	Comments
Accessory information can be found at: **www.agilent.com/find/sa-accessories**		
ESA Specific Accessories		
A5D	12 VDC power cable	DC power connection available on every ESA
AXT	Hard transit case	
AYT	Gray soft carrying/operation case	
AYU	Yellow soft carrying/operation case	
B7K	Cable fault measurement kit (50 ohm)	Requires Option 1DN or STG, and Option 225 or BAH
042	Gray backpack carrying case	
044	Yellow backpack carrying case	
1CP	Rack mount kit with handles	
1D7	50 to 75 ohm minimum loss pad	
E1779A	Rechargeable snap-on battery and charger	Order as separate model number, not option number
UK9	Front panel cover	
Software/Firmware		
B70	Benchlink spectrum analyzer, PC software	Also orderable as E4444A; requires A4H or 1AX; Software available from: **www.agilent.com/find/benchlinksa**
230	Benchlink Web remote control software	Requires Option A4H Software available from: **www.agilent.com/find/web_remote**
—	IntuiLink software (shipped with every instrument)	Connects to Microsoft® Word and Excel; download for free from **www.agilent.com/find/intuilink**
UE2	Firmware upgrade	Firmware updates also available on Web site for free download **www.agilent.com/find/esa_firmware**
Documentation		
OB1	Add extra manual set	Available at **www.agilent.com/find/esa_manuals**
UK6	Commercial calibration certificate with test data	
OBO	Delete manual set (retains CD-ROM version)	
OBV	Service documentation, component level CLIP	Component level information package
OBW	Service documentation, assembly level	
ABO	Taiwan-Chinese user's guide	Available at **www.agilent.com/find/esa_manuals**
AB1	Korea-Korean user's guide	Available at **www.agilent.com/find/esa_manuals**
AB2	China-Chinese user's guide	Available at **www.agilent.com/find/esa_manuals**
ABD	Germany-German user's guide	Available at **www.agilent.com/find/esa_manuals**
ABE	Spain-Spanish user's guide	Available at **www.agilent.com/find/esa_manuals**
ABF	France-French user's guide	Available at **www.agilent.com/find/esa_manuals**
ABJ	Japan-Japanese user's guide	Available at **www.agilent.com/find/esa_manuals**
ABZ	Italy-Italian user's guide	Available at **www.agilent.com/find/esa_manuals**
AKT	Russia-Russian user's guide	Available at **www.agilent.com/find/esa_manuals**
Warranty, Service, and Calibration		
R-51B-001-C	1 year return-to-Agilent warranty and service	Standard
R-51B-001-3C	3 year return-to-Agilent warranty and service	Default
	Calibration Plan (Industry, Inclusive, and Standard-based plans)	More details at **www.agilent.com/find/calibration**
General Spectrum Analyzer Accessories		
11970	Harmonic mixer series (26.5, 40, 50, 60, 75, 110 GHz)	For use in E4407B Option AYZ
11974	Preselected millimeter mixer series (40, 50, 60, 75 GHz)	For use in E4407B Option AYZ
11909A	Low noise amplifier to 1 GHz	
8447A/D	Amplifiers to 400 MHz and 1.3 GHz	
8449B	Preamplifier to 26.5 GHz	

- **Brightest, highest resolution display in its class**
- **1 dB electronic step input attenuator**
- **RBW, 10 Hz to 5 MHz in 10% steps**
- **VBW, 1 Hz to 3 MHz in 10% steps, 4, 5, 6, 8 and 50 MHz**
- **USB and 100 baseT LAN**
- **Channel power measurements**
- **Optional spectrogram**
- **Optional stimulus/response suite with cable fault location**
- **Optional AM and FM tune and listen**
- **Optional AM and FM modulation analysis**
- **Optional preamplifier 3 or 6 GHz**

Performance and Quality You Expected at a Price You can Afford

The Agilent CSA spectrum analyzer brings a level of performance not seen previously in a compact spectrum analyzer. The highest dynamic range in its price class is achieved with unmatched distortion performance, substantial noise performance and standard 10 Hz resolution bandwidth. The CSA also offers overall amplitude accuracy of ±0.5 dB. Now you get all of this capability and more with excellent reliability and low service and support costs.

The user interface is designed to give expert users access to all of the power of the CSA. Logically grouped hard keys, soft keys and menus allow intuitive control of parameters like input attenuator, bandwidth, and detector type. Features such as auto-tune, auto-scale, auto-range, 1 dB step attenuator, built-in preamp and onboard help make the CSA easy to use even for non-experts.

Specifications

Frequency		
Range	100 kHz to 3 GHz/6 GHz	
Internal reference accuracy	≤±5 ppm/year (within two years of adjustment)	
Aging rate	≤±2 ppm/year	
Frequency readout accuracy	±{Frequency indication x frequency reference Accuracy + 1% x span + 10% x RBW + 0.5 x [span/(sweep points – 1)] + 1 Hz}	
Resolution Bandwidth (RBW)	10 Hz to 200 kHz in 10% steps, 250 kHz, 300 kHz, 1 MHz, 3 MHz, 5 MHz	
Zero Span	3 kHz to 5 MHz in 1, 3, 5, sequence, 240 kHz and 1.25 MHz	
Video Bandwidth (VBW)	1 Hz to 10 Hz in 1 Hz steps, 10 Hz to 3 MHz in 10% steps, 4, 5, 6, 8, and 50 MHz (no filtering)	
Display Average Noise Level (Typ)	**Preamp on (10 Hz RBW)**	**Preamp off**
500 MHz	–148 dBm	–130 dBm
1 GHz	–146 dBm	–128 dBm
2 GHz	–142 dBm	–124 dBm
3 GHz	–144 dBm	–130 dBm
4 GHz	–142 dBm	–128 dBm
5 GHz	–139 dBm	–125 dBm
6 GHz	–136 dBm	–122 dBm

Phase Noise (typical)	–85 dBc at 10 kHz offset (0.5 to 2.5 GHz) –82 dBc at 10 kHz offset (2.5 to 6 GHz)	N1996A
Sweep Time and Trace Transfer		
Sweep time setting (zero span)	1 us to 10 s	
Remote sweep and trace transfer		
Span = 0	120 ms	
Span ≤100 MHz	180 ms	
Span = 3 GHz	1 sec	
Amplitude Accuracy (20 to 30°C)		
Peak detector, preamp off, 95% confidence	±0.5 dB 10 MHz to 1 GHz ±0.6 dB 1 GHz to 3 GHz ±0.8 dB 3 GHz to 6 GHz	
Distortion and Residuals		
TOI (Third order intercept)	+18 dBm nominal	
SHI (Second order intercept)	+45 dBm (>700 MHz), +30 dBm (<700 MHz)	
Input related spurs		
Residuals		
Preamplifier	100 kHz to 3 GHz (Option P03) 100 kHz to 6 GHz (Option P06)	
Gain	22 dB (nominal) <2.7 GHz 18 dB (nominal) <6 GHz	
Input/Output		
RF input	Type N, female (50 Ohms)	
Signal source output	Type N, female (50 Ohms)	
USB-A	USB 1.1 (low power device only)	
LAN 100 Base-T	RJ-45 connector	
Reference out	BNC female, 10 MHz, 0 dBm	
Reference in	BNC female, 1 MHz, 2.048 MHz, 4.95 MHz, 10 MHz, 13 MHz, 15 MHz, 19.6608 MHz, 0.5 Hz (even second clock), –5 to +10 dBm	
General Information		
Internal data storage	2 MB for user states and traces	
Display	21.3 cm, color, ZGA TFT-LCD	
Weight with batteries	8.5 kg	
Weight without batteries	7.5 kg	
Dimensions	17.7 x 42.5 x 23.2 cm (without bumpers and handle)	
Operating temperature	A/C power 0 to 40°C; battery power 0 to 50°C	
Probe Power	+15 V at 150 mA –12 V at 150 mA	
EMI Compatibility	CISPR 11, Class A	

Accessories

N1996A-SRK Stimulus/Response Calibration Kit
N1996A-1CM Rack-mount Kit
N1996A-1CP Rack-mount Kit with Handles
N1996A-BAT Battery Pack (2 batteries)
N1996A-BCG External Battery Charger
N1996A-SCC Soft Carrying Case
N1996A-HTC Transit Case (hard cover)
N1996A-ABA Manual Hard Copy (English)
N1996A-ABJ Manual Hard Copy (Japanese)
N1996A-AB2 Manual Hard Copy (Simplified Chinese)
N1996A-0BW Service Documentation

Key Literature and Web Link

CSA Brochure/Data Sheet, p/n 5989-3678EN
Stimulus/Response Measurement Suite, p/n 5989-4602EN
Making a Distance to Fault Measurement, p/n 5989-5209EN
CSA Demonstration Guide, p/n 5989-5159EN

www.agilent.com/find/CSA

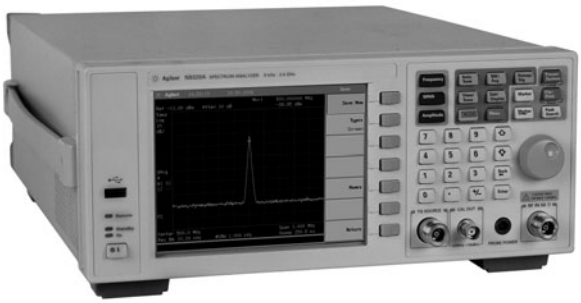
Ordering Information

N1996A-503 Base Box 3 GHz
N1996A-506 Base Box 6 GHz
N1996A-P03 Preamplifier 3 GHz
N1996A-P06 Preamplifier 6 GHz
N1996A-AFM AM/FM Tune and Listen
N8995A-SR3 Stimulus/Response Suite to 3 GHz
N8995A SR6 Stimulus/Response Suite to 6 GHz
N8996A 1FP AM/FM Demodulation Metrics

RF Spectrum Analyzer, N9320A

N9320A

- **Fast sweep: 9.2 ms minimum non-zero span sweep time**
- **Narrow Res BW: 10 Hz to 1 MHz**
- **DANL: –130 dBm, –148 dBm (with preamp on)**
- **TOI: +13 dBm**
- **Auto tune homes in on the highest level of signal across the bandwidth**
- **Power Suite measures RF power easily**



The Agilent N9320A RF spectrum analyzer is one of the new products in Agilent low cost RF instrument family, offering excellent price/performance for customers in consumer electronics manufacturing, bench repair, base station installation and maintenance, and education teaching lab, as well as entry level research and development.

In today's competitive world, you need the measurement to be fast, accurate, and reliable. What is more, you demand a low cost test and measurement solution. Now, Agilent has designed N9320A to fully perform the quality of an Agilent spectrum analyzer to meet your testing needs, and priced the N9320A at an affordable price for you to buy with ease.

As an entry-level spectrum analyzer, Agilent armed N9320A with enhanced usability designs:

- Multi-language user interface helps you to recognize the software menu faster and easier, accelerating front panel operations
- Adequate logical hardkeys and interface, USB connectivity, and SCPI compatible make either front panel operation or remote control easy to start-up

Now, with the exceptional price/performance of the N9320A signal analyzer, you can afford to own the Agilent test equipment you always wanted.

Specifications

Frequency
- Range
  - 9 kHz to 3.0 GHz, AC coupled
  - 100 kHz to 3.0 GHz, Preamp on
- Resolution: 1 Hz

Frequency Readout Accuracy
Marker resolution: (Frequency span)/(number of sweep point –1)
Frequency Counter
Resolution: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz, 1 kHz, Selectable
Resolution Bandwidth (RBW)
- Range: 10 Hz to 1 MHz, in 1-3-10 sequence, –3 dB bandwidth
- Accuracy
  - ±20%, 1 kHz to 1 MHz RBW
  - ±5%, 10 Hz to 300 Hz RBW

Video Bandwidth Range: 1 Hz to 3 MHz, in 1-3-10 sequence
Sweep Time
- Range:
  - 9.2 ms to 4000 s, Span > 0 Hz
  - 20 µs to 4000 s, Span = 0 Hz
- Sweep mode: Continuous, Single

Internal 10 MHz Reference
- Aging rate: ±1 ppm/year
- Temperature stability: ±1 ppm
- Supply voltage stability: ±0.3 ppm

Phase Noise
- Offset from CW signal
  - 10 kHz: <–88 dBc/Hz, typically <–90 dBc/Hz
  - 100 kHz: <–100 dBc/Hz, typically <–102 dBc/Hz
  - 1 MHz: <–110 dBc/Hz, typically <–112 dBc/Hz

Residual FM: ≤100 Hz peak to peak in 100 ms, 1 kHz RBW, 1 kHz VBW
Displayed Average Noise Level (DANL):
–130 dBm, –148 dBm with preamp on
Amplitude
- Measurement range: DANL to +30 dBm
- Input attenuator range: 0 to 70 dB, in 1 dB step
- Maximum damage level
  - ≥+40 dBm, average continuous power
  - ≥+50 dBm, peak pulse power
  - 50 VDC Maximum, DC voltage

Weight: 9.1 kg
Dimensions: 132.5 mm (H) x 320 mm (W) x 400 mm (D)
Warm-up Time: 45 minutes

Key Literature & Web Link

www.agilent.com/find/n9320a

Ordering Information

N9320A RF Spectrum Analyzer
N9320A-PA3 3 GHz Preamplifier
N9320A-TG3 3 GHz Tracking Generator
N9320A-1TC Hard Transit Case
N9320A-1HB Handle and Bumper
N9320A-1CM Rackmount Kit

- **Frequency range: 100 kHz to 3 GHz**
- **RBW: 30 Hz to 1 MHz in 1-3-10 sequence**
- **VBW: 3 Hz to 1 MHz**
- **SSB phase noise: –87 dBc at 30 kHz offset**
- **DANL: (10 MHz<fc≤1.5 GHz)**
  - **–124 dBm**
  - **–144 dBm with preamplifier on**
- **Sweep speed**
  - **10 ms to 1000s, span ≥1 kHz**
  - **<120 ms at full span**
- **Amplitude accuracy: ±1.5 dB**
- **7.2" sunlight-viewable LCD**
- **>4 hours battery operating time**
- **Modern USB connectivity for data transfer and PC control**
- **11-language UI**
- **Tracking generator and preamplifier are options**

The Agilent N9340A handheld RF spectrum analyzer provides exceptional performance and optimized usability for installation & maintenance tasks in the field, such as interference test, spectrum monitoring, and on-site repair etc.. N9340A can meet the requirements of users in a variety of industries, including wireless service providers, aerospace & defense, spectrum management authorities and TV & broadcasting industry. N9340A covers the frequency range of 100 kHz (tuneable to 9 kHz) to 3 GHz.

Exceptional Performance

- N9340A provides fast sweep speed. Its sweep speed at full span is less than 120 ms and its non-zero span sweep speed is 10 ms minimum. The fast sweep speed help users locate and identify elusive and transient inference signals. It requires less time to measure across the span and you need not to wait to see the scan. With less field working time required by N9340A, you can improve the productivity
- N9340A provides the best sensitivity in-the-class. N9340A provides the lowest DANL in-the-class: –124 dBm with preamplifier off or –144 dBm with preamplifier on (30 Hz RBW, 10 MHz<fc≤1.5 GHz). The optional preamplifier with 20 dB gain further improves analyzer sensitivity. The best sensitivity of N9340A help users detect more low level signal and give them more complete understanding of the spectrum
- N9340A provides the best resolution ability with the narrowest RBW of 30 Hz to 1 MHz in 1-3-10 sequence, making it possible to resolve close-in signals. The narrowest RBW also means least noise is introduced by N9340A for overall lowest DANL
- The Agilent N9340A achieves the lowest SSB phase noise which also helps detect low signals (spurious or noise) close to the carrier which would otherwise be missed

Optimized Usability

- The N9340A provides a 7.2" sunlight-viewable LCD screen which gives you a clear reading of the spectrum scans in the strong sunlight
- The Lithium-ion battery together with the advanced built-in power management provide N9340A an impressive 4 hours operating time. One spare battery or 12 V automotive adaptor can help N9340A operate for an entire day in the field
- N9340A offers USB connectivity for PC control and easy data transfer to USB memory stick. The support for USB memory stick makes data transfer in the field more convenient. The support for PC control via USB interface makes test and measurement more efficient
- N9340A supports 11-language on-screen user interface which allows for easy operation in users' native language. These languages include English, simplified Chinese, traditional Chinese, French, German, Italian, Japanese, Korean, Portuguese, Russian, and Spanish
- N9340A's rugged design makes it tough enough to meet the military customers' requirements. Apart from its compact and rugged construction, the large rubberized grips wrap around both ends provides additional robust protection from rough handling. The sealed keypad and screen are moisture resistant and dust proof

Specifications

Frequency Range
100 kHz (tuneable to 9 kHz) to 3 GHz, AC coupled
Internal 10 MHz Frequency Reference
- Aging Rate: ±1 ppm /year
- Temperature Stability: ±2 ppm, 0°C to 30°C; 30°C to 50°C in addition 2 ppm/10°C

Marker Frequency Counter
- Resolution: 1 Hz
- Accuracy:
  - ± (marker frequency x frequency reference Uncertainty + Counter resolution)
    RBW/SPAN ≥0.02; Marker level to displayed; Noise level >25 dB , frequency offset = 0 Hz

Frequency Span
- Range: 0 Hz (zero span), 1 kHz to 3 GHz
- Resolution: 1 Hz

SSB Phase Noise
- 30 kHz: <–87 dBc/Hz
- 100 kHz: <–100 dBc/Hz
- 1 MHz: <–120 dBc/Hz

Resolution Bandwidth (RBW)
- –3 dB bandwidth: 30 Hz to 1 MHz, 1-3-10 sequence
- Accuracy: ±5%, nominal
- Resolution filter shape factor: <5:1, nominal; 60 dB/3 dB bandwidth ratio; Digital, approximately Gaussian shape

Video Bandwidth (VBW)
- –3 dB bandwidth, 3 Hz to 1 MHz , 1-3-10 Sequence
- Accuracy: ±5%, nominal

Amplitude
- Measurement Range: Displayed average noise level to +20 dBm
- Input Attenuator Range: 0 to 51 dB, in 1 dB steps

Maximum Safe Input Level
- Average Continuous Power: ≥+33 dBm, 3 minutes max.; Input attenuator setting ≥20 dB
  (Input protection switch active when input level >33 dBm)
- DC Voltage: 50 VDC max.

Handheld RF Spectrum Analyzer, N9340 (cont.)

N9340A

Displayed Average Noise Level
- Preamp Off
  - 100 kHz<fc≤1 MHz: <–90 dBm; Reference level ≤–50 dBm
  - 1 MHz<fc≤10 MHz : <–110 dBm; Reference level ≤–50 dBm
  - fc = 50 MHz: –126 dBm, typical; Reference level ≤–50 dBm
  - 10 MHz<fc≤1.5 GHz: <–124 dBm; Reference level ≤–50 dBm
  - 1.5 GHz<fc≤3 GHz: <–117 dBm; Reference level ≤–50 dBm
- Preamp On
  - 100 kHz<fc≤1 MHz, <–115 dBm, nominal; Reference level ≤–70 dBm
  - 1 MHz<fc≤10 MHz, <–128 dBm; Reference level ≤–70 dBm
  - fc = 50 MHz, –146 dBm, typical; Reference level ≤–70 dBm
  - 10 MHz<fc≤1.5 GHz, <–144 dBm; Reference level ≤–70 dBm
  - 1.5 GHz<fc≤3 GHz, <–136 dBm; Reference level ≤–70 dBm

Reference Level
Setting Range: –100 dBm to +20 dBm, steps of 1 dB

RF Input VSWR (at tuned frequency)
- Attenuator setting 0 dB
  - <1.8:1, 10 MHz to 3.0 GHz/Nominal
- Attenuator setting 10 dB
  - <1.8:1, 100 kHz to 10 MHz/Nominal
  - <1.5:1, 10 MHz to 2.5 GHz/Typical
  - <1.8:1, 2.5 GHz to 3 GHz/Typical
- Attenuator setting 20 dB
  - <1.6:1, 100 kHz to 10 MHz/Nominal
  - <1.4:1, 10 MHz to 3.0 GHz/Typical

Spurious Responses
- Second Harmonic Distortion: <–70 dBc distortion, Mixer level = –40 dBm
- Third Order Intermodulation (TOI): +10 dBm, typical, third-order IM products, 2 x –20 dBm, reference level = –10 dBm, center frequency 300 MHz, frequency Separation = 200 kHz
- Input Related Spurious: <–70 dBc, –40 dBm signal at input mixer, carry offset >1 MHz
- Inherent Residual Response: <–88 dBm, Input terminated and 0 dB RF attenuation, preamplifier off , reference level –30 dBm, f>30 MHz, RBW ≤10 kHz

Sweep Time
- Range
  - 10 ms – 1000 s, Span >1 kHz
  - 6 us to 200 s, Span = 0 Hz (zero span)
- Sweep Mode: continuous, single
- Trigger Source: free run, video, external
- Trigger Slope: Selectable positive or negative edge

RF Input
- Connector: Type-N female
- Impedance: 50 Ω (nominal)

USB Interface
- Host Connector and Protocol: A plug; Version 1.1
- Device Connector and Protocol: B plug; Version 1.1

10 MHz REF/ External Trigger Input
- Connector: BNC f = Female; 50 Ω
- REF Input Frequency: 10 MHz
- REF Input Amplitude: 0 to +10 dBm
- Trigger Voltage: 5 V TTL level

RF Preamplifier (Option PA3)
- Gain: 20 dB, nominal
- Frequency Range: 1 MHz – 3 GHz

Tracking Generator (Option TG3)
- Connector: Type N, female
- Impedance: 50 Ω, nominal
- Frequency Range: 5 MHz – 3 GHz
- VSWR: <2.0:1, nominal
- Output Level: 0 dBm to –25 dBm, 1 dB step
- Output Flatness: ±3 dB, referenced to 50 MHz, 0 dBm

Calibration Cycle: 1 year

Temperature Range
Operating
- Operating: –10°C to +50°C Battery: 0°C to +50°C
- Storage: –40°C to +70°C Battery: –20°C to 50°C
- Warm-up Time: 30 minute

Power Requirements
Temperature Range
- Voltage: 90 to 120 or 195 to 263 VAC; 47 to 63 Hz; 12 to 18 VDC; <25 W
- Operating Time (with fully charged battery)
  - 4 h with tracking generator off
  - 3 h with tracking generator on
- Battery Charging Time: 3 h
- Lifetime: 300 to 500 charging cycles
- Power Consumption: 12 W, typical

Display: 7.2" STN transflective color display

Weight (without options)
Net: 3 kg (3.5 kg include battery) approximately

Dimensions
318 mm (H) x 207 mm (W) x 69 mm (D) approximately

Key Literature & Web Link

www.agilent.com/find/n9340a

Ordering Information

N9340 Handheld RF Spectrum Analyzer
- **N9340A-PA3** 3 GHz Pre-amplifier
- **N9340A-TG3** 3 GHz Tracking Generator
- **N9340A-ITC** Hard Transit Case
- **N9340A-1DC** Automotive 12 V DC Adaptor
- **N9340A-BAT** Spare Battery Pack

- **Preselected mixers to eliminate signal identification**
- **State-of-the-art technology**
- **Easier automated measurements**
- **Low conversion loss**
- **Individually amplitude calibrated**
- **No bias or tuning adjustments**
- **High 100 mW safe input level**

11970, 11974 Series Mixers

11974 Series Preselected Millimeter Mixers

Eliminate the need for signal identification at millimeter frequencies. The Agilent 11974 series mixers are preselected from 26.5 to 75 GHz for faster, easier testing of millimeter devices and systems. Preselection reduces mixer overload from broadband signals and reduces radiation of local oscillator harmonics back to the device under test. Equipment operators can quickly locate true signals, and software development for automated measurements is greatly simplified.

These mixers feature advanced barium-ferrite technology and come with a standalone power supply. They are particularly useful for broadband millimeter signal analysis, millimeter electromagnetic interference (EMI) measurements, and unattended monitoring of millimeter signals.

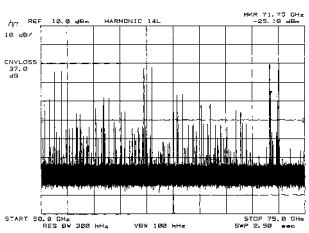
11974 series preselected mixers are available in four bands

Agilent Model	Frequency Range (GHz)	Sensitivity[1] (displayed avg. noise level/10 Hz) (dBm)	Calibration Accuracy[1] (dB)	Image Rejection[1] (dB)	1 dB Gain Compression (dBm)
11974A	26.5 to 40	–111	<±2.3	–54	+6
11974Q	33 to 50	–106	<±2.3	–50	+0
11974U	40 to 60	–109	<±2.6	–50	+0
11974V	50 to 75	–100	<±4.5	–40	+3

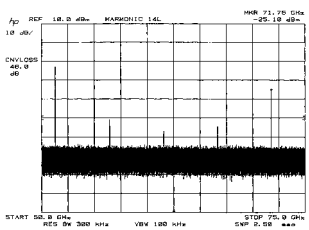
[1] Specifications apply when connected to the PSA, 8566B or 70000 series spectrum analyzers.

Compatibility

Upgrade kits are available to assure the compatibility of PSA Series (E4440A/47A/46A/48A) and ESA (E4407B). Consult your Agilent sales representative to determine requirements. All 8560EC series, PSA (E4440A/47A/46A/48A), and ESA (E4407B) spectrum analyzers and the 70907B external mixer interface modules are fully compatible with the 11974 series.



50 to 75 GHz Sweep Without Preselection



50 to 75 GHz Sweep Using 11974 Series Mixer

11970 Series Harmonic Mixers

The 11970 series waveguide mixers are general-purpose harmonic mixers. They employ a dual-diode design to achieve flat-frequency response and low conversion loss. These are achieved without external dc bias or tuning stubs. Manual operation and computer-controlled hardware operation are simplified because mixer bias and tuning adjustments are not required.

11970 series harmonic mixers are available in six bands (15 to 17 dBm LO)

Agilent Model	Frequency Range (GHz)	LO Harm Number	Conversion Loss (dB)	Noise Level (dB) 1 kHz RBW	Freq.[1] Response (dB)	Gain Compression (dBm)
11970K	18 to 26.5	6+	24	–105	±1.9	–3
11970A	26.5 to 40	8+	26	–102	±1.9	–5
11970Q	33 to 50	10+	28	–101	±1.9	–7
11970U	40 to 60	10+	28	–101	±1.9	–7
11970V	50 to 75	14+	40	–92	±2.1	–3
11970W	75 to 110	18+	47	–85	±3.0	–1

[1] Frequency response of the mixers is reduced by 1 dB for LO range of 14 to 18 dBm.

Compatibility

The 11970 series mixers extend the frequency range of the PSA Series (E4440A/47A/46A/48A) high-performance spectrum analyzers, the 8560EC series portable spectrum analyzers, ESA (E4407B) portable mid-performance spectrum analyzers, the 8566B spectrum analyzer (used with the 11975A amplifier), and the 70000 modular measurement system (used with the 70907A/B external mixer interface modules).

11970 and 11974 Series Specifications

IF Range: dc to 1.3 GHz
LO Amplitude Range: +14 dB to +16 dB; +16 dB optimum
Calibration Accuracy: ±2 dB for 11970 series with optimum LO amplitude
Typical RF Input SWR: <2.2:1, <3.0:1 for 11974 series
Bias Requirements: None
Typical Odd-Order Harmonic Suppression: >20 dB (does not apply to 11974 series)
Maximum CW RF Input Level: +20 dBm (100 mW), +25 dBm for 11974 series
Maximum Peak Pulse Power: 24 dBm (250 mW) with <1 µs pulse (avg. power = +20 dBm)
Bandwidth: 100 MHz minimum (11974 series only)
Environmental: Meets MIL-T-28800, Type III, Class 3, Style C
IF/LO Connectors: SMA (female)
TUNE IN Connector: BNC
LO Range: 3 to 6.1 GHz

Key Literature & Web Link

11970 Series Technical Data, p/n 5968-1445E
11974 Series Technical Data, p/n 5952-2748

Ordering Information

11974A 26.5 to 40 GHz Preselected Mixer
11974Q 33 to 50 GHz Preselected Mixer
11974U 40 to 60 GHz Preselected Mixer
11974V 50 to 75 GHz Preselected Mixer
  11974V-003 Delete Power Supply (11974 series only)
11970K 18 to 26.5 GHz Mixer
11970A 26.5 to 40 GHz Mixer
11970Q 33 to 50 GHz Mixer
11970U 40 to 60 GHz Mixer
11970V 50 to 75 GHz Mixer
11970W 75 to 110 GHz Mixer
11970
  11970-009 Mixer Connection Set adds three 1-m low-loss SMA cables, wrench, Allen driver for any 11970 series mixer
11975A 2 to 8 GHz Amplifier
281A/B Coaxial to Waveguide Adapters
  R281A 26.5 to 40 GHz, 2.4 mm (f)
  R281B 26.5 to 40 GHz, 2.4 mm (m)
  Q281A 33 to 50 GHz, 2.4 mm (f)
  Q281B 33 to 50 GHz, 2.4 mm (m)

11867A and N9355/56 Series Limiters

Protect the input circuits of spectrum analyzers, counters, amplifiers and other instruments from high power levels with minimal effect on measurement performance. The 11867A RF limiter (dc to 1.8 GHz) reflects signals up to 10 W average power and 100 W peak power. Insertion loss is less than 0.75 dB. The N9355/56 series microwave limiters cover frequency ranges from 10 MHz to 18 GHz (N9355B/56B), to 26.5 GHz (N9355C/56C), and to 50 GHz (N9355F), respectively. They provide the best broadband input power protection to sensitive RF and microwave instruments with low insertion loss. Typical limiting threshold for the N9355 limiters is 10 dBm and that for the N9356 is 25 dBm.

11825B Impedance Matching Adapter

Impedance matching adapters are instrument grade tools used in RF and microwave signal matching that adapt 50-ohm impedance to 75-ohm impedance or vice versa. The 11852B minimum loss adapter is a 50 Ω to 75 Ω or 75 Ω to 50 Ω impedance converter with type-N connectors, operating from DC to 3 GHz. Use the Agilent 11852B Option 004 (50 Ω type-N(f), 75 Ω type-N(m)) for spectrum analyzers with 50 Ω input impedance when the 50 Ω/75 Ω impedance conversion is required.

85024A Probe (300 kHz to 3 GHz)

In-circuit measurements are made easy with this 300 kHz to 3 GHz probe. Input capacitance of 0.7 pF shunted by 1 MΩ resistance permits high-frequency probing without adverse loading of the circuit under test. Excellent frequency response and unity gain guarantee highly accurate swept measurements. High sensitivity and low distortion levels allow measurements that take advantage of full analyzer dynamic range.

87405B/C Preamplifiers

Agilent 87405B/C operates from the operating frequency as low as 100 MHz up to 18 GHz. They provide a low noise figure of 4.5 dB on 87405C model and 5 dB on 87405B model and gain from 24 dB. These will improve the dynamic range and sensitivity of your test equipment. With its convenient probe-power bias, the 87405B/C preamplifiers are ideal use as the front end preamplifier for a variety of Agilent instruments such as PSA, ESA, MXA, EXA, and CSA spectrum/signal analyzers. They also come in a rugged and portable design which will ease the use in many field applications. As a whole, Agilent 87405B/C preamplifiers improve the overall system performance and help reduce system errors with reliable gain and low noise figure.

Ordering Information

87405B Preamplifier (10 MHz to 4 GHz)
87405C Preamplifier (100 MHz to 18 GHz)
Cable Options (must order one)
87405C-101 Cables – Banana Plugs
87405C-102 Cables – Probe Power Bias
87405C-103 Cables – DSUB 15 pin

8449B Preamplifier (1 to 26.5 GHz)

This high-gain, low-noise preamplifier increases the sensitivity of any RF/microwave spectrum analyzer for detection and analysis of very low level signals. The improved sensitivity can dramatically reduce measurement time.

8447A and 8447D Amplifiers

The Agilent 8447A and 8447D are low-noise, high gain amplifiers used to improve the sensitivity of counters, spectrum analyzers, RF voltmeters, EMI meters, power meters and other devices. They will also increase the maximum power available from a signal generator or sweeper.

Specifications

	8447A Amplifier	8447D Amplifier
Frequency Range	0.1 to 400 MHz	100 kHz to 1.3 GHz
Typical 3 dB Bandwidth	50 kHz to 700 MHz	75 kHz to 1.7 GHz
Gain (mean, per channel)	20 dB ±1.0 dB at 10 MHz (20° to 30°C)	>25 dB (20° to 30°C)
Gain Flatness Across Full Frequency Range	±1.8 dB (0° to 55°C) ±0.7 dB (20° to 30°C) characteristic	±1.5 dB
Noise Figure	<7 dB	<8.5 dB
Output Power for 1 dB Gain Compression	>+6 dBm	>+7 dBm typical
Harmonic Distortion	–32 dB for 0 dBm output	–30 dB for 0 dBm output (typical)
Output for <–60 dB Harmonic Distortion	–25 dBm (characteristic)	–30 dBm
VSWR	<1.7	<2.0 input <2.2 output 1 to 1300 MHz
Reverse Isolation	>30 dB	>40 dB
Maximum dc Voltage Output	±10 V	±10 V
Size	85.8 mm H x 130 mm W x 261 mm D (3.4 in x 5.1 in x 8.5 in)	85.8 mm H x 130 mm W x 216 mm D (3.4 in x 5.1 in x 8.5 in)
Weight	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)
Power Requirements	110 or 230 Vac + 10 %, 48 to 440 Hz, 15 W	110 or 230 Vac + 10 %, 48 to 440 Hz, 15 W
Options Available	**Option 001:** Dual-channel amp, BNC (f) connectors	**Option 001:** Dual-channel amp, BNC (f) connectors **Option 010:** Single-channel amp, Type-N (f) connectors **Option 011:** Dual-channel amp, Type-N (f) connectors

Key Literature & Web Link

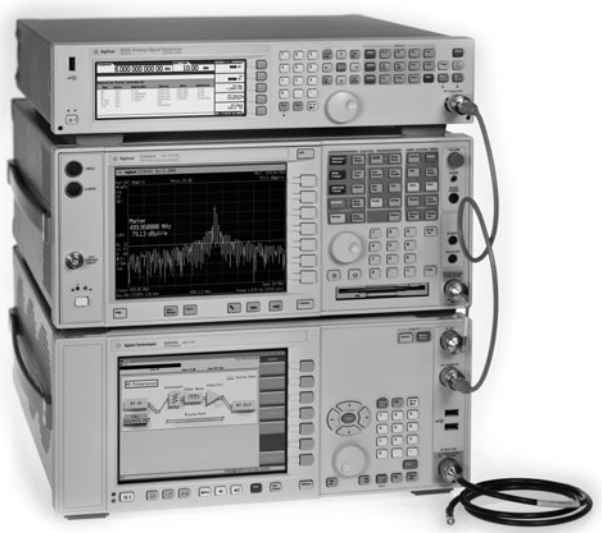
For more information, visit our site: **www.agilent.com/find/mta**

Ordering Information

8447A Amplifier
8447D Amplifier

N9039A

- **RF preselection from 9 kHz to 1 GHz**
- **CISPR bandwidths (200 Hz, 9 kHz, 120 kHz and 1 MHz)**
- **CISPR detectors (quasi-peak, peak and average)**
- **Limit lines and limit margins**
- **Correction factors for antennas, cables, amplifiers and other devices**
- **Preselector filter alignment using external signal source**
- **Built-in limiter for conducted emissions protection**
- **Preamplifier for greater sensitivity**
- **8192 data points for wider scans**



EMI Measurement Receiver

Combine the world class performance of the E444xA PSA spectrum analyzer and the new N9039A RF preselector and the result is an accurate, fast EMI measurement receiver. This new receiver gives you the confidence that the measurements you make are accurate and repeatable.

Agilent's new EMI measurement system offer excellent amplitude and frequency accuracy across the entire band. Delivering 8192 data points per sweep, this system allows you to analyze very broad spans with the resolution recommended by CISPR. In addition, you can quickly switch from bypass to preselected mode for fully compliant measurements.

With the systems excellent amplitude accuracy, you can reduce your margins and increase you pass rate.

Specifications

- Radiated emissions bands sensitivity to 1 GHz: –152 dBm
- Absolute amplitude accuracy ±1.0 dB, 9 kHz to 1 GHz
- Input VSWR 1.2:1
- Preselected TOI +15 dBm
- Span accuracy @ 100 MHz: 20 kHz typical

Key Literature & Web Link

EMI Measurement Receiver, p/n 5989-6807EN

www.agilent.com/find/emi

Ordering Information

E444xA-239 PSA Spectrum Analyzer with EMI Personality
N9039A RF Preselector
N5181A Signal Generator (required for alignment)

E7400A Series EMC Analyzers

Whether your industry is information technology, automotive, communications, or medical electronics, you need to evaluate the EMI performance of your products during the development phase. With Agilent's E7400A Series EMC analyzers, you can evaluate performance quickly and easily.

EMC Express Analyzers Provide Ordering Ease, Faster Delivery, and Best Value

The EMC analyzer is available in two "express option" choices. Express analyzer options are based on the most frequently ordered EMC configurations and most popular options. Express analyzers are favorably priced and provide faster delivery.

Radiated Emissions

When combined with a broadband antenna, the E7400A Series analyzer provides the capabilities to check for radiated emissions coming from your DUT. This is best done in an area that is free from reflective objects such as an open area or EMI chamber.

Conducted Emissions

Test for noise or interference placed on power or data lines by coupling the E7400A series instrument to the power or data line through a line impedance stabilization network (LISN) device or absorbing clamp.

Diagnostics and Problem Isolation

If you have an emissions problem, you can use the E7400A with an 11940A or 11941A close field probe to isolate and diagnose the source of the problem.

Extensive Feature Set Enables Quick Measurements

The E7400A Series EMC analyzers have the following functionality and features to speed you through measurements:

- Detectors to perform peak, quasi-peak, and average measurements
- Complete measurement setups including span and EMI bandwidths
- Display two limit lines and margins
- Corrections for antennas, cables, and amplifiers
- Measure peak, quasi-peak, and average amplitudes of 2000 signals and store the results into the internal list
- Use the "Zone" feature to zoom in on a signal while viewing the broad spectrum
- Built-in 3.5 inch disk drive
- Large, crisp color display
- Built-in preamplifier with 20 dB nominal gain
- Sort, remeasure, mark, and delete signals in the internal list
- Standard GPIB and parallel ports
- Battery pack available
- Edit or customize and store limit lines and correction factors
- Optional built-in tracking generator to 3 GHz

Ordering Information

E7400A Series EMC Analyzer (Express Option STD/STG)

Available Models
E7402A (30 Hz to 3.0 GHz)
E7405A (30 Hz to 26.5 GHz)

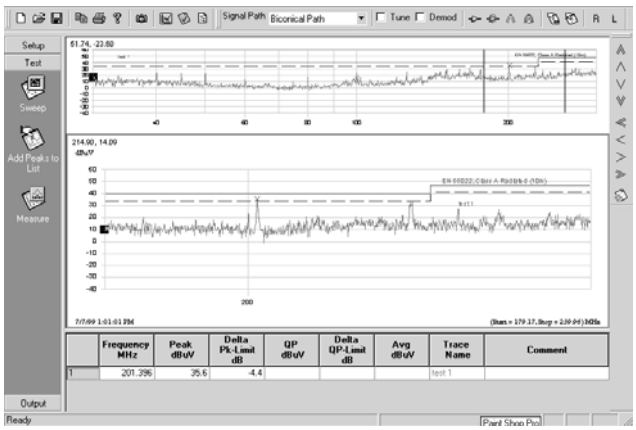
The EMC standard analyzer (option STD) includes all the options listed below. To receive a standard analyzer with a tracking generator order option STG instead of STD.

Options included with STD or STG	
GPIB connection	A4H
EMI detectors and FM demod	AYQ
Fast time domain sweep, IF and video output ports	AYX
100 Hz (30 Hz usable) frequency range extension	UKB
Low emissions shielding	060
Narrow resolution bandwidths (1 Hz resolution)	1DR
Preamplifier built-in for enhanced sensitivity (operates to 3 GHz)	1DS
High stability frequency reference	1D5
EMC measurement firmware (automated EMC measurements; available from **www.agilent.com/find/emc**)	***
IntuiLink PC connectivity software (connects to Microsoft Word and Excel)	***

Available Options	
50 ohm tracking generator (9 kHz to 3.0 GHz) (equivalent to Option 1DN)	STG
Replace GPIB connection (A4H) with serial port (not compatible with Option A4H or E7415A EMI measurement software)	1AX
Time-gated spectrum analysis	1D6

PC Software for the E7400A Series

IntuiLink PC software provides easy transfer of EMC measurement trace data directly into MS Excel spreadsheets or screen images into MS Word documents for analysis, archiving, presentations, or printing. Transfer measurement results over GPIB, RS232, or LAN (using an E2050A GPIB/LAN adapter). Save and restore analyzer states. Unattended operation with repetitive sequence of measurement transfers by date and time. IntuiLink is included standard with GPIB and RS232 options.



E7415A EMI Measurement Software

Choose the level of automation you need, from simple data capture from your EMC analyzer or receiver to fully automated EMI measurements. With the E7415A, you can select the measurement resolution over the span of interest or use the auto-select feature.

Zoom in on an area for a closer look simply by dragging a cursor. Point and click to mark individual signals and add them to a list or use the "Add Peaks to List" function to add all the signals above a limit or margin to a list with one click. Highlight signals in the list to measure peak, quasi-peak and average amplitude or tune and listen.

Generate a report by selecting from a wide range of entries. Your report may include a graph, limit lines, equipment table, transducer factors etc.

The E7415A controls the E7400A Series EMC analyzers as well as the 8590EM Series EMC analyzer and 8546A/42E EMI receivers.

11940A and 11941A Close-Field Probes and 11945A Close-Field Probe Set

These handheld probes are designed to measure magnetic-field radiation from surface currents, slots, cables, and ICs for EMC diagnostic and troubleshooting measurements. Their unique design results in a high level of electric-field rejection. This significantly reduces errors, thus allowing calibrated and repeatable measurements.

The 11941A operates from 9 kHz to 30 MHz, the 11940A, from 30 MHz to 1 GHz. Five antenna factors appear on each probe for calculating absolute magnetic-field strength (dBµA/m) from the dBµV reading of a spectrum analyzer. Each probe is calibrated and comes with a 2-meter RG-223 coaxial cable, and SMA(f)-to-type-N(m) adapter, and an SMA (f)-to-BNC(m) adapter.

The 11945A close field probe set includes both the 11940A and 11941A probes for full coverage from 9 kHz to 1 GHz. Option E51 adds the 11909A preamplifier, with a 36-inch (914-mm) type-N cable, and a carrying bag for storage and protection of the entire set.

119XX Series Antennas

These antennas are individually calibrated and shipped with a calibration certificate showing actual performance data. The series includes the following products:

Model		Frequency Range
11955A	Biconical Antenna[1]	30 to 300 MHz
11956A	Log Periodic Antenna[1]	200 MHz to 2 GHz
11966E	Double-Ridged Waveguide Horn Antenna	1 to 18 GHz
11966J	Double-Ridged Waveguide Horn Antenna	18 to 40 GHz
11966L	Coax Cable, Type-N	10 m
11966P	Broadband Antenna	30 MHz to 2 GHz

[1] Typical cal factor supplied.

These antennas may be ordered directly from ETS Lindgren (**www.ETS-Lindgren.com**). The E7400A Series EMC Analyzers will also work with most third party antennas, LISNs, and other EMC accessories.

11967D Line Impedance Stabilization Network

Used for commercial conducted measurements. Maximum current 10 amps. Includes options for SCHUKO, NEMA, and British power outlet connectors.

11974A Transient Limiter

A Transient Limiter protects the EMC analyzer's input from damage caused by high-level transients. The 11974A is recommended for use with LISN device.

11909A Preamplifier

Improve receiver, sensitivity for more accurate radiated emissions measurements. This amplifier has 32 dB gain with a 1.8 dB noise figure. This amplifier is ideal for use with the 11940A and 11941A close field probes to detect low level signals from device-under-test. Frequency range is 9 kHz to 1 GHz.

8449B Microwave Preamplifier

This high-gain, low-noise preamplifier adds sensitivity for MIL-STD radiated measurements. Frequency range is 1 to 26.5 GHz.

Key Literature

E7400A Series EMC Analyzer Brochure, p/n 5968-2516E
ESA/EMC Configuration Guide, p/n 5968-3412E
E7400A Series Technical Specifications, p/n 5968-3662E
EMC Precompliance Systems and Accessories Catalog, p/n 5988-3290EN
EMC Precompliance Cookbook (AN 1328), p/n 5968-3661E

Noise Figure Analyzers, NFA Series

N8973A
N8974A
N8975A

- **A flexible and intuitive user interface**
- **Easy measurement setup**
- **Low instrument uncertainty**
- **Color graphical display of noise figure and gain versus frequency**
- **Enhanced PC and printer connectivity**
- **SNS, 346 and 347 Series noise source compatible**
- **Ability to automatically upload ENR calibration data from SNS Series noise source**
- **Local oscillator control through second dedicated GP-IB**

N8973A

NFA Series

A Flexible and Intuitive User Interface

The user interface on the NFA series of Noise Figure Analyzers is intuitive and easy to use, with easy to find keys, which are sized and then placed in the relevant key group according to function. The soft-key depths have been kept to a minimum and there are clear visual indicators on the screen showing the current machine state.

Easy Measurement Setup

The NFA series of Noise Figure Analyzers now takes the pain out of complex measurement setups, with their simple but instructive menus. The built-in help button gives key function and remote programming commands, that should eliminate the need to carry manuals when setting up measurements.

Low Instrumentation Uncertainty

When making noise figure measurements, a key parameter to be aware of is measurement uncertainty. The NFA has a low instrumentation uncertainty to aid in accurate and repeatable measurement of manufacturers' components. In addition, to aid customers in setting their components/systems specifications, Agilent has produced a web-based uncertainty calculator that will give customers information on how to improve and classify their measurement specifications more accurately.

For more information, visit our web site at: **www.agilent.com/find/nf**

Increase Measurement Throughput

In manufacturing environments, fast measurement speed and repeatability are critical. The NFA series of Noise Figure Analyzers include many features that can reduce your measurement time and increase throughput. The frequency list function allows you to select specific points within a complete measurement span to make your measurement. The Sweep averaging function allows a real-time update to the screen during a measurement, as you adjust the performance of the DUT during a sweep. Both these functions, as well as the limit line functionality for quick and easy pass/fail testing and the additional ability to recall complete calibrated instrument states, increase productivity and measurement throughput.

Enhanced Connectivity

The built-in floppy disk drive, GPIB, RS232 serial and Printer port connectors allow data transfer between the analyzer and a PC or workstation. There is also a built-in VGA connector for connecting a large-screen monitor.

Color Graphical Display

To enhance usability, the Noise Figure Analyzers come with an integrated 17 cm full color LCD display, for simultaneous viewing of noise figure and gain against frequency. There are three different formats for viewing measurements, the two separate channel or combined graph format, a table format, and a spot frequency noise figure and gain measurement "meter" format.

Ease of Automation

The NFA series of Noise Figure Analyzers include 2 industry-standard GPIB ports and an RS232 serial port, to aid in the automated control of the instrument. The second GPIB port is dedicated to Local oscillator control. The default control language is SCPI, but users can also define custom LO commands.

Ease of Integration

To aid with the integration of the analyzer into manufacturing environments, Agilent has produced a Programmers Reference Manual containing example programs to help migrate to the new system. The NFA is not code compatible with the 8970B, nor can it control the 8971C.

Full Measurement Capability

Features present in all NFA series noise figure analyzers

- ENR data automatically loaded into NFA series noise figure analyzer when using SNS noise source
- Floppy disk loading and saving of ENR data when used with a 346 or 347 noise source
- Enhanced analysis through Limit lines and Marker functions
- Enhanced PC and printer connectivity and VGA output
- Internal data storage capable of storing up to 30 different state, trace, and setup files (dependent upon measurement complexity)
- 4 MHz measurement bandwidth
- Frequency list mode, which enables the user to avoid known, polluted frequencies during a measurement or, used tactically to speed up a measurement

Features Available

- Lower noise figure measurement uncertainty ±<0.05 dB
- Six user selectable bandwidths (100 KHz, 200 KHz, 400 KHz, 1 MHz, 2 MHz, and 4 MHz)

N8973A
N8974A
N8975A

NFA Series Key Specifications

Specifications apply over 0°C to +55°C unless otherwise noted. The analyzer will meet its specifications after 2 hours of storage within the operating temperature range, 60 minutes after the analyzer is turned on, with Alignment running. A user calibration is required before corrected measurements can be made.

Frequency Range

NFA Series:

N8973A	10 MHz to 3 GHz
N8974A	10 MHz to 6.7 GHz
N8975A	10 MHz to 26.5 GHz

Measurement Speed (nominal)

	8 Averages	64 Averages
N8973A:	<50 ms/measurement	<42 ms/measurement
N8974A:	<70 ms/measurement	<50 ms/measurement
N8975A:	<70 ms/measurement	<50 ms/measurement

Measurement Bandwidth (nominal)

N8973A, N8974A, N8975A: 4 MHz, 2 MHz, 1 MHz, 400 kHz, 200 kHz, 100 kHz

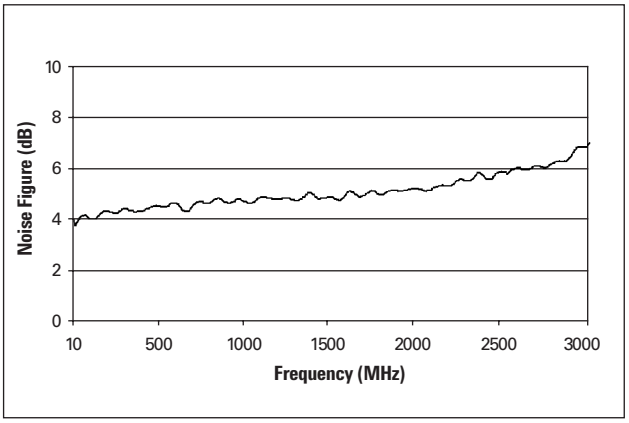
Noise Figure and Gain

(Performance is dependent upon ENR of noise source used)

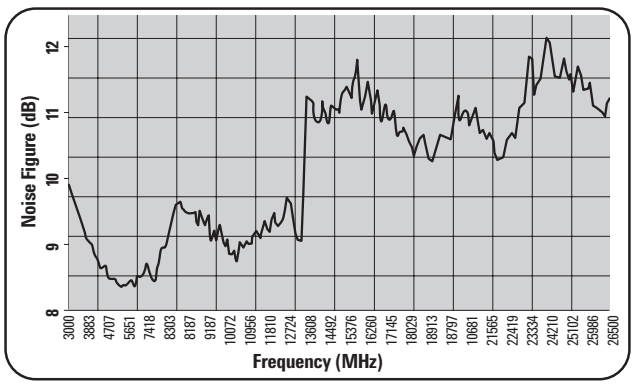
N8973A, N8974A and N8975A (10 MHz to 3.0 GHz)	Noise Source ENR 4 – 7 dB	12 – 17 dB	20 – 22 dB
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±<0.05 dB	±<0.05 dB	±<0.1 dB
Gain			
Measurement range	–20 to +40 dB		
Instrument uncertainty	±<0.17 dB		

N8974A and N8975A (>3.0 GHz)	Noise Source ENR 4 – 7 dB	12 – 17 dB	20 – 22 dB
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±<0.15 dB	±<0.15 dB	±<0.2 dB
Gain			
Measurement range	–20 to +40 dB		
Instrument uncertainty	±<0.17 dB		

Characteristic[1] Noise figure at 23°C ± 3°C (10 MHz to 3.0 GHz)



Characteristic[1] Noise figure at 23°C ± 3°C (3.0 GHz to 26.5 GHz)



Characteristic values are met or bettered by 90% of instruments with 90% confidence.

Frequency Reference

	Standard	Opt.1D5
Aging	±<2 ppm[1]/year	±<0.1 ppm/year
Temperature stability	±<6 ppm	±<0.01 ppm
Settability	±<0.5 ppm	±<0.01 ppm

Tuning Accuracy (Start, Stop, Center, Marker)

4 MHz Measurement Bandwidth (default on all models of Noise Figure Analyzer)

Frequency	Error
10 MHz – 3.0 GHz	±<Reference error + 100 kHz
3.0 GHz – 26.5 GHz	±<Reference error + 400 kHz

<4MHz Measurement Bandwidth (functionality not present in N8972A)

Frequency	Error
10 MHz – 3.0 GHz	±<Reference error + 20 kHz
3.0 GHz – 26.5 GHz	±<Reference error + 20% of measurement bandwidth

[1] Parts Per Million (10e-6).

N8973A
N8974A
N8975A

General Specifications

Dimensions
Without handle: 222 mm H x 375 mm W x 410 mm D
With handle (max): 222 mm H x 409 mm W x 515 mm D

Weight (typical, without options)
N8973A: 15.5 kg
N8974A: 17.5 kg
N8975A: 17.5 kg

Data Storage (nominal)
Internal drive: 30 traces, states or ENR tables
Floppy disk: 30 traces, states or ENR tables

Power Requirements
On (line 1): 90 to 132 V rms, 47 to 440 Hz, 195 to 250 V rms, 47 to 66 Hz
Power consumption: <300 W
Standby (line 0): <5 W

Temperature Range
Operating: 0°C to +55°C
Storage: –40°C to +70°C

Humidity Range
Operating: Up to 95% relative humidity to 40°C (non-condensing)
Altitude range: Operating to 4,600 meters

Calibration Interval
1-year minimum recommended

Electromagnetic Compatibility
Complies with the requirements of the EMC directive 89/336/EEC. This includes Generic Immunity Standard EN 50082-1:1992 and Radiated Interference Standard CISPR 11:1990/EN 55011:1991, Group 1 Class A. The conducted and radiated emissions performance typically meets CISPR 11:1990/EN 55011:1991 Group 1 Class B limits.

Warranty
1-Year warranty as standard

Key Literature

Noise Figure Analyzers, NFA Series Brochure, p/n 5980-0166E
Noise Figure Analyzers, NFA Series Data Sheet, p/n 5980-0164E
Noise Figure Analyzers, NFA Series Configuration Guide, p/n 5980-0163E
Fundamentals of RF and Microwave Noise Figure Measurements Application Note 57-1, p/n 5952-8255E
Noise Figure Measurement Accuracy Application Note 57-2, p/n 5952-3706
10 Hints for Making Successful Noise Figure Measurements, p/n 5980-0228E
NFA Series, Noise Figure Analyzer Programming Examples, p/n 5968-9498E

Ordering Information

N8973A 10 MHz to 3.0 GHz NFA Series Noise Figure Analyzer
N8974A 10 MHz to 6.7 GHz NFA Series Noise Figure Analyzer
N8975A 10 MHz to 26.5 GHz NFA Series Noise Figure Analyzer

All options, other than those marked with *, can be ordered at any time for use with an instrument.

Frequency Reference
N897xA-1D5 NFA series high stability frequency reference*

Calibration Documentation
N897xA-A6J NFA series ANSI Z540 compliant calibration with test data*

Accessories
N897xA-1CP NFA series rackmount and handle kit
N897xA-UK9 NFA series front panel cover
N897xA-1FP NFA series calibration, performance verification and adjustment software

Documentation
A hard copy and CD version of the English language Quick Reference Guide, User's Guide, Programmers Reference, and Calibration and Performance Verification Manual are included with the NFA as standard. Selections can be made to change the localization of the manual set or to delete the hardcopy.
N897xA-AB0 NFA series manual set for Taiwan – Chinese localization
N897xA-AB1 NFA series manual set – Korean localization
N897xA-AB2 NFA series manual set – Chinese localization
N897xA-ABE NFA series manual set – Spanish localization
N897xA-ABF NFA series manual set – French localization
N897xA-ABZ NFA series manual set – Italian localization
N897xA-ABD NFA series manual set – German localization
N897xA-ABJ NFA series manual set – Japanese localization
N897xA-0B0 Delete hardcopy manual set*

Additional Documentation
N897xA-0B1 NFA series manual set (English version)
N897xA-0B2 NFA series user manual (English version)
N897xA-0BF NFA series programmers reference (English version)

Service Options:
Warranty and Service
Standard warranty is 1 year.

Calibration[1]
For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.
R-50C-001 Standard calibration plan*
R-50C-002 Standard compliant calibration plan*

[1] Options not available in all countries.

Note: The localized options will include a localized version of the Quick Reference Guide and User Guide, and an English language version of the Programmers Reference, and Calibration and Performance Verification Manual.

- **Agilent noise sources with frequency range from 10 MHz to 50 GHz**
- **Excess noise ratio (ENR) selected for a variety of user applications**
- **SNS series of noise sources have stored ENR data, decreasing the opportunity for user error**

SNS Series

SNS Series Noise Sources

The Agilent SNS series of noise sources work in conjunction with the Agilent NFA series of noise figure analyzers to simplify measurement set-up and improve accuracy. When connected to the Agilent, NFA series, the noise source automatically downloads electronically stored calibration data to the analyzers. The SNS series also connects to Agilent's ESA spectrum analyzers, or MXA and EXA signal analyzers. The noise sources also have the capability to automatically measure their own temperature so that compensation can be applied to the calibration data. These capabilities increase the overall reliability and accuracy of the noise figure measurement. The SNS noise sources can be used for a various applications with a range of frequencies, Excess Noise Ratio (ENR) and coaxial connector types.

SNS Series Partial Specifications

Instrument Model	Frequency Range	ENR Value
N4000A	10 MHz to 18 GHz	4.5 – 6.5 dB
N4001A	10 MHz to 18 GHz	14 – 16 dB
N4002A	10 MHz to 12 GHz 12 GHz to 26.5 GHz	12 – 16 dB 14 – 17 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
N4000A	0.01 to 3.0 3.0 to 7.0 7.0 to 18.0	<1.04 <1.13 <1.22	0.02 0.06 0.10
N4001A	0.01 to 3.0 3.0 to 7.0 7.0 to 18.0	<1.15 <1.20 <1.25	0.07 0.09 0.11
N4002A	0.01to 3.0 3.0 to 7.0 7.0 to 18.0 18.0 to 26.5	<1.22 <1.25 <1.25 <1.35	0.10 0.10 0.11 0.15

Ordering Information

N4000A SNS Series Noise Source, 10 MHz to 18 GHz, nominal ENR 6 dB
N4001A SNS Series Noise Source, 10 MHz to 18 GHz, nominal ENR 15 dB
N4002A SNS Series Noise Source, 10 MHz to 26.5 GHz, nominal ENR 15 dB
All of the SNS series noise sources are provided with an APC 3.5 (male) connector as standard.

Connector
N400xA-001 Type-N (m) connector

Custom Solution
N400xA-H10 Gold standards calibration (for use with the N2002A)

Service Options:
Warranty and Service
Standard warranty is 1 year.
For warranty and service of 3 years, please order R-51B-001-3C: "1 year Return-to-Agilent warranty extended to 3 years" (quantity = 1).

Calibration[1]
For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.
R-50C-001 Standard calibration plan
R-50C-002 Standard compliant calibration plan

346A/B/C Broadband Noise Sources

346 Series Noise Sources

The Agilent 346 series of noise sources work in conjunction with the Agilent NFA series noise figure analyzer and the PSA series spectrum analyzer to make accurate and reliable noise figure measurements. Each 346 noise source has individually calibrated ENR values at specific frequencies. The calibration data is printed on the label of the noise source and can be manually entered into the NFA or PSA. A floppy disk is also provided with the calibration data, for rapid entry of ENR data into the NFA or PSA. The 346 noise sources are designed for a broad range of measurement applications, with a range of frequencies, Excess Noise Ratio (ENR) and coaxial connector types.

Customer Solution Noise Sources

346B with option 346B-H01 High ENR Noise Source
The 346B-H01 has high ENR (21 dB typical), suitable for measuring high noise figure devices.*

346B with option 346B-H42 DBS Noise Source
The 346B-H42 was developed especially to test low noise block converters (LNB) used for Direct Broadcast Satellite (DBS). WR75 wave-guide output, 5 dB ENR, low ENR calibration uncertainty, and low SWR improve the noise figure measurement accuracy of DBS LNBs.*

346CK01 Broadband Noise Source
This coaxial noise source features coverage from 1 to 50 GHz with the 2.4 mm coaxial connector. ENR is nominally 20 dB at 1 GHz and 7 dB at 50 GHz.*

346 Series Partial Specifications

Instrument Model	Frequency Range	ENR Value
346A	10 MHz to 18 GHz	4.5 – 6.5 dB
346B	10 MHz to 18 GHz	14 – 16 dB
346C	10 MHz to 12 GHz 12 GHz to 26.5 GHz	12 – 16 dB 14 – 17 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
346A/B	0.01 to 3.0 3.0 to 5.0 5.0 to 18.0	1.3 1.15 1.25	0.13 0.07 0.11
346C	0.01to 18.0 18.0 to 26.5	1.25 1.35	0.11 0.15

[1] Option not available in all countries.
* Contact Agilent for technical specifications

Ordering Information

346A 10 MHz to 18 GHz 346 Series Noise Source nominal ENR 5 dB
346B 10 MHz to 18 GHz 346 Series Noise Source nominal ENR 15 dB
346C 10 MHz to 26.5 GHz 346 Series Noise Source nominal ENR 15 dB
All of the 346 series noise sources are provided with an APC 3.5 (male) connector as standard.

Connectors (excludes 346C)
346x-001 Type N (male) connector
346x-002 APC-7mm connector
346x-004 Type N (female) connector

Calibration Documentation
346x-A6J ANSI Z540 compliant calibration with test data

Additional Documentation
346x-910 Extra operation manual

Custom Solution Options
346x-H10 Gold standards calibration (for use with the N2002A)
346B-H01 APC 3.5(m) connector with 21 dB nominal ENR
346B-H42 DBS Waveguide adapter and nominal ENR 5 dB
346CK01 1 GHz to 50 GHz 346 Series Noise Source nominal ENR 21 dB

Service Options:
Warranty and Service
Standard warranty is 1 year.
For warranty and service of 3 years, please order R-51B-001-3C: "1 year Return-to-Agilent warranty extended to 3 years" (quantity = 1).

Calibration[1]
For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.
R-50C-001 Standard calibration plan
R-50C-002 Standard compliant calibration plan

R347B and Q347B Noise Sources

This series of broadband noise sources has been designed to cover high frequency waveguide measurement applications.

Agilent 347 Partial Specifications

Instrument Model	Frequency Range	ENR Value
R347B	26.5 to 44 GHz	10 – 13 dB
Q347B	33 to 42 GHz 42 to 50 GHz	10 – 13 dB 6 – 12.5 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
R347B	26 to 44	<1.42	0.17
Q347B	33 to 50	<1.57	0.22

Warranty
1-Year warranty as standard

- **Simple calibration of noise sources with reduced uncertainty**
- **Traceable results to a national standard**
- **Availability for engineers who require on-site calibration**

N2002A Noise Source Test Set

The N2002A Noise Source Test Set offers customers the opportunity to calibrate their own noise sources with minimal levels of uncertainty. With simple straightforward operations and low cost of equipment it is now viable that this process can occur "in-house" and thus drastically reduces downtime.

For engineers that currently run their own noise source calibration service, the N2002A noise source test set is an ideal addition to their test equipment. By incorporating this low-cost, self-contained unit into a wider noise source calibration system, high quality calibrations of noise sources can be made. When used within a noise source calibration system the N2002A and Agilent N8975A NFA series noise figure analyzer can also drastically reduce the calibration time.

Key Literature

N2002A Noise Source Test Set 10 MHz to 26.5 GHz, Product Overview , p/n 5988-7228EN
Agilent Noise Source Calibration, Using the Agilent N8975A Noise Figure Analyzer and the N2002A Noise Source Test Set, p/n 5988-7229EN

Ordering Information

N2002A Noise Source Test Set

Accessories
N2002A-001
Accessory cable and adapters
Cable (x1): 11500E
3.5 mm female to female adapter (x 3): 1250-1749
3.5 mm female to type-N (female) adapter (x1): 1250-1745

Warranty
1-Year warranty as standard

[1] Option not available in all countries.

Why Network Analysis?

Characterizing the behavior of linear electrical networks that will be stimulated by arbitrary signals and interfaced with a variety of other networks is a fundamental problem in both synthesis and test processes. For example, the engineer designing a multi-component network must predict with some certainty, from knowledge of the individual components, the final network performance. Similarly, a production manager must know allowable tolerances on the products manufactured and whether the final products meet the specified tolerances. Network analysis offers a solution to these problems through complete description of linear network behavior in the frequency domain. Additionally, some network analyzers offer the capability to transform measurement data, taken in the frequency domain, to the time domain, providing further insight into the behavior of linear networks.

Network analysis accomplishes the description of both active and passive networks by creating a data model of such component parameters as impedances and transfer functions. However, these parameters not only vary as a function of frequency but are also complex variables in that they have both magnitude and phase (see Figure 1). Swept network analyzers measure magnitude and phase (the total complex quantity) as a function of frequency with less difficulty than conventional CW measurements. Impedance and transfer functions then can be displayed conveniently on an internal display, or on peripherals such as a printer.

Thus, network analysis satisfies the engineering need to characterize the behavior of linear networks quickly, accurately, and completely over broad frequency ranges. Agilent Technologies manufactures a full line of scalar network analyzers (magnitude only) and vector network analyzers (both magnitude and phase).

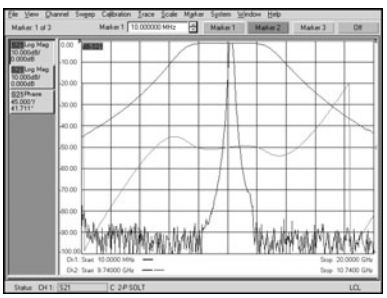


Figure 1: Simultaneous wideband and narrowband sweep of a microwave filter, showing magnitude and deviation from linear phase.

What is Network Analysis?

Network analysis is the process of creating a data model of the transfer and/or impedance characteristics of a linear network through stimulus-response testing over the frequency range of interest. All network analyzers in the Agilent product line operate according to this definition.

At frequencies above 1 MHz, lumped elements actually become "circuits" consisting of the basic elements plus parasitics like stray capacitance, lead inductance, and unknown absorptive losses. Since parasitics depend on the individual device and its construction, they are almost impossible to predict. Above 1 GHz component geometries are comparable to a signal wavelength, intensifying the variance in circuit behavior due to device construction.

Network analysis has classically been limited to the definition of linear networks. Since linearity constrains networks stimulated by a sine wave to produce a sine-wave output, sine-wave testing is an ideal method for characterizing magnitude and phase response as a function of frequency. Modern network analyzers use sine-wave power sweeps to characterize certain parameters of nonlinear behavior, such as gain compression and AM-to-PM. They can also measure frequency translation devices by offsetting the receivers for the source stimulus. Additionally, the source can be pulsed to produce pulsed S-parameters.

Network Analyzers

Agilent network analyzers are instruments that measure transfer and/or impedance functions of linear networks through sine-wave testing (see Figure 2). A network analyzer system accomplishes these measurements by configuring its various components around the device-under-test. The first requirement of the measurement system is a sine-wave signal source to stimulate the device-under-test. Since transfer and impedance functions are ratios of various voltages and currents, a means of separating the appropriate signals from the measurement ports of the device-under-test is required. Finally, the network analyzer itself must detect the separated signals, form the desired signal ratios and display the results.

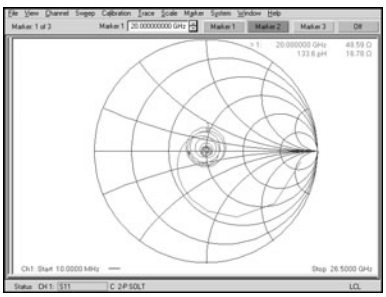


Figure 2: Input impedance of a broadband microwave amplifier is read directly with a Smith Chart display.

Signal Sources and Signal Separation

In the general case, any sine-wave source meeting the network analyzer's specifications can be used to stimulate the device-under-test. If the analyzer is capable of swept measurements, great economies in time can be achieved by stimulating the device-under-test with a sweep oscillator or synthesized sweeper. Most Agilent network analyzers contain internal, synthesized sources with excellent frequency resolution. Swept measurements allow quick and easy characterization of devices over broad frequency ranges.

At high frequencies the problem of signal separation usually involves traveling waves on transmission lines and becomes correspondingly more difficult. Agilent network analyzers employ both internal and external test sets applicable for separating the appropriate traveling waves in a variety of high-frequency measurements.

Broadband and Narrowband Detection

After the desired signals have been obtained from the test set, they must be detected by the network analyzer; Agilent network analyzers can use one of two detection methods. Broadband detection accepts the full-frequency spectrum of the input signal, while narrowband detection involves tuned receivers that convert CW or swept-RF signals to a constant-IF signal. There are certain advantages to each detection scheme.

Scalar analyzers usually employ broadband detection techniques. Broadband detection reduces instrument cost by eliminating the IF section required by narrowband analyzers but sacrifices noise and harmonic rejection. However, noise is not a factor in many applications. Finally, broadband systems can make measurements where the input and output signals are not of the same frequency, as in the measurement of the insertion loss of mixers and frequency doublers.

Vector network analyzers normally employ narrowband detection techniques. Narrowband detection makes a more sensitive low noise detection of the constant IF possible. This allows increased accuracy and dynamic range for frequency-selective measurements (as compared to broadband systems).

Vector network analyzers can vary with their employment of broadband, narrowband, or both types of detection. When both types of detection are available, the user selects the detection method, which allows optimization of the device measurements.

Signal Processing and Display

Once the RF has been detected, the network analyzer must process the detected signals and display the measured quantities (see Figure 3). All Agilent network analyzers are multi-channel receivers utilizing a reference channel and at least one test channel; absolute signal levels in the channels, relative signal level (ratios) between the channels, or relative phase difference between channels can be measured, depending on the analyzer.

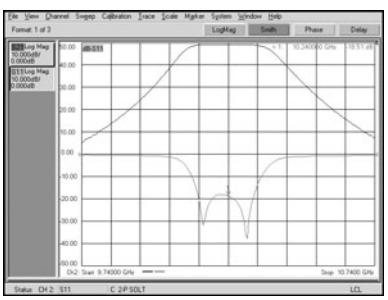


Figure 3: Simultaneous measurement of transmission response and passband reflection return loss.

Relative ratio measurements are usually made in dB, which is the log ratio of an unknown signal (Test Channel) with a chosen reference signal (Reference Channel). This allows the full dynamic range of the instrumentation to be used in measuring variations of both high- and low-level circuit responses. For example, 0 dB implies the two signal levels have a ratio of unity, while ±20 dB implies a 10:1 voltage ratio between two signals.

All network analyzer phase measurements are relative measurements with the reference channel signal considered to have zero phase. The analyzer then measures the phase difference of the test channel with respect to the reference channel.

Phase information complements amplitude data in the measurement of device parameters. Phase is more sensitive to network behavior and it is a required component of complex impedance and transfer functions.

Phase data is also required to measure delay distortion or group delay of networks. Delay distortion occurs when different frequency components of a complex waveform experience nonlinear phase shifts as they are transmitted through a network. Group delay (see Figure 4) is a measure of this distortion and is defined as:

$$T_{gd} = \frac{-d\Theta}{d\omega}$$

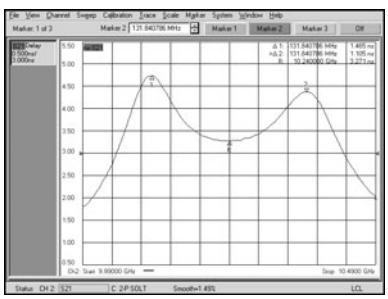


Figure 4: Direct measurement of group delay with digital readout at marker.

An alternative method for measuring phase distortion is deviation from linear phase or differential phase. Deviations from linear phase can be measured by introducing enough electrical length in the network analyzer's reference channel to linearize a device's phase shift. This is usually accomplished by using the electrical-delay feature of the network analyzer, which cancels the average electrical length of a device mathematically.

Scattering parameters, or S-parameters, were developed to characterize linear networks at high frequencies. S-parameters define the ratios of reflected and transmitted traveling waves measured at the network ports. A two-port device is modeled with S-parameters (see Figure 5). S_{11} is the complex reflection coefficient at port 1, and is

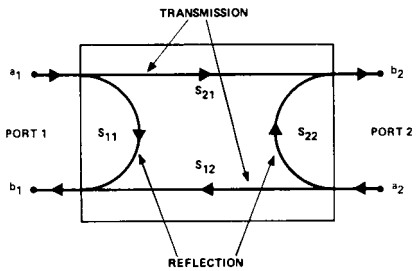


Figure 5: S-parameter model for a two-port linear network.

the ratio of b_1/a_1, if $a_2 = 0$ (port 2 terminated in its characteristic impedance). S_{21} is the complex transmission coefficient from port 1 to port 2, b_2/a_1, if $a_2 = 0$. The "a" and "b" signals represent the amplitude and phase of the incident and emerging or reflected traveling waves. By reversing the ports and terminating port 1 in its characteristic impedance, S_{22} and S_{12} can be similarly defined.

Additional Capabilities

Precision design work and manufacturing tolerances demand highly accurate measurements, but most errors in network measurements are complex quantities that vary as a function of frequency. By characterizing and virtually removing these systematic errors, measurement accuracies are improved by several orders of magnitude. Agilent network analyzers contain built-in, high-speed computational hardware that can perform the complex mathematics required for sophisticated error correction.

Computer-controlled network analyzers can be programmed to set up and make many measurements automatically. The measurement process is further accelerated by the computer's ability to store, transform, summarize, and output data in a variety of formats to a number of peripherals. These capabilities make the computer-controlled network analyzer ideal for both computer-aided design or automatic production testing. Several products have built-in automation features, including GP Instrument BASIC. The PNA family of network analyzers have an integrated Windows® operating system. This provides the user with powerful computer control directly in the network analyzer.

- **Excellent measurement accuracy**
- **Fast, precise, integrated synthesized sources**
- **Choice of integrated S-parameter or T/R test sets**
- **Advanced automation and flexible options to boost capabilities**

Tackle the Most Demanding Active and Passive Devices

From precision design work to high-volume manufacturing, component test manufactures demand fast, accurate measurements. Agilent offers a host of RF and microwave vector network analyzers that are ready to tackle the most challenging active and passive networks, devices, components and subsystems.

Squeeze more performance from your designs with exceptional accuracy. Wide dynamic range and low trace noise make it easy to see the stopband and passband of even the highest-rejection filters.

On the production line, advanced productivity features such as automated pass/fail testing and segmented sweeps help accelerate test throughput. Built-in programming and connectivity capabilities increase the flexibility of your test systems, and can decrease the cost of test.

Selection Guide for Agilent Network Analyzers

	Frequency Range	Number of Ports	Balanced Measurements*	System Impedance	ECal Support	Measurement Speed (1 sweep, 201 points)
Vector E5100A	10 kHz to 300 MHz	2	No	50 ohm	No	8 ms (1-port cal, ramp-sweep) 64 ms (1-port cal, step-sweep)
Combination Network/Spectrum/ Impedance 4395A, 4396B	10 Hz to 1.8 GHz	2	No	50 or 75 ohm	No	165 ms (response cal, gain, 30 kHz BW) 215 ms (response cal, gain and phase, 30 kHz BW)
Vector – ENA-L E5061A, E5062A	300 kHz to 3 GHz	2	No	50 or 75 ohm	Yes	35 ms (2 port cal, 1 to 1.2 GHz, 30 kHz BW)
Vector – ENA E5071C	9 kHz to 8.5 GHz	2 or 4	Yes	50 ohm	Yes	8.8 ms (2 port cal, 1 to 1.2 GHz, 500 kHz BW)
Vector – PNA-L N5230A	300 kHz to 50 GHz	2 or 4	Yes	50 ohm	Yes	18 ms (2-port cal, 1 to 2 GHz, 600 kHz BW)
Vector – PNA E8362/3/4B, E8361A	10 MHz to 67 GHz	2	No	50 ohm	Yes	64 ms (2-port cal, 1 to 2 GHz, 35 kHz BW)
Vector – PNA-X N5242A	10 MHz to 26.5 GHz	2 or 4	Yes	50 ohm	Yes	35 ms (2-port cal, 1 to 2 GHz, 600 kHz BW)
Vector – PNA N5250A	10 MHz to 110 GHz	2	No	50 ohm		
Scalar 8757D	10 MHz to 110 GHz	2	No	50 ohm	No	470 ms (2-port cal,10 kHz BW)

* Table shows the capabilities of the stand-alone instrument. For the PNA, it is possible to add balanced capability with an external test set.
Note: For the E5100A, 4395A and 4396B, number of ports denotes for the use with S-parameter test set or T/R test set.

Network Analyzer Discontinuance and Migration Information

The Agilent 8712ET, 8712ES, 8714ET, 8714ES RF network analyzers were discontinued on June 30, 2004. The Agilent 8719ET, 8719ES, 8720ET, 8720ES, 8722ET and 8722ES microwave network analyzers were discontinued on April 30, 2005. The Agilent 8753ET and 8753ES RF network analyzers were discontinued on October 31, 2006.

Agilent ENA-L, ENA, PNA-L, PNA-X and PNA Series of network analyzers are the recommended replacement products. ENA and PNA models offer fast and accurate RF component measurements for both R&D evaluations and production testing.

Recommended Replacement Products

Max Freq.	Discontinued Products	Suggested Replacement Family	T/R Test Set, 75 Ω	Multiport or Balanced/ Differential	Frequency Offset Mode for Mixers, Harmonics and Intermodulation	Vector & Scalar Mixer Cal	Configurable Test Set	Pulsed RF or Antenna Test
1.5 GHz	8712ET/ES	300 kHz to 1.5 GHz ENA-L Series	E5061A					
3 GHz	E8356A E8801A N3381A 8753ET/ES 8714ET/ES	300 kHz to 3 GHz ENA-L Series or 9/100 kHz to 4.5 GHz ENA Series	E5062A	E5071C (Option 440 or 445)	E5071C (Option 008)	E5071C (Option 008)		
6 GHz	E8357A E8802A N3382A 8753ET/ES (Option 006)	9/100 kHz to 8.5 GHz ENA Series or 300 kHz to 6 GHz PNA-L Series		E5071C (Option 480 or 485)	E5071C (Option 008) N5230A (Option 020 or 025, & 080)	E5071C (Option 008)	N5230A (Option 025)	N5230A (Option 025)
9 GHz	E8358A E8803A N3383A	300 kHz to 13.5 GHz PNA-L Series			N5230A (Option 120 or 125, & 080)		N5230A (Option 125)	N5230A (Option 125)
13.5 GHz	8719ES 8719ET	300 kHz to 13.5 GHz PNA-L Series			N5230A (Option 120 or 125, & 080)		N5230A (Option 125)	N5230A (Option 125)
20 GHz 4-port	8720ES with Special Test Set	10 MHz to 26.5 GHz PNA-X Series		N5230A (Option 240 or 245)	N5230A (Option 240 or 245, & 080)		N5230A (Option 245)	
20/40 GHz	8720/22ES 8720/22ET	10 MHz to 26.5 GHz PNA-X Series			N5230A (Option 220 or 225, 420 or 425, 520 or 525, & 080)	E8362/3/4B (Option 014, UNL, 080, 081, 083)	N5230A (Option 225 or 425 or 525) E8362/3/4B (Option 014)	E8362/3/4B (Option 014, UNL, 080, 081, H11, H08)

ENA-L Series

The Agilent ENA-L Series network analyzers provide reliable, basic S-parameter measurements with easy-to-use features and solid performance based on the latest in modern technologies. The transmission/reflection (T/R) test set options offer lower cost solutions, while the S-parameter test set options provide more accurate measurements with full two-port calibration. 75-ohm options, as well as 50 ohm, are available for CATV component measurements.

- 300 kHz to 1.5 GHz – **E5061A**
- 300 kHz to 3 GHz – **E5062A**

ENA Series

The Agilent ENA Series network analyzers offer fast and accurate measurements for RF components. Built-in 2 and 4 test ports provide simultaneous measurement of all signal paths for components with up to four ports. The ENA Series provides built-in balanced measurement capability, which enables you to test balanced components such as, SAW filters and differential amplifiers. It provides mixed-mode S-parameter measurements with a fixture simulator function.

- 9/100 kHz to 4.5/8.5 GHz – **E5071C**

PNA-L Series

Agilent PNA-L network analyzers are designed for your general-purpose network analysis needs and priced for your budget. PNA-L provides efficiency and flexibility in both manufacturing and R&D applications for industries ranging from wireless LAN components to aerospace and defense.

- 300 kHz to 6 GHz – **N5230A (Option 020/025)**
- 300 kHz to 13.5 GHz – **N5230A (Option 120/125)**
- 300 kHz to 20 GHz 4-port – **N5230A (Option 240 or 245)**
- 10 MHz to 20 GHz – **N5230A (Option 220 or 225)**
- 10 MHz to 40 GHz – **N5230A (Option 420 or 425)**
- 10 MHz to 50 GHz – **N5230A (Option 520 or 525)**

PNA-X Series

The Agilent PNA-X is the premier-performance network analyzer for active device test. Exceptional performance, configurability, and an integrated second source enables engineers to stay on the leading edge of component testing.

- 10 MHz to 26.5 GHz – **N5242A**

PNA Series

The Agilent PNA Series microwave vector network analyzers offer an unsurpassed combination of speed and precision to meet the challenges of general-purpose, high-performance and millimeter-wave component testing from 10 MHz to 110 GHz. Frequency-offset capability for the PNA Series microwave network analyzer offers industry-leading accuracy and ease-of-use for non-linear measurements, including mixer and converter test, as well as amplifier IMD and harmonic measurement capability.

- 10 MHz to 20 GHz – **E8362B**
- 10 MHz to 40 GHz – **E8363B**
- 10 MHz to 50 GHz – **E8364B**
- 10 MHz to 67 GHz – **E8361A**
- 10 MHz to 110 GHz – **N5250A**

Key Literature & Web Link

www.agilent.com/find/nadisco

- **Wide dynamic range: >123 dB**
- **Low trace noise: <0.004 dBrms at 70 kHz IFBW**
- **Fast measurement speed: 39 ms at full 2-port cal, 1601 points**
- **Integrated 2, or 4 test ports**
- **Built-in balanced measurements**
- **Fixture embedding/de-embedding**
- **Mixer evaluation with advanced calibration**
- **Easy automation through USB**
- **LXI class C compliance**
- **4-port electronic calibration kit (ECal) support**
- **Built-in Microsoft Visual Basic for Applications (VBA)**
- **10.4-inch color LCD with touch screen**

E5071C ENA Series RF Network Analyzers

The Agilent E5071C ENA Series RF network analyzer is the ideal solution for manufacturing and R&D engineers evaluating RF components and circuits from 9 kHz to 8.5 GHz, featuring an integrated 2- or 4-port, the highest performance, extended lower frequency range and fastest speed in its class. The ENA Series significantly reduces cost of test through its ability to cover such a wide frequency range in a single instrument. The Agilent ENA series addresses a broad array of component and circuit tests including EMC-related applications and automotive, wireless communications, aerospace and defense, education, and medical applications.

De Facto Industry Standard RF Network Analyzer

The ENA series is a replacement for the legacy de facto industry standard: Agilent 8753 RF network analyzer. The lower-end frequency is 9 kHz without built-in bias tees and 100 kHz with built-in bias tees. Built-in bias tees and AUX inputs for DC measurements allow the ENA series to replace Agilent 8753 in DC-biased measurement applications and amplifier test applications, respectively. The built-in probe power also allows active probes to be used without an external probe power supply. In-circuit testing can be done using the high-impedance probe.

Excellent Measurement Accuracy and Speed

The ENA series provides exceptional performance with industry-leading dynamic range (123 dB), trace noise (0.004 dBrms at 70 kHz IFBW) and fast measurement speed (39 ms at 1601 points, 2-port full cal). The ENA's measurement capabilities enables the design of high performance components with a short cycle time.

Advanced Architecture for Multiport Component Test

Built-in 2, or 4 test ports provide simultaneous measurement of all signal paths for components. This advanced architecture minimizes the number of sweeps to complete a multiport S-parameter measurement and dramatically improves test throughput.

The ENA series holds up to 36 measurement channels in a single instrument state. Independent frequency list, calibration data, measurement parameters, trace layout, triggering, and limit test are applied in each measurement channel, which acts as if it is an independent network analyzer. This multi-channel capability eliminates recall time for sequencing multiple instrument setup states. Up to 36 display windows representing each measurement channel may be observed simultaneously. Within each window, it is possible to display up to 9 traces. The layout of display windows and traces are easily selected from the various preset states.

Integrated Balanced Measurement and Embedding/ De-Embedding

The ENA series provides balanced conversion and delivers mixed mode S-parameter measurements with 4 test ports. This integrated measurement capability improves test efficiency of balanced components.

The matching circuit function (embedding) re-calculates measured data to simulate characteristics of components including matching circuits with arbitrary port characteristic impedance. The de-embedding function removes additional fixture characteristics from the measured data, enabling the measurement of a device's characteristics without the test fixture effects.

Advanced Mixer Measurement Capabilities

The ENA series offers the frequency-offset mode (FOM) that provides frequency-offset sweep, external signal source control, and fixed IF/RF measurement capabilities. In addition, the ENA FOM supports two mixer calibration techniques. The first technique is the vector-mixer calibration (VMC) that corrects for directivity, source match, load match, and reflection frequency response at each test port by using a characterized calibration mixer with de-embedding function. This calibration provides the most accurate measurements of phase and absolute group delay. The second is the scalar-mixer calibration (SMC) that offers the highest accuracy conversion loss/gain measurement results while correcting the mismatches of both input and output test ports.

Reducing Calibration Time Using ECal

The ENA series provides full 2- and 4-port calibration and improves measurement accuracy of multiport devices. The ENA series supports various electronic calibration kits (ECal), including the N4431B 4-port electronic calibration kit. The ECal automatically performs the calibration procedure and minimizes operational errors. The ECal module can be controlled by the ENA series via USB interface without an external PC. The front USB port is available for the ECal module and can easily connect to a rack mounted ENA. The ENA supports various ECal functions. After ECal calibration, performance can be verified using the ECal Confidence Check function. The User-Characterization ECal function enables calibration with various adapters attached, increasing your calibration flexibility.

Evolution of Test Automation, Built-In VBA

The ENA series accelerates test system development, expands customization capability and increases flexibility of test system integration. VBA is a powerful programming language that brings in a new era of test automation. A test program can be developed in the ENA Series by using the built-in VBA editor. This powerful programming tool helps you to accelerate test system development.

A custom user interface can be easily developed with the graphical programming features of the VBA. This allows the limit test results and instructions to be displayed and helps to avoid operational errors.

At times measurement parameters need to be calculated mathematically or processed statistically after data acquisition. The VBA is also useful for such post processing. Unique analysis functions are easily implemented using various VBA functions. This expands analysis capability of the test equipment and fully meets test needs.

Ease-of-Use

The ENA series employs conventional softkey-style operation, which enables users to quickly start using it without any intensive learning. The touch screen provides further enhancement for usability. The large 10.4-inch color display is very useful when looking at many traces for multiport measurements. For those who are familiar with a Windows® PC, the ENA series can also be controlled using Windows-style pull down menus. These easy-to-use features increase engineers' test efficiency.

Key Specifications

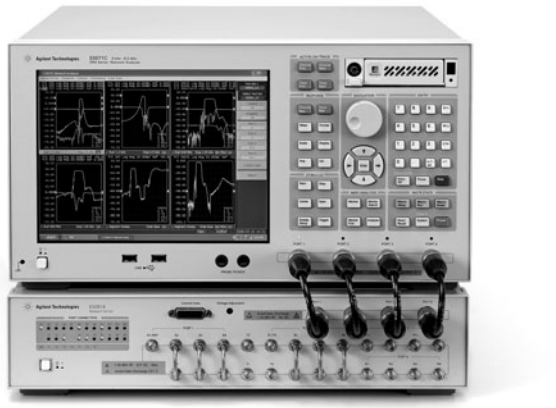
Test Frequency
9 kHz (without bias tees)/100 kHz (with bias tees) to 4.5 GHz/8.5 GHz
Test Port Output Power
–55 dBm to +10 dBm (65 dB power sweep range)
Number of Test Ports
2 or 4
IFBW
10 Hz to 500 kHz (1, 1.5, 2, 3, 4, 5, 7 step)
Channel/Trace Type
1/4, 2/4, 4/16, 9/9, 12/6, 16/4, 16/16, 24/12, 36/9
Number of Points
2 to 20,001 (with only 1 channel/4 traces mode. In other mode, maximum is 1,601)
System Dynamic Range
- 97 dB (9 kHz to 300 kHz at 10 Hz IFBW)
- 107 dB (300 kHz to 10 MHz at 10 Hz IFBW)
- 123 dB (10 MHz to 6 GHz at 10 Hz IFBW)
- 117 dB (6 GHz to 8.5 GHz at 10 Hz IFBW)

Trace Noise (magnitude)
- 0.004 dBrms (9 kHz to 30 kHz at 3 kHz IFBW)
- 0.003 dBrms (30 kHz to 10 MHz at 3 kHz IFBW)
- 0.004 dBrms (10 MHz to 4.38 GHz at 70 kHz IFBW)
- 0.006 dBrms (4.38 GHz to 8.5 GHz at 70 kHz IFBW)

Cycle Time
39 ms at full 2-port calibration, 1601 points, Start 1 GHz, Stop 1.2 GHz
Stability (magnitude)
- ±0.005 dB/°C (9 kHz to 3 GHz)
- ±0.010 dB/°C (3 GHz to 6 GHz)
- ±0.040 dB/°C (6 GHz to 8.5 GHz)

Ordering Information

E5071C Agilent ENA Network Analyzer
E5071C-240 2-port Test Set 9 kHz to 4.5 GHz, without Bias Tees
E5071C-245 2-port Test Set 100 kHz to 4.5 GHz, with Bias Tees
E5071C-440 4-port Test Set 9 kHz to 4.5 GHz, without Bias Tees
E5071C-445 4-port Test Set 100 kHz to 4.5 GHz, with Bias Tees
E5071C-280 2-port Test Set 9 kHz to 8.5 GHz, without Bias Tees
E5071C-285 2-port Test Set 100 kHz to 8.5 GHz, with Bias Tees
E5071C-480 4-port Test Set 9 kHz to 8.5 GHz, without Bias Tees
E5071C-485 4-port Test Set 100 kHz to 8.5 GHz, with Bias Tees
E5071C-008 Frequency-offset Mode
E5071C-010 Time Domain Analysis Capability
E5071C-790 Measurement Wizard Assistant Software
E5071C-1E5 High Stability Timebase



E5091A Multiport Test Set

The E5091A is a multiport test set used with the 4-port ENA Series network analyzer to expand the number of test ports up to 16. This is an ideal solution for testing antenna switch modules for mobile handsets, particularly those modules with balanced ports, although it can be used in a wide range of multiport measurement applications. The test set is available in 9- and 16-port configurations and is controlled as if it were a part of the analyzer rather than a separate test set.

With up to 36 channels, each of which can measure up to 36 measurement parameters, the ENA multiport test solution can measure all the measurement paths required for antenna switch module testing. The signal paths of each measurement channel can also be displayed to help identify complex connections to the device. These capabilities ensure a single connection, single set-up measurement that reduces test time.

Key Literature

ENA Series RF Network Analyzers Brochure, p/n 5989-5478EN
ENA Series RF Network Analyzers Data Sheet, p/n 5989-5479EN
ENA Series RF Network Analyzers Configuration Guide, p/n 5989-5480EN
Agilent Network Analyzer Selection Guide, p/n 5989-5481EN
Test Solutions for Multiport and Balanced Devices Selection Guide, p/n 5988-2461EN

Ordering information

E5091A Multiport Test Set
E5091A-009 9-port Test Set
E5091A-016 13/16-port Configurable Test Set

E5061A
E5062A

- **300 kHz to 1.5 GHz (E5061A) or 3 GHz (E5062A)**
- **T/R or S-parameter test set**
- **50 Ω or 75 Ω system impedance**
- **10.4-inch color LCD with touch screen**
- **Affordable, basic performance**

E5062A ENA-L RF Network Analyzer

Providing the latest in modern technology and flexibility, the Agilent ENA-L network analyzers provide basic vector network analysis in a wide range of industries and applications such as wireless communication, cable TV, automotive, education, and more. Designed to reduce tune and test times, these analyzers provide increased throughput to improve your measurement productivity. The affordably priced ENA-L, equipped with the core functions of the industry-standard ENA, includes many easy-to-use features and is optimized for efficient measurements and high reliability.

Fundamental Performance with Versatile General-purpose Test Capabilities

The ENA-L, with its 120 dB dynamic range and 0.005 dB rms trace noise, provides the accuracy and speed required for many network measurement applications. The wide 30 kHz IF bandwidth (IFBW) and powerful digital processing provide unprecedented measurement speed. The S-parameter test set options offer full two-port calibration for optimum accuracy (Option 250 or 275).

A Variety of Sweep Functions for Effective Analysis

Power sweep and three types of frequency functions provide effective analysis to suit your application needs such as:

- Power sweep to analyze active devices such as amplifiers
- Linear sweep to evaluate narrow-band devices such as filters
- Log sweep to evaluate broadband devices such as cables
- Segment sweep allows you to tailor the sweep condition with up to 201 sweep segments

Optional Electronic Calibration (ECal) Drastically Simplifies Calibration

Unlike the traditional mechanical calibration technique, Agilent's ECal modules only require one set of connections to perform full two-port calibration (controlled through the front panel USB port). The ENA-L controls the ECal module to perform the entire calibration to provide:

- Faster calibration and reduced complexity
- Reduced chance of operator error
- Reduced wear on connectors

Specifications

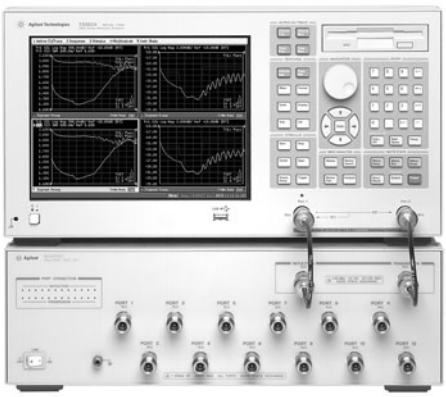
Test Frequency
- 300 kHz to 1.5 GHz (E5061A)
- 300 kHz to 3 GHz (E5062A)

Test Set: T/R or S-parameter
Max Port Output Power: 10 dBm
Port Impedance: 50 or 75 Ω
IFBW: 10 Hz to 30 kHz (1, 3 step)
Number of Points: 2 to 1601
System Dynamic Range: 120 dB @ 10 Hz IFBW (300 kHz to 3 GHz)
Trace Noise (magnitude): 0.005 dBrms @ 3 kHz IFBW (1 MHz to 3 GHz)

Accessories

87075C 75 Ω Multiport Test Set
The ENA-L, with the 87075C 75 Ω multiport test set, provides an ideal solution for multiport CATV component measurement. The test system offers fast measurement speed, high accuracy, and productivity features to maximize your production throughput.

- Specified performance to 1.3 GHz
- 6 or 12 test ports
- Test set calibration technique eliminates redundant connection of calibration standards, and ECal further reduces the number of connections
- Self calibration (an internally automated calibration technique) reduces the effects of test system drift



E5062A ENA-L with 87075C 75 Ω Multiport Test Set

Key Literature

ENA-L Product Brochure, p/n 5989-0167EN
ENA-L Data Sheet, p/n 5989-0018EN
ENA-L Configuration Guide, p/n 5989-0170EN
87075C Technical Overview, p/n 5989-0767EN

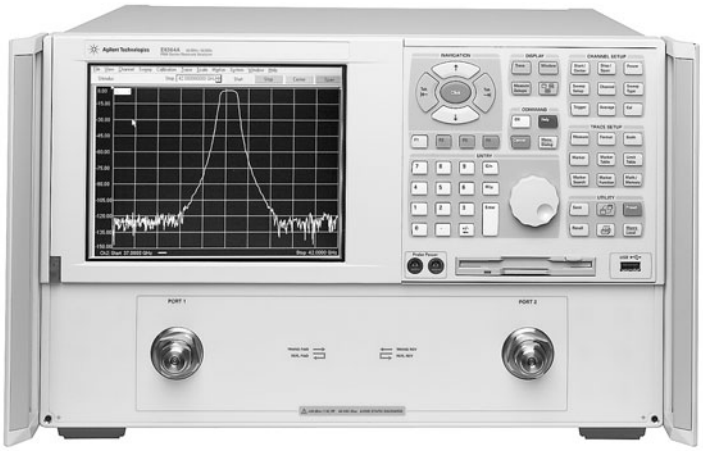
Ordering Information

E5061A 300 kHz to 1.5 GHz Network Analyzer
E5062A 300 kHz to 3 GHz Network Analyzer
E506xA-150 TR Test Set 50 ohm System Impedance
E506xA-175 TR Test Set 75 ohm System Impedance
E506xA-250 S-parameter Test Set 50 ohm System Impedance with Extended Power Range
E506xA-275 S-parameter Test Set 75 ohm System Impedance with Extended Power Range
E506xA-1E1 Extended Power Range (–45 to 10 dBm)
E506xA-100 Add Fault Location and SRL Analysis
E506xA-016 Touch Screen Color LCD

PNA, PNA-X and PNA-L Series MW Network Analyzer

E8362/3/4B
E8361A
N5230A
N5242A
N5250A

- **Frequency coverage from 300 kHz to 110 GHz**
- **Highest performance and broadest range of measurement applications**
- **Electronic calibration (ECal) to 67 GHz**
- **Open Windows XP operating system**



Rapid and continuous changes in RF, microwave, and millimeter-wave technology present a growing challenge for component designers and manufacturers. The Agilent PNA, PNA-X and PNA-L Series of microwave vector network analyzers provides a powerful and flexible measurement platform that meets the challenge with the right combination of high accuracy, fast sweep speeds, wide dynamic range, low trace noise, and enhanced connectivity. The PNA, PNA-X and PNA-L Series will meet your measurement needs now and well into the future.

Common Features

- Electronic calibration for fast, accurate, and convenient system-error correction
- TRL/LRM calibrations for high accuracy fixture and on-wafer measurements
- Configurable test set for a wide variety of measurement setups
- Frequency offset mode for mixer and amplifier-distortion tests
- Time-domain analysis for improved accuracy and filter tuning
- Easy-to-use front-panel hardkey/softkey interface, or use a mouse and pull-down menus
- Extensive built-in help system for quick answers to operation, application, and programming questions
- Open Windows® operating systems for advanced automation and easy connection of peripherals

Advanced Connectivity

The PNA family offers many methods of communication to and from the instrument, using a variety of built-in I/O interfaces. Windows XP lets you take advantage of many features you take for granted on your PC, helping you attain a new level of integration for your component-test processes.

For local storage, use the analyzer's internal hard disk drive or connect a USB-based hard disk, flash, or CD-R/W drive. In addition, using drive mapping and the LAN interface, you can save data directly to remote PCs or file servers. This arrangement makes it very easy to develop statistical- process-controlled manufacturing environments.

The PNA family allows a number of ways to connect and control other test equipment such as power meters and signal sources. You can choose to connect them via the USB, GPIB, LAN, serial, or parallel interfaces, and, using any Windows-compatible test program, you can control the test equipment directly from the analyzer. The LAN interface also makes it easy to perform remote troubleshooting. You can view measurement results and control the analyzer from anywhere on the network, whether you are on another floor, in another building, or even at a different site. Additionally, you can download firmware and help-file updates from our web site: **www.agilent.com/find/pna**

Automation

For manufacturing environments, test automation is essential for high throughput. For R&D, automated tests can save considerable time that might be spent on repetitive and tedious measurements. The PNA family lets you automate your test processes using several powerful automation approaches. You can create programs using familiar SCPI commands via the GPIB or LAN interfaces, or use COM commands over LAN for fast analyzer access and data transfer. Test programs can be executed internally on the PNA or externally on your PC.

Flexibility

In addition to the measurement-hardware flexibility that is achievable using the configurable test set, the PNA's firmware offers unparalleled measurement flexibility as well:

- Configure up to 32 independent measurement channels to eliminate the need for multiple instrument-states recalls
- Use up to 16,001 data points per measurement channel
- Display up to 16 windows, with 4 active traces in each window
- Select up to 10 coupled or independent markers per trace

Throughput

Decreasing test time is often critical for success in manufacturing environments. The PNA family has many attributes that help you accomplish your throughput goals. The outstanding performance of the analyzers starts with exceptionally fast sweeps that do not sacrifice performance. Features such as segmented sweeps and limit lines for pass/fail testing allow you to optimize test efficiency. For devices that once required two to four instrument setups for complete characterization, the PNA Series' ability to have up to thirty-two-measurement channels, each with its own stimulus and response parameters, can also improve your test throughput.

When using Agilent's electronic calibration (ECal) modules, you can dramatically reduce the time it takes to perform calibrations, so you can spend more time measuring your devices. Simply connect the ECal module to your test ports and let the analyzer control and measure all the standards necessary for full two-port calibration. These modules are controlled directly from the analyzer via a USB connection.

PNA-X

The PNA-X is the premier-performance network analyzer for active device test. Exceptional performance, configurability and an integrated second source enable engineers to stay on the leading-edge of component testing.

Key Features

- 2 or 4 port 10 MHz to 26.5 GHz
- Excellent source output power and harmonic performance
- Built-in signal combiner for IMD measurements
- Built-in pulse generators and modulators for pulse RF measurements
- Banded mm-wave systems to 325 GHz
- Compatible with multiport test sets
- Mixed/converter test with advanced calibrations
- Antenna/RCS test

PNA-L Series

The PNA-L Series is a cost-effective solution for general-purpose network-analysis needs. The PNA-L offers the perfect balance of value and performance.

Key Features

- 2-port 300 kHz to 6, 13.5 GHz
- 2-port 10 MHz to 20, 40, 50 GHz
- 4-port 300 kHz to 20 GHz, with mixed-mode S-parameters and advanced fixture corrections
- Frequency and power sweeps for measuring S-parameters and gain compression
- Basic mixer/converter measurements
- Pulsed-RF testing down to 2 µs pulse widths

PNA Series

The PNA Series provides advanced performance and measurement capabilities, and is specifically designed for more-demanding applications such as high-accuracy mixer/converter test including absolute group delay, and antenna, pulsed-RF, and mm-wave measurements.

Key Features

- 2-port 10 MHz to 20, 40, 50, 67, 110 GHz
- Banded mm-wave systems to 325 GHz
- Multiport test sets to 67 GHz
- Mixer/converter test with advanced calibrations
- Antenna/RCS test
- Pulsed-RF testing down to 50 ns pulse widths

E8362/3/4B
E8361A
N5242A
N5250A

MW PNA and PNA-X Series

Model	E8362/63/64B	E8361A	N5250A	N5242A
Frequency Range	10 MHz to 20/40/50 GHz	10 MHz to 67 GHz	10 MHz to 110 GHz[1]	10 MHz to 26.5 GHz
Number of Ports	2	2	2	2 or 4
Connector Type (male)	3.5/2.4/ 2.4 mm	1.85 mm	1.0 mm	3.5 mm
Dynamic Range (at test port)[2]				
10 to 45 MHz	79 dB	61 dB	63 dB	93 dB
45 MHz to 2 GHz	94 to 119 dB	87 to 111 dB	94 to 120 dB	93 to 124 dB
2 to 20 GHz	122 dB	111 dB	111 dB	127 dB
20 to 40 GHz	110 dB	104 dB	42 dB	—
40 to 50 GHz	104 dB	96 dB	84 dB	—
50 to 60 GHz	—	97 dB	80 dB	—
60 to 70 GHz	—	94 dB	68 dB	—
70 to 75 GHz	—	—	74 dB	—
75 to 80 GHz	—	—	85 dB	—
80 to 110 GHz	—	—	87 dB	—
Dynamic Range (receiver access)[2]				
10 to 45 MHz	129 dB	99 dB	—	128 dB
45 MHz to 2 GHz	132 dB	102 to 125 dB	—	115 to 136 dB
2 to 20 GHz	136 dB	125 dB	—	136 dB
20 to 40 GHz	119 dB	115 dB	—	—
40 to 50 GHz	111 dB	109 dB	—	—
50 to 60 GHz	—	107 dB	—	—
60 to 70 GHz	—	100 dB	—	—
Trace Noise (1 kHz IF BW)[2]				
500 MHz to 50 GHz	<0.006 dB rms <0.1 deg rms	<0.006 dB rms <0.1 deg rms	— —	<0.003 dB rms <0.05 deg rms
Maximum Output Power[2]				
10 to 45 MHz	+2 dBm	–9 dBm	–8 dBm	+8 dBm
45 MHz to 10 GHz	+5 dBm	–3 dBm	–3 dBm	+10 to 13 dBm
10 to 20 GHz	+3 dBm	–2 dBm	–5 dBm	+13 dBm
20 to 40 GHz	–4 dBm	–2 dBm	–10 dBm	+13 to 12 dBm[8]
40 to 45 GHz	–5 dBm	–7 dBm	–15 dBm	—
45 to 50 GHz	–10 dBm	–1 dBm	–12 dBm	—
50 to 60 GHz	—	–3 dBm	–17 dBm	—
60 to 70 GHz	—	–5 dBm	–22 dBm	—
70 to 110 GHz	—	—	–8 dBm	—

Full Band Measurement Speed (35 kHz IF bandwidth, 201 points; 100 kHz for N5242A)

Model	Frequency	Cycle Time (ms)[3]	µs/Point	Updates/Second
E8362B	10 MHz to 20 GHz	126	627	8
E8363B	10 MHz to 40 GHz	185	920	6
E8364B	10 MHz to 50 GHz	210	1045	5
E8361A	10 MHz to 67 GHz	244	1214	4
N5242A	10 MHz to 26.5 GHz	75	373	13
N5250A[5]	10 MHz to 110 GHz	500	2488	2

Data Transfer Speed, 32-bit binary (ms)[4]

	201 points	16,001 points
COM[6]	0.4	2
SCPI[6]	1	30
DCOM[7]	0.8	7
SCPI over GPIB[7]	7	435

[1] The PNA can also be configured with waveguide mm-wave heads for banded solutions up to 325 GHz.
[2] Typical performance below 45 MHz and above 67 GHz. All N5250A numbers are typical.
[3] Typical performance includes retrace and band-switching times with response calibration. Two-port calibration approximately doubles cycle time.
[4] Typical performance.
[5] 10 kHz IF bandwidth.
[6] Program executed in PNA.
[7] Program executed on an external PC.
[8] Power 24 to 26.5 GHz = +5 dBm.

Key Specifications

Option	020, 025	120, 125	220, 225	240, 245	420, 425	520, 525
Frequency Range	300 kHz to 6 GHz	300 kHz to 13.5 GHz	10 MHz to 20 GHz	300 kHz to 20 GHz	10 MHz to 40 GHz	10 MHz to 50 GHz
Number of Ports	2	2	2	4	2	2
Connector Type (male)	3.5 mm	3.5 mm	3.5 mm	3.5 mm	2.4 mm	2.4 mm

Dynamic Range, Two-port Models (at test port), dB

Option	020	120	220	420	520
300 kHz to 1 MHz	103	103	—	—	—
1 MHz to 10 MHz	113	113	—	—	—
10 MHz to 45 MHz	122	122	103[1]	89[1]	89[1]
45 MHz to 500 MHz	122	122	105	90	90
500 MHz to 2 GHz	122	122	110	110	110
2 GHz to 6 GHz	122	122	110	110	110
6 GHz to 8 GHz	—	120	110	110	110
8 GHz to 9 GHz	—	120	110	100	100
9 GHz to 10.5 GHz	—	116	110	100	100
10.5 GHz to 12.5 GHz	—	111	110	100	100
12.5 GHz to 13.5 GHz	—	109	108	100	100
13.5 GHz to 20 GHz	—	—	108	100	100
20 GHz to 31.25 GHz	—	—	—	95	95
31.25 GHz to 40 GHz	—	—	—	90	90
40 GHz to 50 GHz	—	—	—	—	79

Dynamic Range, Four-port Model (at test port), dB

Option	240
300 kHz to 10 MHz	111[1]
10 MHz to 4 GHz	120
4 GHz to 6 GHz	118
6 GHz to 10.5 GHz	115
10.5 GHz to 15 GHz	107
15 GHz to 20 GHz	103

Trace Noise (1 kHz BW), dB rms

Option	020	120	220	240	420	520
300 kHz to 10 MHz	0.012	0.012	—	0.015[1]	—	—
10 MHz to 45 MHz	0.004	0.004	0.004[1]	0.006	0.015[1]	0.015[1]
45 MHz to 6 GHz	0.004	0.004	0.006	0.001	0.010	0.010
6 GHz to 13.5 GHz	—	0.004	0.006	0.001	0.010	0.010
13.5 GHz to 20 GHz	—	—	0.006	0.001	0.010	0.010
20 GHz to 40 GHz	—	—	—	—	0.020	0.020
40 GHz to 50 GHz	—	—	—	—	—	0.020

Trace Noise (1 kHz BW), deg rms

Option	020	120	220	240	420	520
300 kHz to 10 MHz	0.080	0.080	—	0.110[1]	—	—
10 MHz to 45 MHz	0.030	0.030	0.025[1]	0.025	0.100[1]	0.100[1]
45 MHz to 6 GHz	0.030	0.030	0.060	0.025	0.060	0.060
6 GHz to 13.5 GHz	—	0.060	0.060	0.050	0.100	0.100
13.5 GHz to 20 GHz	—	—	0.060	0.050	0.100	0.100
20 GHz to 40 GHz	—	—	—	—	0.200	0.200
40 GHz to 50 GHz	—	—	—	—	—	0.200

Maximum Leveled Output Power, dBm

Option	020	120	220	240	420	520
300 kHz to 10 MHz	10	10	—	8[1]	—	—
10 MHz to 45 MHz	10	10	—	8	—	—
45 MHz to 6 GHz	10	10	5	6	0	0
6 GHz to 9 GHz	—	8	5	3	0	0
9 GHz to 13.5 GHz	—	2	3	0	0	0
13.5 GHz to 20 GHz	—	—	3	–3	0	0
20 GHz to 40 GHz	—	—	—	—	–5	–5
40 GHz to 50 GHz	—	—	—	—	—	–11

Measurement Speed

Broadband sweep (10 MHz to 10 GHz, 50 kHz IF bandwidth, 201 points, no calibration): 97 ms[2]
Narrowband sweep, Options 020, 025, 120, 125, 240, 245 (9.95 GHz to 10.05 GHz, 600 kHz IF bandwidth, 201 points, no calibration): 7 ms[3]
Narrowband sweep, Options 220, 225, 420, 425, 520, 525 (9.95 GHz to 10.05 GHz, 250 kHz IF bandwidth, 201 points, no calibration): 9 ms[3]

Data Transfer Speed, 32-bit Binary (ms)[1]

	201 points	1601 points
COM[4]	0.4	2
SCPI (internal)[4]	1	30
DCOM[5]	0.8	7
SCPI over GPIB[5]	7	435

[1] Typical.
[2] Includes sweep, band-cross, and retrace time.
[3] Includes sweep and retrace time.
[4] Program executed in the PNA.
[5] Program executed on an external PC.

PNA Network Analyzers[1]
E8361A/62B/63B/64B, N5250A

PNA (high performance series)
E8362B 10 MHz to 20 GHz
E8363B 10 MHz to 40 GHz
E8364B 10 MHz to 50 GHz
E8361A 10 MHz to 67 GHz
N5250A[2] 10 MHz to 110 GHz

Options
To add options to a product, order the corresponding item number.

	Description	For E8362B	For E8363B	For E8364B	For E8361A	For N5250A System[3]	Additional Information
Test Set							
Option 014	Configurable test set	E8362B-014	E8363B-014	E8364B-014	E8361A-014	Included	—
Power Configuration							
Option UNL	Extended power range and bias-tees	E8362B-UNL	E8364B-UNL	E8364B-UNL	E8361A-UNL	Included	Only E8361A requires 014
Option 016	Add receiver attenuators	E8362A-016	E8364A-016	E8364A-016	E8361A-016	E8361A-016	Requires UNL (only E8361A also requires 014)
Option H85	High-power configuration	E8362B-H85	H8363B-H85	H8364B-H85	Contact Agilent	Contact Agilent	Includes 014, 016, UNL[4]
Non-linear Measurements							
Option 080	Frequency offset	E8362A-080	E8364A-080	E8364A-080	E8361A-080	Included	Requires 014 (E8361A only, 081 required if UNL is also purchased)
Option 081	Reference receiver switch	E8362A-081	E8364A-081	E8364A-081	E8361A-081	Included	Requires 014, 080 (only E8361A also requires UNL)
Option 082[6]	Scalar-calibrated converter measurements	E8362A-082	E8364A-082	E8364A-082	E8361A-082	Included	—
Option 083	Vector and Scalar-calibrated converter measurements	E8362A-083	E8364A-083	E8364A-083	E8361A-083	E8361B-083	Requires 014, 080, 081 (only E8361A also requires UNL, includes GPIB to USB interface (82357A)
Pulse, Antenna, mm-wave							
Option H08[5]	Pulsed-RF measurement capability	E8362B-H08	E8363B-H08	E8364B-H08	E8361A-H08	E8361A-H08	—
Option H11	IF access (for antenna, pulsed-RF and mm-wave measurements)	E8362B-H11	E8363B-H11	E8364B-H11	E8361A-H11	Included	Requires 014, UNL, pulsed-RF and mm-wave 080, and 081
Measurement Features							
Option 010	Time-domain capability	E8362A-010	E8363A-010	E8364A-010	E8361A-010	E8361B-010	—
Accessories							
Option 1CM	Rack mount kit for use without handles	E8362A-1CM	E8363A-1CM	E8364A-1CM	E8361A-1CM	E8361A-1CM	—
Option 1CP	Rack mount kit for use with handles	E8362A-1CP	E8363A-1CP	E8364A-1CP	E8361A-1CP	E8361A-1CP	—
N4688A	USB CD R/W drive	N4688A	N4688A	N4688A	N4688A	N4688A	—
N4689A	USB Hub	N4689A	N4689A	N4689A	N4689A	N4689A	—
Calibration Documentation							
Option 1A7	ISO 17025 compliant calibration	E8362B-1A7	E8363B-1A7	E8364B-1A7	E8361A-1A7	E8361A-1A7	—
Option UK6	Commercial calibration certificate with test data	E8362A-UK6	E8363A-UK6	E8364A-UK6	E8361A-UK6	E8361A-UK6	—
Option A6J	ANSI Z540 compliant calibration	E8362B-A6J	E8363B-A6J	E8364B-A6J	E8361A-A6J	E8361A-A6J	—

Note: Item numbers may not correspond to product model number. For example, to order the time-domain option on the E8362B, the correct item number to order is E8362A-010.

Warranty and Service

One and three-year warranty and service plans are available at time of instrument purchase. The N5250A 110 GHz system carries a full one-year on-site warranty (where available).

Key Literature & Web Link

PNA Series Brochure, p/n 5989-6014EN
PNA Series Technical Specifications, p/n 5988-7988EN
PNA Series Configuration Guide, p/n 5988-7989EN
PNA Millimeter-Wave Network Analyzers Technical Overview, p/n 5988-9620EN

For more information, visit our web site:
www.agilent.com/find/pna

Calibration

Three and five year calibration plans are available at time of instrument purchase.

[1] All models are not available in all countries.
[2] For more detailed information regarding the 110 GHz network analyzer system, refer to the Agilent Web site: **www.agilent.com/find/pna** and download the N5250A Technical Overview, p/n 5988-9620EN.
[3] The N5250A 110 GHz system also includes an N5260A millimeter-wave test set controller, 1.0 mm combiner assembly, interconnecting cables, and installation and productivity assistance.
[4] UNL does not include bias bees. Only includes source attenuators.
[5] Up to 67 GHz.
[6] Option 082 is a subset of Option 083, and therefore, they cannot be ordered together.

PNA-X Network Analyzers N5242A , 10 MHz to 26.5 GHz, 2 or 4 Ports

Options
To add options to a product, order the corresponding item number.

	Description	For N5242A	Additional information
Test Set			
Option 200	2 ports, single source	N5242A-200	
Option 224	2 ports, add internal 2nd source, combiner and mechanical switches	N5242A-224	Requires Options 200, 219, and 080
Option 400	4 ports, dual source	N5242A-400	Recommends Option 080
Option 423	4 ports, add internal combiner and mechanical switches	N5242A-423	Requires Options 400, 419, and 080
Power Configuration			
Option 219	2 ports, extended power range and bias-tees	N5242A-219	Requires Option 200
Option 419	4 ports, extended power range and bias-tees	N5242A-419	Requires Option 400
Non-linear Measurements			
Option 080	Frequency offset	N5242A-080	
Option 082[1]	Scalar-calibrated converter measurements	N5242A-082	Requires Option 080
Option 083[1]	Vector and scalar-calibrated converter measurements	N5242A-083	Requires Option 080
Pulse, Antenna, mm-wave			
Option H08	Pulse measurements	N5242A-H08	
Option 020	Add IF inputs for antenna and mm-wave	N5242A-020	
Option 021	Add pulse modulator to internal 1st source	N5242A-021	
Option 022	Add pulse modulator to internal 2nd source	N5242A-022	Requires Options 224 or 400
Option 025	Add four internal pulse generators	N5242A-025	
Measurement Features			
Option 010	Time-domain measurements	N5242A-010	
Accessories			
Option 1CM	Rack mount kit for use without handles	N5242A-1CM	
Option 1CP	Rack mount kit for use with handles	N5242A-1CP	
N1966A	Pulse I/O adapter	N1966A	
N4688A	USB CD R/W drive	N4688A	
N4689A	USB Hub	N4689A	
Calibration Software			
Option 897[2]	Perpetual license for built-in performance test software for Agilent inclusive calibration	N5242A-897	
Option 898[2]	Perpetual license for built-in performance test software for standards compliant calibration	N5242A-898	
Calibration Documentation			
Option 1A7	ISO 17025 compliant calibration	N5242A-1A7	
Option UK6	Commercial calibration certificate with test data	N5242A-UK6	
Option A6J	ANSI Z540 compliant calibration	N5242A-A6J	

[1] Option 082 is a subset of Option 083, and therefore, they can not be ordered together.
[2] Additional hardware required. Please refer to chapter 2 of the Service Guide for required service test equipment.

Key Literature & Web Link

PNA Series Brochure, p/n 5989-6014EN
PNA Series Technical Specifications, p/n 5988-7988EN
PNA Series Configuration Guide, p/n 5988-7989EN
PNA Millimeter-Wave Network Analyzers Technical Overview, p/n 5988-9620EN

For more information, visit our web site:
www.agilent.com/find/pna

PNA-L (N5230A)

Ordering Guide for PNA-L Series Network Analyzers

This guide is intended to assist you in the ordering process. Additional information and products (such as calibration kits and cables) can be found in the PNA Configuration Guide (see Key Literature below).

Step 1: Select N5230A Model Number

Step 2: Choose your Frequency Range and Test Set
(Mandatory, choose only one)

Description		Ordering Number
300 kHz to 6 GHz	2-port standard test set	Option 020
300 kHz to 6 GHz	2-port configurable test set and extended power range	Option 025
300 kHz to 13.5 GHz	2-port standard test set	Option 120
300 kHz to 13.5 GHz	2-port configurable test set and extended power range	Option 125
10 MHz to 20 GHz	2-port standard test set	Option 220
10 MHz to 20 GHz	2-port configurable test set and extended power range	Option 225
300 kHz to 20 GHz	4-port standard test set	Option 240
300 kHz to 20 GHz	4-port configurable test set and extended power range	Option 245
10 MHz to 40 GHz	2-port standard test set	Option 420
10 MHz to 40 GHz	2-port configurable test set and extended power range	Option 425
10 MHz to 50 GHz	2-port standard test set	Option 520
10 MHz to 50 GHz	2-port configurable test set and extended power range	Option 525

Step 3: Choose Additional Software Options (Optional)

Description	Ordering Number
Time domain for 6 GHz model	N52310-010
Time domain for 13.5, 20, 40 or 50 GHz model	N52300-010
Frequency-offset measurements	N52300-080

Step 4: Choose an Electronic or Mechanical Calibration Kit (Optional)

Description	Ordering Number
300 kHz to 13.5 GHz, 4-port, Type-N or 3.5 mm connectors	N4431B
300 kHz to 26.5 GHz, 2-port 3.5 mm connectors	N4691B
10 MHz to 50 GHz, 2-port 2.4 mm connectors	N4693A

Step 5: Accessories (Optional)

Description	Ordering Number
Rack mount kit without handle	Option 1CM
Rack mount kit with handles	Option 1CP
USB CD R/W drive	N4688A
USB Hub	N4689A

Step 6: Calibration Documentation (Optional)

Description	Ordering Number
ISO 17025 compliant calibration	Option 1A7
Commercial calibration certificate with test data	Option UK6
ANSI Z540 compliant calibration	Option A6J

Step 7: Choose your Warranty and Service (Optional)

Description
1-year return-to Agilent warranty and service
3-year return-to Agilent warranty and service

Key Literature & Web Link

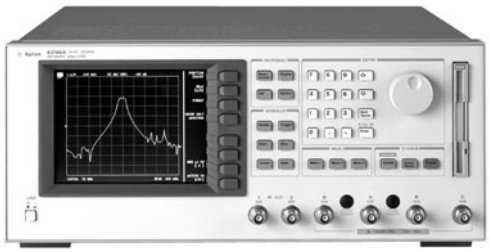
2-port PNA-L Brochure, p/n 5989-0168EN
2-port PNA-L Data Sheet, p/n 5989-0514EN
4-port PNA-L Brochure, p/n 5989-0896EN
4-port PNA-L Data Sheet, p/n 5989-1695EN
PNA Series Configuration Guide, p/n 5988-7989EN

For more information, visit our web site:
www.agilent.com/find/pnal

Note: For additional calibration kits and accessories refer to the Configuration Guide.

E5100A

- 10 kHz to 300 MHz
- 0.04 ms/point measurement speed
- Fine resolution IFBW
- List sweep function
- Stable measurements
- High-speed evaluation using the waveform analysis commands
- Evaporation Monitoring Function
- Phase Tracking Function
- Supports active probes (Option)
- GP Instrument BASIC for easy automation



E5100A

E5100A Network Analyzers

The E5100A network analyzer is a 10 kHz to 300 MHz network analyzer best fitted for production lines of electronic component manufacturers, especially resonator and filter manufacturers, who require extra-high throughput.

The E5100A improves production line productivity with its fast measurement speed (fastest sweep speed is 0.04 ms/point), fast waveform analysis commands, and speedier processor. It provides faster measurements with lower fluctuations because of its low-noise performance and fine selection IFBW.

High-Quality and High-Speed Tests

The E5100A is a versatile network analyzer with many functions and options to fit your needs with a minimum investment. During final tests, both precision and high speed are required for better yield and better productivity. The E5100A makes high-quality and high-speed tests with its fine IFBW selection and low-noise circuitry. Its convenient analysis and processing functions improve the productivity of the final test processes.

Specifications

Source Characteristics

	Option 000	Option 600
Frequency Range	10 kHz to 300 MHz	10 kHz to 300 MHz
Number of RF Output Port	1	2 (Power Splitter inside)
Power Range	–48 to +22 dBm	–52 to +18 dBm (OUT 1) –65 to +5 dBm (OUT 2)
Power Resolution	0.1 dB	0.1 dB
Probe Power Supply	Installed	None

Receiver Characteristics

	Option 000	Option 600
Frequency Range	10 kHz to 300 MHz	10 kHz to 300 MHz
IFBW	10 Hz to 30 kHz (1, 1.5, 2, 3, 4, 5, 8 steps)	10 Hz to 30 kHz (1, 1.5, 2, 3, 4, 5, 8 steps)
Number of Ports	4	2
System Dynamic Range at Test Port	>120 dB (IFBW = 1 kHz)	>120 dB (IFBW = 1 kHz)
Dynamic Accuracy	±0.05 dB, ±0.3 deg	±0.05 dB, ±0.3 deg
Input Impedance (nominal)	50 Ω	50 Ω
Measurement Speed	0.04 ms/point (IFBW = 30 kHz, ramp-sweep)	0.04 ms/point (IFBW = 30 kHz, ramp-sweep)
Phase Tracking DLD Function	Installed	Installed
Evaporation Monitor Function	Installed	Installed

General Characteristics

Measurement Parameters: Gain (Amplitude Ratio), Phase, Group-Delay, Amplitude, Gain-Phase, Gain-Delay, Impedance, Admittance
Display: 6.5 inch TFT Color LCD
Programming: IBASIC
Mass Storage: FDD and internal non-volatile memory
Parallel I/O Port: TTL, 16-bit output, 8-bit input/output (standard)
Power Requirement: 90 to 132 V or 198 to 264 V, 47 to 63 Hz, 400 VA max.
Size: 177 mm H x 425 mm W x 425 mm D (7.08 in x 17 in x 17 in)
Weight: 12 kg (26.4 lb) (typical)

Accessories

41901A SMD PI-Network Test Fixture
The 41901A SMD PI-network test fixture produces the capability to measure surface-mount crystal resonator using the E5100A. Attachment kit (option) is required for measurement. The frequency range of the 41901A is 1 MHz to 300 MHz.

Key Literature

E5100A Network Analyzer Product Overview, p/n 5968-1873E
E5100A Technical Specifications, p/n 5966-2888E

Ordering Information

E5100A Network Analyzer
- **E5100A-000** 300 MHz 4-Receivers Standard Test Set (with mandatory options 801, 400, 706 and 804)
- **E5100A-600** 300 MHz 2-Receivers X'tal Resonator Test w/PI-network (incompatible with E5100A-801, 400 and 706)
- **E5100A-801** Power Extended One RF OUT Port
- **E5100A-400** 300 MHz 4-Receivers with Ports R, A, B and C
- **E5100A-706** Type-N 50 Ω Input Connector on Ports A and B
- **E5100A-804** Parallel I/O Standard
- **E5100A-006** Parallel I/O Mode B
- **E5100A-800** Standard Frequency Reference
- **E5100A-1D5** High Stability Frequency Reference
- **E5100A-1F0** PC Style Keyboard – U.S Version
- **E5100A-1CM** Rackmount Kit
- **E5100A-1CN** Handle Kit
- **E5100A-1CP** Rackmount and Handle Kit
- **E5100A-ABA** English Localization
- **E5100A-ABJ** Japanese Localization

Accessories
41800A Active Probe
41802A 1 MΩ Input Adapter
41901A SMD PI-Network Test Fixture
- **41901A-010** to **41901A-061** Attachment Kit

11667A 50 Ω Power Splitter
87512A Transmission/Reflection Test Kit

- **Full-vector network and spectrum measurement and analysis**
- **Wide dynamic range network measurement with fast sweep speeds**
- **±0.05 dB/±0.3° dynamic magnitude/phase accuracy**
- **Extremely fast narrowband spectrum measurement**
- **Impedance analysis option and test kit available**
- **–145 dBm/Hz sensitivity for spectrum analysis**
- **Built-in IBASIC for easy test automation**
- **Time-gated spectrum analysis option**
- **Color TFT display and built-in disk drive/RAM disk**

4395A with 87511A

4395A Network/Spectrum/Impedance Analyzer

The 4395A provides excellent vector network, spectrum and optional impedance measurements for audio, baseband, HF, VHF, and IF applications. When combined with a test set, the 4395A provides reflection measurements, such as return loss, and SWR, and S parameters. Gain, phase, group delay, distortion, spurious, CN ratio, and noise measurements often required for evaluating components and circuits can be measured using one instrument. As a vector network analyzer, the 4395A operates from 10 Hz to 500 MHz with 1 mHz resolution and its integrated synthesized source provides –50 to +15 dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ±0.05 dB and ±0.3° so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the 4395A operates from 10 Hz to 500 MHz with resolution bandwidths (RBWs) spanning 1 Hz to 1 MHz in a 1-3-10 steps. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ±0.8 dB level accuracy (@ 50 MHz, –20 dBm). Noise sidebands fall below –110 dBc/Hz @ 100 kHz offset from carriers, while sensitivity is –145 dBm/Hz at 10 MHz.

Extremely Fast Spectrum Measurement

The 4395A features Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed for all RBW settings. For example, with 100 Hz RBW and 100 kHz span, the 4395A has a sweep time of 300 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the efficiency of narrowband spectrum measurement.

Time-Gated Spectrum Analysis

With Option 4395A-1D6, the 4395A offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 6 µ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the 4395A by adding Option 4395A-010 and the 43961A RF impedance test kit. Covering from 100 kHz to 500 MHz, impedance parameters |Z|, θ, C, L, Q, D, and more, are directly measured and displayed on the TFT color display. The basic impedance measurement accuracy is 3%. A 7 mm connector is mounted on this kit for easy connection to an appropriate impedance test fixture. A wide variety of fixtures can be used with this test kit, including the surface-mount-device (SMD) fixtures. The Option 4395A-001 DC source is useful in applying DC voltage to the device up to 40 V.

4395A Specifications Summary

Network Measurement

Frequency Characteristics
- Range: 10 Hz to 500 MHz
- Resolution: 1 mHz
- Accuracy: <±5.5 ppm (Option 4395A-1D5: <±0.13 ppm)

Output Characteristics
- Power Range: –50 to +15 dBm
- Resolution: 0.1 dB
- Level Accuracy: ±1.0 dB @ 0 dBm, 50 MHz

Receiver Characteristics
- Frequency Range: 10 Hz to 500 MHz
- Noise Level (referenced to full scale input level, 23 ± 5°C):
  - –85 dB (typical) @ 10 Hz ≤ f <100 Hz, IFBW = 2 Hz
  - –85 dB @ 100 Hz ≤ f <100 kHz, IFBW = 10 Hz
  - (–115 + f/100 MHz) dB @ 100 kHz ≤ f, IFBW = 10 Hz
- IF Bandwidth (Hz): 2, 10, 30, 100, 300, 1 k, 3 k, 10 k, 30 k

Dynamic Accuracy

Input Level (relative to full scale input level –10 dB)	Dynamic Accuracy Frequency ≥100 Hz
Magnitude Dynamic Accuracy	
0 dB ≥ input level ≥–10 dB	±0.4 dB
–10 dB > input level ≥–60 dB	±0.05 dB
–60 dB > input level ≥–80 dB	±0.3 dB
–80 dB > input level ≥–100dB	±3 dB
Phase Dynamic Accuracy	
0 dB ≥ input level ≥–10 dB	±3°
–10 dB > input level –60 dB	±0.3°
–60 dB > input level –80 dB	±1.8°
–80 dB > input level –100 dB	±18°

@ R port input level = full scale input level –10 dB, IFBW = 10 Hz, 23 ± 5°C

Spectrum Measurement

Frequency Characteristics
- Frequency Range: 10 Hz to 500 MHz

Frequency Reference
- Accuracy: <±5.5 ppm (Option 4395A-1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)
- Range: 1 Hz to 1 MHz, 1-3-10 step @ span >0
  3 k, 5 k, 10 k, 20 k, 40 k, 100 k, 200 k, 400 k, 800 k, 1.5 M, 3 M, 5 MHz @ span = 0

Selectivity (60 dB/3 dB)**:** <3 @ span >0

Noise Sidebands
- Offset
  1 kHz –97 dBc/Hz
  10 kHz –97 dBc/Hz
  100 kHz –110 dBc/Hz
  1 MHz –110 dBc/Hz

Displayed Average Noise Level
- Frequency
  1 kHz ≤ f <100 kHz –120 dBm/Hz
  100 kHz ≤ f <10 MHz –133 dBm/Hz
  10 MHz ≤ f (–145 + f/100 MHz) dBm/Hz

Spurious Response
- Second Harmonic Distortion: –70 dBc @ –16 dB full scale
- Third-Order Intermodulation Distortion: –70 dBc @ –16 dB full scale
- Other Spurious: –70 dBc @ –16 dBc full scale
- Scale Fidelity: ±0.05 dB @ 0 to –30 dB from full scale input level –10 dB

Impedance Measurement (Option 4395A-010, 43961A)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy
Frequency Range: 100 kHz to 500 MHz
Measurement Port: 7 mm connector on the 43961A Test Kit
Source Level at Measurement Port: –56 to +9 dBm @ 50 Ω
Calibration: OPEN/SHORT/LOAD calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension
Accuracy (Supplemental Performance Characteristics)**:**
±3% basic accuracy @ 23 ± 5°C, after OPEN/SHORT/LOAD calibration

General Characteristics

Full Scale Input Level

Attenuator Setting (dB)	Full Scale Input Level Network	Spectrum
0	–10 dBm	–20 dBm
10	0 dBm	–10 dBm
20	+10 dBm	0 dBm
30	+20 dBm	+10 dBm
40	+30 dBm	+20 dBm
50	+30 dBm	+30 dBm

Option 4395A-001 DC Voltage/Current Source
- Voltage Range: –40 V to +40 V
- Current Range: –20 mA to –100 mA, 20 mA to 100 mA

Operating Temperature/Humidity
- Disk Drive Non-Operating Condition: 0°C to 40°C, 15% to 95% RH
- Disk Drive Operating Condition: 10°C to 40°C, 15% to 80% RH

Storage Temperature/Humidity: –20°C to 60°C, 15% to 95% RH
Power Requirement: 100/120/220/240 V ±10%, 47 Hz to 66 Hz, 300 VA max.
Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)
Weight: 21 kg (46.2 lb) (typical)

Key Literature

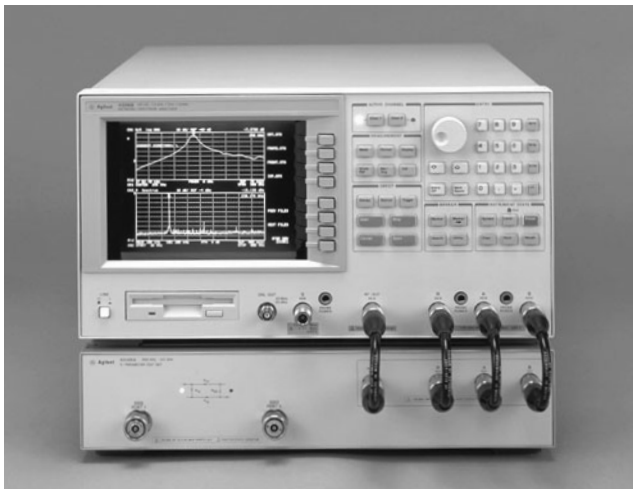
4395A/96B Awareness Brochure, p/n 5965-9374E
4395A Network/Spectrum/Impedance Analyzer, Technical Specifications, p/n 5965-9340E
Dramatic Speed Improvement for Narrow RBW Sweeps by Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E
Network, Spectrum, and Impedance Evaluation of Electronic Circuits and Components, p/n 5967-5942E
How to Measure Noise Accurately Using the Combination Analyzers, p/n 5966-2292E
ADSL Copper Loop Measurements, p/n 5968-1196E
Switching Power Supply Evaluation, p/n 5968-7274E

Ordering Information

4395A Network/Spectrum/Impedance Analyzer
- **4395A-001** Add DC Source
- **4395A-010** Add Impedance Measurement Function (Requires 43961A)
- **4395A-1D5** Add High Stability Frequency Reference
- **4395A-1D6** Add Time-Gated Spectrum Analysis
- **4395A-1D7** 50 Ω to 75 Ω Minimum Loss Pads
- **4395A-810** Add Keyboard
- **4395A-A6J** ANSI Z540 compliant

87511A 50 Ω S-Parameter Test Sets
87511B 75 Ω S-Parameter Test Sets
87512A 50 Ω Transmission/Reflection Test Kits
87512B 75 Ω Transmission/Reflection Test Kits
43961A RF Impedance Test Kit (add test fixture listed below)
16192A Parallel Electrode SMD Test Fixture
16194A High Temperature Component Test Fixture
16196A/B/C/D Parallel Electrode SMD Test Fixture
16197A Bottom Electrode SMD Test Fixture
16092A Spring Clip Test Fixture
41800A Active Probe
41802A 1 MΩ Input Adapter

- **Full-vector network and spectrum measurement and analysis**
- **Wide dynamic range network measurement with fast sweep speeds**
- **±0.05 dB/±0.3° dynamic magnitude/phase accuracy**
- **Extremely fast narrowband spectrum measurement**
- **Impedance analysis option and test kit available**
- **±1.0 dB level accuracy for spectrum analysis**
- **–150 dBm/Hz sensitivity for spectrum analysis**
- **Built-in IBASIC for easy test automation**
- **Time-gated spectrum analysis option**
- **Color TFT display and built-in disk drive/RAM disk**



4396B with 85046A

4396B RF Network/Spectrum/Impedance Analyzer

The 4396B provides excellent RF vector network, spectrum, and optional impedance measurements for lab and production applications. When combined with a test set, the 4396B provides reflection measurements, such as return loss, and SWR, and S-parameters. Gain, phase, group delay, distortion, spurious, CN, and noise measurements often required for evaluating components and circuits can be measured using one instrument. As a vector network analyzer, the 4396B operates from 100 kHz to 1.8 GHz with 1 mHz resolution and its integrated synthesized source provides –60 to +20 dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ±0.05 dB and ±0.3° so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the 4396B operates from 2 Hz to 1.8 GHz with resolution bandwidths (RBWs) spanning 1 Hz to 3 MHz in a 1-3-10 sequence. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ±1.0 dB overall level accuracy. Noise sidebands fall below –105 dBc/Hz offset 10 kHz from carriers below 1 GHz, while sensitivity is –150 dBm/Hz at 10 MHz and –147 dBm/Hz at 1 GHz. In addition, with two independent display channels available, you can simultaneously view network and spectrum (or transmission and reflection) characteristics of the device under test in split-screen format. For example, an amplifier's frequency response (network measurement) and distortion (spectrum measurement) can be shown at the same time.

Extremely Fast Spectrum Measurement

The 4396B features a stepped Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed when the resolution bandwidth (RBW) is set at 3 kHz or below. For example, with a 30 Hz RBW and 10 kHz span, the 4396B has a sweep time of 400 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the speeds of narrowband spectrum measurement such as frequency tuning of a VCO or CN measurements.

Time-Gated Spectrum Analysis

With Option 4396B-1D6, the 4396B offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 2 µsec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the 4396B by adding Option 4396B-010 and the 43961A RF impedance test kit. Covering from 100 kHz to 1.8 GHz, impedance parameters |Z|, θ, C, L, Q, D, and more, are directly measured and displayed. The basic impedance accuracy (typical value) is 3%. The 43961A RF impedance test kit is designed for the 4396B and is required to utilize the features of Option 4396B-010. A 7 mm connector is mounted on this kit for easy connection to an appropriate impedance test figure. A wide variety of Agilent test fixtures can be used with the test kit, including the surface-mount-device (SMD) fixtures.

4396B Specifications Summary

Network Measurement

Frequency Characteristics
- Range: 100 kHz to 1.8 GHz
- Resolution: 1 mHz
- Accuracy: <±5.5 ppm (Option 4396B-1D5: <±0.13 ppm)

Output Characteristics
- Power Range: –60 to +20 dBm
- Resolution: 0.1 dB
- Level Accuracy: <±0.5 dB

Receiver Characteristics
- Frequency Range: 100 kHz to 1.8 GHz
- Noise Level (10 Hz IFBW, ≥10 MHz, f = frequency in GHz):
  - <(–125+3 x f) dBm (A, B inputs);
  - <(–100+3 x f) dBm (R input)
- Full Scale Input Level: –5 dBm (A, B), +20 dBm (R)
- IF Bandwidth (Hz): 10, 30, 100, 300, 1 k, 3 k, 10 k, 40 k

4396B

Dynamic Accuracy

Input level (relative to full scale input level)	
Magnitude Dynamic Accuracy	
0 dB	<±0.3 dB
–10 to –70 dB	<±0.05 dB
–80 dB	<±0.1 dB
–90 dB	<±0.3 dB
–100 dB	<±1.0 dB
–110 dB	<±0.8 dB typical
–120 dB	<±2.5 dB typical
Phase Dynamic Accuracy	
0 dB	<±3°
–10 dB	<±0.6°
–20 to –70 dB	<±0.3°
–80 dB	<±0.7°
–90 dB	<±2°
–100 dB	<±7°
–110 dB	<±8° typical
–120 dB	<±25° typical

@ 23 ±5°C, IFBW 10 Hz, R input = –35 dBm

Measurement Throughput Summary (IFBW 40 kHz, ms)

Measurement (with THRU Cal)	Number of Points 51	201	401	801
(1) Magnitude	62	138	239	443
(2) Magnitude and phase	84	227	417	798

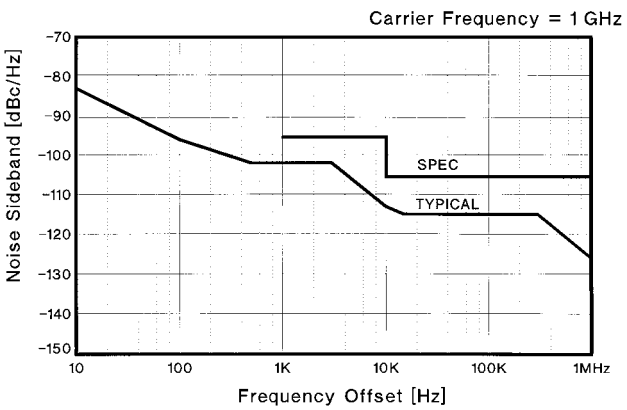
Spectrum Measurement

Frequency Characteristics
- Frequency Range: 2 Hz to 1.8 GHz

Frequency Reference
- Accuracy: <±5.5 ppm (Option 4396B-1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)
- Range: 1 Hz to 3 MHz, 1-3-10 step
- Selectivity (60 dB/3 dB): RBW ≥10 kHz: <10; RBW ≤3 kHz: <3

Noise Sidebands



Noise sidebands normalized to 1 Hz RBW versus offset from carrier (typical)

Displayed Average Noise Level
(@ frequency ≥10 MHz, ref. level ≤–40 dBtm, att. = 0 dBm):
<(–150 + 3f (GHz)) dBm/Hz

Spurious Response
- Second Harmonic Distortion (@ ≥10 MHz, –35 dBm mixer input): <–70 dBc
- Third-Order Intermodulation Distortion (@ ≥10 MHz, –30 dBm, separation >20 kHz): <–75 dBc

Other Spurious (@ –30 dBm mixer input, offset ≥1 kHz): <–70 dBc
Scale Fidelity: ±0.05 dB @ 0 to –30 dB from ref. level

Impedance Measurement (Option 4396B-010, 43961A)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy
Frequency Range: 100 kHz to 1.8 GHz
Measurement Port: 7 mm connector on the 43961A Test Kit
Source Level at RF out: –60 to +20 dBm (6 dB lower at 43961A port)
DC Bias: ±40 V (20 mA maximum). A 2 kΩ ±5% internal resistor is used for dc bias current limitation. An external dc bias source is required.
Connector: BNC (f) on 43961A.
Calibration: OPEN (0 S)/SHORT (0 Ω)/LOAD (50 Ω) calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension compensation
Accuracy (Supplemental Performance Characteristics)**:** 3% basic accuracy at 23°C ± 5°C, after OPEN/SHORT/LOAD calibration

General Characteristics

Operating Temperature/Humidity: 0°C to 40°C, 15% < RH <95%
Storage Temperature: –20°C to 60°C
Power Requirement: 90 V to 132 V, 198 V to 264 V, 47 Hz to 63 Hz, 300 VA max.
Weight: 21.5 kg (47.3 lb) typical
Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)

Key Literature

4395A/96B Awareness Brochure, p/n 5965-9374E
4396B 1.8 GHz Network/Spectrum Analyzer Technical Data, p/n 5965-6311E
Combining Network and Spectrum Analyzes and IBASIC to improve device characterization and test time, p/n 5965-7656E
Configuring the 4396B for O/E Testing, p/n 5965-7657E
How to Characterize CATV Amplifiers Effectively, p/n 5965-9434E
Dramatic Speed Improvement for Narrow RBW Sweeps by Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E
Network, Spectrum, and Impedance Evaluation of Electronic Circuits and Components, p/n 5967-5942E
How to Measure Noise Accurately Using the Combination Analyzers, p/n 5966-2292E

Ordering Information

4396B Network/Spectrum/Impedance Analyzer
- **4396B-010** Add Impedance Measurement Function (Requires 43961A)
- **4396B-1D5** Add High Stability Frequency Reference
- **4396B-1D6** Add Time-Gated Spectrum Analysis
- **4396B-1D7** 50 ohm to 75 ohm Minimum Loss Pads
- **4396B-810** Add Keyboard
- **4396B-A6J** ANSI Z540 Compliant

85046A 50 Ω S-Parameter Test Sets
85046B 75 Ω S-Parameter Test Sets
87512A 50 Ω Transmission/Reflection Test Kits
87512B 75 Ω Transmission/Reflection Test Kits
43961A RF Impedance Test Kit (add test fixtures listed below)
16192A Parallel Electrode SMD Fixture (dc to 2 GHz)
16194A High Temperature Component Test Fixture
16196A/B/C/D Parallel Electrode SMD Test Fixture
16197A Bottom Electrode SMD Test Fixture
16092A Spring-Clip Fixture (dc to 500 MHz)
41800A Active Probe
41802A 1 MΩ Input Adapter

43961A
87511A
87511B
87512A
87512B
41800A

43961A

43961A RF Impedance Test Kit

The 43961A RF impedance test kit provides the capability to measure impedance parameters of 1-port devices with the 4395A with Option 4395A-010 (100 kHz to 500 MHz) or the 4396B with Option 4396B-010 (100 kHz to 1.8 GHz). The test port of the 43961A is a 7 mm connector and can be used with the 16196A/B/C/D, 16197A, or 7 mm type test fixtures. The 43961A includes open/short/load calibration standards, and the test fixtures such as 16197A are optional.

Frequency Range: 100 kHz to 1.8 GHz (100 kHz to 500 MHz with 4395A)
Measurement Parameters: |Z|, |Y|, θ, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|

87512A

87512A/B Transmission/Reflection Test Kits

87512A/B transmission/reflection test kits provide the capability to measure the reflection and transmission characteristics of 50 Ω or 75 Ω devices up to 2 GHz with an Agilent network analyzer. The test port of the 87512A is a 50 Ω type N(f) connector, and the test port of the 87512B is a 75 Ω type N(f) connector. The 87512A/B include precision short/load termination for calibration.

Frequency Range: DC to 2 GHz
Test Port Impedance: 87512A, 50 Ω; 87512B, 75 Ω
Equivalent Directivity: 40 dB (typical)
Insertion Loss: 10 dB ± 1 dB

87511A

87511A/B S-parameter Test Sets

The 87511A/B S-parameter test sets provide the capability to measure S-parameters of 2-port devices from 100 kHz to 500 MHz with an network analyzer. The test ports of the 87511A are 50 Ω connectors (Option 87511A-008: 7 mm or Option 87511A-001: type N(f)), and the test ports of the 87511B are 75 Ω type N(f) connectors. Calibration kits are not included.

Frequency Range: 100 kHz to 500 MHz
Test Port Impedance: 87511A, 50 Ω; 87511B, 75 Ω

	87511A	87511B
Directivity		
100 kHz to 300 kHz	30 dB	30 dB
300 kHz to 200 MHz	40 dB	33 dB
200 MHz to 500 MHz	35 dB	33 dB
Nominal Insertion Loss		
RF IN to port 1, 2	13 dB	19 dB
RF IN to R, A, B	19 dB	31 dB

Size: 90 mm H x 432 mm W x 495 mm D (3.6 in x 17.28 in x 19.8 in)
Weight: 5.7 kg (12.54 lb) (typical)

41800A

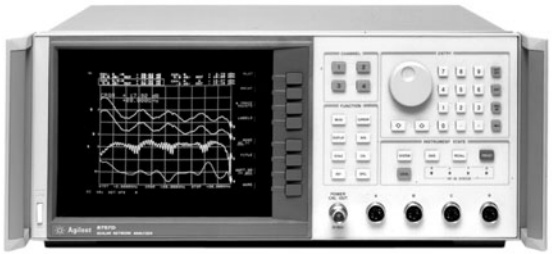
41800A Active Probe

The 41800A active probe provides high input impedance from 5 Hz to 500 MHz. The 41800A is a valuable tool when used with a network and spectrum analyzer for circuit signal analysis.

Specifications

Bandwidth: 5 Hz to 500 MHz
Output Connector: 50 Ω type N male
Input R,C (typical):100 k Ω, 3 pF (probe alone);
1 MΩ, 1 pF (with 10:1, 100:1 divider)
Frequency Response relative to 50 MHz: ±1 dB @ 50 Hz to 200 MHz
Average Noise Level: 10 nV/$\sqrt{\text{Hz}}$ @ ≥300 kHz
Second Harmonic Distortion: <–50 dBc @ 20 dBm (250 MHz) input (typical)
Third-Order Intermodulation Distortion: <–70 dBc @ –26 dBm two signal input (typical)
1 dB Gain Compression: >+3 dBm input @ 500 MHz

- 75 dB dynamic range
- Optional power calibrator
- 40 dB directivity bridges
- Buffered plotter/printer output
- External disk and internal register save/recall
- Built-in limit testing
- Color display



8757D-001 & -002

8757D Scalar Network Analyzers

Measure insertion loss, gain, return loss, SWR, and power quickly and accurately with the 8757D scalar network analyzer. With high-performance detectors and directional bridges, and a companion source and digital plotter, the 8757D is the basis of a complete measurement system with superb performance.

The 8757D features three detector inputs and two independent display channels, allowing simultaneous ratioed or non-ratioed measurement of your device's transmission and reflection characteristics, 75 dB dynamic range (+20 to –55 dBm) for measuring high-rejection devices, and a choice between ac (square wave modulated) or dc detection techniques. The internal plotter/printer buffer allows you to send your measurement data directly to a plotter and then proceed to the next measurement, typically in less than five seconds. The 8757D includes a user-friendly interface, and menu-driven, direct-access softkeys, which simplify its operation.

It offers limit testing, external disk save/recall, and a color display. Limit testing reduces test time by letting the analyzer make quick and objective pass/fail decisions. External disk save/recall allows your measurement state to be preconfigured by an engineer or skilled specialist and then automatically recalled by production technicians. The result is reduced set-up time and greater test integrity at each production station. The precision color display simplifies the separation of measurement information while providing a pleasant display for the technician.

Increase Absolute Power Measurement Accuracy

For near power meter measurement accuracy, configure a system that includes the 8757D Option 002 and the 85037 series precision detectors. Option 002 on the 8757D adds an internal power calibrator used to characterize the 85037 series detectors' accuracy versus power. In addition, each 85037 series precision detector incorporates a dual-diode detector to improve power measurement accuracy when harmonics are present, plus internal frequency correction factors, read by the 8757D, for more accurate power versus frequency measurements. The result is a system optimized for swept absolute power measurements.

Feature	8757D		
Display	Color		
Display channels	4		
Detector inputs	3 standard 4 with Option 001		
Dynamic range	75 dB		
AC/DC detection mode	Yes		
Measurement points:			
Selectable values	101, 201, 401, 801, 1601		
Channels displayed	3 or 4	2	1
Max. points per channel	401	801	1601
Plotter/printer buffer	Yes		
Noise figure display capability*	Yes		
External disk save/recall	Yes		
Internal save/recall registers	9		
Limit testing (channels 1 and 2)	Yes		
Adaptive normalization	Yes		
Cursor search functions	Max., Min., bandwidth, n dB		
SWR display mode	Yes		
Non-standard sweep mode	Yes		
Auxiliary voltage display mode	Yes		
Optional power calibrator	Yes		
Compatible with 85037			
series precision detectors	Yes		

*Product Note 8970 B/S-4, Agilent Literature 5959-8742

Size: 178 mm H x 425 m W x 445 mm D (7 in x 16.75 in x 17.5 in)
Weight: 22 kg (48 lb) net; 28 kg (61.5 lb) shipping

Transit Cases

Agilent offers a complete line of sturdy transit cases in Valise and Tote styles. The cases protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2650 (standard) or model 9211-7521 (tote) fit the 8757D/E.

85037A
85037B
85025A
85025B
85025D
85025E

85037 Series Precision Detectors (ac/dc)

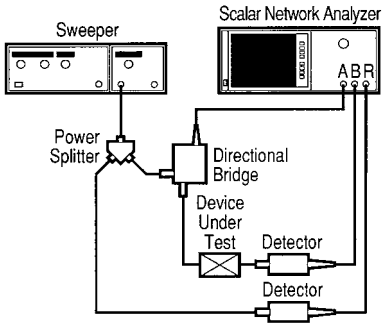
The 85037 series precision detectors are designed specifically for operation with the 8757D scalar network analyzer and may be used in either ac or dc detection modes. These dual diode detectors contain internal frequency correction factors in an internal EE PROM (read automatically by the 8757D) for improved measurement accuracy versus frequency. When used in conjunction with the 8757D's internal power calibrator (Option 002), these detectors provide the maximum absolute power measurement accuracy. The 85037 series detector is not compatible with the 8757E.

Absolute Power Measurement Uncertainty Examples
Assumptions:
- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Measured power = 0 dBm

Uncertainty Component	85037B Detector	85025E Detector
Absolute power accuracy at 50 MHz (±dB)	0.11	0.40
Frequency response (±dB)	0.18	0.50
Mismatch (±dB)	0.18	0.10
Uncertainty Total (±dB)	0.47	1.00

Reflection Measurement Accuracy

Uncertainties due to calibration error and the frequency response of the source, detectors, and bridges are removed via open/short averaging. The remaining uncertainties are primarily the sum of directivity uncertainty, effective source match uncertainty and dynamic power accuracy. See Technical Data Sheet for further information.



Basic scalar coaxial system configured for ratio reflection and transmission measurements.

Precision Detector Summary, 85037 Series For use with the 8757D in either ac or dc detection modes

3

Model	Frequency Range	Connector Type	Dynamic Range	Frequency	Return Loss	Frequency Response	Power (at 50 MHz)	Dynamic Accuracy[4]	Absolute Accuracy[5]
85037A[1]	10 MHz to 18 GHz	Type-N (m) 7 mm[2]	ac mode +20 to –55 dBm dc mode +20 to –50 dBm	0.01 to 0.04 GHz 0.04 to 18.0 GHz	10 dB 20 dB	±0.35 dB ±0.18 dB	20 dBm 10 dBm –30 dBm –50 dBm	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB
85037B[1]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +20 to –55 dBm dc mode +20 to –50 dBm	0.01 to 0.04 GHz 0.04 to 18.0 GHz 18 to 26.5 GHz	10 dB 20 dB 18 dB	±0.35 dB ±0.18 dB ±0.22 dB	20 dBm 10 dBm –30 dBm –50 dBm	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB

85025 and 85026 Series Detectors (ac/dc)

The 85025 and 85026 series detectors are designed specifically for operation with the 8757 scalar network analyzer. The 85025/26 detectors detect either a modulated (ac) or an unmodulated (dc) microwave signal.

85025C Detector Adapters

The 85025C adapter matches the scalar analyzer display to most standard crystal, silicon and gallium arsenide detectors. This enables the user to operate up to 110 GHz with the 8757. The 85025C detector adapter is designed for use with the 8757 only, and can operate in either ac or dc detection modes.

Coaxial Detector Summary, 85025 Series For use with the 8757 only in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Frequency	Return Loss	Frequency Response	Power (at 50 Mhz)	Dynamic Accuracy[4]	Absolute Accuracy[5]
85025A[3]	10 MHz to 18 GHz	Type-N (m) 7 mm[2]	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz	10 dB 20 dB 17 dB	±0.8 dB ±0.5 dB ±0.5 dB	16 dBm 6 dBm –35 dBm –50 dBm	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB
85025B[3]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz 18 to 26.5 GHz	10 dB 20 dB 17 dB 12 dB	±0.8 dB ±0.5 dB ±0.5 dB ±2.0 dB	16 dBm 6 dBm –35 dBm –50 dBm	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB
85025D[3]	10 MHz to 50 GHz	2.4 mm (m)	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.1 GHz 0.1 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	10 dB 20 dB 20 dB 15 dB 9 dB	±0.8 dB ±0.5 dB ±1.0 dB ±2.5 dB ±3.0 dB	16 dBm 6 dBm –35 dBm –50 dBm	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB
85025E[3]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.1 GHz 0.1 to 18 GHz 18 to 25 GHz 25 to 26.5 GHz	10 dB 25 dB 25 dB 23 dB	±0.8 dB ±0.5 dB ±0.5 dB ±1.4 dB	16 dBm 6 dBm –35 dBm –50 dBm	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB

[1] The 85037A/B specifications are applicable when used with the 8757D scalar network analyzer. The absolute power accuracy and dynamic power accuracy specifications apply after a calibration via the 8757D Option 002's internal power calibrator.
[2] Option 001 changes to a 7-mm connector.
[3] The 85025 and 85026 series detectors and the 85025C detector adapter require 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the 11614A firmware enhancement.
[4] Dynamic accuracy refers to measurement accuracy as power varies (in dB) from a 0 dBm reference. 25° ± 5°C, 50 MHz.
[5] DC mode, 25° ± 5°C.

Waveguide Detectors and Detector Adapters Summary For use with the Agilent 8757 only in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Return Loss	Frequency Response	Dynamic Accuracy
R85026A[1]	26.5 to 40 GHz	WR-28	+10 to –50 dBm (ac mode) +10 to –45 dBm (dc mode)	12 dB	±1.5 dB	±(0.3 dB + 0.03 dB/dB)
Q85026A[1]	33 to 50 GHz	WR-22	+10 to –50 dBm (ac mode) +10 to –45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
U85026A	40 to 60 GHz	WR-19	+10 to –50 dBm (ac mode) +10 to –45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
85025C Option K57[3]	50 to 75 GHz	WR-15	+10 to –45 dBm (typical)	9.5 dB (typical)	—	—
85025C Option K71[3]	75 to 110 GHz	WR-10	+10 to –45 dBm (typical)	9.5 dB (typical)	—	—
85025C[1]	[2]	SMA (m)	[2]	[2]	[2]	[2]

[1] The 85025 and 85026 series detectors and the 85025C detector adapter require 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the 11614A firmware enhancement.

[2] Depends upon the particular detector being used.

[3] Must be used with the 85025C detector adapter.

85027 Series Directional Bridges (ac/dc)

The 85027 series directional bridges are designed to operate with either the 8757 in ac or dc detection modes. These bridges offer high directivity, excellent test port match, and a measurement range of up to 50 GHz in coax.

8757D Option 002 Power Calibrator

The 8757D's internal power calibrator provides a 50 MHz reference standard for characterizing the absolute power accuracy and dynamic power accuracy of the 85037 series precision detectors.

Frequency: 50 MHz ± 0.2 MHz
Accuracy at 0 dBm: ±0.05 dB
Linearity: (over any 10 dB range)
±0.08 dB (+20 to +10 dBm)
±0.04 (+10 to –30 dBm)
±0.06 (–30 to –50 dBm)

Directional Bridge Summary For use with the Agilent 8757 in ac or dc detection mode

Model	Frequency Range	Nominal Impedance	Connector – Input	Connector – Test Port	Frequency	Directivity (dB)	Frequency	Test Port Match (SWR)
85027A	10 MHz to 18 GHz	50 Ω	Type-N (f)	7 mm	0.01 to 18 GHz	40 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027B	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (f)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78
85027C	10 MHz to 18 GHz	50 Ω	Type-N (f)	Type-N (f)	0.01 to 12.4 GHz 12.4 to 18 GHz	36 dB 34 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027D	10 MHz to 50 GHz	50 Ω	2.4 mm (f)	2.4 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	36 dB 32 dB 30 dB 25 dB	0.01 to 16 GHz 16 to 30 GHz 30 to 40 GHz 40 to 50 GHz	<1.18 <1.27 <1.57 typically <2.00
85027E	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78

System Accuracy

Transmission Loss or Gain Measurement Accuracy

Transmission loss or gain measurements are made relative to a 0 dB reference point established at calibration. Transmission measurement uncertainty = dynamic power accuracy + mismatch uncertainty.

Dynamic power accuracy is the measurement uncertainty due to the change in power level between calibration and the measurement. Mismatch uncertainty is the uncertainty due to reflections in the measurement setup. The frequency response errors of the source, detectors, bridge and power splitter are removed via calibration.

Transmission Measurement Uncertainty Examples

Assumptions:
- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Change in power after calibration <30 dB (+0 to –30 dBm range)

Uncertainty Component	85037B Precision Detector	85025E Detector
Dynamic accuracy (±dB)	0.11	0.40
Mismatch (±dB)	0.45	0.33
Uncertainty Total (±dB)	0.56	0.73

11679A
11679B
85022A
8757D
11636A
11636B
11852B
11667A
11667B
11667C

11679A

85022A

11667A

11667C

11679A/B Extension Cables

Function

These cables extend the distance between the scalar network analyzer and the detector or bridge to a maximum of 200 feet without degradation of performance.

11679A: 7.6 m (25 ft) extension cable
11679B: 61 m (200 ft) extension cable

85022A System Cable Kit

The 85022A contains all the BNC and GPIB cables to connect an Agilent sweep oscillator (8360 series, 83750, or 83751 synthesized sweepers), an HP computer and a printer to the 8757. This kit contains three one-meter GPIB cables (10833A), three two-foot BNC (m-m) cables (11170B) and one four-foot BNC (m-m) cable (11170C).

BNC Impedance: 50 Ω
Weight: Net, 0.5 kg (1.2 lb); shipping, 1.2 kg (2.9 lb)

11636A/B Power Dividers

The 11636A/B power dividers/combiners are recommended when making wideband comparison measurements without ratioing.

11613B Calibrator

The 11613B is a dedicated transfer standard for calibration of the 8757D/E scalar network analyzers. The 11613B provides a standard, a 27.778 kHz source and a series of precision attenuators. The calibrator includes software that verifies (and adjusts if necessary) the internal calibration parameters stored in the nonvolatile memory of the analyzer.

An HP Series 200 or 300 computer is required for operation. The computer must have BASIC 2.0 or greater and 512 K bytes of RAM. For use with the 8756A Scalar Analyzer, the computer also requires the HP 98622A 16-bit GPIO card.

11852B 50 Ω/75 Ω Minimum-Loss Pad

The 11852B is a low SWR minimum-loss pad required between 75 Ω devices and 50 Ω sources and detectors.

11667A/B/C Power Splitters

The 11667A/B/C power splitters are recommended when making wideband ratio measurements using the 8757 scalar network analyzer. These two-resistor type splitters provide excellent output SWR at the auxiliary arm when used for source leveling or ratio measurement applications. The tracking between output arms over a frequency range from dc to 50 GHz allows wideband measurements to be made with a minimum of uncertainty.

Frequency Range
- **11667A:** DC to 18 GHz
- **11667B:** DC to 26.5 GHz
- **11667C:** DC to 50 GHz

Impedance: 50 Ω nominal
Insertion Loss
- **11667A/B:** 6 dB nominal
- **11667C:** 8.5 dB nominal

Max. Input Power: +27 dBm
Connectors
- **11667A:** N-female on all ports
- **11667B:** 3.5-mm female on all ports
- **11667C:** 2.4-mm female on all ports

8757D Upgrade Kits

Increase your analyzer's measurement capability and performance with an 8757 upgrade kit.

The 86383C upgrade kit allows you to add the fourth detector input to your 8757D (86383C-001) and/or the internal power calibrator (86383C-002). Installation is not included with this kit.

Key Literature

8757D Scalar Network Analyzer Technical Data, p/n 5091-2471E
8757D Scalar Network Analyzer Configuration Guide, p/n 5967-6177E

The 8757 scalar network analyzer is ordered with multiple line items to give you maximum flexibility in specifying a system that meets your needs. Consult your local Agilent Technologies sales office if you would like assistance.

Ordering Information

Analyzer
8757D Scalar Network Analyzer
- **8757D-001** Fourth Detector Input
- **8757D-002** Internal Power Calibrator
- **8757D-W30** Two-Year Extended Service
- **8757D-1BN** MIL-STD-45662A Calibration Certificate
- **8757D-1BP** MIL-STD-45662A Calibration with Test Data
- **8757D-UK6** Commercial Calibration Certificate w/data

Sweepers
Choose the PSG synthesized signal generators for applications from 10 MHz to 110 GHz

Precision Detectors
85037A 0.01 to 18 GHz, Type-N(m)
- **85037A-001** 7-mm Connector

85037B 0.01 to 26.5 GHz, 3.5 mm(m)

Directional Bridges
85027A 0.01 to 18 GHz, 7 mm, 50 Ω
85027B 0.01 to 26.5 GHz, 3.5 mm (f), 50 Ω
85027C 0.01 to 18 GHz, Type-N (f), 50 Ω
85027D 0.01 to 50 GHz, 2.4 mm (m), 50 Ω
85027E 0.01 to 26.5 GHz, 3.5 mm (m), 50 Ω

Detectors
85025A 0.01 to 18 GHz, Type-N (m)
- **85025A-001** 7-mm Connector

85025B 0.01 to 26.5 GHz, 3.5 mm (m)
85025D 0.01 to 50 GHz, 2.4 mm (m)
85025E 0.01 to 26.5 GHz, 3.5 mm (m)
R85026A 26.5 to 40 GHz, WR-28 Waveguide
Q85026A 33 to 50 GHz, WR-22 Waveguide
U85026A 40 to 60 GHz, WR-19 Waveguide
85025C Detector Adapter

System Cable Kit
85022A System Cable Kit

Optional Accessories
(For ratio and/or modulation measurements)
11636A Power Divider dc to 18 GHz
11636B Power Divider dc to 26.5 GHz
11667A Power Splitter dc to 18 GHz
- **11667A-001** N-male on Input Port; N-female on Output Ports
- **11667A-002** N-female on Input Port; 7 mm on Output Ports

11667B Power Splitter dc to 26.5 GHz
11667C Power Splitter dc to 50 GHz
11679A Detector Extension Cable, 7.6 m (25 ft)
11679B Detector Extension Cable, 61 m (200 ft)
11852B 50 to 75 Ω Minimum Loss Pad

Upgrade Kits
86383C Upgrade Kit for 8757D
- **86383C-001** Adds Fourth Detector Input
- **86383C-002** Adds Internal Power Calibrator

Transit Cases
9211-2650 Standard Transit Case
9211-7521 Tote-Style Transit Case

For information on compatible printers, visit our web site:
www.agilent.com/find/pcg

PNA Series Multiport Network Analysis Solutions

N4420B
N4421B
N4421BH67
Z5623AK64
Z5623AK44
Z5623AK66
U3042AE08
U3022AE10
U3025AE10
U3042AE12

- **Full crossbar matrix available at 4-, 6-, 8-, 12-, and 16-ports**
- **Internal couplers enable the highest accuracy for your multiport systems**
- **Option 550 adds 4-port calibration to 2-port PNA/PNA-L/PNA-X**
- **Option 551 adds full-port calibration to 2- or 4-port PNA/PNA-L/PNA-X**
- **Control your DUT during testing with test set control lines**

4-port PNA-L network analyzer with Z5623AK44 multiport test set

Agilent Multiport Test Sets Extend Network Analysis Capabilities to a Greater Number of Test Ports, Increase Throughput, and Enable the Best Accuracy for your Multiport Applications

Many of today's wireless communications and broadband components have three, four or even more ports. These components require multiple connections for complete characterization with a two-port network analyzer. However, time-to-market pressures require these multiport components to be tested quickly while maintaining high levels of accuracy and high repeatability to achieve the desired production volumes. Multiport test sets used in conjunction with standard network analyzers dramatically reduce overall tune and test times because the DUT only needs to be connected once to test multiple signal paths. Minimizing the number of connections also reduces operator fatigue, and lowers the chance of connection to the wrong port. In addition, fewer connections mean less wear on cables, connectors, fixtures and DUTs. A multiport test set is especially valuable in manufacturing applications where the time required for device connection, handling, and/or configuration is significantly greater than the test time.

Agilent provides high-performance multiport test solutions to meet the demands of the never-ending trend to decrease size through integration of modules, and the pressure to increase throughput and lower test cost. A variety of solutions are available for testing devices ranging from integrated front-end modules to base station combiner/divider units to satellite manifolds. These solutions combine hardware, firmware, and sometimes software, plus electronic calibration, to provide high accuracy and fast measurement speeds. For more information, contact your local Agilent Field Engineer or visit **www.agilent.com/find/multiport**

Key Literature

Test Solutions for Multiport and Balanced Devices Selection Guide, p/n 5988-2461EN

Test Set	Number of Ports[1]	Frequency Range	Recommended Network Analyzer	Features
N4420B	4	10 MHz to 40 GHz	PNA E8363B opt 014/550 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
N4421B	4	10 MHz to 50 GHz	PNA E8364B opt 014/550 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
N4421BH67	4	10 MHz to 67 GHz	PNA E8361A opt 014/550 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
Z5623AK64	4, 6	10 MHz to 20 GHz	PNA E8362B opt 014/550 PNA-L N5230A opt 225/550, opt 245/551 PNA-X N5242A opt 200/550, 400/551	– Solid-state switches for fast and repeatable measurements – High power capability on test set ports, up to +38 dBm
Z5623AK44	8	10 MHz to 20 GHz	PNA-L N5230A opt 245/551 PNA-X N5242A opt 400/551	– Solid-state switches for fast and repeatable measurements – AUX inputs to add signal conditioning or connect to external instruments
Z5623AK66	14	10 MHz to 20 GHz	PNA-L N5230A opt 245/551	– Dual 9-port full crossbar with solid-state switches – Front-end mechanical switches expand number of test ports with minimum insertion loss
U3042AE08	12	10 MHz to 20 GHz	PNA-L N5230A opt 245/551 PNA-X N5242A opt 400/551 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
U3022AE10	12	10 MHz to 20 GHz	PNA E8362B opt 014/551 PNA-L N5230A opt 225/551 N1930B PLTS signal integrity software	– Mechanical switches for high accuracy and stability – N1930B adds eye diagrams, RLCG model extraction and advanced data display
U3025AE10	12	10 MHz to 50 GHz	PNA E8364B opt 014/551 PNA-L N5230A opt 525/551 N1930B PLTS signal integrity software	– Mechanical switches for high accuracy and stability – N1930B adds eye diagrams, RLCG model extraction and advanced data display
U3042AE12	16	10 MHz to 20 GHz	PNA-L N5230A opt 245/551 PNA-X N5242A opt 400/551 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display

[1] Includes analyzer and test set ports.

Calibration Kits

Error-correction procedures require that the systematic errors in the measurement system be characterized by measuring known devices (standards) on the system over the frequency range of interest. Agilent Technologies offers two types of calibration kits: mechanical and electronic. For further information about these products, please refer to the following web site **www.agilent.com/find/accessories** or **www.agilent.com/find/nacal**

Mechanical Calibration Kits

All network analyzer, coaxial mechanical calibration kits contain standards to characterize systematic errors. Many mechanical calibration kits also contains adapters for test ports and a torque wrench for proper connection. Mechanical calibration kits are divided into three categories: economy, standard, and precision. Economy kits include a fixed load. Standard kits include a sliding load or a series of offset shorts. Precision kits contain TRL devices.

Electronic Calibration (ECal) Modules

Electronic calibration (ECal) is a precision, single-connection, 1-, 2-, or 4-port calibration technique that uses fully traceable and verifiable electronic calibration modules. ECal provides repeatable, accurate measurements while bringing convenience and simplicity to your daily calibration routine. ECal replaces the traditional calibration technique that uses mechanical standards. With mechanical standards, you are required to make numerous connections to the test ports for a single calibration. These traditional calibrations require intensive operator interaction, which is prone to errors. ECal modules consist of a connector-specific calibration standard. Modules are available with 3.5 mm, 7 mm, Type-N, Type-F, 2.92 mm, 2.4 mm, 1.85 mm and 7-16 connectors. Options exist for 2-port modules with one male and one female connector (MOF), two male (00M) or two female (00F) connectors. Four-port ECal modules support both mixed-sex and mixed-connector-type configurations. In addition to the standard factory characterizations of these connector configurations, users can characterize their ECal modules with adapters on the test ports. The resulting user-characterization data can then be saved into user memories within the ECal modules. The adapters can serve as "connector savers" or be used to change connector type or connector sex, giving maximum calibration flexibility. The user-characterization feature can also bring the convenience of ECal to fixture and wafer-probe environments.

The PNA and ENA Series of network analyzers can control ECal modules directly using a USB connection. 8753 and 8720 network analyzers control ECal modules via the 85097B VNA interface kit. For more information, refer to the ECal Product Overview (literature number 5963-3743E).

PC Interface Module with Control Software

The 85097B consists of a VNA interface module, and power supply. The interface module is the interface between the parallel port on your 8753 or 8720 network analyzer, the ECal module, and the external power supply. The 85097B interfaces with the 8753E/ET/ES, the 8719D/ET/ES, the 8720D/ET/ES and the 8722D/ET/ES network analyzers.

Mechanical Verification Kits

Measuring known devices, other than the calibration standards, is a way of verifying that the network analyzer system is operating properly. Agilent offers verification kits that include precision airlines, mismatch airlines, and precision fixed attenuators. Traceable measurement data, on disk, is shipped with each kit. Verification kits may be recertified by Agilent Technologies. This recertification includes a new measurement of all standards and new data with uncertainties.

Coaxial Mechanical Calibration Kits

Legend: O = open S = short L = load SL = sliding load TRL = TRL adapter

Device Connector Type	Frequency Upper Limit[1]	Included	Available Options	Model
Type-F (75 ohm)	3 GHz	O, S, L (m) and (f), adapters	00M, 00F	**85039B**
Type-N (75 ohm)	3 GHz	O, S, L (m)		**85036E**
Type-N (75 ohm)	3 GHz	O, S, L (m) and (f), adapters		**85036B**
Type-N (50 ohm)	6 GHz	O, S, L (m)		**85032E**
Type-N (50 ohm)	9 GHz	O, S, L (m) and (f)	100, 200, 300, 500	**85032F**
Type-N (50 ohm)	18 GHz	O, S, L, SL (m) and (f), adapters		**85054B**
Type-N (50 ohm)	18 GHz	O, S, L (m) and (f), adapters		**85054D**
7-16	7.5 GHz	O, S, L (m) and (f), adapters		**85038A**
7 mm	6 GHz	O, S, L		**85031B**
7 mm	18 GHz	O, S, L		**85050D**
7 mm	18 GHz	O, S, L, SL		**85050B**
7 mm	18 GHz	O, S, L, TRL		**85050C**
3.5 mm	9 GHz	O, S, L (m) and (f)	100, 200, 300, 400, 500	**85033E**
3.5 mm	26.5 GHz	O, S, L (m) and (f), adapters		**85052D**
3.5 mm	26.5 GHz	O, S, L, SL (m) and (f), adapters		**85052B**
3.5 mm	26.5 GHz	O, S, L (m) and (f), TRL adapters		**85052C**
2.92 mm	50 GHz	O, S, L, SL (m) and (f), adapters	001*	**85056K**
2.4 mm	50 GHz	O, S, L (m) and (f), adapters	001*	**85056D**
2.4 mm	50 GHz	O, S, L, SL (m) and (f), adapters	001*	**85056A**
1.85 mm	67 GHz	Offset, S, L (m) and (f), adapters		**85058B**
1.85 mm	67 GHz	O, S, L (m) and (f), adapters		**85058E**
1 mm	110 GHz	O, S, L (m) and (f), adapters		**85059A**

[1] All coaxial calibration kits are specified from DC to their upper frequency limit.

Waveguide Mechanical Calibration Kits

Device Connector Type	Frequency Range (GHz)	Type	Model
WR-90	8.2 to 12.4	Precision	**X11644A**
WR-62	12.4 to 18	Precision	**P11644A**
WR-42	18 to 26.5	Precision	**K11644A**
WR-28	26.5 to 40	Precision	**R11644A**
WR-22	33 to 50	Precision	**Q11644A**
WR-19	40 to 60	Precision	**U11644A**
WR-15	50 to 75	Precision	**V11644A**
WR-10	75 to 110	Precision	**W11644A**

Electronic Calibration Modules (ECal)

Device Connector Type	Frequency Range	Available Options	Model
Type-F (75 ohm)[1]	300 kHz to 3 GHz	00A, 00F, 00M, MOF, UK6	**85099C**
Type-N (75 ohm)[1]	300 kHz to 3 GHz	00A, 00F, 00M, MOF, UK6	**85096C**
Type-N (50 ohm)[1]	300 kHz to 9 GHz	00A, 00F, 00M, MOF, UK6	**85092C**
Type-N (50 ohm)	300 kHz to 18 GHz	00A, 00F, 00M, MOF, UK6	**N4690B**
7-16[1]	300 kHz to 7.5 GHz	00A, 00F, 00M, MOF, UK6	**85098C**
7 mm[1]	300 kHz to 9 GHz		**85091C**
7 mm	300 kHz to 18 GHz		**N4696B**
3.5 mm[1]	30 kHz to 9 GHz	00A, 00F, 00M, MOF, UK6	**85093C**
3.5 mm	300 kHz to 26.5 GHz	00A, 00F, 00M, MOF, UK6	**N4691B**
PC Interface Kit[2]	N/A	N/A	**85097B**
2.92 mm	10 MHz to 40 GHz	00A, 00F, 00M, MOF, UK6	**N4692A**
2.4 mm	10 MHz to 50 GHz	00A, 00F, 00M, MOF, UK6	**N4693A**
1.85 mm	10 MHz to 67 GHz	00A, 00F, 00M, MOF, UK6	**N4694A**
3.5 mm, Type-N 50 ohm, 7-16 (4-port)	300 kHz to 13.5 GHz	010, 020, UK6	**N4431B**
3.5 mm, Type-N 50 ohm, (4-port)	300 kHz to 18 GHz	020, 030, UK6	**N4432A**
3.5 mm (4-port)	300 kHz to 20 GHz	010, UK6	**N4433A**

[1] Modules have both USB and parallel connectors. A USB cable is supplied with the module.
[2] The VNA Interface Unit is connected to the ECal module(s) via another parallel cable. The VNA Interface kit is not needed with the PNA and PNA-L Series network analyzers. These analyzers control the modules directly.

Mechanical Verification Kits

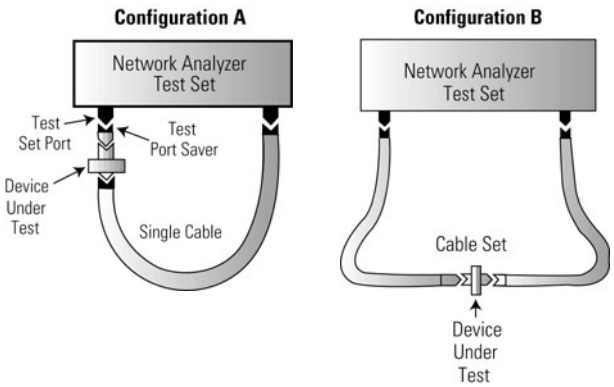
Device Connector Type	Frequency Range (GHz)	Type	Available Options	Compatible Network Analyzers	Model
Type-N	30 kHz to 18	Precision		8719, 8720, 8510, PNA	**85055A**
7 mm	DC to 6	Precision	001**	8753	**85029B**
7 mm	0.045 to 18	Precision		8719, 8720, 8510, PNA	**85051B**
3.5 mm	30 kHz to 26.5	Precision		8719, 8720, 8510, PNA	**85053B**
2.4 mm	0.045 to 50	Precision		8722, 8510, PNA	**85057B**
1.85 mm	0.010 to 67 Hz	Precision		8510, PNA	**85058V**
WR-28	26.5 to 40	Precision		8510, 85106, PNA	**R11645A**
WR-22	33 to 50	Precision		8510, 85106, PNA	**Q11645A**
WR-19	40 to 60	Precision		8510, PNA	**U11645A**
WR-15	50 to 75	Precision		8510, 85106, PNA	**V11645A**
WR-10	75 to 110	Precision		8510, 85106	**W11645A**

Options apply to mechanical calibration, ECal, and verification kits

Option 001* Adds 2.4 mm sliding load and 2.4 mm gauges
Option 001** Adds data for 8702 lightwave component analyzer
Option 00A Adds male to male and female to female adapters
Option MOF ECal module with one male and one female connector
Option OOF ECal module with two female connectors
Option OOM ECal module with two male connectors
Option 100 Adds female to female adapter
Option 200 Adds male to male adapter
Option 300 Adds male to female adapter
Option 400 Adds series of 3.5 mm to Type-N adapters
Option 500 Adds series of 3.5 mm (or Type-N) to 7 mm adapters
UK6 Commercial calibration with measured data
010 Four female, 3.5 mm connectors
020 Four female, Type-N 50 ohm connectors
030 Four 7 mm connectors

Cables

Test port cables provide the connection required when using network analyzers with various test devices and equipment. Test port cables are available for two test configurations as shown below. Configuration A utilizes a single test port cable for use when the device under test (DUT) is connected directly to the port on the test set. Configuration B utilizes two test port cables; which provides more flexibility since the DUT is connected between the test port cables.



In order to select a cable, find the table below that corresponds to the connector type of your network analyzer. Then, search that table for your device's connector type. If the device's connector type is not present in the table, an adapter needs to be selected to mate the test port cable to your device. Adapters may be provided in a calibration kit, or ordered separately. A full detailed list of calibration kit contents is available from the web site: **www.agilent.com/find/naaccessories**

50-ohm, Type-N Test Set Ports

Device Connector Type	Cable Connector Description	Model
Type-N	Type-N (m) to Type-N (m), 24 in (61 cm)	**N6314A**
Type-N	Type-N (m) to Type-N (f)	**N6315A**

75-ohm, Type-N Test Set Ports

Device Connector Type	Cable Connector Description	Model
Type-N	75 ohm, Type-N (m) to Type-N (m) 75 ohm, Type-N (m) to Type-N (f)	**11857B**
Type-F	75 ohm, Type-N (m) to Type-F (m) 75 ohm, Type-N (m) to Type-F (f)	**11857F**

7-mm Test Set Ports

Device Connector Type	Cable Connector Description	Model
7 mm	7 mm to 7 mm, qty 2	**11857D**

3.5-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
7 mm	Semi-rigid	3.5 mm (f) NMD to 7 mm 7 mm adapter set	**85132C** **85130B**
7 mm	Semi-rigid	3.5 mm (f) NMD to 7 mm 3.5 mm (f) NMD to 7 mm	**85132D**
7 mm	Flexible	3.5 mm (f) NMD to 7 mm 7 mm adapter set	**85132E** **85130B**
7 mm	Flexible	3.5 mm (f) NMD to 7 mm 3.5 mm (f) NMD to 7 mm	**85132F**
3.5 mm	Semi-rigid	3.5mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	**85131C** **85130D**
3.5 mm	Semi-rigid	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm (f) NMD to 3.5 mm (m)	**85131D**
3.5 mm	Flexible	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	**85131E** **85130D**
3.5 mm	Flexible	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm (f) NMD to 3.5 mm (m)	**85131F**
Type-N	NMD to 7 mm	Use with 7 mm to Type N adapters Type N adapter set	**85130C**

NMD is a connector type designed to mate only with the 8510, 8720 and PNA series network analyzer test ports.

2.4-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
7 mm	Semi-rigid	2.4 mm (f) NMD to 7 mm 7 mm adapter set	**85135C** **85130E**
7 mm	Semi-rigid	2.4 mm (f) NMD to 7 mm 2.4 mm (f) NMD to 7 mm	**85135D**
7 mm	Flexible	2.4 mm (f) NMD to 7 mm 7 mm adapter set	**85135E** **85130E**
7 mm	Flexible	2.4 mm (f) NMD to 7 mm 2.4 mm (f) NMD to 7 mm	**85135F**
3.5 mm	Semi-rigid	2.4 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	**85134C** **85130F**
3.5 mm	Semi-rigid	2.4 mm (f) NMD to 3.5 mm (f) 2.4 mm (f) NMD to 3.5 mm (m)	**85134D**
3.5 mm	Flexible	2.4 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	**85134E** **85130F**
3.5 mm	Flexible	2.4 mm (f) NMD to 3.5 mm (f) 2.4 mm (f) NMD to 3.5 mm (m)	**85134F**
2.4 mm	Semi-rigid	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm adapter set	**85133C** **85130G**
2.4 mm	Semi-rigid	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm (f) NMD to 2.4 mm (m)	**85133D**
2.4 mm	Flexible	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm adapter set	**85133E** **85130G**
2.4 mm	Flexible	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm (f) NMD to 2.4 mm (m)	**85133F**

NMD is a connector type designed to mate only with the 8510, 8720 and PNA series network analyzer test ports.

1.85-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
1.85 mm	Flexible	1.85 mm (f) to 1.85 mm (f) 1.85 mm adapter set	**N4697C** **85130H**
1.85 mm	Flexible	1.85 mm (f) to 1.85 mm (f) 1.85 mm (f) to 1.85 mm (m)	**N4697F**

1.0-mm Test Set Ports

Device Connector Type	Cable Connector Description	Model
1.0 mm	1.0 mm (f) to 1.0 mm (f)	**11500I**
1.0 mm	1.0 mm (f) to 1.0 mm (m), 16 cm	**11500J**
1.0 mm	1.0 mm (f) to 1.0 mm (m), 20 cm	**11500K**
1.0 mm	1.0 mm (f) to 1.0 mm (m), 24 cm	**11500L**

Network Analyzer Accessories

11930A/B Power Limiters

The 11930A/B limiters protect the input circuits of network analyzers, spectrum analyzers, and sources from transients and short-duration overloads.

86205A/86207A

85024A

86205A/86207A RF Bridges

The 86205A/86207A high directivity RF bridges offer unparalleled performance in a variety of general-purpose applications. They are ideal for accurate reflection measurements and signal leveling applications.

85024A High-Frequency Probe

The 85024A high-frequency probe makes it easy to perform in-circuit measurements. An input capacitance of only 0.7 pF shunted by 1 MΩ of resistance permits high-frequency probing without adversely loading the circuit-under-test. Excellent frequency response and unity gain guarantee high accuracy in swept measurements with this probe. High probe sensitivity and low distortion levels allow measurements to be made while taking advantage of the full dynamic range of RF analyzers. RF network analyzers such as the 8753ET/ES, 8753E, 3577A, and 4195A are directly compatible. Additionally, the 8560, 8590E, and ESA series signal analyzers are also compatible. You can use the 1122A probe power supply or any dual ±15 V, 130 mA supply.

11852B 50 ohm/75 ohm Minimum Loss Pad

The 11852B is a low SWR minimum loss pad used to transform 50-ohm port impedance to 75-ohm or 75-ohm to 50-ohm.

Type-N Accessory Kits

Each kit contains a Type-N (female) short, a Type-N (male) short, two Type-N (male) barrels, two Type-N (female) barrels, and a storage case.

11853A 50-ohm Type-N Accessory Kit

Accessory kit furnishes components for measurement of devices with 50-ohm Type-N connectors.

11855A 75-ohm Type-N Accessory Kit

Accessory kit furnishes components for measurement of devices with 75-ohm Type-N connectors. This kit also contains a 75-ohm Type-N (male) termination.

11878A Type-N/3.5 mm Adapter Kit

Adapter kit contains: 3.5 (f) to Type-N (M), 3.5 (m) to Type-N (m), 3.5 (f) to Type-N (f), and 3.5 (m) to Type-N (f).

BNC Accessory Kits

The BNC accessory kit contains two Type-N (male) to BNC (female) adapters, two Type-N (male) to BNC (male) adapters, two Type-N (female) to BNC (female) adapters, two Type-N (female) to BNC (male) adapters, a BNC (male) short, and a storage case.

11854A 50-ohm BNC Accessory Kit

Accessory kit furnishes components for measurement of devices with 50-ohm BNC connectors.

11856A 75-ohm BNC Accessory Kit

Accessory kit furnishes components for measurement of devices with 75-ohm BNC connectors. This kit also contains a 75-ohm BNC (male) termination.

7-16 Adapter Kits

The 11906 family adapter kits.

11906A 7-16 to 7-16 Adapter Kit

Adapter Kit Contains:	Quantity
7-16 male to male adapter	1
7-16 female to female adapter	1
7-16 male to female adapter	2

11906B 7-16 to 50-ohm Type-N Adapter Kit

Adapter Kit Contains:	Quantity
Type-N male to 7-16 male adapter	1
Type-N female to 7-16 female adapter	1
Type-N female to 7-16 male adapter	1
Type-N male to 7-16 female adapter	1

11906C 7-16 to 7-mm Adapter Kit

Adapter Kit Contains:	Quantity
7-mm to 7-16 male adapter	2
7-mm to 7-16 female adapter	2

11906D 7-16 to 3.5-mm Adapter Kit

Adapter Kit Contains:	Quantity
3.5-mm male to 7-16 male adapter	1
3.5-mm female to 7-16 female adapter	1
3.5-mm female to 7-16 male adapter	1
3.5-mm male to 7-16 female adapter	1

1.0 mm Test Port Connectors

Adapters	Connector Type
11920A/B/C[1] adapters	1.0 mm series adapters
11921A/B/C/D[1] adapters	1.0 mm to 1.85 mm series adapters
11922A/B/C/D[1] adapters	1.0 mm to 2.4 mm series adapters
11923A adapters	1.0 mm (f) to circuit card launch
V281C/D[2] adapters	1.0 mm to V-band waveband guide
W281C/D[2] adapters	1.0 mm to W-band waveband guide

[1] Suffix 'A' denotes male-to-male, 'B' denotes female-to-female, 'C' denotes male-to-female and 'D' denotes female-to-male.
[2] Suffix 'C' denotes 1.0 mm female and 'D 'denotes 1.0 mm male.

Ordering Information

11930A/B Power Limiters
86205A/86207A RF Bridges
85024A High-Frequency Probe
11852B 50-ohm/ 75-ohm Minimum Loss Pad

Type-N Accessory Kits
11853A 50-ohm Type-N Accessory Kit
11855A 75-ohm Type-N Accessory Kit
11887A Type-N/3.5 mm Adapter Kit

BNC Accessory Kits
11854A 50-ohm BNC Accessory Kit
11856A 75-ohm BNC Accessory Kit

7-16 Adapter Kits
11906A 7-16 to 7-16 Adapter Kit
11906B 7-16 to 50-ohm Type-N Adapter Kit
11906C 7-16 to 7-mm Adapter Kit
11906D 7-16 to 3.5-mm Adapter Kit

- **Select from a wide range of models to get the measurement capability for your specific application**
- **Configure for individual or team needs**
- **Identify problems quickly with intuitive triggering**
- **Access signals easily and make accurate measurements with reliable probing solutions**

Fast, Accurate Answers Throughout the Design Validation Cycle

Agilent's logic analyzers help minimize your project risk by providing the most reliable, accurate data capture and the most complete view of system behavior. A comprehensive family of products offers a variety of form factors, acquisition speeds, memory depths, channel counts, and application-specific analysis and protocol tools to create a solution that will meet your toughest digital debug needs.

Selection Guide for Logic Analysis Solutions

Product	16800 Series Portable Logic Analyzers	16900 Series Modular Logic Analysis Systems
Form Factor	A fixed configuration with built-in 15" (38.1 cm) color display, touch screen available. Use for single or dual bus analysis. Models available with built-in 48-channel pattern generator	A configurable system with 2 to 6 slots offers the most flexibility and the highest performance for multiple bus analysis. Use with either built-in 15"(38.1 cm) color touch display or external monitor
Timing Speeds	Up to 4 GHz	Up to 4 GHz
State Speeds	Up to 500 Mb/s	Maximum ranges from 250 MHz up to 1.5 Gb/s
Memory Depth	Up to 32 M	Up to 256 M (512 M in half channel)
Channels	34, 68, 102, 136, 204	From 34 up to 9,782
Additional Considerations	Probes and accessories; Wide variety of processor, bus, FPGA and protocol solutions; View Scope for integrated measurements and analysis with Agilent oscilloscopes; Optional application and analysis software packages	

Accessories

1181BZ Testmobile System Cart

Key Literature & Web Link

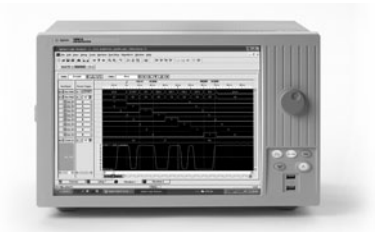
Agilent Technologies 16900 Series Logic Analysis Systems Brochure, p/n 5989-0420EN
Agilent 16900 Series Logic Analysis System Mainframes Data Sheet, p/n 5989-0421EN
Agilent 16800 Series Portable Logic Analyzers Brochure, p/n 5989-5062EN
Agilent 16800 Series Portable Logic Analyzers Data Sheet, p/n 5989-5063EN

www.agilent.com/find/logic
www.agilent.com/find/logicdemos

16901A
16902A

- **Protect your investment by purchasing a system with the capability you need now, then expand as your needs evolve**
- **View cross-domain measurements, correlated in time**
- **Set up measurements easily and navigate through your data quickly with the analyzer's intuitive user interface and touch screen display**
- **Achieve the fastest logic analyzer control and analysis in the industry with Hosted Power Mode. The multi-threading architecture takes full advantage of Gbit LAN and the most current multi-processor, large memory computer technology**
- **Increase your productivity and maximize your analyzer's usage whether you work at your bench or with team members distributed around the world. Use models include offline analysis, remote control and programmability, extended desktop viewing across multiple monitors, and multi-frame configurations**

2 and 6-slot modular logic analysis systems



Large 15" (38.1 cm) color display with touch screen

Get the Performance You Need at a Price to Match Your Budget

The Agilent 16900 Series logic analysis systems provide high-performance, system-level debugging of digital designs. Configure a system for your specific needs with innovative probing, high-performance measurement modules, and post-processing analysis tools.

Accessories

E5861A Multiframe cable. Order 1 less than the number of frames to be connected
16901A-109 External Removable Hard Drive
16902A-109 External Removable Hard Drive
1181BZ Testmobile System Cart

A wide-range of processor, bus and FPGA support
www.agilent.com/find/pnbs
www.agilent.com/find/logic-sw-apps

Key Literature & Web Link

Agilent Technologies 16900 Series Logic Analysis System Brochure, p/n 5989-0420EN
Agilent Technologies 16900 Series Logic Analysis System Mainframes Data Sheet, p/n 5989-0421EN
Agilent Technologies Measurement Modules for the 16900 Series Data Sheet, p/n 5989-0422EN

www.agilent.com/find/16900

Ordering Information

A complete system consists of a logic analyzer mainframe, measurement modules, probes and optional application and analysis software. Refer to pages 181, 182, 185-190 for additional information on measurement modules, probes and optional application and analysis software.

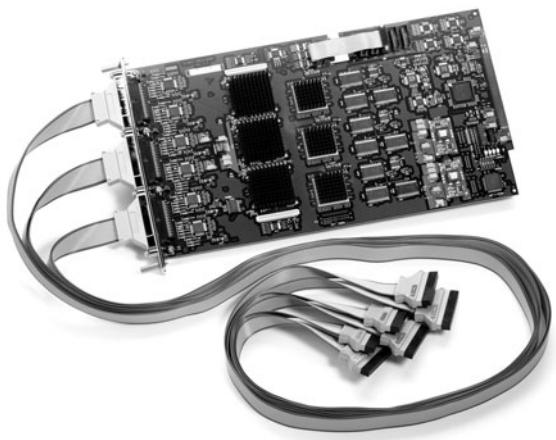
16901A 2-slot Logic Analyzer Mainframe
  16901A-109 External Removable Hard Drive
16902A 6-slot Logic Analyzer Mainframe
  16902A-109 External Removable Hard Drive

Specifications

Product	16902A Logic Analysis System	16901A Logic Analysis System
Module Slots	6	2
PCI Expansion Slots	1 full profile, 1 low profile	1 full profile
Display and Resolution	Built-in 12.1 inch color touch screen, 800 x 600	Built-in 15" (38.1 cm) color touch screen, 1024 x 768
I/O and Storage	2 USB ports (ver 1.1), 10/100 Base-T, parallel port, 80 GB hard drive, external SVGA display port, Trigger In and Trigger Out BNCs	Six USB 2.0 ports, Gbit LAN, parallel port, 80 GB hard drive (external removable hard drive available), external SVGA display port, Trigger In and Trigger Out BNCs
Additional Capabilities	Wide variety of processor, bus and FPGA solutions; View Scope for time-correlated, integrated measurements and analysis with Agilent oscilloscopes; Optional software packages	

16910A
16911A
16950B
16951B
16760A

- **Choose from a wide variety of timing/state analyzers, pattern generator or oscilloscopes**
- **Acquire 4 GHz timing zoom, state analysis up to 1.5 Gb/s, memory depths up to 512 M samples**
- **Sample high-speed synchronous buses accurately and confidently with eye finder**
- **Identify problem signals quickly by viewing eye diagrams across all buses and signals simultaneously with eye scan**
- **Capture either single-ended or differential signals**
- **Upgrade your memory depth and state speed as your needs change**



Configure Custom Measurement Solutions for Demanding Applications

Agilent Technologies offers robust measurement modules for digital analysis as well as target stimulus. Create a custom solution or expand your existing analysis system by selecting one or more timing/state analyzer modules or pattern generator modules to meet your validation needs.

Accessories

16910A and 16911A module cables end with 40-pin cable connectors and are compatible with 40-pin probes. 16950B, 16951B and 16760A module cables end with 90-pin cable connectors and are compatible with 90-pin probes.
www.agilent.com/find/logic_analyzer_probes

A wide range of processor, bus, FPGA and application packages are available.
www.agilent.com/find/pnbs

Key Literature & Web Link

Agilent Technologies Measurement Modules for the 16900 Series, p/n 5989-0422EN
www.agilent.com/find/16900

Ordering Information

16910A and 16911A – Specify desired state speed and memory depth options when ordering
16950B – Specify desired memory depth option when ordering

Upgrades
To increase memory depth or state speed after initial purchase, specify the desired state speed and memory depth options for the following upgrade model numbers:
E5865A for upgrading an existing 16910A
E5866A for upgrading an existing 16911A
E5875A for upgrading an existing 16950B

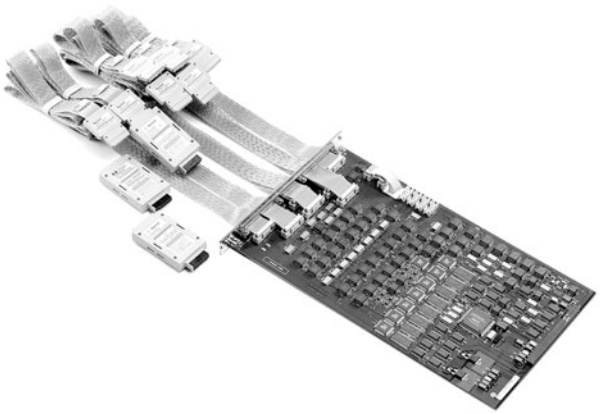
Probes are ordered separately. Choose a probe type that fits your application.
www.agilent.com/find/logic_analyzer_probes

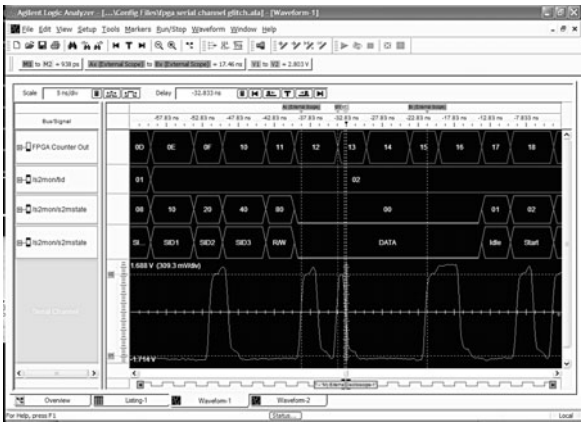
3

Selection Guide for Logic Analyzer Modules

Product	16910A	16911A	16950B	16951B	16760A
Channels per Module	102	68	68	68	34
Max. Channels on a Single Timebase & Trigger	510	340	340	340	170
Memory Depths (Memory depth doubles in half-channel timing)	256 K: Option 256 1 M: Option 001 4 M: Option 004 16 M: Option 016 32 M: Option 032	256 K: Option 256 1 M: Option 001 4 M: Option 004 16 M: Option 016 32 M: Option 032	1 M: Option 001 4 M: Option 004 16 M: Option 016 32 M: Option 032 64 M: Option 064	256 M	64 M
High Speed Timing Rate	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth	—
Max Deep Memory Timing Sample Rate (half/full channel)	1.0 GHz (1.0 ns)/ 500 MHz (2.0 ns)	1.0 GHz (1.0 ns)/ 500 MHz (2.0 ns)	1.2 GHz (833 ps)/ 600 MHz (1.67 ns)	1.2 GHz (833 ps)/ 600 MHz (1.67 ns)	800 MHz (1.25 ns)
Transitional Timing	500 MHz (2.0 ns)	500 MHz (2.0 ns)	600 MHz (1.67 ns)	600 MHz (1.67 ns)	400 MHz (2.5 ns)
Max. State Clock Rate	250 MHz (Option 250) 450 MHz (Option 500)	250 MHz (Option 250) 450 MHz (Option 500)	667 MHz	667 MHz	800 MHz
Max. State Data Rate	250 Mb/s (Option 250) 500 Mb/s (Option 500)	250 Mb/s (Option 250) 500 Mb/s (Option 500)	1066 Mb/s	1066 Mb/s	1.5 Gb/s
Voltage Threshold Ranges	–5 V to 5 V (10 mV increments)	–5 V to 5 V (10 mV increments)	–3 V to 5 V (10 mV increments)	–3 V to 5 V (10 mV increments)	–3 V to 5 V (10 mV increments)
Automated Threshold/ Sample Position, Simultaneous Eye Diagrams on All Channels	Yes	Yes	Yes	Yes	Yes
Supported Signal Types	Single-ended	Single-ended	Single-ended & differential	Single-ended & differential	Single-ended & differential
Probe Compatibility	40-pin Cable Connector	40-pin Cable Connector	90-pin Cable Connector	90-pin Cable Connector	90-pin Cable Connector
Probe Loading	<0.7pF with soft touch connectorless probing				

16720A
View Scope





Digital Stimulus for Performing Functional Verification, Debugging and Stress Testing

The Agilent 16720A digital pattern generator module for Agilent's 16900 Series logic analysis systems is ideal for the functional testing of your digital design. The pattern generator is used to simulate infrequently encountered test conditions in hardware design and software program testing. You can also use a pattern generator to stimulate your electronic designs with ideal or faulty digital patterns for performing functional verification, debugging and stress testing.

Agilent 16720A Pattern Generator Module

	Half Channels	Full Channel
Maximum Clock Speed	300 MHz	180 MHz
Memory Depth in Vectors	16 M	8 M
Maximum Number of Channels per Timebase	24	48
Maximum Vector Width	120 bits	240 bits
Stimulus Commands	Initialize, block, repeat, and break macros	
Logic Levels Supported	5 V TTL, 3-state TTL, 3-state CMOS, 3-state 3.3 V, ECL, 5 V PECL, 3.3 V LVPECL, 3-state 2.5 V, 3-state 1.8 V, LVDS	

Accessories

Pod Options for 16720A Pattern Generator

Option 011 TTL clock pod & lead set
Option 013 3-state TTL/CMOS data pod & lead set
Option 014 TTL data pod & lead set
Option 015 2.5 V clock pod & lead set
Option 016 2.5 V 3-state data pod & lead set
Option 017 3.3 V clock pod & lead set
Option 018 3.3 V 3-state data pod & lead set
Option 021 ECL clock pod & lead set
Option 022 ECL (terminated) data pod & lead set
Option 023 ECL (unterminated) data pod & lead set
Option 031 5 V PECL clock pod & lead set
Option 032 5 V PECL data pod & lead set
Option 033 3.3 V LVPECL clock pod & lead set
Option 034 3.3 V LVPECL data pod & lead set
Option 041 1.8 V clock pod & lead set
Option 042 1.8 V 3-state data pod & lead set
Option 051 LVDS clock pod & lead set
Option 052 LVDS data pod & lead set

Ordering Information

When ordering the 16720A, please note the following:
You must order at least one clock pod for each 16720A module used as a master. You must order at least one data pod for every 8 output channels.
The 10483 is the recommended replacement for the discontinued 10466A.

Unleash the Complementary Power of a Logic Analyzer and an Oscilloscope

Easily make time-correlated measurements between an Agilent logic analyzer and oscilloscope. The time-correlated logic analyzer and oscilloscope waveforms are integrated into a single logic analyzer waveform display for easy viewing and analysis.

Specifications

View Scope Features, Connection and Compatibility

View Scope Capabilities Include
- Automatic de-skew of the waveforms
- Trigger the oscilloscope from the logic analyzer (or vice versa)
- Precisely relate information on the instrument displays with tracking markers
- Maintain tight time-correlation across deep memory acquisitions with synchronized sampling clocks

Logic Analyzer/Oscilloscope Connection
- Use standard LAN connection and two BNC cables to connect Trigger In and Trigger Out

Agilent Oscilloscope Capabilities
- Maximum Scope Bandwidth: 13 GHz
- Maximum Sampling Rate: 40 GSa/s
- Maximum Memory Depth: 128 M points
- Channels per Oscilloscope: 2 and 4

Compatible Agilent Oscilloscopes
- 80000B Infiniium Series High Performance Lab Oscilloscopes
- 8000 Infiniium Series General Purpose Lab Oscilloscopes
- 6000 Series High-performance Portable Oscilloscopes
- 5000 Series Portable Oscilloscopes

Compatible Logic Analyzers
- 16800 Series Portable Logic Analyzers
- 16900 Series Modular Logic Analyzers
- 1690 Series PC-hosted Logic Analyzers
- 1680 Series Logic Analyzers

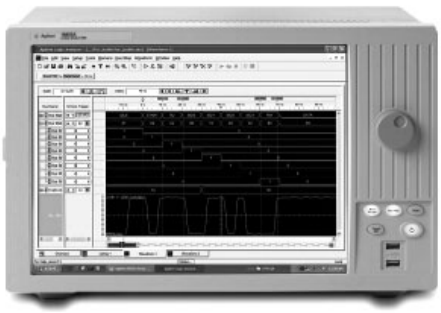
Key Literature & Web Link

Agilent Technologies Measurement Modules for the 16900 Series Data Sheet, p/n 5989-0422EN
Agilent Technologies 16900 Series Logic Analysis System Mainframes Data Sheet, p/n 5989-0421EN
View Scope Logic Analyzer and Oscilloscope Correlation Data Sheet, p/n 5989-4646EN

www.agilent.com/find/logic _modules

16801A
16802A
16803A
16804A
16806A
16821A
16822A
16823A

- **15-inch (38.1 cm) color display (touch screen available) allows you to see more data and gain insight quickly**
- **Up to 32 M memory depth enables you to identify the root cause of a problem widely separated in time from the symptom**
- **Models with a built-in pattern generator allow you to verify operation across a variety of test conditions**
- **Set up measurements easily and navigate through your data quickly with the analyzer's intuitive interface**
- **Meet your application and budget needs by selecting configurations that range from 34 to 204 channels**



Advanced Measurements for Your Digital Applications at a Price that will Fit Your Budget

16800 Series portable logic analyzers offer the performance, applications, and usability your digital development team needs to quickly debug, validate, and optimize your digital system. Meet your application and budget needs by selecting from eight models that range from 34 to 204 channels.

Accurately measure precise timing relationships over longer periods of time with 4 GHz (250 ps) timing zoom at 64 K deep. Find anomalies separated in time with memory depths upgradeable to 32 M. You get it all at a price that fits your budget.

Models with an integrated pattern generator let you control and monitor real-time system operation. Drive down risk early in product development by replacing missing circuits or boards with digital stimulus. Verify operation across a variety of test conditions with normal or faulty digital patterns at full speed or by stepping through individual states.

3

Selection Guide for 16800 Series Portable Logic Analyzers

Product	16801A/16821A	16802A/16822A	16803A/16823A	16804A	16806A
Logic Analyzer Channels	34	68	102	136	204
Pattern Generator Channels	48 (16821A)	48 (16822A)	48 (16823A)	—	—
High-speed Timing Zoom	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth			
Maximum Timing Sample Rate (Half/Full Channel)	1.0 GHz (1.0 ns)/ 500 MHz (2.0 ns)	1.0 GHz (1.0 ns)/500 MHz (2.0 ns)			
Transitional Timing	500 MHz	500 MHz			
Maximum State Clock Rate	250 MHz with option 250	450 MHz with option 500 250 MHz with option 250			
Maximum State Data Rate	250 Mb/s with option 250	500 Mb/s with option 500 250 Mb/s with option 250			
Maximum Memory Depth	1 M with option 001 4 M with option 004 16 M with option 016 32 M with option 032	1 M with option 001 4 M with option 004 16 M with option 016 32 M with option 032			
Supported Signal Types	Single-ended				
Automated Threshold/Sample Position, Simultaneous Eye Diagrams on All Channels	Yes				
Probe Compatibility	40-pin cable connector				
Probe Loading	< 0.7 pF with soft touch connectorless probing				
Display	15-inch (38.1 cm) color display with touch screen available				
I/O and Storage	Six 2.0 USB ports (2 on front panel, 4 on rear panel), Gbit LAN, parallel port, 80 GB hard drive, mouse and keyboard, Trigger In & Trigger Out BNCs				
Additional Capabilities	View Scope; A wide range of processor, bus and FPGA support; Optional analysis software packages; email on trigger; offline analysis, remote programmatic control via COM or ASCII RPI				

Pattern Generator Specifications and Characteristics

Product	16821A/16822A/16823A	
	Half Channel	Full Channel
Maximum Clock	300 MHz	180 MHz
Data Channels	24	48
Memory Depth in Vectors	16 M	8 M
Logic Levels Supported	5 V TTL, 3-state TTL, 3-state TTL/CMOS, 3-state 1.8 V, 3-state 2.5 V, 3-state 3.3 V, ECL, 5 V PECL, 3.3 V LVPECL, LVDS	

16801A
16802A
16803A
16804A
16806A
16821A
16822A
16823A

Accessories

16800 Series portable logic analyzers have 40-pin cable connectors. The following 40-pin probes are compatible with the 16800 Series. Probes are ordered separately.

www.agilent.com/find/logic_analyzer_probes

General Purpose Flying Lead Probe
17-ch E5383A
Connector Probes
Mictor: 34-ch E5346A
Samtec: 34-ch E5385A
Connectorless Probes
17-ch E5396A soft touch
34-ch E5394A soft touch
34-ch E5404A pro-series soft touch

Key Literature & Web Link

Agilent 16800 Series Portable Logic Analyzers Brochure, p/n 5989-5062EN
Agilent 16800 Series Portable Logic Analyzers Data Sheet, p/n 5989-5063EN

www.agilent.com/find/logic

Ordering Information

A complete system consists of a 16800 Series logic analyzer, probes and any additional application software.

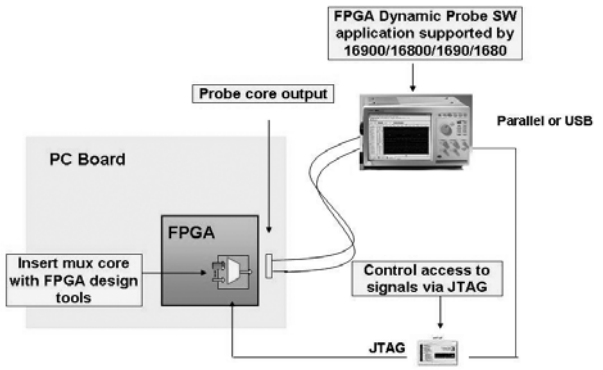
Options
The following options apply to all 16800 Series logic analyzers:
16800A-102 Front Panel with 15" Display
16800A-103 Front Panel with 15" Display and Touch Screen
16800A-101 Internal Hard Drive
16800A-109 External Removable Hard Drive
16800 Series model number-001 1 M Memory Depth
16800 Series model number-004 Increase Memory Depth to 4 M
16800 Series model number-016 Increase Memory Depth to 16 M
16800 Series model number-032 Increase Memory Depth to 32 M
16800 Series model number-250 Maximum State Speed of 250 MHz
16800 Series model number-500 Increase Maximum State Speed to 500 Mb/s (Option 500 applies to 16802A, 16803A, 16804A, 16806A, 16822A and 16823A)

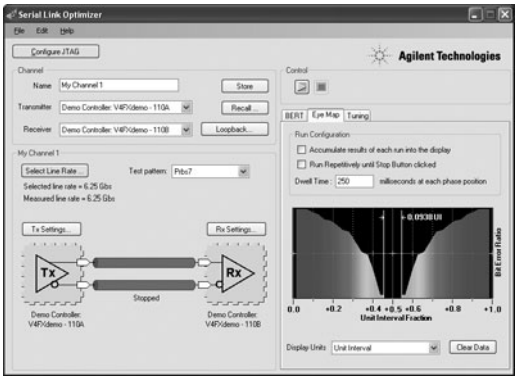
40-pin Probes Compatible with the 16800 Series
General Purpose Flying Lead Probe
17-ch E5383A
Connector Probes
Mictor: 34-ch E5346A
Samtec: 34-ch E5385A
Connectorless Probes
17-ch E5396A soft touch
34-ch E5394A soft touch
34-ch E5404A pro-series soft touch

Pattern Generator Clock and Data Pods See page 182 for details

Upgrades
To increase memory depth or state speed after initial purchase, order the following:

Product	16801A/16821A	16802A/16822A	16803A/16823A	16804A	16806A
Increase Memory Depth to 4 M	E5876A-004	E5877A-004	E5878A-004	E5879A-004	E5880A-004
Increase Memory Depth to 16 M	E5876A-016	E5877A-016	E5878A-016	E5879A-016	E5880A-016
Increase Memory Depth to 32 M	E5876A-032	E5877A-032	E5878A-032	E5879A-032	E5880A-032
Increase State Speed to 500 Mb/s	—	E5877A-500	E5878A-500	E5879A-500	E5880A-500





Quickly Debug Your FPGA and Surrounding System with X-ray Vision for Your FPGAs

B4655A FPGA Dynamic Probe for Xilinx

- Gain visibility into the internal activity of your Xilinx FPGAs. Access up to 128 internal signals for each pin dedicated to debug
- Switch internal probe points in seconds to measure a different set of internal signals without changing your FPGA design
- Leverage the work you did in your design environment. The FPGA dynamic probe maps internal signal names from your ISE design software to the logic analyzer. Automated bus name and signal setup eliminates mistakes and saves time
- Supported Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series

E9524A MicroBlaze Trace Toolset

Easily trace MicroBlaze software execution with Agilent's MicroBlaze trace core and inverse assembler

- Capture real-time code flow from one or more MicroBlaze cores
- Time correlate MicroBlaze activity with measurements from the surrounding system
- Display processor execution in assembly instruction mnemonics correlated to high-level source code
- Supports instruction-side and/or data-side decoding
- Supported Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series

B4656A FPGA Dynamic Probe for Altera

- Gain visibility into the internal activity of your Altera FPGAs. Access up to 256 internal signals for each pin dedicated to debug
- Switch internal probe points in seconds to measure a different set of internal signals without changing your FPGA design
- Leverage the work you did in your design environment. The FPGA dynamic probe maps internal signal names from your Quartus design software to the logic analyzer. Automated bus name and signal setup eliminates mistakes and saves time
- Altera device support: Stratix series, Cyclone series, MAX series, APEX series, and Excalibur series

Automatically Tune Your Xilinx MGT-based Serial Links for Optimal Performance

E5910A Serial Link Optimizer for Xilinx FPGAs

Agilent's Serial Link Optimizer is a software tool that extends the Xilinx ChipScope Pro Serial IO Toolkit and provides easy-to-use BERT, eye mapping, and automatic channel tuning for optimal bit error ratio on your gigabit serial bus implemented with Xilinx FPGAs.

The Serial Link Optimizer is used together with the internal bit error ratio tester (IBERT) core from the Xilinx ChipScope Pro Serial IO Toolkit. This extended analysis and automatic optimization capability saves you considerable time and expense in optimizing the BER of your serial link.

- Graphical margin analysis with eye mapping
- Automatic optimization of your serial link's BER
- On-chip measurements via JTAG means no external instrumentation
- Available from Xilinx worldwide distributors Avnet and Nu Horizons
- Supported Xilinx devices: Virtex-4 FX, Virtex-5 LXT and SXT

Key Literature & Web Link

Agilent Technologies B4655A FPGA Dynamic Probe for Xilinx Data Sheet, p/n 5989-0423EN
Agilent Technologies FPGA Dynamic Probe FAQs for Xilinx Data Sheet, p/n 5989-1170EN
Agilent Technologies B4656A FPGA Dynamic Probe for Altera Data Sheet, p/n 5989-5595EN
Agilent Technologies FPGA Dynamic Probe FAQs for Altera Data Sheet, p/n 5989-5716EN
Agilent E9524A MicroBlaze Trace Toolset Data Sheet, p/n 5989-5187EN
Agilent E5910A Serial Link Optimizer for Xilinx FPGAs Data Sheet, p/n 5989-5969EN
Testing and Optimizing High-Speed Serial Links with the Agilent E5910A Serial Link Optimizer Technical Overview, p/n 5989-6048EN

www.agilent.com/find/fpga
www.agilent.com/find/serial_IO

Ordering Information

B4655A FPGA Dynamic Probe for Xilinx
  Option 011 Perpetual Node Locked License
  Option 012 Perpetual Floating (server) License
B4656A FPGA Dynamic Probe for Altera
  Option 010 Perpetual Node Locked License
  Option 020 Perpetual Floating (server) License
E5910A Serial Link Optimizer
  Option 010 1-year Node Locked License
  Option 020 1-year Floating (server) License
E9524A MicroBlaze Trace Toolset
  Option 010 Perpetual Node Locked License
  Option 020 Perpetual Floating (server) License

Probing Solutions for Logic Analyzers with 40-pin Cable Connectors

E5346A
E5383A
E5385A
E5394A
E5396A
E5404A

- **Easily connect with reliable, electrically and mechanically unobtrusive probing solutions**
- **Achieve low loading (<0.7 pF), an easy connection and a small footprint with soft touch connectorless probes**
- **Save time making bus- and processor-specific measurements with application specific analysis probes**

Accurate Measurements Start with Reliable Probing

Your logic analyzer measurement is only as reliable as your probing. Agilent offers a wide variety of probing accessories that support general-purpose and application specific measurement needs. The probes provide a robust, reliable connection between your Agilent logic analyzer and the system under test. They are easy to connect and are electrically and mechanically unobtrusive, giving you unsurpassed measurement accuracy.

Key Literature & Web Link

Probing Solutions for Logic Analyzers Catalog, p/n 5968-4632E
Application Support for Agilent Logic Analyzers, p/n 5966-4365E

www.agilent.com/find/logic_analyzer_probes

Soft Touch Connectorless

Samtec

Mictor

Flying Lead Set

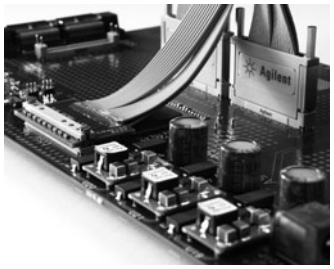
Selection Guide for Agilent Logic Analyzer Probing Solutions

(For Logic Analyzers with 40-pin Cable Connector)

Compatible with 16800 Series, 16910/11A, 16750/51/52A/B, 1674x Series, 1671x Series, 165xx Series modules, 1690 Series, 1680 Series, 1670 Series, 1660 Series, 1650 Series and E9340A logic analyzers

	Soft Touch Connectorless Probes			Samtec Probe	Mictor Probe	General Purpose Flying Lead Set
Product	**E5396A**	**E5404A**	**E5394A**	**E5385A**	**E5346A**	**E5383A**
Application	Quick connection to many channels in a small footprint without a header designed into the target			Quick connection to many signals in a small footprint	Quick connection to many signals in a small footprint	Flexible connection to individual signals
Number of Channels	17 16 data, 1 clock	34 32 data, 2 clock	34 32 data, 2 clock	34 32 data, 2 clock	34 32 data, 2 clock	17 16 data, 1 clock
Supported Signal Types			Single-ended clock, Single-ended data			
Maximum Data Rate	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s	1.5 Gb/s	Equivalent to the logic analyzer data rate the probe is attached to	Equivalent to the logic analyzer data rate the probe is attached to
Minimum Signal Amplitude	500 mV p-p	500 mV p-p	500 mV p-p	500 mV p-p	500 mV p-p	600 mV p-p
Connection to Target System	Requires half-size soft touch footprint designed into the target	Requires Pro Series soft touch footprint designed into the target	Requires original soft touch footprint designed into the target	Requires 100-pin Samtec connector designed into target system	Requires 38-pin Mictor connector designed into target system	Compatible with a wide assortment of accessories to connect to individual leads
Input Capacitance	<0.7 pF	<0.7 pF	<0.7 pF	1.5 pF	3.0 pF	1.5 pF

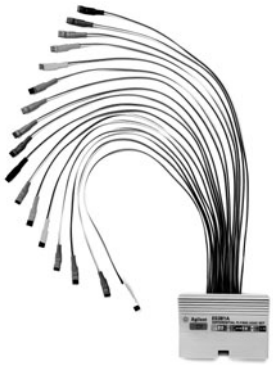
E5387A
E5390A
E5398A
E5402A
E5405A
E5406A
E5378A
E5379A
E5380A
E5381A
E5382A



Soft Touch Connectorless

Samtec

Mictor



Flying Lead Set

Selection Guide for Agilent Logic Analyzer Probing Solutions

(For Logic Analyzers with 90-pin Cable Connector)

Compatible with 16951B, 16950B, 16950A, 16760A, 16756A, 16755A, 16754A, 16753A

Product	Soft Touch Connectorless Probes				
	E5398A	**E5406A, E5402A (low profile)**	**E5390A**	**E5405A**	**E5387A**
Application	Quick connection to many channels in a small footprint without a header designed into the target				
Number of Channels	17 16 data, 1 clock	34 32 data, 2 clock	34 32 data, 2 clock	17 16 data, 1 clock	17 16 data, 1 clock
Supported Signal Types	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Differential or Single-ended data	Differential or Single-ended clock, Differential or Single-ended data
Maximum Data Rate	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s
Minimum Signal Amplitude	250 mV p-p	250 mV p-p	250 mV p-p	$V_{max} - V_{min}$ 200 mV	$V_{max} - V_{min}$ 200 mV
Connection to Target System	Requires half-size soft touch footprint designed into the target	Requires Pro Series soft touch footprint designed into the target system	Requires original soft touch footprint designed into the target system	Requires Pro Series soft touch footprint designed into the target system	Requires original soft touch footprint designed into the target system
Input Capacitance	<0.7 pF	<0.7 pF	<0.7 pF	<0.7 pF	<0.7 pF

Model Number	Samtec Probes		Mictor Probe	General Purpose Flying Lead Sets	
	E5378A	**E5379A**	**E5380A**	**E5382A**	**E5381A**
Application	Quick connection to many channels in a small footprint	Quick connection to many channels in a small footprint	Quick connection to many channels in a small footprint	Flexible connection to individual signals	Flexible connection to individual signals
Number of Channels	34 32 data, 2 clock	17 16 data, 1 clock	34 32 data, 2 clock	17 16 data, 1 clock	17 16 data, 1 clock
Supported Signal Types	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Differential or Single-ended data	Single-ended clock, Single-ended data	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Differential or Single-ended data
Maximum Data Rate	1.5 Gb/s	1.5 Gb/s	600 Mb/s	1.5 Gb/s	1.5 Gb/s
Minimum Signal Amplitude	250 mV p-p	$V_{max} - V_{min}$ 200 mV	300 mV p-p	250 mV p-p	$V_{max} - V_{min}$ 200 mV
Connection to Target System	Requires 100-pin Samtec connector designed into the target system	Requires 100-pin Samtec connector designed into the target system	Requires 38-pin Mictor connector designed into the target system	Compatible with a wide assortment of accessories to connect to individual leads	Compatible with a wide assortment of accessories to connect to individual leads
Input Capacitance	1.5 pF	1.5 pF	3.0 pF	1.3 pF	0.9 pF

Note: E5386A half-channel transition adapter provides transition between probes and 16760A logic analyzer cables. Use to reduce the number of probes and connectors required to run in half-channel mode. Adapter maps even channels to all pins of an E5378A, E5379A, E5387A, E5390A, E5402A, E5405A or E5406A. It supports differential or single-ended clock, differential or single-ended data.

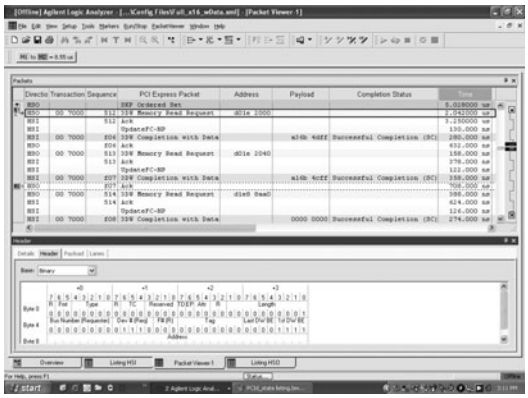
Key Literature & Web Link

Probing Solutions for Logic Analyzers Catalog, p/n 5968-4632E
Application Support for Agilent Logic Analyzers, p/n 5966-4365E

www.agilent.com/find/logic_analyzer_probes

Processor Support
Bus Support
FPGA Support
Protocol Support

- **Display processor mnemonics or bus cycle decode**
- **Get control over your FPGA's internal and external data**
- **Save time making bus- and processor-specific measurements with application-specific analysis probes that quickly and reliably connect to your device under test**
- **Select from a comprehensive coverage of industry-standard processors and buses**
- **Become more productive with industry standard and proprietary protocol support that allows you to trigger, view, search and analyze at the packet level**



Save Time Analyzing Your Unique Design with a Turnkey Logic Analyzer Setup

Agilent Technologies and our partners provide an extensive range of quality tools that offer non-intrusive, full-speed, real-time analysis to accelerate your debugging process.

Available Device Support

Microprocessor/Microcontrollers
AMD, Analog Devices, ARM, AT&T, Dallas, DEC, Freescale, GTE, IBM, IDT, Infineon, Intel, LSI Logic, McDonnell Douglas, MIPS, Motorola, National, NEC, PACE, PMC Sierra/QED, Rockwell, Siemens, Texas Instruments, Toshiba, Zilog

FPGAs
Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series
Altera devices: Stratix series, Cyclone series, MAX series, APEX series, and Excalibur series

I/O Buses
PCI, PCI-X®, PCI-Express, Serial ATA (SATA 1 and 2), SCSI, Serial Attached SCSI (SAS), Serial RapidIO, Parallel RapidIO, HyperTransport

Memory Buses
DDR1, DDR2, PC-100/133, GDDR3, Fully Buffered DIMM (FB-DIMM), Rambus

Serial Buses
CAN, Fibre Channel, FlexRay, I²C, IEEE-488, IEEE-1394, RS-232, Serial ATA (SATA 1 and 2), Serial Peripheral Interface (SPI), Serial RapidIO, System Packet Interface Level 4 (SPI 4.2), USB 2.0/1.1, PCI-Express

Graphics Buses
AGP2x, AGP4x, AGP3.0, PCI-Express

Protocol Solutions for Industry Standard and Proprietary Buses

With Agilent's packet viewer you can quickly gain insight into your system in a familiar protocol format whether you're using Agilent's solutions for industry standard protocols or our B4641A Protocol Development Kit to create a solution for your proprietary protocol. These powerful tools provide non-intrusive probing plus logic analysis triggering and decoding at the packet level. They also enable correlated analysis and sequenced event triggering across multiple buses for virtually every type of bus, making it easy to follow transactions, data, and packets as they flow through an entire system.

Logic analyzer protocol solutions include support for:
- PCI Express
- Advanced Switching Interface
- Serial ATA (SATA) and Serial Attached SCSI (SAS)
- Serial RapidIO
- Parallel RapidIO
- SPI 4.2 (System Packet Interface, POS PHY L4)
- InfiniBand
- FlexRay
- SPI (Serial Peripheral Interface)
- I²C

PCI-Express 2 Protocol Analysis

With the P2L (Protocol to Logic) gateway, you get a unique logic analyzer and Protocol functionality for PCI-Express 2 in a single solution. With this connection you can perform time-correlated cross bus measurements and cross triggering. Both the logic analyzer and protocol analyzer can be operated from a single PC. For more details, please refer to page 192.

Key Literature & Web Link

Application Support for Agilent Logic Analyzers Configuration Guide, p/n 5966-4365E

www.agilent.com/find/pnbs
www.agilent.com/find/logic-sw-apps
www.agilent.com/find/pcie2

Ordering Information

Contact Agilent if you do not see support for your specific vendor or device. A representative can:
- Determine if support is under development
- Recommend third parties that design custom solutions
- Direct you to information or consultants that can help you design a test solution

N4850A
N4860A

- **Independently validate your DigRF v3-based BB-IC and RF-IC**
- **Rapidly deploy DigRF v3-based designs using Agilent's integrated and cross-correlated logic analysis and RF tools**

Meeting the Measurement Challenge of the DigRF Digital Serial Interface

The DigRF v3 standard presents new challenges for mobile wireless development, integration and validation teams as the communications link between the BB-IC and RF-IC evolves from analog to digital. Spectrum analyzers used to evaluate analog interfaces are incapable of measuring the DigRF digital serial interface.

Agilent's N4850A acquisition probe and the N4860A stimulus probe operate in conjunction with Agilent 16800 and 16900 Series logic analyzers to provide the digital serial acquisition and stimulus capabilities required to independently evaluate an RF-IC or BB-IC with a DigRF v3 interface or integrate your mobile wireless designs.

The integration of DigRF v3 logic analysis tools with the Agilent RF portfolio provides the cross-domain solutions that will help you rapidly deploy your DigRF v3-based designs.

Specifications

N4850A DigRF v3 Digital Acquisition Probe

State Analysis for DigRF v3-Compliant Devices
- Maximum acquisition speed: 312 Mbps
- Voltage level support: 1.8 V LVDS, 1.2 V LVDS, SLVDS (200 mV min); See data sheet for SLVDS value updates
- SysClk speed support: 19.2 MHz, 26.0 MHz, 38.4 MHz
- Over air standard support: 2.5G and 3GPP (e.g. GSM, EDGE, CDMA, cdma2000, W-CDMA)

Monitor Device and System Operation
- Simultaneously acquires Tx/Rx bidirectional traffic
- Tracks changes across all speed modes – sleep, low power and high speed
- Displays data and control packets at the protocol level
- Triggers on protocol-specific packets, specific bits within a packet, and protocol violations

Additional Capabilities
- LEDs show DigRF v3 bus status and error conditions
- Identifies invalid sync words
- Supports up to 2048 bits for user-defined payload
- Extracts and transfers digital IQ for analysis with 89600 VSA software

Configuration Considerations
- Requires 16800 or 16900 Series logic analyzers with 68-channels or more
- E5381A flying lead set recommended for high impedance probing for signal integrity
- For stimulus, add an N4860A DigRF v3 stimulus probe and use a logic analyzer with a pattern generator
- Customize DigRF v3 protocol decoding with the B4641A Protocol Development Kit

N4860A DigRF v3 Digital Stimulus Probe

DigRF v3 Compliant Digital Stimulus
- Maximum stimulus speed: 312 Mbps
- Voltage level support: 1.8 V LVDS, 1.2 V LVDS, SLVDS
- SysClk speed support: 26.0 MHz (Contact Agilent for 19.2 MHz or 38.4 MHz support)
- Over air standard support: 2.5G and 3GPP (e.g. GSM, EDGE, CDMA, cdma2000, W-CDMA)

Stimulus Probe Operation
- Converts raw IQ and control information to DigRF v3-compliant data and control packets
- Provides continuous DigRF v3 stimulus to replace a missing BB-IC or RF-IC
- Enables modification of critical control settings while looping

Methods for Creating Raw Digital IQ in Simple ASCII Format
- Signal Studio **www.agilent.com/find/signalstudio**
- Advance Design System (ADS) **www.agilent.com/find/ads**
- Custom programming package
- Captured logic analyzer trace converted to digital stimulus

Configuration Considerations
- Requires N4850A DigRF v3 acquisition probe
- Requires 16800 or 16900 Series 68-channel logic analyzers (or more) with a pattern generator
- Connects to target using SMA (m-m) connectors
- Refer to data sheet for more information

Accessories

B4641A Protocol Development Kit – used to customize the DigRF v3 packet decoder for your unique extensions to the standard

Key Literature & Web Link

Agilent Solutions for the DigRF v3 Digital Serial Interface Used in Mobile Wireless Devices Brochure, p/n 5989-6224EN
N4850A DigRF v3 Acquisition Probe and N4860A DigRF v3 Stimulus Probe Data Sheet, p/n 5989-6058EN

www.agilent.com/find/DigRF
www.agilent.com/find/logic
www.agilent.com/find/DVSA
www.agilent.com/find/E4438C
www.agilent.com/find/signalstudio
www.agilent.com/find/scopes

Ordering Information

Order the following to configure a complete DigRF v3 digital acquisition and stimulus system. Refer to the data sheet for more detailed information

DigRF v3 Probes
N4850A DigRF v3 Acquisition Probe
N4860A DigRF v3 Stimulus Probe

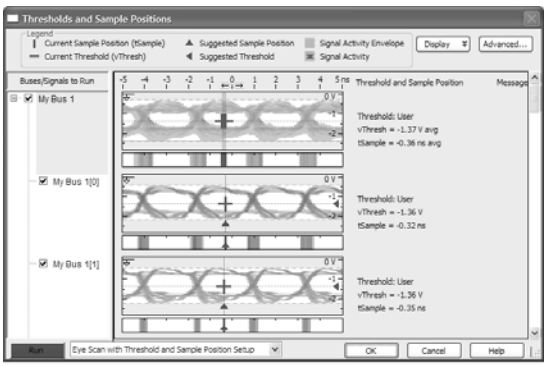
Logic Analyzer with 68 Channels (or more) and a 48-channel Pattern Generator
16800 Series portables:
16822A (68-ch)
16823A (102-ch)
16900 Series modular system: A 16900 Series mainframe with at least one each of the following:
16900 Series Logic Analyzer Module
16720A Pattern Generator Module

Probe between the N4850A and the Device under Test
One of the following for each N4850A. The E5381A differential flying lead probe is recommended for the highest signal quality
E5381A Differential Flying Lead Probe
E5405A Differential Pro Series Soft Touch Probe
E5387A Differential Soft Touch Probe
E5379A Differential Samtec Probe

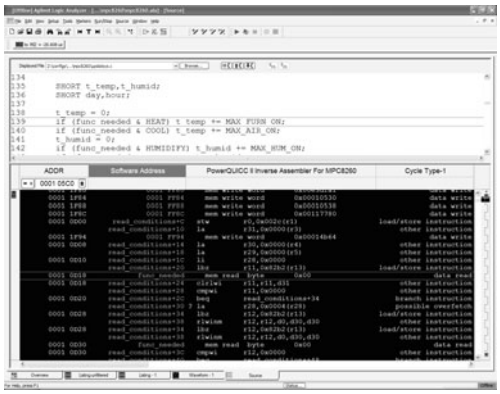
Samtec Probes between the N4850A and the Logic Analyzer
Order two Samtec probes that are compatible with your logic analyzer
E5385A Samtec Probe for Logic Analyzers with a 40-pin Cable Connection (16800 Series, 16910A, 16911A)
E5378A Samtec Probe for Logic Analyzers with a 90-pin Cable Connection (16950A/B, 16951B)

Order Separately to:
Analyze digital IQ:
89601A VSA Software
Create digital IQ data:
Signal Studio, Advanced Design System (ADS)
Customize the DigRF v3 packet decoder for your unique extensions to the standard:
B4641A Protocol Development Kit

B4601C
B4602A
B4606A
B4607A
B4608A
B4610A
B4630A
B4641A



Identify problem signals quickly by viewing eye diagrams across all buses and signals simultaneously.



The split Source window displays the source code on top and the inverse-assembled trace below. The two traces are time-correlated and track as you scroll.

Standard Displays Present Data in Familiar Formats for Faster Debug and Analysis

Automate Measurement Setup and Validate Signal Integrity
As timing and voltage margins continue to shrink, confidence in signal integrity becomes an increasingly vital requirement of the design verification process. With eye scan, you can have the same eye-diagram capability in a logic analyzer that you have in your scope, and it covers up to 510 channels at a time. Eye scan gives you a rapid, comprehensive overview across hundreds of signals simultaneously.

Debug Real-time Code at the Source Level
- Correlate the logic analyzer trace with the high-level source code that produced it
- Locate the cause of a problem by "stepping backward" from the point where you see a problem to its root cause
- Set up your next logic analyzer acquisition by simply pointing and clicking on a line of source code
- Determine the cause of data corruption by acquiring all activity relative to a variable

Trigger, Search, View and Analyze at the Packet Level
More designs are incorporating serial buses. With Agilent's packet viewer you can trigger, search, view and analyze at the packet level. The display is customized for the protocol family being decoded by the packet decode tool. To optimize protocol viewing and analysis you can simultaneously view summarized and detailed packet information. Packet detail views include tabs for header, payload, and lane information.

Get Additional Insights Into Your Design with Multiple Views and Analysis Tools

As the complexity of digital systems increases, you need to analyze and view data in ways that were previously unavailable in a logic analyzer. The following analysis tools enable you to rapidly consolidate large amounts of data into displays that provide rapid insight into your system's behavior.
- The B4601C Serial-to-parallel analysis package converts a serial data stream into parallel data words, performs clock recovery, processes frame and data portions separately, and removes stuffed bits from the data block
- Use the B4602A Signal Extractor Tool to extract I and Q data from simple serial protocols or re-multiplex high-speed digital data that has been de-multiplexed onto additional logic analyzer channels
- B4606A (Development and Runtime) and B4607A (Runtime) Advanced Customization Environment integrates Visual Basic for Applications (VBA) into the logic analyzer application for creating custom data analysis, data visualization, instrument control and measurement automation, and links to external PC applications
- B4608A ASCII Remote Programming Interface (RPI) allows you to remotely control the logic analyzer using ASCII commands
- B4610A Data Import Tool allows you to import external data into the logic analysis system and analyze it just like data acquired by the logic analyzer
- B4630A MATLAB Connectivity and Analysis package allows you to easily use your custom MATLAB routines in conjunction with data acquired from the logic analysis system
- B4641A Protocol Development Kit lets you create or modify existing protocol description files in order to decode, display and trigger on packet data. Useful for proprietary protocols or modifying existing industry standard solutions
- 89601 VSA software provides vector signal analysis and modulation analysis for digital baseband, IF and RF

Key Literature & Web Link

Application Support for Agilent Logic Analyzers, p/n 5966-4365E

www.agilent.com/find/pnbs

Ordering Information

Serial-to-parallel Analysis Package
B4601C-010 Perpetual Node Locked License
B4601C-020 Perpetual Floating (server) License

Signal Extractor
B4602A-010 Perpetual Node Locked License
B4602A-020 Perpetual Floating (server) License

Advanced Customization Environment
B4606A-010 Development and Runtime Package, Perpetual Node Locked License
B4606A-020 Development and Runtime Package, Perpetual Floating (server) License
B4607A-010 Runtime Package, Perpetual Node Locked License
B4607A-020 Runtime Package, Perpetual Floating (server) License

Remote Programming Interface (RPI) – Requires B4606A or B4607A
B4608A-010 Perpetual Node Locked License
B4608A-020 Perpetual Floating (server) License

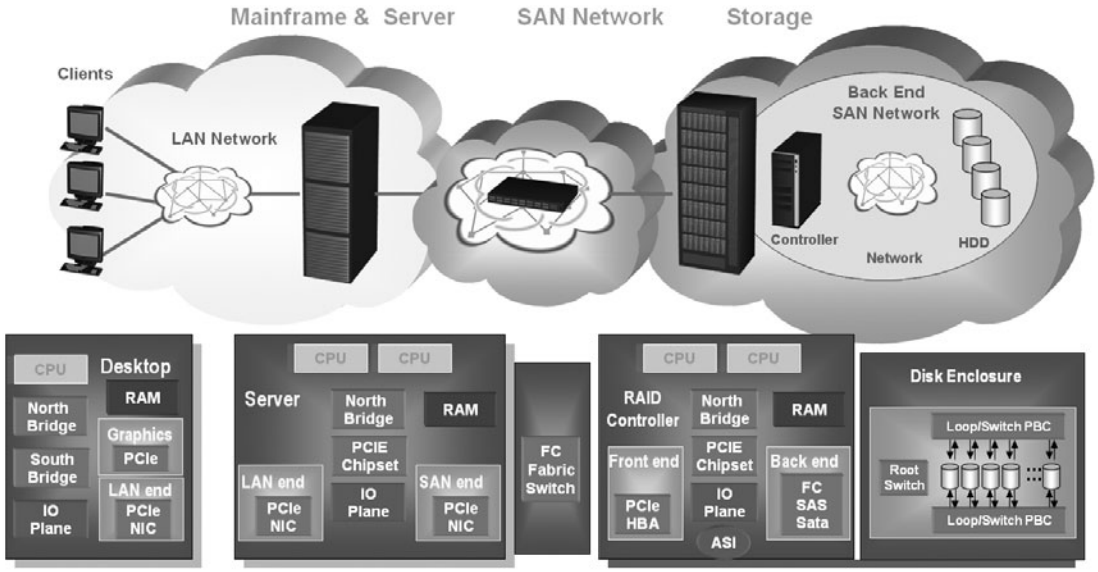
Data Import Tool
B4610A-010 Perpetual Node Locked License
B4610A-020 Perpetual Floating (server) License

MATLAB Connectivity and Analysis Tool
B4630A-010 Perpetual Node Locked License
B4630A-020 Perpetual Floating (server) License

Protocol Development Kit
B4641A-010 Perpetual Node Locked License
B4641A-020 Perpetual Floating (server) License

Digital Vector Signal Analysis (DVSA)
89601A-200 Basic Vector Signal Analysis Software
89601A-300 Hardware Connectivity (includes link to Logic Analyzers)

- **Enhanced system level view with time-correlated measurements on multiple protocol domains**
- **Reduced capital expenditures with common hardware for protocol exercising, traffic generation and protocol analysis**
- **Accelerated test with a complete automation environment and scripting language**
- **Investment protection with a flexible, scalable architecture**



Reduce Computer and Storage Test Time by Combining Multi-Protocol Analysis and Traffic Generation in a Single Platform

Because Computer and Storage system's behavior is the result of tight interactions between multiple busses and protocols, identifying the root cause of defects or performance issues requires a real-time system level view on multiple protocol domains. In order to recreate the right test conditions, your test platform must also provide a deterministic traffic generation and device exercising capabilities.

Based on the modular, scalable, multi-user N2X chassis, the Agilent System Protocol Tester combines multi-protocol analysis, traffic generation, performance and conformance verification to debug, validate and optimize semiconductors, software and systems using high speed protocol standards.

The System Protocol Tester includes multiple test solutions for various applications:

- The **Protocol Analyzer** application helps you transparently record in real-time the protocol communication between two or more devices and easily visualize the trace information at the packet level with the right protocol decoding capabilities. Additional performance measurements and advanced triggering capabilities help quickly identify the root cause of your design problems.
- The **Exerciser** and **Traffic Generator** applications can stimulate your design with sophisticated traffic scenarios, and help accelerate test phases and improve product robustness. These applications also provide sophisticated device emulation capabilities to recreate complex or large scale test environments.
- The **Switch Testers** help characterize switches and networks performance under various traffic conditions, perform scalability testing and product robustness through device virtualization and negative testing
- The **Compliance Test Solutions** will perform tests in order to verify and ensure compliance with specifications defined by the standard bodies

Products & Services

PCI Express Exerciser and Analyzer (E2960A Series)
The E2960A test series, supporting the industry's move from parallel to serial I/O busses, provides the most complete and innovative array of test equipment for serial, PCI Express busses

PCI Express 2.0 Exerciser and Analyzer (E2960B Series)
The New E2960B test series is the industry's first complete solution for PCI Express 2.0 also supporting PCI Express 1.0. With superior midbus probing and the P2L

Fibre Channel Test Solutions for Storage Area Networks (173x Series)
The 173x Protocol Analyzers, traffic generators and SAN tester help you design, debug, validate and characterize your next generation Fibre Channel equipment

E2920 Series Protocol Analyzer and Exerciser for PCI and PCI-X

Key Literature & Web Link

www.agilent.com/find/spt
www.agilent.com/find/fctester
www.agilent.com/find/pcie2

E2960 Series for PCI Express 1.0 and 2.0

E2960A
E2960B

- Reliable traffic capture and analysis using the x1 to x16 analyzer
- Full system viewing by using P2L gateway to connect the logic analyzer for cross correlation to memory and FSB (front side bus)
- Superior midbus probing with Agilent midbus 2.0: Probe the signal without changing it in any way
- Connect to your device with a passive or active slot interposer probe or a soft touch midbus probe
- Thorough link testing using the x1 to x16 LTSSM exerciser to generate training sequences at speed on all lanes
- Exercising the DUT – the fully featured x16 exerciser drives the DUT to the limits
- Two-in one: A single stimulus and response solution with the exerciser and analyzer
- Unique logic and protocol functionality in a single solution understand the data from layer 1 to the transaction domain
- Faster, easier and more effective PCI Express turn-on, debug, validation and compliance testing
- Combined traffic generation and protocol analysis dramatically increase the test coverage to reduce the risk of costly redesigns and recalls
- Universal hardware platform reduces expenditures for test equipment
- Multiprotocol test/cross bus analysis for semiconductors, cards and systems – simultaneously record PCI Express, Fibre Channel and Advanced Switching Interconnect traffic and transactions and time-correlate them within the same test setup and graphical user interface
- True bidirectional analyzer/exerciser for PCI Express x1, x4, x8 and x16
- Use the exerciser/protocol analyzer capabilities in combination to analyze root causes of problems with ease
- For efficient validation, capture traffic conditions, then drag and drop to reproduce system problems
- Multiport testing allows you to stress all slots with the same load conditions and synchronize the tests
- External trigger in/out to synchronize with other devices
- Intuitive GUI lets you view and set up tests with ease
- LAN interface enables remote control and resource sharing
- USB adapter for ease of use
- Flexible and extendable platform protects your hardware investment

Fastest Time to Insight – The E2960B and E2960A for PCI Express 1.0 and 2.0

E2960B Series for PCI Express 1.0 and 2.0

The E2960B Series for PCIe2™ (5 Gb/s) provides customers with the fastest time to insight by providing an integrated suite of analyzer and exerciser tools. With data capture users can trust and non-intrusive probing customers can spend their time analyzing their design and bringing their product to market quickly.

E2960A Series for PCI Express 1.0

The E2960A protocol analyzer and exerciser is ideal for efficient turn on, debug and validation of your PCI Express 1.0 (2.5 Gb/s) systems and designs and allows you to check them for compliance.

A Complete Solution for Every Stage of PCI Express Development

With the E2960B and E2960A Series for PCI Express 1.0 and 2.0, Agilent provides a complete, integrated and scalable tool chain that supports you in every stage of PCI Express device development. Both the E2960A and the E2960B feature a single solution for stimulus and response (exerciser) and traffic analysis (analyzer) enabling a fully integrated overview, a detailed observation of the DUT's behavior and a consistent look and feel across both exerciser and analyzer.

To thoroughly test your PCI Express systems and devices, you may need to create system conditions that are difficult to reproduce with existing PCI Express equipment. The E2960A/B protocol exerciser and analyzer lets you quickly and easily simulate traffic or capture traffic conditions and recreate them. The protocol exerciser lets you stress all data paths in a system and test corner cases and behavior by inserting errors and protocol violations on each layer (physical, data link and transactional).

E2960A/B Protocol Analyzer for PCI Express Gives you Fast Access to Reliable and Understandable Data

The E2960A/B protocol analyzer for PCI Express captures the traffic or transactions on a PCI Express link and allows you to analyze it and troubleshoot problems to find the root cause. The protocol analyzer provides non-intrusive monitoring of traffic between two PCI Express devices (either a system talking to an add-in card or the exerciser talking to an add-in card or system). With its capabilities in analyzing generated PCI Express traffic, the analyzer is perfectly suited for turn-on and debug of PCI Express systems and designs. It captures and analyzes packets from the physical up to the transaction layer as well as training sequences and ordered sets.

There are analyzer solutions for all link width (x1 up to x16) and speed grades (2.5 Gb/S and 5 Gb/S available). Advanced triggering capabilities that reduce the time needed to detect even difficult to find errors are available on all solutions.

The E2960B features "per lane LEDs" that give an instantaneous feedback on the link, lane and speed status (manual and automatic speed setting), both on the I/O module as well as the GUI. The "per lane display" shows data even prior to channel bonding completion including 8b, 10b or K/D symbols. 2 "Trigger-down-the-lane" patterns allow triggering on ordered sets on selected lanes.

An easy-to-use GUI offers graphical trigger setup, search and filter capabilities to help you intuitively interpret PCI Express transactions. The context sensitive and easy flow technologies allow to display data easily understandable but also very condensed.

E2960A/B Probing Options

The E2960A/B analyzer offers various different probing options to support PCI Express 1.0 and 2.0 probing. Beside others, the probing options comprise interposer probing, midbus probing, express card and flying leads.

The Agilent midbus 2.0 series of probes using soft touch technology gives insight to the system without influencing it. It is a non-intrusive and passive probing option, providing extremely low capacitive loading (less than 150 fF). The Agilent Midbus 2.0 probing solution is available to support various layout requirements and needs.

P2L for Full System Viewing

The P2L gateway enables connecting to the Agilent Logic Analyzer to do time correlated cross bus measurements and cross triggering. Both Logic Analyzer and Protocol Analyzer instruments can be operated from a single PC.

E2960A/B Protocol Exerciser for PCI Express lets you Test and Validate your System's Performance under Varied Conditions

With its fully adjustable parameters, the E2960A/B protocol exerciser lets you emulate any PCI Express design. Furthermore it is capable to generate and respond to any PCI Express packet or sequences of packets. It is an intelligent I/O communication tool that can react as a PCI Express end node or root complex. The E2960A/B exerciser's functionality extends far beyond the capabilities of a simple packet generator. It is tailored to validate corner cases and emulate stress conditions for components on system boards and add-in cards. The protocol exerciser is the ideal tool to test and validate x1 up to x16 PCI Express designs.

The E2960A/B exerciser lets you stress all data paths in your system so you can force it to fail. You can also insert errors and test the behavior of designs in response to these errors to enable worst-case-scenario testing.

Using the x1 through x 16 LTSSM exerciser (Link Training and Status State Machine) training sequences and ordered sets can be generated across all the lane widths, enabling effective testing of the link negotiation and supporting dynamic lane width changes.

Using the passive backplane, you can verify your device in a controlled environment that gives you a quite PCI Express bus independent of a system. The passive backplane features 3 independent busses, all prepared for traffic up to x16 and includes reset, standby power, SSC etc.

N2X Platform Continuity

The E2960A/B protocol analyzer and exerciser for PCI Express are based on the modular system tester platform with Agilent's N2X technology. The universal and upgradeable platform offers multi-protocol and time correlated test/cross bus analysis support for ASI, PCI Express and Fibre Channel applications and protects capital investment. Components from one generation can be reused in the next generation.

The complete software including the GUI is also the same for both series of products, so customers can protect their investment and leverage their existing know-how to start PCIe 2.0 testing immediately.

The APIs are backward compatible so that previously developed scripts can be reused.

Powerful Triggering, Easy Setup

The protocol analyzer's sophisticated trigger capabilities are based on a trigger sequencer. It offers an easy-to-use set up and graphical representation of the trigger sequence. Examples and listed predefined conditions reduce time-consuming trigger setups. You can define up to 8 states, 8 patterns and 2 counters with various actions store, increment counter, trigger out and so on.

Specifications

Specification for E2960B Protocol Analyzer

Display Features

- Highly configurable GUI, based on a configurable tabular view
- Color Customization
- Condensed data view using context sensitive columns
- "Ping-Pong" view of upstream/downstream data with Easy Flow
- Easy navigation within captured trace
- Traffic overview (post capture)
- Per lane display to display data of individual lanes
- Record decode and single line view
- Expand and collapse packets in order to obtain more information Packets with errors are highlighted
- Colour-coded transaction types allow easy recognition of various types of traffic
- Multiple markers with comment functionality
- Display with time-stamps

Trigger Features

- Graphical trigger setup
- Trigger sequencer with up to:
  - 8 states
  - 2 counters/timers
  - 4 pattern terms
  - External trigger in and out
  - Protocol error trigger (disparity error and invalid 10b symbols)
  - Multi-way branching
- Filtering (real time):
  - Idles
  - On a per-packet basis controlled by the trigger sequencer
  - Filter conditions can be defined individually for each trigger sequencer state
  - Storage qualification
  - Trigger on payload (first 1 or 2 dwords)

Traffic Capture Features

- Supports capturing in x1, x2, x4, x8, x16 link width with 2.5 GT/s and 5 GT/s
- Non-intrusive traffic capturing
- Captures training sequences, ordered sets, data-link-layer packets and transaction-layer packets in both directions simultaneously
- Supports data rates 2.5 GT/s and 5 GT/s (±300 ppm)
- Error detection
- Disparity errors and invalid 10b symbols in hardware
- LCRC, symbol, disparity, EDB, framing, idle data Malformed packet check (CRC error, invalid field contents, length mismatch) in software

Other Features

- Analyzer to exerciser traffic record and replay
- Example traces + triggers settings + programming examples
- Timestamps with 8 ns resolution (absolute and relative)
- Automatic lane polarity detection
- 1 GB trace memory
- Latency measurements (using markers)
- External trigger in/out

Exerciser Physical Layer

- Fully automated symbol encoding/decoding, and generation and validation of packet framing; ability to report framing errors to user
- Scrambling can be turned on or off by user
- Configurable, automatic link initialization and training:
  - Automatic Lane Polarity Detection (RX), separate for each lane
  - Programmable Lane Polarity Inversion (TX), separate for each lane
  - Automatic link width negotiation; link widths x1, x4 supported; user can configure which widths will be negotiated during link training
  - Programmable Lane Reversal (TX, RX automatic)
  - Programmable Lane Skew: (±7 symbols, resolution: 1 symbol time)
- Link Training and Status State Machine: Full support for states Detect, Polling, Configuration, Recovery, L1, L0s, L0
- Programmable skip rate and number of SKPs per skip OS

E2960 Series for PCI Express 1.0 and 2.0 (cont.)

E2960A
E2960B

Data Link Layer
- Fully implemented data link control and management state machine
- Automatic flow control initialization; programmable credits and flow control update rate
- Automated generation of data link layer packets (DLLPs): ACK/NAK, Init/Update-FC
- Automatic generation and checking of LCRC and sequence numbers; allows the insertion of incorrect LCRCs into TLPs for testing purposes; automatic retry management

Transaction Layer
- User software can define arbitrary sequences of transactions
- "Send single packet" for simple packet transmission one memory for block transactions per virtual channel
  - Full support for two virtual channels (VCs)
  - Conditional start on RX pattern matcher, external trigger in and completion status
  - Generation and receiving of packets at maximum band width (stress testing) up link width x8 at 5 GT/s Infinite loop
- 1 completer queue defines the way completion packets are sent out (e.g., lengths, errors inserted, partitioning, etc)
  - Completions can be split into individual packets
- Up to 32 outstanding requests can be "pending" (256 in extended mode) – request without completion
- Decoders (6 BARS + Expansion ROM decoder)
- Payload generation and reception from/into data memory

Error Generation and Analysis Features

Error insertion capabilities on the physical layer, data link layer and transaction layer

Physical Layer
- Transmitter polarity inversion
- Transmitter lane reversal
- Deterministic lane skew up to 7 symbols
- Link width and lane sequence negotiation emulating an x1, x4 device
- Sending packet with incorrect "running disparity"
- TX framing errors on TLPs

Data Link Layer
- Sending packets with incorrect LCRC
- Programmatically answers NAK instead of ACK, for retry buffer test
- Wrong sequence numbers

Transaction Layer
- Arbitrary header field contents
- Sending "nullified TLPs"
- Sending "poisoned TLPs"
- Advertised packet length (in TLP header) different from actual packet length (by one DWord)
- The transmitter ignores flow control credits
- Completion loss/delay

Configuration Space Features
- Can emulate the configuration of different types of PCI Express devices
- Supports up to 6 base address registers and expansion ROM decoder
- Full support for PCI Header type 0 configuration space
- Supported Capability Structures:
  - PCI power management capability structure
  - MSI capability structure
  - PCI Express capability structure
- Virtual Channel capability structure

LTSSM Exerciser

Display Features
- Explorer like tree structure to select test
- Display of test log in GUI
- Feedback of state transitions performed
- Timestamp in [ns] for all states
- Link status indications
- Link width x1, x4, x8, x16

Debug Support Features
- External trigger on exit from L0
- Log file output of LTSSM-Exerciser state transitions and Timestamps
- Automatic flow control initialization with infinite credits

Supported States
- Detect
- Polling
- Configuration
- L0
- Recovery

Error injection
- Pre-defined test cases for recovery state

Specification for E2960A

Protocol Exerciser

- Generates and responds to PCI Express packets and packet sequences
- GUI, DCOM application programming interface, TCL interfaces and in-system port control
- Error insertion lets you test corner cases and failure behavior
- Simulate or emulate an PCI Express end node

Perform Realistic Tests with Device Emulation
- Simulate various test scenarios by setting exerciser parameters the way you want
- Minimize the number of real devices needed to create a large-scale test environment
- 2 MB data memory allows you to emulate PCI Express end nodes
- Easily record packets from the protocol analyzer and replay with the exerciser as many times as you want. Use drag and drop or copy and paste functionality or export files from the protocol analyzer
- Use external trigger in/out for cross triggering, event triggering and triggering another device/instrument for more thorough troubleshooting
- Real-time data compare feature allows you to check the integrity of your data to give you more confidence in your results

Increase Test Coverage with Configurable Traffic Generation
- Transmit and receive PCI Express traffic at full bandwidth of x1, x2, x4 and x8 link widths with 2.5 Gbps
- Customize the traffic you send: Generate requests with parameters and behaviors you define
- Use a wide range of real-world traffic conditions
- Validate the boundary conditions of your system
- Generate any combination of PCI Express packets for multiple ports and correlate the test results across time for comprehensive system testing
- Stress your system to the max: test your system under worst-case conditions and see how devices act during error conditions
- Algorithmic data generation/checking feature allows you to compare-incoming packet payload against algorithmically generated reference data
- Fully configurable configuration space, including PCI Express extended capabilities

Real-time Statistics Help you See Immediate Changes in your System's Performance
- Real-time performance counters

Customize your Measurements with Test Automation and Scripting Capabilities
- Control software via the easy-to-use graphical user interface, programmatically through DCOM or TCL interfaces and via an in-system port (via system under test)
- Create and automate your test procedure to eliminate tedious manual testing
- Repeat tests for subsequent product builds
- Protocol checker automatically checks 23 protocol rules based on the PCI Express specification

E2960A
E2960B

Protocol Analyzer

- Non-intrusive traffic capturing for PCI Express x1, x2, x4 and x8
- Root cause and performance analysis
- GUI with graphical trigger setup, search and filter capabilities
- Sophisticated trigger capability with patented dynamic triggering and storage qualifications
- Captures training sequences, ordered sets, data-link-layer packets and transaction-layer packets in both directions simultaneously
- Trigger sequencer with up to:
  - 8 states
  - 2 counters/timers
  - 8 pattern terms
  - External trigger in and out
  - Protocol error trigger
- Supports data rates 1.25 – 2.5 GT/s
- 1 GB trace memory
- Traffic overview
- Packet decode view
- Automated Error detection functionality of disparity errors, invalid 10 b symbols in hardware, LCRC, EDB, framing, idle data and Malformed packet check (CRC error, invalid field contents, length mismatch)
- Hex display
- Separate, cross-correlated packet view
- Customizable view of captured transaction
- Tabular view with configurable columns
- Color-coded transaction types allow easy recognition of various types of traffic
- Expand and collapse packets in order to obtain more information
- Context-sensitive field decoding
- Tool tips for each field provide more information as needed
- Interleaved display, including time-stamps
- Performance counters
- Different connections to the device under test with active, passive and midbus probing
- Traffic activity, port link status, and trace content are simultaneously displayed
- Avoid constant scrolling with the tabular display that maximizes information density on the screen
- See packet details by zooming on multiple lines
- Easily retrieve information with embedded markers
- Quickly find problems with automatic error detection highlighted
- Transaction captured from multiple ports are displayed with common time stamps and common markers
- Multiple analyzers can share events for sophisticated cross triggering
- TCL script capabilities for test automation and customized test development

Key Literature & Web Link

www.agilent.com/find/pcie2
www.agilent.com/find/E2960_series
www.agilent.com/find/PCI_Express

Related Literature Publication Number
The Agilent Test Portfolio for PCI Express 2.0, Brochure 5989-5594EN
Agilent E2960B Series for PCI Express 2.0, Brochure 5989-5610N
Agilent E2960B Series for PCI Express 2.0, Data Sheet 5989-5660EN
Agilent Technologies, System Protocol Tester, Brochure 5989-2526EN
Agilent Technologies, PCI Express Tools, From the Physical Layer to a Fully Operating System, Brochure 5988-7780EN
E2960 Protocol Analyzer and Exerciser for PCI Express, Data Sheet 5988-8679EN
Agilent Technologies, Protocol Test Card for PCI Express, Photocard 5988-9502EN
Agilent Technologies, E2969A Protocol Test Card for PCI Express, Data Sheet 5989-0878EN

Ordering Information

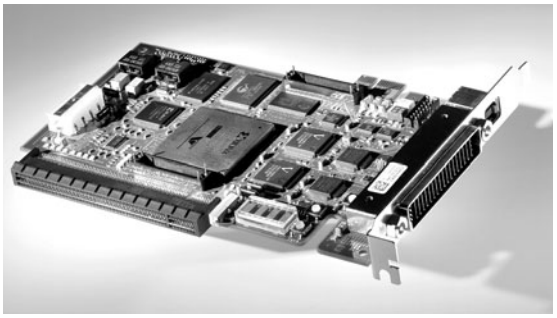
The E2960A and E2960B are available in a variety of setups.

For more details information, visit the product website at **www.agilent.com/pcie2**

E2969A Protocol Test Card for PCI Express

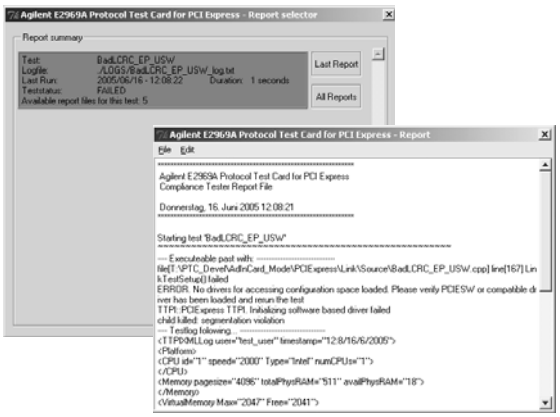
E2969A

- **Fast and easy compliance testing of PCI Express designs**
- **Cost-effective push-button solution**
- **Easy- to-use**
- **Pre-programmed compliance tests**
- **Sophisticated trigger capability and storage qualifications**
- **Support compliance of an PCI Express add-in card and system**



E2969A Protocol Test Card for PCI Express compliance testing.

Graphical User Interface with test selection.



Report Summary Window

The E2969A is a protocol test card for PCI Express, which performs tests in order to verify and ensure compliance with PCI Express specifications as defined by the PCI SIG. The protocol test card is a collaborative development between Agilent and Intel® and will coincide with the Intel product development solutions for PCI Express. In addition the card also guarantees the interoperability of the DUT with other PCI Express devices. It is developed primarily for use by R&D engineers who wish to validate the functional compliance of their PCI Express based designs, including chips, add-in cards or systems. The card is simply plugged into the DUT and is ready for use as soon as the software has been installed. The card supports following operating modes:

- Add-in-card Test Mode
- Known Endpoint Test Mode (KEP)
- Topology/BIOS Simulation Test Mode

The three test modes provide pre-programmed tests, which are executed by means of a Graphical User Interface (GUI). The modes can be selected either via the software (in the GUI) or by setting a dipswitch on the card.

The Graphical User Interface allows the user to select tests and execute them. There are two main windows available in the GUI. All tests in the corresponding mode are listed with name and description relative to the PCI Express Specification. In the description field, tool tips provide a detailed description of each test. Individual or groups of tests can be selected and are executed using the run button. After running the tests, the GUI shows the status of each test by indicating green for passed and red for failed. For more details on the tests, the report window should be selected.

Add-In Card Test Mode

In this mode the PTC is inserted between the system and a PCI Express add-in card to be tested. The Protocol Test Card now acts as switch device between the system and the PCI Express add-in card (the Device Under Test, DUT). The DUT is inserted into the PCI Express slot on top of the Protocol Test Card. The top connector is capable of accepting up to x16 PCI Express cards; however, these will be tested in PCI Express x1 mode. The tests in this mode are used to check the correct behavior and functional compliance of the PCI Express add-in card (DUT). The test software communicates commands to the PTC via PCI Express and performs various tests on the DUT. In this mode it is necessary to power the PTC using the external power connector. A standard AT/ATX Power Connector can be used for this purpose.

The GUI of the PTC monitors the behavior of the add-in card, its device drivers and OS in response to a range of inserted errors.

Known Endpoint Test Mode

In this mode the Protocol Test Card behaves like a known endpoint device. This mode is used for testing chipsets. No other card can be inserted into the Protocol Test Card in this mode. The Protocol Test Card itself acts as a known endpoint. The tests in this mode monitor the behavior of the platform.

Topology/BIOS Simulation Test Mode

This test mode is where the Protocol Test Card appears as a complex PCI Express topology. It aids in verifying the PCI Express compliance of the BIOS, and that it is able to detect and initialize a complex PCI Express topology correctly.

Specifications

- Works in PCI Express x1 mode
- Allows x1, x4, x8 & x16 cards to be plugged in
- Graphical user interface
- Automated pre-canned compliance tests for the Transaction Layer and the Data Link Layer
- Tests power management and configuration space
- Carefully monitors the behavior of the DUT in response to certain error conditions
- Connection to protocol analyzer for root cause analysis of failed compliance tests
- Known endpoint and switch functionality
- Field upgradeable FPGA-based card
- USB 2.0 interface for programming and topology simulation mode
- Can act either as a PCI Express standalone add-in card
- Card controlled via PCI Express or via an external host

Accessories

It is recommended to add the E2960A-A01 Protocol Analyzer for PCI Express x1 to the E2969A test setup so it is possible to debug and trace problems to their root cause. Use the preprogrammed tests to speed your compliance testing. Connect the E2969A PTC to the protocol analyzer and troubleshoot potential out-of-compliance behavior.

Key Literature & Web Link

www.agilent.com/find/E2969_PTC
www.agilent.com/find/E2960_series
www.agilent.com/find/PCI_Express

Related Literature Publication Number

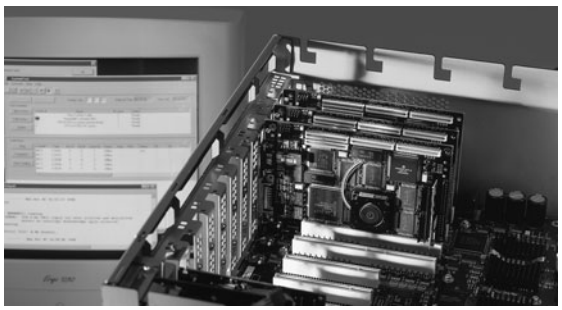
- Agilent Technologies, System Protocol Tester , Brochure 5989-2526EN
- PCI Express Tools, From the Physical Layer to a Fully Operating System, Brochure 5988-7780EN
- Agilent Technologies, E2960 Protocol Analyzer and Exerciser for PCI Express, Data Sheet 5988-8679EN
- Agilent Technologies Protocol Test Card for PCI Express, Photocard 5988-9502EN
- Agilent Technologies, E2969A Protocol Test Card for PCI Express, Data Sheet 5989-0878EN

Ordering Information

Go to the following webpage and request an instant quote for you country via the Agilent online Quick Quote program.
www.agilent.com/find/E2969_PTC

E2928A
E2929B
E2930B
E2940A

- **Support for PCI, PCI-X 1.0/2.0 and CompactPCI**
- **Graphical User Interface**
- **Programming interface (CAPI and TCL)**
- **Analyzer with 2 M state trace memory**
- **Exerciser with split transactions and 1 MB data memory and real-time data generator**
- **Automated real time Protocol Checker with up to 53 rules**
- **Automated test suite with compliance tests**
- **Performance Analysis real time**
- **Patented protocol permutator and randomizer**
- **Fully PCI-X compliant**
- **USB 2.0, external 4 MB fast host interface**
- **Controllable in-system through PCI-X**



PCI Server during system validation with the Agilent E2928A

PCI/PCI-X Series Exerciser & Analyzer

The Agilent E2920 PCI/PCI-X Series of Verification Tools is a family of test tools designed to provide an early and extensive insight into PCI/PCI-X-based designs, revealing and solving design problems sooner throughout the entire development process, from initial bring-up of devices and systems, through to system validation.

The tools supplied with the E2920 PCI/PCI-X Series not only help you get your new designs to market faster, but also give you the confidence of knowing your product will perform in any conceivable situation.

For more information visit or web site:
www.agilent.com/find/pci_overview

Evaluate: Getting Your Design Off to a Good Start

In the early stages of your PCI/PCI-X based prototype evaluation, you need to analyze the behavior of your system, device or firmware and detect the cause of any errors or problems as early as possible during the bring-up and debugging. The PCI/PCI-X Analyzer features a PCI/PCI-X state logic analyzer, real-time protocol and timing checkers, real-time performance measures and a PCI/PCI-X optimized trigger, giving you a fast overview of your system status.

PCI/PCI-X bus traffic from the state waveform level up to data transfer level can be captured and analyzed, allowing the observation of traffic at a level meaningful to the problem. The identification and triggering of protocol violations is possible at any time.

For more information visit our web site:
www.agilent.com/find/pci_evaluate

Optimize: Overcoming the First Hurdles

Optimizing a PCI or PCI-X design means applying your expertise to the analysis of traffic and of bus performance and then applying what you find to help improve your devices. The PCI/PCI-X Performance Optimizer is a powerful tool, which provides you with an in-depth real-time and post processing performance analysis, giving hints for performance optimization. The PCI/PCI-X Exerciser plays an active role in the analysis of complex PCI/PCI-X scenarios by letting you set up worst case traffic patterns quickly and allowing errors to be easily reproduced for deeper investigation. Identifying bottlenecks and true performance potential helps you optimize your design.

For more information visit our web site:
www.agilent.com/find/pci_optimize

Validate: Ensuring Reliability in the Long Run

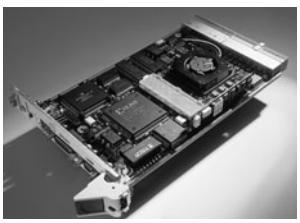
Validating your PCI/PCI-X device means ensuring its reliability in the long run. The E2920 PCI/PCI-X Series use the PCI/PCI-X bus as the "standard" interface to validate a system. Variable levels of background traffic can be generated and typical peripheral traffic patterns emulated to stress arbitration, memory controller, bridges and system interrupts. The System Validation Package (Opt 310) provides a set of tests for testing particular sub-systems. The C-Application Programming Interface (C-API) available with the Protocol Permutator and Randomizer (PPR)(Opt 320) enables full range testing. Automatic protocol permutations within user-defined constraints, enable optimum test coverage of PCI/PCI-X behavior of a device or system, in the minimum amount of time.

For more information visit our web site:
www.agilent.com/find/pci_validate

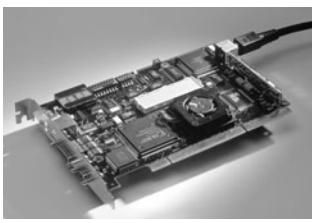
System Description

The PCI/PCI-X Exerciser and Analyzer is delivered as a single, short card, which requires plugging into the system that needs to be tested. Plugging other PCI/PCI-X devices into the system-under-test enables these devices to also be tested.

The E2920 PCI/PCI-X Exerciser and Analyzer can either be externally controlled by a RS-232, a 4 MB fast host interface, USB (E2929B), USB 2.0 (E2930B), or through the system-under-test via PCI/PCI-X.



Compact PCI Exerciser/Analyzer Card



PCI-X Exerciser/Analyzer Card

Key Literature

E2930B Technical Specifications, p/n 5989-0387EN
E2920 Verification Tools, PCI/PCI-X Series, Color Brochure, p/n 5968-9694E
E2928A, Technical Specifications, p/n 5968-3506E
E2922B, Technical Specifications, p/n 5968-9577E
E2929B, Technical Specifications, p/n 5968-8984E
E2940A, Technical Specifications, p/n 5968-1915E
System Validation Package, Technical Overview, p/n 5968-3500E

For customer reference stories/application notes and latest ordering information, please visit our web site: **www.agilent.com/find/pci_overview**

Software/Graphical User Interfaces

The PCI/PCI-X Analyzer Graphical User Interface is a comprehensive Windows graphical user interface for the PCI/PCI-X exerciser and analyzer's on-board logic analyzer. It allows the analysis of bus traffic quickly and easily:

- Easy setup of trigger sequences and storage qualification for the on-board PCI/PCI-X state logic analyzer
- Real-time PCI/PCI-X protocol checker
- State Waveform Lister displays waveform trace of all PCI/PCI-X signals, sideband I/O and internal bus state signals
- Bus Cycle Lister disassembles bus traffic at state level, with comprehensive error reporting including cross references to PCI/PCI-X specification
- Bus Transaction Lister summarizes bus transfer at address and data level

The PCI/PCI-X Exerciser Graphical User Interface (comes with #300) is a comprehensive Windows graphical user interface, which controls the PCI/PCI-X exerciser and analyzer's programmable PCI/PCI-X master and target:

- Configuration Space Editor to set up the configuration space
- Master Transaction Editor to set up master transactions and protocol behavior and requester/completer for PCI-X
- Target Attribute Editor to set up protocol behavior for the target
- Data Memory Editor to view/modify the on-board memory content

PCI/PCI-X Exerciser and Analyzer Comparison Table

	E2940A	E2928A	E2929B	E2930B
Data-Path Width	32/64 bit	32/64 bit	32/64 bit	32/64 bit
Addressing	32/64 bit DAC	32 bit/64 bit DAC	32 bit/64 bit DAC	32 bit/64 bit DAC
PCI Clock Range	0...66 MHz Analyzer 0...33 MHz Exerciser	0...66 MHz	0...133 MHz	0...133 MHz (200 MT/S)
State PCI Logic Analyzer Trace Memory	64 K on-board/ 4 M (E2995A)	64 K on board/ 4 M (E2995A)	#100, 2 M on board	4 M on board
Mechanical	Compact PCI card	PCI short card	PCI-X short card	PCI-X short card
Fast Back to Back (master)	Yes	No	N/A	N/A
Target Decode Speed	Fast/Medium/Slow	Fast[1]/Medium/Slow	Fast/Medium/Slow	Fast/Medium/Slow
LOCK Control	Lock/Hide/Unlock	No lock control	No lock control	No lock control
Programmable Clock Delay Between Transactions	0 to 2,000,000	0 to 2,000,000	1 to 65,536	1 to 65,536
Real-Time Counter Size	64 bit	64 bit	64 bit	64 bit
Signal Levels	3.3/5 V	3.3/5 V	3.3 V	3.3/1.5 V
Temperature Range	–40°C to 70°C	–40°C to 70°C	–40°C to 70°C	0°C to 50°C
Trigger I/O	12	12	4	4
Data Memory	512 KB	512 KB	1 MB	4 MB
Real-Time Checked Protocol Rules	53	53	53	over 64
Control Interfaces	RS 232, fast host interface, PCI	RS 232, fast host interface, PCI	RS 232, fast host interface, USB, PCI-X	USB 2.0
PCI Compatibility	PCI 2.1	PCI 2.1	PCI-X 1.0	PCI-X 2.0

[1] Fast, decode speed up to 66 MHz.

The PCI/PCI-X Performance Optimizer (comes with #200) is a comprehensive Windows graphical user interface using the exerciser and analyzer capabilities to help engineers optimize performance (not available for the E2930B). It features:

- Performance analysis with real-time counters and in-depth post processing
- Hierarchical data representation for fast problem detection and in-depth root cause analysis with report generation
- Numerable ready-to-go tests: data transfer rate, data efficiency, bus usage, retry rate

The System Validation Package (comes with #310), which is a ready-to use software package running on Windows to perform system stress test during system validation. It automatically sets-up tests to stress the computers data paths from:

- CPU and Exerciser to system memory
- Exerciser to system memory
- CPU to Exerciser memory space
- CPU to Exerciser I/O space
- Peer to peer traffic
- Master to target traffic

C-API and PCI/PCI-X Protocol Permutator & Randomizer Library (comes with #320), which provides automatic PCI/PCI-X protocol permutations within user-programmed constraints. It features:

- Reduced and predictable test time, as use of the system CPU is not required
- PCI/PCI-X master and target support
- Comprehensive reports of performed protocol variations

The following accessories are available for the E2920 Verification Tools, PCI/PCI-X Series:

Agilent Products	E2940A	E2928A	E2929B	E2930B
E2991A External Power Supply		✓	✓	✓
E2993A External Agilent Logic Analyzer Adapter		✓		
FS2104 Future Plus Logic Analyzer Adapter			✓	
E2994A General Purpose Logic Analyzer Adapter		✓		
E2995A 155 x 4 M Trace Memory		✓		
E2996A 155 x 4 M Trace Memory	✓			
System Test Library	✓	✓	✓	

In addition, the E2922B PCI-X Master Target Card is available for larger labs with multiple test benches.

173x Fibre Channel Protocol Test Tools

1733A
1733L
1735A
1736A
1736B

- **1 Gb/s, 2 Gb/s, 4 Gb/s and 8 Gb/s Fibre Channel – test current and next generation Fibre Channel systems**
- **One system, Multiple Applications – same hardware can be used for Protocol Analysis, Traffic Generation, or Device Emulation (SAN Testing). This reduces you capital expenditures and increase productivity**
- **Full Featured, Intuitive Operation – focus on solving your problems, not on mastering your debug tools. Set up measurements easily and navigate through your data quickly with the intuitive user interfaces**
- **Reproduce Complex Traffic Conditions – easily reproduce problems with sophisticated traffic generation capabilities**
- **Modularity and Expandability – purchase the capability you need now, then expand as your needs evolve. The same platform can be used from the design phase to system deployment, installation and maintenance. A small, lightweight chassis is available for portable or desktop testing. Users can easily daisy chain up to three racks of high-density Chassis for large test configurations**
- **Multi-User system and Remote Connection – increase your productivity and maximize your test system usage by local or widely-distributed teams with offline analysis, remote control and programmability features**

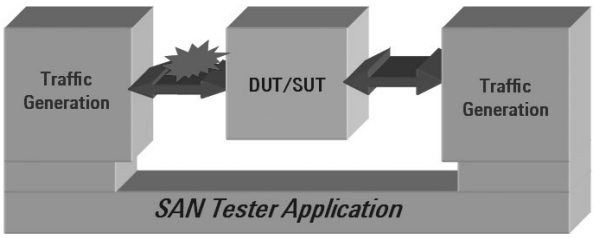
The Agilent 173x Series Fibre Channel Test Solution provides an efficient way for semiconductor manufacturers, network equipment manufactures and storage solution integrators to introduce high-quality products to the market. The 173x Series accelerates the configuration, validation, characterization and debugging of Fibre Channel equipment, while significantly reducing the number of test devices needed.

A traditional Fibre Channel test environment includes active test tools that generate traffic conditions needed to test all of the fabric and equipment capabilities, together with passive protocol analyzers to transparently monitor protocol communications within the network. There are significant challenges related to the integration of heterogeneous test tools and various APIs in a common test environment. The Agilent 173x Series, with its modular and scalable architecture combines Fibre Channel Protocol Analysis, Traffic Generation and Fabric Performance Measurement in a common versatile, multi-user N2X chassis, helping you gain instant insights into your system with multiple applications and analysis tools.

Typical Customers

Typical customers for the 173x Series fibre channel test system include :

- Fibre Channel switch manufactures
- Storage extension device manufactures
- DWDM equipment providers
- Storage IC providers
- Storage equipment manufactures
- Server manufactures
- Storage integrators
- Service providers deploying storage services



Edge Device Emulation

SAN Tester Software Application (Active Test)

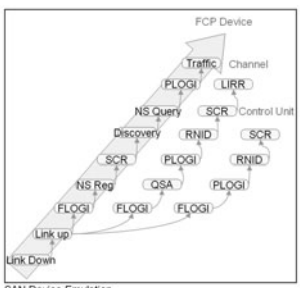
The SAN tester software is an Active Test application that helps you stimulate your Fibre Channel design with configurable traffic. The SAN Tester application will also characterize the performance and scalability of your Fibre Channel design using real-time measurements including Throughput, Latency, Lost Frames and Errors. The SAN Tester application can be used to test Fibre Channel Semiconductors, Switches, Directors & Fabrics.

Using the SAN Tester software application, each test port can be configured as one or multiple Fibre Channel devices sending and receiving wire speed traffic to other devices. Port to port, partial mesh and full mesh configurations can be created, testing your devices with realistic or extreme traffic conditions.

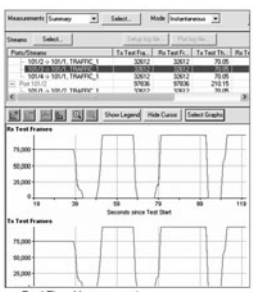
The SAN Tester software application provides extensive parametric control of wire speed Fibre Channel traffic generation and real time continuous monitoring of performance, robustness, reliability of SAN systems. Thanks to the scalability of the Agilent platform, it can test individual devices to large-scale SAN infrastructures.

Features of the SAN Tester software application includes:

- Flexible port emulation – test ports can be configured in N_port or L_port mode
- Configurable device emulation – test ports or emulated devices can be configured to mimic different HBAs and different initialization process
- Multi-protocol support – test ports can be configured as Fibre Channel Protocol (FCP) or FICON devices
- Variable Traffic Modes – varies traffic modes exist to better simulate real network conditions. Traffic load can also be modified in real time to identify the knee of the system's performance curve
- Real time measurement – each test port acquires continuous real-time traffic statistics for better insight into how your system is performing. Statistics reported include throughput, latency, lost frames, CRC errors and sequence errors

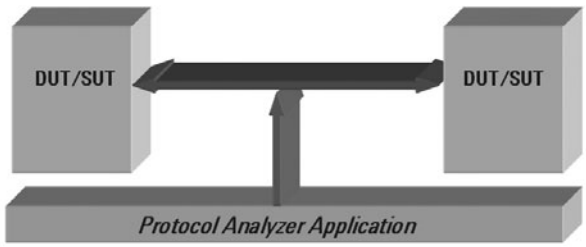


SAN Device Emulation



Real Time Measurement Graphs

Protocol Analyzer Software Application



Passive Monitoring

The Protocol Analysis software application helps you passively monitor the communication between 2 or more Fibre Channel devices. With effective presentation, the protocol analysis application helps you quickly understand what is being communicated and the exact timing of the communication between the multiple devices on the network.

Using the Protocol Analysis software, each analyzer is able to capture relevant information by combining a deep trace and an intuitive dual channel, state based triggering and filtering engine. The application also contains Agilent unique features such as Easy Flow visualization, comprehensive decoding, extensive pattern libraries, drag and drop functionality, helping you quickly find the root cause of problems.

Features of the Protocol Analysis Application include:

- Dual Channel, Multi-state triggering engine – ensures the problem event is actually captured
- Easy Flow visualization – graphically depicts the precise time and flow of information through multiple analyzers
- Context Sensitive Columns – displays only relevant protocol field to maximize understanding the protocol interaction
- Multi-protocol platform – provides cross correlation to other protocols in the same platform

SAN Director Tester

The Agilent Technologies 1733L SAN director tester simplifies the testing of director-class switches in QA and manufacturing environments. Now you can easily generate I/O traffic to test the performance and availability of your director switches while lowering your overall cost of test.

Existing test methods of using a large number of PC controllers, or a "wall of PCs", to generate I/O traffic to stress the director switch has a number of limitations, including lack of centralized control, unable to scale and cost considerations in terms of power and space consumption.

The 1733L SAN Director Tester is small and compact. With realistic Fibre channel 4 Gb/s traffic generation and real time measurements on all 128 ports, and by providing a centralized multiport control panel the 1733L SAN director tester simplifies test setup, execution and analysis, resulting in faster test completion.

Specifications

Technical Specifications for the 173x Series

Physical Interface
Number of Ports
- Up to 4 SAN Tester ports per module
- Up to 2 pairs of Protocol Analyzers per module (4 ports)

Interface Rates Supported
- Supports 1.0625, 2.125, 4.25 or 8.5 Gigabits/second (Gb/s)
- Industry Standard SFP Interface

Programming Languages
Tcl/Tk with graphical interface

Technical Specifications for the SAN Tester Application

Port Type
N_port, Arbitrated loop port (including up to 126 loop devices)
Port Behavior
- Control of port initialization either as FCP or FICON port
- FCP includes control of Flogi, NS registration, RSCN, Discovery, NS Query
- FICON includes control of Flogi, QSA, RNID, RSCN, LIRR

Classes of Service
Class 2 (FICON initialization) and Class 3 traffic
Traffic Profiles
15
Traffic Streams
256 streams per port
Oversized Frame
Oversized frames traffic generation and capture
Interframe Gap
Adjustable from 3 to 1000 IDLEs
Minimum Frame Length
Transmit: 24 bytes, Receive: 24 bytes
Buffer-to-buffer Credit
Adjustable from 1 to 256
Error Generation
Aborted frame, CRC error, oversized frame, invalid SOF, invalid EOF, LOS, Invalid Ordered Sets
Measurements (173x in SAN Tester Mode)
24 real-time measurements including throughput, latency, dropped frames, disparity errors, CRC errors, BB credit, failover recovery time
Result Types
- Cumulative: measurements are reported from the start of the measurement interval
- Instaneous: measurements are reported from the most recently completed sampling interval

Measurement Clock Resolution
10 ns resolution; ±0.5 ppm/year clock drift; 3 ppm maximum difference between cards
Measurement Interval
Range: 1 second to 7 days
Display Sampling Interval
Range: 1 second to 1 hour
Test Card Synchronization
All measurements are synchronized across all test cards within the SAN Test System
Capture Memory (in SAN Tester Application)
32 MB real time memory per port
Capture Triggers
8 patterns per port, as well as triggering capabilities on statistics (throughput, latency, sequence error)
Fabric Service Test
- Fabric Zoning test
- Name server performance
- Name server command coverage
- State change notification

Automation
A suite of pre-defined tests in the QuickTest frame work are available, including tests for Throughput, Latency, State Change Notification, Failover recovery time

Technical Specifications for the Protocol Analyzer Application

Analyzers
- Two independent, dual port, full-duplex analyzers per module
- Each analyzer has its own triggering and filtering resources

Traffic Capture
Each analyzer captures bidirectional traffic between 2 fibre channel devices
Memory Size
1 GB per analyzer (2 GB per module)

1733A
1733L
1735A
1736A
1736B

Trigger
- 2 independent multilevel trigger sequencers per module with multiway branching
- Dual channel triggering, trigger on sequence of events in with specified directions (Tx and Rx)
- 8 states per trigger sequencer

Resources
2 counter/timers (for trigger on time-outs) per sequencer
Pattern Matchers
8 128-byte pattern matchers (primitives or frames) with associated local counters
Global Timers
Two 48-bit (7-day) global timers with associated reset
Counters
Two 24-bit global counters that count up/down and have an associated reset
Flexible Visualization
- Easy Flow – GUI feature to highlight protocol interactions in the trace
- Context Sensitive Display – displays only relevant fields to maximize trace understanding

Combinations
'AND' or 'OR' conditions between pattern matchers
Cross Triggering (internal)
Cross-module arm in/out for inclusion in sequencer events coming from another analyzer
Cross Triggering (external)
1 external trigger in/out per chassis
Filters
Hardware filter conditions can be defined individually for each sequence level
Error Detection
Disparity, code violation, CRC error, undersize frames, oversized frames, loss of sync
Frame Truncation
Beginning at the SOF, specified number of FC words are captured to memory – effectively deepening the trace
Resolution
8.3 ns TimeStamp resolution
Time Correlation
- All analyzers in the same session share the same clock to allow for time-correlated measurements
- Time correlation on up to 128 modules (256 analyzers)

Search
High-speed hardware assisted search
Trigger In/Out
1 external trigger in/out per chassis

Technical Specifications for the SAN Director Tester Application

Number of Ports
128 ports per SAN director tester. The 128 ports can be used as two separate 64 port test system
Line Rate
2.125 or 4.25 Gigabits/second (Gb/s). Industry-standard SFP interface. Shipped with 850 nM SFP
Port Type
N_port
Port Behavior
- Includes full parameter control of Flogi
- Ability to enable or disable; NS registration, Discovery of devices, and PLOGI

Classes of Service
Class 3 traffic
Traffic Profiles
15
Traffic Streams
256 streams per port
Oversized Frame
Oversized frames traffic generation
Inter-frame Gap
Adjustable from 3 to 1000 IDLEs
Minimum Frame Length
Transmit: 24 bytes, Receive: 24 bytes
Buffer-to-buffer Credit
Adjustable from 1 to 256
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Aborted frame, CRC error, oversized frame, invalid SOF, invalid EOF, LOS, Invalid Ordered Sets

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24 real-time measurements including throughput, latency, dropped frames, disparity errors, CRC errors, BB credit, failover recovery time
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- Cumulative: measurements are reported from the start of the measurement interval
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Measurement Clock Resolution
10 ns resolution; ±0.5 ppm/year clock drift; 3 ppm maximum difference between cards
Measurement Interval
Range: 1 second to 7 days
Display Sampling Interval
Range: 1 second to 1 hour
Test Card Synchronization
All measurements are synchronized across all test cards within the 1733L SAN Director Test System

Key Literature & Web Link

www.agilent.com/find/fctester
www.agilent.com/find/santester

Ordering Information

The Agilent 173x Series Fibre Channel Test Solution consists of a system controller and multiple chassis hosting 173x Series test cards. The system controller provides a graphical interface to drive the SAN Tester, Protocol Analyzer or SAN Director Tester software applications and the test cards being used. This flexible test system will be able to incorporate new Agilent 173x test cards in the future, thereby protesting your investment.

System Controller
Several system controllers are available, depending on performance requirements. The controller provides an easy-to-use Windows® environment for running the test system software.
N5543A Portable Laptop System Controller
N5544A Standard 1U Rack-mount Server Controller
N5545A High-performance 1U Rack-mount Server Controller

Option
N5545A-AQ2 15-inch Flat Panel Display: 1024 x 768

Chassis
The compact, 4-slot, 2U-high chassis houses up to 4 Fibre Channel test cards. An ultra-compact 2-slot chassis houses up to 2 Fibre Channel test cards. You can easily daisy-chain multiple chassis to support hundreds of test ports in a single test system. You can move hot-swappable test cards between chassis without affecting other test sessions.
N5540A 2-slot, 2U-high chassis
N5541A 4-slot, 2U-high chassis

Fibre Channel Test Card
High-density, scalable Fibre Channel SAN test cards are equipped with powerful traffic generation and measurement capabilities. There are 3 types of cards to choose from depending on your test needs.
1733A 2 Gb/s and 4 Gb/s, 4-port Active Test Card
1735A 1 Gb/s, 2 Gb/s, and 4 Gb/s 2 Port Multifunction Protocol Analyzer and SAN Tester
1736A/B 1 Gb/s, 2 Gb/s, 4 Gb/s and 8 Gb/s Fibre Channel Multifunction Protocol Analyzer and Traffic Generator

Options
173X-A00 Fibre Channel Protocol Analysis License and Software
173X-ST0 SAN Tester License and Software

- **Modular, flexible and scalable design to fit testing needs from a few Mb/s up to 45 Gb/s**
- **Generate complex sequences & analyze data in real-time**
- **Up to 64 parallel input and output channels at rates up to 13.5 Gb/s**
- **Addresses: MUX, FEC, CEI, AMB, PON, PCIe, SAN, GbE, SONET/SDH**

The ParBERT 81250 parallel bit error ratio tester provides extremely fast parallel BER testing for high-speed digital communication ports, components, chips or modules. Application examples are:

- MUX/DeMUX testing up to OC-768
- FEC device testing
- Multiple transmitter/receiver testing; PON
- Characterization of computing ports; SAN, FC, GbE, AMB
- Characterization of communication ports; SONET/SDH
- Differential input and output; SFI-4, SFI-5, Xaui

The ParBERT 81250 is a modular, flexible and scalable platform with a very comprehensive software and measurement suite designed to fit your application needs.

The system generates complete pattern sequences based on pseudo random word sequences (PRWS), user-defined patterns and standard PRBS up to 2^31-1 on parallel lines. Depending on the data module's speed class, the user pattern length is from 2 Mb up to 128 Mb. This enables fast BER measurements as bits are compared in real-time. The BER can be viewed while a measurement is running.

The ParBERT analyzers can automatically synchronize the incoming data stream. Based on the BER measurement the ParBERT offers a measurement suite:

- BER measurement (One-/Zero Errors, accumulated Errors...)
- Fast eye mask measurement (Mask Test with Pass/Fail)
- DUT output timing measurement (RJ, DJ, TJ, Phase Margin)
- Spectral decomposition of jitter (Spectral Jitter Analysis)
- DUT output level measurement (High/Low level, Amplitude, Q-factor)
- Eye opening (3-Dimensional Eye Analysis Voltage-Time-BER)

The ParBERT 81250 offers independently programmable timing and level parameters on every channel. It can generate and analyze single-ended and differential signals – including differential signals to test devices based on logic technologies such as LVDS, ECL and PECL.

The 3.35 Gb/s and 13.5 Gb/s ParBERT Generator modules offer a delay control input for jitter injection for receiver input stress test. With enhanced jitter generation and analysis capabilities and its broad frequency range, the 13.5 Gb/s ParBERT Generator and Analyzer modules are the ideal solution for testing 10 Gb/s devices like OC-192 devices. These modules work with the E4809A clock module only.

Accessories

15440A Adapter Kit: 4* SMA (M) I/O Adapters
15441A Cable Kit: 10*SMA (m) to SCI Connector
15442A Cable Kit: 4*SMA (m) to SMA (m)
15443A Matched Cable Pair
15446A 8-line Trigger Input Pod
15447A Deskew Probe
N4871A Cable Kit: SMA Matched Pair, 50 ps
N4910A Cable Kit: Matched Cable Pair for 13.5 Gbs
N4911A-002 Adapter 3.5 mm Female to 2.4 mm Male
N4912A 2.4 mm 50 Ohm Termination, Male Connector
N4913A 4 GHz Deskew Probe

Key Literature & Web Link

Agilent ParBERT 81250 Parallel Bit Error Ratio Tester Product Overview, p/n 5968-9188E
Agilent ParBERT 81250: 10 GbE Testing with 81250 ParBERT Application Note, p/n 5988-8278EN
10 GbE Technology and device Characterization Product Note, p/n 5988-6960EN
Agilent ParBERT 81250 Measuring a real 43.2 Gb/s eye pattern Product Note, p/n 5988-6625EN
Agilent ParBERT 81250 Automatic Phase Margin Measurements at 43.2 Gb/s, p/n 5988-5654EN
Jitter Fundamentals: Jitter Tolerance Testing with Agilent 81250 ParBERT Application Note, p/n 5989-0223EN
Jitter Fundamentals: Agilent 81250 ParBERT Jitter Injection and Analysis Capabilities and Application Note, p/n 5988-9756EN
10 GbE Technology and Device Characterization, p/n 5988-6960EN

www.agilent.com/find/parbert

Specifications

Data Modules

	E4832A	E4861A	E4861B
Maximum Data Rate	675 Mb/s	2.7 Gb/s	3.35 Gb/s
Front End Slots per Module	4	2	2
Memory Depth per Channel	Up to 2 Mb	Up to 8 Mb	Up to 16 Mb
Segments PRBS, PRWS	User defined patterns and PRBS 2^n-1, n=7, 9, 10, 11, 15, 23, 31		
Auto-Synchronization	On PRBS and memory based data by: – Bit synchronization with or without automatic phase alignment – Automatic delay alignment around the start sampling delay		
Usable Front Ends	E4838A E4835A	E4862A E4863A E4864A E4865A	E4862B E4863B

Data Generator Front Ends

	E4838A	E4864A	E4862A	E4862B
Maximum Data Rate	675 Mb/s	1.65 Gb/s	2.7 Gb/s	3.35 Gb/s
Outputs	1, differential or single-ended	1, differential or single-ended	1, differential or single-ended	1, differential or single-ended
Data Format	RZ, R1, NRZ, DNRZ	NRZ, DNRZ clock: duty cycle 50% + 10% typ.	NRZ, DNRZ clock: duty cycle 50% + 10% typ.	NRZ, DNRZ, RZ, R1
Transition Times	0.5 ns – 4.5 ns (0.35 ns typ.) @ ECL (10% – 90%)	90 ps typ. @ ECL, LVDS (110 ps typ. @ $V_{pp\,max}$) (20% – 80%)	90 ps typ. @ ECL, LVDS (110 ps typ. @ $V_{pp\,max}$) (20% – 80%)	<75 ps (60 ps typ.) (20% – 80%)
Amplitude/Resolution	<0.1 to 3.5 V_{pp}/10 mV	0.05 to 1.8 V_{pp}/10 mV	0.05 to 1.8 V_{pp}/10 mV	0.05 to 1.8 V_{pp}/10 mV

Data Analyzer Front Ends

	E4835A	E4865A	E4863A	E4863B
Maximum Data Rate	675 Mb/s	1.65 Gb/s	2.7 Gb/s	3.35 Gb/s
Inputs	2, differential or single-ended	1, differential or single-ended	1, differential or single-ended	1, differential or single-ended
Impedance	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential
Input Threshold	–2.0 to +4.5 V	–2.0 to +3.0 V	–2.0 to +3.0 V	–2.0 to +3.0 V

Data Generator Module

	N4874A	N4872A	E4868B 45 Gb/s MUX Module
Maximum Data Rate	7 Gb/s	13.5 Gb/s	43.2 Gb/s (with E4861A + E4862A) 45 Gb/s (with E4861B + E4862B)
Outputs	1, differential or single-ended	1, differential or single-ended	differential
Data Format	NRZ, DNRZ	NRZ, DNRZ	NRZ
Transition Times	<25 ps (10% – 90%)	<25 ps (10% – 90%)	9 ps typ. (20% – 80%)
Amplitude/Resolution	0.1 to 1.8 V_{pp}/5 mV	0.1 to 1.8 U_{pp}/5 mV	0.5 to 2.0 V single ended/10 mV
Average Output Power Level	—	—	—
Extinction Ratio Range/ Resolution/Accuracy	—	—	—
Memory Depth per Channel	Up to 64 Mb	Up to 64 Mb	128 Mb
Segments PRBS, PRWS	User defined patterns and PRBS 2^n-1, n=7, 10, 11, 15, 23, 31 (HW based)	User defined patterns and PRBS 2^n-1, n=7, 10, 11, 15, 23, 31 (HW based)	User defined patterns and PRBS 2^n-1, n=7, 10, 11, 15, 23, 31 (pure PRBS)
Auto-Synchronization	On PRBS and memory based data by: – Bit synchronization with or without automatic phase alignment – Automatic delay alignment around the start sampling delay		—

Specifications (cont.)

Data Analyzer Module

	N4875A	N4873A	E4869B DEMUX Module
Maximum Data Rate	7 Gb/s CDR around 1/2/4 Gb/s	13.5 Gb/s CDR around 1/2/4/10 Gb/s	43.2 Gb/s (with E4861A + E4863A) 45 Gb/s (with E4861B + E4863B)
Inputs	1, differential or single-ended	1, differential or single-ended	differential
Impedance	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω
Input Threshold	–2.0 to +3.0 V	–2.0 to +3.0 V	± 400 mV
Sensitivity	50 mV	50 mV	50 mV

Clock Module

	E4805B	E4808A	E4809A
Frequency Range	1 kHz to 2.7 GHz	170 kHz to 10.8 GHz	20.8 MHz to 13.5 GHz
Resolution	1 Hz	1 Hz	1 Hz
Accuracy	±50 ppm with internal PLL reference	±50 ppm with internal PLL reference	±50 ppm with internal PLL reference
Clock Jitter	<10 ps rms (5 ps typ.)	<10 ps rms (5 ps typ.)	~2 ps rms
Compatible Data Modules	E4832A/E4861A	E4832A/E4861A/ E4861B/E4868B/ E4869B/E4810A/ E4811A	E4832A/E4861B/ E4810A/E4811A/ N4871A/N4872A/ N4874A/N4875A

Ordering Information

Mainframe
81250A ParBERT 81250
- **81250A-013** IEEE 1394 PC link to VXI
- **81250A-014** External PC
- **81250A-015** Laptop including PCMCIA IEEE 1394 Card
- **81250A-149** Mainframe
- **81250A-152** IEEE 1394 'FireWire' Expander Frame

Software
E4875A One License and Software CD ROM for ParBERT 81250

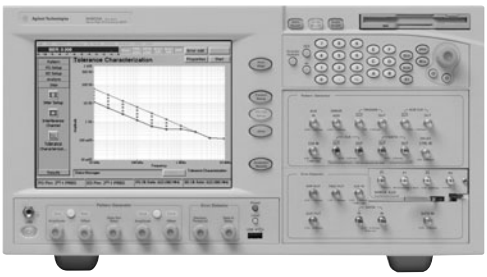
Clock Modules
E4805B 675 MHz Central Clock Module
E4808A High Performance Central Clock Module
E4809A 13.5 GHz Central Clock Module

Data Modules & Front Ends
E4832A 675 Mb/s Generator/Analyzer Module
E4835A Two Differential Analyzer Front-ends, 675 Mb/s
E4838A Differential Generator Front-end, 675 Mb/s
E4861A 2.7 Gb/s Generator/Analyzer Module
E4864A Generator Front-end 1.65 Gb/s
E4865A Analyzer Front-end 1.65 Gb/s
E4862A Generator Front-end 2.7 Gb/s
E4863A Analyzer Front-end 2.7 Gb/s
E4861B 3.35 Gb/s Generator/Analyzer Module
E4862B Generator Front-end 3.35 Gb/s
E4863B Analyzer Front-end 3.35 Gb/s
N4874A Generator Module 7 Gb/s
N4875A Analyzer Module 7 Gb/s
N4872A Generator Module 13.5 Gb/s
N4873A Analyzer Module 13.5 Gb/s
E4868B 45/43.2 Gbit/s Multiplexer Module
E4869B 45/43.2 Gbit/s Demultiplexer Module

J-BERT High-Performance Serial BERT N4903A 12.5 Gb/s and 7 Gb/s

N4903A

- **Operating range 150 Mb/s to 7 Gb/s or to 12.5 Gb/s provides enough margin for today's and tomorrow's serial interfaces**
- **Built-in, compliant and calibrated jitter injection with >0.5 UI (option J10). All in one box: PJ, SJ, RJ, BUJ for stressed eye testing of a receiver**
- **Interference channel plug-in with ISI and sinusoidal interference for emulating channel and noise effects (option J20)**
- **Automated jitter tolerance test saves programming time (option J10)**
- **Transition times <20 ps and jitter <9 ps pp for accurate measurements**
- **Built-in Clock Data Recovery (CDR). Tunable loop bandwidth and compliant CDR settings (option CTR)**
- **Differential pattern and clock generation and differential analysis**
- **Sub-rate clock outputs with any ratio 1:n**
- **Bit recovery mode to analyze undeterministic traffic (option A01)**
- **External Delay Control Input for injection of external jitter**
- **SSC clocking (option J11)**
- **Fast Total Jitter and measurement suite**
- **Remote programmable via GPIB, LAN, and USB interfaces. Compatible with existing command set Agilent 71612, 81630 series, N4900 series**
- **Bench use with intuitive touch-screen user interface based on Windows XP**
- **Applications: PCI Express®, SATA, Fully-buffered DIMM, Display Port, Fibre Channel, CEI, 10 Gb Ethernet, XFP/XFI**



The Smartest Way to Accurate Jitter Tolerance Test and Characterization

The J-BERT N4903A High-Performance Serial BERT provides the only complete jitter tolerance test solution for characterization of serial gigabit devices.

It offers complete, integrated and calibrated jitter composition for stressed eye testing of receivers up to 12.5 Gb/s. Automated and compliant jitter tolerance testing allows quick and accurate characterization for all popular serial bus standards, such as PCI Express, SATA, FB-DIMM, Display Port, Fibre Channel, CEI, 10 Gigabit Ethernet and XFP/XFI.

The J-BERT matches the latest serial bus interfaces perfectly with its ability to analyze undeterministic traffic with idles from the DUT with the analyzer's Bit Recovery Mode. The pattern generator allows setting up complex pattern sequences to bring a device into loop back mode. To match LVDS and other low voltage standards, all clock, data inputs and outputs are differential and can handle small amplitude swings.

Clockless interfaces can be analyzed with the built-in CDR with tunable loop bandwidth (option CTR). The J-BERT offers differential subrate clock outputs with any ratio of clock and data signals without extra equipment. Data and clock outputs support spread Spectrum Clocking (SSC), commonly used in computer bus standards.

The J-BERT is an expandable, future-proof BERT platform where all options can be configured to the current test needs and upgraded later when those needs change.

It is the ideal choice for R&D and validation teams who characterize and stress chips and transceiver modules with serial I/O ports up to 12.5 Gb/s.

Specifications

Pattern Generator

Operation Range
Internal clock: 620 Mb/s to 12.5 Gb/s (option C13 and G13) or 7 Gb/s (option C07 and G07)
External clock: 150 Mb/s to 12.5 Gb/s (option C13 and G13) or 7 Gb/s (option C07 and G07)
Data Output
1, differential or single-ended
Output Amplitude
0.1 Vpp – 1.8 Vpp
Jitter
<9 ps pp
Transition Time
<25 ps (10% to 90% and ECL levels)
Crossing Point Adjustable
20% – 80%
Pattern
PRBS 2^n–1, n = 7, 10, 11, 15, 23, 31
User-definable memory: 32 Mbit and pattern sequencing
Delay Control Input
200 ps @ 1 GHz

Jitter Tolerance Test

Jitter Sources, Built-in & Calibrated (option J10)
Random Jitter: 0 to 14 ps rms, up to 1 GHz
Periodic Jitter: sinewave, rectangular modulation up to 20 MHz, sinusoidal modulation up to 300 MHz
Sinusoidal Jitter: multiple UIs up to 5 MHz
Bounded Uncorrelated Jitter: up to 200 ps pp; according CEI

SSC Clocking (option J11)
triangular modulation – 0.5% @ 28 to 34 kHz on data and clock outputs

Interference Channel (option J20)
ISI: Intersymbol interference by switchable board traces
Sinusoidal Interference: vertical eye closure, common and differential mode

Error Detector:

Operation Range
Internal clock: 500 Mb/s to 12.5 Gb/ s (option C13) or 7 Gb/s (option C07)
External clock: 150 Mb/s to 12.5 Gb s (option C13) or 7 Gb/s (option C07)
Data Input
1, differential or single-ended
Delay Adjust
±0.75 ns
Clock Data Recovery
Fixed loop bandwidth: data rate/1667
Variable loop bandwidth (option CTR): 100 kHz to 12 MHz
Sensitivity
<50 mV
Measurement Suite
BER, accumulated, intervals
BERT Scan, "bathtub" curve includes RJ, DJ, TJ
Output Level
Eye Diagram with BER contour and eye masks
Fast Eye Mask
Spectral Jitter
Error Location Capture
Fast Total Jitter Measurement

Accessories

N4910A 2.4 mm Matched Cable Pair
N4911A-002 One Adapter 3.5 mm (f) to 2.4 mm (m)
N4912A One 50 Ohm Termination, 2.4 mm (m)
N4915A-001 One 47 ps Transition Time Converter
N4915A-002 Short Cable Kit for Connecting ISIS Ports (included in option J20)
N4915A-003 Short Clock Cable (included in option J20)
N4916A De-emphasis Signal Converter

Key Literature & Web Link

www.agilent.com/find/j-bert

Ordering Information

N4903A J-BERT High-Performance Serial BERT 12.5 Gb/s, (includes 5 x 50 Ohm terminations, 6 x adapter SMA to 2.4 mm, USB cable, no signal cables)
N4903A-C07 Pattern Generator & Error Detector 150 Mb/s to 7 Gb/s with Built-in CDR
N4903A-C13 Pattern Generator & Error Detector 150 Mb/s to 12.5 Gb/s with Built-in CDR
N4903A-G07 Pattern Generator 150 Mb/s to 7 Gb/s
N4903A-G13 Pattern Generator 150 Mb/s to 12.5 Gb/s
N4903A-A01 Bit Recovery Mode
N4903A-CTR Compliant and Tunable Loop Bandwidth
N4903A-J10 Jitter Sources: RJ, PJ, SJ, BUJ
N4903A-J11 SSC Generation
N4903A-J12 Automated Jitter Tolerance Compliance Software
N4903A-J20 Interference Channel: ISI, Sinusoidal Interference (includes N4915A-002, N4915A-003)

J-BERT Pattern Generator 7 Gb/s (N4903A-G07) and 12.5 Gb/s (N4903A-G13)

N4903A

- **Operating range 150 Mb/s to 7 Gb/s or to 12.5 Gb/s provides enough margin for today's and tomorrow's serial interfaces**
- **Built-in, compliant and calibrated jitter injection with >0.5 UI (option J10). All in one box: PJ, SJ, RJ, BUJ for stressed eye testing of a receiver**
- **Interference channel plug-in with ISI and sinusoidal interference for emulating channel and noise effects (option J20)**
- **Transition times <20 ps and jitter <9 ps pp for accurate measurements**
- **Differential pattern and clock generation**
- **Sub-rate clock outputs with any ratio 1:n**
- **32 Mbit pattern memory and pattern sequencer**
- **External delay control input for injection of any external jitter**
- **SSC clocking (option J11)**
- **Upgrade path to error detector and complete J-BERT functionality**
- **Remote programmable via GPIB, LAN, and USB interfaces. Compatible with existing command set Agilent 71612, 81630 series, N4900 series**
- **Bench use with intuitive touch-screen user interface based on Windows® XP**
- **Applications: PCI Express, SATA, fully-buffered DIMM, Display Port, Fibre Channel, CEI, 10 Gb Ethernet, XFP/XFI**

Fast and Accurate Characterization of Gigabit Devices

The J-BERT N4903A pattern generator options for data rates up to 7 Gb/s and 12.5 Gb/s provide a complete pattern generator functionality in combination with jitter injection. Design and test engineers can quickly and accurately stimulate serial high-speed ports, such as Display Port, PCI Express, SATA, fully-buffered DIMM, Fibre Channel, CEI, Gigabit Ethernet and XFP/XFI. The J-BERT pattern generators can be used in combination with oscilloscopes, built-in error detectors or other analyzers.

The J-BERT pattern generator provides digital data patterns with all types of calibrated and integrated jitter for stressing the device under test: random, periodic, sinusoidal, bounded-uncorrelated jitter, intersymbol interference and sinusoidal interference.

Accurate measurements are possible with the pattern generators excellent signal performance with the fastest transition times, and low jitter.

The J-BERT N4903A pattern generator simplifies testing of the latest serial bus interfaces. Complex training sequences required to bring a device into loop back mode, can be setup easily with the pattern sequencer. To match LVDS and other low voltage standards, all clock, data inputs and outputs are differential and can handle small amplitude swings. The J-BERT pattern generator offers differential sub rate clock outputs with any ratio of clock and data signals without extra equipment. Data and clock outputs support Spread Spectrum Clocking (SSC), commonly used in computer bus standards.

The J-BERT N4903A pattern generator can be upgraded to a complete J-BERT with error detectors later when test needs change.

Specifications

Pattern Generator

Operation Range
Internal clock: 620 Mb/s to 12.5 Gb/s (option G13) or 7 Gb/s (option G07)
External clock: 150 Mb/s to 12.5 Gb/s (option G13) or 7 Gb/s (option G07)
Data Output
1, differential or single-ended
NRZ
Output Amplitude
0.1 Vpp – 1.8 Vpp
Jitter
<9 ps pp
Transition Time
<25 ps (10% to 90% and ECL levels)
Crossing Point Adjustable
20% – 80%
Pattern
PRBS 2^n–1, n = 7, 10, 11, 15, 23, 31
User-definable pattern: 32 Mbit
Generator pattern sequencer: 4 blocks
Delay Control Input
200 ps @ 1 GHz

Jitter Injection, Built-in and Calibrated (option J10)
Random Jitter: 0 to 14 ps rms, up to 1 GHz
Periodic Jitter: sinewave, rectangular modulation up to 20 MHz, sinusoidal modulation up to 300 MHz
Sinusoidal Jitter: multiple UIs up to 5 MHz
Bounded Uncorrelated Jitter: up to 200 ps pp; according CEI

SSC Clocking (option J11)
triangular modulation – 0.5 % @ 28 to 34 kHz on data and clock outputs

Interference Channel (option J20)
ISI: Intersymbol interference by switchable board traces
Sinusoidal Interference: vertical eye closure, common and differential mode

Accessories

N4910A 2.4 mm Matched Cable Pair
N4911A-002 One Adapter 3.5 mm (f) to 2.4 mm (m)
N4912A One 50 Ohm Termination, 2.4 mm (m)
N4915A-001 One 47 ps Transition Time Converter
N4915A-002 Short Cable Kit for Connecting ISI Ports (included in -J20)
N4915A-003 Short Clock Cable (included in -J20)
N4916A De-emphasis Signal Converter

Key Literature & Web Link

www.agilent.com/find/j-bert

Ordering Information

N4903A-G07 Pattern Generator 150 Mb/s to 7 Gb/s
N4903A-G13 Pattern Generator 150 Mb/s to 12.5 Gb/s
N4903A-J10 Jitter Sources: RJ, PJ, SJ, BUJ
N4903A-J11 SSC Generation
N4903A-J20 Interference Channel: ISI, Sinusoidal Interference

- **Excellent price/performance ratio**
- **Variable frequency up to 3.6 Gb/s or 12.5 Gb/s**
- **<25 ps transition time**
- **<50 mV pp input sensitivity**
- **Fast Eye Mask Measurement for pass/fail testing (Option 101)**
- **True differential data generation and analysis capability (Option 101)**
- **Enhanced Measurement Suite (Option 101)**
- **Integrated Clock Data Recovery (Option 102)**
- **Small form factor saves bench or rack space**
- **LAN, USB, GPIB for remote control**
- **Compatibility with existing remote commands, e.g. Agilent 71612, 86130A series and N4900 Series**
- **Color touch screen, Windows XP**
- **Applications: manufacturing test, Telecom transceivers such as SONET/SDH Fibre Channel, 10 GbE, XFP/XFI, PON-OLT's and high-speed serial computer buses**

The Serial BERT N4906B is a general-purpose bit error ratio tester designed for testing high-speed digital communication components and systems.

It is ideal for cost-effective manufacturing and telecom device testing.

It offers a 3.6 Gb/s or 12.5 Gb/s pattern generator and error detector with excellent price/performance ratio.

Transition times <25 ps allow precise measurements.

The analyzer can be configured with CDR to test clockless interfaces and with true differential inputs to test LVDS and other differential interfaces.

The compact size of the N4906B saves rack space; LAN, USB and GPIB interfaces allow smooth integration into automated test environments.

For bench users the N4906B Serial BERT offers an intuitive user interface with state-of-the-art Windows-XP based touch-screen.

Deeper insight into the device's performance can be obtained with the enhanced measurement suite. It offers many valuable signal analysis tools, such as BERT Scan (so-called bathtub curves) with total jitter and its separation into RJ and DJ, eye contours, spectral jitter decomposition and more.

Specifications

Pattern Generator

Operation Range
9.5 Gb/s to 12.5 Gb/s (Option 012)
150 Mb/s to 12.5 Gb/s (Option 102)
150 Mb/s to 3.6 Gb/s (Option 003)
Data Output
1, differential or single-ended
Output Amplitude
0.10 V to 1.8 V in 5 mV steps
Jitter
9 ps pp typical
Transition Time
<25 ps (10% to 90% and ECL levels)
Cross Point Adjust
20% – 80%
Pattern
PRBS 2^n–1, n = 7, 10, 11, 15, 23, 31
User-definable memory: 32 Mbit

Error Detector

Operation Range
9.5 Gb/s to 12.5 Gb/s
150 Mb/s to 12.5 Gb/s (Option 102)
Data Input
1, single-ended or differential (Option 101 or 003)
Delay Adjust
1.5 ns
Clock Data Recovery (Option 102)
1.058 to 1.6 Gb/s, loop bandwidth 1 MHz typ.
2.115 to 3.2 Gb/s: loop bandwidth 2 MHz typ.
4.23 to 6.4 Gb/s: loop bandwidth 4 MHz typ.
9.9 to 10.9 Gb/s: loop bandwidth 8 MHz typ.
Sensitivity
<50 mV
Measurements
BER
Fast Eye Mask Measurement with pass/fail (Option 101)
BERT Scan with RJ/DJ separation (Option 101)
Fast Total Jitter (Option 101)
Spectral Jitter Decomposition (Option 101)
Eye Contour (Option 101)
Output Level (Option 101)
Error Location Capture (Option 101)

Accessories

N4910A 2.4 mm Matched Cable Pair
N4915A-001 One 47 ps Transition Time Converter

Key Literature & Web Link

www.agilent.com/find/N4900_Series

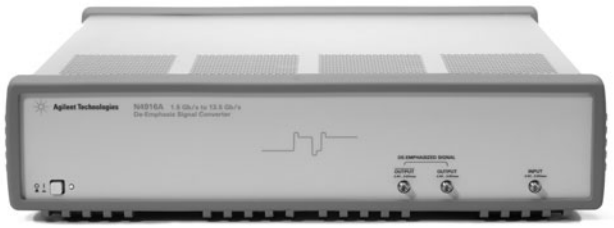
Ordering Information

N4906B-012 Serial BERT 12.5 Gb/s; Pattern Generator & Error Detector; 4 x 50 Ω terminations; 6 x 2.4 mm to 3.5 mm APC converter; No cables included
N4906B-101 Differential Analysis, Fast Eye Mask and Enhanced Measurement Suite (only applicable with N4906B-012)
N4906B-102 Extension to full frequency range 150 Mb/s to 12.5 Gb/s + Clock Data Recovery (only applicable with N4906B-012)
N4906B-003 Serial BERT 3.6 Gb/s Pattern Generator & Error Detector; 4 x 50 Ω terminations; 6 x 2.4 mm to 3.5 mm APC converter; No cables included

De-Emphasis Signal Converter N4916A

N4916A

- **Variable de-emphasis post-cursor up to 12 dB in 0.1 dB steps**
- **Supports data rates up to 13.5 Gb/s**
- **Differential outputs**
- **Operation via integrated user-interface of the J-BERT N4903A and the 81141A and 81142A serial pulse data generators**
- **Jitter feed-through for worst-case testing**



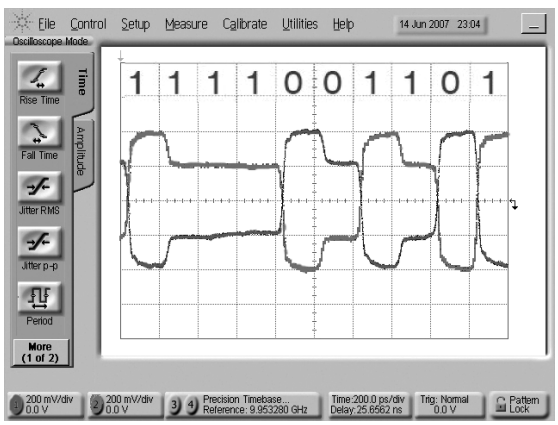
De-emphasis Signal Injection Enables Robust Receiver and Board Designs

The N4916A de-emphasis signal converter enables design and test engineers to accurately characterize gigabit serial ports and channels that operate with de-emphasized signals. This results in more robust receiver designs, with reliable operation in real printed circuit board environments.

De-emphasis is a commonly used technique for transmitting electrical signals at gigabit data rates to compensate for the losses caused by PC board traces.

Many popular serial bus standards, such as Display Port, PCI Express®, SATA 3 Gb/s, fully-buffered DIMM, Hypertransport, CEI, 10 Gigabit Ethernet require transmit de-emphasis.

The de-emphasis signal converter can be controlled via the graphical user interface of the J-BERT N4903A serial high-performance BERT and the 81141/42A serial pulse data generator.



Specifications

Operation Range
1.5 Gb/s to 13.5 Gb/s (12.5 Gb/s max. with J-BERT N4903A)
Format NRZ
Output Amplitude
Differential: 200 mV to 1.6 V
Single-ended: 100 mV to 0.8 V
De-emphasis Amplitude Ratio
0 dB to 12 dB, in 0.1 dB steps
Interface 2.4mm (f), DC coupled 50 Ohm

Accessories

N4910A 2.4 mm Matched cable pair
N4915A-004 One 2.4 mm cable (m-m)

Key Literature & Web Link

www.agilent.com/find/n4916

Ordering Information

N4916A De-emphasis Signal Converter, includes one 50 Ohm termination SMA, one 2.4 mm to SMA adapter. No signal cables included.

- **Standard measurements at rates between 125 Mb/s and 3.125 Gb/s**
- **Generation of Pseudo Random Bit Sequence (PRBS) polynomials and a K28.5 pattern at Low Voltage Differential Signal (LVDS) or Emitter Coupled Logic (ECL) levels**
- **Flexible connections to the device under test via 3.5 mm differential electrical coax connectors and/or standard optical SFP module plug-ins**
- **Optical and electrical error injection (once or at selectable Bit-Error-Ratio)**
- **Analysis of gated Bit-Error-Ratio with display of the absolute number of errors and selectability of gate time**
- **Dramatically simplified transceiver measurements that provide just the essential tests via the one page graphical user interface (running on an external Windows® XP PC via a USB 2.0 interface)**
- **Full programmability of all graphical user interface features from another software program, making automation in manufacturing an easy task**

The Agilent N5980A 3.125 Gb/s Serial BERT is ideal for manual or automated manufacturing test of electrical and optical devices running at speeds between 125 Mb/s and 3.125 Gb/s. It addresses all common standard speeds via selectable bit rates.

Easy-to-use and Cost Efficient

The software user interface has one standard or one advanced screen to ensure intuitive use for operators. It makes the instrument easy to use and easy to learn.

Twice the Measurement Throughput

By using both the electrical and optical (SFP) interfaces concurrently, you can double your measurement throughput (electrical in/optical out and vice versa).

Automation Made Easy

The remote programmability of the user interface, using SCPI – syntax, makes it simple to integrate the N5980A into other programs.

PRBS, K28.5 Pattern or Clock Generation and Integrated Clock Data Recovery

The N5980A can generate standard PRBS polynomials, K28.5 ('Comma') characters and different sub-rate clocks (/2 to /20). It can also inject errors with an adjustable error ratio. The receiver has a clock-data – recovery (CDR) built-in and differential inputs (SMA) for signals from 50 mVpp to 2 Vpp amplitude.

Standard (SFP) Optical Module Plug-in

The instrument has a standard SFP- female connector. This enables all different kind of user-selectable optical modules (e.g for multi-mode/single-mode fiber at 850 nm, 1310 nm and 1550 nm for the test set-up).

Small Size

Its very small size allows the N5980A to fit on any bench and in any automated setup. The dimensions are, 228 mm (W) x 59 mm (H) x 246 mm (D) (Bench top dimensions).

Specifications

Data Rates

Fast Ethernet: 125 Mb/s
OC-3: 155.52 Mb/s
OC-12: 622.08 Mb/s
OC-48: 2.48832 Gb/s
OC-48 with FEC: 2.66606 Gb/s
1 x FC: 1.0625 Gb/s
2 x FC: 2.125 Gb/s
1 x Gigabit Ethernet: 1.25 Gb/s
XAUI: 3.125 Gb/s
Accuracy: ± 50 ppm
Operating System
The software supplied runs on Windows 2000 or XP with .NET v2.0, by a USB 2.0 interface

Pattern Generator

Pattern
PRBS: 2^7–1, 2^{15}–1, 2^{23}–1, 2^{31}–1
Data pattern: K28.5
Clock pattern: data rate divide by n, n = 2, 4, 8, 10, 16, 20
The pattern can be individually adjusted for pattern generator electrical out and optical out
Error Injection
Fixed electrical and optical error inject:
Fixed error ratios of 1 error in 10^n bits, n = 3, 4, 5, 6, 7, 8, 9
Single error injection
Separate error ratios can be adjusted for pattern generator electrical out and optical out
Pattern Generator Electrical Out
A differential electrical output is provided on the front-panel

Output Amplitude

ECL
850 mVpp typ., single-ended
1700 mVpp typ., differential
LVDS
400 mVpp typ., single-ended
800 mVpp typ., differential
Jitter
0.05 UI typ. @ OC-12
0.08 UI typ. @ GbE
0.15 UI typ. @ OC-48
Pattern Generator Optical Out
A standard SFP housing is provided
Minimum number of insertion/deinsertion cycles: 200

Error Detector

A differential electrical input is provided on the front-panel
Data rate is the same as pattern generator
Pattern
The following patterns are supported:
PRBS: 2^7–1, 2^{15}–1, 2^{23}–1, 2^{31}–1
Data Input
differential AC coupled
Max. Input Amplitude
1 Vpp, single-ended
2 Vpp, differential
Clock Data Recovery
Internal CDR
Impedance
100 Ohms nominal
Sensitivity
<50 mV
Synchronization
Automatically on level, polarity, phase, bit and pattern
Operating System
The software supplied runs on Windows 2000 or XP with .NET v2.0, by a USB 2.0 interface

Key Literature & Web Link

www.agilent.com/find/manufacturing_bert

Ordering Information

N5980A 3.125 Gb/s Serial BERT

PXI Synthesizer 3 GHz to 12 GHz

N2099A

- **Cost effective synthesizer for optical transceiver manufacturing**
- **Flexible Modular PXI platform allows multiple instruments and configurations**
- **Tuning range of 2 GHz**
- **Highly accurate source**
- **Center frequencies available between 4 and 11 GHz**
- **Two RF outputs**
- **10 MHz reference output**

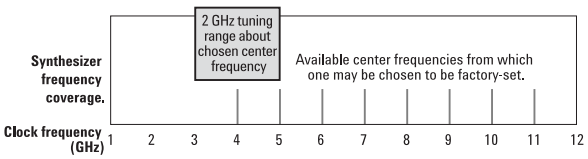
The N2099A PXI Synthesizer is a high quality microwave source capable of 2 GHz tuning range. Available with one of a number of factory-set center frequencies in the range of 4 to 11 GHz.

The N2099A is part of a family of Agilent PXI products that are focused at providing test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can combine the N2099A PXI Synthesizer with the N2102 PXI Pulse Pattern Generator as a complete source for controlling the transmitter portion of the transceiver.

For optical or electrical analysis of eye diagrams the N2100A PXI Digital Communication Analyzer can be included in the system.

Other related PXI products:
N2100A PXI Digital Communication Analyzer
N2101A PXI Bit Error Ratio Tester
N2102A PXI 8.5 Gb/s Pulse Pattern Generator



Specifications

Parameter Specification

Output Frequency (center): 4, 5, 6, 7, 8, 9, 10, 11 GHz
Tuning Range: ±1.0 GHz
Output Power Min.: +9 dBm (4, 5 and 6 GHz)
+7 dBm (7, 8, 9, 10 and 11 GHz)
Power Variation Over Temp/Freq: ±2 dB
Step Size Min: 1 kHz
Switching Speed, 100 MHz Step: 100 ms typical
Output Impedance: 50 Ohms
External Ref. Osc. Output Freq (TCXO): 10 MHz

Accessories

The N2099A PXI Synthesizer requires: A PXI mainframe with either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN
Agilent 7 GHz Digital Communications Analyzer Data Sheet, p/n 5989-6070EN
Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN
Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN

www.agilent.com/find/pxit

Ordering Information

N2099A-H10-n Synthesizer. Replace n with the center frequency required: n = 4, 5, 6, 7, 8, 9, 10 or 11 (GHz)

N2102A

- **Cost effective pattern generator for optical transceiver manufacturing**
- **Flexible Modular PXI platform allows multiple instruments and configurations**
- **Significantly smaller than a traditional pattern generator**
- **Wide bit rate coverage from 1 Gb/s to 8.5 Gb/s**
- **Differential outputs**
- **Standard patterns include PRBS, K28.5, K28.7**
- **User defined patterns**

The N2102A Pulse Pattern Generator is a single slot PXI instrument capable of generating a number of low jitter patterns at rates up to 8.5 Gb/s using an externally supplied clock.

ActiveX drivers provide easy to use software, remote control, and a graphical user interface is provided for manual operation of the module.

The N2102A is part of a family of Agilent PXI products that are focused at providing test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can combine multiple N2102A pattern generators within a mainframe for controlling multiple transceivers simultaneously, along with multiple N2100A PXI Digital Communication Analyzer.

Other Related PXI products:
- N2100A PXI Digital Communications Analyzer
- N2101A PXI Bit Error Ratio Tester
- N2099A PXI Synthesizer

Specifications

Bit Rate Operation Bands: Bands between 1.0 and 8.5 Gb/s
Output Rise/Fall Time (20% – 80%): 35 ps typical
Output Intrinsic Jitter: 2 ps RMS
Output Voltage Range: 25 mV – 1.6 V p-p
Output Voltage Resolution: 5 mV
Output Clock Level: +10 dBm at 8.5 GHz
Maximum Input Clock Level: +3 dBm at 8.5 GHz
Front Panel Connectors: SMA

Accessories

The N2102A requires: A clock input, for example a N2099A PXI Synthesizer

A PXI mainframe with either a PXI embedded controller or a PXI interface card to connect to an external PC

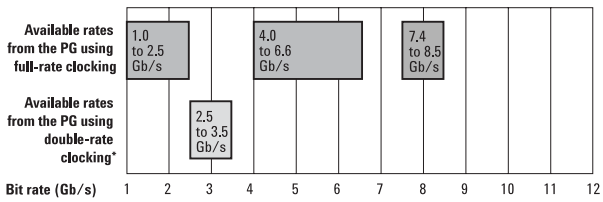
Key Literature & Web Link

Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN
Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN
Agilent 7 GHz Digital Communications Analyzer Data Sheet, p/n 5989-6070EN
Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN

www.agilent.com/find/pxit

Ordering Information

N2102A-H10 8.5 Gb/s Pulse Pattern Generator



* Rates available by using a clock between 5.0 to 7.0 GHz, and setting the PG instrument to the clock frequency divided by two – it automatically takes the double-rate into account.

3

PXI Bit Error Ratio Tester 1 Gb/s to 5 Gb/s

N2101A

- **Cost effective BERT for optical transceiver manufacturing**
- **Flexible Modular PXI platform allows multiple instruments and configurations**
- **Significantly smaller than a traditional BERT**
- **Fixed internal clock rates 1.0625, 1.25, 2.125, 2.488, 2.5, 4.25, 5.0 Gb/s**
- **Data pattern generation, error detection and clock source combined in one module**
- **Bathtub jitter measurement capability**

The N2101A PXI 5 Gb/s BERT consists of a clock source, data pattern generator and error detector within a 2U wide PXI module.

Easily perform bit error ratio analysis to characterize the quality of devices from 1.0625 to 5 Gb/s.

The N2101A is part of a family of Agilent PXI products that are focused on providing cost effective test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can measure all required test parameters by combining the N2101A 5 Gb/s BERT with the N2100A Digital Communications Analyzer.

Other related PXI products:
N2099A PXI Synthesizer
N2100A PXI Digital Communication Analyzer
N2102A PXI 8.5 Gb/s Pulse Pattern Generator

Specifications

Pattern Generator

Output Jitter: 2 ps RMS
Rise/Fall Time (20 – 80%): 35 ps max
Output Range: 250 mV – 1.6 V peak-peak
Amplitude Resolution: 5 mV

Error Detection

Input Range: 50 mV – 2 V
Input Sensitivity: 50 mV
Trigger Output Options: Clock Div 8, Div 9, Div 128 and Pattern Trigger
Output Amplitude DC Coupled: 500 mV peak-peak

Accessories

The N2101A requires: A PXI mainframe and either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN
Agilent 7 GHz Digital Communications Analyzer Data Sheet, p/n 5989-6070EN
Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN
Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN

www.agilent.com/find/pxit

Ordering Information

N2101A-H10 5 Gb/s Bit Error Rate Tester. Includes pattern generation and error detection in a single module. 3U high, 2U wide PXI module Requires PXI mainframe and controller, sold separately.

- **Cost effective DCA for optical transceiver manufacturing**
- **Flexible Modular PXI platform allows multiple instruments and configurations**
- **Significantly smaller than a traditional DCA**
- **Eye diagram, jitter and mask testing**
- **High throughput**
- **Multimode and single-mode fiber input**
- **Single ended electrical input**
- **Three standard hardware filter rates GigE, 2xFC, 4xFC**
- **Digital filter capability**
- **Multiple measurement capability**
- **Unique vector sampling technique**

The N2100A implements a patented coherent vector under-sampling which allows fast data acquisition and multiple eye measurements for higher test throughput.

This PXI instrument uniquely combines the functionality of several traditional instruments in a single PXI module. Perform accurate eye diagram analysis to characterize the quality of transmitters from 50 Mb/s to 4.25 Gb/s.

The N2100A is part of a family of Agilent PXI products that are focused on providing test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can measure all required test parameters by combining the N2101A 5 Gb/s BERT with the N2100A Digital Communication Analyzer.

Other related PXI products:
N2099A PXI Synthesizer
N2101A PXI Bit Error Ratio Tester
N2102A PXI 8.5 Gb/s Pulse Pattern Generator

Specifications

Electrical[1]

Bandwidth of Electrical Input: 0.1 to 7000 MHz (characteristic)
Internal Clock Recovery: 155 to 3000 MHz
Clock Recovery Lock Range: 250 ppm
External Clock Reference: 5 to 300 MHz
External Clock Input Range (CML): 200 to 3000 mV
External Clock Lock Range: ±150 ppm
Transition Time (20% to 80%): 35 pS
Maximum Input Range (p-p): 1500 mV
Input noise (rms): 0.75 mV

Optical[1]

Standard Switchable Filters: 1.25, 2.125, 4.25 Gb/s compliance filters[2]
Unfiltered Optical BW: 7.0 GHz
Optical Responsivity: 780 – 1600 nm
Optical Noise Equivalent Power: –28 dBm
Mask Sensitivity at 850 nm: –10 dBm
Mask Sensitivity at 1310/1550 nm: –12 dBm
Overload Optical Input: 2 dBm
Average Optical Power Monitor: –15 to 2 dBm
Fiber Input: 9, 50, 62.5 µm

Accessories

The N2100A requires: A PXI mainframe with either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent 7 GHz Digital Communications Analyzer Data Sheet , p/n 5989-6070EN
Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN
Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN
Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN

www.agilent.com/find/pxit

Ordering Information

N2100A-H10 7 GHz Optical Bandwidth DCA. Equipped with compliance filters suitable for 1GbE, 2x and 4x Fibre Channel. 9 GHz single ended electrical input. 3 slot PX card, requires PXI mainframe and controller sold separately.

[1] The N2100A is not recommended for use at 3.125 Gb/s with a PRBS-7 pattern.
[2] Consult factory for alternative options.

Digital Multimeters

Overview

Agilent offers a full line of digital multimeters.

L4400

34405A

U1251A & U1252A

34410A & 34411A

Selection Table for Digital Multimeters, Voltmeters

Product	Type	Basic Measurements	Additional Measurements	Connectivity
U1251A	NEW! Handheld digital multimeter, 4½ digit	dc & ac voltage, dc & ac current, resistance, continuity, diode test	Frequency, capacitance, temperature, manual data storage	IR to USB (optional connectivity cable sold separately)
U1252A	NEW! Handheld digital multimeter, 4½ digit	dc & ac voltage, dc & ac current, resistance, continuity, diode test	Frequency, capacitance, temperature, data storage capability, 20 MHz frequency counter, square wave generator	IR to USB (optional connectivity cable sold separately)
34405A	Digital multimeter, 5½ digits	dc & ac voltage, dc & ac current, 2 wire Ω, frequency	Continuity, diode test, capacitance, temperature	USB 2.0
34401A	Digital multimeter, 6½ digit	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency & period	Continuity, diode test	IntuiLink software with built-in GPIB and RS-232
34410A	Next generation high performance digital multimeter, 6½ digit with dual display	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency, period, 10,000 rdgs/s	Continuity, diode test, capacitance, temperature, front panel data logger, dB measurements, dBm measurements, statistics, limit testing	LAN, USB 2.0, and GPIB standard, Web browser interface, IntuiLink software
34411A	Next generation high speed digital multimeter, 6½ digit with waveform capture	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency, period, 50,000 rdgs/s, analog level trigger	Continuity, diode test, capacitance, temperature, front panel data logger, dB measurements, dBm measurements, statistics, limit testing	LAN, USB 2.0, and GPIB standard, Web browser interface, IntuiLink software
L4411A	NEW! Enhanced Performance system Digital Multimeter, 6½ digits	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency, period, 50,000 rdgs/s, analog level trigger	Diode test, capacitance, temperature, dB measurements, dBm measurements, statistics, limit testing	LAN, USB 2.0, and GPIB standard, Web browser interface, IntuiLink software
34420A	NanoVolt/micro-Ohm meter, 7½ digit	dc voltage, 2 & 4 wire Ω, low power resistance, ratio	2 channels – ratio and difference	Standard Intuilink software, RS-232 and GPIB interface
3458A	Reference digital multimeter, 8½ digit	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency & period	3 modes of true RMS, digitizing	GPIB interface

U1251A
U1252A

- **50,000 counts resolution on both displays**
- **Up to 0.025% basic DCV accuracy**
- **True RMS AC, AC + DC measurements**
- **18 measurement functions (including frequency, capacitance, temperature, duty cycle and pulse width) and Min/Max recording**
- **Manual and automatic data logging with optional IR-USB cable**
- **Built-in battery charging**
- **Programmable square wave generator (U1252A only)**
- **20 MHz frequency counter (U1252A only)**

The high performance Agilent U1250A Series handheld digital multimeters (DMMs) bring high performance on-the-go for electronic troubleshooting and validation. Owing to its innovation and credibility, it has been named an EDN Hot 100 Product of 2006 and analogZone Best Value Portable Test Equipment of 2006.

Feature-rich, Value Handheld DMM

The U1250A Series comes with multiple functions in one instrument, including DMM, frequency counter, temperature measurement and square wave output functions. It provides high performance features including true RMS and up to 0.025% accuracy, so you can detect failures and troubleshoot fast. The U1250A Series also comes with calibration certification, GUI data logging software and essential tools for your test needs, so you can get started on your tasks sooner and at no extra cost.

Sort Out Failures and Root Cause Fast

The U1250A Series offers up to 0.025% accuracy, and true RMS AC and AC+DC readings. With its backlit, 50,000 count dual display, you can view simultaneous measurements clearly on the front panel. The U1250A Series offers various math functions such as Min/Max recording, so you can manipulate your measurement results. Use the programmable square wave generator function in the U1252A to stimulate electronic circuits while you debug.

Detect Intermittent Failures Easily

Perform your measurements fast at 7 readings/s. The U1250A Series includes a GUI data logging software so you can automate data logging to PC via the optional IR-USB cable. The software is easy to use and setup with USB.

Make Field Measurements with Assurance

Use the U1250A Series with confidence in almost any environment. The U1250A Series is built in a robust package with shock absorbing overmold and operates within rated temperature specifications of –20°C to 55°C. With a rating of CAT III 1000 V, you have the confidence to carry out measurements on electrical installations in buildings, even if the equipment is connected to the mains circuit.

Specifications

Features	U1251A	U1252A
Display	Dual display	Dual display
Resolution	50,000 counts	50,000 counts
Auto Ranging	Yes	Yes
Manual Ranging	Yes	Yes
True RMS	AC	AC + DC
DC Voltage		
Range	1000 V	1000 V
Accuracy	0.03% + 5 counts	0.025% + 5 counts
DC Current		
Range	10 A	10 A
Accuracy	0.1% + 5 counts	0.05% + 5 counts
Resistance		
Range	500 MΩ	500 MΩ
Accuracy	0.08% + 5 counts	0.05% + 5 counts
AC Voltage		
Range	1000 V	1000 A
Accuracy	0.6% + 25 counts	0.4% + 25 counts
AC Current		
Range	10 A	10 A
Accuracy	0.8% + 20 counts	0.7% + 20 counts
Frequency		
Range	1 MHz	20 MHz
Accuracy	0.02% + 3 counts	0.02% + 3 counts
Temperature		
Thermocouple Type	K	J, K
Accuracy	0.3% + 3°C	0.3% + 3°C
Capacitance		
Range	10 nF – 100 mF	10 nF – 100 mF
Accuracy	1% + 5 counts	1% + 5 counts
Conductance	Yes	Yes
Continuity with Beeper	Yes	Yes
Diode Test	Yes	Yes
Square Wave Output	—	Hz, % selectable
Duty Cycle/Pulse Width	Yes	Yes
dB	Yes	Yes
NULL	Yes	Yes
Min/Max Recording	Yes	Yes
Display Hold	Yes	Yes
Reading Memory	100	100
Automatic and Manual Data Logging	Yes	Yes
Interface	IR-USB	IR-USB
Analog Bargraph	Yes	Yes
Backlighting	Blue LED	Blue LED
Battery	9 V battery	Ni-MH rechargeable battery

Note: Accuracy specifications are best accuracy based on 30 minutes warm up time.

General Specifications

Display
Both primary and secondary displays are 5 digit on the LCD display. Both the primary and secondary displays offer a maximum resolution of 50,000 counts. Automatic polarity indication.

Power Consumption
- 105 mVA/420 mVA (with backlit) maximum (U1251A)
- 165 mVA/480 mVA (with backlit) maximum (U1252A)

Operating Environment
- Full accuracy at –20°C to 55°C
- Full accuracy to 80% RH for temperature up to 35 °C, decreasing linearly to 50% RH at 55 °C

Altitude
- 0 – 2000 meters per IEC 61010-1 2nd Edition CAT III, 1000 V
- 2000 – 3000 meters per IEC 61010-1 2nd Edition CAT III, 600 V

Storage Compliance
–40°C to 70°C

Safety Compliance
Certified by CSA for IEC/EN/CSA/UL 61010-1 2nd Edition and CAN/CSA 22.2 61010-1 2nd Edition

Measurement Category
CAT III 1000 V Overvoltage Protection up to 2000 m, Pollution degree 2

EMC Compliance
Certified to IEC/EN 61326: 2002, CISPR 11, and equivalents for Group 1, Class A

Common Mode Rejection Ratio (CMRR)
>90 dB at DC, 50/60 Hz + 0.1% (1 kΩ unbalanced)

Normal Mode Rejection Ratio (NMRR)
>60 dB at DC, 50/60 Hz + 0.1%

Temperature Coefficient
0.15 * (specified accuracy)/°C (from 20°C to 18°C or 28°C to 55°C)

Shock and Vibration
Tested to IEC/EN 60068-2

Dimension
203.5 mm (W) x 94.4 mm (D) x 59.0 mm (H)

Weight
- 504 ± 5 g with battery (U1251A)
- 527 ± 5 g with battery (U1252A)

Charging Time (only U1252A)
<220 minutes approx. at the environment of 10°C to 30°C

Warranty
3-year factory warranty

Key Literature & Web Link

Data sheet, p/n 5989-5509EN
Brochure, p/n 5989-6381EN

For more information on U1250A Series **www.agilent.com/find/U1250A**
To watch U1250A Series interactive product showcase
www.agilent.com/find/U1250A_showcase

Ordering Information

U1251A Handheld Digital Multimeter
U1252A Handheld Digital Multimeter
Includes soft carrying case, alkaline 9 V battery (U1251A only), rechargeable Ni-MH battery with power adapter (U1252A only), U1160A Standard Test Lead Kit, Product Reference CD (includes the User's and Service Guide, GUI datalogger software and instrument drivers), Quick Start Guide, Certificate of Calibration (CoC) and test report

Accessories
U1160A Standard Test Lead Kit (includes SMT grabbers, a mini grabber, standard test leads, alligator clips and fine tip test probes)
U1161A Extension Test Lead Kit
U1173A IR-to-USB Cable
U1180A Thermocouple Lead Kit
34132A Deluxe Test Lead Kits
34133A Precision Electronics Test Leads

- 120,000 count resolution
- 16 measurement functions including temperature and capacitance
- 6 built-in math functions: Null, dBm, dB, MinMax, Limit and Hold
- Up to 70 readings/s
- 0.025% DC voltage accuracy
- USB 2.0 interface (TMC-488.2-compliant)
- SCPI-compatible
- Data logging capability with DMM IntuiLink connectivity software

Affordable and Feature-rich

The 34405A provides a broad range of features and measurement functions despite its value price, including DC voltage, DC current, true-RMS AC voltage and AC current, 2-wire resistance, frequency, diode test, continuity, temperature (–80°C to 150°C) and capacitance (1000 pF to 10,000 µF). Six built-in math operations are available for efficient, accurate results: Null, dBm, dB, MinMax, Limit and Hold.

Make Measurements Fast

Set up your instrument fast with 34405A's plug-and-play USB interface, and auto-detection by the bundled, award-winning Agilent IO Libraries Suite. The 34405A comes with a dual display feature that allows simultaneous display of two measurements on the front panel. Its fast reading speed of 70 readings/s allows you to detect intermittent failures and anomalies easily. With 34405A's store/recall function, you can configure and store complete instrument setups and load them at anytime from any of the four built-in storing states.

Remote Control and Data Logging via PC

You can use the bundled DMM Intuilink Connectivity software for instrument control, configuration and data logging to PC via USB. The 34405A can also be controlled remotely with industry-standard SCPI commands. For its easy integration into different programming environments, the 34405A is shipped with the Agilent IO Library Suite, LabVIEW driver and IVI-COM driver.

Specifications

DC Specifications[1]

Function	Range[2]	Test Current or Burden Voltage	Input Impedance[3]	Accuracy ± (% of reading + % of range)	
				1 Year 23°C ± 5°C	Temperature Coefficient 0°C – 18°C 28°C – 55°C
Voltage	100.000 mV	—	10.0 MΩ ± 2%	0.025 + 0.008	0.0015 + 0.0005
	1.00000 V	—	10.0 MΩ ± 2%	0.025 + 0.006	0.0010 + 0.0005
	10.0000 V	—	10.1 MΩ ± 2%	0.025 + 0.005	0.0020 + 0.0005
	100.000 V	—	10.1 MΩ ± 2%	0.025 + 0.005	0.0020 + 0.0005
	1000.00 V	—	10.0 MΩ ± 2%	0.025 + 0.005	0.0015 + 0.0005
Resistance	100.000 Ω	1.0 mA	—	0.05 + 0.008[4]	0.0060 + 0.0008
	1.00000 kΩ	0.83 mA	—	0.05 + 0.005[4]	0.0060 + 0.0005
	10.0000 kΩ	100 µA	—	0.05 + 0.006[4]	0.0060 + 0.0005
	100.000 kΩ	10.0 µA	—	0.05 + 0.007	0.0060 + 0.0005
	1.00000 MΩ	900 nA	—	0.06 + 0.007	0.0060 + 0.0005
	10.0000 MΩ	205 nA	—	0.25 + 0.005	0.0250 + 0.0005
	100.000 MΩ	205 nA | | 10 MΩ	—	2.00 + 0.005	0.3000 + 0.0005
Current	10.0000 mA	<0.2 V	—	0.05 + 0.015	0.0055 + 0.0005
	100.000 mA	<0.2 V	—	0.05 + 0.005	0.0055 + 0.0005
	1.00000 A	<0.5 V	—	0.20 + 0.007	0.0100 + 0.0005
	10.0000 A	<0.6 V	—	0.25 + 0.007	0.0150 + 0.0005
Continuity	1000 Ω	0.83 mA	—	0.05 + 0.005	0.0050 + 0.0005
Diode Test[5]	1.0000 V	0.83 mA	—	0.05 + 0.005	0.0050 + 0.0005

[1] Specifications are for 30 minutes warm-up, 5½ digit resolution and calibration temperature 18°C – 28°C.
[2] 20% over range on all ranges except 1000 Vdc.
[3] Input Impedance is in paralleled with capacitance <120 pF.
[4] Specifications are 2-wire ohms using Math Null. If without Math Null, add 0.2 Ω additional error.
[5] Specifications are for the voltage measured at the input terminals only.

AC Specifications[1]

Function	Range[2]	Frequency	Accuracy ± (% of reading + % of range) 1 Year 23°C ± 5°C	Accuracy ± (% of reading + % of range) Temperature Coefficient 0°C – 18°C 28°C – 55°C
True-RMS AC Voltage[3]	100.000 mV	20 Hz – 45 Hz	1.0 + 0.1	0.02 + 0.02
		45 Hz – 10 kHz	0.2 + 0.1	0.02 + 0.02
		10 kHz – 30 kHz	1.5 + 0.3	0.05 + 0.02
		30 kHz – 100 kHz[4]	5.0 + 0.3	0.10 + 0.02
	1.00000 V to 750.00 V	20 Hz – 45 Hz	1.0 + 0.1[5]	0.02 + 0.02
		45 Hz – 10 kHz	0.2 + 0.1	0.02 + 0.02
		10 kHz – 30 kHz	1.0 + 0.1	0.05 + 0.02
		30 kHz – 100 kHz[4]	3.0 + 0.2[6]	0.10 + 0.02
True-RMS AC Current[7]	10.0000 mA	20 Hz – 45 Hz	1.5 + 0.1	0.02 + 0.02
	100.000 mA	45 Hz – 1 kHz	0.5 + 0.1	0.02 + 0.02
	10.0000 A	1 kHz – 10 kHz[8]	2.0 + 0.2	0.02 + 0.02
Frequency[9]	100 mV to 750 V	<2 Hz	0.18 + 0.003	0.005
		<20 Hz	0.04 + 0.003	0.005
		20 Hz – 100 kHz[10]	0.02 + 0.003	0.005
		100 kHz – 300 kHz[11]	0.02 + 0.003	0.005
	10 mA to 10 A	<2 Hz	0.18 + 0.003	0.005
		<20 Hz	0.04 + 0.003	0.005
		20 Hz – 10 kHz[10]	0.02 + 0.003	0.005

Temperature and Capacitance Specifications[1]

Function	Range	Test Current, etc.	Accuracy ± (% of reading + % of range) 1 Year 23°C ± 5°C	Accuracy ± (% of reading + % of range) Temperature Coefficient 0°C – 18°C 28°C – 55°C
Temperature	–80°C – 150°C	5 kΩ Thermistor Probe	Probe Accuracy + 0.2°C	0.002°C
	–110.0°F – 300.0°F	5 kΩ Thermistor Probe	Probe Accuracy + 0.4°F	0.0036°F
Capacitance	1.000 nF	0.75 µA	2.0 + 0.8	0.02 + 0.001
	10.00 nF	0.75 µA	1.0 + 0.5	0.02 + 0.001
	100.0 nF	8.3 µA	1.0 + 0.5	0.02 + 0.001
	1.000 µF – 100.0 µF	83 µA	1.0 + 0.5	0.02 + 0.001
	1000 µF	0.83 mA	1.0 + 0.5	0.02 + 0.001
	10,000 µF	0.83 mA	2.0 + 0.5	0.02 + 0.001

[1] Specifications are for 30 minutes warm-up, 5½ digit resolution and calibration temperature 18°C – 28°C.
[2] 20% over range on all range except 750 Vac.
[3] Specifications are for sinewave inputs >5% of range. Maximum crest factor : 3 at full scale.
[4] Additional error to be added as frequency >30 kHz and signal input <10% of range. 30 kHz – 100 kHz: 0.003% of full scale per kHz.
[5] For input <200 V rms.
[6] For input <300 V rms.
[7] For 12 A terminal, 10 A dc or ac rms continuous, >10 A dc or ac rms for 30 seconds ON and 30 seconds OFF.
[8] For 1 A and 10 A ranges, the frequency is verified for less than 5 kHz.
[9] Specifications are for half-hour warm-up, using 0.1 second aperture. The frequency can be measured up 1 Mhz as 0.5 V signal to 100 mV/1 V ranges.
[10] For 20 Hz – 10 kHz, the sensitivity is AC input current from 10% to 120% of range except where noted.
[11] For 100 Hz – 300 kHz, the sensitivity will be 12% – 120% of range except 750 V range.

Operating Specifications

Function	Digits	Reading Speed[1]	System Speed			
			Function Change (sec)[2]	Range Change (sec)[3]	Auto Range (sec)[4]	Reading Speed Over USB[5]
DCV, DCI	5½	15/s	0.6	0.7	2.2	8/s
	4½	70/s	0.6	0.7	2.2	19/s
ACV, ACI	5½	2.5/s	5.0	2.2	6.1	1/s
	4½	2.5/s	5.0	2.2	6.1	1/s
Frequency[6]	5½	9/s	7.0	2.5	6.1	1/s
	4½	9/s	7.0	2.5	6.1	1/s

[1] Reading rate of the A/D converter.
[2] Time to change from 2-wire resistance to this specified functions and to take at least one reading in 4.5 digit using the SCPI "FUNC" and "READ?" commands.
[3] Time to change one range to the next higher range and to take at least one reading in 4.5 digit using the SCPI "FUNC" and "READ?" commands.
[4] Time to automatically change one range and to take at least one reading in 4.5 digit using SCPI "CONF AUTO" and "READ?" commands.
[5] Number of measurements per second that can be read through USB using SCPI " READ?" command.
[6] Reading rate depend on signal frequency >10 Hz.

Supplemental Measurement Specifications

Math Functions
Null, dBm, dB, Min/Max/Avg, Hold, Limit Test
Remote Interface
USB 2.0 full speed, USBTMC class device (GPIB over USB)
Programming Language
SCPI, IEEE-488.1, IEEE-488.2

General Specifications

Weight
3.75 kg, 8.27 lb
Dimension
Rack: 88.5 mm (H) x 212.6 mm (W) x 272.3 mm (D)
Bench: 103.8 mm (H) x 261.2 mm (W) x 303.2 mm (D)
Safety Compliance
Certified to CSA for IEC/EN/CSA/UL 61010-1 2nd Edition
Warranty
1 year

Key Literature & Web Link

Data Sheet, p/n 5989-4906EN
Easy Steps to Integrate the 34405A Multimeter into a System Application Note, p/n 5989-5980EN
Side-by-Side Comparison: Agilent 34405A and Fluke 45 Digital Multimeter Application Note, p/n 5989-5979EN
Migration from the Agilent 34401A to the Agilent 34405A Digital Multimeter Application Note, p/n 5989-5515EN

For more information on 34405A: **www.agilent.com/find/34405A**
For driver and software downloads: **http://adn.tm.agilent.com/**

Ordering Information

34405A Digital Multimeter
Includes power cord, USB interface cable, Test Lead Kit, Product Reference CD-ROM (includes DMM IntuiLink connectivity software, and IVI-COM and LabVIEW drivers) Agilent IO Library Suite CD-ROM, Certificate of Calibration (CoC), test report, Quick Start Guide in multiple languages, User's and Service Guide

Accessories
34405A-1CM Rack Mount Adapter Kit
34405A-A6J ANSI/NCSL Z540 Compliance Calibration
34132A Deluxe Test Lead Kits
34330A 30 A Current Shunt
34133A Precision Electronics Test Leads
E2308A Thermistor Probe

Low-Cost 6½ Digit Multimeter

34401A

- 12 measurement functions
- 1000 V maximum input
- 15 ppm basic dcV accuracy (24-hour)
- 1000 readings per second direct to GPIB
- GPIB and RS-232 standard
- 512-reading memory
- SCPI commands standard
- IntuiLink Connectivity Software included

34401A

34401A Digital Multimeter

The 34401A digital multimeter establishes a new price/performance standard by offering such features as 6½ digits of resolution, 1000 readings per second, and 15 ppm basic dc accuracy at a surprisingly affordable price. The 34401A has been designed for superior performance while providing the flexibility to meet both your present and future needs.

Great Bench Performance

The clear, logical front panel of the 34401A allows you to easily select all primary measurement functions. Traditional "bench" functions, such as continuity and diode test, are included. Math functions, such as NULL, dB, dBm, limit test, and min/max/avg are easily selected. A simple menu scheme gives you access to powerful advanced features, such as the ability to store up to 512 readings in internal memory. Measurement results are displayed on a bright, high-visibility readout. A rugged case ensures survival even under the toughest conditions, and the optional accessory pouch makes it easy to pack up and go with the 34401A.

Superior Performance in Your System

The 34401A can take up to 1000 readings per second, including GPIB bus transfer in ASCII format. Both GPIB and RS-232 are standard, letting you select the interface that best meets your needs. The 34401A responds to three different command languages. It accepts SCPI commands (Standard Commands for Programmable Instruments), which ensures present and future compatibility. Drivers are also available for both National Instruments Labview and Agilent's VEE software.

IntuiLink Software, included with your 34401A, allows you to transfer your measurement data and images into Microsoft Excel or Microsoft Word with little or no programming. You can specify the meter setup and take a single reading or log data to the Excel spreadsheet in specific time intervals. Programmers can use the ActiveX components to control the DMM using SCPI commands. To find out more about IntuiLink, visit **www.agilent.com/find/intuilink**

Abbreviated Technical Specifications

DC Voltage

Input Characteristics

Range	Maximum Reading (6½ digits)	Resolution in Digits 6½	5½	4½	Input Resistance
100 mV	120.0000	100 nV	1 µV	10 µV	10 MΩ or >10 GΩ
1 V	1.200000	1 µV	10 µV	100 µV	10 MΩ or >10 GΩ
10 V	12.00000	10 µV	100 µV	1 mV	10 MΩ or >10 GΩ
100 V	120.0000	100 µV	1 mV	10 mV	10 MΩ
1000 V	1050.000	1 mV	10 mV	100 mV	10 MΩ

Input Protection: >1000 V on all ranges

Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
100 mV	0.0030 + 0.0030	0.0040 + 0.0035	0.0050 + 0.0035
1 V	0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007
10 V	0.0015 + 0.0004	0.0020 + 0.0005	0.0035 + 0.0005
100 V	0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006
1000 V	0.0020 + 0.0006	0.0035 + 0.0010	0.0045 + 0.0010

Noise Rejection: (50 or 60 Hz, 1 kΩ unbalance in LO lead)
DC CMRR: 140 dB
AC CMRR: 70 dB
Normal Mode Rejection (60 Hz/50 Hz) ± 0.1%:
100 PLC (1.67 s/2.00 s): 60 dB
10 PLC (167 ms/200 ms): 60 dB
1 PLC (16.7 ms/20.0 ms): 60 dB
<1 PLC (3 ms or 800 µs): 0 dB
Maximum Reading Rate: (readings/s)

Power Line Frequency	Resolution in Digits 6½	5½	4½
60 Hz	6	300	1000
50 Hz	5	300	1000

AC Voltage (true rms)
Measurement Accuracy: ±(% of reading + % of range); 1 year, 23°C ± 5°C

Frequency	Ranges 100 mV	Ranges 1, 10, 100, 750 V
3 to 5 Hz	1.00 + 0.04	1.00 + 0.03
5 to 10 Hz	0.35 + 0.04	0.35 + 0.03
10 Hz to 20 kHz	0.06 + 0.04	0.06 + 0.03
20 to 50 kHz	0.12 + 0.04	0.12 + 0.05
50 to 100 kHz	0.60 + 0.08	0.60 + 0.08
100 to 300 kHz	4.00 + 0.50	4.00 + 0.50

Note: –3 dB frequency typically >1 MHz

Input Resistance: 1 MΩ ± 2%, in parallel with 100 pF
Input Protection: >750 V rms on all ranges
Maximum Volt-Hz Product: 8×10^7
Crest Factor: Maximum of 5:1 at full scale
Maximum Reading Rate: 10 readings/s (50 readings/s with default delays defeated)

Frequency and Period
Range: 3 Hz to 300 kHz (333 ms to 3.33 µs)
1-Year Accuracy: 0.01% (40 Hz to 300 kHz); 0.05% (3 to 40 Hz)
Resolution: 10 µHz to 1 Hz

Other Measurement Functions: Continuity, Diode Test, Ratio dc:dc, Limit Test
Math Functions: NULL, Min/Max/Avg, dB, dBm, Limit Test
Memory: 512-reading internal storage
Standard Programming Languages: SCPI, Agilent 3478A and Fluke 8840A/42A
Computer Interface: GPIB and RS-232C standard
Accessories Included: Test lead kit, operators manual, service manual, test report, and power cord

Resistance: (2-wire Ω, 4-wire Ω)
Input Characteristics

Range	Maximum Reading (6½ digits)	Resolution in Digits 6½	5½	4½
100 Ω	120.0000	100 µΩ	1 mΩ	10 mΩ
1 kΩ	1.200000	1 mΩ	10 mΩ	100 mΩ
10 kΩ	12.00000	10 mΩ	100 mΩ	1 Ω
100 kΩ	120.0000	100 mΩ	1 Ω	10 Ω
1 MΩ	1.200000	1 Ω	10 Ω	100 Ω
10 MΩ	12.00000	10 Ω	100 Ω	1 kΩ
100 MΩ	120.0000	100 Ω	1 kΩ	10 kΩ

Input Protection: >1000 V on all ranges
Measurement Accuracy: ±(% of reading + % of range)
Specs are for 4-wire Ω or 2-wire Ω using Math Null

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C	Current Source
100 Ω	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	1 mA
1 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	1 mA
10 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	100 µA
100 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	10 µA
1 MΩ	0.0020 + 0.001	0.008 + 0.001	0.010 + 0.001	5.0 µA
10 MΩ	0.0150 + 0.001	0.020 + 0.001	0.040 + 0.001	500 nA
100 MΩ	0.3000 + 0.010	0.800 + 0.010	0.800 + 0.010	500 nA*

* Measurement is computed from 10 MΩ in parallel with input.

Maximum Reading Rate: Same as dcV

DC Current
Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C	Shunt Resistance
10 mA	0.005 + 0.010	0.030 + 0.020	0.050 + 0.020	5.0 Ω
100 mA	0.010 + 0.004	0.030 + 0.005	0.050 + 0.005	5.0 Ω
1 A	0.050 + 0.006	0.080 + 0.010	0.100 + 0.010	0.1 Ω
3 A	0.100 + 0.020	0.120 + 0.020	0.120 + 0.020	0.1 Ω

Burden Voltage: <2 V for 3 A input; <0.1 V for 10 mA input
Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse
Maximum Reading Rate: Same as dcV

AC Current (true rms)
Measurement Accuracy: ±(% of reading + % of range); 1 year, 23°C ± 5°C

Frequency	Ranges 1 A	Ranges 3 A
3 to 5 Hz	1.00 + 0.04	1.10 + 0.06
5 to 10 Hz	0.30 + 0.04	0.35 + 0.06
10 Hz to 5 kHz	0.10 + 0.04	0.15 + 0.06

Burden Voltage: <1.5 V rms for 3 A input
Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse
Maximum Reading Rate: Same as acV

General Specifications

Power: 100/120/220/240V, ±10%
Power Line Frequency: 45 to 66 Hz, 360 to 440 Hz
Power Consumption: 25 VA peak (10 W average)
Operating Environment: 0 to 55°C, full accuracy to 80% RH, 40°C
Storage Environment: –40°C to 75°C
Size: 88.5 mm H x 212.6 mm W x 348.3 mm D (4 in x 8.5 in x 14 in)
Weight: Net, 3.6 kg (8.0 lb); shipping, 5.9 kg (13 lb)
Safety: Designed to UL-1244, IEC-348, CSA

Ordering Information

34401A Multimeter
  34401A-1CM Rackmount Kit
  34401A-A6J ANSI Z540 Compliant Calibration
34161A Accessory Pouch
34171B Input Terminal Connector (sold in pairs)
34172B Input Calibration Short (sold in pairs)
34131A Hard Transit Case

6½ Digit Digital Multimeters

34410A

- **6½ digit resolution**
- **10,000 readings/sec @ 5½ digits to the PC**
- **LAN, USB & GPIB standard**
- **Capacitance & temperature measurements**
- **Data logger for improved usability**
- **50,000 reading non-volatile memory**
- **LXI class C compliant**

The Agilent 34410A is a high performance digital multimeter designed for high speed and precise triggering, offering maximum versatility for present and future needs. The 34410A is a 6½ digit, dual display, benchtop and system digital multimeter featuring 10,000 readings per second at 5½ digits, datalogging, resistance and frequency, and LAN, USB and GPIB connectivity. If you need up to 50,000 readings/second, consider the 34411A 6½ Digit Enhanced Performance Digital Multimeter.

Specifications

Measurement Capability
0.0030% basic DC accuracy
Capacitance & Temperature
Data Logger with 50,000 reading non-volatile memory
System Capability
LAN (LXI class C), USB & GPIB standard
10,000 readings/sec @5½ digits to the PC
1,000 readings/sec @6½ digits to the PC

Accessories

34132B Deluxe Lead Set with Retractable Sheath
34133A Precision Electronic Test Leads
34134A DC Coupled Current Probe
34136A High Voltage Probe
34138A Test Lead Set
34171B Input Terminal Block
34172B Calibration Short
34190A Rackmount Kit
34308A Thermistor Kit
34330A 30 A Current Shunt
82350B PCI High-Performance GPIB Interface Card
E5810A LAN/GPIB Gateway

Key Literature & Web Link

www.agilent.com/find/34410A

Ordering Information

34410A 6½ Digit DMM

Stand alone order – can select standard options for repair/calibration, power cord, and manuals. Otherwise, it ships with everything you need including a CD with programming examples, drivers, Intuilink, etc.

34411A

- **6½ digit resolution**
- **50,000 readings/sec. @ 4½ digits to the PC**
- **1 M reading memory**
- **Analog level and pre/post triggering**
- **LAN, USB & GPIB standard**
- **Capacitance & temperature measurements**
- **Data logger for improved usability**
- **50,000 reading non-volatile memory**
- **LXI class C compliant**

The Agilent 34411A sets a new benchmark for digital multimeter performance with up to 50,000 readings per second at 4½ digits, 1 million readings of volatile memory and triggering capabilities. The 34411A has all the features of the 34410A, plus additional performance that makes it even more powerful. The 34411A Enhanced Performance 6½ digit digital multimeter can be used in R&D and manufacturing environments as a bench or system instrument.

Specifications

Measurement Capability
0.0030 % basic DC accuracy
Capacitance & Temperature
Data Logger with 50,000 reading non-volatile memory
System Capability
LAN (LXI class C), USB & GPIB standard
50,000 readings/sec @4½ digits to the PC
10,000 readings/sec @5½ digits to the PC
1,000 readings/sec @6½ digits to the PC

1M reading memory
Analog level and pre/post triggering

Accessories

34132B Deluxe Lead Set with Retractable Sheath
34133A Precision Electronic Test Leads
34134A DC Coupled Current Probe
34136A High Voltage Probe
34138A Test Lead Set
34171B Input Terminal Block
34172B Calibration Short
34190A Rackmount Kit
34308A Thermistor Kit
34330A 30 A Current Shunt
82350B PCI High-Performance GPIB Interface Card
E5810A LAN/GPIB Gateway

Key Literature & Web Link

www.agilent.com/find/34411A

Ordering Information

34411A 6½ Digit DMM

Can be ordered with the standard choices of repair/warranty and power cords. The instrument comes complete with programming examples and drivers on a CD.

6½ Digit Digital Multimeters (cont.)

L4411A

- **1 Rack Unit high**
- **6½ digit resolution**
- **50,000 readings/sec. @4½ digits to the PC**
- **1 M reading memory**
- **Analog level and pre/post triggering**
- **LAN, USB & GPIB standard**
- **Capacitance & temperature measurements**
- **50,000 reading non-volatile memory**
- **LXI class C compliant**
- **Compatibility mode for 34401A/E1412A**

The Agilent L4411A is an enhanced performance digital multimeter with up to 50,000 readings per second at 4½ digits, 1 million readings of volatile memory and triggering capabilities in a 1 rack unit high size. With all the features of the 34411A, users can take advantage of the 34401A/E1412A compatibility mode to easily integrate this new multimeter into existing test systems. The simple display shows the user the current reading and LAN address for easy debugging. The L4411A is a 6½ digit, 1 Rack Unit tall enhanced performance digital multimeter optimized for use in manufacturing environments where space is at a premium.

Specifications

Measurement Capability
0.0030 % basic DC accuracy
Capacitance & Temperature
System Capability
LAN (LXI class C), USB & GPIB standard
50,000 readings/sec @4½ digits to the PC
10,000 readings/sec @5½ digits to the PC
1,000 readings/sec @6½ digits to the PC

1M reading memory
Analog level and pre/post triggering
1 Rack Unit tall

Accessories

34132B Deluxe Lead Set with Retractable Sheath
34133A Precision Electronic Test Leads
34134A DC Coupled Current Probe
34136A High Voltage Probe
34138A Test Lead Set
34171B Input Terminal Block
34172B Calibration Short
34190A Rackmount Kit
34308A Thermistor Kit
34330A 30 A Current Shunt
82350B PCI High-Performance GPIB Interface Card
E5810A LAN/GPIB Gateway

Key Literature & Web Link

www.agilent.com/find/L4411A

Ordering Information

L4411A 6½ Digit DMM

Can be ordered with the standard choices of repair/warranty and power cords. The instrument comes complete with programming examples and drivers on a CD.

34420A

- 1.3 nV rms noise/8 nVp-p
- 100 pV, 100 nΩ sensitivity
- Two-channel programmable voltage input; difference and ratio functions
- 7½ digit resolution
- 1 mV to 100 V ranges
- SCPI and Keithley 181 languages
- Direct SPRT, RTD, Thermistor, and thermocouple temperature measurements
- IntuiLink Connectivity Software included

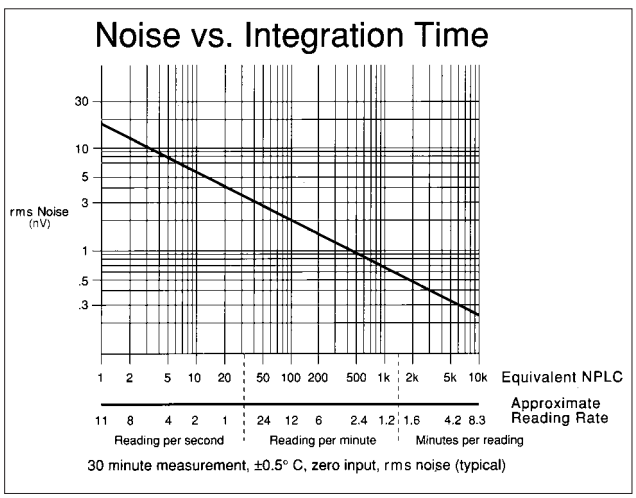
34420A

34420A Nanovolt/Micro-ohm Meter

The Agilent 34420A sets a price/performance standard in low-level measurement capability. The noise performance of the 34420A nanovolt/micro-ohm meter is more than an order of magnitude better than that previously available from Hewlett-Packard.

Accurate, Repeatable Low-Level Measurements

A shielded copper pin screw-down connector, a 7½-digit A/D converter, 2 ppm basic dc accuracy, and a new measurement algorithm that gives 100 dB normal mode rejection without front-end filtering result in measurement capability you can depend on to make accurate and repeatable low-level measurements. Low noise input amplifiers and a highly-tuned input protection scheme bring reading noise down to 8 nVp-p. Longer integration times improve noise performance even further.



Unprecedented Functionality

Two input channels allow voltage measurements to be made independently, or they can be mathematically combined to make difference and ratio measurements. Ohms measurements combine the low-noise input circuits with a highly-stable current source to provide outstanding low-resistance measurements. Offset compensation is employed to eliminate the effects of stray thermal EMFs that would otherwise result in measurement error. Low power ohms and a low-voltage resistance measurement capability allow repeatable measurements to be made where a low voltage (20 mV) is required to avoid oxidation punch-through. A wide range of temperature measurement capabilities are also built in, providing support for SPRT, thermocouple, RTD, and thermistor temperature sensors.

Math Functions Enhance Capabilities

Math functions such as NULL, STATS, and SCALE ease the capture of minimum and maximum readings, provide averages and standard deviation, scale your measurement results, and ultimately makes it easier for you to characterize your input signal. The 34420A can also store up to 1024 readings in internal memory.

Built-in Versatility

You will find that the 34420A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the 34420A from the front panel is straightforward and intuitive. For system applications, the 34420A includes both GPIB and RS-232 interfaces standard, and uses Standard Commands for Programmable Instrumentation (SCPI). This ensures both present and future compatibility. The 34420A also responds to commands for the Keithley 181 nanovoltmeter.

Agilent IntuiLink: Easy Data Access

The Included Agilent IntuiLink software allows your captured data to be put to work easily, using PC applications such as Microsoft Excel or Microsoft Word, to analyze, interpret, display, print, and document the data you get from the 34420A. To find out more about IntuiLink, visit **www.agilent.com/find/intuilink**

Abbreviated Technical Specifications

Accuracy Specifications: ±(% of reading + % of range)

DC Voltage[1] – 7½ digits Resolution all Ranges

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 mV	0.0025 + 0.0020	0.0040 + 0.0020	0.0050 + 0.0020
10 mV	0.0025 + 0.0002	0.0040 + 0.0002	0.0050 + 0.0003
100 mV	0.0015 + 0.0003	0.0030 + 0.0004	0.0040 + 0.0004
1 V	0.0010 + 0.0003	0.0025 + 0.0004	0.0035 + 0.0004
10 V	0.0002 + 0.0001	0.0020 + 0.0004	0.0030 + 0.0004
100 V	0.0010 + 0.0004	0.0025 + 0.0005	0.0035 + 0.0005

DCV1/DCV2 (ratio)**:** Ratio error in % = channel 1 accuracy in % + channel 2 accuracy in %
DCV1-2 (difference)**:** Difference error = channel 1 (% reading + % range) + channel 2 (% reading + % range)

DC Voltage Noise Specifications[2]

Range	2-Minute rms Noise	2-Minute p-p Noise	24-Hour p-p Noise
1 mV	1.3 nV RMS	8 nV p-p	12 nV p-p
10 mV	1.5 nV RMS	10 nV p-p	14 nV p-p
100 mV	10 nV RMS	65 nV p-p	80 nV p-p
1 V	100 nV RMS	650 nV p-p	800 nV p-p
10 V	450 nV RMS	3 µV p-p	3.7µV p-p
100 V	11 µV RMS	75 µV p-p	90 µV p-p

DC Voltage
- Input Resistance:
  - 10 MΩ ± 1% (100 V range)
  - >10 GΩ (1 mV through 10 V range)
- Input Protection:
  - 150 V peak to Channel 1 LO

Resistance[3] – 7½ digits Resolution all Ranges

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 kΩ	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 kΩ	100 µA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 kΩ	10 µA	0.0015 + 0.0003	0.0040 + 0.0004	0.0060 + 0.0004
1 MΩ	5 µA	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Low Power Resistance[3]

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 kΩ	100 µA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 kΩ	10 µA	0.0015 + 0.0004	0.0040 + 0.0004	0.0060 + 0.0004
100 kΩ	5 µA	0.0015 + 0.0012	0.0040 + 0.0015	0.0060 + 0.0015
1 MΩ	5 µA	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Voltage Limited Resistance[3]
Voltage limit selectable: 20 mV, 100 mV, or 500 mV

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
10 Ω	1 mA	0.0020 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
100 Ω	100 µA	0.0025 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002

Temperature – 0.001°C Resolution

Probe Type	Accuracy
SPRT[4]	SPRT probe accuracy +0.003°C
RTD	RTD probe accuracy +0.05°C
Thermistor	Thermistor probe accuracy +0.1°C
Thermocouple[5]	Thermocouple probe accuracy +0.2°C

Temperature
SPRT: ITS-90 calibrated temperature within the range of –190°C to +660°C
RTD: Type $\alpha = 0.00385$ and $\alpha = 0.00392$. R_0 from 4.9 Ω to 2.1 KΩ. ITS-90 (IEC 751) Callendar – Van Dusen conversion
Thermistor: 5 KΩ
Thermocouple: ITS-90 conversions of type B, E, J, K, N, R, S, T

Chart Out (Analog Out)
Resolution: 16 bits
Maximum Output: ±3 V
Span and Offset: Adjustable

Filter (Analog or Digital or Both)
Analog: Low pass 2 pole @13 Hz, available for dcV on 1 mV, 10 mV, 100 mV ranges
Digital: Moving average filter. 10 (fast), 50 (medium) or 100 (slow) reading averages

Math Functions
NULL (Channel 1 dcV, Channel 2 dcV, Difference, Resistance, Temperature)
STATS (Min/max/avg, peak-peak, standard deviation, number of readings)
SCALE (Allows linear scaling as Y=MX + B)
CHART NULL (Establishes zero for rear-panel output)

General Specifications

Front-Panel Connection: Shielded, low-thermal, copper contacts
Interface: GPIB and RS-232 standard
Languages: SCPI-1994 (IEEE-488.2), Keithley 181

Ordering Information

34420A Nanovolt/Micro-Ohm Meter
Includes low-thermal input cable (34102A), low-thermal shorting plug (34103A), operating and service manuals, quick reference guide, test report with calibration sticker, 2.3 ml bottle of contact cleaner, and power cord.
34420A-1CM Rackmount Kit
34420A-A6J ANSI Z540 Compliant Calibration

Accessories
34102A Low-Thermal Input Cable (four-conductor with copper spade lugs)
34103A Low-Thermal Shorting Plug
34104A Low-Thermal Input Connector
34161A Accessory Pouch
34131A Hard Transit Case

[1] Specifications are for channel 1 or channel 2 (100 V range on channel 1 only), after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with filters off.
[2] After a 2-hour warm-up ±1°C, 6.5 digits (10 NPLC) with analog filter off digital filter medium (50 readings). 2 minute rms and 24-hour noise typical.
[3] All resistance specifications are for channel 1 only, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC) with filters off, for 4-wire Ω or 2-wire Ω using Null.
[4] For 25 Ω SPRT with triple-point of water check within last 4 hours. With no triple-point of water check, add 0.013°C for 24-hour, 0.035°C for 90-day, and 0.055°C for 1-year specifications.
[5] For fixed reference junction. Add 0.3°C for external reference junction, add 2.0°C for internal reference junction.

3458A

3458A Multimeter

The Agilent 3458A multimeter shatters long-standing performance barriers of speed and accuracy on the production test floor, in research and development, and in the calibration lab. The 3458A is the fastest, most flexible, and most accurate multimeter offered by Agilent Technologies. In your system or on the bench, the 3458A saves you time and money with unprecedented test-system through-put and accuracy, seven-function measurement flexibility, and low cost of ownership.

Select a rate of 100,000 reading per second for maximal test through-put. Or achieve highest levels of precision with up to 8½ digits of measurement resolution and 0.1 part per million transfer accuracy. Add to this the 3458A's simplicity of operation, and you have the ideal multimeter for your most demanding applications.

High-Test System Throughput

Faster Testing
- Up to 100,000 readings/s
- Internal test setups >340/s
- Programmable integration times from 500 ns to 1 s

Greater Test Yield
- More accuracy for tighter test margins
- Up to 8½ digits resolution

Longer Uptime
- Two-source (10 V, 10 kΩ) calibration, including ac
- Self-adjusting, self-verifying auto-calibration for all functions and ranges, including ac

High-Resolution Digitizing

Greater Waveform Resolution and Accuracy
- 16 to 24-bits resolution
- 100,000 to 0.2 sample/s
- 12 MHz bandwidth
- Timing resolution to 10 ns
- Less than 100 ps time jitter
- Over 75,000 reading internal memory

Calibration Lab Precision

Superb Transfer Measurements
- 8½ digits resolution
- 0.1 ppm dc volts linearity
- 0.1 ppm dc volts transfer capability
- 0.01 ppm rms internal noise

Extraordinary Accuracy
- 0.6 ppm for 24 hours in dc volts
- 2.2 ppm for 24 hours in Ω
- 100 ppm mid-band ac volts
- 8 ppm (4 ppm optional) per year voltage reference stability

3458A Multimeter Performance Features

DC Volts
- 5 ranges: 0.1 V to 1000 V
- 8½ to 4½ digits resolution
- Up to 100,000 readings/s (4½ digits)
- Maximum sensitivity: 10 nV
- 0.6 ppm 24-hour accuracy
- 8 ppm (4 ppm optional)/year voltage reference stability

Resistance
- 9 ranges: 10 Ω to 1 GΩ
- 2-wire and 4-wire Ω with offset compensation
- Up to 50,000 readings/second (5½ digits)
- Maximum sensitivity: 10 μ Ω
- 2.2 ppm 24-hour accuracy

AC Volts
- 6 ranges: 10 mV to 1000 V
- 1 Hz to 10 MHz bandwidth
- Up to 50 readings/s with all readings to specified accuracy
- Choice of sampling or analog true rms techniques
- 100 ppm best accuracy

DC Current
- 8 ranges: 100 nA to 1 A
- Up to 1,350 readings/s (5½ digits)
- Maximum sensitivity: 1 pA
- 14 ppm 24-hour accuracy

AC Current
- 5 ranges: 100 μA to 1 A
- 10 Hz to 100 kHz bandwidth
- Up to 50 readings/second
- 500 ppm 24-hour accuracy

Frequency and Period
- Voltage or current ranges
- Frequency: 1 Hz to 10 MHz
- Period: 100 ns to 1 second
- 0.01% accuracy
- AC or dc coupled

Throughput

Maximum Reading Rates
- 100,000 readings/s at 4½ digits (16 bits)
- 50,000 readings/s at 5½ digits
- 6,000 readings/s at 6½ digits
- 60 readings/s at 7½ digits
- 6 readings/s at 8½ digits

Measurement System Speed
- 100,000 readings/s over GPIB or with internal memory
- 110 autoranges/s
- 340 function or range changes/s
- Postprocessed math from internal memory

Abbreviated Technical Specifications

DC Voltage

Range	Full Scale	Maximum Resolution	1-Year* Accuracy	Transfer Accuracy 10 min., tref ±0.5°C	Input Impedance
			ppm of reading + ppm of range		
100 mV	120.00000	10 nV	9(5) + 3	0.5 + 0.5	>10 GΩ
1 V	1.20000000	10 nV	8(4) + 0.3	0.3 + 0.1	>10 GΩ
10 V	12.0000000	100 nV	8(4) + 0.05	0.05 + 0.05	>10 GΩ
100 V	120.000000	1 µV	10(6) + 0.3	0.5 + 0.1	10 MΩ ± 1%
1000 V	1050.00000	10 µV	10(6) + 0.1	1.5 + 0.05	10 MΩ ± 1%

One-year specifications for NPLC 100 within 24 hours and ±1°C of last ACAL, Tcal ±5°C, MATH NULL, fixed range. Add 2 ppm of reading additional error for Agilent factory traceability of 10 V dc to US NIST. Traceability error is the absolute error relative to National Standards associated with the source of last external calibration. Transfer specifications for NPLC 100, following 4-hour warm-up. Full scale to 10% of full scale. Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling. Tref is the starting ambient temperature. Measurements are made on a fixed range using accepted metrology practices. *High stability (Option 002) ppm of reading in parentheses.

Noise Rejection (dB)[1]

	AC NMR[2]	AC ECMR	DC ECMR
NPLC <1	0	90	140
NPLC ≥1	60	150	140
NPLC ≥10	60	150	140
NPLC ≥100	60	160	140
NPLC =1000	75	170	140

[1] Applies for 1 kΩ unbalance in the LO lead and ±0.1% of the line frequency currently set for LFREQ.
[2] For line frequency ±1%, ACNMR is 40 dB for NPLC ≥1, or 55 dB for NPLC ≥100. For line frequency ±5%, ACNMR is 30 dB for NPLC ≥100.

Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk

True rms AC Voltage
(Synchronous Subsampled Mode)

Range	Full Scale	Maximum Resolution	Accuracy* 24 hour – 2 year 40 Hz to 1 kHz % of reading + % of range	Input Impedance
10 mV	12.00000	10 nV	0.02 + 0.011	1 MΩ ±15% with <140 pf
100 mV	120.00000	10 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
1 V	1.2000000	100 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
10 V	12.000000	1 µV	0.007 + 0.002	1 MΩ ±2% with <140 pf
100 V	120.00000	10 µV	0.02 + 0.002	1 MΩ ±2% with <140 pf
1000 V	700.0000	100 µV	0.04 + 0.002	1 MΩ ±2% with <140 pf

* Specifications apply for full scale to 10% of full scale, dc <10% of ac, sine-wave input, crest factor of 1.4. Within 24 hours and ±1°C of last ACAL. Peak (ac+dc) input limited to 5 x full scale for all ranges. Add 2 ppm of reading additional error for Agilent factory traceability of 10 Vdc to US NIST.

Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk
Volt-Hz product	1 x 10[8]	—

Resistance

Range	Full Scale	Maximum Resolution	Current Through Unknown	1-Year Accuracy* (4-wire Ω) ppm of rdg+ppm of range
10 Ω	12.00000	10 µΩ	10 mA	15 + 5
100 Ω	120.00000	10 µΩ	1 mA	12 + 5
1 kΩ	1.2000000	100 µΩ	1 mA	10 + 0.5
10 kΩ	12.000000	1 mΩ	100 µA	10 + 0.5
100 kΩ	120.00000	10 mΩ	50 µA	10 + 0.5
1 MΩ	1.2000000	100 mΩ	5 µA	15 + 2
10 MΩ	12.000000	1 Ω	500 nA	50 + 10
100 MΩ	120.00000	10 Ω	500 nA	500 + 10
1 GΩ	1.2000000	100 Ω	500 nA	0.5% + 10

* Specifications for 100 NPLC, offset compensation on, within 24 hours and ±1°C of last ACAL, Tcal ±5°C. Add 3 ppm of reading additional error for Agilent factory traceability of 10 kΩ to US NIST.

Memory

	Standard Readings	Bytes	Option 001 Readings	Bytes
Reading Storage (16 bit)	10,240	20 k	+65,536	+128 k
Non-volatile, for Subprograms and/or State Storage	—	14 k	—	—

Math Functions
The 3458A performs the following math functions on measurements: NULL, SCALE, OFFSET, RMS FILTER, SINGLE POLE FILTER, THERMISTOR LINEARIZATION, DB, DBM, % ERROR, PASS/FAIL LIMIT TESTING, and STATISTICS. Two math functions may be used at one time.

General Specifications

Operating Temperature: 0°C to 55°C
Warmup Time: Four hours to all specifications except where noted
Humidity Range: 95% RH, 0°C to 40°C
Storage Temperature: –40°C to +75°C
Power: 100/120 V, 220/240 V ± 10%, 48 to 66 Hz, 360 to 420 Hz automatically sensed. Fused at 1.5 A @115 V or 0.5 A @230 V. <30 W, < 80 VA (peak).
Size: 88.9 mm H x 425.5 mm W x 502.9 mm D (3.5 in x 16.75 in x 19.8 in)
Weight: Net, 12 kg (26.5 lb); shipping, 14.8 kg (32.5 lb)

Ordering Information

3458A Multimeter (with GPIB, 20 KB reading memory, and 8 ppm stability)
- **3458A-001** Extended Reading Memory (expands total to 148 KB)
- **3458A-002** High-Stability (4 ppm/year) Reference
- **3458A-A6J** ANSI Z540 Compliant Calibration
- **3458A-907** Front-handle Kit
- **3458A-908** Rack Flange Kit
- **3458A-909** Rack Flange Kit (with handles)

Digital Multimeter Accessory Compatibility Chart and Products

Accessory	34401A	34410A	34411A	3458A	34420A[1]	L4411A
34132B Deluxe Test Lead Kit w/retractable sheath	Yes	No	No	Yes	No	No
11059A Kelvin Probe Set	Yes	Yes	Yes	Yes	No	Yes
11062A Kelvin Clip Set	Yes	Yes	Yes	Yes	Yes	Yes
34133A Precision Electronic Probe	Yes	No	No	No	No	No
11060A Surface-Mount Device Probe	Yes	No	No	Yes	No	No
34171B DMM Terminal Connector	Yes	No	No	No	No	No
34172B DMM Calibration Short	Yes	No	No	No	No	No
E2308A Thermistor Temp Probe	Yes[2]	No	No	Yes	No	No
34134A AC/DC Current Probe	Yes	No	No	No	No	No
34136A High Voltage Probe	Yes	No	No	No	No	No
34138A Test Lead Set	Yes	Yes	Yes	No	No	Yes
34330A 30 A Current Shunt	Yes	No	No	Yes	No	No
34131A Basic Instrument Transit Case	Yes	No	No	No	Yes	No
34161A Accessory Pouch	Yes	No	No	No	Yes	No
34102A Low Thermal Input Cable	No	No	No	No	Yes	No

[1] Many accessories are listed as incompatible with 34420A because of the specialized termination. Many of these accessories may be rewired onto the low thermal input connector 34104A.
[2] Need 34812A BenchLink Meter or an external program to do temperature measurement.

34133A

11060A

11059A

Test Leads

34132A/B Deluxe Test Lead Kits

The test leads in these kits feature a 1.4 m flexible cable and a soft Sanoprene over mold for a comfortable grip. They are rated at 1000 V CAT III. Each kit contains red and black test leads, needle point and alligator test lead tips, and red and black retractable hook test leads. Supplied in a reusable nylon pouch. The kits are available with the following banana plug configurations:

Model	Description
34132A	Deluxe test lead kit with straight fixed sheath banana plugs
34132B	Deluxe test lead kit with straight retractable sheath banana plugs

34133A Precision Electronic Test Leads

These precision electronic test leads are designed specifically for working with small components and in dense circuit boards. The test leads are small and light. The spring-loaded tip helps absorb those small movements and the crown point digs into solder. The test leads have a 1.2 m flexible cable, terminated in right angle shrouded banana plugs and have a Sanoprene over-mold for a comfortable grip. Each kit includes one black and one red test lead.

11060A Surface Mount Device Tweezers

The gold plated beryllium copper tweezer design provides an easy method to access and accurately measure SMD resistive networks. Length 1.2 m.

Kelvin Probe and Clips

11059A Kelvin Probe Set

This high quality Kelvin probe set is complete and ready to use for making 4-wire Ohm measurements. The 4 color coded banana jacks and Kelvin clips are both gold plated for maximum conductivity and resistance to corrosion. The probe assembly also includes a ground to guard connector to help remove any ground related errors for the ultimate in high accuracy measurement, ideal for use with the 3458A 8½ digit DMM. The wires are encased in a woven shroud for ease of use and to protect the cables.

11062A Kelvin Clip Set

These silver plated Kelvin clips are ideal for constructing your own Kelvin Probe set for 4-wire Ohm measurements. Each set contains 2 clips.

34131A
34134A
34161A
34171B
34172B
34330A
E2308A

34134A

34330A

34171B

34161A

34131A

Current Measurement

34134A DC Coupled Current Probe

A clamp on probe for a wide range of applications such as measuring ground currents, powers ripple or current distribution in systems. Output signals: 1 V/A (1 mV/mA) and 10 mV/A. Frequency range: DC to 2 kHz.

34330A 30 A Current Shunt

This current shunt can be used to extend the current measurement range. Precision 0.001 Ohm resistor. Output is 1 mV per amp of current passing through the shunt. 15 A continuous; 30 A for 15 min continuous.

Temperature Measurement

E2308A Thermistor Temperature Probe

General purpose temperature probe. 5 KOhm @25°C, encapsulated in a stainless steel case. Temperature range: –80°C to 150°C. Accuracy: 0°C to 70°C, ±2%. Time constant: 3 seconds typical.

Miscellaneous DMM Accessories

34171B DMM Terminal Connector

Provides a convenient and reliable method to connect wires to all five input terminals on the 34401A, 34410A, 34411A, and L4411A. Qty. 2

34172B DMM Calibration Short

Provides a convenient and secure method to apply a short to the input connectors of the 34401A, 34410A, 34411A, and L4411A. Qty. 2

34161A Accessory Pouch

Cordura pouch fits on top of the 34401A and 34420A voltmeters as well as the 54131/32/81A counter and the 33120A and 33250A function/arb generators.

34131A Basic Instrument Transit Case

Heavy-duty hard-cover carrying case is constructed from rugged A.B.S. and has rubber-grip steel handles and steel latches. The case can be padlocked. For use with 34401A and 34420A voltmeters as well as the 53131/32/81A counter and the 33120A function/arb generator.

- **Measure power without a power meter**
- **Connect quickly and easily with USB 2.0**
- **Perform zeroing without disconnecting from device-under-test (DUT)**
- **Ease monitoring and troubleshooting with feature-packed software**
- **Perform accurate power measurements with other instruments**

Excellent Performance without Compromise

The Agilent U2000 Series USB power sensors allow you to display power measurement on a PC or on other Agilent instruments without the need of a separate power meter. The compact U2000 Series gives you the same functionality and performance as a conventional power meter and sensor. This is a cost-effective solution that leverages the latest diode sensor technologies, hence, you will experience the same level of performance for your power measurements with a lower cost solution.

Simplified Measurement Setup without the Need of an External Power Supply and Triggering Module

The U2000 Series is a complete solution that simplifies your measurement setup and meets all your measurement needs. No external power supply is required to power up the sensor as it utilizes the power from the USB port. The low current consumption (approximately 170 mA) enables a number of USB sensors to be connected to a PC without the need of an external USB hub to supply any additional power.

The U2000 Series consists of built-in triggering circuit that enables measurement synchronization with the external instrument or event, for instance, to control the timing of capturing a pulse signal. With the plug-and-play capability of the U2000 Series, a quick connection can be established between the USB power sensor and the PC for your immediate measurements.

External Calibration-free Measurements

The U2000 Series provides "internal zeroing" that eliminates the needs of disconnecting or powering off the device under test. It integrates a switching circuit into each USB sensor, hence, users can perform the zeroing while the sensor is still connecting to a device under test.

The compact design of U2000 Series also eliminates the sensor calibration that requires an external reference source, and the path loss calibration caused by the different combination of power meter and sensor. Users can rely on the factory calibration to ensure measurement accuracy.

The internal zeroing and calibration-free designs remove the steps to connect and disconnect the power sensor from the calibration source. Hence, it can reduce the test times, measurement uncertainty, and wear and tear of the connector. The USB power sensors can also be embedded into the test fixtures without switching the reference signals.

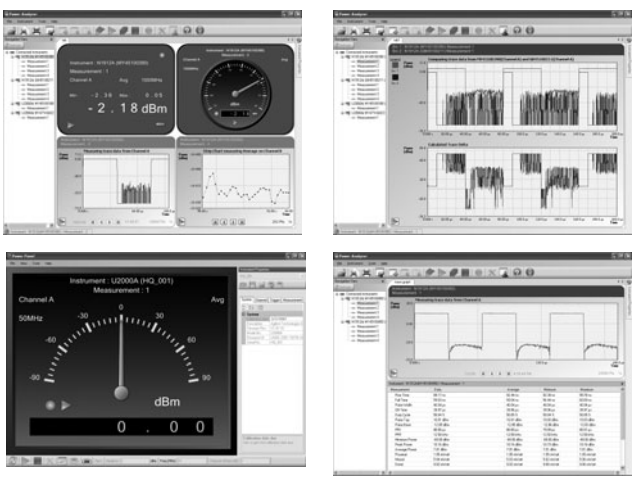
N1918A Power Panel, the Intuitive Soft Front Panel

The U2000 Series is bundled with the Power Panel that offers a standard GUI for basic power measurement. The Power Panel can display power measurements in both analog and numerical formats and a trend chart display that monitors up to 10,000 data points. The Power Panel also comes with mathematical functions for multiple channels such as delta, sum and ratio in multi-list measurement.

The software also comes with integrated Help File that guides you through the operations of each function. The provided save and record capability of U2000 Series can be disabled using the password protection. This aims to prevent any unauthorized data storage and to safeguarding sensitive information and measurements. This makes the Agilent U2000 Series suitable to be used in a secure environment.

Easy Monitoring and Troubleshooting with N1918A-100 Power Analyzer

The N1918A Power Analysis Manager offers an orderable option – N1918A-100 Power Analyzer that further extends the capabilities of the U2000 Series.



Key Features of the Advanced Power Analyzer

- Comes with enhanced visualization with larger and more flexible display formats that includes Digital Softpanel, Gauge, Trace Graph, Strip Chart displays and multiple tabs
- Provides complete 15-point pulse characterization for peak power analysis
- Supports overlay measurements and waveform math computations
- Computes statistical power routines on PDF, CDF and CCDF measurements
- Stores up to seven days of data based on preprogrammed measurement schedules
- Provides limits and alert function for remote monitoring
- Offers data logging and timestamp for deviation monitoring and analysis

Low Power Path and High Power Path for Agilent U2000 Series USB Power Sensors

Sensor	Power Range
U2000A, U2001A, U2002A, U2004A	–60 dBm to +20 dBm Low Power Path: –60 dBm to –10 dBm High Power Path: –10 dBm to +20 dBm

Product Specifications for Agilent U2000 Series USB Power Sensors

Model	Frequency Range	Maximum SWR (25°C ± 10°C)	Maximum SWR (0 – 55 °C)	Maximum Power	Connector Type
U2000A	10 MHz to 18.0 GHz	10 MHz to 30 MHz: 1.15 30 MHz to 2 GHz: 1.13 2 GHz to 14 GHz: 1.19 14 GHz to 16 GHz: 1.22 16 GHz to 18 GHz: 1.26	10 MHz to 30 MHz: 1.21 30 MHz to 2 GHz: 1.15 2 GHz to 14 GHz: 1.20 14 GHz to 16 GHz: 1.23 16 GHz to 18 GHz: 1.27	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	Type-N (m)
U2001A	10 MHz to 6.0 GHz	10 MHz to 30 MHz: 1.15 30 MHz to 2 GHz: 1.13 2 GHz to 6 GHz: 1.19	10 MHz to 30 MHz: 1.21 30 MHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.20	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	Type-N (m)
U2002A	50 MHz to 24 GHz	50 MHz to 2 GHz: 1.13 2 GHz to 14 GHz: 1.19 14 GHz to 16 GHz: 1.22 16 GHz to 18 GHz: 1.26 18 GHz to 24 GHz: 1.30	50 MHz to 2 GHz: 1.15 2 GHz to 14 GHz: 1.20 14 GHz to 16 GHz: 1.23 16 GHz to 18 GHz: 1.27 18 GHz to 24 GHz: 1.30	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	3.5 mm (m)
U2004A	9 kHz to 6.0 GHz	9 kHz to 2 GHz: 1.13 2 GHz to 6 GHz: 1.19	9 kHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.20	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	Type-N (m)

Ordering Information

U2000A 10 MHz to 18 GHz, –60 dBm to +20 dBm USB Power Sensor, N-type (m)
U2001A 10 MHz to 6 GHz, –60 dBm to +20 dBm USB Power Sensor, N-type (m)
U2002A 50 MHz to 24 GHz, –60 dBm to +20 dBm USB Power Sensor, 3.5 mm (m)
U2004A 9 kHz to 6 GHz, –60 dBm to +20 dBm USB Power Sensor, N-type (m)

N1918A-100 Power Analyzer
U200xx-100 Connector Type-N
U2000A-201 Transit Case To fit in 4 USB sensors, Operating & service guide, programming guide, cables
U2000A-202 Soft Carrying Case to carry the sensor for field applications

Cables

A 1.5 m USB 2.0 Compliance cable with USB Mini-B connector and locking mechanism to the sensor is provided as standard

Additional Cables

U2031A: USB 2.0 compliance cable with USB Mini-B connector and locking mechanism, length 1.5 meters (5 ft)
U2031B: USB 2.0 compliance cable with USB Mini-B connector and locking mechanism, length 3 meters (10 ft)
U2031C: USB 2.0 compliance cable with USB Mini-B connector and locking mechanism, length 5 meters (16.7 ft)

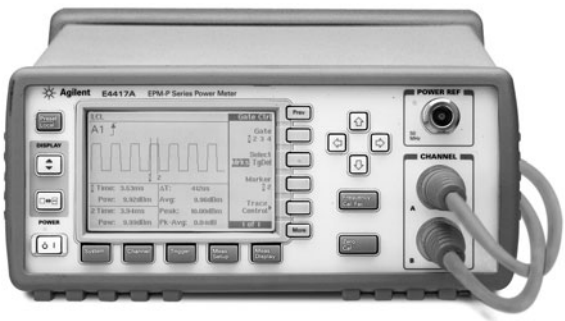
Key Literature & Web Link

U2000 Series USB Power Sensor Data Sheet, p/n 5989-6278EN
U2000 Series USB Power Sensor Technical Overview, p/n 5989-6279EN
U2000 Series USB Power Sensor Configuration Guide, p/n 5989-6281EN
U2000 Series USB Power Sensor Demo Guide, p/n 5989-6280EN
N1918A Power Analysis Manager Technical Overview, p/n 5989-6613EN
N1918A Power Analysis Manager P-Series Power Meter Measurement Application, p/n 5989-6619EN
Steps for Making Better Power Measurements, Application Note 64-4D, p/n 5965-8167EN
Choosing the Right Power Meter and Sensor, Product Note, p/n 5968-7150E

www.agilent.com/find/usbsensor

E4416A
E4417A

- **Peak, peak-to-average ratio and average power measurements**
- **Time-gated power measurements**
- **Analyzer software for pulse and statistical analysis**
- **Fast measurement speed over the GPIB (up to 1,000 readings per second with the E4416A and E9320 power sensors)**
- **5 MHz video (modulation) bandwidth**
- **Operates with all E-series and 8480 series power sensors**



E4416A and E4417A Peak and Average Power Meters

Comprehensive Measurement Capability for TDMA, CDMA, and W-CDMA Signals

The E4416A and E4417A high-performance, single and dual-channel power meters and E932x peak and average power sensors, provide a low-cost, single-box solution for peak, peak-to-average ratio, average power and time-gated measurements, for the complex modulation formats used in today's and future wireless communications systems.

Time-gated measurements are performed using the meters comprehensive triggering features, such as an external TTL compatible trigger input. Up to 4 simultaneous time-gated measurements can be made. Individual start and duration times can be setup, allowing user's to measure the average, peak, or peak-to-average ratio. For example, on a GSM signal, this capability can be used to measure the average power over 5% to 95% of the burst duration, as well as measuring the peak power and pulse droop.

Fast Measurement Speed without Compromising Accuracy and Repeatability

Faster test times improve manufacturing productivity and efficiency. Designed for both bench and automatic test equipment (ATE) operation, the EPM-P series power meters along with the E9320 sensors, provides a measurement speed, over the GPIB, of 1,000 corrected readings per second.

The meter's 20 Msamples/second continuous sampling rate provides the capability to accurately profile complex modulation formats of up to 5 MHz bandwidth.

"Agilent EPM-P Analyzer" Software

The "Agilent EPM-P Analyzer" VEE operates via the GPIB in a PC or laptop environment, and provides the statistical, power, frequency and time measurements that are required for CDMA and TDMA signals. When the software is in control of the meter, all the meter functions and pre-defined setups are not relevant as the software overrides the meter. It's a VEE run-time program and is supplied as standard with all EPM-P power meters, free of charge, on a CD-ROM. It also comes with a VEE installation program.

Low Cost of Ownership

The EPM-P series power meters come with 2-year calibration cycle, and are fully compatible with the 8480 and E-series power sensors, therefore protecting your investment. This also gives an additional choice for conventional average power measurements.

Specifications

Frequency Range: 9 kHz to 110 GHz, sensor dependent
Power Range: –70 to +44 dBm, sensor dependent
Single Sensor Dynamic Range
- 8480 series sensors: 50 dB maximum
- E-series CW power sensors: 90 dB
- E-series E9300 Average power sensors: 80 dB maximum
- E-series E9320 Peak and Average power sensors:
  - 85 dB maximum (CW mode)
  - 75 dB maximum (peak mode)

Display Units
- Absolute: Watts or dBm
- Relative: Percent or dB

Display Resolution: Selectable resolution of 1.0, 0.1, 0.01, 0.001 dB in logarithmic mode, or 1 to 4 significant digits in linear mode
Measurement Characteristics
- Measurements: Average Power, Peak Power, Peak-to-Average Ratio and measurements between two time offsets (time-gating)
- Analyzer Software: statistical and pulse analysis
- Averaging: Averaging over 1 to 1024 readings

Modulation Bandwidth: 5 MHz maximum (set by meter and is sensor dependent)
Instrumentation Accuracy
- Absolute:
  - Logarithmic: ±0.02 dB; Linear: ±0.5%
- Relative:
  - Logarithmic: ±0.04 dB; Linear: ±1.0%

Time Base Accuracy: 0.1%
Trigger Sources: Internal, External TTL, GPIB, RS232/422
Sampling Characteristics
- Sampling Rate: 20 MSamples/second continuous sampling
- Sampling Technique: Synchronous repetitive sampling

1 mW Power Reference: Refer to EPM Series Power Meters

Key Literature

Product Overview, p/n 5980-1471E
Technical Specifications, p/n 5980-1469E
Configuration Guide, p/n 5965-6381E
Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN
Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E
Application Note 1438, EPM-P Series Power Meters Used in Radar and Pulse Applications, p/n 5988-8522EN

Ordering Information

E4416A Power Meter (peak and average, single-channel)
E4417A Power Meter (peak and average, dual-channel)
E4417A-002 Supplies Rear-panel Sensor Input (power reference calibrator is on the front panel)
E4417A-003 Supplies Rear-panel Sensor Input (power reference calibrator is on the rear panel)
E4417A-004 Deletes the E9288A Sensor Cable
E4417A-908 Supplies a One-instrument Rackmount Kit
E4417A-909 Supplies a Two-instrument Rackmount Kit
E4417A-1A7 Supplies ISO17025 Certificate of Calibration with Data
E4417A-A6J Supplies ANSI Z540 Certificate of Calibration with Data

Accessories
34131A Hard Transit Case
34161A Accessory Pouch
34141A Yellow Soft Carry Case

Power Sensor Cables
For operation with E9320 power sensors:
E9288A 1.5 Meters (5 ft)
E9288B 3 Meters (10 ft)
E9288C 10 Meters (31 ft)

For operation with 8480 series, E441x and E9300 power sensors only:
11730A 1.5 Meters (5 ft)
11730B 3 Meters (10 ft)
11730C 6.1 Meters (20 ft)
11730D 15.2 Meters (50 ft)
11730E 30.5 Meters (100 ft)
11730F 61 Meters (200 ft)

Note: The E9288A-C sensor cables will also operate with 8480 and E-series power sensors.

E9321A
E9322A
E9323A
E9325A
E9326A
E9327A

- **Operates with the new EPM-P Series Power Meters (E4416A and E4417A)**
- **Provides peak and average power measurements**
- **Fast measurement speed over the GPIB (up to 1,000 readings per second)**
- **300 kHz, 1.5 MHz and 5 MHz video (modulation) bandwidths**
- **Wide dynamic range sensors**
- **Calibration factors stored in EEPROM**

E9320 Family Peak and Average Power Sensors

E9320 Family Peak and Average Power Sensors

The E9320 power sensors must be used with an E9288A, B or C sensor cable and only operate with the EPM-P or P-Series power meters. These sensors have two measurement paths, one for peak and time-gated measurements (a fast sampled path) and another for stable, low-level average power measurements.

High Performance Sensors

The E932x sensors have two frequency ranges, from 50 MHz to 6 GHz to cover most wireless communications applications, and a higher frequency range 50 MHz to 18 GHz. Each frequency range has a choice of 3 different video bandwidth sensors:

- 300 kHz for TDMA signals, for example GSM
- 1.5 MHz for cdmaOne
- 5 MHz for W-CDMA and cdma2000

Using just one sensor, user's can measure W-CDMA, cdmaOne and TDMA as each sensor provides a high, medium and low video bandwidth setting, selectable by the meter. So user's can select the modulation bandwidth required for their application, while maintaining the maximum dynamic range.

Fast Measurement Speed

The E9320 power sensors provide fast measurement speed, over the GPIB, up to 1,000 corrected readings per second, with the E4416A power meter.

Optimum Measurement Accuracy and Repeatability

To minimize the sensor and source mismatch, one of the main contributors to the overall measurement uncertainty, the E9320 sensors have a low SWR specification (1.15 for signals <+10 dBm, 50 MHz to 2 GHz). Comprehensive error correction is also provided as the calibration factors, linearity, and temperature compensation data are all stored within the E9320 sensor's EEPROM.

Specifications

Sensor Model	Max. Meas. Bandwidth	Frequency Range	Power Range	Max. Power
E9321A	300 kHz	50 MHz to 6 GHz	–65 to +20 dBm (max.)	+23 dBm average
E9322A	1.5 MHz	50 MHz to 6 GHz	–60 to +20 dBm (max.)	+23 dBm average
E9323A	5 MHz	50 MHz to 6 GHz	–60 to +20 dBm (max.)	+23 dBm average
E9325A	300 kHz	50 MHz to 18 GHz	–65 to +20 dBm (max.)	+23 dBm average
E9326A	1.5 MHz	50 MHz to 18 GHz	–60 to +20 dBm (max.)	+23 dBm average
E9327A	5 MHz	50 MHz to 18 GHz	–60 to +20 dBm (max.)	+23 dBm average

Key Literature

Product Overview, p/n 5980-1471E
Technical Specifications, p/n 5980-1469E
Configuration Guide, p/n 5965-6381E
Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
Application Note 64-4, Four Steps for Better Power Measurements, p/n 5965-8167EN
Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E
Application Note 1438, EPM-P Series Power Meters Used in Radar and Pulse Applications, p/n 5988-8522EN

Ordering Information

E9321A Power Sensor, 50 MHz to 6 GHz, 300 kHz Bandwidth
E9321A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9322A Power Sensor, 50 MHz to 6 GHz, 1.5 MHz Bandwidth
E9322A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9323A Power Sensor, 50 MHz to 6 GHz, 5 MHz Bandwidth
E9323A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9325A Power Sensor, 50 MHz to 18 GHz, 300 kHz Bandwidth
E9325A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9326A Power Sensor, 50 MHz to 18 GHz, 1.5 MHz Bandwidth
E9326A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9327A Power Sensor, 50 MHz to 18 GHz, 5 MHz Bandwidth
E9327A-A6J Supplies ANSI Z540 Certificate of Calibration with Data

- **Fast measurement speed (up to 200 readings per second with the E4418B, and 100 readings per second with the E4419B, over the GPIB, with E-series sensors)**
- **Speed improvement of x2 using the 8480-series power sensor (compared to 437B)**
- **Code-compatible with the 436A and 437B (E4418B) and 438A (E4419B)**
- **Operates with the 8480 series and E-series (except the E9320A family) plus all 8480 series power sensors**
- **No range-switching delays with 8480-series sensors (over a 50 dB range), and only one fast-range switch point with E-series sensors (over a 90 dB range)**
- **Internal rechargeable battery option**

EPM Series Power Meters

E4418B Single-Channel Power Meter

The E4418B is a low-cost, high-performance, single-channel, programmable power meter. It is fully compatible with the 8480 series and E-series power sensors, (except the E9320A family). Depending upon which sensor is used, the E4418B can measure from –70 dBm to +44 dBm at frequencies from 9 kHz to 110 GHz. Designed for bench and automatic test equipment (ATE) use, the E4418B makes fast (up to 200 readings per second with E-series sensors), accurate and repeatable power measurements.

The E4418B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a variety of lighting conditions. The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Ten instrument configurations can be saved and recalled, reducing the need to repeat setup sequences.

The E4418B is ideal for service and maintenance applications. The internal rechargeable battery option (Option 001), which provides up to 5.5 hours of continuous operation, brings Agilent's accuracy to field applications. Front and rear panel bumpers protect the E4418B from everyday knocks. The meter weighs only 4 kg (9 lbs), and a bail handle makes it easy to carry.

Because the E4418B power meter is designed to be code-compatible with the previous-generation 436A and 437B power meters, a user's investment in automatic-test procedures, software generation and verification is protected.

E4419B Dual-Channel Power Meter

The E4419B is a low-cost, high-performance, dual-channel, programmable power meter. It is fully compatible with the 8480 series and the E-series power sensors, (except the E9320A family). Depending upon which sensor is used, the E4419B can measure from –70 dBm to +44 dBm at frequencies from 9 kHz to 110 GHz.

Designed for bench and automatic test equipment use (ATE), the E4419B makes fast (up to 100 readings per second with E-series sensors), accurate and repeatable power measurements. The E4419B is a true dual-channel power meter, which means that you get two simultaneous power readings on the display.

The E4419B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a variety of lighting conditions. Users can display both the digital and analog types of readout on the meter's split screen facility. The analog peaking meter allows users to make accurate adjustments.

The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Difference (A-B, B-A) and ratio (A/B, B/A) functions are provided, and ten instrument configurations can be saved and recalled, reducing the need to repeat set-up sequences.

Because the E4419B power meter is code compatible with the 438A and is the same height (88.5 mm /3.5 in) and width (212.6 mm/ 8.5 in) as the 438A, this makes it easy to substitute into rackmount automatic-test-equipment systems.

Specifications

Frequency Range: 9 kHz to 110 GHz, sensor dependent
Power Range: –70 dBm to +44 dBm (100 pW to 25 W), sensor dependent
Power Sensors: Compatible with all 8480 series and E-series sensors except the E9320A family
Single Sensor Dynamic Range
- 90 dB maximum (E-series sensors)
- 50 dB maximum (8480 series sensors)

Display Units
- Absolute: Watts or dBm
- Relative: Percent or dB

Display Resolution: Selectable resolution of 1.0, 0.1, 0.01, and 0.001 dB in log mode, or 1 to 4 digits in linear mode
Default Resolution: 0.01 dB in log mode, 3 digits in linear mode
Accuracy Instrumentation
- Absolute: ±0.02 dB (log) or ±0.5% (linear). Add the corresponding power sensor linearity percentage
- Relative: ±0.04 dB (log) or ±1.0% (linear). Add the corresponding power sensor linearity percentage

Power Reference
Power Output: 1.00 mW (0.0 dBm). Factory set to ±0.4% traceable to the National Physical Laboratory (NPL), UK.
Accuracy
For two years:
- ±0.5% (23 ± 3°C)
- ±0.6% (25 ± 10°C)
- ±0.9% (0 to 55°C)

Frequency: 50 MHz nominal
SWR: 1.06 maximum (1.08 maximum for Option 003)
Connector Type: Type N (f), 50 ohms

Key Literature

Brochure, p/n 5965-6380E
Technical Specifications, p/n 5965-6382E
Configuration Guide, p/n 5965-6381E
Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN
Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Ordering Information

E4418B Power Meter
E4419B Power Meter
E4419B-001 Supplies Internal Rechargeable Battery
E4419B-002 Supplies Rear-panel Sensor Input (power reference calibrator is on front panel)
E4419B-003 Supplies Rear-panel Sensor Input (power reference calibrator is on rear panel)
E4419B-004 Deletes the 11730A Sensor Cable
E4419B-908 Supplies a One-instrument Rackmount Kit
E4419B-909 Supplies a Two-instrument Rackmount Kit
E4419B-1A7 Supplies ISO17025 Certificate of Calibration with Data (E4418B/E4419B)
E4419B-A6J Supplies ANSI Z540 Certificate of Calibration with Data

E4412A
E4413A
E9300A
E9300B
E9300H
E9301A
E9301B
E9301H
E9304A

- **Operates with the E4418A/B, E4419A/B, E4416A, E4417A, N1911A and N1912A power meters**
- **Wide dynamic range, –70 to +44 dBm, sensor dependent**
- **Frequency range, 9 kHz to 26.5 GHz, sensor dependent**
- **Fast measurement speed (up to 200 readings per second, over the GPIB, with the E4418A/B power meter)**
- **Calibration factors, linearity and temperature compensation data stored in EEPROM**

Examples of E-Series Power Sensors

E-Series Power Sensors (E4412A, E4413A and E9300 range)

The E-series diode power sensors are wide dynamic range (90 dB maximum) which operate with the EPM and EPM-P series of power meters.

The E4412A and E4413A sensors are designed for providing power measurements on continuous wave (CW) signals over the range –70 to +20 dBm, whereas the E9300 family of power sensors measure the average power of RF and microwave signals, regardless of modulation format, over an 80 dB maximum range.

8480 Power Sensor Family

The 8480 power sensors are for use with the EPM, EPM-P and P-Series power meters, E1416A and the discontinued 70100A and 43X family power meters. These thermocouple and diode power sensors provide extraordinary accuracy, stability, and SWR over a wide range of frequencies (100 kHz to 110 GHz) and power levels (–70 to +44 dBm).

Best SWR in the Industry

Mismatch uncertainty is usually the largest single source of error in power measurements. The 8480 power sensor family gives you extremely low SWR even at mm-wave frequencies. For example, the W8486A power sensor has a specified SWR of less than 1.08:1 over its entire 75 to 110 GHz frequency range. This low SWR translates into minimum mismatch uncertainty and optimum measurement accuracy.

Accurate Calibration and Traceability

Each power sensor in the 8480 family is individually calibrated and traceable to the U.S. National Institute of Standards and Technology (NIST). The uncertainty in this calibration factor is your link to NIST. The cal factor measurement system used by Standards Lab provides you with minimum cal factor uncertainty.

Millimeter-Wave Sensor Calibration

A 50 MHz calibration port is included in Agilent waveguide power sensors for calibration with the power meter. This calibration provides traceability to NIST at millimeter-wave frequencies, and it eliminates the uncertainties due to temperature changes and the variance in making measurements with different meter/sensor combinations.

Key Literature

EPM Power Meter Brochure, p/n 5965-6380E
E9300 Sensors Product Overview, p/n 5968-4960E
Technical Specifications, p/n 5965-6382E
Configuration Guide, p/n 5965-6381E
Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN
Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Ordering Information

E4412A CW Power Sensor (10 MHz to 18 GHz)
E4413A CW Power Sensor (50 MHz to 26.5 GHz)
E9300A Average Power Sensor (10 MHz to 18 GHz)
E9301A Average Power Sensor (10 MHz to 6 GHz)
E9304A Average Power Sensor (9 kHz to 6 GHz)
E9300B Average Power Sensor (10 MHz to 18 GHz)
E9301B Average Power Sensor (10 MHz to 6 GHz)
E9300H Average Power Sensor (10 MHz to 18 GHz)
E9301H Average Power Sensor (10 MHz to 6 GHz)

E-Series Specifications

Model/Frequency Range	Power Range	Maximum Power	Connector Type
E4412A 10 MHz to 18 GHz	100 pW to 100 mW (–70 to +20 dBm)	200 mW (+23 dBm)	Type-N (m)
E4413A 50 MHz to 26.5 GHz	100 pW to 100 mW (–70 to +20 dBm)	200 mW (+23 dBm)	APC-3.5 mm (m)
E9300A 10 MHz to 18 GHz	1 nW to 100 mW (–60 to +20 dBm)	320 mW (+25 dBm) avg. 2 W (+33 dBm) peak (<10 µsec)	Type-N (m)
E9301A 10 MHz to 6 GHz	1 nW to 100 mW (–60 to +20 dBm)	320 mW (+25 dBm) avg. 2 W (+33 dBm) peak (<10 µsec)	Type-N (m)
E9304A 9 kHz to 6 GHz	1 nW to 100 mW (–60 to +20 dBm)	320 mW (+25 dBm) avg. 2 W (+33 dBm) peak (<10 µsec)	Type-N (m)
E9300B 10 MHz to 18 GHz	1 µW to 25 W (–30 to +44 dBm)	0°C to 35°C: 30 W avg. 35°C to 55°C: 20 W avg. <6 GHz: 500 W peak >6 GHz: 125 W peak 500 Wµs per pulse	Type-N (m)
E9301B 10 MHz to 6 GHz	1 µW to 25 W (–30 to +44 dBm)	0°C to 35°C: 30 W avg. 35°C to 55°C: 20 W avg. <6 GHz: 500 W peak 500 Wµs per pulse	Type-N (m)
E9300H 10 MHz to 18 GHz	10 nW to 1 W (–50 to +30 dBm)	3.16 W avg. 100 W peak 100 Wµs per pulse	Type-N (m)
E9301H 10 MHz to 6 GHz	10 nW to 1 W (–50 to +30 dBm)	3.16 W avg. 100 W peak. 100 Wµs per pulse	Type-N (m)

8480 Series Specifications

Model	Frequency Range	Maximum SWR	Power Linearity[1]	Maximum Power	Connector Type	Weight
25 Watt Sensors 1 mW to 25 W (0 to +44 dBm)						
8481B	10 MHz to 18 GHz	10 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28	+35 to +44 dBm; ±4%	0° to 35°C: 30 W avg[2] 35° to 55°C: 25 W avg 0.01 to 5.8 GHz: 500 W pk	Type-N (m)	Net 0.8 kg (1.75 lb) Shipping 1.5 kg (3.25 lb)
8482B	100 kHz to 4.2 GHz	100 kHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.18		5.8 to 18 GHz: 125 W pk 500 W-µs per pulse	Type-N (m)	
3 Watt Sensors 100 µW to 3 W (–10 to +35 dBm)						
8481H	10 MHz to 18 GHz	10 MHz to 8 GHz: 1.20 8 to 12.4 GHz: 1.25 12.4 to 18 GHz: 1.30	+25 to +35 dBm; ±5%	3.5 W avg, 100 W pk 100 W-µs per pulse	Type-N (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
8482H	100 kHz to 4.2 GHz	100 kHz to 4.2 GHz: 1.20			Type-N (m)	
100 mW Sensors 1 µW to 100 mW (–30 to +20 dBm)						
8485A	50 MHz to 26.5 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 2.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-µs per pulse	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
Option 033	50 MHz to 33 GHz	26.5 to 33 GHz: 1.40				
8481A	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 to 50 MHz: 1.18 50 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28			Type-N (m)	
8482A	100 kHz to 4.2 GHz	100 to 300 kHz: 1.60 0.3 to 1 MHz: 1.20 1 MHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.30			Type-N (m)	
8483A	100 kHz to 2 GHz	100 to 600 kHz: 1.80 600 kHz to 2 GHz: 1.18		300 mW avg, 10 W pk	Type-N (m) 75 Ω	
R8486A	26.5 to 40 GHz	1.4	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-µs per pulse	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)
Q8486A	33 to 50 GHz	1.5			Waveguide Flange UG-383/U	
V8486A	50 to 75 GHz	1.04	+10 to +20 dBm; ±2% –30 to +10 dBm <±1%	200 mV avg 40 W pk 10 µs pulse 0.5% duty cycle	Waveguide Flange UG-385/U	Net 0.4 kg (0.91 lb) Shipping 1 kg (2.11 lb)
W8486A	75 to 110 GHz	1.08	±2%	200 mW avg 40 W peak	Waveguide Flange UG-387/U	Net 0.4 kg (0.9 lb) Shipping 1.0 kg (2.1 lb)
8487A	50 MHz to 50 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25 26.5 to 40 GHz: 1.30 40 to 50 GHz: 1.50	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-µs per pulse	2.4 mm (m)	Net 0.14 kg (0.28 lb) Shipping 0.5 kg (1 lb)
High Sensitivity Sensors 100 pW to 10 µW (–70 to –20 dBm)						
8481D[3,4]	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 MHz to 4 GHz: 1.15 4 to 10 GHz: 1.20 10 to 15 GHz: 1.30 15 to 18 GHz: 1.35	–30 to –20 dBm; ±1%	100 mW avg 100 mW pk	Type-N (m)	Net 0.18 kg (0.41 lb) Shipping 0.9 kg (2 lb)
8485D[3]	50 MHz to 26.5 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 4 GHz: 1.15 4 to 12 GHz: 1.19 12 to 18 GHz: 1.25 18 to 26.5 GHz: 1.29	–30 to –20 dBm; ±2%	100 mW avg 100 mW pk	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
Option 033	50 MHz to 33 GHz	26.5 to 33 GHz: 1.35				
8487D[3]	50 MHz to 50 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 2 GHz: 1.15 2 to 12.4 GHz: 1.20 12.4 to 18 GHz: 1.29 18 to 34 GHz: 1.37 34 to 40 GHz: 1.61 40 to 50 GHz: 1.89	–30 to –20 dBm; ±2%	100 mW avg 100 mW pk	2.4 mm (m)	Shipping 0.5 kg (1 lb) Net 0.2 kg (0.38 lb)
R8486D[3]	26.5 to 40 GHz	1.4	–30 to –25 dBm; ±3%	100 mW avg or pk 40 Vdc max	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)
Q8486D[3]	33 to 50 GHz	1.4	–25 to –20 dBm; ±5%		Waveguide Flange UG-383/U	

[1] Negligible deviation except for those power ranges noted.
[2] For pulses greater than 30 W the maximum average power (Pa) is limited by the energy per pulse (E) in W – µs according to Pa = 30 – 0.02E.
[3] Includes 11708A 30 dB attenuator for calibrating against a 0 dBm, 50 MHz power reference. 11708A is factory set to 30 dB ± 0.05 dB at 50 MHz, traceable to NIST. SWR <1.05 at 50 MHz.
[4] This sensor directly replaces the popular 8484A power sensor.

N1911A
N1912A

- **30 MHz video bandwidth**
- **Single-shot real time sampling at 100 MSa/s**
- **Zero and calibrate while still connected to the DUT**
- **Peak, average, peak-to-average ratio power measurements, time measurements of rise time, fall time, pulse width, pulse period, duty cycle, time to positive/negative occurrences and CCDF statistical analysis**
- **Simplified measurement setup with 22 presets, including WiMAX and WLAN**
- **USB, LAN, and GPIB connectivity**

N1912A P-Series Power Meter (dual channel)

N1911A and N1912A P-Series Power Meters

Designed for Today's Demanding Applications

The N1911A and N1912A single and dual-channel power meters and N192xA sensors deliver the wide bandwidth and high performance measurements that you need to be confident your products are meeting their power specifications.

The P-Series power meters have a 30-MHz video bandwidth and a 100 Msample/s continuous sampling rate for fast, accurate, and repeatable power measurements. When these meters are used with the P-Series wideband power sensors, they provide an extensive measurement capability that has been optimized for aerospace/defense, wireless communication, and wireless networking (802.11a/b/g) applications.

Comprehensive Power and Time Measurements

The P-Series power meters and sensors offer comprehensive measurements that satisfy the requirements of many power applications in R&D and manufacturing.

- Peak power, average power, and peak-to-average power ratio measurements
- Time-gated and free-run measurement modes
- Automatic rise time, fall time, time to positive occurrence and time to negative occurrence

Low Cost of Ownership

Backwards compatibility of the P-Series meters with the current offering of power sensors gives you numerous options for extending the usefulness of your power measurement tools. Identical features and measurements performed by the EPM, EPM-P and P-Series power meters are code compatible, having the same SCPI commands, thus allowing for re-use of test software. A 2-year calibration cycle on the P-Series power meters helps reduce the cost of ownership.

Compatibility with More Than 30 Agilent Sensors

The P-Series power meters also work with 8480 and E-series power sensors. This gives you a selection of more than 30 sensors for peak and average power measurements over a wide dynamic range from –70 to +44 dBm, with frequency coverage from 9 kHz to 110 GHz.

Specifications

General Features

Number of Channels
N1911A P-Series power meter, single channel
N1912A P-Series power meter, dual channel
Frequency Range
N1921A P-Series wideband power sensor, 50 MHz to 18 GHz
N1922A P-Series wideband power sensor, 50 MHz to 40 GHz
Measurements
Average, peak and peak-to-average ratio power measurements are provided with free-run or time gated definition.
Time parameter measurements of pulse rise time, fall time, pulse width, time to positive occurrence and time to negative occurrence are also provided.
Sensor Compatibility
P-Series power meters are compatible with all Agilent P-Series wideband power sensors, E-series sensors and 8480 series power sensors

Key System Specifications and Characteristics

Maximum Sampling Rate
100 Msamples/second, continuous sampling
Video Bandwidth
≥30 MHz
Single Shot Bandwidth
≥30 MHz
Rise Time
≤13 ns (for frequencies >500 MHz)
Fall Time
≤13 ns (for frequencies >500 MHz)
Minimum Pulse Width
50 ns
Dynamic Range
–35 dBm to +20 dBm (>500 MHz)
–30 dBm to +20 dBm (50 MHz – 500 MHz)
Maximum Capture Length
1 second
Maximum Pulse Repetition Rate
10 MHz (based on 10 samples per period)

Timebase

Timebase Range
2 ns to 100 msec/div
Accuracy
10 ppm
Jitter
≤1 ns

Physical Characteristics

Dimensions
The following dimensions exclude front and rear panel protrusions:
88.5 mm H x 212.6 mm W x 348.3 mm D (3.5 in x 8.5 in x 13.7 in)
Net Weight
N1911A: ≤3.5 kg (7.7 lb) approximate
N1912A: ≤3.7 kg (8.1 lb) approximate
Shipping Weight
N1911A: ≤7.9 kg (17.4 lb) approximate
N1912A: ≤8.0 kg (17.6 lb) approximate

Accessories

34131A Basic Instrument Transit Case
34161A Accessory Pouch

Cable Accessories

Sensor cable adapters for use with 8480 and E-Series power sensors only.
N1917A P-Series Meter Cable Adapter, 1.5 m (5 ft)
N1917B P-Series Meter Cable Adapter, 3 m (10 ft)
N1917C P-Series Meter Cable Adapter, 10 m (31 ft)

Key Literature & Web Link

Configuration Guide, p/n 5989-1252EN
Technical Overview, p/n 5989-1049EN
Data Sheet, p/n 5989-2471EN
P-Series Power Meter IEEE 802.16 WiMAX Measurement Application, p/n 5989-6423EN
P-Series Power Sensor Internal Zeroing and Calibration for RF Power Sensors, p/n 5989-6509EN

www.agilent.com/find/wideband_powermeters

Ordering Information

N1911A P-Series Power Meter (single channel)
N1912A P-Series Power Meter (dual channel)
- **N1912A-003** Rear Panel Sensor and Power Reference Connectors
- **N1912A-908** Supplies a One-instrument Rackmount Kit
- **N1912A-909** Supplies a Two-instrument Rackmount Kit
- **N1912A-1A7** Supplies an ISO17025 Certificate of Calibration with Data
- **N1912A-A6J** Supplies ANSI Z540 Certificate of Calibration with Data

N1921A
N1922A

- **Operates with the new P-Series Power Meters (N1911A and N1912A)**
- **Zero and calibrate while still connected to the DUT**
- **Measurement frequency range to 40 GHz**
- **Wide dynamic range peak power measurements**

N192xA P-Series Wideband Power Sensors

N192xA Wideband P-Series Power Sensors

The N1921A (50 MHz to 18 GHz) and the N1922A (50 MHz to 40 GHz) only operate with the P-Series power meters. These sensors have their sensor cable permanently connected (hard-wired) to ensure the best wide bandwidth flatness specifications.

External Calibration-free Measurements

The P-Series power sensors are the first to provide **'internal zero and calibration'** which eliminates the need for sensor calibration using an external reference source. Agilent's patent-pending technology integrates a dc reference source and switching circuits into each power sensor, so that you can zero and calibrate the sensor while it is connected to a device under test. This feature removes the need for connection and disconnection from the calibration source, thereby reducing test times, measurement uncertainty, and wear and tear on connectors. It is especially useful in manufacturing and automated test environments where every second counts. Sensors can be embedded within test fixtures without the need to switch in reference signals.

Simplified Correction Factors

To ensure the accuracy of power measurements, a power meter typically overlays many different sensor correction factors, including linearity, frequency and temperature. At higher bandwidths, this technique can be cumbersome and less than accurate. To simplify the process and improve measurement speed while preserving measurement accuracy, Agilent uses a 4-dimensional modeling technique that measures input power, frequency, temperature, and output voltage across the power sensor's specified measurement ranges. Data from this 4-D model is generated during the initial factory calibration of the sensor and stored in EEPROM, and advanced algorithms are used to quickly and accurately evaluate the sensors against this model, without requiring the power meter to interpolate the calibration factors and linearity curves. If you run tests in which the frequency changes often – testing multi-carrier amplifiers on different bands, for example – you'll notice a marked improvement in measurement speed.

Specifications

Sensor Model	Frequency Range	Dynamic Range	Damage Level	Connector Type
N1921A	50 MHz – 18 GHz	–35 dBm to +20 dBm (>500 MHz) –30 dBm to +20 dBm (50 MHz – 500 MHz)	+23 dBm (average power); +30 dBm (<1 µs duration) (peak power)	Type N (m)
N1922A	50 MHz – 40 GHz	–35 dBm to +20 dBm (>500 MHz) –30 dBm to +20 dBm (50 MHz – 500 MHz)	+23 dBm (average power); +30 dBm (<1 µs duration) (peak power)	2.4 mm (m)

Maximum SWR

Frequency Band	N1921A/N1922A
50 MHz to 10 GHz	1.2
10 GHz to 18 GHz	1.26
18 GHz to 26.5 GHz	1.3
26.5 GHz to 40 GHz	1.5

Sensor Calibration Uncertainty

Definition: Uncertainty resulting from non-linearity in the sensor detection and correction process. This can be considered as a combination of traditional linearity, cal factor and temperature specifications and the uncertainty associated with the internal calibration process.

Frequency Band	N1921A	N1922A
50 MHz to 500 MHz	4.5 %	4.3%
500 MHz to 1 GHz	4.0 %	4.2%
1 GHz to 10 GHz	4.0 %	4.4%
10 GHz to 18 GHz	5.0 %	4.7 %
18 GHz to 26.5 GHz		5.9%
26.5 GHz to 40 GHz		6.0%

Physical Characteristics

Dimensions
N1921A: 135 mm x 40 mm x 27 mm
N1922A: 127 mm x 40 mm x 27 mm
Weight
Weights with cable:
Option 105: 0.4 kg
Option 106: 0.6 kg
Option 107: 1.4 kg
Fixed Sensor Cable Lengths
1.5 m (5-feet); Standard
3.0 m (10-feet); Option 106
10 m (31-feet); Option 107

Key Literature & Web Link

Configuration Guide, p/n 5989-1252EN
Technical Overview, p/n 5989-1049EN
Data Sheet, p/n 5989-2471EN

www.agilent.com/find/wideband_powermeters

Ordering Information

N1921A P-Series Wideband Power Sensor (50 MHz to 18 GHz)
N1922A P-Series Wideband Power Sensor (50 MHz to 40 GHz)
N1922A-105 Fixed 1.5 m (5 -feet) Cable Length (standard)
N1922A-106 Fixed 3 m (10 -feet) Cable Length
N1922A-107 Fixed 10 m (31-feet) Cable Length
N1922A-1A7 Supplies an ISO17025 Certificate of Calibration with Data

Electronic Counters

Starting with the first frequency-measurement projects in the 1940s, Hewlett-Packard pioneered the major technologies enabling today's electronic counters. Today, Agilent Technologies offers a broad line of electronic counters and counter/timers.

Electronic counter/timers are used throughout most technical industries for measuring and analyzing frequency, phase, and time-interval signal characteristics. The breadth of the Agilent offering allows the best product to be selected for each application. An ideal functional and performance fit delivers the greatest value: the best and most cost-effective solution. Agilent counter/timers offer:

- High-measurement accuracy
- Fast system throughput/GPIB capability
- Low cost of ownership
- Ease of use
- Triggering simplicity

The 53131A frequency counter offers high performance for system or bench.

Counter Products

RF Counter

The 53181A leads off Agilent's line of frequency counters. The 53181A RF counter employs continuous measurement technology to provide superior performance at a very low price. Frequency and period measurements are provided over the range of 0.1 Hz to 225 MHz with exceptional resolution of 10 digits in one second. An optional second channel increases the frequency range to 1.5 GHz, 3 GHz, 5 GHz, or 12.4 GHz, making it easy to cover your exact RF measurement needs. Other features of the 53181A include GPIB, automatic limit testing, analog display mode, single-button recall, extensive in-box statistical and math analysis, and more.

The 53181A RF counter is designed for systems and bench applications where high-precision frequency measurements are required in an easy-to-use, small and rugged package.

53181A: The low-cost RF counter for systems and bench use

Universal Frequency and Time Interval Counters

The Agilent universal counter/timers incorporate frequency measurements, just like the 53181A, and additional capabilities for time-interval measurements. Specifically, these counters measure precise timing between two trigger events. These high-performance universal products also provide complete, automatic characterization of rise time, pulse width, and other signal parameters. Options are available (frequency extensions, high-precision time bases) to customize the products.

The current Agilent frequency counter offering includes two high-performance universal counters: the 53131A and 53132A.

The 53131A is designed for manufacturing test, troubleshooting, and service. This counter allows you to easily make highly reliable frequency and timing measurements. Featured are extensive in-box analysis, automatic limit testing, analog display mode, single button recall, and more. The 53131A's half-rack size and light weight make it well suited for both benchtop and rackmounting.

The 53132A is designed for high-performance ATE systems. It combines the functionality of the 53131A with improved frequency and time interval resolution.

53131A: High-performance system and bench counter (10 digits/sec. and 500 ps LSD). Frequency range up to 225 MHz on 2 channels (with optional 3, 5 or 12.4 GHz on the third channel).

53132A: Highest resolution universal counter for system applications (12 digits/sec. and 150 ps LSD). Frequency range up to 225 MHz on 2 channels (with optional 3, 5 or 12.4 GHz on the third channel).

Microwave and Millimeter-Wave Frequency Counters

These products provide fundamental high-performance frequency measurements, dc to 46 GHz. Many enhancements – power measurement, battery operation, systems interface (GPIB), and high-accuracy time bases – are available standard or as options.

53150A/53151A/53152A: Portable CW microwave counter with power measurement for telecommunications service

53147A/53148A/53149A: Portable CW microwave counter with dc DVM plus true power meter for improved power accuracy

High-Precision Oscillators

The accuracy of frequency and time-interval measurements is vitally dependent on the time base or reference element selected. Agilent has pioneered the field of high-precision crystal oscillators. The current counter product line benefits from Agilent's leadership in quality and precision oscillator technology. Three oscillator varieties are standard or optional with Agilent counters and counter/timers:

RTXO: Room-temperature crystal oscillators are designed for minimum frequency change over a change in temperature.

TCXO: Temperature-compensated oscillators use external components to offset temperature effects. TCXO time bases have temperature characteristics which are typically five times better than an RTXO, or $<5 \times 10^{-7}$ for a 0° to 50°C change.

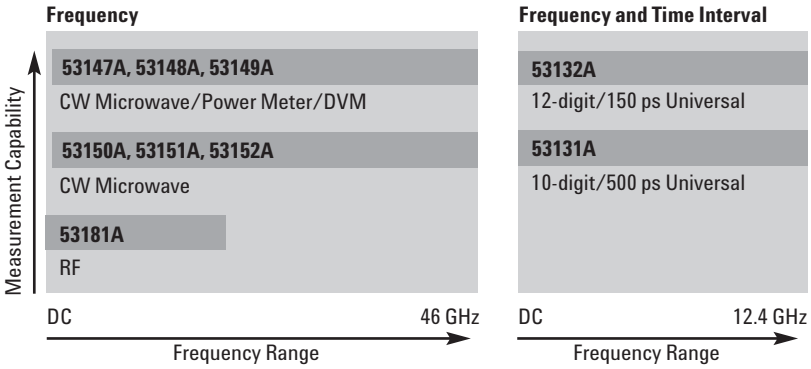
Oven Time Base: This alternative places the crystal and temperature-sensitive elements within a temperature-controlled environment. A heating element maintains a consistent temperature. The best stability is achieved when the operating point is 15° to 20°C above the highest temperature to which the unit will be exposed. After warm-up, the frequency remains very stable, typically $<7 \times 10^{-9}$ over a 0° to 50°C variation.

For more information, please request Application Note 200-2, "Fundamentals of Quartz Oscillators" from the Agilent Call Center in your region.

The 53181A RF counter offers outstanding measurement performance in a low-cost, easy-to-use package.

Electronic Counters

Counter Product Families



Counter Selection Guide

Model	Frequency Range (extension)	Freq. Resolution (1 s gate time)	Best Sensitivity	Time-Interval Res. (single-shot LSD)	Additional Features
Universal Counters					
53131A Optional 3rd channel	225 MHz (3, 5, 12.4 GHz)	10 digits	20 mV_{rms}	500 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization
53132A Optional 3rd channel	225 MHz (3, 5, 12.4 GHz)	12 digits	20 mV_{rms}	150 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization
RF Counter					
53181A Optional 2nd channel	225 MHz (1.5, 3, 5, 12.4 GHz)	10 digits	20 mV_{rms}	—	GPIB standard, full math, statistics, limit testing
CW Microwave Counters					
53150A	20 GHz	1 Hz	–30 dBm	—	GPIB standard, battery optional, simultaneous power measurement
53151A	26.5 GHz	1 Hz	–30 dBm	—	GPIB standard, battery optional, simultaneous power measurement
53152A	46 GHz	1 Hz	–30 dBm	—	GPIB standard, battery optional, simultaneous power measurement
CW Microwave Counter/Power Meter/DVMs					
53147A	20 GHz	1 Hz	–30 dBm	—	DVM and GPIB standard, battery optional, –70 dBm to +20 dBm true power meter
53148A	26.5 GHz	1 Hz	–30 dBm	—	DVM and GPIB standard, battery optional, –70 dBm to +20 dBm true power meter
53149A	46 GHz	1 Hz	–30 dBm	—	DVM and GPIB standard, battery optional, –70 dBm to +20 dBm true power meter

53131A
53132A
53181A

- **High-resolution frequency measurements to 225 MHz (optional 1.5, 3.0, 5.0 or 12.4 GHz)**
- **High-resolution time-interval measurements with 53131A and 53132A**
- **Intuitive user interface with shallow menu structure**
- **GPIB standard with data transfer rate of up to 200 fully-formatted measurements/second; talk-only RS-232**
- **Limit test capability**
- **IntuiLink Connectivity Software included**
- **53181A: 10-digit/s resolution**
- **53131A: 10-digit/s and 500 psec resolution**
- **53132A: 12-digit/s and 150 psec resolution**

53181A RF Counter

53131A and 53132A Universal Counters

A Full Family of High-Performance RF and Universal Counters

Within Budget, Without Compromise

The 53131A/132A/181A high-performance counters offer exceptional price and performance in a rugged, lightweight package with a unique combination of ease of use, complete measurement set, extensive analysis capability, reliability, and high measurement and data transfer speed.

These instruments use real-time digital signal processing technology to analyze data while simultaneously taking new readings, speeding measurement throughput. The technology allows the counters to gather more data for each measurement so you get the high-resolution measurements in a fraction of the time it takes a conventional counter.

Powerful Analysis Capability

The 53131A/132A/181A counters offer built-in statistics and math functions so you can scale measurements and simultaneously measure and track average, min./max. and standard deviation. Automated limit testing lets you set upper and lower limits for any measurement. When a measurement falls outside those limits, the counters log the out-of-limit conditions, notify the operator and generate an output signal to trigger external devices or stop the test. An analog display mode carries limit testing one step further, letting you see at a glance whether a measurement falls within pass/fail limits.

Analog display mode uses an asterisk to represent the current measurement relative to user-defined upper and lower limits. The colon on the left represents the lower limit and the colon on the right represents the upper limit.

High-Speed Automated Test Capability

For computer-controlled systems applications, each counter includes a standard GPIB interface with a data transfer rate of up to 200 fully-formatted measurements per second. The counters use the Standard Commands for Programmable Instruments (SCPI) protocol, letting you leverage your programming investment across your measurement system. The standard RS-232 talk-only interface provides printer support or data transfer to a computer through a terminal-emulation program.

53181A RF Counter

Optimized for RF applications, the single-channel 53181A gives you frequency, period, and peak-voltage measurements with up to 10 digits/sec frequency and period resolution. The low-cost 53181A counter is ideal for benchtop, system RF and analog applications.

A digit-blanking function lets you easily eliminate unnecessary digits when you want to read measurements quickly. For higher-frequency measurements, an optional second channel provides 1.5, 3, 5 or 12.4 GHz bandwidth.

53131A and 53132A Frequency Counters

The two-channel 53131A counter offers 10 digits per second of frequency and period resolution at up to 225 MHz. Single-shot time-interval resolution is specified at 500 ps and averaging can reduce this even further. Measurements include frequency, time interval, ratio, period, phase angle, totalize, peak voltage, pulse parameters and more. For quick access to frequently used tests, a single keystroke recalls up to 20 different stored front-panel set-ups. Choose the 53131A for general bench or system test where you need excellent performance at an unbeatable price.

For applications requiring higher resolution, the 53132A offers the same features and functions as the 53131A with up to 12 digits/s frequency and period resolution. Single-shot time-interval resolution is specified at 150 ps. Choose the 53132A when you need the very best in accuracy and resolution, or when speed in an automated system is critical. With the 53132A, expanded external arming features can be used to control time interval measurements using an external signal.

Whichever counter you choose, you'll have an accurate, reliable counter that will serve you for years to come.

Options Increase Versatility

The 53131A/132A/181A counters can be ordered with an optional RF-input channel to provide frequency measurements up to 3 GHz (531xxA-030), 5 GHz (531xxA-050) or 12.4 GHz (531xxA-124).

A choice of optional timebases is available for the 53131A/132A/181A counters to increase your measurement accuracy. Option 531xxA-010 provides a high-stability oven timebase with aging of less than 5×10^{-10} per day. Option 53132A-012 provides an ultra-high-stability oven timebase with aging of less than 1×10^{-10} per day.

Agilent IntuiLink for counters software turns your PC and counter into a powerful, easy-to-use measurement system. IntuiLink lets you easily configure and run tests from your Windows-based PC, making data gathering more convenient. IntuiLink software helps you get more information from your data by providing a variety of basic display formats and analysis tools that let you manipulate and understand your data quickly and easily.

Abridged Measurement Specification & Characteristics

	53131A	53132A	53181A
Measurements	Frequency, frequency ratio, time interval, period, rise/fall time, positive/negative pulse width, duty cycle,phase (CH 1 to CH 2), totalize, peak voltage, time interval average, time interval delay		Frequency, frequency ratio (with optional CH 2), period, peak voltage
Analysis	Automatic limit testing, math (scale and offset), statistics (minimum, maximum, mean, standard deviation). Statistics available on all measurements or only measurements that fall within limits.		
Measurement Characteristic			
Frequency range	CH 1 & 2: dc – 225 MHz	CH 1 & 2: dc – 225 MHz	CH 1: dc – 225 MHz
Frequency resolution	10 digits/s	12 digits/s	10 digits/s
Time interval resolution (LSD)	500 ps	150 ps	—
Measurement speed	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB
Voltage Range & Sensitivity (Sinusoid)			
DC to 100 MHz	20 mV_{rms} to ±5 Vac + dc	20 mV_{rms} to ±5 Vac + dc	20 mV_{rms} to ±5 Vac + dc
100 MHz to 200 MHz	30 mV_{rms} to ±5 Vac + dc	30 mV_{rms} to ±5 Vac + dc	30 mV_{rms} to ±5 Vac + dc
200 to 225 MHz	40 mV_{rms} to ±5 Vac + dc	40 mV_{rms} to ±5 Vac + dc	40 mV_{rms} to ±5 Vac + dc
Input Conditioning	(Independently selectable on CH 1 & 2)	(Independently selectable on CH 1 & 2)	(Selectable on CH 1)
Impedance, coupling	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc
Low pass filter	100 kHz, switchable	100 kHz, switchable	100 kHz, switchable
Attenuation	x1 or x10	x1 or x10	x1 or x10
External Timebase Reference Input	1, 5, 10 MHz	10 MHz	1, 5, 10 MHz
Trigger	CH 1 & 2	CH 1 & 2	CH 1
	Trigger on rising/falling edge; set level by percent of signal level or absolute voltage; set sensitivity to LOW, MED, or HIGH		
Gating and Arming	Auto, manual (set gate time or number of digits of resolution); external, delay (expanded on 53132A)		
Interfaces	GPIB (IEEE 488.1 and 488.2) with SCPI-compatible language; talk only RS-232		
Software	Includes IntuiLink Connectivity Software		
Power	100 to 120 VAC ± 10% –50, 60 or 400 Hz ± 10% 220 to 240 VAC ± 10% –50 or 60 Hz ± 10% } AC line voltage selection is automatic		
Net Weight/Size	3 kg (6.5 lbs), 88.5 mm H x 212.6 mm W x 348.3 mm D (3.54 in x 8.50 in x 13.932 in)		

For full specifications, request a Product Overview, or visit our web site: **www.agilent.com/find/counter**

Standard and Optional High-Stability Timebases

	Standard (0° to 50°C)	Medium Stability Oven (Option 001)	High Stability Oven (Option 010)	Ultra High Stability Oven (Option 012, 53132A only)
Temperature Stability (referenced to 25°C)	$<5 \times 10^{-6}$	$<2 \times 10^{-7}$	$<2.5 \times 10^{-9}$	$<2.5 \times 10^{-9}$
Aging Rate (after 30 days) Per Day	$<3 \times 10^{-7}$	$<4 \times 10^{-8}$	$<5 \times 10^{-10}$	$<1 \times 10^{-10}$
Per Month		$<2 \times 10^{-7}$	$<1.5 \times 10^{-8}$	$<3 \times 10^{-9}$
Per Year				$<2 \times 10^{-8}$
Turn-on Stability vs. Time (in 30 minutes)		$<2 \times 10^{-7}$ (referenced to 2 hours)	$<5 \times 10^{-9}$ (referenced to 24 hours)	$<5 \times 10^{-9}$ (referenced to 24 hours)
Calibration	Manual Adjust	Electronic	Electronic	Electronic

Note that power to the time base is maintained when the counter is placed in standby via the front panel switch. The internal fan will continue to operate under this condition to maintain long-term instrument reliability.

Optional High-Frequency Channels

	Frequency Range	Coupling	Power Range and Sensitivity	Damage Level
53181A-015[1] **1.5 GHz channel**	100 MHz to 1.5 GHz	ac	–27 dBm to +19 dBm	5 V_{rms}
531xxA-030 3.0 GHz channel	100 MHz to 3.0 GHz	ac	–27 dBm to +19 dBm (100 MHz to 2.7 GHz) –21 dBm to +13 dBm (2.7 GHz to 3 GHz)	5 V_{rms}
531xxA-050 5.0 GHz channel	200 MHz to 5.0 GHz	ac	–23 dBm to +13 dBm	25 dBm
531xxA-124 12.4 GHz channel	200 MHz to 12.4 GHz	ac	–23 dBm to +13 dBm	25 dBm

[1] Option 015 is available only for 53181A counters.

Ordering Information

53131A Frequency Counter
53132A Frequency Counter
53181A RF Counter
- **531xxA-001** Medium-Stability Timebase
- **531xxA-010** High-Stability Timebase
- **53132A-012** High-Stability Timebase (53132A only)
- **53181A-015** 1.5 GHz Ch. w/BNC Connector (53181A only)
- **531xxA-030** 3 GHz Channel with BNC Connector
- **531xxA-050** 5 GHz Channel with Type-N Connector
- **531xxA-124** 12.4 GHz Channel with Type-N Connector
- **531xxA-060** Rear-Panel Connectors
- **531xxA-A6J** ANSI Z540 Compliant Calibration
- **531xxA-1CM** Rackmount Kit

34161A Accessory Pouch
34131A Hard Transit Case

- **Ultra wide range, single input (from 50 MHz up to 46 GHz)**
- **Simultaneous frequency and power measurement with analog peaking indicator**
- **Fully programmable via GPIB and RS-232 standard**
- **Lightweight with optional battery**

53150A
53151A
53152A

53152A

53150A, 53151A, 53152A Microwave Counters

The Agilent 53150 series represent a total re-thinking of microwave counters: innovative designs that offer no-compromise performance and quality while attaining true portability. The 53150A, 53151A, and 53152A measure both frequency and power over the frequency ranges of 20 GHz, 26.5 GHz, and 46 GHz, respectively, and feature a single, extremely wideband microwave input (50 MHz up to 46 GHz).

No Compromise Performance

Utilizing a unique single board design with low phase noise PLL circuitry, the 53150 series offers exceptional sensitivity, excellent power measurement accuracy and repeatability as well as fast acquisition times and full programmability. Performance equals or surpasses the industry standard Agilent 5350 series in virtually every aspect, and in a package that is less than half the weight and size.

Frequency and Power Measurements with a Single Connection

The heart of the 53150 series is an advanced sampler design that integrates a separate zero bias Schottky diode for the accurate measurement of input power. This allows the convenient measurement of both frequency and power with a single connection. The unique cable-loss-compensation feature (power correction) yields accuracies and repeatabilities that rival power meters. Best of all, since the frequency of the test signal is measured simultaneously, the diode's frequency response is automatically adjusted for. And like the latest in diode sensors, deviation from square law is also compensated for.

Functionality Without Clutter

The 53150 series offers a clean, uncluttered front panel with with a minimum of push buttons. Despite their simple appearance, these counters retain all the powerful functions one expects in precision instrumentation, with such useful functions as: measurement averaging, arbitrary as well as nulling offsets for both frequency and power, display of power in either dBm or Watts and full control of resolution, sampling rate, and GPIB address plus extensive self-diagnostics.

Field Tough but Ready for Benchtop or ATE Applications

The 53150 series is as comfortable in the field as in the laboratory. The rugged case with an integrated tilting handle can tolerate the vibration and shock expected in field use. For easy transportation, a soft carrying case is also available. The "see anywhere" backlit LCD display ensures visibility in all environments, from dark to full sunlight. And in situations where AC is unavailable, the internal, replaceable camcorder batteries provide over 2.5 hours of continuous operation. Alternatively, the unit can be powered from an external 11-18 VDC source.

For benchtop and ATE applications, the 53150 series delivers full functionality and high measurement speed along with fully programmable RS-232 interface and high speed GPIB (SCPI compliant) as standard. In addition, these counters are compatible with standard Agilent rackmount hardware.

53150A
53151A
53152A

53150 Series Abridged Measurement Specifications and Characteristics

All measurement specifications are over the full signal ranges of channels 1 and 2. For full specifications or request a Product Overview for the 53150 series microwave counters, please visit our web site **www.agilent.com/find/frequencycounters**

Input Characteristics

	Input 1 (1 MΩ)	Input 2 (50 Ω)	
Frequency Range			
53150A	10 Hz to 125 MHz	0.05 – 20 GHz	
53151A	10 Hz to 125 MHz	0.05 – 26.5 GHz	
53152A	10 Hz to 125 MHz	0.05 – 46 GHz	
Sensitivity		**53150/51**	**53152**
<30 Hz	40 mV_{rms}	—	—
to 125 MHz	25 mV_{rms}	—	—
<300 MHz	—	–20 dBm	–20 dBm
to 12.4 GHz	—	–33 dBm	–33 dBm
to 18 GHz	—	–33 dBm	–30 dBm
to 20 GHz	—	–29 dBm	–27 dBm
to 26.5 GHz	—	–25 dBm (151)	–27 dBm
to 40 GHz	—	—	–23 dBm
to 46 GHz	—	—	–17 dBm
Maximum Input	2 V_{rms}	+5 dBm, <2 GHz +13 dBm, >2 GHz	
Damage Level	5 V_{rms} to 120 Vp	+27 dBm	
Coupling	AC	AC	

Channel 1

Resolution: Selectable 1 Hz to 1 MHz
Connector: BNC female
Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz
Acquisition Time: 100 ms to 140 ms
Gate Time: 1/Resolution
FM Tolerance: 20 MHz p-p max. @10 MHz rate to 26.5 GHz;
12 MHz p-p max. @10 MHz rate to above 26.5 GHz
AM Tolerance: Any depth/rate within dynamic range of input
Amplitude Discrimination (above 250 MHz)**:** 20 dB typ. for greater than 75 MHz separation; 10 dB typ. for less than 75 MHz separation
Connector: 3.5 mm SMA compatible (53150A/53151A);
2.92 mm removable (53152A)

Power Measurement
Range: Counter sensitivity to +7 dBm
Units: dBm or milliwatts/microwatts
Resolution: 0.01 dB

Accuracy* (0 to –20 dBm)**:**

	53150/51	53152
<12.4 GHz	±1.5 dB	±1.0 dB
to 20 GHz	±1.5 dB	±1.5 dB
to 26.5 GHz	±2.0 dB (151)	±1.5 dB
to 46 GHz	—	±2.0 dB

* At channel two input connector

General

Display: Backlit LCD
Sample Rate: User-selectable Fast, Medium, Slow or Hold
Programming: GPIB and RS-232C, SCPI compatible
Math Functions
- Offset: Last reading and/or entered offset to reading for either power or frequency
- Averaging: 1 to 99 measurement running average
- Power Correction (Cable Loss Compensation): Offsets power reading via linear interpolation of up to 10 user-entered frequency attenuations

Save and Recall: Up to 9 complete instrument setups may be saved and later recalled
Sleep Mode (battery option only)**:** Automatically activated if no input is present for 5 minutes
Power Requirements
- 75 VA max. (25 W typ.)
- 90 – 132 VAC; 50, 60, 400 Hz
- 216 – 264 VAC; 50, 60 Hz
- 11 – 18 VDC: 2 A max.: battery option only

Battery (option)**:**
- Type: VHS camcorder, sealed lead acid (2 each)
- Charge Time: 8 hours in unit
- Capacity: 2.5 hours minimum at 25°C

Timebase:

	TCXO (std)	Option 001
Aging Rate	1×10^{-7}/mo	5×10^{-10}/day
Short Term (1 sec. avg.)	1×10^{-9}	2×10^{-10}
Temperature (0° – 55°C)	$<1 \times 10^{-6}$	1×10^{-8}

Accessories Furnished: Power cord and operating, programming, and service manuals
Size: 88.5 mm H x 213 mm W x 300 mm D (3.54 in x 8.52 in x 12 in)
Weight: 4 kg (8.8 lb) without battery option; 6.4 kg (14.08 lb) with battery option

Ordering Information

53150A 20 GHz Microwave Counter
53151A 26.5 GHz Microwave Counter
53152A 46 GHz Microwave Counter
- **5315xA-001** Oven Timebase
- **5315xA-002** Battery/DC Input
- **5315xA-007** Soft Carrying Case
- **5315xA-A6J** ANSI Z540 Compliant Calibration
- **5315xA-1CM** Rack Mounting Kit

- **Three frequency ranges up to 46 GHz**
- **True power meter with 8480 series sensors**
- **DVM standard and battery optional**
- **Fully standard programmable GPIB and RS-232 standard**

53149A

53147A, 53148A, 53149A Microwave Counter/Power Meter/DVMs

The Agilent 53140 series microwave counter/power meter/DVMs have all the fundamental measurements required to install and maintain today's digital microwave radio links. Rugged field portability and a battery option complete the ensemble. These instruments are also at home in ATE applications with GPIB and RS-232 fully programmable I/O ports as standard features. For those demanding R&D application, the 53140 series offer the laboratory-level performance and accuracy you've come to expect from Agilent Technologies.

53140 Series Measurement

Specifications and Characteristics

For full specifications or request a Product Overview for the 53140 series microwave counters, please visit our web site **www.agilent.com/find/frequencycounters**

Counter Specifications

Input Characteristics

	Input 1 (1 MΩ)	Input 2 (50 Ω)	
Frequency Range			
53147A	10 Hz to 125 MHz	0.05 – 20 GHz	
53148A	10 Hz to 125 MHz	0.05 – 26.5 GHz	
53149A	10 Hz to 125 MHz	0.05 – 46 GHz	
Sensitivity		**53147A/48A**	**53149A**
<30 GHz	40 mV_{rms}	—	—
to 125 MHz	25 mV_{rms}	—	—
<250 GHz	—	–20 dBm	–20 dBm
to 12.4 GHz	—	–33 dBm	–33 dBm
to 18 GHz	—	–33 dBm	–30 dBm
to 20 GHz	—	–29 dBm	–27 dBm
to 26.5 GHz	—	–25 dBm (148)	–27 dBm
to 40 GHz	—	—	–23 dBm
to 46 GHz	—	—	–17 dBm
Damage Level	5 V_{rms} to 120 Vp	+27 dBm	

53147A
53148A
53149A

Channel 1

Resolution: Selectable 1 Hz to 1 MHz
Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz
Acquisition Time: 100 ms to 140 ms
Gate Time: 1/Resolution
FM Tolerance
- 20 MHz p-p max. @10 MHz rate to 26.5 GHz
- 12 MHz p-p max. @10 MHz rate to >26.5 GHz

Amplitude Discrimination (above 250 MHz): 20 dB typ. for greater than 75 MHz separation; 10 dB typ. For less than 75 MHz separation
Connector: 3.5 mm SMA compatible (53147A/53148A)
2.92 mm removable (53149A)

Power Meter Specifications

Frequency Range: 10 MHz to 50 GHz, sensor-dependent
Power Range: –70 dBm to +44 dBm, sensor-dependent
Power Sensors: 8480 series
Display Units: Watts, dBm
Resolution: 0.01 dB in log mode, 0.1% of full scale in linear mode
Accuracy
- Instrumentation: ±0.02 dB or ±0.5%

Power Reference
- Power Output: 1.00 mW. Factory set to ±0.7%, traceable to U.S. National Institute of Standards and Technology.

DVM Specifications

Function: DC volts
Range: ±50 Vdc

General

Display: Backlit LCD
Programming: GPIB and RS-232C, SCPI compatible
Math Functions
- Offset: Last reading and/or entered offset to reading for either power of frequency
- Averaging: 1 to 99 measurement running average

Save and Recall: Up to 9 complete instrument setups may be saved and later recalled
Power Requirements:
- 90 – 132 VAC; 50, 60, 400 Hz
- 216 – 264 VAC; 50, 60 Hz
- 11 – 18 VDC: battery option only

Battery (option):
- Type: VHS camcorder, sealed lead acid (2 each)
- Charge Time: 8 hours in unit
- Capacity: 2 hours typical

Timebase:

	TXCO (std)	Oven (opt)
Aging Rate	1×10^{-7}/mo	5×10^{-10}/day
Short Term (1 sec. avg.)	1×10^{-9}	2×10^{-10}
Temperature (0°C – 55°C)	$<1 \times 10^{-6}$	$<1 \times 10^{-8}$

Accessories Furnished: Power cord, 1.5 m power sensor cable (11730A), operating, programming and service manuals

Ordering Information

53147A 20 GHz Counter/Power Meter/DVM
53148A 26.5 GHz Counter/Power Meter/DVM
53149A 46 GHz Counter/Power Meter/DVM
5314xA-001 Oven Timebase
5314xA-002 Battery/DC Input
5314xA-007 Soft Carrying Case
5314xA-1CM Rackmount Kit

120 Hz/1 kHz, 1 kHz/1 MHz Capacitance Meter

4268A
4288A

- **High speed measurement: 7 ms**
- **Accurate C-D testing: 0.075%, 0.0006**
- **Small cabinet size**
- **Constant test level for high value ceramic capacitor tests**
- **High speed measurement: 25 ms**
- **Quick contact check**
- **9-bin comparator**

4288A

4268A

4288A 1 kHz/1 MHz Capacitance Meter

The Agilent 4288A 1 kHz/1 MHz capacitance meter offers a high-speed with reliable measurements for capacitor testing in the production lines. The measurement capabilities of capacitance from low to middle values (up to 20 µF) can be realized with accurate measurements. The 4288A contributes improvements of the test throughput, while attaining excellent component quality for ceramic capacitor testing.

Specifications

Measurement Parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 1 kHz and 1 MHz (–1%, +1%, +2% frequency shift available)
Test Signal Level: 0.1 to 1 V_{rms}, ±5% in 0.1 V_{rms} steps
Measurement Range

Measurement Parameter	1 kHz	1 MHz
C	0.001 pF to 20.000 µF	0.00001 pF to 1500.00 pF
D	0.00001 to 9.99999	0.00001 to 9.99999

Measurement Time: 7 ms, 19 ms (typical)
Cable Length Compensation: 0 m, 1 m, 2 m
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB, and Scanner interface

General Specifications

Operating Temperature/Humidity: 0°C to 45°C, ≤95% RH @ 40°C
Power Requirements: 90 VAC to 132 VAC, 198 VAC to 264 VAC, 47 Hz to 66 Hz, 100 VA max.
Size: 100 mm H x 320 mm W x 300 mm D (4 in x 12.8 in x 12 in)
Weight: Approximately 3 kg (6.6 lb)

Key Literature

4288A Capacitance Meter 1 kHz/1 MHz Technical Overview, p/n 5980-2861EN

Ordering Information

4288A 1 kHz/1 MHz Capacitance Meter

Accessories
16034E SMD Test Fixture
16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
16047A 4-Terminal Contact Lead Component Test Fixture
16047E 2-Terminal Contact Lead Component Test Fixture
16334A Tweezers Contact SMD Test Fixture
16048A Test Leads, BNC (1 m)
16048B Test Leads, SMC (1 m)
16048D Test Leads, BNC (2 m)

4268A 120 Hz/1 kHz Capacitance Meter

The 4268A capacitance meter offers the ability to test high value multi-layer ceramic capacitors at a constant large test signal level and at high speed. The constant test level feature allows the MLCCs to be tested, in compliance with IEC 384-10 standard, for up to 70 µF at 1 V rms at 1 kHz. 120 Hz measurement ensures the constant 1 V test signal for up to 600 µF. The 4268A can provide measured values along with comparator results within 25 ms, maximizing test throughput in MLCC production lines.

Major Specifications

Measurement parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 120 Hz and 1 kHz
Test Signal Level: 0.1 V to 1 V rms, ±10%, in 0.01 V rms steps
Measurement Range

Measurement Parameter	120 Hz	1 kHz
C	0.001 nF to 9.9999 mF	0.0001 nF to 999.99 µF
D	0.0001 to 9.9999	0.0001 to 9.9999

Constant Test Level Range (Typical)

Test Voltage	120 Hz	1 kHz
0.5 V rms	C ≤1200 µF	C ≤140 µF
1 V rms	C ≤600 µF	C ≤70 µF

Measurement Time: 25 ms/43 ms/59 ms (typical)
Contact Check: Detects contact failure in 4T connection within 5 ms
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB and optional scanner interface

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 Vac, 47 to 66 Hz, 100 VA max.
Operating Temperature/Humidity: 0°C to 45°C, ≤95% RH @ 40°C
Size: 100 mm H x 320 mm W x 450 mm D (3.94 in x 12.6 in x 17.72 in)
Weight: Approximately 5 kg (11 lb)

Key Literature

4268A Capacitance Meter Technical Overview, p/n 5967-5873E

Ordering Information

4268A 120 Hz/1 kHz Capacitance Meter

Options
4268A-001 Scanner Interface

Accessories
16034E SMD Test Fixture
16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
16044A 4-Terminal Test Fixture for Chip Components
16334A Tweezers Contact SMD Test Fixture
16048A Test Leads, BNC (1 m)
16048B Test Leads, SMC (1 m)
16048D Test Leads, BNC (2 m)

- **1 MHz to 3 GHz, with 100 kHz steps**
- **Wide impedance measurement range from 200 mΩ to 3 kΩ**
- **Superior measurement repeatability at low test signal level**
- **1% basic accuracy**
- **High-speed measurements: 9 ms**

4287A with the 16196A

4287A RF LCR Meter

The Agilent 4287A RF LCR meter offers accurate, reliable and fast measurements from 1 MHz to 3 GHz to improve quality and throughput of electronic component testing in production lines. The 4287A employs the direct-current voltage-measurement technique, as opposed to the reflection-measurement technique, which yields accurate measurements over a wide impedance range.

High Throughput and Reliable Measurement

The 4287A is suitable for testing electronic components in the RF range. The 4287A's measurement speed is remarkably fast. In addition, the superior measurement repeatability at low test currents such as 100 µA provides a fast throughput since less averaging is required.

Simplified System Integration

The test head cable (1 m or 2 m by using an extension cable) can be easily connected closely to the tip of the device-under-test (of the component handler) without any increase in error. The built-in comparator function, a high-speed GPIB interface, and an handler interface, are available for simple integration with the component handler and PC. The enhanced comparator function makes sophisticated binning possible for multi-frequency or array chip testing.

Ease of Use

The 8.4-inch color display provides a clear view of measurement settings and results. The newly developed user interface makes operability easy and error-free. The built-in statistical analysis functions provide a process for monitoring test quality and efficiency. The LAN interface helps centralize production control and monitor. Also, a number of 7 mm SMD test fixtures can be used with the 4287A's furnished fixture stand and 3.5 mm-to-7 mm adapter, eliminating the need to build custom fixtures.

Specifications

(Refer to Data Sheet for complete specifications)
Measurement Parameters: |Z|, |Y|, θ-z (deg/rad), θ-y (deg/rad), G, B, Ls, Lp, Cs, Cp, Rs, Rp, Q, D (Four Meas.Parameters can be displayed at the same time.)
Test Frequency: 1 MHz to 3 GHz
Frequency Resolution: 100 kHz
Test Signal
- V: 4.47 mV to 502 mV @ f ≤1 GHz, 4.47 mV to 447 mV @ f >1 GHz
- I: 0.0894 mA to 10 mA @ f ≤1 GHz, 0.0894 mA to 8.94 mA @ f >1 GHz

Level Monition Function: Voltage, Current
Basic Z Accuracy: ±1.0%
Measurement Range: 200 mΩ to 3 kΩ (@ 1 MHz, accuracy ≤10%)
Measurement Time: 9 msec per point (max.speed)
Rdc Measurement: Available for contact check
Calibration: Open/Short/Load/Low Loss Capacitor
Compensation: Open/Short, Electrical Length
Mass Storage Function: 30 MB solid-state mass-storage or 2 GB HDD (Option Selection)
Interface: GPIB, LAN (10 Base-T/100 Base-Tx Automatic Selection), Handler Interface
Display: 8.4 inch color LCD display

General Specifications

Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 63 Hz, 350 VA max.
Operating Temperature/Humidity: 5°C to 40°C/20% RH to 80% RH
Size: 234 mm H x 425 mm W x 445 mm D (9.36 in x 17 in x 17.8 in) (Main Frame)
Weight: 16 kg/0.3 kg (35.2 lb/.66 lb) (typical) (Main Frame/Test Head)

Key Literature

4287A RF LCR Meter Technical Overview, p/n 5968-5443E
4287A Technical Specifications, p/n 5968-5758E
LCR Meters, Impedance Analyzers, and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

4287A RF LCR Meter
Furnished Accessories: Test Head (1 m), CD-ROM (Manual), and Power Cable. (No test fixture is supplied with the 4287A)

Options
4287A-004 Add Working Standard Set
4287A-010 Hard-Disk Drive Mass Storage
4287A-011 Solid-State Mass Storage
4287A-020 Add Test Fixture Extension Cable Set
4287A-700 16195B Calibration Kit
4287A-710 Test Fixture Stand
4287A-720 3.5 mm – 7 mm Adapter
4287A-810 Add Keyboard
4287A-820 Add Mouse

Accessories
16190B Performance Test Kit
16195B 7 mm Coaxial Calibration Kit
16192A Parallel Electrode SMD Test Fixture (up to 2 GHz)
16194A High Temperature Test Fixture (up to 2 GHz)
16196A/B/C/D Parallel Electrode SMD Test Fixture
16197A Bottom Electrode SMD Test Fixture
16092A Test Fixture (up to 500 MHz)
16200B External DC Bias Adapter (up to 1 GHz)

4263B

- **0.1% basic accuracy**
- **100 Hz, 120 Hz, 1 kHz, 10 kHz, 100 kHz test frequencies**
- **20 mV to 1 V_{rms} in 5 mV_{rms} steps**
- **Test signal level monitor function**
- **High-speed measurement: 25 ms**
- **High-speed contact check**
- **Wide capacitance test range**
- **Transformer parameter measurements (optional)**

4263B

4263B LCR Meter

The 4263B LCR meter is Agilent Technologies' most cost-effective low-end LCR meter, designed for both component evaluation on the production line and fundamental impedance testing for bench-top applications. The 4263B has five test frequencies that allow you to simulate testing under the correct conditions: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz. An optional 20 kHz test frequency can be added to those five frequencies (4263B-002).

High-Speed Measurements

The 4263B can boost throughput with a measurement speed of 25 ms at any test frequency. This ability improves the throughput of electrolytic capacitor and transformer testing. The 4263B can check the contact condition between the test terminals and the device-under-test (DUT). This function ensures the reliability of PASS/FAIL testing with automatic handlers in production. The quick recovery system of the 4263B improves throughput. Normal operation is resumed the instant a faulty DUT is removed from the handler, so the handler can always be operated at its full speed.

Electrolytic Capacitor Measurements

The 4263B's accuracy and wide measurement range are the right tools to make precise measurements of electrolytic capacitors. Charged capacitors can discharge through the front end and destroy an instrument. The 4263B's front end is designed for protection and maintains test integrity.

Transformer Parameter Measurements

With the 4263B's ability to make turns ratio (N), mutual inductance (M), and dc resistance (DCR) measurements, data calculations and changing test setups are no longer time-consuming tasks (4263B-001). The flexible signal level setting and the voltage-and-current monitor function facilitate the use of the 4263B for level dependent DUTs, such as core inductors.

Specifications

(Refer to Technical Overview for complete specifications)
Measurement Functions
- Measurement Parameters: |Z|, |Y|, u, R, X, G, B, L, C, Q, D, ESR
  - 4263B-001: Add DCR (dc resistance), N (turns ratio), and M (mutual inductance) measurement
- Measurement Circuit Mode: Series and parallel

Mathematical Functions: Deviation and percent deviation
Test Cable Lengths: 0 m, 1 m, 2 m, 4 m (freq. = 100/120/1 kHz); 0 m,1 m, 2 m (freq. = 10 k/20 kHz); 0 m, 1 m (freq. = 100 kHz)
Test Signal Information
- Test Frequency: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz
  - 4263B-002: Add 20 kHz test frequency
- Frequency Accuracy: ±0.01% (freq. = 100 Hz, 1 kHz, 10 kHz, (20 kHz, 100 kHz), ±1% (freq. = 120 Hz)
- Output Impedance: 100 Ω ±10%, 25 Ω ±10% (≤1 Ω range)
- AC Test Signal Level: 20 mV to 1 V_{rms} in 5 mV_{rms} steps
- Accuracy: ±(10% + 10 mV)
- Internal dc Bias
  - Level: 1.5 and 2 V; Accuracy: ±(5% + 2 mV)
- External dc Bias: 0 V to +2.5 V

Measurement Range

Parameter	Measurement Range
|Z|, R, X	1 mΩ to 100 MΩ
|Y|, G, B	10 nS to 1000 S
C	1 pF to 1 F
L	10 nH to 100 kH
D	0.0001 to 9.9999
Q	0.1 to 9999.9
θ	–180° to +180°
DCR	1 mΩ to 100 MΩ
N	0.9 to 200 (unspecified)
L, M	1 µH to 100 H (unspecified)
Δ%	–999.99% to +999.99%

Measurement Accuracy: ±0.1% (basic) (for |Z|, R, X, |Y|, G, B,C, L)
Measurement Time

Mode	Time (typical)
SHORT	25 ms
MEDIUM	65 ms
LONG	500 ms

Test Signal Level Monitor: Voltage and current
Front-End Protection: Internal circuit protection when a charged capacitor is connected to the input terminals. The maximum capacitor voltage is: Vmax = √(8/C) (typical) @ Vmax ≤250 V; Vmax = √(2/C) (typical) @ Vmax ≤1000 V, C is in Farads
Display Digits: 3, 4, or 5 (selectable)
Correction Function
OPEN/SHORT/LOAD: Eliminates measurement errors due to stray parasitic impedances in the test fixtures
Comparator Function: HIGH/IN/LOW for each primary measurement parameter and secondary measurement parameter
Contact Check Function: Contact failure between the test fixture and device can be detected. Additional time for contact check: 5 ms
Other Functions
- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings (except dc bias on/off) are automatically memorized (≤72 hours at 23°C ± 5°C)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors. Output signals include HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include keylock and external trigger

General Specifications

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 45 VA max.
Operating Temperature: 0°C to 45°C
Size: 100 mm H x 320 mm W x 300 mm D (3.94 in x 12.6 in x 11.81 in)
Weight: 4.5 kg (9.9 lb)

Key Literature

4263B LCR Meter Technical Overview, p/n 5964-6181E
Effective Electrolytic Capacitors Testing, p/n 5967-5378E
Effective Transformer/LF Coil Testing, p/n 5967-5377E
Effective Multi-tap Transformer Measurement using a Scanner and the Agilent 4263B LCR Meter, p/n 5091-6310E

Ordering Information

4263B LCR Meter

Options
4263B-001 Add Transformer Parameter Measurement Function
4263B-002 Add 20 kHz Test Frequency
4263B-ABA US-English Localization
4263B-ABJ Japan-Japanese Localization

Accessories
16060A Transformer Test Fixture (4263B-001 Required)
16065C External Bias Adapter (up to 40 Vdc)
16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
16044A Kelvin Contact SMD Test Fixture
16047A 4-Terminal Contact Lead Component Test Fixture
16047E 2-Terminal Contact Lead Component Test Fixture
16334A Tweezers Contact SMD Test Fixture

- **Wide measurement range: 1 x 10^3 Ω to 1.6 x 10^{16} Ω**
- **Stable test fixtures: resistivity cell, component test fixture**
- **High-speed measurement: 10 ms**
- **Test sequence programming**
- **Resistivity calculations**
- **Grounded DUT measurement**

4339B

4339B High-Resistance Meter

The 4339B high-resistance meter is Agilent Technologies' most advanced tool for making precision high-resistance measurements.

Precise and Stable Measurement

The measurement range is from 1 x 10^3 Ω to 1.6 x 10^{16} Ω, with a basic accuracy of 0.6%. This wide range allows accurate, high-resistance measurement of capacitors, relays, switches, connectors, materials, cables, and PC boards. The grounded device-under-test (DUT) measurement capability of the 4339B gives you the ability to evaluate cables and transformers under grounded conditions. The 16008B resistivity cell and the 16339A component test fixture are designed for stable and safe measurements of materials or components.

Simple Operation

The test-sequence program function allows you to control a series of resistance measurements in a sequence (charge-measure-discharge). You can set the charge time, measurement interval time, and number of measurements in a sequence through the front panel. The remaining time can be displayed when executing the sequence measurements. Surface resistivity (ρs) and volume resistivity (ρv) functions can be called to act upon measurement data. Calculated results are then automatically displayed, saving you time and effort.

High-Test Throughput

The 10 ms measurement time, 2 ms high-speed contact check function, built-in comparator, and GPIB/handler interfaces deliver high-speed test throughput for production environments.

Specifications

(Refer to Technical Overview for complete specifications)
Measurement Parameters: R (dc resistance), I (dc current), ρs (surface resistivity), ρv (volume resistivity)
Mathematical Functions: Deviation and percent deviation
Display Digits: 3, 4, or 5 (selectable)
Test Voltage: 0.1 Vdc to 1000 Vdc, 0.1 V steps @ 0.1 V to 200 V, 1 V steps @ 200 V to 1000 V
Voltage Accuracy: (0.16% + 100 mV) @ ≤200 V, (0.16% + 500 mV) @ >200 V
Maximum Current: 10 mA @ ≤100 V, 5 mA @ ≤250 V, 2 mA @ ≤500 V, 1 mA @ ≤1 kV
Current Compliance Setting: 0.5 mA, 1 mA, 2 mA, 5 mA, 10 mA
Output Resistance: 1 kΩ ± 10%
Input Resistance: 1 kΩ ± 10%
Test Cable Lengths: 2 m maximum

Measurement Range/Accuracy

Parameter	Measurement Range	Basic Accuracy
I	60 fA to 100 µA	±0.4%
R (Ω)	1 x 10^3 Ω to 1.6 x 10^{16}	±0.6%

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port (range: hold, display, off)

Mode	Time (typical)
SHORT	10 ms
MEDIUM	30 ms
LONG	390 ms

Correction Function
Zero OPEN: Eliminates measurement errors due to stray parasitic resistance in the test fixtures
Test Sequence Program: Controls a series of resistance measurements. Charge time, measurement internal time, and measurement number can be programmed
Comparator Function: HIGH/IN/LOW for the measurement parameter
Contact Check Function
Contact failure between the test fixture and device can be detected
- Available DUT Type: Capacitive DUTs only
  - DUT Capacitance: ≥1 pF + 5% of residual stray capacitance
  - Residual Stray Capacitance of the Fixture: ≤50 pF
- Additional Measurement Time for Contact Check: 2 ms

Other Functions
- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤72 hours at 23°C ± 5°C)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors. Output signals include: HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include: high voltage off, keylock, and external trigger

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 V, 47 Hz to 66 Hz, 45 VA max.
Operating Temperature: 0°C to 45°C
Size: 100 mm H x 320 mm W x 450 mm D (3.94 in x 12.6 in x 17.72 in)
Weight: 6.5 kg (14.3 lb)

Complies with 73/23/EEC and 92/68/EEC safety standard EN61010-1

Furnished Accessories

Operation manual, shunt connector, power cable (test fixtures and/or test leads must be ordered separately.)

Key Literature

4339B/4349B High Resistance Meters Technical Overview, p/n 5964-6182E
Insulation Resistance Measurement of Plate Type Materials, p/n 5968-3400E
Insulation Resistance Measurements of Electromechanical Components, p/n 5968-0325E
Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

4339B High-Resistance Meter
  4339B-ABA US-English Localization
  4339B-ABJ Japan-Japanese Localization
16339A Component Test Fixture
16008B Resistivity Cell (50 mm Diameter Electrode)
  16008B-001 Add 26/76 mm Diameter Electrodes
  16008B-002 Add 26 mm Diameter Electrode
16117B Low-Noise Test Leads
  16117B-001 Add Pin Probes
  16117B-002 Add Soldering Sockets
  16117B-003 Add Alligator Clips
16117C Low-Noise Test Leads (1 m, connectors)
16118A Tweezer Test Fixture

Precision LCR Meter

E4980A

- **20 Hz to 2 MHz, with over 45001 test frequencies**
- **0.05% basic accuracy, 7-digit resolution**
- **Fast measurement speed: 5.6 ms/meas.**
- **Constant V or I test signal**
- **20 V_{rms} level, and DC source option (E4980A-001)**
- **40 A dc with 42841A**
- **List sweep measurement capability, max 201 points**

The Agilent E4980A Precision LCR Meter offers the highest accuracy and repeatability from 20 Hz to 2 MHz, and supports LAN, USB and GPIB PC connectivity. Unlike competing LCRs, the E4980A offers fast measurement speed and outstanding performance at both low and high impedance. Compared with Agilent's 4284A LCR, the E4980A provides measurements 5 times faster, a modern PC interface, compact size and additional features to further enhance your design and test productivity.

Specifications

(Refer to Data Sheet for complete specifications)
Measurement Parameters: Z, Y, R, X, G, B, L, C, D, Q, ESR, (Rdc, Vdc, Idc, option E4980-001 is required); Deviation and % deviation
Measurement Circuit Modes: Series and parallel
Ranging: Auto and manual
Trigger: Internal, external, manual, and bus (GPIB/USB/LAN)
Delay Time: 0 s to 100 s in 100 us steps, 100 s to 999 s in 1 ms steps
Measurement Terminals: Four-terminal pair
Test Cable Length: 0, 1, 2 and 4 m
Integration Time: Short, medium, and long
Averaging:1 to 256, programmable
Test Signal: 20 Hz to 2 MHz ±0.01%, 45001 selectable frequencies
Test Signal Modes
Normal: Programs selected voltage or current at the measurement terminals open or shorted, respectively, and not at the device-under-test
Constant: Maintains selected voltage or current at the device-under-test independent of changes in the device's impedance

Test Signal Levels (rms)	Normal/Constant
E4980A Standard	0 V to 2 V, 0 A to 20 mA
E4980A-001	0 V to 20 V (test frequency ≤1 MHz), 0 V to 15 V (test frequency >1 MHz), 0 A to 100 mA

DC Bias
- E4980A Standard: 0 V, 1.5 V and 2 V
- E4980A-001: 0 V to ±40 V

DC Source (E4980A-001 only): –10 V to 10 V

Measurement Display Range

Parameter	Range
Z, R, X	1.000000 aΩ to 999.9999 EΩ
Y, G, B	1.000000 aS to 999.99999 ES
C	1.000000 aF to 999.9999 EF
L	1.000000 aH to 999.9999 EH
D	0.000001 to 9.999999
Q	0.01 to 99999.99
Vdc	1.000000 aV to 999.9999 EV
Idc	1.000000 aA to 999.9999 EA
θ	–180.0000° to 180.0000
Δ%	–999.9999% to 999.9999%

Basic Measurement Accuracy

	Z, C, L	D
E4980A	0.05%	0.0005 (relative accuracy)

@23°C ± 5°C, after OPEN and SHORT correction

Supplemental Characteristics

Measurement Time (at 1 MHz): Typical measurement time from the trigger command to the end of measurement (EOM) output at the handler interface connector

SHORT	5.6 ms
MEDIUM	88 ms
LONG	220 ms

E4980A-001 DC Bias Current Output: 100 mA max.

Display

TFT LCD: Displays measured values, control settings, comparator limits and decisions, list sweep tables, self-test messages, and annunciations.

Correction Function

OPEN/SHORT/LOAD: Eliminates measurement errors due to the test fixture's stray parasitic impedance.

List Sweep Function

A maximum of 201 frequencies or test signal levels can be programmed. Single or sequential testing can be performed. When E4980A-001 is installed, dc bias or dc source testing can also be performed.

Comparator

Ten-bin sorting for the primary measurement parameter. IN/OUT for the secondary measurement parameter.
Bin Count: 0 to 999999
List Sweep Comparator: HIGH/IN/LOW decision output for each measurement point in the list sweep table

Other Functions

- STORE/LOAD: Ten instrument setups can be stored/loaded from the internal non-volatile memory. Ten additional setups can also be stored/loaded from a USB memory.
- Remote control: GPIB/USB/LAN All instrument control settings, measured values, comparator limits, list sweep table, and self-test results.
- Memory: The memory buffer can store a maximum of 201 measurement results and output the data over GPIB/USB/LAN, ASCII, and 64-bit binary data formats.

General Specifications

Power Requirements: 90 VAC to 264 VAC, 47 to 63 Hz
Power Consumption: 150 VA max.
Operating Temperature and Humidity
0°C to 55°C, 15% to 85% RH at 40°C
Size: 105 mm H x 375 mm W x 390 mm D (4.13 in x 14.77 in x 15.36 in)
Weight: Approximately 15 kg (11.7 lb)

Accessories

42841A Bias Current Source
- Bias Current Output: (23°C ± 5°C); 0.01 A to 20.0 A
- Basic Impedance Accuracy: 1% when used with the E4980A (1 kHz to 1 MHz)
- Interface: Custom, directly controllable by the E4980A with E4980A-002

42842A/B Bias Current Test Fixture
Used with the E4980A and 42841A for high dc bias current measurements:
- 42842A: 20 A max.
- 42842B: 40 A max.

42843A Bias Current Cable
Used with the E4980A, 42841A (2 units), and 42842B for 40 A maximum applications (necessary for Idc >20 A)

Key Literature & Web Link

E4980A Precision LCR Meter 20 Hz to 2 MHz Brochure, p/n 5989-4235EN
E4980A Precision LCR Meter Data Sheet , p/n 5989-4435EN
LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

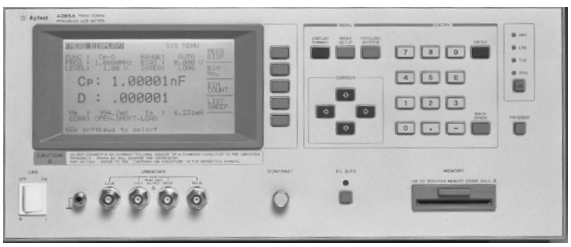
www.agilent.com/find/E4980A

Ordering Information

E4980A Precision LCR Meter, 20 Hz to 2 MHz
E4980A-001 Power and DC Bias Enhancement
E4980A-710 No Interface
E4980A-002 Bias Current Interface
E4980A-201 Handler Interface
E4980A-301 Scanner Interface
E4980A-ABA Add Hardcopy User's Guide
E4980A-ABJ Add Hardcopy Users Guide
E4980A-1A7 Add ISO 17025 Compliant
E4980A-A6J ANSI Z540 Compliant Calibration
E4980A-1CM Add Rack Mount Kit

E4980A
4285A

- **75 kHz to 30 MHz in 100 Hz steps**
- **0.1% basic accuracy**
- **High-speed measurements: 30 ms/meas.**
- **Constant V or I test signal level**
- **10 Adc with 42841A**
- **List sweep measurement capability**



4285A

4285A Precision LCR Meter

The Agilent 4285A precision LCR meters is cost-effective solution for component and material measurement. It can be used to improve component quality by providing an accurate, high-throughput test solution. For demanding RF component tests, the 4285A offers a higher test-frequency range, from 75 kHz to 30 MHz. Whether in research and development, production, quality assurance, or incoming inspection, the 4285A will meet all of your LCR meter test and measurement requirements.

Specifications

(Refer to Data Sheet for complete specifications)
Measurement Parameters: |Z|, |Y|, θ, R, X, G, B, L, C, D, Q, ESR; Deviation and % deviation
Measurement Circuit Modes: Series and parallel
Ranging: Auto and manual
Trigger: Internal, external, manual, and bus (GPIB)
Delay Time: 0 s to 60.000 s in 1 ms steps
Measurement Terminals: Four-terminal pair
Test Cable Length: 0, 1 and 2 m
Integration Time: Short, medium, and long
Averaging: 1 to 256, programmable
Test Signal: 75 kHz to 30 MHz ± 0.01%, 100 Hz steps
Test Signal Modes
Normal: Programs selected voltage or current at the measurement terminals open or shorted, respectively, and not at the device-under-test
Constant: Maintains selected voltage or current at the device-under-test independent of changes in the device's impedance

Test Signal Levels (rms)	Normal	Constant
4285A	5 mV to 2 V, 200 µA to 20 mA	10 mV to 1 V, 100 µA to 20 mA

DC Bias:
4285A-001: 0 V to ±40 V

Measurement Display Range

Parameter	Range
|Z|, R, X	0.01 mΩ to 99.9999 MΩ
|Y|, G, B	0.01 nS to 99.9999 S
C	0.01 fF to 999.999 µF
L	0.001 nH to 99.9999 H
D	0.000001 to 9.99999
Q	0.01 to 99999.9
θ	–180.000° to 180.000°
Δ%	–999.999% to 999.999%

Basic Measurement Accuracy

	|Z|, C, L	D
4285A	0.1%	0.001

@ 23°C ± 5°C, after OPEN and SHORT correction

Supplemental Characteristics

Measurement Time: Typical measurement time from the trigger command to the end of measurement (EOM) output at the handler interface connector

SHORT	30 ms
MEDIUM	65 ms
LONG	200 ms

4285A-001 DC Bias Current Output: 100 mA max.

Display

LCD Dot-matrix Display: Displays measured values, control settings, comparator limits and decisions, list sweep tables, self-test messages, and annunciations.

Correction Function

OPEN/SHORT/LOAD: Eliminates measurement errors due to the test fixture's stray parasitic impedance.

List Sweep Function

A maximum of ten frequencies or test signal levels can be programmed. Single or sequential testing can be performed. When 4285A-001 is installed, dc voltage bias testing can also be performed.

Comparator

Ten-bin sorting for the primary measurement parameter. IN/OUT for the secondary measurement parameter.
Bin Count: 0 to 999999
List Sweep Comparator: HIGH/IN/LOW decision output for each measurement point in the list sweep table

Other Functions

- STORE/LOAD: Ten instrument setups can be stored/loaded from the internal non-volatile memory. Ten additional setups can also be stored/loaded from a memory card.
- GPIB: All instrument control settings, measured values, comparator limits, list sweep table, and self-test results.
- Memory: The memory buffer can store a maximum of 128 measurement results and output the data over GPIB, ASCII, and 64-bit binary data formats.

General Specifications

Power Requirements: 100/120/220 V ± 10%, 240 V 5%/–10%, 47 to 66 Hz
Power Consumption: 200 VA max.
Operating Temperature and Humidity: 0°C to 55°C, ≤95% RH at 40°C
Size: 177 mm H x 426 mm W x 498 mm D (6.97 in x 16.77 in x 19.61 in)
Weight: Approximately 16 kg (35.2 lb)

Accessories

42841A Bias Current Source
- Bias Current Output: (23°C ± 5°C); 0.01 A to 20.0 A
- Basic Impedance Accuracy: 1% when used with the 4285A (1 kHz to 1 MHz)
- Interface: Custom, directly controllable by the 4285A with 4285A-002

42842C Bias Current Test Fixture
Used with the 4285A and 42841A for high dc bias current measurement. 10 A max.

Key Literature

4285A Technical Overview, p/n 5952-1431
4285A Data Sheet, p/n 5963-5395E
LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

4285A Precision LCR Meter
- **4285A-700** No DC Bias
- **4285A-001** DC Bias
- **4285A-002**[1] Accessory Control Interface
- **4285A-004** Memory Card
- **4285A-201** General Purpose Handler Interface
- **4285A-202** Handler Interface
- **4285A-301** Scanner Interface
- **4285A-710** Blank Panel

42841A Bias Current Source
42842C Bias Current Test Fixture (10 A max.)
- **42842C-001** SMD Test Fixture (42842C only)

[1] 4285A-001 and 4285A-002 do not operate simultaneously.

4338B

- **Low and selectable test signal current: 1 µA to 10 mA**
- **Wide measurement range: 10 µΩ to 100 kΩ**
- **10 µΩ resolution**
- **Contact check function**
- **1 kHz ac measurement**
- **High-speed measurement: 34 ms**
- **Built-in comparator**
- **Auto-measurement mode**

4338B

4338B Milliohmmeter

The 4338B milliohmmeter is a precise, reliable, high-speed test tool for measurements of low resistance.

Precise, Low-Resistance Measurement

Contact failure of electromechanical components in a low-current circuit is a key issue for component reliability. The 4338B offers selectable low ac test signals (1 µA to 10 mA). Users can now characterize low resistances of electromechanical components under low-current conditions. A high resolution of 10 µΩ allows you to determine the slightest differences in contact resistance testing of relays, switches, connectors, PC board traces and cables. The 1 kHz test signal eliminates potential errors introduced by thermoelectric effects on the device-under-test (DUT) contacts. The 1 kHz ac test signal is the best solution to evaluate the internal resistance of batteries, because it avoids dc energy consumption.

High-Speed Measurements

The high-speed (34 ms), built-in comparator and GPIB/handler interfaces make it possible to construct a measurement system using an automatic handler and external computer to minimize production test time.

Auto-Measurement Mode

When performing gross continuity testing where the test signal level is not a significant factor in the test, the auto-measurement function allows the instrument to select an appropriate test signal and measurement range setting.

Specifications

(Refer to Technical Overview for complete specifications)
Measurement Function
Measurement Parameters: R (ac resistance), X (reactance), L (inductance), |Z| (impedance), θ (phase [˚])
Combinations: R, R–X, R–L, |Z| –θ (series mode only)
Mathematical Functions: Deviation and percent deviation
Display Digits: 3, 4, or 5 (selectable)
Test Signal Characteristics
- Test Frequency: 1 kHz
- Frequency Accuracy: ±0.1%
- Test Signal Level: 1 µA, 10 µA, 100 µA, 1 mA, 10 mA rms
- Level Accuracy: ±(10% + 0.2 µA)
- Maximum Voltage Across Sample: 20 mV peak in any case

Measurement Range

Parameter	Measurement Range
R	10 µΩ to 100 kΩ
X, |Z|	10 µΩ to 100 kΩ (typical)
L	10 nH to 10 H (typical)
θ	–180˚ to +180˚ (typical)

Measurement Accuracy: ±0.4% Basic for R

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port

Mode	Time (typical)
SHORT	34 ms
MEDIUM	70 ms
LONG	900 ms

Correction Function
Zero SHORT: Eliminates measurement errors due to parasitic impedances in the test fixture
Comparator Function
HIGH/IN/LOW for each primary measurement parameter and the secondary measurement parameter
Contact Check Function
Contact failure between the test fixture and device can be detected
Other Functions
- Superimposed dc: ±42 Vdc maximum may be present on measurement terminals
- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤72 hours at 23°C ± 5°C)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors
- Output Signals Include: HIGH/IN/LOW, index, end of measurement, and alarm. Input signals are keylock and external trigger

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 V, 47 Hz to 66 Hz, 45 VA max.
Operating Temperature: 0°C to 45°C
Size: 100 mm H x 320 mm W x 300 mm D (3.94 in x 12.6 in x 11.81 in)
Weight: 4.5 kg (9.9 lb)

Key Literature

4338B Milliohmmeter Technical Overview, p/n 5964-6183E

Furnished Accessories

Operation manual, power cable (mating cable and test leads, or 16338A test lead set, must be ordered separately)

Ordering Information

4338B Milliohmmeter
Furnished Accessories: CD-ROM (manual), power cable (mating cable and test leads, or **16338A** test lead kit, must be ordered separately)

Options
4338B-ABA US-English Localization
4338B-ABJ Japan-Japanese Localization

Accessories
16338A Test Lead Kit
The 16338A contains the following accessories:
- Kelvin Clip Lead (large, 2 ea)
- Kelvin IC Clip Lead (red, 1 ea)
- Kelvin IC Clip Lead (black, 1 ea)
- Pin-Type Probe Lead (2 ea)
- Alligator Clip Leads (red, 1 ea)
- Alligator Clip Leads (black, 1 ea)
- Mating Cable (1 ea)

Component Measurement

Today's electronic components are designed for higher performance, while being reduced in size, power consumption, and cost. Efficient and accurate component characterization, design evaluation, and manufacturing test are critical to the success of component users and suppliers. Agilent Technologies offers the industry's broadest line of component test instruments for passive as well as active components. The products in this section are designed to measure fundamental impedance-related parameters of electronic components and materials.

Impedance Measuring Instruments

Impedance measuring instruments can be divided into two general categories: LCR meters and impedance analyzers. LCR meters primarily measure inductance, capacitance, and resistance of the test device at spot frequencies. Impedance analyzers, in addition to all the functions of the LCR meter, measure impedance, phase, and sometimes transmission parameters. These analyzers have extended frequency range, a synthesized source, swept frequency capability, and excellent frequency resolution. Combination network/spectrum/impedance analyzers offer the benefits of impedance analysis as well as vector-network and spectrum analysis. See the Selection Guides that follow for general instrument capabilities. For higher frequencies (above 3 GHz) in a 50 Ω environment, a dedicated vector-network analyzer is the best solution for impedance measurements. See Network Analyzers.

Selecting a test fixture is as important as selecting the right instrument. Agilent offers a wide range of accessories for axial, radial, and SMD chip devices. See page 261.

Materials Measurements

Materials have two properties that determine how they interact with electromagnetic fields:

- Permittivity (ε) or dielectric constant for electric fields
- Permeability (μ) for magnetic fields

Permittivity ($\varepsilon^* = \varepsilon' - j\,\varepsilon''$) and permeability ($\mu^* = \mu' - j\,\mu''$) are complex values. The real part (ε' or μ') is a measure of how much energy is stored in a material. The imaginary part (ε'' or μ'') is a measure of how much energy is lost in a material. These properties are not constant and may change with frequency or temperature, for example. Accurate measurements of these material properties during characterization or inspection help to achieve the best performance for a given application while shortening design cycles and minimizing scrap.

A materials measurement system consists of an instrument, a fixture to hold the material, and software or firmware to calculate complex permittivity or permeability values and display the results. For material testing applications, Agilent currently offers three types of solutions: LCR meter-based, impedance analyzer-based, and network analyzer-based systems.

Agilent offers fixture accessories based on the open-ended coaxial probe, the transmission line measurement, the parallel plate capacitance, and the inductor impedance technique. These choices allow you to best match the fixture, frequency range, and measurement technique with your material's physical and electrical test requirements. The chart of material test applications and solutions is shown in the next page 260.

Signal Source Device Test

Agilent provides an excellent performance analyzer for evaluating nearly all types of RF and microwave signal source device such as crystal oscillators, VCOs, DROs, RFICs, and PLL synthesizers. The Agilent Signal Source Analyzer is the single instrument solution enabling phase noise, frequency, power, DC current, and frequency/phase/power over time measurements. See page 268 for the Agilent Signal Source Analyzer.

For specific applications such as resonator and filter measurements, see page 163 and 164.

Impedance Analyzer Selection Guide

Model	Frequency Range	Impedance Range/Other	Additional Information	Page
4294A	40 Hz to 110 MHz	25 mΩ to 40 MΩ*	Color display, equivalent circuit analysis, IBASIC, LAN I/F, SMD fixtures	266
4395A**	100 kHz to 500 MHz	2 Ω to 5 kΩ* S-parameters, gain-phase	Color display, equivalent circuit analysis, SMD fixture vector-network and spectrum analysis , IBASIC	164
4396B**	100 kHz to 1.8 GHz	2 Ω to 5 kΩ* S-parameters, gain-phase	Color display, equivalent circuit analysis, SMD fixture vector-network and spectrum analysis , IBASIC	166
E4991A	1 MHz to 3 GHz	200 mΩ to 20 kΩ	Color display, VBA, SMD fixtures, equivalent circuit analysis, material, LAN I/F, temperature characteristic measurement	262

* 10% accuracy range
** with 4395A/4396B-010 and 43961A

LCR and Resistance Meter Selection Guide

Model	Frequency Range	Impedance Range/ Other	Additional Information	Page
4263B	100 Hz to 100 kHz (5 test frequencies)	1 mΩ to 100 MΩ	Optional transformer test	252
4268A	120 Hz/1 kHz	0.0001 nF to 10 mF	High-value ceramic capacitor test	250
E4980A	20 Hz to 2 MHz	0.001 fΩ to 999.9999 TΩ	42841A for high-current dc bias	254
4285A	75 kHz to 30 MHz (100 Hz steps)	0.01 mΩ to 100 MΩ	42841A for high-current dc bias	256
4287A	1 MHz to 3 GHz (100 kHz steps)	200 mΩ to 3 kΩ	Higher-accuracy, higher-speed RF LCR meter	251
4288A	1 kHz/1 MHz	0.00001 pF to 20 µF	High-speed capacitor test	250
4339B	dc	1 kΩ to 1.6 x 10^{16} Ω	High-resistance meter, volume and surface resistivity, current	253
4338B	1 kHz test signal	10 µΩ to 100 kΩ	Milliohmmeter	258

Material Test Applications and Solutions

	DC Resistivity Cell (16008B) Page 253	Dielectric Test Fixture (16451B) Page 265	Liquid Dielectric Test Fixture (16452A) Page 265	Dielectric and Magnetic Test Fixtures (16453A) (16454A) Page 264	Dielectric Probe System (85070M)	Agilent Material Measurement Software (85071B)
Absorber					•	•
Ceramic	•	•		•	•	
Fermentation					•	
Film (thin)		•		•		
Food					•	
Gel, semi-solid					•	
Liquid			•		•	
Loss		•	•	•	•	
Permeability				•		•
Permittivity (dielectrics)		•	•	•	•	•
Plastic	•	•		•	•	
Powder					•	
Printed circuit board		•		•		
Resistivity	•					
Rubber	•	•		•	•	
Solid	•	•		•	•	
Substrate	•	•		•	•	

Signal Source Device Test

Model	Frequency Range	Brief Description	Page
Signal Source Analyzer E5052B	10 MHz to 7 GHz	Single instrument solution provides a complete set of signal source measurements including phase noise, frequency, power, DC current, and frequency/phase/power transient.	268
Resonator/Filter Test E5100A	10 kHz to 180/300 MHz	Network analyzer best fitted for production line especially for resonator and filter manufacturer with fast measurement speed, low noise floor and powerful dedicated commands.	163

16047E

16034G

16044A

16089E

16196A/B/C/D

Test Accessories/Fixtures

			4263B	4268A	4285A	4287A	4288A	4294A	4294A with 42942A	4395A with 4395A-010 and 43961A	4396B with 4396B-010 and 43961A	E4980A	E4991A
16034E	SMD/Chip Test Fixtures	DC – 40 MHz	•	•	•		•	•				•	
16034G	SMD/Chip Test Fixture, Small	DC – 110 MHz	•	•	•		•	•				•	
16034H	SMD/Chip Test Fixture, General	DC – 110 MHz	•	•	•		•	•				•	
16044A	SMD/Chip Test Fixture, Kelvin Contacts, 10 MHz	DC – 10 MHz	•	•	•		•	•				•	
16047A	Axial and Radial Test Fixture	DC – 13 MHz	•	•	•		•	•				•	
16047D	Axial and Radial Test Fixture	DC – 40 MHz	•	•	•		•	•				•	
16047E	Axial and Radial Test Fixture, 110 MHz	DC – 110 MHz	•	•	•		•	•				•	
16048A	One Meter Test Leads, BNC	DC – 30 MHz	•	•	•		•					•	
16048B	One Meter Test Leads, SMC	DC – 30 MHz	•	•	•		•					•	
16048D	Two Meter Test Leads, BNC	DC – 30 MHz	•	•	•		•					•	
16048E	Four Meter Test Leads, BNC	DC – 2 MHz	•									•	
16048G	One Meter Test Leads, BNC, 110 MHz	DC – 110 MHz						•					
16048H	Two Meter Test Leads, BNC, 110 MHz	DC – 110 MHz						•					
16060A	Transformer Test Fixture	DC – 100 kHz	•										
16065A	Ext. Voltage Bias with Safety Cover (≤200 Vdc)	50 Hz – 2 MHz	•	•	•		•	•				•	
16065C	External Bias Adapter (≤40 Vdc)	50 Hz – 1 MHz	•	•			•						
16085B	Four-terminal Pair to 7-mm Adapter	DC – 40 MHz	•	•	•		•					•	
16089A/B/C/D/E	Kelvin Clip Leads	5 Hz – 100 kHz	•	•	•		•	•				•	
16092A	RF Spring Clip: Axial, Radial and SMD	DC – 500 MHz	•[1]	•[1]	•[1]	•[4]	•[1]		•	•	•	•[1]	•
16095A	LF Impedance Probe	DC – 13 MHz	•[3]	•[3]	•[3]		•[3]					•[3]	
16192A	Parallel Electrode SMD Test Fixture	DC – 2 GHz	•[1]	•[1]	•[1]	•[4]	•[1]		•	•	•	•[1]	•
16194A	High Temperature Component Text Fixture	DC – 2 GHz	•[1]	•[1]	•[1]	•[4]	•[1]		•	•	•	•[1]	•
16196A/B/C/D	Parallel Electrode SMD Test Fixture	DC – 3 GHz	•[1]	•[1]	•[1]	•[4]	•[1]		•	•	•	•[1]	•
16197A	Bottom Electrode SMD Test Fixture	DC – 3 GHz	•[1]	•[1]	•[1]	•[4]	•[1]		•	•	•	•[1]	•
16200B	External DC Bias Adapter	1 MHz – 1 GHz				•[4]			•	•	•		•
16316A	One Terminal (BNC) Balun (100 Ω bal. to 50 Ω unbal.)	100 Hz – 10 MHz								•	•		
16317A	One Terminal (BNC) Balun (600 Ω bal. to 50 Ω unbal.)	100 Hz – 3 MHz								•	•		
16334A	SMD/Chip Tweezers	DC – 15 MHz	•	•	•		•	•				•	
16451B	Dielectric Material Test Fixture	5 Hz – 30 MHz	•	•	•		•	•				•	
16452A	Liquid Test Fixture	20 Hz – 30 MHz			•			•				•	
16453A	Dielectric Material Test Fixture	1 MHz – 1 GHz											•
16454A	Dielectric Material Test Fixture	1 kHz – 1 GHz							•				•
42842A/B	High Bias Current 20 A/40 A Test Fixture	20 Hz – 2 MHz										•	
42842C	High Bias Current 10 A Test Fixture	75 kHz – 30 MHz			•								
42941A	Impedance Probe Kit	DC – 110 MHz						•					
42942A	Four-terminal Pair to 7-mm Adapter	DC – 110 MHz						•					

Note : Refer to the accessory descriptions for frequency and operational limits.
[1] Compatible when used in conjunction with 16085B.
[2] 7-mm cable is required.
[3] Do not connect the ground lead to the instrument.
[4] 3.5-mm(m) to 7-mm Adapter is required.

E4991A

- **Basic accuracy ±0.8%**
- **3 GHz impedance direct read-out**
- **Windows-styled user interface**
- **Sweep parameters (frequency, ac level, dc bias)**
- **Built-in VBA programming function**
- **Various test fixture for components**
- **Data transfer through the LAN interface**
- **Direct read-out permittivity, permeability (Option)**
- **Temperature characteristic measurement**

E4991A

E4991A RF Impedance/Material Analyzer

The new Agilent E4991A RF impedance/material analyzer offers ultimate impedance measurement performance and powerful built-in analysis function. It will provide innovations in R&D of components and circuit designers who evaluate components in the range of 3 GHz. The E4991A uses an RF-IV technique, as opposed to the reflection measurement technique, for more accurate impedance measurement over wide impedance range. Basic impedance accuracy is ±0.8%. High Q accuracy enables low-loss component analysis. The internal synthesizer sweeps frequency from 1 MHz to 3 GHz with 1 mHz resolution.

Versatile Analysis

The E4991A enables display up to 3 scalar and 2 complex parameters. Engineer can easily observe the various impedance parameters. The list-sweep function improves test throughput by segmenting the sweep includes only necessary measurement frequencies. Test signal level ranges enable device evaluation under actual operating conditions. The DC bias, AC signal level swept measurement, and the monitor of test signal functions are available to the E4991A.

Internal VBA programming function is also useful for R&D in order to analyze component or material by using own analysis method. Furthermore, the built-in Equivalent Circuit Analysis Function automatically calculates the circuit constant values of five circuit models. These functions will drastically improve engineering productivity.

Material Evaluation

The E4991A provides the total dielectric/magnetic material measurement solutions in wide frequency range (1 MHz to 1 GHz). See page 264 for more information.

Ease of Use

The 8.4-inch color display and Windows-styled user interface is employed in the E4991A. Color display brings a clear view of measurement settings and results. Windows-styled menu gives you easy access to advanced features. The standard TCP/IP-compliant LAN interface realizes seamless connectivity with PC. With LAN capability, PC can directly read out measurement data from E4991A. It helps you to make documentation and share your test results with others.

Test Fixtures

Various test fixtures are available for the E4991A. Especially the 16196x family, Parallel electrode SMD test fixture, and 16197A, Bottom electrode SMD test fixture, are the new test fixtures for surface mount devices (SMDs) component. These fixtures are covering 3 GHz frequency range. (See page 263 for more information.) The E4991A replaces existing RF impedance material analyzer, 4291B. The E4991A is succeeding most of fundamental features of 4291B and additional new features are significantly improved usability.

Temperature Characteristic Test Solution is Ready

The E4991A provides a temperature characteristic measurement solution for components and materials. This solution provides highly accurate temperature characteristic analysis capability within the wide temperature range from –55°C to +150°C. The E4991A covers the wide impedance measurement range with a single test head. Also, the temperature drift compensation function enables you to perform open/short compensation at pre-defined temperature points so that temperature drift error can be drastically reduced.

Accurate Impedance Measurement with Probe Station

When connecting the E4991A to a probe station, accuracy degradation caused by port extension and improper calibration, is a significant concern. E4991A-010, Probe Station Connection Kit, provides all necessary parts in one option and solves this problem. This option includes extension cables, a connecting plate, and detailed installation procedures. Cascade Microtech is an Agilent channel partner and they provide RF probe stations. By combining E4991A-010 with a Cascade Microtech RF probe station, you can create an accurate on-wafer characterization system.

Specifications

Measurement Parameters:
|Z|,θz,|Y|,θy, R, X, G, B, Cs, Cp, Ls, Lp, Rp, Rs, D, Q, |Γ|, θ_Γ, Γx, Γy
Material Parameters: $|\varepsilon_r|$, ε_r', εr″, $|\mu_r|$, μ_r', μ_r'', tanδ
Basic Impedance Accuracy: 0.8%
Operating Frequency: 1 MHz to 3 GHz
Frequency Resolution: 1 mHz
Frequency Reference Accuracy: <±10 ppm @ 23°C ± 5°C
Precision Frequency Reference: (E4991A-1D5)
Accuracy: <±1 Vppm/year @ 0°C to 55°C, referenced to 23°C

Source Characteristics

OSC Level:
4.47 mV to 477 mV_{rms}
89.4 µA to 8.94 mArms
Display Level Unit: V, I, dBm
Level Monitor Function: Voltage, Current
Connector: 7 mm
Output Impedance (nominal value): 50 Ω

DC Bias (E4991A-001)

DC Level: 0 V to ±40 V, 0 mA to ±50 mA
DC Level Monitor Function: Voltage, Current

Sweep Characteristics

Sweep Parameter: Frequency, AC signal level, DC bias level

Calibration/Compensation

Calibration: Open/Short/Load/Low-loss capacitor
Compensation: Open/Short, Port extension, Fixture electrical length

Key Specifications of Test Fixtures

Type of Fixture	Operating Freq. (typ.)	Operating Temperature	DUT Size (L x W: mm)
16192A	DC to 2 GHz	–55°C to +85°C	1.0 to 20.0
16194A	DC to 2 GHz	–55°C to +200°C	2.0 to 15.0
16196A	DC to 3 GHz	–55°C to +85°C	1.6 x 1.8 only
16196B	DC to 3 GHz	–55°C to +85°C	1.0 x 0.5 only
16196C	DC to 3 GHz	–55°C to +85°C	0.6 x 0.3 only
16196D	DC to 3 GHz	–55°C to +85°C	0.4 x 0.2 only
16197A	DC to 3 GHz	–55°C to +85°C	0.6 to 3.2

Display

CRT: 8.4-inch color LCD display
Number of Display Channel: 1
Format: Single, dual, active + memory, graphic, and tabular

Storage/Programming functions
Type: Built-in 3.5-inch floppy disk drive, Internal HDD
Disk Format: DOS
Programming: VBA (Built-in)

Input and Output Characteristics
External Reference Input: 10 MHz ± 100 Hz (typical)
Internal Reference Output: 10 MHz nominal
Reference Oven Output (E4991A-1D5): 10 MHz nominal
External Trigger Input: BNC female, TTL Level

General Specifications

Operating Temperature/Humidity: 5°C to 40°C/20% to 80% RH
Warm-up Time: 30 min
Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 66 Hz, 350 VA max.
Size/Weight:
Mainframe: 234 mm H x 426 mm W x 445 mm D (9.36 in x 17 in x 18.2 in)/ 17.0 kg (37.44 lb)
Test Station: 64 mm H x 160 mm W x 160 mm D (2.56 in x 6.4 in x 6.4 in)/ 0.9 kg (1.98 lb)

Key Literature

E4991A RF Impedance/Material Analyzer Technical Overview, p/n 5980-1234E
E4991A RF Impedance/Material Analyzer Data Sheet, p/n 5980-1233E
New Generation Analyzer Offers Exceptional and Powerful Analysis Functions for RF Impedance Measurement, p/n 5988-0200EN
Advanced Impedance Measurement Capability of the RF I-V Method Compared to the Network Analysis Method, p/n 5988-0728EN
Achieving Fast Cycle Time Using an Electronic Design Automation (EDA) Tool and the E4991A RF Impedance/Material Analyzer, p/n 5988-3029EN
Accurate Impedance Measurement with Cascade Microtech Probe System, p/n 5988-3279EN

Ordering Information

E4991A RF Impedance/Material Analyzer

Furnished Accessories:
16195B 7 mm Coaxial Calibration Kit, Floppy Disk, CD-ROM (Manual), and Power Cable (No test fixture is furnished with E4991A)

Options
- **E4991A-001** Add DC Bias
- **E4991A-002** Add Material Measurement Firmware
- **E4991A-007** Temperature Characteristic Test Kit
- **E4991A-010** Probe Station Connection Kit
- **E4991A-800** Standard Frequency Reference, No DC Bias
- **E4991A-810** Add Keyboard
- **E4991A-820** Add Mouse
- **E4991A-1D5** High Stability Frequency Reference
- **E4991A-ABA** US-English Localization
- **E4991A-ABJ** Japan-Japanese Localization
- **E4991A-1CM** Rack Mount Kit
- **E4991A-1CN** Front Handle Kit
- **E4991A-1CP** Handle/Rack Mount Kit

Accessories
16190B Performance Test Kit
16195B 7 mm Coaxial Calibration Kit
16192A Parallel Electrode SMD Test Fixture (up to 2 GHz)
16196A/B/C/D Parallel Electrode SMD Test Fixture (up to 3 GHz)
16197A Bottom Electrode SMD Test Fixture (up to 3 GHz)
16092A Test Fixture (up to 500 MHz)
16200B External DC Bias Adapter (up to 1 GHz)
16453A Dielectric Material Test Fixture (up to 1 GHz)
16454A Magnetic Material Test Fixture (up to 1 GHz)

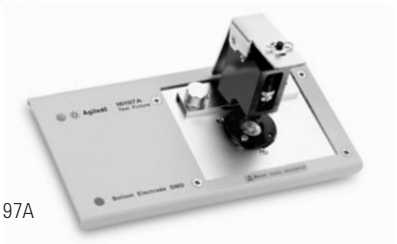
RF SMD Test Fixtures

The following test fixtures can help you achieve the superior accuracy and measurement repeatability you need to evaluate surface mount devices (SMDs) up to 3 GHz.

16196A/B/C/D Parallel Electrode SMD Test Fixtures

The 16196A, 16196B, 16196C and 16196D are coaxial-structured high performance test fixtures for impedance measurements at frequencies up to 3 GHz. These fixtures are your best choice for the characterization of parallel electrode chip inductors and other passive RF components. The 16196A accommodates SMDs with the size code 1.6 mm x 0.8 mm. The 16196B handles SMDs that have the size code 1.0 mm x 0.5 mm. The 16196C is for size code 0.6 mm x 0.3 mm SMDs.

16196A/B/C/D



16197A

16197A Bottom Electrode SMD Test Fixture

The 16197A is designed for impedance evaluations of bottom electrode SMDs components up to 3 GHz. This test fixture accommodates various sizes of SMDs; as small as 0.6 mm x 0.3 mm (16197A-001) and as large as 3.2 mm x 2.5 mm.

Key Specifications of Test Fixtures

Type of Fixture	Operating Freq. (typ.)	Operating Temperature Configuration	Applicable DUT Electrode	DUT Size (l x w = mm)
16196A	DC to 3 GHz	–55°C to +85°C	Parallel electrodes	1.6 x 0.8 only
16196B	DC to 3 GHz	–55°C to +85°C	Parallel electrodes	1.0 x 0.5 only
16196C	DC to 3 GHz	–55°C to +85°C	Parallel electrodes	0.6 x 0.3 only
16196D	DC to 3 GHz	–55°C to +85°C	Parallel electrodes	0.4 x 0.2 only
16197A	DC to 3 GHz	–55°C to +85°C	Bottom electrodes	0.6 x 0.3 to 3.2 x 2.5

Key Literature

Accessories Selection Guide for Impedance Measurement, p/n 5965-4792E

Ordering Information

16196A Parallel Electrode SMD Test Fixtures
- **16196A-710** Add a Magnifying Lens and Tweezers

16196B Parallel Electrode SMD Test Fixtures
- **16196B-710** Add a Magnifying Lens and Tweezers

16196C Parallel Electrode SMD Test Fixtures
- **16196C-710** Add a Magnifying Lens and Tweezers

16196D Parallel Electrodes SMD Test Fixtures
- **16196D-710** Add a Magnifying Lens and Tweezers

16197A Bottom Electrode SMD Test Fixtures
- **16197A-001** Add 0201 (inch)/0603 (mm) Device Guide Set

E4991A
E4991A-002
16453A
16454A

- **Integrated system for permittivity and permeability measurement from 1 MHz to 1 GHz**
- **Versatile fixtures for substrate materials and toroids**
- **Built-in firmware for direct parameter measurement and easy data analysis**

E4991A System (E4991A, 16453A, and 16454A)

E4991A RF Impedance/Material Analyzer (E4991A-002 required)

The E4991A RF impedance/material analyzers provide an easy and versatile material test solution from 1 MHz to 1 GHz. The analyzers measure impedance accurately and automatically calculate permittivity and permeability data from impedance. Various interchangeable test fixtures, designed specifically to work with the E4991A, let you measure dielectric materials and magnetic materials easily.

16453A Dielectric Test Fixture

The 16453A dielectric test fixture is best used for measuring substrate materials (solid, sheet material samples) less than 3 mm in thickness such as PC boards, substrates, and polymer materials. When used with the 16453A, the firmware (E4991A-002) built into the analyzer automatically calculates permittivity parameters. The flexible firmware also lets you display data as a Cole-Cole plot or find relaxation time.

16454A Magnetic Test Fixture

For permeability analysis, the 16454A magnetic test fixture is designed for testing toroidal-shaped samples up to 20 mm in diameter. An example of suitable materials-under-test is soft ferrite magnetic core. The 16454A comes with different sizes of sample holders for different toroid sizes for maximum flexibility. Built-in firmware (E4991A-002) automatically computes permeability parameters, eliminating cumbersome coil-winding or lengthy calculation.

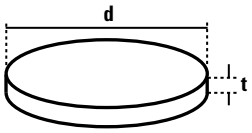
Temperature Coefficient Testing

Both 16453A and 16454A have an operating temperature range from –55°C to +200°C. Both test fixtures can be used with E4991A-007, temperature characteristic test kit.

Specifications

E4991A-002
Material Parameters: $|\varepsilon_r|, \varepsilon_r', \varepsilon_r'', |\mu_r|, \mu_r', \mu_r'', \tan\delta$
Operating Frequency: 1 MHz to 1 GHz

16453A Dielectric Test Fixture

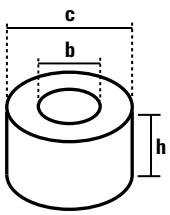


Sample Material Specifications
t: 0.3 mm ≤ t ≤3 mm
d: ≥15 mm

NOTE: Material surface should be flat and parallel.

Operating Frequency Range: 1 MHz to 1 GHz
Operating Temperature Range: –55°C to +200°C

16454A Magnetic Test Fixture



Sample Material Specifications

Fixture Holder	Small A	B	Large C	D
c	≤8 mm	≤6 mm	≤20 mm	≤20 mm
b	≤3.1 mm	≤3.1 mm	≤6 mm	≤5 mm
h	≤3 mm	≤3 mm	≤8.5 mm	≤8.5 mm

Operating Frequency Range: 1 MHz to 1 GHz
Operating Temperature Range: –55°C to +200°C

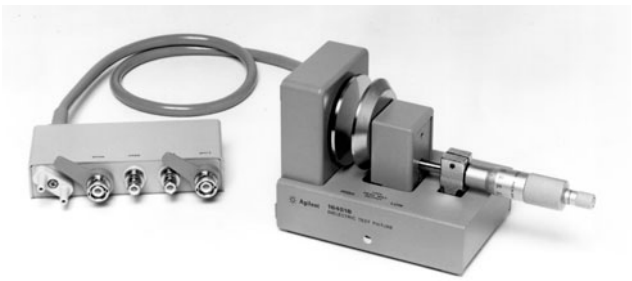
Key Literature

E4991A RF Impedance/Material Analyzer Technical Overview, p/n 5980-1234E
Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

E4991A RF Impedance/Material Analyzer
E4991A-002 Material Measurement Firmware
E4991A-007 Temperature Characteristic Test Kit
16453A Dielectric Test Fixture
16454A Magnetic Test Fixture

- **For measuring capacitance or dielectric constant of solid materials**
- **Designed for four-terminal-pair LCR meters or impedance analyzers**



16451B Dielectric Test Fixture

16451B Dielectric Test Fixture

For dielectric constant evaluation of solid materials such as polymer, electric insulator, PC board, ceramic substrate, etc., use the 16451B dielectric test fixture with any Agilent four-terminal-pair LCR meter or impedance analyzer up to 30 MHz. The 16451B has four types of electrodes which can be replaced according to sample size or measurement technique. Stray admittance and residual impedance of the test fixture can be eliminated by the OPEN/SHORT error correction function of the measurement instrument by using the furnished OPEN/SHORT attachments.

Specifications

Frequency Range: ≤30 MHz (depends on instruments)
Operating Temperature: 0°C to +55°C
Sample Size: Diameter 10 to 56 mm, Thickness ≤10 mm
Parameters: Capacitance, Loss Tangent, $\varepsilon r'$, $\varepsilon r''$ (must be calculated using external computer or IBASIC)
Electrical Interface: Four-terminal pair

Key Literature

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

16451B Dielectric Test Fixture

- **For measuring capacitance or dielectric constant of liquids**
- **Designed for four-terminal-pair LCR meters or impedance analyzers**

16451B
16452A

16452A Liquid Test Fixture

16452A Liquid Test Fixture

For convenient testing of liquids, use the 16452A liquid test fixture with any four-terminal-pair LCR meter or impedance analyzer. With the 16452A, you will be able to measure permittivity and impedance characteristics of liquid materials like plastic resins, or petrochemical products. The fixture has inlet/outlet ports which allow continuous measurements of liquids flowing in a process monitoring environment. The internal cell allows accurate measurements to be performed on a small amount of liquid samples.

Specifications

Operating Frequency: 20 Hz to 30 MHz
Operating Temperature: –20°C to +125°C
Sample Size: 3.4 ml to 6.8 ml
Parameters: Capacitance, Loss Tangent, $\varepsilon r'$, $\varepsilon r''$ (must be calculated using external computer or IBASIC)
Electrical Interface: Four-terminal pair

Key Literature

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

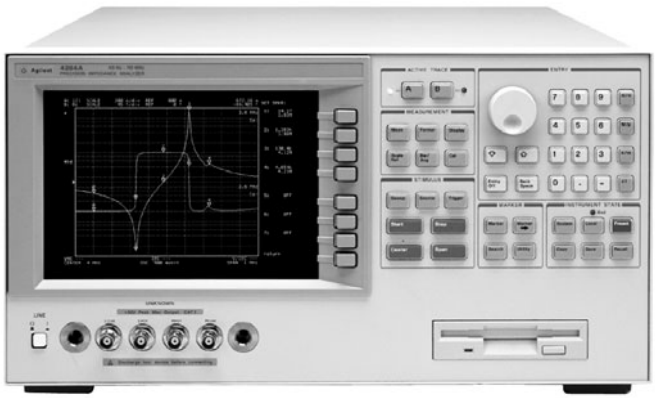
Ordering Information

16452A Liquid Test Fixture
Recommended measurement cables for connecting the 16452A to an Agilent four-terminal-pair LCR meter or impedance analyzer: 16048A Test Lead (0°C to +55°C), 16452-61601 (–20°C to +125°C), or 16048G Test Lead (–20°C to 150°C, only for 4294A)

Note: The 16452A is not capable of measuring salt or ionic solutions, or other liquids with bulk conductivity due to the electrode polarization phenomenon.

4294A

- **Accurate measurement over wide impedance range and wide frequency range**
- **Basic impedance accuracy: ±0.08%**
- **40 Hz to 110 MHz, 3 mΩ to 500 MΩ**
- **Powerful impedance analysis function**
- **Ease of use and versatile PC connectivity**
- **30% typical accuracy range: 3 mΩ (100 Hz to 110 MHz), 500 MΩ (100 Hz to 200 kHz)**



4294A

4294A Precision Impedance Analyzer

The Agilent 4294A precision impedance analyzer is an integrated solution for efficient impedance measurement and analysis of components and circuits. The 4294A covers a broader test-frequency range (40 Hz to 110 MHz) with Basic impedance accuracy: ±0.08%. Excellent High Q/Low D accuracy enables analysis of low-loss components. The wide signal-level ranges enable device evaluation under actual operating conditions. The test signal level range is 5 mV to 1 V_{rms} or 200 µA to 20 mArms, and the DC bias range is 0 V to ±40 V or 0 mA to ±100 mA. Advanced calibration and error compensation functions eliminate measurement error factors when performing measurements on in-fixture devices. The 4294A is a powerful tool for design, qualification and quality control, and production testing of electronic components. Circuit designers and developers can also benefit from the performance/functionality offered.

Wide-Range Accurate Measurement

The 4294A enables impedance measurement using the auto-balancing bridge technique over the frequency range 40 Hz to 110 MHz. The basic impedance accuracy is ±0.08%, and the typical Q accuracy is ±3% @ Q = 100, ≤10 MHz. This advantage permits accurate evaluations of impedance characteristics for a wide variety of electronic devices as well as electronic and non-electronic material within a wide frequency range.

Versatile Analysis

The 4294A graphically displays impedance measurement results. This permits easy analysis of the resonant frequency and impedance values of electronic components using the marker functions. The marker functions offer a simple method to pinpoint the resonant frequency of components, as well, these functions assist users in many other observations. The combination of the accumulate mode (to superimpose traces) and the list sweep functions permits observation of the change in a DUT's characteristics due to a change in the measurement condition. Versatile and high-speed automatic testing is possible using the list sweep function in conjunction with the limit line function. The list-sweep function provides the ability to enhance test throughput by segmenting the sweep to include only necessary measurement frequencies, while the limit-line function (for Go/No-Go Testing) provides the ability to apply test limits within each segment. These functions greatly support the quality and performance required evaluating modern and improved electronic components, equipment and materials.

Equivalent Circuit Analysis

The equivalent-circuit analysis function provides advanced modeling (three and four element models) based on circuit constant values of five available circuit models. This function simulates the frequency characteristics of components by using derived circuit values or user-specified values. Comparison of design values to measurement values can assist with efficient component design.

Programming

Full programmability is provided using built-in Instrument (IBASIC). Desired measurements and computations, including graphics analysis, can be programmed simply by storing front-panel keystroke operations. The one-key execution function allows easy selection and execution of customized IBASIC programs. Several forms of storage are built-in (10 Mbyte no-volatile memory, RAM disk or Floppy Disk).

Good PC Connectivity

Features fit to the latest PC environment include LAN (Local Area Network) capability, VGA monitor output, and the TIFF file format. LAN capability permits simplified networking ability when collecting, sharing and analyzing data. VGA monitor output improves productivity and reduces eyestrain. TIFF file format allows easy transfer of graphics to a PC.

Abundance of Accessories

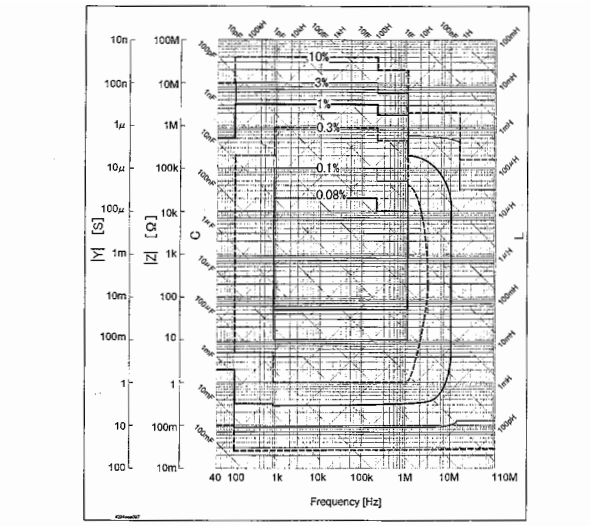
Various Four-terminal-pair test fixtures can be used with the 4294A. The 42941A impedance probe kit (1.5 m), which covers 40 Hz to 110 MHz, enables in-circuit impedance measurement of electronic circuits or components. Grounded devices can also be measured. The 42942A terminal adapter, which covers 40 Hz to 110 MHz, converts the 4-terminal-pair port configuration to a 7 mm test port. This adapter permits the use of familiar 7 mm test fixtures. Again, grounded measurement is available.

Specifications

Measurement Parameters:
|Z|, |Y|, θ, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q

Basic Measurement Accuracy

Basic Impedance Accuracy (4 Terminal Pair): ±0.08%
(See figure in detail)
Basic Impedance Accuracy with 42941A: ±0.8% (typical)
Basic Impedance Accuracy with 42942A: ±0.6%



4294A Impedance Accuracy @ 4-Terminal-Pair, OSC = 0.5 V)

Source Characteristic

Test Frequency: 40 Hz to 110 MHz
Frequency Resolution: 1 mHz
Frequency Accuracy: ±20 ppm (±0.13 ppm with 4294A-1D5)
OSC Level: 5 mV to 1 V/200 µA to 20 mA
OSC Level Resolution: 1 mV/20 µA
OSC Level Accuracy
Voltage: ±((10 + 0.05 * f(MHz))% + 1 mV) @ UNKNOWN Terminal OPEN
Current: ±(10 + 0.3*f(MHz))% + 50 µA) @ UNKNOWN Terminal SHORT
Level Monitor Function: Voltage, Current

DC Bias

DC Bias Level: 0 V to ±40 V, 0 A to ±100 mA (Auto level control function available)
DC Bias Level Resolution: 1 mV/40 µA
DC Bias Voltage Accuracy: ±(0.1% + (5 + 30*Imon (mA))) mV
DC Bias Current Accuracy: ±(2% + (0.2 * Vmon (V)/20) mA
DC Level Monitor Function: Voltage, Current

Sweep Characteristic

Sweep Parameter: Frequency, AC voltage, AC current, DC bias voltage, DC bias current
Sweep Type: Linear, Log, List, Zero Span, Manual, Up/Down
Number of Points: 2 to 801

Calibration/Compensation/Adapter Type

Calibration: Open/Short/Load
Compensation: Open/Short/Load, port extension (electrical length)
Adapter Type: None, 1 m, 2 m, 7 mm Adapter (42942A), Probe (42941A)

Display

Size: 8.4 inch
Type: Color LCD (TFT)

Analysis

Marker: 8 markers, delta marker function, search function, analysis function
Equivalent Circuit Function: Approximation, simulation
Others: IBASIC, Limit Line, Accumulate mode

Interface

LAN Interface: 10 Base-T Ethertwist, RJ45 Connector, TCP/IP
Other Interface: GPIB Interface, Printer (Centronics), 8 bit I/O, 24 bit I/O, VGA monitor output

Storage

Type: Built-in 3.5 inch floppy disk drive, 10 Mbyte non-volatile memory, 512 kbyte volatile RAM disk memory
Disk Format: DOS
Programming: IBASIC

General Specifications

Operating Temperature and Humidity: 0°C to 40°C, 15% to 80% RH
Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 63 Hz, 300 VA Max.
Size: 222 mm H x 426 mm W x 502 mm D (8.88 in x 17.04 in x 20.08 in)
Weight: 25 kg (55 lb)

4294A Material Solution

The dielectric constant of a solid material can be measured with the 16451B dielectric test fixture. The magnetic constant of toroidal core can be also measured using the 16454A magnetic material test fixture with the 4294A/42942A configuration.

In both applications, the dielectric or magnetic constant is calculated from measured impedance value. The measurement sequence of impedance measurement, material constant calculation and data analysis can be automatically executed using built-in IBASIC programming function.

The measurement program is provided as a sample programs in the 4294A operating manual. Users need to learn the IBASIC programming first, then the program can be modified as they like. The electronics knowledge is required to use these fixtures, because it is basically an impedance measurement.

16451B Frequency Range when used with 4294A: 40 Hz to 30 MHz
16454A Frequency Range when used with 4294A: 1 kHz to 110 MHz
Applicable Material Size: See page 264.

Key Literature

4294A Precision Impedance Analyzer Technical Overview, p/n 5968-3808E
4294A Technical Specification, p/n 5968-3809E
Reliable Electronic Component Evaluation and Circuit Design with the 4294A, p/n 5968-4505E
New Technologies for Accurate Impedance Measurement (40 Hz to 110 MHz), p/n 5968-4506E
Evaluation of MOS Capacitor Oxide C-V Characteristics Using the Agilent 4294A, p/n 5988-5102EN
Accurate Impedance Measurement with Cascade Microtech Probe System, p/n 5988-3279EN

Ordering Information

4294A Precision Impedance Analyzer
Furnished Accessories: floppy disk, CD-ROM (Manual), and power cable. (No test fixture is supplied with the 4294A.)
- **4294A-1D5** Add High-Stability Frequency Reference
- **4294A-800** Standard Frequency Reference
- **4294A-810** Add Keyboard

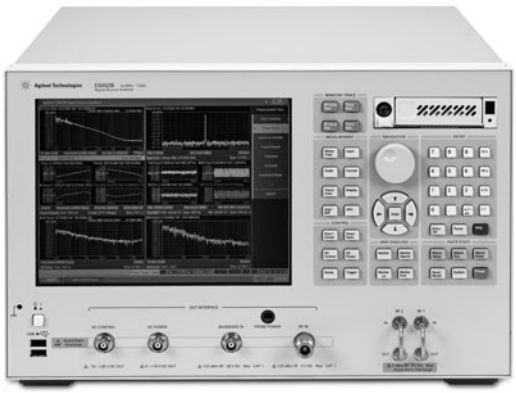
42941A Impedance Probe Kit
42942A 7 mm Terminal Adapter
- **42942A-700** Add 7 mm Open/Short/Load set

16047E Test Fixture for axial lead components
16034G SMD Test Fixture
16044A Kelvin Contact SMD Test Fixture
16048G 1 m Cable
16048H 2 m Cable
16451B Dielectric Material Test Fixture
16454A Magnetic Material Fixture (used with 42942A)

Signal Source Analyzer, 10 MHz to 7 GHz

E5052B

- **10 MHz to 7 GHz RF test frequency range (up to 110 GHz with external down-converters and harmonic mixers)**
- **True single-connection to dramatically simplify signal source evaluations**
- **1 Hz to 100 MHz phase noise analysis offset frequency range**
- **Easy one-step measurement with unparalleled phase noise sensitivity and exceptional measurement speed**
- **Complete set of transient measurements to fully characterize time response of hopping signal sources and PLL**
- **Independent AM and base-band noise measurement capabilities**
- **Built-in ultra-low-noise DC sources provide accuracy and flexibility on oscillator characterization**
- **Internal VBA® programming for simple and easy automated measurements**



The E5052B Signal Source Analyzer is a single-instrument solution that offers an indispensable set of measurement functions for evaluating RF & microwave signal sources such as VCOs, crystal oscillators, SAW oscillators, dielectric resonator oscillators, YIG oscillators, PLL synthesizers, RFICs, and LO circuits.

Applications include mmW signal source characterization with external mixers and precise clock jitter measurement for high-speed digital communication systems and components.

For phase noise, jitter or PM noise, AM noise, low frequency base-band noise measurements, the E5052B offers fast spectrum analysis at logarithmic frequencies up to 100 MHz maximum. Precise and detailed clock jitter analysis for high-speed data communication systems can be done, as well as for traditional low noise signal sources.

For frequency, power, and phase measurements, it has a complete set of test conditions both for statistic and transient characterization, as well as a spectrum monitoring function.

Superior measurement results are achieved by using built-in low-noise reference local oscillators and an innovative cross-correlation technique with two independent internal measurement channels. Thanks to built-in low-noise DC voltage sources the E5052B produces accurate and reliable VCO/PLL tests.

Offering extremely high sampling rate and fine frequency resolution in its transient measurements, which satisfy test needs of fast switching synthesizers for current and future wireless communications and aerospace & defense applications.

This all-in-one solution is designed to provide a significantly accurate and efficient measurement environment with easy-to-use features and excellent PC connectivity in order to improve design and test productivity in signal source engineering.

Select your desired frequency band and connect your signal source. The instrument is set-up automatically and you are ready to measure your DUT.

Specifications

Phase Noise Measurement

Parameters
L(f) single-side-band (SSB) phase noise spectrum density
Residual PM or FM or RJ (random jitter) in user specified bandwidth
RF Input Carrier Frequency Range
10 MHz – 7 GHz (–26.5 GHz with the E5053A)
N(f)-type 50 ohm input connector
RF Input Level
–20 dBm to +20 dBm (–15 dBm to +20 dBm @10 MHz – 30 MHz)
Offset Frequency Range
1 Hz – 100 MHz (10 Hz – 100 MHz for option 011)
Residual Noise Floor: –178 dBc/Hz with built-in low noise reference LO's.
Enhanced Phase Noise Sensitivity
"Cross-correlation method" can improve phase noise sensitivity up to 20 dB (except option 011)
Measurement Speed
0.3 sec per sweep @1 kHz – 100 MHz offset freq. range
13 sec per sweep @1 Hz – 100 MHz offset freq. range

AM Noise Measurement

RF Input Carrier Frequency: 60 MHz – 7 GHz (–26.5 GHz with the E5053A)
RF Input Level: –20 dBm to +20 dBm
Offset Frequency Range: 1 Hz to 40 MHz (10 Hz – 40 MHz for option 011)

Base-Band Noise Measurement

Frequency Range
1 Hz – 100 MHz (AC coupled) [E5052B]
10 Hz – 100 MHz (AC coupled) [E5052B-011]
BNC 50 ohm input

Frequency, Power, and DC Current Measurement

Parameters: Frequency, tuning sensitivity, frequency pushing, RF power level, DC power supply current
Frequency Resolution: 10 Hz/1 kHz/64 kHz
Frequency Uncertainty: same as internal time-base (0.5 ppm typ.)
RF Power Level Uncertainty: 0.5 dB to 1 dB
DC Power Supply Current Measurement Range: 0 – 80 mA
DC Power Supply Current Measurement Resolution: 10 µA minimum

Frequency, Phase, RF Power Over Time (Transient) Measurement

Parameters: Frequency vs. time, phase vs. time, RF power level vs. time
Frequency Transient Range
4.8 GHz max. in wide-band mode (frequency only)
3.125 kHz/25 kHz/200 kHz/1.6 MHz/25.6 MHz/80 MHz in narrow-band mode
Frequency Resolution: 0.0004 Hz min.*
Time Resolution: 8 nsec minimum*

Spectrum Monitoring

RF Input Frequency Range: 10 MHz – 7 GHz
Frequency Span: 15 MHz max. (linear scale of RF input frequency)
Resolution Bandwidth: 1.53 Hz – 400 kHz
Relative Level Uncertainty: 1.5 dB

DC Sources

DC Control Source: –15 V to +35 V, 20 mA output max.
DC Control Source Noise Level: 1 nV_{rms}/Hz @10 kHz typ.
DC Power Supply Source: 0 to +16 V, 80 mA output max.
DC Power Supply Source Noise Level: 10 nV_{rms}/Hz @10 kHz typ.

Front Panel

10.4 inch color LCD (1,024 x 768 res.) display (touch screen)
Removable HDD, 2 USB connectors, Probe power connector (+15 V, –12.6 V, 150 mA maximum), GND terminal

10 MHz Reference Output on Rear Panel

Frequency Uncertainty: 0.5 ppm typ.
Sinusoidal Waveform Level: 2.5 dBm ±3 dB typ.

* depending on frequency range and time span

Accessories

E5053A 26.5 GHz Microwave Down-converter
1250-1744 Adapter, 3.5 mm (f) to Type-N (m), DC to 18 GHz
11500E Cable Assembly, 3.5 mm (m) to 3.5 mm (m), DC to 26.5 GHz
41800A Active Probe (–500 MHz)
41802A 1Mohm Input Adapter
11970 Series Harmonic Mixers
11970A 26.5 GHz – 40 GHz
11970Q 33 GHz – 50 GHz
11970U 40 GHz – 60 GHz
11970V 50 GHz – 75 GHz
11970W 75 GHz – 110 GHz
87405B Preamplifier 10 MHz – 4 GHz 24 dB
87405C Preamplifier 100 MHz – 18 GHz 25 dB
82357B USB/GPIB Interface
E5001A SSA-J Precision Clock Jitter Analysis Software

Key Literature & Web Link

Signal Source Analyzer Brochure, p/n 5989-6389EN
Signal Source Analyzer Data Sheet, p/n 5989-6388EN
7 Hints for Making Innovative Signal Source Measurements, p/n 5989-1618EN
E5001A SSA-J Technical Overview, 5989-5040EN

www.agilent.com/find/ssa

Ordering Information

E5052B 10 MHz to 7 GHz Signal Source Analyzer
- **E5052B-011** Delete Functions
- **E5052B-1A7** ISO 17025 Compliant Calibration
- **E5052B-A6J** ANSI Z540 Compliant Calibration
- **E5052B-1CM** Rackmount Kit
- **E5052B-1CN** Front Handle Kit
- **E5052B-1CP** Rackmount and Front Handle Kit
- **E5052B-810** Add Keyboard
- **E5052B-820** Add Mouse

E5053A 3 GHz to 26.5 GHz Microwave Downconverter
- **E5053A-1A7** ISO 17025 Compliant Calibration
- **E5053A-1CM** Rackmount Kit
- **E5053A-1CN** Front Handle Kit
- **E5053A-1CP** Rackmount and Front Handle Kit
- **E5053A-ABA** Add English Manual Set
- **E5053A-ABJ** Add Japanese Manual Set

E5001A-1FP E5001A Jitter Application – Standard Tier, Fixed, Perpetual License

35670A Dynamic Signal Analyzer

Two- or Four-Channel Dynamic Signal Analyzer 35670A

35670A

- **100 kHz bandwidth**
- **Two or four channels (optional)**
- **1600 line frequency resolution**
- **16-bit ADC/90 dB dynamic range (typical)**
- **16 MB RAM Standard**
- **Integrated source**

35670A

35670A Dynamic Signal Analyzer

The 35670A lets you make laboratory-quality measurements in the field, on an automobile test track, flying above a city, or in the narrow confines of a submarine. Small enough to fit under an airplane seat, the 35670A is a two-, or four-channel (35670A-AY6), FFT-based spectrum/network analyzer. The standard instrument provides spectrum, network, time-domain, and amplitude-domain measurements from virtually dc to slightly over 100 kHz. Your ability to solve problems in the field is enhanced with the optional four-channel 35670A — measure noise at multiple locations inside vehicles, make triaxial vibration measurements, or gather data from several locations along a noise transmission path.

With the 35670A, you carry all your measurement and analysis tools in one package. Octave analysis (35670A-1D1) adds real-time measurements of l/1, 1/3, or 1/12 octave spectra at frequencies up to 40 kHz. Computed order tracking (35670A-1D0) allows you to view spectra as a function of orders, or to view the amplitude of multiple orders as a function of RPM. Standard 16 MB of memory provides deep transient time capture or extra space for 2 MB of non-volatile memory. An arbitrary source (35670A-1D4) lets you test devices with real-life test signals. With Instrument BASIC (35670A-lC2), you can automate measurements or customize your instrument interface. Everything you need to troubleshoot vibration and noise problems in the field is in one instrument. (You can retrofit all options — buy only the functionality you need today and add more as your needs change.)

A deep transient time capture memory can record up to four channels of data plus a tachometer signal for playback in the narrowband FFT, octave, order, correlation, or histogram instrument modes. Pre- and post-trigger delay functions let you capture the leading edge of one-time events or eliminate transmission delay in signals.

Real-Time Octave Analysis to 40 kHz (ANSI S1.11-1986)

Octave analysis (35670A-1D1) adds a real-time octave analyzer to your 35670A for analysis in 1/1-, 1/3-, or 1/12-octave bands. Four LEMO connectors with power for microphones are provided by the microphone adapter and power supply (35670A-UK4). The 1/1- and 1/3-octave band filters in the 35670A comply fully with ANSI S1.11-1986 (Order 3 Type 1-D), DIN 45651, and IEC 225-1966. An overall total power band and an A-weighted overall power band can be activated as needed. All three octave band modes and the overall power band can be A-weighted with an analog filter in full compliance with IEC 651-1979 Type 0. The overall power band can be redefined as a broadband impulse detector that complies with IEC 651-1979 Type 0. A fan-off mode eliminates instrument noise from measurements. A pink noise source allows you to evaluate electroacoustic devices.

View Spectra in the Order Domain (35670A-1D0)

View spectra as a function of orders or track up to five orders on four channels simultaneously with computed order tracking (35670A-1D0). Orders as high as 200 can be tracked. An order map can be displayed as a function of RPM or time, using the waterfall function. Waterfall markers let you view the track of any order.

Computed order tracking is ideal for troubleshooting rotating machinery. Run-up or run-down measurements can be displayed in bode or polar formats. Oscilloscope-quality orbit diagrams are another benefit. Because the data is resampled with changes in RPM, a single-loop orbit display is maintained as the shaft RPM is varied. With four channels (35670A-AY6), two orbits can be measured simultaneously-at both ends of a shaft, for instance. An RPM measurement readout, available in any instrument mode, aids in the interpretation of measurement data from rotating machinery.

Computed order tracking provides alias-protected measurements without expensive and cumbersome external ratio synthesizers and tracking filters. This new technique uses a digital tracking algorithm that follows rapid changes in shaft RPM without time delay and eliminates the phase noise normally associated with ratio synthesizer techniques. Accuracy is enhanced over traditional methods.

Swept-Sine or Broad Measurement Range (35670A-1D2)

The swept-sine instrument mode expands the network analysis range of the 35670A to 130 dB. Higher noise rejection and accuracy are obtained by auto-ranging the instrument during the sweep. Automatic sweep resolution reduces measurement time without sacrificing accuracy. Alternatively, sweep resolution can be set by the user.

Advanced Modeling and Analysis Cut Design Time

Prototype revisions are reduced by modeling design modifications using curve fit and synthesis functions (35670A-1D3). In a typical application, a model of the test device is created by curve fitting a frequency response measurement. Up to 20 poles and 20 zeros are used to describe the device; results can be output in pole/zero, pole/residue, or polynomial formats. The designer then transfers the circuit model to the synthesis function. Using synthesis, the model is modified by adding or deleting poles and zeros. The frequency response function of the modified model is then synthesized to test the design modification.

Automation Improves Productivity

Instrument BASIC (35670A-1C2) replaces the external computer in small test systems. Like the computer, it can be used to automate measurements, create a custom user interface, synthesize new information from raw data, or control other instruments and peripherals. An optional external keyboard plugs into the rear panel. The 35670A provides direct control of external disks, plotters, and printers via GPIB RS-232, or parallel interfaces, and is fully programmable via the GPIB.

Key Literature

35670A Rotor Dynamics Measurement Technique, p/n 5966-0518E
35670A Technical Data Sheet, p/n 5966-3064E
35670A Product Overview, p/n 5966-3063E

For more information, visit our web site:
http://cp.literature.agilent.com/litweb/pdf/5966-3064E.pdf

Ordering Information

35670A Dynamic Signal Analyzer
- **35670A-AY6** Add 2 Input Channels
- **35670A-1D0** Computed Order Tracking Measurements
- **35670A-1D1** Real-Time Octave Measurements
- **35670A-UK4** Microphone Adapter and Power Supply
- **35670A-1D2** Swept-Sine Measurements
- **35670A-1D3** Curve Fit/Synthesis
- **35670A-1D4** Arbitrary Waveform Source
- **35670A-1C2** Instrument BASIC
- **35670A-100** Software Bundle

Accessories
35250A DC Power Cable (3 m)
35251A DC Power Cable w/Cigaretter Lighter Adapter

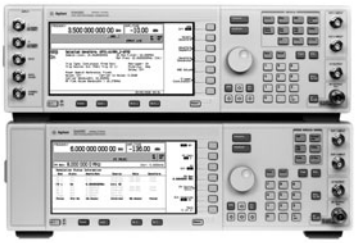
4

GENERATORS, SOURCES, SUPPLIES

E8663B Signal Generator

Signal Studio Software

N9310A Signal Generator



ESG Signal Generators

MXG Signal Generators

PSG Signal Generators

Analog and Vector Signal Generators

Agilent offers the widest selection of signal generators from baseband to 67 GHz, with frequency extensions to 325 GHz. From basic to advanced functionality, each signal generator delivers benchmark performance in its class to address the requirements in design and manufacture of radio transceivers and their components; and applications ranging from low-frequency navigation signals, through cellular mobile radio, to millimeter wave satellite systems. Each offers synthesized frequency accuracy and stability, excellent calibrated level accuracy, and remote programmability. Modulation capabilities vary from general purpose AM, FM, ΦM and I/Q modulation to standard-specific formats such as GSM, EDGE, TD-SCDMA, W-CDMA, cdma2000, and WiMAX.

Signal Studio Software

Agilent is a worldwide leader in complex signal simulation, boasts the most comprehensive collection of application-specific signal creation software. And, with a proven first-to-market track record, Agilent continues to help you stay at the forefront of product development for modern communications systems, including those for digital video, WLAN/MIMO, LTE, and TD-SCDMA.

Considered the benchmark reference signal in the test industry, Agilent vector signal generators feature both Signal Studio software that runs on a PC, as well as embedded software that runs directly on the signal generator. Both of these flexible, easy-to-use signal creation solutions will cut the time you spend on signal simulation and provide a validated reference signal to better characterize, evaluate, and optimize your designs under parametric and functional test conditions. Create reference signals for mobile communications and wireless connectivity standards, test patterns for advanced radar systems, distortion test signals for components, and more.

Baseband Generation

Baseband Studio is a suite of digital baseband hardware, software application tools, and accessories that enable digital baseband and RF designers to generate, capture, impair, playback, and emulate real world signal conditions. Baseband Studio applications can be used with the E4438C ESG and the E8267D PSG vector signal generators, the E5515C wireless communications test set, and PCs equipped with the N5101A Baseband Studio PCI card.

Analog Signal Generators

Model	Frequency Range	Key Feature/Application	Page
N9310A	9 kHz to 3 GHz	Basic performance; low-cost RF signal generation for general-purpose and consumer product manufacturing; provides built-in analog modulation and optional I/Q analog inputs; multi-language user interface.	274
N5181A MXG	100 kHz to 1, 3, 6 GHz	Mid-performance; optimized for manufacturing; provides fast frequency and amplitude switching, simplified self-maintenance, LXI class C compliant.	274
E4428C ESG	250 kHz to 3, 6 GHz	High performance; ideal for general-purpose R&D applications, including LO substitution, component, and receiver test; provides excellent spectral purity, high output power, and flexible dual internal function generator.	274
E8663B	100 kHz to 3.2, 9 GHz	High performance; meets needs of demanding applications such as radar system development, satellite communications evaluation, or very low noise local oscillator substitution; provides the best close-to-carrier phase noise, high output power, and excellent level accuracy.	274
E8257D PSG	250 kHz to 20, 40, 50, 67 GHz	High performance; ideal for developing radar systems, satellite communications, terrestrial microwave radios, and their components; provides industry-leading phase noise, high output power, and excellent level accuracy for LO substitution, component and receiver test.	274
OML Inc. Millimeter-Wave Source Modules	50 to 325 GHz	Frequency extension to 325 GHz for E8257D and E8267D PSG signal generators	274

Signal Sources

Vector Signal Generators

Model	Frequency Range	Key Feature/Application	Page
N5182A MXG	100 kHz to 3, 6 GHz	Mid-performance; optimized for manufacturing and key R&D applications including MCPA development and transceivers for WiMAX and WLAN; provides arbitrary signal generation, industry-leading ACPR, fast switching (frequency, amplitude, and waveform) and simplified self-maintenance; LXI class C compliant; use with Signal Studio software for standard-based signal creation for mobile communications and wireless connectivity.	292
E4438C ESG	250 kHz to 1, 2, 3, 4, 6 GHz	High performance; offers flexible RF signal generation for R&D; provides arbitrary and real-time signal generation; use with Signal Studio software for the broadest offering of standards-based signal creation for audio/video, mobile communications, wireless connectivity, and more; works with Baseband Studio for fading, waveform capture and playback, and digital I/Q inputs and outputs.	292
E8267D PSG	250 kHz to 20, 31.8, 44 GHz	High performance; ideal for developing radar systems, satellite communications, terrestrial microwave radios, and their components; provides industry-leading phase noise, microwave custom I/Q modulation and works with Signal Studio software for complex pulse generation, two-tone and multi-tone signals for distortion test; works with Baseband Studio for fading, waveform capture and playback and digital I/Q inputs and outputs.	292

Signal Studio Software

Industry	Frequency Range	Signal Type	Page
Mobile Communications	Signal Generator Dependent	– LTE, W-CDMA, HSDPA, HSUPA – GSM, EDGE, GPRS, EGPRS – cdmaOne, cdma2000, 1xEV-DO – TD-SCDMA – NADC, PDC, PHS, DECT, TETRA	312
Wireless Connectivity	Signal Generator Dependent	– 802.16 WiMAX (Fixed and Mobile) – 802.11 WLAN (a/b/g/j/p/n) – Bluetooth – MB-OFDM UWB	324
Audio/Video Broadcasting	Signal Generator Dependent	– DVB-T/H/C/S – ATSC – ISDB-T – DTMB – T-DMB – S-DMB	331
Detection, Positioning, Tracking & Navigation	Signal Generator Dependent	– Pulse Building – GPS	334
General RF/MW	Signal Generator Dependent	– Toolkit – Multitone Distortion – Calibrated AWGN – Jitter Injection	336

Baseband Generation

Model	Type	Key Feature/Application	Page
N5101A Baseband Studio PCI Card	Hardware	Required to operate N5115B Baseband Studio for fading or N5110A Baseband Studio for waveform capture and playback. Can be interfaced with the N5102A digital signal interface module for digital signal generation and capture.	341
N5102A Baseband Studio Digital Signal Interface Module	Hardware	Enables digital outputs from and digital inputs to the E4438C ESG and E8267D PSG vector signal generators and custom transceivers. Can also be interfaced with a PC equipped with the N5101A Baseband Studio PCI card to enable digital inputs and outputs from the PC.	342
N5103A Baseband Studio High Speed Serial Interface Card	Hardware	A high-performance, digital, bi-directional CPRI interface used in conjunction with Agilent's N5101A Baseband Studio PCI card and the N5120A Baseband Studio for CPRI RE test software, to emulate an REC (radio equipment controller) to stimulate the RE for many performance tests.	341
N5110B Baseband Studio for Waveform Capture and Playback	Software	Allows streaming of I/Q waveform data directly from a PC hard drive through the N5102A Baseband Studio digital signal interface module and the E4438C ESG or the E8267D PSG vector signals generators. Digital IQ data can also be captured and stored on PC hard drive through the N5102A.	343
N5115B Baseband Studio for Fading	Software	Provides channel simulation of digital signals generated from the E4438C ESG or E8267D PSG signal generator or the E5515C wireless communications test set.	344
N5120A Baseband Studio for CPRI RE Test	Software	Enables the testing of CPRI base station radio equipment (RE) by emulating the REC (Radio Equipment Controller) and providing control signals via a CPRI interface to stimulate the RE. Works with the N5103A Baseband Studio high speed serial interface and N5101A Baseband Studio PCI card.	347

N9310A
N5181A
E4428C
E8663B
E8257D

Analog Signal Generators

Agilent analog signal generators span from economy RF to high performance microwave frequencies and offer precision AM, FM, ΦM, and pulse modulation. They feature excellent spectral purity for LO substitution, superior level accuracy, high output power, as well as digital (step/list) and analog (ramp) sweep with scalar network analyzer compatibility. If you need a repeatable test stimulus to manufacture high-volume, low-cost products, or have more demanding performance requirements for your sensitivity, adjacent channel, and intermodulation measurements, Agilent analog signal generators deliver.

N9310A

N5181A MXG

E4428C ESG

E8663B

E8257D PSG

Side-by-Side Key Specifications Comparison

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	Basic Performance	Mid Performance	High Performance	High Performance	High Performance
	N9310A Page 275	**N5181A MXG Page 276**	**E4428C ESG Page 279**	**E8663B Page 282**	**E8257D PSG Page 285**
Key Attributes	• Low cost • Large (6.5"), easy to operate color screen • Optional I/Q modulator (ext. I/Q inputs only) • Localized GUI with 11 regional languages	• Optional analog modulation • Fast switching speed • Simplified self-maintenance • Compact two rack unit size (2RU)	• Excellent spectral purity • High output power • Dual internal function generators	• Industry's best SSB phase noise • Superior level accuracy • High output power • Narrow pulse modulation	• Industry's best SSB phase noise • High output power • Excellent level accuracy • Optional analog modulation • Narrow pulse modulation
Frequency Range	9 kHz to 3 GHz	100 kHz to 1, 3, or 6 GHz	250 kHz to 3 or 6 GHz	100 kHz to 3.2 or 9 GHz	250 kHz to 20, 31.8, 40, 50, 67 GHz
Output Power	+13 to –127 dBm	+13 to –127 dBm	+17 to –136 dBm	+21 to –135 dBm	+23 to –135 dBm
Level Accuracy	±1 dB	±0.6 to 1.7 dB	±0.5 to 1.5 dB	±0.6 to 1.0 dB	±0.6 to 2.5 dB
Spectral Purity					
Close-in SSB Phase noise (1 GHz; 10 Hz offset)	—	–60 dBc/Hz (measured)	–80 dBc/Hz (measured)	–93 dBc/Hz (typical)	–93 dBc/Hz (typical)
SSB Phase Noise (1 GHz; 20 kHz Offset)	–95 dBc/Hz	–121 dBc/Hz (typical)	–134 dBc/Hz	–134 dBc/Hz	–134 dBc/Hz
Far-from carrier SSB phase noise (1 GHz; 10 MHz offset)	—	–160 dBc/Hz (measured)	–147 dBc/Hz (measured)	–150 dBc/Hz (measured)	–150 dBc/Hz (measured)
Harmonics	<–30 dBc	<–30 dBc to <–44 dBc	<–30 dBc	<–30 to <–55 dBc	<–30 to <–55 dBc
Nonharmonics	<–50 dBc	<–42 to <–61 dBc	<–62 to <–80 dBc	<–62 to <–80 dBc	<–44 to <–80 dBc
Frequency Switching	<10 ms	<1.15 ms <900 µs (list mode)	<9 ms	<8 ms	<8 ms
Jitter (@622 MHz, 5 MHz BW)	—	47 µUI	40 µUI	19 µUI	19 µUI

N9310A

- **Complete function set at an ultra low initial cost**
- **Professional performance: 9 kHz to 3 GHz CW and swept output, 20 Hz to 80 kHz low frequency coverage, –127 to +13 dBm amplitude coverage, –95 dBm SSB phase noise, AM/FM/ΦM/ Pulse modulation**
- **Enhanced usability**
- **Optional analog IQ input (80 MHz RF bandwidth)**

N9310A RF Signal Generator

The Agilent N9310A RF signal generator is one of the new products in Agilent low cost RF test and measurement family, offering ultra high price/performance for customers in consumer electronics manufacturing, base station installation and maintenance, and education teaching lab, as well as low cost research and development.

Rich function set in one box at an affordable price enables you to easily initiate your new projects. Adequate logical hardkeys and interface, USB connectivity, and SCPI compatible make either front panel operation or remote control easy to start-up. What is more, the multi-language user interface helps you to recognize the software menu faster and easier, accelerating front panel operations.

Now, with the exceptionally low price of the N9310A signal generator, you can afford to own Agilent test equipment you always wanted.

Specifications

Frequency
- Range: 9 kHz to 3.0 GHz
- Resolution: 0.1 Hz
- Switching Speed: <10 ms

Output
- Power: –127 to +13 dBm, +20 dBm settable
- Resolution: 0.1 dB
- Accuracy: <±1 dB
- Switching Speed: <10 ms
- VSWR (typical):
  - <1.6, fc = 1.5 MHz to 2.5 GHz
  - <1.8, fc = 2.5 to 3.0 GHz
- Connector: N-type, 50 Ω nominal

Reversal Power
- RF Power: +36 dBm
- DC Voltage: ±30 V

1 minute, the warning for reversed power protection is nominally +25 dBm

Time Base Reference Oscillator
- Stability:
  - <±1 ppm/year, aging
  - <±1 ppm, temperature over 0 to 45°C
- Connector: BNC, female

External Reference Input
- Range: 2, 5, 10 MHz
- Amplitude: 0.5 to 2 V_{rms}
- Connector: BNC, female, 50 Ω

Spectral Purity
- SSB Phase Noise: < –95 dBc/Hz, fc = 1 GHz, at 20 kHz offset
- Residual FM: <30 Hz rms, <90 Hz peak, CW mode, fc = 1 GHz, BW = 0.3 to 3 kHz, <30 Hz rms, ResFM optimized mode
- Harmonics: <–30 dBc, Level ≤0 dBm, fc ≥1 MHz
- Non-harmonics: <–50 dBc, Level ≤0 dBm, >10 kHz from fc

Sweep Type: Step, List

Sweep Mode:
- RF: 9 kHz to 3 GHz
- LF: 20 Hz to 80 kHz
- Amplitude: –127 to +13 dBm
- RF & Amplitude

Analog Modulation: AM/FM/ΦM/Pulse

I/Q Modulation (Option 001):
- Operating Mode: External I/Q inputs
- VSWR: <1.5
- Full Scale Input: 0.5 V_{rms}
- Modulation Frequency Range: DC to 40 MHz. At 3 dB points Mod frequency = 10 kHz
- QPSK EVM: 3%. Typical, 1 Msps, 0.22 RRC filter
- GMSK Phase Error: 1.2° rms. Typical, 1 Msps, BT = 0.5

Weight: 9.2 kg

Dimensions: 132.5 mm (H) x 320 mm (W) x 400 mm (D)

Accessories

N9310A-001 Analog IQ Input Capability. This requires External Stimulus
N9310A-1CM Rackmount Kit
N9310A-1TC Hard Transit Case
N9310A-1HB Handle and Bumper

Key Literature & Web Link

www.agilent.com/find/N9310A

Ordering Information

N9310A RF Signal Generator

N5181A

- **Frequency range from 100 kHz to 1, 3 or 6 GHz**
- **Fast switching speeds**
- **Simplified self-maintenance**
- **ΦM, AM, FM, and pulse modulation**
- **LAN with LXI class C compliance, USB, GPIB connectivity**

N5181A MXG Analog Signal Generator

Featuring fast frequency and amplitude switching, high reliability, and simplified self-maintenance – all in two rack units (2RU) – Agilent MXG analog is optimized to provide accurate and repeatable reference signals in R&D and manufacturing. Agilent MXG analog provides better value for your investment by increasing throughput, maximizing uptime, and saving rack space. With scalable RF performance, the Agilent MXG analog is easily configured to meet your specific test needs, including LO and clock substitution, CW interferers, and modulated signals for analog communication systems such as AM, FM, and ΦM.

Fast Switching Speeds

- Increase throughput in manufacturing
- Faster device characterization in R&D
- Arbitrary switching of frequency or amplitude ≤1.2 ms
- Simultaneously frequency and amplitude switching with list mode in ≤900 µs

Simplified Self-maintenance

- Make any repair onsite in 30 minutes using field-replaceable assemblies
- Verify instrument performance in ≤1 hour using only a spectrum analyzer and power meter

Powerful Features

- Fast switching speeds
- Electronic attenuator up to 6 GHz
- ΦM, AM, FM, and pulse modulation
- Tunable reference input from 1 to 50 MHz
- Embedded help system
- Save and recall instrument settings
- Backward code compatible with signal generators from Agilent and other vendors
- 100BaseT LAN with LXI class C compliance, USB 2.0, GPIB interfaces

Specifications for Frequency and Power Characteristics

Frequency

Frequency Range
- Option 501: 100 kHz to 1 GHz
- Option 503: 100 kHz to 3 GHz
- Option 506: 100 kHz to 6 GHz

Minimum Frequency[1]: 100 kHz
Resolution: 0.01 Hz
Phase Offset: Adjustable in 0.01°
Frequency Switching Speed[2, 3]

Type	Standard	Option UNZ
SCPI mode	≤5 ms (typ)	≤1.15 ms
List/Step sweep mode	≤5 ms (typ)	≤900 µs

Stability

Internal Time Base Reference Oscillator
Aging Rate: ≤±5 ppm/10 yrs, <±1 ppm/yr
Temperature Effects: ±1 ppm (0 to 55°C)
Line Voltage Effects: ±0.1 ppm (nom) for 5% to –10% (nom) change
Reference Output
- Frequency: 10 MHz
- Amplitude: ≥+4 dBm (nom) into 50 Ω load

External Reference Input
- Input frequency
  - Standard: 10 MHz
  - Option 1ER: 1 to 50 MHz (in multiples of 0.1 Hz)
- Lock range: ±1 ppm
- Amplitude: >–3.5 to 20 dBm (nom)
- Impedance: 50 Ω (nom)

Sweep Modes

Frequency Step, Amplitude Step and Arbitrary List
- Dwell time: 100 µs to 100 s
- Number of points: 2 to 65535 (step sweep), 1 to 1601 (list sweep)

Amplitude

Output Power

Range[4]	Standard	Option 1EQ[5]
100 kHz to 250 kHz	–110 to +4 dBm	–127 to +4 dBm
250 kHz to 2.5 GHz	–110 to +13 dBm	–127 to +13 dBm
>2.5 to 3.0 GHz	–110 to +10 dBm	–127 to +10 dBm
>3.0 to 4.5 GHz	–110 to +13 dBm	–127 to +13 dBm
>4.5 to 5.8 GHz	–110 to +10 dBm	–127 to +10 dBm
>5.8 to 6 GHz	–110 to +7 dBm	–127 to +7 dBm

Resolution: 0.02 dB (nom)
Step Attenuator: 0 to 130 dB in 5 dB steps, electronic type
Absolute Level Accuracy in CW Mode[6] (ALC on)

	Standard		Option 1EQ
	+7 to –60 dBm	<–60 to –110 dBm	<–110 to –127 dBm
100 kHz to 250 kHz	±0.6 dB	=/–1.0 dB	—
250 kHz to 1 MHz	±0.6 dB	±0.7 dB	±1.7 dB
>1 MHz to 1 GHz	±0.6 dB	±0.7 dB	±1.0 dB
>1 to 3 GHz	±0.7 dB	±0.9 dB	±1.4 dB
>3 to 4 GHz	±0.8 dB	±0.9 dB	±1.0 dB
>4 to 6 GHz	±0.8 dB	±1.1 dB	±1.3 dB

Absolute Level Accuracy in CW Mode (ALC off, relative to ALC on)
±0.35 dB (typ)
Switching Speed[7]

Type	Standard	Option UNZ
SCPI mode	≤5 ms (typ)	≤750 µs
List/Step sweep mode	≤5 ms (typ)	≤500 µs

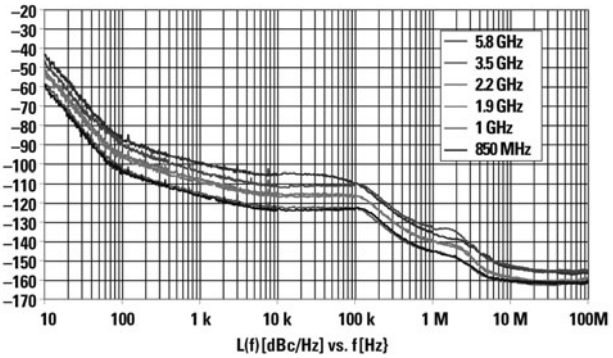
[1] Performance below 250 kHz is unspecified except where noted.
[2] Time from receipt of SCPI command or trigger signal to within 0.1 ppm of final frequency or within 100 Hz, whichever is greater, and amplitude settled to within 0.2 dB.
[3] Additional time may be required for the amplitude to settle within 0.2 dB when switching to or from frequencies <500 kHz or amplitudes >+5 dBm.
[4] Quoted specifications between 20°C and 30 °C. Maximum output power typically decreases by 0.2 dB/°C for temperatures outside this range.
[5] Settable to –144 dBm with option 1EQ, but unspecified below –127 dBm.
[6] Quoted specifications between 20°C and 30°C. For temperatures outside this range, absolute level accuracy degrades by 0.01 dB/°C for frequencies ≤4.5 GHz and 0.02 dB/°C for frequencies >4.5 GHz.
[7] Time from receipt of SCPI command or trigger signal to amplitude settled within 0.2 dB when switching to or from amplitudes <+5 dBm.

Spectral Purity

Single Sideband Phase Noise (at 20 kHz offset)
- 500 MHz: ≤–126 dBc/Hz (typ)
- 1 GHz: ≤–121 dBc/Hz (typ)
- 2 GHz: ≤–115 dBc/Hz (typ)
- 3 GHz: ≤–110 dBc/Hz (typ)
- 4 GHz: ≤–109 dBc/Hz (typ)
- 6 GHz: ≤–104 dBc/Hz (typ)

Residual FM (CW mode, 300 Hz to 3 kHz BW, CCITT, rμs) <N x 2 Hz (typ)

Single sideband phase noise in CW mode



Specifications for Analog Modulation

Frequency Bands[1]

Band	Frequency Range	N
1	100 kHz to <250 MHz	0.5
2	250 to <375 MHz	0.125
3	375 to <750 MHz	0.25
4	750 to <1500 MHz	0.5
5	1500 to <3000.001 MHz	1
6	3000.001 to 6000 MHz	2

Frequency Modulation (Option UNT)

Max Deviation: N times 20 MHz (nom)
Resolution: 0.1% of deviation or 1 Hz, which ever is greater (nom)
Deviation Accuracy (1 kHz rate, deviation is N x 100 kHz): <±2% + 20 Hz
Modulation Frequency Response (at 100 kHz deviation)

	1dB Bandwidth	3 dB Bandwidth
DC coupled	DC to 3 MHz (nom)	DC to 7 MHz (nom)
AC coupled	5 Hz to 3 MHz (nom)	5 Hz to 7 MHz (nom)

Carrier Frequency Accuracy Relative to CW in DCFM
- <±0.2% of set deviation + (Nx1 Hz)[2]
- <±0.06% of set deviation + (Nx1 Hz) (typ)[3]

Distortion (1 kHz rate, deviation is N x 100 kHz): <0.4%
Sensitivity When Using External Input
+1V peak for indicated deviation (nom)

Phase Modulation (Option UNT)

Modulation Deviation and Frequency Response

	Max Dev	3 dB Bandwidth
Normal BW	N times 10 radians (nom)	DC to 1 MHz (nom)
High BW mode	N time 1 radian (nom)	DC to 4 MHz (nom)

Resolution 0.1% of deviation (nom)
Deviation Accuracy (1 kHz rate, normal BW mode): <+0.5% + 0.01 rad (typ)
Distortion (1 kHz rate, deviation normal BW mode): <0.2% (typ)
Sensitivity When Using External Input
+1V peak for indicated deviation (nom)

Amplitude Modulation (Option UNT)[4]

AM Depth Type: Linear or exponential
Depth
- Maximum: 90%
- Resolution: 0.1% of depth (nom)
- Depth accuracy (1 kHz rate): <±4% of setting + 1% (typ)

Modulation Rate (3 dB BW)
- DC coupled: 0 to 10 kHz (typ)
- AC coupled: 5 Hz to 10 kHz (typ)

Distortion (1 kHz rate): <2% (typ)
Sensitivity When Using External Input
+1V peak for indicated depth (nom)

Pulse Modulation (Option UNU)[5]

On/Off Ratio: >80 dB (typ)
Rise Time: <50 ns (typ)
Fall Time: <50 ns (typ)
Minimum Width
- ALC on: ≥2 μs (typ)
- ALC off: ≥500 ns
- Resolution: 20 ns (nom)

Pulse Repetition Frequency
- ALC on: DC to 500 kHz
- ALC off: DC to 2 MHz

Level Accuracy: <1 dB (typ), (relative to CW, ALC on or off)
Video Feedthrough: <0.5 V (typ)
Pulse Overshoot: <15% (typ)
Pulse Compression: 15 ns (typ)
Pulse Delay
- Internal delay: 50 ns (nom)
- External delay: 65 ns (nom)

External Input
- Input impedance: 50 ohm (nom)
- Level: +1 V_{peak} = ON (nom)

Internal Pulse Generator
Modes: Free-run, square, triggered, adjustable doublet, trigger doublet, gated, and external pulse
Square Wave Rate: 0.1 Hz to 10 MHz, 0.1 Hz resolution (nom)
Pulse Period: 500 ns to 42 seconds (nom)
Pulse Width: 500 ns to pulse period –10 ns (nom)
Resolution: 10 ns

Narrow Pulse Modulation (Option UNW)[1]

	10 MHz to 3.2 GHz	Above 3.2 GHz
On/Off ratio	80 dB	80 dB
Rise/Fall times (Tr, Tf)	10 ns (8 ns)	10 ns (6 ns)
Minimum pulse width		
Internally leveled	1 μs	1 μs
Level hold (ALC off with power search)	20 ns	20 ns
Repetition frequency		
Internally leveled	10 Hz to 500 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	dc to 5 MHz	dc to 10 MHz
Level accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB (0.15 dB)
Level hold (ALC off with power search)	±1.3 dB (typ)	±0.5 dB (typ)
Width compression (RF width relative to video out)	±5 ns (typ)	±5 ns (typ)
Video feed-through	<125 mv (typ)	<2 mv (typ)

Internal Analog Modulation Source (Option UNT)

Waveform: Sine
Rate Range: 100 MHz to 2 MHz
Resolution: 1 mHz
Frequency Accuracy: Same as RF reference source (nom)

External Modulation Inputs

Modulation Types: FM, AM, phase mod, pulse mod
Input Impedance: 50 Ω (nom)

Simultaneous Modulation[6]

All modulation types (FM, AM, ΦM and pulse modulation) may be simultaneously enabled except: FM and phase modulation can not be combined; two modulation types can not be simultaneously generated using the same modulation source. For example the baseband generator, AM, and FM can run concurrently and all will modulate the output RF. This is useful for simulating signal impairments

[1] N is a factor used to help define certain specifications within the document.
[2] Specification valid for temperature changes of less than ±5°C since last DCFM calibration.
[3] Typical performance immediately after a DCFM calibration.
[4] AM is specified at carrier frequencies from 500 kHz to 3 GHz, power levels ≤±4 dBm, and depths ≤90%.
[5] Pulse specifications apply to frequencies >500 MHz.
[6] If AM or pulse modulation are on then phase and FM specifications do not apply.

General Characteristics

Remote Programming
- Interfaces
  - GPIB: IEEE-488.2, 1987 with listen and talk
  - LAN: 100BaseT LAN interface, LXI class C compliant
  - USB: Version 2.0
- Control languages
  - SCPI: Version 1997.0
- Compatibility languages supporting a subset of common commands[1]
  - Agilent Technologies: E4438C, E4428C, E442xB, E443xB, E8241A, E8244A, E8251A, E8254A, E8247C, E8257C/D, E8267C/D, 8648 series, 8656B, E8663B, 8657A/B
  - Aeroflex Incorporated: 3410 series
  - Rohde & Schwarz: SMU200A, SMJ100A, SMATE200A, SMIQ, SML, SMV

Power Requirements
- 100 to 120 VAC, 50 to 60 Hz
- 220 to 240 VAC, 50 to 60 Hz
- 250 W maximum

Safety
Complies with European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC
- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL 61010-1

EMC
Complies with European EMC Directive 89/336/EEC, amended by 93/68/EEC
- IEC/EN 61326
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11:2002
- ICES/NMB-001

Memory
Memory is shared by instrument states, user data files, sweep list files, waveform sequences, and other files. There is 512 MB of flash memory available in the N5181A MXG. Depending on how the memory is utilized, a maximum of 1000 instrument states can be saved

Security (Option 006)
Memory sanitizing, memory sanitizing on power on, and display blanking

Weight
≤12.5 kg (27.5 lb.) net, ≤27.2 kg (60 lb.) shipping

Dimensions
103 mm (H) x 426 mm (W) x 432 mm (L) (4.07 in x 16.8 in x 17 in)

Recommended Calibration Cycle: 24 months

Key Literature & Web Link

Agilent MXG Signal Generator Brochure, p/n 5989-5074EN
Agilent MXG Analog Signal Generator Data Sheet, p/n 5989-5311EN
Agilent MXG Signal Generator Configuration Guide, p/n 5989-5485EN
Improving Throughput with Fast RF Signal Generator Switching Application Note, p/n 5989-5487EN

For more information, visit our web site: **www.agilent.com/find/mxg**

Ordering Information

Frequency
501 Frequency Range from 100 kHz to 1 GHz
503 Frequency Range from 100 kHz to 3 GHz
506 Frequency Range from 100 kHz to 6 GHz

Performance Enhancements
UNZ Fast Switching
1EQ Low Power (<–110 dBm)
UNU Pulse Modulation
UNW Narrow Pulse Modulation
UNT AM, FM, Phase Modulation
006 Instrument Security
1ER Flexible Reference Input (1 – 50 MHz)
1EM Move RF Output To Rear Panel
UK6 Commercial Calibration Certificate with Test Data

Accessories
800 Front Panel RF Connector Configuration Service Kit
801 Rear Panel RF Connector Configuration Service Kit
AXT Transit Case
1CM Rackmount Kit
1CN Front Handle Kit
1CP Rackmount and Front Handle Kit
1CR Rack Slide Kit

[1] Firmware version A.01.10 and later.

- **Broad frequency coverage from 250 kHz to 3 or 6 GHz**
- **Excellent spectral purity**
- **High output power and superior level accuracy**
- **Standard high-stability timebase**
- **Built-in modulation source for complex waveforms**
- **LAN, GPIB, and RS-232 connectivity**

E4428C ESG Analog Signal Generator

The combination of a broad frequency range, up to 6 GHz; outstanding phase noise performance; and complete analog modulation capability, including AM, FM, ΦM, and pulse modulation; make the E4428C ESG analog signal generator a great choice for your test equipment needs. This high performance RF signal generator helps eliminate test uncertainty and gives you design confidence.

Frequency Coverage for Today's Market Needs

As RF devices move higher in frequency, test equipment must meet these needs. With the E4428C ESG analog signal generator offering frequency range choices of 3 or 6 GHz, these demands are easily achieved. Now, whether your device is in the cellular, ISM and UNII frequency bands, Agilent has a signal generator for you.

YIG Oscillator Produces Excellent Signal Purity

A standard low noise YIG oscillator provides industry-leading phase noise performance with typical SSB phase noise of –134 dBc/Hz (20 kHz offset at 1 GHz carrier). This makes the E4428C ESG ideal for local oscillator (LO) and low-jitter clock substitution, blocking/interference signals, adjacent channel selectivity tests, and stimulus/response measurements. In addition to high spectral purity, the E4428C ESG comes standard with a high-stability OCXO frequency reference for improved frequency accuracy due to slower aging rate.

Specifications For Frequency and Power Characteristics

Frequency

Frequency Range
Option
- 503 250 kHz to 3 GHz (electronic attenuator standard)
- 506 250 kHz to 6 GHz (mechanical attenuator only)

Frequency Minimum
100 kHz[1]

Frequency Resolution
0.01 Hz

Frequency Switching Speed[2]

Option 503		Option 506	
Freq.[3]	Freq./Amp.[4]	Freq.[3]	Freq./Amp.[4]
(<9 ms)	(<9 ms)	(<16 ms)	(<17 ms)
[For hops <5 MHz within a band]			
(<9 ms)	(<9 ms)	(<12 ms)	(<14 ms)

Phase Offset
Phase is adjustable remotely (LAN, GPIB, RS-232) or via front panel in nominal 0.1° increments

Sweep Modes

Operating Modes
Frequency step, amplitude step and arbitrary list

Dwell Time
1 ms to 60 s

Number of Points
2 to 401

Internal Reference Oscillator

Stability[2]

	Standard
Aging rate	<±0.1 ppm/yr or <±0.0005 ppm/day after 45 days
Temp (0 to 55° C)	(<±0.05 ppm)
Line voltage	(<±0.002 ppm)
Line voltage range	(+5% to –10%)

RF Reference Output
- Frequency: 10 MHz
- Amplitude: 4 dBm ± 2 dB

RF Reference Input Requirements

	Standard
Frequency	1, 2, 5, 10 MHz ±0.2 ppm

Output Power

Power

	Option 503	Option UNB	Option 506
250 kHz to 250 MHz	+11 to –136 dBm	+15 to –136 dBm	+12 to –136 dBm
>250 MHz to 1 GHz	+13 to –136 dBm	+17 to –136 dBm	+14 to –136 dBm
>1 to 3 GHz	+10 to –136 dBm	+16 to –136 dBm	+13 to –136 dBm
>3 to 6 GHz	—	—	+10 to –136 dBm

Level Resolution
0.02 dB

Level Range with *Attenuator Hold* Active

	Option 503	Option UNB	Option 506
250 kHz to 1 GHz	23 dB	27 dB	24 dB
>1 to 3 GHz	20 dB	26 dB	23 dB
>3 to 6 GHz	—	—	20 dB

Level Accuracy [dB]

Option 503[2, 5]

	Power Level			
	+7 to –50 dBm	–50 to –120 dBm	–120 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.5	±0.5	±0.7	(±1.5)
2 to 3 GHz	±0.6	±0.6	±0.8	(±2.5)

with Option UNB[2, 5]

	Power Level			
	+10 to –50 dBm	–50 to –120 dBm	–120 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.5	±0.7	±0.8	(±1.5)
2 to 3 GHz	±0.6	±0.8	±1.0	(±2.5)

[1] Performance below 250 kHz not guaranteed.
[2] Parentheses denote typical performance.
[3] To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
[4] Frequency switching time with the amplitude settled within ±0.1 dB.
[5] Quoted specifications for 23°C ± 5°C. Accuracy degrades by less than 0.03 dB/°C over full temperature range. Accuracy degrades by 0.3 dB above +7 dBm, and by 0.8 dB above +10 dBm.

With Option 506[1,2]

Power Level				
	+7 to –50 dBm	–50 to –110 dBm	–110 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.6	±0.8	±0.8	(±1.5)
2 to 3 GHz	±0.6	±0.8	±1.0	(±2.5)
3 to 4 GHz	±0.8	±0.9	±1.5	(±2.5)
4 to 6 GHz	±0.8	±0.9	(±1.5)	

Level Accuracy with ALC off[1] (±0.15 dB) (relative to ALC on)
Conditions: After power search is executed, with burst off.
Level Switching Speed[1]

	Option 503	Option UNB	Option 506
Normal operation (ALC on)	(<15 ms)	(<21 ms)	(<21 ms)
When using power search manual	(<83 ms)	(<95 ms)	(<95 ms)
When using power search auto	(<103 ms)	(<119 ms)	(<119 ms)

Spectral Purity

SSB Phase Noise (at 20 kHz offset)[1]

	Standard
at 500 MHz	<–135 dBc/Hz, (<–138 dBc/Hz)
at 1 GHz	<–130 dBc/Hz, (<–134 dBc/Hz)
at 2 GHz	<–124 dBc/Hz, (<–128 dBc/Hz)
at 3 GHz	<–121 dBc/Hz, (<–125 dBc/Hz)
at 4 GHz	<–118 dBc/Hz, (<–122 dBc/Hz)
at 6 GHz	<–113 dBc/Hz, (<–117 dBc/Hz)

Specifications For Analog Modulation

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to ≤250 MHz	1
2	>250 MHz to ≤500 MHz	0.5
3	>500 MHz to ≤1 GHz	1
4	>1 to ≤2 GHz	2
5	>2 to ≤4 GHz	4
6	>4 to ≤6 GHz	8

Frequency Modulation[3]

Maximum Deviation[4]
N x 1 MHz
Resolution
0.1% of deviation or 1 Hz, whichever is greater
Modulation Frequency Rate[5] (deviation = 100 kHz)

Coupling	1 dB Bandwidth	3 dB Bandwidth
FM path 1 (DC)	DC to 100 kHz	(DC to 10 MHz)
FM path 2 (DC)	DC to 100 kHz	(DC to 0.9 MHz)
FM path 1 (AC)	20 Hz to 100 kHz	(5 Hz to 10 MHz)
FM path 2 (AC)	20 Hz to 100 kHz	(5 Hz to 0.9 MHz)

Deviation Accuracy[4] (1 kHz rate, deviation <N x 100 kHz)
<±3.5% of FM deviation + 20 Hz

Phase Modulation[3]

Resolution
0.1% of set deviation
Modulation Frequency Response[1,4]
Standard

Mode	Maximum Deviation	Allowable rates (3 dB BW) ΦM path 1	ΦM path 2
Normal BW	N x 10 radians	DC to 100 kHz	DC to 100 kHz
High BW	N x 1 radians	(DC to 1 MHz)	(DC to 0.9 MHz)

Deviation Accuracy (1 kHz rate, Normal BW mode)
<±5% of deviation + 0.01 radians
Distortion[4] (1 kHz rate, deviation, <10N radians, Normal BW mode) <1%

Amplitude Modulation[3,6] (f_C >500 kHz)

Range
0 to 100%
Resolution
0.1%
Rates (3 dB bandwidth)
- DC coupled: 0 to 10 kHz
- AC coupled: 10 Hz to 10 kHz

Accuracy[6,7] 1 kHz rate <±(6% of setting + 1%)
Distortion[6,7] (1 kHz rate, THD)

	Standard	Option 506
30% AM	<1.5%	<1.5%
90% AM	(<4%)	(<5%)

Pulse Modulation

On/Off Ratio[1]
<4 GHz >80 dB
≤4 GHz (>64 dB)
Rise/Fall Times[1]
(150 ns)
Minimum Width[1]
ALC on (2 µs)
ALC off (0.4 µs)
Pulse Repetition Frequency[1]
ALC on (10 Hz to 250 kHz)
ALC off (DC to 1.0 MHz)
Level Accuracy[1,8] (relative to CW at ≤4 dBm, ≤7.5 dBm Option UNB, ≤4.5 dBm Option 506)
(<±1 dB)
Internal Pulse Generator
- Square wave rate: 0.1 Hz to 20 kHz
- Pulse
  Period: 8 µs to 30 seconds
  Width: 4 µs to 30 seconds
  Resolution: 2 µs

[1] Parentheses denote typical performance.
[2] Quoted specifications for 23°C ± 5°C. Accuracy degrades by less than 0.01 dB/°C over full temperature range. Accuracy degrades by 0.2 dB above +10 dBm, and by 0.8 dB above +13 dBm.
[3] All analog performance above 3 GHz is typical.
[4] Refer to frequency bands on this page to compute N.
[5] Bandwidth is automatically selected based on deviation.
[6] AM is typical above 3 GHz.
[7] Peak envelope power of AM must be 3 dB less than maximum output power below 250 MHz.
[8] With ALC off, specifications apply after the execution of power search. With ALC on, specifications apply for pulse repetition rates ≤10 kHz and pulse widths ≥5 µs.

Internal Analog Modulation Source
(Provides FM, AM, pulse, and phase modulation signals and LF audio out)
Waveforms
sine, square, ramp, triangle, pulse, noise
Rate Range
Sine: 0.1 Hz to 100 kHz
Square, ramp, triangle: 0.1 Hz to 20 kHz
Resolution
0.1 Hz
Frequency Accuracy
same as RF reference source
Swept Sine Mode (frequency, phase continuous)
Operating modes: Triggered or continuous sweeps
Frequency range: 0.1 Hz to 100 kHz
Sweep time: 1 ms to 65 sec
Resolution: 1 ms
Dual Sinewave Mode
Frequency range: 0.1 Hz to 100 kHz
Amplitude ratio: 0 to 100%
Amplitude ratio Resolution: 0.1%

External Modulation Inputs
Modulation Types
Ext 1: FM, ΦM, AM, pulse
Ext 2: FM, ΦM, AM, and pulse
High/Low Indicator (100 Hz to 10 MHz BW, AC coupled inputs only). Activated when input level error exceeds 3% (nominal).

Composite Modulation
AM, FM, and ΦM each consist of two modulation paths which are summed internally for composite modulation. The modulation sources may be any two of the following: Internal, External 1, External 2.

Simultaneous Modulation
Multiple modulation types may be simultaneously enabled with some exceptions. Two modulation types cannot be generated simultaneously by the same modulation source.

General Characteristics

Operating Characteristics

Power Requirements	90 to 254 V; 50, or 60 Hz; 300 W maximum, power factor corrected. Not for 400 Hz use[1]
Operating Temperature Range[2]	0 to 55°C
Shock and Vibration	Meets MIL-STD-28800E Type III, Class 3
Leakage	Conducted and radiated interference meets MIL-STD-461C CE02 Part 2 and CISPR 11. Leakage is typically <1 µV (nominally 0.1 µV with a 2-turn loop) at ≤1000 MHz, measured with a resonant dipole antenna, one inch from any surface with output level <0 dBm (all inputs/outputs properly terminated)
Storage Registers	Memory is shared by instrument states, user data files, sweep list files and waveform sequences. Depending on the number and size of these files, up to 100 storage registers and 1000 register sequences (10 per register) are available
Weight	<16 kg (35 lb.) net, <23 kg (50 lb.) shipping
Dimensions	133 mm (H) x 426 mm (W) x 432 mm (D) (5.25 in x 16.8 in x 17 in)
Remote Programming	
Interface	GPIB (IEEE-488.2-1987) with listen and talk, RS-232, LAN (10BaseT)
Control languages[3]	SCPI version 1996.0, also compatible with 8656B and 8657A/B/C/D/J1 mnemonics
Functions controlled	All front panel functions except power switch and knob

Key Literature & Web Link

E4428C ESG Analog Signal Generator Data Sheet, p/n 5989-1992EN
Signal Generator Spectral Purity Considerations in RF Communications Testing Application Note 388, p/n 5952-2019E
RF Source Basics, a self-paced tutorial (CD-ROM), p/n 5980-2060E

For more information, visit our web site: **www.agilent.com/find/esg**

Ordering Information

E4428C Analog Signal Generator

Frequency Range
E4428C-503 250 kHz to 3 GHz (electronic attenuator standard)
E4428C-506 250 kHz to 6 GHz (mechanical attenuator only)

Performance Enhancements
E4428C-UNB High Output Power with Mechanical Attenuator (for Option 503 models only)
E4428C-1EM Moves All Front Panel Connectors to Rear
E4428C-UK6 Commercial Calibrations Certificate with Test Data

Manuals and Accessories
E4428C-CD1 CD-ROM of English User Guide and Assembly Level Service Manual (standard with instrument)
E4428C-ABA Printed English Documentation Set
E4428C-0BW Service Documentation, Assembly Level
E4428C-1CM Rack Mount Kit without Handles
E4428C-1CP Rack Mount Kit with Handles
E4428C-1CN Front Handle Kit

[1] For 400 Hz systems, order transformer 70001-60066.
[2] Save and recall of user files and instrument states from non-volatile storage is guaranteed only over the range 0°C to 40°C.
[3] ESG series does not implement 8657A/B "Standby" or "On" (R0 or R1, respectively) mnemonics.

E8663B

- **High output power**
- **Excellent phase noise performance**
- **100 kHz to 9 GHz frequency coverage**

E8663B Analog Signal Generator

LO Substitution and Component Test Applications

- High output power
- Enhanced phase noise
- Superior level accuracy
- Code compatibility with other Agilent microwave signal generators[1]

4

Advanced Communication Testing of Receiver Quality, Transmitter Sensitivity and Selectivity

- Flexible analog modulation formats: AM, FM, ΦM and pulse
- Internal modulation with sine, square, triangular, ramp, and noise waveforms
- Narrow pulse modulation (20 ns) down to 10 MHz

Specifications

Frequency

Range
Option 503: 100 kHz to 3.2 GHz
Option 509: 100 kHz to 9 GHz
Resolution
CW: 0.001 Hz
All Sweep modes: 0.01 Hz
Accuracy
Aging rate ± temperature effects ± line voltage effects
Switching Speed[2]
<10 ms (typical)
Phase Offset
Adjustable in nominal 0.1° increments
Frequency Bands

Band	Frequency Range	N[3]
1	100 kHz to 250 MHz	1/8
2	>250 to 500 MHz	1/16
3	>500 MHz to 1 GHz	1/8
4	>1 to 2 GHz	1/4
5	>2 to 3.2 GHz	1/2
6	>3.2 to 9 GHz	1

Internal Timebase Reference Oscillator
Aging Rate: $<\pm 3 \times 10^{-8}$/year or $<\pm 2.5 \times 10^{-10}$/day after 30 days
Temperature Effects (typical)
$<\pm 4.5 \times 10^{-9}$ 0 to 55°C
Line Voltage Effects (typical)
$<\pm 2 \times 10^{-10}$ for ±10% change
External Reference Frequency
10 MHz only (within 1 ppm)

Step (digital) Sweep

Operating Modes
Step sweep of frequency or amplitude or both (start to stop)
List sweep of frequency or amplitude or both (arbitrary list)
Sweep Range
Frequency sweep: Within instrument frequency range
Amplitude sweep: Within attenuator hold range
Dwell Time 1 ms to 60 s
Frequency settling time: 28 ms (typical)
Amplitude settling time: 10 ms (typical)
Number of Points
Step sweep: 2 to 65535
List sweep: 2 to 1601 per table
Triggering
Auto, external, single, or GPIB

Output

Power[4] (dBm)

Frequency Range	Standard
Option 503 and 509:	
100 kHz to 250 kHz	–135 to +10 (nom)
250 kHz to 3.2 GHz	–135 to +15 (+18)
250 kHz to 3.2 GHz with Option UNW	–135 to +10 (+13)
> 3.2 to 9 GHz	–135 to +21 (+22)

Step Attenuator
Options 503 and 509 0 dB and 5 dB to 115 dB in 10 dB steps
Attenuator Hold Range Minimum (Same as max power sweep range)
From –20 dBm to maximum specified output power with step attenuator in 0 dB position.
Amplitude Switching Speed[5]
CW or analog modulation: <3 ms (typical) (without power search)
Level Accuracy[6] **(dB)**

Frequency	>+10 dBm	+10 to 0 dBm	0 to –10 dBm	–10 to –70 dBm	–70 to –90 dBm
100 kHz to 250 kHz	±0.6 (nom)	±0.6 (nom)	±0.6 (nom)	±0.7 (nom)	±0.8 (nom)
250 kHz to 2 GHz	±0.6	±0.6	±0.6	±0.7	±0.8
>2 to 9 GHz	±0.8	±0.8	±0.8	±0.9	±1.0

Resolution
0.01 dB
Temperature Stability
0.01 dB/°C (typical)
User Flatness Correction
Number of points: 2 to 1601 points/table
Number of tables: Up to 10,000, memory limited
Path loss: Arbitrary, within attenuator range
Entry modes (user edit/view): Remote power meter[7], remote bus, manual
Output Impedance
50 Ω (nominal)
SWR (internally leveled) (typical)
250 kHz to 2 GHz <1.4:1
>2 GHz to 9 GHz <1.6:1
Leveling Modes
Internal leveling, external detector leveling, ALC Off
External Detector Leveling
Range: –0.2 mV to –0.5 V (nominal) (–36 dBm to +4 dBm using Agilent 33330D/E detector)
Bandwidth: 10 kHz (typical) (Note: not intended for pulsed operation)
Maximum Reverse Power
1/2 Watt (OV DC) (nominal)

[1] 80 to 100% code compatibility with 8662/63A.
[2] To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
[3] N is a factor used at various points in the specification.
[4] Maximum power specification is warranted from 15°C to 35°C, and is typical from 0°C to 15°C.
[5] To within 0.1 dB of final amplitude within one attenuator range.
[6] Specifications apply in CW and List/Step sweep modes over the 15°C to 35°C temperature range, with attenuator hold off (normal operating mode). Degradation outside this range, for ALC power levels >–10 dBm, is typically <0.3 dB. In Ramp sweep mode (with Option 007), specifications are typical. For instruments with type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz. Level accuracy is not specified below –110 dBm.
[7] Compatible with Agilent Technologies EPM Series (E4418B and E4419B) power meters.

Spectral Purity

Harmonics[1] (dBc at +10 dBm or maximum specified output power, whichever is lower)

<10 MHz	–28 dBc (typical below 1 MHz)
10 MHz to 2 GHz	–30 dBc
>2 GHz to 9 GHz	–55 dBc

SSB Phase Noise (CW) Offset from carrier (dBc/Hz)

Frequency	100 Hz spec (typical)	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
250 kHz to 250 MHz	–104 (–120)	–121 (–128)	–128 (–132)	–130 (–133)
>250 to 500 MHz	–108 (–118)	–126 (–132)	–132 (–136)	–136 (–141)
>500 MHz to 1 GHz	–101 (–111)	–121 (–130)	–130 (–134)	–130 (–135)
>1 to 2 GHz	–96 (–106)	–115 (–124)	–124 (–129)	–124 (–129)
>2 to 3.2 GHz	–92 (–102)	–111 (–120)	–120 (–124)	–120 (–124)
>3.2 to 9 GHz	–81 (–92)	–101 (–109)	–110 (–114)	–110 (–115)

Residual FM
CW mode: <N x 4 Hz (typical)
Broadband Noise (CW mode at +10 dBm output, for offsets >10 MHz)
>2.4 to 9 GHz: <–148 dBc/Hz (typical)

Frequency Modulation

Maximum Deviation
N x 16 MHz
Resolution
0.1% of deviation or 1 Hz, whichever is greater
Deviation Accuracy
<±3.5% of FM deviation + 20 Hz (1 kHz rate, deviations <N x 800 kHz)

Modulation Frequency Response[2]

Path	Rates (at 100 kHz deviation) 1 dB Bandwidth	3 dB Bandwidth (typical)
FM 1	DC to 100 kHz	DC to 10 MHz
FM 2	DC to 100 kHz	DC to 1 MHz

DC FM[3] **Carrier Offset**
±0.1% of set deviation + (N x 8 Hz)
Distortion
<1% (1 kHz rate, deviations <N x 800 kHz)
Sensitivity
±1 V_{peak} for indicated deviation

Phase Modulation

Maximum Deviation
N x 160 radians (N x 16 radians in high-bandwidth mode)
Resolution
0.1% of set deviation
Deviation Accuracy
<±5% of deviation + 0.01 radians (1 kHz rate, normal BW mode)

Modulation Frequency Response

Mode	Rates (3 dB BW)
Normal BW	DC to 100 kHz
High BW	DC to 1 MHz (typical)

Distortion
<1 % (1 kHz rate, THD, dev <N x 80 rad, normal BW mode)
Sensitivity
±1 V_{peak} for indicated deviation

Amplitude Modulation (f_c >2 MHz)[4] (typical)

Depth	Linear Mode	Exponential (log) Mode (Downward modulation only)
Maximum	>90%	>20 dB
Settable[5]	0 to 100 %	0 to 40 dB
Resolution	0.1%	0.01 dB
Accuracy (1 kHz rate)	<±(6 % of setting + 1 %)	<±(2% of setting + 0.2 dB)

Ext Sensitivity
Line Mode: ±1 V_{peak} for indicated depth
Exponential (log) Mode: –1 V for indicated depth
Rates (3 dB bandwidth, 30% depth)
dc/10 Hz to 100 kHz (typical) (useable to 1 MHz)
Distortion (1 kHz rate, linear mode, THD)
30% AM <1.5%
60% AM <2 %

External Modulation Inputs (Ext1 & Ext2)

Modulation Types
AM, FM, and ΦM
Input Impedance
50 or 600 Ω (nominal) switched
High/low Indicator (100 Hz to 10 MHz BW, ac coupled inputs only)
Activated when input level error exceeds 3% (nominal)

Simultaneous Modulation

All modulation types may be simultaneously enabled except: FM with ΦM, and linear AM with exponential AM. AM, ΦM, and FM can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2) Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type

Internal Modulation Source

Dual function generators provides two independent signals (internal1 and internal2) for use with AM, FM, ΦM, or LF Out.
Waveforms
Sine, square, positive ramp, negative ramp, triangle, Gaussian noise, uniform noise, swept sine, dual sine[21]
Rate Range
Sine: 0.5 Hz to 1 MHz
Square, ramp, triangle: 0.5 Hz to 100 kHz
Resolution: 0.5 Hz
Accuracy: Same as timebase
LF Out
Output : Internal1 or internal2. Also provides monitoring of internal1 or internal2 when used for AM, FM, or ΦM.
Amplitude: 0 to 3 V_{peak} , (nominal) into 50 Ω
Output impedance: 50 Ω (nominal)
Swept Sine Mode: (frequency, phase continuous)
Operating modes: Triggered or continuous sweeps
Frequency range: 1 Hz to 1 MHz
Sweep rate: 0.5 Hz to 100 kHz sweeps/s, equivalent to sweep times 10 µs to 2 s
Resolution: 0.5 Hz (0.5 sweep/s)

[1] Specifications for harmonics beyond maximum instrument frequencies are typical.
[2] DC coupled.
[3] At the calibrated deviation and carrier frequency, within 5°C of ambient temperature at time of user calibration.
[4] For f_C <2 MHz AM is usable but not specified. AM specifications apply with ALC on, and envelope peaks <maximum specified power. For instruments without Option 1E1 attenuator, specs apply for carrier amplitude >–2 dBm.
[5] For AM depth settings >90% or >20 dB, deep AM mode or 1 kHz ALC BW is recommended.

Pulse Modulation[1,2]

	500 MHz to 3.2 GHz	Above 3.2 GHz
On/Off Ratio	80 dB (typ)	80 dB
Rise/Fall Times (Tr, Tf)	100 ns (typ)	6 ns (typ)
Minimum Pulse Width		
Internally leveled	2 µs	1 µs
Level hold (ALC off with power search)	0.5 µs	0.15 µs
Repetition Frequency		
Internally leveled	10 Hz to 250 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	dc to 1 MHz	dc to 3 MHz
Level Accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB
Level hold (ALC off with power search)	±0.5 dB (typ)	±0.5 dB (typ)
Width Compression (RF width relative to video out)	±50 ns (typ)	±5 ns (typ)
Video Feed-through[3]	<200 mv (typ)	<2 mv (typ)
Video Delay (ext input to video)	50 ns (nom)	50 ns (nom)
RF Delay (video to RF output)	270 ns (nom)	35 ns (nom)
Pulse Overshoot	<10% (typ)	<10% (typ)
Input Level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input Impedance	50 Ω (nom)	50 Ω (nom)

Narrow Pulse Modulation[1,2]

	10 MHz to 3.2 GHz	Above 3.2 GHz
On/Off Ratio	80 dB	80 dB
Rise/Fall Times (Tr, Tf)	10 µs (8 ns typical)	10 µs (6 ns typical)
Minimum Pulse Width		
Internally leveled	1 µs	1 µs
Level hold (ALC off with power search)	20 ns	20 ns
Repetition Frequency		
Internally leveled	10 Hz to 500 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	dc to 5 MHz	dc to 10 MHz
Level Accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB (0.15 dB typical)
Level hold (ALC off with power search)	±1.3 dB (typ)	±0.5 dB (typ)
Width Compression (RF width relative to video out)	±5 ns (typ)	±5 ns (typ)
Video Feed-through[1]	<125 mv (typ)	<2 mv (typ)
Video Delay (ext input to video)	50 ns (nom)	50 ns (nom)
RF Delay (video to RF output)	45 ns (nom)	35 ns (nom)
Pulse Overshoot	<15% (typ)	<10% (typ)
Input Level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input Impedance	50 Ω (nom)	50 Ω (nom)

Internal Pulse Generator

Modes
Free-run, triggered, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source
Period (PRI) (Tp)
70 ns to 42 s (Repetition frequency: 0.024 Hz to 14.28 MHz)
Pulse Width (Tw)
10 ns to 42 s
Delay (Td)
Free-run mode: 0 to ±42 s
Triggered with delay and doublet modes: 75 ns to 42s with ±10 ns jitter
Resolution
10 ns (width, delay, and PRI)

Remote Programming

Interfaces
GPIB (IEEE-488.2,1987) with listen and talk, RS-232, and 10BaseT LAN interface
Control Languages
SCPI version 1997.0
Will emulate most applicable commands for: 8662/63A providing general compatibility with ATE systems, E5500 and 3048A phase noise systems
IEEE-488 Functions
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

General

Power Requirements
100 to 120 VAC, 50 to 60 Hz; or 220 to 240 VAC, 50 to 60 Hz (automatically selected), <250 W typical, 300 W maximum
Operating Temperature Range
0 to 55°C
Storage Temperature Range[4]
–40 to 70°C
Shock and Vibration Meets
Meets requirements of MIL-PRF-28800 F for class 3 equipment
EMC
Conducted and radiated interference and immunity meets IEC/EN 61326-1 Meets radiated emission requirements of CISPR Pub 11/1997 Group 1 class A
Security
Display blanking. Memory clearing functions
Weight
<22 kg (48 lb.) net, <30 kg (68 lb.) shipping
Dimensions
178 mm (H) x 426 mm (W) x 515 mm (D)
(7 in x 16.8 in x 20.3 in)

Key Literature & Web Link

E8663B PSG Analog Signal Generator Data Sheet, p/n 5989-4866EN

www.agilent.com/find/E8663B

Ordering Information

E8663B Analog Signal Generator

Frequency Range (required option)
E8663B-503 100 kHz to 3.2 GHz
E8663B-509 100 kHz to 9 GHz

Performance Enhancements
E8663B-UNW Narrow Pulse Modulation

Manuals and Accessories
E8663B-1EM Moves all Connector to Rear Panel

[1] With ALC off, specs apply after the execution of power search. For instruments without a step attenuator, specs apply between 0 and +10 dBm. For instruments with the step attenuator, specs apply with Atten Hold Off, or ALC level between 0 and +10 dBm.
[2] Power search is a calibration routine that improves level accuracy in ALC-off mode. Un-pulsed RF power will be present typically up to 50 ms when executing power search.
[3] With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.
[4] Storage below –20°C Instrument states may be lost.

E8257D

- **Highest output power up to 67 GHz**
- **Excellent phase noise performance**
- **Ramp sweep and scalar analyzer interface available**
- **Frequency coverage up to 325 GHz for CW and analog modulation applications**

E8257D CW and Analog Signal Generator

LO Substitution and Component Test Applications

- Industry leading high output power
- Enhanced phase noise
- Superior level accuracy
- Code compatibility with other Agilent microwave signal generators[1]
- Ramp sweep capability with fast sweep rate
- Automatic operation with the 8757D scalar network analyzer is included with Option 007 ramp sweep capability

Advanced Communication Testing of Receiver Quality, Transmitter Sensitivity and Selectivity

Select optional modulation and receive:

- Flexible analog modulation formats: AM, FM, ΦM and pulse
- Internal modulation with sine, square, triangular, ramp, and noise waveforms
- Narrow pulse modulation (20 ns) down to 10 MHz

Specifications

Frequency

Range[2]
Option 520: 250 kHz to 20 GHz
Option 532: 250 kHz to 31.8 GHz
Option 540: 250 kHz to 40 GHz
Option 550: 250 kHz to 50 GHz
Option 567: 250 kHz to 67 GHz
Resolution
CW: 0.001 Hz[3]
All Sweep modes: 0.01 Hz
Accuracy
Aging rate ± temperature effects ± line voltage effects
Switching Speed[4]
<10 ms (typical)
Phase Offset
Adjustable in nominal 0.1° increments

Frequency Bands

Band	Frequency Range	N[7]
1	250 kHz to 250 MHz	1/8
2	>250 to 500 MHz	1/16
3	>500 MHz to 1 GHz	1/8
4	>1 to 2 GHz	1/4
5	>2 to 3.2 GHz	1/2
6	>3.2 to 10 GHz	1
7	>10 to 20 GHz	2
8	>20 to 40 GHz	4
9	>40 GHz	8

Internal Timebase Reference Oscillator

	Standard	Option UNX
Aging Rate	$<\pm1 \times 10^{-7}$/year or $<\pm4.5 \times 10^{-9}$/day after 45 days	$<\pm3 \times 10^{-8}$/year or $<\pm2.5 \times 10^{-10}$/day after 30 days

Temperature Effects (typical)
$<\pm5 \times 10^{-8}$ 0 to 55°C
$<\pm4.5 \times 10^{-9}$ 0 to 55°C
Line Voltage Effects (typical)
$<\pm2 \times 10^{-9}$ for +5% –10% change
$<\pm2 \times 10^{-10}$ for ±10% change
External Reference Frequency
Standard: 1, 2, 2.5, 5, 10 MHz (within 0.2 ppm)
Option UNX: 10 MHz only (within 1 ppm)

Step (digital) Sweep

Operating Modes
Step sweep of frequency or amplitude or both (start to stop)
List sweep of frequency or amplitude or both (arbitrary list)
Sweep Range
Frequency sweep: Within instrument frequency range
Amplitude sweep: Within attenuator hold range
Dwell Time 1 ms to 60 s
Frequency settling time: 28 ms (typical)
Amplitude settling time: 10 ms (typical)
Number of Points
Step sweep: 2 to 65535
List sweep: 2 to 1601 per table
Triggering
Auto, external, single, or GPIB

Ramp (Analog) Sweep (Option 007)[5]

Operating Modes
Synthesized frequency sweep (start/stop), (center/span), (swept CW)
Power (amplitude) sweep (start/stop)
Manual sweep
RPG control between start and stop frequencies
Alternate sweep
Alternates successive sweeps between current and stored states
Sweep Span Range
Settable from minimum[6] to full range

[1] 80 to 100% code compatibility with Agilent 8340/8341, E824x/E825xA, 836xxB/L, 8662/63A, and 837xx microwave signal generators.
[2] Useable to 100 kHz.
[3] In ramp sweep mode (Option 007), resolution is limited with narrow spans and slow sweep speeds. Refer to ramp sweep specifications for more information.
[4] To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
[5] During Ramp sweep operation, AM, FM, Phase Modulation and Pulse Modulation are useable but performance is not specified.
[6] Minimum settable sweep span is proportional to carrier frequency and sweep time. Actual sweep span may be slightly different than desired setting for spans less than (0.00004% of carrier frequency or 140 Hz) x (sweep time in seconds). Actual span will always be displayed correctly.
[7] N is a factor used at various points in the specification.

Maximum Sweep Rate

Start Frequency	Maximum Sweep Rate	Max Span for 100 ms Sweep
250 kHz to <0.5 GHz	25 MHz/ms	2.5 GHz
0.5 to <1 GHz	50 MHz/ms	5 GHz
1 to <2 GHz	100 MHz/ms	10 GHz
2 to <3.2 GHz	200 MHz/ms	20 GHz
≥3.2 GHz	400 MHz/ms	40 GHz

Frequency Accuracy
±0.05% of span ± timebase (at 100 ms sweep time, for sweep spans less than maximum values given above)
Accuracy improves proportionally as sweep time increases[1]
Sweep Time (forward sweep, not including bandswitch and retrace intervals)
Resolution: 1 ms
Manual mode: Settable 10 ms to 200 seconds
Auto mode: Set to minimum value determined by maximum sweep rate and 8757D setting
Triggering
Auto, external, single, or GPIB
Markers 10 independent continuously variable frequency markers
Display: Z-axis intensity or RF amplitude pulse
Functions: M1 to center, M1/M2 to start/stop, marker delta
Two-tone (master/slave) measurements[2]
Two PSG's can synchronously track each other, with independent control of start/stop frequencies
Network Analyzer Compatibility
Fully compatible with Agilent 8757D scalar network analyzer[3]
Also useable with Agilent 8757A/C/E scalar network analyzers for making basic swept measurements[4]

Output

Power[5] (dBm)

Frequency Range	Standard	Option 1EA spec. (typ)
Option 520:		
250 kHz to 3.2 GHz	–20 to +13	–20 to +16 (+19)
250 kHz to 3.2 GHz with Option UNW	–20 to +11	–20 to +11 (+14)
250 kHz to 3.2 GHz with Option 1EH	–20 to +13[8]	–20 to +13 (+16)[6]
250 kHz to 3,2 GHz with Options UNW and 1EH	–20 to +10[8]	–20 to +10 (+13)[6]
>3.2 to 5.2 GHz	–20 to +13	–20 to +22 (+23)[7]
>5.2 to 12 GHz	–20 to +13	–20 to +23 (+24)[7]
>12 to 20 GHz	–20 to +13	–20 to +21 (+23)[7]
Option 532 and 540:		
250 kHz to 3.2 GHz	–20 to +9	–20 to +15 (+18)
250 kHz to 3.2 GHz with Option UNW	–20 to +9	–20 to +10 (+13)
250 kHz to 3.2 GHz with Option 1EH	–20 to +9	–20 to +12 (+15)[6]
250 kHz to 3.2 GHz with Options UNW and 1EH	–20 to +9[6]	–20 to +9 (+12)[6]
>3.2 to 17 GHz	–20 to +9	–20 to +19 (+21)
>17 to 37 GHz	–20 to +9	–20 to +16 (+20)
>37 to 40 GHz	–20 to +9	–20 to +14 (+17)
Options 550 and 567:		
250 kHz to 3.2 GHz	–20 to +5	–20 to +14 (+17)
250 kHz to 3.2 GHz with Option UNW	–20 to +5	–20 to +9 (+12)
250 kHz to 3.2 GHz with Option 1EH	–20 to +5	–20 to +11 (+14)[6]
250 kHz to 3.2 GHz with Options UNW and 1EH	–20 to +5	–20 to +8 (+11)[6]
>3.2 to 10 GHz	–20 to +5	–20 to +14 (+21)
>10 to 20 GHz	–20 to +5	–20 to +14 (+17)
>20 to 30 GHz	–20 to +5	–20 to +11 (+17)
>30 to 65 GHz	–20 to +5	–20 to +11 (+14)
>65 to 67 GHz	–20 to +5	–20 to +10 (+14)
>67 to 70 GHz	–20 to +5 (typ)	–20 to +8 (typ)
Option 520 with Step Attenuator (Option 1E1):		
250 kHz to 3.2 GHz	–135 to +11	–135 to +15 (+18)
250 kHz to 3.2 GHz with Option UNW	–135 to +10	–135 to +10 (+13)
250 kHz to 3.2 GHz with Option 1EH	–135 to +11[6]	–135 to +12 (+15)[6]
250 kHz to 3.2 GHz with Options UNW and 1EH	–135 to +9[6]	–135 to +9 (+12)[6]
>3.2 to 20 GHz	–135 to +11	–135 to +18 (+20)
Option 532 and 540 with Step Attenuator (Option 1E1):		
250 kHz to 3.2 GHz	–135 to +7	–135 to +14 (+17)
250 kHz to 3.2 GHz with Option UNW	–135 to +7	–135 to +9 (+12)
250 kHz to 3.2 GHz with Option 1EH	–135 to +7	–135 to +11 (+14)[6]
250 kHz to 3.2 GHz with Options UNW and 1EH	–135 to +7[6]	–135 to +8 (+11)[6]
>3.2 to 20 GHz	–135 to +7	–135 to +17 (+20)
>20 to 30 GHz	–135 to +7	–135 to +14 (+18)
>30 to 40 GHz	–135 to +7	–135 to +12 (+16)
Options 550 and 567 with Step Attenuator (Option 1E1):		
250 kHz to 3.2 GHz	–110 to +3	–110 to +13 (+16)
250 kHz to 3.2 GHz with Option UNW	–110 to +3	–110 to +8 (+11)
250 kHz to 3.2 GHz with Option 1EH	–110 to +3	–110 to +10 (+13)[6]
250 kHz to 3.2 GHz with Options UNW and 1EH	–110 to +3	–110 to +7 (+10)[6]
>3.2 to 10 GHz	–110 to +3	–110 to +13 (+20)
>10 to 20 GHz	–110 to +3	–110 to +13 (+16)
>20 to 30 GHz	–110 to +3	–110 to +9 (+16)
>30 to 65 GHz	–110 to +3	–110 to +9 (+12)
>65 to 67 GHz	–110 to +3	–110 to +8 (+12)
>67 to 70 GHz	–110 to +3 (typ)	–110 to +6 (typ)

Step Attenuator (option IEI)
Options 520 and 540: 0 dB and 5 dB to 115 dB in 10 dB steps
Options 550 and 567: 0 dB and 90 dB in 10 dB steps
Attenuator Hold Range Minimum (Same as max power sweep range)
From –20 dBm to maximum specified output power with step attenuator in 0 dB position. Can be offset using Option 1E1 attenuator
Amplitude Switching Speed[9]
CW or analog modulation: <3 ms (typical) (without power search)

Level Accuracy[9] (dB)

Frequency	>+10 dBm	+10 to 0 dBm	0 to –10 dBm	–10 to –20 dBm
250 kHz to 2 GHz	±0.6	±0.6	±0.6	±1.4
2 GHz to 20 GHz	±0.8	±0.8	±0.8	±1.2
>20 to 40 GHz	±1.0	±0.9	±0.9	±1.3
>40 to 50 GHz	—	±1.3	±0.9	±1.2
>50 to 67 GHz	—	±1.5	±1.0	±1.2 (typ)

Level Accuracy with Step Attenuator[10] **(dB)**

Frequency	>+10 dBm	+10 to 0 dBm	0 to –10 dBm	–10 to –70 dBm	–70 to –90 dBm
250 kHz to 2 GHz	±0.6	±0.6	±0.6	±0.7	±0.8
>2 to 20 GHz	±0.8	±0.8	±0.8	±0.9	±1.0
>20 to 40 GHz	±1.0	±0.9	±0.9	±1.0	±2.0
>40 to 50 GHz	—	±1.3	±0.9	±1.5	±2.5
>50 to 67 GHz	—	±1.5	±1.0	±1.5 (typ)	±2.5 (typ)

Resolution
0.01 dB
Temperature Stability
0.01 dB/°C (typical)
User Flatness Correction
Number of points: 2 to 1601 points/table
Number of tables: Up to 10,000, memory limited
Path loss: Arbitrary, within attenuator range
Entry modes (user edit/view): Remote power meter[11], remote bus, manual
Output Impedance
50 Ω (nominal)
SWR (internally leveled) (typical)

250 kHz to 2 GHz	<1.4:1
>2 GHz to 20 GHz	<1.6:1
>20 GHz to 40 GHz	<1.8:1
>40 GHz to 67 GHz	<2.0:1

[1] Typical accuracy for sweep times >100 ms can be calculated from the equation: [(0.005% of span) + (sweep time in seconds)] ± timebase. Accuracy is not specified for sweep times <100 ms.
[2] For Master/Slave operation use Agilent Technologies part #8120-8806 Master/Slave interface cable.
[3] When measuring low-pass devices in AC mode, dynamic range may be reduced up to 10 dB below 3.2 GHz
[4] GPIB system interface is not supported with 8757A/C/E, only with 8757D. As a result, some features of 8757A/C/E, such as frequency display, pass-through mode, and alternate sweep, do not function with PSG signal generators.
[5] Maximum power specification is warranted from 15°C to 35°C, and is typical from 0°C to 15°C. Maximum power over the 35°C to 55°C range typically degrades less than 2 dB.
[6] With harmonic filters switched off. With filters on, maximum output power is reduced 3 dB for frequencies below 2 GHz.
[7] Specification applies to units with serial numbers ending with 45470000 or greater.
[8] To within 0.1 dB of final amplitude within one attenuator range.
[9] Specifications apply in CW and List/Step sweep modes over the 15°C to 35°C temperature range. Degradation outside this range, for power levels >–10 dBm, is typically <0.3 dB. In Ramp sweep mode (with Option 007), specifications are typical. For instruments with Type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz.
[10] Specifications apply in CW and List/Step sweep modes over the 15°C to 35°C temperature range, with attenuator hold off (normal operating mode). Degradation outside this range, for ALC power levels >–10 dBm, is typically <0.3 dB. In Ramp sweep mode (with Option 007), specifications are typical. For instruments with type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz. Level accuracy is not specified below –110 dBm.
[11] Compatible with Agilent Technologies EPM Series (E4418B and E4419B) power meters.

Leveling Modes
Internal leveling, external detector leveling, millimeter source module, ALC Off
External Detector Leveling
Range: –0.2 mV to –0.5 V (nominal) (–36 dBm to +4 dBm using Agilent 33330D/E detector)
Bandwidth: 10 kHz (typical) (Note: not intended for pulsed operation)
Maximum Reverse Power
1/2 Watt (OV DC) (nominal)

Spectral Purity

Harmonics[1] (dBc at +10 dBm or maximum specified output power, whichever is lower)

<1 MHz	–28 dBc (typical)
1 MHz to 2 GHz	–28 dBc
>2 GHz to 20 GHz	–55 dBc
>20 GHz to 40 GHz (Option 540)	–50 dBc (typical)
>20 GHz to 67 GHz (Options 550 & 567)	–50 dBc (typical)

SSB Phase Noise (CW) Offset from Carrier (dBc/Hz)

Frequency	20 kHz	20 kHz (typical)
250 kHz to 250 MHz	–130	–134
>250 to 500 MHz	–134	–138
>500 MHz to 1 GHz	–130	–134
>1 to 2 GHz	–124	–128
>2 to 3.2 GHz	–120	–124
>3.2 to 10 GHz	–110	–113
>10 to 20 GHz	–104	–108
>20 to 28.5 GHz	–100	–104
>28.5 GHz	–96	–100

Option UNX: Enhanced SSB Phase Noise (CW) Offset from carrier (dBc/Hz)

Frequency	100 Hz spec (typical)	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
250 kHz to 250 MHz	–104 (–120)	–121 (–128)	–128 (–132)	–130 (–133)
>250 to 500 MHz	–108 (–118)	–126 (–132)	–132 (–136)	–136 (–141)
>500 MHz to 1 GHz	–101 (–111)	–121 (–130)	–130 (–134)	–130 (–135)
>1 to 2 GHz	–96 (–106)	–115 (–124)	–124 (–129)	–124 (–129)
>2 to 3.2 GHz	–92 (–102)	–111 (–120)	–120 (–124)	–120 (–124)
>3.2 to 10 GHz	–81 (–92)	–101 (–109)	–110 (–114)	–110 (–115)
>10 to 20 GHz	–75 (–87)	–95 (–106)	–104 (–107)	–104 (–109)
>20 to 28.5 GHz	–69 (–79)	–89 (–99)	–98 (–101)	–98 (–103)
>28.5 to 44 GHz	–64 (–73)	–84 (–90)	–92 (–95)	–92 (–97)

Residual FM
CW mode: <N x 6 Hz (typical)
Option UNX: <N x 4 Hz (typical)
Ramp sweep mode: <N x 1 kHz (typical)
Broadband Noise (CW mode at +10 dBm output, for offsets >10 MHz)
>2.4 to 20 GHz: <–148 dBc/Hz (typical)
>20 to 40 GHz: <–141 dBc/Hz (typical)
>40 GHz: <–135 dBc/Hz (typical)
Option UNT: AM, FM, Phase Modulation, and LF Output

Frequency Modulation

Maximum Deviation
N x 16 MHz
Resolution
0.1% of deviation or 1 Hz, whichever is greater
Deviation Accuracy
<±3.5% of FM deviation + 20 Hz (1 kHz rate, deviations <N x 800 kHz)

Modulation Frequency Response[2]

Path	Rates (at 100 kHz deviation) 1 dB Bandwidth	3 dB Bandwidth (typical)
FM 1	DC to 100 kHz	DC to 10 MHz
FM 2	DC to 100 kHz	DC to 1 MHz

DC FM[3] **Carrier Offset**
±0.1% of set deviation + (N x 8 Hz)
Distortion
<1% (1 kHz rate, deviations <N x 800 kHz)
Sensitivity
±1 V_{peak} for indicated deviation

Phase Modulation

Maximum Deviation
N x 160 radians (N x 16 radians in high-bandwidth mode)
Resolution
0.1% of set deviation
Deviation Accuracy
<±5% of deviation + 0.01 radians (1 kHz rate, normal BW mode)

Modulation Frequency Response

Mode	Rates (3 dB BW)
Normal BW	DC to 100 kHz
High BW	DC to 1 MHz (typical)

Distortion
<1 % (1 kHz rate, THD, dev <N x 80 rad, normal BW mode)
Sensitivity
±1 V_{peak} for indicated deviation

Amplitude Modulation (f_c >2 MHz)[4] (typical)

Depth	Linear Mode	Exponential (log) Mode (Downward modulation only)
Maximum	>90%	>20 dB
Settable[5]	0 to 100 %	0 to 40 dB
Resolution	0.1%	0.01 dB
Accuracy (1 kHz rate)	<±(6 % of setting + 1 %)	<±(2% of setting + 0.2 dB)

Ext Sensitivity
Line Mode: ±1 V_{peak} for indicated depth
Exponential (log) Mode: –1 V for indicated depth
Rates (3 dB bandwidth, 30% depth)
dc/10 Hz to 100 kHz (typical) (useable to 1 MHz)
Distortion (1 kHz rate, linear mode, THD)
30% AM <1.5%
90% AM <4 %

External Modulation Inputs (Ext1 & Ext2)

Modulation Types
AM, FM, and ΦM
Input Impedance
50 or 600 Ω (nominal) switched
High/low Indicator (100 Hz to 10 MHz BW, ac coupled inputs only)
Activated when input level error exceeds 3% (nominal)

Simultaneous Modulation

All modulation types may be simultaneously enabled except: FM with ΦM, and linear AM with exponential AM. AM, ΦM, and FM can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2) Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type

Internal Modulation Source

Dual function generators provides two independent signals (internal1 and internal2) for use with AM, FM, ΦM, or LF Out
Waveforms
Sine, square, positive ramp, negative ramp, triangle, Gaussian noise, uniform noise, swept sine, dual sine[21]
Rate Range
Sine: 0.5 Hz to 1 MHz
Square, ramp, triangle: 0.5 Hz to 100 kHz
Resolution: 0.5 Hz
Accuracy: Same as timebase
LF Out
Output : Internal1 or internal2. Also provides monitoring of internal1 or internal2 when used for AM, FM, or ΦM
Amplitude: 0 to 3 V_{peak} , (nominal) into 50 Ω
Output impedance: 50 Ω (nominal)
Swept Sine Mode: (frequency, phase continuous)
Operating modes: Triggered or continuous sweeps
Frequency range: 1 Hz to 1 MHz
Sweep rate: 0.5 Hz to 100 kHz sweeps/s, equivalent to sweep times 10 µs to 2 s
Resolution: 0.5 Hz (0.5 sweep/s)

[1] Specifications for harmonics beyond maximum instrument frequencies are typical.
[2] DC coupled.
[3] At the calibrated deviation and carrier frequency, within 5°C of ambient temperature at time of user calibration.
[4] For f_C <2 MHz AM is usable but not specified. AM specifications apply with ALC on, and envelope peaks <maximum specified power. For instruments without Option 1E1 attenuator, specs apply for carrier amplitude >–2 dBm.
[5] For AM depth settings >90% or >20 dB, deep AM mode or 1 kHz ALC BW is recommended.

Pulse Modulation[1,2]

	500 MHz to 3.2 GHz	Above 3.2 GHz
On/Off Ratio	80 dB (typ)	80 dB
Rise/Fall Times (Tr, Tf)	100 ns (typ)	6 ns (typ)
Minimum Pulse Width		
Internally leveled	2 µs	1 µs
Level hold (ALC off with power search)	0.5 µs	0.15 µs
Repetition Frequency		
Internally leveled	10 Hz to 250 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	dc to 1 MHz	dc to 3 MHz
Level Accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB
Level hold (ALC off with power search)	±0.5 dB (typ)	±0.5 dB (typ)
Width Compression (RF width relative to video out)	±50 ns (typ)	±5 ns (typ)
Video Feed-through[3]	<200 mv (typ)	<2 mv (typ)
Video Delay (ext input to video)	50 ns (nom)	50 ns (nom)
RF Delay (video to RF output)	270 ns (nom)	35 ns (nom)
Pulse Overshoot	<10% (typ)	<10% (typ)
Input Level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input Impedance	50 Ω (nom)	50 Ω (nom)

Narrow Pulse Modulation[1,2]

	10 MHz to 3.2 GHz	Above 3.2 GHz
On/Off Ratio	80 dB	80 dB
Rise/Fall Times (Tr, Tf)	10 µs (8 ns typical)	10 µs (6 ns typical)
Minimum Pulse Width		
Internally leveled	1 µs	1 µs
Level hold (ALC off with power search)	20 ns	20 ns
Repetition Frequency		
Internally leveled	10 Hz to 500 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	dc to 5 MHz	dc to 10 MHz
Level Accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB (0.15 dB typical)
Level hold (ALC off with power search)	±1.3 dB (typ)	±0.5 dB (typ)
Width Compression (RF width relative to video out)	±5 ns (typ)	±5 ns (typ)
Video Feed-through[1]	<125 mv (typ)	<2 mv (typ)
Video Delay (ext input to video)	50 ns (nom)	50 ns (nom)
RF Delay (video to RF output)	45 ns (nom)	35 ns (nom)
Pulse Overshoot	<15% (typ)	<10% (typ)
Input Level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input Impedance	50 Ω (nom)	50 Ω (nom)

Internal Pulse Generator

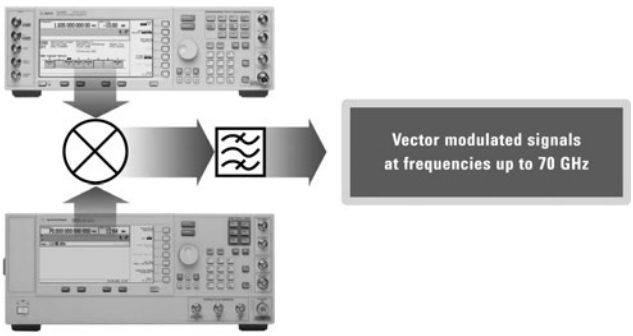
Modes
Free-run, triggered, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source
Period (PRI) (Tp)
70 ns to 42 s (Repetition frequency: 0.024 Hz to 14.28 MHz)
Pulse Width (Tw)
10 ns to 42 s
Delay (Td)
Free-run mode: 0 to ±42 s
Triggered with delay and doublet modes: 75 ns to 42s with ±10 ns jitter
Resolution
10 ns (width, delay, and PRI)

Remote Programming

Interfaces
GPIB (IEEE-488.2,1987) with listen and talk, RS-232, and 10BaseT LAN interface
Control Languages
SCPI version 1997.0
Will emulate most applicable commands for: Agilent 836xxB, Agilent 837xxB, Agilent 8340/41B and 8662/3A providing general compatibility with ATE systems which include these signal generators
IEEE-488 Functions
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

Internal Mixer

For engineers working in the C, X, Ku, K and Ka bands special option H30 adds an internal mixer to the E8257D (with option 520, 532, or 540) to enable it to upconvert modulated RF signals to frequencies up to 44 GHz. For even higher frequencies, special options H60 or H65 can be added to the E8257D (with Options 532 and 540 for H65, and with Option 550 or 565 for H60) to achieve vector modulated signals at frequencies up to 70 GHz. An external filter would be needed to eliminate any unwanted mixing products for these special options



General

Power Requirements
90 to 132 VAC, 47 to 64 Hz or 365 to 435 Hz; or 195 to 267 VAC, 47 to 64 Hz (automatically selected), <250 W typical, 300 W maximum
Operating Temperature Range
0 to 55 °C
Storage Temperature Range[4]
–40 to 70 °C
Shock and Vibration Meets
Meets requirements of MIL-PRF-28800 F for class 3 equipment
EMC
Conducted and radiated interference and immunity meets IEC/EN 61326-1 Meets radiated emission requirements of CISPR Pub 11/1997 Group 1 class A
Security
Display blanking. Memory clearing functions
Compatibility
OML Inc. – AG series mm-wave source modules
Agilent Technologies 83550 Series millimeter heads,
Agilent Technologies 8757D Scalar Network Analyzers,
Agilent Technologies EPM Series Power Meters
Weight
<22 kg (48 lb.) net, <30 kg (68 lb.) shipping
Dimensions
178 mm (H) x 426 mm (W) x 515 mm (D) (7 in x 16.8 in x 20.3 in)

[1] With ALC off, specs apply after the execution of power search. For instruments without a step attenuator, specs apply between 0 and +10 dBm. For instruments with the step attenuator, specs apply with Atten Hold Off, or ALC level between 0 and +10 dBm.
[2] Power search is a calibration routine that improves level accuracy in ALC-off mode. Un-pulsed RF power will be present typically up to 50 ms when executing power search.
[3] With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.
[4] Storage below –20°C Instrument states may be lost.

Key Literature & Web Link

PSG Signal Generators Brochure, p/n 5989-1324EN
E8257D PSG Analog Signal Generator Data Sheet, p/n 5989-0698EN
E8257D PSG Analog Signal Generator Configuration Guide, p/n 5989-1325EN

www.agilent.com/find/psg

Ordering Information

E8257D PSG Analog Signal Generator

Frequency Range (required option)
- **E8257D-520** 250 kHz to 20 GHz
- **E8257D-532** 250 kHz to 31.8 GHz
- **E8257D-540** 250 kHz to 40 GHz
- **E8257D-550** 250 kHz to 50 GHz
- **E8257D-567** 250 kHz to 67 GHz

Performance Enhancements
- **E8257D-1E1** Adds Output Step Attenuator
- **E8257D-1EA** High RF Output Power
- **E8257D-UNX** Enhanced Phase Noise Performance
- **E8257D-UNT** AM, FM, Phase Modulation, and LF Output
- **E8257D-UNU** Pulse Modulation
- **E8257D-UNW** Narrow Pulse Modulation
- **E8257D-007** Provides Analog (Ramp) Sweep and Scalar Network Analyzer Interface

Manuals and Accessories
- **E8257D-1ED** Type-N (f) Connector (Option 520 only)
- **E8257D-1EM** Moves all Connector to Rear Panel

SxxMS-AG

- 50 to 325 GHz frequency range
- High output power
- Driven by Agilent PSG signal generators
- Place the source module up to one meter from the generator
- Low entry cost

SxxMS-AG IML Inc. Millimeter-wave Modules

The seven Oleson Microwave Labs, Inc. (OML) millimeter-wave source modules provide a simple approach to extend the frequency range of a 20 GHz Agilent PSG signal generator to cover frequencies in bands from 50 GHz to 325 GHz. The OML source modules offer high power and the excellent frequency accuracy and resolution of the driving PSG signal generator.

High Accuracy and Resolution

The OML, Inc. millimeter wave source modules use frequency multiplication to generate millimeter wave frequency, thus the millimeter wave frequency specifications are directly proportional to those of the microwave source driving the source modules. Since the frequency resolution of Agilent synthesizer is 0.001 Hz and the frequency multiplication factor of WR-05 is 12, thus the frequency resolution of the source module across the WR-05 band (140 – 220 GHz) is 0.012 Hz.

Spectral Purity

The OML millimeter wave source modules offer harmonic and sub-harmonic suppression of typically 20 dB in any band. The high stability and low phase noise performance of the Agilent PSG signal generator are available at millimeter wave frequencies after offsetting it by the factor of 20 log N (where N is the multiplier of the module).

High Output Power

The millimeter wave source module can be used as a local oscillator (LO) in mixer measurements providing additional dynamic range for insertion losses/gain measurements (8 dBm to 75 GHz and 5 dBm to 110 GHz). The output power is flat across the waveguide band. The output power can be varied using any of three methods: 1) fixed attenuator, 2) Mechanical variable attenuator, and 3) electronic variable attenuator system.

Low Cost

The OML millimeter-wave source modules combine performance and quality with a low cost of entry to higher frequency applications. This is possible since the source modules are compatible with the PSG signal generator you may already own. The PSG models supported are the E8257D, E8267D, E8247C, E8257C and the E8267C. If you do not already own a PSG, the cost is quite low considering the superior performance and reliability of the signal generator.

Specifications[1]

OML Model	S15MS-AG	12MS-AG	S10MS-AG	S08MS-AG	S06MS-AG	S05MS-AG	S03MS-AG
Frequency In (GHz)	12.5 to 18.7	10.0 to 15.0	12.5 to 18.4	11.2 to 17.5	9.1 to 14.1	11.6 to 18.4	12.2 to 18.1
Frequency Out (GHz)	50.0 to 75.0	60.0 to 90.0	75.0 to 110.0	90.0 to 140.0	110.0 to 170.0	140.0 to 220.0	220.0 to 325.0
RF In (dBm)	Supplied by E82x7C/D PSG with Option 1EA (High power)						
RF In, Damage Level (dBm)	+36	+36	+36	+36	+36	+36	+36
RF Out (dBm) Typ.[2]	+8	+6	+5	–2	–6	–12	–25
Harmonics & Sub-Harmonics (dBc) Typ.[3]	≤–20	≤–20	≤–20	≤–20	≤–20	≤–20	≤–20
In-Band Spurious (dBc) Typ.[4]	≤–20	≤–20	≤–20	≤–20	≤–20	≤–20	≤–20
RF In VSWR	≤2.0	≤2.0	≤2.0	≤2.0	≤2.0	≤2.0	≤2.0
RF Out VSWR	≤1.7	≤1.7	≤1.7	≤1.7	≤1.7	≤1.7	≤3.0
RF In Port	SMA female						
RF Out Port[5]	WR-15	WR-12	WR-10	WR-08	WR-06	WR-05	WR-03
Power	Supplied by E82x7C/D PSG (+8 VDC @1.2 A max, +15 VDC @150 mA max)						
Temperature	+20 to +30°C						
Weight	1.13 kg (2.5 lbs) typical						
Size[6]	71 mm (H) x 109 mm (W) x 145 mm (D) (2.8 in x 4.3 in x 5.7 in)						

[1] Specifications subject to change without notice.
[2] Not traceable to NIST above 110 GHz.
[3] As relates to the desired output frequencies.
[4] In-band mixing products. Typically ≤–15 dBc in the lower 10% of the WR-15, WR-12 or WR10 waveguide band.
[5] RF output port flange configuration per MIL-F-3922-67B-xx.
[6] Height excludes the adjustable rubber feet length and depth dimension excludes the output waveguide length.

Accessories

Standard Accessories
2 m DC Power Cable
1 m RF Cable SMA(m) to SMA(m)

Key Literature & Web Link

Millimeter-Wave Source Modules
Technical Overview, p/n 5989-2923EN
Agilent PSG Signal Generator Brochure, p/n 5989-1324EN
Agilent E8257D PSG Analog Signal Generator Data Sheet, p/n 5989-0698EN

www.agilent.com/find/psg
www.oml-mmw.com

Ordering Information[1]

OML Order Information
S15MS-AG WR-15 Source Module
S12MS-AG WR-12 Source Module
S10MS-AG WR-10 Source Module
S08MS-AG WR-08 Source Module
S06MS-AG WR-06 Source Module
S05MS-AG WR-05 Source Module
S03MS-AG WR-03 Source Module

Agilent Order Information
E8257D-S15 WR-15 Source Module
E8257D-S12 WR-12 Source Module
E8257D-S10 WR-10 Source Module
E8257D-S08 WR-08 Source Module
E8257D-S06 WR-06 Source Module
E8257D-S05 WR-05 Source Module
E8257D-S03 WR-03 Source Module

[1] Each source module ordered includes one each of the Standard Accessories listed below (2 m DC power cable and 1 m RF cable)

N9310A
N5182A
E4438C
E8267D

Vector Signal Generators

Whether you are working with wireless communications at RF or sophisticated pulse generation at microwave frequencies, Agilent provides a vector signal generator that will meet your needs. Ranging from basic to advanced performance up to 44 GHz, each instrument has a built-in I/Q modulator to support the complex modulation formats in modern wireless systems. Generate custom and proprietary test signals with a wide range of digital modulation formats or use Signal Studio software to simplify the creation of I/Q waveforms.


E8267D PSG


N9310A


N5182A MXG


E4438C ESG

Side-by-Side Key Specifications Comparison

	Basic Performance	Mid-Performance	High Performance	High Performance
	N9310A **Page 275**	**N5182A MXG** **Page 293**	**E4438C ESG** **Page 298**	**E8267D PSG** **Page 303**
Key Attributes	• Optimized for low-cost consumer electronics manufacturing test, education, service and repair • Large (6.5"), easy to operate color screen • Optional I/Q modulator (ext. I/Q inputs only) • USB interface, with flash memory stick support • Localized GUI with 11 regional languages	• Optimized for manufacturing • Performance arbitrary waveform generator • Fast switching speed • Best ACPR performance • Simplified self-maintenance	• Optimized for R&D • Advanced ARB and real-time baseband generator • Digital I/Q inputs and outputs • Internal BER analyzer • Extensive signal creation software • Low phase noise	• Optimized for R&D • Integrated vector modulation up to 44 GHz • Advanced ARB and real-time baseband generator • High power • Low phase noise • Narrow pulse
Frequency Range	9 kHz to 3 GHz	100 kHz to 3 or 6 GHz	250 kHz to 1, 2, 3, 4, 6 GHz	250 kHz to 20, 31.8, 44 GHz
Output Power	+13 to –127 dBm	+13 to –127 dBm	+17 to –136 dBm	+18 to –130 dBm
Level Accuracy	±1 dB	±0.6 to 1.7 dB	±0.5 to 1.5 dB	±0.6 to 2.0 dB
SSB Phase Noise (20 kHz Offset)	–95 dBc/Hz (at 1 GHz)	–121 dBc/Hz (at 1 GHz)	–134 dBc/Hz (at 1 GHz)	–115 dBc/Hz (at 10 GHz)
Harmonics	<–30 dBc	<–30 dBc	<–32 dBc	<–28 to <–55 dBc
Spurious	<– 50 dBc	<–42 to <–61 dBc	<–62 to <–80 dBc	<–50 to <–80 dBc
Switching Speed	<10 ms	<1.2 ms	<9 ms	<8 ms
Jitter (@622 MHz, 5 MHz BW)	—	47 µUI	33 µUI	25 µUI

- **Frequency range from 100 kHz to 3 or 6 GHz**
- **Industry-best ACPR**
- **Fast switching speeds**
- **Simplified self-maintenance**
- **125 MSa/s baseband generator**
- **LAN with LXI class C compliance, USB, GPIB connectivity**

N5182A MXG Vector Signal Generator

Featuring fast frequency, amplitude, and waveform switching, industry-best ACPR performance, high reliability, and simplified self-maintenance – all in two rack units (2RU) – Agilent MXG vector is optimized for manufacturing cellular communications and wireless connectivity components. Agilent MXG vector provides better value for your investment by increasing throughput, improving test yield, maximizing uptime, and saving rack space. With scalable RF and baseband performance, the Agilent MXG vector is easily configured to meet your specific test needs.

Industry-best ACPR

- –70 dBc ACPR for 4-carrier W-CDMA
- Decrease test uncertainty in manufacturing and increase yields
- Better device characterization in R&D

Fast Switching Speeds

- Increase throughput in manufacturing
- Faster device characterization in R&D
- Arbitrary switching of frequency, amplitude, or waveforms in ≤1.2 ms
- Simultaneously frequency, amplitude, and waveforms switching with list mode in ≤900 µs

Simplified Self-maintenance

- Make any repair onsite in 30 minutes using field-replaceable assemblies
- Verify instrument performance in ≤1 hour using only a spectrum analyzer and power meter

125 MSa/s Baseband Generator

- Generate wide bandwidth signals up to 100 MHz
- 64 MSa of memory for waveform playback
- 16-bit DACs for excellent dynamic range
- Hardware resampling technology eliminates need for multiple reconstruction filters

Powerful Features

- Fast switching speeds
- Superior ACPR performance
- Excellent EVM
- Electronic attenuator up to 6 GHz
- Synchronize multiple MXG's for MIMO
- Tunable reference input from 1 to 50 MHz
- 160 MHz I/Q modulation bandwidth
- 100 MHz baseband generator bandwidth
- Embedded help system
- Differential and single-ended I/Q outputs
- Suite of I/Q adjustments: gain, offsets, quadrature skew, I/Q skew, I/Q delay
- Save and recall instrument settings
- Backward code compatible with signal generators from Agilent and other vendors
- 100BaseT LAN with LXI class-C compliance, USB 2.0, GPIB interfaces

Signal Creation Software

- 3GPP W-CDMA HSPA
- LTE
- 3GPP2 CDMA
- IS-95 and cdma2000
- TD-SCDMA
- EDGE/GSM
- Custom digital modulation
- Multitone
- AWGN
- 802.16 WiMAX
- 802.11 WLAN
- 802.11a/b/g WLAN
- DVB-T/H/C/S
- ATSC
- ISDB-T
- DTMB
- NADC/PDC
- PHS
- DECT
- TETRA
- Pulse
- ΦM/AM/FM
- T-DMB
- Enhanced multitone
- Noise power ratio

Specifications for Frequency and Power Characteristics

Frequency

Frequency Range
- Option 503: 100 kHz to 3 GHz
- Option 506: 100 kHz to 6 GHz

Minimum Frequency[1]: 100 kHz
Resolution: 0.01 Hz
Phase Offset: Adjustable in 0.01°
Frequency Switching Speed[2, 3]

Type	Standard	Option UNZ
Digital modulation off		
SCPI mode	≤5 ms (typ)	≤1.15 ms
List/Step sweep mode	≤5 ms (typ)	≤900 µs
Digital modulation on		
SCPI mode	≤5 ms (typ)	≤1.15 ms
List/Step sweep mode	≤5 ms (typ)	≤900 µs

Stability

Internal Time Base Reference Oscillator Aging Rate
≤± 5 ppm/10 yrs, <± 1 ppm/yr
Temperature effects: ±1 ppm (0 to 55°C)
Line Voltage Effects: ±0.1 ppm (nom) for 5% to –10% (nom) change
Reference Output
- Frequency: 10 MHz
- Amplitude: ≥+4 dBm (nom) into 50 Ω load

External Reference Input
- Input frequency
  - Standard: 10 MHz
  - Option 1ER: 1 to 50 MHz (in multiples of 0.1 Hz)
- Lock range: ±1 ppm
- Amplitude: >–3.5 to 20 dBm (nom)
- Impedance: 50 Ω (nom)

[1] Performance below 250 kHz is unspecified except where noted.
[2] Time from receipt of SCPI command or trigger signal to within 0.1 ppm of final frequency or within 100 Hz, whichever is greater, and amplitude settled to within 0.2 dB.
[3] Additional time may be required for the amplitude to settle within 0.2 dB when switching to or from frequencies <500 kHz or amplitudes >+5 dBm.

Sweep Modes

Frequency Step, Amplitude Step and Arbitrary List
(list can include unique waveforms)
- Dwell time: 100 µs to 100 s
- Number of points: 2 to 65535 (step sweep), 1 to 1601 (list sweep)

Amplitude

Output Power

Range[1]	Standard	Option 1EQ[2]
100 kHz to 250 kHz	–110 to +4 dBm	–127 to +4 dBm
250 kHz to 2.5 GHz	–110 to +13 dBm	–127 to +13 dBm
>2.5 to 3.0 GHz	–110 to +10 dBm	–127 to +10 dBm
>3.0 to 4.5 GHz	–110 to +13 dBm	–127 to +13 dBm
>4.5 to 5.8 GHz	–110 to +10 dBm	–127 to +10 dBm
>5.8 to 6 GHz	–110 to +7 dBm	–127 to +7 dBm

Resolution: 0.02 dB (nom)
Step Attenuator: 0 to 130 dB in 5 dB steps, electronic type
Absolute Level Accuracy in CW Mode[3] (ALC on)

	Standard +7 to –60 dBm	<–60 to –110 dBm	Option 1EQ <–110 to –127 dBm
100 kHz to 250 kHz	±0.6 dB	=/–1.0 dB	—
250 kHz to 1 MHz	±0.6 dB	±0.7 dB	±1.7 dB
>1 MHz to 1 GHz	±0.6 dB	±0.7 dB	±1.0 dB
>1 to 3 GHz	±0.7 dB	±0.9 dB	±1.4 dB
>3 to 4 GHz	±0.8 dB	±0.9 dB	±1.0 dB
>4 to 6 GHz	±0.8 dB	±1.1 dB	±1.3 dB

Absolute Level Accuracy in CW Mode (ALC off, relative to ALC on)
±0.35 dB (typ)
Absolute Level Accuracy in Digital I/Q Mode (ALC on, relative to CW)
- 300 MHz to 2.5 GHz: ±0.25 dB
- 3.3 to 3.8 GHz: ±0.45 dB
- 5.0 to 6.0 GHz: ±0.25 dB

Switching Speed[4]

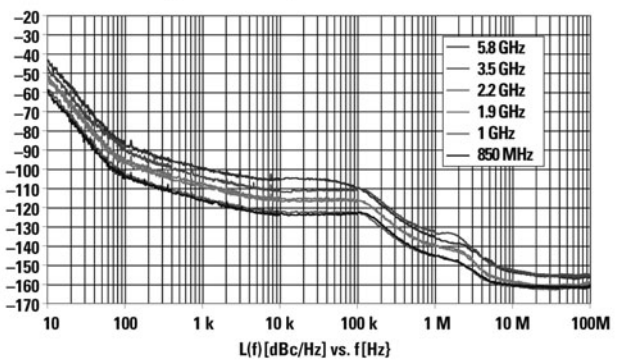
Type	Standard	Option UNZ
Digital modulation off		
SCPI mode	≤5 ms (typ)	≤750 µs
List/Step sweep mode	≤5 ms (typ)	≤500 µs
Digital modulation on		
SCPI mode	≤5 ms (typ)	≤1.15 ms
List/Step sweep mode	≤5 ms (typ)	≤900 µs

Spectral Purity

Single Sideband Phase Noise (at 20 kHz offset)
- 500 MHz: ≤–126 dBc/Hz (typ)
- 1 GHz: ≤–121 dBc/Hz (typ)
- 2 GHz: ≤–115 dBc/Hz (typ)
- 3 GHz: ≤–110 dBc/Hz (typ)
- 4 GHz: ≤–109 dBc/Hz (typ)
- 6 GHz: ≤–104 dBc/Hz (typ)

Residual FM (CW Mode, 300 Hz to 3 kHz BW, CCITT, rµs): <N x 2 Hz (typ)

Single sideband phase noise in CW mode



Specifications for Analog Modulation

Frequency Bands[5]

Band	Frequency Range	N
1	100 kHz to <250 MHz	0.5
2	250 to <375 MHz	0.125
3	375 to <750 MHz	0.25
4	750 to <1500 MHz	0.5
5	1500 to <3000.001 MHz	1
6	3000.001 to 6000 MHz	2

Frequency Modulation (Option UNT)

Max Deviation: N times 20 MHz (nom)
Resolution: 0.1% of deviation or 1 Hz, which ever is greater (nom)
Deviation Accuracy (1 kHz rate, deviation is N x 100 kHz)
<±2% + 20 Hz
Modulation Frequency Response (at 100 kHz deviation)

	1 dB bandwidth	3 dB bandwidth
DC coupled	DC to 3 MHz (nom)	DC to 7 MHz (nom)
AC coupled	5 Hz to 3 MHz (nom)	5 Hz to 7 MHz (nom)

Carrier Frequency Accuracy Relative to CW in DCFM
- <±0.2% of set deviation + (Nx1 Hz)[6]
- <±0.06% of set deviation + (Nx1 Hz) (typ)[7]

Distortion (1 kHz rate, deviation is N x 100 kHz): <0.4%
Sensitivity When Using External Input
+1V peak for indicated deviation (nom)

Phase Modulation (Option UNT)

Modulation Deviation and Frequency Response

	Max Dev	3 dB Bandwidth
Normal BW	N times 10 radians (nom)	DC to 1 MHz (nom)
High BW mode	N time 1 radian (nom)	DC to 4 MHz (nom)

Resolution 0.1% of deviation (nom)
Deviation Accuracy (1 kHz rate, normal BW mode): <+0.5% + 0.01 rad (typ)
Distortion (1 kHz rate, deviation normal BW mode): <0.2% (typ)
Sensitivity When Using External Input
+1 V peak for indicated deviation (nom)

Amplitude Modulation (Option UNT)[8]

Am Depth Type: Linear or exponential
Depth
- Maximum: 90%
- Resolution: 0.1% of depth (nom)
- Depth accuracy (1 kHz rate): <±4% of setting +1% (typ)

Modulation Rate (3 dB BW)
- DC coupled: 0 to 10 kHz (typ)
- AC coupled: 5 Hz to 10 kHz (typ)

Distortion (1 kHz rate): <2% (typ)
Sensitivity When Using External Input
+1V peak for indicated depth (nom)

Pulse Modulation (Option UNU)[9]

On/off Ratio: >80 dB (typ)
Rise Time: <50 ns (typ)
Fall Time: <50 ns (typ)
Minimum Width
- ALC on: ≥2 µs (typ)
- ALC off: ≥500 ns
- Resolution: 20 ns (nom)

Pulse Repetition Frequency
- ALC on: DC to 500 kHz
- ALC off: DC to 2 MHz

Level Accuracy: <1 dB (typ), (relative to CW, ALC on or off)
Video Feedthrough: <0.5 V (typ)
Pulse Overshoot: <15% (typ)

[1] Quoted specifications between 20°C and 30°C. Maximum output power typically decreases by 0.2 dB/°C for temperatures outside this range.
[2] Settable to –144 dBm with option 1EQ, but unspecified below –127 dBm.
[3] Quoted specifications between 20°C and 30°C. For temperatures outside this range, absolute level accuracy degrades by 0.01 dB/°C for frequencies ≤4.5 GHz and 0.02 dB/°C for frequencies >4.5 GHz.
[4] Time from receipt of SCPI command or trigger signal to amplitude settled within 0.2 dB when switching to or from amplitudes <+5 dBm.
[5] N is a factor used to help define certain specifications within the document.
[6] Specification valid for temperature changes of less than ±5°C since last DCFM calibration.
[7] Typical performance immediately after a DCFM calibration.
[8] AM is specified at carrier frequencies from 500 kHz to 3 GHz, power levels ≤±4 dBm, and depths ≤90%.
[9] Pulse specifications apply to frequencies >500 MHz.

Pulse Compression: 15 ns (typ)
Pulse Delay
- Internal delay: 50 ns (nom)
- External delay: 65 ns (nom)

External Input
- Input impedance: 50 ohm (nom)
- Level: +1V_{peak} = ON (nom)

Internal Pulse Generator
Modes: Free-run, square, triggered, adjustable doublet, trigger doublet, gated, and external pulse
Square Wave Rate: 0.1 Hz to 10 MHz, 0.1 Hz resolution (nom)
Pulse Period: 500 ns to 42 seconds (nom)
Pulse Width: 500 ns to pulse period – 10 ns (nom)
Resolution: 10 ns

Narrow Pulse Modulation (Option UNW)[1]

	10 MHz to 3.2 GHz	Above 3.2 GHz
On/Off ratio	80 dB	80 dB
Rise/Fall times (Tr, Tf)	10 ns (8 ns)	10 ns (6 ns)
Minimum pulse width		
Internally leveled	1 µs	1 µs
Level hold (ALC off with power search)	20 ns	20 ns
Repetition frequency		
Internally leveled	10 Hz to 500 kHz	10 Hz to 500 kHz
Level hold (ALC off with power search)	dc to 5 MHz	dc to 10 MHz
Level accuracy (relative to CW)		
Internally leveled	±0.5 dB	±0.5 dB (0.15 dB)
Level hold (ALC off with power search)	±1.3 dB (typ)	±0.5 dB (typ)
Width compression (RF width relative to video out)	±5 ns (typ)	±5 ns (typ)
Video feed-through	<125 mv (typ)	<2 mv (typ)

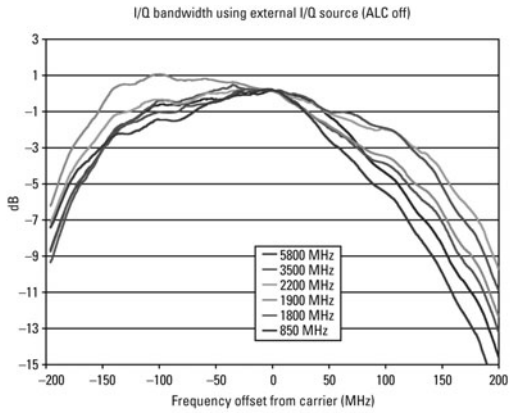
Internal Analog Modulation Source (Option UNT)
Waveform: Sine
Rate Range: 100 mHz to 2 MHz
Resolution: 1 mHz
Frequency Accuracy: Same as RF reference source (nom)

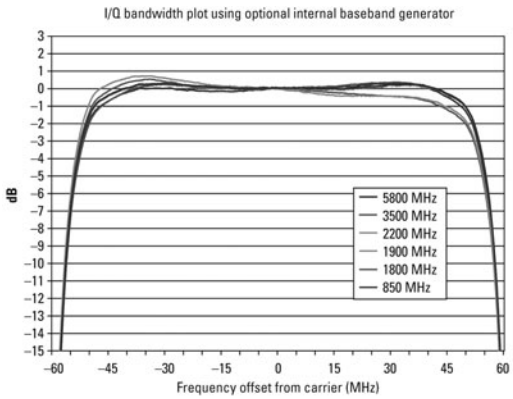
External Modulation Inputs
Modulation Types: FM, AM, phase mod, pulse mod
Input Impedance: 50 Ω (nom)

Simultaneous Modulation[2]
All modulation types (FM, AM, ΦM and pulse modulation) may be simultaneously enabled except: FM and phase modulation can not be combined; two modulation types can not be simultaneously generated using the same modulation source. For example the baseband generator, AM, and FM can run concurrently and all will modulate the output RF. This is useful for simulating signal impairments.

Specifications for I/Q Characteristics

I/Q Modulation Bandwidth
I/Q Inputs
- Input impedance: 50 Ω (nom)
- Full scale input: 1.0 Vp (sqrt(I^2 + Q^2) = 0.15 V_{rms}) (nom)





I/Q Adjustments
I/Q Input and Output Data[3]
- External I/Q inputs
  - Impedance: 50 Ω (nom)
  - Bandwidth: 100 MHz baseband (nom), 200 MHz RF (nom)
  - I offset: ±100 mV
  - Q offset: ±100 mV
  - Quadrature angle adjustment: ±200 units
- Internal I/Q from baseband generator
  - I offset: ±20%
  - Q offset: ±20%
  - I/Q gain: ±1 dB
  - Quadrature angle adjustment: ±10 °
  - I/Q skew: ±800 ns
  - I/Q delay: ±400 ns
- External I/Q outputs
  - Impedance: 50 Ω (nom) per output; 100 ohm (nom) differential
  - Type: Single ended or differential (Option 1EL)
  - Maximum voltage per output ±2 V peak to peak; into high impedance
  - Bandwidth: 50 MHz baseband (nom), 100 MHz RF (nom)
  - Common mode I/Q offset: ±5 V into high impedance
  - Differential mode I offset: ±50 mV into high impedance
  - Differential mode Q offset: ±50 mV into high impedance

[1] N is a factor used to help define certain specifications within the document.
[2] If AM or pulse modulation are on then phase and FM specifications do not apply.
[3] I/Q adjustments represent user interface parameter ranges and not "specifications".

Baseband Generator (Options 651, 652, 654)

Channels: 2 (I and Q)
Sample Rate and Bandwidth

	Clock Rate	Bandwidth
Option 651	1 kSa/s to 30 MSa/s	24 MHz
Option 652	1 kSa/s to 60 MSa/s	48 MHz
Option 654	1 kSa/s to 125 MSa/s	100 MHz

Effective DAC Resolution: 11 bits, 16 bits (Option UNV)
Reconstruction Filter: 50 MHz
Baseband Frequency Offset Range: ±50 MHz
Waveform Switching Speed

	Standard	Option UNZ
SCPI mode[1]	≤5 ms (typ)	≤1.2 ms (typ)
List/Step sweep mode	≤5 ms (typ)	≤900 µs (typ)

Digital Sweep Modes
In list sweep mode each point in the list can have independent waveforms along with user definable frequencies and amplitudes. See the amplitude and frequency sections for more detail.
Data Transfer Rates
- LAN to non-volatile storage: 161 kSa/s (meas)
- LAN to baseband generator: 265 kSa/s (meas)
- Non-volatile storage to baseband generator: 262 kSa/s (meas)

Arbitrary Waveform Memory
- Maximum playback capacity: 8 Msa, 64 Msa (Option 019)
- Maximum storage capacity including markers: 100 Msa

Waveform Segments
- Segment length:
  - 60 samples to 8 MSa
  - 60 samples to 64 MSa (Option 019)
- Maximum number of segments in playback memory: 1024, 8192 (Option 019)
- Maximum number of segments in non-volatile memory: 1024
- Minimum memory allocation per segment: 256 samples

Waveform Sequences
- Maximum number of sequences: Up to 2000 depending on memory usage
- Maximum number of segments/sequence: 1024
- Maximum number of repetitions: 65535

Triggers
- Types: Continuous, single, gated, segment advance
- Source: Trigger key, external, bus (GPIB, LAN, USB)
- Modes
  - Continuous: Free run, trigger and run, reset and run
  - Single: No retrigger, buffered trigger, immediate retrigger
  - Gated: Negative polarity or positive polarity
  - Segment advance: Single or continuous
- External delay time: 8 ns to 30 s
- External delay resolution: 8 ns
- Trigger latency: 490 ns + 1 sample clock period (nom)
- Trigger accuracy: ±4 ns (nom)

Markers
(Markers are defined in a segment during the waveform generation process, or from the front panel. A marker can also be routed to the RF blanking and ALC Hold functions)
- Marker polarity: Negative, positive
- Number of markers: 4

Burst On/Off Ratio: >80 dB (typ)

AWGN (Option 403)
- Type: Real-time, continuously calculated and played using DSP
- Modes of operation: Standalone or digitally added to arbitrary waveform
- Bandwidth[2]: 1 Hz to 100 MHz
- Crest factor: 15 dB
- Randomness: 90 bit pseudo-random generation, repetition period 313 x 10 9 years
- Carrier to noise ratio: ± 100 dB when added to arbitrary waveforms
- Carrier to noise ratio error: Magnitude error ≤0.2 dB at baseband I/Q outputs

Custom Modulation (Option 431)
Modulation:
- PSK, BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK
- QAM: 4, 16, 32, 64, 128, 256
- FSK: Selectable 2, 4, 8, 16 level
- MSK
- ASK

Data: Random only
Modulation Rate: 1 ksps to 50 Msps
Filter Type: Root Nyquist, Nyquist, Gaussian, Rectangle, User definable

Phase Noise Impairment (Option 430)
- Create precise phase noise profiles
- Modes of operation: Standalone or digitally added to arbitrary waveform
- Set start and stop frequencies of phase noise pedestal region
- Set amplitude of phase noise pedestal

Multitone and Two-tone (Option 430)
Number of Tones: 2 to 64 with selectable on/off per tone
Frequency Spacing: 100 Hz to 100 MHz
Phase (per tone): Fixed or random

General Characteristics

Remote Programming
- Interfaces:
  - GPIB: IEEE-488.2, 1987 with listen and talk
  - LAN: 100BaseT LAN interface, LXI class C compliant
  - USB: Version 2.0
- Control languages
  - SCPI: Version 1997.0
- Compatibility languages supporting a subset of common commands[3]
  - Agilent Technologies: E4438C, E4428C, E442xB, E443xB, E8241A, E8244A, E8251A, E8254A, E8247C, E8257C/D, E8267C/D, 8648 series, 8656B, E8663B, 8657A/B
- Aeroflex Incorporated: 3410 series
- Rohde & Schwarz: SMU200A, SMJ100A, SMATE200A, SMIQ, SML, SMV

Power Requirements
- 100 to 120 VAC, 50 to 60 Hz
- 220 to 240 VAC, 50 to 60 Hz
- 250 W maximum

Safety
Complies with European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC
- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL 61010-1

EMC
Complies with European EMC Directive 89/336/EEC, amended by 93/68/EEC
- IEC/EN 61326
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11:2002
- ICES/NMB-001

Memory
Memory is shared by instrument states, user data files, sweep list files, waveform sequences, and other files. There is 512 MB of flash memory available in the N5182A MXG. Depending on how the memory is utilized, a maximum of 1000 instrument states can be saved
Security (Option 006)
Memory sanitizing, memory sanitizing on power on, and display blanking
Weight: ≤12.5 kg (27.5 lb.) net, ≤27.2 kg (60 lb.) shipping
Dimensions
103 mm (H) x 426 mm (W) x 432 mm (L) (4.07 in x 16.8 in x 17 in)
Recommended Calibration Cycle: 24 months

[1] SCPI mode waveform switching speed requires waveforms pre-loaded in list sweep.
[2] Maximum bandwidth depends on installed baseband generator options.
[3] Firmware version A.01.10 and later.

Key Literature & Web Link

Agilent MXG Signal Generators Brochure, p/n 5989-5074EN
Agilent MXG Vector Signal Generator Data Sheet, p/n 5989-5261EN
Agilent MXG Signal Generators Configuration Guide, p/n 5989-5485EN
Accurate Amplifier ACLR and ACPR Testing with the Agilent MXG Vector Signal Generator Application Note, p/n 5989-5471EN
Improving Throughput with Fast RF Signal Generator Switching Application Note, p/n 5989-5487EN

For more information, visit our web site: **www.agilent.com/find/mxg**

Ordering Information

Frequency
503 Frequency Range from 100 kHz to 3 GHz
506 Frequency Range from 100 kHz to 6 GHz

Performance Enhancements
UNZ Fast Switching
1EQ Low Power (<–110 dBm)
UNU Pulse Modulation
UNW Narrow Pulse Modulation
UNT AM, FM, Phase Modulation
006 Instrument Security
1ER Flexible Reference Input (1 – 50 MHz)
1EM Move RF Output to Rear Panel
UK6 Commercial Calibration Certificate with Test Data

Vector Specific Options
651 Internal Baseband Generator (30 MSa/s, 8 MSa)
652 Internal Baseband Generator (60 MSa/s, 8 MSa)
654 Internal Baseband Generator (125 MSa/s, 8 MSa)
019 Increase Baseband Generator Memory to 64 MSa
1EL Differential I/Q Outputs
UNV Enhanced Dynamic Range
403 Calibrated AWGN
430 Multitone and Two-tone
431 Custom Digital Modulation
432 Phase Noise Impairment

Signal Studio Software
N7600B Signal Studio for 3GPP W-CDMA with HSDPA/HSUPA
N7601B Signal Studio for 3GPP2 CDMA
N7602B Signal Studio for GSM/EDGE
N7612B Signal Studio for TD-SCDMA
N7613A Signal Studio for 802.16-2004
N7615B Signal Studio for 802.16 WiMAX
N7616B Signal Studio for T-DMB
N7617B Signal Studio for 802.11 WLAN
N7621B Signal Studio for Multitone Distortion (Enhanced Multitone and NPR)
N7622A Signal Studio Toolkit
N7623B Signal Studio for Digital Video
N7624B Signal Studio for LTE

Accessories
800 Front Panel RF Connector Configuration Service Kit
801 Rear Panel RF Connector Configuration Service Kit
AXT Transit Case
1CM Rackmount Kit
1CN Front Handle Kit
1CP Rackmount and Front Handle Kit
1CR Rack Slide Kit

- **6 GHz frequency range**
- **160 MHz RF modulation bandwidth**
- **320 Mbytes baseband memory**
- **6 Gbyte non-volatile waveform storage**

E4438C RF Vector Signal Generator

The Agilent E4438C ESG vector signal generator meets the needs of engineers who are designing and developing the next generation of wireless communication systems and is well suited for production test environments. An assortment of standards-based receiver and component test software for 3G and emerging communications formats are available to simplify the signal configuration process. The E4438C ESG vector signal generator's performance, extended frequency range, increased memory for waveform playback and storage, and application-specific personalities make it the clear choice for development and manufacturing from the component to the system level.

6 GHz Frequency Range

E4438C ESG provides different frequency options to suit your need: 1, 2, 3, 4 or 6 GHz

160 MHz RF Modulation Bandwidth

- Ideal for multi-carrier signals
- Up to 160 MHz RF modulation bandwidth using external I/Q inputs
- 80 MHz RF modulation bandwidth using internal baseband generator

320 Mbytes Baseband Memory

- 64 Msamples (320 Mbytes) for waveform playback
- 64x the memory of the previous generation
- Build longer, more complex waveforms

6 Gbytes Non-Volatile Memory

- 1.2 Gsamples (6 Gbytes) for storing waveforms and instrument states
- Eliminate waveform build times in manufacturing and development

Powerful Standard Features

- Excellent spectral purity
- Electronic attenuator
- Simple softkey menu structure allows access to sophisticated features
- Built-in help
- Differential and single-ended I/Q outputs
- Suite of I/Q adjustments: gain, DC offsets, quadrature skew
- Save and recall instrument settings
- IntuiLink software allows easy data exchange from Microsoft® applications
- 10BaseT LAN and GPIB interfaces

Superior Dual Mode Baseband Generator

- Dual mode capability supports both waveform playback and real-time signal generation
- 80 MHz RF modulation bandwidth
- 64 Msamples (320 Mbytes) of waveform playback memory
- Generate waveforms at up to 100 Msamples/s
- Hardware resampling technology eliminates need for multiple reconstruction filters
- 16-bit DAC for improved dynamic range
- Flexible baseband reference clock 250 kHz to 100 MHz
- Industry standard filters or user-definable FIR filters
- Set E_b/N_o or C/N ratio for W-CDMA, cdma2000, WiMAX, Digital Video, and more
- Generate AWGN with up to 80 MHz bandwidth
- Generate phase coherent carriers
- Polar modulation

Baseband Studio

Baseband Studio is a suite of baseband signal applications and accessories that work with the E4438C ESG vector signal generator to emulate real-world signal conditions.

- Fading
- Digital inputs and outputs
- Waveform capture and playback
- CPRI RE test

For more information, go to page 341

Signal Creation Software

The software is used for the development and generation of waveforms with the internal baseband generator.

- TD-SCDMA
- W-CDMA
- EDGE/GSM
- 1xEV-DO/1xEV-DV
- cdma2000/cdmaOne
- NADC/PDC
- PHS
- DECT
- TETRA
- GPS
- 802.11a/b/g/j/p/n WLAN
- *Bluetooth*™
- T-DMB
- Toolkit
- AWGN
- Noise power ratio
- Enhanced multitone
- Custom
- Pulse
- ΦM/AM/FM
- S-DMB
- HSDPA
- Pulse building
- Jitter injection
- 802.16 (WiMAX)
- Digital Video
- DVB-T/H/C/S, ISDB-T, ATSC, DTMB

For more information, go to page 310

Specifications For Frequency and Power Characteristics

Frequency

Frequency Range
Option:
- 501: 250 kHz to 1 GHz
- 502: 250 kHz to 2 GHz
- 503: 250 kHz to 3 GHz
- 504: 250 kHz to 4 GHz
- 506: 250 kHz to 6 GHz (requires Option UNJ)

Frequency Minimum
100 kHz[1]

Frequency Resolution
0.01 Hz

Frequency Switching Speed[4]

	Option 501-504		Option 501-504 w/UNJ		With Option 506	
	Freq.[2]	Freq./Amp.[3]	Freq.[2]	Freq./Amp.[3]	Freq.[2]	Freq./Amp.[3]
Digital modulation						
on	(<35 ms)	(<49 ms)	(<35 ms)	(<52 ms)	(<41 ms)	(<57 ms)
off	(<9 ms)	(<9 ms)	(<9 ms)	(<9 ms)	(<16 ms)	(<17 ms)
[For hops <5 MHz within a band]						
Digital modulation						
on	(<9 ms)	(<9 ms)	(<9 ms)	(<9 ms)	(<33 ms)	(<53 ms)
off	(<9 ms)	(<9 ms)	(<9 ms)	(<9 ms)	(<12 ms)	(<14 ms)

Phase Offset
Phase is adjustable remotely (LAN, GPIB, RS-232) or via front panel in nominal 0.1° increments

Sweep Modes

Operating Modes
Frequency step, amplitude step and arbitrary list

Dwell Time
1 ms to 60 s

Number of Points
2 to 65, 535

Internal Reference Oscillator (Option 1E5)

Stability[4]

Aging rate	<±1 ppm/yr <±0.1 ppm/yr or <±0.0005 ppm/day after 45 days
Temp (0 to 55° C)	(<±1 ppm) (<±0.05 ppm)
Line voltage	(<±0.1 ppm) (<±0.002 ppm)
Line voltage range	(+5% to –10%) (+5% to –10%)

RF Reference Output
- Frequency: 10 MHz
- Amplitude: 4 dBm ±2 dB

RF Reference Input Requirements

Frequency	1, 2, 5, 10 MHz ± 0.2 ppm
Amplitude	–3.5 dBm to 20 dBm
Input impedance	50 Ω

Output Power

Power

	Option 501-504	With Option UNB	Option 506
250 kHz to 250 MHz	+11 to –136 dBm	+15 to –136 dBm	+12 to –136 dBm
>250 MHz to 1 GHz	+13 to –136 dBm	+17 to –136 dBm	+14 to –136 dBm
>1 to 3 GHz	+10 to –136 dBm	+16 to –136 dBm	+13 to –136 dBm
>3 to 4 GHz	+7 to –136 dBm	+13 to –136 dBm	+10 to –136 dBm
>4 to 6 GHz	—	—	+10 to –136 dBm

Level Resolution
0.02 dB

Level Range with *Attenuator Hold* Active

	Option 501-504	With Option UNB	Option 506
250 kHz to 1 GHz	23 dB	27 dB	24 dB
>1 to 3 GHz	20 dB	26 dB	23 dB
>3 to 4 GHz	17 dB	23 dB	20 dB
>4 to 6 GHz	—	—	20 dB

Level Accuracy [dB]

Option 501-504

	Power Level			
	+7 to –50 dBm	–50 to –120 dBm	–120 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.5	±0.5	±0.7	(±1.5)
2 to 3 GHz	±0.6	±0.6	±0.8	(±2.5)
3 to 4 Ghz	±0.6	±0.7	±0.8	(±2.5)

With Option UNB[4, 5]

	Power Level			
	+10 to –50 dBm	–50 to –120 dBm	–120 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.5	±0.7	±0.8	(±1.5)
2 to 3 GHz	±0.6	±0.8	±1.0	(±2.5)
3 to 4 GHz	±0.8	±0.9	±1.3	(±2.5)

With Option 506[4, 6]

	Power Level			
	+7 to –50 dBm	–50 to –110 dBm	–110 to –127 dBm	<–127 dBm
250 kHz to 2 GHz	±0.6	±0.8	±0.8	(±1.5)
2 to 3 GHz	±0.6	±0.8	±1.0	(±2.5)
3 to 4 GHz	±0.8	±0.9	±1.5	(±2.5)
4 to 6 GHz	±0.8	±0.9	(±1.5)	

Level Accuracy with Digital Modulation Turned On (relative to CW)
Conditions:
(with PRBS modulated data; if using I/Q inputs, $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$, nominal)[4]

Level Accuracy with ALC on
π/4 DQPSK or QPSK formats
Conditions: With raised cosine or root-raised cosine filter and α ≥0.35; with 10 kHz ≤symbol rate ≤1 MHz; at RF freq ≥25 MHz; power ≤max specified –3 dB

Option 501-504	With Option 506
±0.15 dB	±0.25 dB

Constant amplitude formats (FSK, GMSK, etc)

Option 501-504	With Option 506
±0.1 dB	±0.15 dB

Level Accuracy with ALC off[4, 7] (±0.15 dB) (relative to ALC on)
Conditions: After power search is executed, with burst off.

Level Switching Speed[4]

	Option 501-504	Option UNB	Option 506
Normal operation [ALC on]	(<15 ms)	(<21 ms)	(<21 ms)
When using power search manual	(<83 ms)	(<95 ms)	(<95 ms)
When using power search auto	(<103 ms)	(<119 ms)	(<119 ms)

Spectral Purity

SSB Phase Noise (at 20 kHz offset)[4]

	Option 501-504	With Option UNJ
at 500 MHz	(<–124 dBc/Hz)	<–135 dBc/Hz, (<–138 dBc/Hz)
at 1 GHz	(<–118 dBc/Hz)	<–130 dBc/Hz, (<–134 dBc/Hz)
at 2 GHz	(<–112 dBc/Hz)	<–124 dBc/Hz, (<–128 dBc/Hz)
at 3 GHz	(<–106 dBc/Hz)	<–121 dBc/Hz, (<–125 dBc/Hz)
at 4 GHz	(<–106 dBc/Hz)	<–118 dBc/Hz, (<–122 dBc/Hz)
at 6 GHz	N/A	<–113 dBc/Hz, (<–117 dBc/Hz)

Residual FM[4] (CW mode, 0.3 to 3 kHz BW, CCITT, rms)
- Option UNJ <N x 1 Hz (<N x 0.5 Hz)[8]
- Standard
  - Phase noise mode 1 <N x 2 Hz
  - Phase noise mode 2 <N x 4 Hz

[1] Performance below 250 kHz not guaranteed.
[2] To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
[3] Frequency switching time with the amplitude settled within ±0.1 dB.
[4] Parentheses denote typical performance.
[5] Quoted specifications for 23°C ± 5°C. Accuracy degrades by less than 0.01 dB/°C over full temperature range. Accuracy degrades by 0.2 dB above +10 dBm, and by 0.8 dB above +13 dBm.
[6] Quoted specifications for 23°C ± 5°C. Accuracy degrades by less than 0.02 dB/°C over full temperature range. Accuracy degrades by 0.2 dB above +7 dBm.
[7] When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.
[8] Refer to frequency bands on next page for N values.

Specifications For Analog Modulation

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to ≤250 MHz	1
2	>250 MHz to ≤500 MHz	0.5
3	>500 MHz to ≤1 GHz	1
4	>1 to ≤2 GHz	2
5	>2 to ≤4 GHz	4
6	>4 to ≤6 GHz	8

Frequency Modulation[1,3]

Maximum Deviation

Option 501-504	With Option UNJ
N x 8 MHz	N x 1 MHz

Resolution
0.1% of deviation or 1 Hz, whichever is greater

	Modulation Frequency Rate[4] (deviation = 100 kHz)	
Coupling	**1 dB Bandwidth**	**3 dB Bandwidth**
FM path 1 (DC)	DC to 100 kHz	(DC to 10 MHz)
FM path 2 (DC)	DC to 100 kHz	(DC to 0.9 MHz)
FM path 1 (AC)	20 Hz to 100 kHz	(5 Hz to 10 MHz)
FM path 2 (AC)	20 Hz to 100 kHz	(5 Hz to 0.9 MHz)

Deviation Accuracy[2] (1 kHz rate, deviation <N x 100 kHz)
<±3.5% of FM deviation + 20 Hz

Phase Modulation[1,3]

Resolution
0.1% of set deviation
Modulation Frequency Response[4,5]
Standard

Mode	Maximum Deviation	Allowable Rates (3 dB BW) ΦM Path 1	ΦM Path 2
Normal BW	N x 80 rad	DC to 100 kHz	DC to 100 kHz
High BW[8]	N x 8 rad	(DC to 1 MHz)	(DC to 0.9 MHz)
	N x 1.6 rad	(DC to 10 MHz)	(DC to 0.9 MHz)

With Option UNJ

Mode	Maximum Deviation	Allowable Rates (3 dB BW) ΦM Path 1	ΦM Path 2
Normal BW	N x 10 radians	DC to 100 kHz	DC to 100 kHz
High BW	N x 1 radians	(DC to 1 MHz)	(DC to 0.9 MHz)

Deviation Accuracy (1 kHz rate, Normal BW mode)
<±5% of deviation + 0.01 radians
Distortion[5] (1 kHz rate, deviation <80 radians on Options 501-504,
<10 N radians on Option UNJ models, Normal BW mode) <1%

Amplitude Modulation[1,5] (f_C >500 kHz)

Range
0 to 100%
Resolution
0.1%
Rates (3 dB bandwidth)
- DC coupled: 0 to 10 kHz
- AC coupled: 10 Hz to 10 kHz

Accuracy[4,7] 1 kHz rate <±(6% of setting + 1%)

Distortion[4,7] (1 kHz rate, THD)	Option 501-504/Option UNJ	Option 506
30% AM	<1.5%	<1.5%
90% AM	(<4%)	(<5%)

Wideband AM

Rates (1 dB bandwidth)[4]
ALC on (400 Hz to 40 MHz)
ALC off (DC to 40 MHz)

Pulse Modulation

On/Off Ratio[4]
<4 GHz >80 dB
≤4 GHz (>64 dB)
Rise/Fall Times[4]
(150 ns)
Minimum Width[4]
ALC on (2 µs)
ALC off (0.4 µs)
Pulse Repetition Frequency[4]
ALC on (10 Hz to 250 kHz)
ALC off (DC to 1.0 MHz)
Level Accuracy[4,9] (relative to CW at ≤4 dBm Option 501-504, ≤7.5 dBm Option UNB, ≤4.5 dBm Option 506)
(<±1 dB)
Internal Pulse Generator
- Square wave rate: 0.1 Hz to 20 kHz
- Pulse
  Period: 8 µs to 30 seconds
  Width: 4 µs to 30 seconds
  Resolution: 2 µs

Internal Analog Modulation Source

(Provides FM, AM, pulse, and phase modulation signals and LF audio out)
Waveforms
sine, square, ramp, triangle, pulse, noise
Rate Range

Sine	0.1 Hz to 100 kHz
Square, ramp, triangle	0.1 Hz to 20 kHz

Resolution
0.1 Hz
Frequency Accuracy
same as RF reference source
Swept Sine Mode (frequency, phase continuous)

Operating modes	Triggered or continuous sweeps
Frequency range	0.1 Hz to 100 kHz
Sweep time	1 ms to 65 sec
Resolution	1 ms

Dual Sinewave Mode

Frequency range	0.1 Hz to 100 kHz
Amplitude ratio	0 to 100%
Amplitude ratio Resolution	0.1%

External Modulation Inputs

Modulation Types

Ext 1	FM, ΦM, AM, pulse, and burst envelope
Ext 2	FM, ΦM, AM, and pulse

LO/HI Indicator (100 Hz to 10 MHz BW, AC coupled inputs only). Activated when input level error exceeds 3% (nominal)

External Burst Envelope

Input Voltage
RF On: 0 V
RF Off: –1.0 V
Linear Control Range: 0 to –1 V
On/Off Ratio[4]
Condition: V_{in} below –1.05 V

<4 GHz	>75 dB
≥4 GHz	(>64 dB)

Rise/Fall Time[4]
Condition: With rectangular input (<2 µs)
Minimum Burst Repetition Frequency[4]

ALC on	(10 Hz)
ALC off	DC

Input Port
External 1
Input Impedance
50 Ω, nominal

Composite Modulation

AM, FM, and ΦM each consist of two modulation paths which are summed internally for composite modulation. The modulation sources may be any two of the following: Internal, External 1, External 2

Simultaneous Modulation

Multiple modulation types may be simultaneously enabled with some exceptions. Two modulation types cannot be generated simultaneously by the same modulation source

[1] All analog performance above 4 GHz is typical.
[2] Refer to frequency bands on this page to compute specifications.
[3] For non-Option UNJ units, specifications apply in phase noise mode 2 (default).
[4] Parentheses denote typical performance.
[5] Refer to frequency bands on this page for N.
[6] AM is typical above 3 GHz or if wideband AM or I/Q modulation is simultaneously enabled.
[7] Peak envelope power of AM must be 3 dB less than maximum output power below 250 MHz.
[8] Bandwidth is automatically selected based on deviation.
[9] With ALC off, specifications apply after the execution of power search. With ALC on, specifications apply for pulse repetition rates ≤10 kHz and pulse widths ≥5 µs.

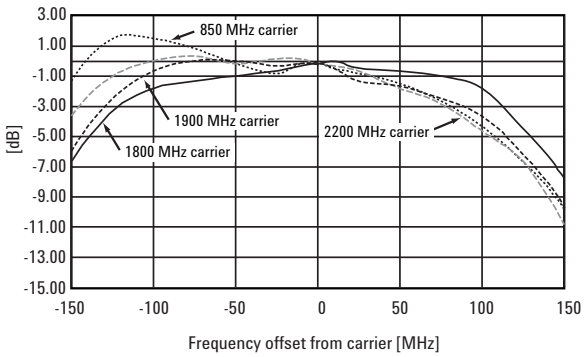
Specifications For I/Q Characteristics

I/Q Modulation Bandwidth

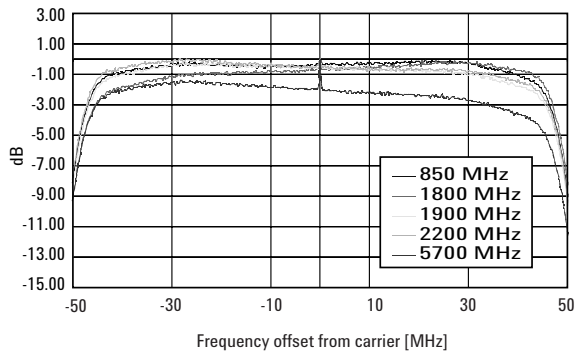
I/Q Inputs

Input impedance	50 Ω or 600 Ω
Full scale input[1]	$\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$

I/Q Bandwidth Using External I/Q Source (ALC off)[2]



I/Q Bandwidth Using Internal I/Q Source



I/Q Adjustments

Source	Parameter	Range
I/Q baseband inputs	Impedance	50 or 600 Ω
	I offset (600 Ω only)	±5 V
	Q offset (600 Ω only)	±5 V
I/Q baseband outputs	I/Q offset adjustment	±3 V
	I/Q offset resolution	1 mV
	I/Q gain balance	±4 dB
	I/Q attenuation	0 to 40 dB
	I/Q low pass filter	40 MHz, through
RF output	I/Q offset adjustment	±50%
	I/Q gain balance	±4 dB
	I/Q attenuation	0 to 40 dB
	I/Q quad skew	
	(≤3.3 GHz)	±10°
	(>3.3 GHz)	±5°
	I/Q low pass filter	2.1 MHz, 40 MHz, through

Baseband Generator (arbitrary waveform mode) (Option 601 or 602) E4438C

Channels
2 (I and Q)
Resolution
16 bits (1/65,536)
Arbitrary Waveform Memory
- Maximum playback capacity
  - 8 Msamples/channel (Option 601)
  - 64 Msamples/channel (Option 602)
- Maximum storage capacity
  - 1.2 Gsamples (Option 005)
  - 2.8 Msample (Standard)

Waveform Segments
- Segment length: 60 samples to 8 Msamples or 64 Msamples
- Maximum number of segments
  - 1,024 (8 Msamples volatile memory)
  - 8,192 (64 Msamples volatile memory)
- Minimum memory allocation: 256 samples or 1 kbyte blocks

Waveform Sequences
- Maximum total number of segment files stored in the non-volatile file system: 16,384
- Sequencing: Continuously repeating
- Maximum number of sequences 16,384 (shared with number of segments)
- Maximum segments/sequence: 32,768 (including nested segments)
- Maximum segment repetitions: 65,536

Clock
Sample rate: 1 Hz to 100 MHz
Resolution: 0.001 Hz
Accuracy: same as timebase $+2^{-42}$ (in non-integer applications)
Baseband Filters
40 MHz: used for spur reduction
2.1 MHz: used for ACPR reduction
Through: used for maximum bandwidth
Reconstruction Filter: (fixed)
50 MHz: (used for all symbol rates)
Triggers
Types: Continuous, single, gated, segment advance
Source: Trigger key, external, remote (LAN, GPIB, RS-232)
External polarity: Negative, positive
External delay time: 10 ns to 40 sec plus latency
External delay resolution: 10 ns
Markers
(Markers are defined in a segment during the waveform generation process, or from the ESG front panel. A marker can also be tied to the RF blanking feature of the ESG.)
Marker polarity: Negative, positive
Number of markers: 4
Multicarrier
Number of carriers: Up to 100 (limited by a max bandwidth of 80 MHz depending on symbol rate and modulation type)
Frequency offset (per carrier): –40 MHz to +40 MHz
Power offset (per carrier): 0 dB to –40 dB
Modulation
PSK: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK
QAM: 4, 16, 32, 64, 128, 256
FSK: Selectable: 2, 4, 8, 16
MSK
ASK
Data
Random ONLY
Multitone
Number of tones: 2 to 64, with selectable on/off state per tone
Frequency spacing: 100 Hz to 80 MHz
Phase (per tone): Fixed or random

[1] The optimum I/Q input level is $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$, I/Q drive level affects EVM, origin offset, spectral regrowth, and noise floor. Typical, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms}.
[2] Plots represent typical performance.

E4438C

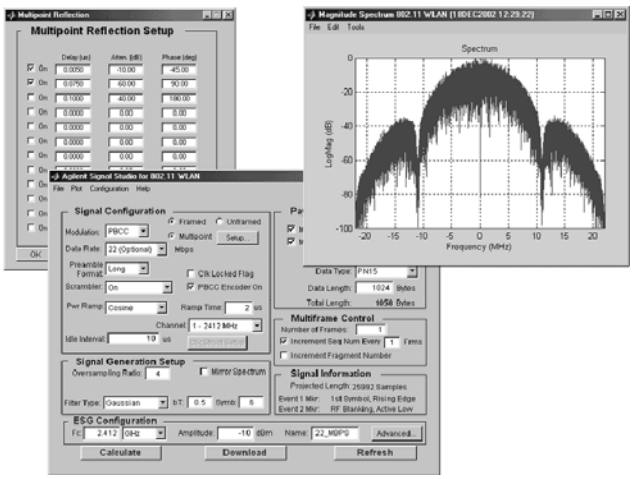
Baseband Generator (real-time mode) (Option 601 or 602)
Basic Modulation Types (custom format)
- PSK: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK
- MSK: User-defined phase offset from 0 to 100°
- ASK: User defined depth from 0.001 to 100%
- QAM: 4, 16, 32, 64, ,128, 256
- FSK
  - Selectable: 2, 4, 8, 16 level symmetric, C4FM
  - User defined: Custom map of up to 16 deviation levels:

Symbol rate	Maximum Deviation
<5 MHz	4 times symbol rate
>5 MHz, <50 MHz	20 MHz

Resolution: 0.1 Hz

I/Q
Custom map of 256 unique values
FIR Filter
Nyquist, root Nyquist, Gaussian, rectangular, APCO 25, Custom FIR α: 0 to 1, B_bT: 0.1 to 1
Symbol Rate
Adjustable up to 50 Mbits/sec
Data Types
- Internally generated data
  Pseudo-random patterns
  - PN9, PN11, PN15, PN20, PN23
  Repeating sequence
  - Any 4-bit sequence
  - Other fixed patterns
- Direct-pattern RAM (PRAM)
  Max size
  - 8 Mbits (Option 601)
  - 64 Mbits (each bit uses an entire sample space) (Option 602)
  Use
  - Non-standard framing
- User File
  Max size
  - 800 kbytes (Option 601)
  - 6.4 Mbytes (Option 602)
  Use
  - Continuous modulation or internally generated TDMA standard
- Externally Generated Data
  Type
  - Serial data
  Inputs
  - Data, bit clock, symbol sync
  - Accepts data rates ±5% of specified data rate

Internal Burst Shape Control
Rise/fall time range: Up to 30 bits
Rise/fall delay range: 0 to 63.5 bits



E4438C Key Literature & Web Link

E4438C ESG Vector Signal Generator Data Sheet, p/n 5988-4093EN
Agilent E4438C ESG Vector Signal Generator Brochure, p/n 5988-3935EN
E4438C ESG Vector Signal Generator Configuration Guide, p/n 5988-4085EN

For more information, visit our web site: **www.agilent.com/find/esg**

Ordering Information

Frequency Ranges
E4438C-501 250 kHz to 1 GHz (Electronic Attenuator Standard)
E4438C-502 250 kHz to 2 GHz (Electronic Attenuator Standard)
E4438C-503 250 kHz to 3 GHz (Electronic Attenuator Standard)
E4438C-504 250 kHz to 4 GHz (Electronic Attenuator Standard)
E4438C-506 250 kHz to 6 GHz (requires Option UNJ, Mechanical Attenuator only)

Performance Enhancements
E4438C-UNB High Output Power with Mechanical Attenuator (for Option 501–504 Models only)
E4438C-UNJ Enhanced Phase Noise Performance (includes 1E5)
E4438C-1E5 High-stability Time Base (Now included in all E4438Cs)
E4438C-1EM Move all Front Panel Connectors to Rear
E4438C-601 Internal Baseband Generator with 8 Msamples with Digital Bus Capability
E4438C-602 Internal Baseband Generator with 64 Msamples with Digital Bus Capability
E4438C-003 Enables Digital Output Connectivity with N5102A
E4438C-004 Enables Digital Input Connectivity with N5102A
E4438C-005 6 Gbyte Internal Hard Drive
E4438C-UN7 Internal Bit-error-rate Analyzer
E4438C-300 GSM/EDGE Base Station Loopback BERT
E4438C-HEC External Baseband Clock Input
E4438C-HBC Phase Coherent Carriers up to 6 GHz
E4438C-HCC Phase Coherent Carriers up to 4 GHz
E4438C-UK6 Hardcopy of the Commercial Calibration Certificate and Calibration Test Data

Signal Creation Software[1]
E4438C-400 3GPP W-CDMA Embedded Personality
E4438C-401 IS-95A and cdma2000 Embedded Personality
E4438C-402 TDMA Suite Embedded Personality
E4438C-403 Calibrated Noise (AWGN) Embedded Personality
E4438C-406 Signal Studio for *Bluetooth*
E4438C-407 Signal Studio for S-DMB
E4438C-409 GPS Embedded Personality
E4438C-419 Signal Studio for 3GPP WCDMA HSPA (HSDPA/HSUPA)
E4438C-SP1 Signal Studio for Jitter Injection
N7600B Signal Studio for 3GPP WCDMA
N7601B Signal Studio for 3GPP2 CDMA (IS95, cdma2000, 1xEV-DO Rev 0 & A)
N7612B Signal Studio for TD-SCDMA
N7613A Signal Studio for 802.16-2004 WiMAX (OFDM Fixed WiMAX)
N7615B Signal Studio for WiMAX (OFDMA Mobile WiMAX)
N7616B Signal Studio for T-DMB
N7617B Signal Studio for 802.11 WLAN (a/b/g/p/j/n)
N7620A Signal Studio for Pulse Building
N7621B Signal Studio for Multitone Distortion (Enhanced Multitone and NPR)
N7622A Signal Studio Toolkit
N7623B Signal Studio for Digital Video (DVB-T/H/C/S, ATSC, ISDB-T, DTMB)

Manuals and Accessories
E4438C-1CM Rackmount Flange Kit
E4438C-1CN Front Handle Kit
E4438C-1CP Rackmount Flange and Front Handle Kit
E4438C-CD1 CD-ROM containing the English Documentation Set
E4438C-ABA Hardcopy of the English Documentation Set
E4438C-AB1 Hardcopy of the Korean User's Guide
E4438C-AB0 Hardcopy of the Chinese (Taiwan) User's Guide
E4438C-AB2 Hardcopy of the Chinese (China) User's Guide
E4438C-ABF Hardcopy of the French User's Guide
E4438C-ABJ Hardcopy of the Japanese User's Guide
E4438C-0BV Hardcopy of the Component Level Service Manual
E4438C-0BW Hardcopy of the Assembly Level Service Manual

[1] Requires either Option 001, 002, 601 or 602 (baseband generator) to function.

- **First microwave signal generator with integrated vector modulation up to 44 GHz**
- **Flexible waveform creation and correction software available**
- **Highest output power in the industry**
- **Excellent phase noise performance**
- **Ramp sweep and scalar analyzer interface available**

The Agilent PSG signal generators offer the features you need to be successful in today's complex technical environment. Whether working on radar systems, satellite communications, terrestrial microwave radio for broadband wireless access, or performing component tests, the PSG is the solution for you.

E8267D PSG Vector Signal Generator

Signal Simulation for Radar, Satellite Communication and Broadband Wireless

- Integrated microwave vector signal generator operating up to 44 GHz
- Internal baseband generator achieves 80 MHz RF modulation bandwidth
- External I/Q inputs achieves 160 MHz RF modulation bandwidth, and 1.6 GHz (f_c >3.2 GHz)
- Flexible waveform sequencing
- Flexible analog modulation formats: AM, FM, ΦM, and pulse
- Narrow pulse modulation (20 ns) down to 10 MHz
- Industry leading high output power
- Enhanced phase noise

The PSG Vector Signal Generator Offers the Flexibility Needed for Any Application

Many systems that operate at microwave frequencies need wide modulation bandwidths ranging from tens to hundreds of megahertz, whether they are pulsed radar sets or broadband wireless communication systems. The E8267D has features that enable the generation of vector modulated signals and include:

- Internal I/Q modulation capability
- Optional wideband I/Q inputs supporting RF modulation bandwidth of 1.6 GHz
- Optional internal baseband generator, which operates in dual mode, combining the capabilities of a 64 Msample, deep memory arbitrary waveform generator with the sophisticated coding power of a real-time baseband generator
- Standard two-tone and multitone utilities are built into the optional internal baseband generator of the PSG vector signal generator. Users can press a few simple soft keys to quickly generate multitone waveforms, and define relative tone spacing, relative tone power and phase relationships. These capabilities eliminate the issues associated with combining multiple continuous wave signal generators, and significantly reduce test costs
- Compatibility with industry-standard software packages – including Agilent's Advanced Design System (ADS) software and other industry standard software packages such as MATLAB and Excel® – which makes it easy to create and download customized arbitrary waveform files

Baseband Studio

Baseband Studio is a suite of baseband signal applications and accessories that work with the E8267D PSG vector signal generator to emulate real-world signal conditions. The N5102A Baseband Studio digital signal interface module enables the input or output of baseband signals as digital I/Q or IF data. A PC equipped with the N5101A Baseband Studio PCI card and N5110B Baseband Studio for waveform capture and playback software lets you playback long and unique waveforms through the PSG from the PC hard drive or the waveform memory on the PCI card.

For more information, go to page 341

Signal Creation Software

Signal creation software is available for development and generation of waveforms with the internal baseband generator. These include:

- 3GPP W-CDMA FDD
- cdma2000 and IS-95-A
- Signal Studio for 802.11 WLAN
- Signal Studio for Jitter Injection
- Calibrated noise (AWGN)
- Pulse Building
- 802.16-2004 (WiMAX)
- Multiband OFDM UWB
- Multitone Distortion (Enhanced Multitone and NPR for narrowband or wideband using N6030A or N8241A arb)

For more information, go to page 310

Specifications

Frequency

Range[1]
Option 520: 250 kHz to 20 GHz
Option 532: 250 kHz to 31.86 GHz
Option 544: 250 kHz to 44 GHz
Resolution[2]
CW: 0.001 Hz
All Sweep modes: 0.01 Hz
Accuracy
Aging rate ± temperature effects ± line voltage effects
Switching Speed[3]
<16 ms (typical)
Phase Offset
Adjustable in nominal 0.1° increments

Frequency Bands

Band	Frequency Range	N[4]
1	250 kHz to 250 MHz	1/8
2	>250 to 500 MHz	1/16
3	>500 MHz to 1 GHz	1/8
4	>1 to 2 GHz	1/4
5	>2 to 3.2 GHz	1/2
6	>3.2 to 10 GHz	1
7	>10 to 20 GHz	2
8	>20 to 28.5 GHz	3
9	>28.5 to 44 GHz	5

Internal Timebase Reference Oscillator

	Standard	Option UNX
Aging Rate	<±1 x 10^{-7}/year or <±4.5 x 10^{-9}/day after 45 days	<±3 x 10^{-8}/year or <±2.5 x 10^{-10}/day after 30 days

[1] Useable to 100 kHz.
[2] In ramp sweep mode (Option 007), resolution is limited with narrow spans and slow sweep speeds. Refer to ramp sweep specifications for more information.
[3] To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.
[4] N is a factor used at various points in the specification.

Temperature Effects (typical)
<±5 x 10^{-8} 0 to 55°C
<±4.5 x 10^{-9} 0 to 55°C
Line Voltage Effects (typical)
<±2 x 10^{-9} for +5% –10% change
<±2 x 10^{-10} for ±10% change
External Reference Frequency
Standard: 1, 2, 2.5, 5, 10 MHz (within 0.2 ppm)
Option UNX: 10 MHz only (within 1 ppm)

Step (digital) Sweep

Operating Modes
Step sweep of frequency or amplitude or both (start to stop)
List sweep of frequency or amplitude or both (arbitrary list)
Sweep Range
Frequency sweep: Within instrument frequency range
Amplitude sweep: Within attenuator hold range
Dwell Time 1 ms to 60 s
Frequency settling time: 8 ms (typical)
Amplitude settling time: 5 ms (typical)
Number of Points
Step sweep: 2 to 65535
List sweep: 2 to 1601 per table
Triggering
Auto, external, single, or GPIB

Ramp (analog) Sweep (Option 007)[1]

Operating Modes
- Synthesized frequency sweep
  (start/stop), (center/span), (swept CW)
- Power (amplitude) sweep (start/stop)
- Manual sweep
  RPG control between start and stop frequencies
- Alternate sweep
  Alternates successive sweeps between current and stored states

Sweep Span Range
Settable from minimum[2] to full range

Maximum Sweep Rate

Start Frequency	Maximum Sweep Rate	Max Span for 100 ms Sweep
250 kHz to <0.5 GHz	25 MHz/ms	2.5 GHz
0.5 to <1 GHz	50 MHz/ms	5 GHz
1 to <2 GHz	100 MHz/ms	10 GHz
2 to <3.2 GHz	200 MHz/ms	20 GHz
≥3.2 GHz	400 MHz/ms	40 GHz

Frequency Accuracy
±0.05% of span ±timebase (at 100 ms sweep time, for sweep spans less than maximum values given above)
Accuracy improves proportionally as sweep time increases[3]
Sweep Time (forward sweep, not including bandswitch and retrace intervals)
Resolution: 1 ms
Manual mode: Settable 10 ms to 200 seconds
Auto mode: Set to minimum value determined by maximum sweep rate and 8757D setting
Triggering
Auto, external, single, or GPIB
Markers (10 independent continuously variable frequency markers)
Display: Z-axis intensity or RF amplitude pulse
Functions: M1 to center, M1/M2 to start/stop, marker delta
Two-Tone (master/slave) Measurements[4]
Two PSG's can synchronously track each other, with independent control of start/stop frequencies
Network Analyzer Compatibility
Fully compatible with Agilent 8757D scalar network analyzer[5]
Also useable with Agilent 8757A/C/E scalar network analyzers for making basic swept measurements[6]

Output

Power[7, 14] (dBm)
Frequency Range
Option 520:
250 kHz to 3.2 GHz: –130 to +16 (typical)
>3.2 to 20 GHz: –130 to +22 (typical)
Option 532 and 544:
250 kHz to 3.2 GHz: –130 to +15 (typical)
3.2 to 40 GHz: –130 to +18 (typical)
40 to 44 GHz: –130 to +13 (typical)
Step Attenuator
0 to 115 dB in 5 dB steps
Attenuator Hold Range Minimum
From –15 dBm to maximum specified output power with step attenuator in 0 dB position. Can be offset using step attenuator.
Amplitude Switching Speed[8]
CW or analog modulation: <3 ms (typical) (without power search)

Level Accuracy[9] (dB)

Frequency	>+10 dBm	+10 to –10 dBm	–10 to –70 dBm	–70 to –90 dBm
250 kHz to 2 GHz	±0.6	±0.6	±0.7	±0.8
>2 to 20 GHz	±0.8	±0.8	±0.9	±1.0
>20 to 32 GHz	±1.0	±0.9	±1.0	±1.7
	±1.0	±0.9	±1.5	±2.0

CW Level Accuracy with I/Q modulation (relative to CW)[10]
(With PRBS modulated data)
With ALC On:
QAM or QPSK formats[11]: ±0.2 dB
Constant-amplitude formats (FSK, GMSK, etc): ±0.2 dB
With ALC Off [12]**:**
±0.2 dB (typical)
Resolution
0.01 dB
Temperature Stability
0.01 dB/°C (typical)
User Flatness Correction
Number of points: 2 to 1601 points/table
Number of tables: Up to 10,000, memory limited
Path loss: Arbitrary, within attenuator range
Entry modes: Remote power meter[13], remote bus, manual (user edit/view)

[1] During Ramp sweep operation, AM, FM, Phase Modulation and Pulse Modulation are useable but performance is not specified; Wideband AM and I/Q modulation are not useable.
[2] Minimum settable sweep span is proportional to carrier frequency and sweep time. Actual sweep span may be slightly different than desired setting for spans less than (0.00004% of carrier frequency or 140 Hz) x (sweep time in seconds). Actual span will always be displayed correctly.
[3] Typical accuracy for sweep times >100 ms can be calculated from the equation: [(0.005% of span) + (sweep time in seconds)] ± timebase. Accuracy is not specified for sweep times <100 ms.
[4] For Master/Slave operation use Agilent Technologies part #8120-8806 Master/Slave interface cable.
[5] When measuring low-pass devices in AC mode, dynamic range may be reduced up to 10 dB below 3.2 GHz.
[6] GPIB system interface is not supported with 8757A/C/E, only with 8757D. As a result, some features of 8757A/C/E, such as frequency display, pass-through mode, and alternate sweep, do not function with PSG signal generators.
[7] With I/Q modulation on, maximum power specification is typical. With external inputs enabled, $\sqrt{(I^2 + Q^2)} > 0.2\ V_{rms}$.
[8] To within 0.1 dB of final amplitude within one attenuator range.
[9] Specifications apply in CW and list/step sweep modes over the 15°C to 35°C temperature range, with attenuator hold off (normal operating mode). Degradation outside this range, for ALC power levels >–5 dBm, is typically <0.3 dB. In Ramp sweep mode (with Option 007), specifications are typical. For instruments with Type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz. Level accuracy is not specified below –110 dBm.
[10] If external inputs are used, specification applies with input level $\sqrt{(I^2 + Q^2)} = 0.3\ V_{rms}$ and I/Q modulator attenuation = 10 dB.
[11] Measured with symbol rate >10 kHz and power ≤0 dBm.
[12] Relative to ALC on, after power search is executed. When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.
[13] Compatible with Agilent Technologies EPM Series (E4418B and E4419B) power meters.
[14] Maximum power specification is warranted, and is typical from 0°C to 15°C. Maximum power over the 35°C to 55°C range typically degrades less than 2 dB.

Output Impedance
50 Ω (nominal)
SWR (internally leveled) (typical)
250 kHz to 2 GHz <1.4:1
>2 GHz to 20 GHz <1.6:1
>20 GHz <1.8:1 (typical)
Leveling Modes
Internal leveling, external detector leveling, millimeter source module, ALC Off
External Detector Leveling
Range: –0.2 mV to –0.5 V (nominal) (–36 dBm to +4 dBm using Agilent 33330D/E detector)
Bandwidth: selectable 0.1 to 100 kHz (nominal) (Note: not intended for pulsed operation)
Maximum Reverse Power
1/2 Watt (nominal), 0 VDC

Spectral Purity

Harmonics[1] (dBc at +10 dBm or maximum specified output power, whichever is lower)
<1 MHz –28 dBc (typical)
1 MHz to 2 GHz –28 dBc
1 MHz to 2 GHz (with Option 1EH) –55 dBc[2]
>2 GHz to 20 GHz –55 dBc
>20 GHz to 44 GHz –45 dBc

SSB Phase Noise (CW)
Offset from Carrier (dBc/Hz)

Frequency	20 kHz	20 kHz (typical)
250 kHz to 250 MHz	–130	–134
>250 to 500 MHz	–134	–138
>500 MHz to 1 GHz	–130	–134
>1 to 2 GHz	–124	–128
>2 to 3.2 GHz	–120	–124
>3.2 to 10 GHz	–110	–113
>10 to 20 GHz	–104	–108
>20 to 28.5 GHz	–100	–104
>28.5 to 44 GHz	–96	–100

Option UNX: Enhanced SSB Phase Noise (CW)
Offset from carrier (dBc/Hz)

Frequency	100 Hz spec (typical)	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
250 kHz to 250 MHz	–104 (–120)	–121 (–128)	–128 (–132)	–130 (–133)
>250 to 500 MHz	–108 (–118)	–126 (–132)	–132 (–136)	–136 (–141)
>500 MHz to 1 GHz	–101 (–111)	–121 (–130)	–130 (–134)	–130 (–135)
>1 to 2 GHz	–96 (–106)	–115 (–124)	–124 (–129)	–124 (–129)
>2 to 3.2 GHz	–92 (–102)	–111 (–120)	–120 (–124)	–120 (–124)
>3.2 to 10 GHz	–81 (–92)	–101 (–109)	–110 (–114)	–110 (–115)
>10 to 20 GHz	–75 (–87)	–95 (–106)	–104 (–107)	–104 (–109)
>20 to 28.5 GHz	–72 (–83)	–92 (–102)	–100 (–103)	–100 (–105)
>28.5 to 44 GHz	–68 (–77)	–88 (–97)	–96 (–99)	–96 (–101)

Residual FM
CW mode: <N x 8 Hz (typical)
Option UNX: <N x 4 Hz (typical)
Ramp sweep mode: <N x 1 kHz (typical) (rms, 50 Hz to 15 kHz bandwidth)
Broadband Noise
(CW mode at +10 dBm output, for offsets >10 MHz)
>2.4 to 20 GHz: <–148 dBc/Hz (typical)
>20 GHz: <–141 dBc/Hz (typical)
Option UNT: AM, FM, Phase Modulation, and LF Output

Frequency Modulation

Maximum Deviation
N x 16 MHz
Resolution
0.1% of deviation or 1 Hz, whichever is greater
Deviation Accuracy
<±3.5% of FM deviation + 20 Hz (1 kHz rate, deviations <N x 800 kHz)

Modulation Frequency Response[6]

Path	Rates (at 100 kHz deviation) 1 dB Bandwidth	3 dB Bandwidth (typical)
FM 1	DC to 100 kHz	DC to 10 MHz
FM 2	DC to 100 kHz	DC to 1 MHz

DC FM[3] **Carrier Offset**
±0.1% of set deviation + (N x 8 Hz)
Distortion
<1% (1 kHz rate, deviations <N x 800 kHz)
Sensitivity
±1 V_{peak} for indicated deviation

Phase Modulation

Maximum Deviation
N x 160 radians (N x 16 radians in high-bandwidth mode)
Resolution
0.1% of set deviation
Deviation Accuracy
<±5% of deviation + 0.01 radians (1 kHz rate, normal BW mode)

Modulation Frequency Response

Mode	Rates (3 dB BW)
Normal BW	DC to 100 kHz
High BW	DC to 1 MHz (typical)

Distortion
<1 % (1 kHz rate, THD, dev <N x 80 rad, normal BW mode)
Sensitivity
±1 V_{peak} for indicated deviation

Amplitude Modulation (f_c >2 MHz)[4] (typical)

Depth	Linear Mode	Exponential (log) Mode (Downward modulation only)
Maximum	>90%	>20 dB
Settable[5]	0 to 100 %	0 to 40 dB
Resolution	0.1%	0.01 dB
Accuracy (1 kHz rate)	<±(6% of setting + 1%)	<±(2% of setting + 0.2 dB)

Ext Sensitivity
Line Mode: ±1 V_{peak} for indicated depth
Exponential (log) Mode: –1 V for indicated depth
Rates (3 dB bandwidth, 30% depth)[6]
DC to 100 kHz (typical) (useable to 1 MHz)
Distortion (1 kHz rate, linear mode, THD)
30% AM <1.5%
90% AM <4 %

Wide Band AM

Rate (typical 1 dB bandwidth)
ALC on: 1 kHz to 80 MHz
ALC off: DC to 80 MHz
External I input
Sensitivity: 0.5 V = 100%
Input impedance: 50 Ω (nominal)

External Modulation Inputs (Ext1 & Ext2)

Modulation Types
AM, FM, and ΦM
Input Impedance
50 or 600 Ω (nominal) switched
High/low Indicator (100 Hz to 10 MHz BW, ac coupled inputs only)
Activated when input level error exceeds 3% (nominal)

[1] Specifications for harmonics beyond maximum instrument frequencies are typical.
[2] In ramp sweep mode (Option 007), harmonics are –28 dBc below 250 MHz.
[3] At the calibrated deviation and carrier frequency, within 5°C of ambient temperature at time of user calibration.
[4] For f_c <2 MHz AM is usable but not specified. AM specifications apply with ALC on, and envelope peaks <maximum specified power.
[5] For AM depth settings >90% or >20 dB, deep AM mode or 1 kHz ALC BW is recommended.
[6] DC coupled.

Simultaneous Modulation

All modulation types may be simultaneously enabled except: FM with ΦM, linear AM with exponential AM, and Wideband AM with I/Q. AM, FM, and ΦM can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2). Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type

Internal Modulation Source

Dual function generators provides two independent signals (internal1 and internal2) for use with AM, FM, ΦM, or LF Out

Waveforms

Sine, square, positive ramp, negative ramp, triangle, Gaussian noise, uniform noise, swept sine, dual sine[1]

Rate Range

Sine: 0.5 Hz to 1 MHz

Square, ramp, triangle: 0.5 Hz to 100 kHz

Resolution: 0.5 Hz

Accuracy: Same as timebase

LF Out

Output: Internal1 or internal2. Also provides monitoring of internal1 or internal2 when used for AM, FM, or ΦM.

Amplitude: 0 to 3 V_{peak} , into 50 Ω (nominal)

Output impedance: 50 Ω (nominal)

Swept Sine Mode: (frequency, phase continuous)

Operating modes: Triggered or continuous sweeps

Frequency range: 1 Hz to 1 MHz

Sweep rate: 0.5 Hz to 100 kHz sweeps/s, equivalent to sweep times 10 µs to 2 s

Resolution: 0.5 Hz (0.5 sweep/s)

Pulse Modulation[2] (Option UNU)

	500 MHz to 3.2 GHz	Above 3.2 GHz
On/Off Ratio	80 dB (typ)	80 dB
Rise/Fall Times (Tr, Tf)	100 ns (typ)	6 ns (typ)
Minimum Pulse Width Internally leveled Level hold (ALC off with power search)	 2 µs 0.5 µs	 1 µs 0.15 µs
Repetition Frequency Internally leveled Level hold (ALC off with power search)	 10 Hz to 250 kHz DC to 1 MHz	 10 Hz to 500 kHz DC to 3 MHz
Level Accuracy (relative to CW) Internally leveled Level hold (ALC off with power search)	 ±0.5 dB ±0.5 dB (typ)	 ±0.5 dB ±0.5 dB (typ)
Width Compression (RF Width relative to video out)	 ±50 ns (typ)	 ±5 ns (typ)
Video Feed-through[3]	<200 mv (typ)	<2 mv (typ)
Video Delay (Ext input to video)	50 ns (nom)	50 ns (nom)
RF Delay (video to RF output)	270 ns (nom)	35 ns (nom)
Pulse Overshoot	<10% (typ)	<10% (typ)
Input Level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input Impedance	50 Ω (nom)	50 Ω (nom)

Narrow Pulse Modulation[2] (option UNW)

	10 MHz to 3.2 GHz	Above 3.2 GHz
On/Off Ratio	80 dB	80 dB
Rise/Fall Times (Tr, Tf)	10 ns (8 ns typ)	10 ns (6 ns typ)
Minimum Pulse Width Internally leveled: Level hold (ALC off with power search):	 1 µs 20 µs	 1 µs 20 µs
Repetition Frequency Internally leveled: Level hold (ALC off with power search):	 10 Hz to 500 kHz DC to 5 MHz	 10 Hz to 500 kHz DC to 10 MHz
Level Accuracy (relative to CW) Internally leveled Level hold (ALC off with power search):	 ±0.5 dB ±1.3 dB (typ)	 ±0.5 dB (0.15 dB typ) ±0.5 dB (typ)
Width Compression (RF width relative to video out)	 ±5 ns (typ)	 ±5 ns (typ)
Video Feed-through[3]	<125 mv (typ)	<2 mv (typ)
Video Delay (Ext input to video)	50 ns (nom)	50 ns (nom)
RF Delay (video to RF output)	45 ns (nom)	35 ns (nom)
Pulse Overshoot	<15% (typ)	<10% (typ)
Input Level	+1 V_{peak} = RF On	+1 V_{peak} = RF On
Input Impedance	50 Ω (nom)	50 Ω (nom)

Internal Pulse Generator

Modes

Free-run, triggered, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source

Period (PRI) (Tp)

70 ns to 42 s (Repetition frequency: 0.024 Hz to 14.28 MHz)

Pulse Width (Tw)

10 ns to 42 s

Delay (Td)

Free-run mode: 0 to ±42 s

Triggered with delay and doublet modes: 75 ns to 42 s with ±10 ns jitter

Resolution

10 ns (width, delay, and PRI)

Vector Modulation

External I/Q Inputs

Input impedance: switched 50 or 600 W (nominal)

Input range[4]: Minimum 0.1 V_{rms}, Maximum 1V_{peak}

Flatness: ±1 dB within ±40 MHz of carrier (with ALC off) (typical)

Vector Accuracy[5]

Formats: BPSK, QPSK, 16-256QAM (α= 0.3, Root Nyquist filter, symbol rate 4 Msyms/s)

- EVM: <1.2% RMS, <0.8% RMS (typical)
- Origin offset
  250 kHz to 3.2 GHz: –45 dBc (typical)
  3.2 to 20 GHz: –50 dBc (typical)

[1] Internal2 is not available when using swept sine or dual sine modes.

[2] With ALC off, specs apply after the execution of power search. Specs apply with Atten Hold off (default mode), or ALC level between –5 and +10 dBm, or specified maximum power, whichever is lower.

[3] With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.

[4] For optimum signal quality, the I and Q inputs should be 0.7 V_{peak}, with $\sqrt{(I^2 + Q^2)}$ + 150 mV_{rms}. Different RMS levels are accommodated by adjusting the internal I/Q modulator attenuator, which may be either manually or automatically set. The minimum input level required to maintain RF level accuracy is $\sqrt{(I^2 + Q^2)}$ = 0.1 V_{rms}.

[5] Measured with Agilent 89441A Vector Signal Analyzer. Valid after executing I/Q calibration, and instrument is maintained within ±5°C of calibration temperature. RF power <0 dBm. External I/Q input level $\sqrt{(I^2 + Q^2)}$ = 0.3 V_{rms}, I/Q modulator attenuator = 10 dB.

I/Q Adjustments
- I & Q offsets
  - External inputs (600 Ω) ±5 Volts
  - External inputs (50 Ω) ±50%
  - Internal baseband generator ±50%
- I/Q attenuation: 0 to 40 dB
- I/Q gain balance: ±4 dB
- I/Q quadrature skew: ±10° range (typical)
- Low pass filter: Selectable 40 MHz or through

I/Q Baseband Outputs
Differential: I, I bar, Q, Q bar
Single ended: I, Q
Frequency range: DC to 40 MHz
Output voltage into 50 Ω: 1.5 V_{p-p} (typical)
DC offset adjustments: ±3 V
DC offset resolution: 1 mV
Low pass filter: Selectable 40 MHz or though path

Wideband External Differential I/Q Inputs (Option 016)

RF Output Frequency Range
250 MHz to 3.2 GHz,
3.2 to 44 GHz

Input
Input (baseband) frequency range: DC to 120 MHz (nominal) for 250 MHz to 3.2 GHz output; DC to >800 MHz for 3.2 to 44 GHz (nominal)[1]

I/Q Offset Adjustments
±50%

RF Path Filters

Carrier Frequency	Low-pass 3 dB cutoff frequency (nominal)
>250 to 396 MHz	200 to 420 MHz bandpass filter
>396 to 698 MHz	350 to 650 MHz bandpass filter
>628 to 1000 MHz	1040 MHz low pass filter
>1 to 1.5 GHz	1.6 GHz low pass filter
>3.2 to 5 GHz	5.5 GHz low pass filter
>5 to 8 GHz	8.9 GHz low pass filter
>8 to 12.8 GHz	13.9 GHz low pass filter
>12.8 GHz	22.5 GHz low pass filter
>20 to 24 GHz	19.6 to 24.5 GHz band pass filter
>24 to 28.5 GHz	23.5 to 29.0 GHz band pass filter
>28.5 to 32 GHz	28 to 32.5 GHz band pass filter
>32 to 36 GHz	31.7 to 36.5 GHz band pass filter
>36 to 40 GHz	35.5 to 40.4 GHz band pass filter
>40 to 44 GHz	39.5 to 44.3 GHz band pass filter

I/Q Baseband Generator (Arbitrary Waveform Mode) (Options 602)

Channels
2 (I and Q)

Resolution
16 bits (1/65,536)

Baseband Waveform Memory
Length (playback): 64 Msamples/channel (Option 602)
Length (storage): 1.2 Gsamples on 6 GB hard drive (Option 005)

Waveform Segments
Segment length: 60 samples to 64 Msamples
Maximum number of segments: 8,192
Minimum memory allocation: 256 samples or 1 kbyte blocks

Waveform Sequences
Maximum total number of segments: 16,384
Sequencing: Continuously repeating
Maximum number of sequences: 16,384
Maximum segments/sequence: 1 to 32,768
Maximum segment repetitions: 1 to 65,536

Clock
Sample rate: 1 Hz to 100 MHz
Resolution: 0.001 Hz
Accuracy: Same as timebase $+2^{-42}$ (in non-integer applications)

Reconstruction Filter: (fixed)
50 MHz (used for all symbol rates)

Baseband Spectral Purity (full scale sinewave)
Harmonic distortion: 100 kHz to 2 MHz: <–65 dBc (typical)
Phase noise: <–127 dBc/Hz (typical) (baseband output of 10 MHz sinewave at 20 kHz offset)
IM performance: <–74 dB (typical) (two sinewaves at 950 kHz and 1050 kHz at baseband)

Triggers
Types: Continuous, single, gated, segment advance
Source: Trigger key, external, remote (LAN, GPIB, RS-232)
External polarity: Negative, positive
External delay time: 10 ns to 40 sec plus latency
External delay resolution: 10 ns

Markers
(Markers are defined in a segment during the waveform generation process, or from the PSG front panel. A marker can also be tied to the RF blanking feature of the PSG.)
Marker polarity: Negative, positive
Number of markers: 4

Multi-Carrier
Number of carriers: Up to 100 (limited by a max bandwidth of 80 MHz depending on symbol rate and modulation type)
Frequency offset (per carrier): –40 MHz to +40 MHz
Power offset (per carrier): 0 dB to –40 dB

Modulation
PSK: BPSK, QPSK, OQPSK, £k/4DQPSK, 8PSK,16PSK, D8PSK
QAM: 4, 16, 32, 64, 256
FSK: Selectable: 2, 4, 8, 16
MSK
ASK
Data: Random ONLY

Two-Tone
Frequency spacing: 100 Hz to 80 MHz (symmetrical about carrier)
IM distortion
250 kHz to 3.2 GHz: <–45 dBc for RF levels <0 dBm (typical)
>3.2 GHz to 20 GHz: <–55 dBc for RF levels <0 dBm (typical)

I/Q Baseband Generator (Real-time Mode) (Options 602)

Basic Modulation Types (custom format)
PSK: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK
MSK: User-defined phase offset from 0 to 100°
QAM: 4, 16, 32, 64, 128, 256
FSK: Selectable: 2, 4, 8, 16 level symmetric
ASK
User defined: Custom map of up to 16 deviation levels
Symbol rate: Maximum deviation
<5 MHz: 4 times symbol rate
5 MHz to 50 MHz: 20 MHz
Resolution: 0.1 Hz

I/Q
Custom map of 256 unique values

FIR Filter
Selectable: Nyquist, root Nyquist, Gaussian, Rectangular, Custom FIR
α: 0 to 1, BbT: 0.1 to 1

Symbol Rate
For external serial data: Adjustable from 1000 symbols/sec to a maximum symbol rate of 50 Mbits/sec ÷ #bits/symbol
For internally generated data: Adjustable from 1000 symbols/sec to 50 Msymbols/sec. and a maximum of 8 bits per symbol. Modulation quality may be degraded at high symbol rates

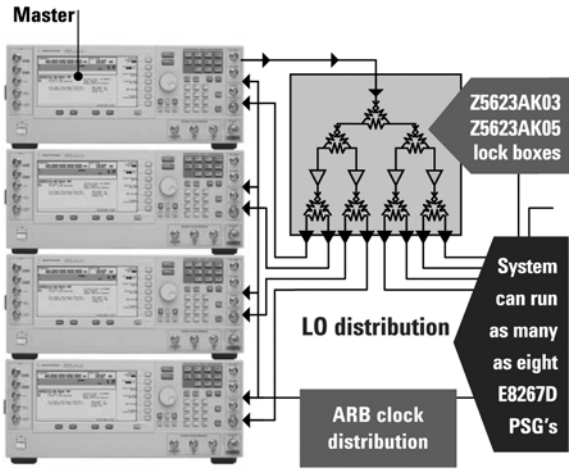
Data Types
- Internally generated data
  Pseudo-random patterns: PN9, PN11, PN15, PN20, PN23
  Repeating sequence: Any 4-bit sequence, Other fixed patterns
- Direct-pattern RAM (PRAM)
  Max size: 64 Mbits (each bit uses an entire sample space)
  Use: Non-standard framing
- User file
  Max size: 3.2 Mbytes
  Use: Continuous modulation or internally generated TDMA standard
- Externally generated data
  Type: Serial data
  Inputs: Data, bit clock, symbol sync Accepts data rates ±5% of specified data rate

[1] Modulation frequency response within ±800 MHz of the carrier frequency may be limited by the RF chain cutoff frequencies.

Generate up to Eight Phase-coherent Signals

Testing multireceiver systems used in phased-array radar, communications networks, and synthetic aperture radar has traditionally been difficult and expensive. Field-testing, while perhaps necessary for final system verification, is an expensive method for the design phase. The phase-coherent simulation system, which consists of up to eight E8267D PSGs and some special options, provides a more repeatable, configurable alternative for the laboratory or the flight line. As shown, one PSG is the master, which delivers the fundamental LO signal to the lock box. The lock box distributes this signal back to the master and all the slaves as a common reference. The E4438C ESG vector signal generator is used as the source to drive the external clock inputs of each PSG's internal baseband generator. The system provides the full-phase coherency that is mandatory for testing multi-receiver systems, as well as full control over time, phase, amplitude and frequency.

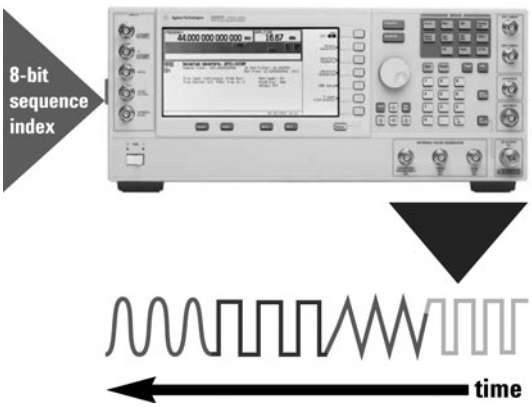
Lock up to eight PSG vector signal generators to achieve phase coherency with special Option HCC



Change the Waveform Sequence Dynamically During Playback

In a system level test environment, having the ability to dynamically change the stimulus waveform without discontinuity is a distinct advantage in evaluating system performance. The E8267D dynamic sequencing special Option SP2 enhances the "segment advance" capability of the Option 601 or 602 arbitrary waveform generator to allow jumping to any of 256 different waveform segments in the playback memory. The sequencing enhancement allows determination of the next segment to be made dynamically via an 8-bit value strobe into the rear panel auxiliary I/O D-type connector.

Jump to different waveform segments seamlessly with special Option SP2



Remote Programming

Interfaces
GPIB (IEEE-488.2,1987) with listen and talk, RS-232, and 10BaseT LAN interface
Control Languages
SCPI version 1997.0
Will emulate most applicable commands for: Agilent 836xxB, Agilent 837xxB, Agilent 8340/41B and 8662/3A providing general compatibility with ATE systems which include these signal generators
IEEE-488 Functions
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

General

Power Requirements
90 to 267 Vac 50 to 60 Hz, (automatically selected) 400 W typical, 650 W maximum
Operating Temperature Range
0 to 55°C[1]
Storage Temperature Range[2]
–40 to 70°C
With Option 005: –4° to 65°C, gradient less than 20°C/hour
Shock and Vibration
Meets requirements of MIL-PRF-28800F for class 3 equipment
EMC
Conducted and radiated interference and immunity meets IEC/EN 61326-1. Meets radiated emission requirements of CISPR Pub 11/1997 Group 1 class A
Security
Display blanking. Memory clearing functions
Compatibility
OML Inc. – AG series mm-wave source modules
Agilent Technologies 83550 Series millimeter heads (not for use with I/Q modulation), Agilent Technologies 8757D scalar network analyzers, Agilent Technologies EPM Series power meters
Self-Test
Internal diagnostic routine tests most modules (including microcircuits) in a preset condition. For each module, if its node voltages are within acceptable limits, then the module "passes" the test
Weight
<25 kg (54 lb.) net, <33 kg (74 lb.) shipping
Dimensions
178 mm (H) x 426 mm (W) x 515 mm (D) (7 in x 16.8 in x 20.3 in)

[1] Save and recall of user filters and instrument states from Option 005 Hard Drive is guaranteed only over the range 0°C to 40°C.
[2] Storage below –20°C Instrument states may be lost.

Key Literature & Web Link

PSG Signal Generators Brochure, p/n 5989-1324EN
E8267D PSG Vector Signal Generator Data Sheet, p/n 5989-0697EN
E8267D PSG Vector Signal Generator Configuration, p/n 5989-1326EN

For more information: **www.agilent.com/find/psg**

Ordering Information

Agilent Microwave Vector Signal Generators Options
Frequency Range (required option)
E8267D-520 250 kHz to 20 GHz
E8267D-532 250 kHz to 31.8 GHz
E8267D-544 250 kHz to 44 GHz

Performance Enhancements
E8267D-UNX Enhanced Phase Noise Performance
E8267D-HCC Multi-source Phase Coherency
E8267D-UNT AM, FM, Phase Modulation, and LF Output
E8267D-UNU Pulse Modulation
E8267D-UNW Narrow Pulse Modulation
E8267D-007 Provides Analog (Ramp) Sweep and Scalar Network Analyzer Interface
E8267D-602 Internal Baseband Generator with 64 Msample Memory
E8267D-005 6 GB Internal Hard Drive
E8267D-003 Enables Digital Output Connectivity with N5102A
E8267D-004 Enables Digital Input Connectivity with N5102A
E8267D-SP2 Dynamic Sequencing
E8267D-016 Wideband External Differential I/Q Inputs

Manuals and Accessories
E8267D-1ED Type-N(f) RF Connector (Option 520 only)
E8267D-1EM Moves all Connectors to the Rear Panel

Signal Creation Software[1]
N7600B W-CDMA FDD Single/Multi-carrier Uplink/Downlink test signals
N7601B cdma2000 and IS-95-A Single/Multi-carrier Forward/Reverse Test Signals
N7613A-102 Signal Studio for 802.16-2004 (WiMAX)
N7617B Signal Studio for 802.11 WLAN
N7620B Signal Studio for Pulse Building
N7621A/B Signal Studio for Multitone Distortion
N7622A Signal Studio Toolkit
N7623B Signal Studio for Digital Video (DVB-T/H/C/S, ATSC, ISDB-T, DTMB)
E8267D-403 Calibrated Noise (AWGN) with 80 MHz of RF Bandwidth
E8267D-SP1 Signal Studio for Jitter Injection

[1] Requires Option 602 (baseband generator) to function.

Signal Studio Software

Overview

- **Create reference signals for mobile communications, wireless connectivity, and digital broadcasting standards**
- **Create test patterns for advanced detection, positioning, tracking, and navigation systems**
- **Create virtually distortion free test signals for component analysis**
- **Create additive signal impairments for receiver tolerance evaluation**

Reduce the Time You Spend on Custom Signal Simulation

Agilent's broad set of **Signal Studio** and **Embedded** signal creation software products enable the generation of a wide range of application-specific test signals using the Agilent MXG, ESG, and PSG vector signal generators. Create reference signals to evaluate the performance of your radio designs, and the components that comprise them, under various parametric and functional test conditions at baseband, RF, and microwave frequencies.

The software offers basic capabilities to create partially coded, statistically correct signals for component and transmitter test and advanced capabilities to create fully channel coded signals for receiver BER analysis. Easily add calibrated signal impairments and AWGN to evaluate receiver tolerance to dirty transmitters and channel effects. Signal Studio and embedded signal creation software reduces the time you spend on custom signal simulation and delivers Agilent validated and performance optimized reference signals that enable you to better characterize, evaluate, and optimize your designs.

Signal Studio Software

4

Comparison Table

	Signal Studio Software	Embedded Software
Platform	Resides and runs on your PC; communicates with the vector signal generator over GPIB or LAN	Resides and runs directly on your vector signal generator
User Interface	Graphical; configure test signals from your PC	Table-based; configure test signals from the instrument front panel
Scalability	Provides scalable options for basic and advanced capability	—
Signal Creation	Custom, standard-based, and presets for common test signals Arbitrary I/Q waveform and real-time I/Q generation	Custom, standard-based, and presets for common test signals Arbitrary I/Q waveform and real-time I/Q generation
Signal Generator Control	Directly from the software GUI and/or from the instrument front panel	Directly from the instrument front panel
Additive Impairments	I/Q impairments, AWGN, and fading with Baseband Studio	I/Q impairments, AWGN, and fading with Baseband Studio
Graphs	I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP, frame structure	CCDF, CDP, frame structure
Automation and Programming	API and SCPI	SCPI
Documentation	Online documentation and embedded HELP	Embedded in signal generator manuals
Licensing	Flexible: fixed and transportable license types with perpetual and time-based durations	Fixed, perpetual license key only
Installation	Via Web download or CD-ROM	Via signal generator firmware update
FREE Trial	14-days; enables all software capabilities for evaluation	—

	Software Type	N5182A MXG Compatible Software	E4438C ESG Compatible Software	E8267D PSG Compatible Software	Page
Mobile Communications					
3GPP W-CDMA	Signal Studio	N7600B	N7600B	N7600B	312
3GPP W-CDMA	Embedded	—	E4438C-400	—	312
3GPP W-CDMA HSPA (HSDPA/HSUPA)	Signal Studio	—	E4438C-419	—	312
LTE	Signal Studio	N7624B	N7624B	—	313
TD-SCDMA	Signal Studio	N7612B	N7612B	—	320
3GPP2 CDMA (IS-95, cdma2000®, 1xEV-DO Rev 0 & A)	Signal Studio	N7601B	N7601B	N7601B	318
IS-95 and cdma2000	Embedded	—	E4438C-401	—	317
GSM and EDGE	Signal Studio	N7602B	N7602B	N7602B	322
TDMA (GSM, EDGE, GPRS, EGPRS, NADC, PDC, PHS, DECT. TETRA)	Embedded	—	E4438C-402	—	322
Wireless Connectivity					
802.11 WLAN (a/b/g/p/j/n)	Signal Studio	N7617B	N7617B	N7617B	324
802.16-2004 WiMAX (OFDM Fixed WiMAX)	Signal Studio	N7613A	N7613A	N7613A	326
802.16 WiMAX (OFDMA Mobile WiMAX)	Signal Studio	N7615B	N7615B	N7615B	327
Bluetooth®	Signal Studio	—	E4438C-406	E8267D-H06	329
MB-OFDM UWB	Signal Studio	—	—	N7619A	330
Audio/Video Broadcasting					
Digital Video (DVB-T/H/C/S, ATSC, ISDB-T, DTMB)	Signal Studio	N7623B	N7623B	N7623B	331
S-DMB	Signal Studio	—	E4438C-407	—	332
T-DMB	Signal Studio	N7616B	N7616B	—	333
Detection, Positioning, Tracking & Navigation					
Pulse Building	Signal Studio	—	N7620A	N7620A	334
GPS	Embedded	—	E4438C-409	—	335
General RF & Microwave					
Toolkit	Signal Studio	N7622A	N7622A	N7622A	336
Calibrated Noise (AWGN)	Embedded	N5182A-403	E4438C-403	E8267D-403	337
Multitone Distortion (multitone and NPR for wideband using the N6030A or N8241A Arb)	Signal Studio			N7621A	338
Multitone Distortion (multitone and NPR for narrowband)	Signal Studio	N7621B	N7621B	N7621B	338
Jitter Injection	Signal Studio	—	E4438C-SP1	E8267D-SP1	340

For complementary signal analysis software, see Signal Analyzers – Measurement Applications and Personalities on page 96.

E4438C-400
N7600B
E4438C-419

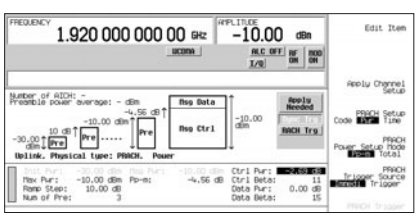
Mobile Communications

Agilent vector signal generators have built a solid reputation as the benchmark test stimulus in the mobile communications industry. A comprehensive suite of Signal Studio and embedded signal creation software is available for the development and manufacturing of existing and evolving 1G, 2G, 3G, and 4G mobile communications systems. Easily create reference signals for component level parametric test, baseband subsystem coding verification (ASICs, DSPs, etc.), and receiver performance characterization and functional evaluation. With systems and standards evolving to support broadband data and video services, Agilent MXG, ESG, and PSG vector signal generators equipped with Signal Studio and embedded signal creation software are ready to tackle your latest design and manufacturing test challenges.

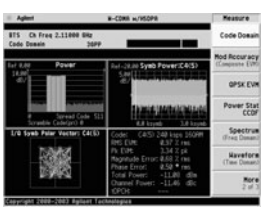
W-CDMA Product Comparison Table

	E4438C-400		N7600B	E4438C-419
	W-CDMA Arbitrary Waveform Playback	**W-CDMA Real-time Signal Generation**	**Signal Studio for W-CDMA FDD**	**Signal Studio for 3GPP W-CDMA HSPA**
Software Type	Embedded	Embedded	PC software	PC software
Access Method Supported	Frequency Division Duplex	Frequency Division Duplex	Frequency Division Duplex	Frequency Division Duplex
Specification Version	Updated as specifications change	Updated as specifications change	Updated as specifications change	Updated as specifications change
Primary Application	Component testing of W-CDMA and HSDPA amplifiers Example: testing ACPR and EVM where spectrally correct signals are needed of baseband ASICs	W-CDMA receiver testing Example: determining receiver sensitivity (BER/BLER) or verification	Component testing of W-CDMA amplifiers with HSDPA /HSUPA technology Example: testing ACPR and EVM where spectrally correct signals are needed	W-CDMA receiver testing of HSPA enabled radios Example: determining receiver sensitivity (BER/BLER)
Coding Level	Partially coded Supports physical layer coding, i.e. spreading and scrambling only turbo coding, interleaving, rate matching, etc	Fully coded Supports transport & physical layer coding, i.e.CRC, convolutional/	Partially coded Supports physical layer coding, i.e. spreading and scrambling only turbo coding, interleaving, rate matching, etc	Fully coded Supports transport & physical layer coding, i.e. CRC, convolutional/
Waveform Length	10 ms continuously repeated	Infinite	10 ms continuously repeated	Infinite
Filters	Standards based and custom	Standards based and custom	Standards based and custom	Standards based and custom
Baseband Clipping	Yes	No	Yes	No
Add AWGN to Signal	Yes	Yes	Yes	Yes
Compressed Mode	No	Yes	No	Uplink including HSUPA
Transmit Diversity	No	Yes	Yes	Yes
Real-time Power Control	No	Real-time control of DL TPC bits Real-time control of UL RF power level	No	Real-time control of UL RF power level
Number of Carriers	16	1	16	1
Number of DPCH Channels	512	2	512	1
Number of OCNS	512	16	512	16
Data Types	PN9, random, 8-bit pattern	PN9, PN15, user file, 4-bit pattern	PN9, random, user defined pattern	PN9, PN15, user defined pattern
Standards Based Setups	Test Models 1 through 5	Reference Measurement Channels and conformance tests	Test Models 1 through 5	Reference Measurement Channels and Fixed Reference Channels
Downlink Channels	C-PICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, PICH, DPCH, OCNS, HS-SCCH, HS-PDSCH	C-PICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH, OCNS	C-PICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, PICH, DPCH, OCNS, HS-SCCH, HS-PDSCH, E-AGCH, E-RGCH, E-HICH	C-PICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH, OCNS, HS-SCCH, HS-PDSCH, E-AGCH, E-RGCH, E-HICH
Uplink Channels	DPCCH, DPDCH	DPCCH, DPDCH, PRACH	DPCCH, DPDCH, HS-DPCCH, E-DPCCH, E-DPDCH	DPCCH, DPDCH, HS-DPCCH, E-DPCCH, E-DPDCH

Please refer to **www.agilent.com/find/signalcreation** for more details.



E4438C ESG configuration of the 3GPP W-CDMA uplink PRACH channel.



E4440A PSA screen image showing incrementing preamble power of the PRACH channel generated by the E4438C ESG.

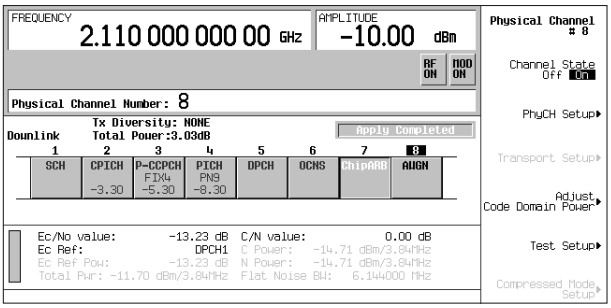
4

Signal Creation
- Single- and multi-carrier 3GPP W-CDMA with HSDPA
- Configure uplink and downlink channel parameters
- Presets for standards-based Test Models (1 – 5), Reference Measurement Channels and conformance tests
- Physical layer and transport layer coding enable component/amplifier testing and receiver/sensitivity testing

Additive Impairments
- I/Q impairments and real-time AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface
- Automate test with SCPI
- LAN and GPIB

Other Features
- Graphs: CCDF and CDP
- Internal software application
- Embedded help
- Advanced features include: Transmit diversity, compressed mode, DPCH/OCNS power balancing, and real-time power control



E4438C ESG configuration of AGWN added to W-CDMA.

E4438C-400 3GPP W-CDMA Embedded Software

Create a variety of W-CDMA FDD single/multi-carrier uplink/downlink test signals at baseband and RF. This option generates physical and transport layer coded signals required for evaluating both amplifiers and receivers in mobile handsets and base stations. This option is continually updated to provide you access to the latest W-CDMA features.

Specifications

See table on page 312

Ordering Information

E4438C-400

Signal Creation

- Single- and multi-carrier 3GPP W-CDMA with HSDPA/HSUPA
- Configure uplink and downlink channel parameters
- Presets for standards-based Test Models (1 – 5)
- High crest factor, time/phase offset, and clipping for amplifier/component test

Signal Generator Control and Additive Impairments

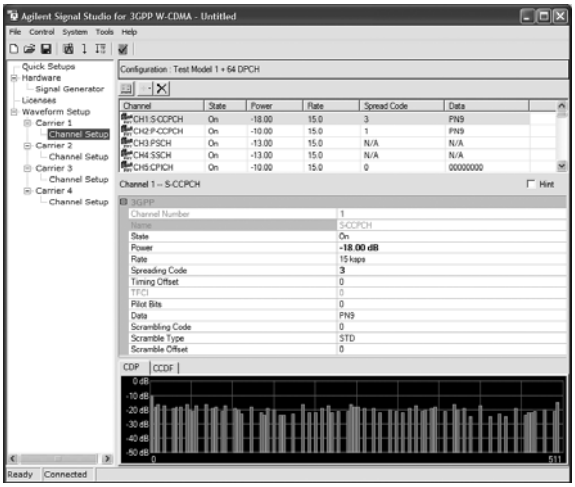
- Compatible signal generators: N5182A MXG, E4438C ESG, E8267D PSG
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time calibrated AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface

- Automate test with .NET API
- API HELP system
- LAN and GPIB

Other Features

- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license



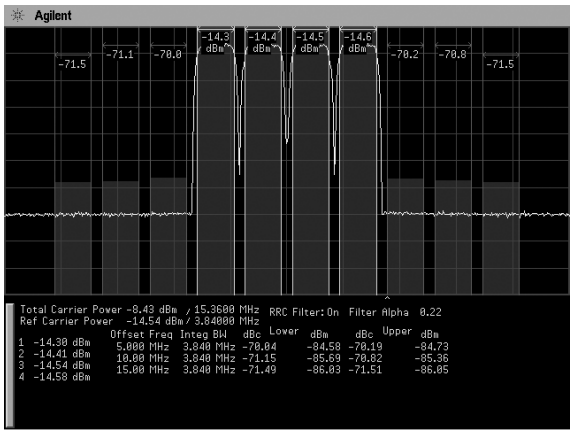
Signal Studio for W-CDMA FDD user interface configured for a 4-carrier Test Model 1 W-CDMA signal.

N7600B Signal Studio for 3GPP W-CDMA FDD

Create a variety of uplink and downlink W-CDMA FDD single and multi-carrier test signals at baseband and RF. This option generates physical layer coded signals required for evaluating amplifier performance in handsets and base stations. The latest W-CDMA uplink and downlink HSDPA and HSUPA channels are included for creating realistic crest factors. This option is continually updated to provide the latest W-CDMA test signals for component testing.

Industry-leading RF Performance with the Agilent N7600B and N5182A MXG Vector Signal Generator

Achieve extremely accurate design characterization of single and multi-carrier power amplifier designs with industry-leading ACLR performance when combined with the MXG vector signal generator.



E4440A PSA screen image showing a 4-carrier W-CDMA ACLR measurement.

Specifications

See table on page 312

Ordering Information

Signal Studio for 3GPP W-CDMA FDD
N7600B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7600B-2FP Connect to E8267D Signal Generator, Fixed, Perpetual License
N7600B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7600B-EFP Basic W-CDMA FDD , Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

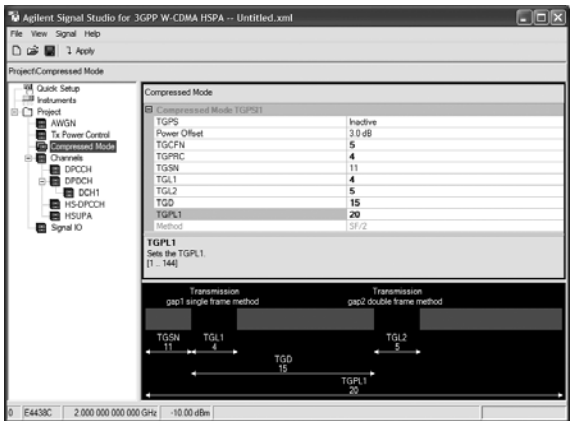
E4438C-419

Signal Creation
- **Single-carrier 3GPP W-CDMA with HSDPA/HSUPA**
- **Configure uplink and downlink channel parameters**
- **Perform AMC and HARQ tests**
- **Uplink real-time RF power control**
- **Uplink compressed mode**
- **Open loop transmit diversity**
- **Evaluate receiver BER/BLER with transport layer coded signals**

Signal Generator Control and Additive Impairments
- **Control frequency, amplitude, I/Q filtering, and more**
- **Real-time AWGN**
- **Real-time fading with Baseband Studio**

Automation and Communication Interface
- **Automate waveform playback with SCPI**
- **LAN and GPIB**

Other Features
- **Graphs: CDP, CQI pattern, ACK/NACK/DTX pattern**
- **Online documentation and embedded HELP**
- **FREE evaluation of software**



Signal Studio for 3GPP HSPA user interface configured for an uplink compressed mode W-CDMA signal.

E4438C-419 Signal Studio for 3GPP W-CDMA HSPA

Create a variety of uplink and downlink W-CDMA FDD HSPA single-carrier test signals at baseband and RF. This option generates physical and transport layer coded signals required for evaluating BER/BLER of HSDPA/HSUPA enabled receivers. The software includes transmit diversity, compressed mode, real-time power control, and AMC and HARQ capabilities for testing advanced functionality of receivers. This option is continually updated to provide the latest W-CDMA test signals for component testing.

Specifications

See table on page 312

Ordering Information

E4438C-419 Signal Studio for 3GPP W-CDMA HSPA

N7624B

Signal Creation
- Single- and multi-carrier 3GPP LTE signals
- Configure uplink and downlink channel parameters
- High crest factor and time/phase offset for amplifier/component test
- Early receiver test with user definable data payload

Signal Generator Control and Additive Impairments
- Compatible signal generators: N5182A MXG and E4438C ESG
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time calibrated AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface
- Automate test with .NET API
- API HELP system
- LAN and GPIB

Other Features
- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license

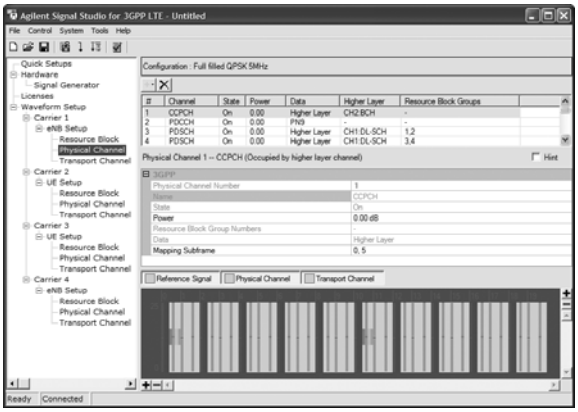
N7624B Signal Studio for 3GPP LTE

Agilent Validated and Performance Optimized 3GPP LTE Reference Signals

The N7624B Signal Studio for 3GPP LTE is a powerful software tool that simplifies the creation of 3GPP LTE signals compliant with the 3GPP specification. Easily generate complex 3GPP LTE reference signals which are validated and optimized for baseband/RF performance. Create your own user-defined signals with use of an intuitive graphical interface (GUI).

Industry-leading RF Performance with the Agilent MXG and ESG Vector Signal Generators

The N5182A MXG offers the industry-best adjacent-channel power (ACPR) performance and switching speeds, making it ideal for the characterization and evaluation of single and multicarrier power amplifiers. The E4438C ESG provides lower phase noise, excellent level accuracy, fading capabilities digital I/Q inputs and outputs, making it better suited for early receiver test.



Signal Studio for 3GPP LTE user interface showing the resource block configuration of a downlink signal.

Specifications

General Features

Transmission bandwidth: 1.4, 3.0, 3.2, 5, 10, 15, 20 MHz
Cyclic prefix: Normal, extended
Waveform generation length: 1 subframe, 1 Frame, 2 Frames
Multicarrier offset: ±37.5 MHz
AWGN power setting: Adjustable as C/N ratio
AWGN bandwidth setting: 1 Hz to 100 MHz

Downlink Features

Reference & Synchronization Channels
Reference signal power: –60 to 20 dB
Reference signal sequence: Adjustable per standard
Primary Synch signal power: –60 to 20 dB
Secondary Synch signal power: –60 to 20 dB

Physical Channels
CCPCH
- Power: –60 to 20 dB
- Data: PN9, PN15, user file
- Subframe Mapping: Adjustable per standard

PDCCH
- Power: –60 to 20 dB
- Data: PN9, PN15, user file

PDSCH
- Power: –60 to 20 dB
- Modulation: QPSK, 16QAM, 64QAM
- Data: PN9, PN15, user file
- Resource block configuration: Adjustable per standard

Uplink Features

Reference Signals
Demodulation reference signal power: –60 to 20 dB
Demodulation reference sequence number: Adjustable per standard
Demodulation reference signal offset: 0 to 99
Demodulation reference signal size: 1 to 100

Physical Channels
PUCCH
- Power: –60 to 20 dB
- Modulation: QPSK, 16QAM, 64QAM
- Data: PN9, PN15, user file
- Resource block configuration: Adjustable per standard

PUSCH
- Power: –60 to 20 dB
- Modulation: QPSK, 16QAM, 64QAM
- Data: PN9, PN15, user file
- Resource block configuration: Adjustable per standard

Ordering Information

Signal Studio for 3GPP LTE
N7624B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7624B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7624B-EFP Basic LTE (3GPP Std April 07), Fixed, Perpetual License

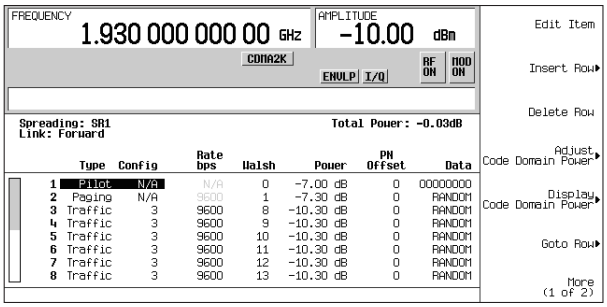
Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

Signal Creation
- Real-time and arb-based cdma2000; arb-based IS-95
- Single and multi-carrier forward and reverse link test signals
- Up to 12 carriers over a 30 MHz bandwidth
- Evaluate receiver BER, FER, and BLER with fully coded test signals

Additive Impairments
- I/Q impairments and real-time AWGN

Automation and Communication Interface
- Automate waveform playback with SCPI
- 10baseT LAN and GPIB

Other Features
- Internal software application



E4438C ESG configuration of a forward link cdma2000 signal for component testing.

E4438C-401 cdma2000 and IS-95-A Embedded Software

Create a variety of cdma2000 and IS-95-A single/multi-carrier forward/reverse link test signals at baseband and RF. This software generates physical and transport layer coded signals required for evaluating both amplifiers and receivers in mobile handsets and base stations and is continually updated to provide you access to the latest cdma2000 & IS-95-A features.

Key Features

	E4438C-401		
	IS-95-A Arbitrary Waveform Playback	**cdma2000 Arbitrary Waveform Playback**	**cdma2000 Real-Time Signal Generation**
Software Type	Embedded	Embedded	Embedded
Primary Application	Component testing	Component testing	Receiver testing and ASIC baseband verification
Signal Coding Level	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Fully coded Supports CRC, convolutional/ turbo coding, interleaving, power control and complex scrambling
Waveform Length	26.67 ms	26.67 ms	Infinite
Filters	Standards and custom based	Standards and custom based	Standards and custom based
Baseband Clipping	Yes	Yes	No
Add AWGN to Signal	Yes	Yes	Yes
Number of Carriers	12	12	1
Number of Channels per Carrier	Up to 256	Up to 256	Up to 8 forward link Up to 5 reverse link
Forward Link Channels	Pilot, Paging, Synch, Traffic	Pilot, Paging, Synch, Traffic, Supplemental 1 & 2 Traffic	F-PICH, F-SYNCH, F-QPCH, F-PCH, F-FCH, F-SCH1, F-SCH2, OCNS
Reverse Link Channels	Pilot, Paging, Synch, Traffic	Pilot, Paging, Synch, Traffic, Supplemental 1 & 2 Traffic	R-PICH, R-ACH, R-EACH, R-DDCH, R-CCCH, R-SCH1, R-SCH2

Please refer to **www.agilent.com/find/signalcreation** for more details.

Ordering Information

E4438C-401

N7601B

Signal Creation

- Single- and multi-carrier 3GPP2 cdma2000 and 1xEV-DO (Rev. 0 & A)
- Configure forward and reverse link channel parameters
- Basic options: create partially coded signals for component test
- Advanced options: create fully coded 1xEV-DO FTM signals for receiver test

Signal Generator Control and Additive Impairments

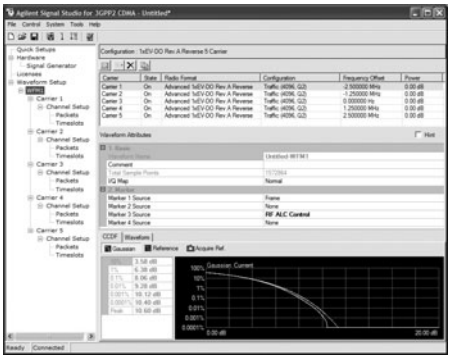
- Compatible signal generators: N5182A MXG, E4438C ESG, E8267D PSG
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface

- Preset configurations for quick setup
- Automate test with .NET API
- API HELP system
- LAN and GPIB

Other Features

- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license



Signal Studio for 3GPP2 CDMA configuration for 5 carrier reverse link 1xEV-DO Rev. A signal.

N7601B Signal Studio for 3GPP2 CDMA

Create basic forward and reverse link IS-95A/cdma2000/1xEV-DO single and multicarrier test signals at baseband and RF. The IS-95A and cdma2000/1xEV-DO signals are generated with the physical layer coding needed for obtaining proper spectral shape and statistics for evaluating amplifier performance. The forward link 1xEV-DO test signals can also be generated with higher layer coding for determining receiver performance.

4

	N7601B			
	IS-95 Array Waveform Playback (basic)	**cdma2000 Waveform Playback (basic)**	**1xEV-DO Rev 0 & Rev A, Waveform Playback (basic)**	**1xEV-DO Rev 0 & Rev A, Waveform Playback (advanced)**
Software Type	PC software	PC software	PC software	PC software
Specification Version	Updated as specifications change	Updated as specifications change	Updated as specifications change	Updated as specifications change
Primary Application	Amplifier/ Component testing Example: testing ACPR and EVM where spectrally correct signals are needed	Amplifier/ Component testing Example: testing ACPR and EVM where spectrally correct signals are needed	Amplifier/ Component testing Example: testing ACPR and EVM where spectrally correct signals are needed	1xEV-DO receiver testing Example: determining receiver sensitivity (PER)
Coding Level	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Fully coded Supports transport & physical layer coding, i.e. CRC, convolutional / turbo coding, interleaving, rate matching, etc
Forward/Reverse Signals	Yes	Yes	Yes	Yes
Filters	Standards based and custom	Standards based and custom	Standards based and custom	Standards based and custom
Baseband Clipping	Yes	Yes	Yes	Yes
Add AWGN to Signal	Yes	Yes	Yes	Yes
Carrier Configuration	Mixed mode	Mixed mode	Mixed mode	Mixed mode
Number of Carriers	25	25	25	25
Number of Channels per Carrier	Forward 64, Reverse 1	Forward 256, Reverse 8	1	1
Data Types	PN9, random, user defined pattern	PN9, random, user defined pattern	PN9, PN15, user defined pattern	PN9, PN15, user defined pattern
Standards Based Setups	Yes	Yes	Yes	Yes
Forward Link Channels	Pilot, Paging, Traffic, Synch	Pilot, Paging, Traffic, Synch, Supplemental1 Traffic, Supplemental2 Traffic	Standards based channels with selectable data rate for traffic channel	Standards based channels with selectable data rate for traffic channel
Reverse Channels	Traffic	Pilot, Dedicated Control, Traffic, Supplemental1 Traffic, Supplemental2 Traffic	Standards based channels with selectable data rate for traffic channel	Standards based channels with selectable data rate for traffic channel

Please refer to **www.agilent.com/find/signalcreation** for more details.

Ordering Information

Signal Studio for 3GPP2 CDMA
N7601B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7601B-2FP Connect to E8267D Signal Generator, Fixed, Perpetual License
N7601B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7601B-EFP Basic cdma2000, Fixed, Perpetual License
N7601B-FFP Basic 1xEV-DO, Fixed, Perpetual License
N7601B-RFP Advanced 1xEV-DO, Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

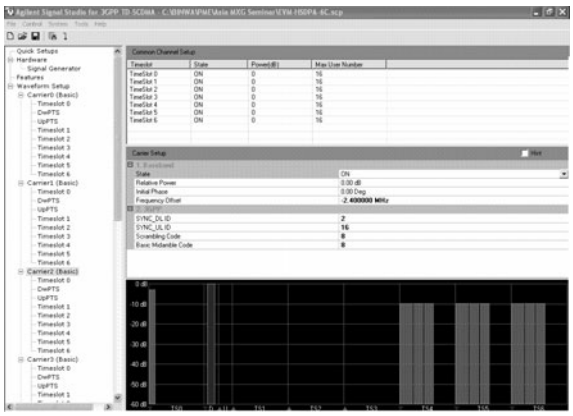
N7612B

Signal Creation
- Single and multi-carrier 3GPP TD-SCDMA LCR with HSDPA
- Configure uplink and downlink transport and physical channels
- Basic options: create partially coded signals for component test
- Advanced options: create fully coded signals for receiver test

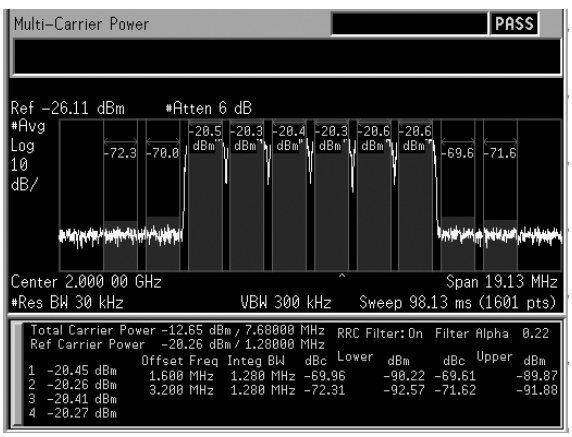
Signal Generator Control and Additive Impairments
- Compatible signal generators: N5182A MXG/E4438C ESG
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface
- Preset configurations for quick setup
- Automate test with .net API and SCPI
- API HELP system
- LAN and GPIB

Other Features
- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license



Signal Studio for TD-SCDMA configuration for 6 carrier downlink signal.



6 carrier TD-SCDMA downlink signal ACLR.

N7612B Signal Studio for TD-SCDMA

Easily Configure Standards-based TD-SCDMA LCR Reference Signals

The N7612B Signal Studio software is used to configure partially or fully coded arbitrary baseband I/Q waveforms for testing TD-SCDMA components (amplifiers, filters, etc.), transmitters, receivers and chipsets. It complies with 3GPP TDD LCR standards and Chinese TD-SCDMA (CWTS) standards and can generate multi-carrier signals (up to 12 carriers) for both LCR and HSDPA.

The software supports a connection with the Agilent N5182A MXG and E4438C ESG vector signal generators and delivers the best ACLR performance for component test, as well as fast switching speeds for manufacturing, when paired with the Agilent MXG.

The N7612B is an enhancement to the N7612A; a free upgrade is provided.

Specifications

Performance Characteristics[1]

EVM – E4438C ESG Vector Signal Generator[2]

Carrier Settings	Characteristic Value[3]	Performance Range[4]
2.01GHz/–10 dBm	–43.7 dB (0.65%)	–49.4 to –43.2 dB (0.34 to 0.69%)

ACLR – E4438C ESG Vector Signal Generator[2]

Carrier Settings[5]	Characteristic Value[3]	Performance Range[4]
Single Carrier: 2.01 GHz/–10 dBm	–68.21 dB	–70.0 to –68.2 dB
3 Carriers: 2.01 GHz/–10 dBm	–60.05 dB	–64.6 to –58.9 dB
6 Carriers: 2.01 GHz/–10 dBm	–58.02 dB	–61.3 to –57 dB

EVM – N5182A MXG Vector Signal Generator[6]

Carrier Settings	Characteristic Value[3]	Performance Range[4]
2.01 GHz/–10 dBm	–43.7 dB (0.65%)	–50.4 to –42.4 dB (0.30 to 0.76%)

ACLR – N5182A MXG Vector Signal Generator[6]

Carrier Settings[5]	Characteristic Value[3]	Performance Range[4]
Single Carrier: 2.01 GHz/–10 dBm	–76.10 dB	–76.9 to –76.1 dB
3 Carriers: 2.01 GHz/–10 dBm	–69.34 dB	–73 to –68.5 dB
6 Carriers: 2.01 GHz/–10 dBm	–66.13 dB	–70.2 to –65.3 dB

[1] Performance characteristics apply to TD-SCDMA waveforms using 16QAM modulation.
[2] E4438C ESG vector signal generator with Option UNB.
[3] Non-warranted value based on testing during development phase of this product. The majority of instruments tested met this value.
[4] Non-warranted range based on testing during development phase of this product. All instruments tested performed within this range.
[5] TD-SCDMA Carrier for ACLR measurement setup included Timeslot 0 with 2 codes, plus DwPTS. For multi-carrier, the SYNC-DL ID, scramble code, and basic midamble code applied for each carrier are different.
[6] N5182A MXG vector signal generator with Option UNV.

Parameter Summary

General
Specification version: Refer to Supported Standards for a detailed listing
Scramble code: 0 to 127
Midamble base: 0 to 127
Max users: 2, 4, 6, 8, 10,12, 14, or 16
Switching point: 1 to 6
Runtime scaling: 10 to 200%
Oversampling ratio: 2 to 32
Chip rate: 1.28 Mcps
Baseband filtering: Root Nyquist, Nyquist, Gaussian, rectangle
Alpha (Root Nyquist or Nyquist filters): 0 to 1.00
Trigger signals:
- Inputs: Frame synchronization trigger
- Outputs: ALC control RF blanking 5, 10, 20, 40, 80 ms frame pulse

AWGN:
- C/N: –100 to 100 dB
- In-channel power: noise power in a 1.28 MHz BW

Uplink/Downlink
Physical layer: Dedicated physical channel (User-defined DPCH)
- Power: –60 to 0 dB
- Transmit time offset: –8 to 8 chips (uplink only)
- Allocated resource units: depends on timeslot and resource unit availability
- Data source: STD, PN9, PN15, user file

Transport format combination indicator pattern (TFCI)
- Value: Binary data up to 10 bits, LSB first

Synchronization shift pattern: PN9, PN15, user file
Transmit power control pattern: PN9, PN15, user file
Number of DCH: 1 to 4
Puncture limit: 0 to 15
Second interleaver type: Frame related, timeslot related
Transport layer: DCH
- Data source: PN9, PN15, user
- Block size: 0 to 5000
- Number of blocks: 1 to 512
- Coding type: 1/2 convolution, 1/3 convolution, 1/3 turbo
- CRC size: 0, 8, 12, 16, 24
- TTI: 5, 10, 20, 40, 80 ms
- Rate matching attribute: 1 to 256

$DPCH_0$ (OCNS): Available in all timeslots, add up to 16 channels per timeslot

Ordering Information

Signal Studio for 3GPP2 CDMA
N7612B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7612B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7612B-EFP Basic TD-SCDMA, Fixed, Perpetual License
N7612B-RFP Advanced TD-SCDMA, Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

E4438C-402
N7602B

GSM/EDGE Product Comparison Table

	E4438C-402	N7602B
	TDMA Suite (GSM, GPRS, EDGE, EGPRS, NADC, PDC, PHS, TETRA, DECT)	**Signal Studio for GSM/EDGE**
Software Type	Embedded	PC software
Specification Version	Updated as specifications change	Updated as specifications change
Primary Application	Receiver and ASIC stimulus	Component (e.g. MCPA) and interfere stimulus
Typical Tests	BER, FER, BLER, RBER	Transmit power, modulation accuracy, OBW, ACP, ORFS, etc.
Number of Carriers	1	25
Carrier Types	Framed, Continuous Pattern	Framed, Continuous Pattern
Channel Coding	TCH/FS, CS-1, MCS-1, MCS-5, MCS-9, E-TCH/43.2NT	None
Burst Types	GSM, EDGE, mixed GSM and EDGE, sync, Fcorr, access, dummy, custom	GSM, EDGE, mixed GSM and EDGE, sync, Fcorr, access, dummy, custom
Data Types	PN9, PN11, PN15, PN20, PN23 Fixed 4, 8, 16, 32, 64 bit patterns, user-defined	PN9, PN15, user-defined
Pre- and Post-FIR Filter Clipping	No	Yes
Add AWGN to Signal	No	Yes
Platforms Supported	E4438C ESG	E4438C ESG, N5182A MXG, E8267C PSG
Automated Signal Configuration	SCPI	.NET API
Automated Waveform Playback	SCPI	—

Please refer to **www.agilent.com/find/signalcreation** for more details.

Signal Creation
- Single-carrier GSM, GPRS, EDGE, EGPRS, NADC, PDC, PHS, TETRA, and DECT
- Apply framing or use non-framed data
- Modify signal parameters in real-time: data type, modulation type, symbol rate, filter type, burst shape, and more
- Evaluate BER/FER/BLER with fully coded GSM and EDGE test signals
- GSM and EDGE timeslots in the same frame
- Import or select from built-in data patterns: PRBS, fixed bit patterns, user file

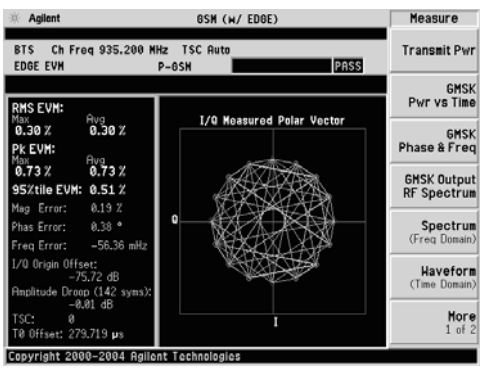
Signal Generator Control and Additive Impairments
- Compatible signal generators: E4438C ESG
- I/Q impairments
- Real-time fading with Baseband Studio

Automation and Communication Interface
- Save configurations for quick setup
- Automate waveform playback with SCPI
- 10baseT LAN and GPIB

Other Features
- Embedded software application – no PC required

E4438C-402 TDMA Suite Embedded Personality

The real-time TDMA personality for the E4438C ESG is a flexible signal creation suite for GSM, GPRS, EDGE, EGPRS, NADC, PDC, PHS, TETRA, and DECT. The TDMA personality enables the generation of development and manufacturing test signals for 2G and 2.5G mobile radios, base stations, and their components. Signal parameters are configured directly from the ESG front panel using a simple table-based interface or programmatically using SCPI over the LAN or GPIB interface.



E4440 PSA screen Image showing an EDGE constellation diagram generated by the E4438C ESG.

Ordering Information

E4438C-402 TDMA Personalities
(GSM, EDGE, NADC, PDC, PHS, DECT, TETRA)

Signal Creation
- Single and multi-carrier arbitrary waveform GSM/EDGE test signals
- Reduce crest factor of multi-carrier signals with pre- or post-FIR filter clipping
- Partially coded signals for component test
- Predefined GMSK and 8PSK carrier configurations
- Adjustable timeslot parameters: power level, burst type, and more

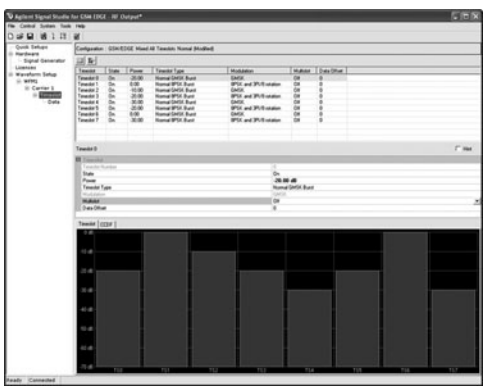
Signal Generator Control and Additive Impairments
- Compatible signal generators: N5182A MXG, E4438C ESG, E8267D PSG
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time calibrated AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface
- Save configurations for quick setup
- Automate test with .net API
- API HELP system
- LAN and GPIB

Other Features
- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license

N7602B Signal Studio for GSM/EDGE

N7602B Signal Studio for GSM/EDGE is a powerful software tool that simplifies creation of GSM and EDGE arbitrary waveform test signals compliant with 3GPP specifications. Easily generate GSM and EDGE reference signals which are validated and optimized for baseband/RF performance. Choose from a broad collection of predefined physical layer setups or use the intuitive graphical interface (GUI) to quickly configure a variety of signal parameters to effectively test your device.



Signal Studio for GSM/EDGE user interface showing individual timeslot power control.

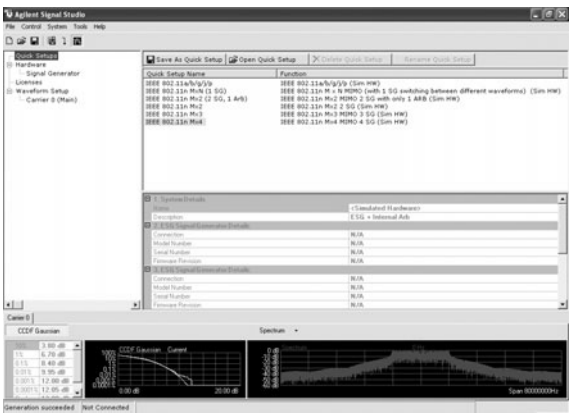
Ordering Information

N7602B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7602B-2FP Connect to E8267D Signal Generator, Fixed, Perpetual License
N7602B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7602B-EFP Basic GSM/EDGE, Fixed, Perpetual License

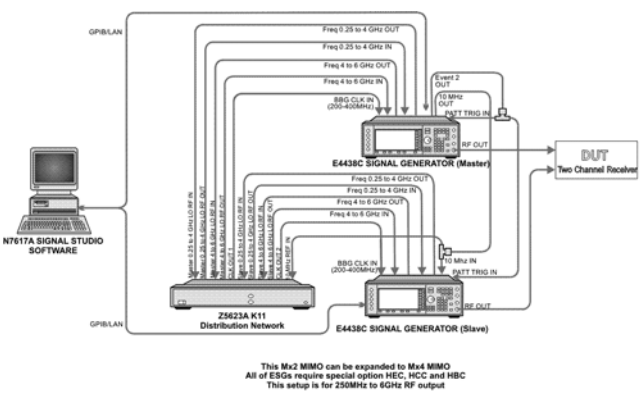
Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

Wireless Connectivity

The race to broadband wireless connectivity is accelerating, and Agilent is helping you meet your time to market needs by delivering the signal creation solutions you need, when you need them. For use with the Agilent MXG, ESG, and PSG vector signal generators, Signal Studio software provides an intuitive, application-specific graphical interface to create Agilent validated and performance optimized reference signals for WiMAX, WLAN, *Bluetooth*, and UWB. Signal Studio offers basic capabilities to create partially coded, statistically correct signals for component and transmitter test and advanced capabilities to create fully channel coded signals for receiver BER/PER/FER analysis. Easily add calibrated signal impairments and AWGN to evaluate receiver tolerance to dirty transmitters and channel effects. So as you move new wireless connectivity standards forward, Agilent is here to clear the way with solutions like Signal Studio.



Signal Studio for WLAN configuration for WLAN 802.11n signal.



Signal generator connection for 2 x 2 phase coherent MIMO test.

Signal Creation

- Single- and multi-carrier 802.11 a/b/g/j/p WLAN
- 802.11n MIMO system test with channel simulation: 2 x 2, 2 x 3, 2 x 4, 3 x 3, 3 x 4 and 4 x 4
- Basic options: create partially coded signals for component test
- Advanced options: create fully coded signals for receiver test

Signal Generator Control and Additive Impairments

- Compatible signal generators: N5182A MXG/E4438C ESG
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface

- Preset configurations for quick setup
- Automate test with .net API and SCPI
- API HELP system
- LAN and GPIB

Other Features

- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license

N7617B Signal Studio for 802.11 WLAN

Create 802.11 WLAN Waveforms

N7617B Signal Studio for 802.11 WLAN is flexible signal creation software designed to create standards-based BB and RF reference signals for testing 802.11a/b/g/j/p/n WLAN receivers and components with N5182A MXG, E4438C ESG and E8267D PSG signal generators. For receiver test, the application provides full channel coding for BER/BLER/FER. For component test, the application provides partially coded, statistically correct waveforms for stimulus/response testing. Free upgrades provide advanced 802.11a/b/g/j/p functionality for Options E4438C-417 and E8267D-H17.

Specifications

EVM Comparison

802.11a/g/j/p OFDM			
ESG E4438C EVM	<1% (typical)	@2.4/5.8 GHz	≤–1 dBm
ESG E8267D EVM	<0.8% (typical)	@2.4 GHz	≤–1 dBm
MXG N5812A EVM	<0.6% (typical)	@2.4/5.8 GHz	≤ 2 dBm
MXG N5812A EVM	<0.6% (typical)	@5.8 GHz	≤–7 dBm
PSG E8267D EVM	<0.6% (typical)	@5.8 GHz	≤6 dBm
802.11b/g DSSS			
ESG E4438C EVM	<1% (typical)	@2.4 GHz	≤–1 dBm
MXG N5812A EVM	<0.6% (typical)	@2.4 GHz	≤0 dBm
PSG E8267D EVM	<0.7% (typical)	@2.4 GHz	≤8 dBm
802.11n OFDM			
ESG E4438C EVM	<1% (typical)	@2.4 GHz	≤5 dBm
ESG E4438C EVM	<1% (typical)	@5.8 GHz	≤0 dBm

- Instrument and software settings are listed below. The EVM was measured with an 89641A vector signal analyzer with Option B7R
- EVM 1% = –40 dB, 0.5% = –46 dB

Performance Characteristics

802.11a/g/j/p OFDM

N5182A Vector Signal Generator

• EVM	<0.6% (typical)	@2.4 GHz	2 dBm
	<0.6% (typical)	@5.8 GHz	–7 dBm
	<1% (typical)	@5.8 GHz	0 dBm
			>–7 dBm

Instrument and software settings are listed below. The EVM was measured with an 89641A vector signal analyzer with Option B7R

Software Settings
- Data rate: 54 Mbps
- Modulation: 64 QAM
- Encoder: 3/4
- Scrambler: On
- Interleaver: On
- Scrambler initialization: 5D
- Support carrier setup:all channels active
- Idle interval: 100 µs
- OSR: 2
- Window length: 8
- Data type: PN15
- Data length: 1024

Signal Generator Settings
- Reconstruction filter: thru
- ALC: On
- RF blanking: Off
- Modulation Attenuation: 8 to 10 dBm

89641A Settings
- Frequency: 2.4/5.8 GHz
- Span: 20 MHz
- Range: optimal
- RMS video average: 20

802.11b/g DSSS

N5182A Vector Signal Generator

• EVM	< 0.6% (typical)	@2.412 GHz	0 dBm

Instrument and software settings are listed below. The EVM was measured with an 89641A vector signal analyzer with Option B7R

Software Settings
- Data rate: 11 Mbps
- High Rate Modulation: CCK
- DSSS Scrambler: On
- Interleaver: On
- Idle interval: 100 us
- OSR: 2
- Data type: PN15
- Data length: 1024

Signal Generator Settings
- Reconstruction filter: thru
- ALC: On
- RF blanking: Off
- Modulation Attenuation: 8 to 10 dBm

89641A Settings
- Frequency: 2.4/5.8 GHz
- Span: default for the standard
- Range: optimal
- RMS video average: 20

Ordering Information

Signal Studio for 3GPP2 CDMA
N7617B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7617B-2FP Connect to E8267D Signal Generator, Fixed, Perpetual License*
N7617B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7617B-EFP Basic 802.11a/b/g/j/p WLAN, Fixed, Perpetual License
N7617B-RFP Advanced 802.11a/b/g/j/p WLAN, Fixed, Perpetual License
N7617B-FFP Basic 802.11n WLAN, Fixed, Perpetual License
N7617B-QFP Advanced 802.11n WLAN, Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

* The E8267D PSG does not support 802.11n.

N7613A-101
N7613A-102
N7613A-SW1

Signal Creation

- **Single-carrier 802.16-2004 (fixed WiMAX)**
- **Configure uplink and downlink channel parameters**
- **Set bandwidth, cyclic prefix ratio (G), sampling factor (n), frame length, preamble, FCH and data bursts**
- **Choose raw or fully coded data (with randomization, Reed-Solomon convolutional coding, and interleaving) and create MAC PDUs including headers and CRC**

Signal Generator Control and Additive Impairments

- **Compatible signal generators: N5182A MXG, E4438C ESG, E8267D PSG**
- **Control frequency, amplitude and ALC, waveform scaling, triggers, markers, and more I/Q impairments and real-time AWGN Real-time fading with Baseband Studio**

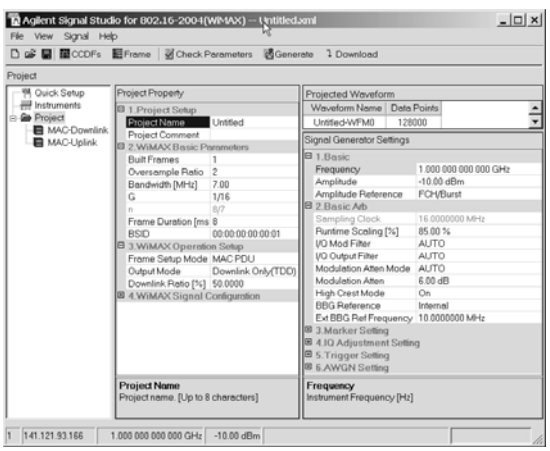
Automation and Communication Interface

- **Automate waveform playback with SCPI**
- **LAN and GPIB**

Other Features

- **Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, frame structure**
- **Online documentation and embedded HELP**
- **FREE 14-day trial license – automatically enabled**

Summary of fixed WiMAX frame structure indicating burst types, modulation formats, data types, and more. Graphical plot of frame, CCDF curves, spectrum, and waveform spectrum.



Intuitive user interface allows quick creation of fixed WiMAX standard compliant signals with easy to use pull down menus as well as control of most signal generator settings.

N7613A Signal Studio for 802.16-2004 (WiMAX)

Signal Studio for 802.16-2004 (WiMAX) enables you to create fixed WiMAX waveforms compliant with the IEEE standard and download them to the N5182A MXG, E4438C ESG, or E8267D PSG vector signal generator for playback. The software provides a simple graphical user interface to configure uplink and downlink waveforms with the signal parameters that meet your specific component and receiver test needs.

Specifications

- **Bandwidth**
  1.25 – 28 MHz
- **Modulation Formats**
  BPSK, QPSK, 16-QAM, 64-QAM
- **Cyclic Prefix Ratios (G)**
  1/4, 1/8, 1/16, 1/32
- **Frame Setup**
  Physical Layer or MAC PDU
- **Payload Data Types**
  1s, 0s, 01s, 10s, BPSK, QPSK, 16-QAM, 64-QAM, PN9, PN15, user file
- **Payload Data Length**
  23 bytes
- **User Data Maximum Length**
  349,056 bytes or 2,972,448 bits
- **Encoding Rates**
  1/2, 2/3, 3/4
- **Output Modes**
  TDD, FDD, Half duplex FDD
- **EVM – E4438C ESG Vector Signal Generator**

Carrier Settings	Characteristic Value[1]	Performance Range[2]
2.5 MHz/–20 dBm	–46 dB (0.5%)	–49.2 to –42.5 dB
3.5 MHz/–20 dBm	–42 dB (0.7%)	–46.4 to –38.7 dB
5.8 MHz/–20 dBm	–48 dB (0.4%)	–50.4 to –45.8 dB

- **EVM – E8267D PSG Vector Signal Generator[3]**

Carrier Settings	Characteristic Value[1]	Performance Range[2]
2.5 MHz/–20 dBm	–44 dB (0.6%)	–49.2 to –40.2 dB
3.5 MHz/–20 dBm	–42.5 dB (0.7%)	–48.6 to –36.8 dB
5.8 MHz/–20 dBm	–44 dB (0.6%)	–49.1 to –37.1 dB

- **EVM – N5182A MXG Vector Signal Generator**

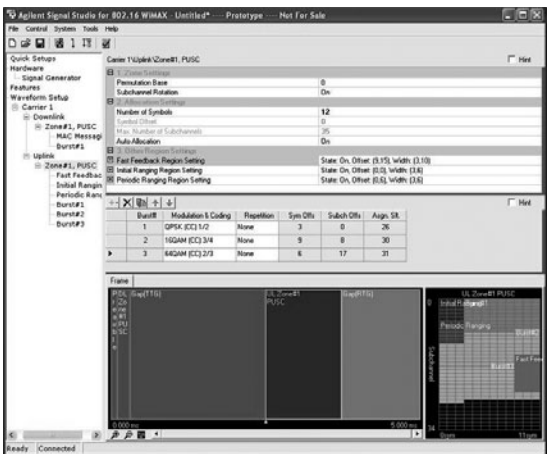
Carrier Settings	Characteristic Value[1]	Performance Range[2]
2.5 MHz/–20 dBm	–45 dB (0.6%)	–50.9 to –42.1 dB (0.3 to 0.8%)
3.5 MHz/–20 dBm	–45 dB (0.6%)	–50.3 to –42.2 dB (0.3 to 0.8%)
5.8 MHz/–20 dBm	–43.6 dB (0.7%)	–48.3 to –41.7 dB (0.4 to 0.8%)

Ordering Information

N7613A-101 License: E4438C ESG
N7613A-102 License: E8267D PSG
N7613A-SW1 License N5182A MXG

[1] Non-warranted value based on testing during development phase of this product. The majority of instruments tested met this value.
[2] Non-warranted range based on testing during development phase of this product. All instruments tested performed within this range.
[3] Performance characteristics based on PSG signal generators with the standard pulse modulation option, E8267D-UNU. EVM performance degrades without this option.

- **Single- and multi-carrier 802.16 mobile WiMAX and WiBRO**
- **Flexible downlink and uplink (or both) frame configuration: zones, bursts, and MAC PDUs**
- **Permutation zones: PUSC, FUSC, OPUSC, AMC, OFUSC**
- **AMC 2 x 3 zones, ranging, fast feedback**
- **Support for Matrix A (STC), Matrix B (2x2 MIMO), and uplink collaborative spatial multiplexing**
- **Bursts and zones allocated by subchannels and symbols**
- **Subchannels divided into segments (BTS sectors)**
- **Basic capability: create partially coded signals for component test**
- **Advanced capability: create fully coded signals for receiver test**
- **Control frequency, amplitude and ALC, waveform scaling, triggers, markers, and more**
- **I/Q impairments and real-time AWGN**
- **Automate test with .net API and SCPI**
- **API HELP system**
- **New licensing featuring transportable or fixed licenses and perpetual or time-based licenses**
- **LAN and GPIB**



Summary of a mobile WiMAX frame structure showing burst types, modulation formats, data types and more.

Intuitive user interface allows quick creation of mobile WiMAX standard-compliant signals with easy to use pull-down menus, as well as control of most signal generator settings. Graphical plot of CCDF curves, spectrum, and power envelope can be displayed.

N7615B Signal Studio for 802.16 WiMAX

N7615B Signal Studio for 802.16 WiMAX is a flexible signal creation software tool which simplifies the design and test of components and receivers for WiBro and mobile WiMAX (802.16e). This user-friendly software is equipped with an intuitive graphical interface that lets you easily create waveforms compliant with IEEE 802.16-2004 and 802.16e-2005 standards, and provides convenient access to the physical layer parameters and basic MAC layer parameters. Easily download WiMAX waveform files to the N5182A MXG, E4438C ESG, or E8267D PSG vector signal generators for instant playback.

Optional capabilities provide application-specific customization with basic capabilities targeted for component design and test or advanced capabilities for receiver design and test. Flexible licensing provides a product structure that allows for fixed or transportable licenses as well as perpetual or time-based licenses, so you only pay for the capabilities you need.

Specifications

- **Bandwidth**
  1.25 – 28 MHz
- **Modulation Formats**
  BPSK, QPSK, 16-QAM, 64-QAM
- **Cyclic Prefix Ratios (G)**
  1/4, 1/8, 1/16, 1/32
- **Frame Setup**
  Physical Layer or MAC PDU
- **Payload Data Types**
  1s, 0s, 01s, 10s, BPSK, QPSK, 16-QAM, 64-QAM, PN9, PN15, user file
- **Payload Data Length**
  23 bytes
- **User Data Maximum Length**
  349,056 bytes or 2,972,448 bits
- **Encoding Rates**
  1/2, 2/3, 3/4
- **Output Modes**
  TDD, FDD, Half duplex FDD
- **EVM[1] – N5182A MXG Vector Signal Generator**

Carrier Settings	Characteristic Value[2]	Performance Range[3]
2.5 GHz/–20 dBm	–48.5 dB (0.4%)	–51.2 to –48.4 dB (0.27 to 0.38%)
3.5 GHz/–20 dBm	–46.0 dB (0.5%)	–48.6 to –45.7 dB (0.37 to 0.52%)

- **EVM[1] – E4438C ESG Vector Signal Generator**

Carrier Settings	Characteristic Value[2]	Performance Range[3]
2.5 GHz/–20 dBm	–48.5 dB (0.4%)	–51.4 to –48.0 dB (0.27 to 0.40%)
3.5 GHz/–20 dBm	–46.0 dB (0.5%)	–50.2 to –44.7 dB (0.31 to 0.58%)

- **EVM[1] – E8267D PSG Vector Signal Generator**

Carrier Settings	Characteristic Value[2]	Performance Range[3]
2.5 GHz/–20 dBm	–48.1 dB (0.4%)	–52.4 to –47.4 dB (0.24 to 0.43%)
3.5 GHz/–20 dBm	–48.9 dB (0.5%)	–42.7 to –48.3 dB (0.23 to 0.38%)

Key Literature & Web Link

Agilent MXG Signal Generator Configuration Guide, p/n 5989-5485EN
Agilent ESG Signal Generator Configuration Guide, p/n 5989-4085EN
Agilent PSG Signal Generator Configuration Guide, p/n 5989-1326EN
WiMAX Concepts and RF Measurements Application Note, p/n 5989-2027EN

For more information, visit our web site:
www.agilent.com/find/SignalStudio

Ordering Information

N7615B-1FP License: E4438C ESG
N7615B-2FP License: E8267D PSG
N7615B-3FP License: N5182A MXG

N7615B-EFP Basic 802.16 OFDMA
N7615B-FFP Advanced 802.16 OFDMA

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at
www.agilent.com/find/signalcreation

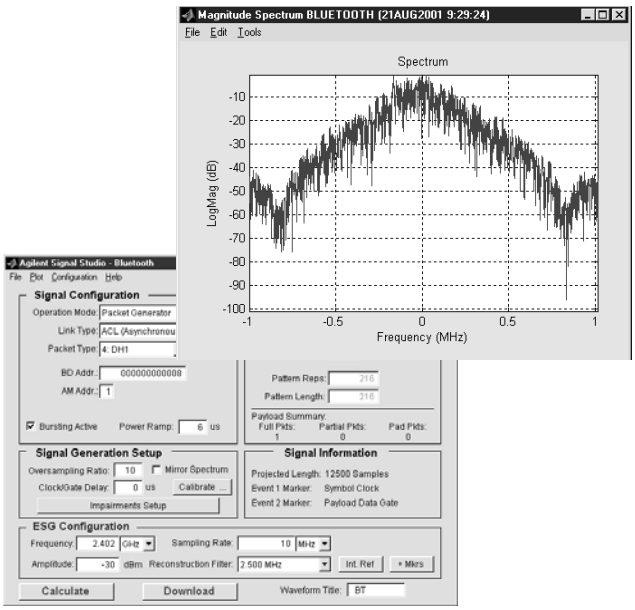
[1] Waveform parameter settings:
Multiple DL-PUSC waveforms were used in different settings:
Bandwidths/FFTs = 5 MHz/512, 10 MHz/1024, and 20 MHz/2048
Burst length = 30 symbols, 5 ms frame length
Modulation types = QPSK and 64QAM
Symbol rolloff = 2.78% (5 MHz and 20 MHz BW), 5.56% (10 MHz BW)
[2] Non-warranted value based on testing during development phase of this product. The majority of instruments tested met this value.
[3] Non-warranted range based on testing during development phase of this product. All instruments tested performed within this range.

Signal Creation
- Configure fully-coded Bluetooth packets and Bluetooth modulated data streams
- Dirty transmitter test setup for receiver sensitivity tests using DH1, DH3, and DH5 packet types
- Simple BER test optimization using BER vs. payload gate delay plot results
- Data stream and packet payload types: PN9, PN15, 8-bit pattern, custom user file

Signal Generator Control and Additive Impairments
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers and more
- Signal impairments: carrier frequency offset, symbol timing error, modulation index, AWGN and more
- Real-time fading with Baseband Studio

Communication Interface
- Automate waveform playback with SCPI
- 10baseT LAN and GPIB

Other Features
- Graphs: I(t), Q(t), I(t) Q(t) overlayed, CCDF
- Online documentation
- FREE evaluation of software interface



Bluetooth™ user interface with spectrum plot of generated waveform.

E4438C-406 Signal Studio for *Bluetooth*™

Create fully-coded, standards-based *Bluetooth* packets and Bluetooth modulated data streams on your PC and download the waveforms to the E4438C ESG internal baseband generator for playback. Thoroughly test Bluetooth transceiver's RF and baseband subsections with fully-coded Bluetooth packets and continuous PN data patterns for BER and PER analysis. To simplify BER test setup, an automated clock/gate/payload delay adjustment optimization routine is provided in the software.

Specifications

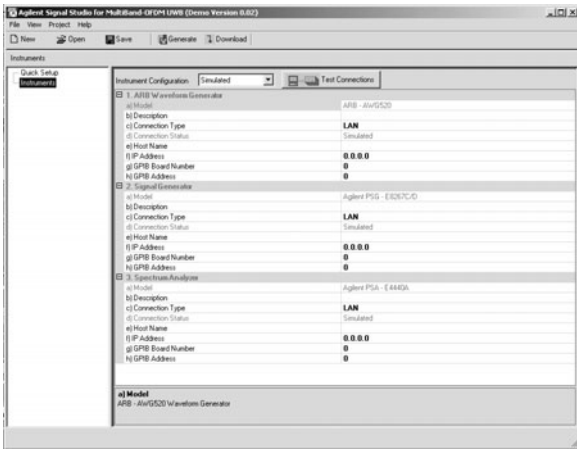
- **Data Streams**
  0s, 1s, 01s, 10s, 8-bit pattern, PN9, PN15
- **Packet Types**
  ACL: DH1, DH3, DH5, DM1, DM3, DM5, AUX1
  SCO: HV1, HV2, HV3, DM1
  Control: NULL, POLL, ID
- ***Bluetooth* Device Address**
  Valid range: 0000 0000 0000 to FFFF FFFF FFFF Hex
- **Active Member Address**
  Valid range: 0 to 7
- **Payload Data Patterns**
  0s, 1s, 01s, 10s, 8-bit pattern, PN9, PN15, user file
- **Burst Power Ramp**
  Power ramp valid range: 1 to 10 µs
  Ramp settling valid range: 1 to 20 µs (cannot be more than 10 µs greater than the power ramp setting)
  Dirty transmitter test menu
  – Power ramp valid range: 1 to 100 µs
  – Ramp settling valid range: 1 to 120 µs (cannot be more than 20 µs greater than the power ramp setting)
  Resolution: 1 µs
- **Impairments Frequency Offset**
  Valid range: –100 kHz to 100 kHz
  Dirty transmitter test valid range: –150 to 150 kHz
  Resolution: 1 kHz
- **Frequency Drift**
  Linear Valid range: –100 kHz to 100 kHz
  Resolution: 1 kHz
  Sinusoidal Valid range: –100 kHz to 100 kHz
  Resolution: 1 kHz
  Rate: 300 Hz, 500 Hz, 1.6 kHz
- **Modulation Index**
  Valid range: 0.250 to 0.400
  Dirty transmitter test valid range: 0.200 to 0.400
  Resolution: 0.001
- **Symbol Timing Error**
  Valid range: –50 ppm to 50 ppm
  Dirty transmitter test valid range: –150 ppm to 150 ppm
  Resolution: 1 ppm
- **AWGN**
  C/N valid range: 10 dB to 40 dB
  Resolution: 1 dB
  Seed valid range: 1 to 65535
- **Clock and Gate Delay**
  Valid range: 0 to 100 µs
  Resolution: (1 µs/oversampling ratio)
- **Oversampling Ratio**
  Valid range: 2 to 20

Ordering Information

E4438C-406

N7619A

- **Generate multiband OFDM UWB waveforms compliant with the WiMedia ultra-wideband (UWB) common radio platform**
- **Create baseband I/Q waveforms from a digital file loaded into a N6030/31A arbitrary waveform generator**
- **Generate full RF waveform by driving E8267D PSG wideband inputs with the baseband I/Q signal**
- **Build individual waveform segments each with unique parameters; combine them to create one waveform with packets that have varying parameters like different data rates**
- **Create custom packets for testing specific receiver functions**
- **Test sub-carrier omission for narrowband receiver interference reduction**
- **Control the specific number of waveforms to be played with burst mode capability**
- **Add waveform impairments like frequency offsets and I/Q phase and amplitude imbalance**



Signal Studio for Multiband OFDM UWB user interface.

N7619A Signal Studio for Multiband OFDM UWB

Create signal waveforms based on the WiMedia Ultra-Wideband (UWB) Common Radio Platform. Signal Studio for UWB produces a digital version of the baseband I and Q waveforms that get loaded into test equipment to generate UWB radio frequency signals. The easy-to-use interface lets you get started quickly, enabling you to focus on the evaluation of the UWB transceiver and perform key measurements, such as sensitivity and interference rejection. Analog baseband I/Q waveforms are generated by the N6030A or N6031A arbitrary waveform generator and the RF signals are generated by the E8267D with wideband I/Q inputs (Option 016).

Specifications

- **Optimize Corrections (when used with Signal Studio Toolkit)**
  Speed, Accuracy or Custom
- **Impairments**
  I/Q Amplitude Imbalance
  I/Q Phase Skew
  Frequency Error
- **MAC Header Data**
  All ones, all zeros, alternate 1's & 0's, PN 15 Code, User defined
- **Packet Mode**
  Standard or Streaming
- **Data Rate**
  53.3 Mbits/sec to 480 Mbits/sec
- **Payload Data Length**
  Standard 0 to 4095 integer
  Streaming 1 to 409 integer
- **Data Source**
  All ones, all zeros, alternate 1's & 0's, PN 15 Code, PN 9 Code, User defined
- **Packet Separation**
  Range: Integers ≥ 0, Typical Value = 6
- **Segment Start Delay**
  Range: Integers ≥ 0, Typical Value = 3
- **Segment End Delay**
  Range: Integers ≥ 0, Typical Value = 3

Ordering Information

N7619A-117 UWB License: External Baseband Generator, N6030A, PXI

Audio/Video Broadcasting

Broadband wireless communications systems and handheld wireless devices are making mobile audio/video broadcasting a reality. Standards are emerging to accelerate adoption and Agilent provides a suite of Signal Studio software solutions for the Agilent MXG, ESG, and PSG vector signal generators to simplify the generation of standards-based audio/video broadcasting reference signals. To meet your digital broadcasting time to market needs, Signal Studio software provides an intuitive, application-specific graphical interface to create Agilent validated and performance optimized reference signals. Easily add calibrated signal impairments and AWGN to evaluate receiver tolerance to dirty transmitters and channel effects. And as standards evolve, count on Signal Studio to stay at the forefront.

Signal Creation

- Multi format DVB-T/H/C/S, ISDB-T, DTMB, ATSC and T-DMB digital video signals and upgradeable with further standards
- Flexible wizard for trimming and editing input Transport Stream (TS) files for seamless video playback for digital video receiver subjective verification
- Support BER test with fixed or user defined data pattern
- Low cost with industry leading modulation quality and spectral purity for video receiver and component test (Set-top-box, Tunner, Handset, etc)

Signal Generator Control and Additive Impairments

- Compatible signal generators: E8267D/E4438C ESG/N5182A
- Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more
- I/Q impairments and real-time AWGN
- Real-time fading with Baseband Studio

Automation and Communication Interface

- Preset configurations for quick setup
- Automate test with .net API and SCPI
- API HELP system
- LAN and GPIB

Other Features

- Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP
- Online documentation and embedded HELP
- Flexible software licensing: fixed and transportable; perpetual or time-based duration
- FREE 14-day trial license

N7623B Signal Studio for 3GPP2 CDMA

N7623B Signal Studio for Digital Video

Create Standard-compliant Digital Video Waveforms

With N7623B Signal Studio, easily create DVB-T/H/C/S, ISDB-T, ATSC and DTMB waveforms. Play back waveforms using the N5182A MXG, E4438C ESG or E8267D PSG high-performance vector signal generators that support a wide range of applications including cellular and wireless connectivity communications. From a simple graphical user interface, specify channel coding and modulation parameters, OFDM frame structure, and seamless TS stream to create video signals that meet your specific receiver and component test needs.

Test Digital Video Handheld Devices

Engineers incorporating digital TV into handheld devices can create test signals in compliance with the new DVB-H and ISDB-T standard. Generate waveforms for use in BER tests using a general-purpose instrument that also supports a variety of mobile and wireless connectivity formats.

Evaluate Digital Video Receivers

Verify receiver performance by adding real-time AWGN and I/Q impairments to fully channel coded **DVB-T/H/C/S**, **ISDB-T**, **ATSC** and **DTMB** signals. Or, monitor video at the receiver by supplying your own MPEG file as source data.

Component Test

Test power amplifiers, filters, modulators, and other system components using statistically correct **DVB-T/H/C/S**, **ISDB-T**, **ATSC** and **DTMB** test signals to make measurements such as power efficiency, linearity, and frequency accuracy. Test receivers with channel coded DVB test signals that can be used for bit error rate (BER) analysis before Viterbi decoder, and before and after RS decoder.

Typical Applications

Test power amplifiers, filters, modulators, and other system components using statistically correct DVB-T/H/C/S test signals to make measurements such as power efficiency, linearity, and frequency accuracy. Test receivers with channel coded DVB test signals that can be used for bit error rate (BER) analysis before Viterbi decoder, and before and after RS decoder.

Ordering Information

Signal Studio for Digital Video
N7623B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7623B-2FP Connect to E8267D Signal Generator, Fixed, Perpetual License
N7623B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7623B-QFP Advanced DVB-T/H/C, Fixed, Perpetual License
N7623B-RFP Advanced ISDB-T, Fixed, Perpetual License
N7623B-SFP Advanced DTMB, Fixed, Perpetual License
N7623B-UFP Advanced ATSC, Fixed, Perpetual License
N7623B-VFP Advanced DVB-S, Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

E4438C-407

- **Generate up to 26 superframes**
- **Full control over coding parameters**
- **Pilot information coding**
- **Calibrated AWGN**
- **Supports scramble codes for both Korea and Japan**
- **Preconfigured S-DMB setups**
- **Create custom data patterns for troubleshooting**
- **Save/recall custom data from the internal hard drive**
- **Plot code domain power, spectrum, and CCDF curves**
- **Fully-coded channels enable receiver BER/BLER**
- **Perform functional receiver test**
- **Test the CAS and EPG channels with custom data**
- **Save time with predefined settings**
- **Create statistically correct signals for amplifier test**

E4438C-407 Signal Studio for S-DMB

Create signals for testing S-DMB (Satellite Digital Multimedia Broadcast) user terminals and gap fillers in a manufacturing environment. Thoroughly test your receiver's RF and baseband subsections with up to 26 superframes of unique data. The coding for each channel can be configured for your custom test needs, including: Reed-Solomon encoding, byte interleaving, convolutional encoding, and bit interleaving. Demodulator-specific testing can be performed by disabling the coding layer and injecting data directly into the physical layer before spreading and scrambling.

Specifications

General Configuration
- Specification version: ITU-R BO.1130-4 (System E section), ARIB STD-B41, B42 (2003 June 2nd)
- Scramble code region: Japan or Korea
- Number of superframes: 1 to 12
- Chip rate: 1 MHz to 25 MHz
- Oversample ratio: 2 to 16
- Baseband filtering: Nyquist, Root Nyquist, Gaussian, Rectangle
- Filter Alpha/BT: 0 to 1
- AWGN C/N ratio: –30 to 30 dB
- Flat AWGN bandwidth: (chip rate) x (oversample ratio) x 0.8
- Graphical displays: Code domain power, CCDF curve, Spectrum

Broadcast Channel
- Walsh code: 0 to 63
- Amplitude: –40 to 0 dB
- Data source: PN9, PN12, PN15, or custom data up to 1018368 bits in length
- Reed Solomon encoder: On or off
- Byte interleaver: On or off
- Convolutional encoder: On or off
- Convolutional encoder rate: 1/2, 2/3, 3/4, 5/6, 7/8
- Bit interleaver: On or off
- Bit interleaver position: 0 to 7

Pilot Channel
- Walsh code: 0
- Amplitude: –40 to 0 dB
- Data pattern: PN9, PN12, PN15, or custom data up to 479232 bits in length
- Data offset: 0 to 32768
- Information coded pilot: On or off
- Entire control information: 00 to FFh
- Reed-Solomon encoder: On or off
- Byte interleaver: On or off
- Convolutional encoder: On or off
- Convolutional encoder rate: 1/2
- Initial CRC Tap: 0000h to FFFFh

Ordering Information

E4438C-407

Signal Creation
- **Supports all 4 transmission modes (I, II, III, and IV) and fully implemented SI, FIC and TII for video, audio and packet data service**
- **Spectrum-compliant T-DMB signal with filter to suppress out-of-channel emission**
- **Flexible MCI parameter configuration and data source inputs (PN, fixed pattern, or user files)**
- **Up to 64 MSa of frame generation for BER test**

Signal Generator Control and Additive Impairments
- **Compatible signal generators: E4438C ESG/N5182A MXG**
- **Control frequency, amplitude, ALC, waveform scaling, triggers, markers, and more**
- **I/Q impairments and real-time AWGN**
- **Real-time fading with Baseband Studio**

Automation and Communication Interface
- **Preset configurations for quick setup**
- **Automate test with .net API and SCPI**
- **API HELP system**
- **LAN and GPIB**

Other Features
- **Graphs: I(t), Q(t), I(t)+Q(t), P(t), spectrum, CCDF, CDP**
- **Online documentation and embedded HELP**
- **Flexible software licensing: fixed and transportable; perpetual or time-based duration**
- **FREE 14-day trial license**

N7616B Signal Studio for T-DMB

Quickly and Easily Create T-DMB Waveforms

Signal Studio for T-DMB enables you to easily create standard-based T-DMB waveforms. The software's intuitive graphical interface provides convenient access to the transmission, channel coding and various signal parameters for T-DMB video, audio and packet data service. Use the E4438C ESG and N5182A MXG vector signal generators to play back your fully channel-coded T-DMB waveforms. Together, Signal Studio for T-DMB and the E4438C or N5182A provide a simple, cost-effective and reliable solution for generating test signals to design and verify T-DMB receivers and components.

Key Features

Quickly and easily configure T-DMB waveforms
- Video, audio and packet data services
- Transmission Mode I, II, III and IV
- RS encoder and convolutional interleaver for video service
- Data source: PN sequence, fixed all '0' or user- supplied media file for each service

Create test signals with fully implemented transmission frame structure
- Fully coded channel for FIC and each sub- channel of MSC
- MCI parameters: data bit rate, protection level, sub-channel Id.
- Service Information (SI): ensemble label, service label, service component label, country ID, extended country code, service reference
- Flexible configuration for Transmission Identification Information (TII)

Graphically display waveform format and signal characteristics
- Real-time display of CIF structure as you configure the waveform
- CCDF curves, I/Q signals, and baseband spectrum

Add real-time AWGN (requires E4438C/N5182A option 403) and access signal generator parameters from user interface

Ordering Information

Signal Studio for T-DMB
N7616B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7616B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7616B-QFP Advanced T-DVB, Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

Detection, Positioning, Tracking & Navigation

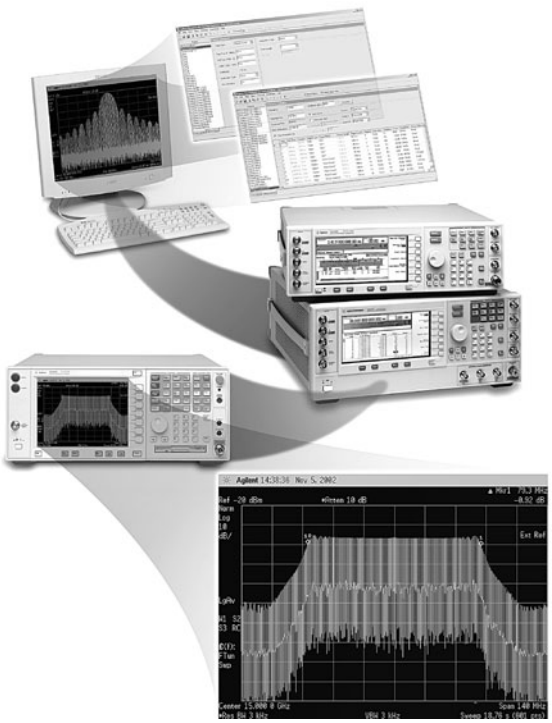
Modern detection, positioning, tracking, and navigation systems require advanced signal creation tools to simulate realistic operating environments for test and evaluation. Agilent ESG and PSG vector signal generators feature deep waveform playback memory, flexible waveform sequencing, and wideband I/Q modulation to generate complex signal scenarios, such as pulse patterns for radar receiver tests and long time records of multi-satellite signals for GPS and Galileo test. With Agilent Signal Studio and embedded software, creating test signals to realistically stress components, devices, subsystems, and systems is easier than ever. What used to require custom test systems with racks of equipment can now be accomplished with commercial off-the-shelf (COTS) test equipment.

Signal Creation
- Build a library of custom pulse shapes (software defined or imported)
- Apply intra-pulse modulation: linear and non-linear FM chirp, FM step, AM step, BPSK, QPSK, Barker codes
- Create, store, and recall custom pulse patterns with 80 dB on/off ratio and up to 80 MHz or 1 GHz BW
- Set repetition interval, number of repetitions, and frequency, phase, and power offsets on a pulse-by-pulse basis

Signal Generator Control
- Compatible signal generators: E4438C ESG, E8267D PSG, N6030A ARB
- Control frequency, amplitude and ALC, markers, and more

Automation and Communication Interface
- Automate test with COM API and SCPI
- API HELP system
- LAN and GPIB

Other Features
- Online documentation and embedded HELP
- FREE 14-day trial license – automatically enabled



Use Signal Studio for Pulse Building to create advanced radar test patterns.

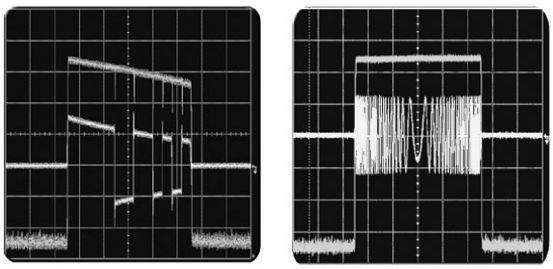
N7620A Signal Studio for Pulse Building

Create complex pulse patterns using a simple interface to construct and import custom pulse envelopes, apply modulation, and create sophisticated single emitter test patterns for radar receiver test. The built-in COM-based application programming interface (API) supports advanced test pattern creation through you own test executive. Using the API, pulse and pattern parameters are efficiently modified on a pulse-by-pulse basis using custom mathematical models and data sets.

Signal Studio for pulse building also utilizes an advanced predistortion algorithm to enhance the signal quality of the test stimulus directly at the input of the device under test. What used to require racks of test equipment can now be accomplished in a single integrated instrument with. Using vector-modulated arbitrary waveforms improves repeatability and eliminates many of the synchronization issues associated with pulsing modulated signals using traditional analog techniques. With full control over pulse frequency, phase, amplitude, and modulation characteristics on a pulse-by-pulse basis, you can generate the long non-repetitive pulse patterns you need to fully test your advanced radar systems.

Key Features

- Create a library of custom pulse shapes by configuring or importing pulses
- Apply intra-pulse modulation to built-in and imported pulses
- Build a library of complex pulse pattern for radar receiver test
- Enhance signal quality using baseband pre-distortion
- Automate signal configuration and generation using the COM based application programming interface (API)
- Connect to the PSG using 10 Base TLAN and GPIB
- Utilize built-in help with pulse and pattern configuration examples



Specifications

Pulse Properties

Trapezoidal and Raised Cosine

Rise time (0 to 100 percent)	Minimum: 25 ns (typical)
Fall time (100 to 0 percent)	Minimum: 25 ns (typical)
Pulse width (100 to 100 percent)	Minimum: 30 ns (typical)
Pulse width jitter	Type: Gaussian or uniform Deviation resolution: 10 ns

Custom I/Q and Custom Profile Pulses
I and Q scale factor: $1/\max(\mathrm{sqrt}(I^2 + Q^2))$

Intra-Pulse Modulation
- AM Step
  - Amplitude range: 0 to –55 dB (typical)
  - Step size: user-defined
- Barker
  - Barker code 2, 3, 4, 5, 7, 11, 13
- BPSK
  - Bit pattern: alternating 01
  - Phase shift: 0 = 0° and 1 =180°
  - Step size: user-defined
- Custom BPSK
  - Bit pattern: user-defined
  - Phase shift: 0 = 0° and 1 = 180°
  - Step size: depends on number of bits in
  - bit pattern

- FM Chirp
  - Maximum deviation:
    ±40 MHz for E4438C and E8267D
    <500 MHz for N6030A/N8241A AWG's
  - Maximum rate:
    80 MHz/µs with E4438C and E8267D
    <500 MHz/usec with N6030A/N8241A AWG's
- FM Step
  - Frequency offset: ±40 MHz from carrier with E4438C and E8267D; <500 MHz from carrier with N6030A/N8241A AWG's

Pattern Properties

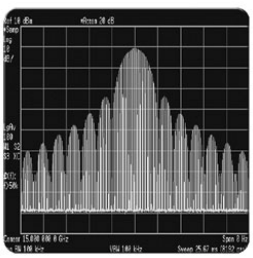
Pattern objects	Pulse, pattern, or off-time
Repetition interval	Minimum: object length (does not apply to off-time)
Repetition interval jitter	Type: Gaussian or uniform Deviation resolution: 10 ns
Number of repetitions	Maximum per pattern object: 65,535 (or up to 64 k*16 k if same pattern object is re-used)
Frequency offset	Range: 0 to ±40 MHz (with no modulation) for E4438C and E8267D; 0 to 500 MHz with N6030A/N8241A AWG's
Phase offset	Range: ± π radians
Scale	Range: 0 to –55 dB (typical)
Pattern length	Unique pulses: up to 16,000 Unique playback memory: 64 Msamples

Markers/Triggers

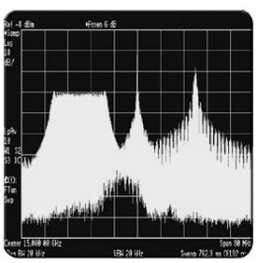
	Signal start, Pulse start, Pulse gate Maximum delay: ±50 ns

Signal Quality

On/Off ratio	≥55 dB with pulse modulator disabled (typical) ≥80 dB with pulse modulator enabled (typical)
Image rejection[1]	≤–40 dBc at ±40 MHz from carrier (typical)
RF modulation flatness[1]	±0.5 dB over 80 MHz RF modulation bandwidth (typical)
Carrier suppression[1]	≤–60 dBc (time and temperature dependent) (typical with I/Q adjustments)



Antenna Scan Pattern.



FM chirp, CW, and phase – coded pulses in a pattern.

Ordering Information

N7620A-101 Pulse Building License for E4438C Vector Signal Generator
N7620A-102 Pulse Building License for E8267C/D Vector Signal Generator
N7620A-113 Pulse Building License for Tektronix AWG520 External Baseband Generator
N7620A-117 Pulse Building License for N6030A External Baseband Generator
N7620A-118 Pulse Building License for N8241A External Baseband Generator

[1] The typical performance shown is after corrections have been applied by the Signal Studio for pulse building software.

Signal Creation
- **Single-satellite Global Positioning System with 37 satellite ID numbers**
- **Apply Doppler shift from –125 kHz to +125 kHz**
- **Spread the L-band carrier with coarse/acquisition (C/A) code**
- **Telemetry, encoded or raw data modes**

Signal Generator Control
- **BER analysis with internal bit error rate analyzer**

Automation and Communication Interface
- **Automate waveform playback with SCPI**
- **10baseT LAN, GPIB, and RS-232**

Other Features
- **Internal software application**

E4438C-409 GPS Embedded Software

Create a framed single-satellite GPS signal with your choice of satellite ID, Doppler shift, data source (including user file), and more. Use the GPS personality to verify functionality of the embedded GPS chip in mobile consumer products such as cellular phones and handheld or vehicle-mounted receivers. The ESG's GPS transmission can be applied to virtually any GPS receiver with a baseband or RF input port. Measure signal-to-noise ratio or test how Doppler shifts can impact signal integrity. A default navigation message with incrementing time of week (TOW) facilitates sensitivity measurements; pseudo-noise (PN) data is available for measuring bit error rate (BER); and parity bits can be inserted for error detection tests. Appropriate default settings are provided to enable quick setup for manufacturing. The GPS signal is generated in real-time by the precision E4438C ESG vector signal generator. The ESG's superior amplitude accuracy and phase noise performance enable repeatable and accurate receiver sensitivity measurements, even at low power levels.

Specifications

Ranging Code
Choice of code: C/A, P, C/A+P
Preset: C/A
Satellite ID
Valid range: 1 to 37
Preset: 1
Carrier Frequency User-settable for 250 kHz up to 6 GHz depending on purchase of Option 501, 502, 503, 504 or 506 for the ESG
Doppler Shift
Valid range: –125 kHz to +125 kHz
Preset: 0.0
Data Modes for C/A
Choice of mode: telemetry, raw, encoded
Code Only
Preset: raw

TLM	Choice of data: not user-selectable
Raw	Choice of data: PN9, PN15, fix-4, user file
Preset:	PN9
Encoded	Choice of data: PN9, PN15, fix-4, user file

GPS Reference
Valid range: 1 kcps to 12.5 Mcps
Frequency (f0)
Preset: 10.23 Mcps
Chip Rate
C/A chip rate is automatically set equal to one-tenth of f0-value; P chip rate set equal to f0-value
Preset: C/A chip rate 1.023 Mcps, P chip rate 10.23 Mcps
GPS Reference Clock
Choice of internal (equal to f0) or external (user supplied) clock source
Preset: internal
Relative P Code Power
Valid range: 0 to –40 dB
Filter Types
Rectangular, IS-95 standard, IS-95 modified (improved ACP), IS-2000, root Nyquist, Nyquist, Gaussian, user FIR
Preset: rectangular
I/Q Code Phase
Choice of normal (P code phase lags C/A code phase) or inverted
Preset: normal

Ordering Information

E4438C-409

General RF & Microwave

Agilent provides innovative waveform creation and performance optimization software tools for use with the Agilent MXG, ESG and PSG vector signal generators to test RF and microwave transceivers and the components that comprise them. Add calibrated I/Q impairments, AWGN, and phase noise to your test signals to evaluate receiver tolerance to impaired signals and noisy environments. Create multitone and NPR signals for distortion test and use the signal correction capability to minimize non-linear distortion and ultimately reduce your measurement uncertainty. Agilent's Signal Studio and embedded software for general RF and microwave test applications shorten development time by simplifying your test setup and lower the overall cost of test.

Waveform Download Utility
- **FREE custom I/Q waveform download utility**
- **Supports various file formats: MATLAB "MAT File 5", ASCII, Agilent 16-bit and 14-bit, and more**

Signal Generator Control and Additive Impairments
- **Compatible signal generators: E4438C ESG, E8267D PSG, N5182A MXG**
- **Compatible arbitrary waveform generators: N6030A, N6031A, N6032A, N6033A, N8241A, N8242A**
- **Control frequency, amplitude, ALC, and more**
- **I/Q impairments and adjustments**

Automation and Communication Interface
- **Automate testing with COM object, .net API, and SCPI command set**
- **API HELP system**
- **LAN and GPIB**

Other Features
- **PC-based graphical user-interface**
- **Online documentation and embedded HELP**

N7622A Signal Studio Toolkit

Free Waveform Download Utility

N7622A Signal Studio toolkit is a software utility for downloading and playing back your custom I/Q waveforms. I/Q waveforms created in common development environments, such as MATLAB® and C++, are automatically translated to the proper file format for the target baseband generator and then download for playback. This base functionality of Agilent's Signal Studio toolkit is free and features an easy-to-use graphical interface to control the entire waveform download and playback process.

E4438C-403
E8267D-403
N5182A-403

Signal Creation

- Add AWGN to any waveform played out of the baseband generator
- Generate stand alone AWGN for use as a general purpose noise source
- Set AGWN level as a C/N ratio from the front panel
- Set Eb/No, Ec/No, or C/N from Signal Studio software

Real-Time Mode

- Noise bandwidth: 50 kHz to 80 MHz
- Crest factor: 16 dB
- Randomness: 89 bit pseudo-random generation
- Repetition period: 3 x 10E9 years

Arbitrary Waveform Mode

- Noise bandwidth: 50 kHz to 15 MHz
- Randomness: 14, 15, 16, 17, 18, 19, or 20-bit pseudo-random waveform with fixed or random seed
- Repetition period: 0.4 ms to 2 s (dependent on noise BW & waveform length combination)

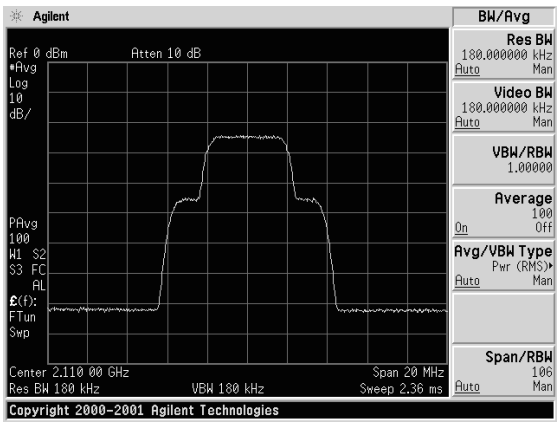
Calibrated Noise (AWGN) Embedded Software

The calibrated noise software provides two modes of operation: real-time and arbitrary waveform playback. Real-time mode generates truly uncorrelated noise with a noise bandwidth (BW) that can be continuously varied up to 80 MHz. Arbitrary waveform playback mode enables the generation of a repeatable noise sequence with a variable bandwidth up to 15 MHz.

It transforms the MXG, ESG or PSG into a flexible stand-alone additive white Gaussian noise (AWGN) source and this capability can be used for setting signal-to-noise ratios directly for any arbitrary waveform file and within other select signal creation software (i.e. W-CDMA, cdma2000, S-DMB, TD-SCDMA, 1xEV-DV, DVB and WiMAX). The arbitrary waveform playback mode provides a repeatable noise stimulus used to isolate and debug the cause of received bit errors under various signal-to-noise ratio conditions.

Specifications

	E4438C-403, E8267D-403	N5182A-403
AWGN (Real-time Mode)		
Noise Bandwidth	50 kHz to 80 MHz	1 Hz to 100 MHz
Crest Factor	>16 dB (output power set at least 16 dB below max. power)	15 dB
Randomness	89 bit pseudo-random generation, repetition period 3 x 10^9 years	90 bit pseudo-random generation, repetition period 313 x 10^9 years
Carrier to Noise Ratio	Magnitude error ≤0.2 dB at baseband I/Q inputs	±100 dB when added to arbitrary waveforms
AWGN (Arbitrary Waveform Mode)		
Noise Bandwidth	50 kHz to 15 MHz	—
Randomness	waveform length: 16384 to 1048576 with fixed or random seed Repetition period: 0.4 ms to 2 seconds (dependent on combination of noise BW and waveform length)	—



W-CDMA signal with calibrated AWGN.

Ordering Information

E4438C-403
E8267D-403
N5182A-403

N7621A/B

Signal Creation

- Create a multitone test stimulus with up to 4096 tones
- Configure an NPR test stimulus with >60 dBc notch depth and ±0.5 db noise flatness
- Automatically apply pre-distortion using a spectrum analyzer to enhance signal quality and minimize test uncertainty

Signal Generator Control

- Compatible signal generators: N5182A MXG, E4438C ESG, E8267D PSG, N6030A ARB, N8241A ARB
- Control frequency, amplitude, ALC, markers, triggers, and more
- Set individual instrument parameters from the software GUI or API

Automation and Communication Interface

- Automate test with COM or .NET API
- API-controlled waveform sequencing for smooth transition between signals
- LAN and GPIB

Other Features

- Graphs: CCDF curves
- Online documentation and embedded HELP

N7621A/B Signal Studio for Multitone Distortion

Create wideband (N7621A) or narrowband (N7621B) multitone distortion I/Q waveforms. The N7621A/B software provides many flexible features to simplify the generation of in-band and out-of-band nonlinear distortion test signals. It uses pre-distortion to provide up to 2048 tones, from a single signal generator, virtually free of IMD products, thus improving signal quality and reducing test uncertainty. Optionally, it also creates NPR test stimulus to characterize in-band nonlinear distortion of wideband components and systems. An NPR test stimulus simulates worst-case loading conditions for a device under test. The software provides many flexible features to configure a wideband noise signal with a user-defined notch position. The N7621A/B software uses a PSA spectrum analyzer to create the notch and improve the flatness of the wideband noise signal and to perform the IMD corrections. It works with the Agilent E8267D PSG, E4438C ESG, and N5182A vector signal generators and with the N6030A or N8241A AWG's. The N7621A/B replaces the E4438C-408, E4438C-421, E8267D-408, and E8267D-421 Signal Studio products.

Key Features

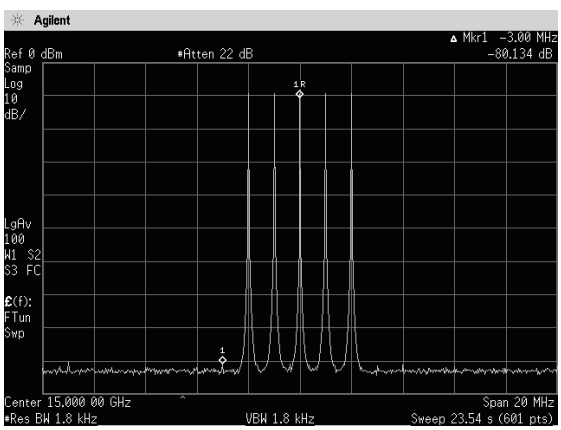
- Intuitive user interface
- Apply pre-distortion to improve signal quality and minimize test uncertainty
- Correct IMD over 80 MHz, 100 MHz or 1 GHz bandwidth (AWG dependent)
- Suppress IMD images
- View peak-to-average statistics by plotting the CCDF curve
- API examples in Visual Basic and LabVIEW
- Built-in Help with multitone configuration examples
- Flexible software licensing: fixed and transportable; perpetual or time-based duration

Specifications

Multitone Signals

Number of Tones	2 to 2048
Tone Spacing	100 Hz minimum, maximum limited by the AWG sample rate Spacing is linear, however individual tones may be disabled
Tone Power (relative)	0 to –50 dB
Phase Distribution	Fixed, random or parabolic
Suppression Bands	Set up to 10 different suppression levels over different band segments
Suppression Level	–50 to –90 dBc, depending on number of tones and available calibration time
Calibration Interval	8 hours (recommended)
Calibration Time (typical)	10 minutes (8 tones, –80 dBc suppression)
Temperature Stability	
ESG	1 dB/°C (typical for IMD products) 5 dB/°C (worst case for LO feedthrough and images)
PSG	3 dB/°C (typical for IMD products) 5 dB/°C (worst case for LO feedthrough and images)
Amplitude Accuracy	±0.2 dB (typical)
Connections	10baseT LAN or IEEE-488 GPIB
Instrument Settings	ESG/PSG Frequency, amplitude, markers PSA Span, RBW, VBW, attenuator setting, detector type, number of averages, trigger source
Graphic Displays	Tone settings and suppression bands, CCDF
Application Programming Interface	COM object

N7621A/B Multitone user interface.



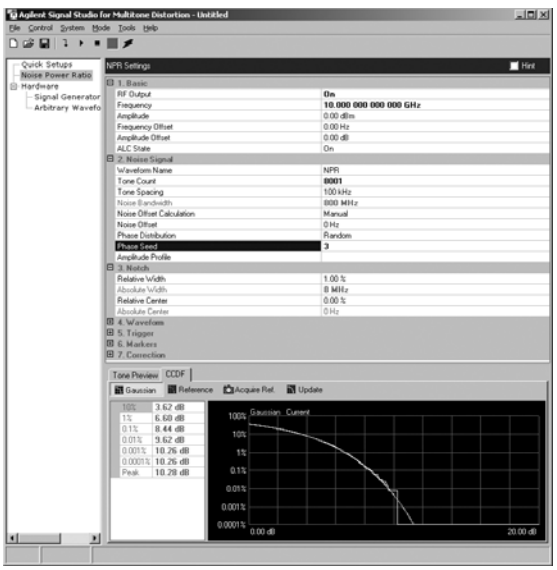
S-tones, 1 MHz tone spacing, center tone at 15 GHz, 80 dBc 3rd order IMD.

Specifications

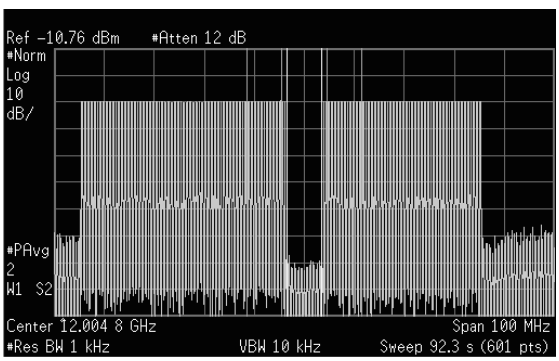
NPR Signals

Number of Tones	101 to 1000, 001, 2500, 001, or 10000, 001 (AWG dependent)[4]
Tone Spacing	100 Hz to 100 kHz, 250 kHz, or 1 MHz (relative): limited by the AWG RF modulation bandwidth
Noise Bandwidth	limited by AWG bandwidth
Notch Width	0.00000% to 20% relative to noise bandwidth
Notch Center	±50% relative to noise bandwidth center frequency
Notch Suppression[1,2]	
$f_c \leq 20$ GHz	
Integrated NPR	–66 dBc (typical for 2001 tones) –61 dBc (typical for 8001 tones)
Notch IMD tones[3]	–60 dBc (typical for 2001 tones) –55 dBc (typical for 8001 tones)
$f_c \geq 20$ GHz	
Integrated NPR	–56 dBc (typical for 2001 tones) –51 dBc (typical for 8001 tones)
Notch IMD tones[3]	–50 dBc (typical for 2001 tones) –45 dBc (typical for 8001 tones)
Amplitude Accuracy	±0.5 dB over 80 MHz noise BW (typical)

[1] Depends on number of tones and available calibration time.
[2] ≤8001 tones (with random phase relationships), 80 MHz noise bandwidth, 1% to 10% notch width, notch offset ≤8 MHz. Carrier feedthrough is ignored.
[3] For best performance, use notch offsets to avoid placing notch within 100 kHz from carrier.
[4] Large number of tones requires up to 4 GBytes of computer memory.



N7621A/B Noise Power Ratio user interface.



NPR test signal with >60 dBc notch depth at 12 GHz.

Ordering Information

N7621A-117 Connect to N603xA, N824xA AWG's
N7621A-203 Perpetual License for Enhanced Multitone
N7621A-204 Perpetual License for NPR

N7621B-1FP Connect to E4438C Signal Generator, Fixed, Perpetual License
N7621B-2FP Connect to E8267D Signal Generator, Fixed, Perpetual License
N7621B-3FP Connect to N5182A Signal Generator, Fixed, Perpetual License
N7621B-EFP Enhanced Multitone, Fixed, Perpetual License
N7621B-FFP NPR, Fixed, Perpetual License

Flexible licensing available. For more information on fixed and transportable license types with perpetual and time-based durations, please refer to the Signal Studio Brochure found at **www.agilent.com/find/signalcreation**

E4438C-SP1
E8267D-SP1

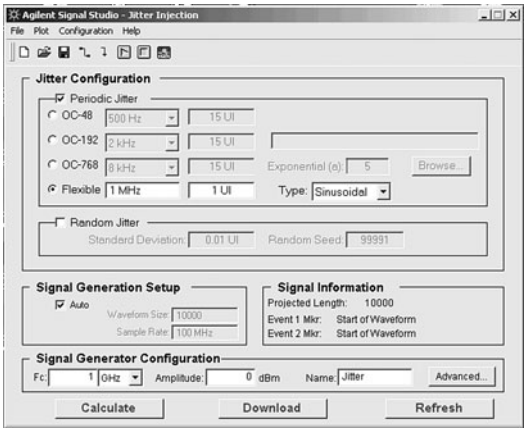
Signal Creation
- **Predefined jitter types: ITU-T G.8251-OC-48, OC-192 and OC-768**
- **Periodic jitter types: sinusoidal, square, triangle, saw tooth, exponential, and custom**
- **Custom jitter rates and deviations: up to 20 MHz at 0.15 UI peak to peak**
- **Random jitter setup: customize the standard deviation and noise seed for randomness down to 1 x 10E6**

Communication Interface
- **10BaseT LAN and GPIB**

E4438C-SP1 and E8267D-SP1 Signal Studio for Jitter Injection

Inject Calibrated Jitter with Digital Accuracy for Tolerance Measurements

Precisely creates periodic jitter and/or random jitter. When used with the E4438C ESG or E8267D PSG vector signal generators, these two jitter subcomponents are available at clock rates from 250 Kb/s to 44 Gb/s. The software takes advantage of the ESG and PSG's advanced complex IQ modulation capability to provide calibrated additive jitter with digital repeatability. This advanced I/Q modulation technique has an 80 MHz instantaneous bandwidth across the entire frequency range of the signal generator.



Signal Studio for Jitter Injection user interface.

Key Features

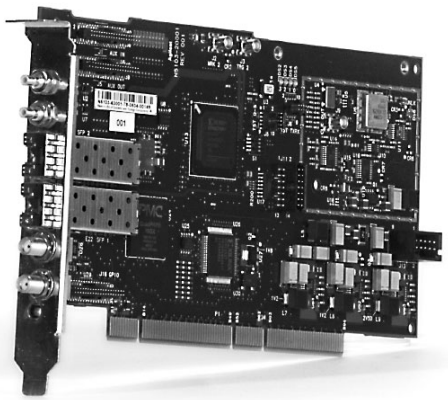
- Predefined jitter types – ITU-T G.8251-OC-48, OC-192 and OC-768
- Periodic jitter types – sinusoidal, square, triangle, saw tooth, exponential, and custom
- Custom jitter rates and deviations – up to 20 MHz at 0.15 UI peak to peak
- Random jitter setup – customize the standard deviation and noise seed for randomness down to 1 x 10^{-6}
- Combine random and periodic jitter – create a composite clock signal
- Random jitter down to 1 x 10^{-12} – mix two sources to achieve this specification (call Agilent for more information)
- Save waveform files – store your waveform files on a PC for automated testing

Typical Applications

High-speed digital transmission systems and digital I/O buses are often required to receive or regenerate data using a clock signal that is recovered or extracted from the data waveform. Variation in the data rate commonly known as jitter can complicate the clock recovery and data regeneration process. To guarantee a high level of performance in the presence of jitter, components and systems are typically required to adhere to a rigorous set of jitter performance standards. For design and test engineers working on new and emerging standards such as CEI, XFP, XFI, UXPi, Fiber Channel, Gigabit Ethernet, PCI Express and Serial ATA, the E4438C or E8267D with Signal Studio for jitter injection software has proven to be the most repeatable and accurate jitter source.

Ordering Information

E4438C-SP1 E4438C ESG Signal Studio for Jitter Injection
E8267D-SP1 E8267D PSG Signal Studio for Jitter Injection



N5101A Baseband Studio PCI Card

The N5101A Baseband Studio PCI card is a software defined, high-performance bi-directional processor. A variety of applications are available, including real-time fading of waveforms from the E4438C ESG signal generator, the E8267D PSG signal generator, and the E5515C wireless communications test set, streaming of large waveforms to the ESG, PSG, or the N5102A digital signal interface module, and capturing digital data for analysis. The Baseband Studio PCI card architecture provides the flexibility to enable current and future applications. An optional 512 MSa of memory can be added to the N5101A PCI card to enable high rate streaming with the N5110B Baseband Studio for waveform capture and playback application.

Key Literature & Web Link

For more information, visit our web site:
www.agilent.com/find/basebandstudio

Software Applications Currently Available

N5110B Baseband Studio for Waveform Capture and Playback
N5115B Baseband Studio for Fading

Ordering Information

N5101A Baseband Studio PCI Card
N5101A-022 Add 512 MSa Memory

N5103A High Speed Serial Interface Card

The N5103A high speed serial interface card is a high-performance, digital, bi-directional CPRI interface with SFP connectors for 614.4, 1228.8 and 2457.6 Mbps link rates. It is used in conjunction with Agilent's N5101A Baseband Studio PCI card and the N5120A Baseband Studio for CPRI RE test software, to emulate an REC (radio equipment controller) to stimulate the RE for many performance tests.

This solution allows uplink test capabilities such as receiver sensitivity testing with real-time BER/BLER, modulation analysis, and data capture as well as downlink test capabilities such as multi-carrier W-CDMA signal and transmitter modulation analysis. It also enables control and management support of HDLC (high-level data link control).

Key Literature & Web Link

Agilent ESG Signal Generator Configuration Guide, p/n 5989-4085EN
Agilent N5120A Baseband Studio for CPRI RE Test Technical Overview, p/n 5989-3324EN

For more information, visit our web site:
www.agilent.com/find/basebandstudio

Ordering Information

N5103A High Speed Serial Interface Card
Requires: N5101A, N5101A-022, N5120A, and N5120A-109 to function
All items are included in the N5120Z Baseband Studio for CPRI RE Test System Bundle

N5102A

Provides either digital inputs or digital outputs

Flexible Data Formats

- **Variable 4 to 16 bit words on dual 16 bit buses**
- **Serial, parallel, and parallel interleaved (DDR)**
- **2's complement and binary offset numbering**
- **Selectable MSB or LSB**
- **Digital IQ or digital IF[1]**

Flexible Clocking

- **Up to 400 MHz in serial mode, 100 MHz in parallel mode**
- **Provision for internal, external, or device clocking**
- **Independent data input and output rates**
- **Adjustable clock phase and skew**
- **Up to four clocks per sample[2]**

Flexible Signal Interface

- **Low voltage TTL, CMOS (1.5 V, 1.8 V, 2.5 V, 3.3 V) and LVDS**
- **Single cable connects signal generator and interface module**
- **Interchangeable break-out boards simplify device connection**

Simple User Interface

N5102A Baseband Studio Digital Signal Interface Module

The N5102A Baseband Studio digital signal interface module provides flexible and reliable digital interfaces to the E4438C ESG and E8267D PSG vector signal generators to interact with your DUT at the digital plane. Additionally, the N5102A module can be connected directly to a PC when RF or analog I/Q signals are not required.

In both situations, the interface module adapts to your device with the logic type, data format, clock features, and signaling you require. With its three-meter extension cable and a selection of connector types, the interface module connects easily to your device, in most cases eliminating the need for custom fixtures.

When connected to the E4438C ESG or E8267D PSG vector signal generator, it performs digital output and input functions. In the output mode, you can deliver realistic complex-modulated signals such as W-CDMA, 1xEV-DV, custom pulses, WLAN, TDMA and many others directly to your digital devices and subsystems. In the input mode, the interface module ports your digital input to the signal generator's baseband system, providing a quick and easy way of up-converting to calibrated analog IF, RF or µW frequencies.

When connected to the N5102A digital module with the N5101A PCI card, it can perform digital capture and playback of custom IQ or IF signals and link to 89601 software for analysis.

Specifications

Data

ESG Complex Signal Formats Supported
3GPP W-CDMA, HSPDA, cdmaOne (IS-95A), cdma2000 (IS-2000), calibrated AWGN, GSM, EDGE, GPRS/EGPRS, NADC, PDC, PHS, DECT, TETRA, 1xEV-DV, multicarrier 1xEV-DO, TD-SCDMA, 802.11a/b/g WLAN, *Bluetooth*, enhanced multitone, noise power ratio, custom digital modulation, arbitrary waveform user file

PSG Complex Signal Formats Supported
Custom digital modulation, two-tone, enhanced multitone, pulse building, noise power ratio, arbitrary waveform user file

Digital Data Format
User-selectable: 2's complement or binary offset, IQ (I, I-bar, Q, Q-bar) or digital IF[1] (real, imaginary)

Data Port
Dual 16-bit data buses support parallel, parallel IQ interleaved, parallel QI interleaved, or serial port configuration

(Device Interface) Connector
144-pin Tyco Z-Dok+ connects to break-out boards (included) that interface with the following connector types:

- 68-pin SCSI
- 38-pin dual AMP Mictor
- 100-pin dual Samtec
- 20-pin dual 0.1 inch headers
- 40-pin dual 0.1 inch headers
- The Z-Dok+ mating connector is also included for custom interfacing

Logic Types

- Single-ended: LVTTL, 1.5 V CMOS, 1.8 V CMOS, 2.5 V CMOS, 3.3 V CMOS
- Differential: LVDS

Data Output Resampling
ESG/PSG baseband output is resampled to the arbitrary clock rate set by the user via real-time curve-fit calculations

Clock

Clock Input
User selectable: internal clock, device under test DUT clock (Device Interface connector), or external clock (Ext Clock In connector) SMA, 50 ohm, 0 dBm nominal, 1 to 400 MHz

Clock Output
User selectable: Device Interface connector, or Clock Out connector SMA, 2 Vpp into load >5 K ohm from 1 to 100 kHz, 400 mVpp into 50 ohm load from 100 kHz to 400 MHz

Sample Rate

- User-selectable up to a maximum 100 MHz, but limited by other user settings
- In serial mode, the maximum rate is 400 MHz/word size
- Tables 4-1 through 4-6 in the User's Guide (N5102-90001) supply a complete list of rates for every case

Bit Rate

- Serial: Up to 400 MHz per serial line (400 Mbps LVDS) or 150 MHz per serial line (150 Mbps (CMOS/LVTTL) 32 lines available
- Parallel: Up to 100 MHz x word size (1.6 Gbps LVDS, CMOS and LVTTL) per parallel bus, 2 parallel buses available

Clocks per Sample
In parallel output mode, the data sample can be held for 1, 2 or 4 clock cycles

Clock to Data Skew
Coarse adjustment in 90° steps from 0 to 270°; fine-adjustment in increments of 100 ps up to 5 ns

Clock Polarity
Clock signals may be inverted

Frequency Reference Input
1 to 100 MHz BNC, 50 ohm, 3 dBm ±6 dB

Power Supply (included)

- Input: 100 to 240 VAC, 0.7 A, 50 to 60 Hz
- Output: 5 V, 4 A DC

www.agilent.com/find/basebandstudio

Ordering Information

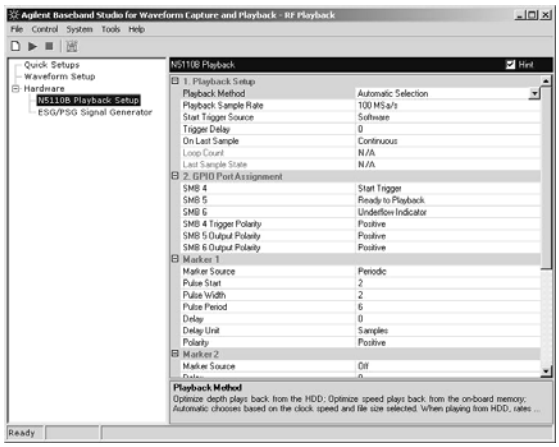
N5102A Baseband Studio Digital Signal Interface Module

[1] IF is available only in output mode.
[2] Multiple clocks/sample only available in parallel and parallel interleaved output mode.

Capture and Playback Using the Speed and Memory Depth that Fit Your Needs
- **Capture or playback digital IQ/IF signals up to 200/400 MSa/s**
- **Playback analog IQ or RF signals up to 100 MSa/a**
- **Capture and playback waveforms at high rates with optional memory**
- **Capture and playback long waveforms to the PC hard disk drive**

Versatile Connection Capabilities
- **Connect with the N5102A digital signal interface module to communicate with your baseband subsystem**
- **Connect with the 89600 Series VSA software for on-line or post-processing of captured data**
- **Connect with the E4438C ESG or E8267D PSG to up-convert signals to RF or MW frequencies**

Complete Controls with One User Interface
- **Comprehensive user interface provides essential control of the software, hardware and operations in one place**
- **Use tools such as markers and triggers to stimulate your device**



N5110B Baseband Studio for Waveform Capture and Playback

Agilent's N5110B Baseband Studio for waveform capture and playback is a powerful set of tools optimized for IQ waveforms that provide the speed and memory depth to efficiently and effectively verify your digital baseband and RF designs. The software enables you to easily capture real-time digital IQ signals directly from your device and save them to a file or send them to the Agilent 89600 Series vector signal analysis (VSA) software for performance evaluation. It also allows you to play back your custom or captured IQ waveforms to generate digital IQ, analog IQ, and RF test stimuli to test your radio at different stages in the design cycle.

Baseband Studio for waveform capture and playback is a powerful tool for baseband design verification that will help you:
- cut performance verification time from weeks to days
- gain confidence in your baseband design, and
- reduce costly rework later in the development process

The waveforms can be played back and captured at rates up to 40 MSa/s using the PCs internal hard disk drive. An optional 512 Msa of memory installed on the Baseband Studio PCI card increases the sample rates up to 100 Msa/s when connected to the ESG or PSG vector signal generators and up to 400 Msa/s when connected to the digital signal interface module.

Specifications

Capture or Playback
- Play waveform from N5101A PCI card
- Capture waveform to N5101A PCI card

Maximum Data Rate
- 40 MSa/s, 32 MHz BW with PC hard disk drive
- 100 MSa/s, 160 MHz BW with optional DRAM when connected to the ESG/PSG
- 400 Msa/s, 320 MHz BW with optional DRAM using the digital signal interface module

Example Waveform Playback Time (4 bytes/sample)
From 512 MSa on-board memory at 100 MSa/s, ≈ 5 seconds

Markers
Selectable support for 0, 2, or 4 output markers

Waveform Resolution
- 16 bits without markers
- 15 bits with two markers set
- 14 bits with four markers set

Supported Hardware
- Agilent E8267C PSG
- Agilent E8267D PSG
- Agilent E4438C ESG
- Agilent N5101A

Supported PC Operating Systems
Windows® 2000 Professional, service pack 2 or 3, or Windows XP Professional, service pack 1 or later

API
Microsoft™ .NET-based

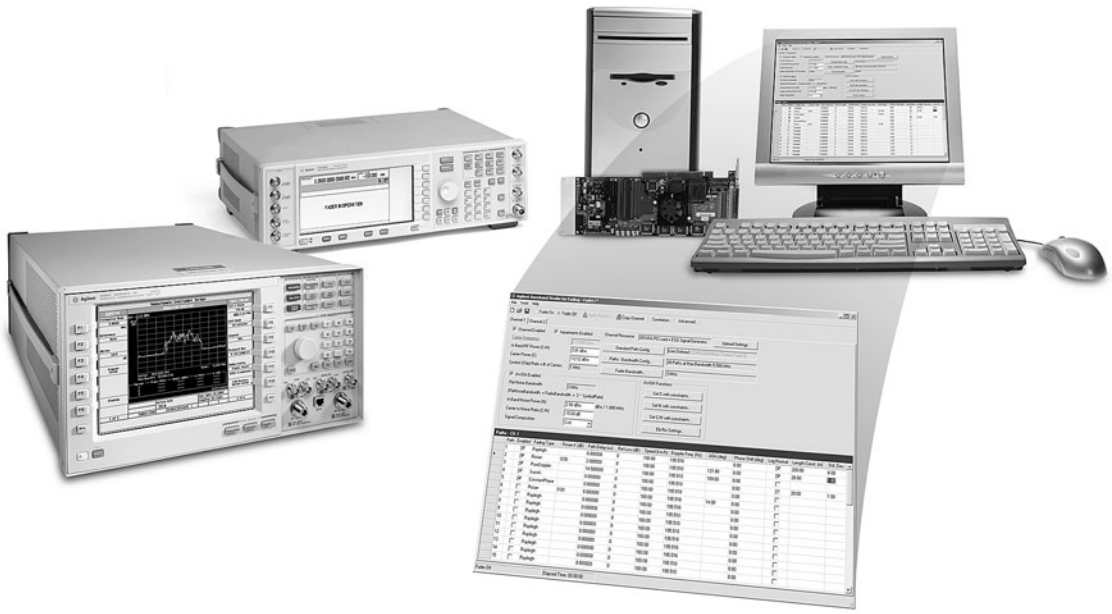
www.agilent.com/find/basebandstudio

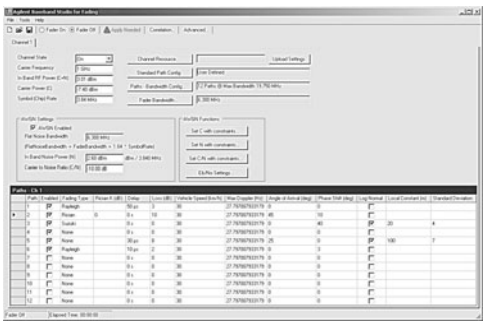
Ordering Information

N5110B Baseband Studio for Waveform Capture and Playback

Applications
Option 194 Play Waveform from N5101A Baseband Studio PCI Card
Option 195 Capture Waveform to N5101A Baseband Studio PCI Card

Sample Rates
Option 130 40 MSa/s Sample Rate, 32 MHz BW
Option 132 100 MSa/s Sample Rate, 80 MHz BW
Option 134 200 MSa/s Sample Rate, 160 MHz BW





- Fading at frequencies up to 44 GHz
- Dynamic fading
- Digital I/Q inputs and digital faded outputs
- Analog baseband I/Q and RF outputs
- Up to 80 MHz fading bandwidth
- Up to 96 paths
- Optional second channel enables antenna diversity testing or interfering signal simulation
- Standards-based fading configurations: W-CDMA, HSDPA/HSUPA, cdma2000, 1xEV-DO, GSM/EDGE, COST259, WLAN, 802.16 OFDM, and TETRA
- Built-in calibrated AWGN for each simulation channel
- Connectivity with E4438C, E6267D, E5515C, and N5102A
- Programmable control with built-in API

N5115B Baseband Studio for Fading

Baseband Studio for fading is a powerful channel simulation tool used with the E4438C ESG or E8267D PSG vector signal generators and the E5515C wireless communications test set to verify cellular radio and WLAN receiver designs under real-world signal conditions. With the fading software you can achieve realistic channel simulation using multi-path fading with the addition of AWGN, and simulate a diversity antenna or an interfering signal by adding a second channel. Preconfigured fading profiles for W-CDMA, HSDPA/HSUPA, TD-SCDMA, cdma2000, cdmaOne, 1xEV-DO, 1xEV-DV, GSM, EDGE, TETRA, WLAN, and 802.16 simplify initial setup. User-defined fading profiles provide flexibility to meet your specific test needs.

Fading with the E4438C ESG or E8267D PSG

Baseband Studio for fading coupled with the E4438C ESG or E8267D PSG vector signal generators offers R&D engineers the features needed to develop and debug today's high performance receivers while providing a flexible platform for tomorrow's needs. Baseband Studio for fading can also be used together with the ESG or PSG and the N5102A Baseband Studio digital signal interface module to provide faded digital baseband outputs or for fading digital baseband inputs. Take advantage of the ability to fade signals created using the ESG's or PSG's built-in personalities and Agilent's comprehensive Signal Studio software suite. Need more flexibility? Access the ultimate in flexibility by fading your own custom waveforms created with Agilent ADS, MatLab®, C++, or your preferred signal modeling tool. Whether it's wide bandwidth fading or dual channel capability, the Baseband Studio fading solution can be configured to meet your need.

Fading with the E5515C

Baseband Studio for fading coupled with the E5515C wireless communications test set offers a comprehensive W-CDMA or cdma2000 RF protocol interface to simulate real network control with realistic fading conditions. The E5515C-based fading solution is ideal for engineers doing final RF qualification and verification of wireless terminals, off-loading the basic RF parametric and functional tests that often are the bottlenecks of larger conformance systems. Additionally, test uncertainty is minimized and since the same fader hardware is used with the E5515C and the ESG, the fading results obtained using the E5515C in final verification will correlate with results obtained using the ESG in early R&D. Now you can get your mobile handset to market more quickly with the confidence it will perform under real-world fading conditions.

Performance Characteristics

Multipath Fading	E4438C ESG, E8267C/D PSG	E5515C Test Communication Set
RF Characteristics		
RF Bandwidth[2], Maximum		
Option 162	17 MHz	W-CDMA, HSDPA: 6.144 MHz; cdma2000, 1xEV-DO: 1.966 MHz
Option 163	80 MHz	W-CDMA, HSDPA: 6.144 MHz; cdma2000, 1xEV-DO: 1.966 MHz
Maximum Paths per Channel		
Option 162	Between 15 and 48 paths[3]	W-CDMA, HSDPA: up to 24; cdma2000, 1xEV-DO: up to 48
Option 163	Between 3 and 48 paths[3]	W-CDMA, HSDPA: up to 24; cdma2000, 1xEV-DO: up to 48
Number of Channels[4]	1 or 2	1
Carrier Feed-through	–55 dBc typical[5]	–47 dBc typical[6]
Signal Input/Output		
Available Inputs[7]	Digital signals from any of the following sources: • customized baseband sources • E4438C-601/602, E8267C-602, or E8267D-601/602 internal baseband generator[8] including user-generated ARB files • E5515C wireless communications test set using the W-CDMA/HSDPA, 1xEV-DO, or cdma2000 lab applications	
Available Outputs	Faded digital or analog I/Q, IF, or RF	Faded analog I/Q, IF, or RF
Simulation Method	Filtered noise or Jakes	Filtered noise or Jakes
Spectral Shape	3 dB, 6 dB, flat, or rounded	3 dB, 6 dB, flat, or rounded
Fading Types	Rayleigh, Rician, Log normal, Suzuki, Pure Doppler, Constant Phase, or Rayleigh with frequency shift	
Rayleigh Distribution		
Deviation from CPDF, filtered noise	0.5 dB from 10 to –30 dB of mean power level	0.5 dB from 10 to –30 dB of mean power level
Deviation from CPDF, Jakes	1 dB from 10 to –30 dB of mean power level	1 dB from 10 to –30 dB of mean power level
Rician Distribution		
Power ratio (k) range	–60 to 60 dB	–60 to 60 dB
Direct ray angle of arrival	0 to 360°	0 to 360°
Log-normal and Suzuki Distributions[9]		
Local constant	1 to 400 m	1 to 400 m
Standard deviation	0 to 12 dB	0 to 12 dB
Path Delay	0 to 10 ms	0 to 10 ms
Resolution	<1 ns	<1 ns
Accuracy	0.4 ns + 0.2% of path delay	<40 ns
Phase Shift	0 to 360°	0 to 360°
Path Loss	0 to 99 dB	0 to 99 dB
Resolution	0.01 dB	0.01 dB
Accuracy	0.1 dB	0.1 dB
Doppler Shift	0 or 0.3 Hz to 2.4 kHz (filtered noise) 0 or 0.01 to 4.8 kHz (Jakes)	Maximum Doppler shift limited to 1900 Hz for cdma2000 or 1xEV-DO
Accuracy	0.2% (digital output) 0.05% (all other setups)	

[1] Listed specifications are characteristics. These characteristics describe performance distribution derived from measurements where the nominal proportion is typically greater than 50%, e.g. 50% of instruments will meet or exceed the described nominal values.
[2] The RF channel simulation bandwidth is dependent upon sample rate and the number of paths selected. The software displays the available paths/bandwidth configurations based on the current settings. The flatness and rolloff characteristics of the source used for upconversion are added to the final RF output. The bandwidth is measured 0.1 dB down from the carrier.
[3] The number of paths can be increased up to a maximum of 96 if the full bandwidth is not required. The number of paths can be doubled (up to 46 MHz bandwidth) by using a second N5101A PCI Card.
[4] Dual-channel mode requires two ESGs/PSGs, two N5101A Baseband Studio PCI cards, and two sets of options for the Baseband Studio for fading software.
[5] Measured under the following condition: After an IQ calibration for a constant amplitude signal at the top of a fade for a single path of Rayleigh fading. Carrier feedthrough will degrade as the crest factor of the modulation signal or fading increases.
[6] Measured under the following conditions: After an IQ calibration for a W-CDMA or cdma2000 signal at the top of a fade for single path of Rayleigh fading. Carrier feedthrough will degrade as the fading crest factor increases.
[7] RF and analog I/Q inputs are not supported.
[8] E4438C-403 calibrated noise personality and E4438C-409 GPS personality are not supported with Baseband Studio for fading. The internal E5515C AWGN is also not supported with fading. To add AWGN to a faded signal order N5115B-168.
[9] Not available when dynamic fading is enabled.

Performance Characteristics (cont.)

Multipath Fading	E4438C ESG or E8267C/D PSG	E5515C Test Communication Set
Channel Simulation		
Vehicle Speed	0, or $V_{min} = \frac{180 \times 10^6}{f_{RF}} \frac{m}{s}$ (Rayleigh) $V_{max} = \frac{7.2 \times 10^{11}}{f_{RF}} \frac{m}{s}$ (Rayleigh) 0, or $V_{min} = \frac{3 \times 10^6}{f_{RF}} \frac{m}{s}$ (Jakes) $V_{max} = \frac{14.4 \times 10^{11}}{f_{RF}} \frac{m}{s}$ (Jakes)	0, or $V_{min} = \frac{180 \times 10^6}{f_{RF}} \frac{m}{s}$ $V_{max} = \frac{5.7 \times 10^{11}}{f_{RF}} \frac{m}{s}$ (cdma2000 or 1xEV-DO) $V_{max} = \frac{7.2 \times 10^{11}}{f_{RF}} \frac{m}{s}$ (W-CDMA)
Resolution[1]	0.001 km/h, m/s, mph	0.001 km/h, m/s, mph
Correlation	0 to 1 for each path between channels 1 and 2	—
Predefined Settings	W-CDMA, HSDPA, HSUPA, COST 259, TD-SCDMA, cdma2000, cdmaOne, 1xEV-DO, GSM, EDGE, WLAN, TETRA, and 802.16	
3 GPP W-CDMA Tests	Birth-death propagation and moving propagation	Birth-death propagation and moving propagation
Dynamic Fading		
Number of dynamic paths[2]	Up to 6	Up to 6
Number of states	1 to 5000	1 to 5000
Dwell time per state	10 ms to 1000 s	10 ms to 1000 s
Path delay	0 to 10 ms	0 to 10 ms
Path loss	0 to 99 dB	0 to 99 dB
Path Doppler	0 or 0.3 Hz to 2.4 kHz (filtered noise) 0 or 0.01 to 4.8 kHz (Jakes)	0 or 0.3 Hz to 2.4 kHz (filtered noise) 0 or 0.01 to 4.8 kHz (Jakes)
Path Vehicle speed	See above	See above
AWGN Specifications		
Carrier to Noise Ratio Accuracy[3]	0.3 dB	0.3 dB
Bandwidth	Up to a maximum of 17 MHz with Option 162 Up to a maximum of 80 MHz with Option 163	W-CDMA, HSDPA: 6.144 MHz; cdma2000, 1xEV-DO: 1.966 MHz
Crest Factor		
3 maximum paths	9 dB minimum	
6 or 9 maximum paths	12 dB minimum	15 dB minimum
≥12 maximum paths	12 dB minimum	15 dB minimum
Randomness	89 bit pseudo-random sequence with a repetition period greater than 3 billion years	
C/N Range	–30 to 30 dB	W-CDMA ±10 dB; cdma2000 ± 20 dB[3]
Resolution	0.01 dB	0.01 dB
Hold one of the following constant as another of these quantities is varied	C/N, C, N, or C+N	C/N, C, N, or C+N
E_b/N_o, E_c/N_o, E_b/N_t range	–30 to 30 dB	cdma2000; ±40 dB for E_b/N_t[4]
Resolution	0.01 dB	cdma2000; 0.01 dB for E_b/N_t
Hold one of the following constant as E_b/N_o, E_c/N_o, E_b/N_t is varied	C, N, or C+N	C, N, or C+N

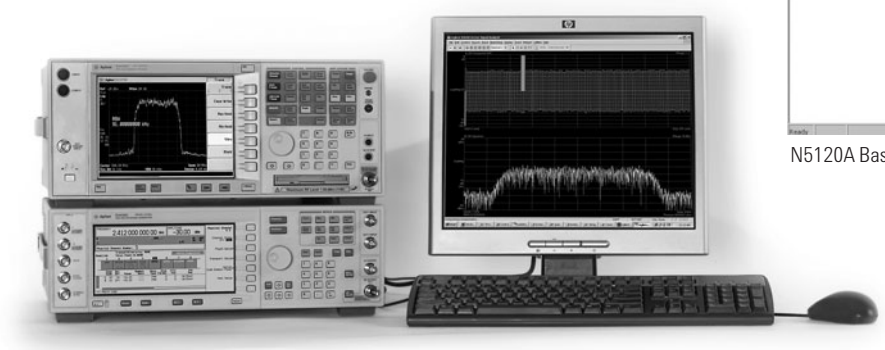
[1] Resolution depends on data rate and carrier frequency.
[2] Additional paths beyond the first 6 can be enabled; however, they are not dynamically faded.
[3] Not including the effects of carrier feedthrough. Measured with one path of constant fading. C/N accuracy for digital input and output may be decreased to 2 dB in some cases. To optimize C/N accuracy, adjust the N5102A clock phase.
[4] Range depends on channel configuration.

www.agilent.com/find/basebandstudio

Ordering Information

N5115B Baseband Studio for fading
- **N5115B-101** ESG Fading Connectivity for One Fading Channel
- **N5115B-102** PSG Fading Connectivity for One Fading Channel
- **N5115B-110** Digital I/Q Output For One Channel
- **N5115B-111** Digital I/Q Input For One Channel
- **N5115B-125** E5515C Fading Connectivity for One Fading Channel
- **N5115B-162** One Fading Channel with up to 17 MHz BW
- **N5115B-163** One Fading Channel with up to 80 MHz BW
- **N5115B-168** Add AWGN to One Fading Channel

- **Supported link rates: 614.4 ,1228.8, and 2457.6 Mbps**
- **CPRI link synchronization**
- **Concurrent uplink/downlink operation supported**
- **Real-time W-CDMA RMC 12.2 signal on uplink using an E4438C ESG**
- **Multi-carrier W-CDMA signal on downlink using N7600A Signal Studio for 3GPP W-CDMA with HSDPA/HSUPA**
- **HDLC C&M support**
- **Timing delay characterization tool**
- **SFP connectors for CPRI interface**
- **Uplink test capabilities including:**
- **Receiver sensitivity (Real-time BER/BLER)**
- **Remote API capability with .NET or COM interfaces**
- **Modulation analysis (VSA)**
- **Data capture**



CPRI RE Test setup with N5120A, E4438C ESG, and E4440A PSA.

N5120A Baseband Studio for CPRI RE Test BER menu.

N5120A Baseband Studio for CPRI RE Test

Test Radio Equipment with a CPRI Digital Interface

Baseband Studio for CPRI RE test software provides the tools needed to test CPRI (Common Public Radio Interface) base station radio equipment (RE) and the confidence that the RE will meet the standard. By emulating the REC (Radio Equipment Controller), this solution provides control signals via a CPRI interface to stimulate the RE. With an easy-to-use software interface the full-featured CPRI RE test solution saves time when testing the base station uplink path, downlink path, and timing.

Specifications

Antenna Carriers: 4, 6, 8, 12, 18, 24 (R-5 to R-10)
CPRI Line Rates
614.4 Mbps (E6)
1228.8 Mbps (E12)
2457.6 Mbps (E24)
SFP Interface
- 2 high speed serial interfaces
- Compatible with SFP committee INF-8047i rev 1.0 specification for Small Form-factor Pluggable transceivers

SFP Host Side Electrical TX RX
- SFP1: Connected to the PMC-Sierra PM8358 QuadPhy 10GX SERDES. Refer to this vendor's SERDES data sheet for details
- SFP2: Connected to the TI TLK1201AIRCP SERDES. Refer to this vendor's SERDES data sheet for details

Output Markers
- Marker 1: TTL output from NI DS90L; 25 Ω series output impedance with ESD clamp to 3.3 V and ground
- Marker 2: 3.3 V LVCMOS output; 25 Ω series output impedance with ESD clamp to 3.3 V and ground

Input Triggers
- Trigger 1: TTL input to NI DS90L V011A; 348 pull up to 3.3 V, 261 Ω pull down to ground; 25 Ω series input impedance with ESD clamp to 3.3 V and ground
- Trigger 2: 3.3 V LVCMOS input; 348 pull up to 3.3 V, 261 Ω pull down to ground; 25 Ω series input impedance with ESD clamp to 3.3 V and ground

RF Pulse In ("CW Off" Pulse Detector)
- CW frequency range: 700 MHz to 2.5 GHz
- CW input level: 10 ± 1 dBm (nominal)
- CW off pulse level: >0 dBm
- CW off pulse period: 260 ns (typical)

Reference In
- Reference frequencies (MHz): 1, 1.2288, 2, 3.84, 5, 10, 13, 19.2, 19.6608, 30.72, 34.8, 40
- Input level:
  0 dBm (nominal)
  +10 dBm (maximum)
  –10 dBm (minimum)
- Slew rate: ≥100 V/µsec

Clock In
Reference frequencies: 24 to 330 MHz, Dependent upon external reference frequency

Downlink
- IQ sample width: 8 – 20 bits
- Basic frame packing: Packed or flexible

Uplink
- IQ sample width: 4 – 10 bits
- Oversampling ratio: 2 or 4
- Basic frame packing: Packed or flexible
- Output: BER/BLER, 89601 VSA software, or a binary file

N5120A

BER/BLER
- Reference measurement channel: Fully coded W-CDMA RMC 12.2 kbps
- DPDCH: Raw PN9

Streaming: Uses 2 GB of DRAM on Baseband Studio PCI card

PC Requirements
- PC class: 2 GHz Pentium® 4 processor
- Memory: 1024 MB memory
- PCI card slots:
  Two adjacent full-length slots available
  One 64-bit and one 32-bit slots or two 64-bit slots
- Bus: 64-bit bus
- Hard drive space: 1024 MB
- Operating system: Windows® 2000 (SP3 or later) or Windows XP (SP1 or later)
- Required software: Microsoft .NET Framework 1.1 SP1 and Microsoft Internet Explorer 5.01 or later

Key Literature & Web Link

Agilent N5120A Baseband Studio for CPRI RE Test Technical Overview, p/n 5989-3324EN

For more information, visit our web site:
www.agilent.com/find/basebandstudio

Ordering Information

N5120Z Baseband Studio for CPRI RE Test System Bundle
Minimum required equipment for CPRI RE Test: N5120A, N5120A-109, N5101A, N5101A-022, and N5103A

N5120A CPRI Test Software Emulates a Radio Equipment Controller to test Uplink and Downlink Paths using CPRI Interface
N5120A-109 License for N5101A Baseband Studio PCI Card
N5120A-121 License for N7600A W-CDMA Software to work with N5120A Software
N5120A-145 Real-time BER Measurement for CPRI
N5101A Baseband Studio PCI Card
N5101A-022 Add 512MSa Memory
N5103A High Speed Serial Interface Card

Discontinued Products Cross Reference Table

This table contains recommended replacement products.
For more detailed information regarding replacement performance please see the pages listed below.

Discontinued Product	Recommended Replacement Product	Options	Page
E8241A PSG-L Series Performance Signal Generator, 20 GHz	E8257D[1]	520	285
E8244A PSG-L Series Performance Signal Generator, 40 GHz	E8257D[1]	520	285
E8251A PSG-A Series Performance Signal Generator, 20 GHz	E8257D	520, UNT, UNW	285
E8254A PSG-A Series Performance Signal Generator, 40 GHz	E8257D	540, UNT, UNW	285
E8247C PSG CW Signal Generator	E8257D[1]		285
E8257C PSG Analog Signal Generator	E8257D	UNT, UNW	285
E8267C PSG Vector Signal Generator	E8267D	UNT, UNW	285
83620A Synthesized Sweeper, 10 MHz to 20 GHz	E8257D	520, 007, UNT[2], UNU[3]	285
83620B Synthesized Swept – Signal Generator, 0.01 to 20 GHz	E8257D	520, 007, UNT[2], UNU[3]	285
83622A Synthesized Sweeper, 2 to 20 GHz	E8257D	520, 007, UNT[2], UNU[3]	285
83622B Synthesized Swept – Signal Generator, 2 to 20 GHz	E8257D	520, 007, UNT	285
83623A Synthesized Sweeper, 10 MHz to 20 GHz, High Power	E8257D	520, 007, UNT[2], UNU[3]	285
83623B High Power Swept – Signal Generator, 0.01 to 20 GHz	E8257D	520, 007, UNT[2], UNU[3]	285
83623L Synthesized Swept – CW Generator, 10 MHz to 20 GHz	E8257D[1]	520, 007	285
83624A Synthesized Sweeper, 2 to 20 GHz, High Power	E8257D	520, 007, UNT[2], UNU[3]	285
83624B High Power Swept – Signal Generator, 2 to 20 GHz	E8257D	520, 007, UNT[2], UNU[3]	285
83630B Synthesized Swept – Signal Generator, 0.01 to 26.5 GHz	E8257D	532, 007, UNT[2], UNU[3]	285
83630L Synthesized Swept – CW Generator, 10 MHz to 26.5 GHz	E8257D[1]	532, 007	285
83640A Synthesized Sweeper, 10 MHz to 40 GHz	E8257D	540, 007, UNT[2], UNU[3]	285
83640B Synthesized Swept – Signal Generator, 0.01 to 40 GHz	E8257D	540, 007, UNT[2], UNU[3]	285
83640L Synthesized Swept – CW Generator, 10 MHz to 40 GHz	E8257D[1]	540, 007	285
83650B Synthesized Swept – Signal Generator, 0.01 to 50 GHz	E8257D	550, 007, UNT[2], UNU[3]	285
83650L Synthesized Swept – CW Generator, 10 MHz to 50 GHz	E8257D[1]	550, 007	285
E4400B ESG-A Series Analog Signal Generator, 1 GHz	N5181A	501, UNT, UNU, 1EQ	276
E4420B ESG-A Series Analog Signal Generator, 2 GHz	N5181A	503, UNT, UNU, 1EQ	276
E4421B ESG-A Series Analog Signal Generator, 3 GHz	N5181A	503, UNT, UNU, 1EQ	276
E4422B ESG-A Series Analog Signal Generator, 4 GHz	N5181A	506, UNT, UNU, 1EQ	276
E4423B ESG-AP Series Analog Signal Generator, 1 GHz	E4428C	503	279
E4424B ESG-AP Series Analog Signal Generator, 2 GHz	E4428C	503	279
E4425B ESG-AP Series Analog Signal Generator, 3 GHz	E4428C	503	279
E4426B ESG-AP Series Analog Signal Generator, 4 GHz	E4428C	506	279
E4430B ESG-D Series Vector Signal Generator, 1 GHz	N5182A	503, UNT, UNU, 1EQ	293
E4431B ESG-D Series Vector Signal Generator, 2 GHz	N5182A	503, UNT, UNU, 1EQ	293
E4432B ESG-D Series Vector Signal Generator, 3 GHz	N5182A	503, UNT, UNU, 1EQ	293
E4433B ESG-D Series Vector Signal Generator, 4 GHz	N5182A	506, UNT, UNU, 1EQ	293
E4434B ESG-DP Series Vector Signal Generator, 1 GHz	E4438C	501, UNJ	298
E4435B ESG-DP Series Vector Signal Generator, 2 GHz	E4438C	502, UNJ	298
E4436B ESG-DP Series Vector Signal Generator, 3 GHz	E4438C	503, UNJ	298
E4437B ESG-DP Series Vector Signal Generator, 4 GHz	E4438C	506, UNJ	298
8645A Frequency-Agile Signal Generator, 1 GHz or 2 GHz	N5181A E4428C	501/503, UNZ 503, UNB	276 279
8644B High-Performance Signal Generator, 1 GHz or 2 GHz	E8257D	UNX	285
8648A Synthesized Signal Generator, 100 kHz to 1 GHz	N5181A	501, UNT, UNU, 1EQ	276
8648B Synthesized Signal Generator, 9 kHz to 2 GHz	N5181A	503, UNT, UNU, 1EQ	276
8648C Synthesized Signal Generator, 9 kHz to 3.2 GHz	N5181A	506, UNT, UNU, 1EQ	276
8648D Synthesized Signal Generator, 9 kHz to 4 GHz	N5181A	506, UNT, UNU, 1EQ	276
8662A High-Performance Signal Generator, 1.2 GHz	E8663B	503, HAR	282
8663A High-Performance Signal Generator, 2.5 GHz	E8663B	503, HAR	282
8664A High-Performance Signal Generator, 3 GHz	E8257D	UNX	285
8665B High-Performance Signal Generator, 6 GHz	E8257D	UNX	285

[1] For CW only capability the E8257D is ordered without analog modulation options.
[2] To add scan modulation to the E8257D, option HSM must be included.
[3] For equivalent operation below 3.2 GHz, option UNW must be substituted for option UNU on the E8257D.

The 33220A and 33250A function and arbitrary waveform generators are accurate and convenient to set up. Also, available software makes it easy to download created or captured waveforms.

Find Your Fit in the Agilent Technologies Family

Besides producing sine waves accurate in frequency and amplitude Agilent function generators are versatile signal sources that can produce all of the following waveforms: square, triangle, ramp and pulse. Tuning is continuous over wide bands, and many models can modulate these waveforms and sweep them across a range of frequencies. Agilent function generators use frequency synthesis techniques to generate their outputs. Applications for these general-purpose signal sources are diverse. Examples include speed sensor characterization, communications receiver design and test.

Agilent waveform generators can also produce arbitrary waveforms, programmable at the front panel or on a PC and downloaded. This capability allows creating complex signals for your unique applications. A typical use for arbitrary waveforms is to simulate specific ECG waveforms to verify that an electronic hospital patient monitor responds in the proper manner.

From complex signals to simple waveforms, there is an Agilent function generator that is right for the job. See the table for additional detail.

33220A & 33250A

Both the Agilent 33220A and 33250A offer an endless variety of waveforms for every measurement challenge.

- Broad feature set and high-quality signals
- 10 built-in waveforms, including pulse, noise and arbitrary
- THD less than 0.04% and flatness as low as ±0.1 dB
- Graphical display simplifies waveform creation

The Agilent 33220A and 33250A function/arbitrary waveform generators give you 10 standard waveforms and the ability to create versatile arbitrary waveforms, with 12-bit or 14-bit resolution and a sample rate of 50 MSa/s (33220A), or 200 MSa/s (33250A). In addition, the 33220A and 33250A can generate pulse waveforms with variable edge time.

Start with the signals a product is supposed to see, then add noise, harmonics, spurs and other extraneous signals to see how well it responds. Built-in modulation capabilities and both linear and log sweeps further expand your test possibilities without requiring additional generators.

Selection Guide for Agilent Function/Arbitrary Waveform Generators

	33220A	33250A
Frequency Range (sine, square)	1 µHz to 20 MHz	1 µHz to 80 MHz
Standard Waveforms	Sine, square, pulse, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, dc volts	Sine, square, pulse, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, dc volts
Pulse	5 MHz, variable edge time	50 MHz, variable edge time
Arbitrary Waveforms	2 to 64 K points	1 to 64 K points
Sample Rate	50 MSa/s	200 MSa/s
Modulation	AM, FM, PM, FSK, PWM (all internal/external)	AM, FM, FSK (all internal/external)
Sweep	Linear or logarithmic; up or down	Linear or logarithmic; up or down
Burst	Gated, N-cycle	Gated, N-cycle
External Clock Reference (Can also be used to create precise phase offsets or to phase-lock two generators)	Optional External lock range: 10 MHz ±500 Hz Internal frequency: 10 MHz	Standard External lock range: 10 MHz ±35 kHz Internal frequency: 10 MHz
Connectivity (IntuiLink SW included)	GPIB, USB, LAN	GPIB, RS-232

Team your function generator with an Agilent scope and IntuiLink Software to capture, edit and replay test signals.

- 20 MHz Sine and Square waveforms
- Pulse, Ramp, Triangle, Noise, and DC waveforms
- 14-bit, 50 MSa/s, 64 K-point Arbitrary waveforms
- AM, FM, PM, FSK, and PWM modulation types
- Linear & logarithmic sweeps and burst operation
- 10 mVpp to 10 Vpp amplitude range
- Graph mode for visual verification of signal settings
- Connect via USB, GPIB and LAN
- IntuiLink Waveform Editor Software
- LXI class C compliant

33220A

33220A Function/Arbitrary Waveform Generator

Uncompromising Performance for Functions and Waveforms

The Agilent Technologies 33220A Function/Arbitrary Waveform Generator uses direct digital synthesis (DDS) techniques to create a stable, accurate output signal for clean, low distortion sine waves. It also gives you square waves with fast rise and fall times up to 20 MHz and linear ramp waves up to 200 kHz.

Pulse Generation

The 33220A can generate variable-edge-time pulses up to 5 MHz. With variable period, pulse width, and amplitude the 33220A is ideally suited to a wide variety of applications requiring a flexible pulse signal.

Custom Waveform Generation

Use the 33220A to generate complex custom waveforms. With 14-bit resolution, and a sampling rate of 50 MSa/s, the 33220A gives you the flexibility to create the waveforms you need. It also lets you store up to four waveforms in nonvolatile memory.

The Agilent IntuiLink Arbitrary Waveform software allows you to easily create, edit, and download complex waveforms using the waveform editor. Or you can capture a waveform using IntuiLink for Oscilloscope and send it to the 33220A for output. To find out more about IntuiLink, visit **www.agilent.com/find/intuilink**

Easy-to-use Functionality

Front-panel operation of the 33220A is straight-forward and user friendly. You can access all major functions with a single key or two. The knob or numeric keypad can be used to adjust frequency, amplitude, offset, and other parameters. You can even enter voltage values directly in Vpp, V_{rms}, dBm, or as high and low levels. Timing parameters can be entered in Hertz (Hz) or seconds.

Internal AM, FM, PM, FSK, and PWM modulation make it easy to modulate waveforms without the need for a separate modulation source. Linear and logarithmic sweeps are also built in, with sweep rates selectable from 1 ms to 500 s. Burst mode operation allows for a user-selected number of cycles per period of time. GPIB, LAN, and USB interfaces are all standard, plus you get full programmability using SCPI commands.

External Frequency Reference (33220A-001)

The 33220A external frequency reference lets you synchronize to an external 10 MHz clock, to another 33220A, or to an Agilent 33250A. Phase adjustments can be made from the front panel or via a computer interface, allowing precise phase calibration and adjustment.

Abbreviated Technical Specifications

Waveforms

Standard: Sine, square, ramp, triangle, pulse, noise, DC
Built-in Arbitrary: Exponential rise, exponential fall, negative ramp, sin(x)/x, cardiac

Waveform Characteristics

Sine
- Frequency Range: 1 µHz to 20 MHz
- Amplitude Flatness[1,2] (relative to 1 kHz)
  - <100 kHz: 0.1 dB
  - 100 kHz to 5 MHz: 0.15 dB
  - 5 MHz to 20 MHz: 0.3 dB
- Harmonic Distortion[2,3]

	<1 Vpp	≥1 Vpp
DC to 20 kHz	–70 dBc	–70 dBc
20 kHz to 100 kHz	–65 dBc	–60 dBc
100 kHz to 1 MHz	–50 dBc	–45 dBc
1 MHz to 20 MHz	–40 dBc	–35 dBc

- Total Harmonic Distortion[2,3] (DC to 20 kHz): 0.04%
- Spurious (non-harmonic)[2,4]
  - DC to 1 MHz: – 70 dBc
  - 1 MHz to 20 MHz: – 70 dBc + 6 dB/octave
- Phase Noise (10 kHz offset): – 115 dBc/Hz, typical

Square
- Frequency Range: 1 µHz to 20 MHz
- Rise/Fall Time: <13 ns
- Overshoot: <2%
- Variable Duty Cycle:
  - 20% to 80% (to 10 MHz)
  - 40% to 60% (to 20 MHz)
- Asymmetry (@50% duty): 1% of period + 5 ns
- Jitter (RMS): 1 ns + 100 ppm of period

Ramp, Triangle
- Frequency Range: 1 µHz to 200 kHz
- Linearity: <0.1% of peak output
- Variable Symmetry: 0.0% to 100.0 %

Pulse
- Frequency Range: 500 µHz to 5 MHz
- Pulse Width (period ≤10 s): 20 ns minimum, 10 ns resolution
- Variable Edge Time: <13 ns to 100 ns
- Overshoot: <2%
- Jitter (RMS): 300 ps + 0.1 ppm of period

Noise
- Bandwidth: 10 MHz typical

Arbitrary
- Frequency Range: 1 µHz to 6 MHz
- Waveform Length: 2 to 64 K points
- Amplitude Resolution: 14 bits (including sign)
- Sample Rate: 50 MSa/s
- Min. Rise/Fall Time: 35 ns typical
- Linearity: <0.1% of peak output
- Setting Time: <250 ns to 0.5% of final value
- Jitter (RMS): 6 ns + 30 ppm
- Non-volatile Memory: Four waveforms

[1] Add 1/10th of output amplitude and offset spec per °C for operation outside the range of 18°C to 28°C.
[2] Autorange enabled.
[3] DC offset set to 0 V.
[4] Spurious noise at low amplitude is limited by –75 dBm typical.

Output Characteristics

Frequency Accuracy
- 90 days: ±(10 ppm +3 pHz)
- 1 year: ±(20 ppm +3 pHz)

Amplitude
- Range
  - 10 mVpp to 10 Vpp into 50 Ω
  - 20 mVpp to 20 Vpp into open circuit
- Accuracy[1,2] (at 1 kHz): ±1% of setting +1 mVpp
- Units: Vpp, V_{rms}, dBm
- Resolution
  - 10.00 to 20.00 Vpp: 10 mVpp
  - 1.000 to 9.999 Vpp: 1 mVpp
  - <9.9999 mVpp: 0.1 mVpp

DC Offset
- Range (peak AC + DC)
  - ±5 V into 50 Ω
  - ±10 V into open circuit
- Accuracy[1,2]
  - ±2% of offset setting
  - ±0.5% of amplitude ±2 mV
- Resolution: 4 digits

Main Output
- Impedance: 50 Ω typical
- Isolation: 42 Vpk maximum to earth
- Protection: Short-circuit protected, overload automatically disables main output

External Clock Reference (Option 33220A-001)
- Rear Panel Input Lock Range: 10 MHz ± 500 Hz
- Rear Panel Output Frequency: 10 MHz
- Phase Offset: +360° to –360°, 0.001° resolution

4

Modulation

AM
- Carrier Waveforms: Sine, square, ramp, Arb
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Depth: 0.0% to 120.0%

FM
- Carrier Waveforms: Sine, square, ramp, Arb
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Deviation: DC to 10 MHz

PM
- Carrier Waveforms: Sine, square, ramp, Arb
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Deviation: 0.0 to 360.0 degrees

PWM
- Carrier waveforms: Pulse
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Deviation: 0% to 100% of pulse width

FSK
- Carrier waveforms: Sine, square, ramp, Arb
- Source: Internal or external
- Internal Modulation: 50% duty cycle square (2 mHz to 100 kHz)

External Modulation Input[3] (for AM, FM, PM, PWM)
- Voltage Range: ±5 V full scale
- Input Impedance: 5 kΩ typical
- Bandwidth: DC to 20 kHz

Sweep

Waveforms: Sine, square, ramp, Arb
Type: Linear or logarithmic
Direction: Up or down
Sweep Time: 1 ms to 500 s
Trigger: Single, external or internal
Marker: Falling edge of sync signal (programmable frequency)

Burst[4]

Waveforms: Sine, square, ramp, triangle, pulse, noise, Arb
Type: Counted (1 to 50,000 cycles), Infinite, Gated
Start/Stop Phase: –360° to +360°
Internal Period: 1 µs to 500 s
Gate Source: External trigger
Trigger Source: Single, external or internal

General Specifications

State Storage Memory: Power off state automatically saved; 4 user-configurable stored states
Interface: USB, GPIB, and LAN standard
Language: SCPI-1993, IEEE-488.2
Dimensions
- Bench Top: 261.1 mm (W) x 103.8 mm (H) x 303.2 mm (D)
- Rackmount: 212.8 mm (W) x 88.3 mm (H) x 272.3 mm (D)

Weight: 3.4 kg (7.5 lb)

For more information, visit our web site: **www.agilent.com/find/33220A**

Ordering Information

33220A Function/Arbitrary Waveform Generator
- **33220A-001** External Clock Reference
- **33220A-A6J** ANSI Z540 Compliant Calibration

34161A Accessory Pouch
34131A Hard Transit Case

[1] Add 1/10th of output amplitude and offset spec per °C for operation outside the range of 18°C to 28°C.
[2] Autorange enabled.
[3] FSK uses trigger input (1 MHz maximum).
[4] Sine and square waveforms above 6 MHz are allowed only with an "infinite" burst count.

33250A

- 80 MHz sine and square waveforms
- Sine, square, triangle/ramp, pulse, noise, and more
- 50 MHz pulse with variable edge times
- 200 MSa/s, 12-bit, 64K-point deep arbitrary waveforms
- Sweep (lin/log), burst (gated/counted/triggered) and modulation (AM/FM/FSK)
- GPIB and RS-232 interfaces standard
- IntuiLink software included

33250A

33250A Function/Arbitrary Waveform Generator

The Agilent Technologies 33250A uses direct digital-synthesis (DDS) techniques to create a stable, accurate output on all waveforms, down to 1 µHz frequency resolution. The benefits are apparent in every signal you produce, from the sine wave frequency accuracy to the fast rise/fall times of square waves to the ramp linearity.

Front-panel operation of the 33250A is straightforward and user friendly. The knob or numeric keypad can be used to adjust frequency, amplitude and offset. You can even enter voltage values directly in Vpp, V_{rms}, dBm, or high/low levels. Timing parameters can be entered in Hertz (Hz) or seconds.

Custom Waveform Generation

Why settle for a basic function generator when you can get arbitrary waveforms at no extra cost? With the 33250A, you can generate arbitrary waveforms with 12-bit vertical resolution, 64 K point memory depth, and a sample rate of 200 MSa/s. You can also store up to four 64 K-deep arbitrary waveforms in non-volatile memory with user-defined names to help you find the right waveform when you need it most. Included IntuiLink software lets you use your Windows-based PC to easily create, edit, and download complex arbitrary waveforms using the IntuiLink Arbitrary waveform editor.

Pulse Generation

The 33250A can generate simple pulses up to 50 MHz. Edge times can be set as low as 5 ns. Voltage levels can be set as amplitude and offset, or as high and low levels. With period and pulse width parameters, the 33250A is ideally suited to a wide variety of pulse applications.

Built-In Versatility

AM, FM, and FSK capabilities make it easy to modulate waveforms with or without a separate source. You can internally modulate with any of the standard waveforms as well as Arb or use an external source. Linear or logarithmic sweeps can be performed with an adjustable frequency marker signal. Programmable burst count (from 1 to 1,000,000 or infinite cycles) and gating allow you to further customize your signal.

For system applications, both GPIB and RS-232 interfaces are standard, and support full programmability using SCPI commands.

Color Graphical Display

The unique design of the 33250A combines a low-profile instrument with the benefits of a color graphical display. Now you can display an image of the output waveform with multiple parameters at the same time. The graphical interface also allows quick and easy modifications to arbitrary waveforms.

Quality and Reliability

The 33250A's TCXO timebase gives you frequency accuracy of 1 ppm for your most demanding applications. The external clock reference input/output lets you synchronize to an external 10 MHz clock.

Abbreviated Technical Specifications

Waveforms

Standard: Sine, square, ramp/triangle, noise, sin(x)/x, exponential rise, exponential fall, cardiac, DC volts

Arbitrary

- Waveform Length: 1 to 64 K points
- Amplitude Resolution: 12 bits (including sign)
- Sample Rate: 200 MSa/s
- Non-Volatile Memory: Four (4) 64 K waveforms

Frequency Characteristics

Sine: 1 µHz to 80 MHz
Square: 1 µHz to 80 MHz
Pulse: 500 µHz to 50 MHz
Arb: 1 µHz to 25 MHz
Ramp: 1 µHz to 1 MHz
Noise (Gaussian): 50 MHz bandwidth
Resolution: 1 µHz; except pulse, 5 digits
Accuracy (1 year)

- 2 ppm, 18°C to 28°C
- 3 ppm, 0°C to 55°C

Sinewave Spectral Purity

Harmonic Distortion:

	≤3 Vpp[1]	>3 Vpp
DC to 1 MHz	–60 dBc	–55 dBc
1 to 5 MHz	–57 dBc	–45 dBc
5 to 80 MHz	–37 dBc	–30 dBc

Total Harmonic Distortion: <0.2% + 0.1 mV_{rms} (DC to 20 kHz)
Spurious (non-harmonic)[2]:

- DC to 1 MHz: –60 dBc
- 1 to 20 MHz: –50 dBc
- 20 to 80 MHz: –50 dBc + 6 dB/octave

Phase noise (30 kHz band):

- 10 MHz: <–65 dBc (typical)
- 80 MHz: <–47 dBc (typical)

Signal Characteristics

Square

- Rise/Fall Time: <8 ns
- Overshoot: <5%
- Asymmetry: 1% of period + 1 ns
- Duty Cycle:
  - ≤25 MHz: 20.0% to 80.0%
  - 25 to 50 MHz: 40.0% to 60.0%
  - 50 to 80 MHz: 50.0% fixed

Pulse

- Period: 20.00 ns to 2000.0 s
- Pulse Width: 8.0 ns to 1999.9 ns
- Variable Edge Time: 5.00 ns to 1.00 ms
- Overshoot: <5%

Ramp

- Linearity: <0.1% of peak output
- Symmetry: 0.0% to 100.0%

Arb

- Minimum Edge Time: <10 ns
- Linearity: <0.1% of peak output
- Settling Time: <50 ns to 0.5% of final value

Output Characteristics

Amplitude (into 50 Ω): 10 mVpp to 10 Vpp

- Accuracy (at 1 kHz, >10 mVpp, Autorange): ± 1% of setting ± 1 mVpp
- Flatness (sinewave relative to 1 kHz, Autorange):
  - <10 MHz ±1% (±0.1 dB)
  - 10 to 50 MHz ±2% (±0.2 dB)
  - 50 to 80 MHz ±5% (±0.4 dB)
- Units: Vpp, V_{rms}, dBm, high and low level
- Resolution: 0.1 mV or 4 digits

Offset (into 50 Ω): ±5 Vpk ac + dc

- Accuracy: 1% of setting + 2 mV + 0.5% of amplitude

Waveform Output

- Impedance: 50 Ω typical (fixed); >10 MΩ (output disabled)
- Isolation: 42 Vpk maximum to earth
- Protection: Short-circuit protected; overload automatically disables main output

Modulation

AM

- Carrier Waveforms: Sine, square, ramp, and Arb
- Modulation Waveforms: Sine, square, ramp, noise, and Arb
- Modulation Frequency: 2 mHz to 20 kHz
- Depth: 0.0% to 120.0%
- Source: Internal/external

FM

- Carrier Waveforms: Sine, square, ramp, and Arb
- Modulation Waveforms: Sine, square, ramp, noise, and Arb
- Modulation Frequency: 2 mHz to 20 kHz
- Deviation Range: DC to 80 MHz
- Source: Internal/external

FSK

- Carrier Waveforms: Sine, square, ramp, and Arb
- Modulation Waveform: 50% duty cycle square
- Internal Rate: 2 mHz to 1 MHz
- Frequency Range: 1 µHz to 80 MHz
- Source: Internal/external

External Modulation Input

- Voltage Range: ±5 V full scale
- Input Impedance: 10 kΩ
- Frequency: DC to 20 kHz

Burst

Waveforms: Sine, square, ramp, pulse, Arb, and noise
Frequency: 1 µHz to 80 MHz (>25 MHz only with infinite burst count)
Burst Count: 1 to 1,000,000 cycles, or infinite
Start/Stop Phase: –360.0° to +360.0°
Internal Period: 1 ms to 500 s
Trigger Source: Single manual trigger, internal, external trigger
Trigger Delay (N-cycle, infinite): 0.0 ns to 85.000 s

Sweep

Waveforms: Sine, square, ramp, and Arb
Type: Linear or logarithmic, up or down
Start F/Stop F: 100 µHz to 80 MHz
Sweep Time: 1 ms to 500 s
Trigger: Single manual trigger, internal, external trigger
Marker: Falling edge of sync signal (programmable)

Clock Reference

Phase Offset: –360.000° to +360.000°
External Reference Input Lock Range: 10 MHz ± 35 kHz
Internal Reference Output Frequency: 10 MHz

General Specifications

State Storage Memory: Power off state automatically saved; 4 user configurable named stored states
Interface: IEEE-488 and RS-232 standard
Language: SCPI-1997, IEEE-488.2
Power Requirements: 100 – 240 V, 50 – 60 Hz; 100 – 127 V, 50 – 400 Hz
Size

- Bench Top: 104 mm H x 254 mm W x 374 mm D (4.16 in x 10.12 in x 14.96 in)
- Rackmount: 89 mm H x 213 mm W x 348 mm D (3.56 in x 8.52 in x 13.92 in)

Weight: 4.6 kg (10.12 lb)

For more information, visit our web site:
www.agilent.com/find/waveform

Ordering Information

33250A Function/Arbitrary Waveform Generator
33250A-1CM Rackmount Kit*
33250A-A6J ANSI Z540 Compliant Calibration
34131A Carrying Case
34161A Accessory Pouch
34190A Rackmount Kit*

* For racking two 33250As side-by-side, order the following items:
Lock-link kit (p/n 5061-9694)
Flange kit (p/n 5063-9212)

[1] Harmonic distortion at low amplitudes is limited by a –70 dBm floor.
[2] Spurious noise at low amplitudes is limited by a –74 dBm floor.

- **1.25 GS/s Sample Rate**
- **15 bit vertical resolution**
- **Dual channel, differential outputs**
- **16 MS waveform memory**
- **Multi-module synchronization**
- **Multiple programmatic interfaces**

N6030A

N8241A

Agilent's N6030A and N8241A arbitrary waveform generators deliver unprecedented performance for creation of complex wideband waveforms. High sampling rate and high bit resolution provided in a single instrument enable designers to create ideal waveforms for accurate test of radar, satellite, and frequency agile systems. Each channel of the arbitrary waveform generator provides 500 MHz of modulation bandwidths and over 65 dBc of spurious free dynamic range. When combined with a wideband I/Q upconverter, modulation bandwidth of 1 GHz can be realized at microwave frequencies for authentic signal simulations for IF and RF subsystem test.

Specifications[1]

Channels
Two independent channels available as baseband or IF outputs
- CH1: Single-ended and differential
- CH2: Single-ended and differential

Modulation Bandwidth
500 MHz per channel (1 GHz I/Q bandwidth)

Resolution
15-bit (1/32,768 levels)

Output Spectral Purity – (CH1 and CH2)
- Harmonic distortion: <–65 dBc for each channel DC to 500 MHz
- Non-Harmonic spurious: <–75 dBc for each channel DC to 500 MHz
- Noise floor: <–150 dBc/Hz across the channel bandwidth

Sample Clock-Internal
Fixed 1.25 GS/s

Internal Clock Output
+3 dBm nominal

External Clock Input
Tunable 100 MS/s to 1.25 GS/s

External Clock Input Drive Level
+5 to –15 dBm typical

Phase Noise Characteristics
1 kHz: –95 dBc/Hz
10 kHz: –115 dBc/Hz
100 kHz: –138 dBc/Hz
1 MHz: –150 dBc/Hz

Noise Floor
–150 dBc/Hz

Accuracy
Same as 10 MHz timebase input

Frequency Reference

Input Drive Level
+2 to +12 dBm into 50 ohms (+2 dBm nominal)

Waveform Length
8 MS per channel (16 MS with Option 016)

Minimum Waveform Length
128 samples

Waveform Granularity
16 samples

Segments
1 to 256 k unique segments can be defined consisting of waveform start and stop addresses, repetitions, and marker enable flags

Sequences
Up to 256 k total unique waveform sequences can be defined. A sequence is a contiguous series of waveform segments

External Triggers

Number of Inputs
5 each (4 SMB female front panel connectors plus one software trigger)

External Markers
Markers can be defined for each waveform segment

Number of Outputs
4 each (SMB female)

Module Synchronization
Supports system scaling for any number of arbitrary waveform generator modules. A single module can support fan-out of 8 modules for precise triggering and repeatability. Driver boards may be used to scale any number of modules

Key Literature & Web Link

N6030A Arbitrary Waveform Generator Technical Overview, p/n 5989-1457EN
N8241A Arbitrary Waveform Generator Technical Overview, p/n 5989-2595EN

www.agilent.com/find/awg
www.agilent.com/find/synthetic

Ordering Information

N6030A 15-bit, 1.25 GS/s Arbitrary Waveform Generator
N6031A 10-bit, 1.25 GS/s Arbitrary Waveform Generator
N6032A 15-bit, 625 MS/s Arbitrary Waveform Generator
N6033A 10-bit, 625 MS/s Arbitrary Waveform Generator
N8241A 15-bit, 1.25 GS/s or 625 MS/s Arbitrary Waveform Generator
N8242A 10-bit, 1.25 GS/s or 625 MS/s Arbitrary Waveform Generator

Typical Arbitrary Waveform Generator Options:
Option PXI Mainframe and Accessory Options
Option 008 8 Mega-sample Memory
Option 016 16 Mega-sample Memory
Option 300 Dynamic Sequencing Capability
Option 330 Direct Digital Synthesis Software

[1] Key specifications for the N6030A and N8241A. Refer to the data sheets for complete specifications on all the different model number products.

Pulse Pattern Generator from 1 mHz to 3.35 GHz

81101A

- 1 channel
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 5 ns and 200 ms
- Internal and external clocking
- 1 mHz to 50 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs

81104A with 81105A

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Complex data patterns
- Pseudo Random Binary Sequence (PRBS) generation

81110A, 81111A and 81112A

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- 1 mHz to 330 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Data patterns
- Pseudo Random Binary Sequence (PRBS) generation

E8311A and E8312A Pulse Pattern Generators

- Same as above in VXI form factor

81130A with 81131A

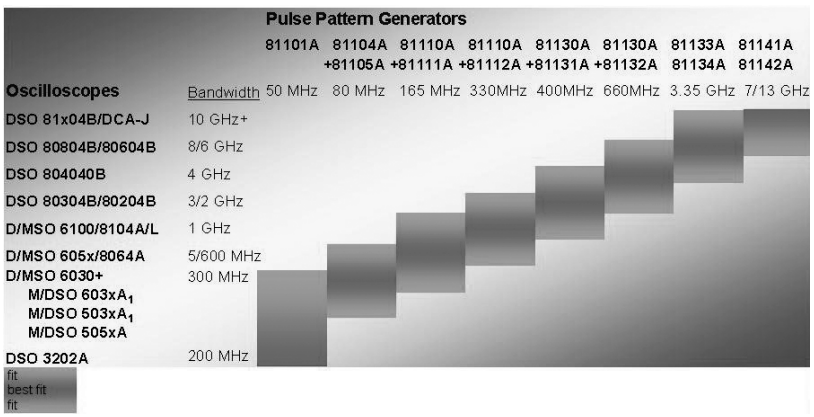
- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 kHz to 400 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Complex data pattern and pattern segment looping
- Pseudo Random Binary Sequence (PRBS) generation

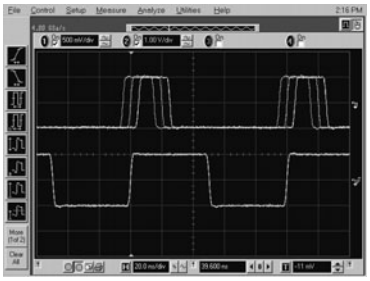
81130A with 81132A

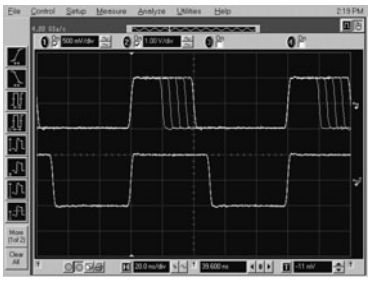
- 1 or 2 channels
- Up to 2.5 Vpp (into 50 Ohm)
- Fixed transition times 500 ps typ.
- Internal and external clocking
- 1 kHz to 660 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Up to 1.32 Gbit/s data generation
- Complex data patterns and pattern segment looping e.g. for USB 2.0 pre-compliance testing
- Pseudo Random Binary Sequence (PRBS) generation

81133A and 81134A

- 1 channel (81133A) or 2 channels (81134A)
- 50 mV up to 2 Vpp amplitude (into 50 Ohm)
- Programmable termination voltage
- Transition times <90 ps (adjustable between 70 ps – 120 ps typ.)
- 15 MHz to 3.35 GHz repetition rate
- Total jitter typically less than 2 ps RMS jitter
- 12 Mbit pattern memory per channel
- PC-based pattern management software
- 1.5 ps typ. clock jitter
- Differential Outputs
- Complex data patterns e.g. for PCI Express, SATA
- Pseudo Random Binary Sequence (PRBS) generation
- Delay Modulation: –250 ps to 250 ps (up to 500 ps total jitter)
- Modulation Frequency: 0 – 200 MHz
- Additional variable crossover between 30% – 70% typ.
- NRZ/RZ/R1 signal formats over the full frequency range







Flexible pulse generation

Leading Pulse, Pattern, Data and Clock Generation for All Test Needs in Digital Design and Manufacturing

Agilent Technologies offers a comprehensive portfolio of signal generation instruments for digital waveforms and data signal. Whether your applications calls for

- Demanding digital pulses
- High-speed clock signals
- Square waves
- Flexible serial or
- Parallel bit patterns and data streams

Key Applications at a Glance

Application	8114A	81101A	81104A 81105A	81110A 81111A	81110A 81112A	81130A 81131A	81130A 81132A	VXI E8305A	VXI E8311A	VXI E8312A	81133A	81134A
Clock Generation		•	•	•	•	•	•	•	•	•	•	•
System Trigger Source		•	•	•	•	•	•	•	•	•	•	•
Diodes – LEDs	•	•	•	•					•			
Laser or IR Diodes	•											
Radar Test				•	•			•	•	•		
Mixed Signal Devices			•	•	•			•	•	•		
Flash Chip Test			•	•				•	•			
EEPROMs	•											
High Power Semiconductors	•											
PRBS Generation			•	•	•	•	•	•	•	•	•	•
Data Generation <56 kBit			•	•	•	•	•	•	•	•	•	•
Data Generation >56 kBit											•	•
Data Looping						•	•					
Serial Bus Test <1 GBit/s			•	•	•	•	•				•	•
High Speed Bus Test >1 GBit/s							•				•	•
Signal Integrity Test											•	•
Jitter (Stress) Test											•	•

Choose the performance you need from the portfolio covering frequency from 1 mHz up to 3.35 GHz and an output amplitude range from 50 mV up to 100 V.

The ability to create user defined bit pattern, standard compliant data and PRBS make the Agilent Pulse Pattern Generators the ideal source for stimulated eye diagram measurement, cross-talk measurements, compliance tests or stress tests for receivers.

Pulse Pattern Generator

Pulse Pattern Generator from 1 mHz to 3.35 GHz (cont.)

Product Specifications at a Glance

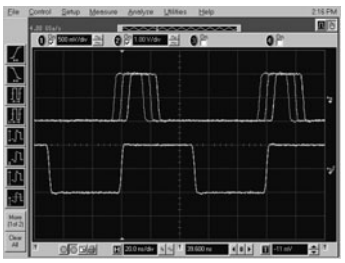
Specification	8114A	81101A	81104A 81105A	81110A 81111A	81110A 81112A	81130A 81131A	81130A 81132A	E8305A	VXI E8311A	VXI E8312A	81133A	81134A
Frequency Range	1 Hz 15 MHz	1 mHz 50 MHz	1 mHz 80 MHz	1 mHz 165 MHz	1 mHz 330 MHz	1 kHz 400 MHz	1 kHz 660 MHz	1 mHz 250 MHz	1 mHz 165 MHz	1 mHz 330 MHz	15 MHz 3.35 GHz	15 MHz 3.35 GHz
Number of Channels	1	1	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	2[1]	2[1]	2[1]	1	2
Optional 2nd Channel (retrofitable)			•	•	•	•	•					
Amplitude Range	1 V 100 V	100 mV 20 V	100 mV 20 V	100 mV 20 V	100 mV 3.8 V	100 mV 3.8 V	100 mV 2.5 V	100 mV 5 V	100 mV 20 V	100 mV 3.8 V	50 mV 2 V	50 mV 2 V
Differential Outputs					•	•	•			•	•	•
LVDS											•	•
Triggerable	•	•	•	•	•			•	•	•		
Gate Mode	•	•	•	•	•		•	•	•	•		
Remotely Programmable	•	•	•	•	•	•	•	•	•	•	•	•
Pulse Generation	•	•	•	•	•	•	•	•	•	•	•	•
Pattern & Data Generation			•	•	•	•	•	•	•	•	•	•
PRBS Generation			•	•	•	•	•	•	•	•	•	•
Bursts	•	•	•	•	•	•	•	•	•	•	•	•
Data Bursts			•	•	•	•	•	•	•	•	•	•
Pattern Memory			16 kBit/ Channel	16 kBit/ Channel	16 kBit/ Channel	64 kBit/ Channel	64 kBit/ Channel	16 kBit/ Channel	16 kBit/ Channel	16 kBit/ Channel	12 MBit/ Channel	12 MBit/ Channel
PRBS Variations ($2^n - 1$)			n = 7, 8,...14	n = 7, 8,...14	n = 7, 8,...14	n = 7, 8,...15	n = 7, 8,...15	n = 7, 8,...14	n = 7, 8,...14	n = 7, 8,...14	n = 5, 6,...32	n = 5, 6,...32
Segment Looping						4 segments 1 looping level	4 segments 1 looping level					
Controlled Jitter Injection											•	•
Variable Width	•	•	•	•	•	•	•	•	•	•	•	•
Variable Delay	•	•	•	•	•	•	•	•	•	•	•	•
Glitch-Free Timing Changes (patented)		•	•	•	•			•	•	•	•[2]	•[2]
Analogue Channel Add			•	•					•			
Digital Channel Add						•	•					
Multi-Level Signals			•	•					•			

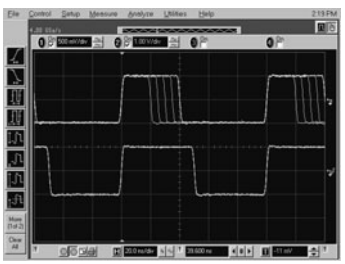
[1] VXI modules with 2 channels per module – multiple modules can be combined in one VXI-frame for multi-channel applications.
[2] Glitch-free frequency changes only in "direct" clock mode with external clock source.

The Agilent **81101A 50 MHz Pulse Generator** is the instrument of choice for cost efficient pulse and clock generation providing flexibility and full control over timing parameters.

- 1 channel
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 5 ns and 200 ms
- Internal and external clocking
- 1 mHz to 50 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs

Complementary products:
D/MSO 601x, DSO 3000, D/MSO 6030 and DSO 3062A Oscilloscopes



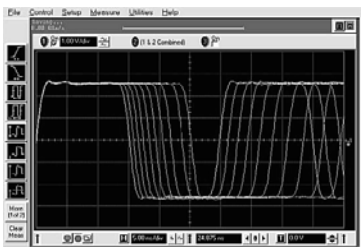


Flexible pulse generation

The Agilent **81104A 80 MHz Pulse Generator** provides the same pulse generation capability as the 81101A with an enhanced frequency range. Even greater flexibility is provided by the modular output channel concept: one or two 81105A output channels can be configured in the 81104A mainframe.

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Complex data patterns
- Pseudo Random Binary Sequence (PRBS) generation

Complementary Products:
D/MSO 6030, D/MSO 601x, DSO 3000 and D/MSO 6050/8064A Oscilloscopes



Glitch-free timing changes

The Agilent **81110A 165 MHz Pulse Pattern Generator** with one or two 81111A output channels is the industry-standard for pulse, pattern, data and PRBS generation up to 165.

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns and 200 ms
- Internal and external clocking
- 1 mHz to 80 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Data patterns
- Pseudo Random Binary Sequence (PRBS) generation

Complementary Products:
D/MSO 6050/8064A, D/MSO 6100/8104A and D/MSO 6030 Oscilloscopes

The Agilent **81110A 330 MHz Pulse Pattern Generator** with one or two 81112A output channels provides up to two differential output channels with fast transition times for a broad range of tests.

- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 mHz to 330 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Differential outputs
- Data patterns
- Pseudo Random Binary Sequence (PRBS) generation

Complementary Product:
D/MSO 6100/8104A, D/MSO 6050/8064A and DSO 80304B Oscilloscopes

From the versatility of Agilent Technologies 81110A comes the convenience of VXI with the **E8311A, E8312A and E8305A Pulse Pattern Generators**. These exercise the same specifications as the 81111A and 81112A modules with the same programmability and pattern and data sequence capabilities in a *plug & play* VXI form (C-size, 1 slot) – compatibility that makes the transition from lab to production quick and simple.

The **81130A 400 MHz Pulse Pattern Generator** with one or two 81131 output channels satisfies higher timing and precision demands. On top of the enhanced data generation and pattern segment looping features allow you to generate complex data patterns.

- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 kHz to 400 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Complex data pattern and pattern segment looping
- Pseudo Random Binary Sequence (PRBS) generation

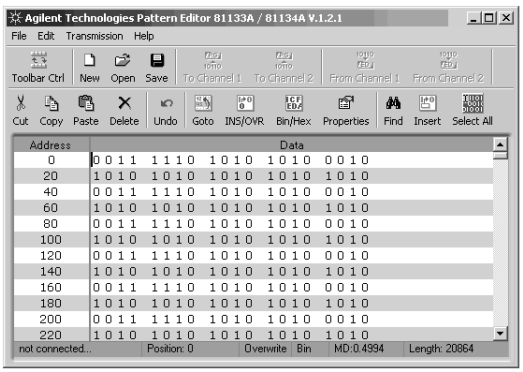
Complementary Products:
DSO 80304B, D/MSO 6100/8104A and DSO 8040B Oscilloscopes

8114A
81101A
81104A with 81105A
81110A with 81111A
81110A with 81112A
81130A with 81131A
81130A with 81132A
81133A
81134A
E8311A
E8312A
E8305A

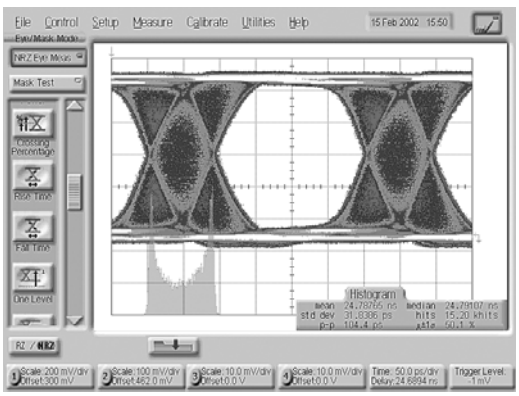
The Agilent **81130A 660 MHz Pulse Pattern Generator** with one or two 81132A output channels offers up to 1.32 Gbit/s by the digital channel add feature.

- 1 or 2 channels
- Up to 2.5 Vpp (into 50 Ohm)
- Fixed transition times 500 ps typ.
- Internal and external clocking
- 1 kHz to 660 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Up to 1.32 Gbit/s data generation
- Complex data patterns and pattern segment looping e.g. for USB 2.0 pre-compliance testing
- Pseudo Random Binary Sequence (PRBS) generation

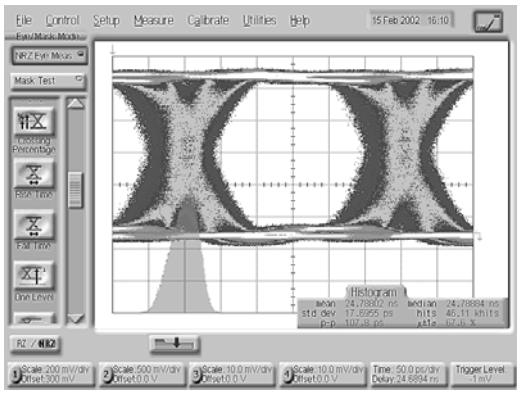
Complementary Products:
DSO 80404B, DSO 80804B/80604B and DSO 80304B Oscilloscopes



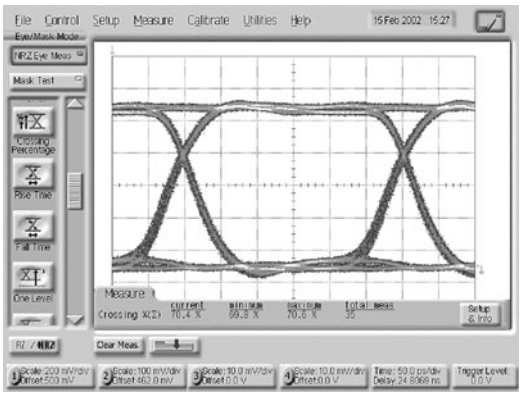
PC-based pattern management tool for 81133A/34A



Jitter modulated with sine wave



Jitter modulated with noise



Variable cross over point at 70%

When timing is crucial and high performance is required, the Agilent **81133A and 81134A** provide the fast rise times and low jitter that are required for in depth analyzes and performance characterizations of your devices

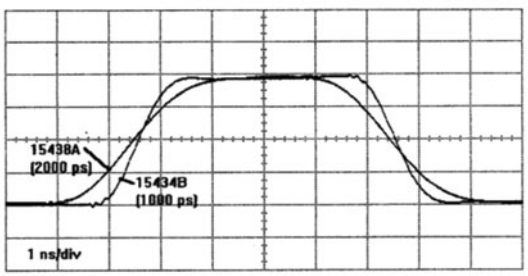
- 1 channel (81133A) or 2 channels (81134A)
- 50 mV up to 2 Vpp amplitude (into 50 Ohm)
- Programmable termination voltage
- Transition times <90 ps (adjustable between 70 ps – 120 ps typ.)
- 15 MHz to 3.35 GHz repetition rate
- Total jitter typically less than 2 ps
- 12 Mbit pattern memory per channel
- PC-based pattern management software
- 1.5 ps typ. RMS jitter
- Differential Outputs
- Complex data patterns e.g. for PCI Express, SATA
- Pseudo Random Binary Sequence (PRBS) generation
- Delay Modulation: –250 ps to 250 ps (up to 500 ps total jitter)
- Modulation Frequency: 0 – 200 MHz
- Additional variable crossover between 30% – 70% typ.
- NRZ/RZ/R1 signal formats over the full frequency range

Complementary Products:
DSO 80804B/80604B, DSO 81xxxB/DCA-J and DSO 80404B Oscilloscopes

For tests and devices that require higher voltage or currents, Agilent **8114A** is the instrument you need.

- 1 channel
- Up to 100 Vpp (into 50 Ohm) or 2 A
- Clean, reliable pulses with variable pulse width and 7 ns transition time
- External Synchronization and gating
- 15 MHz repetition rate and a counted burst mode
- Load compensation
- Optional variable pulse baseline (25 V)
- Device protection to avoid accidental damage

Complementary Products:
54622/24 A/D 100 MHz



15434B and 15438A Output Pulses

Transition-Time Converters have been designed to convert the transition times of instruments with fast, fixed transition times, to slower, fixed transition-times (150 ps, 250 ps, 500 ps, 1 ns, 2 ns). This reduces signal bandwidth, which may be necessary during the development of some devices. Reducing the signal transition times also increases the overall pulse-performance for overshoot/reflection sensitive applications.

Typical Characteristics

- Converter: 15435A, 15432B, 15433B, 15434B, 15438A
- Output Transition Time 150 ps, 250 ps, 500 ps, 1000 ps, 2000 ps
- 3 dB point 2.1 GHz, 1.3 GHz, 640 MHz, 370 MHz, 190 MHz
- Input voltage <10 Vpp
- Insertion Loss <0.2 dB
- Overshoot and Ringing <3 %

Key Literature & Web Link

Related Literature Publication Number

Agilent Technologies 81133A and 81134A, 3.35 GHz Pulse Pattern Generators Data Sheet, p/n 5988-5549EN
Agilent Technologies 81100 Family Pulse Pattern Generators Technical Specifications, p/n 5980-1215E
Agilent Technologies 8133A 3 GHz Pulse Generator Technical Specifications, p/n 5980-1214E
Agilent Technologies 8114A 100 V/2 A Programmable Pulse Generator Technical Specifications, p/n 5980-1213E
Agilent 81100 Family of Pulse Pattern Generators: Radar Distance Test to Airborne Planes Product Note 1, p/n 5968-5843E
Agilent 81100 Family of Pulse Pattern Generators: The Dual Clock Gbit Chip Test Product Note 2, p/n 5968-5844E
Agilent 81100 Family of Pulse Pattern Generators: Magneto-Optical Disk Drive Research Product Note 3, p/n 5968-5845E
Agilent 81100 Family of Pulse Pattern Generators: Simulation of Jittering Synchronization Signals for Video Interfaces Product Note 4, p/n 5968-5846E
PCI Express RX Design Validation with 81133A / 81250, p/n 5988-7432EN
USB 2.0 Pre-Compliance Testing with Agilent Infiniium Application Note 1400, p/n 5988-6219EN

Ordering Information

Main Products

Mainframe	Output Channels and Hardware Options	Description
81101A		50 MHz Pulse Generator
81104A	81105A (1 or 2)	80 MHz Pulse Generator 80 MHz Output Channel for 81104A
81110A	81111A (1 or 2) 81112A (1 or 2)	165/330 MHz Pulse Pattern Generator 165 MHz Output Channel for 81110A 330 MHz Output Channel for 81110A
81130A	81131A 81132A	400/660 MHz Pulse Pattern Generator 400 MHz Output Channel for 81130A 660 MHz Output Channel for 81130A
81133A		3.35 GHz 1 channel Pulse Pattern Generator
81134A		3.35 GHz 2 channel Pulse Pattern Generator
8114A	8114A-001	15 MHz 100 V Pulse Generator Variable Base Line
E8305A	(Included)	250 MHz VXI Pulse Pattern Generator
E8311A	(Included)	165 MHz VXI Pulse Pattern Generator
E8312A	(Included)	330 MHz VXI Pulse Pattern Generator

Pulse Pattern Generator from 1 mHz to 3.35 GHz (cont.)

Options and Accessories

		81101A, 81104A, 81110A	81130A	81133A, 81134A	8114A	E8305A, E8311A, E8312A
0B1	English Manual Set (standard with every order)	•	•	Incl.	•	Incl.
AB0	Taiwan – Chinese Quick Start Guide	•	•			
AB1	Korean Quick Start Guide	•	•			
AB2	Chinese Quick Start Guide	•	•			
ABD	German Quick Start Guide					
ABE	Spanish Quick Start Guide					
ABF	French Quick Start Guide	•	•			
ABJ	Japanese Quick Start Guide	•	•	Incl.	•	
ABZ	Italian Quick Start Guide					
0B0	Do not include any manual	•	•		•	
0BV	Service Documentation, Component Level				•	
0BW	Service Documentation, Assembly Level	•	•		•	
UK6	Commercial Cal Certificate with Test Data	•	•	•	•	•
1BP	Mil Std 45662A Calibration with Test Data				•	
1CM	Rackmount Kit	•	•		•	
1CN	Handle Kit	•	•		•	
1CP	Rackmount and Handle Kit	•	•	•	•	
1CR	Rack Slide Kit	•	•	PN1494-0059	•	
UN2	Rear Panel Connectors	•			•	
	Recommended Cable Kit (SMA)	15442A	15442A	N4871A	15442A	15442A

- **Flexible real-time stimulus and response system**
- **Modular, scalable BER test solution for parallel, serial and mixed applications from 1 kbit/s up to 2.7 Gb/s**
- **PRBS, PRWS and user-defined data for stimulus and analysis**
- **PC-controlled system with powerful GUI and programming interface**
- **Single-ended, low voltage and differential input and output signals for ECL, LVDS and PECL**

The Agilent 81200 data generator/analyzer platform is the right choice for R&D or manufacturing engineers performing functional and parametric tests on digital subsystems, ICs, or boards.

The 81200 is a flexible and scalable platform offering up to 240 channels (at 333 Mb/s) and a frequency range of 1 kb/s to 2.7 Gb/s. It is freely configurable to fit your application needs either as a stand-alone data generator or a platform with any number of generator and analyzer channels. Alternatively, the modules can be integrated into any other standard VXI test platform.

With up to 8 Mbit memory depth per channel and full control of the pulse timing and level parameters for each individual channel, you can really stress your DUT. The 81200 Analyzer provides parametric adjust of timing and threshold to address various technologies. Periodic and deterministic incoming bits are compared in real-time. The user can adjust even large delays between generator and analyzer.

Use the Agilent 81200's modularity to configure a solution that matches your needs and measurement tasks. Because of the modularity you can meet your budget goals today and if necessary expand your system in the future.

Specifications

Data Modules

	E4841A	E4832A	E4861A
Maximum Data Rate	333 Mb/s	675 Mb/s	2.7 Gb/s
Front End Slots per Module	4	4	2
Memory Depth per Channel	0.5 Mb	2 Mb	8 Mb
Segments PRBS, PRWS	User defined patterns and PRBS 2^n-1, n=7, 9, 10, 11, 15, 23, 31		
Usable Front Ends	E4846A E4847A	E4838A E4835A	E4862A E4863A E4864A E4865A

Data Generator Front Ends

	E4846A	E4838A	E4864A	E4862A
Maximum Data Rate	200 Mb/s	675 Mb/s	1.65 Gb/s	2.7 Gb/s
Outputs	2, single-ended	1, differential	1, differential or single-ended	1, differential or single-ended
Data Format	NRZ, DNRZ	RZ, R1, NRZ, DNRZ	NRZ, DNRZ clock: duty cycle 50% + 10% typ.	NRZ, DNRZ clock: duty cycle 50% + 10% typ.
Transition Times	1.2 ns @ ECL (20% – 80%)	0.5 ns – 4.5 ns (0.35 ns typ.) @ ECL (10% – 90%)	90 ps typ. @ ECL, LVDS (110 ps typ. @ $V_{pp\ max}$)	90 ps typ. @ ECL, LVDS (110 ps typ. @ $V_{pp\ max}$)
Amplitude/Resolution	0.3 to 3.5 V_{pp} /10 mV	<0.1 to 3.5 V_{pp}/10 mV	0.05 to 1.8 V_{pp}/10 mV	0.05 to 1.8 V_{pp}/10 mV

Data Analyzer Front Ends

	E4847A	E4835A	E4865A	E4863A
Maximum Data Rate	333 Mb/s	675 Mb/s	1.65 Gb/s	2.7 Gb/s
Inputs	2, single-ended	2, differential or single-ended	1, differential or single-ended	1, differential or single-ended
Impedance	50 Ω single-ended	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential
Input Threshold	–2.1 to +5.1 V	–2.0 to +4.5 V	–2.0 to +3.0 V	–2.0 to +3.0 V

Clock Module

	E4805B
Frequency Range	1 kHz to 2.7 GHz
Resolution	1 Hz
Accuracy	±50 ppm with internal PLL reference
Clock Jitter	<10 ps rms (5 ps typ.)

Accessories

15443A Cable Kit: SMA (m) to SMA (m), Matched Pair
15442A Cable Kit: 4*SMA(m) to SMA(m) 1 meter
15441A Cable Kit: 10*SMA(m) to SCI Connector
8120-4948 SMA Coax. Cable, 1 m
8710-1582 Torque Wrench, SMA
15440A Adapter Kit: 4* SMA(m) I/O Adapter
1250-1200 Adapter SMA (m)/BNC (f)
1250-1249 Adapter Right-angle SMA (m-f)
1250-1397 Adapter Right-angle SMA (m-m)
1250-1698 Adapter Tee SMA
11667B Pulse Adder/Splitter, SMA
15433B 500 ps Transition Converter
15434B 1 ns Transition Converter
15438A 2 ns Transition Converter
10833B Cable, GPIB
E4839A Test Fixture for the 812XX family
15448A Pogo Cables Kit: 4*SMA(m) and 2 Pogo Adapter
15449A-FG DUT Board 50 Ohm Impedance

Key Literature & Web Link

Related Literature
Agilent 81200 Data Generator/Analyzer Platform Brochure, p/n 5980-0488E
Agilent E4839A Test Fixture, p/n 5968-3580E
Flat Panel Display Link Test, p/n 5968-8028E

www.agilent.com/find/81200_overview

Ordering Information

Mainframe
E4849C 81200 Data Generator and Analyzer – mainframe included
E4849C-013 IEEE 1394 PC link to VXI (Firewire)

Clock Module
E4805B 2.7 GHz Central Clock Module

Data Modules & Front Ends
E4841A 200 MHz Generator/Analyzer Module
E4846A Dual 200 Mbit/s Generator
E4847A Dual 200 Msa/s Analyzers
E4832A 675 MHz Module for 4*E4838A, 2*E4835 or 2*E4838+1*E4835
E4838A 333 kHz – 675 MHz Data Generator Front End
E4835A Two 333 kHz – 675 MHz Data Analyzer Front Ends
E4861A 2.75 Gbit/s Module for 2 Front Ends
E4862A 334 MHz – 2.7 Gbit/s Generator Front End
E4863A 334 MHz – 2.7 Gsa/s Analyzer Front End
E4865A 1.65 G Analyzer Front-end
E4864A 1.65 G Generator Front-end

GPIB System Power Supplies

Power Supply Type	Model Number	Max Volts (dc)	Max Amps (dc)	Max Watts	Output Operating Boundary	Page
Mobile Communications DC Source						367
Dual output	66309B/D	15/12	3/1.5	45/18	Rectangular	
Single output	66311B	15	3	45	Rectangular	
Dual output	66319B/D	15/12	3/1.5	45/18	Rectangular	
Single output	66321B/D	15	3	45	Rectangular	
Telecommunications DC Source	E4356A	80	30	2100	Rectangular	369
Solar Array Simulator	E4350B/ E4351B	65/130	8/4	480	Rectangular	370
Dynamic Measurement DC Source	66332A	20	5	100	Rectangular	371
Multiple and Modular Output Power Supplies						
2, 3 or 4 output up to 80 W	662x	See brief specs on the next page			Rectangular	372
Up to 300 W per module, 4 slot modular power system	N6700	Please go to page for detailed specs				373
Up to 150 W per module, 8 slot modular power system	66000	See brief module specs on the next page				377
Single Output Power Supplies (CV, CC)						
Precision measurement, 40 W and 50 W system	661x	up to 100 V	up to 5 A	up to 50 W	Rectangular	379
Precision measurement, 80 W and 100 W system	663x	up to 100 V	up to 10 A	up to 100 W	Rectangular	380
Precision measurement, 200 W, system	664x	up to 120 V	up to 20 A	up to 200 W	Rectangular	381
Precision measurement, 200 W manually controlled	654x	up to 120 V	up to 20 A	up to 200 W	Rectangular	381
Single output system, 500 W	665x	up to 120 V	up to 45 A	up to 500 W	Rectangular	382
Manually controlled, 500 W	655x	up to 120 V	up to 45 A	up to 500 W	Rectangular	382
Single output, 750 W; 6 to 600 V, up to 100 A	N574x, N575x	up to 600 V	up to 100 A	up to 750 W	Rectangular	383
Single output, 1500 W; 6 to 600 V, up to 180 A	N576x, N577x	up to 600 V	up to 180 A	up to 1500 W	Rectangular	385
Single output, system 2000 W	667x	up to 120 V	up to 220 A	up to 2000 W	Rectangular	387
Single output, manually controlled, 2000 W	657x	up to 120 V	up to 220 A	up to 2000 W	Rectangular	387
Single output, system 5000 W	668x	up to 40 V	up to 875 A	up to 5000 W	Rectangular	388
Single output, system 6600 W	669x	up to 60 V	up to 440 A	up to 6600 W	Rectangular	389
Single output Autoranging						
System autoranging (with GPIB)	603x	up to 500 V	up to 120 A	up to 1000 W	Autoranging	390

Basic Bench

Basic Power Supplies						
Dual range, 30 W, single output	E3610A to E3612A	up to 60 V or up to 120 V	up to 3 A	up to 30 W	Dual range	400
Single range, 60 W, single output	E3614A to E3617A	up to 60 V	up to 6 A	up to 60 W	Rectangular	400
50 W, 2 outputs, linear power supply	E3620A	up to 25 V per output	up to 1 A	up to 50 W max total power	Rectangular	401
35 W, 3 outputs, linear power supply	E3630A	up to 6 V up to 20 V up to –20 V	up to 2.5 A up to 0.5 A up to 0.5 A		Rectangular	401
80 W triple output programmable power supply	E3631A	0 to 25 V 0 to –25 V 0 to 6 V	0 to 1 A 0 to 1 A 0 to 5 A	80 W	Rectangular	402
200 W single output dual range programmable power supply	E3632A to E3634A	up to 50 V	up to 20 A	up to 200 W	Dual range	402
30/50/80 W single output programmable power supplies	E3640A to E3645A	up to 60 V	up to 8 A	up to 80 W	Dual range	403
60/100 W dual output power supplies	E3646A to E3649A	up to 60 V	up to 5 A	up to 100 W	Dual range	403
AC Source/Analyzers						
300 V_{rms}, 375 VA single phase	6811B	300 V_{rms}		375 VA		395
300 V_{rms}, 750 VA, single phase	6812B	300 V_{rms}		750 VA		395
300 V_{rms}, 1750 VA, single phase	6813B	300 V_{rms}		1750 VA		395

Selection Index (cont.)

Multiple Output

Range 1		Range 2			Outputs for Each Model Number									
Max. Volts (dc)	Max. Amps (dc)	Max. Volts (dc)	Max. Amps (dc)	Max. Watts Output	6621A page 372	6622A page 372	6623A page 372	6624A page 372	6625A page 372	6626A page 372	6627A page 372	6628A page 372	6629A page 372	E3631A page 402
6	5	—	—	—	—	—	—	—	—	—	—	—	—	Output 3
7	0.015	50	0.5	25	—	—	—	—	Output 1	Outputs 1–2	—	—	—	—
7	5	20	2	40		—	Output 1	Outputs 1–2	—	—	—	—	—	—
7	10	20	4	80	Outputs 1–2	—	Output 3	—	—	—	—	—	—	—
8	20	20	10	200	—	—	—	—	—	—	—	—	—	—
15	7	30	4	120	—	—	—	—	—	—	—	—		
16	0.2	16	2	50	—	—	—	—	Output 2	Outputs 3–4	—	Outputs 1–2	Outputs 1–4	—
16	0.2	50	1	50	—	—	—	—	Output 2	Outputs 3–4	—	Outputs 1–2	Outputs 1–4	—
20	2	50	0.8	40	—		Output 2	Outputs 3–4	—	—	Outputs 1–4	—	—	—
20	4	50	2	100	—	Outputs 1–2	—	—	—	—	—	—	—	—
±25	1			25	—	—	—	—	—	—	—	—		Outputs 1–2
Output Operating Boundary					Rectangular									

Modules for 66000 Modular Power System

Up to 8 per mainframe

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Model Number	Page
8	16	128	66101A	377
20	7.5	150	66102A	377
35	4.5	150	66103A	377
60	2.5	150	66104A	377
120	1.25	150	66105A	377
200	0.75	150	66106A	377

Available on Special Order

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Model Number
5.7	20	114	66101A-J03
12	12	144	66101A-J05
15	10	150	66102A-J05
24	6	144	66103A-J12
28.5	5.5	157	66103A-J09
35	1.25	44	66105A-J01
37	4.5	167	66103A-J01
40	3.6	144	66103A-J02
55	3	165	66104A-J09

For more information, visit our web site:
www.agilent.com/find/power

66309B
66309D
66311B
66319B
66319D
66321B
66321D

- **5 A peak current**
- **Single and dual output models**
- **Fast transient voltage response**
- **Precision µA measurement**
- **Dynamic current pulse measurement**
- **Exceptional sourcing and current sinking**
- **Automatic detection of open sense connections**
- **VXI *plug&play* drivers**
- **Programmable output resistance (66319B/D, 66321B/D)**

66319D

Solutions for Testing Battery-Powered Devices

Agilent's mobile communications dc sources are a family of 45 watt power supplies that functions as a power-source alternative to batteries and charger for testing mobile phones and portable devices. They offer up to 5 A peak current sourcing with improved output stability and superior voltage transient response, Fast Response Power Technology, that prevents device shutdowns due to significant voltage drops in the test wiring.

66319B/D, 66321B/D with Battery Emulation

Four new models, the 66319B, 66319D, 66321B, and 66321D have been added to this family of specialized dc power supplies. These new high performance models offer all the capabilities of the existing Mobile Communications dc Sources, plus they provide the following capabilities:

- Battery emulation (programmable output resistance)
- Very low transient voltage drop (typically <25 mV)
- Excellent output stability for either short or long load leads up to 6 meters
- Four programmable compensation modes to optimize output performance
- Programmable over-voltage soft limits to protect device under test

The new programmable output resistance capability allows you to test your phones under the same power conditions as in actual use; detecting early product failures. These new models can simulates the effects of the internal resistance in a battery, enabling them to accurately emulate the operation of various battery types, as well as batteries nearing end of life. Additionally, they provide the ability to simulate negative resistance that lets you compensate for the voltage drop in the wiring between the test fixture and battery contacts in the cell phone.

A Rack's Worth of Capability in a Single Box

From the dual output 66319D with battery emulation and built-in DVM to the 66311B, this family of solutions offers many capabilities in a single, half-rack box. They eliminate the cost and hassle of integrating and using oscilloscope or high-speed digital voltmeter, shunts, relays and multiplexers to make voltage and current measurements. Now you can catch and characterize those critical pulses using only a power supply.

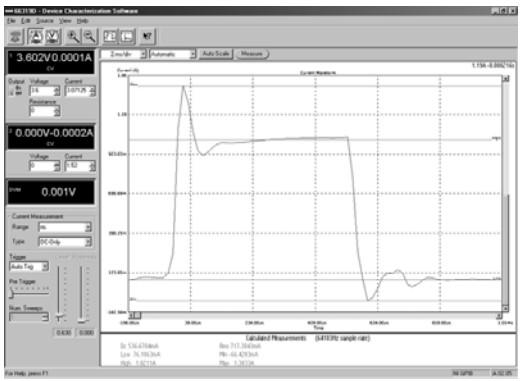
In addition to dynamic measurements, the mobile communications dc source solutions feature output programming response as fast as 400 µs and command processing times of less than 4 ms; the reduced cycle times will boost your test throughput, too.

Maintaining Value

With a full set of device protection features and three-year warranties, the mobile communications dc source solutions will keep delivering superb results year after year. A new Agilent-developed technology that automatically detects open sense connections helps ensure you deliver quality products to your customers.

Simplify Test & Analysis

With the 14565B Device Characterization Software, testing, analyzing, and troubleshooting mobile phone design and subsystem is made simple. The optional 14565B graphical user interface lets you easily control these power supplies. Plus it provides an oscilloscope-like view of the voltage or current waveform of the device under test, provides reference waveform save/recall, and oscilloscope-like waveform measurement and analysis (current or voltage measurements, triggering, markers, zoom control, and more).



Battery Drain Analysis

When coupled with the 66319B/D or 66321B/D, the14565B software also provides battery current drain data logging and analysis for up to 1,000 hours operation. More than just measuring run time, this allows you to characterize battery drain to make design tradeoffs to optimize battery life.

A new automation capability allows the 14565B to be controlled from other test applications (like Agilent VEE, NI LabView, MS Excel). R&D engineers can now save time by automating repetitive tasks associated with characterizing battery current drain during real world use-modeling (video/data streaming).

Ordering Information

Option 120 104 to 127 Vac 47 to 63 Hz
Option 100 87 to 106 Vac, 47 to 63 Hz
Option 220 191 to 233 Vac, 47 to 63 Hz
Option 230 207 to 253 Vac, 47 to 63 Hz
Option 007 Extra 5-pin Output Connectors (2 x p/n 0360-2604)
Option 521 Solid State Relays (66309B/D and 66319 B/D only)
Option 1CM Rackmount Kit p/n 5063-9240
Option AXS Rackmount Kit for Side-by-side Mounting, Locking Kit p/n 5061-9494; Flange Kit p/n 5063-9212
Option 0L1 Standard Documentation Package
Option 8ZL Add Feet

Accessories
14565B Device Characterization Software and Documentation
14565U Device Characterization Software Upgrade (provides upgrade from 14565A to 14565B Software)

Abbreviated Specifications and Characteristics

Model		66311B	66309B 66309D		66319B 66319D		66321B 66321D
Number of Outputs		1	2 Output 1	Output 2	2 Output 1	Output 2	1
Output Ratings	Voltage Current	0 to 15 V 0 to 3 A 5 A[1]	0 to 15 V 0 to 3 A 5 A[1]	0 to 12 V 0 to 1.5 A 2.5 A[2]	0 to 15 V 0 to 3 A 5 A	0 to 12 V 0 to 1.5 A 2.5 A[2]	0 to 15 V 0 to 3 A 5 A[1]
Programming Accuracy At 25°C ± 5°C	Voltage Current	0.05% + 10 mV 0.05% + 1.33 mA	0.05% + 10 mV 0.05% + 1.33 mA	0.2% + 40 mV 0.2% + 4.5 mA	0.05% + 10 mV 0.05% + 1.33 mA	0.2% + 40 mV 0.2% + 4.5 mA	0.05% + 10 mV 0.05% + 1.33 mA
Ripple and Noise (20 Hz to 20 mHz)	Voltage (rms/p-p) Current (rms)	1 mV/6 mV[3] 2 mA	1 mV/6 mV[3] 2 mA	1 mV/ 6 mV[3] 2 mA	1 mV/6 mV[3] 2 mA	1 mV/6 mV[3] 2 mA	1 mV/6 mV[3] 2 mA
dc Measurement Accuracy (via GPIB or front panel meters with respect to actual output at 25°C ± 5°C)	Voltage Current High Current Range +3 A to +5 A +20 mA to +rated I –20 mA to –rated I Medium Current Range –1 A to +1 A Low Current Range –20 mA to +20 mA	0.03% + 5 mV see below 0.2% + 0.5 mA[4] 0.2% + 1.1 mA — 0.1% + 2.5 µA	0.03% + 5 mV see below 0.2% + 0.5 mA[4] 0.2% + 1.1 mA — 0.1% + 2.5 µA	0.02% + 15 mV 0.2% + 3 mA — — — —	0.03% + 5 mV see below 0.2% + 0.5 mA — — 0.1% + 0.2 mA 0.1% + 2.5 µA	0.2% + 15 mV 0.2% + 3 mA — — — — —	0.03% + 5 mV see below 0.2% + 0.5 mA — — 0.1% + 0.2 mA 0.1% + 2.5 µA
Transient Response Time		<35 µs[5]	<35 µs[5]	<400 µs[6]	<20 µs[5]	<400 µs[6]	<20 µs[5]
Programmable Output Resistance	Range Resolution Accuracy	— — —	— — —	— — —	–0.04 to 1 Ω 0.001 Ω 0.5% + 2 mΩ	— — —	–0.04 to 1 Ω 0.001 Ω 0.5% + 2 mΩ
		66311B	66309B 66309D		66319B 66319D		66321B 66321D

[1] Peak current for up to a 7 ms time period. Average current cannot exceed 3 A.
[2] Peak current for up to a 1 ms time period. Average current cannot exceed 1.5 A.
[3] For phone capacitance higher than 6 µF.
[4] Applies with current detector set to dc.
[5] Time for the output voltage to recover to within 20 mV of its final value following a 0.1 A to 1.5 A load change in the High Mode compensation range.
[6] Time for the output voltage to recover to within 20 mV of its final value following a 0.75 A to 1.5 A load change.

Voltmeter Input (66309D, 66319D, and 66321D only)

Input Range	Max differential voltage between input terminals ±25 V
dc Readback Accuracy At 25°C ±5°C	0.04% + 5 mV
(ac + dc) rms Readback Accuracy @25°C ± 5°C with dc plus a sinewave input >25 mV rms	1% + 5 mV at 10 KHz sinewave 60 Hz to 10 KHz: 1% + 5 mV[1] 45 – 60 Hz and 10 – 20 KHz: 4% + 5 mV[1]
Common Mode Voltage Range (from either DVM input with respect to the negative output terminal of Output #1)	–4.5 V pk to 25 V pk

[1] 1 + 15 mV for dc plus sinewave input <25 mV rms.

dc Floating Voltage: Output terminals can be floated up to ±50 Vdc maximum from chassis ground
Remote Sensing: Up to 4 V can be dropped across each load lead, add 2 mV to the voltage load regulation specification for each 1 V change in the positive output lead due to load current change. For the auxiliary output on the 66319B/D, 66321B/D add 3 V to the voltage load regulation for each 1 V change in the negative output lead
Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB (Display disabled)
Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage for 66311B, 66321B/D, Output 1-66309B/D, 66319B/D is <200 µs. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in 2 ms
Measurement Time: Average time to process query, calculate measurement parameter and return data is 50 ms (includes the default time of 30 ms for acquiring data, and a 20 ms data processing overhead)
GPIB Interface Capabilities: IEEE-488.2, SCPI command set, and 6630A series programming capability (except 66309B/D, 66319B/D, 66321B/D)

Input (full load): 47 – 63 Hz @100 Vac mains: 66311B, 66321B/D: 1.7 A, 125 W; 66309B/D, 66319B/D: 2 A, 170 W
Regulatory Compliance: Complies with EMC directive 89/336/EEC (ISM 1B). List pending to UL 3111-1
Warranty Period: One year
Size: 66309B/D, 66311B, 66319B/D, 66321B/D: 88.1 mm H x 212.8 mm W x 435 mm D (3.5 in x 8.4 in x 17.13 in)
Weight: 66309B/D, 66311B, 66319B/D, 66321B/D: 9.07 kg (20 lb) net, 11.1 kg (24.5 lb) shipping

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/66300**

- **Low ripple and noise**
- **Fast up- and down- programming**
- **SCPI (Standard Commands for Programmable Instruments)**
- **Complete front-panel control, calibration and display**
- **Remote programming and sensing**
- **Fan-speed control to minimize acoustic noise**
- **Over-voltage and over-current protection**
- **VXI *plug&play* drivers**
- **Also suitable for non-telecom applications**

E4356A

E4356A Telecom DC Power Supply

The E4356A telecom dc power supply is a one-box solution that delivers the reliable capabilities of an integrated system. This power supply provides power at up to 80 Vdc and up to 30 A in two ranges. When programmed to operate between 0 V and 70 V, the E4356A is automatically placed in the low output range, offering its full 30 A maximum current and 2100 W. When programmed between 70 V and 80 V, the E4356A switches into the high output range, where it is able to provide up to 26 A and 2100 W. Thus, the E4356A's automatic ranging means that you get the most power possible, whether you are operating at 70 V or 80 V.

Since noise elimination is critical for telecom applications, the telecom dc power supply offers low noise output, so that power supply noise does not interfere with testing of telecom devices.

The E4356A is ideal for manufacturing and R&D engineers who build equipment for the telecom industry that operates from a 48 V or higher dc rail. This telecom equipment includes: base stations, switches, public and private telephone network equipment, PBX systems, and dc/dc power supplies that provide power to this equipment.

Although targeted at the telecom industry where 80 V is a common requirement, the E4356A can also be used for other applications requiring 80 Vdc. The E4356A has all of the features found on our general purpose system dc power supplies, such as the 6670 Series of 2000 W system dc power supplies. Therefore it is well suited for both R&D and ATE applications where the features and performance of a one-box solution provide a complete test solution at the price of a single instrument.

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site:
www.agilent.com/find/E4356

Ordering Information

E4356A-200 174 to 220 Vac, 47 to 63 Hz (Japan only)
E4356A-230 191 to 250 Vac, 47 to 63 Hz
E4356A-908 Rackmount Kit (p/n 5062-3977)
E4356A-909 Rackmount Kit w/Handles (p/n 5062-3983)

Accessories
p/n 1494-0059 Accessory Slide Kit
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support Rails for Rack Cabinet

Abbreviated Specifications and Characteristics

Model		E4356A
Number of Outputs		1
Output Ratings	Voltage Current	0 to 70 V/0 to 80 V 0 to 30 A/0 to 26 A
Programming Accuracy At 25°C ± 5°C	Voltage Current	0.04% + 80 mV 0.1% + 25 mA
Ripple and Noise (20 Hz to 20 mHz)	Voltage (rms/p-p) Current (rms)	2 mV/16 mV 25 mA
dc Measurement Accuracy (via GPIB or front panel meters with respect to actual output at 25°C ± 5°C)	Voltage Current	0.05% + 120 mV 0.1% + 35 mA
Transient Response Time		<900 µs[1]

[1] For the output voltage to recover to its previous level within 0.1% of the rated voltage or 20 mV, whichever is greater, following any step change in load current up to 50% of the rated current.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Output Programming Response Time: The rise time (from 10% to 90% of output current) of the output voltage is less than 100 ms. The fall time (90% to 10%) is 200 ms
Modulation: Analog programming of output voltage and current.
- Input signal: 0 to –4 V for voltage, 0 to +6.75 V for current
- Input impedance: 30 k Ohm or greater

Input Power: 3,800 VA 2,600 W at full load, 170 W at no load
GPIB Interface Capabilities: SH1, AH1, TE6, LE6, SR1, RL1, PP0, DC1, DT1, E1 and C0. IEE-448.2 and SCPI-compatible command set
Regulatory Compliance: Listed to UL 1244; certified to CSA556B, conforms to EN61010
Warranty Period: One year
Size: 132.6 mm H x 425.5 mm W x 640 mm D (5.22 in x 16.75 in x 25.2 in)
Weight: 27.7 kg (61 lb) net, 31.4 kg (69lb) shipping

E4350B
E4351B

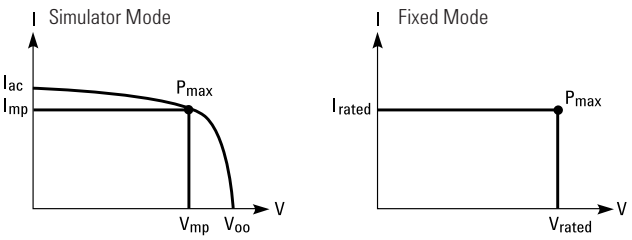
The E4350B/E4351B simulates the output characteristic of a satellite's solar panels as it moves from darkness to light.

Solar Array Simulator

The Agilent one-box Solar Array Simulator (SAS) is a dc power source that simulates the output characteristics of a solar array. The SAS is primarily a current source with very low output capacitance and is capable of simulating the I-V curve of different arrays under different conditions (i.e., temperature, age, etc.). The I-V curve is programmable over the IEEE-488.2 bus and is conveniently generated within the SAS.

The SAS provides three current operating modes:

1. Simulator Mode: An internal algorithm is used to approximate a SAS I-V curve. Four input parameters: Voc (open circuit voltage), Isc (short circuit current), Imp and Vmp (current and voltage at the peak power point on the curve) are needed to establish a curve in this mode.



2. Table Mode: For a fast and accurate I-V simulation, the SAS provides a table mode. The I-V curve is set by a user-defined table of points. A table can have any length up to 4000 points (a point corresponds to a specific value of I and V). As many as 30 tables may be stored in each SAS built-in volatile and non-volatile memory.

Non-volatile memory can store a maximum of 3500 points. The tables (I-V curves) are easily stored and recalled with an IEEE-488.2 command. The table(s) stored in this memory will be retained when the power is turned off.

Volatile memory greatly increases the flexibility by saving up to 30,000 points. Multiple tables are easily accessed with IEEE-488.2 command. These tables will be erased after power is removed.

In Table Mode, current and voltage offsets can be applied to the selected table to simulate a change in the operating conditions of the solar array.

3. Fixed Mode: This is the default mode when the unit is powered on. The unit has the rectangular I-V characteristics of a standard power supply, when an output capacitor is added in this mode.

Specifications

	E4350B	E4351B
For Simulator and Table Modes		
Max. Power	480 W	480 W
Voc, Max.*	65 V	130 V
Isc, Max.*	8 A	4 A
For Fixed Mode		
Max. Power	480 W	480 W
V rated*	0 – 60 V	0 – 120 V
I rated*	0 – 8 A	0 – 4 A

* Other voltage/current combinations may be configured to meet your unique requirements.

Programming Accuracy: at 25°C + 5°C (SAS and Table Mode)
Voltage: (Fixed Mode)
0.075% + 10 mV (E4350B)
0.075% + 20 mV (E4351B)
Current: (Simulator and Fixed Mode)
0.2% + 20 mA (E4350B)
0.2% + 10 mA (E4351B)
Ripple and Noise: (20 Hz to 20 MHz) with outputs ungrounded or with either terminal grounded (Simulator and Table Mode)
Voltage: RMS: 16 mV (E4350B)
24 mV (E4351B)
P-P: 125 mV (E4350B)
195 mV (E4351B)
Current: RMS: 4 mA
Load/Line Regulation: Change in output voltage or current for any load or line change within ratings (Fixed Mode)
Voltage: 2 mV
Current: 1 mA

ac Input: 104 to 127 Vac

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	12 A	10 A	5.7 A	5.3 A

Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the Agilent SAS by describing nonwarranted performance that has been determined by design or type testing.

Load Switching Recovery Time: <5 µs when switched from short circuit to variable load to within 1.5 A of an operating point on the I-V curve
Remote Sensing: Up to 2 V+(Voc–Vmp). Add 3 mV to the voltage load regulation specification for each 1 volt change in the positive output lead due to load current change
Analog Programming of Output Current
- Input Signal: 0 to –4 V
- Input Impedance: 20 k Ohms nominal

Shunt Regulation: Switching frequency up to 50 kHz
Series Regulation: Switching frequency up to 50 kHz
OVP and OCP: Overvoltage and overcurrent protection triggers in <100 µs
Capacitive Load: In fixed mode, the maximum load capacitance (without causing instability) is 2000 µF. In simulator and table mode, it is unconditionally stable at all capacitive loads
Inductive Load: The maximum load inductance (without causing instability) is 200 µH
Regulatory Compliance: Listed to UL3101, certified to CSA 22.2 NO. 1010.1, complies with EMC 61010-1
Complies with EMC directive 89/336/EEC
Size: 132.6 mm H x 425.5 mm W x 497.8 mm D (5.25 in x 16.75 in x 19.6 in)
Weight: Net, 25 kg (54 lb): shipping, 28 kg (61 lb)
Warranty: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site:
www.agilent.com/find/E4350

Ordering Information

Simulators can be ordered as individual modules or as a fully customized system.
E435xB-0B3 Service Manual
E435xB-0BO Delete Manual
E435xB-100 87 to 106 Vac, 47 to 63 Hz
E435xB-120 104 to 127 Vac, 47 to 63 Hz
E435xB-220 191 to 233 Vac, 47 to 63 Hz
E435xB-240 209 to 250 Vac, 47 to 63 Hz
E435xB-908 Rackmount Kit, p/n 5062-3977
E435xB-909 Rackmount Kit with Handles, p/n 5063-9221
E435xB-0L2 Extra Standard Documentation Package

Accessories
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E366AC Support Rails for Agilent Rack Cabinets

66332A

- **Ideal for portable product test**
- **Dynamic pulse measurement**
- **Precision low current measurement**
- **Low-output noise**
- **High-speed programming**
- **SCPI (Standard Commands for Programmable Instruments)**
- **GPIB and RS-232 interface**
- **VXI *plug&play* drivers**

66332A

Abbreviated Specifications and Characteristics

Model			**66332A**
Output Ratings	Voltage/Current		0 to 20 V/0 to 5 A
Programming Accuracy at 25°C ± 5°C	Voltage/+Current	0.05%+	10 mV/2 mA
Ripple and Noise (20 Hz to 20 MHz, with outputs ungrounded or with other terminal grounded)	Voltage normal mode Voltage fast mode Current (rms)	(rms/p-p) (rms/p-p)	0.3 mV/3 mV 1 mV/10 mV 2 mA
DC Measurement Accuracy via GPIB or front-panel meters with respect to actual output at 25°C ± 5°C	Voltage	0.03%+	3 mV
	Low current range –20 mA to +20 mA	0.1%+	2.5 µA
	High current range +20 mA to +rated I –20 mA to –rated I	0.2%+ 0.2%+	0.5 mA 1.1 mA
Load Regulation	Voltage/Current		2 mV/1 mA
Line Regulation	Voltage/Current		0.5 mV/0.5 mA
Transient Response Time: Less than 100 µs (50 µs in the fast mode) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV), following any step change in load current of up to 50% of the output current rating of the supply			
Average Programming Resolution	Voltage/Current		5 mV/1.25 mA
OVP Accuracy		2.4%+	240 mV
Sink Current			5 A
Sink Current Tracking	SCPI mode: Compatibility mode:		0.4% + 2mA –250 mA

Dynamic Measurements: Accuracy of the instantaneous voltage measurement is 0.03% + 5 mV. Accuracy of the instantaneous current measurement is 0.6% + 2 mA. The dc, rms, maximum, minimum, high-level and low-level voltage and current measurements are calculated from the instantaneous voltage and current readings. Up to 4096 data points can be acquired. The sampling interval can be varied from 15.6 µs to 31,200 s. The instantaneous data points can also be read back from the storage buffer. Dynamic measurements on current waveforms with frequency content up to 10 kHz can be made on the low- or high-current range. Above 10 kHz, accurate current measurements can only be made in the high range.
dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground
Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change
Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB(Display disabled)
Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms (400 µs for the fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode)
Measurement Time: Average time to process query, calculate measurement parameter and return data is 50 ms. (Includes the default time of 30 ms for acquiring data, and a 20 ms data processing overhead)
Input Power (full load): 350 VA, 250 W
Regulatory Compliance: Listed to UL-3111-1; certified to CSA 22.2. No. 1010-1, complies with EN61010-1, complies with EMC directive 89/336/EEC (ISM Group 1, Class B)
Warranty Period: One year
Size: 88.1 mm H x 425.5 mm W x 364.4 mm D (3.5 in x 16.75 in x 14.3 in)
Weight: 12.7 kg (28 lb) net, 15.0 kg (33 lb) shipping

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/66332A**

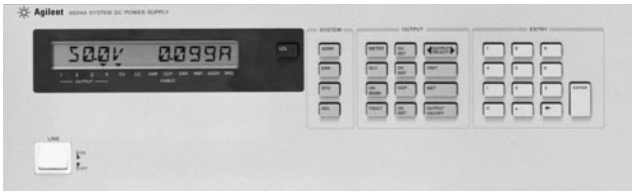
Ordering Information

66332A-100 87 to 106 Vac, 47 to 63 Hz
66332A-120 104 to 127 Vac, 47 to 63 Hz
66332A-220 191 to 233 Vac, 47 to 63 Hz
66332A-230 207 to 253 Vac, 47 to 63 Hz
66332A-020 Front-panel Binding Posts
66332A-760 Isolation and Reversal Relays
66332A-8ZJ Delete Instrument Feet
66332A-1CM Rackmount Kit, p/n 5063-9212
66332A-1CP Rackmount Kit with Handles, p/n 5063-9219
66332A-8ZL Add Feet
66332A-020 Front Panel Binding Posts
66332A-0L1 Standard Documentation Package
66332A-0B3 Service Manual

Accessories
p/n 1494-0060 Rack Slide Kit
14565B Device Characterization Software and Documentation

25 – 80 W per Output, DC System Power Supplies, GPIB, Multiple Output

- **Utilize up to four fully isolated power supplies in a 3 U package**
- **Choose standard or dual-range, high precision models**
- **Perform rapid voltage changes via fast output programming with active down programming**
- **Automate testing via GPIB interface (drivers available)**
- **Enhance signal integrity in test systems via low-noise outputs**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and advanced programmable features**
- **Ensure DUT safety with protection features**



Agilent's multiple-output power supplies are an ideal solution for automated testing environments that require multiple voltage sources.

Abbreviated Specifications and Characteristics

		25-watt Output	40-watt Output	40-watt Output	50-watt Output	80-watt Output	80-watt Output
Output Power	Low-range volts, amps High range volts, amps	0 to 7 V, 0 to 15 mA 0 to 50 V, 0 to 500 mA	0 to 7 V, 0 to 5 A 0 to 20 V, 0 to 2 A	0 to 20 V, 0 to 2 A 0 to 50 V, 0 to 0.8 A	0 to 16 V, 0 to 200 mA 0 to 50 V, 0 to 1 A or 0 to 16 V, 0 to 2 A	0 to 7 V, 0 to 10 A 0 to 20 V, 0 to 4 A	0 to 20 V, 0 to 4 A 0 to 50 V, 0 to 2 A
Output Combinations for each model (total number of outputs)	6621A (2)	—	—	—	—	2	—
	6622A (2)	—	—	—	—	—	2
	6623A (3)	—	1	1	—	1	—
	6624A (4)	—	2	2	—	—	—
	6625A (2) Precision	1	—	—	1	—	—
	6626A (4) Precision	2	—	—	2	—	—
	6627A (4)	—	—	4	—	—	—
	6628A (2) Precision	—	—	—	2	—	—
	6629A (4) Precision	—	—	—	4	—	—
Programming Accuracy (at 25°C ± 5°C)	Voltage	1.5 mV + 0.016% (low) 10 mV + 0.016% (high)	19 mV + 0.06%	50 mV + 0.06%	3 mV + 0.016% (low) 10 mV + 0.016% (high)	19 mV + 0.06%	50 mV + 0.06%
	Current	15 µA + 0.04% (low) 100 µA + 0.04% (high)	50 mA + 0.16%	20 mA + 0.16%	185 µA + 0.04% (low) 500 µA + 0.04% (high)	100 mA + 0.16%	40 mA + 0.16%
Ripple and Noise (peak-to-peak, 20 Hz to 20 MHz; rms, 20 Hz to 10 MHz)	Constant voltage rms	500 µV	500 µV	500 µV	500 µV	500 µV	500 µV
	peak-to-peak	3 mV	3 mV	3 mV	3 mV	3 mV	3 mV
	Constant current rms	0.1 mA	1 mA	1 mA	0.1 mA	1 mA	1 mA
Load Regulation	Voltage	0.5 mV	2 mV	2 mV	0.5 mV	2 mV	2 mV
	Current	0.005 mA	1 mA	0.5 mA	0.01 mA	2 mA	1 mA
Load Cross Regulation	Voltage	0.25 mV	1 mV	2.5 mV	0.25 mV	1 mV	2.5 mV
	Current	0.005 mA	1 mA	0.5 mA	0.01 mA	2 mA	1 mA
Line Regulation	Voltage	0.5 mV	0.01% + 1 mV	0.01% + 1 mV	0.5 mV	0.01% + 1 mV	0.01% + 1 mV
	Current	0.005 mA	0.06% + 1 mA	0.06% + 1 mA	0.01 mA	0.06% + 1 mA	0.06% + 1 mA
Transient Response Time: Less than 75 µs for the output to recover to within 75 mV of nominal value following a load change within specifications							
Average Programming Resolution	Voltage	460 µV (low)/ 3.2 mV (high)	6 mV	15 mV	1 mV (low)/ 3.2 mV (high)	6 mV	15 mV
	Current	1 µA (low)/ 33 µA (high)	25 mA	10 mA	13 µA (low)/ 131 µA (high)	50 mA	20 mA
	OVP	230 mV	100 mV	250 mV	230 mV	100 mV	250 mV
Output Setting Time		6 ms	2 ms	2 ms	6 ms	2 ms	6 ms

dc Floating Voltage: All outputs can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to 1 V (6621 – 24A, 6627A); up to 10 V (6625A, 6626A, 6628A, 6629A) drop per load lead
Command Processing Time: 7 ms typical
Down Programming: Current sink approximately 110% of the rated output current for operating voltage above 2.5 V (6621A, 6622A, 6623A, 6624A, 6627A)
Input Power: 550 W max., 720 VA max.
Regulatory Compliance: Listed to UL-1244; certified to CSA 222.2#10.1; complies with IEC61010-1; carries the CE mark; Complies with EMC directive 89/336/EEC
Size: 132.6 mm H x 425.5 mm W x 497.8 mm D (5.22 in x 16.75 in x 19.6 in)
Weight:
- 6621A – 24A, 6626A, 6627A, 6629A
  Net: 17.4 kg (38 lb); Shipping: 22.7 kg (50 lb)
- 6625A, 6628A
  Net: 15.5 kg (34 lb); Shipping: 20.8 kg (46 lb)

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site:
www.agilent.com/find/6620

Ordering Information

6621A Dual-Output System Power Supply
6622A Dual-Output System Power Supply
6623A Triple-Output System Power Supply
6624A Quad-Output System Power Supply
6625A Precision Dual-Output System Power Supply
6626A Precision Quad-Output System Power Supply
6627A Quad-Output System Power Supply
6628A Precision Dual-Output System Power Supply
6629A Precision Quad-Output System Power Supply
- **662xA-100** 87 to 106 Vac, 47 to 66 Hz Input, 6.3 A (Japan only)
- **662xA-120** 104 to 127 Vac, 47 to 66 Hz, 5.4 A
- **662xA-220** 191 to 233 Vac, 47 to 66 Hz, 3.0 A
- **662xA-240** 209 to 250 Vac, 47 to 66 Hz, 3.0 A
- **662xA-750** Relay Control and DFI/RI
- **662xA-908** Rackmount Kit (p/n 5062-3977)
- **662xA-909** Rackmount Kit w/Handles (p/n 5062-3983)
- **662xA-0B3** Service Manual
- **662xA-0B0** Delete Manual
- **662xA-0L2** Extra Standard Documentation Package

Accessories
Rack Slide Kit (p/n 1494-0059)
E3363AC Support Rails for Agilent Cabinets

- **Use modular system for up to 4 outputs of 300 W/output in 1 U of rack space**
- **Choose from up to 22 different dc power modules (listed below)**
- **Perform remote programming via GPIB, LAN and USB interfaces with SCPI command set (drivers available); LXI class C compliant**
- **Perform rapid voltage changes via fast output programming with active down programming**
- **Synchronize to other events in your ATE system with advanced hardware and software triggering**
- **Achieve true isolation with optional built-in mechanical disconnect relays**
- **Simplify cabling with built-in measurements**
- **Capture transient events with optional built-in digitizer (up to 50 kHz, 4096 points)**
- **Streamline tasks including automated sequencing of up to 512 output settings**
- **Ensure DUT safety with protection features**

The N6700 modular power system is 1 U high configurable multiple-output power system designed to speed test. The N6700 is a flexible modular platform that gives you the ability to mix and match 22 different low-cost, high-performance DC power modules to create a 1- to 4-channel DC power system optimized to meet specific test requirement.

Agilent's N6700 also saves rack space for ATE applications with the smallest, highest density modular power supply available at only 1 rack unit high.

N6700 Low Profile Modular Power System

N6700 Low Profile Modular Power System with 4 Modules

Abbreviated Specification and Characteristics

Basic DC Power Supplies

	N6731B/ N6741B	N6732B/ N6742B	N6733B/ N6743B	N6734B/ N6744B	N6735B/ N6745B	N6736B/ N6746B	N6773A	N6774A	N6775A	N6776A
Output Ratings										
Voltage	5 V	8 V	20 V	35 V	60 V	100 V	20 V	35 V	60 V	100 V
Current	10 A/20 A	6.25 A/12.5 A	2.5 A/5 A	1.5 A/3 A	0.8 A/1.6 A	0.5 A/1 A	15 A	8.5 A	5 A	3 A
Power	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	300 W	300 W	300 W	300 W
Programming Accuracy										
Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 10 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 30 mA
Readback Accuracy										
Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15 % + 20 mA	0.15% + 10 mA	0.15% + 5 mA	0.15% + 4 mA	0.15% + 4 mA	0.15% + 2 mA	0.15% + 15 mA	0.15% + 12 mA	0.15% + 12 mA	0.15% + 6 mA
Ripple & Noise										
Voltage RMS	2 mV	2 mV	3 mV	5 mV	9 mV	18 mV	3 mV	5 mV	9 mV	18 mV
Peak to Peak	10 mV/ 11 mV	12 mV	14 mV	15 mV	25 mV	30 mV	20 mV	22 mV	35 mV	45 mV
Current RMS	8 mA	4 mA	2 mA	2 mA	2 mA	2 mA	6 mA	6 mA	6 mA	6 mA
Load Regulation										
Voltage	5 mV	6 mV	9 mV	11 mV	13 mV/ 16 mV	20 mV/ 30 mV	13 mV	16 mV	24 mV	45 mV
Current	2 mA	2 mA	2 mA	2 mA	2 mA	2 mA	6 mA	6 mA	6 mA	6 mA
Line Regulation										
Voltage	1 mV	2 mV	2 mV	4 mV	6 mV	10 mV	2 mV	4 mV	6 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
Transient Response Time	(Time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load)									
Settling Band	±80 mV/ 100 mV	±80 mV/ 100 mV	±200 mV/ 300 mV	±200 mV/ 300 mV	±400 mV/ 500 mV	±500 mV/ 1000 mV	±0.3 V	±0.3 V	±0.5 V	±1.0 V
Time	<200 µs	<200 µs	<200 µs	<200 µs	<200 µs	<200 µs	<250 µs	<250 µs	<250 µs	<250 µs

High Performance Autoranging & Precision DC Power Supplies

	N6751A	N6752A	N6753A	N6754A	N6761A	N6762A
Output Ratings						
Voltage	50 V	50 V	20 V	60 V	50 V	50 V
Current	5 A	10 A	50 A	20 A	1.5 A	3 A
Power	50 W	100 W	300 W	300 W	50 W	100 W
Programming Accuracy						
Voltage	0.06% + 19 mV	0.06% + 19 mV	0.06% + 10 mV	0.06% + 25 mV	0.016% + 6 mV	0.016% + 6 mV
Current	0.1% + 20 mA	0.1% + 20 mA	0.10% + 30 mA	0.10 % + 8 mA	0.04% + 200 µA	0.04% + 200 µA
Readback Accuracy						
Voltage	0.05% + 20 mV	0.05% + 20 mV	0.05% + 10 mV	0.05% + 25 mV	0.016% + 6 mV	0.016% + 6 mV
Current	0.1% + 4 mA	0.1% + 4 mA	0.10% + 30 mA	0.10% + 8 mA	0.04% + 160 µA	0.04% + 160 µA
Ripple & Noise						
Voltage RMS	350 µV	350 µV	1 mV	1 mV	350 µV	350 µV
Peak to Peak	4.5 mV	4.5 mV	5 mV	6 mV	4.5 mV	4.5 mV
Current RMS	2 mA	2 mA	10 mA	4 mA	2 mA	2 mA
Load Regulation						
Voltage	2 mV	2 mV	2 mV	2 mV	0.5 mV	0.5 mV
Current	2 mA	2 mA	12 mA	5 mA	6 µA	6 µA
Line Regulation						
Voltage	1 mV	1 mV	0.5 mV	1.2 mV	0.5 mV	0.5 mV
Current	1 mA	1 mA	5 mA	2 mA	30 µA	30 µA
Transient Response Time	(Time to recover to within the settling band following a load change) – From 60 % to 100% and from 100% to 60% of full load for models N6751A & N6761A – From 50% to 100% and from 100% to 50% of full load for models N6752A – N6754A & N6762A					
Settling Band	±75 mV	±75 mV	±30 mV	±90 mV	±75 mV	±75 mV
Time	<100 µs	<100 µs	<100 µs	<100 µs	<100 µs	<100 µs

dc Floating Voltage: Output terminals can be floated up to ± 240 Vdc from chassis ground
Remote Sensing: Outputs can maintain specifications with up to a 1-volt drop per load lead
Command Processing Time: less than 1 ms
Up-programming Time with Full Resistive Load for 10% to 90% Transition: as fast as 0.2 ms (for N6751A and N6752A) and 0.6 ms (for N6761A and N6762A)
Up-programming Time with Full Resistive to Settle within 50 mV of Final Value: as fast as 0.5 ms (for N6751A and N6752A) and 0.9 ms (for N6761A and N6762A)
Down-programming Time to Reach <0.5 V with No Load: as fast as 0.3 ms (for N6751A, N6752A, N6761A, and N6762A)
Down-programming Time to Reach <0.5 V with 1000 µF Load: as fast as 2.1 ms (for N6751A and N672A) and 4.5 ms (for N6761A and N6762A)
High Speed Test Extensions – LIST Mode: 1 to 512 steps; Dwell time = 1 µs to 262 seconds per step; Max list repetitions = 256 or infinite
High Speed Test Extensions – Digitizer: Measurement points = 1 to 4096; Sample rate = 0.000025 Hz to 50 kHz
Output Relay Option: Mechanical relays that break conduction path on +output, –output, +sense, and –sense. Relays sequenced to ensure no loss of control when sense lines are opened
Calibration Interval: 1 year
Weight (including 4 modules): 12.73 kg; 28 lbs (N6700B mainframes), 11.82 kg; 26 lbs (N6701A mainframes), 14.09 kg; 31 lbs (N6702A mainframes)
Size: 44.45 mm H x 432.5 mm W x 585.6 mm D (1.75 in x 17.03 in x 23.06 in) (N6700B/N6701A mainframes) 633.9 mm; 24.96 in (N6702A mainframes)
AC Input: 1000 VA typical (N6700B mainframes) 1500 VA typical (N6701A mainframes) 3000 VA typical (N6702A mainframes)

Ordering Information

N6700B Modular Power System Mainframe (4 slots), 400 W
N6701A Modular Power System Mainframe (4 slots), 600 W
N6702A Modular Power System Mainframe (4 slots), 1200 W
N6751A High Performance Autoranging DC Power Module 50 V, 5 A, 50 W
N6752A High Performance Autoranging DC Power Module 50 V, 10 A, 100 W
N6753A High-Performance Autoranging DC Power Module, 20 V, 50 A, 300 W; requires 2 slots
N6754A High-Performance Autoranging DC Power Module, 60 V, 20 A, 300 W; requires 2 slots
N6761A Precision DC Power Module 50 V, 1.5 A, 50 W
N6762A Precision DC Power Module 50 V, 3 A, 100 W
N6731B DC Power Module 5 V, 10 A, 50 W
N6732B DC Power Module 8 V, 6.25 A, 50 W
N6733B DC Power Module 20 V, 2.5 A, 50 W
N6734B DC Power Module 35 V, 1.5 A, 50 W
N6735B DC Power Module 60 V, 0.8 A, 50 W
N6736B DC Power Module 100 V, 0.5 A, 50 W
N6741B DC Power Module 5 V, 20 A, 100 W
N6742B DC Power Module 8 V, 12.5 A, 100 W
N6743B DC Power Module 20 V, 5 A, 100 W
N6744B DC Power Module 35 V, 3 A, 100 W
N6745B DC Power Module 60 V, 1.6 A, 100 W
N6746B DC Power Module 100 V, 1 A, 100 W
N6773A DC Power Module DC Power Module, 20 V, 15 A, 300 W
N6774A DC Power Module DC Power Module, 35 V, 8.55 A, 300 W
N6775A DC Power Module DC Power Module, 60 V, 5 A, 300 W
N6776A DC Power Module Power Module, 100 V, 3 A, 300 W
N6708A Filler Panel Kit for the N6700
(Note: Required when using less than 4 modules in each N6700)
N6709A Rack Mount Kit for the N6700
(Note: DO NOT use standard rack mount hardware. You MUST use product # N6709A to rack mount the N6700)

- **Easy to use R&D tool for sourcing and measuring DC voltage and current into the DUT**
- **Integrates capabilities of up to 4 Power Supplies, DMM, Scope, Arb and Datalogger**
- **Access all capabilities without programming**
- **Intuitive, dedicated physical controls for common functions**
- **Large color graphics display for easy viewing of complex data**
- **Connections and controls color-coded to the display for fast and error-free setup**
- **Programmable via standard GPIB, LAN and USB; LXI class C compliant**

LXI™

The N6705A Saves Time

The N6705A DC Power Analyzer provides unrivaled productivity gains for sourcing and measuring DC voltage and current into the DUT by integrating up to 4 advanced power supplies with DMM, Scope, Arb, and Datalogger features. The N6705A eliminates the need to gather multiple pieces of equipment and create complex test setups including transducers (such as current probes and shunts) to measure current into your DUT. The DC Power Analyzer also eliminates the need to develop and debug programs to control a collection of instruments and take useful measurements because all functions and measurements are available at the front panel. When automated bench setups are required, the N6705A is fully programmable over GPIB, USB, LAN and is LXI class C compliant.

The N6705A can be Tailored to Meet Your Needs

The N6705A offers flexible configuration to meet your power sourcing and analysis requirements. N6705A accepts the same modules as N6700 Modular Power System, with 21 modules to choose from. Basic sources for the N6705A include: 50 W, 100 W, and 300 W; up to 100 V, up to 20 A. High-performance sources for the N6705A include: 50 W, 100 W and 300 W; up to 60 V, up to 20 A. Precision sources for the N6705A include: 50 W and 100 W; up to 50 V, up to 3 A.

N6705A Makes these Tasks Easy, Right from the Front Panel

- Setup and view critical turn-on/turn-off sequences
- Measure and display voltage, current versus time to visualize power into your DUT
- Control DC bias supply ramp-up/down rates
- Generate DC bias supply transients and disturbances
- Log data for seconds, minutes, hours, or even days to see current consumption or capture anomalies
- Save data and screen shots to internal storage or external USB memory devices
- Save and name your setup and tests for easy re-use
- Share setups with colleagues across the building or across the world

High Performance Autoranging & Precision DC Power Supplies

	N6751A	N6752A	N6754A	N6761A	N6762A
Output Ratings					
Voltage	50 V	50 V	60 V	50 V	50 V
Current	5 A	10 A	20 A	1.5 A	3 A
Power	50 W	100 W	300 W	50 W	100 W
Programming Accuracy					
Voltage	0.06% + 19 mV	0.06% + 19 mV	0.06% + 25 mV	0.016% + 6 mV	0.016% + 6 mV
Current	0.1% + 20 mA	0.1% + 20 mA	0.10 % + 8 mA	0.04% + 200 µA	0.04% + 200 µA
Readback Accuracy					
Voltage	0.05% + 20 mV	0.05% + 20 mV	0.05% + 25 mV	0.016% + 6 mV	0.016% + 6 mV
Current	0.1% + 4 mA	0.1% + 4 mA	0.10% + 8 mA	0.04% + 160 µA	0.04% + 160 µA
Ripple & Noise					
Voltage RMS	350 µV	350 µV	1 mV	350 µV	350 µV
Peak to Peak	4.5 mV	4.5 mV	6 mV	4.5 mV	4.5 mV
Current RMS	2 mA	2 mA	4 mA	2 mA	2 mA
Load Regulation					
Voltage	2 mV	2 mV	2 mV	0.5 mV	0.5 mV
Current	2 mA	2 mA	5 mA	6 µA	6 µA
Line Regulation					
Voltage	1 mV	1 mV	1.2 mV	0.5 mV	0.5 mV
Current	1 mA	1 mA	2 mA	30 µA	30 µA
Transient Response Time	(Time to recover to within the settling band following a load change) – From 60 % to 100% and from 100% to 60% of full load for models N6751A & N6761A – From 50% to 100% and from 100% to 50% of full load for models N6752A – N6754A & N6762A				
Settling Band	±75 mV	±75 mV	±90 mV	±75 mV	±75 mV
Time	<100 µs	<100 µs	<100 µs	<100 µs	<100 µs

600 W DC Power Analyzer, Modular (4-slots) (cont.)

N6705A

DC Floating Voltage: Output terminals can be floated up to ± 240 Vdc from chassis ground
Remote Sensing: Outputs can maintain specifications with up to a 1-volt drop per load lead
Command Processing Time: less than 1 ms
Up-programming Time with Full Resistive Load for 10% to 90% Transition: as fast as 0.2 ms (for N6751A and N6752A) and 0.6 ms (for N6761A and N6762A)
Up-programming Time with Full Resistive to Settle within 50 mV of Final Value: as fast as 0.5 ms (for N6751A and N6752A) and 0.9 ms (for N6761A and N6762A)
Down-programming Time to Reach <0.5 V with No Load: as fast as 0.3 ms (for N6751A, N6752A, N6761A, and N6762A)
Down-programming Time to Reach <0.5 V with 1000 µF Load: as fast as 2.1 ms (for N6751A and N672A) and 4.5 ms (for N6761A and N6762A)
Output Relay Option: Mechanical relays that break conduction path on +output, –output, +sense, and –sense. Relays sequenced to ensure no loss of control when sense lines are opened
Calibration Interval: 1 year
Weight (including 4 modules): 17.3 kg; 38 lbs
Size: 177 mm H x 425.6 mm W x 272.6 mm D (7 in x 16.8 in x 10.7 in)
AC Input: 1500 VA typical

Key Literature & Web Link

Agilent N6705A DC Power Analyzer Product Overview, p/n 5989-6319EN
Agilent N6705A DC Power Analyzer Photocard, p/n 5989-6320EN

www.agilent.com/find/N6705
www.agilent.com/find/dcpoweranalyzer

Ordering Information

N6705A DC Power Analyzer Module, 600 W (4-slots)
N6751A High Performance Autoranging DC Power Module 50 V, 5 A, 50 W
N6752A High Performance Autoranging DC Power Module 50 V, 10 A, 100 W
N6754A High-Performance Autoranging DC Power Module, 60 V, 20 A, 300 W; requires 2 slots
N6761A Precision DC Power Module 50 V, 1.5 A, 50 W
N6762A Precision DC Power Module 50 V, 3 A, 100 W
N6731B DC Power Module 5 V, 10 A, 50 W
N6732B DC Power Module 8 V, 6.25 A, 50 W
N6733B DC Power Module 20 V, 2.5 A, 50 W
N6734B DC Power Module 35 V, 1.5 A, 50 W
N6735B DC Power Module 60 V, 0.8 A, 50 W
N6736B DC Power Module 100 V, 0.5 A, 50 W
N6741B DC Power Module 5 V, 20 A, 100 W
N6742B DC Power Module 8 V, 12.5 A, 100 W
N6743B DC Power Module 20 V, 5 A, 100 W
N6744B DC Power Module 35 V, 3 A, 100 W
N6745B DC Power Module 60 V, 1.6 A, 100 W
N6746B DC Power Module 100 V, 1 A, 100 W
N6773A DC Power Module DC Power Module, 20 V, 15 A, 300 W
N6774A DC Power Module DC Power Module, 35 V, 8.55 A, 300 W
N6775A DC Power Module DC Power Module, 60 V, 5 A, 300 W
N6776A DC Power Module Power Module, 100 V, 3 A, 300 W

Abbreviated Specification and Characteristics

Basic DC Power Supplies

	N6731B/ N6741B	N6732B/ N6742B	N6733B/ N6743B	N6734B/ N6744B	N6735B/ N6745B	N6736B/ N6746B	N6773A	N6774A	N6775A	N6776A
Output Ratings										
Voltage	5 V	8 V	20 V	35 V	60 V	100 V	20 V	35 V	60 V	100 V
Current	10 A/20 A	6.25 A/12.5 A	2.5 A/5 A	1.5 A/3 A	0.8 A/1.6 A	0.5 A/1 A	15 A	8.5 A	5 A	3 A
Power	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	50 W/ 100 W	300 W	300 W	300 W	300 W
Programming Accuracy										
Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 10 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 30 mA
Readback Accuracy										
Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15 % + 20 mA	0.15% + 10 mA	0.15% + 5 mA	0.15% + 4 mA	0.15% + 4 mA	0.15% + 2 mA	0.15% + 15 mA	0.15% + 12 mA	0.15% + 12 mA	0.15% + 6 mA
Ripple & Noise										
Voltage RMS	2 mV	2 mV	3 mV	5 mV	9 mV	18 mV	3 mV	5 mV	9 mV	18 mV
Peak to Peak	10 mV/ 11 mV	12 mV	14 mV	15 mV	25 mV	30 mV	20 mV	22 mV	35 mV	45 mV
Current RMS	8 mA	4 mA	2 mA	2 mA	2 mA	2 mA	6 mA	6 mA	6 mA	6 mA
Load Regulation										
Voltage	5 mV	6 mV	9 mV	11 mV	13 mV/ 16 mV	20 mV/ 30 mV	13 mV	16 mV	24 mV	45 mV
Current	2 mA	2 mA	2 mA	2 mA	2 mA	2 mA	6 mA	6 mA	6 mA	6 mA
Line Regulation										
Voltage	1 mV	2 mV	2 mV	4 mV	6 mV	10 mV	2 mV	4 mV	6 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
Transient Response Time	(Time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load)									
Settling Band	±80 mV/ 100 mV	±80 mV/ 100 mV	±200 mV/ 300 mV	±200 mV/ 300 mV	±400 mV/ 500 mV	±500 mV/ 1000 mV	±0.3 V	±0.3 V	±0.5 V	±1.0 V
Time	<200 µs	<200 µs	<200 µs	<200 µs	<200 µs	<200 µs	<250 µs	<250 µs	<250 µs	<250 µs

66000A
66001A
66101A
to 66106A

- **Modular system permits up to 8 outputs of 150 W per output in 4 U of rack space**
- **Simplify reconfiguration, calibration, or repair with modules that remove from the front without disconnecting DUT wiring**
- **GPIB interface with SCPI command set, drivers available**
- **Serial link system enables control of multiple power supplies from one GPIB address**
- **Simplify system cabling when isolation or reverse voltage is needed using optional built-in open/close/polarity reversal relays**
- **Advanced hardware and software triggering system to allow synchronization to other events in your ATE system**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with optional keyboard for manual control and advanced programmable features including automated sequencing of up to 20 output setting steps**
- **Ensure DUT safety with protection features**

66000 Modular Power System

66000 Modular Power System is ideal for automated testing environments for supplying bias power and stimulus to sub-assemblies and final products.

Key Features

- GPIB programmable voltage and current
- Series and parallel operation
- Programmable over-voltage and over-current protection
- Self-test initiated at power-up or from GPIB command
- Electronic calibration over GPIB or from keyboard
- Over-temperature protection
- Discrete fault indicator/remote inhibit (DFI/RI)
- Five nonvolatile store-recall states per output
- User-definable power-on state

Abbreviated Specification and Characteristics (Specifications at 0°C to 55°C unless otherwise noted)

		66101A	66102A	66103A	66104A	66105A	66106A
Output Ratings (at 40°C)	Output Voltage	0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V	0 to 200 V
	Output Current	0 to 16 A	0 to 7.5 A	0 to 4.5 A	0 to 2.5 A	0 to 1.25 A	0 to 0.75 A
	Output Power	128 W	150 W	150 W	150 W	150 W	150 W
Programming Accuracy (at 25°C ± 5°C)	Voltage 0.03%+	3 mV	8 mV	13 mV	27 mV	54 mV	90 mV
	Current 0.03%+	6 mA	3 mA	2 mA	1.2 mA	0.6 mA	0.4 mA
Readback Accuracy (via GPIB or keyboard display at 25°C ± 5°C)	Voltage 0.02%+	2 mV	5 mV	8 mV	16 mV	32 mV	54 mV
	Current 0.02%+	6 mA	3 mA	2 mA	1 mA	0.6 mA	0.3 mA
Ripple and Noise (20 Hz to 20 MHz)	Constant voltage rms	2 mV	3 mV	5 mV	9 mV	18 mV	30 mV
	Peak to Peak	5 mV	7 mV	10 mV	15 mV	25 mV	50 mV
	Constant Current rms	8 mA	4 mA	2 mA	1 mA	1 mA	1 mA
Line Regulation	Voltage	0.5 mV	0.5 mV	1 mV	2 mV	3 mV	5 mV
	Current	0.75 mA	0.5 mA	0.3 mA	0.1 mA	50 µA	30 µA
Load Regulation	Voltage	1 mV	1 mV	1 mV	2 mV	4 mV	7 mV
	Current	0.5 mA	0.2 mA	0.2 mA	0.1 mA	50 µA	30 µA
Transient Response Time: Less than 1 ms for the output voltage to recover within 100 mV of its previous level following any step change in load current up to 10 percent of rated current							
Average Resolution	Voltage	2.4 mV	5.9 mV	10.4 mV	18.0 mV	36.0 mV	60.0 mV
	Current	4.6 mA	2.3 mA	1.4 mA	0.75 mA	0.39 mA	0.23 mA
	Over Voltage Protection (OVP)	50 mV	120 mV	200 mV	375 mV	750 mV	1.25 V
OVP Accuracy		250 mV	500 mV	800 mV	1 V	1.5 V	2.5 V

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped across each load lead. Add 2 mV to the voltage load regulation specification for each 1-V change in the negative output lead caused by a load current change
Command Processing Time: The average time for the output voltage to change after getting a GPIB command is 20 ms
Output Programming Response Time (with full resistive load)**:** The rise time (10/90%) of the output voltage is less than 20 ms. The fall time (90/10%) of the output voltage is less than 20 ms (66101A – 66103A) or 50 ms for (66104A – 66106A). The output voltage change settles within 0.1% of the final value in less than 120 ms
Down Programming: An active down-programmer sinks approximately 10% of the rated output current
Calibration Interval: One year

ac Input of System Mainframe

Voltage	100 Vac	120 Vac	200 Vac	220 Vac	230 Vac	240 Vac
Maximum Current	29 A	25 A	16 A	16 A	15 A	15 A

Input Power of System Mainframe: 3200 VA (max.), 1800 W (max.), 1600 W (typ.)
Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2 No. 1010.1; complies with EN61010-1, carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class A
Weight

- **Net:** 66000A, 15 kg (33 lb); 66001A, 1.05 kg (2.3 lb); 66101 – 66106A, 2.7 kg (6 lb)
- **Shipping:** 66000A, 19 kg (41 lb); 66001A, 1.34 kg (2.95 lb); 66101 – 66106A, 4.1 kg (9 lb)

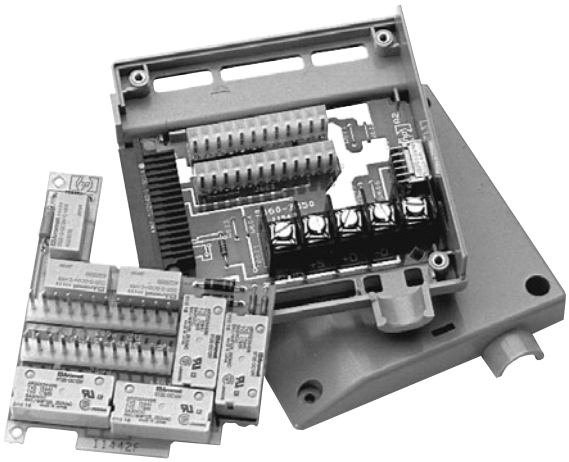
Size: 66000A: 192 mm H x 425.7 mm W x 677.93 mm D (7.28 in x 16.76 in x 26.69 in), including feet and rear connectors
Warranty Period: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN
66000 Modular Power System Product Note, p/n 5988-2800EN

For more information, visit our web site: **www.agilent.com/find/66000**

66000A
66001A
66101A
to 66106A



Isolation and polarity reversal relays are available as an option to the modules. The relay assembly fits into the module connector and can be fully controlled and sensed over the GPIB.

Simple Way to Integrate Multiple Power Sources

The Agilent serial link feature will allow you to control up to 16 outputs at one GPIB address by connecting an auxiliary mainframe. The serial link cable comes standard with the 66000 MPS mainframe. For applications with a broader range of power requirements, one 66000 mainframe can be connected with up to eight of the 6640, 6650, 6670, 6680, 6690 or 6030 series of system power supplies. This solution provides power ranges from 150 watts to 6,600 watts at one primary GPIB address.

System assembly is simplified thanks to a quick-disconnect connector assembly on each module. Once your wires are connected to the load, the connector design permits the modules to be removed from the front of the mainframe without disconnecting cabling or removing the mainframe from the rack. One connector assembly is shipped with each module.

No Compromise Performance with Modular Convenience

66000 MPS offers high performance and reliability and the advantages of modularity. The 66000 MPS offers high stability for applications that need precise output control, accurate readback measurements, and low output noise.

Advanced Programmable Control for Increased Throughput

66000 MPS features a powerful output capability, precise control of voltage and current, programmable protection features, user-definable power-on state, and five non-volatile store-recall states per output. An optional keyboard offers full control of all programmable features. GPIB interface is a standard feature fully compatible with the industry-standard SCPI command set.

Increase test throughput by using the output sequencing feature of the 66000 MPS. This powerful feature allows you to download up to 20 voltage, current, and dwell-time parameter sets per output. This sequence can be paced by the programmed dwell times. As an alternative, triggers can be used to step through the output list. The output sequences can be executed without controller intervention, thereby increasing overall test system throughput.

Ordering Information

66000A MPS Mainframe
- **66000A-908** Rackmount Kit (p/n 5062-3978)
- **66000A-909** Rackmount Kit with Handles (p/n 5062-3984)
  Note: 66000A-908 and 66000A-909 require cabinet rails (p/n E3663AC) or a slide kit (p/n 1494-0059) to support the loaded mainframe's weight
- **66000A-0L2** Extra Standard Documentation Package

66001A MPS Keyboard includes 2 m (6 ft) Cables
66002A Rack Kit for 66001A Keyboard

Module Options
66101A dc Power Module 8 V, 16 A
66102A dc Power Module 20 V, 7.5 A
66103A dc Power Module 35 V, 4.5 A
66104A dc Power Module 60 V, 2.5 A
66105A dc Power Module 120 V, 1.25 A
66106A dc Power Module 200 V, 0.75 A
- **6610xA-760** Open/Close and Polarity Reversal Relays
- **6610xA-0L2** Extra Standard Documentation Package

Accessories
Field-Installable Relay Kit, p/n 5060-3351
Standard Connector Assembly, p/n 5060-3386
Standard Connector Assembly with installed relays (Option 760), p/n 5060-3387
Mainframe Installation Guide, p/n 66000-90001
dc Power Module User's Guide, p/n 5959-3386
dc Power Module Programming Guide, p/n 5959-3362
Mainframe Service Manual, p/n 66000-90003
dc Power Module Service Manual, p/n 5959-3364
4-Pin FLT/Inhibit Connector, p/n 1252-1488

Line Cord Options
A line cord option must be specified. For details, refer to page 397.

6611C
6612C
6613C
6614C

- **Perform rapid voltage changes via fast output programming with active down programming**
- **Utilize GPIB and RS-232 interfaces with SCPI command set (drivers available)**
- **Enhance signal integrity in test systems via low-noise outputs**
- **Achieve greater output flexibility through parallel and series connections of multiple units**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and advanced programmable features**
- **Ensure DUT safety with protection features**

Abbreviated Specifications and Characteristics

			6611C	6612C	6613C	6614C
Output Ratings	Voltage/Current		0 to 8 V/0 to 5 A	0 to 20 V/0 to 2 A	0 to 50 V/0 to 1 A	0 to 100 V/0 to 0.5 A
Programming Accuracy at 25°C ± 5°C	Voltage/+Current	0.05%+	5 mV/2 mA	10 mV/1 mA	20 mV/0.75 mA	50 mV/0.5 mA
Ripple and Noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)	Voltage (rms/p-p) Current (rms)		0.5 mV/3 mV 2 mA	0.5 mV/3 mV 1 mA	0.5 mV/4 mV 1 mA	0.5 mV/5 mV 1 mA
DC Measurement Accuracy via GPIB or front-panel meters with respect to actual output at 25°C ± 5°C	Voltage Low current range –20 mA to +20 mA High current range +20 mA to +rated I –20 mA to –rated I	0.03%+ 0.1%+ 0.2%+ 0.2%+	2 mV 2.5 µA 0.5 mA 1.1 mA	3 mV 2.5 µA 0.25 mA 0.85 mA	6 mV 2.5 µA 0.2 mA 0.8 mA	12 mV 2.5 µA 0.1 mA 0.7 mA
Load Regulation	Voltage/Current		2 mV/1 mA	2 mV/0.5 mA	4 mV/0.5 mA	5 mV/0.5 mA
Line Regulation	Voltage/Current		0.5 mV/0.5 mA	0.5 mV/0.5 mA	1 mV/0.25 mA	1 mV/0.25 mA
Transient Response Time: Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of the output current rating of the supply						
Average Programming Resolution	Voltage/Current		2 mV/1.25 mA	5 mV/0.5 mA	12.5 mV/0.25 mA	25 mV/0.125 mA
Sink Current (does not track the programmed current)			3 A	1.2 A	0.6 A	0.3 A

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground
Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change
Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB
Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms
Measurement Time: Average time to make a voltage or current measurement is 50 ms
Input Power: (full load) 1.6 A, 100 W (6611C: 2.2 A, 120 W)
Regulatory Compliance: Listed to UL 3111-1; certified to CSA 22.2 No. 1010.1; complies with EN61010-1; complies with EMC directive 89/336/EEC (ISM Group 1, Class B)
Warranty Period: One year
Size: 88.1 mm H x 212.8 mm W x 368.3 mm D (3.5 in x 8.4 in x 14.5 in)
Weight: 8.2 kg (18.16 lb) net; 10.6 kg (23.5 lb) shipping

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6610**

Ordering Information

661xC-100 87 to 106 Vac, 47 to 63 Hz
661xC-120 104 to 127 Vac, 47 to 63 Hz
661xC-220 191 to 233 Vac, 47 to 63 Hz
661xC-230 207 to 253 Vac, 47 to 63 Hz
661xC-760 Isolation and Reversal Relays
661xC-8ZJ Delete Instrument Feet
661xC-1CM Rackmount Kit, p/n 5063-9240
661xC-0B3 Service Manual, p/n 5962-8200
(Standard unit is shipped with operating guide and programming guide only)
661xC-OL2 Extra Standard Documentation Package

80 – 100 W, DC System Power Supplies, GPIB, Single Output (CWS)

6631B
6632B
6633B
6634B

- **Perform rapid voltage changes via fast output programming with active down programming**
- **Utilize GPIB and RS-232 interfaces with SCPI command set (drivers available)**
- **Enhance signal integrity in test systems via low-noise outputs**
- **Achieve greater output flexibility via parallel and series connections of multiple units**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and advanced programmable features**
- **Ensure DUT safety with protection features**

Abbreviated Specifications and Characteristics

			6631B	6632B	6633B	6634B
Output Ratings	Voltage/Current		0 to 8 V/0 to 10 A	0 to 20 V/0 to 5 A	0 to 50 V/0 to 2 A	0 to 100 V/0 to 1 A
Programming Accuracy at 25°C ± 5°C	Voltage/+Current	0.05%+	5 mV/4 mA	10 mV/2 mA	20 mV/1 mA	50 mV/0.5 mA
Ripple and Noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)	Voltage Normal mode (rms/p-p) Voltage Fast mode rms/p-p) Current (rms)		0.3 mV/3 mV 1 mV/10 mV 3 mA	0.3 mV/3 mV 1 mV/10 mV 2 mA	0.5 mV/3 mV 1 mV/15 mV 2 mA	0.5 mV/3 mV 2 mV/25 mV 2 mA
DC Measurement Accuracy via GPIB or front-panel meters with respect to actual output at 25°C ± 5°C	Voltage Low current range –20 mA to +20 mA High current range +20 mA to +rated I –20 mA to –rated I	0.03%+ 0.1%+ 0.2%+ 0.2%+	2 mV 2.5 µA 1 mA 1.6 mA	3 mV 2.5 µA 0.5 mA 1.1 mA	6 mV 2.5 µA 0.25 mA 0.85 mA	12 mV 2.5 µA 0.25 mA 0.85 mA
Load Regulation	Voltage/Current		2 mV/2 mA	2 mV/1 mA	4 mV/1 mA	5 mV/1 mA
Line Regulation	Voltage/Current		0.5 mV/1 mA	0.5 mV/0.5 mA	1 mV/0.25 mA	1 mV/0.25 mA
Transient Response Time: Less than 100 µs (50 µs in the fast mode) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV) following any step change in load current of up to 50% of the output current rating of the supply						
Average Programming Resolution	Voltage/Current		2 mV/2.5 mA	5 mV/1.25 mA	12.5 mV/0.5 mA	25 mV/0.25 mA
Sink Current			10 A	5 A	2 A	1 A
Sink Current Tracking	SCPI mode: Compatibility mode:		0.4% + 4 mA –500 mA	0.4% + 2 mA –250 mA	0.4% + 1 mA –100 mA	0.4% + 0.5 mA –50 mA
Minimum Current in Constant Current Mode*			40 mA	20 mA	8 mA	4 mA

* When programming in the 6630A Series language compatibility mode.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground
Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change
Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB (display disabled)
Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms (400 µs in fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode)
GPIB Interface Capabilities: IEEE-488.2, SCPI command set, and 6630A Series programming compatibility
Measurement Time: Average time to make a voltage or current measurement is 50 ms
Input Power (Full load): 3 – 5 A, 250 W
Regulatory Compliance: Listed to UL-3111-1; certified to CSA 22.2 No. 1010.1; complies with EN 61010-1; complies with EMC directive 89/336/EEC (ISM Group 1, Class B)
Warranty Period: One year
Size: 88.1 mm H x 425.5 mm W x 364.4 mm D (3.5 in x 16.8 in x 14.3 in)
Weight: 12.7 kg (28 lb) net; 15.0 kg (33 lb) shipping

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6630**

Ordering Information

663xB-100 87 to 106 Vac, 47 to 63 Hz
663xB-120 104 to 127 Vac, 47 to 63 Hz
663xB-220 191 to 233 Vac, 47 to 63 Hz
663xB-230 207 to 253 Vac, 47 to 63 Hz
663xB-020 Front-panel Binding Posts
663xB-760 Isolation and Reversal Relays (N/A on 6631B)
663xB-8ZJ Delete Instrument Feet
663xB-1CM Rackmount Kit, p/n 5062-3974
663xB-1CP Rackmount Kit with Handles, p/n 5062-3975*
663xB-0B3 Service Manual
662xA-0L2 Extra Standard Documentation Package (Standard unit is shipped with operating guide and programming guide only.)

Accessories
p/n 1494-0060 Rack Slide Kit
E3663AC Support Rails for Agilent Cabinets

* Support rails required.

6541A
6542A
6543A
6544A
6545A
6641A
6642A
6643A
6644A
6645A

- **Increase test throughput with fast, low-noise outputs**
- **Perform remote programming using GPIB or RS-232 interface with SCPI command set (drivers available)**
- **Utilize analog control of output voltage and current**
- **Control up to 16 supplies through one GPIB address via serial link system**
- **Achieve greater output flexibility through parallel and series connections of multiple supplies**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and advanced programmable features**
- **Ensure DUT safety with protection features**

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			**6641A**	**6642A**	**6643A**	**6644A**	**6645A**
Manually Controlled Power Supplies (w/o GPIB)			**6541A**	**6542A**	**6543A**	**6544A**	**6545A**
Output Ratings	Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
	Output current (40°C)		0 to 20 A	0 to 10 A	0 to 6 A	0 to 3.5 A	0 to 1.5 A
	Maximum current (50°C/55°C)		18 A/17 A	9 A/8.5 A	5.4 A/5.1 A	3.2 A/3 A	1.4 A/1.3 A
Programming Accuracy (at 25°C ± 5°C)	Voltage	0.06%+	5 mV	10 mV	15 mV	26 mV	51 mV
	Current	0.15%+	26 mA	13 mA	6.7 mA	4.1 mA	1.7 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Voltage	rms	300 µV	300 µV	400 µV	500 µV	700 µV
		peak-peak	3 mV	3 mV	4 mV	5 mV	7 mV
	Current	rms	10 mA	5 mA	3 mA	1.5 mA	1 mA
Readback Accuracy at 25°C ± 5°C (percent of reading plus fixed) System models only	Voltage	0.07%+	6 mV	15 mV	25 mV	40 mV	80 mV
	+Current	0.15%+	18 mA	9.1 mA	5 mA	3 mA	1.3 mA
	–Current	0.35%+	40 mA	20 mA	12 mA	6.8 mA	2.9 mA
Load Regulation	Voltage		1 mV	2 mV	3 mV	4 mV	5 mV
	Current		1 mA	0.5 mA	0.25 mA	0.25 mA	0.25 mA
Line Regulation	Voltage		0.5 mV	0.5 mV	1 mV	1 mV	2 mV
	Current		1 mA	0.5 mA	0.25 mA	0.25 mA	0.25 mA
Transient Response Time: Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply, or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current							
Average Resolution	Voltage		2 mV	5 mV	10 mV	15 mV	30 mV
	Current		6 mA	3 mA	2 mA	1.2 mA	0.5 mA
	OVP		13 mV	30 mV	54 mV	93 mV	190 mV
OVP Accuracy			160 mV	400 mV	700 mV	1.2 V	2.4 V
System Power Supplies (GPIB)			6641A	6642A	6643A	6644A	6645A
Manually Controlled (w/o GPIB)			6541A	6542A	6543A	6544A	6545A

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time (6641A, 6642A, 6643A, 6644A, 6645A only)**:** Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms
Down Programming: An active down programmer sinks approximately 20% of the rated output current
Modulation: (Analog programming of output voltage and current)
- Input Signal: 0 to –5 V
- Input Impedance: 10 k Ohm nominal

ac Input: (ac input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	230 Vac	240 Vac
Current	4.4 A	3.8 A	2.2 A	2.1 A	2.0 A

Input Power: 480 VA, 400 W at full load; 60 W at no load
Regulatory Compliance: Complies with IEC 61010-1; certified to CSA 22.2 No. 1010.1; carries the CE mark; complies with EMC directive 89/336/EEC
Size: 88.1 mm H x 425.5 mm W x 439 mm D (3.5 in x 16.75 in x 17.3 in)
Weight: Net, 14.2 kg (31.4 lb); shipping, 16.3 kg (36 lb)
Warranty Period: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site:
www.agilent.com/find/6640
www.agilent.com/find/6540

Ordering Information

For 664xA & 654xA
Option 100 87 to 106 Vac, 47 to 63 Hz
Option 120 104 to 127 Vac, 47 to 63 Hz
Option 220 191 to 233 Vac, 47 to 63 Hz
Option 240 209 to 250 Vac, 47 to 63 Hz
Option 908 Rackmount Kit (p/n 5063-9212) (support rails required)
Option 909 Rackmount Kit w/Handles (p/n 5063-9219) (support rails required)
Option 0B3 Service Manual
Option 0L2 Extra Standard Documentation Package

Accessories
p/n 1494-0060 Accessory Slide Kit
The following accessories for 6641A, 6642A, 6643A, 6644A and 6645A only:
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support Rails for Agilent Rack Cabinets

Power Supplies

Single Output System and Manually Controlled: 500 W

- **Increase test throughput with fast, low-noise outputs**
- **Perform remote programming using GPIB interface with SCPI command set (drivers available)**
- **Utilize analog control of output voltage and current**
- **Control up to 16 supplies through one GPIB address via serial link system**
- **Achieve greater output flexibility through parallel and series connections of multiple supplies**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and advanced programmable features**
- **Ensure DUT safety with protection features**

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			**6651A**	**6652A**	**6653A**	**6654A**	**6655A**
Manually Controlled Power Supplies (w/o GPIB)			**6551A**	**6552A**	**6553A**	**6554A**	**6555A**
Output Ratings	Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
	Output current (40°C)		0 to 50 A	0 to 25 A	0 to 15 A	0 to 9 A	0 to 4 A
	Maximum current (50°C/55°C)		45 A/42.5 A	22.5 A/21.3 A	13.5 A/12.8 A	8.1 A/7.7 A	3.6 A/3.4 A
Programming Accuracy (at 25°C ± 5°C)	Voltage	0.06%+	5 mV	10 mV	15 mV	26 mV	51 mV
	Current	0.15%+	60 mA	25 mA	13 mA	8 mA	4 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Voltage	rms	300 µV	300 µV	400 µV	500 µV	700 µV
		peak-peak	3 mV	3 mV	4 mV	5 mV	7 mV
	Current	rms	25 mA	10 mA	5 mA	3 mA	2 mA
Readback Accuracy at 25°C ± 5°C (percent of reading plus fixed) System models only	Voltage	0.07%+	6 mV	15 mV	25 mV	40 mV	80 mV
	+Current	0.15%+	67 mA	26 mA	15 mA	7 mA	3 mA
	–Current	0.35%+	100 mA	44 mA	24 mA	15 mA	7 mA
Load Regulation	Voltage		1 mV	2 mV	3 mV	4 mV	5 mV
	Current		2 mA	1 mA	0.5 mA	0.5 mA	0.5 mA
Line Regulation	Voltage		0.5 mV	0.5 mV	1 mV	1 mV	2 mV
	Current		2 mA	1 mA	0.75 mA	0.5 mA	0.5 mA
Transient Response Time: Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply, or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current							
Average Resolution	Voltage		2 mV	5 mV	10 mV	15 mV	30 mV
	Current		15 mA	7 mA	4 mA	2.5 mA	1.25 mA
	OVP		12 mV	30 mV	54 mV	93 mV	190 mV
OVP Accuracy			160 mV	400 mV	700 mV	1.2 V	2.4 V
System Power Supplies (GPIB)			6651A	6652A	6653A	6654A	6655A
General Purpose (w/o GPIB)			6551A	6552A	6553A	6554A	6555A

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time (6651A, 6652A, 6653A, 6654A, 6655A only)**:** Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms
Down Programming: An active down programmer sinks approximately 20% of the rated output current
Modulation: (Analog programming of output voltage and current)
- Input signal: 0 to –5 V
- Input impedance: 10 k Ohm nominal

ac Input: (ac input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	12 A	10 A	5.7 A	5.3 A

Input Power: 1,380 VA, 1,100 W at full load; 120 W at no load
Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2 No. 1010.1; complies with IEC 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC
Size: 132.6 mm H x 425.5 mm W x 497.8 mm D (5.22 in x 16.75 in x 19.6 in)
Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)
Warranty Period: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site:
www.agilent.com/find/6650
www.agilent.com/find/6550

Ordering Information

For 665xA & 655xA
Option 100 87 to 106 Vac, 47 to 63 Hz
Option 120 104 to 127 Vac, 47 to 63 Hz
Option 220 191 to 233 Vac, 47 to 63 Hz
Option 240 209 to 250 Vac, 47 to 63 Hz
Option 908 Rackmount Kit (p/n 5062-3977) (support rails required)
Option 909 Rackmount Kit w/ Handles (p/n 5063-9221) (support rails required)
Option 0B3 Service Manual
Option 0L2 Extra Standard Documentation Package

Accessories
Rack Slide Kit (p/n 1494-0059)
The following accessories for 6651A, 6652A, 6653A, 6654A and 6655A only:
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E663AC Support Rails for Agilent Rack Cabinets

- **Save space with up to 780 W in a small 1 U package**
- **Use 85 – 265 Vac universal AC input to enable automatic operation from any AC mains voltage worldwide**
- **Perform remote programming via GPIB, LAN and USB interfaces with SCPI command set (drivers available)**
- **Utilize analog control and monitoring of output voltage and current**
- **Achieve greater output flexibility with parallel and series connections of multiple supplies**
- **Simplify cabling with built-in measurements**
- **Ensure DUT safety with protection features**
- **LXI class C compliant**

N5741A – N5772A

The N5700 is a family of affordable 750 W and 1500 W single output programmable DC power supplies designed to simplify system development and are ideal for basic DC power applications. The N5700 saves valuable rack space with up to 1500 W in a small 1 U high package and all models offer GPIB, LAN and USB 2.0 interfaces standard.

N5700 Series System DC Power Supplies Front Close Up

Abbreviated Specification and Characteristics (at 0°C to 40°C unless otherwise specified)

750 W Models

	N5741A	N5742A	N5743A	N5744A	N5745A	N5746A
Output Ratings						
Voltage	6 V	8 V	12.5 V	20 V	30 V	40 V
Current	100 A	90 A	60 A	38 A	25 A	19 A
Power	600 W	720 W	750 W	760 W	750 W	760 W
Programming Accuracy						
Voltage 0.05% +	3 mV	4 mV	6.25 mV	10 mV	15 mV	20 mV
Current 0.1% +	100 mA	90 mA	60 mA	38 mA	25 mA	19 mA
Readback Accuracy						
Voltage 0.1% +	6 mV	8 mV	12.5 mV	20 mV	30 mV	40 mV
Current 0.1% +	300 mA	270 mA	180 mA	114 mA	75 mA	57 mA
Ripple & Noise						
CV Peak to Peak[1]	60 mV	60 mV	60 mV	60 mV	60 mV	60 mV
CV Rms[2]	8 mV	8 mV	8 mV	8 mV	8 mV	8 mV
CC rms[3]	200 mA	180 mA	120 mA	76 mA	63 mA	48 mA
Load Regulation						
Voltage	2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current	25 mA	23 mA	17 mA	12.6 mA	10 mA	8.8 mA
Line Regulation						
Voltage	2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current	12 mA	11 mA	8 mA	5.8 mA	4.5 mA	3.9 mA
Transient Response Time[4]	≤1.5 ms	≤1.5 ms	≤1.5 ms	≤1 ms	≤1 ms	≤1 ms
Average Programming Resolution						
Voltage	0.72 mV	0.96 mV	1.5 mV	2.4 mV	3.6 mV	4.8 mV
Current	12 mA	10.8 mA	7.2 mA	4.56 mA	3 mA	2.3 mA
Over Voltage Protection						
Range	0.5 – 7.5 V	0.5 – 10 V	1 – 15 V	1 – 24 V	2 – 36 V	2 – 44 V
Accuracy	0.06 V	0.08 V	0.125 V	0.20 V	0.30 V	0.40 V

[1] Up to 20 MHz.
[2] From 5 Hz to 1 MHz.
[3] From 5 Hz to 1 MHz at 10% to 100% of output voltage at full load (6 V units from 33% to 100% of output voltage).
[4] Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10 to 100% of rated output.

750 W Models

	N5747A	N5748A	N5749A	N5750A	N5751A	N5752A
Output Ratings						
Voltage	60 V	80 V	100 V	150 V	300 V	600 V
Current	12.5 A	9.5 A	7.5 A	5 A	2.5 A	1.3 A
Power	750 W	760 W	750 W	750 W	750 W	780 W
Programming Accuracy						
Voltage 0.05% +	30 mV	40 mV	50 mV	75 mV	150 mV	300 mV
Current 0.1% +	12.5 mA	9.5 mA	7.5 mA	5 mA	2.5 mA	1.3 mA
Readback Accuracy						
Voltage 0.1% +	60 mV	80 mV	100 mV	150 mV	300 mV	600 mV
Current 0.1% +	37.5 mA	28.5 mA	22.5 mA	15 mA	7.5 mA	3.9 mA
Ripple & Noise						
CV Peak to Peak[1]	60 mV	80 mV	80 mV	100 mV	150 mV	300 mV
CV Rms[2]	8 mV	8 mV	8 mV	12 mV	20 mV	60 mV
CC rms[3]	38 mA	29 mA	23 mA	18 mA	13 mA	8 mA
Load Regulation						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	7.5 mA	6.9 mA	6.5 mA	6 mA	5.5 mA	5.26 mA
Line Regulation						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	3.25 mA	2.95 mA	2.75 mA	2.5 mA	2.25 mA	2.13 mA
Transient Response Time[4]	≤1 ms	≤1 ms	≤1 ms	≤2 ms	≤2 ms	≤2 ms
Average Programming Resolution						
Voltage	7.2 mV	9.6 mV	12 mV	18 mV	36 mV	72 mV
Current	1.5 mA	1.14 mA	0.9 mA	0.6 mA	0.3 mA	0.156 mA
Over Voltage Protection						
Range	5 – 66 V	5 – 88 V	5 – 110 V	5 – 165 V	5 – 330 V	5 – 660 V
Accuracy	0.60 V	0.80 V	1 V	1.5 V	3 V	6 V

[1] Up to 20 MHz.
[2] From 5 Hz to 1 MHz.
[3] From 5 Hz to 1 MHz at 10% to 100% of output voltage at full load (6 V units from 33% to 100% of output voltage).
[4] Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10 to 100% of rated output.

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/N5700**

Ordering Information

For N574x & N575x (750 W Models)
Option 900 Power Cord, United Kingdom
Option 902 Power Cord, Europe
Option 903 Power Cord, USA, Canada
Option 918 Power Cord, Japan
Option 922 Power Cord, China

Accessories for all N5700 Models
N5740A Rack Mount Slide Kit
(required for rack mounting; standard system 11 rack-mounting hardware will not work)

Command Response Time: 55 ms Typical

Modulation: (Analog programming of output voltage and current)
Input Signal: selectable, 0 to 5 V/0 to 10 V full scale
Input Impedance: selectable, 0 to 5 k Ohm/0 to 10 k Ohm full scale

AC Input
Input Range: 85 – 265 VAC; 47 – 63 Hz
Input Current 750 W: 10.5 A at 100 VAC nominal; 5 A at 200 VAC nominal
Input Current 1500 W: 21 A at 100 VAC nominal; 11 A at 200 VAC nominal
Power Factor: 0.99 at nominal input and rated output power

Regulation: European EMC directive 89/336/EEC for Class A products, Australian C-Tick mark, this ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Size: 43.6 mm H x 422.8 mm W x 432.8 mm D (1.72 in x 16.65 in x 17.04 in), excluding connectors and handles

Weight: 750 W – 7 Kg (15.4 lbs); 1500 W – 8.5 Kg (18.7 lbs)

1500 W, DC System Power Supplies, GPIB, Single Output

- **Get up to 1560 W in a compact 1 U package that offers solid performance and a variety of basic and enhanced capabilities**
- **Use 85 – 265 Vac universal AC input to enable automatic operation from any AC mains voltage worldwide**
- **Perform remote programming via GPIB, LAN and USB interfaces with SCPI command set (drivers available)**
- **Utilize analog monitoring and control of output voltage and current**
- **Achieve greater output flexibility with parallel and series connections of multiple supplies**
- **Simplify cabling with built-in measurements**
- **Ensure DUT safety with protection features**
- **LXI class C compliant**

1500 W Models

	N5761A	N5762A	N5763A	N5764A	N5765A	N5766A
Output Ratings						
Voltage	6 V	8 V	12.5 V	20 V	30 V	40 V
Current	180 A	165 A	120 A	76 A	50 A	38 A
Power	1080 W	1320 W	1500 W	1520 W	1500 W	1520 W
Programming Accuracy						
Voltage 0.05% +	3 mV	4 mV	6.25 mV	10 mV	15 mV	20 mV
Current 0.1% +	180 mA	165 mA	120 mA	76 mA	50 mA	38 mA
Readback Accuracy						
Voltage 0.1% +	6 mV	8 mV	12.5 mV	20 mV	30 mV	40 mV
Current 0.1% +	540 mA	495 mA	360 mA	228 mA	150 mA	114 mA
Ripple & Noise						
CV Peak to Peak[1]	60 mV	60 mV	60 mV	60 mV	60 mV	60 mV
CV Rms[2]	8 mV	8 mV	8 mV	8 mV	8 mV	8 mV
CC rms[3]	360 mA	330 mA	240 mA	152 mA	125 mA	95 mA
Load Regulation						
Voltage	2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current	41 mA	38 mA	29 mA	20.2 mA	15 mA	12.6 mA
Line Regulation						
Voltage	2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current	20 mA	18.5 mA	14 mA	9.6 mA	7 mA	5.8 mA
Transient Response Time[4]	≤1.5 ms	≤1.5 ms	≤1.5 ms	≤1 ms	≤1 ms	≤1 ms
Average Programming Resolution						
Voltage	0.72 mV	0.96 mV	1.5 mV	2.4 mV	3.6 mV	4.8 mV
Current	21.6 mA	19.8 mA	14.4 mA	9.12 mA	6 mA	4.6 mA
Over Voltage Protection						
Range	0.5 – 7.5 V	0.5 – 10 V	1 – 15 V	1 – 24 V	0 – 36 V	2 – 44 V
Accuracy	0.06 V	0.08 V	0.125 V	0.20 V	0.30 V	0.40 V

[1] Up to 20 MHz.
[2] From 5 Hz to 1 MHz.
[3] From 5 Hz to 1 MHz at 10% to 100% of output voltage at full load (6 V units from 33% to 100% of output voltage).
[4] Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10 to 100% of rated output.

1500 W Models

	N5767A	N5768A	N5769A	N5770A	N5771A	N5772A
Output Ratings						
Voltage	60 V	80 V	100 V	150 V	300 V	600 V
Current	25 A	19 A	15 A	10 A	5 A	2.6 A
Power	1500 W	1520 W	1500 W	1500 W	1500 W	1560 W
Programming Accuracy						
Voltage 0.05% +	30 mV	40 mV	50 mV	75 mV	150 mV	300 mV
Current 0.1% +	25 mA	19 mA	15 mA	10 mA	5 mA	2.6 mA
Readback Accuracy						
Voltage 0.1% +	60 mV	80 mV	100 mV	150 mV	300 mV	600 mV
Current 0.1% +	75 mA	57 mA	45 mA	30 mA	15 mA	7.8 mA
Ripple & Noise						
CV Peak to Peak[1]	60 mV	80 mV	80 mV	100 mV	150 mV	300 mV
CV Rms[2]	8 mV	8 mA	8 mV	12 mV	20 mV	60 mV
CC rms[3]	75 mA	57 mA	45 mA	35 mA	25 mA	12 mA
Load Regulation						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	10 mA	8.8 mA	8 mA	7 mA	6 mA	5.5 mA
Line Regulation						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	4.5 mA	3.9 mA	3.5 mA	3 mA	2.5 mA	2.26 mA
Transient Response Time[4]	≤1 ms	≤1 ms	≤1 ms	≤2 ms	≤2 ms	≤2 ms
Average Programming Resolution						
Voltage	7.2 mV	9.6 mV	12 mV	18 mV	36 mV	72 mV
Current	3 mA	2.28 mA	1.8 mA	1.2 mA	0.6 mA	0.312 mA
Over Voltage Protection						
Range	5 – 66 V	5 – 88 V	5 – 110 V	5 – 165 V	5 – 330 V	5 – 660 V
Accuracy	0.60 V	0.80 V	1 V	1.5 V	3 V	6 V

[1] Up to 20 MHz.
[2] From 5 Hz to 1 MHz.
[3] From 5 Hz to 1 MHz at 10% to 100% of output voltage at full load (6 V units from 33% to 100% of output voltage).
[4] Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10 to 100% of rated output.

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/N5700**

Ordering Information

For N576x & N577x (1500 W Models)
Option 861 Unterminated Power Cord, USA, Canada, China, Japan, Other
Option 862 Harmonized Unterminated Power Cord, Europe

Accessories for all N5700 Models
N5740A Rack Mount Slide Kit
(required for rack mounting; standard system 11 rack-mounting hardware will not work)

Command Response Time: 55 ms Typical

Modulation: (Analog programming of output voltage and current)
Input Signal: selectable, 0 to 5 V/0 to 10 V full scale
Input Impedance: selectable, 0 to 5 k Ohm/0 to 10 k Ohm full scale

AC Input
Input Range: 85 – 265 VAC; 47 – 63 Hz
Input Current 750 W: 10.5 A at 100 VAC nominal; 5 A at 200 VAC nominal
Input Current 1500 W: 21 A at 100 VAC nominal; 11 A at 200 VAC nominal
Power Factor: 0.99 at nominal input and rated output power

Regulation: European EMC directive 89/336/EEC for Class A products, Australian C-Tick mark, this ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Size: 43.6 mm H x 422.8 mm W x 432.8 mm D (1.72 in x 16.65 in x 17.04 in), excluding connectors and handles

Weight: 750 W – 7 Kg (15.4 lbs); 1500 W – 8.5 Kg (18.7 lbs)

- **Increase test throughput with fast up- and down programming**
- **Perform remote programming using GPIB interface with SCPI command set (drivers available)**
- **Address noisy environments and process applications with analog control of output voltage and current**
- **Control up to 16 supplies through one GPIB address via serial link system**
- **Simplify cabling with built-in measurements**
- **Achieve versatile control of voltage and current using front panel keypad plus analog programming**
- **Ensure accurate results with clean output with low ripple and noise**
- **Achieve greater output flexibility via parallel or series connection of multiple units**
- **Perform quick configuration changes with five store and recall operating states**
- **Protect DUTs quickly and automatically with overvoltage and overcurrent features**

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			**6671A**	**6672A**	**6673A**	**6674A**	**6675A**
General Purpose Power Supplies (w/o GPIB)			**6571A**	**6572A**	**6573A**	**6574A**	**6575A**
Output Ratings	Output voltage Output current (40°C)		0 to 8 V 0 to 220 A	0 to 20 V 0 to 100 A	0 to 35 V 0 to 60 A	0 to 60 V 0 to 35 A	0 to 120 V 0 to 18 A
Programming Accuracy (at 25°C ± 5°C)	Voltage Current	0.04%+ 0.11%+	8 mV 125 mA	20 mV 60 mA	35 mV 40 mA	60 mV 25 mA	120 mV 12 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Voltage Current	rms peak-peak rms	650 µV 7 mV 200 mA	750 µV 9 mV 100 mA	800 µV 9 mV 40 mA	1.25 mV 11 mV 25 mA	1.9 mV 16 mV 12 mA
Readback Accuracy at 25°C ± 5°C (percent of reading plus fixed) System models only	Voltage ±Current	0.05%+ 0.1%+	12 mV 150 mA	30 mV 100 mA	50 mV 60 mA	90 mV 35 mA	180 mV 18 mA
Load and Line Regulation	Voltage Current	0.002%+ 0.005%+	300 µV 10 mA	650 µV 7 mA	1.2 mV 4 mA	2 mV 2 mA	4 mV 1 mA
Transient Response Time: Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply							
Typical Resolution	Voltage Current OVP		2 mV 55 mA 15 mV	5 mV 25 mA 35 mV	10 mV 15 mA 65 mV	15 mV 8.75 mA 100 mV	30 mV 4.5 mA 215 mV
Output Voltage Programming Response Time* (excluding command processing time) System models only			30 ms	60 ms	130 ms	130 ms	195 ms
System Power Supplies(GPIB) General Purpose (w/o GPIB)			6671A 6571A	6672A 6572A	6673A 6573A	6674A 6574A	6675A 6575A

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Output Common-Mode Noise Current: (to signal ground binding post) 500 µA rms, 4 mA peak-to-peak
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time: (6671A, 6672A, 6673A, 6674A, 6675A only) Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Modulation: (Analog programming of output voltage and current)
- Input signal: 0 to –4 V for voltage, 0 to 7 V for current
- Input impedance: 60 K Ohm, nominal

Input Power: 3,800 VA, 2,600 W at full load; 170 W at no load
Regulatory Compliance: Listed to UL-3111.1; certified to CSA 22.2 No. 1010.1; complies with EN 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC
Size:132.6 mm H x 425.5 mm W x 640 mm D (5.22 in x 16.75 in x 25.2 in)
Weight: Net, 27.7 kg (61 lb); shipping, 31.4 kg (69 lb)
Warranty Period: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site:
www.agilent.com/find/6670
www.agilent.com/find/6570

Ordering Information

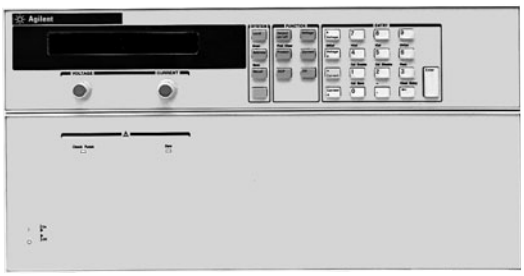
For 667xA & 657xA
Option 200 174 to 220 Vac, 47 to 63 Hz (Japan only)
Option 230 191 to 250 Vac, 47 to 63 Hz
Option 908 Rackmount Kit (p/n 5062-3977) (support rails required)
Option 909 Rackmount Kit w/ Handles (p/n 5063-9221) (support rails required)
Option 083 Service Manual
Option 0L2 Extra Standard Documentation Package
A line cord option must be specified. See page 397 for ordering information.

Accessories
Rack Slide Kit (p/n 1494-0059)
The following accessories for 6671A, 6672A, 6673A, 6674A and 6675A only:
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support Rails for Agilent Rack Cabinets

5000 W, DC System Power Supplies, GPIB, Single Output

6680A
6681A
6682A
6683A
6684A

- **Perform remote programming using the GPIB interface and SCPI command set**
- **Enhance measurement accuracy with low ripple and noise**
- **Utilize selectable compensation to enable trouble-free powering of inductive loads**
- **Control up to 16 supplies through one GPIB address via serial link system**
- **Use built-in measurement system to provide DMM-quality voltage and current readings**
- **Protect DUTs quickly and automatically with overvoltage and overcurrent features**



Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			6680A	6681A	6682A	6683A	6684A
Output Ratings	Voltage Current (derated linearly 1%/°C from 40°C to 55°C)		0 to 5 V 0 to 875 A	0 to 8 V 0 to 580 A	0 to 21 V 0 to 240 A	0 to 32 V 0 to 160 A	0 to 40 V 0 to 128 A
Programming Accuracy (at 25°C ± 5°C)	Voltage Current	0.04%+ 0.1%+	5 mV 450 mA	8 mV 300 mA	21 mV 125 mA	32 mV 85 mA	40 mV 65 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Constant voltage Constant current	rms peak-to-peak rms	1.5 mV 10 mV 290 mA	1.5 mV 10 mV 190 mA	1.0 mV 10 mV 40 mA	1.0 mV 10 mV 28 mA	1.0 mV 10 mV 23 mA
Readback Accuracy at 25°C ± 5°C (percent of reading plus fixed)	Voltage Current	0.05%+ 0.1%+	7.5 mV 600 mA	12 mV 400 mA	32 mV 165 mA	48 mV 110 mA	60 mV 90 mA
Load and Line Regulation	Voltage Current	0.002%+ 0.005%+	190 µV 65 mA	300 µV 40 mA	650 µV 17 mA	1.1 mV 12 mA	1.5 mV 9 mA
Transient Response Time: Less than 900 µs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply							
Average Programming Resolution	Voltage Current OVP		1.35 mV 235 mA 30 mV	2.15 mV 155 mA 45 mV	5.7 mV 64 mA 120 mV	8.6 mV 43 mA 180 mV	10.8 mV 34 mA 225 mV
Output Voltage Programming Response Time (excludes command-processing time)	Full-load programming rise or fall time (10/90% or 90/10%, resistive load)		9 ms	12 ms	45 ms	60 ms	60 ms
Output Common-Mode Noise Current (to signal-ground binding post)		rms peak-to-peak	1.5 mA 10 mA	1.5 mA 10 mA	3 mA 20 mA	3 mA 20 mA	3 mA 20 mA

dc Floating Voltage: Output terminals can be floated up to ±60 Vdc maximum from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB
Modulation (analog programming of output voltage and current)
- Input Signal: 0 to –5 V for voltage, 0 to +5 V for current
- Input Impedance: 30 k Ohm or greater

ac Input (47 to 63 Hz)**:** 180 to 235 Vac (line-to-line, 3 phase), 27.7 A rms maximum; 360 to 440 Vac, 14.3 A rms maximum (maximum line current includes 5% unbalanced phase voltage condition.) Output voltage derated at 50 Hz and below 200 Vac
Input Power: 7350 VA and 6000 W maximum; 160 W at no load
Regulatory Compliance: Listed to UL-3111.1; certified to CSA 22.2 No. 1010.1; complies with IEC 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC
Size: 220 mm H x 425.5 mm W x 675.6 mm D (8.75 in x 16.75 in x 26.6 in)
Weight: Net, 51.3 kg (113 lb); shipping, 63.6 kg (140 lb)
Warranty Period: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6680**

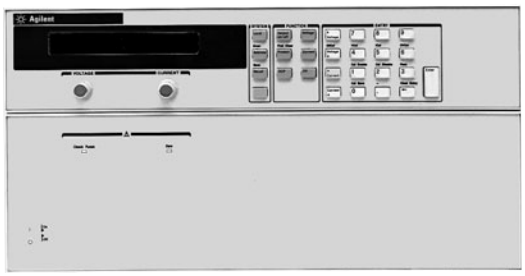
Ordering Information

668xA-208 180 to 235 Vac, 3 phase, 47 to 63 Hz
668xA-400 360 to 440 Vac, 3 phase, 47 to 63 Hz
668xA-602 Two Bus-Bar Spacers for Paralleling Power Supplies (p/n 5060-3514)
668xA-908 Rackmount Kit (p/n 5062-3977 and p/n 5063-9212)
668xA-909 Rackmount Kit with Handles (p/n 5063-9221 and p/n 5063-9219). Support rails required for Option 908 and 909 Rack
668xA-0B3 Service Manual
668xA-0L2 Extra Standard Documentation Package

Accessories
p/n 5060-3513 Three 30-A Replacement Fuses for 180 to 235 Vac line
p/n 5060-3512 Three 16-A Replacement Fuses for 360 to 440 Vac line
E3663AC Support Rails for Agilent Rack Cabinets
p/n 5080-2148 Serial Link Cable 2 m (6.6 feet)

6690A
6691A
6692A

- **Perform remote programming using the GPIB interface and SCPI command set**
- **Ensure accurate results via precise voltage and current programming with low ripple**
- **Control up to 16 supplies through one GPIB address via serial link system**
- **Use built-in measurement system to provide DMM-quality voltage and current readings**
- **Protect DUTs quickly and automatically with overvoltage and overcurrent features**
- **Use fast-response analog control of output voltage and current to address challenging environments**



Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			6690A	6691A	6692A
Output Ratings	Voltage Current (derated linearly 1%/°C from 40°C to 55°C)		0 to 15 V 0 to 440 A	0 to 30 V 0 to 220 A	0 to 60 V 0 to 110 A
Programming Accuracy (at 25°C ± 5°C)	Voltage Current	0.04%+ 0.1%+	15 mV 230 mA	30 mV 125 mA	60 mV 65 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Constant voltage Constant current	rms peak-to-peak rms	2.5 mV 15 mV 200 mA	2.5 mV 25 mV 50 mA	2.5 mV 25 mV 30 mA
Readback Accuracy at 25°C ± 5°C (percent of reading plus fixed)	Voltage Current	0.05%+ 0.1%+	22.5 mV 300 mA	45 mV 165 mA	90 mV 80 mA
Load and Line Regulation	Voltage Current	0.002%+ 0.005%+	650 µV 40.5 mA	1.1 mV 17 mA	2.2 mV 9 mA
Transient Response Time: Less than 900 µs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply					
Average Programming Resolution	Voltage Current OVP		4.1 mV 118.5 mA 90 mV	8.1 mV 59 mA 170 mV	16 mV 30 mA 330 mV
Output Voltage Programming Response Time (excludes command-processing time)	Full-load programming rise or fall time (10/90% or 90/10%, resistive load)		45 ms	60 ms	100 ms
Output Common-Mode Noise Current (to signal-ground binding post)		rms peak-to-peak	3 mA 20 mA	3.5 mA 20 mA	4 mA 25 mA

dc Floating Voltage: Output terminals can be floated up to ±60 Vdc maximum from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB
Modulation (analog programming of output voltage and current)
- Input Signal: 0 to –5 V for voltage, 0 to +5 V for current
- Input Impedance: 30 k Ohm or greater

ac Input (47 to 63 Hz)**:** 180 to 235 Vac (line-to-line, 3 phase), 36 A rms maximum; 28 A rms nominal, 360 to 440 Vac, 18 A rms maximum (maximum line current includes 5% unbalanced phase voltage condition.) Output voltage derated at 50 Hz and below 200 Vac
Input Power: 9000 VA and 7950 W maximum; 175 W at no load
Regulatory Compliance: Listed to UL-3111.1; certified to CSA 22.2 No. 1010.1; complies with IEC 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC
Size: 220 mm H x 425.5 mm W x 675.6 mm D (8.75 in x 16.75 in x 26.6 in)
Weight: Net, 51.3 kg (113 lb); shipping, 63.6 kg (140 lb)
Warranty Period: One year

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6690**

Ordering Information

669xA-208 185 to 235 Vac, 3 phase, 47 to 63 Hz
669xA-400 360 to 440 Vac, 3 phase, 47 to 63 Hz
669xA-602 Two Bus-Bar Spacers for Paralleling Power Supplies (p/n 5060-3514)
669xA-908 Rackmount Kit (p/n 5062-3977 and p/n 5063-9212)
669xA-909 Rackmount Kit with Handles (p/n 5063-9221 and p/n 5063-9219). Support rails required for 669xA-908 and 669xA-909 Rack
669xA-0B3 Service Manual
669xA-0L2 Extra Standard Documentation Package

Accessories
p/n 5065-6934 Three Replacement Fuses for 180 to 235 Vac line
p/n 5065-6935 Three Replacement Fuses for 360 to 440 Vac line
p/n 5080-2148 Serial Link Cable 2 m (6.6 feet)
E3663AC Support Rails for Agilent Rack Cabinets

Power Supplies

200 W & 1200 W, DC System Power Supplies, GPIB, Single Output

- **These single-output supplies can replace multiple units, saving rack space and reducing system cost and complexity**
- **Autoranging outputs provide maximum power at a variety of operating points**
- **Overvoltage features protect DUTs quickly and automatically**
- **Auto-parallel or auto-series connections enable greater output flexibility**
- **Ten-turn pots for precise local control**

6030A, 6031A, 6032A, and 6035A

6033A and 6038A (Option 001 on right)

Abbreviated Specifications and Characteristics

System Autorangers (GPIB)			6030A	6031A	6032A	6033A	6035A	6038A
Output Ratings	Voltage Current		0 to 200 V 0 to 17 A	0 to 20 V 0 to 120 A	0 to 60 V 0 to 50 A	0 to 20 V 0 to 30 A	0 to 500 V 0 to 5 A	0 to 60 V 0 to 10 A
Maximum Power	Watts		1,200 W	1,072 W	1,200 W	240 W	1,050 W	240 W
Autoranging Output	V1, P1 V2, P2 V3, P3		200 V, 5 A 120 V, 10 A 60 V, 17 A	20 V, 50 A 14 V, 76 A 7 V, 120 A	60 V, 17.5 A 40 V, 30 A 20 V, 50 A	20 V, 10 A 14 V, 17.2 A 6.7 V, 30 A	500 V, 2 A 350 V, 3 A 200 V, 5 A	60 V, 3.3 A 40 V, 6 A 20 V, 10 A
Programming Accuracy (at 25°C ± 5°C)	Voltage Current		0.035% + 145 mV 0.2% + 25 mA	0.035% + 15 mV 0.25% + 250 mA	0.035% + 40 mV 0.2% + 85 mA	0.035% + 9 mV 0.15% + 20 mA	0.25% + 400 mV 0.3% + 63 mA	0.035% + 40 mV 0.09% + 10 mA
Ripple and Noise, (20 Hz to 20 MHz)	Voltage Current	rms p-p rms	22 mV 50 mV 15 mA	8 mV 50 mV 120 mA	5 mV 40 mV 25 mA	3 mV 30 mV 30 mA	50 mV 160 mV 50 mA	3 mV 30 mV 5 mA
Readback Accuracy (at 25°C ± 5°C)	Voltage Current		0.08% + 80 mV 0.36% + 15 mA	0.08% + 7 mV 0.4% + 100 mA	0.08% + 20 mV 0.36% + 35 mA	0.07% + 6 mV 0.3% + 25 mA	0.5% + 200 mV 0.5% + 50 mA	0.07% + 50 mV 0.2% + 11 mA
Load Regulation	Voltage Current	0.01%+ 0.01%+	5 mV 10 mA	3 mV 15 mA	5 mV 10 mA	2 mV 9 mA	40 mV 0.03 + 34 mA	3 mV 5 mA
Line Regulation	Voltage Current	0.01%+ 0.01%+	5 mV 5 mA	2 mV 25 mA	3 mV 10 mA	1 mV 6 mA	13 mV 0.03 + 17 mA	2 mV 2 mA
Transient Response Time 10% step change	Time Level		2 ms 150 mV	2 ms 100 mV	2 ms 100 mV	1 ms 50 mV	5 ms 200 mV	1 ms 75 mV
dc Floating Voltage (either terminal can be grounded or floated from chassis ground)			±550 V	±240 V	±240 V	±240 V	±550 V	±240 V
ac Input Current	100 Vac 120 Vac 220 Vac 240 Vac		24 A 24 A 15 A 14 A	24 A 24 A 15 A 14 A	24 A 24 A 15 A 14 A	6.0 A 6.5 A 3.8 A 3.6 A	24 A 24 A 15 A 14 A	6.0 A 6.5 A 3.8 A 3.6 A
Weight	Net Shipping		16.3 kg (36 lb) 21.7 kg (48 lb)	16.3 kg (36 lb) 21.7 kg (48 lb)	16.3 kg (36 lb) 21.8 kg (48 lb)	9.6 kg (21 lb) 11.4 kg (25 lb)	16.3 kg (36 lb) 21.7 kg (48 lb)	9.6 kg (21 lb) 11.4 kg (25 lb)

Remote Sensing: Up to 2 V drop in each lead. Voltage regulation degrades for greater than 0.5 V drop
Regulatory Compliance: Listed to UL-1244; certified to CSA 556B; complies with EN 61010-1, carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class A
Size:
6030A–32A, 6035A: 132.6 mm H x 425.5 mm W x 503.7 mm D (5.25 in x 16.75 in x 19.83 in)
6033A, 6038A: 177.0 mm H x 212.3 mm W x 516.4 mm D (6.97 in x 8.36 in x 17.87 in)

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6030**

Ordering Information

603xA-001 Front panel has only line switch, line indicator, and OVP adjust (6030A – 33A and 6038A only)
603xA-100 87 to 106 Vac, 48 to 63 Hz (power supply output is derated to 75%) 6030A – 33A, 6035A, 6038A only
603xA-120 104 to 127 Vac, 48 to 63 Hz
603xA-220 191 to 233 Vac, 48 to 63 Hz
603xA-240 209 to 250 Vac, 48 to 63 Hz
603xA-800 Rackmount Kit for Two Half-rack Units Side by Side. p/n 5061-9694 and 5063-9215
603xA-908 Rackmount Kit for a Single Half-rack Unit Models 6033A and 6038A (with blank filler panel); p/n 5062-3960
Models 6030A – 32A and 6035A; p/n 5062-3977
603xA-909 Rackmount Kit with Handles. For 6030A – 32A and 6035A; p/n 5062-3983
603xA-0L2 Extra Standard Documentation Package

A line cord option must be specified, see the AC line cord section.

Accessories
5080-2148 Serial Link Cable, 2 m (6.6 ft) for 6030A, 6031A, 6032A, 6033A, 6035A, and 6038A
1494-0060 Rack Slide Kit

- **Convenient for lab bench use**
- **Built-in GPIB programming and measurement**
- **Continuous and pulse loading operation**
- **CC, CV, and CR operation**
- **Trigger for external synchronization**

6060B and 6063B

Single Input dc Electronic Loads

The 6060B and 6063B dc electronic loads are suitable for applications where only one input is needed. They are particularly convenient for engineering lab bench use. They have built-in measurement features, so a DMM is not necessary to monitor the output voltage, current or power of the power supply under test.

Abbreviated Technical Specifications

Model	6060B	6063B
Amperes	0 to 60 A	0 to 10 A
Volts	3 to 60 V	3 to 240 V
Maximum Power (at 40°C)	300 W	250 W
Constant Current Mode		
Ranges	0 to 6 A, 0 to 60 A	0 to 1 A, 0 to 10 A
Accuracy	0.1% ± 75 mA	0.15% ± 10 mA
Regulation point	10 mA	8 mA
Constant Voltage Mode		
Accuracy	0.1% ± 50 mV	0.12% ± 120 mV
Regulation (w/remote sense)	10 mV	10 mV
Constant Resistance Mode	0.033 to 1.0 Ω	0.20 to 24.0 Ω
Ranges	1 to 1,000 Ω	24 to 10,000 Ω
	10 to 10,000 Ω	240 to 50,000 Ω
Readback Measurement		
Current Accuracy	0.05% ± 65 mA	0.12% ± 10 mA
Voltage Accuracy	0.05% ± 45 mV	0.1% ± 150 mV

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6060**

Ordering Information

6060B Single-input, 300 W dc Electronic Load
6063B Single-input, 250 W dc Electronic Load
- **6063B-020** Front Panel Inputs
- **606xB-908** Rackmount Kit (p/n 5062-3974)
- **606xB-909** Rackmount Kit with Handles (p/n 5062-3975)

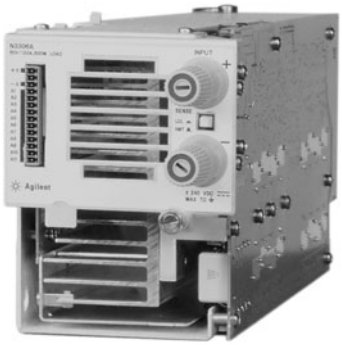
Standard Options (these options apply to all 60xx products)
- **60xx-100** 87 to 106 Vac, 47 to 66 Hz (for Japan only)
- **60xx-120** 104 to 127 Vac, 47 to 66 Hz
- **60xx-220** 191 to 233 Vac, 47 to 66 Hz
- **60xx-240** 209 to 250 Vac, 47 to 66 Hz
- **60xx-0L2** Additional Set of Standard Documentation
- **60xx-0B3** Service Manual

High Performance Electronic Load Family

N3300A to N3307A

- Accurate programmable control in CC, CV, and CR modes
- Download lists of commands for fast execution
- Continuous and pulse loading
- Synchronize loading and measurement of all inputs
- Analog programming for waveform generation
- dc connection terminal for ATE applications
- Simultaneous measurement of voltage, current, and power
- Synchronize loading and measurements of all inputs
- Waveform digitization
- Parallel units for higher power
- Increase test system throughput

N3300A



N3306A

Optimized for High-Volume Manufacturing Test

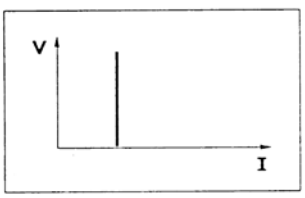
These loads provide many tools to significantly reduce test time of dc power supplies in high-volume manufacturing environments. They execute all commands quicker than any other Agilent Technologies electronic load, and have many additional features to assist in further increasing system throughput. They also have greater accuracy in programming and measurement functions than any other Agilent electronic loads.

Everything You Need in a One-Box Solution

Agilent electronic loads form an integrated solution, which formerly required more instruments and more complex system configuration.

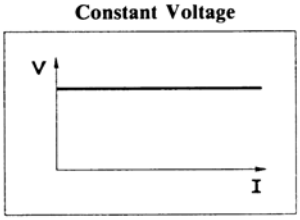
To monitor the outputs of the power supply under test, a DMM would have had to be switched to each power supply output using a multiplexer. Now, the DMM, the multiplexer, the cabling, and current shunts can all be replaced by the accurate measurement system inside each input of the N3300A Series loads. The built-in digitizer within each load module can also replace an oscilloscope, and associated multiplexer and cabling, for many measurement tasks. The result is a simpler, more reliable, and easier to service test system.

Constant Current



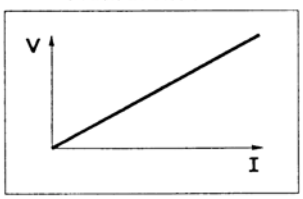
- Power Supply Load Regulation Testing
- Battery Capacity Testing
- Capacitor Discharging

Constant Voltage



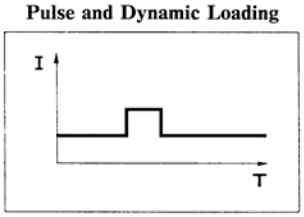
- Current Source Testing
- Current Limit Testing
- Shunt Regulator

Constant Resistance



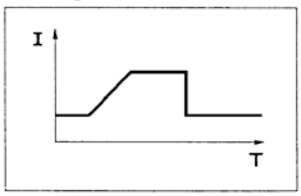
- Characterizing Power Supply Crossover
- Power Supply Start-Up Delay
- Power Resistor Emulation

Pulse and Dynamic Loading



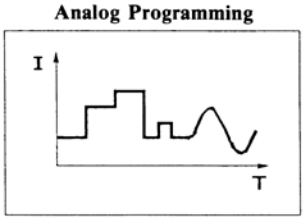
- Power Supply Load Transient Response
- Power Component Testing
- Pulse Electroplating

Programmable Slew Rate



- Power Supply Testing
- Power Component Testing
- Power Supply Load Transient Response
- Program Rising and Falling Rate Separately

Analog Programming



- Battery Capacity Testing
- "Real-life" Load Simulation

DC Electronic Load Applications

Flexible Programmable Features

GPIB, RS-232, and analog programming are all standard features. These electronic loads are compatible with the industry standard SCPI command set. Most features are also controllable from the front panel to quickly set up engineering tests on the lab bench. Measurement data can be monitored on the LED front panel display or read by a computer for further processing.

Download Program Sequences

A new feature called Lists allows you to download sequences of load input settings to the electronic load. They are then resident in memory and will execute at maximum rate during runtime. This feature will provide reductions in test time for repetitively executed routines in manufacturing test. Up to four 50-step lists can be stored in non-volatile memory for each load input.

Powerful Built-in Measurement Features

The input voltage, current, and power of all load inputs can be accurately and simultaneously measured. Up to 4096 samples can be taken and averaged to provide a high level of accuracy and noise immunity. The 4096 long measurement buffer can be used as a digitizer with programmable sample rate. The measurement can be read by a computer as either one averaged number or a 4096 long array. This capability is available for both current and voltage measurements. It is also possible to store multiple measurements in the buffers to be read back to the computer at the completion of a test.

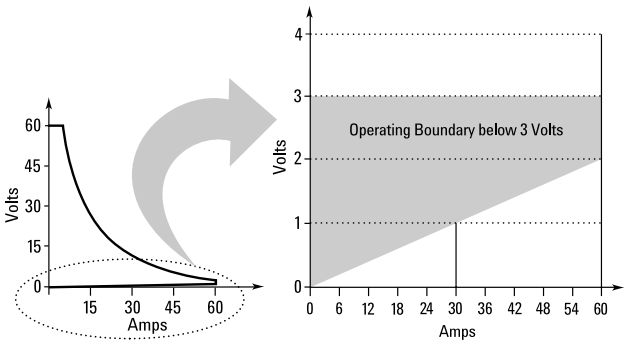
Mainframe Configuration

The N3300A is a full rack width mainframe. It has six slots. The N3301A is a half rack width mainframe and it has two slots. The 150-, 250- and 300-watt load modules each require one slot. The 500- and 600-watt load modules each require two slots.

Operation Below Three Volts

Agilent electronic loads meet all specifications when operated above 3 V; however, the dc operating characteristics also extend below this minimum input voltage for static tests. The figure below shows the operating range of a typical dc electronic load. Low voltage operation is possible at correspondingly reduced current levels, depending on the minimum resistance of the load. Agilent electronic loads can, therefore, be used in many applications that previously required zero-volt loads. However, transient performance may be degraded.

Another alternative for low voltage operation is to place a three-volt dc power supply in series with the device under test. Then the electronic load would always have at least three volts across it. The N3300A Series of electronic loads has a built-in protection circuit that will protect your power supply under test from being reversed biased by the external boost supply. The external boost power supply must be rated to provide up to the full rated current of the power supply under test.



Example of N3304A Input Characteristics

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN
Data Sheet p/n 5980-0232E
Increasing dc Power Supply Test System Throughput with Agilent Technologies N3300A dc Electronic Loads p/n 5980-0233E
Fuel Cell AC Impedance Measurements p/n 5988-5398EN

For more information, visit our web site: **www.agilent.com/find/N3300**

Supplemental Characteristics

Analog Programming Bandwidth
10 kHz (–3 db frequency)
Analog Programming Voltage
• Voltage: 0 – 10 V, Current: 0 – 10 V
Analog Monitor Ports
• Voltage: 0 – 10 V, Current: 0 – 10 V
Remote Sensing: 5 V dc between sense and load input
Net Weight
N3300A: 13.2 kg (29 lb); N3301A: 7.3 kg (16 lb)
N3302A, N3303A or N3304A: 2.7 kg (6 lb);
N3305A or N3306A: 4.6 kg (10 lb), N3307A: 2.7 kg (6 lb)
Shipping Weight
N3300A: 15.9 kg (35 lb); N3301A: 9.8 kg (22 lb)
N3302A, N3303A, or N3304A: 4.1 kg (9 lb), N3305A or N3306A: 8 kg (15 lb), N3307A: 4.1 kg (9 lb)

Ordering Information

N3300A 1800 W dc Electronic load Mainframe
N3300A-908 Rackmount Kit (two p/n 5062-3974 for N3300A or p/n 5062-3960 for one N3301A). For the N3301A, the Kit includes a Blank Filler Panel
N3300A-909 Rackmount Kit with Handles for N3300A (two p/n 5062-3975)
N3300A-0B0 Full Documentation on CD ROM; no Printed Documentation
N3300A-0L1 Full Documentation on CD ROM with Printed Operating Manual and Programming Guide
N3300A-0L2 Extra Standard Documentation Package
N3300A-UJ1 8 mm Screw Terminal Connector (available on all load modules N3302A – N3307A)
N3301A 600 W Half Rack Width dc Electronic Load Mainframe
N3301A-800 Rackmount Kit for two Units side-by-side, p/n 5061-9694 and 5062-3978
N3302A 150 W dc Electronic Load Module
N3303A 250 W dc Electronic Load Module
N3304A 300 W dc Electronic Load Module
N3305A 500 W dc Electronic Load Module
N3306A 600 W dc Electronic Load Module
N3307A 250 W dc Electronic Load Module

Specifications

Model	N3302A	N3303A	N3304A	N3305A	N3306A	N3307A
Amperes	0 to 30 A	0 to 10 A	0 to 60 A	0 to 60 A	0 to 120 A	0 to 30 A
Volts	0 to 60 V	0 to 240 V	0 to 60 V	0 to 150 V	0 to 60 V	0 to 150 V
Max. Power @40°C[1]	150 W	250 W	300 W	500 W	600 W	250 W
Current at Low Voltage						
2.0 V	30 A	10 A	60 A	60 A	120 A	30 A
1.5 V	22.5 A	7.5 A	45 A	45 A	90 A	22.5 A
1.0 V	15 A	5 A	30 A	30 A	60 A	15 A
0.5 V	7.5 A	2.5 A	15 A	15 A	30 A	7.5 A
0 V	0 A	0 A	0 A	0 A	0 A	0 A
Constant Current Mode[2]						
Low Range/High Range	3 A/30 A	1 A/10 A	6 A/60 A	6 A/60 A	12 A/120 A	3 A/30 A
Low Range Accuracy 0.1%+	5 mA	4 mA	7.5 mA	7.5 mA	15 mA	7.5 mA
High Range Accuracy 0.1%+	10 mA	7.5 mA	15 mA	15 mA	37.5 mA	15 mA
Regulation	10 mA	8 mA	10 mA	10 mA	10 mA	10 mA
Constant Voltage Mode[2]						
Low Range/High Range	6 V/60 V	24 V/240 V	6 V/60 V	15 V/150 V	6 V/60 V	15 V/150 V
Low Range Accuracy 0.1%+	3 mV	10 mV	3 mV	10 mV	3 mV	10 mV
High Range Accuracy 0.1%+	8 mV	40 mV	8 mV	20 mV	8 mV	20 mV
Regulation	5 mV	10 mV	10 mV	10 mV	20 mV	10 mV
Constant Resistance Mode[2, 3]						
Range 1	0.067 to 4 Ω	0.2 to 48 Ω	0.033 to 2 Ω	0.033 to 5 Ω	0.017 to 1 Ω	0.067 to 10 Ω
Range 2	3.6 to 40 Ω	44 to 480 Ω	1.8 to 20 Ω	4.5 to 50 Ω	0.9 to 10 Ω	9 to 100 Ω
Range 3	36 to 400 Ω	440 to 4800 Ω	18 to 200 Ω	45 to 500 Ω	9 to 100 Ω	90 to 1000 Ω
Range 4	360 to 2000 Ω	4400 to 12000 Ω	180 to 2000 Ω	450 to 2500 Ω	90 to 1000 Ω	900 to 2500 Ω
Transient Generator						
Frequency Range	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz
Pulse Width	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%
Current Measurement[4, 5]						
Low Range 0.05%+	3 mA	2.5 mA	5 mA	5 mA	10 mA	3 mA
High Range 0.05%+	6 mA	5 mA	10 mA	10 mA	20 mA	6 mA
Voltage Measurement[5]						
Low Range 0.05%+	3 mV	10 mV	3 mV	8 mV	3 mV	8 mV
High Range 0.05%+	8 mV	20 mV	8 mV	16 mV	8 mV	16 mV
Power Measurement[5]						
Accuracy 0.1%+	0.4 W	1.2 W	0.6 W	1.6 W	1.3 W	0.9 W

Supplemental Characteristics

Programming Resolution						
Constant Current Mode	0.05 mA/0.5 mA	0.02 mA/0.2 mA	0.1 mA /1 mA	0.1 mA/1 mA	0.2 mA/2 mA	0.05 mA/0 5 mA
Constant Voltage Mode	0.1 mV/1 mV	0.4 mV/4 mV	0.1 mV/1 mV	0.25 mV/2.5 mV	0.1 mV/1 mV	0.25 mV/2.5 mV
Constant Resistance Mode	0.07/0.7/7/70 mΩ	0.82/8.2/82 mΩ	0.035/0.35/ 3.5/35 mΩ	0.085/0.85/8.5/ 85 mΩ	0.0175/0.175/ 1.75/17.5 mΩ	0.17/1.7/17/170 mΩ
Readback Resolution						
Current	0.05 mA/0.5 mA	0.02 mA/0.2 mA	0.1 mA/1 mA	0.1 mA/1 mA	0.2 mA/2 mA	0.05 mA/0 5 mA
Voltage	0.1 mV/1 mV	0.4 mV/4 mV	0.1 mV/1 mV	0.25 mV/2.5 mV	0.1 mV/1 mV	0.25 mV/2.5 mV
Programmable Slew Rate[6]						
Current	0.5 A/ms to 2.5 A/µs	0.17 A/ms to 0.83 A/µs	1 A/ms to 5 A/µs	1 A/ms to 5 A/µs	2 A/ms to 10 A/µs	0.5 A/ms to 2.5 A/µs
Voltage	1 V/ms to 0.5 V/µs	4 V/ms to 2 V/µs	1 V/ms to 0.5 V/µs	2.5 V/ms to 1.25 V/µs	1 V/ms to 0.5 V/µs	2.5 V/ms to 1.25 V/µs
Ripple and Noise (20 Hz to 10 MHz)						
Current	2 mA rms 20 mA p-p	1 mA rms 10 mA p-p	4 mA rms 40 mA p-p	4 mA rms 40 mA p-p	6 mA rms 60 mA p-p	2 mA rms 20 mA p-p
Voltage	5 mV rms	12 mV rms	6 m V rms	10 mV rms	8 mV rms	10 mV rms

Note: Specifications subject to change.

* Special modifications are available to change input voltage, current, and accuracy specifications. Please ask us about what is possible.
Operating temperature range is 0°C to 55°C. All specifications apply for 25°C ± 5°C unless otherwise noted.

[1] Maximum continuous power available is derated linearly from 100% of maximum at 40°C, to 75% of maximum at 55°C.

[2] Accuracy specification is ±(% of programmed value + fixed offset) in those cases where a percentage + fixed term are given. Otherwise, the specification is given as a negative and positive percentage error term. This specification may degrade when the unit is subject to an RF field of 3 V/meter, the unit is subject to line spikes of 500 V, or an 8 kV electrostatic discharge.

[3] For resistance ranges 3 through 4, accuracy specifications apply with input voltages ≥6 V.

[4] DC current accuracy specifications apply 30 seconds after input current is applied.

[5] Accuracy specification is ±(% of reading + fixed offset). Measurement is 1000 samples. This specification may degrade when the unit is subject to an RF field of 3 V/meter, the unit is subject to line spikes of 500 V, or an 8 kV electrostatic discharge.

[6] Slew rate bands are not programmable. When you program a slew rate value outside the indicated bands, the electronic load will automatically adjust the slew rate to fit within the band that is closest to the programmed value. The slew rate accuracy specification is only applicable to slew rates within the indicated bands.

- **Versatile ac power test solutions**
- **Generate stable or distorted ac and dc power**
- **50/60 Hz power up to 300 V_{rms}**
- **400 Hz avionics power up to 300 V_{rms}**
- **Arbitrary waveform generation**
- **Built-in precision power analyzer**
- **Easy to integrate into ATE systems**
- **VXI *plug&play* drivers available**
- **SCPI (standard commands for programming instruments)**
- **Drop-in replacement – Elgar PIP9012 code built in**
- **Electronic calibration**
- **Full protection features (OV, OI, OP, OT)**
- **CE mark**
- **FREE graphical user interface**
- **Dual power analyzer option**

6811B, 6812B, 6813B

6800 AC Power Solutions
AC Power Sources/Analyzers

6811B 300 V_{rms}, 375 VA Single phase model
6812B 300 V_{rms}, 750 VA Single phase model
6813B 300 V_{rms}, 1750 VA Single phase model

Agilent Technologies ac power source/analyzers are designed for applications which require precise control, accurate measurement, and analysis of single-phase ac power. The feature set and performance levels of this product family provide the flexibility necessary to power and test a wide variety of devices. These products are ideal for applications such as power supply testing, AC Mains CE Mark Testing UPS testing, avionics, air traffic control equipment, testing power-factor-corrected equipment and telecom equipment.

The 6800 series utilizes a low noise switching topology, which delivers high performance and reduced size. These products can output dc, ac complex, and user-defined waveforms for exceptional application flexibility over the bus.

Key Features

- High peak current capability
- Programmable voltage, frequency, phase, output impedance, distortion, and current limit
- Voltage and frequency slew control
- Power line disturbance simulation
- Avionics power disturbance simulation
- Measurement of V_{rms}, Irms, Ipeak, frequency, phase, VA, watts, PF, and THD
- Two current measurement ranges. Low range increases sensitivity 10:1
- Harmonic analysis of V and I
- Built-in GPIB and RS-232 interfaces
- Built-in output isolation relays
- MIL-STD 704 and RTCA DO160 testing capability
- Built-in 26 V_{rms} AUX output option
- Remote shutdown via TTL signal
- Autoranging dc output
- Application specific options

Powerful Direct Digital Synthesis (DDS) Waveform Generation

The 6800 series offers the ultimate in waveform generation versatility. For testing products under ac line distortion conditions, clipped sine waves can be generated with 0% to 43% distortion. There are a number of methods for creating waveforms; some include inputting harmonic content, phase angles, and data points. These waveforms can be used to generate steady state outputs or can be combined for more complex transient generation schemes.

Flexible Transient Generation

When testing requires precise synchronization between waveform generation and measurement of the device under test, the 6800 series transient generation capability provides a powerful tool. The output voltage amplitude, frequency, phase, waveform shape, voltage slew rate, and frequency slew rate can be controlled in response to an input trigger generated from an internal or external event. The Step and Pulse modes offer an easy and convenient method of executing single-step and continuous-output changes. The List transient mode further extends this capability for more complex waveform generation needs. Up to 100 sets of output settings can be precisely executed in response to a trigger or paced by programmed dwell times without computer intervention.

Extensive Measurement and Analysis

The 6800 series has measurement functionality equivalent to commercially available high-accuracy power analyzers. This eliminates the need for this standalone instrument for most applications, and lowers systems cost, increases available rack space, and simplifies cabling. All measurements are made with 16-bit resolution, suitable for even the most demanding applications.

The 6800 series has built-in voltage and current waveform digitization combined with harmonic analysis capability. Amplitude, phase, and total harmonic distortion results up to the 50th harmonic are provided for output frequencies equal to or less than 250 Hz. This measurement feature, accessible via the front panel, graphical user interface software, or over the bus, provides a sophisticated solution for testing during product development.

The dual power analyzer option (020) adds an additional built-in power analyzer to the standard ac power source/analyzer with inputs accessible from the rear of the instrument. The standard instrument's built-in power analyzer monitors its own output voltage and current, while the dual power analyzer option (also built-in) enables the user to simultaneously analyze the power of any external power source, like the output of a UPS.

Multiple Interfaces

The 6800 series ac power solutions offer multiple programming interfaces for convenience. The front panel offers access to most commonly used commands, SCPI can be sent via GPIB or RS-232. The graphical user interface (GUI) that is shipped with every ac power solution provides easy access to the capabilities of the instrument. Key tests such as inrush characterization are set-up in templates to facilitate testing. In addition to saving waveforms in non-volatile memory, they can be saved in the GUI and quickly downloaded to the source.

Key Literature & Web Link

2006 Agilent System and Bench Instruments Catalog, p/n 5989-4702EN

For more information, visit our web site: **www.agilent.com/find/6800**

Specification[1] (at 0 to 40°C unless otherwise noted)

		6811B	6812B	6813B
Number of Phases		1	1	1
Output Ratings	Power	375 VA	750 VA	1750 VA
	Maximum rms voltage	300 V	300 V	300 V
	Maximum rms current	3.25 A	6.5 A	13 A
	Maximum repetitive peak current	40 A	40 A	80 A
	Crest factor	12	6	6
	Output frequency range	dc; 45 Hz to 1 kHz	dc; 45 Hz to 1 kHz	dc; 45 Hz to 1 kHz
	dc power (watts)	285 W	575 W	1350 W
	dc voltage	±425 V	±425 V	±425 V
	dc current	2.5 A	5 A	10 A

Measurement Accuracy ((25 ± 5°C) from 45 – 100 Hz in High range where applicable)

		6811B	6812B	6813B
Output Ratings	Rms voltage	0.03% + 100 mV	0.03% + 100 mV	0.03% + 100 mV
	Rms current	0.05% + 10 mA	0.05% + 10 mA	0.05% + 10 mA
	Power (VA)	0.1% + 1.5 VA +12 mVA/V	0.1% + 1.5 VA +12 mVA/V	0.1% + 1.5 VA +12 mVA/V
	Power (Watts)	0.1% + 0.3 W +1.2 mW/V	0.1% + 0.3 W +1.2 mW/V	0.1% + 0.3 W +1.2 mW/V

[1] For a sinewave with a resistive load.

Remote Sensing: Up to 1 V_{rms} can be dropped across each load lead
Command Processing Time: The average time for the output rms voltage to start to change after receiving a GPIB command is 10 milliseconds
Calibration Interval: One year
GPIB Capabilities: SH1, AH1, T6, L4, SR1, RL1 PPO, DC1, DT1, E1, and CO, and a command set compatible with IEEE-488.2 and SCPI
Regulatory Compliance: Safety: UL3111-1, CSA C22.2 No 1010.1, IEC 61010-1; EMC: Complies with EMC directive 89/336/EEC

Ordering Information

6813B-019 2000 VA ac Power Source/Analyzer
681xB-020 Dual Power Analyzer Option
681xB-026 26 volt, 0.1 A Auxiliary Reference Output (6812B, 6813B only)
681xB-1CM Rackmount Kit, p/n 5062-3977 (support rails required)
681xB-1CP Rackmount Kit with Handles, p/n 5062-3983 (support rails required)
Support Rails p/n E3663AC required when rackmounting the 6811B, 6812B, and 6813B Opt 1CM and Opt 1CP
681xB-100 (6811B and 6812B only) 87 to 106 Vac (100 Vac nominal), 47 to 63 Hz, Japan only
681xB-120 (6811B and 6812B only) 104 to 127 Vac (120 Vac nominal), 47 to 63 Hz
681xB-200 (6813B only) 174 to 220 Vac (200 Vac nominal), 47 to 63 Hz, Japan only
681xB-208 (6811B and 6812B only) 174 to 220 Vac (208 Vac nominal), 47 to 63 Hz
681xB-230 191 to 254 Vac (230 Vac nominal), 47 to 63 Hz

A line cord option must be specified. For details, see the AC line section.

Choosing AC Line Voltage and Cord Options for your Power Product

Power distribution systems, regulations, and connection techniques vary greatly among geographic regions as a result of local AC electrical standards. Most Agilent products, including power products which draw less than 500 watts of power from the AC line, can be readily adjusted to accept different line voltages or frequencies.

Line voltage and frequency for certain Power Products may not be field changeable. Choosing the correct voltage option for these products requires care. This is especially true for higher power products.

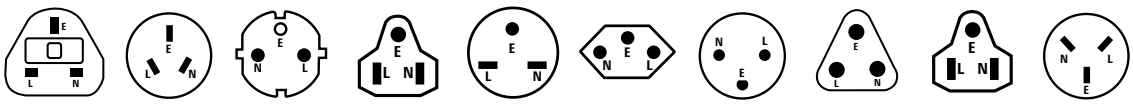
4 Easy Steps for Choosing Line Cord Options

1. Go to the tables. Find the model number and the correct line cord option of the product you are ordering.
2. If your model number requires a 900 series line cord, the correct one will automatically be shipped for the destination country on the purchase order.
3. If your model number requires an 800 series line cord, determine if there is a line cord with plug that matches your outlet receptacle. If not, choose the appropriate unterminated line cord.
4. Add the option number for the appropriate line cord to your purchase order.

Low Power Products

For lower power products, a universal receptacle on the rear panel accepts a wide range of line cords to meet local regulatory requirements. The tables containing the 900 series line cords show a range of standard line cords that Agilent offers, with option numbers and part numbers. Part numbers are needed to order a line cord separately.

For products which use the 900 series line cords, the appropriate type is automatically selected at time of shipment, based on the country to which the product is being shipped. If you plan to use your power products in a different country or region than the country to which the product is being shipped, you will need to specify the appropriate line voltage and line cord options on your order, so that we can provide the appropriate configuration. Contact your local Agilent Field Engineer for assistance.

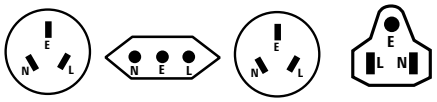


United Kingdom | Australia New Zealand | Europe Korea | United States Canada | United States Canada | Switzerland | Denmark | South Africa India | Japan | Israel

Cord Options	900	901	902	903	904	906	912	917	918	919
6033A, 38A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6060B, 63B	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6541A – 45A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6551A – 55A	8120-1351	8120-5412	8120-5413	8120-5337	8120-5421	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
6611C – 14C	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6621A – 6629A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6631B – 34B	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6641A – 45A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6651A – 55A	8120-1351	8120-5412	8120-5413	8120-5337	8120-5421	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
6811B	8120-1351	8120-5412	8120-1689	8120-5337	8120-5421	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
66309B/D	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66311B	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66319B/D	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66321B/D	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66332A	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
E3610 – 17A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3620A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3630A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3631 – 34A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3640 – 49A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E4350B, 51B	8120-1351	8120-5412	8120-5413	8120-5337	8120-5421	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
N5741A – 52A	8120-1351	—	8120-1689	8120-4383	—	—	—	—	8120-4753	—
N6700B, N6701A – 02A N6710B, N6711A, 12A	8120-1351	8120-1369	8120-1689	8120-4383[1]	8120-0698	8120-1351	8120-1369	8120-1689	8120-4383[1]	8120-0698
N3300A, 31A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800

L = Line or Active Conductor (also called "live" or "hot")
N = Neutral or identified Conductor
E = Earth or Safety Ground
[1] For models N6702A and N6712A: Using 100 – 120 Vac limits total output power to 600 W. 200 – 240 Vac line is required to permit full 1200 W operation.

AC Line Cord Options (cont.)

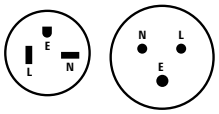


Argentina Chile China Brazil Thailand

Cord Options	920	921	922	927
6033A, 38A	8120-6869	8120-6980	8120-8376	8120-8871
6060B, 63B	8120-6869	8120-6980	8120-8376	8120-8871
6541A – 45A	8120-6869	8120-6980	8120-8376	8120-8871
6551A – 55A	8120-6869	8120-6980	8120-8376	8120-8871
6611C – 14C	8120-6869	8120-6980	8120-8376	8120-8871
6621A – 6629A	8120-6869	8120-6980	8120-8376	8120-8871
6631B – 34B	8120-6869	8120-6980	8120-8376	8120-8871
6641A – 45A	8120-6869	8120-6980	8120-8376	8120-8871
6651A – 55A	8120-6869	8120-6980	8120-8376	8120-8871
6811B	8120-6869	8120-6980	8120-8376	8120-8871
66309B/D	8120-6869	8120-6980	8120-8376	8120-8871
66311B	8120-6869	8120-6980	8120-8376	8120-8871
66319B/D	8120-6869	8120-6980	8120-8376	8120-8871
66321B/D	8120-6869	8120-6980	8120-8376	8120-8871
66332A	8120-6869	8120-6980	8120-8376	8120-8871
E3610 – 17A	8120-6869	8120-6980	8120-8376	8120-8871
E3620A	8120-6869	8120-6980	8120-8376	8120-8871
E3630A	8120-6869	8120-6980	8120-8376	8120-8871
E3631 – 34A	8120-6869	8120-6980	8120-8376	8120-8871
E3640 – 49A	8120-6869	8120-6980	8120-8376	8120-8871
E4350B, 51B	8120-6869	8120-6980	8120-8376	8120-8871
N5741A – 52A	—	—	8120-8376	—
N6700B, N6701A – 02A N6710B, N6711A, 12A	8120-6869	8120-6980	8120-8376	8120-8871
N3300A, 31A	8120-6869	8120-6980	8120-8376	8120-8871

L = Line or Active Conductor (also called "live" or "hot")
N = Neutral or identified Conductor
E = Earth or Safety Ground

Cord Options	No Plug #12AWG 831	No Plug 4 mm² 832	No Plug 1.5 mm² 833	No Plug #10AWG 834
6030A, 31A, 32A, 35A	8120-5573	—	8120-5568	8120-5566
6571A – 75A	8120-5488	8120-5490	—	8120-5545
6671A – 75A	8120-5488	8120-5490	—	8120-5545
6812B	8120-5573	—	8120-5568	8120-5566
6813B	8120-5573	8120-6502	—	8120-5566
66000A	8120-5573	—	8120-5568	8120-5566
E4356A	8120-5488	8120-5490	—	8120-5545



Cord Options	No Plug (AWG) N/S America, (AWG wire) 861	No Plug (Metric) Asia, Europe, Harmonized (metric wire) 862	NEMA 6-20P #12AWG N/S America Japan 841	IEC 309 32-A 4mm² Europe Korea 842
6030A, 31A, 32A, 35A	—	—	8120-5572	—
6571A – 75A	—	—	—	8120-5489
6671A – 75A	—	—	—	8120-5489
6680A – 84A	8121-6203	8120-6204	—	—
6690A – 92A	8121-0694	8121-0695	—	—
6812B	—	—	8120-5572	—
6813B	—	—	—	8120-6506
66000A	—	—	8120-5572	—
E4356A	—	—	—	8120-5489
N5761A – 72A	8121-1330	8121-1331	—	—

High Power Products

There are several factors which limit the amount of power which can be readily drawn from a normal branch circuit. For example, in the U.S., the typical 115/120 Vac branch circuit has a circuit breaker rated for 15 A. For industrial applications, 20 A service is commonly available.

Linear power supplies with outputs over 500 watts and switching supplies rated over 750 watts will generally exceed the capability of a 15 A branch circuit. Connecting power products above these power levels will require installing either a higher voltage or higher current service. Some practical examples are:

- standard line voltage for 2 KW products such as the 667xA is 230 Vac; they can not be powered off a 120 Vac line
- the 1 KW 603xA products cannot be powered off a standard 15 A/120 Vac circuit; they can operate off a 30 A/120 Vac service, or they can be configured for 208/240 Vac operation

Agilent offers a range of 800 series line cords for many higher power products to mate with the wall receptacles commonly specified for these higher power services. Refer to the tables to determine if there is a 800 series line cord for your product with a plug that meets the local requirements. If not, you must order an unterminated line cord.

Often, higher power products (over 1 kW) are hardwired, i.e. connected directly to a breaker panel or distribution box. The line cord may also be hard wired to the back of the power supply where a universal receptacle is impractical. Typically, a local electrician should be consulted to determine the best alternative to connect a high power product to the AC line.

NEMA L6-30P #10AWG N/S America Japan	IEC 309 16-A 1.5 mm² Denmark Switzerland Austria, China	NEMA L5-30P #10AWG N. America	CEE 7/7 16-A 1.5 mm² Europe Korea	BS 546 15-A 1.5 mm² India South Africa

Cord Options	844	845	846	847	848
6030A, 31A, 32A, 35A	—	8120-5570	8120-5565	8120-5567	8120-5569
6571A – 75A	8120-5546	—	—	—	—
6671A – 75A	8120-5546	—	—	—	—
6812B	—	8120-5570	8120-5565	8120-5567	8120-5569
6813B	8120-6507	—	—	—	—
66000A	—	8120-5570	8120-5565	8120-5567	8120-5569
E4356A	8120-5546	—	—	—	—

The countries or regions indicated here are for general guidance only. Local electrical codes governing wire size, wire type (AWG or metric) and plug type should be consulted to determine which of these available line cords/plugs is correct in your country to make proper connection to your AC mains. Please consult a qualified, licensed electrician for more information.

Products with 3-Phase Inputs

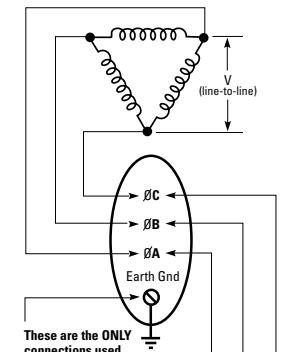
Some of the higher power products exceed the capability of a single phase line. Agilent offers several power products which require 3-phase inputs, including the 5 kW 668xA and 6.6 kW 669xA DC source family. For 3-phase power distribution up to the building, there are two different distribution systems in wide use: delta, predominantly used in the US; and wye predominantly used in Europe. However, for service inside the building, the 5 wire wye is the predominant configuration. Products which are delta loads, are compatible with either delta or wye. Agilent 3-phase products are delta loads.

In selecting the correct operating voltage for 3-phase products you need to distinguish between the line-to-line and the line-to-neutral voltages. The line-to-line voltage is the square root of 3 x the line-toneutral voltage. It is the line-to-line voltage that is used to specify the input voltage to be applied to Agilent power products.

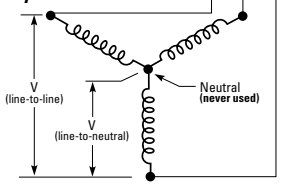
Key Literature & Web Link

For more detailed specifications see the product manual at
www.agilent.com/find/power

Delta



Wye

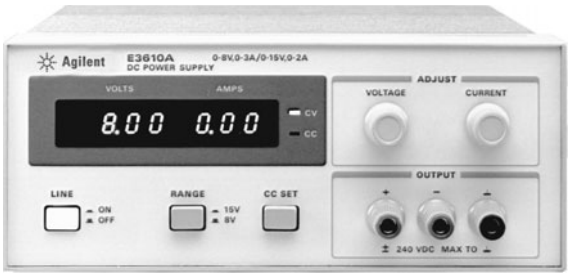


In a wye system

$$V_{(\text{line-to-neutral})} = \frac{V_{(\text{line-to-line})}}{\sqrt{3}}$$

4

- **Reliable and convenient power for benchtop use**
- **Save space on the bench with small, compact form factor**
- **Enhance measurement results via low-noise output with excellent regulation**
- **Apply CV/CC capabilities to enable use as voltage or current source**
- **Utilize dual-range outputs to provide greater current at lower voltages (E3610A/11A/12A)**
- **Use remote sensing to compensate for voltage drops in load leads (E3614A/15A/16A/17A)**
- **Ensure DUT safety with over-voltage protection (E3614A/15A/16A/17A)**



E3610A – E3617A

E3610A, E3611A, E3612A

These popular low-cost CV/CC bench supplies are designed for general laboratory use. The constant-voltage, constant-current output allows operation as either a voltage source or current source. The changeover occurs automatically, based on the load. This feature also provides an adjustable current limit, allowing you to set the safest current limit level for a particular DUT. Also, a CC-set button lets you set the current limit without having to short the output.

Each model has two ranges, allowing more current at a lower voltage. For a higher-output voltage, supplies can be connected in series. Either the positive or negative terminal can be connected to ground, providing a positive or negative voltage output. Either terminal can also be floated up to 240 V from ground.

Dual digital meters monitor current and voltage simultaneously. Adjustments are made with the 10-turn voltage control and the 10-turn current control. Each power supply is 88 mm H x 212 mm W x 318 mm D (3.5 in x 8.4 in x 12.5 in) and weights 3.8 kg (8.4 lb).

E3614A, E3615A, E3616A, E3617A

These flexible single range CV/CC power supplies can be used as either voltage sources or current sources. The CC-set button allows you to quickly set the current limit when operating in the CV mode, without shorting the output. 10-turn controls allow accurate adjustment of voltage and current output settings. The output voltage and current can also be controlled with external 0 to 10 volt analog signals or variable resistance.

Output connections can be made on either the front or rear panel. Remote sensing is available to eliminate the errors in voltage regulation due to voltage drops in the load leads. Either the positive or negative output terminal may be connected to ground to provide positive or negative output voltage. Either terminal can also be floated to a maximum of 240 volts. Multiple units can be combined in auto-parallel, auto-series and auto-tracking configurations to obtain more voltage or current output.

The load is protected with the over-voltage protection feature, which is easily monitored and adjusted from the front panel. The digital voltage and current meters provide continuous and accurate readings of the output levels. The E3614A – E3617A are 88 mm H x 212 mm W x 373 mm D (3.5 in x 8.5 in x 14.7 in).

Key Literature & Web Link

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
2002/03 Agilent General Purpose Test Instruments Catalog, p/n 5988-7165ENUS

For more information, visit our web site:
www.agilent.com/find/power
www.agilent.com/find/E3600

Ordering Information

E361xA-0EM 115 Vac ± 10%, 47 to 63 Hz
E361xA-0E3 230 Vac ± 10% 47 to 63 Hz
E361xA-0E9 100 Vac ± 10% 47 to 63 Hz
E361xA-0L2 Additional Standard Documentation Package

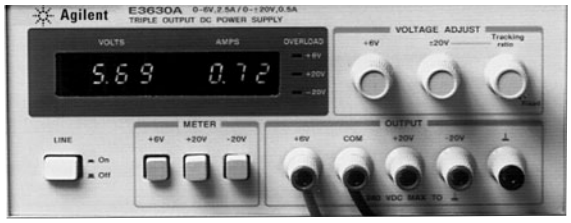
Specifications (at 0°C to 55°C unless otherwise specified)

Single-Output Models		E3610A	E3611A	E3612A	E3614A	E3615A	E3616A	E3617A
Number of Output Ranges		2	2	2	1	1	1	1
Output Ratings[1]	Range 1	0 to 8 V, 0 to 3 A[1]	0 to 20 V, 0 to 1.5 A[1]	0 to 60 V, 0 to 0.5 A[1]	0 to 8 V, 0 to 6 A	0 to 20 V, 0 to 3 A	0 to 35 V, 0 to 1.7 A	0 to 60 V, 0 to 1 A
	Range 2	0 to 15 V, 0 to 2 A[1]	0 to 35 V, 0 to 0.85 A[1]	0 to 120 V, 0 to 0.25 A[1]	—	—	—	—
	Power (max.)	30 W	30 W	30 W	48 W	60 W	60 W	60 W
Load and Line Regulation		0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV
Ripple and Noise (from 20 Hz to 20 MHz)	rms	200 µV	200 µV	200 µV	200 µV	200 µV	200 µV	200 µV
	peak-to-peak	2 mV	2 mV	2 mV	1 mV	1 mV	1 mV	1 mV

[1] Maximum current is derated 1% per °C between 40°C to 55°C.

Supplemental Characteristics Non-warranted characteristics determined by design and useful in applying the product

Control Mode		CV/CC	CV/CC	CV/CC	CV/CC	CV/CC	CV/CC	CV/CC
Resolution	Voltage	10 mV	100 mV	100 mV	10 mV	10 mV (0 – 20 V) 100 mV (>20 V)	10 mV (0 – 20 V) 100 mV (>20 V)	10 mV (0 – 20 V) 100 mV (>20 V)
(minimum change using front-panel controls)	Current	10 mA	10 mA	1 mA	10 mA	10 mA	1 mA	1 mA



E3620A, E3630A

E3630: 35 W, DC Bench Power Supply, Triple Output

Three Versatile Outputs for Benchtop Applications

- Conserve rack space with triple outputs in a compact enclosure
- Monitor output with overload indicator and front panel meters
- Use auto-tracking control of both 20 V outputs when testing circuits that require balanced voltages

E3620: 50 W, DC Bench Power Supply, Dual Output

Two Clean, Reliable Outputs for General Purpose Applications

- Save space on the bench with a small, dual-output supply
- Enhance measurement results via low-noise output with excellent regulation
- Monitor output with overload indicator and front panel meters
- Achieve precise adjustments via ten-turn pots

These multiple-output power supplies have 0.01% load and line regulation which keeps the outputs steady with changes of the power line and load. These supplies specify both normal-mode voltage noise and common-mode current noise. The low normal-mode noise specification of 350 µV rms assures clean power for precision circuitry, and the low common-mode current specification of 1 µA rms minimizes line frequency current injection.

Both power supplies have separate digital panel meters to monitor both the voltage and current of any output simultaneously. An LED indicator for each output lets the user know when any supply is overloaded. All the outputs on these models are protected against overload and short-circuit damage. Protection circuits prevent output voltage overshoot when supply is turned on and off. The +6 V output of E3630A employs current foldback; all others are current limited.

E3630A

This general-purpose power supply provides three outputs, one 0 to 6 V output to power logic or other circuitry and one 0 to +20 V and 0 to –20 V to power linear circuits. The 0 to +20 V and 0 to –20 V outputs track to within 1%. The 0 to –20 V output can be set to any value less than the 0 to +20 V output. One voltage control may be used to vary both simultaneously.

The E3630A is 88 mm H x 213 mm W x 213 mm D (3.6 in x 8.4 in x 12.6 in) and weights 3.8 kg (8.4 lbs).

E3620A

This general-purpose power supply provides two separate, independent and isolated power supplies in one small package. Each output has a ten-turn potentiometer for fine adjustment. Convenient meter selection allows the user to read voltage and current of either output. Each output can deliver up to 25 watts.

The E3620A is 88 mm H x 213 mm W x 400 mm D (3.6 in x 8.4 in x 15.8 in) and weights 5.5 kg (12.1 lb).

Specifications (at 0°C to 55°C unless otherwise specified)

		E3620A	E3630A
Number of Outputs		2	3
Number of Output Ranges		1	1
Output Ratings	Output 1 Output 2 Output 3 Maximum Total Power	0 to 25 V, 0 to 1 A 0 to 25 V, 0 to 1 A 50 W	0 to 6 V, 0 to 2.5 A* 0 to +20 V, 0 to 0.5 A 0 to –20 V, 0 to 0.5 A 35 W
Load and Line Regulation		0.01% + 2 mV	0.01% + 2 mV
Ripple and Noise	rms peak-to-peak	350 µV 1.5 mV	350 µV 1.5 mV
Control Mode		CV/CL	CV/CL (±20 V) CV/CF (+6 V)
Resolution (minimum change using front-panel controls)	Voltage Current	10 mV (0 – 20 V), 100 mV (>20 V) 1 mA	10 mV 10 mA

* Maximum current is derated 3.3% per °C from 40°C to 55°C.

Key Literature & Web Link

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
2002/03 Agilent General Purpose Test Instruments Catalog, p/n 5988-7165ENUS

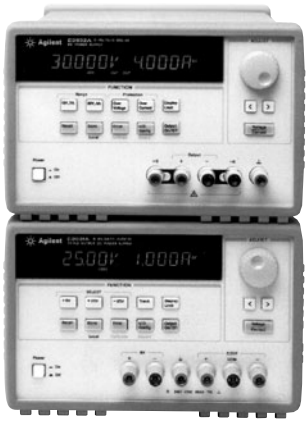
For more information, visit our web site:
www.agilent.com/find/power
www.agilent.com/find/E3600

Ordering Information

E36x0A-0EM 115 Vac ± 10%, 47 to 63 Hz Input
E36x0A-0E3 230 Vac ± 10%, 47 to 63 Hz Input
E36x0A-0E9 100 Vac ± 10%, 47 to 63 Hz Input
(For use in Japan)
E36x0A-0L2 Extra Standard Documentation Package
E36x0A-1CM Rackmount Kit

E3631A
E3632A
E3633A
E3634A

- **Cover more voltage and current combinations with dual-range outputs**
- **Perform remote programming using GPIB or RS-232 interface with SCPI command set (drivers available)**
- **Enhance measurement results via low ripple and noise with excellent regulation**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and advanced programmable features**
- **Ensure DUT safety with protection features**



Above: E3632A, Below: E3631A

E3633A/34A

E3631A – E3634A

The E3631A is a triple-output programmable dc power supply designed to meet the most exacting engineering requirements with traditional quality and reliability designed in.

The E3632A (120 W) and E3633A, E3634A (200 W) are single output, dual range programmable dc power supplies designed to deliver reliable and high quality operation at a very attractive price.

Low Noise/Excellent Regulation

0.01% load and line regulation keep the output steady. The linear supply specifies both normal-mode voltage noise and common-mode current noise. The low normal-mode specification assures clean power for precision circuitry and the low common-mode current provides isolation from power line current injection.

Front Panel Operation

Both voltage and current can be monitored simultaneously for output from the front panel on an easy-to-read vacuum fluorescent display. A knob allows you to set the output at the resolution you need for the most exacting adjustments. Store and recall key enables you to save and recall up to three frequently-used states. The output on/off button enables/disables the output.

Isolated

All the outputs are isolated from the chassis ground and from the remote interface. In the E3631A, 6 V supply is isolated from the ±25 V supply to minimize any interference between circuits-under-test.

For more information, visit our web site:
www.agilent.com/find/power
www.agilent.com/find/E3600

Abbreviated Specifications and Characteristics (at 0°C to 55°C unless otherwise specified)

		E3631A			E3632A Low Range/ High Range	E3633A Low Range/ High Range	E3634A Low Range/ High Range
dc Outputs	Voltage Current	0 to +25 V/ 0 to 1 A	0 to –25 V/ 0 to 1 A	0 to 6 V/ 0 to 5 A	0 to 15 V, 7 A/ 0 to 30 V, 4 A	0 to 8 V, 20 A/ 0 to 20 V, 10 A	0 to 25 V, 7 A/ 0 to 50 V, 4 A
Load and Line Regulation	Voltage Current	<0.01% + 2 mV <0.01% + 250 µA	<0.01% + 2 mV <0.01% + 250 µA	<0.01% + 2 mV <0.01% + 250 µA	<0.01% + 2 mV <0.01% + 250 µA	<0.01% + 2 mV <0.01% + 250 µA	<0.01% + 2 mV <0.01% + 250 µA
Ripple and Noise (20 Hz to 20 MHz)	Normal-mode Voltage Normal-mode current Common-mode current	<350 µV rms/ 2 mV p-p <500 µA rms <1.5 µA rms	<350 µV rms/ 2 mV p-p <500 µA rms <1.5 µA rms	<350 µV rms/ 2 mV p-p <2 mA rms <1.5 µA rms	<350 µV rms/ 2 mV p-p <2 mA rms <1.5 µA rms	<350 µV rms/ 3 mV p-p <2 mA rms <1.5 µA rms	<500 µV rms/ 3 mV p-p <2 mA rms <1.5 µA rms
Programming Accuracy (25°C ± 5°C)	Voltage Current	0.05% + 20 mV 0.15% + 4 mA	0.05% + 20 mV 0.15% + 4 mA	0.1% + 5 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% + 10 mA
Readback Accuracy (25°C ± 5°C)	Voltage Current	0.05% + 10 mV 0.15% + 4 mA	0.05% + 10 mV 0.15% + 4 mA	0.1% + 5 mV 0.2% + 10 mA	0.05% + 5 mV 0.15% + 5 mA	0.05% + 5 mV 0.15% + 5 mA	0.05% + 5 mV 0.15% + 5 mA
Resolution	Program/ readback Meter	1.5 mV, 0.1 mA/ 1.5 mV, 0.1 mA 10 mV/1 mA	1.5 mV, 0.1 mA/ 1.5 mV, 0.1 mA 10 mV/1 mA	0.5 mV, 0.5 mA/ 0.5 mV, 0.5 mA 1 mV/1 mA	1 mV, 0.5 mA/ 0.5 mV/0.1 mA 1 mV/1 mA	1 mV, 1 mA/ 0.5 mV, 1 mA 1 mV, 1 mA (<10 A), 10 mA (≥10 A)	3 mV, 0.5 mA/ 1.5 mV, 0.5 mA 1 mV/1 mA (<10 A), 10 mA (≥10 A)

Transient Response Time: 50 µsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa

Product Regulation: Certified to CSA 22.2 No. 231 (E3631A), No. 1010.1 (E3632A/33A/34A); conforms to IEC 1010.1; carries CE mark; complies with CISPR-11, Group 1, ClassA
Size: E3631A, 32A, 33A, 34A 132 mm H x 213 mm W x 348 mm D (5.2 in x 8.4 in x 13.7 in)
Weight: E3631A 8.2 kg (18 lb); **E3632A, E3633A, E3634A** 9.5 kg (21 lb)

Ordering Information

E363xA-0EM 115 Vac ± 10%, 47 to 63 Hz
E363xA-0E3 230 Vac ± 10% 47 to 63 Hz
E363xA-0E9 100 Vac ± 10% 47 to 63 Hz
E363xA-1CM Rackmount Kit
E363xA-0L2 Extra Documentation Package

- **Address benchtop and ATE applications with small size and optional front-panel binding posts**
- **Utilize GPIB and RS-232 interfaces with SCPI command set (drivers available)**
- **Enhance signal integrity in test systems via low-noise outputs**
- **Simplify cabling with built-in measurements**
- **Streamline tasks with front panel control and basic programmable features**
- **Ensure DUT safety with overvoltage protection**

E3640A – E3649A

E3640A – 49A Single and Dual Output

Agilent's E364xA-series programmable DC power supplies are 30 W/50 W/80 W single output and 60 W/100 W dual output power supplies with standard GPIB & RS-232 interface. For general-purpose use, these programmable power supplies offer the performance of system power supplies at a surprisingly affordable price.

Clean and Stable Output

All models deliver clean and reliable power, and dependable regulation. With 0.01% load and line regulation, the E364xA power supplies keep output steady when power line and load changes occur. These linear supplies specify both normal mode voltage noise and common mode current noise to assure less interference with your DUT.

Standard Remote Interface

Standard GPIB and RS-232 interfaces, SCPI programming and *plug&play* drivers for Agilent VEE and NI LabView make it easy to program and integrate into automated test system. You can monitor the output terminals for voltage and current and a query command lets you read the programmed voltage and current.

Versatile Power

E364xA power supplies give you the flexibility to select from dual output ranges. Both front and rear output terminals are standard and output load is protected by over-voltage protection. Remote sense is available to eliminate the errors in voltage regulation due to voltage drops in the load leads. New front panel binding posts offer flexibility to use safety test leads, banana plugs or stripped wires. Store and recall key enables you to save and recall up to 5 frequently used operating states. For dual output models, the two outputs are electrically isolated to each other.

Abbreviated Specifications and Characteristics (at 0°C to 55°C unless otherwise specified)

Model Number	E3640A	E3641A	E3642A	E3643A	E3644A	E3645A
Maximum Power	30 W	30 W	50 W	50 W	80 W	80 W
# of Output	1	1	1	1	1	1
Output Ratings	0 to 8 V/3 A or 0 to 20 V/1.5 A	0 to 35 V/0.8 A or 0 to 60 V/0.5 A	0 to 8 V/5 A or 0 to 20 V/2.5 A	0 to 35 V/1.4 A or 0 to 60 V/0.8 A	0 to 8 V/8 A or 0 to 20 V/4 A	0 to 35 V/2.2 A or 0 to 60 V/1.3 A

Model Number	E3646A	E3647A	E3648A	E3649A
Maximum Total Power	60 W	60 W	100 W	100 W
# of Output	2	2	2	2
Output Ratings	0 to 8 V/3 A or 0 to 20 V/1.5 A	0 to 35 V/0.8 A or 0 to 60 V/0.5 A	0 to 8 V/5 A or 0 to 20 V/2.5 A	0 to 35 V/1.4 A or 0 to 60 V/0.8 A

Common to All Models		
Load and Line Regulation ±(% of output +offset)	Voltage Current	<0.01% + 3 mV <0.01% + 250 µA
Ripple and Noise (20 Hz to 20 MHz)	Normal Mode Voltage Normal Mode Current Common Mode Current	<5 mVpp/0.5 mV_{rms} for 8 V/20 V models; <8 mVpp/1 mV_{rms} for 35 V/60 V models <4 mArms <1.5 µArms
Accuracy 12 Months (@ 25°C ± 5°C), ±(% output +offset)	Programming Voltage Current Readback Voltage Current	 <0.05% + 10 mV (<0.1% + 25 mV for output 2 of E3646/47/48/49A) <0.2% + 10 mA <0.05% + 5 mV (<0.1% + 25 mV for output 2 of E3646/47/48/49A) <0.15% + 5 mA (<0.15% + 10 mA for output 2 of E3646/47/48/49A)
Resolution	Program Readback Meter	<5 mV/1 mA <2 mV/1 mA 10 mV/1 mA

Transient Response: Less than 50 usec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa

30 – 80 W DC System Power Supplies, GPIB, Single Output (cont.)

E3640A
E3641A
E3642A
E3643A
E3644A
E3645A
E3646A
E3647A
E3648A
E3649A

Product Regulation
Designed to comply with UL3111-1; certified to CSA 22.2 No. 1010.1; conforms to IEC 1010-1; complies with EMC directive 89/336/EEC (Group1, Class A)
Size:
104 mm H x 254 mm W x 374 mm D (4.1 in x 10 in x 14.8 in),
(For E3640A – E3645A)
146 mm H x 228 mm W x 374 mm D (5.2 in x 8.9 in x 14.7 in),
(For E3646A – E3649A)

Key Literature & Web Link

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
Agilent GP Instruments Catalog, p/n 5988-7165ENN

For more information, visit our web site:
www.agilent.com/find/power
www.agilent.com/find/E3600

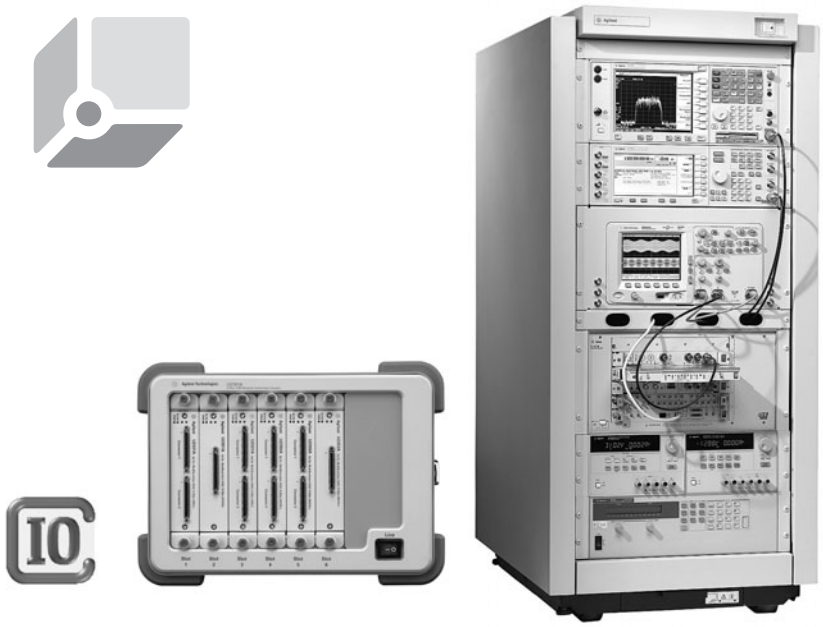
Ordering Information

E364xA-0EM 115 Vac ± 10% at 47 Hz to 63 Hz
E364xA-0E9 100 Vac ± 10% at 47 Hz to 63 Hz
E364xA-0E3 230 Vac ± 10% at 47 Hz to 63 Hz
E364xA-1CM Rackmount Kit
For E3640A – E3645A, Agilent p/n 5063-9240
For E3646A – E3649A, Agilent p/n 5063-9243
E364xA-0L2 Extra Standard Documentation Package

5

TEST SYSTEM & SOFTWARE, AUTOMOTIVE, DATA ACQUISITION

Agilent Open



Agilent Open: Testing your Way

Your test system architecture should give you choices. Its range of possibilities should fit your requirements, your preferences and your existing test assets – hardware, software and I/O.

That's the power of Agilent Open, a combination of proven standards and time-saving tools for test automation. By giving you greater flexibility, Agilent Open accelerates the creation of cost-effective measurement solutions – and enables testing, your way.

Whether you are putting together a complex test system with LAN or setting up a bench top test using USB, new, smaller, faster Agilent instruments have native LAN, GPIB and USB interconnect offering you the flexibility to test your way in any test application environment.

Create Versatile Measurement Solutions with System-ready Instrumentation

Agilent Open instruments are designed for faster throughput and easier integration – in test software and system racks. Choose classic benchtop instruments for R&D then use their modular, system-optimized equivalents in manufacturing – and run the same software with few or no changes. To reduce software development time, many instruments let you install measurement personalities that address specific applications or protocols – Mobile WiMAX, jitter, phase noise and more.

Achieve Efficient Development and Deployment with Open Software Tools

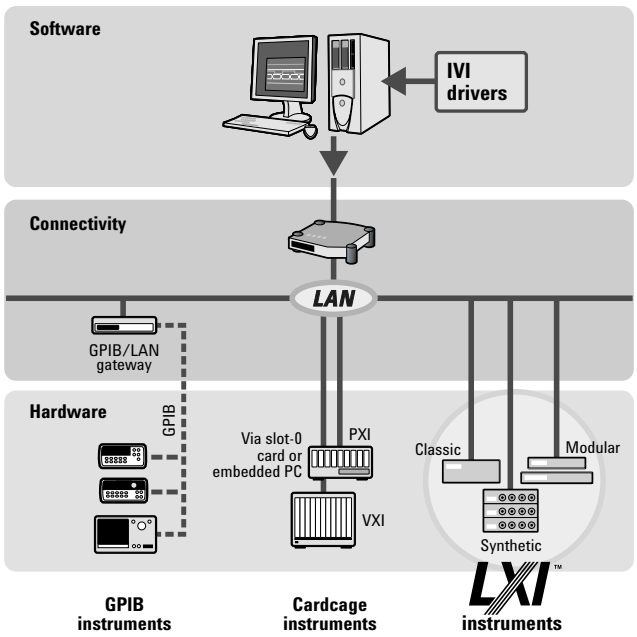
Configure a typical system in less than 15 minutes with the Agilent IO Libraries Suite, which supports literally thousands of instruments from hundreds of vendors. Get your systems up and running sooner with industry-standard IVI drivers that put instrument functionality at your fingertips – and work in the application development environment you prefer.

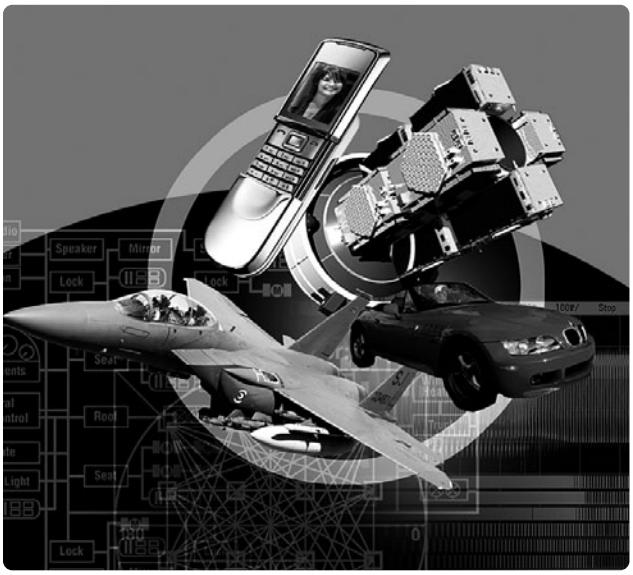
Simplify System Communication and Connectivity

Choose the best connection for your requirements through instruments equipped with LAN, GPIB and USB ports. You can connect those instruments quickly and easily with the Agilent IO Libraries Suite software, which supports the major test-system interfaces – LAN, GPIB, USB, VXI and RS-232. With support for LXI, you can control instruments and monitor measurements remotely via the Web servers built into Agilent Open instruments.

Develop Hybrid Systems that Combine New and Existing Assets

Protect your existing assets by easily integrating GPIB instruments into LAN- and USB-based systems with Agilent interface gateways and converters. You can even add VXI and PXI equipment to LAN-based systems via LAN slot-0 cards. Utilize the multiple I/O ports of Agilent Open instruments to connect via GPIB now and LAN or USB in the future. Using VISA, making the transition from GPIB to LAN or USB requires nothing more than simple address changes in your system software.





With Agilent Open and LXI, LAN becomes the backbone of test systems that easily incorporate present and future test assets.

Create New Possibilities with LXI

When the challenges of testing threaten to overload your budget or your team, lighten the load with LXI, the test-system architecture that's based on proven, widely used standards such as Ethernet. By specifying the interaction of those standards, LXI enables fast, efficient and cost-effective creation – and reconfiguration – of test systems.

Agilent's line of LXI-compliant products includes classic benchtop instruments, faceless modular instruments and functional building-block modules. Even when space is at a premium, you can achieve high levels of functionality, accuracy and performance.

Apply the Advantages of Proven Standards

With LXI, you can bring the speed, flexibility and simplicity of Ethernet to your test systems. To simplify set up, integration, software testing and troubleshooting, you can control and monitor system hardware through the Web-browser interface built into all LXI-compliant Agilent instruments.

Reduce the Overall Cost of your Systems

LXI isn't an "all-or-nothing" proposal. You can manage the cost of transition by creating hybrid systems that include GPIB, VXI, PXI and LXI devices. To control start-up costs, you can use individual LXI instruments and cut the overhead of adding "just one more" unit: LXI eliminates expensive cardcages, slot-0 controllers and proprietary interfaces. It also helps you reuse software across R&D, design validation and manufacturing: system-ready instruments such as Agilent 6000L Series oscilloscopes are 100 percent software compatible with their benchtop equivalent, the 6000A Series portable scopes.

Gain Leverage through Greater Versatility

Test-system experts are becoming scarce in many organizations and they can't be everywhere at once – onsite, offshore or anywhere in between. Extend the reach of your expertise via corporate or public connections: with LXI you can place test systems practically anywhere on your LAN – or virtually everywhere with WLAN – to enable centralized trouble-shooting, remote monitoring and more.

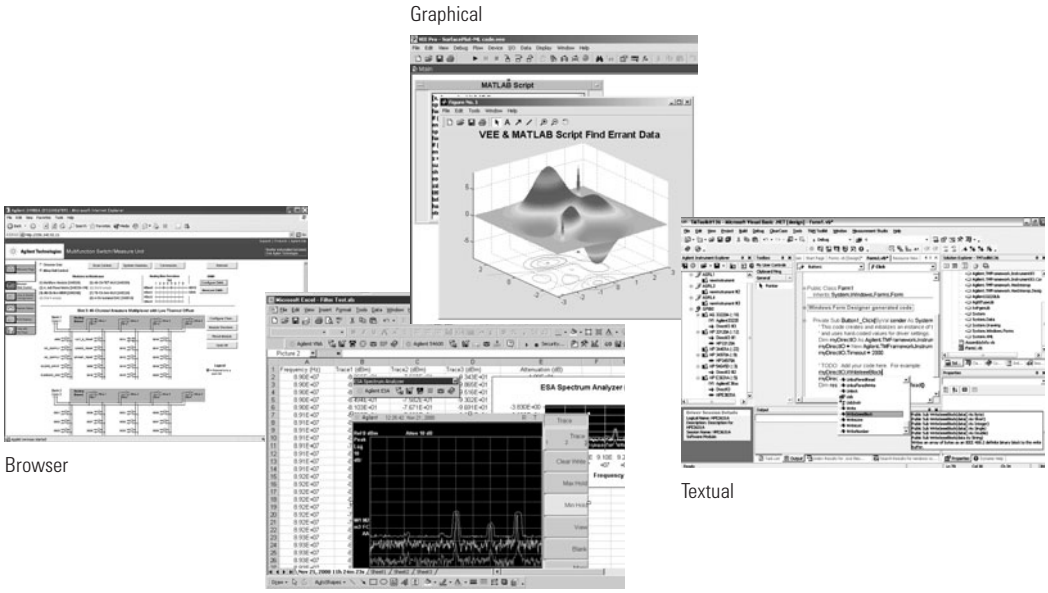
The LXI Consortium

The consortium is a not-for-profit corporation initially established by Agilent and VXI Technology, Inc. Its primary purpose is to promote the development and adoption of the LXI Standard as an open, accessible standard that identifies specifications and solutions relating to the functional test, measurement and data acquisition industries. The Consortium is open to all test and measurement companies – more than 50 are now members – as well as industry professionals, system integrators and government representatives. For more information about the consortium, please visit its Web site at **www.lxistandard.org**

Key Literature & Web Link

Discover The Difference with Agilent Open Testing, your Way, 5989-2042EN

For more information on LXI and Agilent Open products, please go to our brochure online at: **http://cp.literature.agilent.com/litweb/pdf/5989-2042EN.pdf**. You can also visit **www.agilent.com/find/open** for more information on how to build your own test system.



Whether you choose a graphical language and/or any textual language in Microsoft Visual Studio (such as C, C++, C#, Visual Basic), Agilent has a solution for you. With our unique Agilent IO Libraries Suite you can easily obtain industry-standard I/O libraries and broad, multi-vendor driver support for ease of use and compatibility with a wide range of hardware and software. You can predict test effectiveness across your product life cycle with Fault Detective. All from one company, choose the software and the development environment you want to use to minimize your learning curve and maximize your productivity.

For additional information on these and other software products please visit **www.agilent.com/find/software**

Engineering Productivity from R&D to Manufacturing

Open Software and Standard I/O maximize reuse across your lifecycle:

Product	Description
Agilent VEE Pro	Open graphical programming environment optimal for iterative tests, measurement analysis and results presentation.
T&M Toolkit with Test Automation	Set of test and measurement tools and components including sequencing capability integrated into Visual Studio® to create a powerful engineering development environment.
Fault Detective	Predict test effectiveness during development; diagnose manufacturing faults and measure test system and repair loop effectiveness.
IO Libraries Suite	Make error-free instrument setup and connections to your PC in less than 15 minutes. Available at no charge with Agilent instruments.

Agilent IO Libraries Suite

- **Automatically detects instruments connected to your PC and configures the interfaces**
- **Compatible with GPIB, USB, Ethernet/LAN, RS-232, and VXI test instruments from a variety of vendors**
- **I/O software that enables instrument communication for a variety of development environments including VEE Pro, LabVIEW, Visual Studio and more**

Connecting is as Easy as 1-2-3

Step 1: Install Agilent IO Libraries Suite software on your PC
Step 2: Hook up the USB, LAN, RS-232 or GPIB cables between your instruments and your PC
Step 3: Detect instruments and devices, and configure interfaces using Connection Expert

Establish an Error-free Connection Between your Test Instruments and your PC in Less Than 15 minutes

Agilent IO Library, a software that provides instrument-to-PC connection, is available intrinsically with every Agilent instrument, converter/interface and software. It provides the framework for instrument communication and is used in conjunction with any software development environment that you choose (VEE Pro, LabVIEW, IntuiLink, Visual Studio, etc). During installation on your PC, it dynamically installs software for optimal compatibility with your hardware and previously installed I/O software. The Suite's Connection Expert then automatically configures interfaces, discovers attached instruments, and displays the status of all interfaces and connected instruments – from all vendors, Agilent and non-Agilent. It then points you to hundreds of samples to get you started.

Specifications

Please see **www.agilent.com/find/iosuite** for current system requirements and specifications

Key Literature & Web Link

5989-1439EN Data Sheet

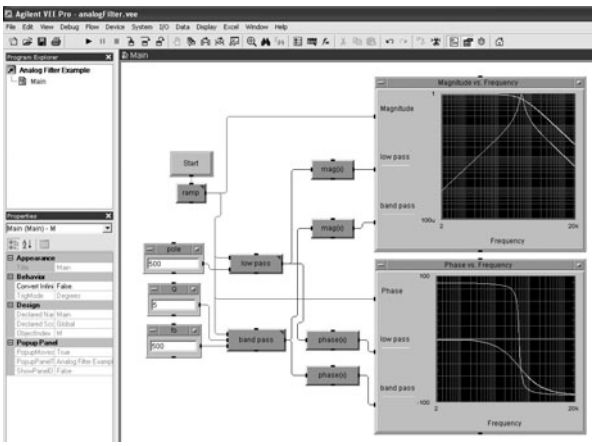
www.agilent.com/find/iosuite

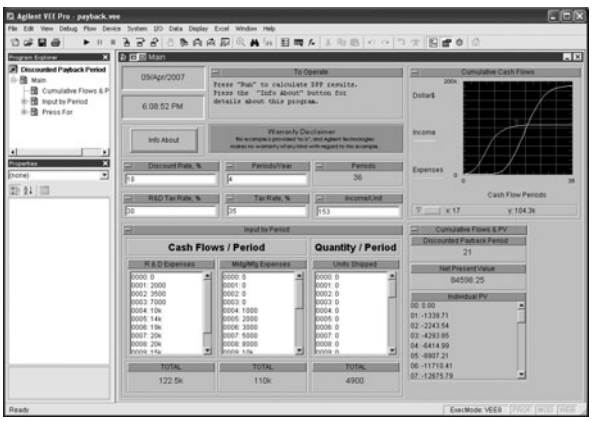
Ordering Information

The Agilent IO Libraries Suite is delivered to you on the *"Automation-Ready CD"*. The CD is included with Agilent instruments, I/O hardware (such as USB/GPIB converters, GPIB cards, LAN/GPIB converters), and VEE Pro and T&M Toolkit. If you already own any of the above Agilent products, and would like to upgrade to the most recent version of the IO Libraries Suite, download the free upgrade software at **www.agilent.com/find/iosuite**

VEE Pro 8.0
VEE Express 8.0

- **Quick connection to Agilent and non-Agilent instruments**
- **Easy to learn for developing powerful programs in less time**
- **Watch Window for easy debugging**
- **Code Completion and Code Insight for fast coding**
- **Programmatic object properties to build better GUIs faster and easier**
- **Minimap for easy navigation of the workspace**
- **Multiple transaction enhancements for all "transaction-based" objects**





Agilent VEE is an intuitive graphical language environment that lets you build programs easily with high-level task-oriented blocks so you can have a quick and easy path to measurement and analysis. Hence, you can focus on your measurement tasks: connect, measure, analyze and report – rather than programming. Agilent VEE Express is a subset of Agilent VEE Pro, designed for automated data acquisition and analysis with Agilent USB-based instruments, including the U2300A and U2700A Series devices. Kindly visit **www.agilent.com/find/vee** for more Agilent VEE products.

Fast-connects to Agilent Instruments – In Just 3 Steps

Agilent VEE fast-connects to Agilent (and non-Agilent instruments, for Agilent VEE Pro) in a minimum of 3 clicks with your mouse button. This, thanks to the software's Instrument Manager that auto-detects your connected instruments so you can get started on your tasks sooner. Not only that, Agilent VEE Pro works seamlessly with hardware and software from virtually any company – including Microsoft®, so you can feel confident that your program is flexible, expandable and compatible with industry standards.

Easy to Learn with High-level Task-oriented Blocks

Agilent VEE is easy to learn, as you only need to create objects or blocks from pull-down menus and link them up with wires to mimic the program's flow. Programming tasks that would require hundreds of lines of code in traditional textual languages are simplified to a few high-level blocks. This rapidly reduces development time, so you can focus more on your measurement and analysis, rather than programming. Agilent VEE also comes with built-in tutorials and more than 150 sample programs to jump-start your program development.

Powerful – Builds Better Programs in a Short Time

Agilent VEE is integrated with Excel Library for easy, menu-driven control of spreadsheets in saving and retrieving data, as well as automating reports. It has built-in Microsoft .NET Framework for easy menu access to a multitude of functions and controls to enhance your program – including adding email capability to programs and accessing databases. You can also use Agilent VEE to interact with ActiveX to control Microsoft Word for report, Microsoft Outlook for e-mails and Microsoft Access for database operations. Use Agilent VEE Pro to perform advanced graphing and analysis with 500 of the most popular MATLAB® functions.

Over the past 15 years, Agilent VEE has helped thousands of scientists and engineers make better measurement faster. Agilent VEE Pro was named an EDN Magazine Hot 100 Product two years in a row (in 2004 for Agilent VEE Pro 7.0 and in 2005 for Agilent VEE Pro 7.5).

Key Literature & Web Link

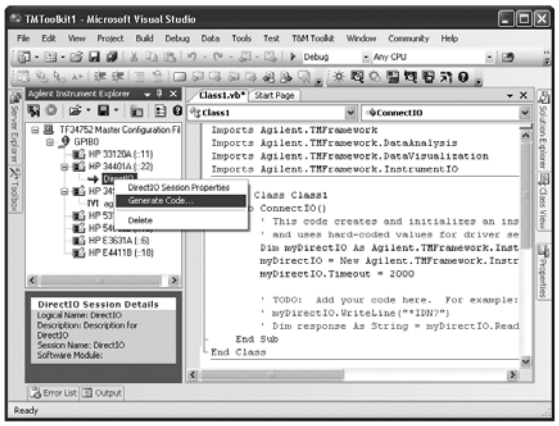
Data Sheet, p/n 5989-6164EN
Quick Start Guide, p/n W1141-90025

www.agilent.com/find/vee
Test-drive Agilent VEE for 30 days:
www.agilent.com/find/vee_download
Watch and learn how to use Agilent VEE:
www.agilent.com/find/veedemos

Ordering Information

Agilent VEE Pro 8.0 (W1141A-PRO) includes the full feature of Agilent VEE Pro 8.0, media and Quick Start Guide
Agilent VEE Express 8.0 (W1141A-EXP) includes the basic feature of Agilent VEE Pro 8.0, media and Quick Start Guide
Agilent VEE Pro 8.0 Education version (W1141A-ED1) for education customers only; includes 50 licenses of Agilent VEE Pro 8.0, media and Quick Start Guide
Agilent VEE Pro 7.5 upgrade to Agilent VEE Pro 8.0 (W1141A-UP7.5) includes media and Quick Start Guide
Agilent VEE Pro 7.x upgrade to Agilent VEE Pro 8.0 (W1141A-UP7) includes media and Quick Start Guide
Agilent VEE Pro 6.x upgrade to Agilent VEE Pro 8.0 (W1141A-UP6) includes media and Quick Start Guide
Agilent VEE Express 8.0 upgrade to Agilent VEE Pro 8.0 (W1141A-UP8EXP) includes media and Quick Start Guide

For additional ordering information, including upgrade options, technical policy, part numbers and pricing assistance, please visit
www.agilent.com/find/vee



As an extension of Microsoft VisualStudio the T&M Toolkit simplifies programmatic access to your instruments and speeds your development.

Test & Measurement Toolkit

Agilent Test and Measurement Toolkit is a set of test and measurement tools and software components (wizards, APIs, class libraries, graphs and help) integrated into Microsoft Visual Studio. You can use the built-in T&M data types, I/O driver wizards, data analysis, and test sequencing to make Microsoft programming languages (VB.NET, C++, C#) more test and measurement friendly.

Features

Get Started Quickly

- T&M Toolkit's Project Wizard helps you get started quickly, allowing you to select your programming language, choose either an executable (.exe) or library (.dll) project, and easily import and reference all necessary T&M libraries.

Control Instruments and Collect Data

- The Instrument Explorer helps you quickly configure your test system by finding instruments on your PC or network and helps you easily manage instruments and drivers.
- Choose either DirectIO, VXI *plug&play*, IVI-COM or an IVI-C instrument driver and then drag and drop the instrument icon into your work window to automatically generate code to connect with the instrument.
- Interactive IO gives you the ability to easily send and receive responses from instruments.

Analyze your Data Using Engineering Math and Graphs

- Get access to math and analysis routines through APIs that provide fundamental math routines such as digital signal processing functions, Bessel functions, statistical function, regression functions, as well as a complex number of waveform and spectrum classes and an engineering formatter.

Debug Instrument Control Applications

- The IO Monitor helps you debug and track interaction between instrument drivers and your software by capturing and displaying instrument communication details from several I/O layers. Or you can save the file for later analysis.

Easily Test your Prototype Using T&M Toolkit's Test Automation

T&M Toolkit with Test Automation capability helps you get more directly to the insight you need from your tests. It also gives you instant data analysis using automatically generated control charts and histograms. The test automation capability will enable you to:

- Manage your results and get quick answers from automatically generated tabular test data and statistical graphs
- Easily control and automate measurements for design validation
- Easily create tests using built-in branch logic, limit checking and debugging
- Build a library of reusable test sequences

Try T&M Toolkit, Completely Risk Free

We believe that the T&M Toolkit will simplify your instrument connection and control tasks. But there is no reason to take our word for it. Download your FREE copy of the T&M Toolkit at **www.agilent.com/find/toolkit**. And if you purchase after the evaluation period, you have our exclusive money-back guarantee. If you are not fully satisfied for any reason, you can return it within 90 days for a full refund, no questions asked.

Minimum System Requirements

T&M Toolkit requires Visual Studio. For a complete list of minimum system requirements please visit **www.agilent.com/find/toolkit**

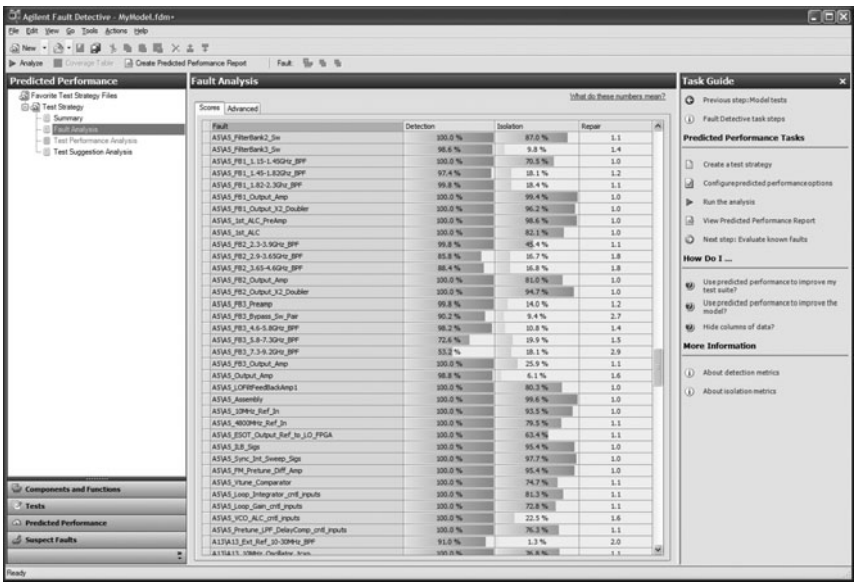
Ordering Information

Agilent W1130B T&M Toolkit with Test Automation includes Toolkit and Test Automation Development Software
Agilent W1130B-TA Additional Test Automation Development and Debug License
Agilent W1130B-UN Faculty Version with a Quantity of 50 Licenses. For Accredited Universities Only

Fault Detective Software

- **Better transfer of information from R&D to manufacturing**
- **Reduced cost of scrap and repair**
- **Metrics to predict test effectiveness during development**
- **Measures test system and repair loop effectiveness**
- **More efficient tests**

Agilent's award winning Fault Detective software works in conjunction with your existing hardware and software tools. Your test engineers capture information about the test strategy in a Fault Detective model. Fault Detective analyzes the model to provide metrics for performance. Changes to a test suite can be made based on objective measures, early in the lifecycle, in a way that hasn't been available before. The same model used for the analysis can then be deployed to production to automate repair and rework.



As a Design Tool

Fault Detective predicts fault coverage on a component by component basis. Test escapes and test redundancies can be identified and eliminated. Fault Detective can also predict the number of repair attempts and how accurately your test strategy will point directly to the cause of failure. Improvements can be made to the test strategy early in the lifecycle and can reduce test development effort and reduce new product introduction risk.

As a Launch Tool

Transferring product and test strategy information from design to manufacturing is another product launch challenge. Using the Fault Detective model, transfer just enough knowledge for troubleshooting without revealing too much of the product's design. In production Fault Detective uses the same model and pass/fail test results to quickly and accurately pinpoint the most likely cause of failure. The result is consistent troubleshooting at any bench anywhere in the world. The reduction in debug time, scrap and the increase in throughput can translate into millions of dollars in savings.

Greg Jordan, Cisco Systems, Director of Manufacturing Technology, lists three positive results of working with the Agilent Fault Detective technology:

1. Consistent, instant, automated diagnostics,
2. New model for moving products from R&D to manufacturing, and
3. Automated, predictable results.

Paul Worrell, Agilent Technologies Wireless Business Order Fulfillment Engineering Manager, relies on Fault Detective for key and complex product lines:

"Fault Detective is an integral part of our test strategy. Today, Fault Detective provides important elements to reduce our cost of manufacturing and helps ensure consistent high quality products to our customers".

1. It has improved our yield before our most expensive processes such as calibration tests and final functional tests,
2. In addition to use in manufacturing, we're working with our service organization to facilitate the use of Fault Detective in our service centers.

Description	Key Attributes
Fault Detective	• Accurate and automated functional debug and trouble shooting • Protects R&D intellectual property • Test effectiveness metrics • Repair loop effectiveness metrics • Identifies test gaps and redundancies

Specifications

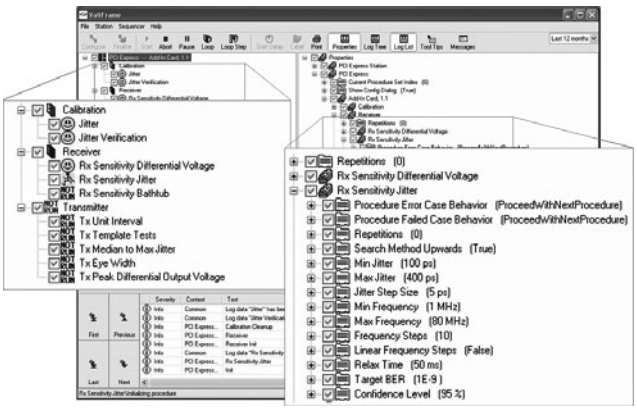
Please see **www.agilent.com/find/tos** for more information

Key Literature & Web Link

Test Optimization Software Products Brochure, p/n 5989-1586EN

www.agilent.com/find/fd

- **Software test platform for one-button compliance test**
- **Expert mode for in-depth characterization and margin test**
- **Common test structure and user interface for a wide range of high-speed digital buses, e.g. PCIe, USB, SATA, HDMI**
- **Test libraries, optimized for ease of use, minimum test and calibration times**
- **Automated single and multi-lane measurements**
- **Powerful interfaces to data bases and web servers**



The Agilent N5990A test automation software platform is the most powerful tool for **serial and multi-lane gigabit testing**. It is the **unique universal platform** for testing a wide range of digital buses such as PCI Express®, USB 2.0 or HDMI. N5990A can be tailored to your individual test needs with the **flexible test sequencer** and fully controls the instruments needed for your tests. The **configurable database interface** of the N5990A test automation platform enables the convenient storage of all test results. A **web interface** allows effective and easy operation.

N5990A runs on standard Windows XP PCs. It takes test automation to the next level of performance and convenience. It addresses specific bus standards by individual software options with the same look and feel. All modules share the same user interface which increases efficiency and productivity.

As an example, the option 150 HDMI sink (receiver) test module reduces the time needed for calibration and test execution with conventional, last-generation stand-alone applications by 50%. N5990A's transmitter test interface options call the Infiniium oscilloscope series' transmitter performance validation and compliance test software products. They enhance the oscilloscope applications by e.g. providing remote control and data upload from the oscilloscopes to a PC controller.

The Agilent partner company **BitifEye Digital Test Solutions**, a specialist for test automation, provides customizations and integrated solutions based on N5990A and the Agilent instrument portfolio. For more information on BitifEye and their range of products and services, see **www.bitifeye.com**

Specifications

PCI Express Test Coverage

Test No.	Assertion	Description	N5393A	N5990A Option 101
1.4	PHY .3.3#2	Non-SSC Transmitter Data Rate	•	
1.5	PHY .3.2#1, 2, 14, PHY .3.3#1, 4, 9, EM.4#13, 14, 15, 19, 20	Signal Quality	•	
1.6	PHY .3.1#12, 26	TX DC Common Mode Voltage	•	
1.12	PHY .3.3#3	TX Output Rise/Fall Time	•	
1.13	PHY .3.3#5	TX RMS AC Common Mode Voltage	•	
1.21	PHY .3.4#1, 6, EM.4#21	Receiver Sensitivity		•
1.24	EM .4#4	Wake Enabled Platform Vaux Power	•	

HDMI Test Coverage by CTS 1.3a Test ID and Name

N5399A and N5990A Opt. 250	Source Test Name	N5990A Option 150	Sink and Cable Test Name
7-2	TMDS VL	5-3	TMDS data eye diagram
7-4	TMDS rise & fall times	8-5	Min. differential sensitivity
7-5	TMDS over/undershoot	8-6	Intra-pair skew
7-6	TMDS inter-pair skew	8-7	Jitter Tolerance
7-7	TMDS intra-pair skew	8-15	Character synchronization
7-8	TMDS clock duty cycle	8-19	Pixel encoding
7-9	TMDS clock jitter	8-20	Video format timing
7-10	TMDS data eye diagram	8-22	Audio sample packet jitter
		8-24	Interoperability with DVI
		8-25	Deep Color

USB 2.0 Test Coverage

N5990A Opt. 102	Receiver Test Name
EL_11	Receiver Data Rate
EL_13	Receiver Differential Voltage
EL_13	Receiver Jitter Tolerance
EL_15	Receiver Common Mode Voltage
EL_16	Receiver Squelch Detection
EL_18	Receiver Minimum SYNC Field

For the list of supported instruments and PC controller system requirements, see the N5990A Data Sheet.

Key Literature & Web Link

N5990A Data Sheet, p/n 5989-5483EN
Automated PCI Express Receiver Compliance Test and Characterization with the Agilent N5990A Software Platform Application Note, p/n 5989-5500EN
Automated USB 2.0 Receiver Compliance Test and Characterization with the Agilent N5990A Software Platform Application Note, p/n 5989-6232EN
HDMI Sink and Source Compliance Test and Characterization Application Note, p/n 5989-4959EN

www.agilent.com/find/automation

Ordering Information

N5990A-010 Test Automation Software Platform, required for all other options
N5990A-001 Interfaces to Databases (MS and SQL) and Web Browsers
N5990A-002 Multi-bus Support, required if you want to test more than one bus standard on the same platform
N5990A-003 PCI Express High-lane Count (>4) option, required to test more than 4 lanes in parallel
N5990A-500 User Programming (API including templates)

Option Class High-Speed Electrical Receiver/Sink Test Libraries
N5990A-101 PCI Express for ParBERT 3.3 Gb/s – 13 Gb/s and High-performance Serial BERT
N5990A-102 USB 2.0 for 81134A
N5990A-150 HDMI for ParBERT 7 Gb/s

Option Class Interfaces to High-Speed Electrical Transmitter/Source Tests (on Infiniium oscilloscopes)
N5990A-201 Interface to N5393A PCI Express Software (N5393A not included)
N5990A-250 Interface to N5399A HDMI Software (N5399A not included)

GPIB, USB, LAN PC-Instrument Connections

Agilent I/O Hardware Family Benefits

- Easy connection to GPIB and RS-232 instruments – Agilent I/O hardware products offer simple "plug and go" setup and configuration
- Use PC-standard interfaces – Connect via your computer PCI slot or use the built-in USB or LAN ports on your PC to connect to your instruments
- Choice of interfaces (GPIB, RS-232, USB, LAN, PCI) – Agilent offers you a selection of products to meet your I/O needs. We work where you do
- Use industry-standard I/O libraries – The included industry-standard VISA I/O libraries make it easy for you to use your existing software programs and let you mix and match test instruments and software from different vendors in a single system.

Choose your Interfaces

To protect your investment in existing equipment, you can continue to mix and match virtually any combination of instruments and interfaces.

Choose your instrument and computer interfaces, then select the optimum converter.

Which Interface is Best for You?

USB: ease and convenience
LAN: remote system configuration
GPIB: highest throughput
RS-232: compatibility with older instruments

Now you can connect your PC and test instruments more easily than ever. The Agilent I/O hardware product family is designed to offer you a choice of interfaces and to simplify the connection. Agilent is a leader in offering Ethernet/Local Area Network (LAN) and universal serial bus (USB) interfaces in its instruments. The I/O products features here will help you connect your current instruments that have GPIB or RS-232 interfaces to your PC with ease.

GPIB Cards and Converters

From Instrument...	to Converter...	to PC
GPIB	Agilent 82357B USB/GPIB Interface	USB
		
RS-232	Agilent E5805A USB/4-port RS-232 Interface	USB
		
GPIB	Agilent E5810A LAN/GPIB Gateway	LAN
		
USB	Agilent E5813A Networked 5-port USB Hub	LAN
		
GPIB	Agilent 82350B High Performance GPIB Card	PCI
		

82357B

- **35% faster in performance as compare to its predecessor at the same price**
- **High speed USB 2.0 offers fast and easy *plug-and-play* connection and auto configuration**
- **GPIB transfer rate of more than 1.15 MB/s that supports small block transfers**
- **IEEE 488 interface (connect to up to 14 instruments)**
- **Backward compatible with USB 1.1**

Connect GPIB Instruments Quickly and Easily to your Computer's UBS Port

The Agilent 82357B USB/GPIB interface provides a direct connection from the USB port on your desktop and laptop computers to GPIB instruments. Once the software is loaded, your computer automatically detects the 82357B when it is connected to the computer USB port.

With the 82357B USB/GPIB interface and its convenient plug-and-play feature, you just plug and go. It is also hot pluggable, making it easy to connect and disconnect without having to shut down the computer. No external power supplies are necessary.

The 82357B USB/GPIB interface implements USB 2.0 and is backward compatible with USB 1.1. The 82357B USB/GPIB interface uses a thin, flexible, high-quality USB cable. The USB cable is shielded, and the connector is specified to 1,500 insertions, ensuring a durable connection and reliable data transfer.

For programming capability, you have access with the latest version of IO Libraries Suite to program in all standard development environments. Agilent's IO Libraries Suite is easy to use and works with virtually any vendor's instrument or T&M programming software application and includes automatic configuration for Agilent or NI VISA, NI-488.2, VISA COM or T&M Toolkit Direct IO. Even if you use NI IO software, Agilent will configure automatically so as a user you do not have to be concerned with the behind the scenes details.

Specifications

General Requirements

Minimum System Requirements
- Windows 2000/XP Professional
- 450 MHz Pentium II (800 MHz is recommended)
- 128 MB RAM (256 MB or greater is recommended)
- 400 MB free disk space
- USB port (OS and Microsoft .NET Framework may require more resources)

Supported Standards
- Support USB 2.0 high speed and full speed
- Standard USB endpoints supported
- IEEE-488.1 and IEEE-488.2 compatible
- SICL and VISA 2.2

Software Requirements
- 82357B driver (included)
- Agilent IO Libraries Suite (included)

Please refer to **www.agilent.com/find/iosuite**

Supported Languages and Applications

Applications (with Intui Link)
- Microsoft Excel 97 and 2000
- Microsoft Word 97 and 2000
- Check the Web for latest supported applications

Software Development Applications
- Visual Basic 6.0
- Visual C++ 6.0
- Visual Studio .NET
- Agilent VEE 6.0 or greater
- BASIC for Windows
- LabVIEW 6.0 or greater

General Characteristics

Power
USB bus-powered device, +5 V, 500 mA (max), 200 mA (typ)
GPIB Transfer Rate
1.15 MB/s or better
Connectors
Standard 24-pin IEEE-488, Standard USB A
USB Hubs
Self-powered hubs
Parallel Polling
A single parallel poll can check up to 8 individual devices at once, corresponding to the number of data lines on the GPIB
Dimensions
105 mm (L) x 64 mm (W) x 30 mm (H) (includes connectors)
Weight
215 grams
Cable
2.5 meters, shielded, connector rated for 1500 insertions
LED Indicators
Ready, Access, Fail
Warranty
1 year
Maximum Connections
Maximum 4 converters can be connected to the PC
Instrument Connection
14 instruments – daisy chain via GPIB
Configuration
Plug-and-play

Environmental Specifications

Operating Environment
0°C to 55°C
Storage Environment
–40°C to + 70°C
Operating Humidity
Up to 90% at 40°C non-condensing
Storage Humidity
Up to 90% at 65°C non condensing

Accessories

See cables page 416
www.agilent.com/find/gpibcables

Key Literature & Web Link

Data Sheet, p/n 5989-5983EN

www.agilent.com/find/82357B

Ordering Information

82357B USB/GPIB Interface for Windows
82357B-0B1 – Add Manual Set
82357B-ABJ – Japanese Localization

High-performance PCI GPIB Interface and Cables

82350B
10833

- **PCI IEEE-488 interface for PCs**
- **Transfer rates up to 900 KB/s**
- **Dual processor support on Windows 2000/XP**

BEST for: Maximum GPIB throughput for all configuration

High Performance for Manufacturing Test Applications

The 82350B is Agilent's highest performance GPIB interface. With a direct PCI computer connection, transaction overhead is minimized for the best overall performance. The 82350B card de-couples GPIB transfers from PCI bus transfers. Buffering provides I/O and system performance that is superior to direct memory access (DMA). The hardware is software configurable and compatible with the *Plug-and-Play* standard for easy hardware installation. The GPIB interface card plugs into a 5 volt PCI slot in the backplane of your PC.

Specifications

General Requirements

Minimum System Requirements
Windows 98(SE)/Me/2000/XP
Software Required
refer to **www.agilent.com/find/iosuite**
PCI Bus Slot
5-V PCI slot, 32 bits
Supported Standards
- PCI rev 2.2
- IEEE 488.1 and IEEE 488.2 compatible

General Characteristics

Power
Backplane +5 V PCI
Connectors
- Standard 24-pin GPIB (IEEE-488)
- +5 V PCI

Maximum Data Rate
More than 900 KB/s
Maximum Instrument Connection
14 instruments – daisy chain via GPIB
Buffering
Built-in
Configuration
Plug-and-Play
EMC and Safety*
- IEC 61326-1 Group 1, Class A
- IEC 61010-1

Warranty
1 year

Dimensions

Length, Width, and Height
122 mm (L) x 122 mm (W) x 22 mm (H) (a full-height PCI card)
Weight
0.091 kg

Environmental Specifications

Operating Environment
0°C to 55°C
Operating Humidity
Up to 90% at 40°C non-condensing
Storage Environment
–40°C to +70°C
Storage Humidity
Up to 90% at 65°C non-condensing

Accessories

See cables below

Key Literature & Web Link

5989-1889EN Data Sheet
www.agilent.com/find/82350B

Ordering Information

82350B PCI High-performance GPIB Interface Card

10833B GPIB cable and 10834A GPIB-to-GPIB adapter.

Cables

Agilent also offers a variety of cables that provide easy and reliable connections. Agilent cables are engineered for exceptional reliability and durability, even under the harshest conditions.

Adapter

10834A GPIB-to-GPIB Adapter

The 10834A GPIB-to-GPIB adapter can help when limited rear-panel space and other design considerations make cabling difficult. The 10834A adapter extends the first cable 2.3 cm away from the rear panel to provide clearance for other connectors, switches, and cables.

Key Literature & Web Link

Data Sheet, p/n 5989-1889EN

www.agilent.com/find/io

Ordering Information

Cable
10833D GPIB Cable 0.5 meter
10833A GPIB Cable 1 meter
10833B GPIB Cable 2 meter
10833C GPIB Cable 4 meter
10833F GPIB Cable 6 meter
10833G GPIB Cable 8 meter
10834A GPIB Adapter

* Additional detail and information in the Declaration of Conformity.

E5810A

- **Remote access and control of GPIB instruments via the LAN**
- **Easy setup and use via digital display and Web browser**
- **Interface with up to 14 GPIB instruments and one RS-232 device**

BEST for: Connection to remote GPIB and RS-232 instruments
BEST for: Shared test systems

Remote Access and Collaboration with GPIB Instruments via your LAN

The Agilent E5810A LAN/GPIB gateway provides a high-performance solution for remote access of GPIB and RS-232 test instruments over your standard LAN. The E5810A can use DHCP, if available, to automatically configure necessary network parameters, including its IP address. The gateway can be controlled from multiple locations and by multiple users via your LAN, so it is easy to share control of instruments and test systems from locations worldwide. For easy set up and use simply enter the IP address from the digital display as the URL in your Web browser and gain access to connected GPIB and RS-232 instruments. Then use your browser to send instrument commands interactively and quickly see your measurement results. Use the digital display and LEDs to check the IP address and troubleshoot locally.

System Use

For system environments, the E5810A gateway can be rack mounted. The rack mount kit (Option 100) allows two devices to be placed side-by-side in one rack width. With its built-in power supply, there are no additional power modules to mount.

Choosing a Remote Connection

Guidelines for selecting between the E5810A and E5813A for a remote connection:

- Use the E5810A LAN/GPIB gateway when you are connecting only to GPIB instruments or a mix of GPIB instruments and one RS-232 instrument
- Use the E5810A when you need to share your instruments with more than one user at a time
- Use the E5813A networked 5-port USB hub when you have a mix of devices (for example, when you need a remote USB printer and multiple RS-232 devices, or have a mix of GPIB, USB, and RS-232 devices)

You will obtain the best performance when you do the fewest format conversions. For example using the E5810A (LAN to GPIB) will generally be faster than 82357B and an E5813A (LAN to USB to GPIB).

Specifications

General Requirements

Minimum System Requirements (client computers)
Available 10BASE-T/100BASE-TX LAN port
Operating System
Windows 98(SE)/2000/Me/XP
Supported Web Browsers
- Internet Explorer 4.0 or higher
- Netscape Navigator 4.7 and higher

Software Required
Web browser or for programmatic control – Agilent IO Library Suite (included); refer to **www.agilent.com/find/iosuite**
Supported Standards
- IEEE 488.1 and IEEE 488.2 compatible
- 10BASE-T/100BASE-TX networks
- VXI-11 protocol
- EIA-232

General Characteristics

Power Supply: 100 – 240 V ±10%
Power Consumption: (7 watts) 25 VA peak
Power Line Frequency: 47 to 63 Hz
Connectors: Std 24-pin GPIB (IEEE-488), RS-232 (9-pin), LAN RJ-45
Maximum Data Rates
- More than 900 KB/s – GPIB port
- 115 Kb/s – RS-232 port

RS-232 Baud Rate
300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 b/s
RS-232 Flow Control
None, RTS/CTS, XON/XOFF, DTR/DSR
RS-232 Parity
None, Odd, Even, Space, Mark
RS-232 Bits
5, 6, 7, 8
RS-232 Stop Bits
1, 2
RS-232 SRQ Interrupts
on RI, DSR, DCD, CTS
Max Instrument Connections
- 14 instruments – daisy chain via GPIB
- 1 RS-232 device
- Up to 16 simultaneous I/O connections

Indicators
LEDs for Power, Activity, Fault
EMC and Safety*
- IEC 61326-1 Group 1, Class A
- IEC 61010-1

Warranty
1 year
Network Protocols
See the E5810A User's Manual for supported network protocols and functions

Dimensions

Length, Width, and Height
211 mm (L) x 230 mm (W) x 41 mm (H) (1U height, 1/2 rack)
Weight
1.6 kg

Environmental Specifications

Operating Environment
0°C to 55°C
Operating Humidity
Up to 90% at 40°C non-condensing
Storage Environment
–40°C to +70°C
Storage Humidity
Up to 90% at 65°C non-condensing

Accessories

See cables page 416

Key Literature & Web Link

Data Sheet, p/n 5989-1889EN

www.agilent.com/find/E5810A

Ordering Information

E5810A LAN/GPIB Gateway
E5810A-100 Rack Mount Kit

* Additional detail and information in the Declaration of Conformity.

USB/4-port RS232 Interface

E5805A

- **Easy connection from standard USB port on your PC to up to four RS-232 instruments or devices**
- **Fully compatible with Windows COM driver and industry-standard VISA I/O software**

BEST for: Easy connection to RS-232 devices
BEST for: Notebook computer RS-232 connections

Add Four Serial Ports in Minutes

The Agilent E5805A USB/4-port RS232 interface provides a direct connection from the USB port on your notebook or desktop PC to up to four RS-232 instruments or devices. There are no switches to set, no PC cards to install, and no external power supplies are required. Simply install the driver and plug in the E5805A USB 4-port RS232 interface to add four RS-232 ports to your computer. Since the E5805A is a standard *Plug-and-Play* device, your computer automatically detects and configures it when it is connected to your computer USB port. You can interface up to four devices, with baud rates up to 230 Kb/s per serial port. The E5805A provides four DB9 serial connectors and ships with a 1.8-meter USB cable.

Specifications

General Requirements

Minimum System Requirements
- Windows 98(SE)/Me/2000/XP
- A USB port

Software Required
E5805A driver (included)
Software Recommended
Agilent IO Library Suite (included) – refer to **www.agilent.com/find/iosuite**
Supported Standards
- USB 1.1 (fully compatible with USB 2.0)
- EIA-232

General Characteristics

Power
USB bus-powered device, +5 V, 500 mA (max), 200 mA (typ)
Support for USB Hubs
Self-powered hubs
Connectors
Standard USB A, RS-232 (9-pin) on each port
Cable
1.8 meter USB, USB A (host side) to USB B (device side)
Maximum Data Rates
230 Kb/s per port
RS-232 Baud Rates
300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400 b/s
RS-232 Flow Control
None, RTS/CTS, XON/XOFF, DTR/DSR
RS-232 Parity
None, Odd, Even, Space, Mark
RS-232 Bits
5, 6, 7, 8
RS-232 Stop Bits
1, 2
RS-232 SRQ Interrupts
on RI, DSR, DCD, CTS (using IO libraries)
Maximum Instrument Connections
4 RS-232 instruments/devices
Configuration
Plug-and-Play
Indicators
Tri-state LED displays device status and COM port activity
EMC and Safety*
- CISPR 22 Class B
- CISPR 24
- IEC 60950

Warranty
1 year

Dimensions

Length, Width, and Height
111 mm (L) x 183 mm (W) x 26 mm (H)
Weight
0.311 kg

Environmental Specifications

Operating Environment
0°C to 55°C
Operating Humidity
Up to 90% at 40°C non-condensing
Storage Environment
–40°C to +70°C
Storage Humidity
Up to 90% at 65°C non-condensing

Key Literature & Web Link

Data Sheet, p/n 5989-1889EN

www.agilent.com/find/E5805A

Ordering Information

E5805A USB/4-port RS232 Interface (not available in Korea)

* Additional detail and information in the Declaration of Conformity.

- **Interface a variety of GPIB, RS-232 and USB devices to complete your test system**
- **Extend USB devices beyond five meters**
- **USB ports appear to be locally attached and are locked to one computer**

BEST for: Remote access to USB ports, devices or instruments

Connect Remote USB, GPIB or RS-232 Instruments or Devices via a Standard LAN

The Agilent E5813A networked 5-port USB hub uses LAN technology to overcome the 5-meter distance limitation for USB cabling, so you can place USB devices anywhere on a LAN network. With access to remote devices, you can collect data, perform measurements, or monitor the progress of your tests.

Using the included IO Libraries Suite, you can connect an Agilent 82357B USB/GPIB interface to one of the USB ports for access to GPIB devices. You also can connect an E5805A USB/4-port RS-232 interface for access to RS-232 devices. The software for the E5813A locks access to a single computer. Once you unlock the connection another user can then connect from a different computer.

Choosing a Remote Connection

Guidelines for selecting between the E5810A and E5813A for a remote connection:

- Use the E5810A LAN/GPIB gateway when you are connecting only to GPIB instruments or a mix of GPIB instruments and one RS-232 instrument
- Use the E5810A when you need to share your instruments with more than one user at a time
- Use the E5813A networked 5-port USB hub when you have a mix of devices (for example, when you need a remote USB printer and multiple RS-232 devices, or have a mix of GPIB, USB, and RS-232 devices)

You will obtain the best performance when you do the fewest format conversions. For example using the E5810A (LAN to GPIB) will generally be faster than 82357B and an E5813A (LAN to USB to GPIB).

Specifications

General Requirements

Minimum System Requirements
- Windows 2000/XP
- Available USB 1.1 or 2.0 port

Software Required
E5813A driver (included)

Software Recommended
Agilent IO Library Suite; refer to **www.agilent.com/find/iosuite**

Supported Standards
- 10BASE-T/100BASE-TX networks
- USB 1.1 (fully compatible with USB 2.0)

General Characteristics

Power Supply
External switching AC adapter

Input Power Consumption
120/230 volts AC, 0.7amps

Power Line Frequency
50 to 60 Hz

Output
5 volts DC, 3 amps max

USB Device Power Available
500 mA per device

Connectors
- LAN RJ-45
- Standard USB A on each of 5 ports

Maximum Data Rates
12 Mbps from each port

Maximum Instrument Connections
5 USB instruments or devices

Configuration
Remote LAN configuration utility

Indicators
LEDs for system and device status

EMC and Safety*
- CISPR 22 Class B
- CISPR 24
- IEC 60950
- ITE equipment intended only for use with ISM equipment

Warranty
1 year

Network and Device Recommendations

IP Addresses
One IP address per unit

E5813A Device Sharing
Locked to one computer at a time. One computer must release the E5813A before another computer can use it

Network Utilization
Maximum network utilization below 50%

Compatibility
Compatible with bulk or interrupt-type USB devices; isochronous devices are not supported

Dimensions

Length, Width, and Height
- Device: 112 mm (L) x 182 mm (W) x 26 mm (H)
- Power adapter: 110 mm (L) x 60 mm (W) x 35 mm (H)

Weight
- Device: 0.284 kg
- Power adapter: 0.25 kg

Environmental Specifications

Operating Environment
0°C to 55°C

Operating Humidity
Up to 90% at 40°C non-condensing

Storage Environment
–40°C to +70°C

Storage Humidity
Up to 90% at 65°C non-condensing

Key Literature & Web Link

Data Sheet, p/n 5989-1889EN

www.agilent.com/find/E5813A

Ordering Information

E5813A Networked 5-port USB Hub (Not available in Korea, Singapore, Taiwan, China, Mexico or Russia)

* Additional detail and information in the Declaration of Conformity.

Synthetic Instrument Modules

N8201A
N8211A
N8212A
N8221A
N8241A
N8242A

- **Flexible, reconfigurable, modular measurement instrumentation**
- **Enables the design of scalable test systems**
- **Provides the flexibility to accommodate future test requirements**
- **Provides obsolescence protection of automated test systems by providing the longest future support life architecture**
- **Reduces the lifetime cost of ownership of automated test systems**
- **The highest RF/MW performance synthetic instruments in the industry**
- **Provides the smallest footprint for automated test systems**
- **LXI interface provides computer interface longevity**

RackSynthetic

Synthetic

Synthetic Instrumentation

Synthetic instrumentation and the new LXI interface standard are a new concept for automated test systems that provide maximum flexibility, and minimize the cost of the system over its lifetime. The synthetic instrument concept breaks the measurement instrumentation down into its most basic functional components, and uses these basic synthetic instrumentation modules as building blocks for synthesizing a variety of different measurements. Different software modules are then used to make many different measurement functions from a few common hardware modules. An RF/microwave synthetic instrument is comprised of three basic functional modules; a frequency converter, a data converter, and a numeric processor. Using these three functional modules, any type of signal can be generated or analyzed.

Extend Longevity and Lower Lifetime Costs

Synthetic instrumentation is a modular hardware and software test initiative driven by the defense and military community as they develop a next generation test vision. The synthetic instrument concept involves linking individual hardware and software test modules together to emulate standard instruments in a new, compact form factor. The result is an adaptable, common system architecture that enables the military and defense prime contractors to design scalable automated test systems (ATS), giving them the flexibility to insert future technology and transform the ATS to accommodate future new measurement applications. The synthetic instrument concept reduces the number of hardware modules required, increases the reusability of the modules, and enables future technology updates. It provides an economic benefit of extending the useful lifetime of automated test systems, as well as greatly reducing the total lifetime costs associated with these automated test systems.

Highest Performance Synthetic Instruments

Agilent's synthetic instruments offer the highest performing RF/microwave LAN-based modular instrumentation available in the industry. When it comes to military automated test systems, measurement assurance and system readiness are the military's greatest needs. Performance, accuracy, and reliability of the test equipment are required to provide the best assurance of military system readiness. Agilent's synthetic instruments offer the high performance of traditional instrumentation in a synthetic instrument format. When it comes to military test systems, Agilent meets your needs with synthetic instrument modules that have the high performance required by these demanding automated test system applications.

N8201A
N8211A
N8212A
N8221A
N8241A
N8242A

Specifications

N8201A Performance Downconverter
- Downconverts a microwave signal to an IF signal
- Frequency range of 3 Hz to 26.5 GHz standard
- Frequency range extension to 110 GHz with optional external mixing
- Three IF output frequencies of 7.5, 21.4, and 321.4 MHz
- Amplitude input range: –70 to +30 dBm

N8211A Performance Analog Upconverter
- A high performance analog microwave source for generating a stimulus signal
- Frequency range: 250 kHz to either 20 or 40 GHz
- AM, FM, or pulse modulation
- Internal or external modulation
- Multi-source coherent carrier capability

N8212A Performance Vector Upconverter
- A high performance vector microwave source for generating a stimulus signal
- >1 GHz I/Q vector modulation capability
- AM, FM, or pulse modulation capability
- Internal or external modulation capability
- Multi-source coherent carrier capability

N8221A IF Digitizer
- A high dynamic range IF digitizer
- 30 MS/s sampling rate
- Digitizes a 7.5 MHz IF signal
- 10 MHz modulation bandwidth
- 80 dB of dynamic range; 14 bits of vertical resolution

N8241A 15-Bit Arbitrary Waveform Generator
- High-performance arbitrary waveform generator for creating complex wideband waveforms
- 15 bits of vertical resolution and 1.25 Gs/s
- ≤–65 dBc spurious free dynamic range
- Choice of either 1.25 GS/s or 625 MS/s sampling rate
- Corresponding instantaneous analog bandwidths of either 500 MHz or 250 MHz per channel
- Dual channel, with single-ended and differential outputs
- Sophisticated sequencing engine
- Multiple AWG synchronization capability

N8242A 10-Bit Arbitrary Waveform Generator
- High-performance arbitrary waveform generator for creating complex wideband waveforms
- 10 bits of vertical resolution and 1.25 GS/s
- ≤–50 dBc spurious free dynamic range
- Choice of either 1.25 GS/s or 625 MS/s sampling rate
- Corresponding instantaneous analog bandwidths of either 500 MHz or 250 MHz per channel
- Dual channel, with single-ended and differential outputs
- Sophisticated sequencing engine
- Multiple AWG synchronization capability

N8201A
N8211A
N8212A
N8221A
N8241A
N8242A

Key Literature & Web Link

N8201A Data Sheet, p/n 5989-5720EN
N8211A Data Sheet, p/n 5989-2592EN
N8212A Data Sheet, p/n 5989-2593EN
N8221A Data Sheet, p/n 5989-2594EN
N8241A Technical Overview, p/n 5989-2595EN
N8242A Technical Overview, p/n 5989-5010EN

www.agilent.com/find/synthetic

Ordering Information

N8201A Performance Downconverter
- **N8201A-526** Frequency Range from 3 Hz to 26.5 GHz
- **N8201A-AYZ** External Mixing Capability
- **N8201A-123** Switchable Microwave Pre-selector Bypass
- **N8201A-1DS** Built-in Preamplifier; 100 kHz to 3 GHz
- **N8201A-110** Built-in Preamplifier; 10 MHz to 26.5 GHz

N8211A Performance Analog Upconverter
- **N8211A-520** Frequency Range from 250 kHz to 20 GHz
- **N8211A-540** Frequency Range from 250 kHz to 40 GHz
- **N8211A-007** Analog Ramp Sweep Interface
- **N8211A-UNT** AM/FM/PM Modulation
- **N8211A-UNU** Standard Pulse Modulation
- **N8211A-UNW** Narrow Pulse Modulation
- **N8211A-UNX** Enhanced Close-in Phase Noise Performance
- **N8211A-1EA** High Output Power
- **N8211A-1E1** Step Attenuator
- **N8211A-1EH** Improved Harmonics Below 2 GHz

N8212A Performance Vector Upconverter
- **N8212A-520** Frequency Range from 250 kHz to 20 GHz
- **N8212-007** Analog Ramp Sweep Interface
- **N8212A-016** Wideband, Single and Differential I/Q Modulation Inputs
- **N8212A-UNT** AM/FM/PM Modulation
- **N8212A-UNU** Standard Pulse Modulation
- **N8212A-UNW** Narrow Pulse Modulation
- **N8212A-UNX** Enhanced Close in Phase Noise Performance

N8221A IF Digitizer

N8241A 15-bit Arbitrary Waveform Generator
- **N8241A-625** 625 Mega-samples per Second Sample Rate
- **N8241A-125** 1.25 Mega-samples per Second Sample Rate
- **N8241A-008** 8M Sample Memory
- **N8241A-016** 16M Sample Memory
- **N8241A-300** 16-bit Dynamic Sequencing Software
- **N8241A-330** Direct Digital Synthesis Software

N8242A 10-bit Arbitrary Waveform Generator
- **N8242A-625** 625 Mega-samples per Second Sample Rate
- **N8242A-125** 1.25 Mega-samples per Second Sample Rate
- **N8242A-008** 8M Sample Memory
- **N8242A-016** 16M Sample Memory
- **N8242A-300** 16-bit Dynamic Sequencing Software
- **N8242A-330** Direct Digital Synthesis Software

Standard Rack Cabinets: E3661B (32 EIA), E7590A (25 EIA), E3662B (41 EIA)

Rack Solution for Agilent Systems

Agilent Technologies offers 19-inch EIA (Electronics Industries Association) rack cabinets tailored to meet the needs of test and measurement instrumentation customers. Rack mounting is fast and easy with unique design features. A selection of options and accessories provides flexibility to meet the vast majority of racking applications.

Standard Rack Includes:

- Vented top for better cooling
- Solid base
- Leveling screws
- Retractable anti-tip foot
- 4 Concealed lifting hooks. Each hook can support 227 kg (500 lbs)
- One Agilent System II rail kit, including a pair of rails
- 3-Inch heavy duty casters
- Power distribution Unit (PDU) – must specify 110 V or 220 V
- Vented, swinging rear door with lock
- Easy to remove side panels, which can be lifted off
- Attractive quartz gray color

Shipping Features

All racks and accessories are shipped with basic assembly completed, as shown.

Agilent Rack Value

Agilent racks have been designed and engineered to save time and money for our customers:

- Package design – Designed for easy unloading from the pallet
- Pallet re-use – Racks are sent out with double pallets, as well as a ramp. Racks can be integrated on the pallet, which adds a convenient system for integrating the rack. The pallet has been tested up to 1000 pounds and can be used to ship an integrated system, saving you time and money
- Fully assembled rack – Customers receive Agilent racks fully assembled and ready for equipment installation saving time and money. Accessories can be ordered, and will be shipped ready to be integrated onto the rack
- Unique column and rail design – Equipment installation time is cut in half because of Agilent's unique column and support rail design. Our special cutouts in the columns, spaced at EIA intervals and rail hooks assure instruments are mounted easily in the right place the first time

Enhance Your Instrument Investment

Agilent racks are specifically designed for Agilent's test and measurement equipment, virtually ensuring a perfect fit. Agilent racks will also accommodate non-Agilent equipment making them suitable for the customer of a mixed instrument environment. Designed for today's competitive environment, three heights are offered to accommodate any system: 1.3 m, 1.6 m, and 2.0 m. All racks are deep enough to hold Agilent instruments of varying sizes.

Load a Rack in Less Time

The design of Agilent support rails can cut in half the time required to install equipment in a rack. The rails hang on discrete slots on the vertical mounting columns, corresponding to each EIA unit in the rack. Vertical adjustment between instruments is minimized by selecting the proper rail. Rails are available for Agilent System II instruments and for flat bottom instrument chassis. The system was specifically designed to minimize the time required to install instruments.

Rack Systems Fast and Easily

Racks are shipped with all basic materials assembled. No time is lost preparing a rack with basic assembly. Accessories, kits and supplementary small parts are shipped separately, as ordered, and are ready for immediate configuration. More than just a way of storing instruments, the racks reflect Agilent's reputation for quality and design. A sturdy frame provides structural integrity, which allows lightweight, easy-to-lift off side panels that allow for installation and easy access to equipment and cables. Rails are placed into keyed slots in the vertical columns, resulting in quick and accurate positioning.

Use Vertical Space Efficiently

Vertical space within a rack is measured in industry-standard EIA units, where 1 EIA unit = 1.75 inches (44.5 mm). Equipment height is also specified in EIA units. System configuration is made easier by counting EIA units from the base of the rack. A seamless fit of instrument and rail is ensured.

Manage Power Requirements

A power management system must be ordered. Option AW3 (110 V) or option AW5 (220 V). It is vertically mounted behind the rack rear column and supplies power to the cabinet. An illuminated master switch, which is conveniently located on the front of the rack, provides easy access to turn the power on and off.

Protect from Heat Buildup

It is important for racks to efficiently dispose of heat. Instruments increasingly generate more heat, and in a compact rackmounted system the heat buildup can be detrimental to the system. System-generated heat is removed by natural convection through a ventilation path incorporated in the roof of the racks. The vented rear door also helps reduce the heat captured within the rack. For greater heat dissipation, an optional easy to install top-mounted extractor fan is available.

Secure Instruments During Test

Both the rear door and the optional Plexiglas front door can be locked to secure against disruption of tests or unauthorized removal of system components. The symmetrical rear door design allows it to be mounted for opening to either left or right, useful for multi-bay configurations.

Move Racks Easily

Each rack is provided with four 3-inch diameter, smooth-rolling, heavy-duty casters to facilitate moving racks over short distances. Four lifting hooks conveniently concealed in the top of the rack allow for transport, even when fully loaded. Each hook can support 227 kg (500 lbs) to easily handle the maximum recommended gross weight for a loaded rack of 816 kg (1800 lbs).

Enhance Stability

A front mounted retractable anti-tip stabilizer that can be extended into place with ease is standard on all racks. It provides temporary anti-tip capability for slide mounted products when they are in their extended position. Use the optional anti-tip ballast kit when permanent anti-tip capability is desired.

Improve Cable Management

Agilent racks, including the 1.3 m, 1.6 m and 2.0 m, have an additional 100 mm of internal space that is available at the rear of the rack. This convenient space is available for the installation of power distribution units (PDUs) and as a convenient location for cables, which are routed out the bottom of the rack. The added rear space also enhances air flow.

Ventilation

Agilent standard racks include a vented top cap and 100 mm additional internal rear space enhancing air flow.

Material

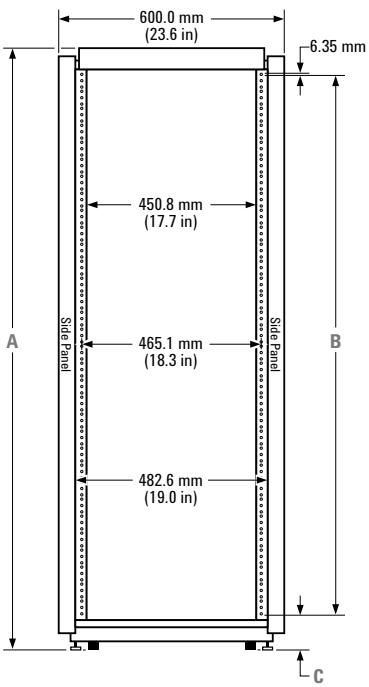
Frame/columns: 13 Ga. cold rolled steel.
Side Panels: 18 Ga. cold rolled steel.

Rack Dimensions, Weight and Load Ratings

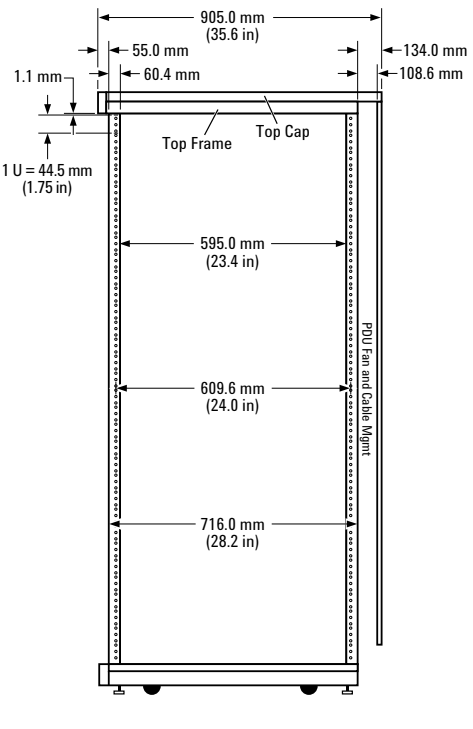
Prod. No.		Dim	Height	Width	Depth	Weight	Load Capacity	EIA Units
E7590A	**Exterior**	A	1320 mm (51.9 in)	600 mm (23.6 in)	905 mm (35.6 in)	89 kg (196 lbs) empty	816 kg (1800 lbs)	25
	Interior*	B	1111.25 mm (43.8 in)	450.8 mm (17.8 in)	851 mm (33.5 in)			
E3661B	**Exterior**	A	1620 mm (63.8 in)	600 mm (23.6 in)	905 mm (35.6 in)	100 kg (221 lbs) empty	816 kg (1800 lbs)	32
	Interior*	B	1422.5 mm (56.0 in)	450.8 mm (17.8 in)	851 mm (33.5 in)			
E3662B	**Exterior**	A	2020 mm (79.5 in)	600 mm (23.6 in)	905 mm (35.6 in)	116 kg (255 lbs) empty	816 kg (1800 lbs)	41
	Interior*	B	1822.5 mm (71.8 in)	450.8 mm (17.8 in)	851 mm (33.5 in)			

* Interior = EIA units = Rackmountable space.
Front to rear column hole spacing: 610 mm (24 in)
Note: For racks ordered in Asia, use local part number: E7590AA, E3661BA, E3662BA. For Europe order, E7590AE, E3661BE, E3662BE.

E7590A	
A	1,320 mm (51.9 in)
B	1,111.25 mm (43.75 in)
C	120.81 mm (4.76 in)
E3661B	
A	1,620 mm (63.8 in)
B	1,422.4 mm (56.0 in)
C	131.83 mm (5.19 in)
E3662B	
A	2,020 mm (79.5 in)
B	1,822.45 mm (71.75 in)
C	131.83 mm (5.19 in)



Front Rack View



Side Rack View

Rack Specifications

Casters Rating
318 kg (700 lb) each, 816 kg (1,800 lb) total
Casters have a point contact, convex cross section

Lift Hook Rating
227 kg (500 lb) each
Total system and cabinet weight is a maximum 816 kg (1,800 lbs), static.
Lift cabinet using all four (4) hooks.

Material
Frame/columns: 13 Ga. cold rolled steel
Side Panels: 18 Ga. cold rolled steel

Ventilation
Vented top cap
100 mm additional internal rear space to enhance air flow

Parts List

Rack Cabinets

Standard Racks

E7590A	1.3 m Rack Cabinet, Quartz Gray (25 EIA U)
E3661B	1.6 m Rack Cabinet, Quartz Gray (32 EIA U)
E3662B	2.0 m Rack Cabinet, Quartz Gray (41 EIA U)

Local versions – Order E7590AA, E3661BA, E3662BA for Asia, or E7590AE, E3661BE, E3662BE for Europe.

Rack Accessories

Power Distribution Units (PDUs)
For 1.3 m Racks

E4451-67000	100/120 V PDU (North America)
E4453-67000	200/240 V (International)

For 1.6 m and 2.0 m Racks

E4455-67000	100/120 V PDU (North America)
E4457-67000	200/240 V (International)

PDU Installation Kits: Not needed for factory-installed PDUs.

E7685AZ	PDU brackets and forehead bezel replacement, Quartz gray

Front Doors: Plexiglas is transparent and rim is quartz gray

E4461BZ	1.3 m Plexiglas Front Door
E4462BZ	1.6 m Plexiglas Front Door
E4463BZ	2.0 m Plexiglas Front Door

Rear Doors

Vented Rear Doors

E4477-67000	1.6 m Vented Rear Door
E4479-67000	2.0 m Vented Rear Door

Solid Rear Doors

E4476-67000	1.6 m Solid Rear Door
E4478-67000	2.0 m Solid Rear Door

Tie Kits

E4468BZ	1.6 m Tie Kit
E7792AZ	2.0 m Tie Kit

Side Panels

E4458-67000	1.6 m Solid Side Panel
E7749-67000	2.0 m Solid Side Panel

Extractor Fans

E4470AZ	100/120 V 200 cfm Fan
E4471AZ	200/240 V 200 cfm Fan

Ballast

C2790AC	30 lb. Steel Ballast

Rackmount Kits

Monitor Rackmount Kit

J1519BC	Fits 14" – 19" Monitors

Keyboard Rackmount Kits

J1518AC	Retractable Keyboard
E7714AC	Fixed Keyboard

Instrument Rackmount Kits

Handles and Rackmount Flanges

Instrument Module Height	Front Handle Kit Part No.	Flange Kit Part No.	Flange Kit and Handles Part No.	Flange Kit for supplied handles Part No.
88.1 mm (3 1/2 in)	5063-9226	5063-9212	5063-9219	5063-9232
88.1 mm (3 1/2 in)	—	5063-9213	5063-9220	—
132.6 mm (5 1/4 in)	5063-9227	5063-9214	5063-9221	5063-9234
177.0 mm (7 in)	5063-9228	5063-9215	5063-9222	5063-9235
221.5 mm (8 3/4 in)	5063-9229	5063-9216	5063-9223	5063-9236
265.9 mm (10 1/2 in)	5063-9230	5063-9217	5063-9224	5063-9237
310.4 mm (12 1/4 in)	—	5063-9218	5063-9225	—

Rack Adapter Kits

Instrument Module Height	Mounts 1/4 MW Module	Mounts 1/2 MW Module (or 2 ea. 1/4 MW modules)	Mounts 3/4 MW Module (3 ea. 1/4 MW or 1/4 + 1/2 MW side by side)
		Mounts 1/4 MW	or 2 each 1/4 MW or 1/4 and 1/2 MW
88.1 mm (3 1/2 in)	5063-9239	5063-9240	5063-9241
132.6 mm (5 1/4 in)	—	5063-9243	—
177.0 mm (7 in)	—	5063-9245	—

Support Shelves

88.1 mm (3 1/2 in)	5063-9255
132.6 mm (5 1/4 in)	5063-9256
177.0 mm (7 in)	5063-9257

Required Slide Rail Kit

1494-0015	Slide Rail Kit for Support Shelf

Replacement Part for Support Shelf

1600-1424	Tie-down Clip

Support Shelf Filler Panels

For 88.1 mm (3 1/2 in) H support shelf partially filled with instruments, and having the following front panel space to fill	1/2 MW to fill 5002-3999

Rail Kits

E3663AC	System II Rail Kit
E3664AC	3rd Party Rail Kit
E3665AC	VXI Rail Kit

Slide Rail Kits

Slide Kit: Non-tilting, Standard-duty

1494-0060	Fits 345.4 D and 421.6 D
1494-0059	Fits 497.8 D and 574.0 D

Slide Kit: Non-tilting, Heavy-duty

1494-0058	Fits 345.4 D and 421.6 D

End Brackets

1494-0061	Standard-duty, Quantity: 4
1494-0064	Heavy-duty, Quantity: 4

Lock Link Kit

5061-9694	Lock Link Kit

E7590A
E3661B
E3662B

Small Parts, Cables & Adapters

Drawers

35181J	89 mm (3.5 in) Drawer
35181M	133 mm (5.25 in) Drawer

Plain Shelf

J1520AC	Plain Shelf (does not slide)

Work Surface

46298SZ	Work Surface

Sliding Shelf

J1526AC	Sliding Shelf

Rack Filler Panels

E7731A	1 EIA Unit
E7732A	2 EIA Unit
E7733A	3 EIA Unit
E7734A	4 EIA Unit
E7735A	5 EIA Unit
E7736A	6 EIA Unit
E7737A	7 EIA Unit

Feedthrough Panels

E3668B	Feedthrough Panel w/2 cutout grooves
E3669B	BNC-BNC (f) to (f) Panel

Mounting Hardware

E7694A	50 Clip-on nuts; 50 10 – 32 screws; non-decorative
E7797A	50 Clip-on nuts; 50 10 – 32 screws; Quartz gray
0590-0804	1 Clip-on nut

Additional Hardware

5062-3999	Locking Feet Kit

Cables and Adapters

IEC-320 Cables

8120-1575C	IEC-320 Female-Male Power Cable (30 in)
8120-1860	IEC-320 Female-Male Power Cable (60 in)

5

Testmobiles and Accessories

Testmobiles

1180CZ	Scope Cart
1181BZ	System Cart

Accessories

35181HZ	Testmobile plotter/printer stand
35181J	89 mm (3.5 in) drawer
35181M	133 mm (5.25 in) drawer
35181KZ	Testmobile work surface
35181E	Testmobile anti-static mat for 35181D
8120-1575C	IEC-320 female-male power cable (30 in)
8120-1860	IEC-320 female-male power cable (60 in)
5181-8707	IEC-320 male power cable adapter

Key Literature

A complete catalog of Agilent racks and accessories is located at **www.agilent.com/find/enclosures**

Power Distribution Units (PDUs)

The power distribution unit is a convenient way to supply power to everything mounted in the rack. The PDU is mounted vertically behind the rear column and does not reduce vertical mounting space in the rack.

A lighted master power switch is supplied with the PDU. The switch provides rapid system shutdown in case of emergency or turns off power conveniently. The switch controls a relay in 1 or 2 PDUs and uses low voltage signal lines for safety and to minimize electrical noise.

- Circuit breakers are provided on both hot (live) and neutral lines
- All PDUs are single phase
- A maximum of two PDUs can be installed in a rack
- The top receptacle of all PDUs is configured as IEC-320 and is intended for the extractor fan. It can be used for other purposes if no fan is installed
- Different power cords and sizes are offered. Select the one that is appropriate for your location and rack solution

PDUs must be Specified as Option:

- AW3 for 100 – 120 V North American configuration, or
- AW5 for 200 – 240 V International configuration.

Additional PDUs can be Ordered as Follows:

PDUs for 1.3 m Racks

Prod. No.	Voltage	Region
E4451-67000	100 – 120 V	North America
E4453-67000	200 – 240 V	International

PDUs for 1.6 m and 2.0 m Racks

Prod. No.	Voltage	Region
E4455-67000	100 – 120 V	North America
E4457-67000	200 – 240 V	International

Monitor Rackmount Kit

Product Number: J1519BC

- Quartz gray
- The monitor rackmount kit can accommodate 14 – 19 inch monitors. The kit consists of a shelf, all required mounting hardware, and cosmetic panels around the monitor
- EIA units required: 11 EIA U

Keyboard and Mouse Rackmount Kits

Select a fixed or retractable keyboard and mouse kit appropriate for your needs. Keyboard and mouse are not included.

Retractable Keyboard

Product Number: J1518AC

- Quartz gray
- Keyboard security is available by using a front door on the rack cabinet
- EIA units required: 2 EIA U
- Includes all mounting hardware

Fixed Keyboard

Product Number: E7714AC

- Quartz gray
- Mounts on the outside of the front columns
- EIA units required: 1 EIA U
- All mounting hardware is included

Note: Cannot be used with a front door.

Rackmount Adapter Kits

Modules of less than 1 MW can be rackmounted using these kits.

- Individual 1/4 MW or 1/2 MW modules use the kits shown below directly
- Combinations of 1/4 MW or 1/2 MW (of equal depth) are first joined side-by-side with the Lock Link Kit (5061-9694), then the rackmount adapter kit is applied
- For combinations of instruments adding to 1 MW, use regular rackmount flange kit

Kits include attaching screws and front-panel rackmounting screws. Hole patterns conform to EIA and IEC standards.

Rack Adapter Kits

Instrument Module Height	Mounts 1/4 MW Module	Mounts 1/2 MW Module (or 2 ea. 1/4 MW modules)	Mounts 3/4 MW Module (3 ea. 1/4 MW or 1/4 + 1/2 MW side by side)
		Mounts 1/4 MW	or 2 each 1/4 MW or 1/4 and 1/2 MW
88.1 mm (3 1/2 in)	5063-9239	5063-9240	5063-9241
132.6 mm (5 1/4 in)	—	5063-9243	—
177.0 mm (7 in)	—	5063-9245	—

Support Shelf, Slides and Filler Panels

These shelves are available for instruments less than 1 MW

- Submodules of differing heights, widths, and depths (up to 20 inches deep) can be rackmounted using these support shelves. Any combination of 1/4 MW and 1/2 MW will fit side-by-side up to 1 MW
- Shelves support up to 50 pounds
- Special filler panels are available to close up vacant spaces either on top of a short module or side-by-side
- The slide kit is required. It provides ready access to internal shelf areas and is required for installation of the support shelf. Slide kit includes brackets and mounting hardware

Drawers

Keep manuals or spare cables close to where they are needed. Two drawer sizes are available.

- Sliding rails and mounting hardware are included
- Quartz gray

1180CZ
1181BZ

Testmobile Scope Cart (1180CZ)

Testmobile System Cart (1181BZ)

Testmobile Carts

Agilent Testmobile Carts add protection and mobility to test instruments and systems. The convenience of mobility makes instruments readily available when needed. The cart effectively extends the amount of lab bench space. Ergonomic cart and accessory design makes test equipment accessible to the operator, whether seated or standing at the test area. Additionally, several operators can cost effectively share expensive equipment that has been mounted on a Testmobile Cart.

Competitively priced Agilent testmobile carts are offered in cart capacities to provide optimum instrument test configuration:

- Scope cart, 59 kg (130 lb)
- System cart, 227 kg (500 lb)

A variety of easy-to-mount accessories are available for customized solutions.

Add Mobility to Your Instruments

Agilent Testmobile Carts provide convenient mobility of test equipment, PCs, or workstations to make them readily available when needed. This capability effectively extends the amount of lab bench space available. Mar-resistant, heavy-duty 5-inch hard rubber casters make moving instruments easy. All casters swivel, which lets the cart move right up to the workbench.

Bring the Equipment to the Test

Rather than bringing the test to the equipment, Agilent Testmobile Carts bring the equipment to the test, to save time and get right to the task. Testmobile Carts provide a convenient way to move everything from a small oscilloscope to a complete test system to the work to be tested.

Share Expensive Instruments

Agilent Testmobile Carts allow several operators in a work group to cost-effectively share expensive equipment. In the case of a small test system, all instruments can be conveniently combined in one place through the sufficient space, load capacity, and rackmount capability of the Testmobile System Cart.

Protect Your Investment

Unlike general-purpose cart design, Agilent Testmobile Carts have a nylon strap and steel buckle that secure instruments to the cart, and instrument feet fit securely in slots in both upper tilt tray and lower fixed tray. Expensive instruments are prevented from sliding or tipping off the cart. Locking brakes on rear wheels provide added safety and convenience.

Use Instruments with Ease

The ergonomically designed tilt tray adjusts 30-plus degrees for viewing and using instruments in comfort whether seated or standing. Lifting and carrying heavy instruments is no longer necessary with the mobility provided by Agilent Testmobile Carts.

Key Features

Agilent's Testmobile Carts offer the following attractive features:

- Ergonomic design. Test equipment is operator-accessible whether seated or standing
- Heavy-duty casters make moving instruments easy
- Includes a nylon strap and steel buckles to secure instruments to the cart
- Tilt tray adjusts 30-plus degrees for viewing comfort

Enhance Instrument Output

Agilent Testmobile System and Instrument Carts can be customized with a range of easy-to-mount accessories that enhance instrument input and output:

- Work surface and anti-static mat that provide a secure, static free work area in front of the instrument
- Plotter/printer stand, which can be set up either 305 mm or 381 mm (12 in or 15 in) high, enables hardcopy output on the spot
- Storage drawer (3.5 inch or 5.25 inch) for a convenient place to store probes, cables, and manuals
- Angle rails for supporting rack mounted instruments
- Attractive quartz gray color

Testmobile Cart Selection Criteria

A key criterion for cart selection is instrument depth. For instruments with a depth up to 17 inches, select the Agilent 1180CZ Testmobile Scope Cart. The Agilent 1181BZ Testmobile System Cart should be used for instruments up to 24 inches. Static drag chain is supplied on the 1181BZ.

1180CZ Testmobile Scope Cart

- Tilt tray load capacity = 29.5 kg (65 lb)
- Total load capacity = 59 kg (130 lb)
- Tilt tray = 457 mm W x 457 mm D (18 in x 18 in)

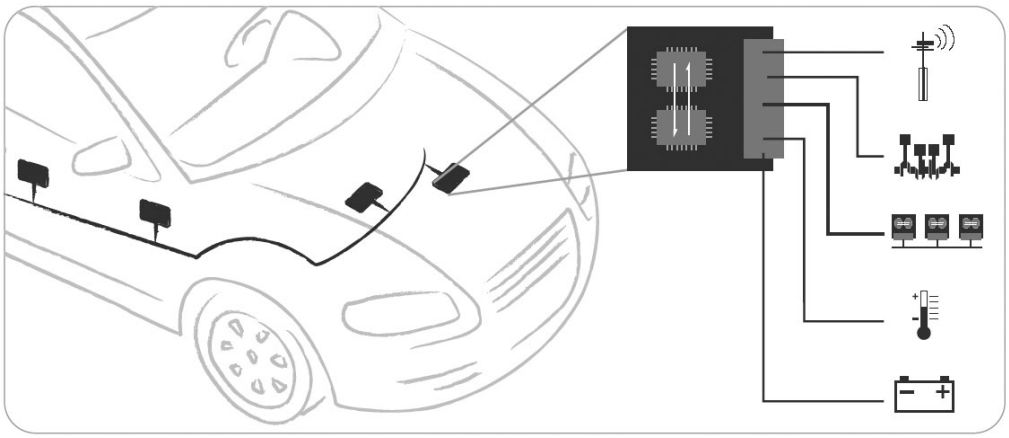
1181BZ Testmobile System Cart

- Tilt tray load capacity = 90.7 kg (200 lb)
- Total load capacity = 226.8 kg (500 lb)
- Tilt tray = 559 mm W x 660 mm D (22 in x 26 in)
- Rackmount any 19-inch EIA instrument up to 24 inches deep beneath the tilt tray in EIA columns
- 12 EIA units available for rack mounting
- Includes one set of 5957-8476 angle rails to support rack-mounted instruments

Specifications

	1180CZ Scope Cart	1181BZ System Cart
Capabilities		
Tilt tray load	29.5 kg (65 lb)	90.7 kg (200 lb)
Total load	59.0 kg (130 lb)	226.8 kg (500 lb)
Cart net weight	18.1 kg (40 lb)	39.0 kg (86 lb)
Dimensions		
Tilt tray size (w x d)	457 x 457 mm (18 x 18 in)	559 x 660 mm (22 x 26 in)
Height	721 mm (28.4 in)	721 mm (28.4 in)
Width	475 mm (18.7 in)	566 mm (22.3 in)
Depth	508 mm (20.0 in)	737 mm (29.0 in)
Vertical rack space*	—	533 mm (21.0 in – 12 EIA units)
Maximum Instrument Depth	432 mm (17.0 in)	635 mm (25.0 in)
Casters	101 mm (4 in) diameter	127 mm (5 in) diameter

* Vertical rack space is reduced the more the tilt tray is angled.



Test & Measurement for Automotive Electronics

Today's vehicles incorporate numerous sensors, actuators and control modules. So far, a majority of the electronic systems had their own dedicated ECUs (Electronic Control Unit) and were not interlinked with each other. For improved ADAS (Advanced Driver Assistance Systems) functionality, reduced cost and higher reliability, multiple ECUs are now linked together and run distributed applications.

In the automotive industry, Agilent supports OEMs, suppliers and service providers during development, quality assurance and manufacturing of electronic modules. Agilent supplies a comprehensive portfolio of test equipment, both for the validation of digital networks and electronic control units as well as for the integration of technologies from the communication and computer industry.

As an automotive engineer, we will help you develop electronic products faster and under budget, while meeting your quality requirements. The Agilent automotive test products can easily be integrated in complex, automated functional test configurations, which you can leverage from design validation into production.

Base the integration of your instruments on Agilent Open and gain from an unmet flexibility by utilizing different I/O interconnect technologies and I/O SW Libraries. For more information on Agilent Open go to page 406.

Learn More

Besides the selection of products shown on the following pages, learn about Agilent's complete product offering for Automotive Test & Measurement at **www.agilent.com/find/automotive-test**

- **Integrated serial triggering for testing your CAN/LIN and FlexRay serial buses**
- **Real-time protocol decode update rates using hardware-accelerated protocol decoding**
- **Precision differential active probes**
- **Mixed-signal measurements across analog sensors, serial buses, and digital ECU signals**

Debug the Signal Integrity of your Automotive Designs Faster with the Agilent 6000 Series Oscilloscopes

The Agilent 6000 Series digital storage oscilloscopes (DSOs) and mixed signal oscilloscopes (MSOs) offer integrated serial triggering and hardware-accelerated protocol decoding solutions that give you the tools you need to efficiently and effectively debug your embedded automotive designs.

The Agilent N5424A CAN/LIN option (Option AMS) allows you to trigger on either standard or extended CAN message IDs, including the message ID of a remote transfer request frame. It supports triggering on a data frame, and allows you to specify message IDs, data and data length for filtering messages of interest. Triggering on active error frames also is supported. In addition, the N5424A supports triggering on specific LIN frame IDs and includes color-coded parity and check sums errors.

Agilent's N5432A FlexRay option (Option FRS) for the 6000 Series mixed signal oscilloscopes offer a robust set of FlexRay frame, slot, and error triggering, including the ability to trigger on specific FlexRay communications qualified on base-cycle and cycle-repetition. This oscilloscope FlexRay measurement system combines an Agilent 6000 Series mixed signal oscilloscope (MSO) with a DECOMSYS::BUSDOCTOR 2 protocol analyzer from Dependable Computer Systems GmbH (DECOMSYS) to provide the first time-correlated slot/segment boundary display of the global FlexRay timing schedule on an oscilloscope.

Specifications

Triggering
- Frame: Frame ID, Frame type (Sync, Startup, Normal, Null, ~ Null, Cycle-base/repetition
- Timing: Slot #, Segment type (Static, Dynamic, Symbol Window, NIT), Cycle-base/repetition
- Errors: All, plus extensive list of specific errors

Decoding
- Frame: Frame type, Frame ID, cycle, payload length, header CRC, payload, frame CRC
- Timing: Slot #, cycle, segment
- Error: Refer to data sheet

For detailed specifications, refer to data sheet (5989-6220EN)

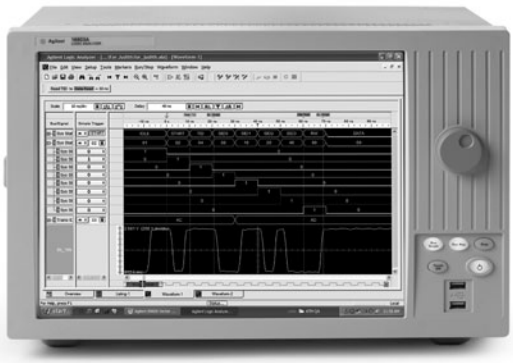
Key Literature & Web Link

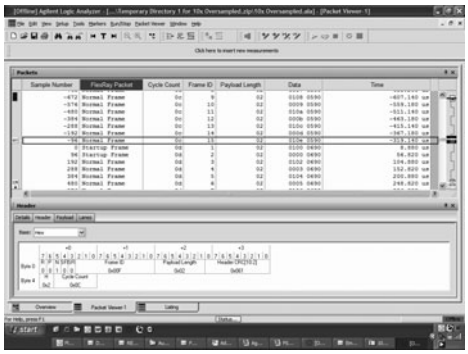
CAN/LIN (N5424A) and FlexRay (N5432A) Options for Automotive Applications Using Agilent's 6000 Series Oscilloscopes Data Sheet, p/n 5989-6220EN

www.agilent.com/find/flexray

16800 Series
16900 Series
B4655A
B4656A
B4641A

- **Trigger, view and analyze at the packet level with solutions that support CAN/LIN, FlexRay and proprietary protocols**
- **Save time making measurements with application – specific analysis probes that quickly and reliably connect to your device under test**
- **Display processor mnemonics or bus cycle decode**
- **Get control over your FPGA's internal and external data**





Save Time Analyzing your Automotive Designs with a Turnkey Logic Analyzer Setup

Agilent logic analyzers are the perfect choice for debugging complex automotive systems. Logic analyzers provide support for hundreds of channels, each backed with acquisition memory up to 256 M deep. You can make time-correlated measurements across multiple buses and analyze complex timing and trigger relationships from a single interface. In addition, you can easily make time-correlated measurements between an Agilent logic analyzer and oscilloscope. The time-correlated logic analyzer and oscilloscope waveforms are integrated into a single logic analyzer waveform display for easy viewing and analysis.

Accurate Measurements Start with Reliable Probing

A wide range of connector-less, connector, flying-lead and application-specific probing solutions that support data rates of 1500 Mb/s are available. Agilent Technologies and our partners provide an extensive range of quality probes and analysis tools that offer non-intrusive, full-speed, real-time analysis to accelerate your automotive debug process. Support for automotive buses includes:

- FlexRay
- CAN
- LIN
- SPI
- I^2C

Trigger, Search, View and Analyze at the Packet Level

With Agilent's packet viewer you can quickly gain insight into your system in a familiar protocol format. The packet viewer provides summarized and detailed packet information in a single display. The event editor allows you to specify trigger and search events in terms of protocol packets. The B4641A Protocol Development Kit gives you the additional flexibility to create a decode solution for a proprietary protocol or modify the protocol decoder for an existing industry standard.

For more information on specific logic analyzers see pages 179-190.

Quickly Debug your Xilinx or Altera FPGA and Surrounding System

FPGAs play an increasingly important role in your automative designs. Getting visibility across critical internal interactions and integrating those results with surrounding system activity is essential. Agilent's FPGA dynamic probes provide you with x-ray vision for your FPGAs.

B4655A FPGA Dynamic Probe for Xilinx

- Gain visibility into the internal activity of your Xilinx FPGAs. Access up to 128 internal signals for each pin dedicated to debug
- Switch internal probe points in seconds to measure a different set of internal signals without changing your FPGA design
- Leverage the work you did in your design environment. The FPGA dynamic probe maps internal signal names from your ISE design software to the logic analyzer. Automated bus name and signal setup eliminates mistakes and saves time
- Supported Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series

B4656A FPGA Dynamic Probe for Altera

- Gain visibility into the internal activity of your Altera FPGAs. Access up to 256 internal signals for each pin dedicated to debug
- Switch internal probe points in seconds to measure a different set of internal signals without changing your FPGA design
- Leverage the work you did in your design environment. The FPGA dynamic probe maps internal signal names from your Quartus design software to the logic analyzer. Automated bus name and signal setup eliminates mistakes and saves time
- Altera device support: Stratix series, Cyclone series, MAX series, APEX series, and Excalibur series

Key Literature & Web Link

Application Support for Agilent Logic Analyzers Configuration Guide, p/n 5966-4365E

www.agilent.com/find/pnbs
www.agilent.com/find/logic-sw-apps

Ordering Information

B4655A FPGA Dynamic Probe for Xilinx
  B4655A-011 Perpetual Node Locked License
  B4655A-012 Perpetual Floating (server) License
B4656A FPGA Dynamic Probe for Altera
  B4656A-010 Perpetual Node Locked License
  B4656A-020 Perpetual Floating (server) License
Protocol Development Kit
  B4641A-010 Perpetual Node Locked License
  B4641A-020 Perpetual Floating (server) License

N6700 Low-Profile Modular Power System

- **Very Fast to change both current and voltage minimizing test time for automotive high volume manufacturing**
- **Up to four 50 W, 100 W, or 300 W power modules in the required N6700 mainframe**
- **Small size: 1U of rack space**
- **Choose from 20 different DC power modules: Basic to High-performance**
- **Connect via built-in GPIB, LAN, or USB**
- **LXI class C compliant**

N5700 Series System DC Power Supplies

- **Single Output – simulates car battery**
- **750 W and 1500 W high-power single-output power supplies**
- **Small size: 1U of rack space**
- **LAN, USB and GPIB interfaces standard**
- **LXI class C compliant**

N3300A Series Configurable DC Electronic Loads

- **Ideal for simulating loads thus increasing production efficiency in high volume automotive electronic module manufacturing**
- **6-slot full-rack width and 3-slot half-rack width mainframes, 1800 W max**
- **7 interchangeable electronic load modules, 150 W to 600 W**
- **Up to 240 V, 120 A**

N3300

N6702A

Good measurements start with good power. "Device Under Test" power requires a versatile selection of power supplies. New Agilent supplies have just the power requirements you need, whatever your application looks like.

Agilent's Newest Power Supplies for the Automotive Market: Fast and Compact

- N5700 Series DC Power Supplies, single output, 1500 Watt
- N6700 Modular Power System, 1 – 4 Outputs, 50 – 300 Watt per output

The N6700B is a 1 U, 4 slot mainframe that accepts 1 to 4 modules in any combination. Modules are ordered separately. Maximum output power in this series is 1200 W. For applications that need higher output power, the N5700A series offers up to 1560 W in a compact 1 U package that offers solid performance and a variety of basic and enhanced capabilities.

Electronic Loads for Automotive Testing

- N3300 Series DC Electronic Load, 1 – 6 Channels, up to 1800 Watt

The Agilent N3300A is a full-rack-width mainframe with 6-slots that accepts combinations of N330x user-installable load modules (150 W to 600 W) for easy system configuration and future reconfiguration. The N3300A holds up to six N3302A, N3303A, N3304A, and N3307A load modules, or up to three N3305A and N3306A load modules, allowing up to 1800 W of total maximum power.

Specifications

N6700

Mainframes

- **N6700B** 400 W Modular Power System Mainframe (4-slots, 400 W total power)
- **N6701A** 600 W Modular Power System Mainframe (4-slots, 600 W total power)
- **N6702A** 1200 W Modular Power System Mainframe (4-slots, 1200 W total power)

Modules

	N6731B	N6732B	N6733B	N6734B	N6735B	N6736B
Power	50 W	50 W	50 W	52.5 W	50 W	50 W
V-range	5 V	8 V	20 V	35 V	60 V	100 V
I-range	10 A	6.25 A	2.5 A	1.5 A	0.8 A	0.5 A

Note: Required mainframe – N6700B, N6701A, or N6702A

	N6741B	N6742B	N6743B	N6744B	N6745B	N6746B
Power	100 W	100 W	100 W	105 W	100 W	100 W
V-range	5 V	8 V	20 V	35 V	60 V	100 V
I-range	20 A	12.5 A	5 A	3 A	1.6 A	1 A

Note: Required mainframe – N6700B, N6701A, or N6702A

	N6773A	N6774A	N6775A	N6776A
Power	300 W	300 W	300 W	300 W
V-range	20 V	35 V	60 V	100 V
I-range	15 A	8.5 A	5 A	3 A

Note: Required mainframe – N6700B, N6701A, or N6702A

	N6751A	N6752A	N6761A	N6762A
Power	50 W	100 W	50 W	100 W
V-range	50 V	50 V	50 V	50 V
I-range	5 A	10 A	1.5 A	3 A

Note: Required mainframe – N6700B, N6701A, or N6702A

More detailed specifications at **www.agilent.com/find/N6700**

N5700

	N5741A	N5742A	N5743A	N5744A	N5745A	N5746A
Power	600 W	720 W	750 W	760 W	750 W	760 W
V-range	6 V	8 V	12.5 V	20 V	30 V	40 V
I-range	100 A	90 A	60 A	38 A	25 A	19 A

	N5747A	N5748A	N5749A	N5750A	N5751A	N5752A
Power	750 W	760 W	750 W	750 W	750 W	780 W
V-range	60 V	80 V	100 V	150 V	300 V	600 V
I-range	12.5 A	9.5 A	7.5 A	5 A	2.5 A	1.3 A

	N5761A	N5762A	N5763A	N5764A	N5765A	N5766A
Power	1080 W	1320 W	1500 W	1520 W	1500 W	1520 W
V-range	6 V	8 V	12.5 V	20 V	30 V	40 V
I-range	180 A	165 A	120 A	76 A	50 A	38 A

	N5767A	N5768A	N5769A	N5770A	N5771A	N5772A
Power	1500 W	1520 W	1500 W	1500 W	1500 W	1560 W
V-range	60 V	80 V	100 V	150 V	300 V	600 V
I-range	25 A	19 A	15 A	10 A	5 A	2.6 A

More detailed specification at **www.agilent.com/find/N5700**

N3300

Mainframes

- **N3300A** Full-rack Width, 6-slot, 1800 W Max Mainframe
- **N3301A** Half-rack Width, 2-slot, 600 W Max Mainframe

Modules

	N3302A	N3303A	N3304A	N3305A	N3306A	N3307A
Current	0 – 30 A	0 – 10 A	0 – 60 A	0 – 60 A	0 – 120 A	0 – 30 A
Voltage	0 – 60 V	0 – 240 V	0 – 60 V	0 – 150 V	0 – 60 V	0 – 150 V
Maximum Power	150 W	250 W	300 W	500 W	600 W	250 W

Note: Required mainframe – N3300A or N3301A

More detailed specifications at **www.agilent.com/find/N3300**

Key Literature & Web Link

Agilent N6700 MPS Low-Profile Modular Power System Data Sheet, p/n 5989-1411EN
Agilent N5700 Series System DC Power Supplies Data Sheet, p/n 5989-1330EN
Agilent dc Electronic Loads Models N3300A – N3307A Data Sheet, p/n 5980-0232E
Increase Automotive ECU Test Throughput Application Note 1505, p/n 5989-1682EN

www.agilent.com/find/power

- **34410A and 34411A, dc & ac voltage, dc & ac current, 2 & 4 wire, frequency, period, 50,000 rdgs/s, analog level trigger, DC Voltage = 1000 V**
- **34420A, dc voltage, 2 & 4 wire, low power resistance**
- **3458A dc & ac voltage, dc & ac current, 2 & 4 wire, frequency & period**

53131A

33250A

34410A

Functional and Arbitrary Generators

Cost effective automotive signal source for simulation of VRS and Hall-Effect devices typical automotive frequency generating devices. The ARBS simulates wheel, crankshaft, camshaft, and knock sensors and can also generate PWM signal typical for body control electronics (BCU) application.

- **33220A**, 20 MHz, AM, FM, PM, FSK, and PWM modulation types, output Isolation 42 Vpk maximum to earth
- **33250A**, 80 MHz, 50 MHz pulse waveforms with variable rise/fall times, output Isolation 42 Vpk maximum to earth

Counters

Cost effective automotive counters used in many automotive applications to test time dependent measurements, such as frequency ratios, Time interval, Rise/fall time, Phase, Duty, cycle, Positive/negative pulse width, Totalize, Peak voltage, Time interval average and time interval delay

- **53131A, 53132A, 53181A** dc to 225 MHz (1.5, 3, 5, or 12.4 GHz)

Key Literature & Web Link

Agilent 34410A and 34411A Multimeters: Setting the Standard for Next Generation Benchtop and System Testing Data Sheet, p/n 5989-3738EN
Agilent 33220A 20 MHz Function/Arbitrary Waveform Generator Data Sheet, p/n 5988-8544EN
Agilent 33250A 80 MHz Function/Arbitrary Waveform Generator Data Sheet, p/n 5968-8807EN
Agilent 53131A/132A/181A Counters: High-performance, Low-cost Counters Simplify and Speed Systems and Bench Frequency Measurements Data Sheet, p/n 5967-6039EN

Digital Multimeters
www.agilent.com/find/DMM
Functional & Arbitrary Generators
www.agilent.com/find/generators
Frequency Counters
www.agilent.com/find/counter

34980A
L4400
34970A

34980A Multifunction Switch/Measure Unit

Cost effective automotive switch unit: Built in DMM, fast reed-relays to reduce test time

- 8-slot mainframe with integrated 6½ digital DMM
- 19 plug-in modules with LF/RF/uW switch, DIO, D/A converter, and counter
- 560 2-wire mux or 1024 2-wire matrix cross-points in one mainframe
- Scan rates up to 1,000 channels/sec
- Standard LAN, USB, GPIB connectivity to PC
- LXI class C compliant
- Priced up to 40% less than comparable module solutions in VXI or PXI
- BenchLink Data Logger software offers high-speed data logging with no programming required
- Automotive-focused plug in Modules
  - 34923/24A reed relay matrix card
  - 34938A 20 Ch for higher current automotive loads
  - 34951A 4 Ch Isolated D/A & 200 kHz waveforms (Simulate automotive VRS sensors)
  - 34950A 64 Ch DIO with 2 10 mHz counters
  - 3494xA RF switches for automotive radio and RKE testing

L4400 Series

Provide key system control functionality in a small, scalable, stand-alone LXI standard package, excellent in small automotive test applications for sensors and any low pin count devices

- Low Frequency Switching
  - L4421A 40-ch armature multiplexer
  - L4433A Dual/Quad 4 x 8 reed matrix
  - L4437A 32-ch General Purpose switch
- High Frequency Switching
  - L4445A Microwave switch/attenuator driver
- DIO, D/A, Counter/Timer
  - L4450A 64-bit Digital I/O w/memory
  - L4451A 4 channel D/A converter w/memory
  - L4452A Multifunction w/32 DIO, 2 D/A, counter

34970A Data Acquisition Switch Unit

- Three-slot mainframe, choice of 8-plug-in modules
- 6½ digits (22 bits) of resolution
- Scan rates of up to 250 channels/second
- 60 2-wire mux or 96 2-wire matrix cross-points in one mainframe
- Includes BenchLink Data Logger software to configure and control tests, display results and move data for further analysis

34980A

L4400 Series

34970A

Switching is the heart of a functional test system. All other subsystems interact with it in some way. Agilent has a number of effective switching solutions suitable for use in automotive functional tests.

- 34980A Multifunction Switch/Measure Mainframe and Modules for high channel count & versatile applications
- L4400 Series LXI Switch and Control Instruments
- 34970A Data Acquisition/Switch Mainframe and Modules for multiplexing, switching and smaller general purpose applications

Specifications

34980A RF/Microwave Switching

The 34980A was engineered to be the heart of your functional test system. An integrated 6½ digit DMM connects to an internal 8 wire bus that in turn connects to matrix, mux and general purpose relays configured in various ways.

Mainframe

34980A Multifunction switch/measure mainframe – holds up to 8 plug-in modules

Automotive-focused Plug-in Modules

	Description	Max Volts	Max Current	BW (MHz)	Scan ch/sec	Thermal Offset	Comments
34923A	40/80-channel reed multiplexer	±150 V	0.5 A	45 MHz	500	<50 uV	Config as 1-wire, 2-wire or 4-wire
34924A	70-channel reed multiplexer	±150 V	0.5 A	25 MHz	500	<50 uV	Config as 2-wire or 4-wire
34938A	20-channel 5-amp Form A	250 AC	5 A	1 MHz	—	<3 uV	—

	Description	Insertion Loss	Isolation	Freq Range	VSWR	Input Impedance	Comments
34941A	Quad 1 x 4 50 ohm 3 GHz RF multiplexer	0.6 dB	>58 dB	3 GHz	<1.25	50 Ω	@1 GHz
34942A	Quad 1 x 4 75 ohm 1.5 GHz RF multiplexer	0.6 dB	>60 dB	1.5 GHz	<1.35	75 Ω	@1 GHz
34945A/ 34945EXT	Microwave switch/attenuator driver	Can drive up to 64 external switch coils; 32 SPDT switches, 8 multiport switches, 8 attenuators, or your own combination. Expand with additional 34945EXTs					
34946A	Dual 1 x 2 SPDT terminated microwave switch	<0.42 dB <0.69 dB	>85 dB >67 dB	4 GHz or 20 GHz	<1.15 <1.30	50 Ω	@4 GHz @20 GHz
34947A	Triple 1 x 2 SPDT unterminated microwave switch	<0.42 dB <0.69 dB	>85 dB >67 dB	4 GHz or 20 GHz	<1.15 <1.30	50 Ω	@4 GHz @20 GHz

	Description	Information
34950A	64-bit digital I/O with memory and counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V, with 7 handshaking protocols and pattern memory. Two 10-MHz frequency counter/totalizers and programmable clock output to 20MHz
34951A	4-channel isolated D/A converter with waveform memory	Output DC voltage up to ±16 V or DC current up to ±20 mA Output waveforms with a 200 kHz update rate and 16 bits of resolution Use on-board memory to create point-to-point waveforms with more than 500,000 points

Complete list of modules and more detailed specifications at **www.agilent.com/find/34980**

34826A BenchLink Data Logger Software for 34980A. This Windows®-based application offers high-speed data logging with no programming required.

L4400 Series LXI Switch and Control Instruments

The Agilent L4400 series switch and control instruments offer high-performance switching, digital I/O, D/A converters, counter/ totalizer and more in standalone LXI instruments.

Low Frequency Switching	Max Volts	Max Current	Scan Ch/Sec
L4421A 40 Channel Armature	±300 V	1 A	100
L4433A Dual 4 x 8 Reed Matrix	±150 V	0.5 A	500
L4437A			
28 Channel Form C	300 V	1 A	—
4 Channel Form A	30 VDC/250 VAC	5 A	—

RF and Microwave Switching	
L4445A Microwave Switch/Attenuator Driver	Drive up to 64 external switch coils; 32 SPDT switches, 8 multiport switches, 8 attenuators, or custom combination

System Measurement and Control	
L4450A 64-Bit Digital I/O with Memory and Counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V with handshaking protocols and 128 kbytes pattern memory. Two 10 MHz frequency counters and programmable clock output
L4451A 4 Channel Isolated D/A Converter with Memory	Output DCV up to ±16 V or DC current up to ±20 mA. Output waveforms w/200 kHz update rate and 16 bit resolution. 500 k memory for waveform
L4452A Multifunction	Four 8-bit digital I/O channels, 2 Channel ±12 V analog outputs, 100 kHz gated totalizer

Switching and Data Logging (cont.)

34970A Data Acquisition Switch Unit

The 34970A Data Acquisition Control Unit is a compact, economical, one-box solution for data logging, data acquisition, and general-purpose switching and control applications.

	Description	Speed (ch/sec)	Max Voltage	Max Current	Comments
34901A	20-ch. multiplexer (2/4-wire)	60	300 V	1 A	2 current channels (22 ch. total); built-in cold junction reference; connects to internal DMM
34902A	16-ch. multiplexer (2/4-wire)	250	300 V	50 mA	Built-in cold junction reference; reed relays multiplex inputs to internal DMM
34903A	20-ch. actuator/GP switch	120	300 V	1 A	Form C (SPDT) switches; no connection to internal DMM
34904A	4 x 8 matrix	120	300 V	1 A	2-wire, full crosspoint; no connection to internal DMM
34905A	2-GHz dual 1:4 RF mux, 50 Ω	60	42 V	0.7 A	1-GHz through provided BNC-to-SMB adapter cables; no connection to internal DMM
34906A	2-GHz dual 1:4 RF mux, 75 Ω	60	42 V	0.7 A	1-GHz through provided BNC-to-SMB adapter cables; no connection to internal DMM
34907A	Two 8-bit digital IO ports 26-bit, 100-kHz event counter Two 16-bit analog outputs	—	42 V 42 V ±12 V	400 mA 10 mA	Open drain; gated, selectable input threshold; Earth referenced; calibrated; no connection to internal DMM
34908A	40-ch. single-ended multiplexer	60	300 V	1 A	Common low, no 4-wire meas. Built-in cold junction reference; connects to internal DMM
34970A	Data Acquisition/Switch Unit. Three-slot mainframe with internal 6½ digit DMM. GPIB, RS-232 and 50 K reading non-volatile memory with timestamp.				

Key Literature & Web Link

Agilent 34980A Multifunction Switch/Measure Unit Data Sheet, p/n 5989-1437EN
Agilent 34970A Data Acquisition/Switch Unit Data Sheet, p/n 5965-5290EN
L4400 Series LXI Switching and Control Summary, p/n 5989-4921EN
Automotive Electronic Functional Test Using Agilent System Components Application Note, p/n 5989-3364EN

www.agilent.com/find/34980A
www.agilent.com/find/L4400
www.agilent.com/find/LXI

- **RF Signal Generator N9310A, 9 kHz to 3 GHz, –127 to +13 dBm output power, CW and analog modulations**
- **RF Signal Generator MXG Series, 100 kHz – 6 GHz, –127 to +13 dBM, analog or vector signal generation**
- **RF Handheld Spectrum Analyzer N9340A, 100 kHz – 3 GHz, –144 dBm DANL (w. preamplifier)**
- **RF Spectrum Analyzer N9320A, 9 kHz to 3 GHz, –148 dBm DANL, 10 Hz – 1 MHz RBW, +13 dBm TOI**
- **RF Signal Spectrum Analyzers MXA Series, 20 Hz – 26.5 GHz, –154 dBm DANL**

In today's car architecture there are multiple applications which need RF test and measure solutions. Popular automotive applications are RF fading simulation, modulation and demodulation of keyless access telegrams and signal analysis of radar transmitters.

Agilent, the worldwide No.1 for signal source generators, power meters, spectrum, network and impedance analyzers, delivers the widest range of solutions in these application areas.

N9310A RF Signal Generator

The Agilent N9310A RF signal generator is one of the new products in Agilent low cost RF test and measurement family, offering ultra high price/performance for customers in consumer electronics manufacturing, base station installation and maintenance, and education teaching lab, as well as low cost research and development.

Rich function set in one box at an affordable price enables you to easily initiate your new projects. Adequate logical hardkeys and interface, USB connectivity, and SCPI compatible make either front panel operation or remote control easy to start-up. What is more, the multi-language user interface helps you to recognize the software menu faster and easier, accelerating front panel operations.

Now, with the exceptionally low price of the N9310A signal generator, you can afford to own Agilent test equipment you always wanted.

- Complete function set at an ultra low initial cost
- Professional performance: 9 kHz to 3 GHz CW and swept output, 20 Hz to 80 kHz low frequency coverage, –127 to +13 dBm amplitude coverage, –95 dBm SSB phase noise, AM/FM/ΦM/ Pulse modulation
- Enhanced usability
- Optional analog IQ input (80 MHz RF bandwidth)

For more information on N9310A, please refer to page 275 or visit **www.agilent.com/find/N9310A**

N5181A MXG Analog Signal Generator

Featuring fast frequency and amplitude switching, high reliability, and simplified self-maintenance – all in two rack units (2RU) – Agilent MXG analog is optimized to provide accurate and repeatable reference signals in R&D and manufacturing. Agilent MXG analog provides better value for your investment by increasing throughput, maximizing uptime, and saving rack space. With scalable RF performance, the Agilent MXG analog is easily configured to meet your specific test needs, including LO and clock substitution, CW interferers, and modulated signals for analog communication systems such as AM, FM, and ΦM.

- Frequency range from 100 kHz to 1, 3 or 6 GHz
- Fast switching speeds
- Simplified self-maintenance
- ΦM, AM, FM, and pulse modulation
- LAN with LXI class C compliance, USB, GPIB connectivity

For more information on MXG, please refer to page 276 or visit **www.agilent.com/find/mxg**

N9340A Handheld Spectrum Analyzer

The Agilent N9340A handheld spectrum analyzer has superior sensitivity with the narrowest RBW and lowest DANL in its class

- Frequency range: 100 kHz to 3 GHz
- RBW: 30 Hz to 1 MHz in 1-3-10 sequence
- VBW: 3 Hz to 1 MHz
- SSB phase noise: –87 dBc at 30 kHz offset
- DANL: (10 MHz<fc≤1.5 GHz)
  - –124 dBm
  - –144 dBm with preamplifier on
- Sweep speed
  - 10 ms to 1000s, span ≥1 kHz
  - <120 ms at full span
- Amplitude accuracy: ±1.5 dB
- 7.2" sunlight-viewable LCD
- >4 hours battery operating time
- Modern USB connectivity for data transfer and PC control
- 11-language UI
- Tracking generator and preamplifier are options

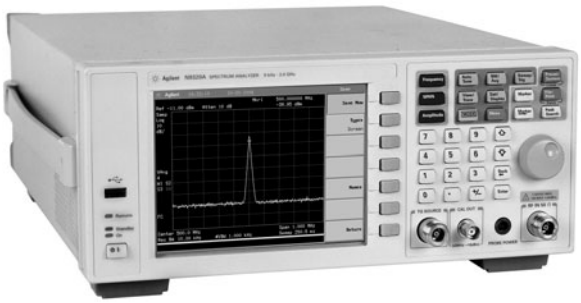
For more information on N9340A, please refer to page 137 or visit **www.agilent.com/find/N9340A**

N9320A RF Spectrum Analyzer

As an entry level spectrum analyzer, N9320A is armed with exceptional price/performance and enhanced usability.

- Fast sweep: 9.2 ms minimum non-zero span sweep time
- Narrow Res BW: 10 Hz to 1 MHz
- DANL: –130 dBm, –148 dBm (with preamp on)
- TOI: +13 dBm
- Auto tune homes in on the highest level of signal across the bandwidth
- Power Suite measures RF power easily

For more information on N9320A, please refer to page 136 or visit **www.agilent.com/find/N9320A**



N9020A MXA Series RF Signal Analyzer

The MXA signal analyzer drives signal and spectrum analysis to the next level by offering the highest performance in a midrange analyzer and the industry's fastest signal and spectrum analysis.

- 30 to 300% faster than other analyzers
- Optional 25 MHz analysis bandwidth
- +15 dBm TOI, –154 dBm/Hz DANL
- 0.3 dB absolute amplitude accuracy
- 78 dB W-CDMA ACLR dynamic range
- Built in one-button measurement applications for Mobile WiMAX™, W-CDMA, HSDPA/HSUPA, phase noise, and more
- World-leading 89601A vector signal analysis software runs inside

For more information on MXA, please refer to page 115 or visit **www.agilent.com/find/mxa**

Major Product Features
- **Full master and slave emulation capability**
- **Accurate timing measurements with 10 µs resolution**
- **LIN Go editor to connect signals to graphical objects in the PC environment**
- **Extensive online and offline protocol analysis capabilities**

Real-time Control
- **Easy-to-use script editor**
- **All script functions realized in HW application. Guarantees real-time behavior**
- **Predefined functions for controlling protocol properties and error emulation**
- **Digital I/O for external triggering or input**

Technical Specifications
- **Supports all LIN revisions up to 2.0**
- **MS Windows XP compatible**
- **32-bit MCU-based HW**
- **Compatible with LIN 12 V and 24 V buses**

LIN Tester

The Agilent J8115A LIN Tester combines in just one product version, both analyzing as well as emulating capabilities. The tool consists of only two components: an external hardware box and PC-based software. There is no need for external adapters or transceivers.

Complete Emulation and Analysis

The PC software operates in an MS Windows® XP environment and provides all features needed to do effective emulation and analysis in a LIN network. Starting with a LIN Description File (LDF) import, the LIN Tester software allows for monitoring and displaying of all LIN network related data. Signals are decoded, nodes, frames and all other information is displayed and can be accessed. Emulation can be started codeless, without the need to program.

Key emulation and analysis features are:
- Advanced analysis with logical name and scaled physical value
- Full emulation of one or many nodes (master and/or slave)
- Communication logging and replay of captured traces (also offline)
- Start and stop logging can be controlled via logic-based triggers
- An external trigger can be used to access external devices like logic analyzers or scopes
- Detection and triggering on an extensive list of protocol errors
- Extract protocol timing information from the captured trace
- User can switch between schedule tables or modify signal values of all emulated nodes on the fly

Advanced API

The programming interface allows control of the LIN Tester's advanced emulation features through a C-like programming language, LEC (LIN Emulation Control) and enables flexible test automation through LEC scripts. It allows full control over frame contents (sync byte, ID, payload, checksum), a programmatic error injection to stress the robustness of the system (variable break length, inter byte times, framing errors, no answer, extra bytes, wrong checksum, transfer speed) and to switch schedules, change speed, sleep/wake up. Its LEC scripts are compiled in the PC software environment and downloaded into the LIN Tester hardware guaranteeing proper real-time behavior.

GUI Control Panels with LIN Go

The included LIN Go application supports the creation of sophisticated GUI control panels to enable test automation control and comfortable visualization. LIN Go allows you to visualize and manipulate signal and network data and to control LEC script execution by graphical objects. It provides an easy-to-use editor that allows the user to add pictures and predefined objects such as image lists and gauges to the panels. The software distribution contains a set of easy to use sample files that allow a fast start of creating its own LIN Go applications.

Diagnostic Transport Layer Test

In order to test Diagnostic Transport Layer software implementation in LIN nodes, the user can assemble and run LIN diagnostic sequences with pre- or user defined diagnostic requests, delays and schedule table changing. Predefined diagnostic services, requests and responses can be independently set up in the software. The LIN diagnostic tool has two modes: Diagnostic and Spy. In Diagnostic mode, LIN Tester sends diagnostic requests and monitors the response. In Spy mode, LIN Tester only monitors, and "decodes" the diagnostic activity on the LIN bus.

Key Literature & Web Link

Agilent J8120A VPT501 Vehicle Protocol Tester Series 500 Data Sheet, p/n 5989-6818EN
Agilent J8115A LIN Tester Data Sheet, p/n 5989-6817EN

www.agilent.com/find/lintester
www.agilent.com/find/vpt501
www.agilent.com/find/automotive-test

Ordering Information

J8115A LIN Tester

J8120A VPT501 Vehicle Protocol Tester Series 500

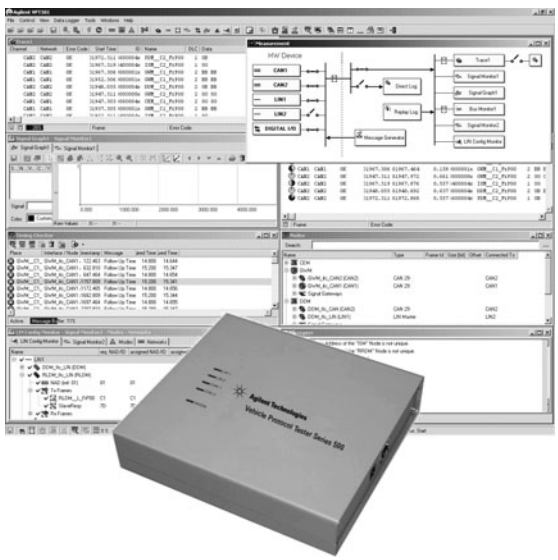
J8120A

Hardware Features
- 2 CAN, 2 LIN interfaces
- Integrated transceivers for High Speed and Fault Tolerant CAN
- 8 configurable digital I/O
- Standalone data logger mode

Technical Specifications
- 1 µs time stamp synchronized across all interfaces
- 100 Mbps Ethernet link to PC or network
- Integrated 2 GB memory
- Supports internal/external trigger sources

Configurability
- Import existing network databases, such as CAN database files (.dbc), LIN descriptor files (.ldf); measurement configuration files (.mcf)
- Automatic communication parameter testing
- Single click node and network emulation
- Codeless functional chain verification

Software Capabilities
- Powerful comprehensive analysis features
- Effectively identify network timing errors (system, node, and gateway)
- Test and verify signal chain tolerances
- Develop customized simulations and tests



The J8120A VPT501 Vehicle Protocol Tester Series 500 addresses the needs of today's advancing automotive challenges brought about by the growth of distributed electrical communication systems. The Vehicle Protocol Tester uses innovative methods to isolate all complexities of network related errors within distributed systems to enable communication robustness and deliver a higher degree of system quality.

VPT501

The VPT501 from the Agilent Vehicle Protocol Tester Series 500 is the next generation of vehicle communication test tools, redefining the test and validation of networked systems. With a highly versatile hardware interface combined with unique and powerful software features, the VPT501 creates a testing environment loaded with functionality needed for validating networked system behavior. Especially useful for identifying network communication failure points associated with complex gateway timing analysis, digital to protocol and protocol to digital signal measurements, and also verification of node level communication requirements. The VPT501 provides a complete and comprehensive solution that will prove invaluable to those with networked system test and validation needs.

Hardware

VPT501 hardware was developed on the concept of a single test product does it all by providing flexibility of interfaces for connections to Controller Area Networks (2x), Local Interconnect Networks (2x), Digital I/O (8x), hardware triggering, and standalone data logging capabilities. All network interfaces include software enabled transceivers and termination resistors for making the appropriate physical layer connections to any test environment without customization of cables.

The VPT501 is controlled from the host PC via LAN to ensure maximum flexibility and enable remote usage.

Key Literature & Web Link

Agilent J8120A VPT501 Vehicle Protocol Tester Series 500 Data Sheet, p/n 5989-6818EN
Agilent J8115A LIN Tester Data Sheet, p/n 5989-6817EN

www.agilent.com/find/lintester
www.agilent.com/find/vpt501
www.agilent.com/find/automotive-test

Ordering Information

J8120A VPT501 Vehicle Protocol Tester Series 500

TS-5020

- **Just enough test capability system based on the industry-leading Agilent 34980A**
- **Open software and hardware architecture for future enhancements**
- **WW support and customization team with the expertise to meet specific customer requirements**

TS-5020 (E2240A L2000 Mac Panel)

With the look and feel of the higher-end TS-5400 Series II, the TS-5020 addresses the requirements for a lower cost measurement system catered for medium pin count range with light duty switching. Its diverse ability to test simple ECMs like airbag, ABS/TC and tire pressure monitoring has made it possible for the TS-5020 to meet price for performance value.

Specifications

Interface
Express Connect & L2000 Mac Panel
Controller
Advantech IPC Industrial Grade PC
Test Executive
Agilent TestExec SL current release 5.1.3, preloaded with the TS-5400 Autolibs which provide more than 609 actions
GPIB Instrumentation
Variety of GPIB equipments to enhance your measurement capabilities
Power Supply
GPIB power supplies from the Agilent 66xxA family ranging from 200 W to 2000 W, including the new modular power supply from the N67xxB family with LXI capability
Serial Communications
Engenius Multicom III – Multipurpose communication adapter capable of supporting common automotive communication protocols like ISO 9141, ISO 9141-2, CAN, J1939, J1850, Ford SCP, Fault Tolerant CAN, Single or Dual Wire CAN
Switching
Measurement switching provided by Agilent 34980A, Multifunction Switch/Measurement Unit with built-in 6.5 digit DMM which allows for both DC and RF switching
Mini Switch/Load Unit (SLU)
6-slot mini SLU designed with a flexible load topology capable of meeting any load strategy

Key Literature & Web Link

Product Note, p/n 5989-5460EN
Catalog, p/n 5989-5857EN & 5989-6283EN

www.agilent.com/find/ts5020
www.agilent.com/find/automotive

5

Automotive Electronics Functional Test Systems

Automotive Functional Test Systems and TestExec SL Software

- **High test throughput for automotive functional test applications**
- **Fast test generation process using integrated hardware and software**
- **Reliable high quality tests for automotive manufacturers**
- **Flexible architecture allows re-use and investment protection**

TS-5400 (E8780B Express Connect)

TS-5400 (E8786B Series 75 Mac Panel)

TS-5410 (E2230A Low Profile Express Connect)

Agilent's Automotive Test Systems provide customers with a scalable family of software compatible testers allowing rapid test development and significantly decreasing cost of test. These systems can be configured to test many different Electronic Control Modules (ECMs) for the customer to buy just enough test capability. The test and measurement capability of these systems ensures high quality tests for these electronics manufacturers. Agilent's global delivery and support provides customers with the ability to easily transport their test systems as manufacturers balance worldwide capacity.

TS-5400

The TS-5400 is available in two configurations. The full size E8780B system with the Express Connect interface can handle 30 to 150 test points. This model is ideal for testing ABS, traction control, airbag, navigation, information, and entertainment modules.

The high-performance E8786B system offers additional measurement horsepower for complex modules such as those used for engine management, power train control and body electronics. A Mac Panel test system interface provides maximum flexibility when connecting with devices with 50 to 300 test points.

TS-5410

The TS-5410 automotive functional test system is a fully integrated platform ideal for low pin count applications. This system is capable enough to deliver a complete measurement solution yet small enough to fit beneath standard conveyor lines. The TS-5410 uses the Low Profile Express Connect interface that provides tremendous flexibility for specific test requirements and is pre-wired and fully documented for easy integration into production lines.

TestExec SL Software

All systems include fully integrated software and documentation. TestExec SL software is a mature test executive that combines with the TS-5400 application software to provide a development environment and a library of over 400 test routines. Its integrated programming language – Microsoft Visual Basic for Applications (VBA) – supports rapid system development and debugging.

Accessories

Stand alone accessories, spare parts and upgrades are available for all test system families, and can be ordered using the following reference numbers:
E8781A for the E878XB systems or the
E2231A for the E2230A systems

Key Literature & Web Link

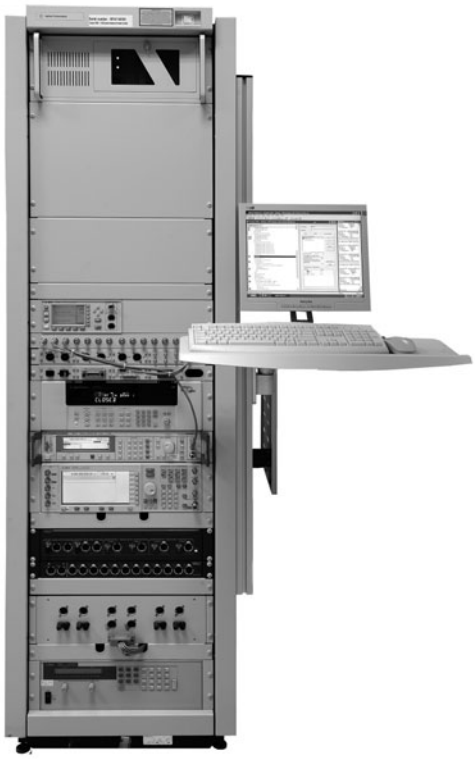
Product Note, p/n 5989-6784E
Catalog, p/n 5989-5857EN, 5989-6283EN

www.agilent.com/find/ts5400
www.agilent.com/find/ts5410
www.agilent.com/find/automotive

TS-5030

Testing of:

- **AM/FM/RDS Simulation**
- **In-car GPS**
- **In-car Bluetooth compatible applications**
- **DAB/DVB Broadcasts**
- **In-vehicle Mobile Communications**
- **ISDB-T**



TS-5030

The new TS-5030 is an infotainment system that allows you to focus on your desired test with upward compatibility as required. It is more than just a system – It's a total solution that can be customized to your needs, including the fixturing and interface.

This infotainment platform is capable of managing a broad range of tests for analog as well as digital broadcasting, mobile communications and telematics information networks.

Specifications

- Audio loadbox that handles up to 6 channels – 4 fixed and 2 customizable
- Audio analysis that provides reliable and accurate test capabilities
- AM/FM/RDS simulation
- GPS simulation of single and multi satellite signals using I/Q files allowing flexibility on data content and length
- Using I/Q files to enable DAB/DVB/ISDB-T
- Customization
- Combination of XLR, SMA, BNC
- Express Connect
- L2000 Mac Panel

Key Literature & Web Link

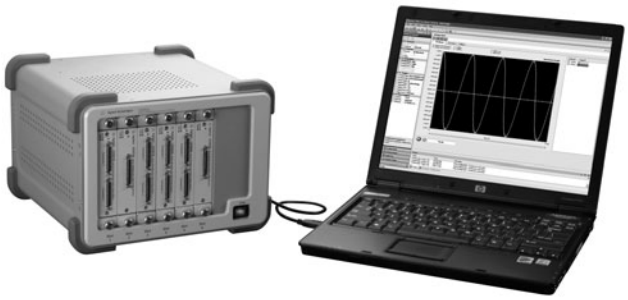
Data Sheet, p/n 5989-6643EN

www.agilent.com/find/ts5030
www.agilent.com/find/automotive

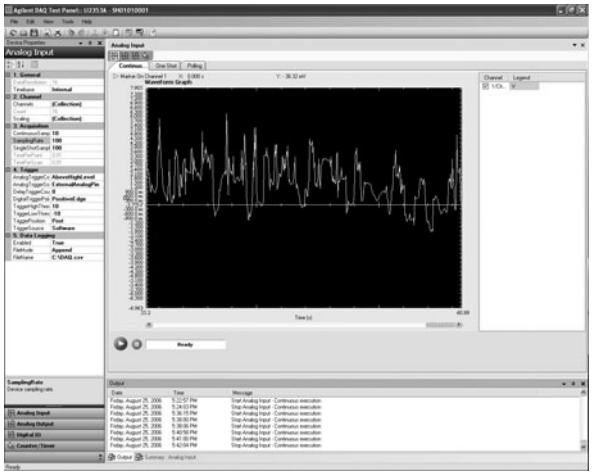
U2300A USB Data Acquisition Device

- **Up to 3 MSa/s single channel sampling rate**
- **Functions as a standalone or modular unit**
- **Plug-and-play setup and hot-swappable**
- **Up to 384 channels when incorporated into the U2781A chassis**
- **Includes Agilent Modular Instruments Measurement Manager software for easy configuration and data logging to PC**
- **Compatible with a wide variety of Application Development Environments**

The U2300A data acquisition device setup in standalone operation.



The U2300A data acquisition device setup in modular operation, with the U2781A chassis.



The Agilent Modular Instruments Measurement Manager software interface.

The Agilent U2300A Series USB modular multifunction data acquisition (DAQ) devices are available in seven models that provide 16 or 64 inputs at a variety of sampling rates. With high sampling rates of up to 3 MSa/s, you can easily detect intermittent failures. These compact devices enable easy expansion of system channel count when used with the U2700A Series chassis. Module setup and configuration are quick and simple through plug-and-play functionality and the bundled Agilent Modular Instruments Measurement Manager software. The U2300A Series is also compatible with popular Application Development Environments like Agilent VEE, LabVIEW and Microsoft® Visual Studio®. You simply need to install the IVI-COM driver to enable the U2300A Series to interact with Agilent VEE or Microsoft Visual Studio.

U2700A Series USB Modular Instrument Chassis

The compact 4U high Agilent U2700A Series USB modular instrument chassis uses AC power and includes an external trigger input, a trigger output and an external reference clock input of 10 MHz. With slots for up to six U2300A Series DAQ devices, the chassis allows expansion of up to 384 channels for various test and measurement applications. The U2700A has Hi-Speed USB 2.0 interface for plug-and-play setup and hot-swappable connectivity. It also offers simultaneous synchronization of the modules, and star trigger bus for synchronization between external trigger source and the modules. For convenient installation into a test system, the chassis is mountable with an optional rack mount kit.

Agilent Modular Instruments Measurement Manager

The Agilent Modular Instruments Measurement Manager comes bundled with the U2300A or U2700A Series. This ready-to-use application data viewer software is designed for quick configuration, measurement control, data logging and acquisition with the U2300A Series DAQ devices and U2700A Series chassis. Key features include the following:

- Analog input with continuous, single shot and polling modes
- Analog output with voltage output, and function and arbitrary waveform generation modes
- Digital input/output function
- Digital counter with totalizer and measurement modes
- Save/recall instrument configuration
- Save/load previously logged data
- Graph display of waveform output
- Channel editor for channel configuration and customization
- Data export to Microsoft Excel (CSV), text and HTML formats
- Self-calibration function

Software Requirements

- Windows 2000/XP
- Agilent IO Libraries Suite & DAQ hardware driver
- Agilent T&M Toolkit 2.1 Runtime version
- Microsoft .NET Framework 2.0

U2300A Specifications

	Basic Multifunction USB DAQ				High Density Multifunction USB DAQ		
	U2351A	**U2352A**	**U2353A**	**U2354A**	**U2355A**	**U2356A**	**U2331A**
Analog Input							
Resolution	16 bits, no missing codes				16 bits, no missing codes	16 bits, no missing codes	12 bits, no missing codes
Number of Channels	16 SE/8 DI (software selectable/ch)				64 SE/32 DI (software selectable/ch)		
Maximum Sampling Rate	250 kSa/s	250 kSa/s	500 kSa/s	500 kSa/s	250 kSa/s	500 kSa/s	3 MSa/s (single channel) 1 MSa/s (multiple channels)
Scan List Memory	Up to 100 selectable channel entries						
Programmable Bipolar Input Range	±10 V, ±5 V, ±2.5 V, ±1.25 V				±10 V, ±5 V, ±2.5 V, ±1.25 V	±10 V, ±5 V, ±2.5 V, ±1.25 V	±10 V, ±5 V, ±2.5 V, ±1.25 V, ±1 V, ±0.5 V, ±0.25 V, ±0.2 V, ±0.05 V
Programmable Unipolar Input Range	0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V				0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V	0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V	0 to 10 V, 0 to 5 V, 0 to 4 V, 0 to 2.5 V, 0 to 2 V, 0 to 1 V, 0 to 0.5 V, 0 to 0.4 V, 0 to 0.1V
Input Coupling	DC						
Input Impedance	1 GΩ / 100 pF						
Operational Common Mode Voltage Range	±7.5 V maximum						
Overvoltage Protection	Power on: Continuous ±30 V, Power off: Continuous ±15 V						
Trigger Sources	External analog/digital trigger, SSI/star trigger[1]						
Trigger Modes	Pre- trigger, delay-trigger, post-trigger and middle-trigger						
Fifo Buffer Size	Up to 8 MSa						
Analog Output							
Resolution	16 bits	—	16 bits	—	12 bits		
Number of Channels	2	—	2	—	2		
Maximum update rate	1 MSa/s	—	1 MSa/s	—	1 MSa/s		
Output Ranges	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF[2]	—	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF[2]	—	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF[2]		
Output Coupling	DC	—	DC	—	DC		
Output Impedance	0.1 Ω typical	—	0.1 Ω typical	—	0.1 Ω typical		
Stability	Any passive load up to 1500 pF	—	Any passive load up to 1500 pF	—	Any passive load up to 1500 pF		
Power on State	0 V steady state	—	0 V steady state	—	0 V steady state		
Trigger Sources	External analog/ digital trigger, SSI/star trigger[1]	—	External analog/ digital trigger, SSI/star trigger[1]	—	External analog/ digital trigger, SSI/star trigger[1]		
Trigger Modes	Post-trigger and delay-trigger	—	Post-trigger and delay-trigger	—	Post-trigger and delay-trigger		
FIFO Buffer Size	1 channel: Maximum 8 MSa 2 channels: Maximum 4 MSa/ch	—	1 channel: Maximum 8 MSa 2 channels: Maximum 4 MSa/ch	—	1 channel: Maximum 8 MSa 2 channels: Maximum 4 MSa/ch		
Function Generation Mode	Sine, square, triangle, sawtooth and noise waveforms	—	Sine, square, triangle, sawtooth and noise waveforms	—	Sine, square, triangle, sawtooth and noise waveforms		

[1] System Scynchronous Interface (SSI) and star trigger commands are used when the modular device is incorporated into the chassis.
[2] Maximum external reference voltage for analog output channels (AO_EXT_REF) is ±10 V.

U2300A USB Data Acquisition Device (cont.)

	Basic Multifunction USB DAQ				High Density Multifunction USB DAQ		
	U2351A	U2352A	U2353A	U2354A	U2355A	U2356A	U2331A
Digital I/O							
Number of Channels	24-bit programmable input/output						
Compatibility	TTL						
Input Voltage	V_{IL} = 0.7 V max, I_{IL} = 10 µA max V_{IH} = 2.0 V min, I_{IH} = 10 µA max						
Input Voltage Range	–0.5 V to +5.5 V						
Output Voltage	V_{OL} = 0.45 V max, I_{OL} = 8 mA max V_{OH} = 2.4 V min, I_{OH} = 400 µA max						
General Purpose Digital Counter (GPC)							
Maximum Count	$(2^{31}–1)$ bits						
Number of Channels	2 independent up/down counter						
Compatibility	TTL						
Clock Source	Internal or external						
Base Clock Available	48 MHz						
Maximum Clock Source Frequency	12 MHz						
Input Frequency Range	0.1 Hz to 6 MHz at 50% duty cycle						
Pulse Width Measurement Range	0.167 µs to 178.956 s						
Analog Trigger							
Trigger Source	All analog input channels, External analog trigger (EXTA_TRIG)						
Trigger Level	±Full scale for internal; ±10 V for external						
Trigger Conditions	Above high, below low and window (software selectable)						
Trigger Level Resolution	8 bits						
Bandwidth	400 kHz						
Input Impedance for EXTA_TRIG	20 kΩ						
Coupling	DC						
Overvoltage Protection	Continuous for ±35 V maximum						
Digital Trigger							
Compatibility	TTL/CMOS						
Response	Rising or falling edge						
Pulse Width	20 ns minimum						
Calibration[1]							
On Board Reference Voltage	5 V						
Temperature Drift	±2 ppm/°C						
Stability	±6 ppm/1000 hrs						
General							
Remote Interface	USB 2.0 High Speed						
Device Class	USBTMC class device						
Programmable Interface	Standard Commands for Programmable Instruments (SCPI) and IVI-COM						

[1] Recommended warm-up time is 20 minutes.

U2700A Specifications

Remote Interface
USB 2.0 high speed; USBTMC class device
Dimension
270 mm (W) x 271.2 mm (D) x 197 mm (H)
Each Slot Dimension
25.4 mm (W) x 174.54 mm (D) x 105 mm (H)

Minimum System Requirements

Operating System
Windows® 2000 or higher
PC Hardware
500 MHz Pentium III or higher, 256 MB RAM, 40 GB hard disk space, CD-ROM drive, USB 2.0 high speed interface

Key Literature & Web Link

U2300A data sheet, p/n 5989-5626EN
U2781A data sheet, p/n 5989-5762EN

For more information on U2300A Series **www.agilent.com/find/U2300A**
For more information on U2700A Series **www.agilent.com/find/U2700A**
To watch U2300A Series interactive product showcase and demos **www.agilent.com/find/U2300A_showcase**

Ordering Information

U2351A 16 bits, 16SE/8DI, 250 kSa/s, USB Modular Multifunction Data Acquisition
U2352A 16 bits, 16SE/8DI, 250 kSa/s, no Analog Output, USB Modular Multifunction Data Acquisition
U2353A 16 bits, 16SE/8DI, 500 kSa/s, USB Modular Multifunction Data Acquisition
U2354A 16 bits, 16SE/8DI, 500 kSa/s, no Analog Output, USB Modular Multifunction Data Acquisition
U2355A 16 bits, 64SE/32DI, 250 kSa/s, USB Modular Multifunction Data Acquisition
U2356A 16 bits, 64SE/32DI, 500 kSa/s, USB Modular Multifunction Data Acquisition
U2331A 12 bits, 64SE/32DI, 3 MSa/s, USB Modular Multifunction Data Acquisition
U2781A 6-slot USB Modular Instrument Chassis

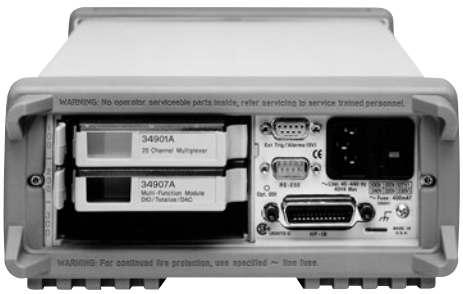
Includes 2m Mini B-type USB Cable, L-Mount Kit, Agilent IO Libraries Suite 14.2 CD, Product Reference CD (includes Agilent Modular Instruments Measurement Manager software, Quick Start Guide, Programming Guide, and User's Guide), Quick Start Guide and Certificate of Calibration

U2781A USB Modular Instrument Chassis
Includes USB interface cable, Quick Start Guide, Functional Test Certificate, Product Reference CD and Agilent IO Libraries Suite 14.2 CD

Accessories
U2901A Terminal Board and SCSI-II 68-pin Connector with 1-meter Cable
U2902A Terminal Board and SCSI-II 68-pin Connector with 2-meter Cable
U2905A Rack Mount Kit for U2781A

- 3-slot data acquisition and switching mainframe
- 6½-digit (22 bit) internal DMM
- 11 built-in measurement functions
- 8 switch and control plug-in modules
- BenchLink data logger software included

34970A (Front Panel)



34970A (Back Panel)

34970A Data Acquisition/Switch Unit

The Agilent 34970A is a high performance, low-cost data acquisition and switching mainframe ideal for data logging, data acquisition, and general-purpose switching and control applications. It consists of a half-rack mainframe with an internal 6½-digit (22 bit) digital multimeter. Three module slots are built into the rear of the unit to accept a combination of switch and control modules. Whether you need a few channels of simple data logging or a hundred channels of ATE performance, the 34970A meets your data acquisition needs at a price that meets your budget.

Measurements you can Trust

The 34970A incorporates the measurement engine from our best-selling benchtop digital multimeter (DMM). You get the benefit of proven Agilent performance, universal inputs with built-in signal conditioning, and modular flexibility, all in a low-cost, compact data acquisition package. The 34970A features 6½ digits (22 bits) of resolution, 0.004% basic dcV accuracy, and ultra-low reading noise. Combine that with scan rates of up to 250 channels/sec, and you've got the speed and accuracy you need to get the job done.

Powerful Flexibility

The 34970A's unique design allows per-channel configurability for maximum flexibility and quick, easy setup. The internal autoranging DMM measures 11 different functions directly, eliminating the need for expensive external signal conditioning. Temperature conversion routines are built-in to display raw thermocouple, RTD, or thermistor inputs in degrees C, F, or Kelvin. Use Mx+B scaling to convert linear transducer outputs directly into engineering units. You can even set high/low alarm limits to warn you of out-of-tolerance conditions.

Custom Configurations that Grow with You

Three module slots and eight switch and control modules allow you to customize the 34970A to meet your unique requirements. Buy only what you need, and add more modules later as your application grows. Measure up to 120 inputs with a single half-rack unit.

Free BenchLink Software Simplifies your Data Gathering

If you want PC-based data logging capabilities, but don't want to spend hours programming, BenchLink Data Logger is the answer. Use it to set up your test, acquire and archive measurement data, and perform real-time display and analysis of the incoming measurements.

A familiar spreadsheet environment makes it easy to configure and control your tests. A rich set of colorful graphics provides many options for displaying your data — all with point-and-click ease. Set up multiple graphics using strip charts, histograms, individual channel results and more. Also use Agilent BenchLink Data Logger to easily move data to other applications for further analysis, or for inclusion in your presentations and reports.

Applications

Data Logging

Configured with the 34901A 20-channel relay multiplexer, the 34970A becomes a rugged, low-cost data logger that's ideal for quick tests in the lab or in the field. An intuitive front panel with self-guiding menus and a bright, easy-to-read vacuum fluorescent display make standalone set-up fast and easy. All readings are automatically time stamped and stored in a 50,000 reading memory — enough memory to hold a week's worth of data (20 channels scanned every five minutes). The non-volatile memory holds your data even after power is removed, so you can use the 34970A to collect data at a remote location for later uploading to a PC. The system configuration is also held in non-volatile memory, so in the event of a power failure the unit automatically resumes scanning when power is returned. And for PC-based testing, Agilent BenchLink Data Logger software is included to simplify your test configurations, data analysis and data management.

Automated Testing

For automated test and benchtop automation applications, the 34970A's three slots and choice of eight plug-in switch and control modules allow easy customization. The 6½-digit internal DMM brings you the power and performance of a world-class standalone DMM, but in a fraction of the space and at a fraction of the cost. Software drivers that support Agilent VEE and National Instruments LabVIEW are available to make an easy integration of the 34970A into your test system. Standard RS-232 and GPIB interfaces and SCPI programming language make integration even easier. A one-year warranty is also standard, as is our proprietary relay maintenance system which automatically counts and stores every individual switch closure to help you predict relay end-of-life and avoid costly production line downtime.

Switching

For test applications that don't require the built-in measurements of the 34970A, the unit can be ordered without the internal DMM. This provides an ultra low-cost solution for routing test signals to and from your device-under-test and assorted instruments, including external DMMs, scopes, counters and power supplies. Plus, you can add the DMM later if your needs change.

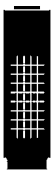
Module Overview

Up to three modules, in any combination, can be inserted into a single mainframe. The 34970A's internal DMM connections are accessible only through the 34901A, 34902A, and 34908A multiplexers. The 34970A accuracy specifications already include the switching offset and reference junction errors shown in the table below; these errors are listed separately for determining system error with external measurement devices.

The **34901A** 20-channel multiplexer is the most versatile module for general-purpose scanning. It combines dense, multi-function switching with 60 channel/second scan rates to address a broad spectrum of data acquisition applications.

The **34902A** 16-channel high-speed multiplexer employs reed relays to achieve scan rates of up to 250 channels-per-second. This module is ideal for high-throughput automated test applications, as well as high-speed data logging and monitoring tasks.

Use the **34903A** 20-channel general-purpose switch module to cycle power to products-under-test, control indicator and status lights, actuate external relays requiring large drive signals, and to build custom switch configurations.



The **34904A** is a two-wire, 4 x 8 full cross-point matrix that gives you the most flexible connection path between your device-under-test and your test equipment, allowing different instruments to be connected to multiple points on your DUT at the same time.

The **34905A** and **34906A** RF multiplexers offer broadband switching capabilities for high-frequency and pulsed signals to 2 GHz. Use them to route test signals between your device-under-test and your signal generator, oscilloscope, spectrum analyzer, video amplifier, or receiver.

The **34907A** multifunction module allows great flexibility for a variety of sense and control applications. It combines two 8-bit ports of digital input and output, a 100 kHz gated totalizer, and two ±12 V analog outputs — all on a single module.

Use the **34908A** 40-channel single-ended multiplexer for the greatest density in common-low applications, such as battery test, component characterization, and benchtop testing.

Module Specifications

Module Description	Type	Connects to Internal DMM	Speed (ch./sec.)	Maximum Input Voltage, Current, Power			Offset Voltage	Bandwidth	Comments
34901A 20-ch. Multiplexer	2-wire armature (4-wire selectable)	yes	60	300 V	1 A	50 W	<3 µV	10 MHz	2 current channels (22 ch. total) Built-in cold junction reference
34902A 16-ch. Multiplexer	2-wire reed (4-wire selectable)	yes	250	300 V	50 mA	2 W	<6 µV	10 MHz	Built-in cold junction reference
34903A 20-ch. Actuator/GP Switch	SPDT / form C	no	120	300 V	1 A	50 W	<3 µV	10 MHz	—
34904A 4 x 8 Matrix	2-wire armature	no	120	300 V	1 A	50 W	<3 µV	10 MHz	Full crosspoint
34905A Dual 1: 4 RF Mux, 50 Ω	Common Low (unterminated)	no	60	42 V	0.7 A	20 W	<6 µV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
34906A Dual 1: 4 RF Mux, 75 Ω	Common Low (unterminated)	no	60	42 V	0.7 A	20 W	<6 µV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
34907A Multifunction Module	Two 8-bit digital I/O ports 26-bit event counter Two analog outputs	no no no	— — —	42 V 42 V ±12 V	400 mA — 10 mA	— — —	— — —	— 100 kHz dc	Open drain Gated; selectable input threshold 16-bit, earth referenced
34908A 40-ch. single-ended Mux	1-wire armature (common low)	yes	60	300 V	1 A	50 W	<3 µV	10 MHz	No 4-wire measurements

These are abbreviated specifications. For more detailed information on the 34970A, refer to publication number 5965-5290.

Accuracy Specifications ±(% of reading + % of range)[1]

Includes measurement error, switching error and transducer conversion error

Function	Range[2]	Frequency, etc.	1 Year 23°C ± 5°C
DC Voltage	100.0000 mV		0.0050 + 0.0040
	1.000000 V		0.0040 + 0.0007
	10.00000 V		0.0035 + 0.0005
	100.0000 V		0.0045 + 0.0006
	300.000 V		0.0045 + 0.0030
True RMS AC Voltage[3]	100.0000 mV to 100.0000 V	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.35 + 0.04
		10 Hz – 20 kHz	0.06 + 0.04
		20 kHz – 50 kHz	0.12 + 0.05
		50 kHz – 100 kHz	0.60 + 0.08
		100 kHz – 300 kHz[4]	4.00 + 0.50
	300.0000 V	3 Hz – 5 Hz	1.00 + 0.08
		5 Hz – 10 Hz	0.35 + 0.08
		10 Hz – 20 kHz	0.06 + 0.08
		20 kHz – 50 kHz	0.12 + 0.12
		50 kHz – 100 kHz	0.60 + 0.20
		100 kHz – 300 kHz[4]	4.00 + 1.25
Resistance[5]	100.0000 Ω	1 mA current source	0.010 + 0.004
	1.000000 kΩ	1 mA	0.010 + 0.001
	10.00000 kΩ	100 µA	0.010 + 0.001
	100.0000 kΩ	10 µA	0.010 + 0.001
	1.000000 MΩ	5.0 µA	0.010 + 0.001
	10.00000 MΩ	500 nA	0.040 + 0.001
	100.0000 MΩ	500 nA || 10 MΩ	0.800 + 0.010
Frequency and Period[6]	100 mV to 300 V	3 Hz – 5 Hz	0.10
		5 Hz – 10 Hz	0.05
		10 Hz – 40 Hz	0.03
		40 Hz – 300 kHz	0.01
DC Current (34901A only)	10.00000 mA	<0.1 V burden	0.050 + 0.020
	100.0000 mA	<0.6 V	0.050 + 0.005
	1.000000 A	<2 V	0.100 + 0.010
True RMS AC Current[3] (34901A only)	10.00000 mA to 1.00000 A	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.30 + 0.04
		10 Hz – 5 kHz	0.10 + 0.04
	100.0000 mA[7]	3 Hz – 5 Hz	1.00 + 0.5
		5 Hz – 10 Hz	0.30 + 0.5
		10 Hz – 5 kHz	0.10 + 0.5

Temperature	Type	Best Range Accuracy[8]	
Thermocouple	B	1100°C to 1820°C	1.2°C
	E	–150°C to 1000°C	1.0°C
	J	–150°C to 1200°C	1.0°C
	K	–100°C to 1200°C	1.0°C
	N	–100°C to 1300°C	1.0°C
	R	300°C to 1760°C	1.2°C
	S	400°C to 1760°C	1.2°C
	T	–100°C to 400°C	1.0°C
RTD	R_0 from 49 Ω to 2.1 kΩ	–200°C to 600°C	0.06°C
Thermistor	2.2 k, 5 k and 10 k	–80°C to 150°C	0.08°C

Measurement Characteristics[9]

DC Voltage	
Measurement Method	Continuously integrating multi-slope III A – D Converter
A – D Linearity	0.0002% of reading + 0.0001% of range
Input Resistance	
100 mV, 1 V, 10 V ranges	Selectable 10 MΩ or >10,000 MΩ
100 V, 300 V ranges	10 MΩ ± 1%
Input Bias Current	<30 pA at 25°C
Input Protection	300 V all ranges
True RMS AC Voltage	
Measurement Method	AC coupled True RMS – measures the AC component of the input with up to 300 Vdc of bias on any range
Crest Factor	Maximum of 5:1 at full scale
Additional Crest Factor Errors (non-sinewave)	Crest Factor 1 – 2 0.05 % of reading Crest Factor 2 – 3 0.15 % of reading Crest Factor 3 – 4 0.30 % of reading Crest Factor 4 – 5 0.40 % of reading
Input Impedance	1 MΩ ± 2% in parallel with 150 pF
Input Protection	300 V_{rms} all ranges
Resistance	
Measurement Method	Selectable 4-wire or 2-wire Ohms Current source referenced to LO input
Offset Compensation	Selectable on 100 Ω, 1 kΩ, 10 kΩ ranges
Maximum Lead Resistance	10% of range per lead for 100 Ω and 1 kΩ ranges 1 kΩ on all other ranges
Input Protection	300 V on all ranges
Frequency and Period	
Measurement Method	Reciprocal counting technique
Voltage Ranges	Same as AC voltage function
Gate Time	1 s, 100 ms, or 10 ms
Measurement Timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit
DC Current	
Shunt Resistance	5 Ω for 10 mA, 100 mA; 0.1 Ω for 1 A
Input Protection	1 A 250 V fuse on 34901A module
True RMS AC Current	
Measurement Method	Direct coupled to the fuse and shunt. AC coupled True RMS measurement (measures the ac component only)
Shunt Resistance	5 Ω for 10 mA; 0.1 Ω for 100 mA, 1 A
Input Protection	1 A 250 V fuse on 34901A module
Thermocouple	
Conversion Conformity	ITS-90 based software routines
Reference Junction Type	Internal, Fixed, or External
Open Thermocouple Check	Selectable per channel. Open >5 kΩ
RTD	Type α = 0.00385 (DIN) and α = 0.00392
Thermistor	44004, 44007, 44006 series
Measurement Noise Rejection 60 (50) Hz[10]	
dc CMRR	140 dB
ac CMRR	70 dB
Integration Time	**Normal Mode Rejection**[11]
200 plc/3.33 s (4 s)	110 dB[12]
100 plc/1.67 s (2 s)	105 dB[12]
20 plc/334 ms (400 ms)	100 dB[12]
10 plc/167 ms (200 ms)	95 dB
2 plc/33.3 ms (40 ms)	90 dB
1 plc/16.7 ms (20 ms)	60 dB
<1 plc	0 dB

[1] Specifications are for 1-hour warm-up and 6½ digits, slow ac filter.
[2] 20% over range on all ranges except 300 Vdc and ac ranges and 1 A dc and ac current ranges.
[3] For sinewave input >5% of range. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range additional error.
[4] Typically 30% of reading error at 1 MHz, limited to 1 x 108 V Hz.
[5] Specifications are for 4-wire ohms function or 2-wire ohms using scaling to remove the offset. Without scaling, add 1 Ω additional error in 2-wire ohms function.
[6] Input >100 mV. For 10 mV inputs, multiply % of reading error x 10.
[7] Specified only for inputs >10 mA.
[8] 1 year accuracy. For total measurement accuracy, add temperature probe error.
[9] 300 Vdc, ac rms isolation voltage (ch-ch, ch-Earth).
[10] For 1 KΩ unbalance in LO lead.
[11] For power line frequency ±0.1%.
[12] For power line frequency ±1%, use 40 dB or ±3% use 30 dB.

Operating Characteristics[1]

Single Channel Measurement Rates[2]

Function	Resolution	Reading/s
dcV, 2-wire Resistance	6½ digits (10 plc)	6 (5)
	5½ digits (1 plc)	57 (47)
	4½ digits (0.02 plc)	490
Thermocouple	0.1°C (1 plc)	57 (47)
	(0.02 plc)	280
RTD, Thermistor	0.01°C (10 plc)	6 (5)
	0.1°C (1 plc)	47 (47)
	1°C (0.02 plc)	280
acV	6½ Slow (3 Hz)	0.14
	6½ Med (20 Hz)	1
	6½ Fast (200 Hz)	8
	6½[3]	100
Frequency, Period	6½ digits (1s gate)	1
	5½ digits (100 ms)	9
	4½ digits (10 ms)	70

System Speeds[4]	Channel/s
INTO Memory	
Single channel dcV	490
34902A scanning dcV	250
34907A scanning digital in	250
34902A scanning dcV with scaling and 1 alarm fail	220
34907A scanning totalize	170
34902A scanning temperature	160
34902A scanning acV[3]	100
34902A scanning dcV/Ohms on alternate channels	90
34901A/34908A scanning dcV	60
INTO and OUT of Memory to GPIB or RS-232 (init/fetch)	
34902A scanning dcV	180
34902A scanning dcV with timestamp	150
OUT of Memory to GPIB	
Readings	800
Readings with timestamp	450
Readings with all format options ON	310
OUT of Memory to RS-232	
Readings	600
Readings with timestamp	320
Readings with all format options ON	230
DIRECT to GPIB or RS-232	
Single channel dcV	440
34902A scanning dcV	200
Single channel MEAS DCV10/MEAS DCV 1	25
Single channel MEAS DCV/ MEAS OHMS	12
BenchLink Performance	
Scan and save to disk with 2 strip-charts displayed	100

System Specifications

Scanning Inputs	
Analog	34901A, 34902A, and 34908A multiplexer channels
Digital	34907A digital in and totalize
Scan list	Scans channels in ascending order
Triggering	
Source	Interval, external, button press, software, or on monitor channel alarm
Scan count	1 to 50,000 or continuous
Scan interval	0 to 99 hours; 1 ms step size
Channel delay	0 to 60 seconds per channel; 1 ms step size
External trig delay	<300 µs. With monitor on <200 ms
External trig jitter	<2 ms
Alarms	
Analog inputs	Hi, Lo, or Hi + Lo evaluated each scan
Digital inputs	34907A digital in: maskable pattern match or state change 34907A totalize: Hi limit only
Monitor channel	Alarm evaluated each reading
Alarm outputs	4 TTL compatible; selectable TTL logic Hi or Lo on fail
Latency	5 ms (typical)
Memory (Battery backed, 4 year typical life[5])	
Readings	50,000 with timestamp Readable during scan
States	5 instrument states with user label
Alarm queue	Up to 20 events with channel number, reading, and timestamp
System Features	
Per-channel math	Individual Mx + B scaling and Min/Max/Average calculated real time
Power fail recovery	Resumes scanning automatically
Relay maintenance	Counts each relay closure and stores on module User resettable
Real time clock	Battery-backed, 4 year typical life[5]

Software

Agilent BenchLink Data Logger 3 (not included with Option 001)

System Requirements[2]	
Operating System	Windows 98SE, NT® 4.0 SP6a, 2000 SP4, XP SP2 Adobe® Acrobat® Reader V5.0 or higher (to view documentation) Microsoft® Internet Explorer V6.0 or higher (required when using Windows NT®)
Controller	Recommend Pentium® 4, 800 MHz or greater, Min: Pentium III, 500 MHz
RAM	Recommend 256 MB or greater, Min 128 MB
Disk Space	Recommend 200 MB, Min 100 MB
Display	800 x 600 resolution, 256 colors
Computer Interfaces[7]	
GPIB	Agilent and National Instruments PCI-GPIB
LAN-to-GPIB	E5810A
USB-to-GPIB	82357A
	RS-232 (Serial Port) PC COM 1-4

General

Power Supply: 100 V/120 V/220 V/240 V ± 10%
Power Line Frequency: 45 Hz to 66 Hz automatically sensed
Power Consumption: 12 W (25 VA peak)
Operating Environment:
Full accuracy for 0°C to 55°C
Full accuracy to 80% R.H. at 40°C
Storage Environment: –40°C to 70°C
Weight: Net: 3.6 kg (8.0 lbs)
Safety: Conforms to CSA, UL-1244, IEC 1010 Cat I
RFI and ESD: CISPR 11, IEC 801/2/3/4

Ordering Information

34970A Data Acquisition/Switch Unit
Includes internal 6½ digit DMM, operating and service manuals (CD ROM), test report, power cord, and Quick Start package (includes Agilent Benchlink Data Logger software, RS-232 cable, thermo-couple, and screw-driver). Modules are purchased separately and are required to operate.
- **34970A-001** Delete Internal DMM
  Same as above but deletes DMM and quick start package
  Order 34970-80010 to retrofit DMM at a later time
- **34970A-1CM** Rackmount Kit
- **34970A-0B0** Delete Manual Set

34901A 20-Channel Armature Multiplexer
34902A 16-Channel Reed Multiplexer
34903A 20-Channel Actuator/General Purpose Switch
34904A 4 x 8 Two-Wire Matrix Switch
34905A Dual 4-Channel RF Multiplexer, 50 Ohms
Includes (10) SMB-to-BNC(f) 50 Ω adapter cables
34906A Dual 4-Channel RF Multiplexer, 75 Ohms
Includes (10) SMB-to-BNC(f) 75 Ω adapter cables
34907A Multifunction Module
34908A 40-Channel Single-Ended Multiplexer

Accessories
34161A Accessory Pouch
34131A Hard Carrying Case
E5810A LAN/GPIB Gateway
82357A USB to GPIB Converter
34970-80010 DMM Field Installation Kit
Fully calibrated with Test Report and Quick Start Kit

[1] Reading speeds for 60 Hz and (50 Hz) operation.
[2] For fixed range and function, readings to memory, scaling and alarms off, autozero off.
[3] Maximum limit with default settling delays defeated.
[4] Speeds are for 4½ digits, delay 0, display off, autozero off. Using 115 kB RS-232 setting.
[5] Storage at temperatures above 40°C will decrease battery life.
[6] Software provided on CD-ROM and includes utility to create floppy disks for installation.
[7] Interface and driver must be purchased separately.

34980A Multifunction Switch/Measure Mainframe and Modules

34980A

- **8-slot mainframe with 19 different plug-in modules so you can create your own custom configuration**
- **High-performance switching: Up to 560 2-wire multiplexer channels or 1024 matrix cross-points in one mainframe**
- **Optional built-in 6½ -digit DMM lets you make 11 measurements with up to 2000 readings/sec**
- **Easy to integrate: Built-in Ethernet, USB 2.0, and GPIB connectivity, standard connectors and software drivers for most common programming environments**
- **Optional BenchLink data logger software for easy data collection and analysis**
- **LXI class C compliant**

34980A Front & Back Panel

34980A Modules, Terminal Blocks & Cables

High-performance Unit Provides Low-cost Alternative to PXI and VXI Switch and Measurement Platforms

If you use automated test equipment for design validation or manufacturing, you now have a cost-effective alternative to PXI and VXI based test-system platforms. The 34980A multifunction switch/measure unit provides comparable functionality that is much easier to use than PXI and VXI and costs less. The 34980A helps you lower your cost of test and accelerate your test-system integration and development.

The 34980A handles your system switching needs up to 20 GHz and provides basic measurements and system control. It offers optional DMM measurements, counter/totalizer functionality, digital I/O with pattern capabilities, and analog outputs with basic waveforms – all in one low-cost, compact box. And with its standard connectors and software drivers, computer-standard I/O, and Web browser interface, the 34980A easily integrates into electronic functional test and data acquisition systems.

Flexible Switching, Measurements, and System Control

The 34980A accommodates up to 8 plug-in modules to give you the flexibility you need. Choose from 19 different modules to define your own configuration. You can buy what you need now and add to it or reconfigure it as your requirements change.

Whether you are measuring temperature, AC or DC voltage, resistance, frequency, current, or custom measurements, the 34980A offers the functionality you need in a single box. Switch in different measurements with high-performance signal switching – no external signal conditioning is required. Choose between different switch types and topologies with frequency ranges from DC to 20 GHz. The 34980A offers high-density multiplexers for scanning multiple channels, matrices for connecting multiple points at one time, and general purpose switches for simple control and high power needs.

The 34980A also offers flexible choices for system control. You can control external devices such as microwave switches, attenuators, solenoids, and power relays. Or use the digital inputs to sense limit-switch and digital-bus status.

Optimized for Test Systems

Your signals are switched to the right measurement device without compromising signal integrity. Switch your signals to the optional internal DMM and achieve optimal throughput on switch closure time.

The rugged instrument comes with a variety of system-ready features:

- Web browser interface shows settings at a glance and provides remote access and control
- Self-guiding front panel to configure, troubleshoot or view data
- Low EMI and efficient system cooling
- Heavy-duty cabling and connection options
- Rackmount options
- Relay counters help predict end-of-life
- In-rack calibration for reduced maintenance time
- DMM measurement accuracies include the switch for simple calculations

Make system connections easily and quickly with simple, reliable connection options:

- Built-in Ethernet, USB 2.0, and GPIB connectivity
- Standard IVI and LabVIEW software drivers
- Low-cost, standard 50- or 78-pin Dsub connectors and cables
- Detachable terminal blocks with strain relief
- Mass interconnect solutions

Easier signal routing with four 2-wire internal analog buses. You can route your measurements directly to the internal DMM, or you can connect to external instruments through the analog bus connector on the rear of the mainframe. And since you have four 2-wire buses, you can dedicate one bus for use with the internal DMM and use the other three buses for module extensions or additional signal routing between modules, reducing your wiring needs.

Measurements you can Trust

Get proven performance from Agilent instruments, with the resolution, repeatability, speed, and accuracy you've come to expect.

The 34980A offers built-in signal conditioning and modular flexibility. When you use it with the internal DMM, you can configure each channel independently for the measurements you choose. It includes a variety of features that give you confidence in your measurements:

- $6^{1}/_{2}$ digits of resolution with .004% of accuracy with DC voltage measurements
- Alarms per channel – high limit, low limit, or both
- Math functions – use Mx+B for custom linear conversions and converting raw inputs
- Built-in thermocouple reference for temperature measurements (34921T)
- Time-stamped readings

The integrated DMM is mounted inside the mainframe and does not consume any of the eight user-available slots and gives you the flexibility to measure 11 types of inputs:

- Temperature with thermocouples, RTDs, or thermistors (with 34921A)
- DC and AC voltage
- 2- and 4-wire resistance
- Frequency and period
- DC and AC current

BenchLink Data Logger Software for Easy Data Collection and Analysis

The Agilent 34826A BenchLink Data Logger software provides a convenient way to collect and analyze your data from a windows-based application. The tab-based format makes it easy to set up and initiate scans. Simply identify the measurements you want to acquire, initiate the process, and see the data displayed real-time. You can specify individual channel setups, set alarms and perform statistical calculations to analyze the data points you want. Graph your data, save it to disk or export it to other applications for presentation and analysis.

Also get the high performance of the 34980A. Log data at speeds up to 900 ch/sec with the FET multiplexer, or take advantage of the high-density capabilities of the 34980A. Get PC-based data logging capability without spending hours programming.

Standard Interfaces Take the Hassle Out of Connecting to your PC

Standard Ethernet, USB and GPIB

Standard interfaces are included in every mainframe. Use one of the interfaces that is already available in your computer, or if you prefer, GPIB is still available.

Remote Access and Control

The built-in Web browser interface provides remote access and control of the instrument via a Java-enabled browser such as Internet Explorer. Using the Web interface, you can set up, troubleshoot, and maintain your system remotely.

- View and modify instrument setup
- Open, close, or monitor switches
- Send SCPI commands
- Define and execute switch sequences
- View error queue
- Get status reports on relay counts

The Web interface makes it easy to set up, troubleshoot and maintain your system remotely.

Works With your Choice of Software

You can save time and preserve your software and hardware investments. You can program directly with SCPI, use BenchLink Data Logger or IVI or LabVIEW software drivers that provide compatibility with the most popular development environments and tools.

Modules at a Glance

The 34980A mainframe holds up to eight plug-in modules. Mix and match them to create a custom system to meet your switching and system control needs. You can easily add or replace modules as your needs change.

Low Frequency Switch

Modules		Max Volts	Max Current	BW (MHz)	Scan ch/sec	Thermal Offset	Comments
34921A	40-channel armature multiplexer w/ low thermal offset	±300 V	1 A	45 MHz	100	<3 µV	Temperature reference 4 current channels Config as 2- or 4-wire
34922A	70-channel armature multiplexer	±300 V	1 A	25 MHz	100	<3 µV	Config as 2- or 4-wire
34923A	40/80-channel reed multiplexer	±150 V	0.5 A	45 MHz	500	<50 µV	Config as 1-, 2- or 4-wire
34924A	70-channel reed multiplexer	±150 V	0.5 A	25 MHz	500	<50 µV	Config as 2- or 4-wire
34925A	40/80-channel optically isolated FET multiplexer	±80 V	0.05 A	1 MHz	1000	<3 µV	Config as 1-, 2- or 4-wire
34931A	Dual 4x8 armature matrix	±300 V	1 A	30 MHz	100	<3 µV	Backplane expandable
34932A	Dual 4x16 armature matrix	±300 V	1 A	30 MHz	100	<3 µV	Backplane expandable
34933A	Dual/Quad 4x8 reed matrix	±150 V	0.5 A	30 MHz	500	<50 µV	Backplane expandable Config as 1- or 2-wire
34937A	28-channel Form C and 4-channel Form A	300 V 250 VAC	1 A 5 A	10 MHz	—	<3 µV <3 µV	— —
34938A	20-channel 5-amp Form A	250 VAC	5 A	1 MHz	—	<3 µV	—

RF & Microwave

Modules		Insertion Loss	Isolation	Freq Range	VSWR	Input Impedance	Comments
34941A	Quad 1x4 50 ohm 3 GHz RF multiplexer	0.6 dB	>58 dB	3 GHz	<1.25	50 Ω	@1 GHz
34942A	Quad 1x4 75 ohm 1.5 GHz RF multiplexer	0.6 dB	>60 dB	1.5 GHz	<1.35	75 Ω	@1 GHz
34945A/ 34945EXT	Microwave switch/attenuator driver	Can drive up to 64 external switch coils; 32 SPDT switches, 8 multiport switches, 8 attenuators, or your own combination. Expand with additional 34945EXTs.					
34946A	Dual 1x2 SPDT terminated microwave switch	<0.42 dB <0.69 dB	>85 dB >67 dB	4 GHz or 20 GHz	<1.15 <1.30	50 Ω	@4 GHz @20 GHz
34947A	Triple 1x2 SPDT unterminated microwave switch	<0.42 dB <0.69 dB	>85 dB >67 dB	4 GHz or 20 GHz	<1.15 <1.30	50 Ω	@4 GHz @20 GHz

System Control Modules		Description
34950A	64-bit digital I/O with memory and counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V, with handshaking protocols and pattern memory. Two 10-MHz frequency counter and programmable clock output to 20 MHz.
34951A	4-channel isolated D/A converter with waveform memory	Output DC voltage up to ±16 V or DC current up to ±20 mA. Output waveforms with a 200 kHz update rate and 16 bits of resolution. Use on-board memory to create point-to-point waveforms with more than 500,000 points.
34952A	Multifunction module with 32-bit DIO, 2-ch D/A and totalizer	Four 8-bit digital I/O channels, two ±12 V analog outputs, and a 100-kHz gated totalizer.
34959A	Breadboard module	Create your own custom designs with access to the +12 V and +5 V supplies, 16 GPIO ports and 28 relay drive lines.

DC Accuracy[1] ±(% of reading + % of range)

Includes measurement error, switching error and transducer conversion error

Function	Range[4]	Frequency, etc.	1 Year[2] Tcal ± 5°C
DC Voltage (with 34921A/ 22A/25A/31A/ 32A)[10]	100.0000 mV	–	0.0050 + 0.0040
	1.000000 V	–	0.0040 + 0.0007
	10.00000 V	–	0.0035 + 0.0005
	100.0000 V	–	0.0045 + 0.0006
	300.000 V	–	0.0045 + 0.0030
True RMS AC Voltage[5]	100.0000 mV to 100.0000 V	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.35 + 0.04
		10 Hz – 20 kHz	0.06 + 0.04
		20 kHz – 50 kHz	0.12 + 0.05
		50 kHz – 100 kHz	0.60 + 0.08
		100 kHz – 300 kHz[5]	4.00 + 0.50
	300.0000 V	3 Hz – 5 Hz	1.00 + 0.08
		5 Hz – 10 Hz	0.35 + 0.08
		10 Hz – 20 kHz	0.06 + 0.08
		20 kHz – 50 kHz	0.12 + 0.12
		50 kHz – 100 kHz	0.60 + 0.20
		100 kHz – 300 kHz[6]	4.00 + 1.25
Resistance[7]	100.0000 Ω	1 mA	0.010 + 0.004
	1.000000 kΩ	1 mA	0.010 + 0.001
	10.00000 kΩ	100 µA	0.010 + 0.001
	100.0000 kΩ	10 µA	0.010 + 0.001
	1.000000 MΩ	5.0 µA	0.010 + 0.001
	10.00000 MΩ	500 nA	0.040 + 0.001
	100.0000 MΩ	500 nA 10 MΩ	0.800 + 0.010
Frequency and Period[8]	100 mV to 300 V	3 Hz – 5 Hz	0.10
		5 Hz – 10 Hz	0.05
		10 Hz – 40 Hz	0.03
		40 Hz – 300 kHz	0.01
DC Current (34921A only)	10.00000 mA	<0.1 V burden	0.050 + 0.020
	100.0000 mA	<0.6 V	0.050 + 0.005
	1.000000 A	<2 V	0.100 + 0.010
True RMS AC Current (34921A only)	10.00000 mA[5] and 1.0 A	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.30 + 0.04
		10 Hz – 5 Hz	0.10 + 0.04
	100.0000 mA[9]	3 Hz – 5 Hz	1.00 + 0.5
		5 Hz – 10 Hz	0.30 + 0.5
		10 Hz – 5 kHz	0.10 + 0.5

[1] One hour warm-up and a fixed configuration with slow AC filter, sine wave input, and 6½ digits. Temperature within ±5°C of temperature at calibration (Tcal between 18 – 28°C).
[2] 90 minute warm-up and a fixed configuration and 6½ digits. Temperature within ±1°C of temperature at calibration (Tcal between 18 – 28°C).
[3] Relative to calibration standards.
[4] 20% over range on all ranges except 300 VDC and AC ranges and 1 ADC and AC current ranges.
[5] For sine wave input >5% of range. For inputs from 1% to 5% of range and <50 kHz add 0.1% of range additional error. For AC filter slow.
[6] Typically 30% of reading error at 1 MHz, limited to 1 x 108 volt-hertz.
[7] For 4-wire ohms or 2-wire ohms using scaling to remove offset. Add 4 ohms additional error to 2-wire ohms function without scaling. 34923/24/25/33 have series resistance that may limit low 2-wire ohm measurements.
[8] Input >100 mV. For 10 mV inputs multiply % of reading error x 10. For 1 sec aperture (6½ digits).
[9] Specified only for inputs >10 mA. For AC filter slow.
[10] Add 50 µV error for 34923/24/33.

Temperature Measurement Accuracy[1] ±(% of reading + % of range)

Temperature 1-Year Accuracy	Type	Best Range[1]	
Thermocouple (34921A only, includes cold junction accuracy on terminal block)	B	1100°C to 1820°C	1.2°C
	E	–150°C to 1000°C	1.0°C
	J	–150°C to 1200°C	1.0°C
	K	–100°C to 1200°C	1.0°C
	N	–100°C to 1300°C	1.0°C
	R	300°C to 1760°C	1.2°C
	S	400°C to 1760°C	1.2°C
	T	–100°C to 400°C	1.0°C
RTD	R_0 from 49 Ω to 2.1 kΩ	–200°C to 600°C	0.06°C
Thermistor	2.2 k, 5 k and 10 k	–80°C to 150°C	0.08°C

[1] For total measurement accuracy, add temperature probe error.

Operating Characteristics Single Channel Measurement Rates[1,2]

Function	Resolution	Reading/s
DCV	4½ digits (0.02 plc)	3000
	5½ digits (1 plc)	59
	6½ digits (10 plc)	6
2-wire Resistance	4½ digits (0.02 plc)	2000
	5½ digits (1 plc)	58
	6½ digits (10 plc)	6
Thermocouple	(0.02 plc)	2000
	0.1°C (1 plc)	59
RTD, Thermistor	1°C (0.02 plc)	1900
	0.1°C (1 plc)	58
	0.01°C (10 plc)	6
ACV	6½ Fast (200 Hz)	350
	6½ Med (20 Hz)	350
	6½ Slow (3 Hz)	300
Frequency, Period	4½ digits (10 ms)	70
	5½ digits (100 ms)	9
	6½ digits (1 s gate)	1

[1] Reading speeds for 60 Hz: autozero OFF.
[2] For fixed function and range, readings to memory, scaling and alarms off, autozero OFF.

Measurement Characteristics

DC Voltage	
Measurement Method	Continuously integrating multi-slope III A-D Converter
A-D Linearity	0.0002% of reading + 0.0001% of range on 10 V Range
Input Resistance	
100 mV, 1 V, 10 V ranges	Selectable 10 MΩ or >10.000 MΩ
100 V, 300 V ranges	10 MΩ ± 1%
Input Bias Current	<50 pA at 25°C
Input Protection	300 V all ranges
True RMS AC Voltage	
Measurement Method	AC coupled True RMS – measures the AC component of the input with up to 300 Vdc of bias on any range
Crest Factor	Maximum of 5:1 at full scale
Additional Crest Factor Errors (non-sinewave)	Crest Factor 1 – 2 0.05% of reading Crest Factor 2 – 3 0.15% of reading Crest Factor 3 – 4 0.30% of reading Crest Factor 4– 5 0.40% of reading
Input Impedance	1 MΩ ± 2% in parallel with 150 pF
Input Protection	300 V_{rms} all ranges
Resistance	
Measurement Method	Selectable 4-wire or 2-wire Ohms
Current source	referenced to LO input
Offset Compensation	Selectable on 100 Ω, 1 kΩ, 10 kΩ ranges
Maximum Lead Resistance	10% of range per lead for 100 Ω and 1 kΩ ranges 1 kΩ on all other ranges
Input Protection	300 V on all ranges
Frequency and Period	
Measurement Method	Reciprocal counting technique
Voltage Ranges	Same as AC voltage function
Gate Time	1 s, 100 ms, or 10 ms
Measurement Timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit
DC Current	
Shunt Resistance	5 Ω for 10 mA, 100 mA; 0.1 Ω for 1 A
Input Protection	1 A 250 V fuse on 34921A module
True RMS AC Current	
Measurement Method	Direct coupled to the fuse and shunt, AC coupled True RMS measurement (measures the AC component only)
Shunt Resistance	5 Ω for 10 mA; 0.1 Ω for 100 mA, 1 A
Input Protection	1 A 250 V fuse on 34921A module
Thermocouple	
Conversion	ITS-90 software compensation
Reference Junction Type	Internal, Fixed, or External
Open Thermocouple Check	Selectable per channel, Open >5 kΩ
Thermistor	44004, 44007, 44006 series
RTD	α = 0.00385 (DIN) and = 0.00392
Measurement Noise Rejection 60 (50) Hz[1]	
DC CMRR	140 dB
AC CMRR	70 dB
Integration Time	**Normal Mode Rejection**[2]
200 plc/3.33 s (4 s)	105 dB[3]
100 plc/1.67 s (2 s)	100 dB[3]
20 plc/333 ms (400 ms)	95 dB[3]
10 plc/167 ms (200 ms)	90 dB
2 plc/33.3 ms (40 ms)	85 dB
1 plc/16.7 ms (20 ms)	60 dB
<1 plc	0 dB

[1] For 1 KΩ unbalance in LO lead.
[2] For power line frequency ±0.08%.
[3] For power line frequency ±1% use 75 dB or ±2.5% use 60 dB.

System Specifications

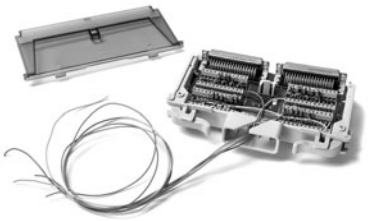
Scanning Inputs	
Analog	34921A, 34922A, 34923A, 34924A, and 34925A multiplexer channels
Digital	34950A/52A digital in and totalize
Scan Triggering	
Source	Interval, external, button press, software, or on monitor channel alarm
Scan count	1 to 50,000 or continuous
Scan interval	0 to 99 hours; 1 ms step size
Channel delay	0 to 60 seconds per channel; 1 ms step size
External trig delay	<2 ms, With monitor on <200 ms
External trig jitter	<2 ms
Alarms	
Analog inputs	Hi, Lo, or HI + Lo evaluated each scan
Digital inputs	34950A digital in maskable pattern match or state change 34952A frequency and totalize: Hi limit only
Monitor channel	Alarm evaluated each reading
Alarm outputs	4 TTL compatible; selectable TTL logic Hi or Lo on fail
Latency	5 ms (typical)
Memory	
Type	Volatile
Readings	500,000 with timestamp; Readable during scan
States	5 instrument states with user label
Alarm queue	Up to 20 events with channel number, reading, and timestamp
System Features	
Per-channel math	Individual Mx + B scaling and calculated real time
Min/Max/Average	
Power fail recovery	Save switch states
Relay maintenance	Counts each relay closure and stores on module. User resettable.
Real time clock	Battery-backed, 20 year typical life
General Specifications	
Power supply	Universal 100 V to 240 V ± 10%
Power line frequency	50 – 60 Hz ± 10% automatically sensed
Power consumption	150 VA
Operating environment	Full accuracy 0°C to 55°C Full accuracy to 80% R.H. at 40°C IEC 60664-1 pollution degree 1
Storage environment	–40°C to 70°C[1]
Mainframe dimensions	133 x 426 x 341 mm (5.25" x 18.8" x 14") Full rack, 3 units high
Mainframe Weight	8.8 kg (19.6 lbs)
Module dimensions	280 H x 170 W x 27D mm (11" x 6.7" x 1")
Safety	Conforms to CSA, UL/IEC/EN 61010-1
EMC	Conforms to IEC/EN 61326-1, CISPR 11
Warranty	1 year
Software	
Agilent connectivity software included	Agilent IO Libraries Suite 14.2 (E2094N)
Minimum System Requirements (IO) Libraries and Drivers	
PC hardware	Intel Pentium100 MHz, 84 MByte RAM 210 MByte disk space Display 800 x 600, 256 colors, CD-ROM Drive
Operating System[2]	Windows® 98 SE/NT/2000/XP
Computer Interfaces	Standard LAN 10 BaseT/100 BaseTx Standard USB 2.0 IEEE400 2 GPIB
Software Driver Support for Programming Languages	
Software drivers	IVI-C and IVI-COM for Windows NT/2000/XP LabVIEW
Compatible with programming tools and environments	Agilent VEE Pro, Agilent T&M Tool kit (requires Visual Studio.NET) National Instruments Test Stand, Measurement Studio, LabWindows/CVI LabVIEW, Switch Executive Microsoft Visual Studio.NET, C/C++ Visual Basic 6

[1] Storage at temperature above 40°C will decrease battery life.
[2] Load IO libraries version M for Windows NT Support.

34980A Mainframe, Modules and Terminal Blocks

Connector Kit Accessory
to the 34980A Switch/Measure Modules

Cable Accessory to the 34980A Switch/Measure Modules



Terminal Block for the 34980A
Switch/Measure Modules

Accessories	
Y1130A	Rackmount kit for 34980A, forward or reverse mount (must order either E3663AC rail kit for forward rack mounting or E3664AC rail for reverse rack mounting)
Y1131A	Verification and diagnostic tools for 34980A mainframe and modules (selection option for specific module support)
Y1132A	Module extender for 34980A
Terminal Blocks (Used for discrete wiring. Fully loaded terminal blocks support up to 20 AWG wire.)	
3492xT	Multiplexer terminal blocks
3493xT	Matrix and General Purpose terminal blocks
3495xT	Measurement and Control terminal blocks
Cables (Used for direct cable connection to module. Some modules require 2 cables.)	
Y1135A	1.5 m 50 pin Dsub, M/F twisted pair with outer shield cable – 300 V
Y1136A	3 m 50 pin Dsub, M/F twisted pair with outer shield cable – 300 V
Y1137A	1.5 m 78 pin Dsub, M/F twisted pair with outer shield cable – 300 V
Y1138A	3 m 78 pin Dsub, M/F twisted pair with outer shield cable – 300 V
Connector Kits[1] (Used to build custom cables)	
Y1139A	Solder cup connector kit for 34921/23/25/31/32/33/37/38 – 50 pin Dsub female
Y1140A	Solder cup connector kit for 34922/34924 – 78 pin Dsub female
Y1141A	Solder cup connector kit for 34951, 34952 – 50 pin Dsub male
Y1142A	Solder cup connector kit for the 34950A – 78 pin Dsub male
34945A Accessories (Distribution boards required for control of external switch)	
34945EXT	External driver for 34945A, one required for each 64 coils – holds 4 distribution boards
Y1150A	34945EXT distribution board for 8 N181x SPDT switches
Y1151A	34945A distribution board for two 87104x/106x multiport or 87406B matrix switches
Y1152A	34945EXT distribution board for one 87204x/206x or 87606B switch and 2 N181x switches
Y1153A	34945EXT distribution board for 84904/5/6/7/8 and 8494/5/6 step attenuators
Y1154A	34945EXT distribution board for two 87222 transfer switches and 6 N181x SPDT switches
Y1155A	34945A distribution board w/generic screw terminals for driving 16 switch coils
Y1157A	9-to-10 pin cable kit for Y1150A, Y1152A, Y1154A – supplies to build 4 cables
Y1158A	10-to-10/10-to-14 pin cable kit for Y1153A, Y1154A – supplies to build 2 cables
Y1159A	16-to-16 pin cable kit for Y1150A/51A/52A/53A/54A/55A – supplies to build 2 cables
Thermocouples/Thermistors	
34307A	10 pack of J type thermocouples
34308A	5 pack of 10 k thermistors

[1] Module specifications include terminal block. Performance may be degraded when using cables or connector kits.

What Ships with a 34980A

5061-0701	LAN Cross Over Cable
E2094-60003	IO Library Suite CD
34980-90610	Firmware Update Flyer
8710-0059	Screwdriver

34980A Multifunction Switch/Measure Mainframe and Modules (cont.)

34980A Ordering Information

Mainframe – holds up to 8 plug-in modules

34980A	Multifunction switch/measure mainframe	Comes standard with "DMM" option	
	Description	**Module Connectors**	**Optional Terminal Blocks, Cables, Connector Kits**
Multiplexer Modules			
34921A	40-channel armature multiplexer w/low thermal offset	2 – 50 pin Dsub, Male	3492xT Terminal block with screw connectors Y1135A – 1.5 m 50 pin M/F Dsub cable Y1136A – 3 m 50 pin M/F Dsub cable Y1139A – 50 pin female solder cup connector kit
34923A	40/80-channel reed multiplexer		
34925A	40/80-channel optically isolated FET multiplexer		
34922A	70-channel armature multiplexer	2 – 78 pin Dsub, Male	3492xT Terminal block with solder connections Y1137A – 1.5 m 78 pin M/F Dsub cable Y1138A – 3 m 78 pin M/F Dsub cable Y1140A – 78 pin female solder cup connector kit
34924A	70-channel reed multiplexer		
Matrix Modules			
34931A	Dual 4 x 8 armature matrix	2 – 50 pin Dsub, Male	3493xT Terminal block with screw connectors Y1135A – 1.5 m 50 pin M/F Dsub cable Y1136A – 3 m 50 pin M/F Dsub cable Y1139A – 50 pin female solder cup connector kit
34932A	Dual 4 x 16 armature matrix		
34933A	Dual/quad 4 x 8 reed matrix		
General Purpose/Actuator Modules			
34937A	28-channel Form C and 4-channel Form A	2 – 50 pin Dsub, Male	3493xT Terminal block with screw connectors Y1135A – 1.5 m 50 pin M/F Dsub cable Y1136A – 3 m 50 pin M/F Dsub cable Y1139A – 50 pin female solder cup connector kit
34938A	20-channel 5-amp Form A switch		
RF & Microwave Modules			
34941A	Quad 1 x 4 50-ohm 3 GHz multiplexer	10 – SMA	Requires standard 50 ohm SMA RF cables, adapters
34942A	Quad 1 x 4 75-ohm 1.5 GHz multiplexer	10 – Mini SMB	Requires mini 75 ohm SMB RF cables, adapters
34945A	Microwave switch/attenuator driver	—	Requires 34945EXT and optional Y1150A – Y1155A distribution boards
34946A	Dual 1 x 2 SPDT terminated microwave switch Option 004: 4 GHz switches installed Option 020: 20 GHz switches installed	SMA	Requires standard 50 ohm SMA cables and adapters
34947A	Triple 1 x 2 SPDT unterminated microwave switch Option 004: 4 GHz switches installed Option 020: 20 GHz switches installed	SMA	Requires standard 50 ohm SMA cables and adapters
System Measurement & Control Modules			
34950A	64-bit digital I/O with memory and counter	2 – 78 pin Dsub, Female	3495xT Terminal block with screw connectors Y1137A – 1.5 m 78 pin M/F Dsub cable Y1138A – 3 m 78 pin M/F Dsub cable Y1142A – 78 pin male solder cup connector kit
34951A	4-channel isolated D/A converter with waveform memory	1 – 50 pin Dsub, Female	3495xT Terminal block with screw connectors Y1135A – 1.5 m 50 pin M/F Dsub cable Y1136A – 3 m 50 pin M/F Dsub cable Y1141A – 50 pin female solder cup connector kit
34952A	Multifunction module with 32-bit DIO, 2-ch D/A and totalizer		
34959A	Breadboard module	26 & 40 pin internal ribbon cable connectors	Any terminal block can be used assuming 50 or 78 pin Dsub is used

Features Switching, Digital I/O, Analog Outputs and Counter Functionality in Compact, Self-contained LXI Instruments

- **LXI class C compliant**
- **Small, 1U, half-rack size**
- **Built-in Ethernet connectivity**
- **Full-featured graphical Web interface**
- **Standard Dsub connectors for flexible connection options**
- **Software drivers for most common programming environments**

The Agilent L4400 Series LXI instruments are high-performance LXI class C compliant instruments that encompass all benefits of LXI with an Ethernet connection, instrument Web server, standard software drivers and more. With their small size and Ethernet connectivity, these instruments are easily placed anywhere on the network.

L4400 Series LXI Instruments

L4400 Series offers a broad range of functionality to meet a wide variety of application needs in design verification, automated test and data acquisition.

Low Frequency Switching

		Max Volts	Max Current	Scan Ch/s
L4421A	40 Channel Armature Mux	±300 V	1 A	100
L4433A	Dual 4x8 Reed Matrix	±150 V	0.5 A	500
L4437A	28 Channel Form C	300 V	1 A	—
	4 Channel Form A	30 VDC/250 VAC	5 A	—

RF and Microwave Switching

L4445A Microwave Switch/ Attenuator Driver	Drive up to 64 external switch coils; 32 SPDT switches, 8 multiport switches, 8 attenuators, or custom combination

System Measurement and Control

L4450A 64-Bit Digital I/O with Memory and Counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V with handshaking protocols and 128 kB pattern memory. Two 10 MHz frequency counters and programmable clock output
L4451A 4-Channel Isolated D/A Converter with Memory	Output DCV up to ±16 V or DC current up to ±20 mA, Output waveforms w/200 kHz update rate and 16 bit resolution. 500 k memory for waveforms. Four independent D/A converters.
L4452A Multifunction Module	Four 8-bit digital I/O channels, 2 Channel ±12 V analog outputs, 100 kHz gated totalizer

L4433A Dual 4 x 8 matrix web interface

Ethernet Connectivity Enables Simple Connection to the Network and Remote Access to your Measurements

You can set up a private network to filter out unwanted LAN traffic and speed up the I/O throughput, or take advantage of the remote capabilities and distribute your tests worldwide.

Use the Built-in Graphical Web Interface for Remote Access and Control of your Instruments via a Java-enabled Web Browser

Monitor, troubleshoot, or debug your application remotely. The web interface includes features that allow you to view and modify instrument setup, setup and initiate scans or switch sequences, and get status reports on relay counts, firmware revisions and more.

System Connections you can Trust

The L4400 series instruments come with standard Dsub connectors for simple, reliable connection options that include quick disconnect terminal blocks, cables and connector kits.

Software Drivers and Connection Tools to Work in your Environment

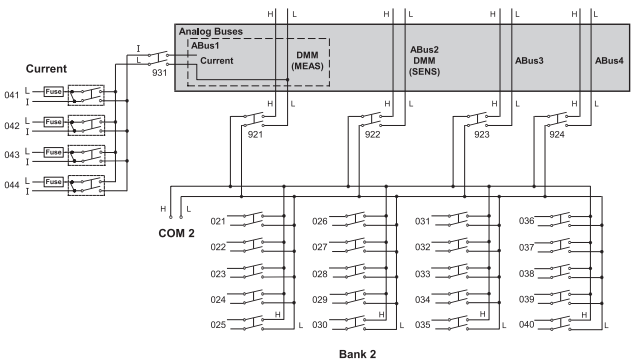
The Agilent IO Libraries Suite makes it easy for you to configure and integrate instruments into your system – even if your system includes instruments from other vendors. Additionally, these instruments include IVI and LabVIEW software drivers making it easy to program in the most popular programming environments including Agilent VEE and T&M Toolkit, National Instruments LabVIEW and LabWindows, and Microsoft programming languages.

Agilent's Family of LXI Instruments offer Versatility

In addition to the L4400 Series LXI instruments, Agilent offers the 34980A Switch/Measure unit for high-density systems. So whether you need a full-blown switching system with high-density switching, measurement and system control, or just a few channels of switching, Agilent's family of LXI switch/measure instruments have great versatility so you can choose what you need and easily add to it when your requirements change.

L4421A

- **40 2-wire latching armature relays**
- **Thermocouple reference junction for temperature measurements (reqs ext DMM)**
- **Relay counter**
- **Scan up to 100 ch/s**
- **300 V, 1 A switch; 2 A carry current**



L4421A 40-channel armature multiplexer with low thermal offset (bank 2)

L4421A 40-Channel Armature Multiplexer

The L4421A is a versatile multiplexer for general purpose scanning. The low thermal offset characteristics and built-in thermocouple reference on the terminal block, make it ideal for temperature measurements with an external DMM. The dense, multifunction switching with 100 ch/s scan rates addresses a broad spectrum of data acquisition, design verification and functional test applications.

Four additional fused inputs (44 channels total) can route up to 1 A of current to an external DMM, allowing for AC and DC current measurements without the need for external shunt resistors.

Specifications and Characteristics

Channels/Configurations
40 2-wire
20 4-wire
4-current (1.5 A fused)
Switch Type: Armature Latching

Input Characteristics (per channel)

Max Volts: (DC, AC RMS) ±300 V
Max Current: (DC, AC RMS)
Switch Current: 1 A
Carry Current: 2 A
Power (W, VA): 60 W
Volt-Hertz Limit: 10^8

General Specifications

Offset Voltage: <3 µV
Initial Closed Channel Resistance: <1.5 Ω
DC Isolation (ch-ch, ch-earth): >10 GΩ
T/C cold junction accuracy: <0.8°C

AC Characteristics

Bandwidth at Terminal Block: 45 MHz
Crosstalk at Terminal Block (ch-ch)

300 kHz	–75 dB
1 MHz	–75 dB
20 MHz	–50 dB
45 MHz	–40 dB

Capacitance at Terminal Block

HI-LO	150 pF
LO – earth	150 pF

General Characteristics

Relay Life: typical
No Load: 100 M
10 V, 100 mA: 10 M
Rated Load: 100 k
Scanning Speeds: 100 ch/s
Open/Close Time: typical 4 ms/4 ms
Analog Bus Connection: Yes

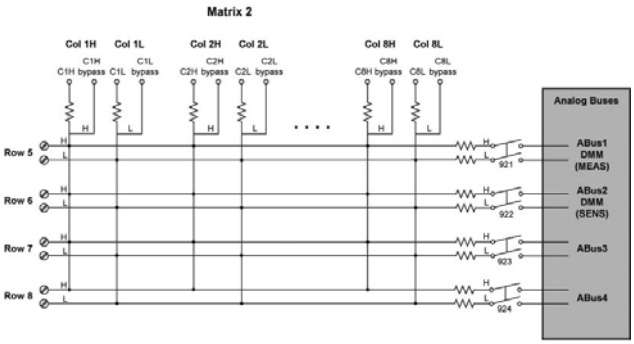
Ordering Information

L4421A 40-chan Armature Multiplexer

Connection Options
34921T Terminal Block with Temp Reference
Y1135A 1.5 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1136A 3 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1139A Solder Cup Connector Kit with Female 50-pin Dsub
Y1160A Rack Mount Kit for Two L4400 Series Instruments

L4433A

- **Configure as Dual 4 x 8, 8 x 8, or 4 x 16 2-wire matrix**
- **64 2-wire or 128 1-wire cross-points**
- **High speed reed relays**
- **Analog bus connection**
- **Relay counter**
- **±150 V peak, 0.5 A switch, 1.5 A carry current**



L4433A Dual/Quad 4 x 8 Reed Matrix.

L4433A Dual/Quad 4 x 8 Reed Matrix

The L4433A is a full cross-point matrix that offers a flexible connection path between your devices and your test equipment. Each cross-point in the matrix switch has two wires – a high and a low for the measurement or the matrix can be configured as a 1-wire matrix, increasing the number of crosspoints to 128. The L4433A also has in-rush resistors on each column for added protection. Expand your matrix using the analog bus connector to create a larger matrix, or easily connect to an external measurement device like a DMM.

Specifications and Characteristics

Channels/Configurations
dual 4 x 8, 8 x 8, 4 x 16, 2-wire
quad 4 x 8, 1-wire
Switch Type: Reed non-latching

Input Characteristics (per channel)

Max Volts: ±150 V peak
Max Current: (DC, AC RMS)[1]
Switch Current: 0.5 A/0.05 A[1]
Carry Current: 1.5 A/0.05 A[1]
Power (W, VA): 10 W
Volt-Hertz Limit: 10^8

General Specifications

Offset Voltage
<50 µV, 2-wire
<100 µV 1 wire
Initial Closed Channel Resistance[1]: <1.5 Ω/200 Ω
DC Isolation (ch-ch, ch-earth): >10 GΩ

AC Characteristics

Bandwidth at Terminal Block
30 MHz/4 MHz, 2-wire[1]
2 MHz 1-wire
Crosstalk at Terminal Block (ch-ch)

300 kHz	–65 dB
1 MHz	–65 dB
20 MHz	–40 dB

Capacitance at Terminal Block

HI-LO	80 pF
LO – earth	75 pF

General Characteristics

Relay Life: typical
No Load: 1000 M
10 V, 100 mA: 10 M
Rated Load: 10 k
Open/Close Time: typical 0.5 ms/0.5 ms
Analog Bus Connection: Yes

Ordering Information

L4433A Dual/Quad 4 x 8 Reed Matrix

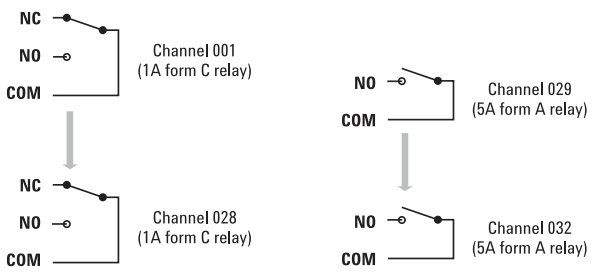
Connection Options
34933T Terminal Block for Discrete Wiring
Y1135A 1.5 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1136A 3 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1139A Solder Cup Connector Kit with Female 50-pin Dsub
Y1160A Rack Mount Kit for two L4400 Series Instruments

[1] Shown with input resistor bypassed and with 100 Ω input protection resistor. Bypassing input resistors will reduce the life of the relays.

5

L4437A

- **28 Form C channels up to 1 A, 60 W**
- **4 Form A channels up to 5 A, 150 W**
- **Armature latching relays**
- **Relay counter**
- **Temperature sensor for overheating conditions**
- **Simultaneous channel switching**



L4437A 32-Chan General Purpose Switch.

L4437A 32-chan Form A/Form C General Purpose Switch

The L4437A has 32 general purpose switches that can be used to cycle power to products under test, control status lights, and to actuate external power relays and solenoids.

This product has 28 independent single-pole, double-throw (Form C) 1 A relays and 4 single-pole, singlethrow (Form A) 5 A relays. The 28 Form C channels have 300 V, 1 A contacts and can handle up to 60 W. The form A channels are 30 VDC/250 VAC, 5 A contacts and can handle up to 150 W, enough for many power line-switching applications. These switches are made of latching armature relays where multiple channels can be closed at the same time. Additionally, for switching reactive loads, the optional terminal blocks have pads for snubbing circuits.

Specifications and Characteristics

Channels/Configurations
28 Form C
4 Form A
Switch Type: Armature Latching

Input Characteristics (per channel)

Max Volts: (DC, AC RMS)
Form C – 300 V
Form A – 30 VDC/250 VAC
Max Current: (DC, AC RMS)
Form C – 1 A switch (2 A carry)
Form A – 5 A switch (8 A carry)
Power (W, VA):
Form C – 60 W
Form A – 150 W
Volt-Hertz Limit: 10^8

General Specifications

Offset Voltage: <3 µV
Initial Closed Channel Resistance:
Form C – 125 mΩ
Form A – 50 mΩ
DC Isolation (ch-ch, ch-earth): >10 GΩ

AC Characteristics

Bandwidth at Terminal Block: 10 MHz
Channel Isolation at Terminal Block (ch-ch)

100 kHz	55 dB
1 MHz	35 dB
10 MHz	15 dB

Capacitance at Terminal Block
Ch-Ch – Form C 12 pF/Form A 10 pF
Ch-earth – Form C 21 pF/Form A 18 pF

General Characteristics

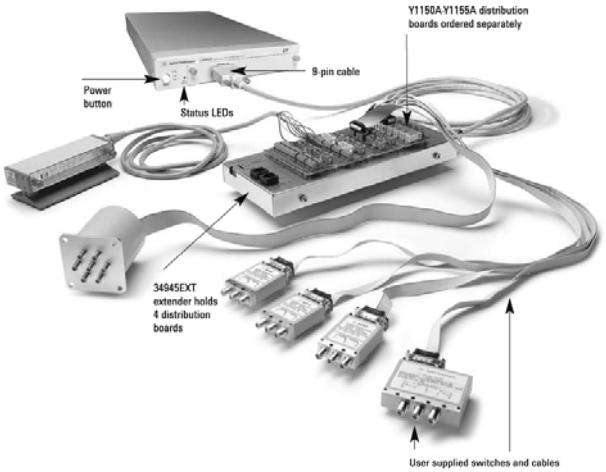
Relay Life: No Load/Rated
Form C – 100 M/100 k
Form A – 50 M/30 k
Open/Close Time
Form C – 4 ms/4 ms
Form A – 10 ms/10 ms
Initial/Reset Relay State
Form C – maintains state
Form A – user configurable
Analog Bus Connection: No

Ordering Information

L4437A 32 Channel Form C/Form A General Purpose Switch

Connection Options
34937T Terminal Block for Discrete Wiring
Y1135A 1.5 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1136A 3 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1139A Solder Cup Connector Kit with Female 50-pin Dsub
Y1160A Rack Mount Kit for Two L4400 Series Instruments

- **Control of most popular microwave switches and attenuators**
- **Expandable with 34945EXT**
- **Distribution boards allow for easy wiring**
- **Switch read-back capabilities**
- **External power option for simultaneous switching**



L4445 Microwave Switch/Attenuator Driver with 34945EXT.

L4445A Microwave Switch/Attenuator Driver

The L4445A allows you to control switches, attenuators and other devices close to your device under test. The L4445A combined with the 34945EXT provides the power and control signals to drive up to 64 switch coils – that's 32 standard SPDT switches. The L4445A can be extended by adding additional 34945EXT extenders.

The following microwave switches and attenuators are supported with the Y1150A – Y1155A distribution boards:

- N181x series SPDT switches
- 8762/3/4 series SPDT switches (screw terminals)
- 87104x/106x multiport switches
- 87406x series matrix switches
- 87204x/206x series
- 87606x series matrix switches
- 87222x transfer switches
- 849x series attenuators
- 8490x series attenuators
- Screw terminal connections for other devices including the N9397A/C

Specifications and Characteristics

34945EXT Switch Drive

64 Channels, Low Side Drive Mode
Driver Off voltage (max): 30 V
Driver Off Leakage Current: 500 µA
Driver On Current (max): 600 mA
Driver On Voltage (max): 0.5 V @ 600 mA
64 Channels, TTL Drive Mode
Hi output voltage: 3 V @ I_{out} = 2 mA
Lo Output Voltage: 0.4 V @ I_{in} = 20 mA
Lo Input Current: 20 mA

34945EXT Position Indicator Sense Inputs

Channels: 64
Lo Input Voltage (max): 0.8 V
Hi Input Voltage (min): 2.5 V
Input resistance:
>100 kΩ @ Vin ≤5 V
>20 kΩ @ Vin >5 V
Maximum Input Voltage: 30 V

34945EXT Switch Drive Power Supply (34945EXT Powered by L4445A)

Voltage: 24 V nominal
(external power supply required for switches needing different voltages)
Current: 100 mA continuous +
200 mA (15 ms pulse, 25% duty cycle)

34945EXT External Power Connection

Voltage Range: 4.75 V to 30 V
Current limit: 2 A

LED Indicator (Current mode divers)

Channels: 64
Supply Voltage: 5 V nominal
LED Drive Current:
5 mA nominal (prog 1 – 20 mA)
Driver Compliance Voltage: 0.8 V
Maximum 8 34945Ext's per L4445A

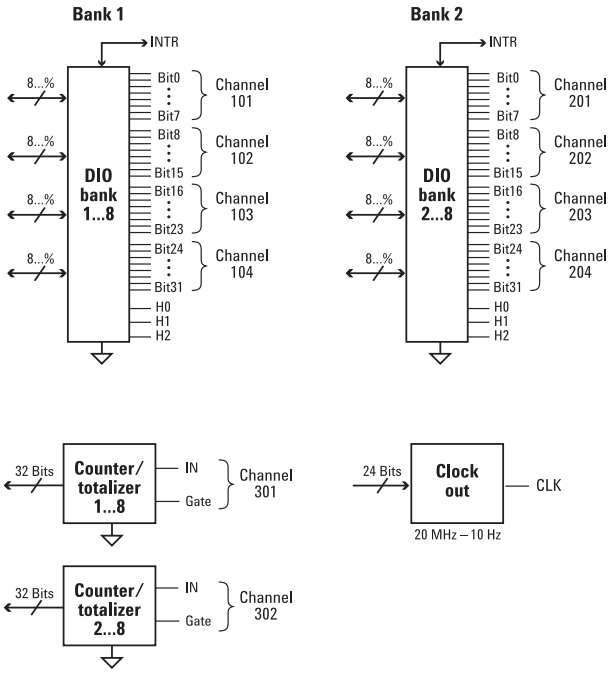
Ordering Information

L4445A Microwave Switch/Attenuator driver
(requires 34945EXT extender)

Accessories
Y1150A Distribution Board for 8 N181x SPDT Switches
Y1151A Distribution Board for Two 87104x/106x Multiport or 87406B Matrix Switches
Y1152A Distribution Board for One 87204x/206x or 87606B Switch and Two N181x Switches
Y1153A Distribution Board for Two 84904/5/6/7/8 or 8494/5/6 Step Attenuators
Y1154A Distribution Board for Two 87222 Transfer Switches and Six N181x SPDT Switches
Y1155A Distribution Board w/Generic Screw Terminals for Driving 16 Switch Coils
Y1157A 9- to 10-pin Cable Kit for Y1150A, Y1152A, Y1154A – Supplies to Build 4 Cables
Y1158A 10- to 10/10- to-14-pin Cable Kit for Y1153A, Y1154A – Supplies to Build 2 Cables
Y1159A 16- to 16-pin Cable Kit for Y1150A/51A/52A/53A/54A/55A Supplies to Build 2 Cables
Y1160A Rack Mount Kit for Two L4400 Series Instruments

L4450A

- 64 bi-directional digital I/O bits with programmable polarity
- Variable threshold from 0 V to 5 V
- Handshaking protocols
- Source/sink current up to 24 mA
- 128 kB pattern memory
- Two 10 MHz counter channels
- 20 MHz divide-by-n clock



L4450A 64-bit digital I/O.

Agilent L4450A 64-Bit Digital I/O with Memory and Counter

The high-speed L4450A digital I/O can be used to simulate or detect digital patterns. It has 64-bits of digital I/O with handshaking, pattern memory; two 10 MHz counters with gate functions; and a programmable clock output.

The 64 bi-directional lines are configured as eight 8-bit channels. Each 8-bit channel has programmable polarity and thresholds up to 5 V. The 128 k of memory is useful for simulating and capturing digital patterns up to 10 MHz. The configurable handshaking protocols can be used for a wide variety of applications.

The two counter channels can be used to count events, frequency, period, duty cycle, pulse width and totalize.

Specifications and Characteristics

Digital Input/Output Characteristics

Eight 8-bit channels: 8 bits wide, input or output, non-isolated
V_{in}: 0 V – 5 V
V_{out}: 1.65 V – 5 V
I_{out} (max): 24 mA
Frequency (max): 10 MHz
I_{Load} (max): 400 mA
tr + tf (typ): 6 ns

Handshake Lines

V_{in}: 0 V– 5 V
V_{out}: 1.65 V– 5 V
I_{out} (max): 24 mA
Frequency (max): 10 MHz

Counter Function Characteristics

Maximum Freq
10 MHz (max)
50% duty cycle
V_{in}: 0 V– 5 V

Totalizer Function Characteristics

Maximum Count: 2^32 – 1 (4,294,967,296)
Max Input Freq: 10 MHz (max), rising or falling edge programmable
V_{in}: 0 V– 5 V
Gate Input: 0 V – 5 V

System Clock Generator Characteristics

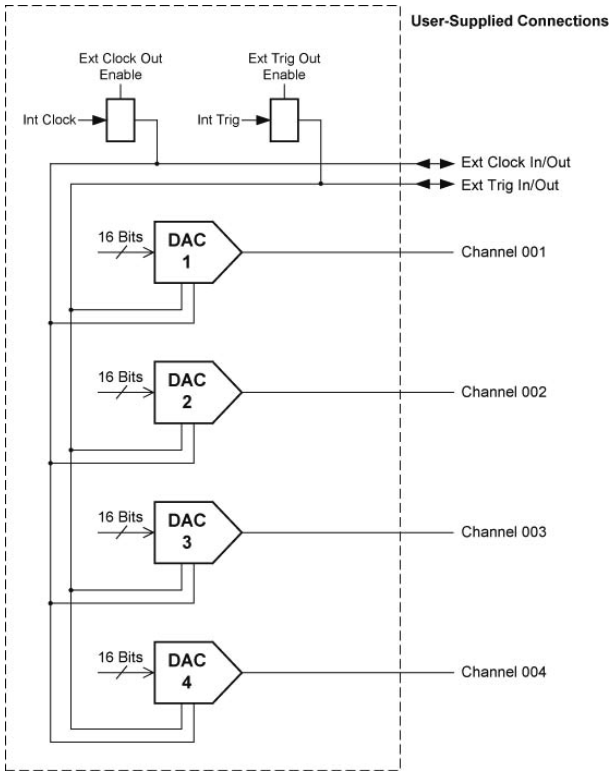
Frequency
20 MHz – 10 Hz configurable
divide-by-n 24-bits,
programmable on/off
V_{out}: 1.65 V – 5 V
Accuracy: 100 ppm

Ordering Information

L4450A 64-bit Digital I/O with Memory and Counter

Connection Options
34950T Terminal Block for Discrete Wiring
Y1137A 1.5 m 78-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1138A 3 m 78-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1142A Solder Cup Connector Kit with Male 78-pin Dsub
Y1160A Rack Mount Kit for Two L4400 Series Instruments

- **Four isolated analog outputs**
- **Outputs up to ±16 V or ±20 mA DC**
- **16-bits of resolution**
- **500 k memory**
- **200 kHz update rate**
- **Default standard waveforms**



L4451A 4-channel isolated D/A converter.

L4451A 4-Channel Isolated D/A Converter with Memory

The Agilent L4451A has four isolated analog channels that are useful to source bias voltages to your device under test, to control your analog programmable power supplies, or use the outputs as setpoints for your control systems. You can use the standard waveforms provided or create your own using over 500,000 points. These points can be dynamically allocated among one or more channels and output as a point-to-point arb.

The four independent, isolated channels can output DC voltage up to ±16 V or DC current up to ±20 mA with 16 bits of resolution. The gain and offset can be adjusted on-the-fly. And since these are isolated channels, they can be stacked to create waveforms with higher output voltages.

Specifications and Characteristics

Output Specifications

Maximum Update Rate: 200 kHz point-to-point
Monotonic: to 16 bits
Isolation: >80 VDC/AC peak (chan-to-chassis or chan-to-chan)
Synchronization: Software commands or external trigger
Internal/External CLK Accuracy: 100 ppm
AC Accuracy: Not specified

DC Voltage

Amplitude: ±16 V up to 10 mA
Resolution: 16-bit = 500 µV
Amplitude Accuracy (DC): ±(0.05% + 3.0 mV)
Ripple and Noise: < 2 mV_{rms}, 20 Hz to 250 kHz into 10 kΩ load
Settling Time: 40 µs (–full scale to +full scale step, single channel, to rated accuracy)
Output Impedance: <1 Ω with the load sensed

DC Current

Range: ±20 mA
Resolution: 16-bit = 630 nA
Accuracy
±(% value + amps) (temperature within ±5°C of Tcal or *Cal?)
90-day: ±(0.09% + 5.0 µA)
Ripple and Noise: <2 µArms,
20 Hz to 250 kHz into 250 Ω
Compliance Voltage: ±12 V
Max Open Circuit Voltage: <±22 V

Phase-locking I/O Trigger Characteristics

Trigger Input
Input Level: TTL compatible
(3.3 V logic, 5 V tolerant)
Slope: Rising or falling, selectable
Pulse Width: >100 ns
Input Impedance: >10 kΩ, DC coupled
Trigger Output
Level: TTL compatible
into 1 kΩ (3.3 V logic)
Output Impedance: 50 Ω typical
Clock Input
Input Level: TTL compatible
(3.3 V logic, 5 V tolerant)
Input Impedance: >10 kΩ, DC
Maximum Rate: 10 MHz
Clock Output
Level: TTL compatible
Into 1 kΩ (3.3 V logic)
Output Impedance: 50 Ω typical
Maximum Rate: 10 MHz
Accuracy: ±100 ppm

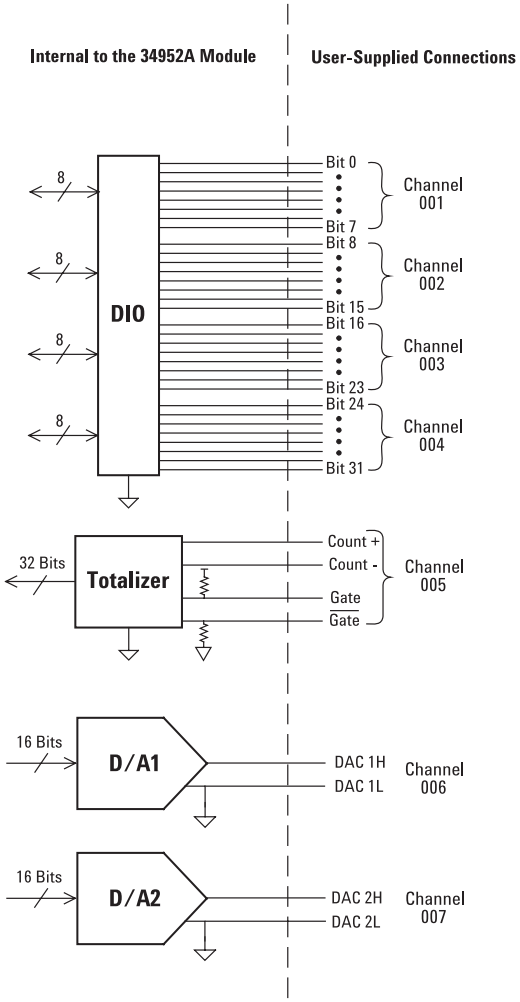
Ordering Information

L4451A 4-Channel Isolated D/A Converter with Memory

Connection Options
34951T Terminal Block for Discrete Wiring
Y1135A 1.5 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1136A 3 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1141A Solder Cup Connector Kit with Male 50-pin Dsub
Y1160A Rack Mount Kit for Two L4400 Series Instruments

L4452A

- 32-bits of digital I/O up to 42 V
- 100 kHz gated totalizer
- Two ±12 V analog outputs with 1 mV of resolution



L4452A Multifunction with Digital I/O, D/A, Totalizer

The L4452A is a multifunction instrument that combines four 8-bit channels of digital input and output, a 100 kHz gated totalizer, and two ±12 V analog outputs all on a single earth-referenced module.

The digital I/O supports output levels up to 42 V. These channels can be used with an external power supply to control external devices or to sense limit switch and digital bus status with no complex handshake modes.

The analog outputs can output up to ±12 V or 10 mA DC with 1 mV of resolution. They can be used to source bias voltages to your device under test, to control your analog programmable power supplies, or use the outputs as set points for your control systems.

The totalizer inputs can be used to count events and can be included in a scan. Alarm limits for the digital and event counter inputs are evaluated continuously, capturing and logging alarm conditions even between scans.

Specifications and Characteristics

Digital Input/Output Characteristics

Four 8-bit Channels, 8-bits Wide: Input or output, non-isolated
V_{in}(L): <0.8 V (TTL)
V_{in}(H): >2.0 V (TTL)
V_{out}(L): <0.8 V @ Iout = –400 mA
V_{out}(H): >2.4 V @ Iout = 1 mA
V_{in}(H) max: <42 V with external open drain pull-up
Alarm: Maskable pattern match or state change
Speed: 4 ms (max) alarm sampling
Latency: 5 ms (typical) to 34980A alarm output
Read/Write: 95/s

Totalize Input Characteristics

Max Count: $2^{26} - 1$
Totalize Input: 100 kHz (max) rising or falling edge, programmable
Signal Level: 1 Vp-p (min) 42 Vpk (max)
Threshold: 0 V or TTL
Gate Input: TTL-Hi, TTL-Lo, or none
Count Reset: Manual or read + reset
Read Speed: 85 rdgs/s

Analog Output Characteristics

DAC 1, 2: ±12 V, non-isolated
Resolution: 1 mV
I_{out}: 10 mA max
Settling Time: 1 ms to 0.01% of output
Accuracy: ±(% of output + mV)
1 year (0.25% + 20 mV)
Temp. Coefficient: ±(0.015% + 1 mV)/°C

Ordering Information

L4452A Multifunction Instrument with Digital I/O, D/A Converters and Totalizer

Connection Options
34952T Terminal Block for Discrete Wiring
Y1135A 1.5 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1136A 3 m 50-pin Dsub, M/F Twisted Pair with Outer Shield Cable – 300 V
Y1141A Solder Cup Connector Kit with Female 50-pin Dsub
Y1160A Rack Mount Kit for Two L4400 Series Instruments

L4400 General Specifications

Power Supply
Universal 100 V to 240 V ± 10%

Power Line Frequency
50 Hz to 60 Hz ± 10% automatically sensed

Power Consumption
15 VA

Operating Environment
Full accuracy for 0°C to 55°C
Full accuracy to 80% R.H. at 40°C
Pollution Degree: 1 of IEC 61010-1

Storage Environment
–40°C to 70°C

Approximate Dimensions
40.9mm (H) x 212.3 mm (W) x 379.3 mm (L)
1.61 in (H) x 8.36 in (W) x 14.93 in (L)

Approximate Weight
3.9 kg, 8.6 lbs.

Safety
Conforms to CSA, UL/IEC/EN 61010-1

EMC
Conforms to IEC/EN 61326-1, CISPR 11

Warranty
1 year

Software

Agilent Connectivity Software Included
Agilent I/O Libraries Suite 14 or greater (E2094N)

Minimum System Requirements
PC Hardware
Intel Pentium
100 MHz, 64 MB RAM,
210 MB disk space
Display
800 x 600, 256 colors, CD-ROM drive
Operating System
Windows® 98 SE/NT/2000/XP
Computer Interfaces
Standard LAN 10BaseT/100BaseTx
Optional IEEE 488.2 GPIB

Software Driver Support for Programming Languages
Software drivers
- IVI-C and IVI-COM for Windows NT®/2000/XP
- LabVIEW
  Compatible with programming tools and environments
- Agilent: VEE Pro, T&M Toolkit (reqs Visual Studio.NET)
- National Instruments: TestStand, Measurement Studio, LabWindows/CVI, LabVIEW, Switch Executive
- Microsoft: Visual Studio.NET®, C/C++, Visual Basic 6®

High-speed 10-bit PXI/CompactPCI Digitizers, 1 to 4 ch, 8 GS/s

U1065A

- Quad-, dual- and single-channel models
- Up to 8 GS/s sampling rate with 10-bit ADC resolution
- Choice of mezzanine front ends with input protection
- Standard input option, 2 GHz bandwidth, 50 Ω, DC or AC-coupled, with internal DC calibration
- High-frequency input option, 3 GHz bandwidth, 50 Ω, DC-coupled
- High-impedance input option, 1 GHz bandwidth, 50 Ω/1 MΩ, DC or AC-coupled with internal DC calibration
- Acquisition memory from 256 kpoints to 1 Gpoints (optional)
- 2 GHz Auto-Synchronous Bus system (AS Bus 2) for trigger and clock signal distribution to multiple modules
- Multipurpose I/O connectors for trigger, clock, reference and control signals
- Low dead time (350 ns) sequential recording with time stamps
- Built-in high-resolution Trigger Time Interpolator (TTI) for accurate timing measurements
- Modular, 6U PXI/CompactPCI Standard
- High-speed 64-bit PCI bus transfers data at sustained rates up to 400 MB/s to host PC
- Device drivers for Windows 2000/XP, LabView RT, Wind River VxWorks, and Linux (support for other operating systems on request)
- Drivers with application code examples for LabWindows/CVI, LabVIEW, C/C++ and Microsoft Visual Basic
- Software adapter for MATLAB PCI 32-bit/66 MHz interface

The Acqiris DC282, DC252 and DC222 PXI/CompactPCI 10-bit digitizers can each achieve a dazzling single channel sampling rate of 8 GS/s, and offer a choice of front-end input mezzanines providing up to 3 GHz input bandwidth or switchable high impedance input coupling. This front-end flexibility, coupled with astounding data conversion performance, makes these digitizers ideal for implementation in applications such as high-resolution radar, lidar, and ultrasound, as well as semiconductor test and large scale physics research experiments.

The DC282 offers synchronous four channel sampling at up to 2 GS/s, or interleaved dual- or single-channel sampling at up to 4 and 8 GS/s respectively. The DC252 and DC222 digitizers offer the same dual- and single-channel sampling performance, with the model DC222 achieving 8 GS/s on its single input channel. These digitizers are fully compliant with both the PXI and CompactPCI standards, and incorporate Acqiris' proprietary ADC chipsets, designed for the specific purpose of optimizing highspeed ADC performance.

The three modules combine this ultra fast sampling rate with standard acquisition memories of 256 kpoints (DC282), 512 kpoints (DC252), to 1 Mpoints (DC222) per channel, and optional acquisition memories to 256 Mpoints, 512 Mpoints and 1 Gpoints, respectively.

Accessories

Standard front-end 2 GHz
High-impedance front-end (50 Ohm/1 MOhm)
High-frequency front-end 3 GHz
32 – 128 Mpoint acquisition memory option
256 – 1024 Mpoint acquisition memory option

Key Literature & Web Link

Brochure DC282/252/222

www.agilent.com/find/acqiris

Ordering Information

U1065A DC282, Base Module for Quad-channel, 2 – 8 GS/s, 256 – 1024 kpoints
U1065A DC252, Base Module for Dual-channel, 4 – 8 GS/s, 512 – 1024 kpoints
U1065A DC222, Base Module for Single-channel, 8 GS/s,1024 kpoints

High-speed 8-bit PCI Digitizer, 2 ch, 2 GS/s

U1071A

- **Dual-channel, 8-bit digitizer**
- **1 GS/s real-time sampling rate on each channel, up to 2 GS/s in single-channel mode**
- **1 GHz bandwidth guaranteed over 50 mV to 5 V full scale ranges**
- **Power requirements <15 W**
- **Auto-synchronous bus system for trigger and clock signal distribution to multiple modules (up to 3 modules)**
- **Optional simultaneous multibuffer acquisition and readout mode for increased measurement throughput**
- **Device drivers for Windows®, VxWorks, LabView RT, and Linux, with application code examples for MATLAB®, C/C++, Visual Basic, LabVIEW, and LabWindows/CVI**

Agilent Technologies Acqiris DP1400 high-speed digitizer is designed to provide optimized data conversion performance and maximum data throughput. It offers a very high level of integration, and features exceptional low power consumption in a compact package.

The digitizers' front-end includes both signal conditioning and a high-speed analog to digital converter (ADC) components. As with other Acqiris products, the entire front end is mounted on a removable mezzanine card so, in the event of accidental damage, replacement is fast and efficient.

The DP1400 digitizer is designed to obtain maximum data throughput from this mezzanine ADC to the host PC. The card features a PCI 32-bit/66 MHz interface, which allows PCI bus data transfers to the host PC at sustained rates of up to 220 MB/s.

The card offers on-board storage memory of 256 kpoints. This acquisition memory can be segmented for burst mode acquisitions (sequence mode). In this configuration, each triggered event is stored in its own memory segment until the entire memory is filled. All triggers are time-stamped with a 13 ps resolution counter, stored along with each waveform. At readout, all recorded segments can be retrieved at once with a single efficient DMA transfer.

The card also features an optional simultaneous multibuffer acquisition and readout (SAR) mode. This allows an acquired buffer of data to be read out through the PCI bus whilst another buffer is filled with new data, drastically increasing data throughput and increasing the maximum trigger rate for lossless acquisition.

Accessories

Simultaneous multibuffer acquisition and readout firmware
Calibration certificate
MCX to BNC, 1 m cable
AS Bus 2 connector for PCI
Fan unit for DP1400
Fan unit for two adjacent DP1400 units

Key Literature & Web Link

Brochure High-Speed Acqiris DP1400 Digitizer

www.agilent.com/find/acqiris

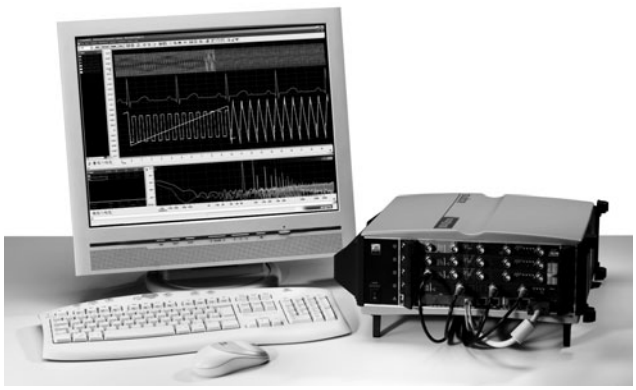
Ordering Information

U1071A High-speed Acqiris DP1400 Digitizer

MAQbox 3000/5000/8000 Multichannel Data Acquisition System

U1056A

- **A turnkey solution for measurements and analysis of up to 28 high-speed signals**
- **Multi-waveform display on a large high resolution screen**
- **Complete overview of your system hardware**
- **Parameter measurements and analysis**
- **Compact and low power for portable applications**
- **Clear physical identification of each trace on the screen**
- **Autosetup mode to quickly find unknown signals**
- **Speedy hardware set up**
- **High data throughput for automatic storage to disk (bridge to MATLAB)**
- **Multichannel synchronization capability**
- **Allows the combination of different digitizers for 8-, 10-, and 12-bit recording**



MAQbox delivers essential multichannel oscilloscope capabilities in a compact package. It offers a benchtop stand-alone solution to multichannel data acquisition and eliminates the need for extensive software development. MAQBox is a modular instrument providing a wide range of capabilities that can not be matched by monolithic instruments. Its scope-like GUI has been optimized for the set-up of multiple digitizers. MAQbox incorporates innovative features to easily display, compare, store and analyze large numbers of waveforms.

MAQbox is the instrument of choice whenever you need to make measurements and analysis of many different analog signals.

Thanks to its modularity, MAQbox not only allows you to mix different digitizer types in the same system (8-, 10-, and 12-bit modules), but also offers the possibility to acquire just the hardware you need. If you want to add more channels, simply insert another digitizer. Modularity means that you can even build up large systems over time. This helps avoid instrumentation obsolescence and greatly reduces budgeting pressure.

Specifications

There are three MAQbox formats, all equipped with carrying handles and feet, ready to be configured for your application:

- Embedded processor 1.6 GHz Pentium, 1 GB of RAM, and 60 GB HDD
- AcqirisMAQS, multichannel acquisition software
- Windows XP Professional

Key Literature & Web Link

Brochure MAQbox3000/5000/8000

www.agilent.com/find/acqiris

Ordering Information

U1056A MAQbox3000 Multichannel Acquisition System
U1056A MAQbox5000 Multichannel Acquisition System
U1056A MAQbox8000 Multichannel Acquisition System

High Resolution Multi-start, Multi-stop Time-to-digital Converter

U1051A

- **6 channel multi-stop time-to-digital converter (TDC) with multi-start acquisition mode**
- **50 ps timing resolution**
- **Ideal for measurement in time-of-flight applications including mass spectrometry and LIDAR and for various pulse-timing measurements**
- **Large internal memory buffer, with up to 4 million events**
- **Low jitter (<3 ps rms) stable (±2 ppm) internal clock source**
- **External 10 MHz reference input**
- **FPGA based data processing unit**
- **Fast DMA readout mode for increased data throughput**
- **Data streaming mode allows continuous acquisition and readout**
- **Built-in self test and status monitoring**
- **Modular, single-slot 6U PXI/CompactPCI form factor**
- **Low power consumption (<24 W)**

The Agilent Technologies Acqiris TC890 features six independent stopwatches for precise timing measurements from a common start event to multiple stop events at a high resolution.

The TC890 is ideal for time measurement applications including LIDAR for 3D mapping and navigation, fluorescence lifetime spectrometry and ion counting in time-of-flight mass spectrometry (TOFMS). Many pulse timing measurements, such as period, frequency and time interval analysis (TIA), also benefit from the new TDC's precise measurement technology.

The TC890 CompactPCI module records multiple events or hits on each of its six input channels, with a timing resolution of 50 ps and a mean dead time between sequential pulses on the same input (double pulse resolution) of less than 15 ns. Running at full speed, the TC890 offers a massive 25 million events-per-second data-throughput rate. The TC890 enables event counting or histogram creation for easy data and spectra comparison.

Six of the seven identical input channels are independent stop inputs and the seventh is the common start. The module operates in a multi-start, multi-stop acquisition mode with the timing information of stop events on all independent channels encoded relative to the most recent start event on the common channel.

In standard mode, the recording range is up to 10 ms. If one channel can be dedicated to a fiducial signal, the 10 ms recording time can be extended to a much wider range. The large internal buffer allows the recording of up to four million stop-events per module.

Key Literature & Web Link

Brochure High Resolution Multi-Start, Multi-Stop Time to Digital Converter

www.agilent.com/find/acqiris

Ordering Information

U1051A Acqiris Time-to-Digital Converter, Six-channel, High resolution Multi-start, Multi-stop

High-speed 10-bit 3U PXI/CompactPCI Digitizers, 1 to 2 ch, up to 4 GS/s

U1062A

- **Dual- and single-channel models**
- **Up to 4 GS/s sampling rate with 10-bit ADC resolution**
- **Dual-channel 50 Ω front end (DC152 only), with 2 GHz bandwidth, software selectable interleaved single-channel mode, on either input**
- **Choice of single-channel front-end mezzanines (DC122 only)**
- **Standard input option, with 2 GHz bandwidth, 50 Ω, DC or AC-coupled, with internal DC calibration**
- **High-frequency input option, with 3 GHz bandwidth, 50 Ω, DC-coupled**
- **512 kpoints acquisition memory**
- **Low dead time (350 ns) sequential recording with time stamps**
- **Multipurpose I/O connectors for trigger, clock, reference and control signals**
- **3U single-slot compliant to both the PXI and CompactPCI standards**
- **2 GHz Auto-Synchronous Bus system (AS Bus 2) for trigger and clock signal distribution to multiple modules**
- **High-speed PCI bus transfers data at sustained rates up to 100 MB/s to host PC**
- **Built-in high-resolution Trigger Time Interpolator for accurate timing measurements**
- **Device drivers for Windows, LabView RT, Wind River VxWorks and Linux (support for other operating systems on request)**
- **Drivers with application code examples for LabWindows/CVI, LabVIEW, C/C++ and Microsoft Visual Basic**
- **Software adapter for MATLAB**

The dual-channel DC152 and single-channel DC122 digitizers significantly increase data acquisition and testing rates, each achieving a dazzling single-channel sampling rate of 4 GS/s.

The digitizers are ideal for high-speed applications such as telecommunications, ATE, and semiconductor testing, where test time should be limited only by the speed limits of the device under test (DUT). In addition, the input bandwidth of up to 3 GHz for the DC122 makes these high-precision, high-speed digitizers ideal for use in synthetic instrumentation systems for the replacement of standard digital multimeters, oscilloscopes, power meters, and frequency counters in RF and microwave test systems.

The DC152, with 2 GHz of bandwidth, provides synchronous sampling of 2 GS/s on both input channels with up to 256 kpoints of acquisition memory; in single-channel applications this doubles to 4 GS/s and up to 512 kpoints.

The single-channel DC122 offers sampling rates of up to 4 GS/s with 512 kpoints of acquisition memory. It also offers the choice of standard or high frequency or high-impedance front ends that can be selected at the time of order, tailoring the digitizer module to the users needs. These digitizers are fully compliant with both the PXI and CompactPCI standards, and incorporate Acqiris' proprietary ADC chipsets, designed for the specific purpose of optimizing highspeed ADC performance.

Accessories

Standard front end
High-frequency front end
Calibration certificate
MMCX to BNC cable (1 m)

Key Literature & Web Link

Brochure Acqiris DC152/DC122 High-Speed 10-bit 3U PXI/CompactPCI Digitizers

www.agilent.com/find/acqiris

Ordering Information

U1062A DC152 Base Module for Dual-channel, 2 – 4 GS/s, 256 – 512 kpoints
U1062A DC122 Base Module for Single-channel, 4 GS/s, 512 kpoints

6

WIRELESS DEVICE TEST SETS & WIRELESS SOLUTIONS

8960 Series 10 Wireless Communications Test Set, Model E5515C

E5515C
8960

- **The flexible design of the 8960 Series 10 supports multiple modes and wireless technologies in a single chassis**
- **Provides all the features and functionality you need for fast, accurate, repeatable, and automated testing of today's most popular wireless formats**
- **Supports cdma2000, IS-95, W-CDMA, HSDPA, HSUPA, GPRS, GSM, EGPRS, IS-136 (TDMA), AMPS, 1xEV-DO**
- **Lab applications and other enhancements accelerate the pace of product development and help move your design from the lab into manufacturing in the shortest possible time**
- **Fast-settling hardware eliminates waiting for the measurement path to stabilize**
- **Separate analog-to-digital converters for measurements eliminate the wait for shared resources, allowing protocol, receiver, and transmitter measurements to run simultaneously**
- **Separate processors and receivers handle the link maintenance and make RF measurements**
- **Hardware speed is optimized using fast processing algorithms and the latest processor technology**

The Agilent 8960 Series 10 wireless communication test set offers mobile manufacturers **immediate competitive advantages**. Developed for high-volume, automated mobile phone manufacturing test, the proven 8960 Series 10 test set offers **speed**, **accuracy**, **repeatability**, **multi-format capability**, **ease of programming**, and **format-flexible** architecture. For the mobile manufacturer, this translates into lower test costs and higher production output to help meet customer demand for phones now and into the future.

For wireless device development, the Agilent 8960 offers essential parametric measurement plus flexible protocol triggering/analysis, and network emulation with full connectivity to the Internet. The 8960's network simulation and software verification tools are designed specifically for the needs of wireless developers doing software design verification and integration. These test solutions offer realistic network simulation and give you Internet connectivity with real data traffic flows. Additional capability is provided with extensive real-time protocol logging and analysis tools.

The 8960 Series 10 can be configured for **W-CDMA**, **HSDPA**, **HSUPA**, **cdma2000**, **1xEV-DO**, **1xEV-DO Release A**, **IS-95**, **GSM/GPRS**, **EGPRS**, **TIA/EIA-136**, and **AMPS** mobile phone testing and device development.

Specifications

Detailed specifications are found in the data sheets for the individual test applications and lab applications.

Accessories

8960 Series 10 Test Applications and Lab Applications

E1961A AMPS/136 Mobile Test Application
E1962B cdma2000/IS-95/AMPS Mobile Test Application
E1963A W-CDMA Mobile Test Application
E1966A 1xEV-DO Terminal Test Application
E1968A GSM/GPRS/EGPRS Mobile Test Application
E1976A 1xEV-DO Rel 0 FTM Test Application
E1987A Fast Switching Mobile Test Application
E1991B 8960 Series 10 Test Application Suite
E1993A UMTS Test Application Suite
E1996A cdma2000/1xEV-DO Test Application Suite
E6701E GSM/GPRS Lab Application
E6702B cdma2000 Lab Application
E6703D W-CDMA Lab Application
E6704A EGPRS Lab Application
E6706A 1xEV-DO Lab Application
E6785D GSM/GPRS/EGPRS_W-CDMA Lab Application (fast switching)
E6716A cdma2000/1xEV-DO Lab Application Suite
E6717B UMTS Lab Application Suite
E6719D Lab Application Suite

Wireless Test Manager Test Automation Software

E6560C cdma2000/IS-95 Wireless Test Manager
E6562C W-CDMA Wireless Test Manager
E6563A AMPS/136 Wireless Test Manager
E6564A 1xEV-DO Wireless Test Manager
E6566C GSM/GPRS Wireless Test Manager
E6568C W-CDMA/GSM/GPRS Wireless Test Manager
E6569C Wireless Test Manager Suite
N5880A cdma2000/IS-95/AMPS Enhanced Wireless Test Manager
N5882A W-CDMA Enhanced Wireless Test Manager
N5884A 1xEV-DO Enhanced Wireless Test Manager

Key Literature & Web Link

www.agilent.com/find/8960
www.agilent.com/find/8960devicedesign
www.agilent.com/find/mfg
www.agilent.com/find/wtm
www.agilent.com/find/8960upgrades

Ordering Information

E5515C Wireless Communications Test Set
  E5515C-002 2nd RF Source
  E5515C-003 Flexible CDMA Base Station Emulator
  E5515C-004 Digital Bus

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

Regression and Integration Testing
- **Adaptive Multi-Rate (AMR)**
- **Dual Transfer Mode (DTM), including enhanced DTM**
- **2-Cell Inter-RAT handovers to/from W-CDMA/HSDPA**

RF and Baseband Development
- **Flexible GSM/GPRS (optional EGPRS) Measurements**
- **Mobile Measurement Reports**

Software Application Development
- **Class 12 and Class 30-33 Packet data throughput**
- **2-Cell Inter-RAT handovers to/from W-CDMA/HSDPA**
- **Push to Talk over Cellular (POC), SMS/MMS and many other application tests**

The Agilent E6701E GSM/GPRS (Optional E6704A EGPRS) Lab Application provides the incredibly successful E5515C (8960) wireless communications test set with a long list of analysis features for RF, applications, mobility, services, and protocol. Whether you design, integrate, debug, or validate wireless devices, the E6701E, with its breadth of capabilities, will help you deliver mobile devices that hit your market window.

R&D Managers – You will be pleasantly surprised by the number of engineers you can enable with a single instrument – from RF development all the way to signaling conformance.

RF Engineers – Get your transmitter and receiver validated before the mobile protocol stack is complete with our non-signaling modes.

QA Managers – Regression test all your devices existing functionality including, AMR, SMS/MMS, plus the VERY latest GSM enhancements such as dual transfer mode (DTM), and the capability to test all of this during handovers and cell (re-) selection.

Pre-conformance and Conformance Engineers – The 8960 can be used in Anite SAS/SAT conformance systems as well as in Agilent's GS8800 pre-conformance system.

Software Application Engineers – Test simultaneous voice or data connections while sending an SMS or MMS, test MMS, video, instant messaging (IM) or over cellular (PoC), rapidly resolve or device to device interoperability issues with the included Wireless Protocol Advisor PC software for point-and-click simple analysis of mobile and cell protocol messaging from decoded L1 to IP.

Specifications

Connection Types
- ETSI A, ETSI B, BLER
- AMR, HR, FR and EFR Codecs
- IP Data Channel (Auto)

Signaling Variables
- 450/480/700/RGSM bands
- 850/900/1800/1900 bands
- T-GSM 810 (China)
- Downlink block corruption
- Forced uplink retransmission
- Extended UL TBF, Delayed DLTBF and TBF re-establish
- Dual Transfer Mode (DTM)
- Class 30, 31, 32, 33 signaling
- 2-box handoff & cell reselection

Measurements and Reports
- BER/BLER measurements
- BLER MS report
- GSM/GPRS MS reports
- TxP, PvT, ORFS, PFER
- Phase and Amplitude vs Time (PAvT)
- Bad Frame Indication (BFI)
- FACCH FER
- AMR I-FER
- IP data throughput monitor

Services
- GSM Cell Broadcast (CB) SMS
- GSM/GPRS Point to Point SMS
- Binary SMS (for MMS test)
- Service interoperability
- Suspend/Resume
- Dual Transfer Mode
- E-OTD and A-GPS
- Push to Talk over Cellular (PTT or PoC)
- Web browsing
- Data download

Accessories

E6785D GSM/GPRS/EGPRS_W-CDMA Lab Application (Fast Switching)
E6566C GSM/GPRS/EGPRS Wireless Test Manager makes is quick and easy to automate GSM, GPRS, and EGPRS testing with the E6701E lab application. Parametric measurements only.

Key Literature & Web Link

www.agilent.com/find/E6701E
www.agilent.com/find/E6785D
www.agilent.com/find/E6566C

Ordering Information

E6701E GSM/GPRS Lab Application
E6701EU GSM/GPRS Lab Application Upgrade
E6704A EGPRS Lab Application
E6720A-001 GSM/GPRS Annual Contract

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

EGPRS Lab Application

E6704A

Regression and Integration Testers

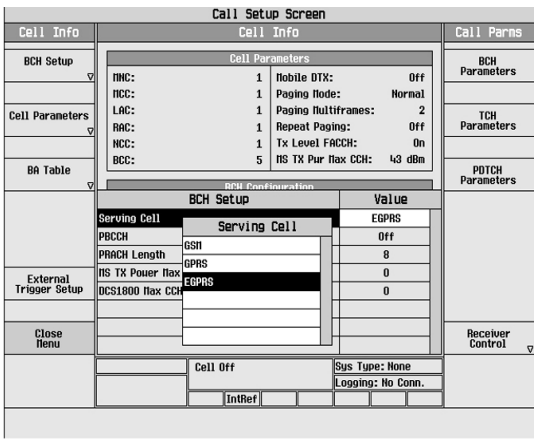
- **All the features of the E6701E extended to EGPRS**
- **Test the latest capabilities such as DTM**
- **Handover and cell (re-)selection testing between W-CDMA/HSDPA and GSM/EGPRS**

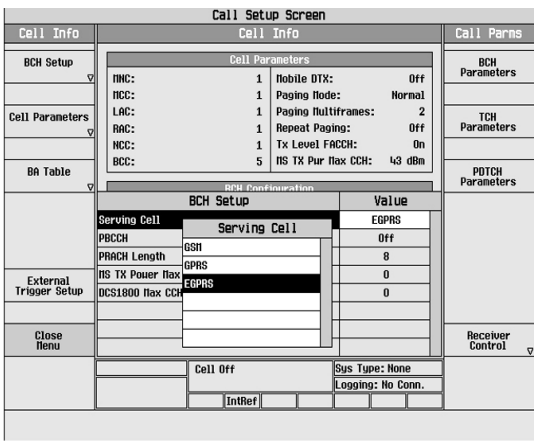
RF and Baseband Developers

- **Downlink corruption and deliberate NACK of good uplink blocks to force re-transmission and test of incremental redundancy**
- **GMSK and 8PSK Tx/Rx measurements**

Software and Application Developers

- **Full MCS9 throughput up to class 33**
- **RF to IP connectivity**
- **Test the latest applications such as PoC**





The Agilent E6704A EGPRS Lab Application provides the incredibly successful E5515C (8960) wireless communications test set with a long list of analysis features for RF, applications, mobility, services, and protocol. Whether you design, integrate, debug, or validate wireless devices, the E6704A, with its breadth of capabilities, will help you deliver mobile devices that hit your market window.

R&D Managers – You will be pleasantly surprised by the number of engineers you can enable with a single instrument – from RF development all the way to conformance.

RF Engineers – Get your transmitter and receiver validated before the mobile protocol stack is complete with our non-signaling modes.

QA Managers – Regression test all your devices existing functionality including, AMR, SMS/MMS, plus the VERY latest GSM enhancements such as Dual Transfer Mode (DTM), and the capability to test all of this during handovers and cell (re-) selection.

Pre-conformance and Conformance Engineers – The 8960 can be used in Anite SAS/SAT conformance systems as well as in Agilent's GS8800 pre-conformance system.

Software Application Engineers – Test simultaneous voice or data connections while sending an SMS or MMS, test end-to-end data, MMS, video, instant messaging (IM) or push-to-talk over cellular (PoC), rapidly resolve inter-service or device to device interoperability issues with the included Wireless Protocol Advisor PC software for point-and-click simple analysis of mobile and cell protocol messaging from decoded L1 to IP.

E6704A is a license extension to the E6701E. The E6701E is required for the E6704A to operate.

Specifications

Connection Types
- ETSI A, ETSI B, BLER
- EGPRS SRB
- EGPRS IP Data

Signaling Variables
- All signaling variables for the E6701E are extended to EGPRS plus:
- Incremental redundancy

Measurements and Reports
- All receiver measurements for the E6701E are extended to EGPRS
- All transmitter measurements for the E6701E are extended to EGPRS (GMSK and 8PSK) plus:
- IP data throughput monitor
- Modulation accuracy

Services
- All services for the E6701E are extended to EGPRS plus:
- (E)GPRS Point to Point SMS

Accessories

E6701E GSM/GPRS Lab Application *REQUIRED* to run E6704A

Key Literature & Web Link

www.agilent.com/find/E6704A
www.agilent.com/find/E6701E

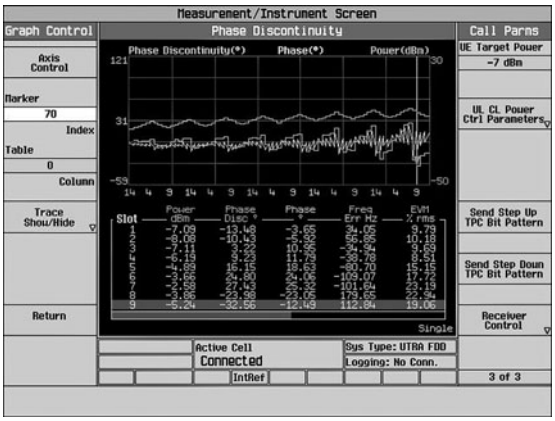
Ordering Information

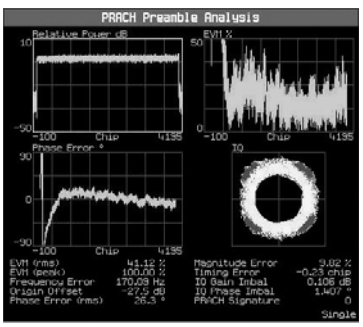
E6704A EGPRS Lab Application

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

Note: The E6704A requires the E6701C, E6701D or E6701E to operate.

- **7.2 Mbps IP data throughput available to E6703T annual upgrade contract customers**
- **2-cell voice and data Inter-RAT handovers while on a packet data call when the E6703D/T is used in conjunction with a second instrument operating the E6701E GSM/GPRS lab application**
- **The industry's first conforming measurements of mobile HS-DPCCH with Power, SEM, ACLR, HBLER, and the latest specification changes for 5.7 A HS-DPCCH and EVM**
- **7.2 Mbps HSDPA throughput testing of the MAC layer with our user defined channel within a radio bearer test mode call**
- **Enhanced measurement reporting within a greatly expanded compressed mode offering with multiple patterns and gaps**
- **HSDPA packet data connection providing end-to-end multimedia connection of network services such as SMS, MMS**





The Agilent E6703D Lab Application combined with the successful E5515C (8960) Wireless Communications Test Set provides network simulation and software verification tools designed specifically for the needs of wireless developers integrating and verifying a wide range of hardware and software design. This test solution offers realistic network simulation and gives you Internet connectivity with real data traffic flows. Additional capability is provided with extensive real-time protocol logging and analysis tools.

R&D Managers – You will be pleasantly surprised by the number of engineers you can enable with a single instrument – from RF development all the way to signaling conformance.

RF Engineers – Validate transmitter and receiver performance before the mobile protocol stack is integrated, as well as verify operation after protocol is integrated.

QA Managers – Regression test all your devices existing functionality including, SMS/MMS, plus the VERY latest W-CDMA/HSDPA enhancements, and the capability to test during handovers and cell (re-) selection.

Pre-conformance and Conformance Engineers – The 8960 can be used in Anite SAS/SAT conformance systems as well as in Agilent's GS8800 pre-conformance system.

Software Application Engineers – Test voice or data connections while sending an SMS or MMS, test end to end Data. MMS, or video, rapidly resolve inter service or device to device interoperability issues with the included Wireless Protocol Advisor PC software for point-and-click simple analysis of mobile and cell protocol messaging from decoded L1 to IP.

Specifications

E6703D
E6703T

Applications
- AMR voice
- Circuit data
- 3G-H324 video
- SMS
- MMS
- Cell broadcast SMS
- W-CDMA PS data to 384 kbps
- HSDPA RB Test Mode to 7.2 Mbps
- HSDPA IP data throughput to 7.2 Mbps with E6703T

Network Mobility
- Bands 1 to 10
- ARFCN hard handovers
- Soft handoff
- Compressed mode
- Physical channel re-configuration
- Transport channel re-configuration
- Inter-RAT 1-box
- Inter-RAT 2-box

Analysis Tools
- RF analysis – Tx and Rx
- W-CDMA protocol logging
- Data throughput monitor
- HSDPA protocol logging
- Optional digital fading

Accessories

E6703T Special High Data Rate W-CDMA/HSDPA Lab Application
E6785D GSM/GPRS/EGPRS_W-CDMA Lab Application (Fast Switching)
E6562C Wireless Test Manager Test Automation Software makes it quick and easy to automate W-CDMA testing with the E6703D lab application. Parametric measurements only

Key Literature & Web Link

www.agilent.com/find/E6703D
www.agilent.com/find/E6703T
www.agilent.com/find/E6562C

Ordering Information

E6703D W-CDMA/HSDPA Lab Application
E6703T Special High Data Rate W-CDMA/HSDPA Lab Application

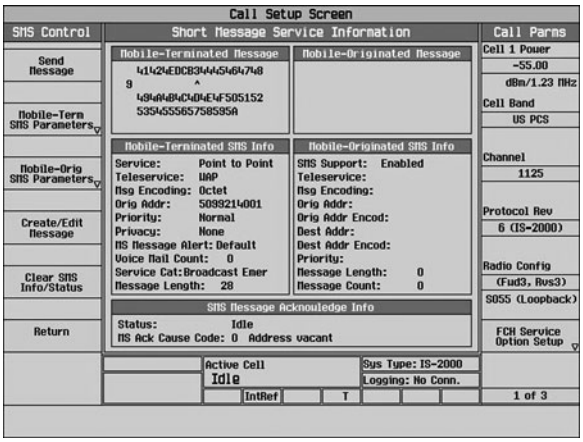
For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

cdma2000 Lab Application

E6702B

Regression and Integration Testing

- **Synchronize two 8960 test sets for functional test of cdma2000/1xEV-DO hybrid mode devices**
- **Powerful cdma2000 and IS-95 network emulation support for HTTP SMS/MMS, Authentication, Fast Forward Power Control, Mobile IP, Soft/Softer Handoff, Call Waiting, and Caller ID**
- **IP data throughput with graphical monitor**
- **Add Baseband Studio for Fading for accurate and realistic network fading impairments**
- **External protocol logging and analysis software**
- **Includes all E1962B Test Application features and measurements**
- **Support for cdma2000 Rel A**



The Agilent E6702B cdma2000 lab application for the 8960 wireless communication test set (E5515C) is a direct replacement for the E6702A. The E6702B has expanded on the E6702A's functionality, providing enhanced protocol and application development tools.

The E6702B speeds wireless appliance development with one-box support for SMS, Mobile IP, soft and softer handoffs, comprehensive parametric measurement capabilities including enhanced frame error rate and wireless protocol advisor support.

The E6702B cdma2000 lab application contains external wireless protocol analyzer software, which allows users to find and resolve difficult signaling functionality and timing issues. This software operates on an external PC connected to the 8960 test set through the 10 base-T Ethernet port. You can capture targeted data with three levels of filtering and triggering, thereby reducing the time needed to view lengthy log files.

- The E6702B includes all E1962B Test Application manufacturing – specific features and measurements, helping smooth the transition from development to manufacturing
- External protocol logging and analysis software real time captures and analyzes difficult signaling functionality and timing issues faster
- IP data throughput graphical monitor allows real time analysis of data throughput using controlled data impairments
- Additional features include:
  - HTTP SMS/MMS
  - Call Waiting
  - Fast device tune for fast calibration
  - Band Class 14 support
  - Hybrid mode support when synchronized with a separate E5515C running the E6706A 1xEV-DO Lab Application
  - Authentication
  - Band Class 0 updates
  - MEID support
  - Real time vocoder

Specifications

CDMA Tx Measurements
- Maximum power
- Minimum power
- Multi-code waveform quality
- Handoff waveform quality
- Open loop power accuracy
- Open loop power calibration
- Access probe power
- Graphical access probe power
- Code domain power
- Gated power
- Code channel timing and phase
- Spurious emissions
- Time response of open loop
- Tx dynamic power

CDMA Rx Measurements
- Fundamental/traffic channel sensitivity
- Demodulation of F-FCH in multipath fading
- Demodulation of F-FCH in multipath fading with closed loop power control (FPC_Mode=000)
- Demodulation of F-FCH in multipath fading with out loop and closed loop
- power control (FPC_Mode=000)
- Supplemental channel sensitivity
- Dynamic range
- Demodulation with AWGN
- Slotted paging channel MER

AMPS Tx Measurements
- RF power output
- RF frequency and frequency error
- FM modulation limiting
- FM deviation and distortion
- Audio frequency response
- Audio distortion
- FM hum and noise
- SAT deviation and frequency error
- Compressor response
- Signaling tone frequency and deviation
- DTMF symbol, frequency, and deviation
- Wideband data deviation

AMPS Rx Measurements
- SINAD
- Audio frequency response
- Audio distortion
- FM hum and noise
- Expander response

Accessories

E6560C Wireless Test Manager Test Automation Software makes it quick and easy to automate cdma2000, IS-95, and AMPS testing with the E6702B lab application
N5115A Baseband Studio for Fading products deliver external digital fading capabilities

Key Literature & Web Link

www.agilent.com/find/E6702B
www.agilent.com/find/E6560C
www.agilent.com/find/baseband

Ordering Information

E6702B cdma2000 Lab Application
E6702BU cdma2000 Lab Application Upgrade

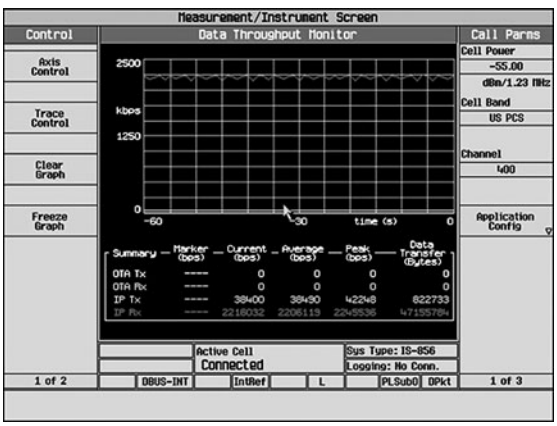
For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

Regression and Integration Testing

- **Synchronize two 8960 test sets for functional test of cdma2000/1xEV-DO hybrid mode devices**
- **Powerful 1xEV-DO network emulation support for Hybrid Mode, Mobile IP, MEID, Call Waiting, and Caller ID**
- **Add Baseband Studio for Fading for accurate and realistic network fading impairments**
- **External protocol logging and analysis software**

RF and Baseband Development

- **Includes all E1966A test application features and measurements**
- **1xEV-DO Rel A ETAP**



The Agilent E6706A Lab Application works with the E5515C (8960) wireless communication test set to create a network in a box that delivers true dynamic network performance using default packet application support for real throughput analysis and network emulation. That means the E6706A speeds wireless appliance development with one-box support for fading, Mobile IP, and throughput analysis on a packet data connection, while providing comprehensive parametric measurements.

The Agilent E6706A 1xEV-DO Lab Application is the first one box test set to support 1xEV-DO Rel A Extended Test Application Protocol (ETAP), in addition to the support of TAP for Rel 0. This functionality provides R&D engineers with standardized RF parametric tests for Rel A, ensuring that components are designed to handle the more stringent modulation requirements. 1xEV-DO Rel A ETAP (Enhanced Test Application Protocol) provides the standards compliant measurements required to test the mobile's transmitter quality at 1.8 Mbps and the receiver quality at 3.1 Mbps.

The E6706A includes external wireless protocol analyzer software which allows users to find and resolve difficult signaling functionality and timing issues. This software operates on an external PC connected to the 8960 test set through the Ethernet port. You can capture targeted data with three levels of filtering and triggering, thereby reducing the time needed to view lengthy log files.

Want a smooth transition from development to manufacturing? Use the E6706A lab application for development and the E1966A 1xEV-DO test application for manufacturing. These 1xEV-DO products establish identical test limits, allowing you to implement test code development earlier in your process – and with less effort.

Emulate Real Network Conditions, including Fading, without Leaving your Lab

The E6706A 1xEV-DO lab application delivers superior RF parametric measurements and the ability to connect to IP networks, allowing throughput analysis of applications and protocol development. Add impairments such as digital baseband fading and AWGN, and you have a virtual network on your deck – providing network performance data without the cost and hassle of drive testing a real network.

- The E6706A includes all E1966A test application manufacturing-specific features and measurements, helping smooth transition from development to manufacturing
- Troubleshoot design issues or test setup problems with enhanced data throughput analysis with peak data rates up to 2.4 Mpbs and sustained data rates up to 1.5 Mbps
  - Data channel connectivity tests high speed packet data connection to a network
  - IP throughput graphical monitor allows analysis of data throughput using controlled data impairments

Gain full 2.4 Mbps IP data throughput through the E6706T Lab Application

- Digital baseband fading provides a complete solution for fading 1xEV-DO access terminals. By integrating the base station emulation functionality and measurements of the E5515C (8960) test set with the digitally-generated channel impairments supplied by the Baseband Studio for Fading you are able to emulate real network conditions without leaving the lab
- Mobile IP is supported with an external simulator developed and sold by Software Concepts, Inc. The simulator connects to the E5515C using an Ethernet connection and provides mobile IP up to the PPP layers.
- External protocol logging and analysis software finds and resolves difficult signaling functionality and timing issues faster

Emulate a Rel A network with data speeds up to 3.1 Mbps on the forward link and 1.8 Mbps on the reverse link. In addition to the higher network speeds of Rel A, this allows support of the Multi-Flow Packet Application with QoS. This is available with the E6720A-006 Annual Contract.

1xEV-DO Lab Application (cont.)

E6706A

Specifications

1xEV-DO Call Processing
- UATI assign
- Session close
- Connect
- FTAP support
- FETAP support
- Channel handoff
- Default packet application
- Session open
- Session negotiation
- Disconnect
- RTAP support
- RETAP support
- Band handoff

Tx Measurements
- Average power
- Code domain power
- Modulation quality
- Spectrum monitor
- Tx dynamic power measurement
- Fast device tune measurement
- Channel power
- Access probe power
- Time response of open loop power
- Tx spurious emissions
- Graphical access probe power

Rx Measurements
- FTAP loopback
- Sensitivity
- PER with AWGN
- Data throughput
- FETAP loopback
- Dynamic range
- PER with fading (optional fader)
- Data rate histogram

Accessories

E6564C Wireless Test Manager Test Automation Software makes it quick and easy to automate 1xEV-DO test processes with the E6706A lab application
N5115A Baseband studio for fading products deliver external digital fading capabilities

Key Literature & Web Link

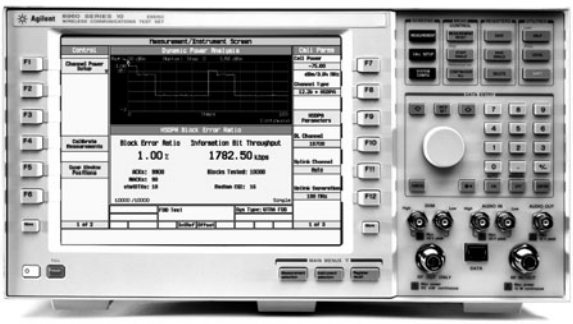
www.agilent.com/find/E6706A
www.agilent.com/find/E6564C
www.agilent.com/find/baseband

Ordering Information

E6706A 1xEV-DO Lab Application
E6706A-102 1xEV-DO Rel A
E6720A-006 1xEV-DO Annual Contract

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

- **Provides individualized early notification of lab application product functionality updates and enhancements**
- **Provides access to pre-release revisions of lab application product updates and enhancements**
- **Provides lab application updates during the term of the contract for no additional charge**
- **New firmware and licenses (if required) are delivered electronically on demand via the web**
- **Order Option 001 for E6701E, Option 003 for E6703D, and Option 006 for E6706A**



With rapidly evolving standards and the continuing stream of new product features, the E6720A lab application annual contract offers an edge for getting reliable products to market quickly. By ordering an annual contract, you get all new releases coming out in the next year for Agilent's powerful lab applications including subscription releases that are only available with the contract. Provides a permanent license for the next product revision (i.e., E6703D to E6703E) of the lab application. The features are not available without the contract. You get all releases for that license (i.e., E6703E) until a new license (i.e., E6703F) is released whether or not the annual contract is expired. The E6720A optimizes your ability to quickly isolate and resolve product faults and incompatibility issues, and prevent manufacturing delays.

Technology	Annual Contract	Annual Contract Extension
GSM/GPRS/EGPRS	E6720A-001	E6720A-201
W-CDMA/HSDPA	E6720A-003	E6720A-203
1xEV-DO	E6720A-006	E6720A-206
UMTS*	E6720A-017	E6720A-217

* E6720A-017 combines 001 and 003, E6720A-217 combines 201 and 203
Note 1: The Annual Contract Extension is to avoid overlap when renewing your existing Annual Contract.
Note 2: To purchase the E6720A Annual Contract, you must have the most current lab application product.

Useful Links for Current Contract Users

What	How Used
Software Manager Page	Initial signup and license kit ordering
Software License Page	Application license redemption
Application Download Page	Getting the latest lab application software releases
E6720A Quick Reference Guide	Guide that takes you through all the steps above. (PDF format)
8960 News	Get the latest information on 8960 applications and features

Key Literature & Web Link

www.agilent.com/find/E6720A

Ordering Information

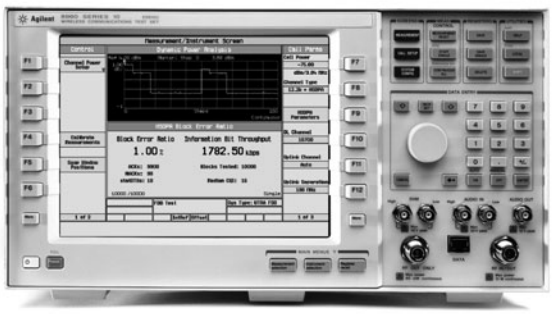
E6720A Lab Application Annual Contract
E6720A-001 GSM/GPRS
E6720A-003 W-CDMA
E6720A-006 1xEV-DO
E6720A-017 Annual Upgrade Contract for UMTS Lab Application Suite
E6720A-201 Annual Upgrade Contract Extension (12 month renewal) of E6720A-001
E6720A-203 Annual Upgrade Contract Extension (12 month renewal) of E6720A-003
E6720A-217 Annual Upgrade Contract Extension (12 month renewal) of E6720A-017

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

8960 Series 10 Lab Application Suites

E6716A
E6717B
E6719D

- **Ordering convenience of one model number, providing a suite of lab application formats for the 8960 Series 10 test set**
- **Lab applications included in the E6716A: E6702B (cdma2000 lab application), E6706A (1xEV-DO lab application)**
- **Lab applications included in the E6717B: E6701E (GSM/GPRS lab application), E6703D (W-CDMA/HSPA lab application), E6704A (EGPRS lab application), and E6785D (GSM/GPRS/EGPRS, W-CDMA/HSPA Fast Switching lab application)**
- **Lab applications included in the E6719D: E6701E (GSM/GPRS), E6702B (cdma2000), E6703D (W-CDMA/HSPA), E6704A (EGPRS), E6706A (1xEV-DO), and E6785D (GSM/GPRS/EGPRS, W-CDMA/HSPA Fast Switching lab application)**



The Agilent E6716A is a powerful suite of 8960 lab applications that gives R&D developers of cdma2000 and 1xEV-DO wireless devices the leading edge tools they need to verify today's multi-format wireless device designs. Available at significant cost savings over individual lab application purchases, the E6716A Lab Application Suite supports equipment using cdma2000 and 1xEV-DO technologies. The lab applications in the E6716A suite work with the E5515C test set, creating a complete Network in a Box, which allows you to test wireless devices under life-like application environments – using just one test device.

The Agilent E6717B is a collection of 8960 lab applications that gives developers of UMTS wireless devices the tools they need to verify new designs. The E6717B UMTS Lab Application Suite supports equipment using GSM, GPRS, EGPRS and W-CDMA/HSPA technologies. These lab applications in the E6717B suite work with the E5515C test set, creating a complete Network in a Box that allows you to test wireless devices under life-like application environments – using just one test set.

The Agilent E6719D Lab Application Suite includes all the lab applications for GSM, GPRS, EGPRS, W-CDMA, HSPA, cdma2000, and 1xEV-DO technologies.

Specifications

The E6716A cdma2000/1xEV-DO LA Suite combines the measurements and features from the following into a single model number: E6702B cdma2000 lab application and E6706A 1xEV-DO lab application.

The E6717B UMTS Lab Application Suite combines the measurements and features from the following into a single model number: E6701E GSM/GPRS lab application, E6703D W-CDMA/HSPA lab application, E6704A EGPRS lab application, and the E6785D GSM/GPRS/EGPRS, W-CDMA/HSPA Fast Switching lab application which allows fast switching across the lab applications.

The E6719D Lab Application Suite combines the measurements and features from the following into a single model number: E6701E GSM/GPRS lab application, E6702B cdma2000 lab application, E6703D W-CDMA/HSPA lab application, E6704A EGPRS lab application, E6706A 1xEV-DO lab application, and the E6785D GSM/GPRS/EGPRS, W-CDMA/HSPA Fast Switching lab application which allows fast switching across the lab applications.

Accessories

E6569C Wireless Test Manager Suite
E6706A-102 1xEV-DO Rel A

Key Literature & Web Link

www.agilent.com/find/E6716A
www.agilent.com/find/E6717B
www.agilent.com/find/E6719D
www.agilent.com/find/E6569C

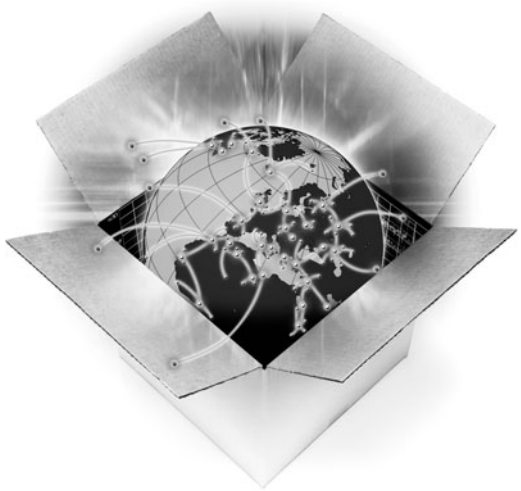
Ordering Information

E6716A cdma2000/1xEV-DO LA Suite
E6717B UMTS Lab Application Suite
E6719D Lab Application Suite

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

E6785D

- **Wireless formats supported: GSM, GPRS, EGPRS, W-CDMA, and HSPA (with corresponding lab applications installed)**
- **Switches between W-CDMA/HSPA and GSM/GPRS/EGPRS formats in less than two seconds**
- **Data channel functionality to test end-to-end connectivity and to verify throughput, robustness of radio link control and IP connectivity**
- **Fast transmitter and receiver measurements in all technologies**



Network In A Box

The majority of 3G mobile devices are being developed for W-CDMA/GSM dual mode applications. Along with the performance expectations in each technology, is the requirement of the device to properly deal with a W-CDMA to GSM handover.

The Agilent E6785D GSM/GPRS/EGPRS_W-CDMA/HSPA lab application (fast switching) for the 8960 Series 10 test set allows designers to integrate and debug in W-CDMA/HSPA and handover to GSM/GPRS/EGPRS for interoperability validation. The E6785D offers extensive network simulation and RF measurement capability to test UMTS signaling functionality, IP performance and user experience.

For details of the capabilities in a specific technology refer to the lab application that supports that technology: E6703D for W-CDMA/HSPA, E6701E for GSM/GPRS and E6704A for EGPRS.

Specifications

Requires the purchase of two or more individual lab applications in order to fast switch between them (E6701E, E6703D, E6704A)

Accessories

E6701E GSM/GPRS Lab Application
E6703D W-CDMA/HSPA Lab Application
E6704A EGRPS Lab Application

Key Literature & Web Link

www.agilent.com/find/E6785D
www.agilent.com/find/E6701E
www.agilent.com/find/E6703D
www.agilent.com/find/E6704A

Ordering Information

E6785D GSM/GPRS/EGPRS_W-CDMA/HSPA Lab Application (Fast Switching)

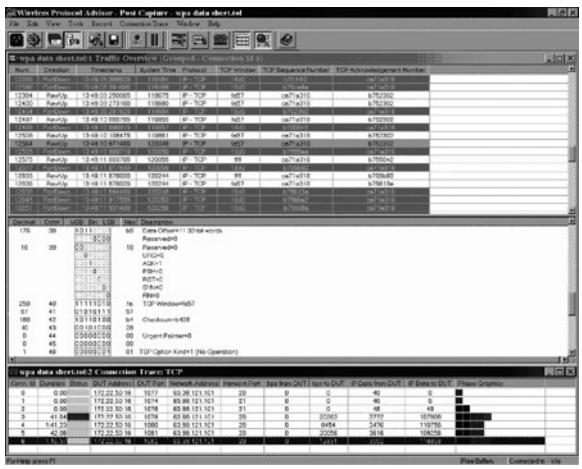
For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

Wireless Protocol Advisor Software

Wireless Protocol Advisor Products

E6584A

- **Multi-format support for key wireless technologies: GSM, GPRS, EGPRS, cdma2000, and W-CDMA**
- **Real time logging of Layer 1, 2, and 3 protocol**
- **Free post-capture analysis of protocol log files for a separate PC**
- **Now log data from 2 cell-site emulators**
- **Connection Trace feature tracks TCP/IP messaging and throughput**
- **Configurable trigger settings make it easy to sort through the huge volume of messaging to and from the mobile**
- **Configurable views and logging options provide additional flexibility**
- **Color tagging and graphical representations highlight areas of interest**



Get Multi-Format Support with a Single, Easy-to-use Powerful Analytic Tool

Features of emerging mobile devices are increasing in complexity and software content. Only by testing these features in a realistic mobile environment can you ensure the quality of your wireless subscriber equipment. So what's the easiest way to expedite production without compromising quality?

Use the flexible and powerful E6584A Wireless Protocol Advisor software with your wireless communications test set and lab application. This product trio creates a complete *Network in a Box* – Giving you a single box test solution for emulating real-life wireless applications. You'll be able to quickly collect and interpret wireless protocol messaging, verify functionality, and isolate and resolve protocol problems when developing new wireless products or applications. Take a look below at the features of this software.

One Product, Multi-Format Support

The Wireless Protocol Advisor software is included with every lab application allowing you to analyze files on a separate PC without having to purchase a new license.

Discover Its Power

Take a closer look at the Wireless Protocol Advisor software today! See the demonstration version download in the E6584A Key Library online.

Accessories

E5515C Wireless Communications Test Set Lab Applications

Key Literature & Web Link

www.agilent.com/find/E6584A

Ordering Information

E6584A Wireless Protocol Advisor Software
- **E6584A-001** Decodes for GSM/GPRS/EGPRS
- **E6584A-002** Decodes for cdma2000
- **E6584A-003** Decodes for W-CDMA
- **E6584A-006** Decodes for 1xEV-DO

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

E1968A

- **Supports GSM, GPRS, EGPRS (Class 12 capable)**
- **Call processing capability (complying with 3GPP TS51.010 specification)**
- **Test mode (non-signaling test)**
- **CW mode**
- **Multi-slot Class 12 transmit power measurement**
- **Multi-slot Class 12 power versus time measurement**
- **Fast device tune**
- **Phase and amplitude versus time enhancement measurement**
- **Fast switch capable with other technology formats**

The Agilent E1968A GSM/GPRS/EGPRS Mobile Test Application for the E5515C (8960) test set provides critical capabilities to verify the performance of your GSM, GPRS and EGPRS mobile devices. This test application, designed for high-volume manufacturing and wireless device development, help you achieve your time-to-market goals for GSM, GPRS and EGPRS wireless devices.

Use the E1968A to simultaneously measure up to four uplink time slots in the multi-slot Class 12 configuration. For more information, see: E1968A, E6701E/F/T/U, E6704A Online User's Guide.

Fast device tune allows simultaneous calibration of a device's transmitter and receiver across level and frequency in a single sweep (per frequency band) to significantly reduce calibration time during manufacturing. For more information, see: E1968A, E6701E/F/T/U, E6704A Online User's Guide.

Because this GSM/GPRS/EGPRS test solution is based on the high-performance E5515C test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support.

The E1968A test application helps product testing engineers by reducing test costs, quickly ramping up, and increasing yield with the following major features:

- Fast device tune measurement (NEW!!!)
- Phase and amplitude versus time measurement
- Dynamic power measurement

The E1968A test application helps R&D RF engineers and QA engineers by assuring confidence in your design with the following major features:

- Multi-slot Class 12 PVT measurement (NEW!!!)
- Multi-slot Class 12 TxP measurement

Specifications

GSM Functionality

- Mobile station power output level control: meets GSM phase one and phase two power control levels
- Traffic channels: TCH/FS – FR, EFR, and HR speech modes
- Broadcast channel configuration: BCCH + CCCH + SDCCH/4
- Signaling protocol setup: FACCH audio speech echo with one-second fixed delay

GPRS Functionality

- Multislot classes supported: 1 through 12
- Control channels: BCH on timeslot 0 on any ARFCN in any band
- Broadcast channel configuration: FCCH + SCH + BCCH + CCCH + SDCCH/4 (0-3) + SACCH/C4 (0-3)
- Downlink PDTCH: one, two, three, or four on the same PDTCH ARFCH with one or two PDTCH amplitudes settable between 0 and 55 dB below BCH amplitude; amplitudes in adjacent timeslots selectable as off, PRL (power reduction level) one, or PRL two

EGPRS Functionality

- Multislot classes supported: 1 through 6 for all operating modes, 7-12 for EGPRS BCH+PDTCH operating modes and other operating modes in some configurations
- Control channels: BCH on timeslot 0 on any ARFCN in any band
- Broadcast channel configuration: FCCH + SCH + BCCH + CCCH + SDCCH/4 (0-3) + SACCH/C4 (0-3)
- Downlink PDTCH: one, two, three, or four on the same PDTCH AFTCN with one or two PDTCH amplitudes settable between 0 and 55 dB below BCH amplitude; amplitudes in adjacent timeslots selectable as off, PRL one, or PRL two

Integrated GSM, GPRS, and EGPRS Functionality

- Switch between GSM, GPRS, and EGPRS serving cells
- Switch between data and voice connections without losing camp or attach
- Establish a voice or data connection after initial GPRS attach

Audio Functionality

- Choice of speech encoded on downlink TCH: none, echo, 300 Hz sine, 1 kHz sine, 3 kHz sine or PRBS-15, multi-tone, or custom
- GSM analog audio measurement (audio level, distortion, frequency, SINAD)

Receiver Measurements

- GSM burst-by-burst bit error ratio (fast BER)
- GSM bit error ratio (BER)
- GPRS/EGPRS multislot BER
- GPRS/EGPRS multislot block error ratio (BLER)
- Fast device tune

Transmitter Measurements

- GSM/GPRS/EGPRS multi-slot transmit power
- 8PSK multislot-tolerant modulation accuracy (peak, rms, 95th percentile and sample EVM; frequency, magnitude and phase errors, origin offset suppression; IQ imbalance)
- GMSK multislot-tolerant frequency error
- GMSK multislot-tolerant phase error (peak and rms with confidence limits)
- Multislot power versus time (burst mask comparison with settable masks)
- Burst timing
- Multislot-tolerant output RF spectrum due to modulation and switching
- IQ tuning
- GSM decoded audio level
- Dynamic power
- Phase and amplitude versus time (PAvT)
- Fast device tune

Instruments

- Audio generator
- General-purpose spectrum monitor
- GSM multi-tone audio

Accessories

E1987A Fast Switching Mobile Test Application
E6566C Wireless Test Manager Test Automation Software makes it quick and easy to automate GSM, GPRS, and EGPRS testing with the E1968A test application

Key Literature & Web Link

www.agilent.com/find/E1968A
www.agilent.com/find/E1987A
www.agilent.com/find/E6566C

Ordering Information

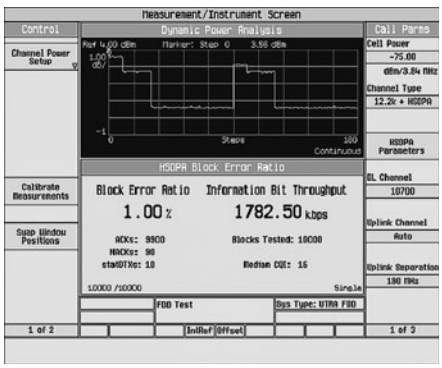
E1968A GSM/GPRS Mobile Test Application
E1968A-101 GSM Functionality
E1968A-102 GPRS Functionality
E1968A-103 EGPRS Functionality
E1968A-201 GSM and GPRS Functionality
E1968A-202 GSM, GPRS, and EGPRS Functionality
E1968A-410 EGPRS Phase and Amplitude versus Time Functionality

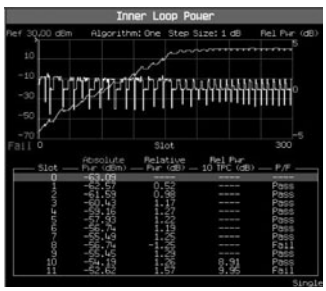
For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

W-CDMA Test Application

E1963A

- **In-call system handover from W-CDMA to GSM – 2-second switch providing the fastest UMTS production signaling possible**
- **Fast and accurate TX/RX measurements in compliance with 3GPP TS34.121**
- **Frequency support for Bands I – X**
- **Complete HSPA/UMTS test solution integrated into a single test set**
- **User-configurable Fixed Reference Channel (FRC) enable HSPA data throughput testing in radio bearer (RB) test mode**
- **PS/CS combined HSPA call setup allows robust device connections**
- **Uplink closed-loop power control algorithm and step size can now be modified without losing connection in order to perform a handover in the physical channel domain**
- **HSPA channel power, adjacent channel leakage ratio spectrum emission mask, dynamic power, waveform quality, IQ tuning and code domain measurements are optimized for speed**





The E1963A W-CDMA/HSPA mobile test application continues as the industry standard W-CDMA application for UMTS mobile test. Adopted worldwide since introduction, this product is used in many applications including: Manufacturing, R&D, Service, RF Conformance, and UE Certification Test.

The E1963A, when loaded into the industry leading 8960 test set, provides fast and accurate characterization of W-CDMA devices. When coupled with our leading GSM/GPRS/EGPRS test applications and HSDPA and HSUPA test modes option, this solution provides complete testing of UMTS devices worldwide. If your interests extend beyond UMTS, all other major wireless technologies are also available as a simple firmware upgrade over instrument LAN.

HSDPA and HSUPA Test Modes for the E1963A enable fast production test by providing both W-CDMA and HSPA test results from a single call connection. Maximize your production throughput with Best In Class suite of fast and accurate TX/RX measurements in compliance with 3GPP TS34.121. Exceed your calibration test time goals with the E1999A-201 Fast Device Tune Measurement. Simultaneously calibrate your device's transmitter (Tx) output power and receiver (Rx) input level across level and frequency.

Specifications

Tx Measurements
- Thermal power
- Channel power
- Adjacent channel leakage ratio
- Waveform quality
- Spectrum emission mask
- Phase discontinuity
- Inner loop power
- Occupied bandwidth
- Code domain power
- IQ tuning
- PRACH Tx on/off power
- Dynamic power analysis
- Tx dynamic power
- Spectrum monitor

Rx Measurements
- Loopback BER
- BLER on DPCH (W-CDMA)
- HBLER on HS-DPCCH (HSDPA)
- UE relative code domain power accuracy (HSUPA)
- Relative code domain error (HSUPA)

Call Processing
- Test Control call processing for RMC
- Call Control call processing for Voice Echo
- Reduce signaling FDD test mode
- 3G-H324 video call with E1963A-401
- Location update
- MS and BS Originate/Release
- UARFCN Hard Handoff
- GSM system handover
- Closed loop power control
- Loopback modes 1 and 2
- In-call spectrum analysis
- AWGN and OCNS sources
- HSDPA user-defined downlink

Audio Measurements
- Frequency stability
- Audio level
- SINAD
- Distortion
- Audio frequency

Accessories

E1987A Fast Switching Mobile Test Application
E1999A-201 Fast Device Tune Measurement
E6562C Wireless Test Manager Test Automation Software makes it quick and easy to automate W-CDMA testing with the E1963A test application

Key Literature & Web Link

www.agilent.com/find/E1963A
www.agilent.com/find/E1987A
www.agilent.com/find/E6562C

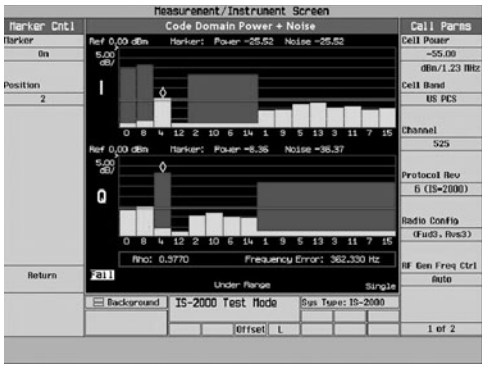
Ordering Information

E1963A W-CDMA Mobile Test Application
E1963A-401 W-CDMA Video Test
E1963A-403 HSDPA Test Modes
E1963A-413 HSUPA Test Modes

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

E1962B

- **First to market to support cdma2000 Release A on wireless terminal one-box-testers**
- **Extremely fast measurements**
- **Flexible cdma2000 and IS-95 forward-link emulation used in R&D and product-test applications**
- **Feature Options add cdma2000 Release A protocol support along with enhanced AMPS measurements and CDMA Authentication tests**



The Agilent E1962B cdma2000 Mobile Test Application for the 8960 Series 10 test set provides critical capabilities to verify the RF performance of your cdma2000 and IS-95 devices. This test application, designed for high-volume manufacturing and wireless device development, helps you achieve your time-to-market goals for cdma2000/IS-95/AMPS tri-mode wireless devices based on the new IS-2000 standard.

The fully-coded IS-2000 forward-link emulation supports Radio Configurations 1 through 5 and all supplemental channel data rates associated with those configurations. Comprehensive signal generation capabilities include all applicable CDMA channels, modulation, and an AWGN source. Flexible user control of the forward link emulation is provided through easy-to-use front panel control and remote GPIB.

Get the proven benefits of the Agilent 8960 test set. Because this cdma2000 test solution is based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. These proven features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

IS-95 and IS-2000 Call Processing
- Registration
- MS/BS origination
- IS-2000 to IS-95 handoff
- One button page
- Hard handoff (band & channel)
- F/R-SCH support
- Prev-7 support of BCCH, CCCH, R-EACH (E1962B-401 is required)

CDMA Tx Measurements
- Maximum power
- Minimum power
- Multi-coded waveform quality
- Open loop power accuracy
- Open loop power calibration
- Access probe power
- Code domain power
- Gated power
- Code channel timing and phase
- Spurious emissions
- Time response of open loop
- Tx dynamic power

CDMA Rx Measurements
- Fundamental/Traffic channel sensitivity
- Supplemental channel sensitivity
- Dynamic range
- Demodulation with AWGN

AMPS Call Processing
- Registration
- MS/BS origination
- TX power level change
- One button page
- Hard handoff (channel)

AMPS Tx Measurements
- RF power output
- RF frequency and frequency error
- FM deviation and distortion
- FM modulation limiting
- Audio frequency response
- Audio distortion
- FM hum and noise
- SAT deviation and frequency error
- Compressor response
- Signaling tone frequency and deviation (Option E1962B-402)
- DTMF symbol, frequency, and deviation (Option E1962B-402)
- Wideband data deviation (Option E1962B-402)

AMPS Rx Measurements
- SINAD
- Audio frequency response
- Audio distortion
- FM hum and noise
- Expander response

Additional Functions
- Fast call setup
- Spectrum monitor
- Code domain power supports dated IS-98E standard

Accessories

E1987A Fast Switching Mobile Test Application
E6560C Wireless Test Manager Test Automation Software makes it quick and easy to automate cdma2000, IS-95, and AMPS testing with the E1962B test application

Key Literature & Web Link

www.agilent.com/find/E1962B
www.agilent.com/find/E1987A
www.agilent.com/find/E6560C

Ordering Information

E1962B cdma2000/IS-95/AMPS Mobile Test Application
E1962B-401 cdma2000 Rel A New Control Channels
E1962B-402 Advanced AMPS Measurements
E1962B-403 cdma2000 Authentication

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

1xEV-DO Test Application

E1966A

- **First to market to support 1xEV-DO Release 0 and Release A on wireless terminal one-box-testers**
- **Support FTAP/RTAP and FETAP/RETAP call processing for accurate physical layer performance qualification**
- **Reduce the risk of returns and recalls by testing Packet Error Rate at all QPSK, 8PSK, 16QAM forward link modulation modes supported in the 1xEV-DO Release 0 and Release A standards**
- **Verify new reverse link modulation formats including 8-PSK supported in the 1xEV-DO Release A standard**

The Agilent E1966A 1xEV-DO Test Application is the first one box test set to support 1xEV-DO Rel A ETAP. This functionality provides R&D engineers with standardized RF parametric tests for Rel A, ensuring that components are designed to handle the more stringent modulation requirements. Manufacturers can easily expand their existing 1xEV-DO production tests to include Rel A. Order the E1966A-102 to receive the Rel A functionality.

The Agilent E1966A 1xEV-DO Terminal Test Application for the E5515C (8960) wireless communication test set provides the first one-box manufacturing solution for testing 1xEV-DO at high data rates giving you confidence in the quality of your wireless access terminals.

The E1966A meets the needs of mobile manufacturers as well as developers and designers of leading edge 1xEV-DO wireless access terminals. Designed for use with Agilent's industry standard platform, the 8960, it ensures efficient test times, accuracy, and repeatability in 1xEV-DO test processes. Because this 1xEV-DO test solution is based on the high-performance 8960 test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. These proven features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

1xEV-DO Call Processing
- UATI assign
- Session open
- Session negotiation
- Connect/disconnect
- FTAP and RTAP support
- FETAP and RETAP support (optional)

Tx Measurements
- Average power
- Channel power
- Code domain power
- Access probe power
- Modulation quality
- Time response of open loop power
- Spectrum monitor
- Tx spurious emissions
- Tx dynamic power
- Fast device tune (optional)

Rx Measurements
- FTAP/FETAP loopback
- Dynamic range
- Sensitivity
- PER with AWGN

Accessories

E1987A Fast Switching Mobile Test Application
E6564C 1xEV-DO Wireless Test Manager Test Automation software makes it quick and easy to automate 1xEV-DO testing with the E1966A test application

Key Literature & Web Link

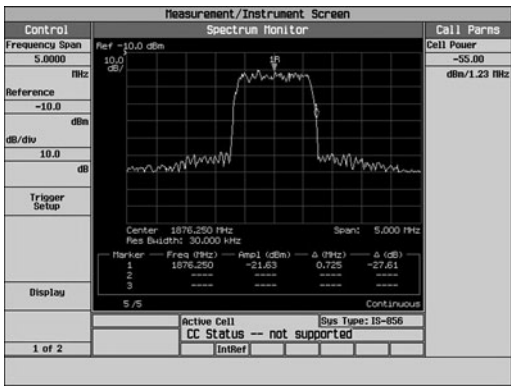
www.agilent.com/find/E1966A
www.agilent.com/find/E1987A
www.agilent.com/find/E6564C

Ordering Information

E1966A 1xEV-DO Terminal Test Application
E1966A-102 1xEV-DO Rel A

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

- **E5515C generates forward link physical channels**
- **No call processing to bring up connection, automation through Qualcomm Serial Interface Command Set**
- **Independent receiver measurements on phone's transmitted signal**



The Agilent E1976A 1xEV-DO Factory Test Mode Test Application is the subset of the E1966A 1xEV-DO Mobile Test Application for Release 0 and Release A, it is also the first one-box test set solution to support 1xEV-DO Rel A Factory Test Mode supported by Qualcomm®. This functionality enables R&D engineers and production engineers to test the terminal's physical channel performance through test mode, rather than call processing. The test requires external serial port control of mobile device. Order the E1976A-102 to receive the Release A Factory Test Mode functionality.

The E1976A meets the needs of mobile manufacturers with higher speed and lower cost. Designed for use with Agilent's industry standard platform, the 8960, it ensures efficient test times, accuracy, and repeatability in 1xEV-DO test processes.

Specifications

The Agilent E1976A 1xEV-DO Factory Test Mode Test Application is the subset of the E1966A 1xEV-DO Mobile Test Application for Release 0 and Release A. Refer to the specifications for the E1966A 1xEV-DO Terminal Test Application.

Key Literature & Web Link

www.agilent.com/find/E1976A

Ordering Information

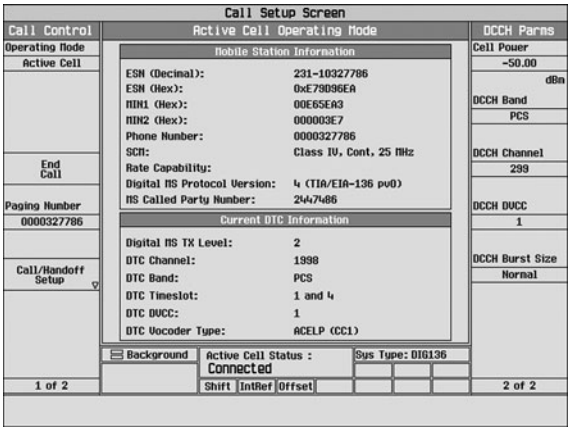
E1976A 1xEV-DO Rel 0 FTM Test Application
E1976A-102 1xEV-DO Rel A FTM

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

AMPS/136 Test Application

E1961A

- **Cellular formats supported: IS-136 (800 MHz and 1900 MHz bands) and AMPS**
- **Extremely fast transmitter and receiver measurements**
- **High level programming decreases test times, shortens test development, and decreases support costs**
- **Statistical test results and measurement integrity reporting**



The Agilent E1961A AMPS/136 mobile test application for the 8960 Series 10 wireless communications test set provides critical capabilities to verify the performance of your AMPS/136 mobile devices. This test application, designed for high-volume manufacturing and wireless device development, helps you achieve your time-to-market goals for AMPS/136 wireless devices.

The E1961A offers an extensive list of transmitter and receiver tests for the AMPS/136 format. Additional tests provide extensive audio and call processing performance analysis. AMPS/136 test operating modes include full signaling (active mode), limited signaling (DTC or AVC generation in the test mode) and CW modes.

Get the proven benefits of the Agilent 8960 test set. Because this AMPS/136 test solution is based on the high-performance 8960 Series 10 wireless communications test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

Analog Transmitter Measurements
- Analog Tx power
- RF frequency and frequency error
- FM deviation and distortion
- Modulation frequency

Analog Receiver Measurements
These measurements can be made using the RF generator and audio analyzer:
- SINAD
- Audio harmonic distortion
- Hum and noise
- Expandor
- Audio frequency response

Digital Transmitter Measurements
- Modulation accuracy (includes rms EVM, rms EVM 10, origin offset, frequency error, rms phase error and rms magnitude error)
- Digital Tx power
- Adjacent first alternate and second alternate channel powers
- IQ tuning

Digital Receiver Measurement
- Loopback bit error rate (BER)

Signal Generation Functionality
- RF generator
- Audio generator
- RF IN/OUT port
- RF OUT ONLY port

RF Analysis Functionality
- General purpose spectrum monitor

Audio Analyzer Functionality
- Audio level measurement using rms or peak detector
- SINAD measurement
- Distortion measurement
- Frequency measurement
- Swept audio measurement
- Expandor on or off
- 750 microseconds de-emphasis on or off

Audio Analyzer Filters
User-selectable choice of none or:
- C-message
- 100 Hz bandwidth tunable band pass
- 50 Hz to 15 kHz band pass
- 300 Hz to 15 kHz band pass

Mobile-reported Information
- Electronic serial number (ESN)
- Mobile identification number (MIN)
- Phone number
- Station class mark (SCM)
- Mobile protocol capability indication for analog control channels (MPCI)
- Protocol version for digital control channels
- Rate capability for digital control channels
- Called number
- MAHO BER on digital traffic channels
- MAHO RSSI on digital traffic channels and neighboring channels

AMPS/136 Functionality
- **Mobile Station Power Output Level Control:** meets TIA/EIA 136 and 136A power control levels
- **Digital Traffic Channels:** full rate speech
- **Audio Speech Echo:** minimum reasonable delay
- **Analog Measurement Coordination:** flexible control of ACC channel number and SID, AVC channel number and power level, SAT color code, FM rate and FM deviation
- **Digital Measurement Coordination:** flexible control of DCCH band, channel number, DVCC, SID, MCC, SOC and burst size, DTC band, channel number, power level, timeslot, DVCC, burst size, vocoder type and induced error level
- **External Trigger:** signal output each frame with user-settable timeslot and bit

Signaling Modes
- **Full Signaling Call Setup (Active Cell Mode):** protocol used to establish, maintain, change channels and power levels and terminate the link. Full signaling is available with analog and digital signals in both bands
- **No Signaling Call Setup (Test Mode):** mobile station is set up on a channel without the test set. Test set provides RF generator output and RF and audio analysis input. Test mode with no signaling is available with analog and digital signals in both bands

Call Processing Functionality

	ACC	Cell, DCCH	PCS DCCH	AVC	Cell. DTC	PCS DTC
Camp	Yes	Yes	Yes	—	—	—
Register	Yes	Yes	Yes	—	—	—
Originate	To AVC To cell. DTC	To AVC To cell. DTC To PCS DTC		From ACC From cell. DCCH From PCS DCCH	From ACC From cell. DCCH From PCS DCCH	From cell. DCCH From PCS DCCH
Page	To AVC To cell. DTC	To AVC To cell. DTC To PCS DTC		From ACC From cell. DCCH From PCS DCCH	From ACC From cell. DCCH From PCS DCCH	From cell. DCCH From PCS DCCH
Conversation	—	—	—	Yes	Yes	Yes
Hand Off	—	—	—	To AVC To cell. DTC	To AVC To cell. DTC To PCS DTC	To AVC To cell. DTC To PCS DTC
MS Release	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH
BS Release	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH

Accessories

E1987A Fast Switching Mobile Test Application
E5883A Wireless Test Manager Test Automation Software makes it quick and easy to automate IS-136 (TDMA) and AMPS testing with the E1961A test application

Key Literature & Web Link

www.agilent.com/find/E1961A
www.agilent.com/find/E1987A
www.agilent.com/find/E5883A

Ordering Information

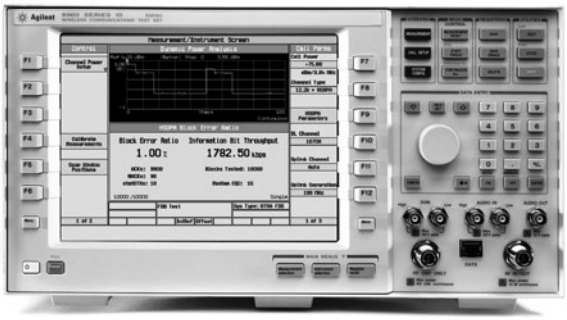
E1961A AMPS/136 Mobile Test Application

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

8960 Series 10 Test Application Suites

E1991B
E1993A
E1996A

- **Ordering convenience of one model number, providing a suite of test application formats for the 8960 Series 10 test set**
- **Test applications included in the E1991B: E1961A (AMPS/IS-136), E1962B (cdma2000/IS-95/AMPS), E1963A (W-CDMA/HSPA), E1966A (1xEV-DO), E1968A (GSM, GPRS, EGPRS), and E1987A for fast switching**
- **Test applications included in the E1993A: E1963A (W-CDMA/HSPA), E1968A (GSM, GPRS, EGPRS), and E1987A for fast switching**
- **Test applications included in the E1996A: E1962B (cdma2000/IS-95/AMPS), E1966A (1xEV-DO), and E1987A for fast switching**
- **Switches between formats in two to four seconds**
- **Allows configuration of idle formats while testing using an active application**



The Agilent E1991B test application suite for the 8960 Series 10 test set delivers the most popular wireless formats in one easy-to-order model number providing the most cost-effective way to purchase multiple test applications for your Agilent 8960 Series 10 wireless communications test set, model E5515C. You can now meet shifting market demands by having all popular cellular formats available when you need them. Your test set and production lines can be ready to go with a new format in minutes to give you maximum flexibility on your production lines.

The Agilent E1993A UMTS test application suite for the 8960 Series 10 test set delivers the wireless formats needed to test UMTS devices in one easy-to-order model number. The E1993A provides the most cost-effective way to purchase multiple test applications to test UMTS devices with GSM, GPRS, EGPRS, and W-CDMA/HSPA formats.

The Agilent E1996A cdma2000/1xEV-DO test application suite for the 8960 Series 10 test set delivers the wireless formats needed to test cdma2000 and 1xEV-DO devices in one easy-to-order model number. The E1996A includes applications to test wireless devices with cdma2000/IS-95/AMPS, and 1xEV-DO formats.

Get the proven benefits of the industry-standard Agilent 8960 test set. Because these test solutions are based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, accuracy, reliability, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These proven features help you shorten development time, increase throughput, and minimize support costs.

Specifications

The E1991B Mobile Test Application Suite combines the measurements and features from the following into a single model number: E1961A AMPS/IS-136, E1962B cdma2000/IS-95/AMPS, E1963A W-CDMA/HSPA, E1966A 1xEV-DO, E1968A GSM/GPRS/EGPRS, and the E1987A Fast Switching Mobile Test Application which allows fast switching across all test applications.

The E1993A UMTS Test Application Suite combines the measurements and features from the following into a single model number: E1963A W-CDMA/HSPA, E1968A GSM/GPRS/EGPRS, and the E1987A Fast Switching Mobile Test application which allows fast switching across the test applications.

The E1996A cdma2000/1xEV-DO TA Suite combines the measurements and features from the following into a single model number: E1962B cdma2000/IS-95/AMPS, E1966A 1xEV-DO, and the E1987A Fast Switching Mobile Test Application which allows fast switching across the test applications.

Accessories

E6569C Wireless Test Manager Suite
E1962B-401 cdma2000 Rel A New Control Channels
E1962B-402 Advanced AMPS Measurements
E1962B-403 cdma2000 Authentication
E1962B-405 cdma2000 Digital Bus (Fading)
E1962B-406 cdma2000 Multi-Unit Sync
E1962B-407 cdma2000 Protocol Logging
E1963A-401 W-CDMA Video Test
E1963A-403 HSDPA Test Modes
E1963A-413 HSUPA Test Modes
E1966A-102 1xEV-DO Rel A
E1966A-405 1xEV-DO Digital Bus (Fading)
E1966A-406 1xEV-DO Multi-Unit Sync
E1966A-407 1xEV-DO Protocol Logging
E1968A-410 EGPRS Phase and Amplitude vs Time
E1968A-417 8PSK Distortion Calibration

Key Literature & Web Link

www.agilent.com/find/E1991B
www.agilent.com/find/E1993A
www.agilent.com/find/E1996A
www.agilent.com/find/E6569C

Ordering Information

E1991B Mobile Test Application Suite
E1993A UMTS Test Application Suite
E1996A cdma2000/1xEV-DO TA Suite

For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

E1987A

- **Provides fast switching between GSM, GPRS, EGPRS, cdma2000, IS-95, IS-136, W-CDMA, 1xEV-DO, and 1xEV-DO Release A**
- **Switching between wireless formats in two to four seconds**
- **Fast, high-quality transmitter and receiver measurements across the most popular wireless formats. For more information see individual format applications**
- **Allows configuration of idle applications while testing using an active application providing further test time reductions**

The Agilent E1987A is a single application for fast switching across all Agilent test applications. With the new E1987A, the 8960 can fast switch from cdma2000 to W-CDMA, from GSM to 1xEV-DO, and any other test application combination.

New multi-format appliances require test equipment that provides complete wireless technology format flexibility and the ability to switch between those formats fast. To offer complete format flexibility and simplify test set configuration, the new Agilent E1987A combines all 8960 fast switching in a single fast switching test application (TA.)

The E1987A fast switching TA runs on the Agilent 8960 Series 10 wireless set and is designed to minimize test setup, significantly reduce test times, and help you meet your customer demands for multi-format wireless devices. Using the E1987A fast switching TA, you can minimize setup time when reconfiguring production lines by switching between test applications in less than two to four seconds!

The E1987A offers an extensive list of transmitter and receiver tests for the most popular analog and digital wireless mobile formats. They support full signaling (active mode), limited signaling (test mode), and CW modes. For details of the test capabilities in a specific format, refer to the application that supports that format: E1968A for GSM, GPRS and EGPRS; E1961A for AMPS and 136, E1962B for cdma2000, IS-95 and AMPS; E1963A for W-CDMA; and E1966A for 1xEV-DO.

Get the Proven Benefits of the Agilent 8960 Test Set

Because these test solutions are based on the high-performance 8960 Series 10 test set, you gain the additional benefits of fast measurement speed, high quality measurements, ease of programming, accuracy, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These features help you shorten test development time, increase throughput, guarantee device quality, and minimize support costs.

Specifications

The E1987A Fast Switching Test Application combines the measurements and features from the E1961A AMPS/IS-136, the E1962B cdma2000/IS-95/AMPS, the E1963A W-CDMA, the E1966A 1xEV-DO, and the E1968A GSM/GPRS/EGRPS Mobile Test Applications into fast switching test applications.

The fast switching products do not include the individual test applications, only the ability to fast switch between them when they are installed concurrently. Purchase the individual test application you need along with the E1987A.

Accessories

Requires the purchase of two or more individual mobile test applications in order to fast switch between them (E1961A, E1962B, E1963A, E1966A, E1968A)

E6560C, E6562C, E6564C, E6566C, E6567C, E6568C Wireless Test Manager Software

Key Literature & Web Link

www.agilent.com/find/E1987A
www.agilent.com/find/E6567C
www.agilent.com/find/E6568C

Ordering Information

E1987A Fast Switching Test Application

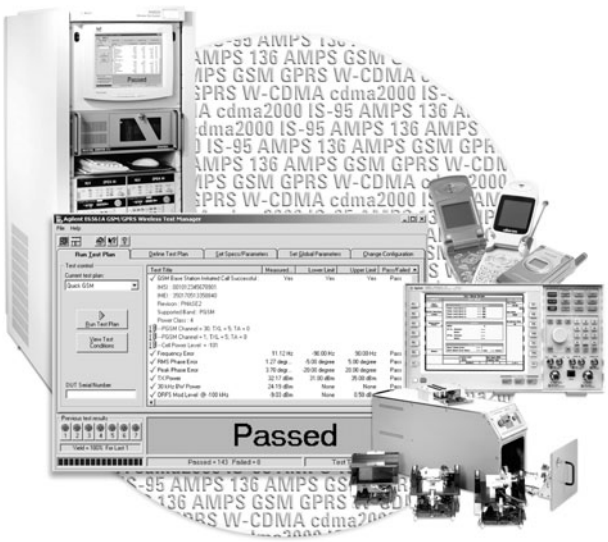
For detailed configuration information, refer to the 8960 Configuration Guide (5968-7873EN) at **www.agilent.com/find/8960config**

Wireless Test Manager Software

Wireless Test Manager Products

E6560C
E6564C
E6566C
E6567C
E6568C
E6569B/C
E6571A/C
N4018C
N4019C
N5880A
N5882A
N5884A

- **Software family supports cdma2000, IS-95, 1xEV-DO, W-CDMA, GSM, GPRS, EGPRS, *Bluetooth*™ and AMPS**
- **Technology specific, pre-defined automated test plans help you start testing immediately**
- **High-level, technology specific test steps make for compact, easy to read test plans**
- **Simple and powerful test step sequencer for fast custom test development**
- **Common, easy-to-use operator interface decreases training time and operator errors**
- **Simple interface to set test parameters, limits and system hardware configuration simplifies customization and support**
- **Common Microsoft®, Visual Basic.NET® based development for powerful test and calibration program/debug capability**
- **Integrated test wizard reduces the programming required to add custom tests and hardware**
- **Windows® PC compatible including XP, 2000, NT and 98 Second Edition**
- **Integrated HELP application for test executive and measurement technology assistance**



Revolutionize the Automation of Test to Get Your Wireless Device to Market Quickly and Reduce Test Cost

Agilent's wireless test manager is a family of test automation software for wireless device calibration and test. The wireless test manager supports most popular wireless technologies. Developed for a Windows PC, the wireless test manager controls Agilent test sets and other test system hardware via GPIB and serial interfaces. Features include ready-to-use tests, pre-defined test plans, customizable test sequencing, an integrated Visual Basic test development environment and custom application development utilities.

Multiple Technologies

Available for the key wireless technologies, the wireless test manager products support W-CDMA, cdma2000, 1xEV-DO, IS-95, GSM, GPRS, EGPRS, *Bluetooth*, WLAN, IS-136 (TDMA) and AMPS testing.

Simplify and Expedite Test Efforts

Designed specifically for test engineers, the test manager eliminates the frustrating complexity associated with automating device testing. Why struggle with computer control and data management issues, when the test manager lets you focus on test?

Use Agilent or Custom Test Plans

Run a pre-defined Agilent test plan, customize an existing plan, or create your own custom test plan. The test manager makes it easy to modify test parameters, adjust test limits, change the order of test steps, or build your own test plan – without programming.

Create Custom Test Steps

To guide you through the process of adding your own custom test steps, the test manager features a test wizard. Tests created with the wizard and Visual Basic are added to the test menu and can be used in a custom test plan without additional programming.

Flexibility to Meet Your Test Needs

The wireless test manager makes it easy to configure system hardware. It provides for point and click set-up of select Agilent test sets, power supplies, bar code readers, test fixtures, and printers. Other instruments can be added using a wizard. Plus the test manager gives you the flexibility to save test results for further analysis, and set run conditions to stop, continue, or retry on failure. For more information on the adaptable wireless test manager, visit the product pages on the Web.

Common Software Savings

The wireless test manager is easy to learn and simple to use. You will not have to learn complex applications and multiple programming languages to support calibration and testing. Since wireless test manager interfaces and development tools are common for all products, leveraging your knowledge across wireless technologies has never been easier.

Specifications

The tests supported for each technology include call processing, transmitter, receiver, general and fast-combined tests. To review the supported tests, PC requirements and supported hardware go to **www.agilent.com/find/wtm** and select a product/technology then select the technical overview (or product overview) for that product.

Accessories

8960 Series 10 Test Applications and Lab Applications

Key Literature & Web Link

Technical information, specifications, downloadable demonstration software and product literature are available at **www.agilent.com/find/wtm**

Ordering Information

Standard Wireless Test Managers
E6560C for cdma2000, IS-95, AMPS
E6564C for 1xEV-DO
E6566C for GSM, GPRS, and EGPRS
N4019C for *Bluetooth* and WLAN
N5880A for cdma2000/IS-95/AMPS Enhanced Wireless Test Manager
N5882A for W-CDMA Enhanced Wireless Test Manager
N5884A for 1xEV-DO Enhanced Wireless Test Manager

Run-Time, Combination and Suite Wireless Test Managers
E6567C for cdma2000, IS-95, AMPS, 1xEV-DO
E6568B for W-CDMA, GSM and GPRS
E6568C for W-CDMA, GSM, GPRS, and EGPRS
E6569B Suite (includes E6560A, E6562A, E6563A, E6564A, E6568B)
E6569C Suite (includes E6567C, E6568C)
E6571A/C Run-Time License
N4018C *Bluetooth* and WLAN Run-Time License

For detailed configuration information, click the Wireless Test Manager Configuration Guide link in the Key Library Information section at **www.agilent.com/find/wtm**

- **Reduce cost of test for mobile phone manufacturing**
- **Industry leading measurement speed and integrity**
- **2G thru 3.5G technology flexible architecture**
- **Applications for GSM/GPRS/EGPRS, W-CDMA/HSDPA, cdma2000/1xEV-DO, and TD-SCDMA testing**
- **Built-in open Windows XP PC**
- **Technology specific software applications optimized for mobile phone manufacturing test**
- **Advanced fast calibration techniques provide state of the art test speeds**
- **Built-in help system**

The Next Generation of Mobile Phone Manufacturing Test

The Agilent E6601A is the next-generation solution for 2G, 2.5G, 3G, and 3.5G mobile phone / cell phone calibration and non-signaling test. Combining industry-leading measurement speed and integrity, buy only what you need architecture, and an integrated Windows® PC, the E6601A helps you achieve the lowest cost of test in wireless device manufacturing.

Industry-leading Measurement Speed and Integrity – are designed into the E6601A architecture – with its wide measurement bandwidth and high dynamic range, the E6601A saves test time by making an entire suite of both in-channel and out-of-channel measurements from a single sample. Optional Fast Device Tune capability is designed to work efficiently with the newest calibration methodologies to give you the lowest possible cost of test.

Buy Only What You Need – selectable calibration formats and flexible licensing allow you to quickly respond to changing production needs with rapid adjustments in test equipment capacity.

Built-in Windows PC running Microsoft® Windows XP Pro eliminates the need for an external PC saving test time, cost, power consumption, and valuable space.

E6601A non-signaling test performance complements the industry-leading full call processing performance of the 8960 Wireless Communications Test Set which is continually evolving to meet mobile test needs in R&D, manufacturing, and repair.

Specifications

Detailed specifications are found in the data sheets for the individual cal applications.

Applications

E6831A GSM/GPRS/EGPRS Cal Application
E6832A W-CDMA/HSDPA Cal Application
E6833A cdma2000/1xEV-DO Cal Application
E6835A TD-SCDMA Cal Application
E6889A E6601 Application Features
E6890A General Purpose Application

Key Literature & Web Link

www.agilent.com/find/E6601A

Ordering Information

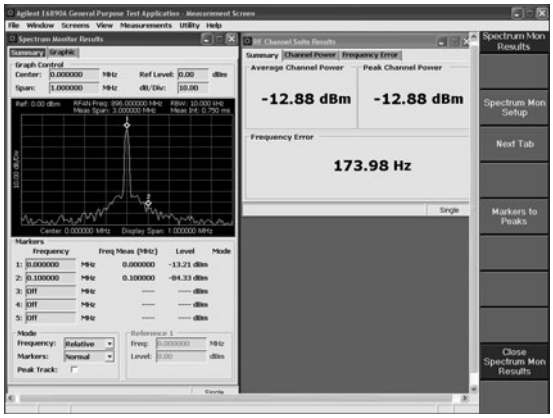
E6601A Wireless Communications Test Set

For detailed configuration information, refer to the E6601A Wireless Communications Test Set Configuration Guide (5989-5556EN) found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/E6601A**

General Purpose Application

E6890A

- **General Purpose Application for the E6601A Wireless Communications Test Set**
- **RF Source, CW, AM, FM, DSSC, DSBSC**
- **RF analyzer**
- **Spectrum monitor**
- **Transmitter power measurement**
- **Frequency error measurement**
- **Easy front panel measurement control**
- **Externally programmable from GPIB, USB, and LAN**
- **Industry standard SCPI control commands**
- **Built-in help system**



The Agilent E6890A general purpose application for the E6601A test set provides a calibrated source and receiver for wireless device test. This general purpose application, designed for non-signaling test in re-work and troubleshooting stations, and development can play an important role in meeting your time-to-market goals and reducing your cost of test.

This general purpose test solution is based on the new, next-generation, high-performance E6601A test set. You gain the benefits of industry leading measurement speed, an integrated open Windows PC, and basic RF capability in a Windows interface. With an application focused on basic RF generation and measurement, flexible connectivity (LAN, GP-IB, USB) and access via Windows Remote Desktop, the next-generation capabilities of this test set offers a general purpose solution that can increase your efficiency and reduce your test costs.

- CW/AM/FM/DSB-SC Source
- High-speed transmitter measurements:
  - Channel Power
  - Settable fixed channels from 1 kHz to 5 MHz
  - Frequency Error
  - Power versus Time
- High-performance Spectrum Monitor
  - Spectral analysis in a Windows interface
- Optional IQ capture
  - Allows sampling of virtually any waveform
- QPSK waveform quality measurement

Specifications

Features
- CW/AM/FM/DSB-SC source
- High-speed TX Measurements: Channel Power, Settable fixed channels from 1 kHz to 5 MHz, Frequency Error, Power vs Time (zero span spectrum monitor)
- High-performance Spectrum Monitor (spectral analysis in a Windows interface)
- Optional IQ capture for waveform sampling

RF Generator
- Frequency Range: 380 to 2700 MHz
- CW Output Level: –130 to –3 dBm

RF Analyzer
- Frequency Range: 380 to 2700 MHz
- Peak Power Range: –65 to +37 dBm

Spectrum Monitor
- Input Range for Average: Power –65 to +35 dBm

Applications

Other applications available for the E6601A:
E6831A GSM/GPRS/EGPRS Cal Application
E6832A W-CDMA/HSDPA Cal Application
E6833A cdma2000/1xEV-DO Cal Application
E6835A TD-SCDMA Cal Application
E6889A E6601 Application Features

Key Literature & Web Link

www.agilent.com/find/E6890A

Ordering Information

E6890A General Purpose Application
E6890A-1FP General Purpose Application – Fixed, Perpetual License
E6890A-2FP IQ Capture – Fixed, Perpetual License
E6890A-R2C Upgrade to Current Revision

For detailed configuration information, refer to the E6601A Wireless Communications Test Set Configuration Guide (5989-5556EN) found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/E6601A**

E6831A

Features

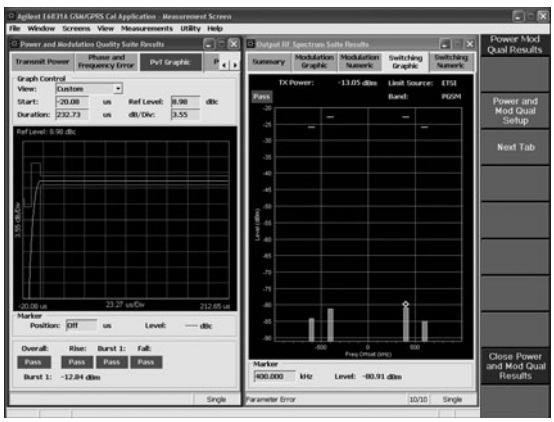
- **GSM/GPRS ARB source for flexible phone receiver (RSSI) testing**
- **Full set of high-speed transmitter measurements support all GSM/GPRS chipset calibration**
- **Dynamic Power provides fast series of power measurements for high-speed amplitude characterization (requires chipset support)**
- **Optional Phase and Amplitude versus Time measurement for high-speed characterization of phase-varying amplifiers (requires chipset support)**
- **Optional EGPRS calibration capability**

Accuracy

- **GMSK modulation frequency error <0.01 ppm (<0.005 ppm typical) + timebase accuracy**
- **TX Power measurement <±0.6 dB (<±0.3 dB typical)**
- **Phase Error <1 degrees rms, < 4 degrees peak**

Dynamic Range

- **TX Power measurement –40 dBm to +33 dBm**
- **Phase and Frequency Error measurement –15 dBm to +33 dBm**



The Agilent E6831A GSM/GPRS/EGPRS cal application for the E6601A test set provides all the necessary capabilities to calibrate your GSM, GPRS and EGPRS mobile devices. This cal application, designed for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for GSM, GPRS and EGPRS wireless devices.

This GSM/GPRS/EPGRS test solution is based on the new, next-generation, high-performance E6601A test set. You gain the benefits of industry leading measurement speed, optional time-based and portable licensing, and an integrated open Windows PC. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a UMTS calibration solution that can increase your throughput and reduce your test costs.

- ARB-like source for flexible phone receiver (RSSI) testing
- Full set of transmitter measurements:
  - Tx Power
  - Power vs Time
  - Phase and Frequency Error
  - Output RF Spectrum
- Dynamic power for fast series of power measurements
- High-performance Spectrum Monitor
  - Spectral analysis in a Windows interface
- Optional Phase and Amplitude versus Time (PAvT) measurement for high-speed characterization of phase-varying amplifiers
- Optional EGPRS calibration capability
  - 8PSK ARB source
  - EVM and Frequency Error waveform quality
  - New 8PSK EVM graphics available with upgrade

Specifications

Source Modulation
- CW, amplitude, frequency, GSM, 8PSK

Power Measurements
- Transmit power
- Power versus time
- Dynamic power

Spectral Measurements
- Output RF spectrum
- Spectrum monitor

Modulation Quality
- Phase and frequency error

Key Literature & Web Link

www.agilent.com/find/E6831A

Ordering Information

E6831A GSM/GPRS/EGPRS Cal Application
- **E6831A-1FP** GSM/GPRS Measurements – Fixed, Perpetual License
- **E6831A-1TP** GSM/GPRS Measurements – Transportable, Perpetual License
- **E6831A-1F1** GSM/GPRS Measurements – 1 month, Fixed License
- **E6831A-1F3** GSM/GPRS Measurements – 3 month, Fixed License
- **E6831A-1F6** GSM/GPRS Measurements – 6 month, Fixed License
- **E6831A-1FY** GSM/GPRS Measurements – 12 month, Fixed License
- **E6831A-2FP** EGPRS Measurements – Fixed, Perpetual License
- **E6831A-2TP** EGPRS Measurements – Transportable, Perpetual License
- **E6831A-2F1** EGPRS Measurements – 1 month, Fixed License
- **E6831A-2F3** EGPRS Measurements – 3 month, Fixed License
- **E6831A-2F6** EGPRS Measurements – 6 month, Fixed License
- **E6831A-2FY** EGPRS Measurements – 12 month, Fixed License
- **E6831A-3FP** PAvT Measurements – Fixed, Perpetual License
- **E6831A-3TP** PAvT Measurements – Transportable, Perpetual License
- **E6831A-3F1** PAvT Measurements – 1 month, Fixed License
- **E6831A-3F3** PAvT Measurements – 3 month, Fixed License
- **E6831A-3F6** PAvT Measurements – 6 month, Fixed License
- **E6831A-3FY** PAvT Measurements – 12 month, Fixed License
- **E6831A-R2C** Upgrade to Current Revision

For detailed configuration information, refer to the E6601A Wireless Communications Test Set Configuration Guide (5989-5556EN) found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/E6601A**

W-CDMA Cal Application

E6832A

Features

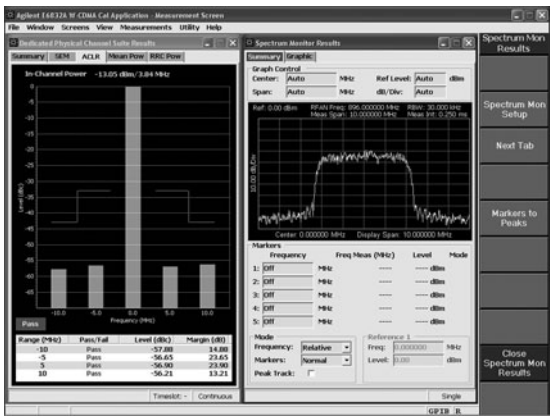
- **W-CDMA ARB source for flexible phone receiver (RSSI) testing**
- **Full set of high-speed transmitter measurements support all W-CDMA chipset calibration**
- **Dynamic Power provides fast series of power measurements for high-speed amplitude characterization (requires chipset support)**
- **Optional Fast Device Tune capability combines Dynamic Power, frequency hopping and simultaneous source (RSSI) for high-speed transmitter and receiver characterization of supported chipsets**

Accuracy

- **QPSK Modulation Residual EVM <10% (<3% typical)**
- **Channel Power measurement <±0.6 dB (<±0.3 dB typical)**
- **EVM measurement <± 2.5% rms**

Dynamic Range

- **Channel Power measurement –65 dBm to +28 dBm**
- **Waveform Quality measurement –25 dBm to +28 dBm**



The Agilent E6832A W-CDMA cal application for the E6601A test set provides all the necessary capabilities to calibrate your W-CDMA and HSDPA mobile devices. This cal application, designed for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for W-CDMA and HSDPA wireless devices.

This W-CDMA/HSDPA test solution is based on the new, next-generation, high-performance E6601A test set. You gain the benefits of industry leading measurement speed, optional time-based and portable licensing, and an integrated open Windows PC. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a UMTS calibration solution that can increase your throughput and reduce your test costs.

- ARB-like source for flexible phone receiver (RSSI) testing
- Full set of transmitter measurements:
  - Mean Power and RRC-filtered Power
  - Adjacent Channel Leakage Ratio
  - Spectrum Emission Mask
  - EVM
  - Frequency Error
  - Peak Code Domain Error
  - Occupied Bandwidth
- Dynamic power for fast series of power measurements
- High-performance Spectrum Monitor
  - Spectral analysis in a Windows interface
- Optional Fast Device Tune capability
  - Simultaneous Tx Power and RSSI measurements in 20 ms step sizes
  - Upgrade available for various step sizes from 5 ms to 20 ms

Specifications

Source Modulation
- CW, amplitude, frequency, W-CDMA

Power Measurements
- Mean power
- Root-raised cosine power
- Dynamic power

Spectral Measurements
- Spectrum emission mask
- Adjacent channel leakage
- Spectrum monitor

Modulation Quality
- CW frequency error
- DPCH EVM, OBW, frequency error

Key Literature & Web Link

www.agilent.com/find/E6832A

Ordering Information

E6832A W-CDMA Cal Application
- **E6832A-1FP** W-CDMA Measurements – Fixed, Perpetual License
- **E6832A-1TP** W-CDMA Measurements – Transportable, Perpetual License
- **E6832A-1F1** W-CDMA Measurements – 1 month, Fixed License
- **E6832A-1F3** W-CDMA Measurements – 3 month, Fixed License
- **E6832A-1F6** W-CDMA Measurements – 6 month, Fixed License
- **E6832A-1FY** W-CDMA Measurements – 12 month, Fixed License
- **E6832A-R2C** Upgrade to Current Revision

E6889A E6601 Application Features
- **E6889A-1FP** Fast Device Tune Measurement – Fixed, Perpetual License
- **E6889A-1TP** Fast Device Tune Measurement – Transportable, Perpetual License
- **E6889A-1F1** Fast Device Tune Measurement – 1 month, Fixed License
- **E6889A-1F3** Fast Device Tune Measurement – 3 month, Fixed License
- **E6889A-1F6** Fast Device Tune Measurement – 6 month, Fixed License
- **E6889A-1FY** Fast Device Tune Measurement – 12 month, Fixed License

For detailed configuration information, refer to the E6601A Wireless Communications Test Set Configuration Guide (5989-5556EN) found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/E6601A**

E6833A

Features

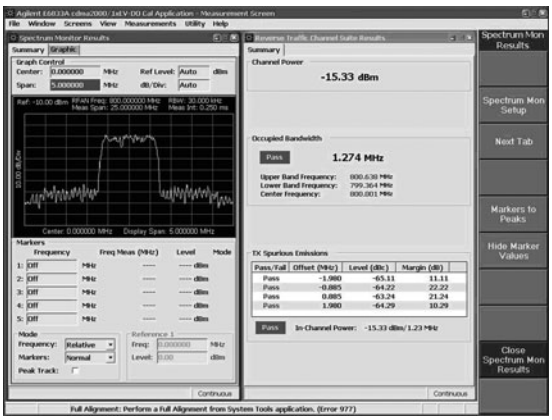
- **cdma2000/1xEV-DO ARB source for flexible phone receiver (RSSI) testing**
- **High-speed transmitter measurements support cdma2000/1xEV-DO chipset calibration**
- **Dynamic Power provides fast series of power measurements for high-speed amplitude characterization (requires chipset support)**
- **Optional Fast Device Tune capability combines Dynamic Power, frequency hopping and simultaneous source (RSSI) for high-speed transmitter and receiver characterization of supported chipsets**

Accuracy

- **Modulation quality – Residual Rho >0.99 (typical)**
- **Modulation quality – Residual EVM <3% (typical)**
- **Channel power measurement <±0.6 dB (<±0/3 dB typical)**

Dynamic Range

- **Channel Power measurement –65 dBm to +28 dBm**
- **TX spurious emissions 0 dBm to 30 dBm**



The Agilent E6833A cdma2000/1xEV-DO cal application for the E6601A test set provides all the necessary capabilities to calibrate your cdma2000 and 1xEV-DO mobile devices. This cal application, design for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for cdma2000 and 1xEV-DO wireless devices.

This cdma2000/1xEV-DO test solution is based on the new, next-generation, high-performance E6601A test set. You gain the benefits of industry leading measurement speed, optional time-based and portable licensing, and an integrated open Windows PC. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a cdma2000/1xEV-DO calibration solution that can increase your throughput and reduce your test costs.

- ARB source for flexible phone receiver (RSSI) testing
- High-speed transmitter measurements:
  - Channel Power
  - Occupied Bandwidth
  - TX Spurious Emissions
  - Waveform Quality
- Dynamic power for fast series of power measurements
- High-performance Spectrum Monitor
  - Spectral analysis in Windows interface
- Optional Fast Device Tune capability
  - Simultaneous Tx Power and RSSI measurements in variable (5 ms to 20 ms) step sizes

Specifications

Source Modulation
- CW, amplitude, frequency, IS-95, cdma2000, and 1xEV-DO

Power Measurements
- Channel power
- Dynamic power
- Fast Device Tune

Spectral Measurements
- TX spurious emissions
- Occupied bandwidth
- Spectrum monitor

Key Literature & Web Link

www.agilent.com/find/E6833A

Ordering Information

E6833A cdma2000/1xEV-DO Cal Application
- **E6833A-1FP** cdma2000/1xEV-DO Measurements – Fixed, Perpetual License
- **E6833A-1TP** cdma2000/1xEV-DO Measurements – Transportable, Perpetual License
- **E6833A-1F1** cdma2000/1xEV-DO Measurements – 1 month, Fixed License
- **E6833A-1F3** cdma2000/1xEV-DO Measurements – 3 month, Fixed License
- **E6833A-1F6** cdma2000/1xEV-DO Measurements – 6 month, Fixed License
- **E6833A-1FY** cdma2000/1xEV-DO Measurements – 12 month, Fixed License
- **E6833A-R2C** Upgrade to Current Revision

E6889A E6601 Application Features
- **E6889A-1FP** Fast Device Tune Measurement – Fixed, Perpetual License
- **E6889A-1TP** Fast Device Tune Measurement– Transportable, Perpetual License
- **E6889A-1F1** Fast Device Tune Measurement – 1 month, Fixed License
- **E6889A-1F3** Fast Device Tune Measurement – 3 month, Fixed License
- **E6889A-1F6** Fast Device Tune Measurement – 6 month, Fixed License
- **E6889A-1FY** Fast Device Tune Measurement – 12 month, Fixed License

For detailed configuration information, refer to the E6601A Wireless Communications Test Set Configuration Guide (5989-5556EN) found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/E6601A**

TD-SCDMA Cal Application

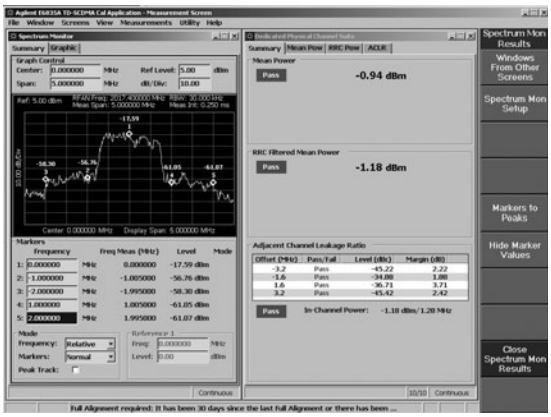
E6835A

Source Modulation
- **CW, Amplitude, Frequency**
- **TD-SCDMA ARB source for flexible phone receiver (RSSI) testing**

Power Measurements
- **Channel Power (Mean Power and RRC-filtered Power)**
- **Dynamic Power Measurement**

Spectral Measurements
- **Adjacent Channel Leakage Ratio**
- **Spectrum Emission Mask**
- **Spectrum Monitor**

Modulation Quality
- **CW Frequency Error**
- **DPCH EVM, Frequency Error, PCDE**



The Agilent E6835A TD-SCDMA cal application for the E6601A test set provides all the necessary capabilities to calibrate your TD-SCDMA mobile devices. This cal application, designed for non-signaling test in high-volume manufacturing, helps you achieve your time-to-market goals while lowering your cost of test for TD-SCDMA wireless devices.

This TD-SCDMA test solution is based on the new, next-generation, high-performance E6601A test set. You gain the benefits of industry leading measurement speed, optional time-based and portable licensing, and an integrated open Windows PC. With applications focused on calibration, flexible licensing, a built-in PC and high-speed measurements, the next-generation capabilities of this test set offers a TD-SCDMA calibration solution that can increase your throughput and reduce your test costs.

- ARB source for flexible phone receiver (RSSI) testing
- High-speed transmitter measurements:
  - Channel Power (Mean Power and RRC-filtered Mean Power)
  - Adjacent Channel Leakage Ratio
  - Spectrum Emission Mask
  - EVM (without specification)
  - Frequency Error (without specification)
  - Peak Code Domain Error (without specification)
  - Dynamic Power Measurement (without specification)
- High-performance Spectrum Monitor
  - Spectral analysis in a Windows Interface

Specifications

Accuracy
- Channel Power measurement: <±0.6 dB (<±0.3 dB typical)
- Adjacent Channel Leakage Ratio measurement
  ±1.6 MHz offsets: <±0.8 dB (<±0.4 dB typical) at –33 dBc
  ±3.2 MHz offsets: <±0.8 dB (<±0.4 dB typical) at –43 dBc

Dynamic Range
- Channel Power measurement: –65 dBm to +28 dBm
- Adjacent Channel Leakage Ratio measurement: +5 dBm to +28 dBm

Key Literature & Web Link

www.agilent.com/find/E6835A

Ordering Information

E6835A TD-SCDMA Cal Application
- **E6835A-1FP** TD-SCDMA Measurements – Fixed, Perpetual License
- **E6835A-1TP** TD-SCDMA Measurements – Transportable, Perpetual License
- **E6835A-1F1** TD-SCDMA Measurements – 1 month, Fixed License
- **E6835A-1F3** TD-SCDMA Measurements – 3 month, Fixed License
- **E6835A-1F6** TD-SCDMA Measurements – 6 month, Fixed License
- **E6835A-1FY** TD-SCDMA Measurements – 12 month, Fixed License

For detailed configuration information, refer to the E6601A Wireless Communications Test Set Configuration Guide (5989-5556EN) found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/E6601A**

- **Support for all of Anite's key test applications – Development and Conformance Toolsets, and SAS**
- **Support for multi-RAT, soft and hard handover**
- **Layer 1, 2, and 3 control and analysis**
- **Performance testing**
- **Cell selection and location update**
- **Graphical analysis tools**
- **Dynamic power level, timing and BER, BLER adjustment**
- **PDU encode/decode libraries**
- **Test system automation**
- **Various digital I+Q interfaces**

SAT is Anite's single platform wireless communications test solution that hosts a suite of Anite software tools. The current generation, SAT(A), enables the testing of terminals that are being developed to support GERAN and UTRAN radio-access technologies: GSM, GPRS, EGPRS, W-CDMA (FDD) and HSPA.

Anite's SAT is designed to address Development, Conformance and Interoperability testing, focused on the physical, signaling and service enabler layers and features hardware sourced from Anite and Agilent Technologies. SAT(A) system components comprise:

- A PC controller
- Up to 8 Agilent 8960 radio transceivers
- Up to 8 Anite Baseband Processors (ABP) – an add-on unit that provides the processing capabilities necessary for testing W-CDMA and HSPA
- The Anite RF Combiner
- The Anite Fading Adapter Unit (FAU) – an add-on unit used for advanced fading tests including Closed Loop Transmit Diversity (CLTD)
- The Anite TTL-Adapter Unit (TTL-AU) – an add-on unit providing connectivity to an ASIC Emulator

Anite's objective is always to provide the maximum value to its customers. The SAT(A) platform architecture is designed with the future in mind by reusing as many hardware and software components as possible when new and emerging technologies are introduced. The Anite Baseband Processor uses an industry-unique software radio and fast-processing baseband elements to provide unrivaled flexibility and time to market for new technology introductions.

The SAT(A) platform supports two principal Toolsets, the Development Toolset – comprising a suite of GUI's and C/C++ API's, and the Conformance Toolset – comprising a test manager that executes an extensive suite of test packages based on internationally-agreed standards such as those required by GCF and PTCRB certification schemes. Furthermore, these Toolsets contain an extensive range of utilities to assist with test script creation, results analysis and the enabling of automation for stable, quick regression testing.

SAT is also the very same platform on which Anite's interoperability tool, SAS, is supported. SAT(A) systems are configured from Anite's Modular Product Structure (MPS), which enables the purchase of hardware, and software components that make up SAT systems without the need to specify the configuration in which they will be used. The associated software licenses (such as toolsets) are pooled on a license server and these license resources can then be accessed by one or more test platforms to most efficiently meet testing requirements.

Specifications

GERAN Specifications

- Up to 8 cells
- GSM 850, 900, 1800, 1900 operating bands
- Multi-band inter-working
- GSM, GPRS, EGPRS
- Full rate, half rate, EFR, AMR, WB-AMR
- RLC/MAC, LLC, SNDCP
- PDU libraries
- Support for Tx and Rx on up to 8 time slots
- Support for EGPRS MCS 1-9
- Dynamic power level and timing
- m-RAT interworking

UTRAN Specifications

- Up to 8 cells/carriers
- W-CDMA (FDD) & HSPA support
- AMR, WB-AMR and PDCP
- PDU libraries
- Support for 8 of 9 operating bands
- UE HS-DSCH Categories 1 to 12 (HSDPA)
- UE E-DCH Categories 1 to 6 (HSUPA)
- Closed-Loop Transmit Diversity (CLTD) (requires additional hardware)
- m-RAT interworking

Key Literature & Web Link

www.anite.com/wireless

Ordering Information

Contact your nearest Anite representative:
www.anite.com/wireless

Note: The SAT(A) system is also capable of supporting RRM tests, through the addition of specialist hardware.

Bluetooth® & WLAN Test Set

Wireless Connectivity Test Set

N4010A

- **Test multiple wireless connectivity technologies with one test platform**
- **Increase manufacturing throughput with fast, accurate measurements**
- **Repeatable measurement results from development through to production**
- **Use with N4011A MIMO/Multi-port Adapter for testing WLAN MIMO devices and modules**
- **Use with the 89601A Vector Signal Analyzer software or N4018C/19C Bluetooth®/WLAN Wireless Test Manager software to make a broad range of measurements for evaluating wireless formats in the 2.4 GHz or 5 GHz bands**
- **The N4010A covers Bluetooth, WLAN, and ZigBee™**

Gain the flexibility to measure the latest emerging wireless standards and increase test efficiency with the N4010A wireless connectivity test set.

The N4010A is a versatile multi-format wireless connectivity test solution that you can configure for your particular Bluetooth, ZigBee™, Wireless LAN (WLAN) 802.11a, b, g and 802.11n MIMO applications in R&D, integration and verification, or manufacturing.

Additional Flexibility

- For MIMO device and module testing use with the N4011A MIMO/Multi-port Adapter
- For *Bluetooth* analysis use with the N4017A Bluetooth Graphical Measurement Applications
- Test automation software simplifies test sequence creation and optimization with the N4018C/19C Bluetooth and WLAN Wireless Test Manager
- For general signal analysis use with the 89601A Vector Signal Analysis Software

Specifications

Detailed specifications are found in the N4010A Data Sheet (5989-4035EN) for the individual technology options

Accessories

N4011A MIMO/Multi-port Adapter
N4017A Bluetooth Graphical Measurement Application
N4018C Bluetooth and WLAN Wireless Test Manager (run-time license and software)
N4019C Bluetooth and WLAN Wireless Test Manager (development license and software)

Key Literature & Web Link

N4010A Brochure, p/n 5989-4150EN
N4017A Product Overview, p/n 5989-2771EN
N4018C and N4019C Brochure, p/n 5989-5809EN
Bluetooth Enhanced Data Rate (EDR): The Wireless Evolution, Application Note, p/n 5989-4204EN
Next Generation of WLAN Manufacturing Test Solutions, Application Note, p/n 5989-1194EN
N4010A Programming Made Easy for WLAN Applications, Application Note, p/n 5989-6233EN

www.agilent.com/find/N4010A
www.agilent.com/find/N4011A
www.agilent.com/find/N4017A
www.agilent.com/find/N4018C
www.agilent.com/find/N4019C

For more detailed configuration information, refer to the N4010A Wireless Connectivity Test Set Configuration Guide (5989-3486EN) found in the Selection and Configuration section of the Product Library at
www.agilent.com/find/N4010A

Ordering Information

N4010A Wireless Connectivity Test Set
N4010A-101 Bluetooth
N4010A-102 2.4 GHz Wireless LAN Tx/Rx Analysis (for WLAN and ZigBee)
N4010A-103 2.4 GHz/5 GHz Wireless LAN Tx/Rx Analysis (for WLAN)
N4010A-104 Fully Flexible Arb
N4010A-105 Bluetooth EDR – Transmit and Receive
N4010A-106 Bluetooth EDR – Transmit
N4010A-107 Bluetooth EDR Link Plus Measurements
N4010A-108 802.11n MIMO Modulation Analysis
N4010A-112 Bluetooth Headset Profile
N4010A-113 Bluetooth Audio Generation and Analysis
N4010A-204 Signal Studio License
N4011A MIMO/Multi-port Adapter

The Mobile WiMAX Test Set and associated software products provide a comprehensive set of tools for design verification, conformance and manufacturing test

- **WiMAX base station emulation**
- **Multi-profile support**
- **Physical layer measurement suite**
- **Functional test**
- **Protocol test**
- **TTCN-3 scripting**

The E6651A represents a significant breakthrough in Mobile WiMAX testing. It incorporates flexible base station emulation, RF parametric tests and a scripting interface into one integrated unit and extends Agilent's unmatched portfolio of WiMAX test solutions for development, verification and manufacturing customers.

The Agilent E6651A provides RF signal generation and signal analysis capability up to 6 GHz and includes a full suite of high-speed, RF measurements for characterization, calibration and verification purposes.

The Mobile WiMAX test set can be extended to enable protocol interoperability and application testing. With realistic base station emulation the test set offers a controlled environment, with flexibility to configure a wide range of network parameters in which you may test, stress and debug the protocol and data handling capabilities of your design.

The E6651A also offers a TTCN-3 protocol scripting interface. This can be used in conjunction with a PC based PCT (Protocol Conformance Test) application for both WiMAX forum validated conformance testing and for user generated script based testing during development.

With this exciting new product, Agilent will help you get your designs to market faster and more efficiently, and will continue to provide comprehensive tools for all stages of your product lifecycle. For further WiMAX solutions see **www.agilent.com/find/WiMAX**

Features of emerging mobile devices are increasing in complexity and software content. The E6655A WiMAX Lab Application allows testing of emerging mobile devices in a realistic network environment to ensure the quality of your mobile equipment design. The WiMAX lab application allows you to do this – supporting real-time, end-to-end functional test of your WiMAX design. Features of the lab application include:

- Controlled network environment – no need to run tests on a live network
- Verify correct operation, stress test your WiMAX device by running multiple applications
- Configure key elements of MAC operation

Quickly collect and interpret wireless protocol messaging, verify functionality, and isolate and resolve protocol problems when developing mobile stations and applications with the N6421A WiMAX Protocol Logging and Analysis software. Features include:

- Real-time logging and decodes of PHY and MAC layer protocol
- Post-capture analysis of protocol log files
- Log filtering makes it easy to sort through the huge volume of messaging to and from the WiMAX device

The Agilent N6422C WiMAX Wireless Test Manager software provides ready-to-use tests, test plans, test sequencing, and menu-selectable hardware support for quick and easy automation of device calibration and test processes. An integrated test development wizard simplifies making software modifications adding user-defined tests. The test manager runs on a PC and supports Agilent test system hardware. Features of the WiMAX wireless test manager software include:

- Ready-to-use tests, test plans, and test sequencing
- Customize test steps and test parameters by using Wizards to reduce time on coding
- Results can be logged, compared, and post processed

Specifications

- Multi-profile support
- Frequency coverage to 6 GHz
- PHY measurements including timing, frequency, modulation, power, RSSI, PER, sensitivity
- Network entry testing
- Traffic connection establishment
- Data transfer
- Functional test
- Protocol logging
- TTCN-3 protocol test case support

Accessories

E6655A WiMAX Lab Application
N6421A WiMAX Protocol Logging and Analysis
N6422C WiMAX Wireless Test Manager
N6430A WiMAX Protocol Conformance Test Solutions

Key Literature & Web Link

www.agilent.com/find/E6651A

Ordering Information

E6651A Mobile WiMAX Test Set
E6651A-503 Frequency Range from 450 MHz to 2.7 GHz
E6651A-506 Frequency Range from 450 MHz to 6 GHz

Wireless Networking Test Set

N8300A

- **Complete one-box transmitter and receiver test solution for mobile WiMAX devices**
- **Fast, accurate and repeatable 802.16e-2005 standards-based OFDMA measurements for mobile WiMAX manufacturing test**
- **Superior measurement consistency through the product lifecycle from R&D to design verification to manufacturing using industry leading WiMAX R&D test tool algorithms**
- **Simplify test development with easy-to-use graphical user interface and SCPI programming**
- **Frequency ranges: 2.15 to 2.7 GHz and 3.3 to 3.8 GHz (using the N6301A measurement application software)**
- **Comprehensive connectivity: USB, 100baseT LAN and GPIB**
- **Use with the industry standard 89601A Vector Signal Analyzer (VSA) software to simplify mobile WiMAX signal analysis**
- **Use with the N7615B Signal Studio to easily download WiMAX waveform files for instant playback**
- **Software upgrades along with a flexible hardware structure protects your investment in the N8300A for future wireless networking applications**

The N8300A is a one-box RF parametric test set specifically targeting manufacturing and design engineers who need a standard-compliant 802.16e physical layer (PHY) test tool for mobile WiMAX Tx and Rx applications. Based on an architecture comprising an integrated Vector Signal Analyzer (VSA) and Vector Signal Generator (VSG), the N8300A provides a graphical user interface, a SCPI interface and consistency of software and measurements with industry standard WiMAX R&D test tools that enables fast test development.

Specifications

Detailed specifications are found in the Specifications section of the Product Library at **www.agilent.com/find/N8300A**

Key Literature & Web link

N8300A Brochure, p/n 5989-7063EN
N8300A Data Sheet, p/n 5989-7064EN
WiMAX Concepts and RF Measurements, Application Note, p/n 5989-2027EN)
WiMAX Brochure, p/n 5989-5914EN
WiMAX Poster, p/n 5989-5936EN

www.agilent.com/find/wimax
www.agilent.com/find/N8300A

For more detailed configuration information, refer to the N8300A Wireless Networking Test Set Data Sheet or Configuration Guide found in the Selection and Configuration section of the Product Library at **www.agilent.com/find/N8300A**

Ordering Information

N8300A Wireless Networking Test Set
- **N8300A-505** Frequency Range to 4.8 GHz
- **N8300A-1CR** Rack Slide Kit
- **N8300A-KYB** Keyboard, USB
- **N8300A-MSE** Mouse, USB
- **N8300A-UK6** Commercial Calibration Certificate with Test Data

The rack-mount kit and handle come as standard with all N8300A shipments

N6301A 802.16 OFDMA Measurement Application
- **N6301A-1FP** 802.16 OFDMA Measurement Application – Fixed Perpetual License

N4041A
N4042A
GS-8000

- **A complete functional test solution customized to cope with your changing needs over time**
- **Optimized for device calibration and performance testing at the circuit board and assembled product level**
- **Support and test knowledge available anywhere in the world where you decide to manufacture**
- **The GS-8000 is designed to accommodate your reference design choices**
- **Fewer test decisions and investments reduce your cost of test per unit**

The new Agilent GS-8000 Functional Test Solution is for customers wanting to succeed in the wireless appliance manufacturing marketplace. If your goal is to take a new wireless device from design to high volume manufacturing quickly or you are broadening the wireless products that you want to manufacture with the latest and greatest technology, then look no further. The GS-8000 is tailored just for you by our worldwide delivery teams to significantly drive down your cost of test and increase the speed at which you get these new products to market.

Keeping Up with Ever-Changing Technologies

The GS-8000 is designed to cope with your design and technology changes now and in the future. Whether these changes are protocol related (GSM/GPRS/CDMA and 3G Third Generation wireless technology) or user interface features (i.e stereo audio) the GS-8000 is flexible and will adapt to your changing needs. A combination of these features designed in the Agilent solution will not only protect your investment, but will also give you an overall lower cost of test.

Agilent will Help you Protect your Investment

Agilent's relationships with key Reference Design Providers assure you that our solution copes with current and future designs for your marketplace. If you decide to use a reference design without modification, the GS-8000 system has been created to test the devices with minimal customization. If you need to change the reference design mechanical, electrical or firmware features, Agilent will provide low-cost and easy to change adaptations to your systems such as:

- Selecting different tests
- Test parameters
- Mechanical adaptation in the fixturing
- Update in protocols for reference designs

Local Support with Global Knowledge

Our local delivery team will work with you to tailor a solution to meet your needs and growing business environment. For example, we can customize the fixtures, device under test (DUT) calibration software, phone interface and work through non-standard measurements and test optimization problems with the help of our local team.

Specifications

Test Systems

The GS-8000 test system contains the Agilent 8960 wireless communication test set (a platform designed to support all major cellular protocols), power supplies, industrial PC, display, keyboard and modular interconnect panel. It is configurable with options for power, rack size, instrument set (one-up or two-up testing), multiplexer, digital multimeter and digital input/output.

Test Software

The GS-8000 test software contains a test development environment, a test execution environment, a system offset service, generic test applications, and reference test applications focused on wireless appliance manufacturing functional test.

- Using Agilent's Wireless Test Managers, the test development environment provides the conditions and tools for the test developer to construct the test software for a particular application
- Built around an open component object model architecture and implemented in Visual Basic, the test execution environment provides configurable user interfaces and test cell management
- The system offset service provides the audio and RF path loss correction factors needed for accurate measurements
- Test applications provide support for specific phone protocol measurements using Agilent's 8960 Series10 wireless communications test set. The test applications provide generic test plans, which include tests and measurements for each protocol. More protocols will be added in the future
- Reference test applications provide robust test plans, device calibration routines, and tests and measurements for a specific reference phone design. This is accomplished in partnership with the reference design providers and allows us to provide test plans, tests, measurements and unique algorithms that optimize reference design test processes

Fixturing

Agilent offers a range of fixturing options for manual or automated device handling. The fixture provides excellent RF isolation and can provide automatic engagement of connections to the device under test.

System Summary

The GS-8000 functional test platform is a complete test solution tailored to your manufacturing needs now and for the future to keep up with changing technologies and market demand. With local support and test knowledge available anywhere in the world, Agilent will work with you to create a solution tailored to your needs and growing business environment.

Accessories

System characterization is key to facilitating accurate testing in the manufacturing process which can help improve yield. Accounting for the cable losses in the RF cables connecting the DUT to the test system is a major component of accurately measuring the RF signal from the DUT. The characterization cart available in the GS-8000 platform family solves this problem. The characterization cart is a cost effective solution containing a signal generator, power meter, and uninterruptible power supply (UPS). The characterization software available in the GS-8000 greatly simplifies measuring these losses in the system. Not only does it instruct the user on when and which cable connections to make for measuring the cable losses, it also automatically stores the data where the system offset service can retrieve it for use in the test applications.

Key Literature & Web Link

www.agilent.com/find/gs8000
Then type GS-8000 in Search Column GS-8000 Overview, p/n 5988-2555EN

Ordering Information

N4041A 1-up Testing System
N4042A 2-up Testing System
Contact Agilent Technologies to configure a customized test system.

RF Shielded Wireless Test Fixture

E8421A
Z2049A

- **Standard universal base unit, with a variety of configuration options**
- **High quality RF isolation provides an ideal environment to ensure repeatable and accurate measurements – essential for reducing your no-trouble-found (NTF) failures**
- **Standard software containing control drivers and diagnostic tools help simplify implementation, maintenance, and support processes. Production up-time is improved while lowering the support costs**
- **System design is greatly simplified due to built in communication paths with the device-under-test (DUT), direct and over-the-air**
- **RF paths, acoustic testing, switching, automation and control**

The Agilent wireless/WLAN test fixture will help you **improve time-to-volume** while **increasing your production flexibility**. The feature-rich E8421A/Z2049A is an innovative flexible design with integrated system functionality.

It provides well-defined device under test (DUT) nest tailoring that supports automated, as well as manual, loading at board and final test. Agilent's global service and support helps you implement your test system solutions in a cost effective manner.

The E8421A/Z2049A utilizes a standard base unit architecture and custom nest designs that are easily interchanged. This allows you to leverage the same base unit structure across device technologies, device form factors, board or final test, and production line implementations.

By leveraging the same base unit, support costs and new product line development time can be reduced.

The Agilent Z2049A is a simplified version of the E8421. It is intended to provide a very simple RF test environment for use with Agilent systems and solutions. The Z2049A has been designed to improve the RF test environment. The functionality of Z2049A can be expanded by customization according to the customers' requirement.

Specifications

RF Specifications

RF Isolation
- 800 – 1000 MHz: 65 dB min, 70 – 80 dB typ
- 1700 – 2200 MHz: 60 dB min, 65 – 80 dB typ
- 2400 – 2700 MHz: 55 dB min, 60 – 70 dB typ
- 5150 – 5800 MHz: 40 dB min, 45 – 55 dB typ
- Optional RF Absorber adds 5 – 10 dB typ

Isolation measurements from mode-stirred-reverberation chamber for reliable and repeatable results.

RF Capabilities Optional RF Absorber Kit
- Reduces reflections – required for Over-the-Air couplers
- Improves RF isolation 5 – 10 dB, up to 5 GHz

Optional Non-parametric Over-the-Air RF Coupler
Provides between 8 and 25 dB coupling, depending on the DUT antenna and nest environment

Low Spurious Noise in RF Cavity

Nest Materials and Design for Reduced RF Reflections

Mechanical Specifications

Overall Size
- 304.8 mm H x 212.7 mm W x 634.5 mm D (12.00" x 8.37" x 24.98")

Weight
- 30 kg (66 lb.), fixture without customization
- 35 kg (77 lb.), fixture with customization, typical

Available Working Space for Tailored Nests
- 135 mm H x 170 mm W x 300 mm D (5.5" x 7" x 12")

Ordering Information

Contact Agilent Technologies to configure a customized test Fixture.

E8421A Wireless Test Fixture
Includes one E8421A RF isolation chamber; RF shield gasket between the drawer front and RF chamber; Operator User Interface on fixture front; System connectors on rear panel of fixture; Front and rear lift handles; Optional nest kits that can be customized for the DUT.

E8421A-010 RF Absorber Kit
E8421A-040 Expanded Pneumatics Add 8 Valves
E8421A-100 Diagnostic Loop Back Nest
E8421A-140 Sliding Rack Mount Kit
E8421A-160 Test System Cables
E8421A-300 Spare Part Kits
E8421A-240 Non-parametric Over-the-air RF Coupler
E8421A-ABA US English Localization
E8421A-800 Custom Next for Final Fixture
E8421A-801 Custom Nest for Board Fixture

Z2049A Wireless Test Fixture
Includes one Z2049A RF isolation chamber; RF shield gasket between the drawer front and RF chamber; Manual Operator User Interface on fixture front; Optional System connectors on rear panel of fixture; Front and rear lift handles; Optional nest kits that can be customized for the DUT.

Z2049A-010 RF Absorber Kit
Z2049A-140 Slide Rack Mount Kit
Z2049A-100 Standard Signal Paths – 1RF, 9 Power, 9 Serial, 25 GP
Z2049A-199 Signal Paths not included
Z2049A-240 Non-parametric Over-the-air RF Coupler Kit
Z2049A-ABA English Documentation Set
Z2049A-803 Additional RF Path Kits
Z2049A-804 W2049 Upper Nest Pneumatic
Z2049A-805 W2049 Drawer Automatic Open and Close Pneumatic

N4995A
N4996A
GS-8100

- **A test solution optimized for device calibration for high volume production**
- **Multiple devices tested in parallel or sequential depends on different test items**
- **Reduce cost of test per unit by sharing resources of test equipment**
- **Designed to fit different technologies of wireless appliances**
- **High quality of performance and isolation between multiple devices while testing**

System Overview

Agilent GS-8100 test system is designed for RF calibration testing of wireless handset in production. GS-8100 incorporates a special parallel testing technique and makes it possible to perform the calibration test for multiple devices (up to 4). GS-8100 test platform automates the testing with typical test report and test sequence control. Automated testing avoids the human error and reduces test time.

Followings are the features of GS-8100 Wireless handset RF Calibration Test System:

- Concurrent test of multiple devices (up to 4)
- Hardware resource sharing to reduce cost of test
- Supports major chipsets
- Decrease test development time
- Robust system structure makes hardware maintenance easier
- Reliability improves the system up time

System Structure

The system is a 1.6 m rack with integrated test equipment and software.

GS-8100 Base System includes:

- E5515C Wireless Communication Test Set
- E4416A EPM Power Meter
- 66321B Mobile Communication DC Source
- N4995A Multiple Devices Calibration RF Interface Test Set
- Industrial PC Controller
- Wireless Test Manager

Specifications

GS-8100 Typical Performance Characteristics

- Power Measurement Range up to 35 dBm
- Isolation between RF path of different devices >80 dB
- Typical VSWR for different ports <1.4
- 800 – 2,200 MHz frequency range covering most wireless bands

GS-8100 Typical RF Calibration Items

- TX Adjustment/Alignment
- RX Adjust/Alignment
- TX Signal Demodulation Adjustment/Alignment

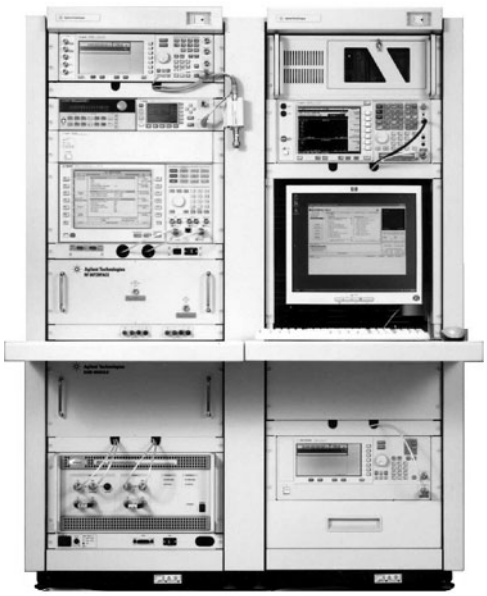
Ordering Information

N4995A RF Interface Test Set
N4996A GS-8100 RF Calibration Test System
Contact Agilent Technologies to configure a customized test system.

GS-8800 RF Design Verification Systems

GS-8800
N1960A

- **Reduce costs and accelerate time to market**
- **Supports multi formats: AMPS, GSM/GPRS/EGPRS, cdmaOne/cdma2000, W-CDMA, 1xEV-DO**
- **High speed measurement for pre-conformance test with accurate test results**
- **Extensibility and Scalability**
- **Local delivery and global support**



System Overview

The system is integrated in the rack (1.6 m x 2 racks or 2 m rack) with test equipment and software.

Base System:
- E5515C Wireless Test Set
- E4445A Spectrum Analyzer
- E4438C ESG Digital Signal Generator
- E8257D Microwave Signal Generator
- 66311B Power Supply
- N1961A RF I/F
- 87130A Switch Driver
- E4418B Power Meter
- Industrial PC
- Wireless Test Manager and System Software

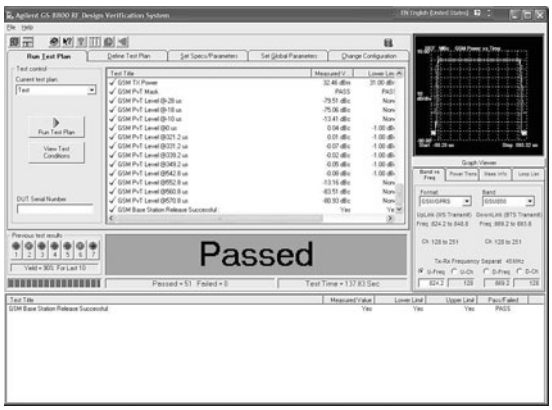
Optional:
Fading Simulator Option
N1962A GSM Module Option

System Concept

The Agilent GS-8800 is a multi-format RF design verification system. It is designed to minimize the customer's cost of design validation by ensuring better results when undergoing a complete conformance test. Conformance testing is expensive and often iterative. The Agilent system can help the product designer validate aspects of the design long before conformance testing is performed, thereby increasing the chances that the design will pass conformance test the first time.

The system is centered on a standard platform, which is then expanded to meet the advanced requirements of an R&D design verification environment. The system is comprised of Agilent standard equipment and software. The system capabilities are augmented by configuring a RF interface module, which is optimized for the highest measurement accuracy possible. The RF Interface module handles all of the RF switching and conditioning. The software is made up of pre-defined tests that conform to the individual technology standard.

User Interface Screen



Example GS-8800 User Interface Screens

Key Features and Benefits

Reduce Costs and Accelerate Time to Market

Pre-Conformance test reduces capital cost, and you can validate your design before full conformance testing. The lower system price permits wider deployment.

Support Multi-Formats

The GS-8800 supports:

- GSM
- GPRS
- EGPRS
- W-CDMA
- cdmaOne
- cdma2000
- 1xEVDO/1xEVDO Rev. A
- HSDPA

Extensibility and Scalability

It is easy to add support for new formats. The GS-8800 scales from small system to full system.

Local Delivery and Global Support

Agilent can deploy a system solution globally, which is verified to conform to your exact specifications. We then tailor a system support package for your local sites to achieve the best in responsiveness and communication.

Key Literature & Web Link

www.agilent.com/find/gs8800

Ordering Information

N1960A GS-8800 Design Verification System
Contact Agilent Technologies to configure a customized test system.

Specifications

Description	Specification
	GSM Test Case Coverage (3GPP TS 51.010-1 section number)
Transceiver Tests	Conducted Spurious Emissions, MS allocated channel (12.1.1); Conducted Spurious Emissions, MS in idle mode (12.1.2)
Transmitter Tests	Phase & Frequency Error (13.1); Frequency Error Under Fading (13.2); Tx Output Power, Normal Burst (13.3); Monotonic Power Sequence (13.3); Power vs. Time, Burst Timing, Normal Burst (13.3); Tx Output Power, Access Burst (13.3); Power vs. Time, Burst Timing, Access Burst (13.3); ORFS due to Modulation (13.4); ORFS due to Switching (13.4); Wideband Noise, 1800 KHz offset to Edge of Tx band (13.4); Spurious Emissions in MS Rx band (13.4)
Receiver Tests	Bad frame indication – TCH/FS – Random RF input (14.1.1.1); Bad frame indication – TCH/FS – Frequency hopping and downlink DTX(14.1.1.2); Reference Sensitivity, TCH/HS (14.2.2); Reference Sensitivity, FACCH/F(14.2.3); Reference Sensitivity, TCH/AFS(14.2.10); Co Channel Rejection, TCH/HS (14.4.2); Receiver performance, co-channel & frequency hopping on one carrier (14.4.7); Co-Channel Rejection, TCH/AFS (14.4.8); Adjacent Channel Rejection, Speech Channel, TCH/AFS (14.5.1.2); Signal Quality under static conditions TCH/HS (21.3.2); Reference Sensitivity, TCH/FS (14.2.1); Reference Sensitivity, TCH/EFS (14.2.7); Usable Receiver Input Level Range (14.3); Co-Channel Rejection, TCH/FS (14.4.1); Co-Channel Rejection, TCH/EFS (14.4.6); Adjacent Channel Rejection, Speech Channel, TCH/FS (14.5.1.1); Intermodulation Rejection, Speech Channel (14.6.1); Blocking & Spurious Response, Speech Channel (14.7.1); AM Suppression, Speech Channel (14.8.1); Signal Strength (21.1); Signal Strength selectivity (21.2); Signal Quality under static conditions TCH/FS (21.3.1)
	GPRS Test Case Coverage (3GPP TS 51.010-1 section number)
Transceiver Tests	Conducted Spurious Emissions, MS allocated channel (12.1.1); Conducted Spurious Emissions, MS in idle mode (12.1.2)
Transmitter Tests	Phase & Frequency Error in GPRS multislot configuration (13.16.1); Tx Output Power in GPRS multislot configuration, Normal Burst (13.16.2); Monotonic Power Sequence in GPRS configuration (13.16.2); Power vs. Time, Burst Timing, in GPRS configuration, Normal Burst (13.16.2); Tx Output Power in GPRS multislot configuration, Access Burst (13.16.2); Power vs. Time, Burst Timing, in GPRS configuration, Access Burst (13.16.2); ORFS due to Modulation in GPRS multislot configuration (13.16.3); ORFS due to Switching in GPRS multislot configuration (13.16.3); Wideband Noise, 1800 KHz offset to Edge of Tx band in GPRS multislot configuration (13.16.3); Spurious Emissions in MS Rx band in GPRS multislot configuration (13.16.3)
Receiver Tests	Minimum Input Level for Reference Performance for GPRS operation (14.16.1); Co-Channel Rejection for Packet Channel (14.16.2)
	EGPRS Test Case Coverage (3GPP TS 51.010-1 section number)
Transmitter Tests	Frequency error in EGPRS configuration (13.17.1); Modulation accuracy in EGPRS configuration (13.17.1); Frequency error under multipath and interference conditions in EGPRS configuration (13.17.2); EGPRS Transmitter output power (13.17.3); ORFS for EGPRS operation (13.17.4)
Receiver Tests	Minimum Input Level for Reference Performance for EGPRS operation (14.18.1); Co-Channel Rejection for EGPRS operation (14.18.2); Adjacent Channel Rejection for EGPRS operation (14.18.3); Intermodulation Rejection for EGPRS operation (14.18.4); Blocking and spurious response for EGPRS operation (14.18.5); EGPRS Usable receiver input level range (14.18.6)
	W-CDMA (3GPP TS 34.121 section number)
Transmitter Characteristics	Maximum Output Power (Thermal and CH power) (5.2); Frequency Error (5.3); Open Loop Power Control in the Uplink (5.4.1); Inner Characteristics Loop Power Control in the Uplink (5.4.2); Minimum Output Power (5.4.3); Out-of-synchronization handling of output power (5.4.4) Transmit OFF Power (5.5.1); Transmit ON/OFF Time mask (5.5.2); Change of TFC (5.6) Occupied Bandwidth (5.8); Spectrum emission mask (5.9); Adjacent Channel Leakage Power Ratio, ACLR (5.10); Spurious Emissions (5.11); Transmit Intermodulation (5.12); Error Vector Magnitude, EVM (5.13.1); Peak code domain error (5.13.2)
Receiver Characteristics	Reference Sensitivity Level (6.2); Maximum Input Level (6.3); Adjacent Channel Selectivity, ACS (6.4); Spurious Response (6.6); Intermodulation Characteristics (6.7); Spurious emissions (6.8); Blocking Characteristics (6.5)
Performance Requirement	Demodulation of Dedicated Channel, DCH (7.2.1); Demodulation of DCH in Multi-path Fading Propagation conditions (7.3); Demodulation of DCH in Moving Propagation conditions (7.4); Demodulation of DCH in Birth-Death Propagation conditions (7.5)

Specifications (cont.)

Description	Specification
	CDMA (3GPP2 CS 0011-A1 section number)
Transmitter Tests	Frequency Accuracy (4.1); Reverse Pilot Channel to Code Channel Time Tolerance (4.3.2); Reverse Pilot Channel to Code Channel Phase Tolerance (4.3.3); Waveform Quality and Frequency Accuracy(4.3.4); Code Domain Power (4.3.5); Range of Open Loop Output Power (4.4.1); Time Response of of Open Loop Power Control (4.4.2); Access Probe Output Power (4.4.3); Range of Closed Loop Power Control (4.4.4); Maximum RF Output Power (4.4.5); Minimum Controlled Output Power (4.4.6); Standby Output Power and Gated Output Power (4.4.7); Code Channel to Reverse Pilot Channel Power Accuracy (4.4.9); Conducted Spurious Emissions (4.5.1); Occupied Bandwidth (4.5.3)
Receiver Tests	Neighbor Set pilot Detection and Incorrect Detection in Soft Handoff (3.2.2.1); Candidate Set Pilot Detection and Incorrect Detection in Soft Handoff (3.2.2.2); Active Set Pilot Loss Detection in Soft Handoff (3.2.2.3); Demodulation of Forward Traffic Channel in Additive White Gaussian Noise (3.4.1); Demodulation of Forward Traffic Channel in Multipath Fading Channel (3.4.2); Demodulation of Forward Traffic Channel During Soft Handoff (3.4.3); Decision of Power Control Bit for Channels Belonging to Different Power Control Sets During Soft Handoff (3.4.4); Decision of Power Control Bit for Channels Belonging to the Same Power Control Set (3.4.5); Demodulation of Power Control Subchannel During Soft Handoff (3.4.6); Receiver Sensitivity and Dynamic Range (3.5.1); Single Tone Desensitization (3.5.2); Intermodulation Spurious Response Attenuation (3.5.3); Adjacent Channel Selectivity (IMT2000 only) (3.5.4); Receiver Blocking Characteristics (IMT2000 only) (3.5.5); Conducted Spurious Emissions (3.6.1); Paging Channel (3.7.1)
	1XEVDO
Transmitter Tests	Frequency Accuracy (3.1.2.1.2); Time Reference (3.1.2.2.1); Waveform Quality and Frequency Accuracy (3.1.2.2.2); Range of Open Loop Output Power (3.1.2.3.1); Time Response of of Open Loop Power Control (3.1.2.3.2); Range of Closed Loop Power Control (3.1.2.3.3); Maximum RF Output Power (3.1.2.3.4); Minimum Controlled Output Power (3.1.2.3.5); Standby Output Power (3.1.2.3.6); RRI Channel Output Power (3.1.2.3.7); DRC Channel Output Power (3.1.2.3.8.1); ACK Channel Output Power (3.1.2.3.8.2); Data Channel Output Power (3.1.2.3.8.3); Conducted Spurious Emissions (3.1.2.4.1); Occupied Bandwidth (3.1.2.4.3); Access Probe Output Power (4.3.1.1)
Receiver Tests	Demodulation of Forward Traffic Channel in Additive White Gaussian Noise (3.1.1.2.1); Demodulation of Forward Traffic Channel in Multipath Fading Channel (3.1.1.2.2); Receiver Sensitivity and Dynamic Range (3.1.1.3.1); Single Tone Desensitization (3.1.1.3.2); Intermodulation Spurious Response Attenuation (3.1.1.3.3); Adjacent Channel Selectivity (3.1.1.3.4); Receiver Blocking Characteristics (3.1.1.3.5); Conducted Spurious Emissions (3.1.1.4.1)

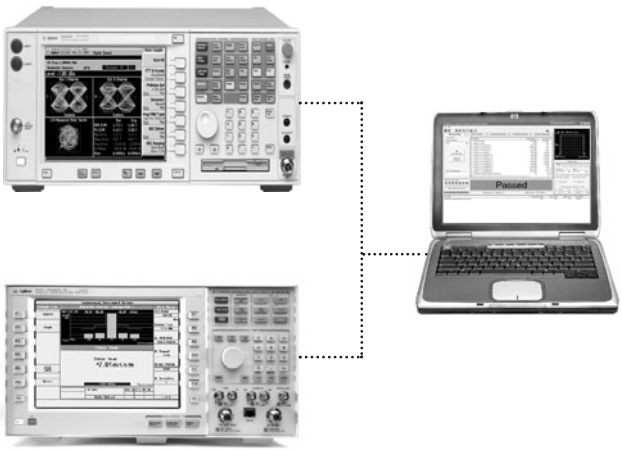
Key Literature & Web Link

www.agilent.com/find/gs8800

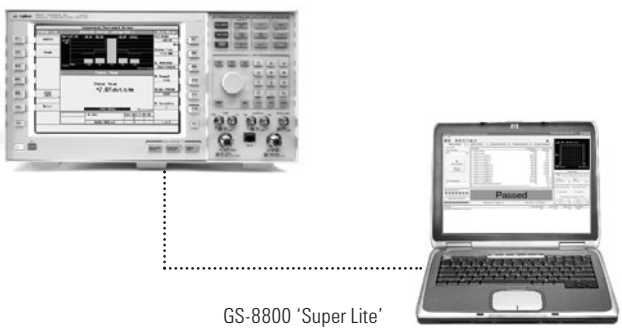
Ordering Information

N1960A GS-8800 Design Verification System
Contact Agilent Technologies to configure a customized test system.

- **Entry-level and mid-range design verification systems for wireless handset R&D**
- **Support multiple formats: GSM/GPRS/EGPRS, cdmaOne/cdma2000, W-CDMA, 1xEV-DO**
- **High speed measurement for pre-conformance test with accurate test results**
- **Flexible scalability from GS-8800 'Super Lite' to GS-8800 'Lite' to standard GS-8800 RF Design Verification System**
- **Accurate measurement with wide frequency range up to 13.5 GHz and wide dynamic range that compliant to international standards**
- **Automatic measurement using loop-back test protocol**



GS-8800 'Lite'



GS-8800 'Super Lite'

System Overview

Agilent GS-8800 'Lite' and 'Super Lite' RF Design Verification Systems are part of the GS-8800 RF Design Verification System family that provide entry-level and mid-range platforms for wireless handset and designed to support multi- format RF. Agilent GS-8800 systems provide product designers with pre-conformance test coverage that help to ensure better results before their new wireless handset go into full conformance testing. This will in turn help customer to reduce their cost of design validation by increase the passing rate at the first time when undergoing a complete conformance testing. Normally a complete conformance testing is expensive and often iterative if no pre-conformance test.

System Structure

While all GS-8800 systems can help to reduce cost of design validation by ensuring better results when undergoing full conformance testing, the 'Lite' and 'Super Lite' systems provide an alternative for users who are looking for an entry-level or a mid-range solution with good pre-conformance test coverage. GS-8800 'Super Lite' provides customer who wants a entry-level pre-conformance test solution with the minimal test coverage for pre-conformance testing while GS-8800 'Lite' has higher test coverage than GS-8800 'Super Lite'. An easy and flexible upgrade path with GS-8800 family is possible with multiple RF formats, customer can choose to upgrade their GS-8800 'Super Lite 'to GS-8800 'Lite' and to the standard GS-8800 RF Design Verification System.

GS-8800 'Super Lite' consists of:
- E5515C Wireless Test Set
- 66311B Power Supply
- Wireless Test Manager and VERIFY – Agilent RF Design Verification Software Suite

GS-8800 'Lite' consists of:
- E5515C Wireless Test Set
- E4445A Spectrum Analyzer
- 66311B Power Supply
- 87302C Power Divider
- Wireless Test Manager and VERIFY – Agilent RF Design Verification Software Suite

Quick Reference Table for GS-8800 Systems Family

	GS-8800 'Super Lite'	GS-8800 'Lite'	GS-8800
Hardware Configuration	E5515C Wireless Test Set + 66311B DC Power Supply	E5515C Wireless Test Set + 66311B DC Power Supply + E4445A Spectrum Analyzer + 87302C Power Divider	E5515C Wireless Test Set + 66311B DC Power Supply + E4438C Signal Generator + E8257D Microwave Signal Generator + E4445A Spectrum Analyzer + E4418B Power Meter + N1961A RF I/F + 87130A Switch Driver
Software Configuration Selection for Different Wireless Formats	• Agilent Wireless Test Manager: selection of AMPS, GSM/GPRS/EGPRS, cdmaOne/cdma2000, W-CDMA, 1xEV-DO • VERIFY – Agilent RF Design Verification Software Suite		

Specifications

Test Coverage Comparison Table for Agilent GS-8800 System Family

RF Format	GS-8800 'Super Lite'	GS-8800 'Lite'	GS-8800
WCDMA	18/30	21/30	30/30
GSM/GPRS, EGPRS	20/42	24/42	40/42
CDMA2000	14/26	20/26	26/26
1xEV-DO	12/23	17/23	23/23

Agilent GS-8800 systems family provides full range of scalability to satisfy user requirements of cost-efficiency versus the test coverage. The GS-8800 'Super Lite' has the minimum test coverage for pre-conformance testing and an entry-level solution. For example GS-8800 'Super Lite' system covers 18 out of 30 WCDMA test cases defined by global standards-making community like 3GPP. Whereas GS-8800 'Lite' provides a mid-range solution and slightly more test coverage compared to the 'Super Lite' version. Finally the standard GS-8800 RF Design Verification System provides the full coverage solution for wireless handset design verification.

Ordering Information

N8993A-F01 GS-8800 'Super Lite' RF Design Verification System
N8993A-F02 GS-8800 'Lite' RF Design Verification System
Contact Agilent Technologies to configure a customized test system.

Note: The test coverage of the denominator refers to the standard requirement of 3GPP. Please contact Agilent Technologies to obtain the detail test coverage for GS-8800 Systems family.

GS-8300 Wireless LAN RF Functional Test System

GS-8300
N4993A
N4994B

- **Reduce time-to-volume by providing flexible Wireless LAN test system that can be tailored to test on IEEE 802.11 a, b & g Tx and Rx tests**
- **Support *Bluetooth* test**
- **Built-in ARB replacing golden radio approach for Wireless LAN test**
- **Effective Error Vector Magnitude (EVM) measurement**
- **System platform includes adaptation concept for different Wireless LAN chipset**
- **Support multiple form factors such as PCMCIA, USB, Mini PCI, etc.**

GS-8300 is a Flexible Turnkey Manufacturing Solution Supporting a Wide Range of Chipsets

Manufacturing test strategy today includes more than just a test set. A test strategy must take into consideration the total integrated manufacturing solution. In addition, many customers require a flexible test strategy from design verification to manufacturing, local to distributed manufacturing.

The GS-8300 Wireless LAN RF Functional Test System provides a full test system to meet the customer's needs. It is a turnkey solution that provides the instrumentation, software and fixturing required to fully support a total manufacturing test solution.

Agilent provides the local expertise to fully integrate the system into your manufacturing environment. In addition, our worldwide support team is able to support distributed manufacturing that include multi-site-multi-vendor strategies.

GS-8300 Base System includes:

- N4010A Wireless Connectivity Test Set
- 66321B DC Power Supply
- Industry PC
- Agilent N4993A Software

Specifications

Description	Specification
	802.11a/b/g Test Coverage
General Tests	Power on Current Check, Tx and Rx Current, Standby Current, MAC and Cal Factor Flash, Power Down Current
Transmitter Tests	Power Calibration/Adjustment, Transmit Power Measurement, Carrier Frequency Accuracy, Spectral Mask Compliance, Carrier Suppression, Error Vector Magnitude (EVM)
Tx Optional	Go/No-Go Tx Power Check, Antenna Diversity Check, Tx Total Supply Current, Occupied Bandwidth
Receiver Tests	Rx Packet Error Rate
Rx Optional	Antenna Diversity Check, Go/No-Go Rx PER Check, Rx Sensitivity, Rx Total Supply Current; RSSI Calibration
	***Bluetooth* RF Test Coverage (defined by *Bluetooth* SIG)**
Transmitter Tests	Output power (TRM/CA/01/C); Power control (TRM/CA/03/C); Modulation characteristics (TRM/CA/07/C); ICFT (TRM/CA/08/C); Carrier Frequency drift (TRM/CA/09/C);
Receiver Tests	Sensitivity/single-slot packets (RCV/CA/01/C); Sensitivity/multi-slot packets (RCV/CA/02/C); C/I performance[1] (RCV/CA/03/C); Blocking performance[2] (RCV/CA/04/C); Intermodulation performance[3] (RCV/CA/05/C); Maximum input level (RCV/CA/06/C)

[1] The C/I performance receiver test requires an additional signal source with *Bluetooth* capability such as the N4010A or the ESG for the interfering signal.
[2] The blocking performance receiver test requires a *Bluetooth* modulated source such as the N4010A or ESG and a microwave signal source such as the E8257D to generate the interfering signal (30 MHz to 12.75 GHz).
[3] The intermodulation performance receiver test requires two *Bluetooth* modulated sources such as the N4010A or ESG and one CW source such as the ESG or the E8257D to generate intermodulation.

Key Literature & Web Link

www.agilent.com/find/gs8300

GS8300/8600 WLAN Test Systems Data Sheet, p/n 5988-8857EN
802.11 a/g Manufacturing Test Application Note, p/n 5988-6788EN

Ordering Information

N4993A GS-8300 Wireless LAN RF Functional Test System
N4994B GS-8300 Wireless LAN Integration Bundle
Contact Agilent Technologies to configure a customized test system.

- **Fully automated, turnkey solution for testing power amplifiers that can be tailored to meet application specific needs**
- **Excellent R&D tool that will allow near seamless transition to manufacturing test**
- **High up time ensured by Agilent's world wide support team**
- **Upgrade path tracks Agilent's instrument roadmaps as well as industry needs**
- **Supports current formats and will grow as the industry grows**

Solution for Production Testing of Power Amplifiers, RF Transistors, and Gain Modules

The Agilent GS-9200 is a system designed for manufacturers who are testing MCPA's (Multi-Carrier Power Amplifiers) and/or testing power amplifier components such as multi-carrier power amplifiers, RF power transistors, and gain modules. Agilent base station test systems help streamline the transition from R&D to Manufacturing with a test platform for Multi-Carrier Power Amplifier Testing. There are also custom options to support transistor, transceiver and full base station test.

Quickly ramp up multi-carrier power amplifier (MCPA) production with an automatic test system designed to increase product yields while reducing the overall cost of test. Agilent's base station test systems include everything needed to support production testing.

Making customers successful in today's wireless business market is our job, from defining a test solution to implementing production testing. Besides fast system delivery, Agilent will install our fully integrated, tailorable test systems in our customer's production area and provide two-day start-up assistance from an Agilent technical-consulting engineer. Technical consultants can help customers start testing their products and offer suggestions on DUT fixturing and test plans. If they need additional help, an Agilent engineer can discuss their needs and recommend a consulting-service package. Value Proposition:

- Ensure proper support of the test system, especially at remote manufacturing sites
- Improved throughput by reduced test time, better accuracy (tighter margins) and better uptime
- Frees up engineering resources in the test department for value added tasks
- Multi-standard platform
- Accelerates deployment and new product ramp-up with short lead time
- Reduced NRE when comparing to Built-to-Print equivalent

Specifications

GS-9200 Typical Performance Characteristics

- 85 dB dynamic range for complex signals such as four W-CDMA carriers with 64 channels each
- High-power network and spectrum analysis up to +25 dBm input and +50.8 dBm output
- 800 – 2,200 MHz frequency range covering most wireless bands
- Harmonics and spurious measurements up to 13 GHz
- High-power S parameter measurements
- Low residual EVM performance of 1.3% at 800 MHz and 1.8% at 2,200 MHz

GS-9200 Measurement Confidence

Network Measurements	
S11 parameter measurement confidence	±0.004 typical[1] for 1.02 VSWR (–40 dB return loss)
S21 parameter measurement confidence	±0.1 dB ±1° typical for 50 dB range
S22 parameter measurement confidence	CW signal-source for DUT input, and DUT full-power output ±0.004 typical[1] for 1.02 VSWR (–40 dB return loss)
DUT delay measurement confidence	Input to output ±0.1 ns typical for the 1 ns to 1 ums range
Additional Option	+32 (up to 40) dBm input power to DUT (with booster amp)

Spectrum Measurements	
ACLR (or ACPR) measurement confidence[2]	±1 dB typical for single carrier, one active W-CDMA channel, and up to –60 dBc range ±1 dB typical for four carriers, each with one active W-CDMA channel, and ACLR up to –55 dBc range
SEM measurement confidence	±1 dB typical for W-CDMA and cdma2000 and BTS P_{out}<+50.8 dBm (120 Wrms)
EVM measurement confidence	±0.3% typical for W-CDMA in the 1 – 10% range

Power Measurements		
Power measurement confidence[3]	For –50 to +20 dBm range	
	P_{ave}	±0.2 dB typical
	Modulated power gain	±0.5 dB typical
	PAE[4]	±3% typical

[1] VSWR measurement accuracy improves with larger VSWR values.
[2] Assumptions are that the DUT takes an input of –20 to –10 dBm and produces 43 – 50 dBm output power, and the DUT delay-response variation is within 0.5 n sec for a 30 MHz span. Measurement range can be increased over the –60 or –55 dBc values, resulting in degraded measurements uncertainty.
[3] Assumption is that the DUT has better than 20 dB return loss at input and output ports.
[4] If a measured PAE is 10%, then the uncertainty is 10 ±0.3%.

Key Literature & Web Link

www.agilent.com/find/gs9200

Ordering Information

N1886A GS-9200 MCPA Test System
Contact Agilent Technologies to configure a customized test system.

Low Cost Repair and Manufacturing Solution

GS-8000 Lite

Features and benefits

- Low cost and no frills test platform
- Ideal for Low cost manufacturing
- Supports wireless UMTS protocols
- Box tester provides repair capability
- Worldwide technical support available

Agilent GS-8000 Lite Wireless Functional Test System is ideally suited for low cost handset manufacturing. The test facilities available in the GS-8000 Lite have been carefully selected to ensure that the product's pricing is kept to a minimum without compromising the GS-8000 Lite's functionality by ensuring that all essential test functions are included. Agilent GS-8000 Lite Wireless Functional Test System also comes with RF semi-automatic shield enclosure with good RF isolation to fit into standard 19" equipment rack. Two shield enclosure are racked side by side to facilitate a sequential test configuration. The RF shield enclosure offers the environment to simulate call operation over the air with fixture nest or direct conducted measurement.

Specifications

Description	Specification
GS-8000 Lite (U1030A)	
Wireless Technology Supported	GSM, GPRS, E-GPRS, W-CDMA
System Power Requirement	100 – 120 VAC for America & Europe region 200 – 240 VAC for Asia Pacific region 50 or 60 Hz, 4118 VA maximum
Transmitter	**Test Coverage for GSM** Phase & Frequency Error Tx Output Power (Normal Burst) Power vs Time (Burst Timing) (Normal Burst)
Receiver	Reference Sensitivity, TCH/FS
Transmitter	**Test Coverage for GPRS** Phase & Frequency Error in GPRS multislot configuration Tx Output Power in GPRS multislot configuration (Normal Burst) Power vs. Time (Burst Timing) in GPRS configuration (Normal Burst)
Receiver	Minimum Input Level for Reference Performance for GPRS operation
Transmitter	**Test Coverage for E-GPRS** Frequency Error in E-GPRS configuration Modulation accuracy in E-GPRS configuration E-GPRS transmitter output power OFRS due to modulation in E-GPRS configuration OFRS due to switching in E-GPRS configuration
Receiver	Minimum Input Level for Reference Performance for E-GPRS operation Incremental redundancy performance
	Test Coverage for Short Message Service (SMS) SMS mobile terminated SMS mobile originated SMS cell broadcast
Transmitter	**Test Coverage for W-CDMA** Maximum Output Power (Thermal & CH Power) Frequency Error Open Loop Power Control in the Uplink Inner Loop Power Control in the Uplink Minimum Output Power Occupied Bandwidth (OBW)* Adjacent Channel Leakage Power Ration (ACLR)* Error Vector Magnitude (EVM)
Receiver	Reference Sensitivity Level Maximum Input Level
	Test Coverage for Short Message Service (SMS) SMS mobile terminated SMS mobile originated
	Operating Environment
General	Indoor
Actual Temperature	–20 to +60°C
Operating Temperature	5 to 40°C 5% to 80% relative humidity (non-condensing) up to 31°C
Humidity	Decreasing linearly to 50% at 40°C
Altitude	0 to 2 km
1.6 m rack (EIA:32 RU)	**Rack Dimension** Exterior: 1620 mm (H) x 600 mm (W) x 905 mm (D) Interior: 1422 mm (H) x 450.8 mm (W) x 851 mm (D)

* Test mode only

Key Literature & Web Link

Data Sheet
www.home.agilent.com/USeng/nav/-536900830.383759/pd.html

Ordering Information

Instruments	Qty	Option Number	Description
34980A Multi-function Switch	1	U1030A-G01	The main unit is with digital multi-meter functionality Consist of 2 module: 1. 34595A breadboard module that functions as DIO card, 16 digital input line and 26 digital output line 2. 34921A with 40 channel multiplexer card, 2 x 40 (2 input, 40 output)
Power Supply and Control Module	1	U1030A-G01	Split digital I/O line from 34595A to two RF test chamber and power up the handsets together. There is a RF switch to switch RF signal from N9360A to shield box 1 or shield box 2
N9360A Multi UE Test System	1	034	Multi-format test capability for GSM, GPRS-E-GPRS and W-CDMA testing
Advantech IPC	1	U1030A-PC1	Configured for GS-8000 Lite system
RF Test Chamber	2	U1030A-F02	Semi-automated RF test shield box with nest RF isolation >60 dB up to 2.5 GHz Comes with DB9, DB25 & DB37 connector and a flat build in antenna
System Power	1	U1030A-110 or U1030A-220	System Power Distribution Unit: 100 – 120 VAC system power or 200 – 240 VAC system power

Features

- Quad-band test capability
- SMS test capability
- Six traffic-channel test in automatic mode
- Multi-format test capability for GSM/GPRS/EDGE and W-CDMA, CDMA2000
- Future upgradeable format: 1xEV-DO, HSDPA
- User-friendly test software

The GS-8210 is a cost-effective multi-format wireless handset test system.

It is designed with "just-enough" test mindset to better serve the low cost mobile phone testing market.

The system comprises the N9360A, a mobile station tester, test software and RF shield box with build-in antenna coupler. The RF shield box provides the environment to simulate call operation to ensure reliable test results and to avoid conflicts with real networks. The GS-8210 test software adds automation to your testing program.

Specifications

Description	Specification	
GS-8210 (N9360A-034) for GSM/GPRS/E-GPRS/W-CDMA (GSM/GPRS/E-GPRS portion only)		
Frequency Bands	GSM850, GSM900, DCS1800, PCS1900	
	Uplink	**Downlink**
	GSM850: 824 – 849 MHz	869 – 894 MHz
	P-GSM: 890 – 915 MHz	935 – 960 MHz
	E-GSM: 880 – 915 MHz	925 – 960 MHz
	R-GSM: 876 – 915 MHz	921 – 960 MHz
	DCS1800: 1710 – 1785 MHz	1805 – 1880 MHz
	PCS1900: 1850 – 1910 MHz	1930 – 1990 MHz
Test Features for GSM	Location update; MS Call; BS Call; MS Release; BS Release; TCH Loop; Voice Loop Back; Emergency Call; Handover; SMS (Short Message Service)	
Test Features for GPRS	Attach; Detach; TCH Loop	
Measurement Function	Peak Tx Power; Power Ramp; Burst Timing; Frequency Error; Phase Error; Sensitivity (BER, FER, BLER); Spectrum Monitor	
GS-8210 (N9360A-034) for GSM/GPRS/E-GPRS/W-CDMA (W-CDMA portion only)		
Frequency Bands	Band I, II, III, IV, V, VI	
	Uplink	**Downlink**
	Band I: 1920 – 1980 MHz	2110 – 2170 MHz
	Band II: 1850 – 1910 MHz	1930 – 1990 MHz
	Band III: 1710 – 1785 MHz	1805 – 1880 MHz
	Band IV: 1710 – 1770 MHz	2110 – 2179 MHz
	Band V: 824 – 849 MHz	869 – 894 MHz
	Band VI: 830 – 840 MHz	875 – 885 MHz
Test Features	Registration; UE Origination Call; UE Release Call; BS Origination Call; BS Release; Voice (AMR) Loop Back; RMC Test Loop Back	
Measurement Function	Maximum Output Power; Open Loop Power Control; Inner Loop Power Control; Frequency Error; EVM; Sensitivity (BER), Adjacent Channel Leakage Power Ratio (ACLR)*; Occupied Bandwidth (OBW)*	

* Test mode only

Accessories

GS-8210 Cable Option Class
N9360A-C01 RF Cable Option
N9360A-C02 GPIB Cable Option (1 meter)
N9360A-C03 USB/GPIB Interface to Control GPIB Instruments over USB
N9360A-C04 RS-232 Serial Cable
N9360A-C05 LAN Crossover Cable
N9360A-C06 EF 400 RF Cable

GS-8210 Accessories Option Class
N9360A-A01 Additional Test SIM Option
N9360A-A-02 Additional Antenna Coupler Option

GS-8210 Power Cord Option Class (FREE)
N9360A-900 Power Cord – United Kingdom
N9360A-902 Power Cord – Continental Europe
N9360A-917 Power Cord – South Africa and India
N9360A-922 Power Cord – China
N9360A-927 Power Cord – Brazil and Thailand
N9360A-920 Power Cord – Argentina
N9360A-903 Power Cord – United States and Canada 120 V
N9360A-912 Power Cord – Denmark
N9360A-918 Power Cord – Japan
N9360A-902 Power Cord – Continental Europe
N9360A-919 Power Cord – Israel
N9360A-906 Power Cord – Switzerland
N9360A-921 Power Cord – Chile
N9360A-901 Power Cord – Australia and New Zealand

Key Literature & Web Link

Data Sheet
http://cp.literature.agilent.com/litweb/pdf/5989-5988EN.pdf
Brochure
http://cp.literature.agilent.com/litweb/pdf/5989-5986EN.pdf

Ordering Information

N9360A-034* GSM/GPRS/E-GPRS/W-CDMA Mobile Station Tester
N9360A-W34 GSM/GPRS/E-GPRS/W-CDMA Test Software for N9360A
N9360A-S01 RF Shielded Test Chamber with 2 x N-type Connector
N9360A-S02 RF Shielded Test Chamber with 2 x N-type & USB Connector
N9360A-S03 RF Shielded Test Chamber with 2 x N-type & D-SUB 25 Connector
N9360A-S04 RF Shielded Test Chamber with 2 x N-type, USB & D-SUB 25 Connector
N9360A-C01** RF Cable Option
N9360A-C02** GPIB Cable Option (1 meter)
N9360A-C03** USB/GPIB Interface to Control GPIB Instruments over USB
N9360A-C04** RS232 Serial Cable
N9360A-C05** LAN Crossover Cable
N9360A-C06** EF400 RF Cable
N9360A-A01 Additional Test SIM Option
N9360A-A02 Additional Antenna Coupler Option

* Include 1 x Test SIM & 1 x Antenna Coupler
** Recommended to pick with RF Shielded Test Chamber

- **Quad-band and SMS test capabilities**
- **Supports band I to VI for W-CDMA**
- **Twelve traffic-channel test in automatic mode**
- **Multi-format test capability for GSM/GPRS/EGPRS/W-CDMA, CDMA2000 and 1xEVDO**
- **Future upgradeable format: HSDPA**

The Agilent N9360A is a cost-effective multi-format wireless handset repair tester. It is designed with "just-enough" test mindset to better serve the low cost mobile phone testing market.

Designed as a standalone unit tester, the N9360A offers users a complete test solution for the repair and servicing of wireless handsets. Supporting the various wireless communication protocols such as GSM, GPRS, E-GPRS and W-CDMA, the vast majority of wireless handsets currently in the market are compatible with the N9360A.

The N9360A can also be upgraded with an option to support the 3G CDMA2000 standard. At the core of the N9360A's functionality is its ability to generate a Go/No-Go test result which is particularly useful for low cost manufacturers. With this final test result, the handset can be immediately classified its fit to be released into the market.

Specifications

Description	Specification
N9360A-034 for GSM/GPRS/E-GPRS/W-CDMA (GSM/GPRS/E-GPRS portion only)	
Frequency Bands	GSM850, GSM 900, DCS 1800, PCS 1900
	Uplink / **Downlink** GSM850: 824 – 849 MHz / 869 – 894 MHz P-GSM: 890 – 915 MHz / 935 – 960 MHz E-GSM: 880 – 915 MHz / 925 – 960 MHz R-GSM: 876 – 915 MHz / 921 – 960 MHz DCS1800: 1710 – 1785 MHz / 1805 – 1880 MHz PCS1900: 1850 – 1910 MHz / 1930 – 1990 MHz
Test Features for GSM	Location update; MS Call; BS Call; MS Release; BS Release; TCH Loop; Voice Loop Back; Emergency Call; Handover; SMS (Short Message Service)
Test Features for GPRS	Attach; Detach; TCH Loop
Measurement Function	Peak Tx Power; Power Ramp; Burst Timing; Frequency Error; Phase Error; Sensitivity (BER, FER, BLER); Spectrum Monitor

Description	Specification
N9360A-034 for GSM/GPRS/E-GPRS/W-CDMA (W-CDMA portion only)	
Frequency Bands	Band I, II, III, IV, V, VI
	Uplink / **Downlink** Band I: 1920 – 1980 MHz / 2110 – 2170 MHz Band II: 1850 – 1910 MHz / 1930 – 1990 MHz Band III: 1710 – 1785 MHz / 1805 – 1880 MHz Band IV: 1710 – 1770 MHz / 2110 – 2179 MHz Band V: 824 – 849 MHz / 869 – 894 MHz Band VI: 830 – 840 MHz / 875 – 885 MHz
Test Features	Registration; UE Origination Call; UE Release Call; BS Origination Call; BS Release; Voice (AMR) Loop Back; RMC Test Loop Back
Measurement Function	Maximum Output Power; Open Loop Power Control; Inner Loop Power Control; Frequency Error; EVM; Sensitivity (BER); Adjacent Channel Leakage Power Ratio (ACLR)*; Occupied BandWidth (OBW)*

* Test mode only

Accessories

Cable Option Class
N9360A-C01 RF Cable Option
N9360A-C02 GPIB Cable Option (1 meter)
N9360A-C03 USB/GPIB Interface to Control GPIB Instruments over USB
N9360A-C04 RS-232 Serial Cable
N9360A-C05 LAN Crossover Cable
N9360A-C06 EF 400 RF Cable

Accessories Option Class
N9360A-A01 Additional Test SIM Option
N9360A-A-02 Additional Antenna Coupler Option

Power Cord Option Class (FREE)
N9360A-900 Power Cord – United Kingdom
N9360A-902 Power Cord – Continental Europe
N9360A-917 Power Cord – South Africa and India
N9360A-922 Power Cord – China
N9360A-927 Power Cord – Brazil and Thailand
N9360A-920 Power Cord – Argentina
N9360A-903 Power Cord – United States and Canada 120V
N9360A-912 Power Cord – Denmark
N9360A-918 Power Cord – Japan
N9360A-902 Power Cord – Continental Europe
N9360A-919 Power Cord – Israel
N9360A-906 Power Cord – Switzerland
N9360A-921 Power Cord – Chile
N9360A-901 Power Cord – Australia and New Zealand

Key Literature & Web Link

Data Sheet
http://cp.literature.agilent.com/litweb/pdf/5989-5988EN.pdf
Brochure
http://cp.literature.agilent.com/litweb/pdf/5989-5986EN.pdf

Ordering Information

N9360A-034* GSM/GPRS/E-GPRS/W-CDMA Mobile Station Tester
N9360A-W34 GSM/GPRS/E-GPRS/W-CDMA Test Software for N9360A
N9360A-C01** RF Cable Option
N9360A-C02** GPIB Cable Option (1 meter)
N9360A-C03** USB/GPIB Interface to Control GPIB Instruments over USB
N9360A-C04** RS232 Serial Cable
N9360A-C05** LAN Crossover Cable
N9360A-C06** EF400 RF Cable
N9360A-A01 Additional Test SIM option
N9360A-A02 Additional Antenna Coupler Option

* Include 1 x Test SIM & 1 x Antenna Coupler
** Recommended to pick with RF Shielded Test Chamber

RFIC Test System

RFIC Test System

- **A complete integrated rack system covering RFIC test from R&D to manufacturing**
- **Able to measure S-parameters as well as performing spectrum and modulation analysis**
- **High speed – from 0.625 s per frequency point**
- **Support multi-format: W-CDMA, HSDPA, GSM/GPRS/EDGE, 1xEVDO, cdma2000, WLAN, WiMAX, DSRC**
- **Modulated signal generation up to 6 GHz**
- **Up to maximum 40 dBm device input and output**
- **Reduce test time by using parallel-measurement software platform**
- **Support from 2 ports up to 16 ports**

A fully integrated RFIC test system specially designed for RF semiconductor manufacturer to perform IC measurement test from R&D to production stages.

Benefits to Customer

- Scalable – the RFIC test system is capable to cover test measurement from R&D to production with less correlation cost and shorten test development time
- Reduce test time – besides from the high speed performance (from 0.625 s /frequency pt), it also helps to reduce the total cost of test by using the interface unit and software that allows sequential and parallel test to save the test time
- Reduce space, less investment – With the all-in-one high-performance integrated rack and stack system, you don't need to invest in multiple instruments and develop your own bench top systems. We have the right people with right skills to help you develop and maintain the system
- Upgradeable – instead of changing the whole box, you just need to upgrade the software
- Customizable – if you have different requirements from what we offer, we have a team of experienced engineers who can work out the best solution for your need

Key Literature & Web Link

www.agilent.com/find/RFIC_testsystem

Ordering Information

Please contact your nearest Agilent office for more details.

The E7495B base station test set offers these comprehensive tools

- **W-CDMA, HSDPA, EDGE, GSM, cdmaOne, CDMA2000 1X, CDMA2000 1xEV-DO analyzer**
- **Power meter**
- **Signal generator (CW, cdmaOne, CDMA2000 1X, CDMA2000 1xEV-DO, iDEN)**
- **Over-air test measurements for W-CDMA, HSDPA, cdmaOne, CDMA2000 1X**
- **Backhaul measurements for E1/T1**
- **High sensitivity spectrum analyzer**
- **Cable fault/antenna test analyzer**
- **NEM test software**
- **Built in GPS receiver**

The Agilent Base Station Test Set combines the most highly utilized wireless and wireline tools into a single, rugged test tool that technicians can use for everyday 2G, 2.5G and 3G base station installation and maintenance needs. Furthermore, this test set is the most functional one-box tool available today – eliminating the need for technicians to carry, manage and learn multiple test tools. Incorporating the most frequently used tools into one easy-to-use box dramatically increases technicians' productivity, decreases time spent per cell site and reduces tracking, calibration and maintenance costs.

Power Meter

The built in power meter replaces the need to carry a separate power meter, simplifying overall maintenance routines and shortening site visits. Additionally, using an appropriate power sensor enables technicians to make power measurements of microwave links. Accurate power settings help technicians maximize network capacity while reducing coverage holes and minimizing the effects of interference.

TX Modulation Analysis – W-CDMA, HSDPA, EDGE, GSM, cdmaOne, CDMA2000 1X, CDMA2000 1xEV-DO

TX modulation testing provides extensive transmitter analysis for various 2 – 3G formats like modulation quality (phase error, Rho, EVM), time offset, code domain power and display, channel power, etc. In addition, W-CDMA, and CDMA applications include Codogram analysis.

W-CDMA, HSDPA, cdmaOne/CDMA2000 1X, CDMA2000 1xEV-DO, Over-Air Test Tool

Provides fast, qualified measurements in less than five minutes. Enables time for proactive maintenance and makes pole top testing practical. Problem areas can be identified without interrupting service.

Antenna Tester with Vector Network Analysis Capability

- cable tests
- swept insertion loss
- swept insertion gain
- distance to fault (DTF)

Lets technicians evaluate one of the primary BTS trouble spots in a matter of minutes. Dual port insertion loss allows technicians to sweep various components like filters, duplexers, amps and more. DTF options include 256, 512, or 1024 data points, enough resolution to locate and isolate faults within a few centimeters (inches) of one another or resolve short jumper cables at the end of a long antenna feed line. A healthy antenna and feed line network yields improved voice quality, better system reliability and reduced dropped calls.

Spectrum Analyzer

Provides necessary functionality so technicians don't need to carry a separate spectrum analyzer. Built-in spectrum emissions masks, occupied BW, Spectrogram, and markers make it easy-to-use. Industry-leading low noise figure receiver is capable of measuring down to –150 dBm, allowing technicians to identify and pull out low level, intermittent rogue interferers. Quick interference detection leads to improved quality of service.

CW, cdmaOne/CDMA2000 1X, CDMA2000 1xEV-DO and iDEN Reverse Link Signal Generator

Provides the technician with a source to conduct sensitivity measurements. Additionally, this option allows a technician to perform component level characterization utilizing simultaneous spectrum analysis and built-in RF, iDEN and CDMA sources. Reverse link testing helps to ensure network Rx service quality.

T1 or E1

Identifies and diagnoses T1 or E1 problems. Dual channel capability allows "loop-back" measurements. Fewer wireline problems mean reduced service problems and down time.

Channel Scanner for CDMA/W-CDMA/TDMA/GSM/EDGE/GPRS/AMPS/iDEN

Provides easy to interpret bar graph display illustrating channel power versus frequency of user defined channels. The channel scanner quickly identifies improper power levels that can adversely affect network performance.

Internal GPS Receiver

Provides position location, highly accurate frequency measurements and enables independent verification of base station GPS receiver timing. For CDMA networks, the internal GPS receivers helps reduce dropped calls by identifying the "island cell" effect – improving the quality of service.

Interference Analysis

Allows engineers and technicians to find intermittent, interfering signals using a spectrogram display, signal strength meter and signal ID capability. Eliminating interfering signals from the network improves quality of service.

Ease-of-Use

The E7495B was built from the "ground up" with "ease of use" as a primary objective in defining the user interface. For example, a single hard key interface provides easy navigation to perform quick and accurate measurements. Menu structures are only two levels deep so users do not get lost in a myriad of options. Built in diagrams assist technicians in proper cable hook ups and calibration procedures. All of this is aimed at simplifying user interface with the test tool, so technicians spend less time familiarizing themselves with their tool, and more time focusing on measurements. The bottom line result is reflected in how quickly technicians become efficient in utilizing this test tool.

Rugged Design

The test set's water resistant rubber membrane key pad and sealed display enables technicians to go anywhere, anytime, regardless of weather conditions. The rugged design keeps water and dirt out, helping to ensure measurement integrity. Furthermore, a magnesium alloy case provides a lightweight, yet strong enclosure that enhances heat dissipation and provides additional RF shielding.

Specifications

General Specifications

Specifications describe the instrument's warranted performance and are valid over the entire operating/environmental range unless otherwise noted. Characteristics and specifications are show as follows:

- *Bold type indicates a warranted, hard specification*
- *Normal type indicates a nominal value. Nominal values are design center values and are not normally tested during the manufacturing process*
- *Supplemental characteristics are intended to provide additional information useful in applying the instrument by giving typical, but not warranted, performance parameters. These characteristics are show in italics or labeled as "typical," or "usable to."*

Frequency Accuracy

- Using internal time base: **≤±1 ppm with >15 minute warm-up**
- Internal time base aging: **±1 ppm aging/year**
- With GPS lock for: >15 minutes: ≤±0.03 ppm

Input Frequency Range

- 10 MHz to 2.7 GHz
- *Usable to 500 KHz (specifications and typical values do not apply below 375 MHz unless otherwise noted)*

Maximum Input Level: +20 dBm (.1 W), *+50 dBm w/supplied attenuator*
Maximum Input Power without Damaging Instrument: *100 W* (with external attenuator); *1W* (without attenuator)
Frequency and Time Reference
Can use internal timebase or external signal:
GPS (external antenna supplied)
Even second pulse
1 MHz – ≥0 dBm
2.048 MHz – ≥0 dBm
4.95 MHz – ≥0 dBm
10.0000 MHz – ≥0 dBm
13.0 MHz – ≥0 dBm
15.0 MHz – ≥0 dBm
19.6608 MHz – ≥0 dBm
40 dB Attenuator

- Frequency range: 10 to 3000 MHz
- Attenuation accuracy: ±0.5 dB
- Max power: 50 dBm (100 W)

Spectrum Analyzer/TX Analyzers

Reference Level Range: –150 to +100 dBm
Input Frequency Range: 10 MHz to 2700 MHz (*usable to 500 KHz*)
Dynamic Range: +50 dBm to –150 dBm (with supplied 40 dB attenuator) (30 Hz RBW)
Input Attenuation: 0 to 30 dB automatically selected, 10 dB controllable
Amplitude Accuracy: ±*1 dB* (100 – 2500 MHz @ 25°C)
Resolution Bandwidth: 10 Hz to 1 MHz, settable to 1 Hz precision
Adjacent Channel Power Accuracy: ±*0.75 dBc*
Span: 1 kHz – 2.6995 GHz
Trace Update

- Span: *2.69 GHz = 5.1 sec*
  60 MHz = 400 mS
  1 MHz, 100 Hz RBW 1.2 sec

Simultaneous Dynamic Range: *>90 dB (CW signals @ 300 KHz separation, span 500 KHz, 30 Hz RBW)*
SSB Phase Noise: *–85 dBc (30 kHz offset)*
Spurious Responses

- *Range control set to auto, high sensitivity mode*
- *Internally generated, 50 ohm*
- *Load on input: <–115 dBm*
- *Crossing spurs: ≤–50 dBc*

Displayed Average Noise Level: *–150 dBm (30 Hz RBW, 375 MHz to 1.5 GHz)*
Port 2 VSWR: *<2 : 1*

Antenna/Cable[1]

Frequency Range: 375 – 2500 MHz
Frequency Resolution: <500 Hz
Immunity to Interfering Signals: *+20 dBm (with interference rejection turned on)*
Measurement Speed

- *<17 mS/point*
- *<7 mS/point*

Return Loss (Port 1)

With ≥16 Averages: 375 to 2500 MHz
Range: *>40 dB*
VSWR: *<1.02*
Resolution: 0.1 dB
Display Range: –5 to +150 dB
SWR Range: 1 to 500

Distance to Fault (Port 1)

Range (m): 1 m to 300 m
Resolution: (1.5x10^8) (Vf)/(f2-f1) Hz where VF is relative propagation velocity of cable *(typically 1% of measurement distance)*
Data Points: 256, 512, 1024
VSWR: 1 to 500

Insertion Loss (Port 1 to Port 2)

Measurement uses supplied 10 dB pads
Usable Range: *>100 dB wide range mode*
Accuracy: ±1 dB *(over 0 to 60 dB, ≥16 averages)*
Average Insertion Loss (readout) Accuracy

- Range: 0 to 40 dB
- Frequency: 824 to 960 MHz, 1710 to 2170 MHz (mobile phone bands)
- Readout Resolution: ±0.1 dB

Power Meter Option 600

Display Range: –100 dBm to +100 dBm (range is power sensor dependent)
Display limits: ±100 dBm (user settable)
Resolution: Settable 1.0, 0.1, 0.01, 0.001 in logarithmic mode, or 1, 2, 3, or 4 significant digits in linear mode
Instrumentation Accuracy

- Absolute: ±0.02 dB (log) or ±0.5% (linear). Add the corresponding power sensor linearity percentage
- Relative: ±0.04 dB (log) or ±1.0% (linear). Add the corresponding power sensor linearity percentage

Zero Set: Zero set is the digital zero with an 8482A sensor: ±50 nW
Power Reference

- **Power Output: 1.00 mW (0.0 dBm)** traceable to the U.S. National Institute of Standards and Technology (NIST)
- **Accuracy: ±1.2% worst case (±0.9% rss) for one year**
- **SWR: <1.08**

External Attenuator Option 803

Max Power: 100 Watts
Attenuation: *40 dB ±0.5 dB*[2]

Power Meter Option 600 with Agilent 8482A Power Sensor

Frequency Range: 100 KHz to 4.2 GHz
VSWR:
100 KHz to 0.3 MHz **<1.60**
0.3 MHz to 1 MHz **<1.20**
1 MHz to 2 GHz **<1.10**
2 GHz to 4.2 GHz **<1.3**
Power Linearity: +10 dBm to +20 dBm; ±3%
Maximum Power: 300 mW average, 1 W peak, 30 W-us per pulse
Measurement Noise: <93.5 nW (0.85 + 110 nW)
Averaging Filter: Fixed at 32 in normal mode
Zero Drift: <±10 nW

For additional/current specification/characteristic information, refer to the Agilent Base Station Test Set Technical Overview available at:
www.agilent.com/find/basestations

[1] For Antenna/Cable measurements, a short self-calibration procedure must be run prior to making the measurement. For more information about the calibration procedures and when they are needed, see sections 2 and 3 in the users manual or use the online help.
[2] Attenuator can be characterized to within 0.1 dB in the mobile phone bands using the insertion loss measurement. This value can be stored for use with the power meter.

Key Literature & Web Link

For current literature, please visit: **www.agilent.com/find/basestations**

Technical Overview Link:
http://cp.literature.agilent.com/litweb/pdf/5988-7186EN.pdf
W-CDMA/HSDPA Flyer:
http://cp.literature.agilent.com/litweb/pdf/5989-4060EN.pdf
GSM/EDGE Flyer:
http://cp.literature.agilent.com/litweb/pdf/5989-4563EN.pdf
Nortel CDMA BTS Software Flyer:
http://cp.literature.agilent.com/litweb/pdf/5989-1783EN.pdf
1xEV-DO Flyer:
http://cp.literature.agilent.com/litweb/pdf/5989-2846EN.pdf
Free Poster:
http://cp.literature.agilent.com/litweb/pdf/5988-7188EN.pdf

For more information, visit our web site **www.agilent.com/find/E7495B**

Ordering Information

E7495B Base Station Test Set
Standard test set functionality includes spectrum analysis and antenna measurements
Standard accessories include:
- PCMCIA 128 MB flash memory card
- AC/DC converter
- NI2040AG lithiumion battery
- GPS antenna
- 10 dB Coaxial attenuator (Q2)
- Coax 50 ohm terminated N-male
- Open/short M type N
- Adapter storage box
- Shoulder strap
- Documentation (CD ROM)
- 2' M-N to M-N cables (Q2)
- 10' M-N to M-N cable
- N-female to N-female barrel (Q2)
- Adapters

Option
E7495B-200 cdmaOne and CDMA2000 1X TX Analyzer
E7495B-205 CDMA2000 1xEV-DO Analyzer (RX testing requires Option 510, adds OTA functionality if Option 210 is selected)
E7495B-210 cdmaOne, CDMA2000 1X Over-the-air Test (requires Option 200, recommend 810/811/812 or equivalent)
E7495B-220 Channel Scanner
E7495B-230 GSM TX Analyzer
E7495B-235 EDGE TX Analyzer
E7495B-240 W-CDMA (UMTS) TX Analyzer
E7495B-245 HSDPA TX Analyzer
E7495B-250 W-CDMA (UMTS) Over-the-air Test (requires Option 240, recommend 813 or equivalent)
E7495B-270 Interference Analyzer
E7495B-300 DC Bias
E7495B-330 Nortel CDMA Base Station Software (requires Option 200, 510, 600)
E7495B-500 CW Signal Generator
E7495B-510 CW, iDEN, cdmaOne, CDMA2000 1X, CDMA2000 1xEV-DO (1xEV-DO requires Option 205) Reverse Link Signal Generator
E7495B-600 Power Meter (requires 8481A/D or 8482A power sensors)
E7495B-700 T1 Analyzer
E7495B-710 E1 Analyzer
E7495B-801 Soft Carry Case
E7495B-802 Backpack
E7495B-803 40 dB 100 W Attenuator
E7495B-805 Paper Manual
E7495B-810 Cellular Antenna and Pre-selector Filter for Option 210
E7495B-811 PCS Antenna and Pre-selector Filter for Option 210
E7495B-812 Korean PCS Antenna and Pre-selector Filter (required for Option 210)
E7495B-813 Antenna and Pre-selector Filter (required for Option 250)
E7495B-820 Battery Pack, External Battery Charger, DC Car Adapter
E7495B-840 Transit Case
E7495B-51B Return to Agilent Repair
E7495B-50C Return to Agilent Calibration
8482A/8481A Power Sensor

Note: Upgrade options for the E7495A/B use the designation E7495XU before the respective option number.

Wireless Network Optimization Platform

2G, 2.5G, 3G and 3.5G Drive Test System

E6474A
E6473B
W1314A
B9990A

- **Provides RF coverage and service performance measurements**
- **Wireless data measurements – (i) Client-server system for uplink and downlink route verification (ii) service assurance, including voice, video, MMS, SMS, WAP, email, http and FTP performance tests**
- **Controls multiple receivers and phones simultaneously, including different technologies and bands**
- **Works with DSP-based receivers for BSIC and scrambling code scanning – including interference analysis (GSM), spectrum analysis and CW/Channel power measurements**
- **Provides comprehensive phone-based physical layer, layer 3 and QoS measurements**
- **Supports CDMAOne, CDMA2000, 1xEVDO, TD-SCDMA, HSPA, UMTS, GSM, GPRS, EDGE, iDEN, WiMAX and continually reviewing emerging technologies**
- **Scalability between indoor and outdoor measurement capability**

The Agilent Wireless Network Optimization Platform is a comprehensive, single platform drive test system that optimizes and troubleshoots 2G, 2.5G, 3G and 3.5G wireless networks. This platform enables wireless service providers and network equipment manufacturers to proactively address challenges with wireless voice and data networks by quickly and accurately identifying problems.

Specifications

The E6474A Wireless Network Optimization Platform supports offers specialized receiver and test mobile measurements to allow optimization and troubleshooting of wireless networks. It provides support on a comprehensive selection of test mobiles for the following technologies:

- CDMA/CDMA2000/1xEVDO
- W-CDMA/UMTS/HSPA
- GSM/GPRS/EDGE
- iDEN

In a given drive test system, up to 4 phones and 4 receivers can be used simultaneously.

The E6474A Wireless Network Optimization Platform is completely scalable in that it can support:

- Both phone and receiver measurements
- Multiple technologies/bands on one system
- Both indoor and outdoor measurements
- Both public Internet data testing or dedicated server data testing
- Data service performance measurements including video, MMS, SMS, WAP, email, http, FTP tests. Also supports LAN and wiFi measurements
- MOS rating for voice and video streaming test

The data testing within E6474A supports all technologies. The E6474A Wireless Network Optimization Platform can support 2 data devices, with simultaneous trace measurements. In certain instances, more than 2 data phones can be supported, please contact your local Agilent representative for further information. Measurement set is dependent on technology but typical parameters include:

- At physical layer – Cell ID, neighbor cell and mobility information RxLev, RxQual, TxLevel, Tslot, FER, RSSI, Ec/Io, SIR, Delay spread and protocol logging
- Mobile's QoS Layer – RLC and RLP throughput, PDU errors/retransmissions and BLER
- Data Layer – IP and application layer throughput, delay measurements, Download time, TCP connection time, Server response time, embedded object errors, Total response time, Authentication time

Accessories

Accessories for the E6474A Wireless Network Optimization Platform can be found under E6473B.

Please contact your Agilent representatives for the current list of supported phone models and accessories.

Key Literature & Web Link

Main Product Page Link: **www.agilent.com/find/E6474A**. All literature pieces are linked from this site including:

Product Overview:
http://cp.literature.agilent.com/litweb/pdf/5988-3558EN.pdf
UMTS/HSDPA Technical Overview:
http://cp.literature.agilent.com/litweb/pdf/5989-5735EN.pdf
GSM/GPRS/EDGE Technical Overview:
http://cp.literature.agilent.com/litweb/pdf/5989-5722EN.pdf
CDMA2000/1xEVDO Technical Overview:
http://cp.literature.agilent.com/litweb/pdf/5989-5904EN.pdf
Drive Test Configuration Guide:
http://cp.literature.agilent.com/litweb/pdf/5989-5545EN.pdf

Ordering Information

Choose Required E6474A Technology Software
CDMAOne (E6474A-120)
CDMA2000 – includes CDMAOne (E6474A-121)
CDMA2000 to 1xEVDO upgrade (E6474A-135)
GSM (E6474A-220)
GPRS – includes GSM (E6474A-620)
GPRS to EDGE upgrade (E6474A-635)
UMTS (E6474A-320)
UMTS to HSDPA upgrade (E6474A-325)
UMTS to HSUPA upgrade (E6474A-326)
iDEN (E6474A-420)
WiMAX (E6474A-655/656)

Choose Generic E6474A Software
Multiple Phone License (E6474A-010)
Indoor Mapping License (E6474A-030)
MapX Mapping Software License (E6474A-040)
Client Data Measurement Software License (E6474A-700)
Server Data Measurement Software License (E6474A-710)
Wireless Application Measurement Software (E6474A-740)
Video Streaming (E6474A-741)
Video Telephony (E6474A-742)
Video Streaming plus Non-reference Video MoS (E6474A-744)
WAMS Lite (E6474A-745)

E6474A
E6473B
W1314A
B9990A

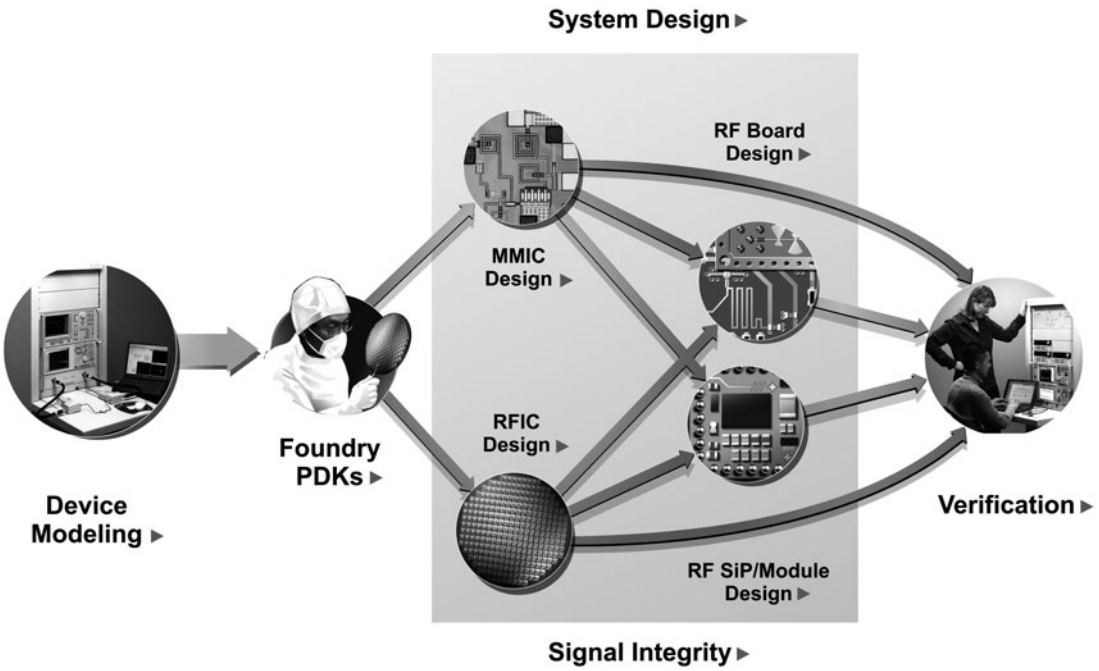
Software Update Service (SUS)
1 Year Drive Test SUS – Support and Software Update Service (E6474A-060)
1 Year Drive Test Corporate SUS – Support and Software Update Service (E6474A-061)
1 Year Drive Test Tech Tool SUS – Support and Software Update Service (E6474A-062)

Choose Voice MOS Test Options (if required)
Single Phone Mobile Voice MOS Test (B9990A-200)
Multi Phone Mobile Voice MOS Test Upgrade (B9990A-300)
Office Unit Voice MOS Test (B9990A-400)
Nokia POP Port Cable to Audio Module (E6473B-882)
2.5 mm Jack Plug Cable to Audio Module (E6473B-883)

Choose W1314A Agilent NGR (if required)
W1314A-050 W1314A Receiver – Power Distribution Module (PDM) Adjust
W1314A-070 W1314A Receiver – Indoor Data Collection Kit
W1314A-100 GSM 900/1800 (UL/DL)
W1314A-103 GSM 900/1800 (DL)
W1314A-110 GSM/CDMA/TDMA/UMTS 850/1900 (UL/DL)
W1314A-113 GSM/CDMA/TDMA/UMTS 850/1900 (UL/DL)
W1314A-120 GSM/CDMA 450 (DL), GSM 900/1800 (DL) and UMTS 2100 (DL)
W1314A-123 GSM/CDMA 450 (DL), GSM 900 (DL)
W1314A-130 GSM/CDMA/UMTS 850/1900 (DL) and GSM 900/1800 (DL)
W1314A-140 GSM/CDMA/UMTS 850 (DL), GSM 900/1800 (DL) and UMTS 2100 (DL)
W1314A-150 GSM/CDMA/UMTS 850/1900 (DL), UMTS 1700 (UL), CDMA/UMTS 2100 (DL)
W1314A-153 GSM/UMTS/CDMA 1900 (DL) UMTS/CDMA 2100 (DL)
W1314A-200 UMTS 2100 (UL/DL) GSM 900/1800 (DL)
W1314A-203 UMTS 2100 (UL/DL) NGR
W1314A-233 CDMA/UMTS 850/2100 (DL)
W1314A-210 UMTS 2100 (DL), UMTS TDD 2100 (TDD) and GSM 900/1800 (DL)
W1314A-220 CDMA/UMTS 1900/2100 (DL), UMTS TDD 2100 (TDD) and CDMA 850 (DL)
W1314A-230 CDMA/UMTS 850/2100 (UL/DL)
W1314A-233 CDMA/UMTS 850/2100 (DL)
W1314A-300 iDEN 800/900 (UL/DL)
W1314A-310 iDEN 800/900 (DL), GSM/CDMA/UMTS 850/1900 (DL)
W1314A-313 iDEN 800/900 (DL)
W1314A-410 JCDMA 800 (DL), JCDMA/UMTS 1700 (DL) and UMTS 2100 (DL)
W1314A-500 WiLAN (TDD), GSM 900/1800 (DL) and UMTS 2100 (DL)
W1314A-600 WiMAX 2500/850 DL/1900 DL
W1314A-603 WiMAX 2500 TDD

EESOF EDA DESIGN & SIMULATION SOFTWARE

EEsof EDA Design and Simulation Software



Agilent EEsof EDA is the leading supplier of Electronic Design Automation (EDA) software for high-frequency system, circuit, and modeling applications. These applications include signal integrity as well as RF and microwave amplifier, mixer and filter design for commercial wireless, aerospace and defense markets.

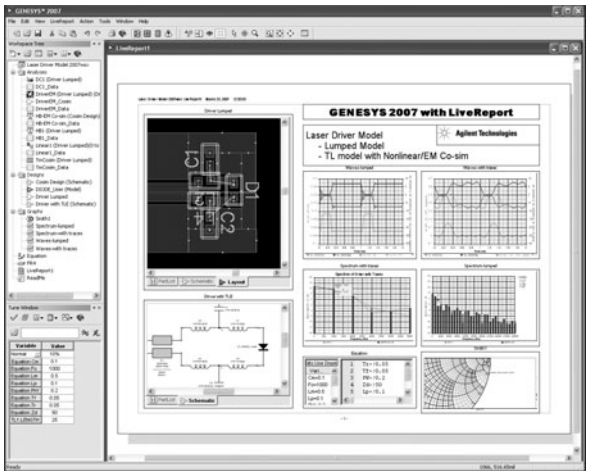
Agilent EEsof EDA products include Advanced Design System EDA software, RF Design Environment, IC-CAP device modeling software, Momentum, Electromagnetic Design System, GENESYS, SystemVue, and GoldenGate.

GENESYS and SystemVue are key Agilent products developed originally by Eagleware-Elanix, the industry leader in ease-of-use and RF synthesis. GoldenGate is the most advanced RFIC simulation and analysis solution for integrated RF IC design. It was developed originally by Xpedion Design Systems.

World-Class Product to Enable the High-Frequency Design Chain, from Device Modeling through Verification

- **Advanced Design System (ADS)** is a powerful electronic design automation software platform. It offers complete design integration to designers of products such as cellular and portable phones, wireless networks, and radar and satellite communications systems. ADS now addresses the needs of high-speed digital designers with it's signal integrity simulation technology.
- **Agilent RF Design Environment (RFDE)** integrates Agilent's leading RF simulation technologies into the Cadence industry-standard analog/mixed signal design flow framework for large-scale RF/mixed-signal IC design.
- **Agilent GoldenGate** is an RFIC Simulator delivering high capacity and unique analysis for full chip verification and design for yield. Developed for the specific needs of RFIC designers. Fully integrated in the Cadence Analog Design Environment.
- **Electromagnetic Design System (EMDS)** is a complete solution for electromagnetic simulation of arbitrarily-shaped, passive three-dimensional structures. It makes full 3D EM simulation an attractive option for designers working with RF circuits, MMICs, PC boards, modules, and Signal Integrity applications.
- **Momentum** is a 3D planar electromagnetic (EM) simulator used for passive circuit analysis. It accepts arbitrary design geometries (including multi-layer structures) and accurately simulates complex EM effects including coupling and parasitics. And because Momentum is an integrated component in the Advanced Design System (ADS) design flow, simulation setup times are reduced, and design productivity is increased.
- **Antenna Modeling Design System (AMDS)** is a 3D, dedicated design and modeling tool for antennas and antenna systems. With AMDS, full-wave EM simulations that used to take weeks can now be performed in just a few hours, and eliminates the need for physical prototyping early in the design flow.
- **GENESYS** is an affordable, easy-to-use, integrated electronic design automation (EDA) software package focused on RF and microwave circuit and system design. GENESYS is available in standalone configurations, but is also affordable enough that its unique capabilities can augment a variety of existing RF EDA toolsets with new capability.
- **SystemVue** is a fast easy to learn development tool for design, simulation and analysis of communications architectures and signal processing algorithms. SystemVue has an easy to learn, intuitive block level design interface with extensive model libraries of bit-true fixed point elements, communications system building blocks, adaptive control elements, and digital signal processing components. SystemVue supports algorithm prototyping and implementation via VHDL generation for FPGAs and ANSI C-Code for embedded DSP.
- **IC-CAP (Integrated Circuit Characterization and Analysis Program)** is a Parameter Extraction and Device Modeling Software package that provides powerful characterization and analysis capabilities for all of today's semiconductor modeling processes.

To learn more about Agilent EEsof EDA products and applications, visit **www.agilent.com/find/eesof**



GENESYS™ is an integrated electronic design automation (EDA) software for RF and microwave component and subsystem designers needing affordable, professional design tools that focus on the task of the RF designer.

From initial system architecture through final documentation, GENESYS provides state-of-the-art performance in a single easy-to-use design environment that is fast, powerful, and accurate. It offers all the essential synthesis and nonlinear simulation technologies for modern RF design at an affordable price, with five new attractive suites starting at just U.S.$3,995*.

Used by thousands of RF designers worldwide, GENESYS originated nearly a decade ago in Eagleware-Elanix, a company which has been acquired by Agilent. Agilent has continued to improve the GENESYS platform with quarterly updates to provide more accurate models and higher performance, as well as new features such as phase noise. GENESYS also now links to Agilent's enterprise RF design environment, the Advanced Design System (ADS), for a continuous spectrum of design capability.

GENESYS
- Easy to Use
- Incredible Value
- Innovative array of proven RF design technology

GENESYS

W1410L GENESYS Core is the central focus of the GENESYS family of products, and the foundation on which all other modules are built. GENESYS Core is an integrated design suite that incorporates schematic capture, linear frequency-domain simulation, data visualization, and layout.

W1410L GENESYS Core also features powerful workgroup automation capabilities that make sharing, transferring, and saving design information among design team members simple.

To learn more about GENESYS, and to request a software evaluation, visit **www.agilent.com/find/eesof-genesys-evaluation**

Simulation Products

Once a design is entered, use these tools to simulate design performance and eliminate prototypes.
- W1601L SPECTRASYS™ – RF architecture simulator
- W1605L WhatIF – frequency planning tool
- W1604L CAYENNE – time domain simulator
- W1602L HARBEC™ – harmonic balance non-linear simulator
- W1603L EMPOWER/ML™ – multi-level planar 3D EM simulator

Synthesis Products

Synthesis is design automation at its best. A variety of powerful tools take your design specifications and provide first-pass designs that are ready for refinement with simulation tools.
- W1510L SIGNAL CONTROL – splitter, coupler, and attenuator synthesis
- W1503L S/FILTER™ – advanced direct LC/distributed filter synthesis
- W1504L A/FILTER™ – active op-amp filter synthesis
- W1505L EQUALIZE – delay equalization synthesis
- W1506L MATCH – impedance matching synthesis
- W1507L OSCILLATOR – oscillator synthesis
- W1508L ADVANCED T/LINE™ – transmission line synthesis and circuit conversion
- W1509L PLL – phase lock loop design
- W1511L MIXER – design and analyze mixer configurations using various Topologies

Configurations

W1410L GENESYS™ Core
Fully-functional linear RF circuit design suite that is the foundation for all other GENESYS™ products

W1411L GENESYS™ Designer Pro
Adds the complete range of synthesis products to W1410L GENESYS Core

W1416L GENESYS™ Nonlinear Pro
Adds HARBEC for nonlinear simulation, and EMPOWER for planar EM Simulation to W1410L GENESYS Core

W1417L GENESYS™ Comms Pro
Adds SPECTRASYS for spectral domain simulation, and WhatIF for spurious-free response analysis to W1410L GENESYS Core

W1418L GENESYS™ Integrated
The most complete set of GENESYS™ products – adds all 5 frequency and time-domain simulators and all nine synthesis products to W1410L GENESYS Core

Key Literature & Web Link

http://literature.agilent.com/litweb/pdf/5989-5096EN.pdf
http://eesof.tm.agilent.com/products/genesys/

* The price may differ slightly in different countries. Please contact your local Agilent sales office for details.

Agilent Ptolemy Simulation Framework

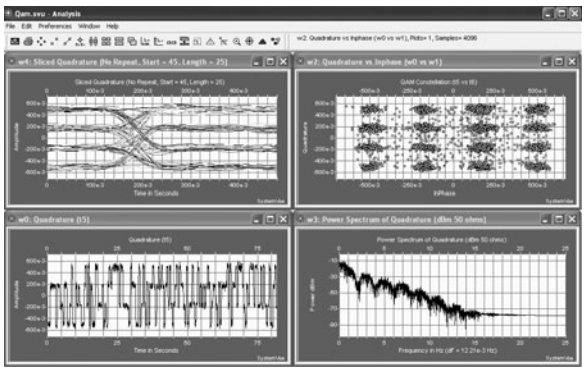
- **Advanced RF-DSP co-verification with Circuit Simulation**
- **Available wireless verification libraries – 3GPP-LTE (New), WLAN, Cellular, WiMAX**
- **IP Import for Verilog, VHDL, M-Code, C++**
- **Connected Solutions: Connecting simulation and HW test**

Agilent SystemVue

- **End-End Communications System Design**
- **Bit-True Fixed Point DSP Algorithm Design**
- **VHDL Generation for FPGA Development**
- **ANSI C-Code Generation for Embedded DSP Development**
- **Distortion true analog/RF behavioral models**

Agilent SpectraSys

- **Accurate and Fast RF System Analysis**
- **Supports forward transmission and reverse path signal propagation**
- **Full non-linear modeling of RF building blocks**
- **Add SSB phase noise to sources and signals**
- **Capture IMD artifacts and isolate signal contributors**



Agilent EEsof EDA provides a full range of System Level design, analysis, verification, and implementation tools.

Agilent SystemVue is a full featured signal processing design platform focused on the development of communications systems. SystemVue is an intuitive block level graphical design framework with extensive model libraries of modulation standards, adaptive control elements, and digital signal processing components that support bit true fixed point algorithm design and distortion true analog/RF block level modeling. Results can be output as C code for an Embedded DSP algorithm design or as VHDL code for an algorithm implementation in FPGA. Hardware-in-loop simulation is supported via links with TI DSP development systems and Xilinx FPGA boards.

Agilent Ptolemy is a simulation framework for the Advanced Design System family of design products. Ptolemy provides a simulation "backplane" supporting advanced RF-DSP co-design and co-verification. By integrating user supplied IP in Verilog, VHDL, C++, or M-Code, along with circuit level or behavior RF models, Ptolemy allows complete verification of your circuits and algorithms in higher level communications system contexts. Agilent provides verification libraries for all commercial wireless standards, including WLAN 802.11a/b/g, Mobile and Fixed WiMAX 802.16 d/e, and 3GPP/GSM/EDGE, along with emerging wireless technologies like WiMEDIA and 3GPP-LTE (Long Term Evolution 4G). These libraries provide the system contexts for design verification.

Agilent SpectraSys provides RF System and subsystem design, analysis, and debug tools that are unmatched by any other technology. SpectraSys supports both the Advanced Design System family of products and the Agilent GENESYS product line. Unlike spreadsheet-based tools, SpectraSys accounts for a much greater level of physical detail and analog performance issues that spreadsheets assume away – such as mismatch effects, intermodulation terms that are difficult to filter, reverse propagation, single-sideband noise, phase noise, and nonlinear effects. Unlike numeric or time-based system simulators that focus on a single, idealized, modulated carrier bandwidth, SpectraSys accounts for a variety of analog distortions and analog interactions throughout the complete spectrum, and as a result provides much richer, realistic RF scenarios.

Key Literature & Web Link

Agilent System Level products:
http://eesof.tm.agilent.com/products/design_flows/system/

Agilent SystemVue:
http://eesof.tm.agilent.com/products/systemvue/

Agilent Ptolemy:
http://eesof.tm.agilent.com/products/e8823a-new.html

Agilent SpectraSys for ADS:
http://eesof.tm.agilent.com/products/w1422.html

Agilent SpectraSys for GENESYS:
http://eesof.tm.agilent.com/products/genesys/spectrasys.html

Ordering Information

Agilent SystemVue

W1450 – SystemVue™ Professional
SystemVue design, simulation, and analysis

W1451 – SystemVue™ Communication Design Suite
SystemVue Professional + Communication, DSP, Logic, RF/Analog libraries and link with MATLAB

W1453 – SystemVue™ Real-Time Communication Design Suite
SystemVue Communication Design Suite, Advanced C-Code Generator Interface + Real-Time TI Interface

W1455 – SystemVue™ Wireless Design Suite
SystemVue Communication Design Suite + UWB, DVB, CDMA, and 802.11a/b/g libraries

W1457 – SystemVue FPGA Developers Suite
SystemVue Communication Design Suite, Automatic Program Generation (APG), Hardware Design Studio – Fixed Point design, analysis, and VHDL Generation

W1458 – SystemVue Algorithm Developers Suite
SystemVue Communication Design Suite, Automatic Program Generation (APG), Fixed Point Library, and advanced C-Code Generation

ADS Ptolemy and RF Architect

E8851L – Commsys Designer Pro
ADS Design Environment, Data Display, Ptolemy simulation kernel, RF Behavioral models, digital filter design tool, Advanced communications models for OFDM, MATLAB Link

E8829L – Comms Verification Bundle
ADS Design Environment, Data Display, Ptolemy simulation kernel, circuit envelope, harmonic balance, and Spice circuit simulators, RF Behavioral models, digital filter design tool, ModelSim/NCSim HDL cosim link, MATLAB Link

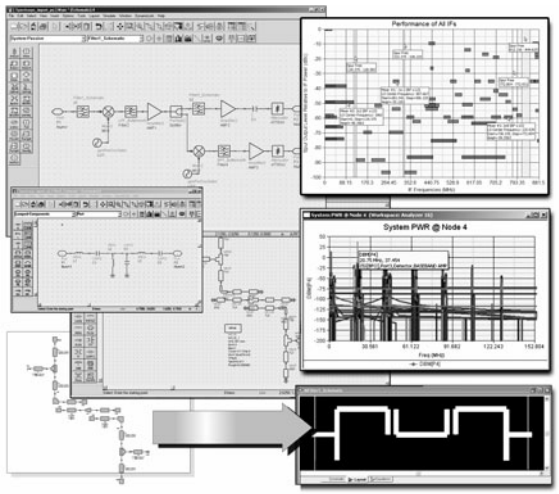
E8896 – Wireless Networking Verification Bundle
802.11a/b/g, 802.16 d/e with MIMO, 802.11n signal processing libraries for ADS Ptolemy

E8897 – 2G/3G Cellular Verification Bundle
GSM/EDGE, CDMA, CDMA2000, 1x-EV, 3GPP, HSPA signal processing libraries for ADS Ptolemy

E8898 – Mature Wireless Verification Bundle
GSM/EDGE, CDMA, CDMA2000, 1x-EV, 3GPP, 802.11a/b/g, DTV

E8899 – "All-In-One" Wireless Verification Bundle
Everything in E8896, E8897, and E8898 along with 3GPP-LTE, WiMEDIA

W1422 – RF Architect
SpectraSys, WhatIF, Filter Synthesis tools integrated in the ADS design environment



Speeding Optimized Designs from Concept to Implementation

The Agilent Advanced Design System (ADS) helps designers meet the multidimensional challenge of mixed-signal design, from RF to digital to baseband. When equipped with Agilent's broad range of high-performance design tools, project teams can quickly explore a host of ideas and then simulate the electrical and physical characteristics of the most promising design candidates. ADS offers complete design integration for products ranging from mobile phones to wireless networks and radar systems.

Boost Productivity with Integrated Design Tools

ADS is a powerful suite of electronic design automation (EDA) software that can simulate the entire communications signal path. It integrates a wide variety of proven RF, Signal Integrity, mixed-signal and electromagnetic design tools into a single, flexible environment. Seamless integration minimizes the need for data or design transfer, and ADS works with other EDA frameworks for full compatibility within your overall design process.

Use ADS and its highly integrated links and support as a basis for your design verification solution. ADS can be used for virtual prototyping, debugging, or as an aid in manufacturing test.

To enhance engineering productivity and shorten time-to-market, ADS software offers a high level of design automation and applications intelligence. This proven software environment is easily extensible: you can customize ADS by adding features focused on your particular application needs. ADS runs on PCs and workstations, with complete file compatibility between platforms and across networks.

Optimize System Performance and Resolve Design Conflicts

With RF mixed-signal co-simulation, you can examine RF and mixed-signal interactions and make architectural tradeoffs. For instance, you can explore alternatives and decide whether to implement a particular filter in the baseband stage or in the RF section. This also provides a unique verification capability using full transistor-level co-simulation not limited to only behavioral or extracted models. This verification step can be extended into the lab environment by connecting ADS to test equipment. Signal sources and signal analyzers may be connected to the candidate hardware prototype, enabling verification using the exact same sources and measurements used in the design process.

ADS lets you choose either a baseband design flow or an analog/RF track, or both. You can build the physical design for the RF portions in ADS, then choose to integrate with other third-party EDA frameworks.

You can also add the GENESYS/RF Architect to ADS, which enables the unique RF system architecture tools in GENESYS, Spectrasys and WhatIF to be available from within ADS. When combined with ADS, these tools provide a unique way to correctly architect the system's design for frequency planning and power/gain budgeting, as well as identifying the root causes of potential design problems. In addition, powerful synthesis modules are available. Once the design is optimized, it may be transferred to ADS for further design, verification and implementation.

Meet the Unique Challenges of your Application

Customize ADS for demanding applications and design flows from RF chips and boards to microwave circuits and baseband/DSP elements. All design suites share a common database, user interface and data display. The flexible product structure of ADS lets you begin with pre-configured suites and add capabilities as you need them. For more information on available suites, please contact your Agilent EEsof representative.

The following represents highlights of available ADS Design Suites. Many are available in Pro and Premier versions offering various levels of capability to fit needs and budget.

RF Designer

Provides essential circuit simulation, RF model sets and layout functionality.

Microwave Circuit Designer

A complete solution for developing high-frequency designs, including MMICs and hybrids, with optimized performance and manufacturing yield. Combines high-frequency simulation and optimization with accurate models, libraries and physical design tools.

MMIC Designer

A complete front-to-back MMIC design capability in a single integrated design flow. Offers a front-to-back design solution with synchronized schematic/layout, Data Display, Harmonic Balance, Linear, Electromagnetic simulators, and GDSII file translator.

Signal Integrity Designer

Signal Integrity Designer provides the ideal design environment, a comprehensive set of device models including IBIS, accurate transmission line models, and industry-leading time-domain simulation technologies necessary to design high speed data-rate circuits, such as backplanes and circuit boards for >1 Gb/s applications. Validates system channels for jitter and BER. Extensible to designing and optimizing pre-emphasis networks and LFE/DFE equalizers using mixed-signal simulation. When combined with Agilent's Physical Layer Test System (PLTS), ADS provides a uniquely complete, accurate and flexible solution for high-speed serial link design.

Communication System Designer

Provides a unified environment from system concept to implementation. Validates RF system designs. RF simulator and linear/nonlinear RF block models predict the performance of complete RF systems. Offers RF and floating-point DSP modeling and design to simulate critical specifications such as BER and EVM. Allows bidirectional co-simulation with MATLAB®. Expandable to include HDL co-simulation and fixed-point Analysis.

Physical Designer

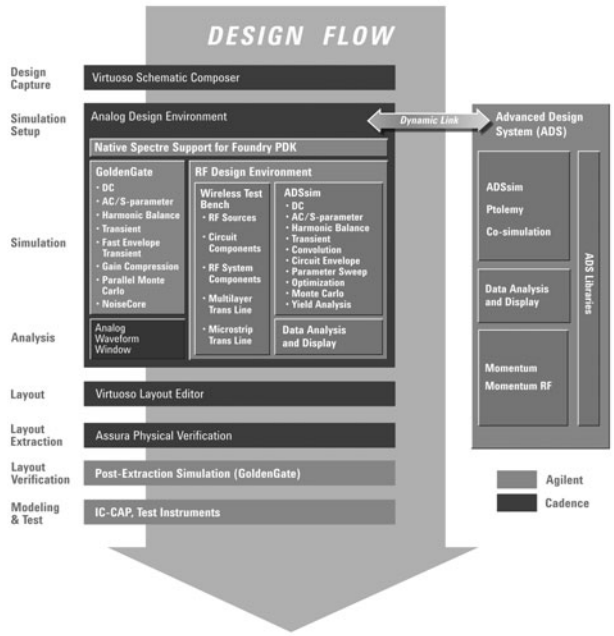
Physical Designer Pro/Premier product bundles are complete and extensible high-frequency physical design suites that integrate standard and advanced layout editing features with key technologies that speed the physical design and verification of MMIC, hybrid and PCB layouts.

Momentum Circuit Designer

Momentum Circuit Designer is a basic, high-frequency physical design suite that integrates standard and advanced layout editing features with Momentum electromagnetic (EM) simulation technology and Linear (S-parameters) circuit simulation to speed physical circuit design.

Key Literature & Web Link

http://literature.agilent.com/litweb/pdf/5988-3326EN.pdf
www.agilent.com/find/eesof-ads



Agilent EEsof delivers the full range of simulation and verification tools to meet the needs of RFIC designers. To keep pace with the constant push for higher levels of integration and advanced silicon process geometries, Agilent has responded with two powerful tools. RFDE and GoldenGate provide the framework for designers to rapidly simulate circuits, verify specs and validate potential yield. Designers can confidently simulate blocks, combinations of blocks and full Receive/Transmit chains to understand the negative influences introduced by noise, distortion, parasitics and numerous other effects confronted in modern RFIC design. Additionally, designers can analyze the manufacturability of circuits by using industry proven techniques such as Monte Carlo and process corner boundaries.

RFDE and GoldenGate, combine Agilent's leading wireless and wireline simulation technologies, model sets, and waveform viewing capabilities. These outstanding tools provide a comprehensive circuit simulation methodology that has been masterfully integrated into the Cadence Analog Design Environment. Designers can move smoothly through schematic capture, test bench setup, simulation and analysis to achieve amazing insight into design performance and manufacturability prior to tape out, avoiding costly mistakes and design re-spins.

Improved Design Productivity

As data rates, carrier frequencies, and specification complexities increase, so does the designer's need to utilize a broader range of fast and accurate EDA tools. Agilent's extensive set of RFIC simulation, mixed-domain simulation, statistical design, optimization, and post-simulation analysis capabilities ease the design challenge from within the familiar Cadence framework. Agilent's simulation technology produces fast measurements for typical high-frequency applications. Increased simulation speed makes complex analysis and optimizations practical, providing greater insight into circuit behavior. No matter what the design standard, circuit, or requirement, adding Agilent RFDE and GoldenGate to the design flow reduces costly design iterations and shortens design cycles.

Built on a Proven Foundation

Agilent EEsof offers a unique combination of proven simulation and integration technologies. The RF simulation engine (ADSsim), component and model libraries (adsLib), and postsimulation analysis and display engines come from the Advanced Design System (ADS) platform. GoldenGate brings additional simulation capacity for "radio level" verification and manufacturability analysis. Both Technologies are the result of twenty years of innovation by Agilent EEsof EDA, a true leader in high-frequency design software.

Complete RF/Mixed-Signal IC Design Flow

RFDE and GoldenGate are part of a comprehensive RF/MS IC design flow which originates at design capture and flows seamlessly to prototype test. Designs initially are created in Cadence Virtuoso Schematic Composer. Circuits are then simulated in RFDE and GoldenGate directly from the schematic, enabling smooth transition from schematic capture to simulation. Advanced simulation options, including optimization, parameter sweeps, pre-configured measurements, and statistical analysis provide a "real-world" view of performance and yield. Simulation results are viewed using Agilent's rich set of data display capabilities.

After the IC layout is complete, extracted parasitics can be re-simulated and analyzed within GoldenGate. Additional parasitic and passive layout component modeling is performed using the ADS Momentum and Momentum RF simulators. Co-simulation with the Agilent Ptolemy system simulator (accessed through RFIC Dynamic Link) is used to verify that overall system behavior matches specification. Final prototype measurements, and additional circuit and device modeling, are performed with Agilent test equipment and IC-CAP software.

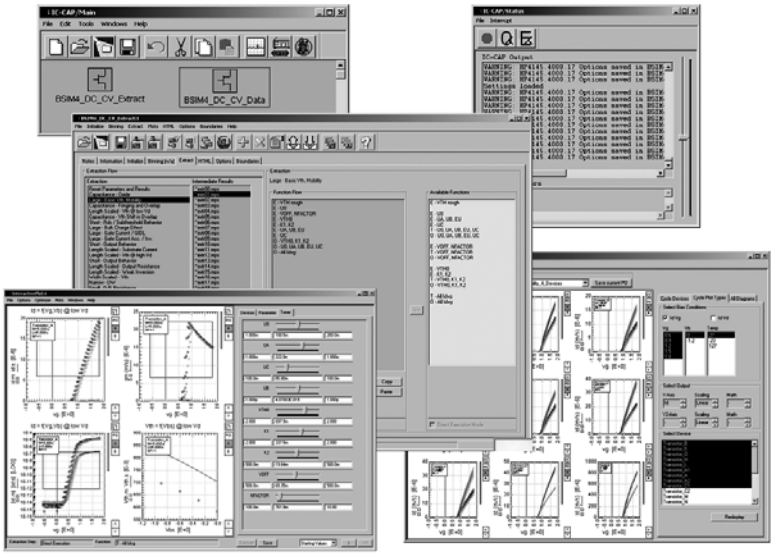
Training, Support, and Service – When and Where You Need It

Support for RFDE and GoldenGate is provided through Agilent's world-class, global technical support organization. Agilent's experienced application and technical support engineers are dedicated to addressing the special challenges of high frequency design. Product, application, training, and support information is also available 24 hours a day from Agilent EEsof EDA's up-to-date and comprehensive web site, **www.agilent.com/find/eesof-support**

Key Literature & Web Link

RF Design Environment: World-Class RF/Mixed-Signal IC Design Technology Integrated Into Your Design Flow (PDF, 3.1 MB).
8-page Color Brochure, p/n 5988-6931EN

http://eesof.tm.agilent.com/pdf/goldengate_11_2006.pdf
www.agilent.com/find/eesof-rfde
www.agilent.com/find/eesof-goldengate



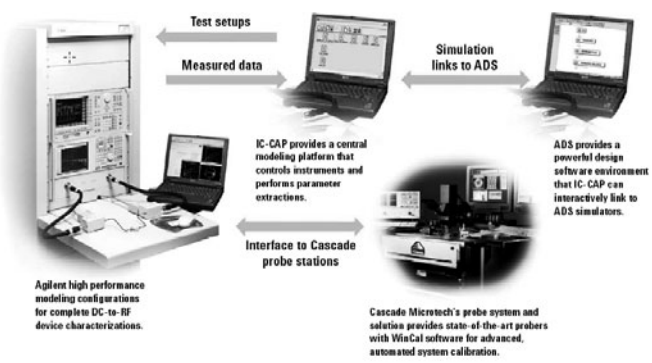
IC-CAP is a device modeling program that provides powerful characterization and analysis capabilities for all of today's semiconductor modeling processes.

IC-CAP offers device engineers and circuit designers state-of-the-art modeling software that performs numerous modeling functions including instrument control, data acquisition, graphical analysis, simulation, optimization, and statistical analysis.

All of these processes are combined into a flexible and intuitive Windows style software environment for efficient and accurate extraction of active device and circuit model parameters. IC-CAP also provides the power to build model libraries for Agilent EEsof's ADS and other simulators.

A Complete Device Modeling Solution

Successful device modeling requires thorough understanding of the complex integration between the measurement hardware and the modeling software. IC-CAP provides a complete set of tools for a fully integrated solution for device modeling engineers.



Measurement

IC-CAP software provides powerful modeling measurement capabilities including DC, LCRZ, CV, RF and 1/f noise measurements. To fully automate the measurement environment, these systems can be readily interfaced to wafer probers for a complete on-wafer solution.

Extraction Modules

The device modeling world comprises a wide variety of technologies, each having its own particular application focus. IC-CAP provides complete model extraction solutions along with convenient user interfaces and extraction methodologies.

IC-CAP actively supports the following modeling technologies:

- CMOS
- BJT
- HEMT
- Diode
- HBT
- FET
- Custom model developments
- 1/f Noise

The Most Efficient CMOS Modeling Solutions on a Single Platform

An efficient device modeling flow is the critical path to any foundry's success. Time, money, and customer share can be compromised if there are problems in this process.

IC-CAP is the first modeling tool to provide a comprehensive family of extraction solutions for all three Compact Modeling Council (CMC) standard CMOS device models, BSIM3, BSIM4 and PSP, on a single platform. IC-CAP's unified measurement approach allows data from one technology to be used for extraction in the next without having to take new measurements, assuming there are no additional measurements required. This single platform approach to CMOS modeling facilitates smooth, risk free transitions from one model technology to the next.

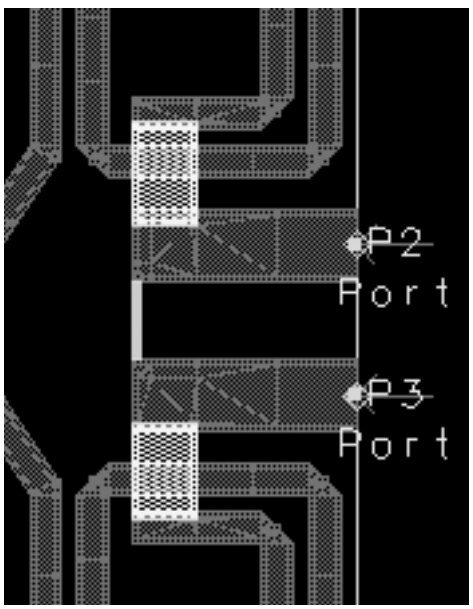
In addition to the advantage of a single platform, IC-CAP users save time and effort with an efficient, intelligent, direct extraction methodology. Dramatic reductions in extraction time can be experienced with the IC-CAP CMOS model extraction packages. The BSIM4 extraction package has demonstrated a 2 day model extraction that is accurate and physically based. This is significant reduction from the typical 14 day extraction.

Key Literature & Web Link

Agilent 85194K IC-CAP BSIM4 Modeling Package (PDF, 2.6 MB).
8-page Product Overview, 28 June 2005, p/n 5988-3983EN

www.agilent.com/find/eesof-iccap

- **Full wave EM solver accounts for full dispersion and radiation**
- **Quasi-static EM solver for faster modeling of larger circuits from DC to a half wavelength**
- **Fully-integrated with ADS Layout environment**
- **"Edge mesh" for improved behavioral characterization of current crowding in high frequency signals**
- **Adaptive frequency sampling (AFS) provides the greatest frequency sweep resolution with a minimal number of actual solved frequencies**
- **Available sidewalls simulation (waveguide mode) to model the effects of placing a circuit near a package sidewall**
- **Incorporates box resonance mode to model package effects and discover if box resonance occurs anywhere in the frequency range of interest**
- **Generates the DC operating point with S-parameters for circuit simulations that need bias flowing to an active device**
- **Fully automated EM design optimization with Momentum Optimization add-on**
- **3D visualization and current animation capabilities with Momentum Visualization add-on**



Momentum is a 3-D planar electromagnetic (EM) simulator used for passive circuit analysis. It accepts arbitrary design geometries (including multi-layer structures) and accurately simulates complex EM effects including coupling and parasitics. Accurate EM simulation enables RF/MMIC designers to improve passive circuit performance and increases confidence that the manufactured product will function as simulated.

Momentum RF is a second solver technology within the Momentum EM engine that reduces simulation time without sacrificing accuracy on large structures under a half wavelength. Because Momentum is an integrated component in the Advanced Design System (ADS) design flow, simulation setup times are reduced, and design productivity is increased.

Momentum is a 3-D planar electromagnetic (EM) simulator that enables RF and microwave designers to significantly expand the range and accuracy of their passive circuits and circuit models. The ability to analyze arbitrary shapes, on multiple layers and to consider real-world design geometries when simulating coupling and parasitic effects, makes Momentum an indispensable tool for customized passive circuit design.

Momentum works together with Advanced Design System (ADS) to compute S-, Y-, and Z-parameters of general planar circuits. Microstrip, stripline, slotline, coplanar waveguide, and other circuit topologies can be analyzed quickly and accurately with Momentum. Vias that connect one layer to another can also be simulated; enabling design engineers to more fully and accurately simulate multilayer RF/MMIC's, printed circuit boards, hybrids, and Multi-Chip Modules (MCMs).

When to Use Momentum 3-D Planar EM Simulator

Momentum 3-D planar EM modeling is especially valuable in the following design situations:

When Parasitic Coupling is Present. Even when circuit models are physically far apart, unexpected coupling can take place. Examples include stubs that seem sufficiently separated, but are actually inductively couple to each other because of a resonance condition, and surface waves that are bound to substrate interfaces and are excited when the right substrate parameters and frequencies are present. Momentum predicts the parasitic coupling and radiation.
When a Circuit Model Does Not Exist. Momentum should be used when a circuit model does not exist. For example, if a designer wants to analyze a microstrip Y-junction for which there is no model, Momentum is the solution.

When There are Slots in Ground Planes. Designers remove portions of ground planes for a variety of reasons, such as reducing the capacitance to ground of a spiral inductor, or to allow a via to pass through a ground plane. Momentum's ability to treat metal slots as easily as metal patterns is an added advantage. For example, Momentum performs efficient analysis of coplanar waveguide circuits.

When the Model Range is Exceeded. All circuit simulator models are developed with a number of range limited control parameters, (such as width, length, height, or dielectric constant). Some models break down gradually, while others generate significant errors as soon as the range limits are exceeded. Momentum allows designers to generate highly accurate models beyond these built-in range limits.

Configuration

Momentum Product Suites

E8920A Product Bundle offers Momentum full-wave and quasi-static modeling engines (Momentum E8921A) as well as Momentum Optimization E8925A, and Momentum Visualization E8925A. E8811A/8812A MMIC Designer Pro/Premier is a front-to-back design solution that incorporates EM modeling including Momentum full-wave and quasi-static modeling engines (Momentum E8921A) as well as Momentum Optimization E8925A, and Momentum Visualization E8925A.

Required
- **E8900A** Design Environment
- **E8901A** Data Display
- **E8902A** Layout

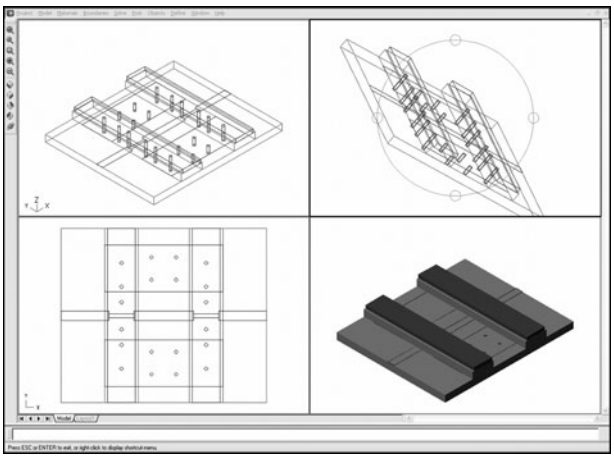
Add-On Modules
- **E8925A** Momentum Optimization
- **E8922A** Momentum Visualization

Key Literature & Web Link

Momentum (PDF, 4.0 MB)
12-page Color Product Overview, 20 November 2000, p/n 5968-1613E

www.agilent.com/find/eesof-momentum

Electromagnetic Design System (EMDS)



Electromagnetic Design System (EMDS) is a complete solution for electromagnetic simulation of arbitrarily-shaped, passive three-dimensional structures.

It makes full 3D EM simulation an attractive option for designers working with RF circuits, MMICs, PC boards, modules, and Signal Integrity applications. It provides the best price/performance, 3D EM simulator on the market, with a full 3D electromagnetic field solver, a modern solid modeling front-end, and fully automated meshing and convergence capabilities for modeling arbitrary 3D shapes such as connectors, machined parts, components, bond wires, antennas, and packages.

EMDS also comes with integration into Agilent's Advanced Design System (ADS), giving RF and microwave engineers access to the most comprehensive EM simulation tools in the industry.

Features

Electromagnetic Design System (EMDS) comes with a list of impressive features. These key technological enablers demonstrate the advantages of full 3D EM design and verification:

- Arbitrarily shaped 3D passive structures for generalized EM analysis
- Conductors, resistors, isotropic and anisotropic dielectrics, isotropic and anisotropic linear magnetic material modeling allow a wide range of application coverage
- An unlimited number of ports, which enables simulating multi-I/O design applications such as packages
- Electric and magnetic fields modeling, allowing visualization of EM fields in a design
- Absorbing boundary condition (free space), allowing antenna modeling
- Full-wave, EM-accuracy for first-pass design success
- Multi-Mode impedance and propagation constants that overcome single-mode modeling limitations in many other EM modeling tools
- Antenna parameters (gain, directivity, polarization, and so on), to allow better insight into antenna design
- An EMDS/ADS link, providing an integrated approach to EM/Circuit design

Application Areas

EM modeling tools are known for their great accuracy. Agilent Electromagnetic Design System (EMDS) redefines this term with broad application coverage, from machined waveguide components to micron-level circuits, including the following:

- Microstrip, stripline, CPW elements (filters, couplers, spiral inductors, via holes, air bridges, meander lines...)
- Multilayer structures
- Launches/transitions (coax-to-microstrip, microstrip-to-stripline)
- Ceramic filters
- Surface-mount components
- Waveguide filters
- Adapters/transitions
- Antennas
- Couplers
- Power splitters/combiners
- Connectors
- Mode converters
- Finline discontinuities

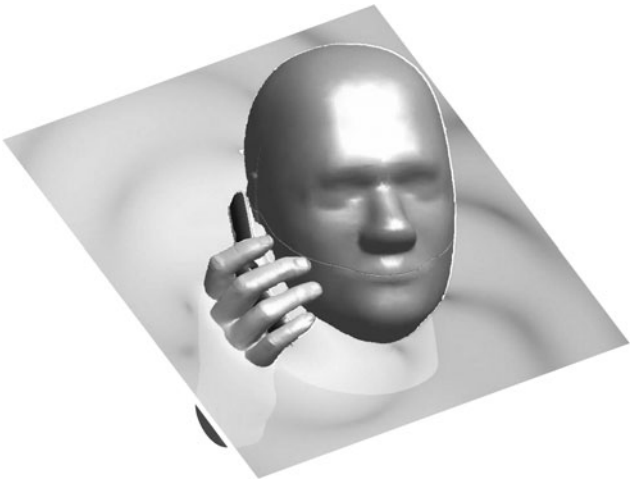
System Requirements

EMDS is available in single-user and network-licensed versions for PC platforms.

Key Literature & Web Link

Electromagnetic Design System (PDF, 1.0 MB).
4-page Technical Overview, 20 July 2006, p/n 5989-5340EN

http://eesof.tm.agilent.com/products/emds_main.html



A Dedicated 3D Electromagnetic Design, Modeling and Verification Tool for Antenna System and Placement

Wireless appliance designs face the challenges of fitting multi-band antennas into small stylish housings to entice consumers and yet have to comply with regulatory, operator and end-user demands for radiation safety and performance quality.

AMDS is the only 3D-EM antenna design tool specifically developed to enable antenna and product industrial designers to overcome these challenges. It efficiently imports, meshes and simulates the entire wireless appliance including its surrounding real-world environment to analyze compliance standards such as SAR (Specific Absorption Rate), HAC (Hearing Aid Compatibility), and MIMO (Multiple-Input, Multiple Output) antenna diversity. It cuts design cycle time and risks before going into slow and expensive physical testing.

Features

- Efficiently import CAD data from product designers and eliminates time-consuming EM modeling redefinition in subsequent design iterations between antenna and product designers
- Guarantee antenna performance against compliance standards such as Over-The-Air, SAR and HAC
- Optimize end-user product performance quality by analyzing MIMO and antenna diversity and by introducing real world proximity interaction of the human body into the antenna EM simulation

Ready for the Latest Acceleration Technology

- Multi-threaded Simulation Technology
- Graphical Processor Unit Acceleration

Bio-EM Capabilities

- SAR with 1- and 10-gram averages, whole body average, locate peak SARs
- Follows protocol of latest C95.3 standard, for the most up-to-date analysis
- Temperature rise in human body
- Specific Anthropomorphic Mannequin (SAM) head for SAR for meeting FCC specifications
- Manual/automatic partial volume SAR
- HAC Compliance

CAD Import/Export Formats Support the Most Popular Programs Available Today

- SAT Files
- STEP Files
- IGES Files
- Pro-E Files

Key Literature & Web Link

AMDS Brochure, p/n 5989-7192EN

www.agilent.com/find/eesof-amds


Ethernet (NDIS:Broadcom NetXtreme Gigabit Ethernet) - [Runn...
Go To Setup Window Help
100%
50%
0%
Health
128 MB
Trend (% Utilization)
20%
15%
10%
05%
00%
11:30
11:34
11:39
11:43
11:32
11:36
11:41
Triple Play Analyzer - [Video Media]
File View Help
No Store to File
239.001.016.001:8090
MPEG Stream
Avg PCR Jitter
Avg Throughput (bps)
Video Streams
2,607,231.25
18,698,019
239.001.016.001:809
936,089.69
8,298,028
239.001.016.003:809
845,696.88
239.001.014.001:809
6,039,907.50
VOD Streams
N3900A Modular Network Tester
Operator: Dieter Gustedt
Profile: Dieter Gustedt
Agilent Technologies
Multi FiberTest
Video Microscope
Instrument Config
Total Packet Count
Packet Count
Total Byte Count
55,596
5,479,158,668
55,596
5,478,958,260
55,372
5,499,369,044
55,372
5,499,306,628
9,462
1,224,841,808
9,462
1,224,825,264
29,143,395
55,596
35,018
67

8

WIRELINE COMMS TEST EQUIPMENT & NETWORK ASSURANCE SOLUTIONS

Agilent N2X

Multiservices Test Solution

N5555A

- **Unique Realism: Simultaneously test a wide variety of services across broadband access, carrier edge and IP/MPLS core**
- **Superior Scalability: Comprehensive protocol coverage to emulate the ultimate scale and complexity of network services**
- **Rapid Time to Insight: Powerful measurement and analysis tools to rapidly isolate problems anywhere in the network**

The Agilent N2X provides the ultimate solution for validating the performance and scalability characteristics of next-generation network equipment for voice, video and data (triple-play) services. N2X addresses the complex challenges of validating next generation equipment by providing a single test environment to simultaneously validate leading edge services over the latest infrastructures.

Network equipment manufacturers and service providers can gain unique insight into quality of experience (QoE) of each individual subscriber service under real-world conditions. N2X addresses the test challenges triple-play services impose across the IP/MPLS core, carrier edge and broadband-access networks, enabling a more complete characterization of service quality and the networking mechanisms required to deliver it. With the industry's most powerful integrated data and control plane test capability, N2X uniquely validates QoS mechanisms and high availability implementations. Using powerful emulation software, purpose built applications and industry-leading hardware test cards, users can test a broader range of test cases in much less time than ever before.

Triple Play Infrastructure Testing

Triple play services are driving significant change throughout the core, edge and broadband access networks. Access networks must deliver real-time services (IPTV, VoIP) which mandate multicast technologies at the edge, and a tighter tolerance of non-stop traffic forwarding under protection and restoration conditions in the core. Aggressive data services, such as peer-to-peer file-sharing applications, consume bandwidth and threaten the delivery of real-time services and business VPNs.

Manufacturers and service providers need powerful tools to optimize per-subscriber service quality under highly scaled and dynamic environments before they deploy their networks. The Agilent N2X enables realistic triple play testing with simultaneous voice, video, and hardware-based stateful TCP data on the same physical port, controlled through a single software application.

N2X: Industry-leading Solutions

Agilent continues to lead the industry with innovative and industry-first solutions for cutting edge technologies. From layer 2/3 MPLS VPNs, multicast, and high availability routing solutions through to access protocols, EPON, 40G, Carrier Ethernet, IPTV, voice and stateful data services testing, N2X continues to address the most complex service and infrastructure test challenges for today and tomorrow.

Specifications

The N2X system consists of a system controller and multiple chassis containing purpose built Test Cards for specific test requirements. The system controller provides a graphical user interface to drive applications running on the test cards.

System Controller

A number of system controllers are available depending upon your performance requirements. The controller provides an easy-to-use Windows environment.

N2X Chassis

The highly compact 4-slot chassis and 2-slot portable chassis are available for both development environment and in-field use. Hot-swappable test cards can be moved between chassis without affecting other test sessions.

N2X Test Cards

The N2X product architecture is based on programmable measurement test cards that offer best in class performance over a wide range of interfaces from 10/100 Ethernet through to OC-768c.

Accessories

E7912-80012 N2X 2-slot Chassis Hard Transit Case
E7900-80012 N2X 4-slot Chassis Hard Transit Case
E7900-64207 N2X Chassis to Chassis Cable
E7900-64208 N2X Rack-to-Rack Cable

Key Literature and Web Link

www.agilent.com/find/N2X

N5557A
N4192A

- **Broadest in industry range of application protocols over 100% standard compliant TCP/IP stack**
- **Integrated network access protocols and VLAN support**
- **100% Triple-Play ready – VoIP, VoD, IPTV and Internet Data on one interface**
- **Testing Under Load and Negative Testing**
- **Stateful and intelligent Capture/Replay**

The Agilent Network Tester is the most powerful and flexible solution for testing the real-world performance and stress resilience of network security and application-aware devices. Network Equipment Manufacturers, Service Providers and Network Operators use Network Tester to analyze application-aware device real-world performance characteristics under peak levels of load and stress expected in real network environments. This allows test engineers to confidently assess equipment's ability to perform without disrupting service or compromising quality of user experience.

Network Tester achieves unparalleled testing realism by using real Internet Data, VoIP, VoD and IPTV traffic in realistic protocol and transaction distributions combined with malicious attacks and exploits to subject the devices to complex traffic conditions indistinguishable from real-world network environments. Coupled with the ability to simulate proprietary protocols such as Peer-to-Peer, IM and On-line Gaming, Network Tester provides for the most comprehensive Layer 4-7 performance and stress resilience testing system on the market. Network Tester key application areas include network security, traffic management and content networking.

Typical devices-under-test include Firewalls; Intrusion Detection and Prevention Systems; Virus and Spam Filters; Content Switches and Servers; SSL Accelerators; Load Balancers and IPsec VPN Gateways. As security enforcement and other application aware features are integrated into Service/Edge Routers, B-RASs and IP DSLAMs, Network Tester provides perfect match to L4-7 performance and stress testing requirements of those network elements. Network Tester is specifically designed to test integrated devices where point test solutions fall short.

Specifications

The Network Tester system consists of a number of stackable Ethernet traffic modules, a system controller, a system management Ethernet switch, the NetPressure software application, and optional software licenses such as IPSec, IPv6, and VoIP.

Traffic Modules

Each traffic module has four test interfaces to connect Network Tester to the System Under Test (SUT), as well as one management interface. Two of the test interfaces are RJ-45 based Electrical Gigabit Ethernet. Two other test interfaces are SFP based and can be populated with any combination of Electrical or Optical Gigabit Ethernet SFPs. Multiple modules can be stacked to linearily increase system performance.

System Controller

A system controller runs the NetPressure software application. Portable and rackmount controller configurations are available to match your performance requirements. Rackmount controllers have remote access and multi-user capabilities.

Management Switch

The 10/100 Mb/s Ethernet system management switch interconnects the Ethernet management interfaces of the traffic modules and the system controller.

IPSec Software License

The IPSec software license fully integrates emulation of the IPSec into the NetPressure application, enabling rapid configuration of IPSec and powerful testing of stateful traffic over IPSec tunnels.

IPv6 Software License

The IPv6 software license adds integrated IPv6 emulation into the NetPressure application, enabling testing of next-generation devices that support both IPv4 and IPv6.

VoIP Software License

The VoIP Software License adds integrated VoIP emulation into the NetPressure application, enabling testing of devices such as application-aware firewalls, session border controllers and integrated security devices that support VoIP.

Key Literature and Web Link

www.agilent.com/find/networktester

Signaling Analyzer Real-Time

J7830A

Faster 3G deployment

- Graphical call visualization engine for rapid troubleshooting and problem isolation
- Expert analysis system to visualize statistics and key performance indicators with drill down into root cause identification
- Support of UMTS R99, R4, R5, R6, HSDPA & HSUPA, ATM & IP UTRAN, GSM, GPRS, EDGE, CDMAOne, CDMA2000, IMS, VoIP, SS7, vendor variants, etc

UTRAN Optimizer

- Supports 3GPP R5 & R6 high-speed packet access technologies. Delivers full support for analysis including call trace, statistics, decodes and reassembly of supported release 5 protocols and radio channels including HS-DSCH

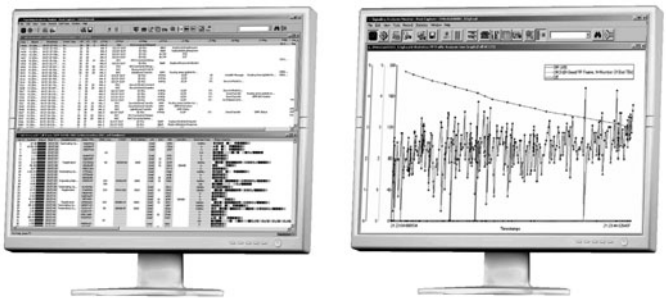
Lower cost of ownership

- Multi-user functionality enables high-performance multi-client analysis by several clients in a single solution. All clients have simultaneous yet fully independent access to measurements flowing through the same hardware platform without impacting or limiting performance of the overall system
- Multi-technology – the ability to trace calls in IMS, SS7, SS7/IP, 2G, 2.5G and 3G mobile networks, which simplifies resolution of the most complex interoperability problems in telephony

Leverage investment

- Running on the Agilent DNA, DNA PRO and DNA MX platforms to leverage the same hardware used for data analysis, which enables 7 layer analysis with the same test tool

DNA & DNA Pro



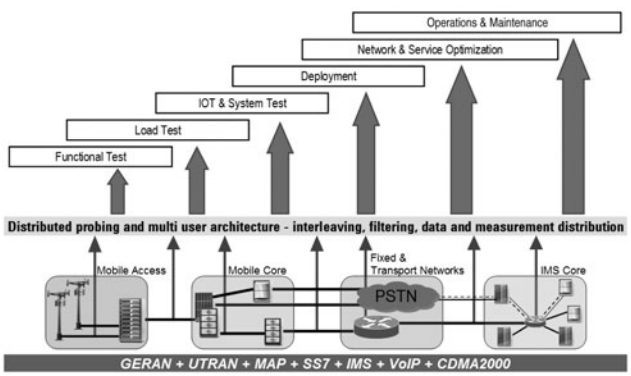
Signaling Analyzer Software Screenshots

Line Interface Modules

The Agilent J7830A Signaling Analyzer is a high-performance solution for 2G, 2.5G and 3G system verification, troubleshooting, and RAN optimization. Its intelligent call trace-centric approach enables distributed call trace, performance measurements, and drill-down problem isolation for calls on UMTS, GSM, and CDMA RANs, as well as the mobile core, IMS, PSTN and Internet.

The Signaling Analyzer solution allows complete testing of network and individual call performance across mobile networks which simplifies the resolution of the most complex interoperability problems in telephony.

The Signaling Analyzer has an intuitive graphical interface that makes it popular with both new and experienced network engineers. Its design makes it ideal for use in distributed as well as centralized text environments.



Specifications

For the most current information, please visit **www.agilent.com/find/sart**

Accessories

For the most current information, please visit **www.agilent.com/find/sart**

Key Literature & Web link

For the most current collateral, press releases and product information, please visit **www.agilent.com/find/sart**

Ordering Information

For the most current ordering information, please visit **www.agilent.com/find/sart**

- **Functional and performance verification**
- **System integration**
- **Equipment interoperability testing**
- **Troubleshooting and monitoring**
- **Network optimization**

J6801B
J6802B
J6803B

Testing today's complex network infrastructures can be a daunting task. The use of distributed configurations, wide and dynamic range of network protocols, and emerging triple play services all produce significant challenges.

Agilent DNA allows network professionals to quickly maintain and optimize Voice, Data, Video and Mobile services over Next Generation Networks decreasing operational cost by testing any technology, over any interface, from anywhere by anyone. Agilent's scaleable DNA hardware platform provides the foundation of advanced protocol analysis. Take advantage of extensive diagnostic capabilities for troubleshooting and optimizing voice, video, data networks, as well as 2G, 2.5G and 3G mobile networks.

The Agilent Distributed Network analyzer product family is a breakthrough in test and measurement technology, bringing together the testing of all access network technologies into a single product. This allows full and uniform testing of network and higher-supported lower-layer LAN or WAN technology. The system is designed for multiple operational modes of testing, including dispatched on-site testing, remote attended, remote unattended, and distributed testing. Time-synchronization of local and remote analyzers provides the means to deliver advanced quality of service measurements, essential for testing multiple-service networks.

Specifications

For the most current information, please visit
www.agilent.com/find/dna

Accessories

For the most current information, please visit
www.agilent.com/find/dna

Key Literature & Web Link

DNA Data Sheet, p/n 5988-4176EN
DNA Platform Technical Overview, p/n 5989-5455EN

For the most current literature, press releases and up-to-date product information, please visit: **www.agilent.com/find/dna**

Ordering Information

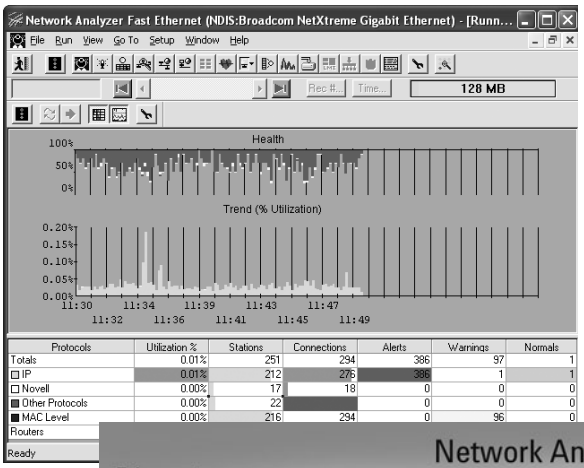
For the most current ordering information, please visit:
www.agilent.com/find/dna

Distributed Network Analyzer

Network Analyzer Software

J6840A

- **Agilent Network Analyzer software is one of the key software applications that runs on the scaleable Network Analysis and Troubleshooting Solutions platform. This platform provides the foundation of advanced protocol analysis**
- **It is the base software for controlling the Distributed Network Analyzer family of products**
- **It runs on PCs as a software analyzer, using off-the-shelf NDIS network interface cards (NICs) as measurement interfaces for LAN (10/100/1000 Mb/s Ethernet, token Ring and FDDI)**
- **It is the client software and GUI for accessing the J6835A Network Analyzer NDIS Server running on another PC**
- **It provides off-line analysis, allowing previously captured and saved LAN and WAN data from any Network Analyzer hardware platform, Agilent Advisor or NDIS-based NIC to be re-analyzed using the full features available on-line for captured data**



The Network Analyzer software allows network professionals to maintain and optimize voice, data, and video services quickly over next-generation networks, and to decrease operational costs by testing any technology, over any interface, from anywhere and by anyone.

The Network Analyzer software, in coordination with Distributed Network Analyzer hardware platform, provides an expert network testing and troubleshooting solution that supports real-time measurements in LAN, WAN, and ATM environments. In addition, this solution provides SNMP/RMON2 data collection and can be deployed so that network monitoring and troubleshooting activities can be coordinated from a single, centralized location.

The Network Analyzer software runs on a standalone PC or on the Distributed Network Analyzer platform.

Specifications

For the most current information, please visit
www.agilent.com/find/networkanalyzer

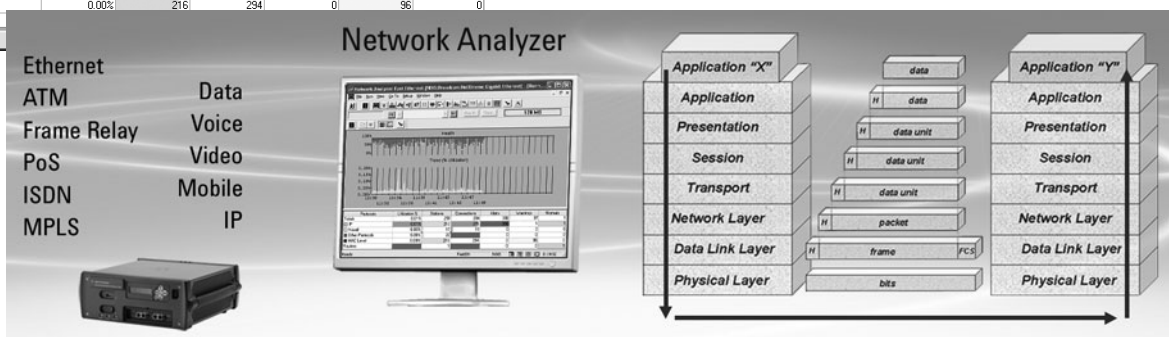
Accessories

For the most current information, please visit
www.agilent.com/find/networkanalyzer

Key Literature & Web Link

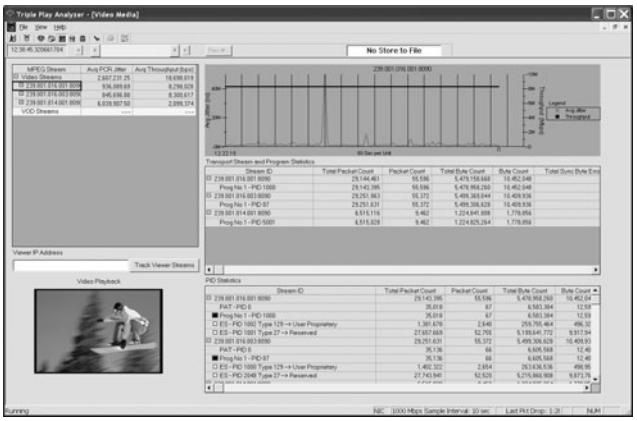
DNA Platform Technical Overview, p/n 5989-5455EN

For the most current collateral, press releases and product information, please visit **www.agilent.com/find/networkanalyzer**



J6900A

- **Extensive IPTV, MSTV, VoD, VoIP and data analysis in a single solution**
- **In-depth signaling and media analysis for IPTV, MSTV, VoD and VoIP**
- **Passive analysis and troubleshooting of user traffic in real time**
- **Analysis of channel zapping latency and VoD command response times**
- **Video and voice MOS, QoE with transmission layer analysis, including RFC4445 – MDI (Media Delivery Index) and ETSI TR101-290 analysis**
- **IPTV channels, VoD programs and voice calls statistics**



The Triple Play Analyzer is based on the successful Agilent DNA (Distributed Network Analyzer) platform and is the new addition to Agilent solutions for triple play analysis. The Agilent Triple Play Analyzer is the most complete in-service analysis and troubleshooting tool in a single solution for network equipment manufacturers and communication service providers, who develop, install, monitor and troubleshoot voice, data and video applications. The analyzer provides accurate measurements of VoIP, IPTV, MSTV and VoD Quality of Experience as well as channel zapping analysis. By providing the essential measurements and key performance indicators, the analyzer helps you realize faster time to market and decrease operational costs by passively testing any technology, over any interface, from anywhere and by anyone.

- Simplify Triple Play Test Complexity
- Reduce development and deployment time: Get ahead in the IPTV race

Specifications

For the most current information, please visit **www.agilent.com/find/tpa**

Accessories

For the most current information, please visit **www.agilent.com/find/tpa**

Key Literature & Web Link

Triple Play Analyzer Technical Overview, p/n 5989-5783EN

For the most current collateral, press releases and product information, please visit **www.agilent.com/find/tpa**

Ordering Information

For the most current information, please visit **www.agilent.com/find/tpa**

FrameScope™ Pro

Handheld Gigabit Ethernet Network and Service Quality Tester

N2620A

- **RFC 2544 network performance benchmarking**
- **Autotest application performance testing**
- **Triple Play transport quality and QoS testing**
- **Network discovery of stations and resources**
- **Remote control via any web browser**
- **Gigabit copper and fiber interfaces on board**

Quickly Diagnose and Troubleshoot Network Problems

With the FrameScope™ Pro, technicians deploying Ethernet based services and networks can rely on a fast, efficient and very cost effective test solution for measuring bandwidth at line rates up to 1 Gbit/s. FrameScope™ Pro connects via RJ45 interface to 10/100/1000 Mbit/s copper networks and via SFP (Small Form Factor Pluggable) interface to Gigabit fiber networks.

End-User Centric Quality of Service Testing

Using RFC 2544 test parameters, the FrameScope™ Pro is capable to measure network transport quality up to Gigabit line rate between any two points in an Ethernet-based network. Its unique network Autotest applies service quality scores to network resources such as DNS, DHCP, web, print, file servers and other automatically discovered services. Its voice and video over IP test functions accelerate the deployment of new services at high quality of experience, and help resolving troubleshooting tickets faster. A complete arsenal of test tools is included to locate failures and bottlenecks, ranging from a simple ping to more advanced functions such as traffic generator, statistics, SNMP queries, locate switch port and others.

Specifications

- Copper and SFP fiber interfaces
- Supported Protocols: IP, IPX, PPPoE, NetBIOS
- Autotest performance measurement of Email, Web, File, DNS, DHCP, WNS, Novell, Print, FTP, Primary DC, Secondary DC Servers, Switches and Routers
- Ping, Trace Route, and SNMP Queries verify device connectivity
- Statistical analysis of the network condition
- Traffic Generator up to 1 Gbit/s speed
- RFC 2544 tests for throughput, latency, back-to-back frames and frame loss measurement up to 1 Gbit/s
- Stacked VLAN support with configurable tags and priority fields
- QoS, IP TOS and DSCP settings are configurable
- Layer 2 (MAC) and 3 (IP) Loopback measurement of roundtrip delay
- Locate Switch Port
- Blink Hub Port locates live network cable connections
- Network Database stores station information
- Optional: Wiremap Test to locate miswires using the Wiremap Adapter
- Optional: Auxiliary Ethernet port for remote control over separate LAN

Test of SIP (RFC 3261) based VoIP Service (options N2620A-030, -03E)

- R-factor and MOS calculation (ITU-T G.107)
- Packet loss, packet inter-arrival jitter and round-trip delay
- STUN support (option N2620A-03E)

IPTV Service Test (option N2620A-071)

- RTP packet loss, packet statistics, packet inter-arrival jitter
- ETSI TR 101 290 MPEG-2 transport stream statistics
- IGMP join/leave latency, channel zapping time
- Media Delivery Index (MDI), average throughput

Memory

- 512 MB CompactFlash™ card included

Power

- Removable/Rechargeable Li-Ion battery
- Battery life: 5 to 8 hours of operation

Dimensions

- Size: 228 mm x 114 mm x 66 mm (9 in x 4.5 in x 2.6 in)
- Weight: 1.2 kg (2.5 lbs.)
- Display Dimensions: 60 mm x 160 mm (2.38 in x 6.25 in) touch-sensitive color LCD display

Ports

- RJ45 10/100/1000BASE-T Ethernet test port
- SFP interface for 1000BASE-SX or -LX 1 Gbit/s fiber connections
- Talkset Interface: 3.5 mm stereo jack
- Alternatively: RJ45 Wiremap test port or auxiliary 10/100BASE-T port

Accessories

N2620A-050 Multimode SFP Transceiver, 1000BASE-SX
N2620A-051 Single Mode SFP Transceiver, 1000BASE-LX
N2620A-053 Media Converter, 100BASE-FX
N2620A-060 Headset, 2 ear pieces, microphone and volume control (included in N2620A-003)
N2595A-096 Rechargeable Battery Pack
N2620A-080 Additional Universal AC Adapter
N2595A-094 Auto Lighter DC Adapter
N2605A-134 Hard Carrying Case

Key Literature & Web Link

FrameScope™ Pro Data Sheet, p/n 5989-1908EN

www.agilent.com/find/framescope

Ordering Information

N2620A-001 FrameScope™ Pro Ethernet with RFC 2544 Testing License
N2620A-003 FrameScope™ Pro without Additional Licenses

Software Licenses
N2620A-030 VoIP Testing (standard SIP stack)
N2620A-03E VoIP Testing (SIP stack with STUN support)
N2620A-031 RFC 2544 Testing (included in N2620A-001)
N2620A-071 IPTV – RTP Transport and MPEG-TS Analysis

Ports (must choose one)
N2620A-040 Wiremap Port (requires N2614A-001 Wiremap Adapter)
N2620A-041 Auxiliary 10/100 Mbit/s Port

N2640A
N2641A
N2642A
N2643A
N2644A
N2647xM
N2648A

- **Accelerated service deployment with lightning fast, automated LAN cabling and fiber certification**
- **Unique Alien Crosstalk measurement technique provides results on the instrument, without use of a PC**
- **Future proof 1 GHz frequency range exceeding Augmented Cat 6 and Class F limits**
- **DualRemote™ Pro unit operates fully unattended for workflow optimized dual-ended testing**
- **Dual-wavelength Fiber SmartProbes perform dual-wavelength measurements without swapping fibers**
- **Truly field portable with extreme battery life, Color LCD and easy touch screen user interface**

WireScope™ Pro – An Expandable Platform

WireScope™ Pro supports cable certification to TIA Categories 3 to 6 and 6A, and ISO Classes C through E, Class EA and Class F. Sweeping a full 1 GHz in a few seconds, it boosts Cat 6A and Class F autotest measurement times to industry leading speed, and provides a future proof platform. The WireScope™ Pro grows with its users' needs, offering a lower cost Category 6 product and supporting upgrades through software licenses later as needed.

Faster Measurement and Optimized Workflow

WireScope™ Pro has been designed for best user friendliness with a bright color 6" touchscreen that simplifies navigation through easy-to-read menus and comprehensive test results. User interactions have been optimized for a better workflow when testing LAN cable parameters. Once connected, the DualRemote Pro unit operates entirely remote controlled. Auto-continuous testing eliminates key clicks when certifying an entire bundle of cables, or a patchpanel. The validation of Alien Crosstalk for compliance with 10GBASE-T operation, a task that used to take hours, can now be completed in minutes. And finally, documenting the test results of an installation is a breeze with the ScopeData Pro software: clear, systematic measurement reports are easily generated for submission and approval.

Specifications

Supported frequency range: 1 MHz to 1000 MHz
TIA Level IV accuracy, compliance certified by ETL

Supported Tests
- Attenuation (Insertion Loss)
- Near End Crosstalk (NEXT, pair to pair and PowerSum)
- Equal Level Far End Crosstalk (ELFEXT)
- Return Loss and Loop Resistance
- Ambient noise versus frequency (optional)
- Wiremap, cable length, fiber length
- Total propagation delay and delay skew between pairs
- PSANEXT, PSAACRF (optional)
- Optical power and attenuation

Test Standards
- TIA/EIA-606-A and TIA/EIA-568-B Categories 3 through 6 and 6A
- ISO/IEC 11801, EN 50173 and Australia/New Zealand Classes C, D, E, EA and F
- UTP, STP, and SCTP cabling
- IEEE 802.3 10BASE-T, 100BASE-TX, 1000BASE-T, 10GBASE-T
- IEEE 802.5 Token Ring and IBM Type 1, TP and PMD interfaces
- Fiber TIA 568A, 568.3, ISO/IEC 11801
- 10BASE-FL, -FB, 100BASE-F, 1000BASE-SX, -LX
- ATM-155, -622, ATM/SONET OC-3, OC-12
- FDDI, FiberChannel-133, -266, -531, -1062

Power Supply
- Removable/Rechargeable Li-Ion batteries last a full work shift

Dimensions
- Size: 232 mm x 126 mm x 86.7 mm (9.1 in x 5 in x 3.4 in)
- Weight: approx. 1.36 kg (approx. 3.0 lbs.)

Memory
- 64 MByte internal flash memory, 16 MByte available
- 256 MByte USB Flash Drive included
- Semi-automated software upgrade using USB Flash Drive

Accessories

Recommended SmartProbes (set of two) and Accessories
N2644A-100 Cat 6A Universal Channel
N2644A-101 Cat 6A Universal Link
N2644A-104 Siemon Class F TERA Channel
N2644A-105 Siemon Class F TERA Link
N2644A-106 Nexans Class F Link
N2647MM Multimode Fiber SmartProbe
N2647SM Single Mode Fiber SmartProbe
N2643A-100 Cat 6A, Class EA/F, Alien Crosstalk and External (Ambient) Noise Measurement Software License
N2641A-134 Hard Carrying Case
N2641A-135 Rechargeable Battery Pack
N2595A-094 Auto Lighter DC Adapter
N2641A-080 Universal AC Adapter

Alien Crosstalk Test Kits
N2648A-100 Alien Crosstalk 1 Pair Stimulator Kit
N2648A-150 Alien Crosstalk 3 Pair Stimulator Kit
N2648A-200 Alien Crosstalk 6 Pair Stimulator Kit

Key Literature & Web Link

WireScope™ Pro Data Sheet, p/n 5989-5203EN

www.agilent.com/find/wirescope

Ordering Information

All WireScope™ Pro Product Kits contain:
WireScope™ Pro, DualRemote Pro, Software, (2) Category 6A Universal Channel SmartProbes, (2) Category 6A Universal Link SmartProbes, AC Power Adapters, Headsets, USB Flash Drive, Carrying Case, User's Guides, Accessories

Category 6 Test Kits
N2640A-100 WireScope™ Pro Cat 6 Certification Kit (Copper)
N2642A-130 WireScope™ Pro Cat 6 and MM Fiber
N2642A-140 WireScope™ Pro Cat 6 and SM Fiber
N2643A-150 WireScope™ Pro Cat 6, MM and SM Fiber

Category 6A, Class EA/F Test Kits
Cat 6A/Class EA/F Software License included, Class F SmartProbes not included
N2640A-200 WireScope™ Pro Cat 6A/Class EA/F (Copper)
N2642A-230 WireScope™ Pro Cat 6A/Class EA/F and MM Fiber
N2642A-240 WireScope™ Pro Cat 6A/Class EA/F and SM Fiber
N2643A-250 WireScope™ Pro Cat 6A/Class EA/F, MM and SM Fiber

Optical Time Domain Reflectometer

Fiber Installation, Commissioning and Maintenance

E6000C
E6020B
E60xxX

- **High dynamic range, up to 45 dB**
- **Fiber Break Locator to quickly find breaks and bends**
- **Locate and characterize splice and connector losses**
- **Multifiber testing for fast high-count cable qualification**
- **Perform power and loss measurement with the built-in light source and the power meter module**
- **Graphical representation of measurement results in event tables, showing loss and reflection, and pass/fail results**
- **Visual Fault Finder to check patch cords for light leakage**
- **New cost-effective FTTx OTDR for fiber-to-the-home or short distance fiber links**

The Mini-OTDR is designed to provide you with the fastest tool available for installing and commissioning multiple fiber links and locating faults for fiber maintenance. This is accomplished through high measurement performance and an award winning simple user interface.

The Agilent Mini OTDR family offers you the most advanced technology for portable equipment: measurements that are simultaneously fast, reliable and accurate, best trace resolution from the connector to the end of the link, 8 hours of battery operation and just 2.9 kg. It makes your work easier before you even switch it on.

Agilent's new E6020B FTTx OTDR is a cost-effective, easy to use solution for the installation and maintenance of access fiber networks, ideally suited to serve the needs of technicians who deploy fiber-to-the-home or short distance fiber links, such as enterprise networks or links to wireless base stations.

Built-in Applications

- OTDR expert mode
- Multi-fiber test
- Pass fail test and event table
- Optical return loss and end to end loss
- Traffic detection
- Fiber break locator
- OTDR wizard and auto-text for novice operators

Specifications

Minimum Sample Space: 4 cm
Pulse Width: 10 ns to 20 µs
Event Dead Zone: 3 m
Attenuation Dead Zone: 10/12/14 m at 1310/1550/1625 nm

Single Mode OTDR Modules

Wavelength	Deadzone	30 dB	35 dB	40 dB	43 dB	45 dB
1310/1550 nm	3 m	E6004A	E6003A	E6003B		E6008B
1310/1550 nm	1.5 m				E6003C	
1550/1625 nm	3 m				E6012A	
1310/1550/1625 nm	3 m			E6013A		

Multimode OTDR Modules

Wavelength	Deadzone	23 dB	35 dB
850/1300 nm	3 m		E6005A
850/1300 nm	3 m	E6009A	

Power Meter Submodule E6006A

Wavelength	Power Range
800 – 1650 nm	–70 dBm to +10 dBm

Visual Fault Locator Submodule E6007A

Wavelength	Distance Range
Red Visible Light (635 nm)	up to 5 km

Accessories

E6080A Spare NiMH Battery Pack
E6081A Mini-Keyboard
E6082A Hard Transit Case
E6092A OTDR Toolkit III Plus Trace Analysis & Acceptance Test Documentation Software
N3980A CompactFlash™ Card 192 MB
E6000-13601 OTDR Support CD

Key Literature & Web Link

E6000C Mini-OTDR Color Brochure, p/n 5988-2238EN
E6000C Mini-OTDR Technical Specifications, p/n 5988-2302EN

www.agilent.com/comms/otdr

Ordering Information

E6000C Mini-OTDR Mainframe
  E6000C-003 Color Screen VGA – LCD
E6003A 1310/1550 nm Standard Performance Single Mode Module
E6003B 1310/1550 nm High Performance Single Mode Module
E6003C 1310/1550 nm Very High Performance Single Mode Module
E6004A 1310/1550 nm Economy Single Mode Module
E6005A 850/1300 nm High Performance Multimode Module
E6006A Optical Power Meter Submodule
E6007A Visual Fault Finder Submodule
E6008B 1310/1550 nm Ultra High Performance Single Mode Module
E6009A 850/1300 nm Economy Multimode Module
E6012A 1550/1625 nm Ultra High Performance Single Mode Module
E6013A 1310/1550/1625 nm Very High Performance Single Mode Module
E6020B FTTx OTDR with Color Display and Visual Fault Finder Submodule
  E6020B-011 1310 nm Single-mode OTDR Module, 30 dB
  E6020B-012 1310 nm/1550 nm Single-mode OTDR Module, 30 dB
  E6020B-013 1310/1550 nm Single-mode OTDR Module, 30 dB and 850 nm/1300 nm Multimode OTDR Module, 23 dB

Note: the submodules E6006A and E6007A can not be inserted to the E6013A OTDR module.

- **Large, brilliant 10.4" color TFT display 800 x 600 pixels**
- **Only 3.3 kg (including battery pack)**
- **5 hours of continuous measurement, <3 hours charging time**
- **OTDR Mode**
- **Multi Fiber Test**
- **Accumulated optical return loss**
- **Accumulated end-to-end loss**
- **Loop Back fiber testing mode**
- **Build-in continuous wave source (CW)**
- **Pass/Fail Test**

The Agilent N3900A Modular Network Tester is a portable, lightweight, rugged test platform for the installation, commissioning and maintenance of optical networks. Developed from customer feedback from installation and maintenance (I&M) technicians worldwide, its modular design delivers the measurements you need, when you need them. Snap-on measurement modules meet your test requirements for today's communications networks; the modular platform protects your investment, and lets you grow into your future measurement needs.

The Modular Network Tester can hold up to three modules to perform OTDR measurements, chromatic dispersion, polarization mode dispersion or optical spectrum analysis. From the carrying case to the handles and tilt-stand, from the pop-up connector to your choice of interface, attention to detail and to your feedback provide the perfect fit for the way you work.

Each OTDR engine has built in RISC processing power for fast and accurate trace acquisition. For long haul links, use Agilent N3910AL (1310 & 1550 nm) and N3911AL (1550 & 1625 nm). For metro links, use Agilent N3914AL (1310, 1550 & 1625 nm).

The Agilent N3909A is a field PMD analyzer based on the "golden standard" Jones Matrix Eigenanalysis method. It helps to optimize revenues through fiber plant capacity and repeater distance optimization by minimizing the effects of PMD using the most robust PMD measurement available. The measurement result includes the DGD distribution over the transmission band and link loss over wavelength up to the L-band.

The Agilent N3916AL Chromatic Dispersion Analyzer comes with powerful built-in measurement algorithms that provide fiber type and accurate chromatic dispersion information. Access to just one fiber end is necessary. This engine combines the CD analyzer with the capabilities of a 4-Wavelength OTDR, measuring fiber loss test and chromatic dispersion in one go. For easy dispersion compensation planning, measurement are expressed in dispersion values and dispersion slope ratios as a function of the wavelength.

The Agilent N3935A Optical Spectrum Analyzer Engine is designed for use in systems with channel spacing down to 25 GHz. It covers the S, C, L bands and beyond. It is capable to resolve up to 256 simultaneous channels. Built-in test routines and applications include a channel planning tool, real time and averaged spectral analysis, automatic detection of missing and/or unexpected channels and pass/fail test for all parameters (OSNR, power, channel frequency and drift, total power).

Specifications

Single Mode OTDR Modules

Wavelength	40 dB	43 dB	45 dB
1310/1550 nm	N3910AM		N3910AL
1550/1625 nm		N3911AL	
1310/1550/1625 nm		N3914AL	
1310/1480/1550/1625 nm	N3916AL		

Minimum Sample Spacing: 4 cm
Pulse Width: selectable, from 10 ns to 20 µs
Event Dead Zone: 3 m (for all single mode modules)
Attenuation Dead Zone: 10 m @ 1310 nm/12 m @ 1550 nm, 14 m @ 1625 nm
Linearity: ±0.03 dB (1 – 100 km)

Chromatic Dispersion Analyzer Agilent N3916AL

Zero Dispersion Wavelength	Repeatability ±0.6 nm
Dispersion Coefficient	Accuracy ±0.5 ps/nm/km
	Repeatability ±0.05 ps/nm/km
Dispersion Range	±2500 ps/nm
Wavelength Range	1250 nm to 1700 nm

Polarization Mode Dispersion Analyzer Agilent N3909A

Wavelength Range	1525 nm to 1620 nm
Wavelength Resolution	50 pm
DGD Range	0 ps to 150 ps
PMD Range	0 ps to 50 ps
PMD Accuracy	±(0.03 ps + 2% of PMD)
Link Loss Accuracy	±0.4 dB

Optical Spectrum Analyzer Engine Agilent N3935A

Wavelength Range	1450 nm to 1650 nm
Dynamic Range	45 dBc @ 100 GHz and 40 dBc @ 50 GHz
Resolution Bandwidth (FWHM)	≤100 pm
Scanning Resolution	0.005 nm
PDL	± 0.05 dB
Wavelength Accuracy	±40 pm
Power Noise Level	–70 dBm

Accessories

N3980A CompactFlash™ Card 192 MB
N3985A Battery Lilon
N3993A Hard Carrying Case for Modular Network Tester, Modules and Accessories
E6081A Mini-Keyboard
E6092A OTDR Toolkit III Plus Trace Analysis & Acceptance Test Documentation Software

Key Literature & Web Link

Agilent N3900A Modular Network Tester Brochure, p/n 5988-5065EN
Agilent N3900A Modular Network Tester Technical Specifications, p/n 5988-8190EN

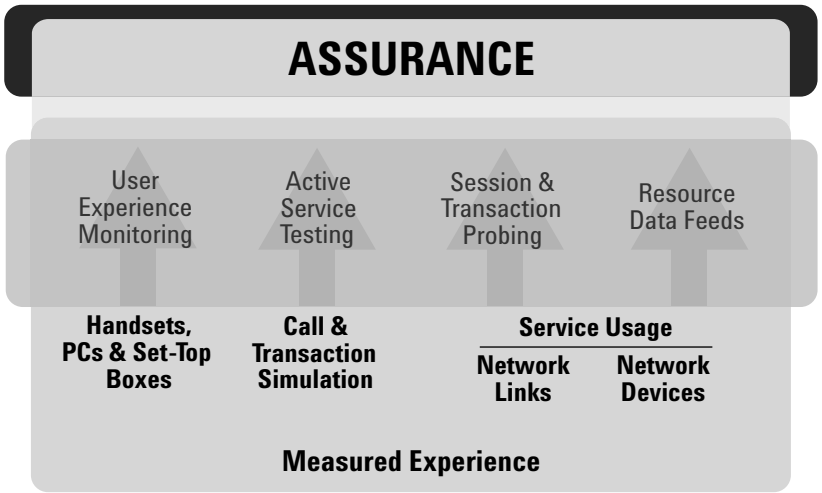
www.agilent.com/comms/mnt

Ordering Information

N3900A Agilent Modular Network Tester Mainframe
N3910AM OTDR Test Engine 1310/1550 nm 40/39 dB
N3910AL OTDR Test Engine 1310/1550 nm 45/43 dB
N3911AL OTDR Test Engine 1550/1625 nm 43/39 dB
N3914AL OTDR Test Engine 1310/1550/1625 nm 43/41/38 dB
N3909A Polarization Mode Dispersion Test Solution, includes N3909AR Polarization Mode Dispersion Receiver Module, 81944A Compact Tunable Laser Source, 8163B Lightwave Multimeter
N3916AL CD/OTDR Test Engine 1310/1480/1550/1625 nm 43/40/41/38 dB
N3935A Optical Spectrum Analyzer Test Engine

N3900A
N3909A
N391xXX
N3916AL
N3935A

Understanding the Customer Experience



In today's hotly competitive communications markets, it's not enough to simply win new customers. To protect your revenue base and grow your business, you have to also win your customers' loyalty – day after day.

How do you do that? Provide a consistently great customer experience. Agilent assureME solutions help you make this happen. The assureME portfolio puts a customer-centric focus on traditional network assurance. It broadens the management scope to encompass measurement of the actual customer experience, as well as network faults and performance issues.

To enable this customer-centric approach, the assureME portfolio combines new, ground-breaking technologies with Agilent's existing industry-leading management products to address critical challenges for service providers. By measuring the actual customer experience, you gain the insights you need to deliver a consistently great customer experience and keep your revenue growing.

Measure the Actual Experience

Agilent assureME solutions vault you ahead of today's common network monitoring products, which can't get to the heart of the customer experience. Some do little more than provide information on the status of network elements, so all you can do is make educated guesses about the customer experience.

In today's competitive markets, guesses aren't good enough. To deliver a consistently great customer experience, you need precise measurements based on continuous data collection and non-stop testing of services, networks and user experiences. Customer assurance is becoming increasingly important in marketing, customer care and service management operations, as well as network operations.

Solutions in the assureME portfolio draw on Agilent's unique ability to collect and analyze information from a broad spectrum of sources to enable end-to-end customer assurance management. These comprehensive solutions give you new insights into service quality for individual customers, groups of customers or customer categories. They help you to understand not only the quality of service delivered to the customer, but also how network and service information relates to each customer. This information is important to network operations teams that keep networks and services running smoothly, helping them to prioritize repairs based on customer impact.

Exploit the Power of 3

Agilent assureME solutions deliver a unique set of tools for service assurance across 3 key process areas: monitoring, troubleshooting and intelligence. The solutions in the assureME family help you correlate the actual customer experience with network performance – in real-time – for root-cause analysis and analytics.

The assureME family arms you with the Power of 3: Alarms in 3 minutes. Troubleshooting in 3 clicks. Intelligence across 3 dimensions: customer, service and network. You can now spend less time wondering what's happening out there and more time enhancing the customer experience. That's the Power of 3.

Agilent assureME Monitor : Detect violations within 3 minutes

Agilent assureME Monitor provides real-time monitoring of KPIs providing the insight required to enable you to proactively maintain service levels. In addition to highlighting anomalies these advanced surveillance tools, provide you with alarms when pre-defined thresholds are violated in less than 3 minutes.

Agilent assureME Troubleshoot : Identify the root cause in 3 clicks

Agilent assureME Troubleshoot arms you with a consistent, efficient solution for fast troubleshooting across technologies – at both the session and protocol levels. These tools get you to the root cause of many network and service problems in just 3 clicks, saving you time and money.

Agilent assureME Intelligence : Capture insight across 3 dimensions

Agilent assureME Intelligence provides historical analysis and insight into performance and quality issues across 3 key dimensions of your business: networks, services and customers. These tools help you identify usage trends, understand complex service issues and utilize the KPIs you need to deliver a better customer experience.

Agilent Assurance Solutions for Communications

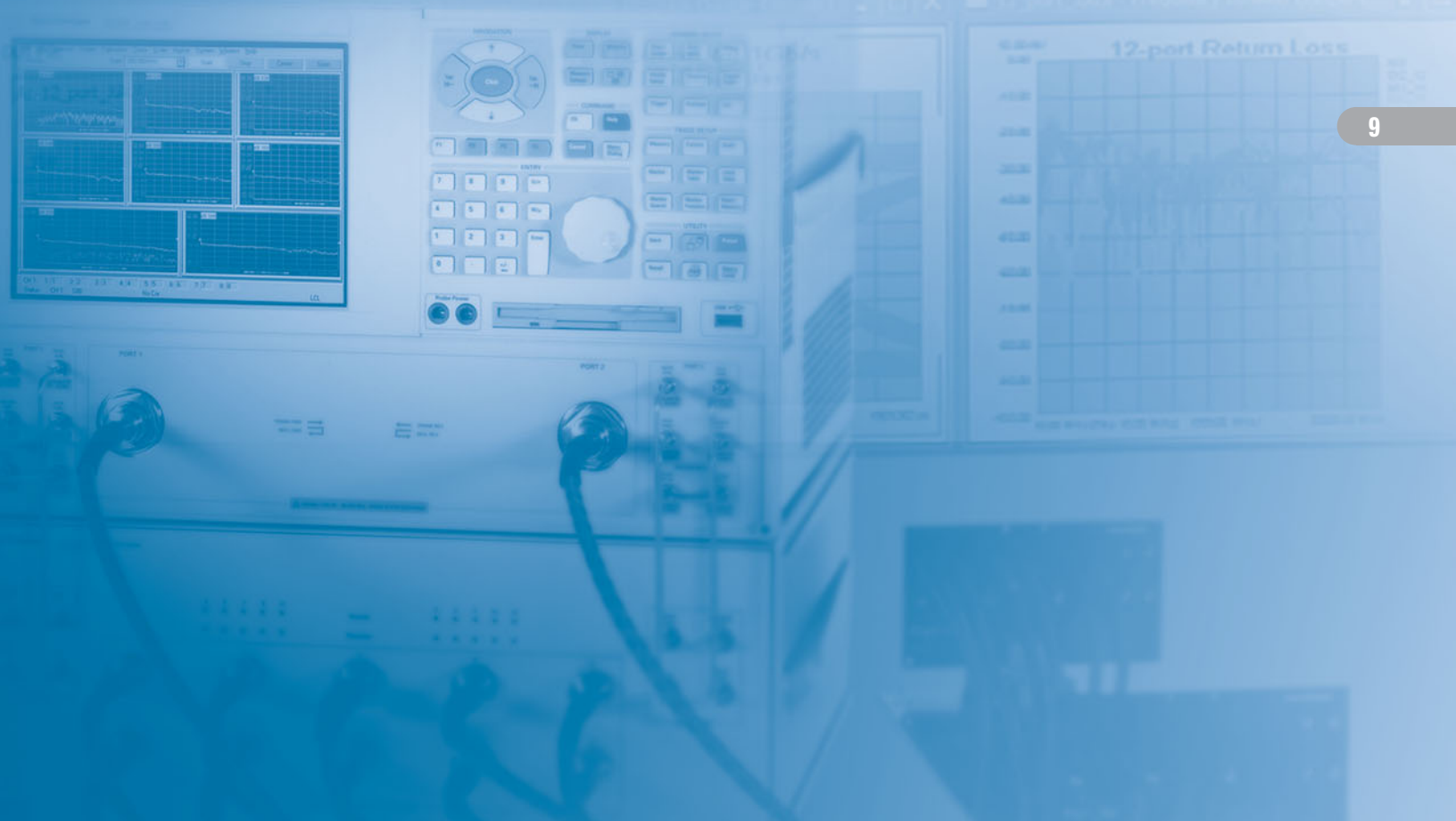
The assureME solutions are based on the technology in Agilent's broad family of customer assurance solutions. The offerings in the Agilent portfolio enable you to get new services to market quickly, improve quality of service and reduce the cost of operations. Our open, modular solutions support both current and next-generation network architectures, by improving levels of performance and reducing fault resolution times.

Collectively, Agilent assurance solutions help network operations teams keep networks and services running smoothly and provide business-critical information to the customer care, marketing, planning and corporate sales groups tasked with customer retention, value-added services upselling and new services rollout.

To learn more about assureME solutions, visit:
www.agilent.com/comms/assureME

9

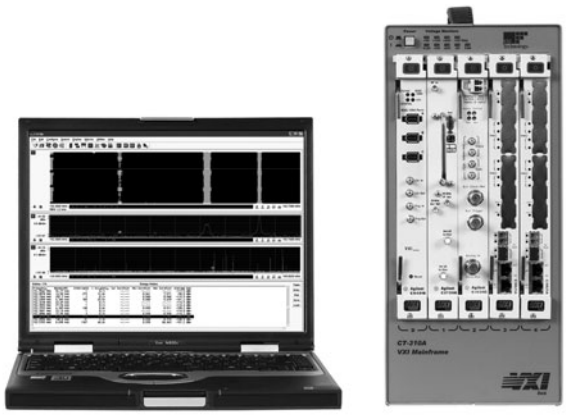
SIGNAL MONITORING, PHASE NOISE, MATERIALS, PHYSICAL LAYER TEST SYSTEMS



Signal Monitoring System, 20 MHz to 6 GHz, or up to 26.5 GHz

E3238S/
N6820E

- **Extremely fast wideband search and high resolution**
- **Available in three frequency ranges: 20 MHz to 2.6 GHz, 20 MHz to 6 GHz, 100 kHz to 26.5 GHz**
- **Optimized signal detection tools provide data only on signals of interest**
- **New-energy database simplifies cataloging spectrum survey results**
- **Ability to record time and frequency snapshots to memory**
- **Re-configure signal detection without programming**
- **Optional narrowband signal processing using low-cost digital downconverter channels**
- **Ability to record time and frequency snapshots to memory**



Monitoring the RF spectrum requires extremely high speed RF search and high resolution. The faster a system can monitor a wide spectrum, the more likely you will see short-duration signals. A system with high resolution can find signals of interest near to other larger signals and low level signals close to the noise floor. Swept spectrum analyzers only provide speed or resolution because of resolution bandwidth (RBW) filter settling time limitations. The E3238S/N6820E Signal Survey System provides speed and resolution. It scans the spectrum more than 100 times faster that conventional swept spectrum analyzers at the same resolution bandwidth. This RF spectral monitoring solution is an optimized system with good LO Settling time, proper IF and digitizer Bandwidth and embedded signal processing.

The E3238S/N6820E with its high speed search to find short duration signals along with high resolution to dig out hidden signals will generate hundreds of thousands of data points per second. Only a few of these data points are of interest. The E3238S/N6820E provides tools to reduce the collected data to information from the few critical transmissions present. Typically, you do not want the entire spectral data. Signal detection tools are required to reduce the spectral search data to information on the signals of interest. Once the signals are identified, they should be collected and recorded for later analysis.

The E3238S/N6820E supports integration into a complete signal monitoring solution with handoff receivers, direction finding subsystems and antenna switching. This system allows developers to create their own drivers, customize the user interface, and easily interface with other applications.

Key Literature & Web link

E3238S/N6820E Product Overview, p/n 5989-2836EN
E3238S/N6820E Product Tour DVD, p/n 5989-2838EN
E3238S/N6820E Configuration, Performance and Reference Guide, p/n 5989-2837EN

Ordering Information

E3238S-030/031 Tuner/Downconverter, 20 MHz – 2.6 GHz or 6 GHz
E3238S-040 Cable Kit for PSA as Tuner
E1439D 70 MHz IF ADC with Filters and Memory for E3238 Systems
E1439D-001 1.2 GB Total RAM
N6820E Signal Survey Software
- **N6820E-103** Standard Software for Windows
- **N6820E-1RU** One-year Software Update Service
- **N6820E-NBR** Narrowband Recorder
- **N6820E-AU1** Audio Output
- **N6820E-USD** Universal Signal Detection
- **N6820E-MR1** Standard Modulation Recognition Application
- **N6820E-ASD** Host User Programming Libraries and Documentation

N6829B Audio Player Software

E5500 Series Phase Noise Measurement Solutions, 50 kHz to 26.5 GHz

- **50 kHz to 26.5 GHz with expanded carrier frequencies to 110 GHz**
- **Quick and easy integration into ATE test systems**
- **Ability to test a wide range of devices**
- **Measure AM noise directly**

The E5500 Series solutions use the power of a flexible software program to automate phase noise carrier measurements. The E5505A Series includes the N5500A phase noise test set, a Pentium PC running Windows XP, a PC digitizer, an optional RF spectrum analyzer, selected low noise frequency downconverters and measurement software.

Specifications

E5505A
Carrier Frequency Ranges
50 kHz to 1.6 GHz
50 kHz to 6.6 GHz
50 kHz to 18 GHz
50 kHz to 26.5 GHz

Frequency Offset Range
0.01 Hz to 100 MHz

System Noise Response
–180 dBc/Hz typically (>10 kHz offsets)

System Spurious Response
–120 dBc typically

E5500A-Series Optional Capabilities
Add RF reference source
Add high power input capability (includes uWave phase and AM detectors)
Extended carrier frequency to 110 GHz
Add SCPI remote programming client

Key Literature & Web Link

www.agilent.com/find/phasenoise
E5500 Series product overview, p/n 5965-7590E

Ordering Information

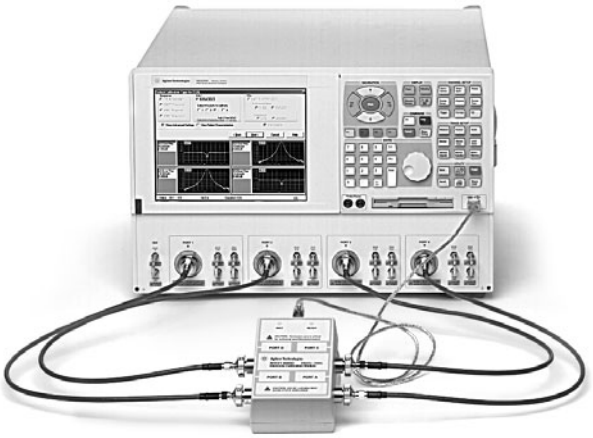
See the E5500 Series configuration guide 5965-7589E

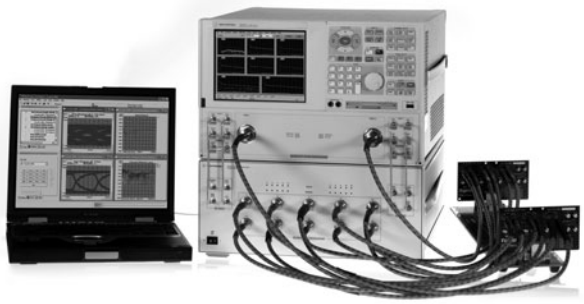
Physical Layer Test System

Physical Layer Test System (PLTS version 4.0)

N1930B
N1955B
N1957B
N1958B

- **Gain unique multi-domain insight into device performance by using 4-port VNA or 4-channel TDR**
- **Completely characterize the single-ended, differential and mixed mode behavior of your high speed digital interconnect**
- **Export measurement-based models to industry leading simulators for faster design cycle**





Confidence Based on Accurate Model Extraction and Complete Characterization

The Agilent N1930B series physical-layer test system (PLTS) is the premier signal-integrity solution for designing and validating high-speed digital interconnects. PLTS combines frequency-domain, time-domain and eye-diagram analysis to provide a comprehensive view of device performance. Measurement-based model extraction provides the most accurate models of components, such as printed circuit boards, connectors, backplanes, IC packages, cables and flexible interconnects. Now you can validate interconnect performance of high-speed standards such as Advanced Telecommunications Architecture (ATCA), PCI Express II, Serial Advanced Technology Attachment (SATA), Infiniband, High Density Multimedia Interface (HDMI), Rapid IO and others.

The PLTS utilizes a four-port vector network analyzer (VNA) or four-channel Time Domain Reflectometer (TDR) with an external PC running a unique signal integrity software analysis tool. This enables the most accurate and comprehensive solution for complete characterization of your high-speed interconnects. With a single setup to your device under test (DUT), you can measure all transmission and reflection terms in both frequency and time domain in all possible modes of operation, including single-ended, differential, common and mixed modes. In addition, the use of co-axial electronic calibration modules reduce the amount of time required for test system calibration by a factor of 30.

PLTS version 4.0

PLTS version 4.0 software extends the capabilities of today's demanding signal integrity applications:

- 12-port VNA implementation for multiple aggressor differential crosstalk analysis
- Advanced file import for building .s12p files from .s4p files quickly
- Low-cost analysis package for post-measurement characterization of interconnects
- Display improvements for 16 traces and 9 markers per plot

The advanced features of PLTS v4.0 support the needs of high speed digital applications exceeding 10 Gb/s serial data rates. As backplane channels increase in transmission rate and density on printed circuit boards, crosstalk must be minimized to reduce bit error ratio. Measuring 3 differential channels at one time requires a 12-port test system and the ability to manage 144 S-parameters, a task easily accomplished with PLTS v4.0.

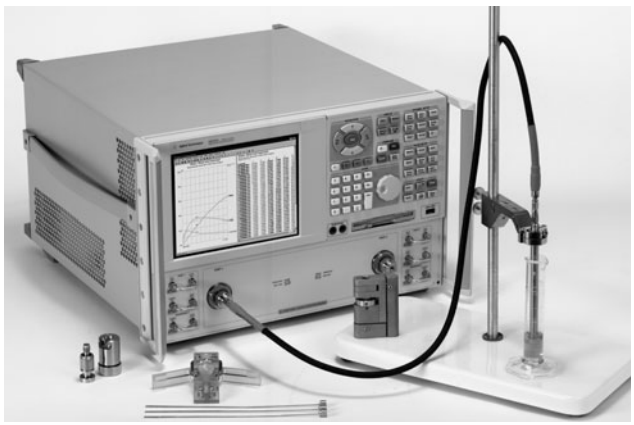
Rather than writing custom script to build .s12p files, PLTS can now automatically populate the S-parameter matrix with a simple-to-use graphical interface. Viewing up to 16 traces per plot can simplify comparisons between multiple channels at one time. Viewing all 12 single-ended insertion loss waveforms simultaneously can shorten the time required to troubleshoot problematic printed circuit boards. In addition, having extra markers makes compliance report generation easy and fast.

If S-parameter measurements or Touchstone models are already available, then a less expensive solution is now available. By using the "analysis only" package of PLTS v4.0, these files types can be imported and all analysis features can be used for multi-domain correlation. The typical cost of this new reader package is approximately half of the standard PLTS configuration. Whatever passive interconnect characterization is required, the PLTS software is the premier solution for signal integrity analysis.

Selection Guide for Agilent N1930B Series Physical-Layer Test Systems

Product	N1930A	N1955B	N1957B	N1958B
Description	Physical-layer test system software that controls the system and provides advanced data analysis tools	E8363B PNA and N4420B Test Set 4-Port/4-Receiver	E8364B PNA and N4421B Test Set 4-Port/4-Receiver	N5230A PNA-L with built-in Test Set (pictured above)
Frequency Range		10 MHz to 40 GHz	10 MHz to 50 GHz	300 KHz to 20 GHz
Rise Time		18 pS	14 pS	35 pS

- **Measure dielectric properties**
- **Display results as e′, e″, loss tangent, and Cole-Cole**
- **Frequency range from 10 MHz to 50 GHz**



85070E Dielectric Probe Kit

With Agilent Technologies 85070E dielectric probe kit, simply immerse the probe into liquids or semi-solids. Measurements are non-destructive and can be made in real time. The complete system is based on a network or impedance analyzer, which measures the material's response to RF or microwave energy. Depending on the Agilent analyzer and probe used, frequencies can extend from 10 MHz to 50 GHz. The included software controls the analyzer and guides the user through easy calibration and measurement steps. In seconds, it calculates and displays complex permittivity in a variety of formats, including dielectric constant, dielectric loss factor, loss tangent or Cole-Cole. Data is easily shared with other Windows-based programs or through the user programmable Component Object Model (COM) Interface.

High Temperature Probe

Withstands corrosive chemicals and high temperatures:

- Frequency range: 200 MHz to 20 GHz using a microwave network analyzer; 10 MHz to 3 GHz using an N4991A RF impedance/ material analyzer
- 3.5 mm male connector

Rugged in design, this probe features a hermetic glass-to-metal seal, which makes it resistant to corrosive or abrasive chemicals. The probe withstands a wide –40°C to +200°C temperature range. The large flange allows measurements of flat-surfaced solid materials, in addition to liquids and semi-solids.

Slim Form Probe

Low cost and Consumable. The smaller diameter fits into tight spaces:

- Frequency range 500 MHz to 50 GHz
- 2.4 mm male connector

This probe features a slim low-cost, super design. It is best used for liquids and soft semi-solids. Because of the consumable nature of this design, these probes are offered in sets of three. The slim-form-probe kit comes with a sealed slim-form holder that allows the 2.2 mm probes to be held in the standard 10 mm mounting bracket, as well as in commercially available "Midi"-sized adapters and bushings.

Performance Probe

Combines rugged, high temperature, and frequency performance in a slim design:

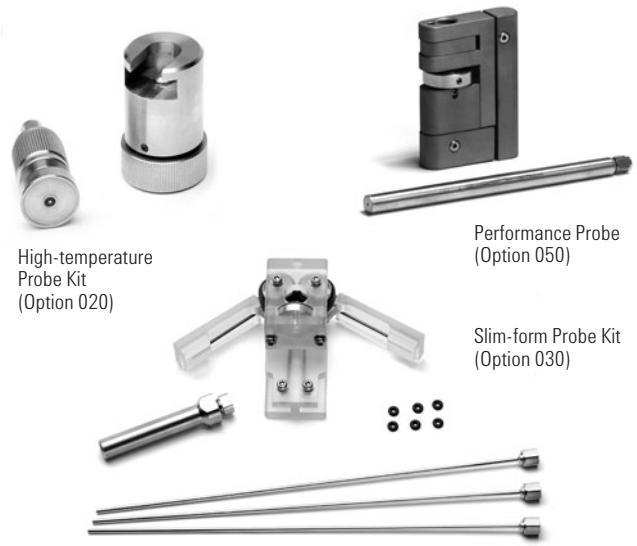
- Frequency range 500 MHz to 50 GHz
- 2.4 mm male connector

This probe features rugged, high temperature and frequency performance in a slim design, perfect for your most demanding applications. The probe is sealed on both the probe tip and the connector end, which make it our most rugged probe, and suitable for autoclaving. The probe withstands –40°C to +200°C temperature range.

Ordering Information

85070E
85071E

85070E Dielectric Probe Kit
Includes:
Dielectric probe software application on CD-Rom
Mounting bracket to connect probe to Option 001 probe stand or similar stand
ECal holder to connect ECal module to mounting bracket
Type-N-female-to-3.5-mm-male adapter, 1250-1743
3.5-mm-male-to-2.4-mm-female adapter, 11901D
Foam-lined walnut box



85070E-020 High Temperature Probe Kit
Includes one high-temperature probe and one calibration short

85070E-030 Slim Form Probe Kit
Includes three slim-form probes, one calibration short, one 10 mm diameter sealed-probe holder, and six O-rings, and 1 connector saver

85070E-033 Slim Form Probe Replenishment Kit
Contains three extra slim-form probes

85050-050 Performance Probe
Includes one performance probe and one calibration short

Cables – Choose any or all of the following optional cables:
85070E-002 High-temperature cable
85070E-022 20 GHz flexible cable
85070E-032 50 GHz flexible cable

Probe Stand – Optional, but Highly Recommended
85070E-001 probe stand

Security Key – Must choose one of the following:
85070E-UL7 Parallel security key (required for Windows NT)
85070E-UL8 USB security key

Software Upgrade
85070EU-070 Upgrade software from any previous version

PC Requirements
Windows 98, 2000, ME, XP, or Windows NT 4.0*

CD-ROM drive to load software

Software can be run directly on the PNA network analyzer, or on an external PC with a LAN connection to the PNA

All other network analyzers require a PC with a GPIB interface card with a compatible driver (Agilent SICL or National Instruments 488.2M)

Compatible Analyzers
N4991A, 8712/14/ET/ES, 8753ET/ES, 8719/20/22ET/ES, 8510C, all PNA Series, all ENA Series

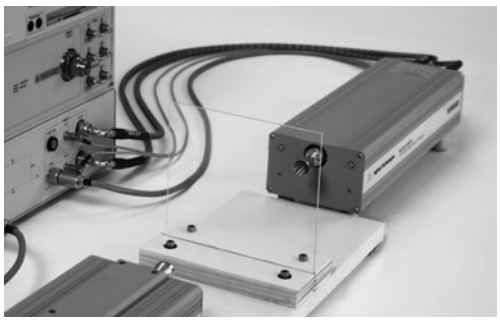
Key Literature

85070E Technical Overview, p/n 5989-0222EN

* Windows NT 4.0 requires Option UL7 parallel-security key

85070E
85071E
85072A

- **Measure dielectric and magnetic properties of liquids and solids**
- **Display results as e', e", u', u", loss tangent, and Cole-Cole**
- **Frequency range to 325 GHz**



85071E Materials Measurement Software

The Agilent 85071E materials measurement software converts S-parameter network analyzer measurements to complex permittivity and permeability. It's friendly graphical user interface sets up the measurements and displays results in seconds. Results can be charted in a variety of formats: er', er", tan delta, µr', µr", tan µm, and Cole-Cole. Data is easily shared with other Windows-based programs or through the user-programmable Component Object Model (COM) interface. A variety of measurement methods and mathematical models are provided to meet most application needs. Free-space calibration and arch-reflectivity options increase ease and reduce costs for free-space measurements. New resonant cavity option provides support for several resonant cavity fixtures.

Measurement Methods

Transmission-line Method

Coaxial airlines or rectangular waveguide transmission lines are used as sample holders. The transmission-line method works best for materials that can be precisely machined to fit inside the sample holder. The 85071E features an algorithm that corrects for the effects of air gap between the sample and holder, considerably reducing the largest source of error with the transmission line technique.

Free-space Method

Materials are placed between antennas for a non-contacting measurement. The free space method works best for large, flat, solid materials, but granular and powdered materials can also measured in a fixture. It is very useful for many applications such as nondestructive testing, measuring materials that must be heated to very high temperatures, or measuring a large area of material that is non-homogenous.

The gated-reflect-line (GRL) calibration technique converts a coaxial/waveguide 2-port calibration into a full 2-port free-space calibration. Accurate free-space measurements are now possible without expensive spot-focusing antennas, micro-positioned fixtures, or direct-receiver access.

New arch-reflectivity software is available to automate NRL arch measurements. The program guides the user through the setup, calibration, and measurement of material absorption. The software offers the same easy-to-use graphical user interface.

Resonant Cavity Method

Choose the Resonant Cavity method, for thin films, substrate materials, and other low loss materials. The resonant cavity method uses a network analyzer to measure resonant frequency and Q of a resonant cavity fixture, first empty and then loaded with the sample under test. Permittivity can then be calculated from these measurements, knowing the volume of the sample, and some other parameters about the resonant cavity. Because it is a resonant method, only one frequency point is reported. However, it is much more sensitive and has better resolution than broadband techniques. Agilent's Resonant Cavity software supports a variety of resonant techniques: ASTM, split post dielectric resonator, and the new Agilent 85072A split cylinder resonator.

New! 85072A 10 GHz Split Cylinder Resonator

Part of the complete turn-key solution for IPC test method TM-650 2.5.5.13. Agilent Technologies 85072A Split Cylinder Resonator is specifically designed to measure relative permittivity and loss tangent of thin film, un-clad substrate and low loss sheet materials.

The cylinders are diamond turned for the best possible surface finish and then kinematic mounted for precise, rigid alignment. These features allow for a high Q cavity and the best loss tangent resolution. The side mounting of the cylinders allows for large samples to be measured. An integrated digital micrometer measures the sample thickness at the time of the measurement. Electrical coupling into the cavity is adjustable with large dials on the top of the fixture, while the coupling loops and cabling are kept under protective covers.

Ordering Information

85071E Materials Measurement Software
The user must also choose one of the following security-key options:

Option UL7 Parallel-interface software-security key

Option UL8 USB-interface software-security key

Option 100 Free-space calibration option
Provides gated-reflect-line calibration technique for free-space measurement method. Only compatible with 8510C and PNA Series network analyzers with time-domain option installed

Option 200 Arch reflectivity software
Provides a separate software program that automates the use of NRL arch measurements. Only compatible with 8510C and PNA Series network analyzers with time-domain option installed

Option 300 Resonant Cavity Software
Provides separated software program that automates a variety of resonant techniques. The split cylinder resonator technique is only compatible with PNA network analyzers

85071EU-071 Upgrade Software from any previous version

Compatible Network Analyzers
8712/14/ET/ES, 8753ET/ES, 8719/20/22ET/ES, 8510C, all PNA Series, all ENA Series

PC Requirements
Windows 98, 2000, ME, XP, or Windows NT 4.0*

CD-ROM drive to load software

Software can be run directly on the PNA network analyzer, or on an external PC with a LAN connection to the PNA

All other network analyzers require a PC with a GPIB interface card with a compatible driver (Agilent SICL or National Instruments 488.2M)

Free Trial Demo
Evaluate a demo version of the 85071E materials measurement software for up to two weeks. Visit: **www.agilent.com/find/materials** to download this demo program

Key Literature

85071E Technical Overview, p/n 5988-9472EN
85072A Technical Overview, p/n 5989-6182EN

* Windows NT 4.0 requires Option UL7 parallel-security key

10

LIGHTWAVE, OPTICAL TEST EQUIPMENT

Modular Test and Measurement Platform for Optical Networks and Components

Flexible

Free combination of Agilent modules to generate the best fit for each application

Scalable

The right form factor for each setup in R&D and manufacturing

Efficient

Plug&Play drivers and the Photonic Foundation Library from Agilent provide a variety of application functions for increased measurement performance

Fast

Modules and controllers optimized for high test speed and data throughput

Ergonomic

Comfortable color, high contrast displays for enhanced benchtop usability

Tunable laser modules
(Use with 8164B mainframe)

Compact tunable laser modules

Distributed feedback (DFB) laser modules

Fabry-Perot laser modules

Attenuator modules

Switch modules

Return loss modules

Power sensor modules

Optical heads

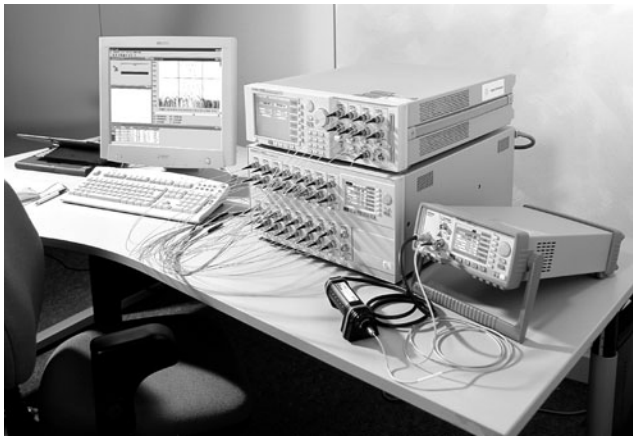
Lightwave Platform Application Portfolio

Enabling Service Innovation Manufacturing Integration Test Speed, Accuracy Automation

Optical Component Test	Passive Component Test													Optical Amplifier Test			Bit Error Ratio Test		
	Mux/DeMux/V-Mux	TFF Test	FBG Filter Test	Connector Test	Switch Test	TFF Align-/Adjustment	Fiber to AWG Alignment/AWG Chip Test	Coupler/Splitter/Combiner	Isolator/Circulator	Variable Optical Attenuator	Gain Flattening Filter	Dispersion Compensators	Interleaver	EDFA	Raman Amplifiers	SOA	Rx/Tx	Line Card	System Test
Tunable Laser 81600B OPT 200, 160, 150, 140, 130	•	•	•		•	•	•	•	•	•	•	•	•						
High Power Tunable Laser OPT 142, 132					•			•	•	•	•	•	•	•	•	•			
Compact Tunable Laser 81980A/81940A/ 81689A/81949A					•			•	•	•	•	•	•	•	•	•	•	•	•
Fabry-Perot Laser 81650A/51A/54A 81655A/56A/57A				•	•	•	•	•	•										
Power Meter 81630B/34B/35B/36B	•	•	•	•	•	•	•			•	•	•	•	•	•		•	•	•
Optical Heads 81623B/24B/26B/28B						•		•	•	•	•	•	•				•	•	•
Return Loss Modules 81610A/81613A			•	•	•	•	•	•	•	•	•	•	•	•					
Attenuator 81670A/71A/76A/77A/78A														•	•	•			
Switches 81591B/94B/95B	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Polarization Controller 8169A	•	•	•		•		•	•	•	•	•	•	•	•		•			
Mainframes 8163B 8164B 8166B	• •	•	•	•	• •	•	• •	• •	• •	• •	• •			• •	• •	• •	• •	• •	• •
All Parameter Test 86038B	•	•	•						•	•	•	•	•						
Photonic Foundation Library N4150A	•	•	•		•	•	•	•	•	•	•		•						

For further information, please visit **www.agilent.com/comms/lightwave**

- **Fast – modules and controllers optimized for high test speed and data throughput**
- **Flexible – free combination of Agilent modules to generate the best fit for each application**
- **Scalable – the right form factor for each setup in R&D and manufacturing**



The Agilent Lightwave Solution Platform – the right choice of modules, controllers, and software for your application

From simple standalone connector testing, fully automated high-channel count test stations, optical amplifier test at high power levels to BERT testing on a complete transmission system – the modular Lightwave Solution Platform from Agilent Technologies always provides the combination of modules for your optical domain test needs.

Controllers and Software

The 8163B, 8164B and 8166B mainframes, together with the *Plug&Play* drivers and the Photonic foundation library from Agilent, form the backbone of your optical measurement application. The high data throughput rate of the controllers, the PFL's pre-tested ready-to-use software routines, and the enhanced displays make them the optimal team for remotely controlled and standalone setups.

Laser Modules for All Purposes

Four different families of laser source modules are available for the Lightwave Solution Platform – tunable laser sources (TLS), distributed feedback laser sources (DFB), compact tunable laser sources (CTLS), and Fabry-Perot (FP) laser sources.

The Agilent high performance tunable laser source are used for precise and fast swept measurements, mainly for testing critical passive components and for calibration purpose.

The Agilent compact tunable laser sources are flexibly fit for both cost effective passive component application as well as amplifier test solution.

The Agilent DFB laser sources are offered at all ITU wavelengths on a 100 GHz grid across the C- and L-bands, mainly used as simulating transmission signal on DWDM and optical amplifier test.

The Agilent FP laser sources are available for testing single or dual fix wavelength point. They are insensitive to back reflections and are stabilized for short and long term test application.

Signal Conditioning

The Agilent optical attenuator and optical switch modules feature excellent repeatability and can handle high input power levels. Combined with their low insertion loss, they are ideal for optical amplifier test, such as characterization of EDFA and Raman amplifier, as well as for other multi-wavelength applications, such as DWDM transmission system test. Availability of single mode and multi mode fiber option fits the need of testing transceiver, receiver, and transponder for Giga Bit Ethernet and Fibre Channel to characterize such parameter as sensitivity in conjunction with oscilloscope or bit error tester.

Power Meters and Optical Heads

The Agilent optical power meters and optical heads provide various selections of power range, wavelength, measurable dynamic range, and size of photo detector to fit various applications including multi-channel device characterization and free space optic test. Superior accuracy, high linearity, low polarization dependent loss (PDL) ensure excellent measurement results. High power up to 40 dBm can be measured to meet ever increasing high power test demand in amplifier and multiple channel mux/demux tests. The measurement speed can be decreased to 25 us, which further optimizes the power measurement. Each power sensor and each optical head are individually calibrated over its complete wavelength range and is traceable to NIST and PTB for precise optical power measurement. A broad variety of advanced interfaces and adapters make it easy to connect the test devices.

Return Loss Solution

Return loss test from Agilent is cost-effective and easy operation using single small mainframe with built-in application software for guided operation. Its modules offer high precision and high accuracy test capability with one-touch operation. Due to the excellent stability of the build-in laser source, the return loss modules also provide the convenience of self-calibration.

8163/64/66B Mainframes – Specification

Mainframes

8163B Lightwave Multimeter, 2 slot mainframe
8164B Lightwave Measurement System, 4 slot plus 1 slot for tunable laser
8166B Lightwave Multichannel System, 17 slot mainframe

Software

N4150A Photonic Foundation Library, single-user license

Full-Size Tunable Laser Sources

81600B-200 Tunable Laser Module, Low-SSE, 1440 – 1640 nm
81600B-160 Tunable Laser Module, Low-SSE, 1495 – 1640 nm
81600B-140 Tunable Laser Module, Low-SSE, 1370 – 1495 nm
81600B-150 Tunable Laser Module, Low-SSE, 1450 – 1590 nm
81600B-130 Tunable Laser Module, Low-SSE, 1260 – 1375 nm
81600B-142 High-Power Tunable Laser Module, 1370 – 1495 nm
81600B-132 High-Power Tunable Laser Module, 1260 – 1375 nm

Compact Tunable Laser Source Modules

81940A 1520 – 1630 nm, >+10 dBm, resolution @1 pm
81980A 1465 – 1575 nm, >+10 dBm, resolution @1 pm
81949A 1520 – 1630 nm, >+10 dBm, resolution @5 pm
81989A 1465 – 1575 nm, >+10 dBm, resolution @5 pm

Source Modules 0 dBm (Fabry-Perot)

81650A 1310 nm, single-mode
81651A 1550 nm, single-mode
81654A 1310/1550 nm, single-mode

Source Modules 17 dBm (Fabry Perot)

81655A 1310 nm, single-mode
81655A-E01 850 nm, multi-mode
81656A 1550 nm, single-mode
81657A 1310/1550 nm, single-mode

Optical Spectrum Analyzer

86142B High Performance Optical Spectrum Analyzer
86146B High Performance Optical Spectrum Analyzer with Filter Mode

Optical Attenuator Modules

81570A High Power Module, Straight Contact Connector
81571A High Power Module, Angled Contact Connector
81576A 2 Slot Wide High Power Module with Power Control, Straight Contact Connector
81577A 2 Slot Wide High Power Module with Power Control, Angled Contact Connector
81578A High Power Module, Multimode, Straight Contact Connector
Option 050 50/125 µm MMF
Option 062 62.5/125 µm MMF

Optical Switch Module

81591B 1 x 2 Optical Switch Module
81594B 2 x 2 Optical Switch Module
81595B 1 x 4 Optical Switch Module
Option 009 Single-mode
Option 062 Multimode

Power Sensor Modules

81634B InGaAs, +10 dBm to –110 dBm, 800 to 1700 nm
81635A (Dual Sensor) InGaAs, +10 dBm to –80 dBm, 800 to 1650 nm

Fast Power Sensor Modules
81636B InGaAs, +10 dBm to –80 dBm, 1250 to 1640 nm

High Power Sensor Module
81630B InGaAs, +28 dBm to –70 dBm, 970 to 1650 nm

Optical Heads

Optical heads require an interface module, Agilent 81618A (single) or 81619A (dual).
81623B Ge, +10 dBm to –80 dBm, 750 to 1800 nm
81624B InGaAs, +10 dBm to –90 dBm, 800 to 1700 nm

High Power Optical Heads
Optical heads require an interface module, Agilent 81618A (single) or 81619A (dual).
81626B InGaAs, +27 dBm to –70 dBm, 850 to 1650 nm
81628B InGaAs integrating sphere, +40 dBm to –60 dBm, 800 to 1700 nm

Return Loss Modules

81610A InGaAs, no internal source, dynamic range 70 dB
81613A InGaAs, internal sources 1310/1550 nm, dynamic range 75 dB

Accessories for Optical Heads 8162xB

81624CE Extension Cable, 4 m
81624DD Adapter (D-shape)
81624RM Rackmount for two heads
81625RM Rackmount for four heads

Accessories for Return Loss Modules 8161xA

81610CC Calibration Cable (requires connector interface 81000SI for connection to return loss module)

Ordering Information

For the most up-to-date information on the Agilent lightwave solution platform, please contact your Agilent Technologies sales representative or visit our web site at: **www.agilent.com/find/oct**

This overview shows all modules, controllers, and software packages for the Agilent lightwave solution platform.

All modules, except the full-size tunable laser sources (used with the 8164B mainframe), may be used with any of the mainframes.

The modules support a wide range of fiber connectors. Connector interfaces should be ordered for each input and output.

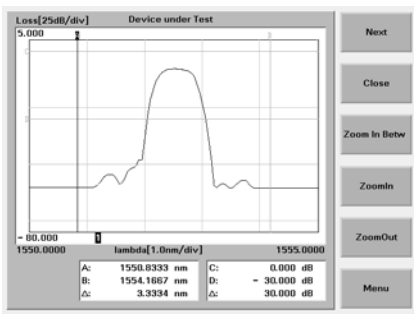
8163B Lightwave Multimeter

8163B

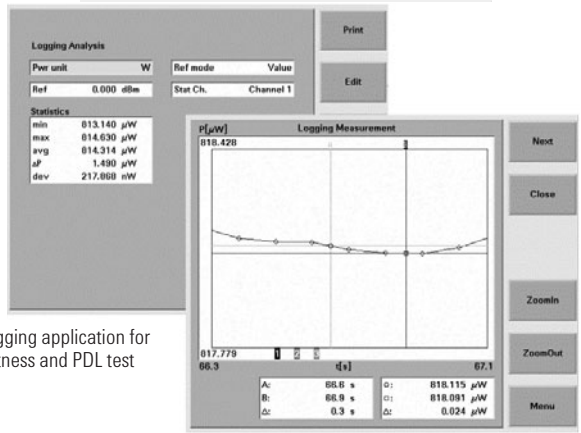
- **Benchtop and smart carry-along instrument**
- **Ready-to-use applications for ease of operation**
- **Cost effective solution for component test**
- **High-contrast color display**
- **Backward compatible with 815x and 816x-series modules**

The Agilent 8163B – Modular Stimulus-Response Solutions with Excellent Performance

The two slots Agilent 8163B lightwave multimeter is one of the basic measurement tools in the fiber optics industry. Its modularity and compact format makes it flexible enough to meet changing measurement needs, whether measuring optical power and loss with laser and power meter modules or using attenuator and switch as signal conditioning.



Insertion loss test result using laser source and power meter



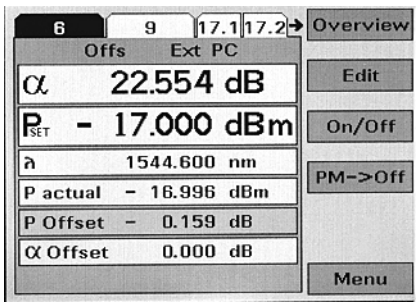
Logging application for flatness and PDL test

Built-In Applications

- Passive component test (PACT) – test pigtailed or connectorized-devices over all wavelengths with a compact tunable laser module and a power meter module
- Return loss/loss – measure the return loss and insertion loss of your devices with one of the 8161xA return loss modules and a power meter module
- Stability – check the long term power stability of the device under test with a source module and a power meter module or power head
- Logging – perform statistical analysis on the power readings of your device

Easy-hands-On and Remote Operation

A glance of instrument gives all information about instrument setting and measurement result with high-contrast color display. The wide viewing angle allows for clear readings, even when the instrument cannot be placed right in front of you. Its compactness and light weighted body is a smart and portable solution for manufacturing. When the need of system automation is considered for advanced manufacturability, GPIB and RS-232C ports together with Agilent's software library support easy system integration.



Signal conditioning operation for active component

- **High speed, high power, high dynamics measurement for passive component test**
- **Ready-to-use application for ease of operation**
- **Remote control for system automation**
- **Backward compatible with 815x and 816x series modules**

The Agilent 8164B – The Platform for Testing Fiber Optic Components

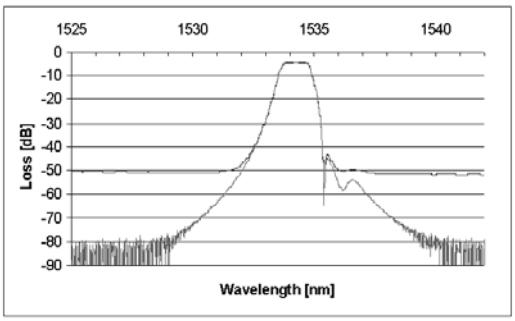
The Agilent 8164B lightwave measurement system supports a wide range of tunable laser modules together with measurement capability up to 8 channel power meter port in one-box, fit into today's requirement of AWG and CWDM applications. Its GPIB and RS-232C ports provide connectivity for remote controlling capability that can be utilized for system automation supported with Agilent's software library. For easy standalone operation of the 8164B, a 3.5 inch floppy disk drive, VGA port, PS/2 keyboard connector, and parallel printer port are provided.

Built-In Applications

- Passive component test (PACT) – test pigtailed or connectorized devices over all wavelengths with an Agilent tunable laser module and our power meter modules
- Stability – check the long term power stability of your device with a source module and a power meter module or power head
- Logging – Perform statistical analysis on the power readings of your device. Save the results to disk or print out a hardcopy

High Speed, High Power, High Dynamics

High standard performance is compressed within a small compact form factor of Agilent's lightwave mainframe that enables optical component research and development for new technology. Such challenge can only be solved with minimum measurement uncertainties by analyzing spectral characteristic of device under test with >70 dB dynamic range and pico-meter wavelength accuracy in loss properties such as IL, RL, and PDL. Same is true for dispersion property in component supporting higher data rate. All these capability is supported in one-box.



Agilent's spectrum analysis solution compared with conventional solution

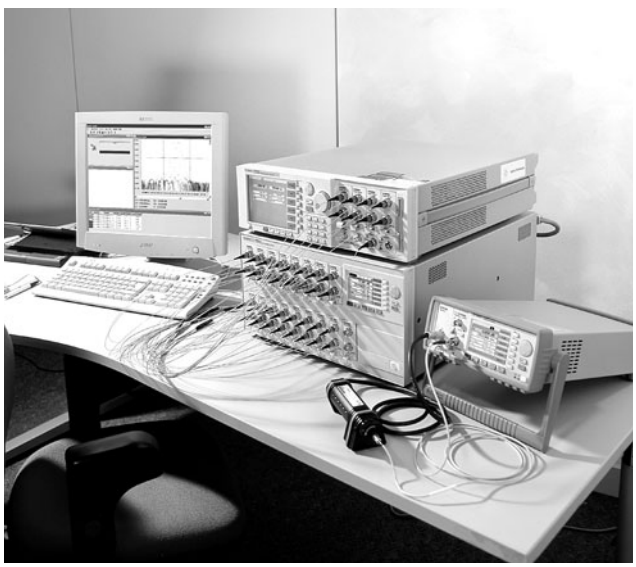
Improve Cost of Manufacturing

Optical component markets are matured and competitive price is a key success factor to win market share. The Agilent 8164B is especially designed for component manufacturing with it flexibility of pluggable modules that provide the test environment for multiple applications. Today's test need of WDM component, for example, can be easily reconfigured to fit the need of production in amplifier test by just changing its modules, saving extra cost for additional mainframe. Ease of manufacturing automation with Agilent's *Plug&Play* software library supported with the mainframe also plays important role in return of instrument investment by improving yield and volume production.

- **Extender platform to flexibly adjust high channel-count applications**
- **Variety of plug-in modules for optimized setup**
- **Synchronize with laser module for simultaneous measurement**

The Agilent 8166B – Lightwave Multichannel System

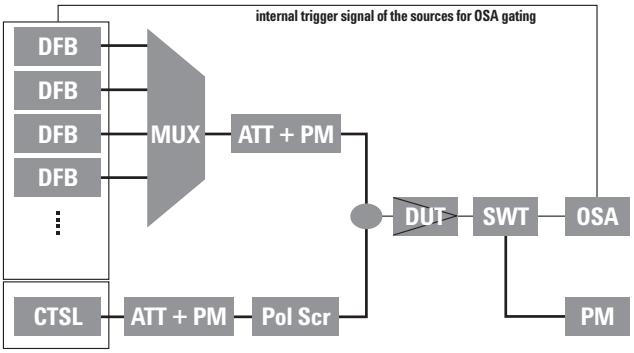
The Agilent 8166B lightwave multichannel system is the mainframe of choice for applications that involve testing high-channel count devices or devices with a need for a complete array of sources or sensors. For multi-port device such as WDM component, the ability to synchronize with tunable laser source even with other mainframe ensures simultaneous data logging at all plugged power meter. The platform offers 17 slots which can be equipped with any combination of modules to configure your own research and manufacturing test system.



40ch spectrum analysis synchronizing tunable laser source and power meter

Flexible Module Configuration for Complex Manufacturing Line

Simple configuration of instrument for one test parameter adds up and creates complex mechanism of manufacturing line when tests are moved from R&D to Production. Integrating all necessary test instruments into one box can minimize such complexity. General setup of EDFA can be build with a series of DFB bank together with switch, attenuator, and power meters. The Agilent's 8166B hosts 17 slots with customer specific module configuration.



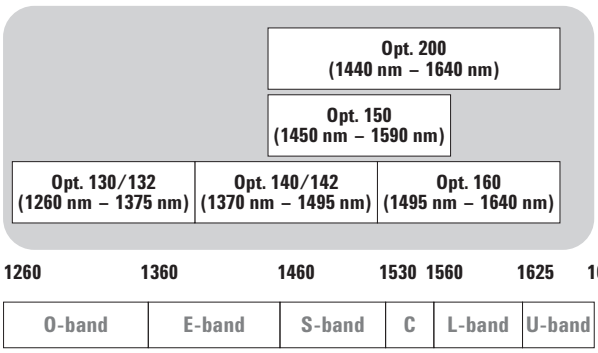
EDFA test system with configurable channel count

Further more, complexity of system configuration in manufacturing environment could induce operational mistake and a need of engineering skill for operation. One advantage of configuring all necessary test instrument into one box is to crease an environment for ease of integration. GPIB and RS-232C ports together with Agilent's software library lower integration and maintenance cost of system. Same process and procedures are repeated constantly without any human error by just clicking single button for setting, measurement, report.

- **Complete wavelength coverage from 1260 nm to 1640 nm**
- **Low SSE output for high dynamic range**
- **Built-in wavelength meter for high wavelength accuracy**
- **Sweep speeds up to 80 nm/s to reduce test times**
- **No compromise of measurement accuracy for sweep speed**

Tuning Range from 1260 nm to 1640 nm

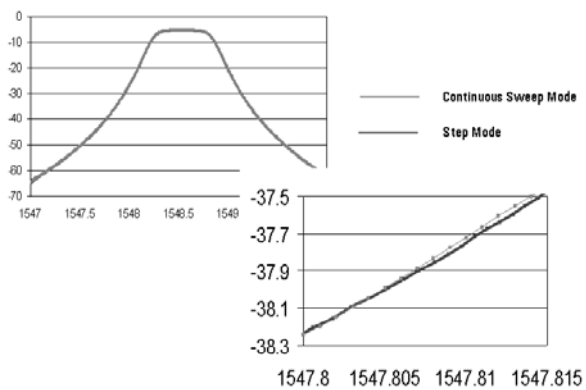
Agilent offers a family of tunable laser sources to cover the wavelength range of 1260 nm to 1640 nm. Whether you are measuring Dense Wavelength Division Multiplexing (DWDM) devices or a WDM device, such as, an LX4 component for 10 Gigabit Ethernet, Agilent has a laser to fit your testing needs.



Agilent TSL portfolio

It Sweeps as Precisely as It Steps

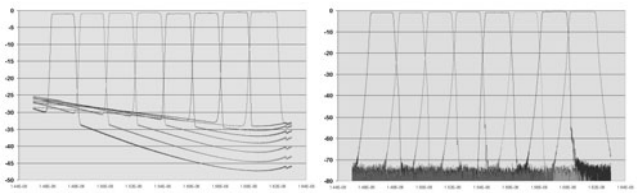
As manufacturing yields become more demanding it is critical for your test instruments to have optimal performance for any measurement condition. The 81600B offers several sweep speeds up to 80 nm/s without compromising measurement accuracy. In contrast to other lasers, the 81600B sweeps with the same precision as it steps; without the use of an external wavelength-tracking filter. No compromise on sweep speed.



No compromise on sweep speed

Advantage of Using Suppressed Laser Noise (SSE)

Source Spontaneous Emission (SSE), the sum of all spontaneous emissions inside the laser diode, of the tunable laser, is broadband light output in addition to the monochromatic laser line. This emission limits the noise floor of the tunable laser, which, in turn, limits the dynamic range of your measurements. The Agilent tunable laser source offers a low signal to source spontaneous emission ratio. For you, this means more dynamic range to enable your measurements to completely characterize DWDM devices with high channel isolation.



Low SSE and high power measurement result

Reduce Cost of Test

For DWDM components, high wavelength accuracy and dynamic range are most important. For CWDM components, a wide wavelength range, high power stability, dynamic range and low cost targets are key. Agilent's state-of-the-art tunable lasers meet the demanding requirements of high tech optical manufacturing facilities with fast sweep speed, high wavelength accuracy and power stability. This will reduce your test time while increasing your throughput, hence, reducing the cost of test in manufacturing to give you the competitive advantage.

Protect your Investment

Upgrade your earlier model Agilent tunable laser (8164xA/B, 8168xA/B) to the latest 81600B.

TLS Upgrade Option
Upgrade an Agilent tunable laser source to the latest 81600B Family product

	81600B#200
81640A/B	#UG1
81680A/B	
81480A/B	
81642A/B	
81682A/B	
81482B	

81600B-200 All-Band Tunable Laser Source, 1440 nm – 1640 nm, Low SSE

	Agilent 81600B-200			
Wavelength Range	1440 nm to 1640 nm			
Wavelength Resolution	0.1 pm, 12.5 MHz at 1550 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ±3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[4] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1475 nm – 1625 nm, at max. constant output power)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Maximum Output Power **(Continuous Power During Sweep)**	≥+3 dBm peak (typ.) ≥+2 dBm (1520 nm – 1610 nm) ≥–2 dBm (1475 nm – 1625 nm) ≥–7 dBm (1440 nm – 1640 nm)	≥+9 dBm peak (typ.) ≥+8 dBm (1520 nm –1610 nm) ≥+4 dBm (1475 nm –1625 nm) ≥–1 dBm (1440 nm – 1640 nm)		
Attenuation		max. 60 dB		
Power Repeatability (typ.)	±0.003 dB			
Power Stability[4]	±0.01 dB, 1 hour typ. ±0.03 dB, 24 hours			
Power Linearity	±0.1 dB	±0.1 dB (±0.3 dB in attenuation mode)		
Power Flatness Versus Wavelength	±0.25 dB[3], typ. ±0.1 dB	±0.3 dB[3], typ. ±0.15 dB		
		Continuous Sweep Mode		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.02 dB	±0.04 dB
Side-mode Suppression Ratio (typ.)	≥60 dB (1520 nm – 1610 nm)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Signal to Source **Spontaneous Emission Ratio**[2]	≥70 dB/nm (1520 nm –1610 nm) ≥80 dB/0.1 nm (typ., 1520 nm – 1610 nm) ≥66 dB/nm (typ., 1475 nm – 1625 nm) ≥60 dB/nm (typ., 1440 nm – 1640 nm)	≥48 dB/nm (1520 nm – 1610 nm) ≥58 dB/0.1 nm (typ., 1520 nm – 1610 nm) ≥43 dB/nm (1475 nm – 1625 nm) ≥37 dB/nm (1440 nm – 1640 nm)		
Signal to Total Source **Spontaneous Emission Ratio**[2]	≥65 dB (1520 nm – 1610 nm) ≥57 dB (typ., 1440 nm – 1640 nm)	≥30 dB (typ., 1520 nm – 1610 nm)		
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–145 dB/Hz (1520 nm – 1610 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] Wavelength range 1440 nm – 1630 nm.
[4] At constant temperature ±1 K.

81600B-160 Tunable Laser Source, 1495 nm – 1640 nm, Low SSE

	Agilent 81600B-160			
Wavelength Range	1495 nm to 1640 nm			
Wavelength Resolution	0.1 pm, 12.5 MHz at 1550 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ± 3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[3] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1510 nm – 1620 nm, at max. constant output power)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Maximum Output Power **(Continuous Power During Sweep)**	≥–2 dBm peak (typ.) ≥–4 dBm (1520 nm – 1610 nm) ≥–6 dBm (1510 nm – 1620 nm) ≥–7 dBm (1495 nm – 1640 nm)	≥+7 dBm peak (typ.) ≥+5 dBm (1520 nm –1610 nm) ≥+3 dBm (1510 nm – 1620 nm) ≥–1 dBm (1495 nm – 1640 nm)		
Attenuation		max. 60 dB		
Power Repeatability (typ.)	±0.003 dB			
Power Stability[3]	±0.01 dB, 1 hour typ. ±0.03 dB, 24 hours			
Power Linearity	±0.1 dB	±0.1 dB (±0.3 dB in attenuation mode)		
Power Flatness Versus Wavelength	±0.2 dB, typ. ±0.1 dB (1495 nm – 1630 nm)	±0.3 dB, typ. ±0.15 dB		
		Continuous Sweep Mode		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.02 dB	±0.04 dB
Side-mode Suppression Ratio (typ.)[2]	≥40 dB (1520 nm – 1610 nm)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Signal to Source **Spontaneous Emission Ratio**[2]	≥64 dB/nm (1520 nm –1610 nm) ≥74 dB/0.1 nm (typ., 1520 nm – 1610 nm) ≥62 dB/nm (typ., 1510 nm – 1620 nm) ≥59 dB/nm (typ., 1495 nm – 1640 nm)	≥45 dB/nm (1520 nm – 1610 nm) ≥55 dB/0.1 nm (typ., 1520 nm – 1610 nm) ≥42 dB/nm (1510 nm – 1620 nm) ≥37 dB/nm (1495 nm – 1640 nm)		
Signal to Total Source **Spontaneous Emission Ratio**[2]	≥59 dB (1520 nm – 1610 nm) ≥56 dB (typ., 1495 nm – 1640 nm)	≥27 dB (typ., 1520 nm – 1610 nm)		
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–145 dB/Hz (1520 nm – 1610 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] At constant temperature ±1 K.

81600B-140 Tunable Laser Source, 1370 nm – 1495 nm, Low SSE

	Agilent 81600B-140			
Wavelength Range	1370 nm to 1495 nm			
Wavelength Resolution	0.1 pm, 15 MHz at 1450 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s (1372 nm to 1945 nm)			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ±3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[4] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1430 nm – 1480 nm, at max. constant output power)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Maximum Output Power **(Continuous Power During Sweep)**	≥–4.5 dBm peak (typ.) ≥–5 dBm (1430 nm – 1480 nm) ≥–7 dBm (1420 nm – 1480 nm) ≥–13 dBm (1370 nm – 1495 nm)	≥+5.5 dBm peak (typ.) ≥+5 dBm (1430 nm – 1480 nm) ≥+3 dBm (1420 nm – 1480 nm) ≥–3 dBm (1370 nm – 1945 nm)		
Attenuation		max. 60 dB		
Power Repeatability (typ.)	±0.003 dB			
Power Stability[4]	±0.01 dB, 1 hour (1420 nm – 1495 nm) typ. ±0.01 dB, 1 hour (1370 nm – 1420 nm) typ. ±0.03 dB, 24 hours			
Power Linearity	±0.1 dB (1420 nm – 1495 nm) typ. ±0.01 dB (1370 nm – 1420 nm)	±0.3 dB (1420 nm – 1495 nm) typ. ±0.03 dB (1370 nm – 1420 nm)		
Power Flatness Versus Wavelength	±0.2 dB, typ. ±0.1 dB (1420 nm – 1495 nm) typ. ±0.2 dB (1370 nm – 1420 nm)	±0.3 dB, typ. ±0.02 dB (1420 nm – 1495 nm) typ. ±0.03 dB (1370 nm – 1420 nm)		
		Continuous Sweep Mode[3]		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.015 dB	±0.03 dB
Side-mode Suppression Ratio (typ.)[2]	≥40 dB (1430 nm – 1480 nm)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Signal to Source **Spontaneous Emission Ratio**[2]	≥63 dB/nm (1430 nm –1480 nm) ≥73 dB/0.1 nm (typ., 1430 nm –1480 nm) ≥61 dB/nm (1420 nm – 1480 nm) ≥55 dB/nm (typ., 1370 nm – 1495 nm)	≥42 dB/nm (1430 nm –1480 nm) ≥52 dB/0.1 nm (typ., 1430 nm –1480 nm) ≥40 dB/nm (1420 nm – 1480 nm) ≥35 dB/nm (typ., 1370 nm – 1495 nm)		
Signal to Total Source **Spontaneous Emission Ratio**[2]	≥60 dB (1430 nm – 1480 nm) ≥58 dB (1420 nm – 1480 nm) ≥53 dB (typ., 1370 nm – 1495 nm)	≥28 dB (typ., 1430 nm – 1480 nm)		
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–145 dB/Hz (1430 nm – 1480 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] Valid for absolute humidity of 11.5 g/m³ (For example, equivalent of 50% relative humidity at 25°C).
[4] At constant temperature ±1 K.

81600B-150 Tunable Laser Source, 1450 nm – 1590 nm, Low SSE

	Agilent 81600B-150			
Wavelength Range	1450 nm to 1590 nm			
Wavelength Resolution	0.1 pm, 12.5 MHz at 1550 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ±3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[3] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1480 nm – 1580 nm, at max. constant output power)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Maximum Output Power **(Continuous Power During Sweep)**	≥–1 dBm peak (typ.) ≥–3 dBm (1520 nm – 1570 nm) ≥–6 dBm (1480 nm – 1580 nm) ≥–7 dBm (1450 nm – 1590 nm)	≥+7 dBm peak (typ.) ≥+5 dBm (1520 nm – 1570 nm) ≥+4 dBm (1480 nm – 1580 nm) ≥–1 dBm (1450 nm – 1590 nm)		
Attenuation		max. 60 dB		
Power Repeatability (typ.)	±0.003 dB			
Power Stability[3]	±0.01 dB, 1 hour typ. ±0.03 dB, 24 hours			
Power Linearity	±0.1 dB	±0.1 dB (±0.3 dB in attenuation mode)		
Power Flatness Versus Wavelength	±0.2 dB, typ. ±0.1 dB	±0.3 dB, typ. ±0.15 dB		
		Continuous Sweep Mode		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.02 dB	±0.04 dB
Side-mode Suppression Ratio (typ.)[2]	≥40 dB (1480 nm – 1580 nm)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Signal to Source **Spontaneous Emission Ratio**[2]	≥65 dB/nm (1520 nm –1570 nm) ≥75 dB/0.1 nm (typ., 1520 nm – 1570 nm) ≥61 dB/nm (typ., 1480 nm – 1580 nm) ≥59 dB/nm (typ., 1450 nm – 1590 nm)	≥45 dB/nm (1520 nm – 1570 nm) ≥55 dB/0.1 nm (typ., 1520 nm – 1570 nm) ≥42 dB/nm (1480 nm – 1580 nm) ≥37 dB/nm (1450 nm – 1590 nm)		
Signal to Total Source **Spontaneous Emission Ratio**[2]	≥60 dB (1520 nm – 1570 nm) ≥50 dB (typ., 1450 nm – 1590 nm)	≥30 dB (typ., 1520 nm – 1570 nm)		
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–145 dB/Hz (1480 nm – 1580 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] At constant temperature ±1 K.

81600B-130 Tunable Laser Source, 1260 nm – 1375 nm, Low SSE

	Agilent 81600B-130			
Wavelength Range	1260 nm to 1375 nm			
Wavelength Resolution	0.1 pm, 17.7 MHz at 1300 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ±3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[4] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1270 nm – 1350 nm, at max. constant output power)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Maximum Output Power **(Continuous Power During Sweep)**	≥–4 dBm peak (typ.) ≥–6 dBm (1290 nm – 1370 nm) ≥–9 dBm (1270 nm – 1375 nm) ≥–13 dBm (1260 nm – 1375 nm)	≥+5 dBm peak (typ.) ≥+4 dBm (1290 nm – 1370 nm) ≥+1 dBm (1270 nm – 1375 nm) ≥–3 dBm (1260 nm – 1375 nm)		
Attenuation		max. 60 dB		
Power Repeatability (typ.)	±0.003 dB			
Power Stability [4]	±0.01 dB, 1 hour (1260 nm – 1350 nm) typ. ±0.01 dB, 1 hour (1350 nm – 1375 nm) typ. ±0.03 dB, 24 hours			
Power Linearity	±0.1 dB (1260 nm – 1350 nm) typ. ±0.1 dB (1350 nm – 1375 nm)	±0.3 dB (1260 nm – 1350 nm) typ. ±0.3 dB (1350 nm – 1375 nm)		
Power Flatness Versus Wavelength	±0.2 dB, typ. ±0.1 dB (1260 nm – 1350 nm) typ. ±0.2 dB (1350 nm – 1375 nm)	±0.3 dB, typ. ±0.15 dB (1260 nm – 1350 nm) typ. ±0.3 dB (1350 nm – 1375 nm)		
		Continuous Sweep Mode[3]		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.02 dB	±0.04 dB
Side-mode Suppression Ratio (typ.)[2]	≥40 dB (1290 nm – 1370 nm)			
	Output 1 (Low SSE)	**Output 2 (High Power)**		
Signal to Source **Spontaneous Emission Ratio (typ.)**[2]	≥63 dB/nm (1290 nm – 1370 nm) ≥61 dB/nm (1270 nm – 1375 nm) ≥55 dB/nm (1260 nm – 1375 nm)	≥42 dB/nm (1290 nm – 1370 nm) ≥40 dB/nm (1270 nm – 1375 nm) ≥35 dB/nm (1260 nm – 1375 nm)		
Signal to Total Source **Spontaneous Emission Ratio (typ.)**[2]	≥58 dB (1290 nm – 1370 nm) ≥56 dB (1270 nm – 1375 nm) ≥51 dB (1260 nm – 1375 nm)	≥26 dB (1290 nm – 1370 nm)		
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–140 dB/Hz (1270 nm – 1375 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] Valid for absolute humidity of 11.5 g/m³ (For example, equivalent of 50% relative humidity at 25°C).
[4] At constant temperature ±1 K.

81600B-142 Tunable Laser Source, 1370 nm – 1495 nm, High Power

	Agilent 81600B-142			
Wavelength Range	1370 nm to 1495 nm			
Wavelength Resolution	0.1 pm, 15 MHz at 1450 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s (1372 nm – 1495 nm)			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ±3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[4] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1430 nm – 1480 nm, at max. constant output power)			
Maximum Output Power **(Continuous Power During Sweep)** **With Option 003**	≥+8.5 dBm peak (typ.) ≥+7.5 dBm (1430 nm – 1480 nm) ≥+5 dBm (1420 nm – 1480 nm) ≥0 dBm (1370 nm – 1495 nm) reduced by 1.5 dB			
Power Repeatability (typ.)	±0.003 dB			
Power Stability[4]	±0.01 dB, 1 hour (1420 nm – 1495 nm) typ. ±0.01 dB, 1 hour (1370 nm – 1420 nm) typ. ±0.03 dB, 24 hours			
Power Linearity **With Option 003**	±0.1 dB (1420 nm – 1495 nm) typ. ±0.1 dB (1370 nm – 1420 nm) Add ±0.2 dB			
Power Flatness Versus Wavelength **With Option 003**	±0.2 dB, typ. ±0.1 dB (1420 nm – 1495 nm) typ. ±0.2 dB (1370 nm – 1420 nm) Add ±0.1 dB			
		Continuous Sweep Mode[4]		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.015 dB	±0.03 dB
Side-mode Suppression Ratio (typ.)[2]	≥ 40 dB (1430 nm – 1480 nm)			
Signal to Source **Spontaneous Emission Ratio**[2]	≥42 dB/nm (1430 nm – 1480 nm) ≥52 dB/0.1 nm (typ., 1430 nm – 1480 nm) ≥40 dB/nm (1420 nm – 1480 nm) ≥35 dB/nm (typ., 1370 nm – 1495 nm)			
Signal to Total Source **Spontaneous Emission Ratio (typ.)**[2]	≥28 dB (1430 nm – 1480 nm)			
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–145 dB/Hz (1430 nm – 1480 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] Valid for absolute humidity of 11.5 g/m³ (For example, equivalent of 50% relative humidity at 25°C).
[4] At constant temperature ±1 K.

81600B-132 Tunable Laser Source, 1260 nm – 1375 nm, High Power

	Agilent 81600B-132			
Wavelength Range	1260 nm to 1375 nm			
Wavelength Resolution	0.1 pm, 17.7 MHz at 1300 nm			
Mode-hop Free Tunability	Full wavelength range			
Maximum Sweep Speed	80 nm/s			
	Stepped Mode	**Continuous Sweep Mode (typ.)**		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Absolute Wavelength Accuracy[1]	±10 pm, typ. ±3.6 pm	±4.0 pm	±4.6 pm	±6.1 pm
Relative Wavelength Accuracy[1]	±5 pm, typ. ±2 pm	±2.4 pm	±2.8 pm	±4.0 pm
Wavelength Repeatability	±0.8 pm, typ. ±0.5 pm	±0.3 pm	±0.4 pm	±0.7 pm
Wavelength Stability[2] **(typ.)**	≤±1 pm, 24 hours			
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On**	100 kHz >50 MHz (1270 nm – 1350 nm, at max. constant output power)			
Maximum Output Power **(Continuous Power During Sweep)**	≥+9 dBm peak (typ.) ≥+7 dBm (1290 nm – 1370 nm) ≥+3 dBm (1270 nm – 1375 nm) ≥0 dBm (1260 nm – 1375 nm)			
Power Repeatability (typ.)	±0.003 dB			
Power Stability[4]	±0.01 dB, 1 hour (1260 nm – 1350 nm) typ. ±0.01 dB, 1 hour (1350 nm – 1375 nm) typ. ±0.03 dB, 24 hours			
Power Linearity	±0.1 dB (1260 nm – 1350 nm) typ. ±0.1 dB (1350 nm – 1375 nm)			
Power Flatness Versus Wavelength	±0.2 dB, typ. ±0.1 dB (1260 nm – 1350 nm) typ. ±0.2 dB (1350 nm – 1375 nm)			
		Continuous Sweep Mode[3]		
		at 5 nm/s	**at 40 nm/s**	**at 80 nm/s**
Dynamic Power Reproducibility (typ.)		±0.005 dB	±0.01 dB	±0.015 dB
Dynamic Relative Power Flatness (typ.)		±0.01 dB	±0.015 dB	±0.03 dB
Side-mode Suppression Ratio (typ.)[2]	≥40 dB (1270 nm – 1375 nm)			
Signal to Source **Spontaneous Emission Ratio**[2]	≥45 dB/nm (1290 nm – 1370 nm) ≥55 dB/0.1 nm (typ., 1290 nm – 1370 nm) ≥40 dB/nm (1270 nm – 1375 nm) ≥35 dB/nm (typ., 1260 nm – 1375 nm)			
Signal to Total Source **Spontaneous Emission Ratio (typ.)**[2]	≥28 dB (1290 nm – 1370 nm)			
Relative Intensity Noise (RIN) **(0.1 – 6 GHz) (typ.)**[2]	–145 dB/Hz (1270 nm – 1375 nm)			

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing.
[2] At maximum output power as specified per wavelength range.
[3] Valid for absolute humidity of 11.5 g/m³ (For example, equivalent of 50% relative humidity at 25°C).
[4] At constant temperature ±1 K.

Specifications

Wavelength and amplitude accuracy specifications require an angled connector from the source output to the receiver input ports. Wavelength specifications are defined with frequency terms. For convenience, the frequency delta ranges are provided with wavelength units (in parentheses) assuming a center wavelength of 1550 nm. Unless otherwise specified, amplitude specifications apply in peak detection mode, with unmodulated linewidths <2 MHz.

- **Compact form factor of tunable laser source**
- **Full wavelength range in S/C-band or C/L-band (110 nm coverage in one module)**
- **High power output up to +13 dBm**
- **SBS suppression feature enables high launch power**
- **Built-in wavemeter for active wavelength control**
- **Dynamic power control for excellent repeatability**

High Power Compact Tunable Lasers for S-, C- and L-band

The Agilent 819xxA compact tunable laser sources supply an output power of up to +13 dBm. Each module covers a total wavelength range of 110 nm, either in the S+C-band with the high power in C (81980A and 81989A), or in the C+L-band with the high power in the L-band (81940A, 81944A, 81949A).

Device Characterization at High Power Levels

The high output power of the 819xxA tunable lasers enhances test stations for optical amplifier, active components and broadband passive optical components. It helps overcome losses in test setups or in the device under test itself. Thus, engineers can test optical amplifiers such as EDFAs, Raman amplifiers, SOAs and EDWAs to their limits. These tunable lasers provide the high power required to speed the development of innovative devices by enabling the test and measurement of nonlinear effects.

SBS Suppression Feature Enables High Launch Power

The new SBS-suppression feature prevents the reflection of light induced by Stimulated Brillouin Scattering (SBS). It enables the launch of the high power into long fibers without intensity modulation, which is detrimental in time-domain measurements.

Compact tunable laser source with dual power meter in one box

Coherence Control Reduces Interference-Induced Power Fluctuations

A high-frequency modulation function is used to increase the effective linewidth to reduce power fluctuations caused by coherent interference effects. The modulation pattern is optimized for stable power measurements, even in the presence of reflections.

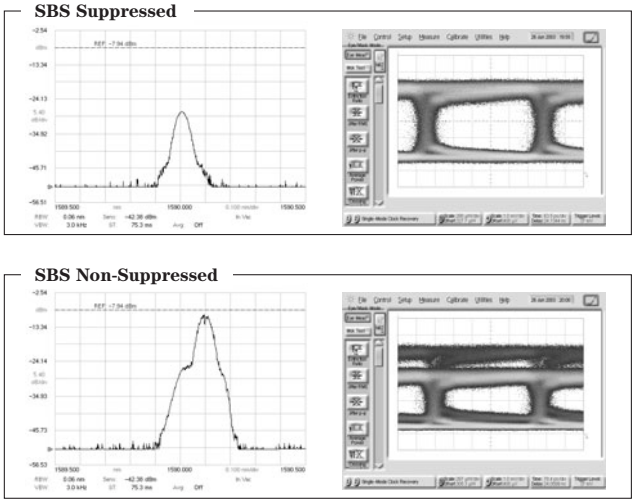
Internal Modulation

The internal modulation feature enables an efficient and simple time-domain extinction (TDE) method for Erbium-based optical amplifier test when used together with the external gating feature of the Agilent OSA.

It also supports the transient testing of optical amplifiers by simulating channel add/drop events.

Cost Effective Passive Component Test

Agilent's compact tunable laser sources provide excellent wavelength and power accuracies to enable reliable swept wavelength measurement for passive component test in a cost effective way. The built-in wavelength meter with a closed feedback loop for enhanced wavelength accuracy allows dynamic wavelength logging in continuous sweep mode. The integrated dynamic power control loop guarantees highly repeatable measurements.



Laser characteristics in long fiber with and without SBS suppression

8198xA and 8194xA Compact Tunable Laser Source (cont.)

81980A and 81989A Compact Tunable Laser Source, 1465 nm – 1575 nm
81940A and 81949A Compact Tunable Laser Source, 1520 nm – 1630 nm

	Agilent 81980A, 81940A	Agilent 81989A, 81949A
Wavelength Range	1465 nm to 1575 nm (81980A and 81989A) 1520 nm to 1630 nm (81940A and 81949A)	
Wavelength Resolution	1 pm, 125 MHz at 1550 nm	5 pm, 625 MHz at 1550 nm
Mode-hop Free Tuning Range	Full wavelength range	
Maximum Tuning Speed	50 nm/s	
Absolute Wavelength Accuracy	±20 pm	±100 pm
Relative Wavelength Accuracy	±10 pm, typ. ±5 pm	±50 pm
Wavelength Repeatability	±2.5 pm, typ. ±1 pm	±5 pm
Wavelength Stability (typ., over 24 h)[3]	±2.5 pm	±5 pm
Linewidth (typ.), Coherence Control Off **Effective Linewidth (typ.),** **Coherence Control On[1]**	100 kHz >50 MHz for 1525 nm – 1575 nm (81980A and 81989A) >50 MHz for 1570 nm – 1620 nm (81940A and 81949A)	
Maximum Output Power **(Continuous Power During Tuning)**	≥+10 dBm ≥+13 dBm for 1525 nm – 1575 nm (81980A and 81989A) ≥+13 dBm for 1570 nm – 1620 nm (81940A and 81949A)	
Minimum Output Power	+6 dBm	
Power Linearity (typ.)	±0.1 dB	
Power Stability[3]	±0.01 dB over 1 hour typ. ±0.0075 dB over 1 hour typ. ±0.03 dB over 24 hours	
Power Flatness Versus Wavelength	±0.3 dB, typ. ±0.15 dB	
Power Repeatability (typ.)	±10 mdB	
Side-mode Suppression Ratio (typ.)[1]	≥45 dB	
Signal to Source Spontaneous **Emission Ratio[2]**	≥45 dB 48 dB/nm for 1525 nm – 1575 nm (81980A and 81989A) 48 dB/nm for 1570 nm – 1620 nm (81940A and 81949A)	
Signal to Total Source **Spontaneous Emission Ratio (typ.)[1]**	≥25 dB ≥30 dB for 1525 nm – 1575 nm (81980A and 81989A) ≥30 dB for 1570 nm – 1620 nm (81940A and 81949A)	
Relative Intensity Noise (RIN) (typ.)[1]	–145 dB/Hz	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm	

[1] At maximum output power as specified per wavelength range.
[2] Value for 1 nm resolution bandwidth.
[3] At constant temperature ±0.5 K.

- **SMF with 1310 nm, 1550 nm, or 1310/1550 nm, and MMF with 850 nm**
- **Selectable 1 mW or 20 mW output power**
- **Excellent CW power stability of <±0.005 dB (15 min.)**
- **Return loss test in combination with Agilent Return Loss module**

Flexible Application Fit

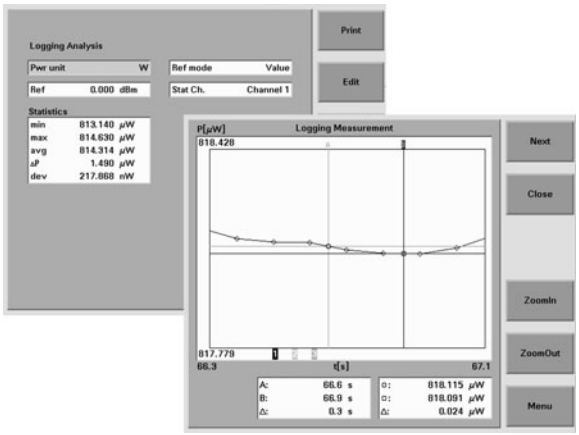
Agilent 8165xA Fabry-Perot laser source are a family of plug-in modules for Agilent's Lightwave Solution Platform. Laser module offers ideal power and loss characterization solution for optical component and fiber with wavelength at 850 nm, 1310 nm, and 1550 nm, mainly used in optical telecommunication including today's fiber to the home (FTTH) and short reach applications such as Fibre Channel and Gigabit Ethernet.

Ideal Solution for IL, RL, and PDL Tests

Combination of Agilent's Fabry-Perot laser source and wide variety of power meter (or optical head) provides basic setup for insertion loss (IL) characterization. Operations of single click to reference and single connection of test device immediately show result of IL. Such measurement can be continuously repeated over time with ensured laser stability of <±0.005 dB to test in different environmental condition for durability which is normally required by fiber and sub-component manufactures. Agilent's 8161xA return loss module can utilize external laser source such as Fabry-Perot laser to setup Return loss (RL) test. Adding Agilent 8169A Polarization Controller enables testing of polarization property of optical components.

Ease of Manual Operation

Test environment is simple and small footprint. Manual manufacturing operation on work-bench requires friendly operating environment which allows user to operate without instrument training. Mainframe's build-in applications including stability, logging, PACT provides application-fit environment for instrument operation.



Logging application for flatness and PDL test using Fabry-Perot laser module

PnP Software Drivers for Fast Process Automation

The powerful and easy to use *Plug&Play* drivers allow fast implementation of complex measurement control programs.

8165xA Fabry-Perot Laser Modules (cont.)

Standard Modules, 0 dBm

	Agilent 81650A	Agilent 81651A	Agilent 81654A	Agilent 81655A E01[5]
Type	Fabry-Perot Laser			
Center Wavelength[1]	1310 nm ±15 nm	1550 nm ±15 nm	1310/1550 nm ±15 nm	850 nm ±10 nm
Fiber Type	Single-mode 9/125 µm	Single-mode 9/125 µm	Single-mode 9/125 µm	Standard multi-mode 50/125 µm
Spectral Bandwidth (rms)[1,2]	<3.5 nm	<4.5 nm	<3.5 nm/ 4.5 nm	<5.0 nm
Output Power	>0 dBm (1 mW)			>3 dBm (2 mW)
CW Power Stability[3,4] – short term (15 min.) – long term (24 h) – to back reflection (RL ≥14dB)	<± 0.005 dB typ. <± 0.003 dB with coherence control active typ. ±0.03 dB typ. ±0.003 dB			typ. <±0.005 dB typ.<±0.05 dB
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8″ x 1.3″ x 13.2″)			
Weight	0.5 kg			
Recalibration Period	2 years			
Operating Temperature	0°C to 45°C			
Humidity	Non condensing			
Warm-up Time	60 minutes[3]			

High Power Modules, 13 dBm

	Agilent 81655A	Agilent 81656A	Agilent 81657A
Type	Fabry-Perot Laser		
Center Wavelength[1]	1310 nm ± 15 nm	1550 nm ± 15 nm	1310/1550 nm ± 15 nm
Fiber Type	Standard single-mode 9/125 µm	Standard single-mode 9/125 µm	Standard single-mode 9/125 µm
Spectral Bandwidth (rms)[1,2]	<5.5 nm	<7.5 nm	<5.5 nm/7.5 nm
Output Power	>+13 dBm (20 mW)		
CW Power Stability[3,4] – short term (15 min.) – long term (24 h) – to back reflection (RL ≥14 dB)	<±0.005 dB typ <±0.003 dB with coherence control active typ. ±0.03 dB typ. ±0.003 dB		
Dimensions (H x W x D)	75 mm H x 32 mm W x 335 mm (2.8″ x 1.3″ x 13.2″)		
Weight	0.5 kg		
Recalibration Period	2 years		
Operating Temperature	0°C to 45°C		
Humidity	Noncondensing		
Warm-up Time	60 min[3]		

[1] Central wavelength is shown on display.
[2] rms: root mean square.
[3] Warm-up time 20 min, if previously stored at the same temperature.
[4] Controlled environment ($_{\Delta}$T = ±1°C).
[5] Special Option.

Supplementary Performance Characteristics

Internal Digital Modulation Mode

270 Hz, 330 Hz, 1 kHz, 2 kHz and free selection 200 Hz to 10 kHz.
All output signals are pulse shaped, duty cycle 50 %.
Internal coherence control for linewidth broadening.

Output Attenuation

The output power of all source modules can be attenuated from 0 dB to 6 dB in steps of 0.1 dB.

81635A
81634B
81630B
81636B
81623B
81624B
81626B
81628B

- **Complete wavelength range, 750 nm – 1800 nm**
- **Low uncertainty of ≤±0.8% at reference conditions**
- **Low PDL of ≤±0.005 dB, for polarization sensitive tests**
- **High dynamic range of 55 dB**
- **High power measurements of up to +40 dBm**
- **Support of high channel count testing with dual power sensor**
- **Support of bare-fiber and open-beam applications with a 5 mm detector**
- **Synchronous measurements with a laser source or external modulation**

Wide Variety of Optical Power Sensors and Optical Heads

Superiority of Agilent's stimulus-response test solutions have guaranteed performance. Agilent has been an industry leader in optical instrumentation since the early 1980s – excellence in laser sources, reliable power sensor modules and large detector optical heads.

Passive Component Test

For multi-channel devices, such as, CWDM and AWG, for R&D or the manufacturing environment, accurate measurements at a minimum cost are in demand. The modular design provides the user with the flexibility to add power meters or mainframes for high channel count or high dynamic range applications. Testing of free space optics, such as, thin film filter (TFF) and waveguide alignment, are easily supported with the optical head. Its 5 mm detector and long, moveable reach provides the user with easy handling.

Active Component Test

High power amplifiers and sources are developed today in order to transmit signals over longer distances and to support a high loss environment for complex systems. High power measurements of +40 dBm, can be accomplished without an attenuator, of which could add to the measurement uncertainty.

Research and Calibration

Low measurement uncertainty of <±0.8% and low PDL of <±0.005 dB are a couple of the key features found in the Agilent power sensors. All of Agilent's power meter products are NIST and PTB traceable to guarantee precise optical power measurements. All metrology labs are ISO 17025 certified to meet general requirements for the competence of testing and calibration laboratories.


Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
PTB
copy
Kalibrierschein
Calibration Certificate
Optical Power Meter
Agilent Technologies
Agilent 81624B
Agilent Technologies Manufacturing GmbH & Co KG
Photonic Measurement Division
Herrenberger Str. 130
71034 Böblingen, Germany
4
17.01.2005 - 03.02.2005
Braunschweig, 2005-02-07

Certificate of Calibration

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Specifications

	Agilent 81635A	Agilent 81634B	Agilent 81630B
Sensor Element	InGaAs (dual)	InGaAs	InGaAs
Wavelength Range	800 nm to 1650 nm	800 nm to 1700 nm	970 nm to 1650 nm
Power Range	–80 dBm to +10 dBm	–110 dBm to +10 dBm	–70 dBm to +28 dBm
Applicable Fiber Type	Standard SM and MM up to 62.5 µm core size, NA ≤0.24	Standard SM and MM up to 100 µm core size, NA ≤0.3	Standard SM and MM up to 100 µm core size, NA ≤0.3
Uncertainty (accuracy) at Reference Conditions	typ. <±3.5 % (800 nm to 1200 nm) ±3 % (1200 nm to 1630 nm)	±2.5 % (1000 nm to 1630 nm)	±3.0 % for 1255 nm to 1630 nm at 980 nm ±3.5 % (add ±0.5% per nm if 980 nm is not the center wavelength) at 1060 nm ±4.0 % (add ±0.6% per nm if 1060 nm is not the center wavelength)
Total Uncertainty	typ. ±5.5% ± 200 pW (800 nm to 1200 nm) ±5% ± 20 pW (1200 nm to 1630 nm)	±4.5% ± 0.5 pW (1000 nm to 1630 nm)	±5 % ± 1.2 nW (1255 nm to 1630 nm) at 980 nm ±5.5 % ± 1.2 nW (add ±0.5% per nm if 980 nm is not the center wavelength) at 1060 nm ±6.0 % ± 1.2 nW (add ±0.6 % per nm if 1060 nm is not the center wavelength)
Relative Uncertainty – due to polarization – spectral ripple (due to interference)	 typ. <±0.015 dB typ. <±0.015 dB	 <±0.005 dB <±0.005 dB	 <±0.01 dB <±0.005 dB
Linearity (power) – at 23°C ± 5°C – at operating temp. range	CW –60 dBm to +10 dBm typ. <±0.02 dB (800 nm to 1200 nm) <±0.02 dB (1200 nm to 1630 nm) typ. <±0.06 dB (800 nm to 1200 nm) <±0.06 dB (1200 nm to 1630 nm)	CW –90 dBm to +10 dBm <±0.015 dB (1000 nm to 1630 nm) <±0.05 dB (1000 nm to 1630 nm)	CW –50 dBm to +28 dBm (970 nm – 1630 nm) ≤±0.05 dB ≤±0.15 dB
Return Loss	>40 dB	>55 dB	>55 dB
Noise (peak to peak)	typ. <200 pW (800 nm to 1200 nm) <20 pW (1200 nm to 1630 nm)	<0.2 pW (1200 nm to 1630 nm)	<1.2 nW (1255 nm – 1630 nm)
Averaging Time (minimal)	100 µs	100 µs	100 µs
Analog Output	None	included	included
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8″ x 1.3″ x 13.2″)	75 mm x 32 mm x 335 mm (2.8″x 1.3″x 13.2″)	75 mm x 32 mm x 335 mm (2.8″x 1.3″x 13.2″)
Weight	0.5 kg	0.5 kg	0.6 kg
Recommended Recalibration Period	2 years	2 years	2 years
Operating Temperature	+10°C to +40°C	0°C to +45°C	0°C to +35°C
Humidity	Non-condensing	Non-condensing	Non-condensing
Warm-up Time	20 min	20 min	20 min

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	Agilent 81636B
Sensor Element	InGaAs
Wavelength Range	1250 nm to 1640 nm
Power Range	–80 dBm to +10 dBm
Applicable Fiber Type	Standard SM and MM up to 62.5 µm core size, NA ≤0.24
Uncertainty (accuracy) at Reference Conditions	±3 % (1260 nm to 1630 nm)
Total Uncertainty	±5% ± 20 pW (1260 nm to 1630 nm)
Relative Uncertainty – due to polarization – spectral ripple (due to interference)	 typ. ±0.015 dB typ. ±0.015 dB
Linearity (power) – at 23°C ± 5°C – at operating temperature range	CW –60 to +10 dBm, (1260 nm to 1630 nm) <±0.02 dB <±0.06 dB
Return Loss	>40 dB
Noise (peak to peak)	<20 pW (1260 nm – 1630 nm)
Averaging Time (minimal)	25 µs
Dynamic Range at Manual Range Mode – at +10 dBm-range – at ±0 dBm-range – at –10 dBm-range – at –20 dBm-range	 typ. >55 dB typ. >55 dB typ. >52 dB typ. >45 dB
Noise at Manual Range Mode (peak to peak) – at +10 dBm-range – at ±0 dBm-range – at –10 dBm-range – at –20 dBm-range	CW –60 to +10 dBm, 1260 nm to 1630 nm <50 nW <5 nW <1 nW <500 pW
Analog Output	Included
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")
Weight	0.5 kg
Recommended Recalibration Period	2 years
Operating Temperature	+10°C to +40°C
Humidity	Non-condensing
Warm-up Time	0 min

	Agilent 81623B	Agilent 81623B Calibration Option C85/C86	Agilent 81623B Calibration Option C01/C02
Sensor Element	Ge, ø 5 mm		
Wavelength Range	750 nm to 1800 nm		
Power Range	–80 dBm to +10 dBm		
Applicable Fiber Type **Open Beam**	Standard SM and MM max 100 µm core size, NA ≤0.3 Parallel beam max ø 4 mm		
Uncertainty at Reference Conditions	±2.2 % (1000 nm to 1650 nm) ±3.0 % (800 nm to 1000 nm)	±2.2 % (1000 nm to 1650 nm) ±2.5 % (800 nm to 1000 nm)	±1.7 % (1000 nm to 1650 nm) ±3.0 % (800 nm to 1000 nm)
Total Uncertainty	±3.5% ± 100 pW (1000 nm to 1650 nm) ±4.0% ± 250 pW (800 nm to 1000 nm)	±3.5% ± 100 pW (1000 nm to 1650 nm) ±3.5% ± 250 pW (800 nm to 1000 nm)	±3.0% ± 100 pW (1000 nm to 1650 nm) ±4.0% ± 250 pW (800 nm to 1000 nm)
Relative Uncertainty – due to polarization – spectral ripple (due to interference)	<±0.01 dB (typ. <±0.005 dB) <±0.006 dB (typ. <±0.003 dB)		
Linearity (power) – at 23°C ±5°C – at operating temp. range	(CW –60 dBm to +10 dBm) <±0.025 dB <±0.05 dB		
Return Loss	>50 dB, typ. >55 dB		>56 dB
Noise (peak to peak)	<100 pW (1200 nm to 1630 nm) <400 pW (800 nm to 1200 nm)		
Averaging Time (minimal)	100 µs		
Analog Output	included		
Dimensions	57 mm x 66 mm x 156 mm		
Weight	0.5 kg		
Recommended Recalibration Period	2 years		
Operating Temperature	0°C to 40°C		
Humidity	Non-condensing		
Warm-up Time	40 min		

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Optical Power Meter (cont.)

	Agilent 81624B	Agilent 81624B Calibration Option C01/C02	Agilent 81626B	Agilent 81626B Calibration Option C01/C02
Sensor Element	InGaAs, ø 5 mm		InGaAs, ø 5 mm	
Wavelength Range	800 nm to 1700 nm		850 nm to 1650 nm	
Power Range	–90 dBm to +10 dBm		–70 to +27 dBm (1250 nm to 1650 nm) –70 to +23 dBm (850 nm to 1650 nm)	
Applicable Fiber Type Open Beam	Standard SM and MM max 100 µm core size, NA ≤0.3 Parallel beam max ø 4 mm		Standard SM and MM max 100 µm core size, NA ≤0.3 Parallel beam max ø 4 mm	
Uncertainty at Reference Conditions	±2.2 % (1000 nm to 1630 nm)	±1.5 % (970 nm to 1630 nm)	±3.0 % (950 nm to 1630 nm)	±2.5 % (950 nm to 1630 nm)
Total Uncertainty	±3.5% ± 5 pW (1000 nm to 1630 nm)	±2.8% ± 5 pW (970 nm to 1630 nm)	±5.0% ± 500 pW (950 nm to 1630 nm)	±4.5% ± 500 pW (950 to 1630 nm max 23 dBm) (1250 to 1630 nm max 27 dBm)
Relative Uncertainty – due to polarization – spectral ripple (due to interference)	≤±0.005 dB (typ. ±0.002 dB) ≤±0.005 dB (typ. <±0.002 dB)		≤±0.005 dB (typ. ±0.002 dB) ≤±0.005 dB (typ. <±0.002 dB)	
Linearity (power) – at 23°C ±5°C – at operat. temp. range	CW –70 dBm to +10 dBm, 1000 nm to 1630 nm <±0.02 dB <±0.05 dB		CW –50 dBm to +27dBm, 950 nm to 1630 nm <±0.04 dB <±0.15 dB	
Return Loss	typ. 60 dB		>45 dB	>47 dB
Noise (peak to peak)	<5 pW		<500 pW	
Averaging Time (min.)	100 µs		100 µs	
Analog Output	included		Included	
Dimensions	57 mm x 66 mm x 156 mm		57 mm x 66 mm x 156 mm	
Weight	0.5 kg		0.5 kg	
Recommended Recalibration Period	2 years		2 years	
Operating Temperature	0°C to 40°C		0°C to +35°C	
Humidity	Non-condensing		Non-condensing	
Warm-up Time	40 min		40 min	

	Agilent 81628B with Integrating Sphere
Sensor Element	InGaAs
Wavelength Range	800 nm to 1700 nm
Power Range	–60 dBm to +40 dBm (800 nm to 1700 nm) For operation higher than 34 dBm[1]
Damage Power	40.5 dBm
Applicable Fiber Type Open Beam	Single mode NA ≤0.2, Multimode NA ≤0.4 ø ≤3 mm center of sphere
Uncertainty at Reference Conditions	±3.0 % (970 nm to 1630 nm)
Total Uncertainty ≤10 dBm >10 dBm to ≤20 dBm >20 dBm to ≤38 dBm	(970 nm to 1630 nm) ±4.0% ± 5 nW ±4.5% ±5%
Relative Uncertainty – due to polarization – due to speckle noise at source linewidth: 0.1 pm to 100 pm >100 pm	 typ. ≤±0.006 dB typ. ≤±0.02 dB typ. ≤±0.002 dB
Linearity (power) ≤10 dBm >10 dBm to ≤20 dBm >20 dBm to ≤37 dBm >37 dBm to ≤38 dBm	(CW –40 dBm to +38 dBm), (970 nm to 1630 nm) ≤±0.03 dB ≤±0.06 dB ≤±0.09 dB ≤±0.10 dB at 23°C ± 5°C, for operating temperature range add ±0.03 dB
Return Loss	typ. >75 dB
Noise (peak to peak)	<5 nW
Averaging Time (minimal)	100 µs
Analog Output	Included
Dimensions	55 mm x 80 mm x 250 mm
Weight	0.9 kg (without heat sink)
Recommended Recalibration Period	2 years
Operating Temperature	0°C to +40°C
Humidity	Non-condensing
Warm-up Time	40 min

[1] For optical power higher than 34 dBm the attached heat sink MUST be used! For continuous optical power or average optical power higher than 38 dBm the connector adapters will get warmer than permitted according to the safety standard IEC 61010-1. The 81628B Optical Head can handle optical power up to 40 dBm, however, operation above 38 dBm is at the operators own risk. Agilent Technologies Deutschland GmbH will not be liable for any damages caused by an operation above 38 dBm.

81610A
81613A

- **Single module for return loss (RL) test**
- **High dynamic range of 75 dB**
- **Build-in Fabry-Perot laser source for 1310 nm and 1550 nm**
- **Use any external laser source, including tunable laser for swept RL applications**
- **Three easy calibration steps for enhanced accuracy**

Plug&Play for RL measurement

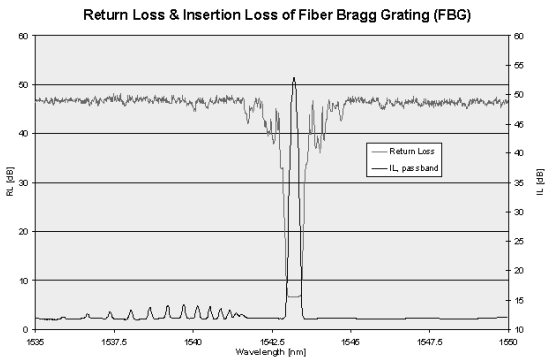
Portability and cost effective; a single mainframe, single module and single connection to the device under test are all you need to make a return loss (RL) measurement. Agilent's RL test solution solves the complex operation of calibration and is able to exclude measurement uncertainties due to coupler/filter usage in your design. In addition, a built-in FP laser at 1310 nm and 1550 nm enables basic component tests.

Meeting Manufacturing Needs

The need for IL and RL for optical component test is fulfilled with the RL module when used with an optical power meter – preferably an optical head due to its flexibility. On-board application software supports step-by-step operation with instructions.

Swept RL Measurement with a Tunable Laser Source

Today's passive component devices are not only characterized at a single wavelength, but over a wide wavelength range using a tunable laser source. The swept wavelength measurement concept is applicable for RL measurements using an Agilent tunable laser source (TLS) in synchronous operation of the two modules.



Swept RL Measurement, FBG with open and terminated output

Specifications

	81610A		81613A	
Source	external input only		Fabry-Perot Laser (internal)	
Output Power	—		typ. –4 dBm	
Center Wavelength	—		1310 nm/1550 nm ±20 nm typ.	
Sensor Element	InGaAs		InGaAs	
Fiber Type	Standard single-mode 9/125 µm		Standard single-mode 9/125 µm	
External Input	max input power: 10 dBm min input power: 0 dBm damage input power: 16 dBm		— — —	
Wavelength Range for External Input	1250 nm to 1640 nm		—	
Dynamic Range	70 dB		75 dB	
Relative Uncertainty of Return Loss (RL)	with broadband source	with Agilent FP sources	User calibration	*Plug&play*
RL ≤55 dB	<±0.25 dB	typ. <±0.5 dB	<±0.5 dB (typ. <±0.3 dB)	typ. <±0.6 dB
RL ≤60 dB	<±0.3 dB	typ. <±1.0 dB	<±0.6 dB (typ. <±0.4 dB)	typ. <±1.5 dB
RL ≤65 dB	<±0.65 dB	typ. <±2.0 dB	<±0.8 dB (typ. <±0.5 dB)	—
RL ≤70 dB	<±1.7 dB	—	<±1.9 dB (typ. <±0.8 dB)	—
RL ≤75 dB	—	—	typ. <±2.0 dB	—
Total Uncertainty	add ±0.2 dB	add typ. ±0.2 dB	add ±0.2 dB	add typ. ±0.2 dB
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")		75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")	
Weight	0.6 kg		0.6 kg	
Recommended Recalibration Period	2 years		2 years	
Operating Temperature	10 to 40°C		10 to 40°C	
Humidity	Non-condensing		Non-condensing	
Warm-up Time	20 minutes		20 minutes	

- **Low insertion loss of 0.7 dB**
- **Flatness over Wavelength**
- **Wide wavelength coverage in both singlemode and multimode fiber**
- **High attenuation resolution of 0.001 dB**
- **Active power control option**

Modular Design, Fit for Various Components or Networks

Agilent's 8157xA variable optical attenuators are a family of plug-in modules for the Lightwave Solution Platform, 8163A/B, 8164A/B and 8166A/B. The attenuator modules 81570A, 81571A and 81578A occupy one slot, while modules 81576A and 81577A occupy two slots.

Variable Optical Attenuators

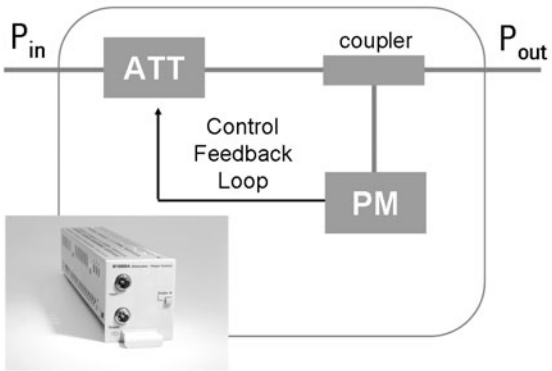
The Agilent 81570A, 81571A and 81578A are small, high resolution and are cost effective. Attributes of the attenuators are excellent wavelength flatness, ability to handle high input power levels and various calibration features to allow the user to set the reference power level. The attenuation and the power level, relative to the reference power, can be set and displayed on the mainframe user interface. The integrated shutter, can be used for protection from high power signals or to simulate channel drops.

Attenuators for High Optical Input Power

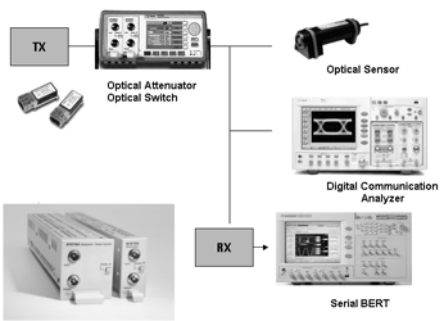
The Agilent attenuator modules feature excellent wavelength flatness and can handle input power levels of 2 mW. This attribute combined with the low insertion loss make them ideal for optical amplifier tests, such as, characterization of EDFAs and Raman amplifiers; as well as, for other multi-wavelength applications, for instance, DWDM transmission system test.

Attenuators with Power Control

Agilent's 81576A and 81577A attenuators have an added feature of dynamic power control. This function allows the user to control the attenuation more precisely by setting the output power level of attenuator, as opposed to only setting the attenuation. The module firmware uses a feedback signal from a photodiode after a monitor tap, both integrated in the module, to set and monitor the desired power level. When the power control mode is enabled, the module automatically corrects for power changes in the input signal to maintain the output level set by the user. After an initial calibration for connector interface uncertainties, absolute power levels can be set with high accuracy. The absolute accuracy of these power levels depends on the accuracy of the reference power meter used for calibration.



Block diagram of attenuator with power control



Transceiver and Receiver Test

Calibration Processes

A unique feature of the attenuator is the wavelength-offset table, which enhances the calibration capacity by setting the integral power of a DWDM signal with a known spectrum.

Specifications for 8157xA

Agilent's modular optical attenuators are a family of plug-in modules for Agilent's 8163A/B, 8164A/B and 8166A/B mainframes. Their high power handling capability together with excellent wavelength flatness and low insertion loss make them ideal for testing optical amplifiers and other DWDM test applications.

Modular Optical Attenuator Modules for High-Power Applications

	81570A	81571A	81576A		81577A	
Connectivity	Straight connector versatile interface	Angled connector versatile interface	Straight connector versatile interface		Angled connector versatile interface	
Fiber Type	9/125 µm SMF28		9/125 µm SMF			
Wavelength Range	1200 – 1700 nm		1250 – 1650 nm			
Attenuation Range	0 – 60 dB		0 – 60 dB			
Resolution	0.001 dB		0.001 dB			
			Attenuation Setting	**Power Setting**	**Attenuation Setting**	**Power Setting**
Repeatability[1]	±0.01 dB		±0.010 dB	±0.015 dB[14]	±0.010 dB	±0.015 dB[14]
Accuracy (uncertainty)[1, 2, 3, 4]	±0.1 dB		±0.1 dB	—	±0.1 dB	—
Settling Time (typical)[5]	typ. 100 ms		100 ms	300 ms	100 ms	300 ms
Transition Speed (typical)	0.1 – 12 dB/s		0.1 – 12 dB/s			
Relative Power Meter Uncertainty[15]	—		±0.03 dB ± 200 pW[16]			
Attenuation Flatness[1, 4, 6]	<±0.07 dB (typically ±0.05 dB) for 1520 nm <λ <1620 nm[8] typically ±0.10 dB for 1420 nm <λ <1640 nm[8]					
Spectral Ripple (typical)[7]	±0.003 dB		±0.003 dB			
Insertion Loss[2, 4, 9, 10]	Typically 0.7 dB excluding connectors <1.6 dB (typically 1.0 dB) including connectors[11]		Typically 0.9 dB (excluding connectors) <1.8 dB (typically 1.2 dB) Connectors Including[11]			
Insertion-Loss Flatness (typical)[1, 11]	±0.1 dB for 1420 nm <λ <1615 nm[4]		±0.1 dB for 1420 nm <λ <1615 nm[4]			
Polarization-Dependent Loss[2, 9, 11]	<0.08 dBpp (typically 0.03 dBpp)		<0.10 dBpp (typically 0.05 dBpp)			
Polarization Extinction Ratio	—		—			
Return Loss (typical)[9, 11]	45 dB (at 1550 nm ±15 nm)	57 dB (at 1550 nm ±15 nm)	45 dB		57 dB	
Maximum Input Power[13]	+33 dBm	+33 dBm	+33 dBm		+33 dBm	
Shutter Isolation (typical)	100 dB	100 dB	100 dB		100 dB	

[1] At constant temperature.
[2] Output power >–40 dBm, input power <+27 dBm. For input power >+27 dBm add typically ±0.01 dB.
[3] Temperature within 23°C ± 5°C.
[4] Input power <+30 dBm; λ = 1550 nm ± 15 nm; typical for 1250 nm <λ <1650 nm.
[5] For unpolarized light (SMF versions), or polarized light with TE mode injected in the slow axis (PMF version).
[6] Step size <1 dB; for full range: typically 6 s.
[7] Relative to reference at 0 dB attenuation.
[8] Linewidth of source ≥100 MHz.
[9] λ_{disp} set to 1550 nm; attenuation ≤20 dB.
For attenuation >20 dB:
add typically 0.01 dB (α [db] – 20) for 1520 nm < λ <1620 nm.
and typically 0.02 dB (α [db] – 20) for 1420 nm <λ <1640 nm.
[10] For λ = 1550 nm ± 15 nm.
[11] Add typically 0.1 dB for λ = 1310 nm ± 15 nm.
[12] Measured with Agilent reference connectors.
[13] Excluding connectors, measured using a broadband source.
[14] Agilent Technologies assumes no responsibility for damages caused by scratched or poorly cleaned connectors.
[15] Output power >–40 dBm, input power <+27 dBm; for input power >+27 dBm add typically ±0.01 dB.
[16] Wavelength and SOP constant; temperature constant and between 23°C ±°C; λ <1630 nm.
[17] Input power ≤+27 dBm; for input power >+27 dBm add ±0.02 dB.

Variable Optical Attenuator Modules (Multimode Fibers)

The specifications below are valid for constant operating and signal launch conditions.

	81578A-050	81578A-062
Connectivity	Straight connector versatile interface	
Fiber Type	50/125 µm MMF	62.5/125 µm MMF
Wavelength Range	700 nm – 1400 nm	
Attenuation Range	0 – 60 dB	
Resolution	0.001 dB	
Repeatability[1, 2, 5]	±0.015 dB	
Accuracy (uncertainty)[1, 2, 3, 4, 5]	typ. ±0.15 dB (800 nm – 1350 nm) ±0.2 dB (at 850 nm ±15 nm, 1310 nm ±15 nm)	
Settling Time[6]	typ. 100 ms	
Transition Speed	typ. 0.1 – 12 dB/s	
Insertion Loss[1, 2, 4, 5]	typ. 1.0 dB (NA = 0.1) typ. 1.3 dB (NA = 0.2) 2.0 dB (NA = 0.2)	typ. 1.0 dB (NA = 0.1) typ. 1.3 dB (NA = 0.2) 2.0 dB (NA = 0.2) typ. 3.0 dB (NA = 0.27)
Return Loss[2, 5, 7]	typ. 27 dB	
Maximum Input Power[8]	+27 dBm	
Shutter Isolation	typ. 100 dB	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.8" x 1.3" x 13.2")	
Weight	0.9 kg	
Recommended Recalibration Period	2 years	
Operating Temperature	10°C – 45°C	
Humidity	Non-condensing	
Warm-up Time	30 minutes	

[1] At constant operating conditions.
[2] Effective spectral bandwidth of source >5 nm.
[3] For mode launch conditions with NA = 0.2; for every ΔNA = 0.01 add typ. ±0.01 dB.
[4] Temperature within 23°C ±5°C and unpolarized light.
[5] At 850nm ±15 nm, 1310 nm ±15 nm.
[6] Step size <1 dB, for full range: typ. 6 seconds.
[7] The return loss is mainly limited by the return loss of the front panel connectors.
[8] Agilent Technologies Deutschland GmbH assumes no responsibility for damages caused by scratched or poorly cleaned connectors.

Ordering Information

For the most up-to-date information on Agilent 8157xA optical attenuators, please contact your Agilent Technologies sales representative or visit our web site at: **www.agilent.com/comms/lightwave**

Please contact your Agilent Technologies sales representative for a polarization maintaining fiber pigtail version.

Connector Interface
All modules require two connector interfaces, 81000xI series (physical contact).

81591B
81594B
81595B

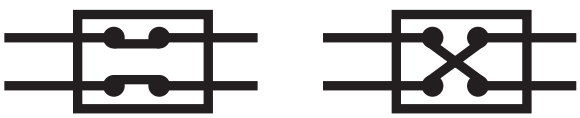
- **Wide wavelength range for singlemode and multimode applications**
- **Excellent repeatability specified over 10,000 random cycles**
- **Low insertion loss of <1.0 dB**
- **Single-slot modular design, allows up to 17 switches in one mainframe**

Modular Design for Solution Platform

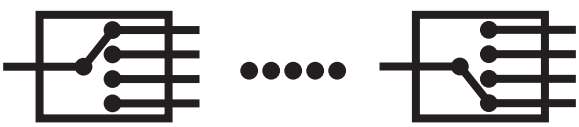
The Agilent modular optical switches are a family of plug-in modules to be used with the Lightwave Solution Platform. The switches enable manufacturers' of optical networks and components to automate their processes by routing optical signals to various test instrumentation. Adding modular optical switches to this instrument platform allows for a flexible and cost effective all-in-one solution to be developed for optical component tests in automated test environments.

The 1 x 2 optical switch has two positions:

The 2 x 2 non-blocking (crossover) optical switch also has two positions:

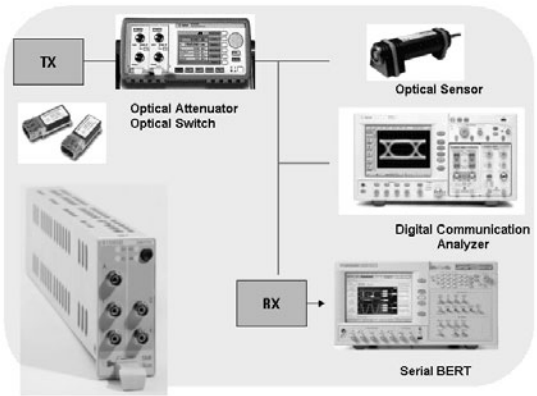


The 1 x 4 optical switch also has four positions:



Application Fit for Passive and Active Component Tests

Agilent's 8159xB modular optical switch family offers 1 x 2, 2 x 2 and 1 x 4 input/output port switching as plug-in modules for Agilent's 8163A/B, 8164A/B and 8166A/B mainframes. High repeatability makes the switches ideal for signal routing in automated test environments. Each switch type is available with angled FC connectors for singlemode and straight FC connectors for multimode applications.



Solution for system integration using optical switch

Integrating Switches Without Increasing System Uncertainty

Agilent's switching modules are designed for the best optical performance. Therefore you gain the flexibility you need in your automated test stations without compromising your measurement accuracy.

81591B/81594B/81595B Modular Optical Switches (cont.)

81591B
81594B
81595B

Modular Optical Switch Specifications

	81591B		81594B		81595B	
Switch Type	1 x 2		2 x 2		1 x 4	
Fiber Interface	# 009 single mode	# 062 multimode	# 009 single mode	# 062 multimode	# 009 single mode	# 062 multimode
Fiber Type	9/125 µm SMF	62.5/125 µm MMF	9/125 µm SMF	62.5/125 µm MMF	9/125 µm SMF	62.5/125 µm MMF
Connectivity	FC/APC – R angled	FC/PC straight	FC/APC – R angled	FC/PC straight	FC/APC – R angled	FC/PC straight
Wavelength Range	1270 – 1670 nm	700 – 1400 nm	1270 – 1670 nm	700 – 1400 nm	1270 – 1670 nm	700 – 1400 nm
Insertion Loss	<1.0 dB[3]	<1.0 dB[1]	<1.5 dB[3]	<1.0 dB[1]	<2.0 dB[4]	<2.0 dB[1]
Polarization Dependent Loss	typ. 0.05 dBpp	N/A	typ. 0.05 dBpp	N/A	typ. 0.07 dBpp	N/A
Repeatability[2]	±0.02 dB	±0.02 dB[1]	±0.02 dB	±0.02 dB[1]	±0.03 dB	±0.03 dB[1]
Return Loss	typ. 55 dB	typ. 20 dB	typ. 50 dB	typ. 20 dB	typ. 55 dB	typ. 20 dB
Crosstalk	typ. –70 dB	typ. –70 dB	typ. –70 dB	typ. –70 dB	typ. –70 dB	typ. –70 dB
Switching Time	<10 ms					
Lifetime	>10 million cycles					
Maximum Input Power	+20 dBm					
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm (2.9″ x 1.3″ x 13.2″)					
Weight	0.5 kg					
Operating Temperature	10°C to 45°C					
Storage Temperature[5]	–40°C to 70°C					
Humidity	Non-condensing					
Warm-up Time	30 min.					

[1] Specification is typical with 50/125 µm multimode fiber.
[2] Worst case measurement deviation over 10,000 random switching cycles.
[3] For λ = 1550 nm; for 1270 nm < λ < 1670 nm add 0.3 dB.
[4] For λ = 1550 nm; for 1270 nm < λ < 1670 nm add 0.6 dB.
[5] Allow minimum acclimatization of 2 hours if previously stored outside operating temperature range before turning on the module.

Ordering Information

Modules for single mode fiber interface: #009
Modules for multimode fiber interface: #062

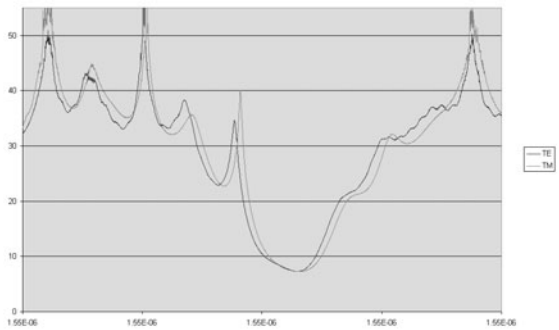
- **Precise manual and remote adjustments of polarization state**
- **Nine Save/Recall registers of SOP**
- **Continuous autoscanning mode, tuning the SOP across the entire Poincaré sphere**

Developing and manufacturing competitive, high-value components and systems for today's optical industries requires precise attention to polarization dependence. The Agilent 8169A Polarization Controllers can help by saving time, money and effort when measuring with controlled polarization.

Polarization dependence can occur in many components, including filters, multiplexers, EDFAs, polarization maintaining fiber, isolators, switches, lasers, detectors, couplers, modulators, interferometers, retardation plates and polarizers. Device performance will be determined by polarization-dependent sensitivity, loss, gain, degree of polarization and polarization mode dispersion. These polarization phenomena enhance or degrade performance depending on the application area, be it communications, sensors, optical computing or material analysis.

An Important Part of a Measurement System

A polarization controller is an important building block of an optical test system because it enables the creation of all possible states of polarization. For passive device test, the polarized signal stimulates the test device while the measurement system receiver monitors the response to changing polarization. Sometimes polarization must be adjusted without changing the optical power. At other times, polarization must be precisely synthesized to one state of polarization (SOP) and then adjusted to another SOP according to a predetermined path.



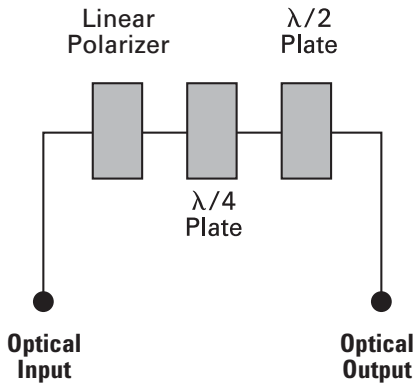
Characterizing polarization dependence of a passive optical filter component. Orthogonal great circles on the Poincaré sphere show how the Agilent 8169A synthesizes relative state-of-polarization points according to a specified path.

The Agilent 8169A Polarization Controller

The Agilent 8169A provides polarization synthesis relative to a built-in linear polarizer. The quarter-wave plate and half-wave plate are individually adjusted to create all possible states of polarization. The input light can be either polarized or unpolarized due to the input polarizer. Built-in algorithms within the Agilent 8169A enable the transition path from one state of polarization on the Poincare sphere to another to be specified along orthogonal great circles. These features are important because device response data can be correlated to specific states of polarization input to the test device. PDL measurement of DWDM components using the Mueller Matrix method is one of the main applications. The Mueller method stimulates the test path with four precisely known states. Precise measurement of the corresponding output intensities allows calculation of the upper row of the Mueller matrix, from which PDL is calculated. This method is fast, and ideal for swept-wavelength testing of PDL with high wavelength resolution.

Application Matrix for Agilent 8169A Polarization Controllers

Application Description	Agilent 8169A Application
1. Polarization synthesis	Yes
2. Complete, automatically stepped, adjustments of polarization over the entire Poincare sphere	Yes (deterministic)
3. Single-wavelength polarization – dependent loss measurement	Yes
4. Swept-wavelength polarization – dependent loss measurement	Yes
5. Polarization – dependent gain measurements of EDFA	Yes
6. Polarization nulling for EDFA characterization	Yes
7. Polarization sensitivity measurements of optical coupling factor	Yes (power delta vs SOP)
8. Optical waveguide TE/TM mode testing	Yes
9. Polarized beam alignment relative to principal polarization states of the test device	Yes
10. Polarization adjustment of optical launch conditions for polarization mode dispersion measurements	Yes
11. Simulate depolarized signals using rapid polarization scanning	Yes



Agilent 8169A Block Diagram

Specifications

Specifications describe the instruments' warranted performance over the 0° C to +55° C temperature range after a one-hour warm-up period. Characteristics provide information about non-warranted instrument performance. Specifications are given in normal type. Characteristics are stated in *italicized* type.Spliced fiber pigtail interfaces are assumed for all cases except where stated otherwise.

Description	Agilent 8169A
Operating Wavelength Range	1400 to 1640 nm
Insertion Loss Variation over 1 full rotation Variation over complete wavelength range	<1.5 dB ±<0.03 dB ±<0.1 dB
Polarization Extinction Ratio *Characteristic*	>45 dB (1530 to 1560 nm) >40 dB (1470 to 1570 nm) *>30 dB (1400 to 1640 nm)*
Polarization Adjustment Resolution Fast axis alignment accuracy at home position Angular adjustment accuracy: minimum step size greater than minimum step size *Settling time (characteristic)* Memory Save/Recall registers Angular repeatability after Save/Recall Number of scan rate settings Maximum rotation rate	 0.18° (360°/2048 encoder positions) ±0.2° ±0.09° ±<0.5° *<200 ms* 9 ±0.09° 2 360°/sec
Maximum Operating Input Power Limitation	+23 dBm
Operating Port Return Loss (characteristic) *Individual reflections*	 *>60 dB*
Power Requirements	48 to 60 Hz 100/120/220/240 V_{rms} 45 VA max
Weight	9 kg (20 lb)
Dimensions (H x W x D)	10 x 42.6 x 44.5 cm 3.9 x 16.8 x 17.5 in

81490A Reference Transmitter

Agilent's 81490A Reference Transmitter is designed to offer excellent eye quality as a reference for testing 10_GbE-L and 10_Gb-E according to IEEE 802.3ae and according to 10 GFC Fibre Channel specifications. The module is fully integrated into the industry standard LMS 816xB platform.

Offering both 1310 and 1550 nm gives the fastest reconfiguration between these two transmission bands without reconnecting.

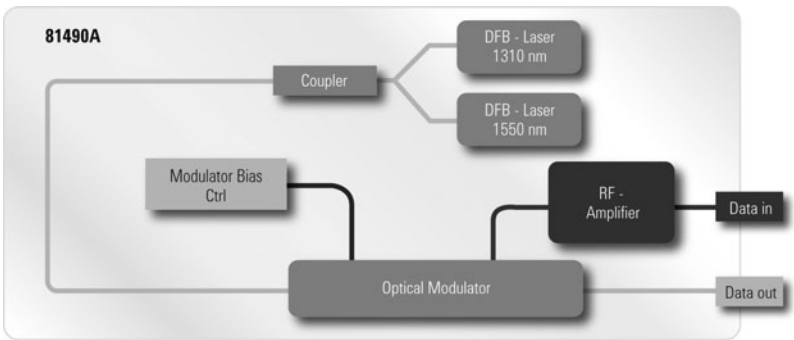
The separation of the signal source and the modulator is the only way to offer a zero-chirp modulation. This is essential for a clean and repeatable eye diagram when modulating with an appropriate clean external source to fulfill the requirements of the IEEE standard. Another advantage of this design compared to directly modulated transmitters is the wide extinction ratio range that can only be achieved with this design.

Key Benefits

- Repeatable and reproducible measurements permit narrower production test margins and improved specifications of the characterized devices
- Reliable measurements ensure comparability of the test results
- Support for full compliance to IEEE 802.3ae stressed eye test in combination with the N4917A Optical Receiver Stress Test solution
- Wide extinction range offers highest test range coverage to ensure best quality of the tested devices under all target operating conditions
- Rapid test reconfiguration with dual-wavelength to switch between 1310 nm and 1550 nm by remote control or manually without exchanging a module
- Scalability with integration into industry-standard Agilent LMS platform extends your optical workbench capabilities

Specifications

Extinction Ratio
ER 1 ... 10 dB
Rise and Fall Times
t_r, t_f (80/20) <30 ps
Vertical Eye Closure Penalty
VECP <0.5 dB
Jitter
<0.2 UI
Relative Intensity Noise (RIN)
RIN <–136 dB/Hz
Transmitter Wavelength
1310 ± 10 nm, 1550 nm ± 10 nm
Unmodulated Optical Output Power
P_{out} >4 mW



Reference Optical Receiver Module

81495A Reference Receiver

81495A

Key Benefits

- Clean eye for best loop back performance in transceiver test
- Low noise and low jitter to support reliable O/E conversion for stressed eye test
- Compliance to IEEE 802.3/10 GFC stressed eye test in combination with the N4917A Optical Receiver Stress Test solution
- Quick signal level verification and diagnosis with average optical power meter
- Scalability with integration in the industry standard Agilent LMS platform extends your optical workbench capabilities

Specifications

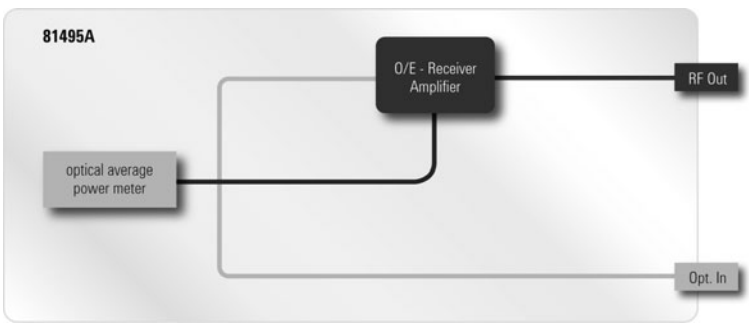
Conversion Gain
>400 V/W
Conversion Bandwidth
$f_{-3\ dB\ el}$ >9 GHz
Wavelength Range
1290 – 1560 nm
Measurement Range of Optical Power Meter
+3 ... –30 dBm
RF Output Coupling
DC
Fiber Output
SMF 9/125

81495A Reference Receiver

Agilent's 81495A single mode reference receiver is designed for testing transceiver loopback according to IEEE 802.3/10 GFC. The module is fully integrated into the industry standard LMS 816xB platform.

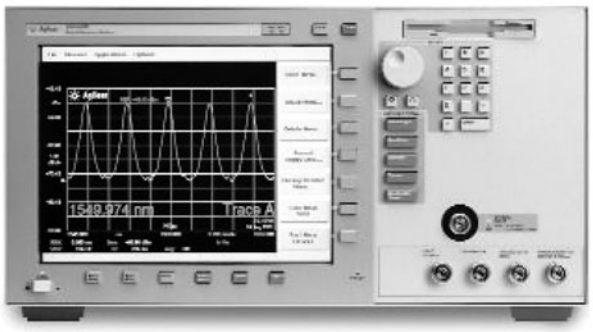
For the transceiver loop back test the return signal of the transceiver is feed back to the BERT (Bit Error Ratio Tester). As the transceiver output is optical, the signal must first be converted to the electrical domain with the 81495A Reference Receiver. The performance of this conversion has significant influence on the results of the loopback test. The 81495A reference receiver works perfectly with the N4917A Optical Transceiver Stress Test solution.

The 81495A reference receiver provides an integrated optical average power meter. The capability of verifying the average optical power of the connected signal at any time is a fast and simple way to avoid problems with the test setup and the test results.



86142B
86146B

- **Filter mode**
- **Excellent wavelength accuracy and low polarization dependence**
- **90 dBm sensitivity and 90 dB dynamic range**
- **Flexible monochromator output model**
- **Applications with automatic pass/fail checking**



Agilent 86164B

86142B and 86146B Optical Spectrum Analyzers

The Agilent 8164xB family of grating-based optical spectrum analyzers display the amplitude of light versus wavelength over a 600 to 1700 nm wavelength range. The OSA uses a patented double-pass monochromator design to simultaneously achieve high sensitivity and dynamic range with a fast sweep time. This is key for characterizing DWDM components and multiple channel systems, especially in a manufacturing environment where speed, accuracy and throughput are critical. The OSAs also have a two year calibration cycle keeping production on-line longer.

Built-in Applications

Agilent Technologies has developed a unique concept for built-in applications. The complete suite of applications enables the user to develop tests that can be customized to their particular measurement. The current package of applications contains the following:

- Passive component test application
- WDM application
- Amplifier test application
- Source test application

Additional Features

The Agilent 8614xB family of optical spectrum analyzers feature up to six traces and four independent markers. The built-in trace math function of the OSA allows for multiple traces to be used for normalization measurements. The markers allow for easy measurement of wavelength separation (GHz or nm), power density and optical signal-to-noise ratio.

Filter Mode

In Filter Mode, available with the 86146B, the light from the grating monochromator is directed to a single-mode fiber optical output from the instrument. The monochromator can be swept or set to a fixed wavelength. At the front panel, the user has the option of routing the light back to a photodetector in the OSA, especially for alignment, or to another instrument for analysis. As with standard operation, the resolution bandwidth of this tunable wavelength filter can be set by the user.

Channel Drop

One of the features of Filter Mode is to allow a single channel to be isolated from a tightly spaced DWDM signal. The WDM firmware application can sequentially or selectively drop WDM channels that require additional analysis. It is possible to select a certain wavelength or a certain channel to be dropped out. It can then be quantitatively analyzed in the time domain. It is now possible to switch between parametric measurements in the physical domain to functional measurements in the time domain.

Time Resolved Chirp

Agilent's filter mode channel-drop feature enables lower cost of test and higher flexibility of use than other solutions. However, the benefits don't end there. A second feature of Agilent's filter mode is the ability to measure time-resolved chirp (TRC). Chirp is the small frequency shift that occurs during optical signal modulation. It is caused by the slight changes in refractive index of the optical modulator. TRC is the instantaneous optical frequency deviation versus time. Measuring TRC enables lower cost lasers to be used in DWDM components.

The TRC measurement is made using the 86146B OSA and the 86100C Digital Component Analyzer. The 86100C requires an optical module like the 86105B, 86105C or 86116A. The software, provided with the 86146B performs the TRC measurement and Dispersion Penalty Calculation (DPC). The DPC routine can be used to qualify transmitters for the distance over which they can be used and is an alternative to measuring dispersion penalty using a bit error ratio setup.

Core Specification*	86142B	86146B
Wavelength		
Range	600 – 1700 nm	600 – 1700 nm
Accuracy		
1480 – 1570 nm	±0.01 nm	±0.01 nm
1570 – 1620 nm	±0.025 nm	±0.025 nm
Resolution Bandwidth		
FWHM	0.06, 0.1, 0.2, 0.4, 1.2, 5, 10 nm	0.06, 0.07, 0.1, 0.14 0.2, 0.33, 0.4, 1.2, 5, 10 nm
Polarization Dependence		
1530 nm, 1565 nm	±0.05 dB	±0.05 dB
1250 nm – 1650 nm	±0.25 dB	±0.25 dB
Dynamic Range (0.1 nm RBW)		
1250 – 1610nm		
±0.5, 1, 5 nm	–70 dB	
At ±0.8 nm	–60 dB	–60 dB
At ±0.4 nm	–55 dB	–55 dB

* For detailed spec conditions please refer to technical specification.

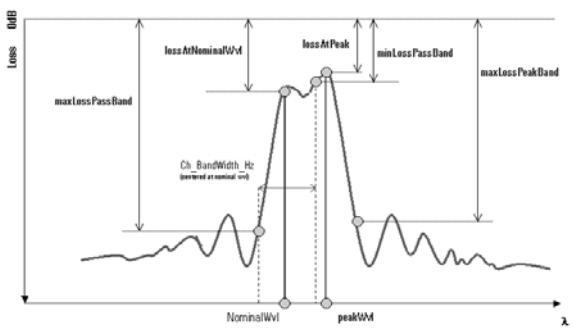
N4150A Photonic Foundation Library

N4150A

- **Software library to enable automation of stimulus-response system**
- **Predetermined solution specification**
- **Easy-to-use Application-Programmable Interface (API) with *Plug&Play* drivers**
- **Ready-to-go user interface with the Photonic Analysis Toolbox**

Comprehensive Analysis Tool for Component Research

Measuring just the IL or PDL is often not sufficient to characterize component and fibers. To obtain a more complete picture of the component's characteristics, especially for WDM components, further parameters such as bandwidth, channel spacing, center wavelength are desired. The PFL offers a set of functions to analyze spectral insertion loss measurement.

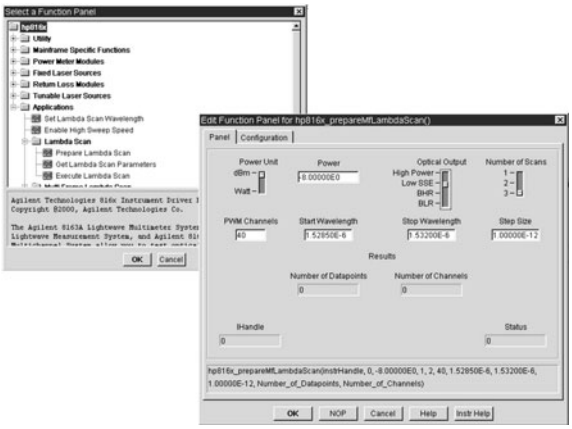


Analysis Tool for Component Characterization

Test Software Solution for High-Volume Manufacturing

A novel class of test software, especially designed to suit the speed, automation and reliability requirements of the manufacturing floor, can now be combined with the well-regarded reliability of Agilent's optical component test equipments.

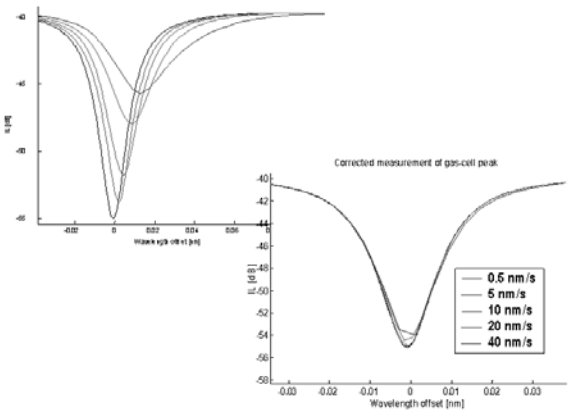
Reduce implementation time for system automation with easy Plug&Play driver or using user-friendly graphical programming environment of Agilent Photonic Foundation Library. Or simply copy & past from variety of sample programs provided in various programming environment.



Plug&Play driver

Remove Measurement Uncertainties

Adaption of appropriate power meter average time in conjunction with sweep speed of tunable laser source, correction of waveplate retardation error by polarization controller, correction of wavelength accuracy are some measurement uncertainty needed to be considered when tunable laser source and power meter are used for component test in a swept condition. Agilent Photonic Foundation Library is the industry's only tool to improve the measurement accuracy by proprietary methods, ensuring swept measurement performance close to the static performance at full speed.



Correction algorithm for spectrum characterization

Specifications

	Technical Specifications
Required Instruments and Options	8164B Lightwave Measurement System (mainframe); 81600B Tunable Laser module, #072 angled connector interface; One or more 81634A or 81634B Power Sensor(s); 8166A Lightwave Multichannel System(s) (mainframe), as many as required; Launch cable (81113PC or comparable), standard single-mode fiber, max. length 2 m, connects directly to power meter (straight cleave or connector) for reference measurement, and to device under test for device measurement (splice or connector); 8169A Polarization Controller, #022 angled connector interface; N4160A Jumper Cable Kit, length 0.4 m, protected standard single-mode fiber, E-2108.6 angled connectors, required to connect tunable laser with polarization controller; Matching connector interfaces and adapters.
Required Test Station Controller and Software	PC as test station controller, according to minimum system requirements; N4150A or N4151A Photonic Foundation Library, release 1.0 or later; Mainframe software release 2.57 or later; Module firmware release 2.62 or later (81600B: release 2.63 or later); 816x VISA VXI*plug&play* driver, release 2.91 or later; 8169A VISA VXI*plug&play* driver, release 1.31 or later.
Wavelength Range	1520 nm to 1620 nm
Wavelength Resolution	0.5 pm, 62.5 MHz at 1550 nm
Absolute Wavelength Uncertainty (typ.)[1]	±3 pm
Relative Wavelength Uncertainty (typ.)[1]	±2 pm
Wavelength Repeatability (typ.)[1]	±1 pm
Insertion Loss Measurement Range (typ.)[2]	≥75 dB (3 sweeps) ≥60 dB (2 sweeps) ≥35 dB (1 sweep)
Operating Conditions	ambient temperature 20°C to 30°C, constant ±1 K relative humidity <80%, non-condensing
Warm-up Time	1 hour

	Insertion loss ≤10 dB PDL ≤0.25 dB_{pp}	**Insertion loss ≤35 dB PDL ≤0.25 dB_{pp}**	**Insertion loss ≤55 dB PDL ≤0.25 dB_{pp}**
Number of Sweeps	1	2	3
Relative Insertion Loss Uncertainty (typ.)[3, 4, 5]	±0.022 dB	±0.022 dB	±0.032 dB
Polarization Dependent Loss (PDL) Uncertainty (typ.) Device Under Test Connected with Fusion Splices[3, 5]	±0.020 dB	±0.030 dB	±0.080 dB
Polarization Dependent Loss (PDL) Uncertainty (typ.) Device Under Test Connected with Physical Connectors[3, 5]	±0.035 dB	±0.040 dB	±0.085 dB
Total Measurement Time (typ)[3, 6]	60 s (1 channel)	110 s (1 channel) 10 min (40 channels)	155 s (1 channel)

[1] Wavelength range 1520 – 1540 nm; sweep speed ≤10 nm/s, step size = sweep speed x 0.1 ms or integer multiples; power meter range ≥–40 dBm.
[2] Source power set to –8.5 dBm; power meter zeroing prior to measurement.
[3] Measurement settings as follows: 20 nm span; 2 pm step size; 5 or 10 nm/s sweep speed; coherence control off; individual reference measurement for each power meter channel prior to measurement. Source power set to –8.5 dBm. Valid where spectral response is flat within a range of ±50 pm.
[4] For polarization dependent devices, the measurement result corresponds to the insertion loss for unpolarized light.
[5] All optical patchcords and fibers fixed and settled for 3 minutes; launch cable connected directly to power meter.
[6] With recommended system configuration, no other application running in parallel. Includes instrument initialization, measurement of device under test at four states of polarization, data acquisition and transmission. Reference measurements excluded.

N7781A
N7782A
N7783A
N7784A
N7785A
N7786A
N7788A

N7781A Polarization Analyzer

The Agilent N7781A is a compact high-speed Polarization Analyzer which provides comprehensive capabilities for analyzing polarization properties of optical signals. This includes representation of the State of Polarization (SOP) on the Poincaré Sphere (Stokes Parameter). The on-board algorithms together with the on-board calibration data ensure highly accurate operation across a broad wavelength range.

Due to its real time measurement capability (1 MSamples/s) the instrument is well suited for analyzing disturbed and fluctuating signals as well as for control applications requiring real time feedback of polarization information.

Analogue data output ports are provided, for example for support of control loops in automated manufacturing test systems.

Key Features

- Measurement of Stokes Parameter (SOP)
- Measurement of degree of polarization (DOP)
- High-speed operation (>1 MSamples/s)
- Analog output port for DOP/SOP data
- Robust, no moving parts

N7782A PER Analyzer/N7783A Thermal Cycling Unit

Agilent's N7782A series of PER Analyzers has been designed for high speed and highly accurate testing of the polarization extinction ratio (PER) in PM fibers. The polarimetric measurement principle guarantees reliable measurements of PER values of up to 50 dB.

The real time measurement capability in combination with automation interfaces makes this unit ideally suited for integration in manufacturing systems, for example pig-tailing stations for laser diodes and planar waveguide components. Analog interfaces are provided for integration of the system in control loop applications.

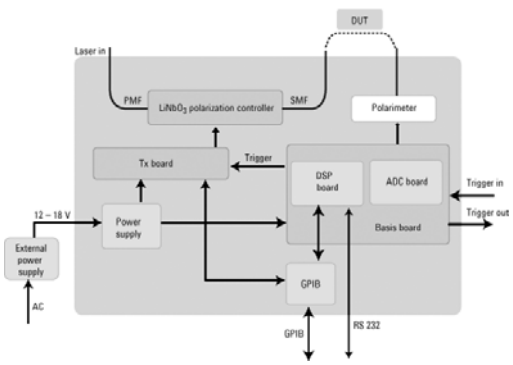
Key Benefits

- Accurate PER-measurement up to 50 dB
- Real-time display of PER
- Easy-to-use: Reliable results independent of operator skill set
- Swept-wavelength and heating/stretching method available
- Measurement of the PER versus wavelength
- Fast/slow axis detection
- Instruments available for 850 nm up to 1640 nm
- Internal fixed wavelength sources at 850 nm/1310 nm/1550 nm available

10

Agilent's Thermal Cycling Unit N7783A is fully controlled by the Agilent N7782A PER-Analyzer and allows accurate and repeatable cycling of the temperature of the fiber under test. The PER measurement system consisting of the Agilent N7782A and the Agilent N7783A shows excellent accuracy and repeatability. Ease of use and automation interfaces, such as analog output ports for active alignment, make it particularly useful for production environments.

N7788A PMD / PDL component analyzer setup



N7784A, N7785A, N7786A Polarization Conditioning Solutions

As Polarization Stabilizer the Agilent N7784A provides a stable output State of Polarization (SOP) even with fluctuations and drifts of the input SOP as occurring for example through temperature drift and mechanical settling processes. The stabilized output signal is guided in a Polarization Maintaining Fiber (PMF). Alternatively an external electrical feedback signal can be provided for stabilizing the SOP.

As Synchronous Scrambler the Agilent N7785A switches the SOP of the output signal in a (pseudo) random way. Switching of the SOP occurs within few microseconds. The SOP is stable for a predefined time until it again switches to a new SOP. An electrical trigger input can be used to synchronize the scrambler with external events.

As Polarization Stabilizer the Agilent N7786A provides a stable output State of Polarization (SOP) even with fluctuations and drifts of the input SOP. The stabilized output signal is guided in a Standard Single-Mode Fiber (SMF). The output SOP can be defined in following ways:

- **Set-and-forget:** When the front button is pushed, the current SOP is stored and maintained, even if polarization changes occur on the instrument input
- **Defined Stokes:** The target output SOP can be defined by the user using the Stokes parameters

With a built-in polarimeter the Agilent N7786A provides truly high-speed polarization analysis capabilities: More than 500,000 samples can be taken with a sample rate of up to 1 Megasamples per second.

The units do not contain any moving parts and therefore are robust and withstand even rough environmental conditions. All above mentioned are supported by a PC software package.

N7788A Optical Component Analyzer

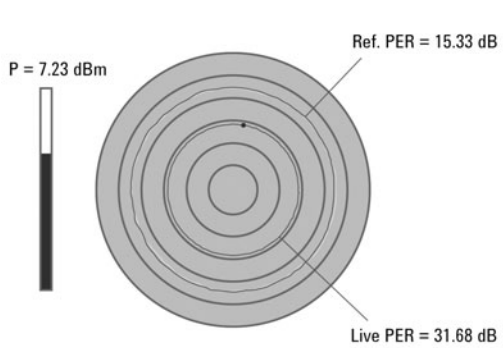
Agilent Technologies pushes the limits of component measurements with the N7788A Component Analyzer. Its proprietary technology is comparable with the well-known **Jones-Matrix-Eigenanalysis (JME)** which is the standard method for measuring Polarization Mode Dispersion (PMD) or differential group delay (DGD) of optical devices. Compared to the JME, Agilent's new **single scan technology** offers a range of advantages:

A complete set of parameters:

- DGD/PMD/PDL/2nd order PMD
- Power/Loss
- TE/TM-Loss
- Principal States of Polarization (PSPs)
- Jones and Mueller Matrices

Key Benefits

Highest accuracy in a single sweep: no averaging over multiple sweeps required
High measurement speed
Complete measurement across C/L-band in less than 10 seconds (no need to wait for many averages)
Robustness against fiber movement/vibration and drift: Fixing fibers with sticky tape on the table or even operation on isolated optical table is not required
No limitation on optical path length of component
The internal referencing scheme guarantees reliable and accurate measurements



N7781A Polarization Analyzer Characteristics

	Benchtop		
Option	-100	-200	-500
Operating Wavelength Range	850 nm – 1000 nm	950 nm – 1100 nm	1260 nm – 1640 nm
Factory Calibrated Range[1]	850 nm	980 nm	1460 nm to 1620 nm
SOP Accuracy	<±1° on Poincaré Sphere		
DOP Accuracy	<±2% <±0.5 % (typ.) after calibration[2]		
Sampling Rate	up to 1 MHz		
Maximum SOP Movement	Rate >50 K SOP-revolutions/s[3,4]		
Input Power Range	–50 dBm ... +7 dBm		
Operating Temperature	+10°C ... 40°C		
Interfaces	GPIB, USB		
Optical Connector Interfaces (other on request) N7781-021 N7781-022	 FC/PC Optical Connector (straight) FC/APC Optical Connector (angled)		
Dimensions (H x W x D)	70 mm x 330 mm x 270 mm (2.75" x 12.0" x 10.6")		
Analogue Output	0...5 V		
Power	100 V – 240 V, <36 W		

[1] Other factory calibration ranges on request.
[2] Valid at calibration wavelength and calibration temperature.
[3] SOP-revolutions in Stokes representation (Poincaré sphere).
[4] For input power >–20 dBm.

N7782A PER Analyzer Characteristics

	Benchtop						
Option	-100	-101	-200	-400	-401	-500	-501
Internal Fixed Wavelength Source	—	850 nm	—	—	1310 nm 1550 nm	—	1550 nm
Wavelength Operating Range	850 – 1000 nm		950 – 1100 nm	1260 – 1640 nm			
Factory Calibrated Range	850 nm		980 nm	1270 – 1375 nm 1460 – 1620 nm		1460 – 1620nm	
PER Range	0 – 50 dB						
Input Power Range	–35 ...10 dBm		–40 ...10 dBm	–50 dBm ... +7 dBm			
Measurement Update Rate	>10 Hz						
Displayed Parameters	PER, Power, Angle						
Operating Temperature	+5°C ... +40°C						
Interfaces	USB, GPIB, Analog ports for measurement output (0 to 5 V)						
Power	100 – 240 VAC, <36 W						
Dimensions (H x W x D)	70 mm x 330 mm x 270 mm (2.75" x 12.0" x 10.6")						

N7783A Thermal Cycling Unit Characteristics

Fiber Jacket Diameter	up to 3 mm
Thermal Cycling Time	1 to 10 seconds (adjustable)
Thermal Cycling Range	0°C to 60°C
Power	100 – 240 VAC, <36 W
Dimensions (H x W x D)	64 mm x 160 mm x 61 mm A state of the art PC with GPIB/USB Interface is required; it is not included

N7784A High Speed Polarization Controller Characteristics

Wavelength Operating Range	SOP scrambling and switching operation SOP stabilization[1]	1260 – 1640 nm 1550 ± 30 nm[2]
Speed	SOP Switching time Scrambler	<10 µs Up to 100 K SOPs/s
Reset Free, Endless Operation		Yes
DOP		<5% (when working as scrambler)
Polarization Extinction Ratio (when working as stabilizer)		>25 dB
Insertion Loss	SOP scrambling and switching operation SOP stabilization	<3 dB <5 dB
Max Input Power	Port I, II Port III	20 dBm 0 dBm[3]
Optical Connector Interface		FC/APC (others on request)

[1] Using the optical feedback signal through ports III and IV.
[2] Other wavelength ranges on request.
[3] Other Max Input Power levels for port III available upon request.

N7785A Synchronous Scrambler Characteristics

Wavelength Operating Range		1260 – 1640 nm
Speed	SOP Switching time Scrambler	<10 µs Up to 100 K SOPs/s
DOP		<5% (when working as scrambler)
Insertion Loss		<3 dB
Max. Input Power		20 dBm
Optical Connector Interface		FC/APC (others on request)

N7786A Polarization Synthesizer Characteristics

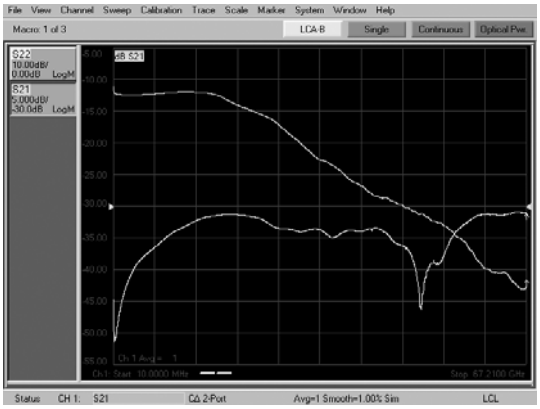
Polarization Control & Stabilization			
Wavelength Operating Range		1260 – 1640 nm[1]	
Speed	SOP Switching time SOP Cycle time Scrambler	<10 µs (non-deterministic) <25 µs (deterministic SOPs) Up to 100 K SOPs/s	
DOP		<5% (when working as scrambler)	
Reset-free, Endless Operation		Yes	
Remaining SOP Error (when stabilizing)		<2°	
Polarization Analysis			
Option		-400	-500
Wavelength Operating Range		1260 – 1640 nm	1260 – 1640 nm
Factory Calibrated Range		1270 – 1375 nm 1460 – 1620 nm	1460 – 1620 nm
SOP Accuracy		<±1° on Poincaré Sphere[2]	
DOP Accuracy		<±2% <±0.5% (typ.) after calibration	
Sampling Rate		Up to 1 MHz	
Internal Buffer		>500 000 samples	
Input Power Range		–26 dBm ... +19 dBm	
General			
Optical Connector Interface		FC/APC (others on request)	
Trigger Input/Output		TTL	
Insertion Loss		<4 dB	

[1] In "Defined Stokes" application: full accuracy is achieved only in factory calibration range of Polarization Analyzer.
[2] With respect to the signal at the Output connector of the instrument.

N7788A Optical Component Analyzer Characteristics

Option		-400	-500
Wavelength Operating Range[1]		1260 – 1640 nm	1260 – 1640 nm
Factory Calibrated Range[2]		1270 – 1375 nm 1460 – 1620 nm	1460 – 1620 nm
Wavelength Resolution		1 pm[3]	
Wavelength Accuracy		15 pm[3]	
PMD[4] **Range**		0 – 1000 ps	
PMD Accuracy		±(0.03 ps + 2% of PMD value)	
PDL Range		0 – 10 dB	
PDL Accuracy		±(0.01 dB + 4% of PDL value)[5]	
Dynamic Range		>57 dB	
Input Power Range		–50 dBm ... +7 dBm	
Optical Connector Laser Input		FC/APC (others on request)	
Optical Connector DUT	N7788A-031 N7788A-032	Straight DUT Port Angled DUT Port	

[1] The wavelength range for passive component test applications is determined by the overlap between the wavelength range of the tunable laser source and the wavelength range of the instrument.
[2] Other factory calibration wavelength ranges on request.
[3] Valid for operation with Agilent family of tunable laser sources. Because wavelength accuracy is determined by the tunable laser, operation with other laser sources may result in different wavelength accuracy.
[4] Average DGD value across 100 nm wavelength range.
[5] Valid for 1500 nm to 1620 nm.



N4373B Lightwave Component Analyzer

Agilent's N4373B Lightwave Component Analyzer (LCA) is the instrument of choice to test the most advanced 40 Gb/s electro-optical components, with up to 67 GHz modulation bandwidth.

Modern optical transmission systems require fast, accurate and repeatable characterization of the core electro-optical components, the transmitter, receiver, and their subcomponents (lasers, modulators and detectors), to guarantee performance with respect to modulation bandwidth, jitter, gain, and distortion.

The N4373B achieves fast measurements by including the E8361A Performance Network Analyzer. A unique new calibration concept significantly reduces setup time to a maximum of several minutes, depending on the selected measurement parameters. This results in increased productivity in R&D or on the manufacturing floor.

The fully integrated "turn-key" N4373B helps reduce time to market, compared to the time-consuming development of a self-made setup.

By optimizing the electrical and the optical design of the N4373B for lowest noise and ripple, the accuracy has been improved by better than a factor of 2, compared to its predecessor, the 86030A 50 GHz LCA. This increased accuracy improves the yield from tests performed with the N4373B by narrowing margins needed to pass the tested devices.

Using the advanced measurement capabilities of the network analyzer, all S-parameter related characteristics of the device under test, like responsivity and 3 dB-cutoff frequency, can be qualified with the new N4373B Lightwave Component Analyzer from 10 MHz to 67 GHz.

Key Benefits

- High absolute and relative accuracy measurements improve the yield of development and production processes. With the excellent accuracy and reproducibility, measurement results can be compared among test locations world wide
- High confidence and fast time-to-market with a NIST-traceable turn-key solution
- Significantly increased productivity using the fast and easy measurement setup with a unique new calibration process leads to lower cost of ownership

Relative Frequency Response Uncertainty
±0.5 dB @50 GHz (typ)
±1.0 dB @67 GHz (typ)
Absolute Frequency Response Uncertainty
±0.9 dB @50 GHz (typ)
±1.3 dB @67 GHz (typ)
Typical Noise Floor
–60 (55) $dB_{A/W}$ for O/E measurements @50 (67) GHz
–64 (59) $dB_{W/A}$ for E/O measurements @50 (67) GHz
Typical Phase Uncertainty: ±2.7°
Time Domain Option -010 Included
Transmitter Wavelength: 1550 nm ± 20 nm
Selectable Output Power at the Transmitter
Polarization Maintaining Fiber Output
Optimizes repeatability, especially for modulator characterization
Build-in Performance Test
Optical Input Power up to +15 dBm
Powerful Remote Control
State of the art COM programming interface based on Microsoft .NET® makes remote control fast and easy
USB Connector on Front Panel
Allows easy data transfer to other computers, even if no LAN is used

Applications

In digital photonic transmission systems, the performance is ultimately determined by Bit Error Ratio Test (BERT). As this parameter describes the performance of the whole system, it is necessary to design and qualify subcomponents like modulators and PIN detectors, which are analog by nature, with different parameters that reflect their individual performance.

These components significantly influence the overall performance of the transmission system with the following parameters:

- 3 dB bandwidth of the electro- optical transmission
- Relative frequency response, quantifying how the signal is transformed between optical and electrical or input and output vs. modulation frequency
- Absolute frequency response, relating the conversion efficiency of signals from the input to the output
- Electrical reflection at the RF port
- Group delay of the opto-electronic component

Only a careful design of these electro-optical components over a wide modulation signal bandwidth guarantees successful operation in the transmission system.

Features

Turn-key Solution

In today's highly competitive environment, short time-to-market with high quality is essential for new products. Instead of developing a time consuming home-grown measurement solution that might be limited in transferability and support, a fully specified and supported solution, helps to focus resources on faster development and on optimizing the manufacturing process.

In the N4373B, all optical and electrical components are carefully selected and matched to each other, to minimize noise and ripple in the measurement traces. Together with the temperature stabilization of the core components, this improves the repeatability and the accuracy of the overall system. Extensive factory calibration data ensures accurate and reliable measurements that can only be achieved with an integrated solution like the N4373B.

Easy Calibration

An LCA measures the modulation relation between optical and electrical signals. This is why user calibration of such systems can evolve into a time consuming task. With the new calibration process implemented in the N4373B the tasks that have to be done by the user are reduced to one electrical calibration. Even this can be automated with an ECAL kit, taking only several minutes depending on the LCA settings, without manual interaction.

State-of-the-art Remote Control

Testing the frequency response of electro-optical components under a wide range of parameters, which is often necessary in qualification cycles, is very time consuming and repetitive.

Therefore all functions of the LCA could be controlled remotely via LAN over a state-of-the-art Microsoft .NET or COM interface. Based on example programs it is very easy for every user to build applications for their requirements.

These examples are covering applications like integration of complete LCA measurement sequences into a Microsoft Excel® document.

Integrated Optical Average Power Meter

In cases where an unexpectedly low responsivity is measured from the device under test, it is very helpful to get a fast indication of the CW optical power that is launched into the LCA receiver. The reason might be caused by a bad connection or a bent fiber in the setup. For this reason a measurement of the average optical power at the LCA receiver is very helpful for fast debugging of the test setup.

This average power meter can be also used to set the exact average output power of the LCA transmitter by shorting the connection between the LCA optical transmitter output and the LCA optical receiver input. By adjusting the transmitter output power in the LCA user interface, the desired transmitter optical average power can be set.

PMF Output and Power Setting of the Transmitter

In applications like $LiNbO_3$ modulator characterization, it is necessary to launch stably polarized CW light into the optical modulator input. The N4373B LCA offers just this, as an additional feature for the E/O measurement. This saves the need for an additional DFB laser source, decreasing test cost and simplifying the setup.

Specification (for detailed specifications see technical data sheet)

Frequency Range	10 MHz to 67 GHz
LCA Optical Input	
Operating input wavelength range	1280 nm to 1625 nm
Maximum linear average input power	Optical input 1: +5 dBm Optical input 2: +15 dBm
Optical return loss (typ.)	>27 dBo
Average power measurement range	Optical input 1: –20 dBm to +5 dBm on optical input 1 Optical input 2: –10 dBm to +15 dBm on optical input 2
Average power measurement uncertainty (typ.)	±0.5 dBo
LCA Optical Output	
Optical modulation index (OMI)	>5 % typ. at 1 GHz modulation frequency and –8 dBm RF power
Output wavelength	(1550 ± 20) nm
Average output power range	–1 dBm to +5 dBm
Average output power uncertainty (typ.)	±0.5 dBo

N4373B Lightwave Component Analyzer (cont.)

System Performance O/E Measurements	0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz	20 GHz to 50 GHz	50 GHz to 67 GHz
DUT Response ≥–26 dB (W/A)[1] Relative Frequency Response Uncertainty	±2.0 dBe typ.	±0.8 dBe (±0.5 dBe typ.)	±0.8 dBe (±0.5 dBe typ.)	±0.8 dBe (±0.5 dBe typ.)	±2.3 dBe (±1.3 dBe typ.)
DUT Response ≥–26 dB (W/A)[1] Absolute Frequency Response Uncertainty	±2.5 dBe typ.	±1.8 dBe (±0.9 dBe typ.)	±1.8 dBe (±0.9 dBe typ.)	±1.8 dBe (±0.9 dBe typ.)	±2.8 dBe (±1.3 dBe typ.)
DUT Response ≥–26 dB (W/A)[1] Frequency Response Repeatability (typ.)	±0.02 dBe	±0.02 dBe	±0.02 dBe	±0.1 dBe	±0.2 dBe
Minimum Measurable Frequency response (noise floor)[2]	–64 dB (W/A) typ.	–64 dB (W/A)	–64 dB (W/A)	–64 dB (W/A)	–59 dB (W/A)
DUT Response ≥–15 dB (A/W)[1] Relative Frequency Response Uncertainty[2]	±2.0 dBe typ.	±0.8 dBe (±0.5 dBe typ.)	±0.8 dBe (±0.5 dBe typ.)	±0.8 dBe (±0.5 dBe typ.)	±2.3 dBe (±1.3 dBe typ.)
DUT Response ≥–25 dB (A/W)[1] Absolute Frequency Response Uncertainty[2]	±2.5 dBe typ.	±1.8 dBe (±0.9 dBe typ.)	±1.8 dBe (±0.9 dBe typ.)	±1.8 dBe (±0.9 dBe typ.)	±2.8 dBe (±1.3 dBe typ.)
DUT Response ≥–15 dB (A/W)[1] Frequency Response Repeatability (typ.)[2]	±0.02 dBe	±0.02 dBe	±0.02 dBe	±0.2 dBe	±0.5 dBe
Minimum Measurable Frequency Response (noise floor)[2,3]	–60 dB (A/W) typ.	–60 dB (A/W)	–60 dB (A/W)	–60 dB (A/W)	–55 dB (A/W)

Ordering Information

The N4373B consists of an N4373B-014, -010 67 GHz PNA and an optical test set which is mechanically connected to the PNA.
To protect your network analyzer investment, Agilent offers the integration of an already owned E8361A PNA with the optical test set.

N4373B Ordering Options

LCA Options

N4373B-301 67 GHz LCA Based on E8361A-014, -010 (time domain) PNA and 1550 nm Optical Test Set
Warranty: 1 year warranty

N4373B-399[1] 67 GHz, 1550 nm Optical Test Set with Integration of
- E8361A-014 Customer Supplied PNA,
- E8361A-UNL Customer Supplied PNA[2]

Includes:
- Recalibration and Performance Verification of PNA[3]
- 1 Year Warranty for Complete System Including PNA

N4373B-021 Straight Connector
N4373B-022 Angled Connector (recommended)

Recommended Accessory

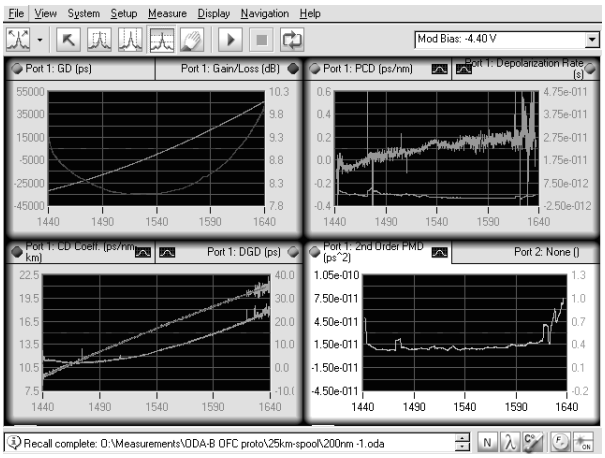
N4694A-00F 2 Port Microwave Electronic Calibration Kit f-f (required for specified performance)

Accessories[4]

N4373-87906 FC/APC to FC/APC Optical Patch Cord (0.5 m)
N4373-87907 FC/APC to FC/PC Optical Patch Cord (0.5 m)
81000NI FC/APC Optical Adapter
N5520B Adapter, 1.85 mm (f) to 1.85 (f), DC to 67 GHz
85058-60121 1.85 mm Test Port Adapter f-m
N4697-60200 f-m 1.85 mm Flexible Test Port Cable

[1] Customer supplied PNA other than the mentioned models will need additional technical effort. In this case call your local Agilent sales representative.
[2] Option -UNL decreases receiver sensitivity of PNA with impact to overall system specifications.
[3] Possible repair effort needed due to failure in recalibration and verification is not included.
[4] These accessories are included in the LCA shipment, and can be ordered separately for replacement.

- **Fastest measurement speed for high throughput in manufacturing test**
- **Highest CD and PMD accuracy and resolution for manufacturing and R&D**
- **Specified operation over 1260 to 1640 nm (O-L band)**
- **2nd-order PMD, GD-ripple and other analysis functions**
- **Expandable for enhanced PDL accuracy and multiport use**
- **Industry-standard measurements with the modulation phase shift method**



Agilent 86038B User Interface Display

An Innovative Solution for Loss and Dispersion Measurements

High transmission data rates in optical communication networks are achieved with components and fibers ensured to have appropriate loss and dispersion properties. The challenge is to deliver this assurance in an accurate and cost-effective way. The new Agilent 86038B can simultaneously measure chromatic dispersion (CD), polarization mode dispersion (PMD), insertion loss (IL), and polarization dependent loss (PDL), with the industry standard modulation phase shift method, allowing full characterization of optical components and fibers with a single connection. By integrating Agilent's premier tunable laser source (TLS) and performance network analyzer (PNA), the Agilent 86038B is optimized for high accuracy and resolution with fast swept-wavelength measurements.

Reduce Time to Market for 10 and 40 Gb/s

The new Agilent 86038B provides reliable accuracy and extensive analysis tools, giving deeper insight into device characteristics, faster, to reduce time to market. The time-consuming task of polarization-resolved spectral measurement is solved by implementing swept-wavelength measurements, characterizing group delay (GD) and attenuation spectra at a pre-determined set of polarization states, and using matrix analysis to calculate differential group delay (DGD), PMD and PDL. Higher-level analysis for 2nd-order PMD is also provided. For example, the measurement time for a 200 nm wavelength range is 20 seconds, enabling high throughput for lower costs.

Increase Throughput and Reduce Cost of Test

The modularity of the system design, using the modular TLS and 4-slot Lightwave Measurement System allows exchanging laser options and adding functional modules for flexible adaption to specific test needs, allowing more projects to be accepted and completed.

Specification

Group Delay and Differential Group Delay Measurement

Relative Group Delay Repeatability	
<0 dB to –10 dB level	±20 fs
<–10 dB to –20 dB level (characteristic)	±150 fs
<–20 dB to –30 dB level (characteristic)	±500 fs
<–30 dB to –40 dB level (characteristic)	±5 ps
Relative Group Delay Uncertainty (<0 dB to –10 dB level)	±50 fs
Differential Group Delay Repeatability	±50 fs
Differential Group Delay Uncertainty (<0 dB to –10 dB level)	±90 fs
PMD Uncertainty	±0.03 ps + 7%
2nd-order uncertainty (typ)	PCD based on DGD uncertainty
Group Delay Time Resolution	1 fs
Modulation Frequency Range	5 MHz to 2.5 GHz
Group Delay Loss Range	50 dB

Measurements performed at the same temperature as the normalization temperature ±0.5°C
Performance measured using a 2.2 meter thermally isolated SMF patch cord.
Modulation frequency = 2 GHz. IFBW = 70 Hz, 1 nm wavelength step size
Repeatability is defined as the worst (plus or minus) standard deviation over the TLS wavelength range from 10 sweeps.

Length Measurement

Length Uncertainty (typ)	±0.2 mm +5x10^{-6} L for L<56 km

Amplitude Measurement

Polarization Dependent Loss Accuracy	±0.15 typ (0.03 dB with Option #400)
System Dynamic Range (characteristic)	50 dB
Gain Loss Uncertainty	±0.1 dB typ. (0.02 dB with Option #400)

Wavelength Measurement

Wavelength Range	
with Agilent 81600B-200 Tunable Laser Source	1440 nm to 1640 nm
with Agilent 81600B-160 or 81640B	1495 nm to 1640 nm
with Agilent 81600B-150	1450 nm to 1590 nm
with Agilent 81600B-140	1370 nm to 1495 nm
with Agilent 81600B-130	1260 nm to 1375 nm
with Agilent 81640A	1510 nm to 1640 nm
Minimum Wavelength Step Size	0.1 pm
Absolute Wavelength Accuracy[1,2]	
Stepped mode with Agilent 86122A (typ.)	±1 pm
Swept mode without Agilent 86122A and with 81600B or 81640B	<5 pm
Stepped mode without Agilent 86122A and with 81640A	±15 pm
Relative Wavelength Accuracy[1,3]	
Stepped mode without Agilent 86122A and with 81600B or 81640B	±5 pm
Stepped mode without Agilent 86122A and with 81600B or 81640B (characteristic)	±2 pm
Stepped mode without Agilent 86122A and with 81640A	±7 pm
Stepped mode with Agilent 86122A and with 81640A (characteristic)	±3 pm

Optical Fiber Chromatic Dispersion Measurement

CD Accuracy	0.1ps/nm +0.3%CD
Zero Dispersion Wavelength Accuracy (characteristic)[4]	±150 pm
Zero Dispersion Wavelength Repeatability (characteristic)[4]	±9 pm
Accuracy of dispersion slope at the zero dispersion wavelength (characteristic)[4]	±25 fs/nm^2
Repeatability of dispersion slope at the zero dispersion wavelength (characteristic)[4]	±3 fs/nm^2

General Information

Assembled Dimensions: (H x W x D)	55.5 cm x 43.5 cm x 55.5 cm
Net Weight	Standard system: 54 kg

[1] Valid for one month and within a ±4.4 K temperature range after automatic wavelength zeroing. Measured with wavelength meter based on wavelength in vacuum.
[2] For details, refer to tunable laser's absolute wavelength accuracy specification.
[3] For details, refer to tunable laser's relative wavelength accuracy specification.
[4] Derived from GD specification.

- **Characterize WDM spectra during R&D, manufacturing, and commissioning**
- **Wavelength accuracy up to ±0.2 ppm**
- **Simultaneously measure wavelengths and powers of up to 1000 channels**
- **Automatic optical signal-to-noise ratio measurements**
- **Automated measurement routines and data logging**

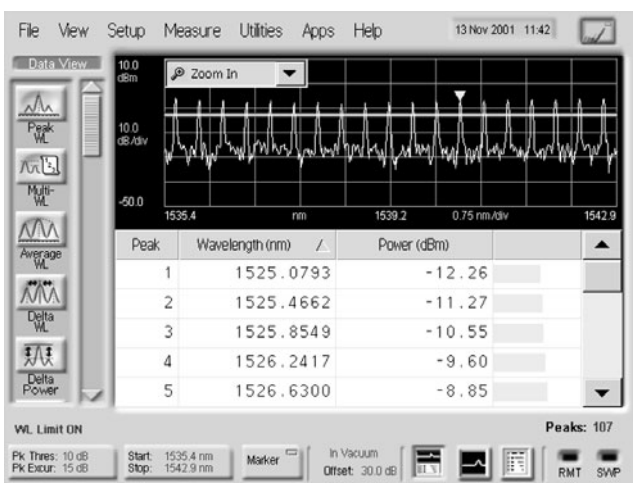
As the demand for access to more information increases, the need for greater capacity on transmission systems drives component manufacturers and network equipment manufacturers to push their capabilities to new limits. The successful design and deploy dense wavelength division multiplexing (DWDM) systems stringent performance criteria must be met in order to guarantee quality, uninterrupted communication. With Agilent multi-wavelength meters, you will be able to address these demands with confidence.

The Performance You Need – When You Need It

The Agilent family of multi-wavelength meters is just that – a family. Each model uses compatible SCPI remote commands. You pay for only the performance you need, when you need it. If your requirements become more demanding in the future, you can substitute another Agilent multi-wavelength meter, avoiding unnecessary cost and time developing new code for your test system. With the new 86122A, you can upgrade to a unit with the best performance available. Agilent multi-wavelength meters allow you to optimize test costs while protecting your investments.

Simultaneously Measure up to 1000 Wavelengths and Powers

The Agilent 86120B, 86120C, and 86122A multi-wavelength meters, like other Michelson interferometer-based wavelength meters, allow you to measure the average wavelength of the input signal. In addition, the Agilent multi-wavelength meters – with advanced digital processing – accurately and easily differentiate and measure up to 1000 (200 and 100 for the 86120C and 86120B, respectively) discrete wavelengths.



The new 86122A offers an easy-to-use graphical interface to optimize efficiency

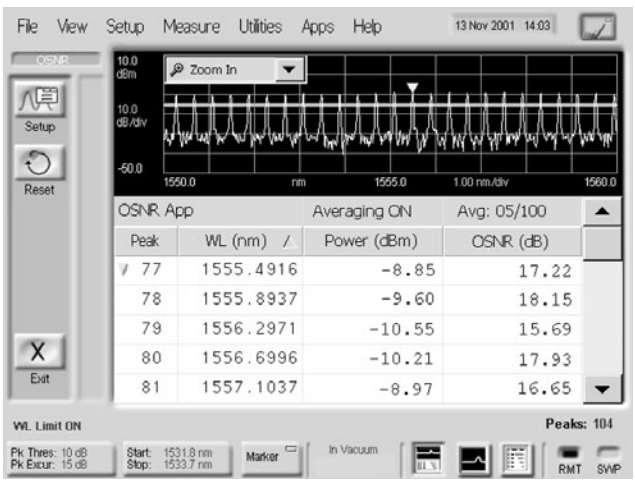
Agilent multi-wavelength meters simultaneously measure the individual powers of discrete wavelengths, offering the following measurement capabilities:

- 1 to 1000 wavelengths and powers
- Average wavelength and total power
- Up to ±0.2 ppm wavelength accuracy
- Up to 5 GHz wavelength resolution
- Calibrated for evaluation in air or vacuum
- Wavelength units in nm, THz, or wave number (cm^{-1})
- Amplitude units in dBm, mW, or µW
- OSNR and averaged OSNR for WDM SONET/SDH systems
- Rugged design to withstand strong shocks and vibrations

WDM Transmission Systems

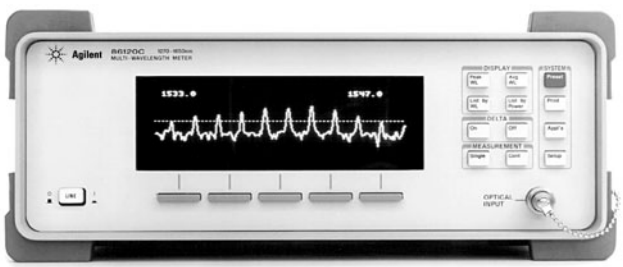
Combining measurement performance with reliability, the Agilent multi-wavelength meters allow easy and accurate verification of optical carrier performance in transmission systems by measuring wavelength, power, and optical signal-to-noise ratios during design and manufacturing test.

The 86122A multi-wavelength meter is optimized for measuring ultra-dense channel spacing with an absolute wavelength accuracy of up to ±0.2 ppm (±0.3 pm referenced to 1550 nm). With a resolution of <5 GHz, it is an ideal solution for the design and manufacturing of next-generation optical networks.



The Agilent 86122A displaying signal-to-noise ratios

With a rugged and portable package, the 86120B and 86120C multi-wavelength meters are ideal for optical network commissioning and monitoring applications. With the 86120C resolution of <10 GHz (<20 GHz for the 86120B) and absolute wavelength accuracy of ±2 ppm or ±3 pm at 1550 nm (±3 ppm, ±5 pm at 1550 nm for the 86120B), you can confidently verify system performance of DWDM systems with channels spaced at <50 GHz.



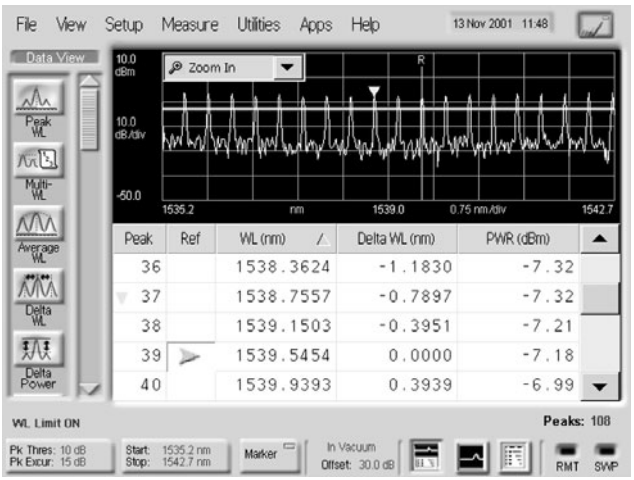
The Agilent 86120B/C and 86122A can simultaneously resolve and measure the individual optical carrier wavelengths and powers to confirm channel spacing, drift, crosstalk, and optical signal-to-noise ratios.

Sources

The superior wavelength and amplitude measurement capabilities of the Agilent 86120B, 86120C and 86122A multi-wavelength meters enable maximum performance of your components. You can measure DFB, FP or multiple DFB laser wavelengths and amplitudes during burn-in, environmental evaluation, final test, and incoming inspection. Calculate center wavelengths of broader linewidth sources, such as LED's or Bragg-grating filtered ASE responses, using the user-selectable broadband algorithm.

Relative Wavelength and Amplitude Measurements

The Agilent 86120B, 86120C, and 86122A allow you to optimize systems or components for wavelength stability and channel spacing. You can compare individual optical carrier wavelengths and powers to those of a user-selected reference, and monitor dynamic changes.



In Delta Mode, the Agilent 86122A displays relative wavelengths and powers

Built-in Data Logging

Designed with the R&D engineer in mind, the 86122A multi-wavelength meter allows you to capture changes in all system parameters over time, without having to develop external remote programs. Using the data-logging mode, the 86122A records measured data at user-specified intervals with a time stamp and stores the data on the built-in hard drive of the instrument. This data can then be easily downloaded via floppy drive, GPIB, or the LAN as a comma-separated variable (.csv) file to your spreadsheet program for graphing and analysis.

Advanced Measurement Applications Allow System Verification and Monitoring

The Agilent 86120B/C and 86122A multi-wavelength meters augment your productivity by processing the measurement data to automatically and directly give you system performance results, such as:

Drift

The Drift routine allows you to monitor, as a function of time or other dynamic conditions, changes in wavelength and amplitude of your optical signal or signals while simultaneously logging wavelength and amplitude:

- Current values – to give you the real-time status of your laser sources
- Maximum and minimum values – so you can record the limits reached during the measurement
- Total drift – so that you can measure the total variation of your signals during testing

Optical Signal-To-Noise Ratio

Verify transmission system performance with the Optical Signal- to-Noise Ratio routine, which easily allows you to determine all the signal-to-noise ratios in your system with:

- Noise measured halfway between channels – for quick verification
- Noise measured at user-defined wavelengths – for maximum flexibility
- Noise normalized to a 0.1 nm bandwidth – for easy comparison

Fabry-Perot Laser Characterization (available on 86120C and 86122A)

This measurement routine allows you to characterize your Fabry-Perot laser source quickly, easily, and accurately. You can obtain immediate results of:

- Total power
- Full-width at half maximum
- Mean wavelength
- Mode spacing

Coherence Length (available on 86120B only)

The Agilent 86120B automatically allows accurate measurements of the coherence length of Fabry-Perot laser sources typically used in CD-ROM drives or datacom transmission systems:

- Measurement range from 1 to 200 mm
- Accuracy within 5%
- Display laser coherence length and cavity optical length

Instrument Drivers

Instrument drivers compatible with LabView, Visual Basic, C++, and LabWindows are available for the Agilent 86120B, 86120C, and 86122A multi-wavelength meters. These drivers enable remote program development by offering building blocks that allow you to customize your measurements.

Specifications

The technical specifications apply to all functions over the temperature range 0 to 55°C and relative humidity <95%, unless otherwise noted. All specifications apply after the instrument's temperature has been stabilized for 15 minutes in Normal Update mode, unless otherwise noted.
Specifications describe the instrument's warranted performance. Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal values, and are printed in *italic* typeface.

		86120B	86120C	86122A
Maximum Number of Laser Lines Input		100	200	1000
Wavelength	Range	700 – 1650 nm (182 to 428 THz)	1270 – 1650 nm (182 to 236 THz)	1270 – 1650 nm (182 to 236 THz)
	Absolute Accuracy	±3 ppm (±0.005 nm at 1550 nm, ±0.004 nm at 1310 nm) for laser lines separated by ≥30 GHz	±2 ppm (±0.003 nm at 1550 nm and 1310 nm) for laser lines separated by ≥15 GHz	±0.5 ppm (±0.75 pm at 1550 nm and ±0.65 pm at 1310 nm); ±0.2 ppm[1] (±0.3 pm at 1550 nm and 1310 nm) for laser lines separated by ≥10 GHz
	Minimum Resolvable Separation (equal power lines input)	*20 GHz (0.16 nm at 1550 nm, 0.11 nm at 1300 nm)*[2]	*10 GHz (0.08 nm at 1550 nm, 0.06 nm at 1300 nm)*[3]	*5 GHz (0.04 nm at 1550 nm; 0.03 nm at 1310 nm)*[4]
	Display Resolution	0.001 nm, normal update mode; 0.01 nm, fast update mode	0.001 nm	0.0001 nm
	Units	nm (vacuum or standard air), cm^{-1}, THz	nm (vacuum or standard air), cm^{-1}, THz	nm (vacuum or standard air), cm^{-1}, THz
Power	Absolute Accuracy	±0.5 dB (at ±30 nm from 780, 1310, and 1550 nm)	±0.5 dB (at ±30 nm from 1310 and 1550 nm)	±0.5 dB (at ±30 nm from 1310 and 1550 nm)
	Flatness, 30 nm from any wavelength	*±0.2 dB, 1200 – 1600 nm* *±0.5 dB, 700 – 1650 nm*	*±0.2 dB, 1270 – 1600 nm* *±0.5 dB, 1270 – 1650 nm*	*±0.2 dB, 1270 – 1600 nm* *±0.5 dB, 1270 – 1650 nm*
	Linearity	±0.3 dB, 1200 – 1600 nm	±0.3 dB, 1270 – 1600 nm	±0.3 dB, 1270 – 1600 nm
	Polarization Dependence	±0.5 dB, 1200 – 1600 nm *±1.0 dB, 700 – 1650 nm*	±0.5 dB, 1270 – 1600 nm *±1.0 dB, 1600 – 1650 nm*	±0.5 dB, 1270 – 1600 nm *±1.0 dB, 1600 – 1650 nm*
	Units	dBm, mW, µW	dBm, mW, µW	dBm, mW, µW
Sensitivity[5]	Single Line Input	–40 dBm, 1200 – 1600 nm	–40 dBm, 1270 – 1600 nm –30 dBm, 1600 – 1650 nm	–40 dBm, 1270 – 1600 nm –30 dBm, 1600 – 1650 nm
	Multiple Lines Input	*30 dB below total input power, but not less than single line input sensitivity, 700 – 1650 nm*	*30 dB below total input power, but not less than single line input sensitivity, 1270 – 1650 nm*	*30 dB below total input power, but not less than single line input sensitivity, 1270 – 1650 nm*
Input Power	Maximum Displayed Level (sum of all lines input)	+10 dBm	+10 dBm	+10 dBm
	Maximum Safe Input Level (sum of all lines input)	+18 dBm	+18 dBm	+18 dBm
Built-in Automatic Measurement Applications				
	Signal-to-Noise Ratio (0.1 nm noise bandwidth), lines above –25 dBm	*>35 dB, channel spacing ≥200 GHz* *>27 dB, channel spacing ≥100 GHz*	*>35 dB, channel spacing ≥100 GHz* *>27 dB, channel spacing ≥50 GHz*	*>35 dB, channel spacing ≥100 GHz* *>27 dB, channel spacing ≥50 GHz*
	Signal-to-Noise Ratio of Modulated Lasers (with averaging) (0.1 nm noise bandwidth), lines above –25 dBm, 100 averages	*>35 dB, channel spacing ≥200 GHz* *>27 dB, channel spacing ≥100 GHz*	*>35 dB, channel spacing ≥100 GHz* *>27 dB, channel spacing ≥50 GHz*	*>35 dB, channel spacing ≥100 GHz* *>27 dB, channel spacing ≥50 GHz*
	Drift	Max, Min, Max-Min wavelengths and powers over time		
Laser Classification		FDA Laser Class I according to 21 CFR 1040.10; IEC Laser Class 1 according to IEC 60825		
Dimensions		140 mm H x 340 mm W x 465 mm D (5.5 in x 13.4 in x 18.3 in)		133 mm H x 425 mm W x 520 mm D (5.2 in x 16.7 in x 20.5 in)
Weight		9 kg (19 lb)		14.5 kg (32 lb)

[1] Specify 86122A-002 option.
[2] For lines separated by less than 30 GHz, wavelength accuracy is reduced.
[3] For lines separated by less than 15 GHz, wavelength accuracy is reduced.
[4] For lines separated by less than 10 GHz, wavelength accuracy is reduced.
[5] Contact Agilent Technologies for availability of special instruments with higher sensitivity.

Accessories

Optical Head Adapters

These adapters are to be used with Agilent optical heads only.
The connector adapters are needed to attach connectorized fibers.
Optical Head Adapters with integral D-shape for 8162xx optical head (except 81628B – see threaded version):

81001FA FC/PC, FC/APC
81001KA SC
81001LA LC/F3000
81001PA E2000
81001MA MU
81000ZA Blank Adapter

Optical Head Adapters with threaded version for 81628B optical heads:

81000FA FC/PC, FC/APC
81000KA SC
81003LA LC/F3000
81000PA E2000
81000VA ST
81003TD MTP (for female connectors only)

Connector Adapter for Optical Heads

81624DD D-shaped adapter to be used with the Agilent 8162xx optical heads except 81628B. For use with threaded adapters.

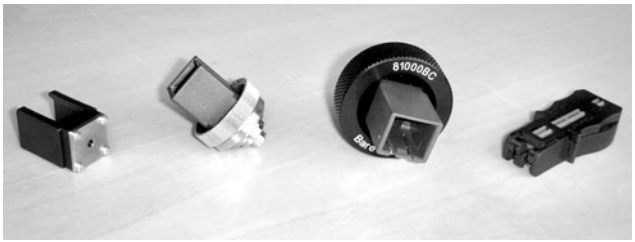
Optical Connector Interface

Used with Agilent Lightwave instruments and modules. Not to be used with optical heads. These flexible connector interfaces can be exchanged by the user and allow easy cleaning of instrument front-end interfaces.

Optical Connector Interface for straight and angled, physical and non-physical contact. All connectors are available for straight and angled connection, unless otherwise noted.

81000FI FC/PC (wide key)
81000NI FC/APC (narrow key)
81000KI SC
81000LI LC/F3000 physical contact
81002LI LC/F3000 sensor modules only
81000HI E2000 physical contact
81000PI E2000 sensor modules only
81000MI MU physical contact
81002MI MU sensor modules only
81000VI ST

Bare Fiber Adapters and Interfaces



81000BC Bare Fiber Connectivity Set for 81623B, 81624B and 81626B (1x head Adapter, 1x 0-400 µm fiber holder, 1x 400-900 µm fiber holder, 1x gauge)
81000BI Bare Fiber Connectivity Set for 81630B and 81634B (1x sensor adapter, 1x 0-400 µm fiber holder, 1x 400-900 µm fiber holder, 1x gauge)
81004BH Bare Fiber Holder Set (10x 0-400 µm fiber holder)
81009BH Bare Fiber Holder Set (10x 400-900 µm fiber holder)

Lenses

Used with the Agilent optical heads in combination with an optical head adapter.

81050BL Lens, effective focal length of lens = 6.2 mm, NA_{max} = 0.37, wavelength range 900 to 1700 nm, for multi-mode fibers with NA ≤0.3
81010BL Lens, effective focal length of lens = 2.9 mm, NA_{max} = 0.19, wavelength range 900 to 1700 nm, for single-mode fibers with NA ≤0.13

Universal Through Adapter

In combination with an Agilent 81000xI connector interface, this adapter allows you to mate an HMS-10 connector to another HMS-10, FC/PC/SPC, APC, DIN, ST, E-2000, or SC connector. It can also be used to mate an Agilent 81000BR reference reflector to a patchcord. The Agilent 81000UM is a through-adapter only. It can not be used at the fiber interfaces of the modules.

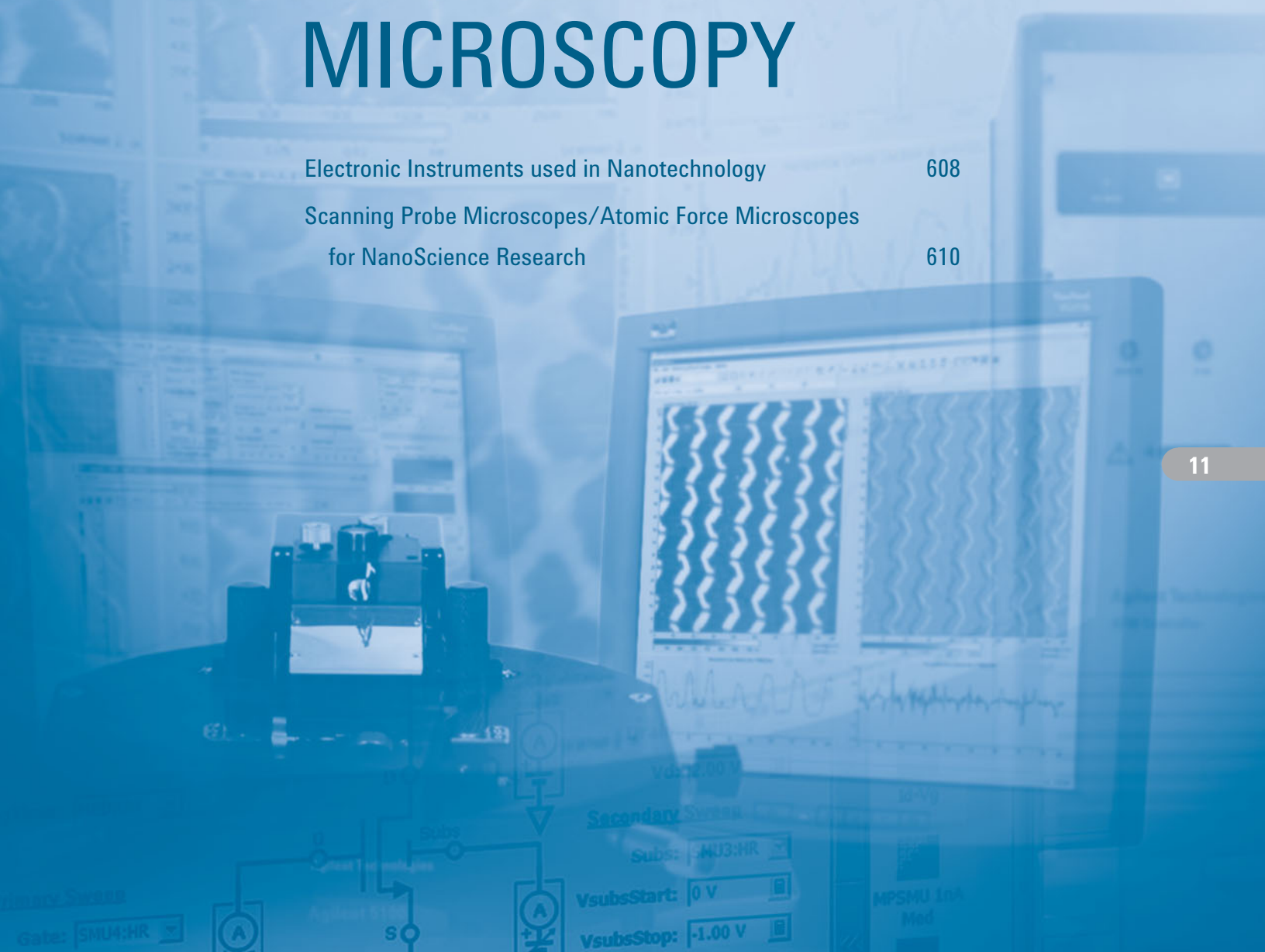
81000UM Universal Through Adapter

Reference Reflector

81000BR Reference Reflector
A gold-plated HMS-10 connector for use in calibrating return loss. Return loss is 0.18dB ± 0.1dB (96% ± 2%)
81610CC Calibrated Reflection Patchcord for use in calibrating return loss and front-panel offset in return loss measurements.

11

ELECTRONIC INSTRUMENTS IN NANOTECHNOLOGY, NANOSCALE MICROSCOPY



Nanotechnology

Electronic Instruments used in Nanotechnology

- **Broad portfolio of electronic instruments**
- **High precision measurements**
- **Flexible functionality**
- **Ease of operation**

B1500A

4294A

34410A

E4980A

N6705A

Features and Specifications

Semiconductor and Parametric Analyzers

Model	Maximum Force Voltage	Maximum Force Current	Voltage Resolution	Current Measurement Resolution	PC and Software
B1500A Semiconductor Device Analyzer	100 V	100 mA	0.5 µV	100 aA	Internal (built-in)
4157B Modular Semiconductor Parameter Analyzer	200 V	1 A	0.5 µV	100 aA	External
4156C Precision Semiconductor Parameter Analyzer	100 V	100 mA	0.2 µV	1 fA	External
4155C Semiconductor Parameter Analyzer	100 V	100 mA	0.2 µV	10 fA	External

Impedance and Materials Analyzers

Model	Frequency Range	10% Accuracy Range	Basic Impedance Accuracy	Test Signal Level	DC Bias
4294A Precision Impedance Analyzer	40 Hz to 110 MHz	25 mΩ to 40 MΩ	±0.08%	5 mV to 1 V_{rms} or 200 µA to 20 mArms	0 V to ±40 V or 0 mA to ±100 mA
E4991A RF Impedance/ Material Analyzer	1 MHz to 3 GHz	200 mΩ to 20 kΩ	±0.8%	–	0 to ±40 V or +100 µA to +50 mA

Precision LCR and Resistance Meters

Model	Frequency Range	Measurement Range
E4980A Precision LCR Meter	20 Hz to 2 MHz	0.001 fΩ to 999.9999 TΩ
4284A Precision LCR Meter	20 Hz to 1 MHz	0.01 mΩ to 100 MΩ
4285A Precision LCR Meter	75 kHz to 30 MHz	0.01 mΩ to 100 MΩ
4338B Milliohm Meter	1 kHz	10 µΩ to100 kΩ

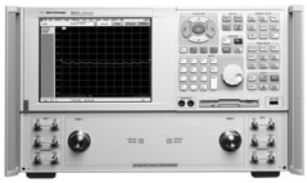
Digital Multimeters

Model	DC Voltage Sensitivity	Resistance Sensitivity	DC Current Sensitivity	Frequency Measurement	Capacitance Sensitivity	Max Digitizing Speed
34410A Digital Multimeter	100 nV	100 µΩ	100 µA	3 Hz to 300 kHz	0.1 pF	10 kHz
34411A Digital Multimeter	100 nV	100 µΩ	100 µA	3 Hz to 300 kHz	0.1 pF	50 kHz
34420A NanoVolt, Micro-Ohm Meter	100 pV	100 nΩ	–	1 Hz to 10 MHz	–	–
3458A Digital Multimeter	10 nV	10 µΩ	1 pA	–	–	100 kHz

Power Supplies

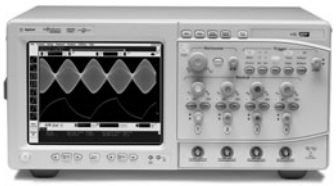
Model	Power Level	Channels	Voltage Range	Voltage Resolution	Current Range	Current Resolution
N6700 Modular Power System, N6705A DC Power Analyzer[1]	Up to 400 W in a 4-slot frame	Up to 4 per frame	12 mV to 5.5 V	90 µV	100 µA to 100 mA	2 µA
6610 Series High Performance DC Power Supplies	Up to 50 W in a compact 2U, 1/2-rack	1	0 to 100V	As low as 2 mV	0 to 5 A	As low as 0.25 mA
E3630A DC Bench Power Supply	35W total output power for basic bench top use	3	0 to 20V	10 mV	0 to 2.5 A	10 mA

[1] Using the N6761A/N6762A high precision power modules.



E8361A

E5052A



8000 Series

81100 Series

Network Analyzers

Model	Frequency Range	Dynamic Range	Trace Noise	Other Products in the Family
E8361A PNA Network Analyzer	10 MHz to 67 GHz	136 dB	<0.006 dB	E8362B PNA E8363B PNA E8364B PNA
N5230A PNA-L Network Analyzer	300 kHz to 50 GHz	79 – 122 dB	<0.004 dB	N5250A Millimeter Wave PNA
E5071C ENA RF Network Analyzer	9 kHz to 8.5 GHz	123 dB	<0.004 dB @70 kHz IFBW	E5070B
E5062A ENA-L RF Network Analyzer	300 kHz to 3.0 GHz	115 dB	<0.005 dB	E5061A ENA-L

Signal Source Analyzers

Model	Frequency Range	Phase Noise	Frequency	RF Power	DC Current (10 µA resolution)	Frequency Over Time	Phase Over Time	Power Over Time	Transients Over Time
E5052A Signal Source Analyzer	10 MHz to 7 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Plus E5053A Microwave Downconverter[1]	10 MHz to 26.5 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11970A Waveguide Harmonic Mixer[2]	10 MHz to 110 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[1] Add the E5053A to the E5052A to increase the frequency.
[2] Add the E5053A and the 11970 Series Mixers to the E5052A to increase the frequency.

Oscilloscopes

Model	Application	Bandwidth	Sample Rate	Channels
3000 Series Economy Oscilloscopes	Low cost general purpose benchtop	60 MHz to 200 MHz	Up to 1 GSa/s	2 Analog
6000 Series High Performance Oscilloscopes	Medium performance in portable package	100 MHz to 1 GHz	2/4 GSa/s	4 Analog 16 Digital (with MSO option)
8000 Series Infiniium Oscilloscopes	General purpose for laboratory research	600 MHz to 1 GHz	4 GSa/s	4 Analog 16 Digital (with MSO option)
80000 Series Ultra-high Performance Oscilloscopes	Highest performance for laboratory research	2 GHz to 13 GHz	40 GSa/s	4 Analog

Function Generators

Model	Frequency Range	Built-In Waveforms	Arbitrary Waveform Memory	Minimum Pulse Width	Pulse Rise/ Fall Time
33220A Function/Arbitrary Waveform Generator	1 µHz to 20 MHz	Sine, square, triangle, ramp, pulse, noise, sin(x)/x, exponential rise & fall, cardiac, DC volts, arbitrary, AM, FM, PM, FSK, PWM	64 K points	20 ns	<13 ns
33250A Function/Arbitrary Waveform Generator	1 µHz to 80 MHz	Sine, square, pulse, triangle, ramp, noise, sin(x)/x, exponential rise & fall, cardiac, DC volts, arbitrary, AM, FM, FSK	64 K points	8 ns	<8 ns
81100 Series Pulse Pattern Generators	1 mHz to 330 MHz	Pulse, pattern	12 Mbit/channel	1.5 ns to 20 ns	500 ps to 5 ns
N5181A MXG Analog Signal Generator	250 kHz to 6 GHz	AM, FM, ΦM, Pulse Modulation	100 MSa	500 ns	<50 ns

Key Literature & Web Link

5989-5839EN

www.agilent.com/find/nano

Scanning Probe Microscopes/Atomic Force Microscopes for NanoScience Research

N9410S
N9430S
N9435S
N9490S
N9420A

- **Highly modular AFM system affords utmost flexibility**
- **Unrivaled environmental and temperature control while imaging**
- **Superior scanning in liquids, gases, or ambient conditions**
- **High-resolution scanner with large scan range**
- **Complete set of imaging modes**
- **Options and accessories compatible on *ALL* systems**
- **Ideal for life science, materials science, electrochemistry and polymer research**

The Ultimate AFM Platform

Agilent 5500 System

The 5500 atomic force microscope is an ideal multiple-user research system. In addition to atomic-scale resolution, the 5500 offers many unique features, including true modularity that enables you to add application-specific options when the need arises.

The intelligent, modular design of this exceptional microscope permits the simple integration of numerous imaging modes with easy-to-use nose cones, MAC Mode for imaging soft materials in liquid, application-specific sample-handling plates, as well as setting the industry standard for environmental and temperature control. Our balanced-pendulum, top-down-design multipurpose scanners come in a range of sizes, both open and closed loop, all offering outstanding linearity and accuracy.

Agilent 5500 LS

The 5500 LS AFM large stage enables fast, accurate probe positioning for imaging and mapping large specimens in high-resolution. This large, motorized stage allows you to precisely locate and identify an area of interest and, with the coordinates stored, automatically repositions the sample rapidly and accurately for further study. The 5500 LS stage is very well suited for imaging large samples in air, liquid, and under temperature control.

Agilent 5500 ILM

The 5500 inverted light microscope (ILM) adapter combines high-resolution AFM imaging with the direct optical viewing capability of an inverted light microscope to provide both atomic force and optical microscopy data. This system's advanced design allows the atomic force microscope to sit on top of an inverted microscope and under the illumination pillar, resulting in better optical contrast for the images.

The 5500 ILM offers unparalleled performance and ease of use for imaging in liquids or ambient air. Atomic force and optical (or fluorescence) microscopy data can be obtained simultaneously enabling a wide range of complementary techniques, such as FRET, darkfield, and brightfield.

Emphasis on Education

Agilent 5400 AFM System

The 5400 atomic force microscope is a high-precision instrument engineered to provide superb ease of use and versatility. This scientific-grade microscope delivers atomic-scale resolution at a remarkably affordable price, making it an outstanding choice for education as well as research.

Complete with its Agilent-developed microscope curriculum, the 5400 offers educators an unprecedented opportunity to introduce their students to a wide range of powerful AFM techniques. This AFM is ideal for material sciences, polymers and general surface characterization such as adhesion, friction and elasticity.

Price and Performance

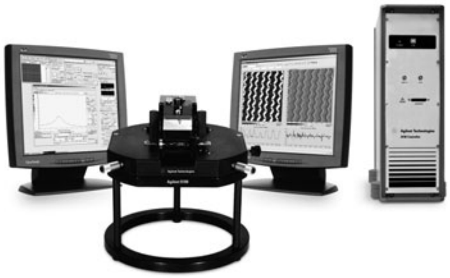
Agilent 5100 AFM System

The 5100 atomic force microscope is a high-resolution system that provides excellent imaging capabilities in an easy-to-upgrade package. The entry-level priced 5100 offers easy upgradeability to our flagship 5500 microscope as your research needs occur.

The 5100 microscope delivers atomic-scale resolution as well as direct video access to the scan area. The 5100 comes with our multipurpose scanners and imaging modes. It is compatible with MACMode for imaging soft materials in liquid and Agilent's superior temperature control allowing a versatile solution for a diverse set of applications.


N9410S


N9435S


N9420A


N9430S


N9490S

Agilent's SPM/AFM Systems for Superior Application Flexibility

SPM/AFM	N9410S 5500 AFM	N9430S 5500LS AFM	N9435S 5500 ILM AFM	N9490S 5400 AFM	N9420A 5100 AFM
Sample Size	20 mm x 20 mm	150 mm or 200 mm	20 mm x 20 mm	20 mm x 20 mm	20 mm x 20 mm
Imaging Modes	Contact Mode Acoustic AC Mode MAC Mode Phase Imaging STM LFM EFM MFM Force Modulation Current Sensing	Contact Mode Acoustic AC Mode MAC Mode Phase Imaging STM LFM EFM MFM Force Modulation Current Sensing	Contact Mode Acoustic AC Mode MAC Mode Phase Imaging STM LFM EFM MFM Force Modulation Current Sensing	Contact Mode Acoustic AC Mode MAC Mode Phase Imaging STM LFM EFM MFM Force Modulation Current Sensing	Contact Mode Acoustic AC Mode MAC Mode Phase Imaging STM LFM EFM MFM Force Modulation Current Sensing
Options	Electrochemical Environment Control Temp Control MAC Mode PicoTREC Multi-purpose Scanner Nose Cones Glove Box	Temp Control Multi-purpose Scanner Nose Cones MAC Mode	Temp Control Multi-purpose Scanner Nose Cones MAC Mode PicoTREC	Temp Control Multi-purpose Scanner Nose Cones Mac Mode	Electrochemical Environment Control Temp Control MAC Mode Multi-purpose Scanner Nose Cones Glove Box
Accessories	Liquid Cell Sample Plates Vibration Isolation Q-Control Breakaway Box Video	Liquid Cell Sample Plates Q-Control Breakaway Box	Liquid Cell Sample Plates Q-Control Breakaway Box	Liquid Cell Sample Plates Vibration Isolation Q-Control Breakaway Box	Liquid Cell Sample Plates Vibration Isolation Q-Control Breakaway Box Video
Applications	Electrochemistry Polymers Nanolithography Nanografting Life Science Materials Science	Materials Science Semiconductor	Life Science	Materials Science Polymers Surface Characterization Nanolithography Education	Electrochemistry Polymers Materials Science

Key Literature & Web Link

www.agilent.com/find/afm


Count:
Device ID:
TR WQS339
My Favorite Setup
Engineer #1
C-V Sweep
Id-Vg
MPSMU 1nA Med
Simple Vth
Charge Pumping
Save
Recall
Extended Setup
Drain:
SMU1:HP
Vd:
2.00 V
Secondary Sweep
Subs:
SMU3:HR
VsubsStart:
0 V
VsubsStop:
-1.00 V
VsubsStep:
-200 mV
Source:
SMU2:HP
Remarks
Device ID
TR WQY717
Good device

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SEMICONDUCTOR PARAMETRIC TEST, FLAT PANEL DISPLAY TEST

Parametric Tester

4080 Series

4082A
4082F
4083A

- Accurate and reliable DC current and voltage measurement with 1 femtoamp and 0.1 microvolt measurement resolution capability
- Synchronous parallel test capability
- Optional asynchronous parallel test capability by the Virtual Multiple Testhead Technology
- An optional high-speed capacitance measurement unit (HSCMU) for high-throughput capacitance measurement
- Flash cell write/erase endurance testing via integrated high-voltage semiconductor pulse generator units (HV-SPGUs) with –40 V to +40 V (80 V peak-to-peak) output capability (4082F and 4083A)
- RF S-parameter measurement at up to 20 GHz with support for an optional 8 x 10 RF switching matrix (4083A only)
- Software compatibility to Agilent 4070 Series
- Support for low-cost Linux workstations
- Full compliance with SEMI factory automation standards E5 (SECS II), E30 (GEM), E87 (CMS), E39 (OSS), E40 (PMS), E90 (STS) and E94 (CJM)

New Wafer Fabs Face Increased Measurement Challenges

The parametric testing challenges facing new wafer fabs are intensifying, and they will continue to intensify into the future. The need to make accurate and reliable DC voltage and current measurements remains very important. However, parametric test has moved away from the realm of pure DC measurement and has branched out into many new directions. Parametric test now spans a variety of different types of measurements including parallel test, Flash cell testing, and RF S-parameter characterization. Wafer fabs running advanced processes require a more versatile and flexible platform to adequately meet this broad spectrum of parametric measurement challenges.

A Family of Solutions that Meets Both Basic and Advanced Measurement Needs

Building on the well-proven parametric test capabilities of the industry-standard Agilent 4070 Series, the Agilent 4080 Series of Parametric Testers are modular and expandable production test platforms with the capabilities to meet all of the parametric characterization challenges posed by the most advanced semiconductor processes. Besides having a flexible configuration at time of purchase, each 4080 platform also has the ability to easily add new testing capabilities if your measurement needs change. All members of the 4080 Series can also run existing 4070 test algorithms with little or no modification, which minimizes transition costs while ensuring that your new capital investment is protected for many years into the future. The 4080 Series consists of three products optimized for different market needs. The 4082A is focused on high-speed general-purpose parametric test; the 4082F is focused on parametric test of Flash memory processes; the 4083A is focused on the evaluation of high-speed semiconductor processes.

	4082A Parametric Test System	4082F Flash Memory Cell Parametric Test System	4083A DC/RF Parametric Test System
Standard Resources			
MPSMU (up to 8)	10 fA and 2 µV resolution 100 V and 100 mA maximum output	10 fA and 2 µV resolution 100 V and 100 mA maximum output	10 fA and 2 µV resolution 100 V and 100 mA maximum output
HPSMU (up to 2)	10 fA and 2 µV resolution 200 V and 1 A maximum output	10 fA and 2 µV resolution 200 V and 1 A maximum output	10 fA and 2 µV resolution 200 V and 1 A maximum output
HRSMU (up to 2)*	1 fA and 2 µV resolution 100 V and 100 mA maximum output	1 fA and 2 µV resolution 100 V and 100 mA maximum output	1 fA and 2 µV resolution 100 V and 100 mA maximum output
HV-SPGU (up to 5)	—	–40 V to +40 V output (80 V peak-to-peak) 20 ns transition times 2-level and 3-level pulses	–40 V to +40 V output (80 V peak-to-peak) 20 ns transition times 2-level and 3-level pulses
GNDU	1.6 A @0 V	1.6 A @0 V	1.6 A @0 V
Optional Integrated Resources			
3458A DVM	0.1 µV resolution* 1 µV resolution	0.1 µV resolution* 1 µV resolution	0.1 µV resolution* 1 µV resolution
HSCMU (up to 1)	1 fF to 100 nF measurement range 1 kHz to 2 MHz frequencies	1 fF to 100 nF measurement range 1 kHz to 2 MHz frequencies	1 fF to 100 nF measurement range 1 kHz to 2 MHz frequencies
E4980A LCR Meter	1 fF to 100 nF measurement range 1 kHz, 10 kHz, 100 kHz, and 1 MHz frequencies	1 fF to 100 nF measurement range 1 kHz, 10 kHz, 100 kHz, and 1 MHz frequencies	1 fF to 100 nF measurement range 1 kHz, 10 kHz, 100 kHz, and 1 MHz frequencies
E8362B PNA Network Analyzer	—	—	10 MHz to 20 GHz
DC Switching Matrix (12 to 48 output pins) Plus one pin for prober chuck connection	2 active-guarded shielded low-current paths (non-Kelvin)* 6 full Kelvin active guarded paths 8 auxiliary input ports 48 extended path inputs 48 full Kelvin active guarded outputs		
HF Switching Matrix	Configurable as one 3 x 48 or two 3 x 24 matrices Pulse switch	Configurable as one 3 x 48 or two 3 x 24 matrices Pulse switch	Configurable as one 3 x 48 or two 3 x 24 matrices Pulse switch
RF Switching Matrix	—	—	8 x 10 configuration 20 GHz bandwidth

* Requires ultra low-current matrix cards

Accessories

The Agilent 4080 Series testers are system products and do not have accessories as do instrument products. They must be configured in consultation with an Agilent sales professional specializing in these products.

Key Literature & Web Link

www.agilent.com/see/4080

Ordering Information

The Agilent 4080 Series testers are system products and must be configured in consultation with an Agilent sales professional specializing in these products.

Parametric Tester

4070 Series

- **Standards-based family with broad feature-set – All members of the 4070 Series family provide complete DC parametric test capability, including Flash memory cell testing, capacitance versus voltage (CV) measurement and ring oscillator evaluation. Additionally, you can integrate all models into your SECS/GEM compatible 300 mm automated factory environment**
- **Laboratory test capabilities now available for production test – Until now, the precise current and voltage measurement resolution needed for advanced 65 nm processes have been available only in a laboratory environment. The Agilent 4070 Series enables you to measure sensitive device parameters during production test**
- **Improved throughput and lowered cost of test – In the Agilent 4070 Series, the high-speed capacitance measurement unit (CMU) is integrated into the test head, enabling you to make extremely fast capacitance measurements in the 1 KHz to 2 MHz frequency range**
- **Ultimate flexibility in testing ultra thin oxide structures – The Agilent 4070 Series supports both HFCV and RFCV techniques, which allows users to choose the best method to characterize CV behavior that fits both their process technology and production test needs**
- **Accurate testing for high-speed devices – The Agilent 4070 Series supports RF S-parameter measurement (PNA) to accurately characterize these types of high-speed devices**
- **Ultra short-pulsed measurement capability eliminates thermal effects – The Agilent 4070 Series provides ultra short-pulsed IV measurements down to 10 nanoseconds, which enables characterization of highly thermally sensitive devices such as silicon-on-insulator (SOI) transistors and/or charging effect sensitive high-k transistors**

With Moore's Law driving the evolution of ever-smaller transistor device structures, and new breakthroughs leading to ever-greater circuit densities, semiconductor manufacturers must perform a larger variety of parametric measurements, and also measure many parameters to greater levels of accuracy, in production. Agilent has responded to these challenges with the Agilent 4070 Series, which offers the widest range of solutions and price-performance points available today for production parametric test systems. The 4070 Series provides the DC and RF measurement capabilities needed to test the today's advanced process technologies.

Specifications

Product	DC Parametric Test	Flash Cell Testing	Ring Oscillator Evaluation	1 fA Current Measurement Resolution	High-Speed Capacitance Measurement (to 2 MHz)
4072A	S	A	A	N/A	N/A
4073A	S	A	A	S	N/A
4072B	S	A	A	N/A	S
4073B	S	A	A	S	S
4075	S	A	A	N/A	A
4076	S	A	A	S	A

S = Standard Feature A = Available Feature N/A = Not Available

In addition to the above, the Agilent 4075 and 4076 have the following features available as options:

- RF S-parameter/RFCV Measurement up to 20 GHz via integrated Agilent PNA
- High-frequency CV Measurement (up to 110 MHz) via integrated Agilent Impedance Analyzer
- Pulsed IV measurement down to 10 ns via integrated Agilent Pulse Generator and Agilent Oscilloscope

Accessories

The Agilent 4070 Series testers are system products and do not have accessories as do instrument products. They must be configured in consultation with an Agilent sales professional specializing in these products.

Key Literature & Web Link

The Agilent 4070 | 300 Total Parametric Measurement Solution, p/n 5988-3842EN

www.agilent.com/see/4070

Ordering Information

The Agilent 4070 Series testers are system products and must be configured in consultation with an Agilent sales professional specializing in these products.

N9201A

- **Up to 40 SMU Channels for Array Structure Test – In addition to the existing Agilent Parametric Tester measurement resources, the N9201A can provide up to 40 additional SMUs to support massive parametric testing of Array structures**
- **Up to 32 bit Address Generation Function – The N9201A has an address generation function capability (supporting address decoders, shift registers, etc.) for active array test structure testing**
- **Concurrent parametric test capability – The N9201A can work concurrently with an Agilent parametric test system. This permits the simultaneous use of both N9201A and Agilent parametric test system measurement resources**

Parametric Tester for Fast Yield Ramp Up

The decreasing size on integrated circuits (90 nm and smaller) is driving the need for new parametric test capabilities. These capabilities must accommodate the advanced test structures developed for fast yield ramp up in process integration as well as process monitoring in semiconductor manufacturing.

High throughput measurement of high volume parametric data is required to shorten the time for ramping up the process yield. This is accomplished by statistically analyzing and correcting the cause of wide range of process performance variation across a 300 mm wafer. Advanced test structures, addressable array test structures that contain address decoder circuitry and a large number of test array elements with fewer probing pads and silicon area, have been developed by major semiconductor manufacturers for this purpose.

Providing Array Structure Parametric Test for Agilent Parametric Testers

The Agilent N9201A Parametric test Option offers high throughput parametric measuring capability for a variety of addressable array test structures (e.g. passive arrays, active arrays, etc.) with synchronized mixed operation of DC SMUs and digital outputs. Digital outputs (parallel, serial, or clock signals) are used for the address decoder that is built into addressable array test structures. This allows the selection of the specific array element to be measured. DC SMUs measure the DC voltage and current parameters of selected array elements.

A DC power source is used for applying the power supply voltage (Vdd) to the address decoder logic circuitry that is built in the addressable array test structures. The N9201A is able to provide maximum 48 signal lines. This is accomplished by combining DC SMUs, Digital outputs and a DC power source to the test structures through the test head of the 4072A/B, 4073A/B, 4075, and 4076 parametric tester and probe card.

Specifications

Measurement Functions
DC Current, DC Voltage, Digital Output

DC Measurement

Measurement Unit
High Speed MPSMU (Medium Power SMU)
8 SMUs (minimum), increment of one SMU channel up to 40 SMUs (maximum)
(Maximum total signal channels of SMUs, Digital outputs and DC power supply is 48)
Range of Operation: –42 V to 42 V
–200 mA to 200 mA
Minimum Resolution: 100 µV, 5 pA
Maximum Voltage between Common and Ground: ±42 V

Ground Unit (GNDU) Specification
Output Voltage: 0 V ± 100 µV
Maximum sink current: 0.5 A
Output terminal/connection: Triaxial connector, Kelvin (remote sensing)

High Speed MPSMU Specification
Specified at the connector of equipment's front panel

Accessories

The N9201A Array Structure Parametric Test Option is a system product option and does not have accessories as do instrument products. It must be configured in consultation with an Agilent sales professional specializing in these products

Key Literature & Web Link

Agilent N9201A Array Structure Parametric Test Option Data Sheet, p/n 5989-5747EN

www.agilent.com/see/parametric

Ordering Information

The N9201A Array Structure Parametric Test Option is a system product option and must be configured in consultation with an Agilent sales professional specializing in these products.

Note: You must have a 4070 Series parametric test system (4072A/B, 4073A/B, 4075, or 4076) in order to use the N9201A.

Parametric Tester

Integrated Parametric Analysis and Characterization Environment (iPACE)

- **Integrated switching matrix, probe card interface, and probe card: Enables automation of wafer characterization without compromising the 1 fA measurement performance of the semiconductor parameter analyzer**
- **B2200 and B2201 switching matrices have 8 triaxial and 6 coaxial inputs: Allows utilization all of the measurement resources of the semiconductor parameter analyzer**
- **Atto sense unit (ASU): Easy to switch between CV and IV measurements; no need to physically change cabling or move to a different probe station; 100 attoamp (0.1 femtoamp) resolution**
- **Complete, integrated solution: Simpler, less expensive alternative that is optimized for use in wafer characterization environments**

Integrated Parametric Measurement Solutions that Do Not Compromise Performance

Engineers and scientists working on current and future semiconductor process technologies frequently require an efficient means to characterize wafers with high accuracy in a low-volume test environment. The Agilent 41000 Series or integrated parametric analysis and characterization environment (iPACE) provides an effective solution to meet this challenge.

The 41000 Series solution solves the most common challenges facing parametric instrument users who require high-resolution 1 fA performance all the way to the interface of the probe card needle and the wafer. Four standard 41000 Series configurations come pre-racked and cabled. Two are positioner-based solutions and two include a new high-performance switching matrix with a new probe card interface. These integrated solutions eliminate the tedious and confusing job of racking, cabling, and verifying the performance of parametric instruments.

With the 41000 Series' advanced switching matrix users can perform 1 fA, low-volume capacitance versus voltage (CV) characterization and current versus voltage (IV) characterization of wafers in development lab environments. There is also support for full Kelvin measurements using 4 SMUs or CV measurements, using the same setup.

Advanced switching matrix and probe card technology enable Agilent to initially offer two probe card-based solutions, in 1 fA and 10 fA measurement performance versions. Each standard configuration also allows users to add a wide range of options. All versions of the 41000 Series can also support CV measurement using an optional capacitance meter (initially the Agilent E4980A, with others to be added later).

The Agilent 41000 Series offers a new solution that fills the gap between expensive production-level testers and the low performance, user-created instrument solutions.

1 fA Measurements through a Switching Matrix

The Agilent 41000 Series allows engineers and scientists doing wafer characterization in development lab environments to make highly accurate measurements through a switching matrix and probe card without any compromise in the performance of their semiconductor parameter analyzers. Resolution of 1 fA is maintained all the way to the interface of the probe card needle and the wafer.

The new B2200 and B2201 low-leakage switching matrices, which form the core of the 41000 Series solution, enable respective measurements of 1 fA and 10 fA to be made through them. When combined with the B2220 probe card interface and Agilent's advanced low-leakage probe card expertise, this unequaled measurement performance allows the full measurement potential of semiconductor parameter analyzers (4155C, 4156C, or E5270B) to be realized. This integration eliminates the arduous task of building a custom instrument solution and ensures that the performance standards of the parameter analyzer are maintained.

Support for CV and IV Measurements through Positioners

Prior to the introduction of the 41000 Series, switching between CV and IV measurements using positioners required manual disconnection and reconnection of the parameter analyzer cables and C meter cables. The 41000 Series' patented E5288A atto-sense and switch unit (for the E5270B parameter analyzer) and the B2200/B2201 switching matrices enable you to switch between CV and IV measurements simply by issuing a few software commands.

Support for Full Kelvin Measurements using 4 SMUs

The switching matrices have 14 inputs (8 triaxial and 6 coaxial). Each input corresponds to a unique internal path, which offers the highest level of flexibility by eliminating the need to multiplex inputs. The 8 triaxial inputs support full Kelvin measurements (force and sense) using 4 SMUs. Two dedicated coaxial inputs are available for CV measurements on the same setup while the 4 remaining coaxial inputs provide flexibility for future expansion. This level of automation dramatically increases test efficiency.

Support for CV Measurements with Built-in Compensation

Models 200, 300 and 400 of the 41000 Series use the B2200 and B2201 switching matrices, which have built-in compensation features for CV measurement data.

Specifications

Current Measurement Resolution (Model 100): 0.1 fA (100 aA)
Current Measurement Resolution (Model 200, 300): 1.0 fA
Current Measurement Resolution (Model 400): 10.0 fA
Voltage Measurement Resolution
(All 4155C and 4156C option-based Models): 0.2 µV
Voltage Measurement Resolution
(All E5270B HRSMU and MPSMU option-based Models): 0.5 µV
Probe Card I/F Pins: 24 or 48
Kelvin Channels: 0 to 4
C Measurement (Optional): 1 MHz (E4980A)

Options
41000 Model 100: Ultra-Precision (0.1 fA/0.5 µV) CV/IV Measurement
41000 Model 200: Ultra-Precision (1 fA/0.5 µV) CV/IV Measurement
- Analyzers option (4155C, 4156C and E5270B)
- E4980A C Meter (optional)
- PDU/EMO (optional)

41000 Model 300: 1 fA/0.5 µV General Purpose CV/IV Measurement
- Analyzers option (4156C or E5270B) Model 400 only
- Probe Card I/F Pins (24 or 48)
- Kelvin channel numbers (0-8)
- E4980A C Meter (optional)
- PDU/EMO (optional)

41000 Model 400: 10 fA/0.5 µV General Purpose CV/IV Measurement
- Analyzers option (4155C, 4156C or E5270B) Model 400 only
- Probe Card I/F Pins (24 or 48)
- Kelvin channel numbers (0-8)
- E4980A C Meter (optional)
- PDU/EMO (optional)

Accessories and Cables

All necessary accessories and cables are included with each model of the 41000.

Key Literature & Web Link

Measurement Solutions without Compromise Brochure, p/n 5989-1434EN
Agilent 41000 Models 100, 200, 300 and 400 Integrated Parametric Analysis and Characterization Environment (iPACE) Technical Overview, p/n 5989-2319EN

Ordering Information

The Agilent 41000 has a complex configuration and should be configured in consultation with an Agilent sales professional familiar with these products.

Semiconductor Parameter Analyzer

4155C

- **Set measurement and/or stress conditions**
- **Control measurement and/or stress execution**
- **Perform arithmetic calculations**
- **Display measured and calculated results on the LCD display**
- **Perform graphical analysis**
- **Store and recall measurement setups, and measurement and graphical display data**
- **Dump to printers or plotters for hardcopy output**
- **Perform measurement and analysis with built-in instrument BASIC**
- **Self test, Auto calibration**

The 4155C Semiconductor Parameter Analyzer provides cost-effective, accurate laboratory bench top parameter analyzers for advanced device characterization. The low-current and low-voltage resolution and built-in quasi-static CV measurement capability of the 4155C provide a firm foundation for future expansion with other measurement instruments. The 41501B Expander can extend your capabilities to 1 A/200 V as well as supporting dual pulse generator units (PGUs) and a 1.6 A ground unit.

The 4155C offers all-in-one packaged solutions with Agilent's PC-based Parametric Analysis and Characterization Environment. Standard configurations include a parameter analyzer, Agilent Desktop EasyEXPERT Software, and a notebook PC controller with Windows XP™ Professional operating system. Desktop EasyEXPERT Software provides a new, more intuitive task-oriented approach to device evaluation.

Specifications

General Features

- Cost-effective, accurate laboratory bench top parameter analyzer
- 4 x Medium-power SMU, 2 x VSU and 2 x VMU
- Fill-in-the blanks front panel operation
- Includes Desktop EasyEXPERT Software for PC-based GUI instrument control

Measurement Capabilities

- 10 femtoamp and 0.2 microvolt measurement resolution
- QSCV, Stress Mode, Knob-sweep, and Stand-by functions
- ±200 Volts and ±1 Amp High-Power SMU, Pulse Generator capabilities available by optional 41501B

Desktop EasyEXPERT Software Capabilities

- An innovative task oriented approach user interface
- Easy test automation with built-in semi-automatic prober drivers
- Test sequencing without programming via Quick Test mode
- A Classic Test mode to provide the look, feel, and terminology of the 4155/4156 interface
- Intuitive GUI-based switching matrix control for the B2200A, B2201A, and E5250A (optional)

SMU Measurement Range
Voltage: 2 µV/200 V*
Current: 10 fA/1 A*
SMU Measurement Resolution
Voltage: 2 µV
Current: 10 fA
SMU Measurement Accuracy
Voltage: 700 µV
Current: 3 pA
SMU Pulse Width
500 µs/100 ms
VMU
Resolution: 2 µV
Accuracy: 200 µV
VMU (differential)
Resolution: 0.2 µV
Accuracy: 10 µV
Dual High Voltage Pulse Generator
Voltage Range: ±40 V
Output Current: ±200 mA
Minimum Pulse Width: 1 µs
Minimum Pulse Period: 2 µs

Accessories and Cables

N1254A-100 Ground Unit to Kelvin Adapter
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

Expand Your Parametric Test Horizons Brochure, p/n 5989-0932EN
Agilent 4155C Semiconductor Parameter Analyzer Data Sheet, p/n 5988-9238EN

www.agilent.com/see/parametric

Ordering Information

You must specify either 1.5 m or 3.0 m length for the included accessory cables
You can delete the Windows-based PC controller by specifying option 020; however, the Desktop EasyEXPERT Software is still included with the product
The Agilent 41501B expander box can be ordered with the following options:

1 HPSMU, 2 MPSMUs, or no additional SMUs
2 PGUs or no PGUs
1.6 A ground unit (GNDU) – Standard with all 41501B units

* The 200 V and 1 A ranges are available when using the Agilent 41501B with the HPSMU option.

4156C

- **Set measurement and/or stress conditions**
- **Control measurement and/or stress execution**
- **Perform arithmetic calculations**
- **Display measured and calculated results on the LCD display**
- **Perform graphical analysis**
- **Store and recall measurement setups, and measurement and graphical display data**
- **Dump to printers or plotters for hardcopy output**
- **Perform measurement and analysis with built-in instrument BASIC**
- **Self test, auto calibration**

The 4156C Precision Semiconductor Parameter Analyzer provides highly accurate laboratory bench top parameter analyzers for advanced device characterization. The superior low-current and low-voltage resolution and built-in quasi-static CV measurement capability of the 4156C provide a firm foundation for future expansion with other measurement instruments. The 41501B Expander can extend your capabilities to 1 A/200 V as well as supporting dual pulse generator units (PGUs) and a 1.6 A ground unit.

The 4156C offers all-in-one packaged solutions with Agilent's PC-based Parametric Analysis and Characterization Environment. Standard configurations include a parameter analyzer, Agilent Desktop EasyEXPERT Software, and a notebook PC controller with Windows XP™ Professional operating system. Desktop EasyEXPERT Software provides a new, more intuitive task-oriented approach to device evaluation.

Specifications

General Features

- Highly accurate laboratory bench top parameter analyzer for advanced device characterization
- 4 x High-resolution SMU, 2 x VSU and 2 x VMU
- Fill-in-the blanks front panel operation
- Includes Desktop EasyEXPERT Software for PC-based GUI instrument control

Measurement Capabilities

- 1 femtoamp and 0.2 microvolt measurement resolution
- Full Kelvin; force, sense and guard connection for each SMU
- QSCV, Stress Mode, Knob-sweep, Stand-by function
- ±200 Volts and ±1 Amp High-Power SMU, Pulse Generator capabilities available by optional 41501B

Desktop EasyEXPERT Software Capabilities

- An innovative task oriented approach user interface
- Easy test automation with built-in semi-automatic prober drivers
- Test sequencing without programming via Quick Test mode
- A Classic Test mode to provide the look, feel, and terminology of the 4155/4156 interface
- Intuitive GUI-based switching matrix control for the B2200A, B2201A, and E5250A (optional)

SMU Measurement Range
Voltage: 2 µV/200 V*
Current: 1 fA/1 A*
SMU Measurement Resolution
Voltage: 2 µV
Current: 1 fA
SMU Measurement Accuracy
Voltage: 200 µV
Current: 20 fA
SMU Pulse Width
500 µs/100 ms
VMU
Resolution: 2 µV
Accuracy: 200 µV
VMU (differential)
Resolution: 0.2 µV
Accuracy: 10 µV
Dual High Voltage Pulse Generator
Voltage Range: ±40 V
Output Current: ±200 mA
Minimum Pulse Width: 1 µs
Minimum Pulse Period: 2 µs

Accessories and Cables

N1254A-100 Ground Unit to Kelvin Adapter
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

Expand Your Parametric Test Horizons Brochure, p/n 5989-0932EN
Agilent 4156C Semiconductor Parameter Analyzer Data Sheet, p/n 5988-9238EN

www.agilent.com/see/parametric

Ordering Information

You must specify either 1.5 m or 3.0 m length for the included accessory cables
You can delete the Kelvin cables by specifying option 010; in this case you must order standard triaxial cables (16494A-001/002) as a separate line item if you need triaxial cables
You can delete the Windows-based PC controller by specifying option 020; however, the Desktop EasyEXPERT Software is still included with the product
The Agilent 41501B expander box can be ordered with the following options:

1 HPSMU, 2 MPSMUs, or no additional SMUs
2 PGUs or no PGUs
1.6 A ground unit (GNDU) – Standard with all 41501B units

* The 200 V and 1 A ranges are available when using the Agilent 41501B with the HPSMU option.

Semiconductor Device Analyzer

B1500A

- **Superior IV measurement performance: 0.1 fA / 0.5 µV measurement resolution**
- **Optional, integrated capacitance module supports CV measurements up to 5 MHz**
- **Over 180 pre-defined application tests to get you up and running quickly**
- **EasyEXPERT software provides an innovative, task-based approach to parametric test**
- **Optional positioner-based CV-IV switching solutions available with 0.5 µV voltage measurement resolution and 10 fA, 1 fA or 0.1 fA current measurement resolution capability**
- **Easy test automation with built-in semiautomatic wafer prober drivers and test sequencing without programming via the Quick Test mode**
- **10 ns pulsed IV solution is available for characterizing high-k gate dielectric and SOI (silicon-on-insulator) transistors**
- **A Classic Test mode is available to provide the look, feel, and terminology of the 4155/4156 interface while enhancing user interaction by taking full advantage of Microsoft Windows GUI features**

The Agilent B1500A Semiconductor Device Analyzer is a modular instrument with a ten-slot configuration that supports both IV and CV measurements. Its familiar, MS Windows user interface supports Agilent's EasyEXPERT software, which provides a new, more intuitive task-oriented approach to device characterization. Because of its extremely low-current, low-voltage, and integrated capacitance measurement capabilities, the Agilent B1500A can be used for a wide range of semiconductor device characterization needs.

Specifications

Mainframe Characteristics

Available Slots: 10
Ground Unit Sink Capability: 4.2 A
USB Ports: 2 front and 2 rear
Instrument Control: GPIB
Networking: 100BASE-TX/10BASE-T LAN Port
External Trigger Inputs/Outputs
1 BNC trigger in; 1 BNC trigger out;
8 programmable trigger in/out

Module Selection Guide

Module	HPSMU (B1510A)	MPSMU (B1511A)	HRSMU (B1517A)	ASU (E5288A)	MFCMU (B1520A)
Required Slots	2	1	1	—	1
Maximum Force Voltage	±200 V	±100 V	±100 V	±100 V	—
Maximum Force Current	±1 A	±100 mA	±100 mA	±100 mA	—
Voltage Measurement Resolution	2 µV	0.5 µV	0.5 µV	0.5 µV	—
Current Measurement Resolution	10 fA	10 fA	1 fA	0.1 fA	—
Min/Max Capacitance Measurement Frequency	—	—	—	—	1 kHz to 5 MHz
Maximum Capacitance dc Bias Capability	—	—	—	—	±100 V*

* When used with the SCUU and SMUs.

HV-SPGU (B1525A)

Maximum Voltage Level: ±40 V (80Vp-p)
Minimum Transition Time: 20 ns
Minimum Pulse Width: 12.5 ns
Other Functions: 3 level pulse, ALWG

Accessories

N1254A-100 Ground Unit to Kelvin Adapter
N1300-001/002 Capacitance Measurement Unit Cable (1.5 meter/3 meter)
N1301A-100 SMU CMU Unify Unit
N1301A-102 SCUU Cable (3 meter)
16444A-001 USB Keyboard
16444A-002 USB Mouse
16444A-003 Stylus
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

Making Every User a Parametric Test Expert, p/n 5989-5440EN

www.agilent.com/see/b1500a

Ordering Information

The B1500A does not have any automatic base configuration. All desired modules, accessories, and cables must be distinctly specified at the time of order.

Note: Since the B1500A is a modular product, you can add new modules to it at any time after initial purchase as long as you have open slots.

- **1 femtoamp resolution current measurement capability – Switching matrix does not degrade the measurement performance of the semiconductor parameter analyzer**
- **8 triaxial and 6 BNC inputs – Supports a 4-SMU, full-Kelvin configuration and a capacitance meter, with 4 BNC inputs remaining for future expansion**
- **14 concurrent internal paths – Enables you to use all 8 triaxial inputs and all 6 BNC inputs at the same time**
- **Capacitance measurement compensation feature – Corrects for the error introduced by the matrix's internal path lengths, allowing you to make accurate capacitance measurements through a switching matrix**
- **LED display and front panel control via keypad or optional light pen – Enables you to perform off-line debug of your measurement structures by giving a visual indication of the matrix relay status and by enabling you to change the relay status manually**
- **30 MHz bandwidth – You can use instruments such as pulse generators through the B2200A switch**

Unsurpassed Switching Matrix Performance

The B2200A fA leakage Switch Mainframe provides exceptional low-current leakage and capacitance measurement performance, without the limitations imposed by alternative solutions. The ability to support 1 fA measurements means that it does not detract from the high-performance of the semiconductor parameter analyzer. Inputs are sufficient to support a 4-SMU, full-Kelvin configuration. All 14 inputs correspond to unique internal paths, so all inputs can be used simultaneously. Unlike competing solutions, capacitance measurement results are not distorted by the inherent error introduced by each channel's varying path lengths; additionally, the system provides the parameters and algorithms necessary to compensate for such variances. Flexible use is provided by a modular structure that supports 12, 24, 36 or 48 output configurations. The 30 MHz bandwidth supports the use of instruments such as pulse generators. Flexible operator control is provided by the supplemental LED display and front panel control via keypad or optional light pen.

Keep Pace with the Performance of Semiconductor Parameter Analyzers

State-of-the-art semiconductor parameter analyzers have reached new levels of performance. With the ability to support 1 fA measurement resolution, the B2200A Switching Matrix keeps pace with the capabilities of your semiconductor parameter analyzer without any compromise in measurement performance.

Avoid Measurement Limitations of Multiplexing

Avoid delays and time-consuming manual switching with the B2200A's 14 internal measurement paths. Every input has its own unique internal path, enabling you to use all inputs simultaneously.

Accurate Capacitance Measurements

When measuring capacitance, the cable length, which includes the path through the matrix, has a significant impact on measurement results. When using the two BNC inputs that are optimized for capacitance measurement, the B2200A Switching Matrix Mainframe – unlike competitive solutions – corrects for the error introduced by the matrix's internal path lengths, supplying compensation parameters to enable undistorted measurement results.

Specifications

Number of Ports
- IV port: 8 Triaxial Ports (with Guard)
- AUX port: 6 BNC Ports (2 CV port)
- Output channel: Triaxial Ports (with Guard), x12, x24, x36, and x48 Configurations Available

Number of Slots: 4 slots for 48 mm height switch module
Max Current Rating
- IV port: 1.0 A
- AUX port: 0.5 A

Max Voltage Rating
- IV port (Other Ch): 200 V
- IV port (Common): 300 V
- AUX port (Other Ch): 100 V
- AUX port (Common): 100 V

Channel Isolation
- IV (triaxial) port: 1 x 10^14 (ohm)
- AUX (coaxial) port: 1 x 10^9 (ohm)

Effective Current Measurement Resolution
IV (triaxial) port: 1 fA*
Offset Current (Supplemental)
IV port: 50 fA
IM Noise (RMS) (Supplemental)
IV port: 5 fA
Additional C Measurement Error (Supplemental): <±1 % +0.2 pF
Bandwidth (at –3 dB): 30 MHz
Settling Time (Supplemental): 2.0 sec at 50 fA

Accessories and Cables

Agilent 16443A Light Pen for B2200A/B2201A
Agilent 16494A Triaxial Cable
Agilent 16493K Kelvin Triaxial Cable (for input port)
(Between 4155/56 series or E5270 series and B2200A/2201A input port)
Agilent 16494B Kelvin Triaxial Cable (for output port)
Agilent 16494F CMU Input Cable
Agilent 16493N GND Cable
(Between GND of E5270/41501 and B2200A/2201A)

Key Literature & Web Link

Solving the Most Difficult Switching Challenges Brochure, p/n 5989-5761EN
Agilent B2200A fA Leakage Switch Mainframe/Agilent B2201A 14-ch Low-Leakage Switch Mainframe Data Sheet, p/n 5989-1354EN

www.agilent.com/see/switch

Ordering Information

The B2200A switch does not come with any minimum number of matrix cards. You must specify from 1 – 4 of the B2210A matrix cards at the time of order. You can add additional B2210A matrix cards (up to 4 maximum per B2200A) at a later date.
The 16443A light pen is not required to control the matrix from its front panel.

* Typical measurement performance when using the B2200A with the 4156C, E5270B, or B1500A high-resolution SMU.

14ch Low Leakage Switch Mainframe

B2201A

- **10 femtoamp resolution current measurement capability – Switching matrix does not degrade the measurement performance of the semiconductor parameter analyzer**
- **8 triaxial and 6 BNC inputs – Supports a 4-SMU, full-Kelvin configuration and a capacitance meter, with 4 BNC inputs remaining for future expansion**
- **14 concurrent internal paths – Enables you to use all 8 triaxial inputs and all 6 BNC inputs at the same time**
- **Capacitance measurement compensation feature – Corrects for the error introduced by the matrix's internal path lengths, allowing you to make accurate capacitance measurements through a switching matrix**
- **LED display and front panel control via keypad or optional light pen – Enables you to perform off-line debug of your measurement structures by giving a visual indication of the matrix relay status and by enabling you to change the relay status manually**
- **30 MHz bandwidth – You can use instruments such as pulse generators through the B2201A switch**

Excellent Switching Matrix Performance at an Affordable Price

The B2201A 14ch Low Leakage Switch Mainframe provides exceptional low-current leakage and capacitance measurement performance, without the limitations imposed by alternative solutions. The ability to support 10 fA measurements means that it does not detract significantly from the high-performance of the semiconductor parameter analyzer. This model is priced to provide cost-effective measurement performance for less demanding measurement situations. Inputs are sufficient to support a 4-SMU, full-Kelvin configuration. All 14 inputs correspond to unique internal paths, so all inputs can be used simultaneously. Unlike competitive solutions, capacitance measurement results are not distorted by the inherent error introduced by each channel's varying path lengths; additionally, the system provides the parameters and algorithms necessary to compensate for such variances. Flexible use is provided by a modular structure that supports 12, 24, 36 or 48 output configurations. The 30 MHz bandwidth supports the use of instruments such as pulse generators. Flexible operator control is provided by the supplemental LED display and front panel control via keypad or optional light pen.

Keep Pace with the Performance of Semiconductor Parameter Analyzers

State-of-the-art semiconductor parameter analyzers have reached new levels of performance. With the ability to support 10 fA measurement resolution, the B2201A Switching Matrix keeps pace with the potential of your semiconductor parameter analyzer without significant compromise in measurement performance.

Avoid Measurement Limitations of Multiplexing

Avoid delays and time-consuming manual switching with the B2201A's 14 internal measurement paths. Every input has its own internal path operating concurrently, therefore eliminating limitations caused by multiplexing inputs over shared paths.

Accurate Capacitance Measurements

Specifically with capacitance measurement, cable length, which includes the path through the matrix, has a significant impact on measurement results. When using the two BNC inputs that are optimized for capacitance measurement, the B2201A Switching Matrix Mainframe – unlike competitive solutions – corrects for the error introduced by the matrix's internal path lengths, supplying compensation parameters to enable undistorted measurement results.

Specifications

Number of Ports
- IV port: 8 Triaxial Ports (with Guard)
- AUX port: 6 BNC Ports (2 CV port)
- Output channel: Triaxial Ports (with Guard), x12, x24, x36, and x48 Configurations Available

Number of Slots: 4 slots for 48 mm height switch module
Max Current Rating
- IV port: 1.0 A
- AUX port: 0.5 A

Max Voltage Rating
- IV port (Other Ch): 200 V
- IV port (Common): 300 V
- AUX port (Other Ch): 100 V
- AUX port (Common): 100 V

Channel Isolation
- IV (triaxial) port: 5 x 10^13 (ohm)
- AUX (coaxial) port: 1 x 10^9 (ohm)

Effective Current Measurement Resolution
IV (triaxial) port: 10 fA*
Offset Current (Supplemental)
IV port: 50 fA
IM Noise (RMS) (Supplemental)
IV port: 5 fA
Additional C Measurement Error (Supplemental): <± 1 % + 0.2 pF
Bandwidth (at –3 dB): 30 MHz
Settling Time (Supplemental): 2.0 sec at 300 fA

Accessories and Cables

Agilent 16443A Light Pen for B2200A/B2201A
Agilent 16494A Triaxial Cable
Agilent 16493K Kelvin Triaxial Cable (for input port)
(Between 4155/56 series or E5270 series and B2200A/2201A input port)
Agilent 16494B Kelvin Triaxial Cable (for output port)
Agilent 16494F CMU Input Cable
Agilent 16493N GND Cable
(Between GND of E5270/41501 and B2200A/2201A)

Key Literature & Web Link

Solving the Most Difficult Switching Challenges Brochure, p/n 5989-5761EN
Agilent B2200A fA Leakage Switch Mainframe/Agilent B2201A 14-ch Low-Leakage Switch Mainframe Data Sheet, p/n 5989-1354EN

www.agilent.com/see/switch

Ordering Information

The B2201A switch does not come with any minimum number of matrix cards. You must specify from 1 – 4 of the B2211A matrix cards at the time of order. You can add additional B2211A matrix cards (up to 4 maximum per B2201A) at a later date.
The 16443A light pen is not required to control the matrix from its front panel.

* Typical measurement performance when using the B2201A with the 4156C, E5270B, or B1500A high-resolution SMU.

The E5250A switch supports two different matrix card types:

10 x 12 Matrix Card (E5252A) for Non-Kelvin Parametric Measurements

- **Sequential measurement of many devices on a test structure**
- **Ten inputs and 48 outputs provide flexibility and accuracy**
- **Two low-leakage inputs and four standard inputs for I-V measurements**
- **Two C-V path with accurate capacitance compensation**
- **Two auxiliary inputs for pulsed, differential voltage and other measurements**

24 (8 x 3) Channel Multiplexer Card (E5255A) for Reliability Testing

- **Up to 384-channel capability for efficient parallel test**
- **Permits the use of inexpensive power supplies for consistent stressing**
- **Provides protection against power surges to prevent device damage**
- **Supports cables compatible for use in a thermal chamber**

The Agilent E5250A Low Leakage Switch supports non-Kelvin measurement on four SMUs, with six additional multiplexed inputs for other needs. Besides supporting traditional matrix functionality (Agilent E5252A cards), the E5250A also supports long-term reliability stress testing (Agilent E5255A cards). The E5250A can be configured with one to four output cards or either type. The E5250A also supports a VXI*plug&play* driver for easy programmatic control.

The E5250A and E5252A matrix card combine to form a basic non-Kelvin matrix solution. The E5252A card has 6 triaxial inputs and 4 BNC inputs, with 6 internal paths. The inputs to rows 5 and 6 consist of a 3-to-1 multiplexer. This configuration maintains cost-effectiveness without sacrificing essential CV-IV measurement performance.

The E5250A supports the E5255A multiplexer card for long-term reliability stress testing. The multiplexer card has 24 outputs, organized in groups of 8. Each card has one multilevel dc bias input for each set of eight channels, permitting the use of inexpensive power suppliers for consistent stress. The E5250A accepts four of these cards, for a total of 96 outputs. Each channel can also have a user-selected protection resistor to limit the current surge after device breakdown or rupture. You can gang up to four E5250A mainframes together using the E5255A cards to create a system with 384-channel capability.

Specifications

Matrix Switch (Specification defined with the mainframe)

Max Current Rating
Port: 1.0 A
Max Voltage Rating
- Channel to ground: – 200 V
- Channel to channel: – 300 V

Close Channel Residual Resistance
- Low-leakage I-V port: – 0.6 ohms
- General I-V port: – 1.0 ohms
- C-V, HF port: – 10E9 ohms

Channel Isolation
- Low-leakage I-V port: – 10E13 ohms
- General I-V port: – 10R12 ohms
- C-V, HF port: – 10E9 ohms

24 Channel Multiplexer (Specification defined with the mainframe)

Max Current Rating
Port: 1.0 A
Max Voltage Rating
- Channel to ground: – 200 V
- Channel to channel: – 300 V

Close Channel Residual Resistance
- Low-leakage I-V port: – 0.6 ohms
- General I-V port: – 1.0 ohms
- C-V, HF port: – 10E9 ohms

Channel Isolation
- Low-leakage I-V port: – 10E13 ohms
- General I-V port: – 10E12 ohms
- C-V, HF port: – 10E9 ohms

Measurement Capabilities
- Effective current measurement resolution: 20 fA*
- Transient current settling time (10 V input step): <3.5 sec at 400 fA
- Bandwidth (at –3 dB, using E5252A cards): 10 MHz

Accessories and Cables

Agilent 16494A Triaxial Cable
Agilent 16494B Kelvin Triaxial Cable
Agilent 16494C Kelvin Triaxial Cable for 4142
Agilent 16494D 8 channel Shielded Coaxial Cable
Agilent 16495A Connector Plate w/12 Triaxial Interlock/GNDU
Agilent 16495B Connector Plate w/24 Triaxial Interlock/GNDU
Agilent 16495C Connector Plate w/68 channel SHLD connector
Agilent 16495D Connector Plate w/128 channel SHLD connector
Agilent 16495E Half Size Blank Plate

Key Literature & Web Link

Solving the Most Difficult Switching Challenges Brochure, p/n 5989-5761EN
Agilent E5250A Low Leakage Switch Mainframe Data Sheet, p/n 5964-2378E

www.agilent.com/see/switch

Ordering Information

The E5250A switch does not come with any minimum number of matrix cards. You must specify either the E5252A matrix cards or the E5255A multiplexer cards at the time of order. The mainframe holds up to four cards, and you can have both card types in the same mainframe.

* Typical measurement performance when using the E5250A with the 4156C, B1500A, or E5270B high-resolution SMU.

8-Slot High Speed Measurement Mainframe

E5260A

- **Eight module slots – Flexibility now and expandability in the future**
- **SMUs that measure several times faster than 4142B SMUs – Faster test times and improved throughput, resulting in a lower cost-of-test**
- **Code compatible with the 4142B – Replace current 4142Bs with the E5260A and enjoy a large throughput improvement with only minimal test code modification**
- **16 digital I/O lines for instrument triggering in addition to BNC trigger-in & trigger-out connectors – Sophisticated triggering schemes involving multiple instruments can easily be created**
- **All trigger signals are processed via hardware rather than firmware – Fastest possible trigger response from the instrument**
- **Front panel control – Can conveniently perform and report spot measurements via a simple front-panel interface, without programming. View other items of interest, such as error messages, valuable when debugging the instrument performance under automated control**
- **When 4 HPSMUs are installed then each HPSMU can output 1 A – No power restrictions; no need to think about mainframe power restrictions when developing applications**
- **4.0 Amp Ground unit (GNDU) – Sink the current output of 4 HPSMUs without worrying about resistive ground rise issues**

Fast Measurement that Lowers Cost-of-test

The fast measurement speed and modular nature of the E5260A makes it an ideal choice for high-speed production test. For technologically advanced devices of today and tomorrow, the Agilent E5260A lowers your cost-of-test with a high-speed parametric test solution for semiconductor, RFIC, and optical component testing. Based on well-proven Agilent 4070 Series system technology, the E5260A provides superior measurement throughput that is several times faster than earlier products such as the Agilent 4142B. The instrument is modular, which enables customization now and provides for future expansion as requirements change. A number of innovative design elements help to improve the efficiency of complex testing, such as expanded program memory to accelerate the measurement process, and 16 digital I/O lines for sophisticated triggering requirements. Moreover, historically encountered power limitations on the instrument mainframe (such as often occur with the 4142B) have been eliminated.

Modular Design Enables Customization Now and Provides for Future Expansion

The flexible, modular configuration has eight slots available for plug-in modules. Currently available source/monitor unit (SMU) types are a medium power SMU (MPSMU) – requiring one slot – and a high-power SMU (HPSMU) – requiring two slots. Easily expand into the E5260A from your current environment because commands developed on the 4142B can also run on the new system.

High Measurement Speed

The E5260A performs DC measurements of current and voltage through measurement speeds of SMUs that are 2 – 3 times faster than that of the Agilent 4142B.

Innovative Design Elements Support Complex Testing and Improve Efficiency

Program memory has been greatly enhanced, with storage capacity for up to 40,000 command lines, which accelerates the measurement process. A fast and flexible advanced triggering scheme, based upon 16 digital I/O lines, in addition to the BNC trigger-in & trigger-out connectors, is ideal for sophisticated triggering requirements. Also, trigger signals are routed through hardware rather than firmware, resulting in the fastest instrument response possible. To enable parallel testing, each SMU is equipped with its own analog-to-digital converter (ADC) therefore no bottlenecks. Engineers can perform and report spot measurements easily via a simple front-panel interface, without programming. In addition, you can use the same user interface to view other items of interest, such as error messages when debugging the instrument performance under automated control.

Designed to Withstand Heavyweight Power Demands

Alternative testing solutions may present power limitations, but not the E5260A. No matter which type or how many modules are installed into the E5260A mainframe, all installed modules can output maximum voltage or current at the same time. For example, if 4 HPSMUs are installed in the E5260A, then each HPSMU can output 1 Amp. A 4.0 Amp ground unit is resident in the instrument mainframe to ensure that you can sink the current output of these 4 HPSMUs without having to worry about resistive ground rise issues. In addition, each MPSMU can source and sink up to 200 mA each, which is twice the capability typically found in a MPSMU.

Specifications

Mainframe Characteristics

E5260A 8-Slot Precision Measurement Mainframe

- Available Slots: 8
- Ground Unit (GNDU) Sink Capability: 4.0 A
- Instrument Control: GPIB
- External Trigger Inputs/Outputs
  - 1 BNC Trigger In;
  - 1 BNC Trigger Out;
  - 8 Programmable Trigger In/Out

Available Modules

E5290A High Speed HPSMU

- Required Slots: 2
- Maximum Force Voltage: ±200 V
- Maximum Force Current: ±1 A
- Voltage Measurement Resolution: 100 µV
- Current Measurement Resolution: 5 pA

E5291A High Speed MPSMU

- Required Slots: 1
- Maximum Force Voltage: ±100 V
- Maximum Force Current: ±200 mA
- Voltage Measurement Resolution: 100 µV
- Current Measurement Resolution: 5 pA

Accessories and Cables

N1254A-100 Ground Unit to Kelvin Adapter
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

Agilent E5260A 8 Slot High Speed Measurement Mainframe Data Sheet, p/n 5989-1356EN

www.agilent.com/see/parametric

Ordering Information

The E5260A does not have any base configuration. All desired modules, accessories, and cables must be specified at the time of order.

Note: Since the E5260A is a modular product, you can add new modules to it at any time after initial purchase as long as you have open slots.

- **Two MPSMU configuration – Cost effective solution provides just enough test capability**
- **SMUs that measure several times faster than 4142B SMUs – Faster test times and improved throughput, resulting in a lower cost-of-test**
- **Code compatible with the 4142B – Replace current 4142Bs with the E5262A and enjoy a large throughput improvement with only minimal test code modification**
- **16 digital I/O lines for instrument triggering in addition to BNC trigger-in & trigger-out connectors – Sophisticated triggering schemes involving multiple instruments can easily be created**
- **All trigger signals are processed via hardware rather than firmware – Fastest possible trigger response from the instrument**
- **Front panel control – Can conveniently perform and report spot measurements via a simple front-panel interface, without programming. View other items of interest, such as error messages, valuable when debugging the instrument performance under automated control**

Fast Measurement that Lowers Cost-of-test

The fast measurement speed of the E5262A makes it an ideal choice for high-speed production test in situations requiring only one or two SMUs. Based on Agilent 4070 Series system technology, the Agilent E5262A lowers your cost-of-test with a high-speed parametric test solution for semiconductor, RFIC, and optical component testing. Two MPSMU modules and a ground unit are included in the E5262A, providing just enough test capability for many component-testing needs. The E5262A provides superior measurement throughput, several times faster than earlier products such as the Agilent 4142B. A number of innovative design elements help to improve the efficiency of complex testing, such as expanded program memory to accelerate the measurement process, and 16 digital I/O lines for sophisticated triggering requirements.

High Measurement Speed

The E5262A performs DC measurements of current and voltage and achieves measurement speeds that are 2 – 3 times faster than that of the Agilent 4142B. Easily migrate from your current 4142B test environment to the E5262A because programs developed for the 4142B can run on the E5262A with only minor modification.

Innovative Design Elements Support Complex Testing and Improve Efficiency

Program memory has been greatly enhanced, with storage capacity for up to 40,000 command lines, which accelerates the measurement process. A fast and flexible advanced triggering scheme, based upon 16 digital I/O lines, in addition to the BNC trigger-in & trigger-out connectors, is ideal for sophisticated triggering requirements. Also, trigger signals are routed through hardware rather than firmware, resulting in the fastest instrument response possible. To enable parallel testing, each SMU is equipped with its own analog-to-digital converter (ADC) therefore no bottlenecks. Engineers can perform and report spot measurements easily via a simple front-panel interface, without programming. In addition, you can use the same user interface to view other items of interest, such as error messages when debugging the instrument performance under automated control.

Cost-effective Solution for Simple Parametric Test Requirements

Many component measurements, such as laser diode and photo diode characterization, require only one or two source/monitor units. The configuration of the E5262A provides the ideal balance of functionality for such tasks at an affordable price.

Specifications

Mainframe Characteristics

E5262A 2-Channel (Medium Power, Medium Power) Source Monitor Unit

- Available Slots: Two channel (2X MPSMU) configuration
- Ground Unit (GNDU) Sink Capability: 2.2 A
- Instrument Control: GPIB
- External Trigger Inputs/Outputs:
  1 BNC Trigger In;
  1 BNC Trigger Out;
  8 Programmable Trigger In/Out

Included Module

High Speed MPSMU

- Maximum Force Voltage: ±100 V
- Maximum Force Current: ±200 mA
- Voltage Measurement Resolution: 100 µV
- Current Measurement Resolution: 5 pA

Accessories and Cables

N1254A-100 Ground Unit to Kelvin Adapter
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

Agilent E5262A 2 Channel (Medium Power, Medium Power) Source/Monitor Unit Data Sheet, p/n 5989-1357EN

www.agilent.com/see/parametric

Ordering Information

The E5262A is a fixed-configuration product; there are no options or required accessories.

2-Channel High Speed Source Monitor Unit

E5263A

- **One HPSMU and one MPSMU configuration – Cost effective solution provides just enough test capability**
- **SMUs that measure several times faster than 4142B SMUs – Faster test times and improved throughput, resulting in a lower cost-of-test**
- **Code compatible with the 4142B – Replace current 4142Bs with the E5263A and enjoy a large throughput improvement with only minimal test code modification**
- **16 digital I/O lines for instrument triggering in addition to BNC trigger-in & trigger-out connectors – Sophisticated triggering schemes involving multiple instruments can easily be created**
- **All trigger signals are processed via hardware rather than firmware – Fastest possible trigger response from the instrument**
- **Front panel control – Can conveniently perform and report spot measurements via a simple front-panel interface, without programming. View other items of interest, such as error messages, valuable when debugging the instrument performance under automated control**

Fast Measurement that Lowers Cost-of-test

The fast measurement speed of the E5263A makes it an ideal choice for high-speed production test in situations requiring only one or two SMUs. Based on Agilent 4070 Series system technology, the Agilent E5263A lowers your cost-of-test with a high-speed parametric test solution for semiconductor, RFIC, and optical component testing. HPSMU and MPSMU modules and a ground unit are included in the E5263A, providing just enough test capability for many component-testing needs. The E5263A provides superior measurement throughput, several times faster than earlier products such as the Agilent 4142B. A number of innovative design elements help to improve the efficiency of complex testing, such as expanded program memory to accelerate the measurement process, and 16 digital I/O lines for sophisticated triggering requirements.

High Measurement Speed

The E5263A performs DC measurements of current and voltage and achieves measurement speeds that are 2 – 3 times faster than that of the Agilent 4142B. Easily migrate from your current 4142B test environment to the E5263A because programs developed for the 4142B can run on the E5263A with only minor modification.

Innovative Design Elements Support Complex Testing and Improve Efficiency

Program memory has been greatly enhanced, with storage capacity for up to 40,000 command lines, which accelerates the measurement process. A fast and flexible advanced triggering scheme, based upon 16 digital I/O lines, in addition to the BNC trigger-in & trigger-out connectors, is ideal for sophisticated triggering requirements. Also, trigger signals are routed through hardware rather than firmware, resulting in the fastest instrument response possible. To enable parallel testing, each SMU is equipped with its own analog-to-digital converter (ADC) therefore no bottlenecks. Engineers can perform and report spot measurements easily via a simple front-panel interface, without programming. In addition, you can use the same user interface to view other items of interest, such as error messages when debugging the instrument performance under automated control.

Cost-effective Solution for Simple Parametric Test Requirements

Many component measurements, such as laser diode and photo diode characterization, require only one or two source/monitor units. The configuration of the E5263A provides the ideal balance of functionality for such tasks at an affordable price.

Specifications

Mainframe Characteristics

E5263A 2-Channel (High Power, Medium Power) Source Monitor Unit

- Available Slots: Two channel (HPSMU and MPSMU) configuration
- Ground Unit (GNDU) Sink Capability: 2.2 A
- Instrument Control: GPIB
- External Trigger Inputs/Outputs
  - 1 BNC Trigger In;
  - 1 BNC Trigger Out;
  - 8 Programmable Trigger In/Out

Included Module

High Speed HPSMU

- Maximum Force Voltage: ±200 V
- Maximum Force Current: ±1 A
- Voltage Measurement Resolution: 100 µV
- Current Measurement Resolution: 5 pA

High Speed MPSMU

- Maximum Force Voltage: ±100 V
- Maximum Force Current: ±200 mA
- Voltage Measurement Resolution: 100 µV
- Current Measurement Resolution: 5 pA

Accessories and Cables

N1254A-100 Ground Unit to Kelvin Adapter
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

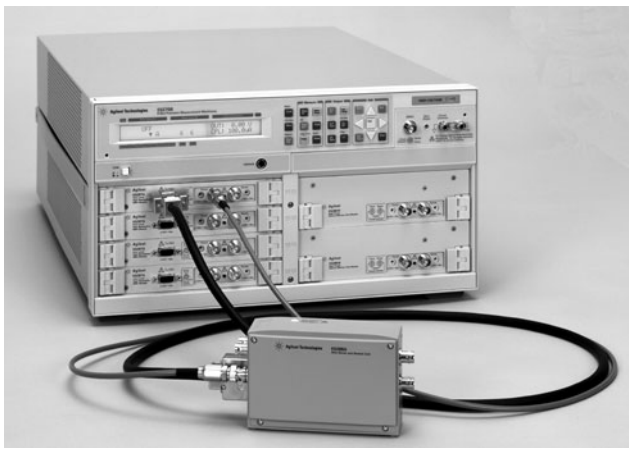
Agilent E5263A 2 Channel (High Power, Medium Power) Source/Monitor Unit Data Sheet, p/n 5989-1357EN

www.agilent.com/see/parametric

Ordering Information

The E5263A is a fixed-configuration product; there are no options or required accessories.

- **No embedded controller in the instrument – Manage your instrument measurement resources separately from your controller and software resources, ensuring that your test investment does not become obsolete too quickly**
- **HRSMU has 1 femtoamp current measurement resolution – Can meet the measurement challenges posed by the vast majority of current and future devices, without the need for external preamplifiers**
- **HRSMU combines with optional atto sense and switch unit (ASU) to achieve 100 attoamp current measurement resolution – Stable 100 attoamp current resolution via remote sensing meets the most demanding ultra low current measurement requirements**
- **Switch between CV and IV measurements on positioners via software commands – No need to physically change cabling or move to a different probe station when changing from CV to IV measurement**
- **MPSMU and HRSMU can measure voltage with 0.5 microvolt resolution. Both SMUs also support new 0.5 V and 5 V measurement ranges – Enables you to perform very demanding component matching and metal line resistance voltage measurements with ease**
- **Includes industry-standard VXI*plug&play* driver – Ideal when you choose to use your own software, instead of Agilent-provided software. Improves programmer productivity by removing the need to learn detailed programming of the instrument**
- **TIS (Test Instruction Set) commands supported for both BASIC and C – Develop algorithms on an instrument that you can then easily transport into your 4070 Series-based production test environment**



Solves the Most Extreme Parametric Measurement Challenges

For engineers and scientists working on current and future semiconductor process technologies, the E5270B provides a solution that both meets their needs and lowers their cost of test. The wide variety of available modules and advanced measurement features provide a complete solution for parametric measurement and analysis. Both a VXI*plug&play* driver and TIS commands are provided as programming aids for customers who choose to use their own software instead of software provided by Agilent.

Unlike solutions that include both the system controller and measurement resources combined, the E5270B gives you the freedom to manage these resources separately, thereby avoiding the expensive problem of the system controller becoming obsolete years before other elements. The E5270B can be controlled from MS Windows-based, UNIX®-based, or even LINUX-based operating system environments. Because you can upgrade your system controller hardware or software without losing the use of your instrument, your investment is protected against unforeseeable technology shifts.

Ultra Low Current Measurement without Cumbersome External Preamplifiers

The E5270B HRSMU supplies 1-femtoamp measurement resolution without the need for cumbersome external preamplifiers, providing an extremely efficient solution for situations not requiring ultra low current measurement. This innate capability enables you to meet the measurement challenges posed by the vast majority of current and future devices. The HRSMU (and redesigned MPSMU) also provides voltage measurement resolution down to 0.5 microvolts. The HRSMU (as well as the redesigned MPSMU) also supports new 0.5 V and 5 V measurement ranges, which improve measurement accuracy for modern lower-voltage transistors. Advanced measurement features include multi-channel sweep mode with parallel test capability, linear/binary search, range management, and force value self-monitoring.

Flexibility to Provide Stable 100 Attoamp Measurements

The HRSMU accepts an optional atto sense and switch unit (ASU), which increases the low current measurement resolution to 100 attoamps. This is invaluable for certain extreme characterization needs such as memory cell leakage testing. In addition, the ASU allows you to make voltage measurements and force both voltage and current up to the limits of the HRSMU specification.

Switch Between CV and IV Measurement Without Wasting Time Swapping Cables

The ASU enables switching between 100 attoamp measurement and precise capacitance measurement without changing any cabling. The ASU includes two BNC inputs that are compatible with the outputs of a capacitance meter. Simple software commands enable you to switch between SMU based measurement (IV) and capacitance meter based measurement (CV) without having to change any cabling. You can also use the BNC inputs with other instruments such as a digital voltmeter (DVM) or a pulse generator unit (PGU). No matter what your configuration, the ASU provides better switching measurement performance than an external switching matrix, and offers improved ease of use.

Cost-effective Alternative that Takes Advantage of Your Own Testing Software

Agilent provides an industry-standard VXI*plug&play* driver, a high-level programming interface that saves time by allowing your programmers to avoid having to learn the detailed programming of the instrument. In addition, the TIS – test instruction set – interface enables code developed for the lab environment to be used in production. Specifically, TIS allows you to write algorithms for subsequent transfer to the Agilent 4070 production test environment.

Specifications

Mainframe Characteristics

E5270B 8-Slot Precision Measurement Mainframe

- Available Slots: 8
- Ground Unit (GNDU) Sink Capability: 4.0 A
- Instrument Control: GPIB
- External Trigger Inputs/Outputs
  - 1 BNC Trigger In;
  - 1 BNC Trigger Out;
  - 8 Programmable Trigger In/Out

Available Modules

E5280B HPSMU

- Required Slots: 2
- Maximum Force Voltage: ±200 V
- Maximum Force Current: ±1 A
- Voltage Measurement Resolution: 2 µV
- Current Measurement Resolution: 10 fA

E5281B MPSMU

- Required Slots: 1
- Maximum Force Voltage: ±100 V
- Maximum Force Current: ±100 mA
- Voltage Measurement Resolution: 0.5 µV
- Current Measurement Resolution: 10 fA

E5287A HRSMU

- Required Slots: 1
- Maximum Force Voltage: ±100 V
- Maximum Force Current: ±100 mA
- Voltage Measurement Resolution: 0.5 µV
- Current Measurement Resolution: 1 fA

E5288A ASU

- Required Slots: N/A
- Maximum Force Voltage: ±100 V
- Maximum Force Current: ±100 mA
- Voltage Measurement Resolution: 0.5 µV
- Current Measurement Resolution: 0.1 fA

Accessories and Cables

N1254A-100 Ground Unit to Kelvin Adapter
16442B Test Fixture
16494A-001/002 Triaxial Cable (1.5 meter/3 meter)

Key Literature & Web Link

Agilent E5270B 8-Slot Precision Measurement Mainframe Data Sheet, p/n 5989-1355EN

www.agilent.com/see/parametric

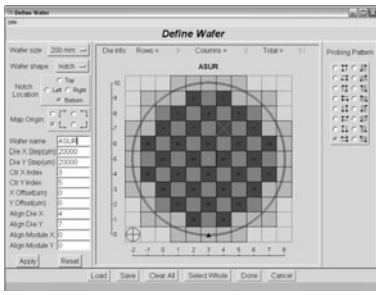
Ordering Information

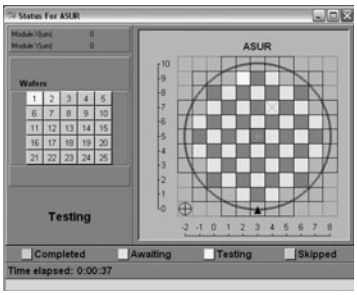
The E5270B does not have any base configuration. All desired modules, accessories, and cables must be specified at the time of order.

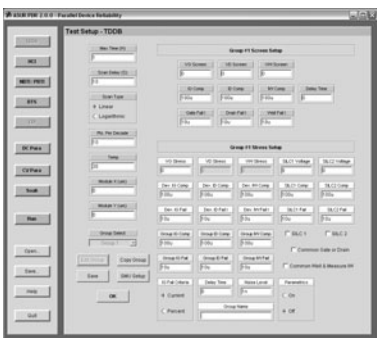
Note: Since the E5270B is a modular product, you can add new modules to it at any time after initial purchase as long as you have open slots.

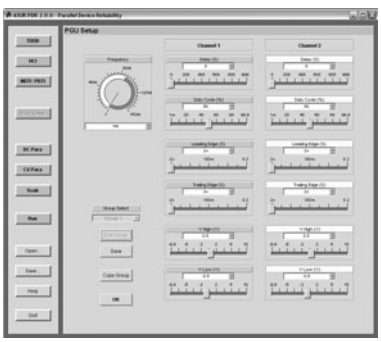
C1280A

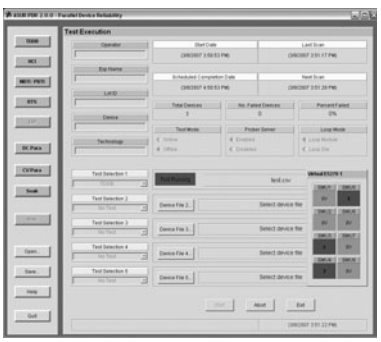
- Modular precision architecture and scalable test control
- Agilent WLR technology in its sixth generation
- Device topology independent non-relaxation measurement techniques
- Accelerated to long-term reliability testing
- Single-, multi-site and multi-die parallel test
- Per-pin, Quasi-per-pin or Group topologies switching or non-switching
- Kelvin, Pseudomorphic Kelvin and non-Kelvin wiring configurations
- Traditional methods and DSP based phenomena detection
- ASUR PDQ-WLR algorithm libraries and techniques for DC and AC reliability
- Automatic and semiautomatic 200 mm and 300 mm wafer prober support
- Test cells may include single to multiple instruments mainframes E5270B, B1500A, E5250A, B2200, 4294A, E4980A, 8114A, 81110A, etc.
- High pin-count parallel test with multiple stress groups
- Industry's only dedicated reliability analysis environment











ASUR PDR provides parallel, multi-site, on-wafer DC and AC (Pulsed) TDDB, BTS, HCI, N|P BTI and EM accelerated to long-term reliability tests. Advanced features allow detection of novel effects found in modern materials such as high-k and low-k dielectrics, copper and transition silicide barrier metallization. In dielectric reliability ASUR PDR can use advanced adaptive scanning and specialized failure detection methods to zero in on relevant operating regimes and identify soft breakdowns. In its BTI module, ASUR PDR includes on-the-fly sub-millisecond measurements for proper detection and avoids relaxation effects in any supported topology.

ASUR PDR builds upon and extends the popular PDQ-WLR algorithms to cover reliability studies from accelerated to long-term allowing users to selectively test devices whether individually (per-pin), in sets (groups) or a combination of those (quasi-per-pin) at different stresses, polarities, etc. with no relaxation.

All test conditions are under full user control allowing a single test methodology to scale from accelerated to long-term reliability testing without the need for customized programming. Parametric test monitoring is user-defined with the same high degree of test condition control.

The modularity and scalability of ASUR PDR provides seamless expansion beyond first E5270/E5260 SMU mainframe and E5250/B2200 switching units where multiple mainframes can be used for high pin-count tests.

ASUR PDR will generate statistically significant results sufficient to perform lifetime extraction quickly even when performing long-term reliability testing, from days to weeks per test cycle.

All modules do not require programming and each having special value added features such as non-relaxation techniques, fast measurements, device conditioning, pre- and post-stress tests, compensation for over and under-shoot, memory programming, and on-the-fly techniques.

ASUR PDR architecture supports Kelvin, Pseudomorphic Kelvin and non-Kelvin wiring configurations for different operating regimes of devices, test techniques, instrumentation, etc.

Instrument pre-check is provided prior to committing long test runs and run-time status is provided in real-time. In addition, sophisticated real-time graphics are provided for accurate test monitoring and includes the support of automatic and semiautomatic 200 mm and 300 mm wafer probers.

ASUR PDR is part of the ASUR scalable set of solutions.

Specifications

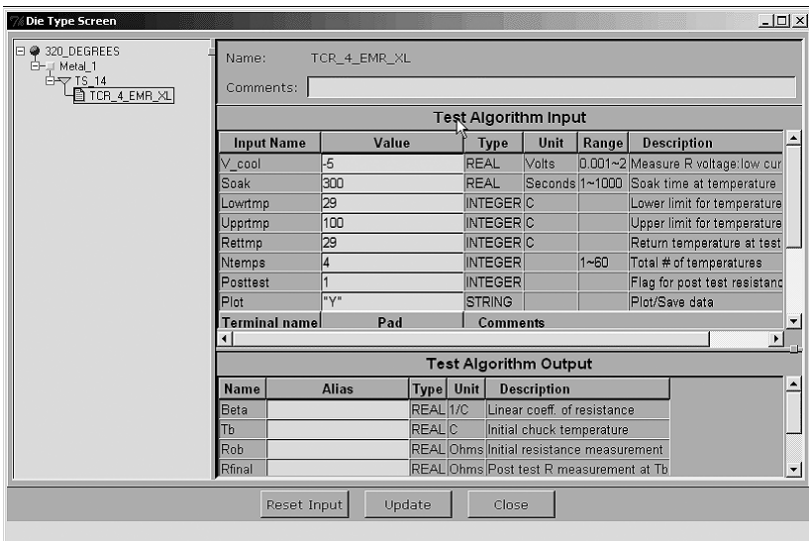
DC Modules
- Gate Oxide Integrity (GOI)
- Bias Temperature Stress (BTS)
- Hot Carrier Injection (HCI)
- Electromigration (EM)
- Bias Temperature Instability (N|P BTI), etc
- AC Modules
- AC Time Dependent Dielectric Breakdown (AC TDDB)
- AC Bias Temperature Instability (AC BTI)
- AC Hot Carrier Injection (AC HCI)
- Double-Pulse AC (AC HCI and N|P BTI)

Agilent Instruments Supported
- Agilent B1500A, E5270B and E5260A Test Instruments
- Agilent E5250A, B2200 and B2201 Switch Matrix
- Agilent 81110A, 8114A Pulse Generators
- Agilent 4284A, E4980A LCR Meters
- Agilent 4294A Impedance Analyzer
- Agilent E5288A ASU, Atto-sense Unit
- Agilent 41000-400 to -100 Series Systems
- Agilent Power Supplies, etc

Advanced Scalable Unified Reliability (ASUR) (cont.)

C1281A

- Single-site Device Reliability
- Popular PDQ-WLR subset built-in, ready for use
- Additional advanced nanometer era test libraries that include on-the-fly sub-millisecond BTI, pulsed BTI, RO, etc
- Interactive Measurement Tool (IMT) allows users build test algorithms without programming
- Create or reuse custom BASIC, C, built-in and IMT algorithms simultaneously
- Import/Export 4070/4062 SPECS algorithms
- Import/Export SPECS test plans
- Build and execute test plans independently
- Algorithm test mode
- Save and re-use test plan components at die, module and device level
- Test plan wizard is fast, intuitive and creates complex test plans in minutes
- Real-time graphics support
- Site constants supported as inputs for the most popular algorithms
- Adaptive testing – output from one algorithm can be input to another
- Test plan looping allows for HCI tests with user-defined algorithms
- Selectable data output formats
- Kelvin, Pseudomorphic Kelvin, and non-Kelvin wiring supported
- Per-pin and switched test architectures supported
- Automatic and semiautomatic 200 mm and 300 mm wafer prober support



ASUR SDR is a high-performance, low-cost, accelerated reliability and pre- and post-stress parametric for single-site device testing that incorporates the proven accelerated techniques of PDQ-WLR using instruments-based solutions. Methods are provided for reliability testing of gate oxides, hot carrier injection, BTI and electro migration. User interfaces are wizard-driven and easy to learn. User custom algorithms are supported via BASIC, C or automatically generated from the programless graphical Interactive Measurement Tool.

All interfaces in ASUR SDR are designed with the SPECS user in mind. The same test plan hierarchy is observed and simplified for the instrument environment. Users importing or designing their own custom algorithms have no need of GPIB-specific knowledge; the application program interface follows the standard TIS and the algorithm builders extend the user's capability to add templates for connectivity.

The Interactive Measurement Tool (IMT) is used to perform device or parameter exploration for rapid turnaround or as the basis for the industry's most advanced programless user-assisted custom algorithm builder.

The BASIC and C languages supported are fully source code compatible with that used by the Agilent system testers workstation.

A choice of data output formats are check-box selectable for PDQ-DB style for use with ASUR RDA or for test-plan level outputs showing linear output during test execution allowing for open transport to other data systems.

ASUR SDR provides the flexibility to standardize test cells and methodologies with different instruments. It is mission ready; same testing capabilities and structure as industry standard 4070 PDQ-WLR.

Instrument pre-check is provided prior to committing long test runs and run-time status is provided in real-time. In addition, sophisticated real-time graphics are provided for accurate test monitoring.

ASUR SDR is part of the ASUR scalable set of solutions.

Specifications

JEDEC Standard Reliability Test Algorithms Supported

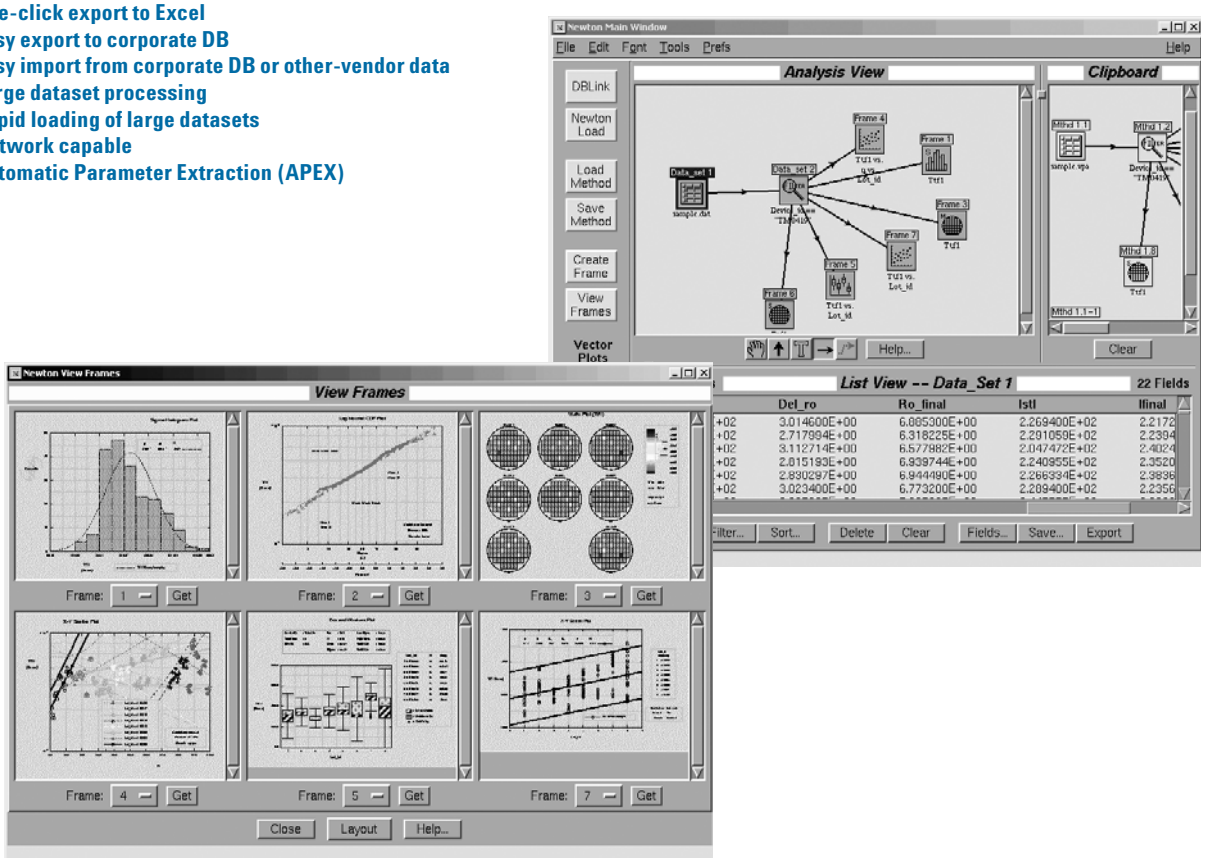
- Gate Oxide Integrity (GOI)
- Bias Temperature Stress (BTS)
- Hot Carrier Injection (HCI)
- Bias Temperature Instability (BTI)
- Electromigration (EM)

Agilent Instruments Supported

- Agilent B1500A, E5270B and E5260A Test Instruments
- Agilent 4155/6 B/C
- Agilent E5250A, B2200 and B2201 Switch Matrix
- Agilent 81110A, 8114A Pulse Generators
- Agilent 4284A, 4980A LCR Meter
- Agilent 4294A Impedance Analyzer
- Agilent E5288A ASU, Atto-sense Unit
- Agilent 41000-400 to -100 Series Systems
- Agilent Spectrum Analyzer 4411B
- Agilent Power Supplies, Frequency Counters, etc

C1282A

- Supports ASUR SDR and ASUR PDR data
- Popular semiconductor test analysis built in
- Site-configurable macro editor
- One-click export to Excel
- Easy export to corporate DB
- Easy import from corporate DB or other-vendor data
- Large dataset processing
- Rapid loading of large datasets
- Network capable
- Automatic Parameter Extraction (APEX)



Agilent ASUR RDA is post-test statistical and physical analysis software. It aids in the analysis of production, development or qualification test data taken by the Agilent ASUR test software.

ASUR RDA provides powerful, built-in EM, HCI and dielectric statistical distribution plotting and lifetime extraction. Advanced filtering, macro data manipulation and plotting capabilities are tailored for semiconductor reliability test and analysis. Filtering allows large datasets to be pared down to specific analysis datasets and tasks. Macros can be applied to both scalar and vector data over time. Plotting includes wafer mapping and reliability statistical plots. Data tunneling allows outliers and novel points to be traced back to specific wafer die locations, lots and tests facilitating process optimization and failure analysis based on reliability.

With a GUI interface and PDQ-WLR database links, access to the source of unusual or defective data is literally a mouse click away.

Click on the defective data and the source of this data (e.g. lot, wafer, site, date, operation, etc.) is displayed. If the I-V curve used to generate the data point is stored, one more mouse click will reveal this information. These features make ASUR RDA post-measurement analysis capability sophisticated and easy-to-use.

Agilent ASUR RDA provides standard statistical analysis graphical tools such as Log-Normal Cumulative Distribution Function (CDF) plots with Least Squares Fit (LSF). Since the operation is simple and GUI-based, complicated statistical analysis required for reliability can be done without much knowledge about the statistical theory. For example, the fit can be graphically changed to fit the main or defective population. Then, clicking on outlying data quickly identifies its source.

In addition to the statistical analysis tools, Agilent ASUR RDA provides physical reliability analysis capability. Physical reliability parameters are easily determined for the following:

- Hot-Carrier Degradation Lifetime extraction (Ib, 1/Vd and Ig model)
- Electromigration activation energy and lifetime extraction

In addition, a unique and easy-to-use graphical calculator provides advanced users with the capability to perform mathematical operations on any set of data variables. Frequently used functions can be stored and accessed as macros in the calculator window. This gives the user significant freedom in defining new acceleration models and extracting the parameters. Direct extraction to and import of spreadsheet data further enhances the customization.

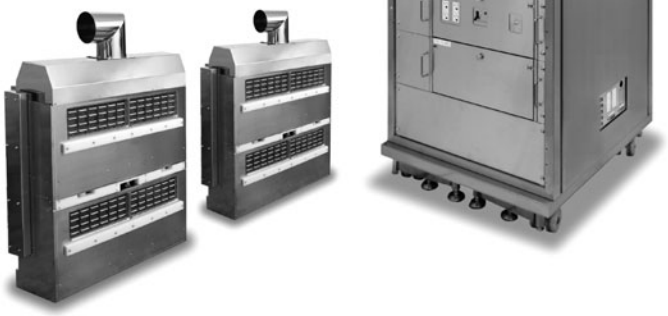
Agilent ASUR RDA also supports trend charts for Statistical Process Control (SPC) in a production environment. Agilent ASUR RDA provides complete data manipulation capability including data merge (from different lots, tests, processes, etc.); data filter for filtering of useful/defect/bad data from the group; data sorting and data extraction with simple graphical operation.

Flat Panel Display Tester

ATS-620 Series Array Test System

88000

- **Sure defect detection capability with short TACT (Total Average Cycle Time) – Through the use of up to four test heads, multiple gate activation, and up to 15,360 data channels using two test heads, the ATS-620 series can achieve the fastest throughput of the current generation of testers. This makes full testing an efficient and much less costly option for manufacturers**
- **High test sensitivity improves process and product quality – The ATS-620 series enables electrical testing of all array pixels covering transistor, capacitance, electrode, and bus lines, which prevents any defective pixels in the array process from flowing into the next phase. The tester automatically checks the TFT characteristics and the open/short status of the lines and pixels and then effectively analyzes the defect mode based upon the result of the check**
- **Efficient process feedback and productivity improvement – The ATS-620 series' full array test capability eliminates process defects, which leads to a large increase in process yield, improved manufacturing productivity and a significant reduction in cost**



The Agilent 88000 ATS-620 series Array Test System, together with the complete line of Agilent 88000 Series Flat Panel Display (FPD) Test Systems, provides FPD manufacturers with a high-quality, low-cost production test solution for all key technologies in the rapidly growing FPD market. Agilent Technologies has expanded its test coverage into FPD test by providing FPD manufactures with the Agilent 88000 ATS-620 series, providing both high sensitivity and short TACT.

An array tester can provide significant cost savings by detecting defects early in the process of manufacturing flat-panel displays. This produces downstream savings in parts and cell assembly cost. The Agilent 88000 ATS-620 series is a fast and proven solution for amorphous silicon (a-Si) TFT array testing of 7th and 8th generation FPD production lines.

The Agilent 88000 ATS-620 series tests TFT arrays of a-Si LCD panels based on TN, MVA and IPS, with wide coverage up to Q-HDTV. The ATS-620 series reduces manufacturing costs and improves process quality and yield by providing precise upstream defect detection in large and wide-size FPDs, while reducing TACT. Leveraging Agilent's extensive measurement expertise, the ATS-620 series also provides greater sensitivity than competitive solutions. This means the ATS-620 series can detect more performance inconsistencies, which helps to reduce scrap cost, improve quality, and boost yield.

Specifications

Primary Test Target
TFT arrays of a-Si LCD panels
Maximum Number of Test Heads
Four
Typical Evaluation Items
Line and Pixel area: Open, Short, Ion, Ioff, Vth, Cs, and Charge in pixel
Number of Channels
15,360 data and 3,072 gate
Multi-site Test
Up to 8 sites

Accessories

System Components
- Tester Rack (Main Frame)
  - Control Unit
  - AC Unit
  - Power Unit
  - Controller
- Test Head
- Master Controller
- System Software

Key Literature & Web Link

Agilent 88000 ATS-620 series Array Test System Product Overview, p/n 5989-5424EN

www.agilent.com/see/fpdtest

Ordering Information

The Agilent 88000 ATS-620 series testers are system products and must be configured in consultation with an Agilent sales professional specializing in these products.

Note: When ordering, please use product number N2455B.

- **Fast full array test technology within allotted TACT (Total Average Cycle Time) – The Agilent 88000 HS-100 series is the only array tester that offers a full, rather than sample, testing solution for FPD manufacturers. In addition, customers have reported measurement times (TACT seconds/glass) that are 3 to 10 times faster than alternative solutions**
- **High testing sensitivity and exact defect detection – With greater sensitivity than competitive solutions or the human eye, the Agilent 88000 HS-100 series can detect more performance inconsistencies, or "mura", which helps to boost yields, to reduce scrap cost and to improve quality assurance**
- **Provides the data needed for efficient process feedback and product cost reduction – The Agilent 88000 HS-100 series' full array test improves product yield by eliminating defective parts from the process**
- **Adapts to new FPD technology, including AM-OLED, COG (Chip On Glass) and SOG (System On Glass) – The Agilent 88000 HS-100 series is the first solution to realize array test value and, therefore, the most suitable and most effective solution available for new FPD technologies, including various types of AM-OLEDs and SOG, with test consulting and continuous enhancements**
- **Total test solution – Tight collaboration with solution partners, such as FPD prober and probe unit suppliers, provides a highly integrated test environment**

The Agilent 88000 HS-100 series High Speed and Sensitivity Array Test System, together with the complete line of Agilent 88000 Series FPD Test Systems, provides FPD manufacturers with a high-quality, low-cost production test solution for all key technologies in the rapidly growing FPD market. The Agilent 88000 HS-100 series leverages Agilent's knowledge and expertise in providing both ultra-precise measurement solutions for parametric testing and high-speed tester architectures for IC testing. Agilent Technologies has expanded its test coverage into FPD test by providing FPD manufactures with the Agilent 88000 HS-100 series as a complement to our existing parametric test solutions.

For manufacturers of LTPS LCD and AM-OLED, the Agilent 88000 HS-100 series provides both high sensitivity and short TACT. Due to its broad application-fast go/no go testing for mass production, process management and a variety of other roles such as sorting, minute defect detection, reliability analysis and electrical test after LC filling/EL deposition in cell process – customers can expect to achieve post-process cost savings, expedited yield ramp-up, and stabilization of the production process.

Unlike current sample testing, the Agilent 88000 HS-100 series offers complete product testing, which reduces manufacturing costs while improving yield. To augment the HS-100 series, especially for COG LCD testing, the HS-101 series with an external multiplexer is available as a cost-effective solution. The full value of array testing is realized with the Agilent 88000 HS-100 series. With more data for process feedback and an exact segregation of scrap parts, the Agilent 88000 HS-100 series offers highly sensitive testing at lower cost.

The Agilent 88000 HS-100 series – a complete solution comprised of hardware, software and services – is the first solution to fully realize array test value and, therefore, the most suitable and most effective solution available.

Specifications

Primary Test Target
TFT arrays of LTPS LCD, HTPS LCD, AM-OLED, SOG, and COG panels
Typical Evaluation Items
- Pixel area: Open, Short, Ion, Ioff, Vth, OLED drive transistor
- Peripheral circuitry area: Open or short between lines, Shift register carry out

Current Measurement Range and Resolution
- Range: 20 µA, 2 µA, 200 nA, 20 nA
- Resolution: 5 nA, 500 pA, 50 pA, 5 pA

Charge Measurement Repeatability (Supplemental Characteristics)
$\sigma \leq 5$ fC (equivalent to 1 fF)
Number of Measurement Pins
Up to 2304 pins (2 test heads with multiplexer)
Multi Site Test
Up to 16

Accessories

System Components
- System Cabinet
- Test Head
- Pixel Measurement Card (PMC) [charge and current measurement, video signal setting]
- High Performance Channel Test Card (HPCTC) [peripheral circuit setting and evaluation]
- Device Power Supply to Panel (DPS)
- Multiplexer Unit (MUX) [MUX on testhead or external MUX]
- System Controller
- System Software, Abundant Test and Analysis Libraries

Key Literature & Web Link

Agilent 88000 HS-100 series High-Speed and Sensitivity Array Test System Product Overview, p/n 5989-1625EN

www.agilent.com/see/fpdtest

Ordering Information

The Agilent 88000 HS-100 series testers are system products and must be configured in consultation with an Agilent sales professional specializing in these products.

Note: When ordering, please use product number N2500A.

13

PRINTED CIRCUIT BOARD TEST & INSPECTION

In-Circuit Test Solution

U9401A
U9402A

- **Ease of Use**
- **AutoDebug**
- **VTEP v2.0 Test Suite**
- **Automatic Guard**
- **Press-down and Vacuum Fixture**

The Agilent *Medalist* i1000 In-Circuit Test (ICT) system is a revolutionary platform targeted for maximum cost effectiveness. It offers award winning state-of-the-art features with the answer to most test challenges faced by today's manufacturers. Advanced defects coverage features coupled with a simplified software model shortens the learning curve of new users, making this an ideal investment for manufacturers who need a cost effective ICT solution. Here are some feature highlights:

Ease of Use

It's back to the basics with the *Medalist* i1000 software to help new users get up to speed in the shortest time possible. Following the development model of a typical Manufacturing Defects Analyzer, the user can now get a fixture and program up and running in just a few days. Simplified graphical user interfaces allow the user to quickly make changes to individual tests during debug, with a comprehensive toolset of menus and buttons complete with AutoDebug features. This allows inexperienced users to start using the system quickly.

AutoDebug

With the *Medalist* i1000, unpowered passive analog components can be debugged with the click of a button, so even someone with limited ICT experience can perform a complete analog test debug in a matter of hours. AutoDebug fine-tunes tests so boards pass reliably in production. Statistical measures (CPK) are employed to determine the stability of the test. This automatic feature can reduce the normal debug process which takes days, to just a few hours.

VTEP v2.0 Test Suite

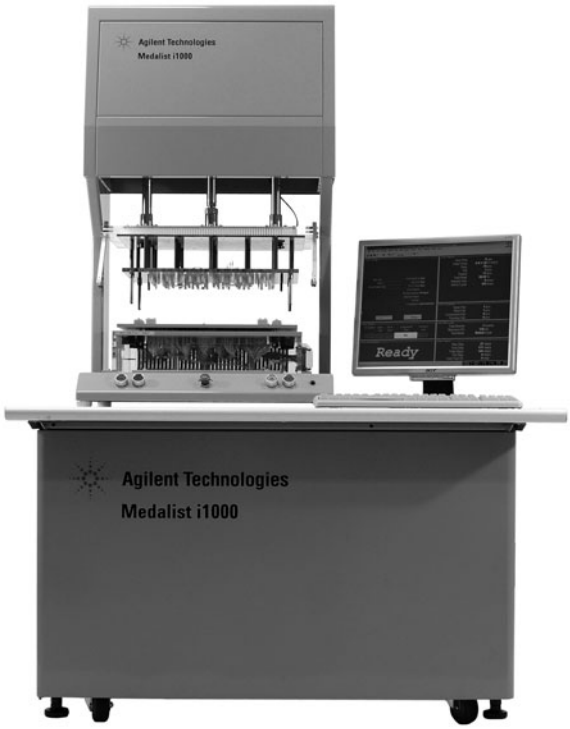
Medalist VTEP v2.0 is a suite of vectorless test solutions which encompasses the new Network Parameter Measurement technology as well as the original *Medalist* VTEP technology and the award-winning *Medalist* iVTEP. Bringing all these solutions together into VTEP v2.0 means having the best vectorless test in your hands. An industry first, Network Parameter Measurement technology detects defects on power and ground pins while iVTEP focuses on ultra low value measurement of signal pins (<5 fF) on Integrated Circuits (ICs). Furthermore, having the original *Medalist* VTEP as its core means enabling measurements which are 4X more sensitive and 5X better in standard deviation. As technology advances with shrinking packages and faster signaling speeds, VTEP v2.0 is a necessity to meet the challenges of today and beyond.

Auto Guard

The Auto Guard feature is a tool for the production test engineer as well as test programmer. It automatically selects different guard points based on board topology for the user during the debug process. This eliminates the need for the user to manually check the schematics for each possible guard points and will significantly reduce the overall debug time.

Press-Down and Vacuum Fixture

The *Medalist* i1000 offers users two different fixture options. The first option uses a typical MDA-type fixture with cable connections. This provides users with affordable fixture options. The second option employs a vacuum-type fixture and a mechanical fixture lock-down system using electrical motors. This cable-less design provides fast fixture swapping time while maintaining high signal integrity.



Key Literature & Web Link

www.agilent.com/find/i1000

Ordering Information

Contact your Agilent sales representatives to configure solutions to meet you manufacturing requirements: **www.agilent.com/find/contactus**

- **Test development improvements**
- **AutoDebug**
- **AutoOptimizer**
- **Flexibility to convert form Mux to UnMux pin cards**
- **VTEP v2.0**

E9901D
E9902D
E9903D
E9905D

The Agilent *Medalist* i3070 is the next generation In-Circuit Test System (ICT) that provides significant return of investment with unparalleled test coverage and robustness. Our solution enables up to 20% more output while boosting coverage by expanding on our award winning vectorless test innovations, extending the performance of the world's most proven In-Circuit Test Platform.

The *Medalist* i3070 combines all the features of the state-of-the-art Agilent 3070 with the advanced architecture and streamlined usability of the *Medalist* i5000 making it the most flexible and stable In-Circuit Test System in the world that is the fastest-to-learn and easiest-to-deploy. An intuitive point-and-click interface, automated test debug and optimization tools, and a host of other features, accelerate every aspect of test programming and deployment.

The *Medalist* i3070 has exciting new test features that achieve unprecedented coverage. Here are some highlights:

Test Development Improvements

The algorithm for test development has been improved. For resistors and capacitor tests, wires selection and test options selection has been improved in the IPG such that they reduce the test times of these tests. It is possible for a typical board to see 20% improvements to the analog test time. The node sequencing in the shorts test has been recalculated to reduce the occurrence of phantom shorts.

AutoDebug

AutoDebug was introduced with the i5000. This feature is now available for the i3070. Using a set of rules that a user can modify, the AutoDebug feature will base on a known good board to modify each analog test for stability. The set of rules mimic the actions that a user will take during the debug process. A different set of rules is available for each component type, thus allowing for more accuracy in the debug. Statistical measures (CPK) are employed to determine the stability of the test. This automatic feature can reduce the normal 3 day debug process to about 4 hours.

AutoOptimizer

The AutoOptimizer feature is a tool for the production test engineer. With wear and tear of the fixture during the production process and changes in process parameters, it may be necessary for the production test engineer to modify test options. The AutoOptimizer can optimize the test times for these tests with a click of a button, reducing the test times by 10 to 50 percent per test. AutoOptimizer checks to see that tests are stable up to a user specified CPK. It's great for cleaning up programs that have been modified during production runs, allowing tests to once again run fast and reliably.

Flexibility to Convert Form Mux to UnMux Pin Cards

The i3070 provides a single software stream and compatible hardware to allow the user to use both HybridPlus Mux pin cards as well as Hybrid144 UnMux pin cards.

VTEP v2.0

Medalist VTEP v2.0 is a suite of vectorless test techniques which encompasses the new Network Parameter Measurement technology as well as the original Agilent *Medalist* VTEP technology and the award-winning *Medalist* iVTEP. The new Network Parameter Measurement technology is a world-first, allowing users to detect opens on power and ground pins on connectors – something which many industry players had previously considered as beyond existing test capabilities.

Key Literature & Web Link

www.agilent.com/find/i3070

Ordering Information

Contact your Agilent sales representatives to configure solutions to meet you manufacturing requirements: **www.agilent.com/find/contactus**

Automated X-ray Inspection for PCBA Manufacturing Solution to Identify Failing Solder Joints

N7280A

- **High throughput 3D X-ray analysis to meet in-line speeds**
- **Double-sided inspection on a single pass**
- **High PCBA solder defect coverage**
- **Able to inspect large PCBAs**
- **Easy-to-use development environment**
- **Statistical learning to speed test development**

The focus of the *Medalist* x6000 is to reduce the manufacturers' PCBA conversion costs. In order to do this, the system provides the highest possible 3D inspection throughput, low false call rates, easy-to-use while maintaining the high level of defect coverage provided by X-ray inspection.

The x6000 utilizes an innovative imaging architecture that provides a high speed inspection solution. For many PCBAs, the x6000 throughput meets the manufacturing line rates. This high speed enables two key benefits: reduced capital investment and high defect coverage. The high speed directly reduces the number of systems required to meet manufacturing volumes. As a secondary effect, this enables manufacturers to test the entire board using 3D X-ray high defect detection rate. Today's solutions often require manufacturers to sample test. This approach can allow defects to escape to functional test steps where the PCBA failure diagnostics can be lengthy and expensive.

To reduce the test development costs and barriers to outsourcing, the x6000 brings a new test development environment. This new environment enables new programmers develop applications with high coverage and low false calls. The tuning portion of the interface uses a statistical learning technique that quickly and accurately sets basic thresholds to levels which maximizes coverage and minimizes false calls. Total test development time can be less than 1 day for a complex application.

Specifications

Throughput Performance Specifications

Total Test Speed: 3.5 in^2/sec[1]

Defect Detection and Reporting Capability

Solder defects such as shorts, opens, missing, voiding, and others are detected for typical solder joints for components such as:

- ≥0.4 mm Ball Grid Array (BGA)
- Chip Scale Packages (CSPs)
- Column Grid Array (CGA)
- Ball Grid Array (BGA) – noncollapsible and collapsible
- ≥0201 Chip: capacitor, resistor
- Polarized capacitors
- SMT Connector and Sockets
- Direct FET
- Fine Pitch and Standard Gullwing
- JLead
- Leadless Chip Carrier (LCC)
- Metal Electrical Face (Melf)
- Plated Throughhole (PTH)
- Quad-Flatpack No Lead (QFN)
- Small Outline Transistor (SOT)
- Heat Sinks

Panel Specifications

Maximum Panel Size: 457 mm x 609 mm (18.0 in x 24.0 in)
Minimum Panel Size: 102 mm x 127 mm (4.0 in x 5.0 in)
Maximum Panel Thickness: 3.2 mm (0.125 in)
Minimum Panel Thickness: 0.5 mm (0.020 in)
Top Clearance: 25.0 mm (1.0 in)
Bottom Clearance: 50.0 mm (2 in)
Panel Edge Clearance: 3 mm (0.118 in) on parallel edges of the panel
Maximum Panel Weight: 4.5 kg (10 lb) (including applicable carrier)
Minimum Panel Weight: 0.03 kg (0.066 lb)

System Dimensions

System Footprint: 1.5 m x 1.9 m (60 in x 76 in)
Total System Weight: 3220 kg (7500 lb)

Power Specifications

Voltage Requirements

- 200 – 240 VAC three phase
- 380 – 415 VAC three phase wye (±5 %) (50 or 60 Hz)

Accessories

Associated Training and Consulting Products

These accessories provide the necessary training and consulting to achieve successful implementations:

- x6000 Basic Maintenance Training
- Repair Image Interpretation Training
- x6000 Test Development Training
- x6000 Basic Operator Training
- x6000 Implementation Success Package

Paperless Repair and Data Analysis Tools

In addition to the basic system, a whole product solution provides integrated PCBA repair and data analysis tools. The *Medalist* Repair Tool provides state-of-the art tools to enable repair operators to quickly and efficiently review X-ray failures. The *Medalist* Quality Tool enables process engineering to track inspection trends, spot areas to improve, and provides a feedback loop to improve applications:

- Direct Connect Repair Tool
- Intelligent Test Framework Software
- Quality Tool Viewer License

Key Literature & Web Link

www.agilent.com/find/axi

Ordering Information

Contact your Agilent sales representatives to configure solutions to meet you manufacturing requirements: **www.agilent.com/find/contactus**

[1] Total test speed varies depending panel size. Estimates include image acquisition, alignment, and board handling time. Per panel Load/Unload times can be reduced by using carriers with multiple panels.

N5054D
N5065D

- **Imaging chain technology changes provide increased inspection speeds, demonstrating the ability to keep up with ever-increasing line rates**
- **Algorithm advancements provide greater image clarity to low contract components, leaving users with better defect analysis capability and lower false call rates**
- **User-friendly programming, universal and self-learning algorithms, geometric pattern matching, and click and drag optical character recognition and verification**
- **The system utilizes revolutionary 3D Solid Shape Modeling (SSM) for inspection needs**
- **Operator interfaces available for Simplified and Traditional Chinese, Japanese, Hungarian, German, and English language formats**
- **Optional head swap conversion kit for 3D solder paste inspection**

The Agilent *Medalist* SJ50 Series 3 is a cost-effective, fast, easy-to-use and highly reliable imaging platform that provides full coverage which can be flexibly deployed at multiple locations on the surface mount technology manufacturing line to detect and prevent defects.

The SJ50 is an extremely versatile platform that provides algorithms for post-paste 2D solder, pre and post-reflow components, and solder joint inspection. Through scalable resolution, the SJ50 Series 3 is capable of inspecting the most challenging of components, including 01005.

Key Literature & Web Link

www.agilent.com/find/aoi

Ordering Information

Contact your Agilent sales representatives to configure solutions to meet you manufacturing requirements: **www.agilent.com/find/contactus**

Automated Solder Paste Inspection Systems

N4774D
N5090D

- **Performs 100% 3D inspection, giving critical volume and location information for all deposits**
- **Identifies solder paste defects at the most cost effective process step**
- **Maximizes throughput with no compromise to detection performance**
- **Measurement data combined with statistical tools provides users with real-time process control**
- **User friendly programming environment**

The Agilent *Medalist* SP50 Series 3 is a high-speed inline or offline solder paste inspection system designed specifically for the SMT manufacturing marketplace.

The SP50 Series 3 provides automated 3D paste inspection for process characterization and defect prevention.

Key Literature & Web Link

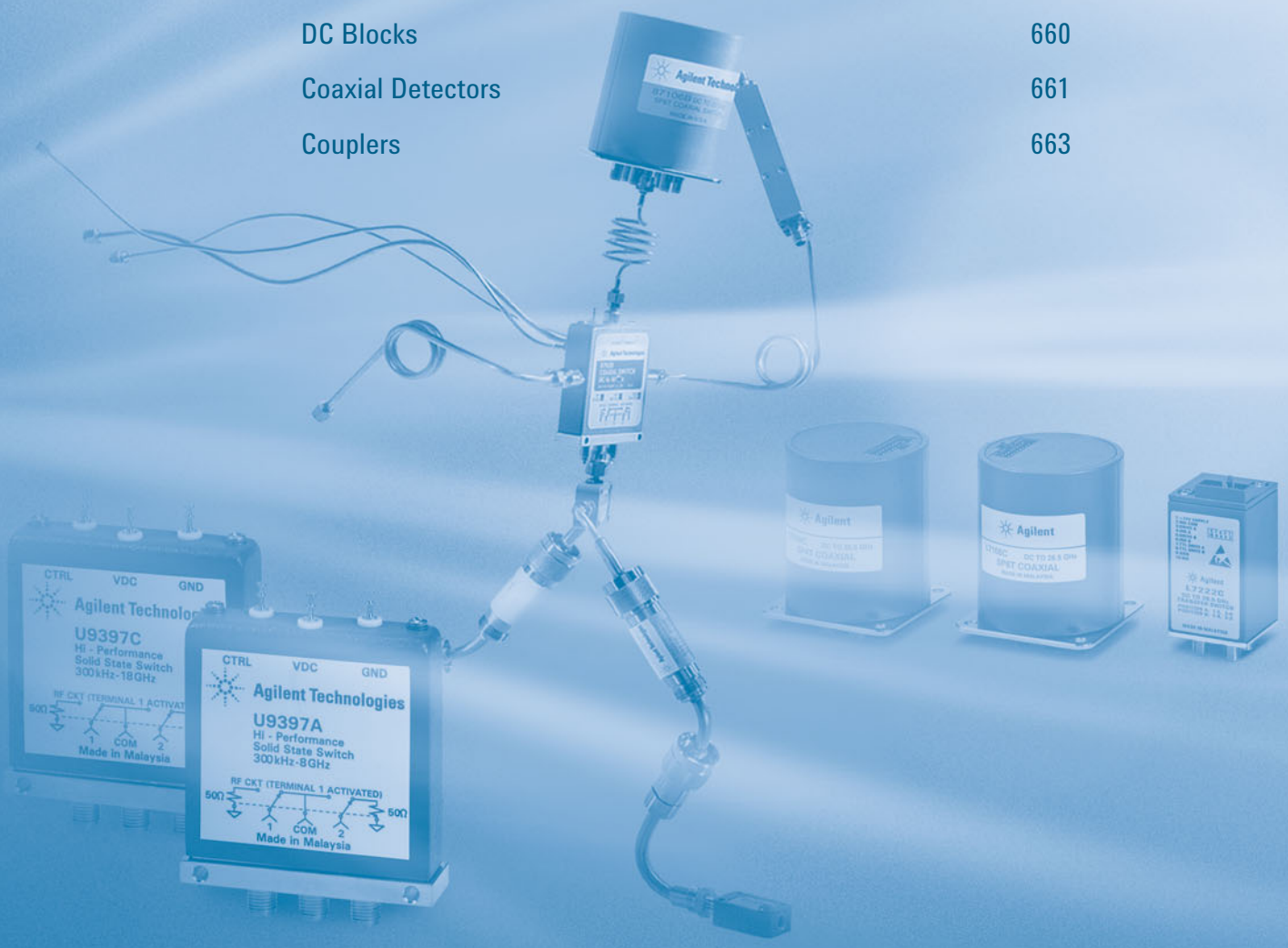
www.agilent.com/find/aoi

Ordering Information

Contact your Agilent sales representatives to configure solutions to meet you manufacturing requirements: **www.agilent.com/find/contactus**

14

RF & MICROWAVE TEST ACCESSORIES



83006A
83017A
83018A
83020A
83050A
83051A
87405B
87405C
87415A

- **Ultra broadband to 50 GHz**
- **Up to 1 watt output power**
- **Compact size**

Microwave System Amplifiers

Use these amplifiers to increase output power from microwave sources and to increase test system measurement speed with improved dynamic range. Drive a variety of narrowband travelling wave tubes with a single driver solution that is highly reliable and low in cost to maintain year after year. With excellent noise figure relative to its broad bandwidth and high gain, these amplifiers can make significant improvement to system noise figure. By using feedback to an external source ALC input, system designers can level output power at the test port, negating the effects of post sweeper reflections and losses. Place power where you need it with a remotely-locatable DC power supply. The amplifier and the power supply are provided with a 2-m DC bias cable.

Agilent 87405B/C preamplifiers operate from 100 MHz up to 18 GHz. The reliable gain and low noise figure of these preamplifiers help reduce system errors and improve the overall system performance. A convenient probe-power bias, makes the portable 87405B/C preamplifiers ideal as front end preamplifiers for a variety of Agilent instrument such as PSA, ESA and MXA spectrum analyzers.

Specifications (+20°C to +30°C)

Model	Frequency (GHz)	Power out Psat (dBm)	Power out P1dBC (dBm)	Gain dB (min)	Noise Figure (dB typ.)	Detected Output	DC Bias volt/amp	RF Connectors (Input/Output)
83006A	0.01 to 26.5	+18 typ. 0.01 to 10 GHz +16 typ. 10 to 20 GHz +14 typ. 20 to 26.5 GHz	+13, 0.01 to 20 GHz +10, 20 to 26.5 GHz	20	13, 0.01 to 0.1 GHz 8, 0.1 to 18 GHz 13, 18 to 26.5 GHz	No	+12 V at 450 mA –12 V at 50 mA	3.5 mm (f)
83017A	0.5 to 26.5	+20 typ. 0.5 to 20 GHz +15 typ. 20 to 26.5 GHz	+18, 0.5 to 20 GHz +13, 20 to 26.5 GHz***	25	8, 0.5 to 20 GHz 13, 20 to 26.5 GHz	Yes	+12 V at 700 mA –12 V at 50 mA	3.5 mm (f)
83018A	2 to 26.5	+24, 2 to 20 GHz +21, 20 to 26.5 GHz	+22, 2 to 20 GHz +17, 20 to 26.5 GHz	27, 2 to 20 GHz 23, 20 to 26.5 GHz	10, 2 to 20 GHz 13, 20 to 26.5 GHz	Yes	+12 V at 2 A –12 V at 50 mA	3.5 mm (f)
83020A	2 to 26.5	+30, 2 to 20 GHz +30, 20 to 26.5 GHz*	+28, 2 to 20 GHz +28, 20 to 26.5 GHz*	30, 2 to 20 GHz 27, 20 to 26.5 GHz	10, 2 to 20 GHz 13, 20 to 26.5 GHz	Yes	+15 V at 3.2 A –15 V at 40 mA	3.5 mm (f)
83050A	2 to 50	+20, 2 to 40 GHz +19, 40 to 50 GHz**	+15, 2 to 40 GHz +13, 40 to 50 GHz	21	6, 2 to 26.5 GHz 10, 26.5 to 50 GHz	No	+12 V at 830 mA –12 V at 50 mA	2.4 mm (f)
83051A	0.045 to 50	+12, 0.045 to 45 GHz +10, 45 to 50 GHz	+8, 0.045 to 45 GHz +6, 45 to 50 GHz	23	12, 0.045 to 2 GHz 6, 2 to 26.5 GHz 10, 26.5 to 50 GHz	No	+12 V at 425 mA –12 V at 50 mA	2.4 mm (f)
87405B	0.01 to 4	+10 typ.	+8	22 – 27	5	No	+15 V at 105 mA	N (f)/N (m)
87405C	0.1 to 18	+18 typ. 0.1 to 4 GHz +17 typ. 4 to 18 GHz	+15, 0.1 to 4 GHz +14, 4 to 18 GHz	25	6, 0.1 to 4 GHz 4.5, 4 to 18 GHz	No	+15 V at 140 mA –15 V at 140 mA 0 V at 140 mA	N (f)/N (m)
87415A	2 to 8	+26 typ.	+23	25	13	No	+12 V at 900 mA	SMA (f)

* –0.7 dB/GHz (20<f<26.5)
** –0.2 dB/GHz (40<f<50)
*** –0.75 dB/GHz (20<f<26.5)

Dimensions

83006A, 83017A, 83050A, 83051A, 87415A: 45 mm H x 103 mm W x 132 mm L (1.8 in x 4 in x 5.2 in)
83018A: 76 mm H x 114 mm W x 212 mm L (8.3 in x 3 in x 4.5 in)
83020A: 87 mm H x 202 mm W x 275 mm L (10.8 in x 3.4 in x 8 in)
87405B: 28 mm H x 28 mm W x 110 mm L (1.1 in x 1.1 in x 4.3 in)
87405C: 40.3 mm H x 18 mm W x 98.3 mm L

Weight

83006A, 83017A, 83050A, 83051A, 87415A: .64 kg (1.4 lb);
83018A: 1.8 kg (4 lb); **83020A:** 3.9 kg (8.5 lb);
87405B: 0.233 kg (0.6 lb)
87405C: 0.22 kg (0.485 lb)

Bias Cable

2-m cable with a connector on one end and bare wires on the other, shipped with the amplifiers below
83006A, 83017A, 83018A, 83050A, 83051A, 87415A: p/n 83006-60004
83020A: p/n 83020-60004
2-m cable to connect between amplifier and power supplies, shipped with power supplies below
87421A: p/n 83006-60005
87422A: p/n 87422-60001, 83006-60005

Power Supply	AC Input Voltage	DC Output Voltage/Current	Output Power	Size (H, W, D)
87421A	100 to 240 VAC 50/60 Hz	+12 V at 2.0 A, –12 V at 200 mA	25 W max	57 mm, 114 mm, 176 mm (2.3 in, 4.5 in, 6.9 in)
87422A	100 to 240 VAC 50/60 Hz	+15 V at 3.3 A, –15 V at 50 mA +12 V at 2.0 A, –12 V at 200 mA	70 W max	86 mm, 202 mm, 276 mm (3.4 in, 8.0 in, 10.9 in)

Key Literature

For more information, visit our web site: **www.agilent.com/find/mta**

11713B/C Attenuator/Switch Driver

The Agilent 11713B/C attenuator/switch drivers provide remote or front panel drive control for programmable attenuators and electro-mechanical switches. Designed with both with both benchtop and ATE environments in mind, these attenuator/switch drivers provide an intuitive user interface, a variety of switching options, software programmability and remote control features for quick, easy design validation and automated testing. Front panel push-buttons and an easy-to-read LCD display simplify setup of functions such as voltage, TTL functions, IP address, etc.

The 11713B/C is a LXI Class C compliant instrument, so it can be easily controlled and triggered remotely using a full-featured graphical web interface. This feature is used in high-volume production environments. Software instrument drivers such as IVI-COM provide programming compatibility with popular application development environments and support PC industry standards such as Component Object Model (COM). Standard GPIB connectivity supports automated programmed scripting and ensures backward compatibility to Agilent 11713A attenuator/ switch drivers.

34980A Multifunction Switch/Measure Unit for RF & Microwave Switching

The 34980A offers plug-in modules for RF and microwave switching and attenuation. This can be accomplished with either on-board RF & microwave switches, or with the 34945A/EXT microwave switch/attenuator driver module. The 34945A/EXT module provides power and control signals for the most popular microwave switches and attenuators. One 34945A/EXT can drive up to 64 switch coils – equivalent to 32 SPDT switches. Additional 34945EXT boards can be added to accommodate up to 512 coils from one 34980A mainframe. Distribution boards enable simple connections to external switches and attenuators.

The 34941A/42A plug-in modules are configured with four independent 1x4 RF multiplexers for switching signals up to 3 GHz. Multiple banks can be connected together to create a larger multiplexer. The 34945A/46A plug-in modules offer single-pole, double-throw switches in either 4 GHz or 20 GHz configurations. These modules internally mount two or three independent coaxial switches on the module.

E1368A, E1369A and E1370A VXI Attenuator/ Switch Drivers

Agilent's VXI family of instrumentation includes modules for microwave switching and attenuation control up to 18.0 GHz. E1368A contains three factory-installed SPDT switches such as the 8762B which features all-port termination, DC to 18.0 GHz. E1369A is identical to the E1368A except the switches are not included. This allows user-substitution of 8763 or 8764 transfer switches. E1370A allows the user to customize the internal configuration for 8766 series multiport switches or 8494/95/96/97 step attenuators.

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

11713B Attenuator/Switch Driver (must order 1 option)
- **11713B-STD** 1 Bank of Outputs, Single Voltage 24 V Supply
- **11713B-LXI** 1 Bank of Outputs, Single Voltage 24 V Supply, LAN (LXI-C), USB

11713C Attenuator/Switch Driver 2 Banks of Outputs, Tri & External Voltage Supply, LAN (LXI-C), USB

34980A Multifunction Switch/Measure Unit
- **34941A** Quad 1x4 50-ohm 3 GHz RF Multiplexer
- **34942A** Quad 1x4 75-ohm 1.5 GHz Multiplexer
- **34945A** (with **34945EXT**) Microwave Switch/Attenuator Driver
- **34946A** Dual 1x2 SPDT Terminated Microwave Switch
- **34947A** Triple 1x2 SPDT Unterminated Microwave Switch

E1368A 18 GHz Microwave Switch
E1369A Microwave Switch Driver
E1370A Microwave Switch/Step Attenuator Driver

Solid State Switches

U9397A
U9397C
85331B
85332B

- **High isolation**
- **Low video leakage**
- **Fast settling time**
- **Broad frequency range**

U9397A & U9397C

85331B & 85332B

Solid State Switches

Agilent's solid state switches provide superior performance with high isolation and fast switching speed across a broad operating frequency range. These absorptive switches are designed for high frequency, single-pole double-throw (SPDT) and single-pole-four-throw (SP4T) operations. Applications include instrumentation, communications, radar, antenna and many other test systems that require high speed RF and microwave switching.

U9397A/C FET Solid State Switch

Agilent U9397A and U9397C FET solid state switches, SPDT provide superior performance in terms of video leakage, isolation, settling time, and insertion loss across a broad frequency (300 KHz to 8 GHz). The U9397A/C is particularly suitable for measuring sensitive components, such as mixers and amplifiers, where video leakage may cause damage or reliability issues.

85331B/32B Solid State Switch

The Agilent 85331B (SPDT) and 85332B (SP4T) are absorptive PIN diode solid state switches which provide a superior performance in terms of isolation and fast switching speed across a broad frequency range of 45 MHz to 50 GHz. These absorptive switches are designed for high frequency usage and are extremely useful for applications in instrumentation, communications, radar and many other test systems that require high speed RF and microwave switching.

U9397A/C Specifications

	U9397A	U9397C
Frequency Range	300 KHz to 8 GHz	300 KHz to 18 GHz
Insertion Loss	<3.0 dB (300 KHz to 4 GHz) <5.0 dB (300 KHz to 8 GHz)	<3.5 dB (4 to 8 GHz) <6.5 dB (8 to 18 GHz)
Isolation	100 dB	90 dB
Return Loss (ON and common port)	>15 dB	>10 dB
Return Loss (OFF port)	>18 dB	>13 dB
Settling Time	350 µs	350 µs
Switching Speed Rise/Fall[1]	5/0.5 µs (typical)	5/0.5 µs (typical)
Video Leakage	<10 mVpp	<10 mVpp
Characteristic Impedance	50 Ω (nominal)	50 Ω (nominal)
Connectors	SMA (f)	SMA(f)

[1] Switching speed is based on 10% to 90% RF.

85331B/32B Specifications

Model Number	Frequency Range (GHz)	Insertion Loss (dB)	Isolation (dB)	Return Loss (OFF Port) (dB)	Return Loss (ON Port) (dB)	Return Loss (COM Port) (dB)
85331B SP2T	0.045 to 0.5 0.5 to 18 18 to 26.5 26.5 to 40 40 to 50	–2.0 –4.5 –6.0 –10.0 –15.5	–85 –90 –90 –85 –75	–19.0 –19.0 –12.5 –10.0 –6.0	–10.0 –10.0 –6.0 –6.0 –4.5	–10.0 –10.0 –5.5 –4.5 –4.0
85332B SP4T	0.045 to 0.5 0.5 to 18 18 to 26.5 26.5 to 40 40 to 50	–2.0 –4.5 –7.0 –12.0 –21.5 –15.5	–85 –90 –90 –85 –75	–19.0 –19.0 –12.5 –10.0 –6.0	–9.0 –9.0 –5.0 –4.5 –4.5	–10.0 –10.0 –5.5 –4.0 –4.0

U9397A
U9397C
85331B
85332B

Key Literature & Web Link

For more information, visit our web site:
www.agilent.com/find/mta

Ordering Information

U9397A 8 GHz High-performance FET Solid State Switch
U9397C 18 GHz High-performance FET Solid State Switch
85331B SP2T 45 MHz to 50 GHz Solid State Switch
85332B SP4T 45 MHz to 50 GHz Solid State Switch

For 85331B & 85332B

Option 001 Switch Control Cable – 1 meter
Option 002 Switch Control Cable – 2 meter
Option 005 Switch Control Cable – 5 meter
Option 010 Switch Control Cable – 10 meter
Option 015 Switch Control Cable – 15 meter
Option 102 Switch Control Cable (one end bare wire) – 2 meter
Option 115 Switch Control Cable (one end bare wire) – 15 meter
Option 201 Switch Control Unit

N1810UL
N1810TL
N1811TL
N1812UL

- **Low SWR**
- **Low insertion loss**
- **High isolation – up to 134 dB @ 4 GHz**
- **Long life – 5 million cycles**
- **Excellent repeatability**

N181x Series

Coaxial Switches

Featuring unparalleled reliability and the longest life available, Agilent switches are the clear choice for high volume wireless communications manufacturing test. All switches utilize magnetically latched solenoids and break-before-make RF contacts for test simplicity. In precision measurements and monitoring applications where insertion loss repeatability is crucial, these switches will operate in excess of 5 million cycles with better than 0.03 dB of insertion loss repeatability at 25°C.

N1810UL – Unterminated Latching SPDT

The 1810UL is a single-pole, double throw switch available in the frequency range from DC to 26.5 GHz.

N1810TL – Terminated Latching SPDT

The 1810TL is a single-pole, double throw switch available in the frequency range from DC to 26.5 GHz. The unused port is terminated into 50 Ω, making it ideal for applications where source matching is required.

N1811TL – Terminated Latching Bypass

The 1811TL is a terminated bypass switch available in the frequency range from DC to 26.5 GHz. The switch's internal load can terminate the device under test when in the through mode (up to 1 watt). Because of its compact design, it is ideal for drop-in, drop-out applications.

N1812UL – Unterminated Latching 5-port

The 1812UL is a versatile, unterminated 5-port switch available in the range of frequency from DC to 26.5 GHz. In bypass switch applications, the fifth port can be terminated externally with a high power termination. It can also be utilized for signal path reversal or as a calibration port.

General Operating Characteristics: N181x series

Switching Speed	Repeatability	Life	Impedance
<15 ms	<0.03 db typical	5 mil cycles	50 Ω

Standard Performance Specifications: N181x series

Isolation	= 90 – 1.132 x F, where F is specified in GHz				
(dB)	**DC**	**4 GHz**	**12.4 GHz**	**20 GHz**	**26.5 GHz**
	90	85	76	67	60
Insertion	= 0.35 + 0.45/26.5 x F, where F is specified in GHz				
Loss (dB)	**DC**	**4 GHz**	**12.4 GHz**	**20 GHz**	**26.5 GHz**
	0.35	0.42	0.56	0.69	0.80
SWR		**DC to 4 GHz**	**4 to 12.4 GHz**	**12.4 to 20 GHz**	**20 to 26.5 GHz**
		1.15	1.25	1.30	1.60

Optional High Performance Specifications: N181x series

Isolation	= 125 – 1.321 x F, where F is specified in GHz				
(dB)	**DC**	**4 GHz**	**12.4 GHz**	**20 GHz**	**26.5 GHz**
Opt. 301	125	120	109	99	90
Insertion	= 0.2 + 0.017 x F, where F is specified in GHz				
Loss (dB)	**DC**	**4 GHz**	**12.4 GHz**	**20 GHz**	**26.5 GHz**
Opt. 302	0.15	0.27	0.41	0.53	0.65
SWR		**DC to 4 GHz**	**4 to 12.4 GHz**	**12.4 to 20 GHz**	**20 to 26.5 GHz**
Opt. 302		1.10	1.20	1.23	1.45

Key Literature

N1810/1/2 Coaxial Switches Product Overview, p/n 5968-9653E

Ordering Information

N1810UL, N1810TL, N1811TL, N1812UL

Frequency
- **002** DC to 2 GHz w/SMA(f) RF Connector
- **004** DC to 4 GHz w/SMA(f) RF Connector
- **020** DC to 20 GHz w/SMA(f) RF Connector
- **026** DC to 26.5 GHz w/SMA(f) RF Connector

Voltage
- **105** 5 volts
- **115** 15 volts
- **124** 24 volts

DC Connector
- **201** D-subminiature 9 pin (f)
- **202** Solder lugs

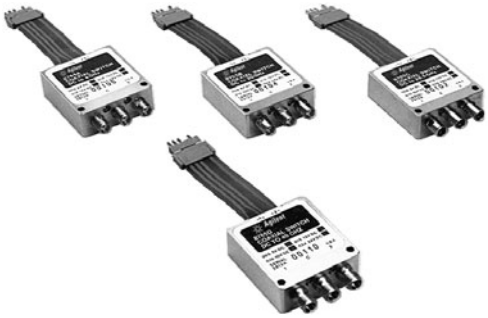
Options

Performance (chose any)
- **301** Higher Isolation (see specs)
- **302** Low SWR and Insertion Loss (see specs)

Drive (chose any)
- **401** TTL/5V CMOS Compatible Drive
- **402** Position Indicators
- **403** Current Interrupts

Ordering example: For an unterminated 5-port switch, operating up to 20 GHz, with 15 volt coils, D-sub connector, TTL drive, and high isolation, the order should look as follows: **N1812UL-020, -115, -201, -301, -401**

8761
8762
8763
8764
8765



Coaxial Switches

Agilent coaxial switches feature low SWR, low insertion loss, excellent isolation and exceptional repeatability of 0.03 dB for more than 1 million switching cycles. Agilent offers a broad line of coaxial switches, covering up to 40 GHz, for use in test and measurement applications. All switches use magnetically-latched solenoids and break-before-make RF contacts for test simplicity.

8761 Series

8761A/B is a SPDT switch which operates up to 18 GHz. Each port features six connector options plus 50 Ω termination for design flexibility. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles.

8762 Series

8762A/B/C switches operate up to 26.5 GHz. These switches provide 50 Ω match termination at all ports. Control voltage options T15 and T24 are compatible with TTL/5 V CMOS drive circuitry. Another model, 8762F is designed for 75 Ω transmission lines, making it valuable for commercial communication applications up to 4 GHz.

8763 Series

8763A/B/C switches operate up to 26.5 GHz. They are preferred for drop-out or drop-in applications due to their compact design. These switches are used to automatically insert or remove a test component from a signal path. One port is internally terminated. Options T15 and T24 are available for TTL/5 V CMOS compatibility.

8764 Series

8764A/B/C switches are available in three models up to 26.5 GHz. These switches are similar to the 8763, but with the internal termination replaced with a fifth port. The fifth port can be utilized for signal path reversal or as a calibration port. Options T15 and T24 offer TTL/5 V CMOS compatibility.

8765 Series

8765A/B/C/D/F are available in four models up to 40 GHz, as well as a 75 Ω model to 4 GHz. These SPDT switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. Unlike the 8762 switches, they do not have internal, switched RF loads or DC current interrupts. Coil voltage options cover the complete range from 5 Vdc to 24 Vdc. Since the coils are not interrupted, the coil voltage may be continuous or may be switched off after 15 ms.

Key Literature & Web Link

www.agilent.com/find/mta

Ordering Information

8761A/B Coaxial Switches
Specify voltage and connectors (including built-in 50 Ω terminations) by alphabetic suffix on the switch model number and the appropriate 3-digit option number. Specify all connectors.
8761A 12 to 15 V Supply Voltage
8761B 24 to 30 V Supply Voltage
Connector Options (Port 1, Port 2, Port C):

Option Code	Connector Type
100/200/300	Type-N Female
101/201/301	Type-N Male
102/202/302	7-mm Threaded Sleeve (APC-7®)[1]
103/203/303	7-mm Coupling Nut (APC-7)[1]
104/204/304	7-mm for UT-250 Coax
105/205/305	3-mm Female (SMA)
106/206/306	3-mm Male (SMA)
107/207/307	50-ohm Termination

8762, 8763, 8764 Coaxial Switches
Specify the frequency and voltage by the alphabetic suffix and option number. The standard model has 24 V supply voltage.
8762A SPDT, DC to 4 GHz
8762B SPDT, DC to 18 GHz
8762C SPDT, DC to 26.5 GHz
8762F SPDT, DC to 4 GHz, 75 Ω
8763A 4-Port, DC to 4 GHz
8763B 4-Port, DC to 18 GHz
8763C 4-Port, DC to 26.5 GHz
8764A 5-Port, DC to 4 GHz
8764B 5-Port, DC to 18 GHz
8764C 5-Port, DC to 26.5 GHz
8765 Coaxial Switches
A voltage option must be ordered with the switch. Specify frequency, voltage, DC connectors, and ribbon cable extension options by alphabetic suffix and option number.
8765A SPDT, DC to 4 GHz
8765B SPDT, DC to 20 GHz
8765C SPDT, DC to 26.5 GHz
8765D SPDT, DC to 40 GHz
8765F SPDT, DC to 4 GHz, 75 Ω

[1] Either option will connect to a standard, sexless, 7-mm connector. To daisy-chain two 8761A's you must use one option 102, 202, or 302 and one option 103, 203, or 303 on the two mating connectors. If you have two of the same options, you will need to use a cable with two standard 7-mm connectors.

8761 – 5 Series Specifications

Model	Frequency Range (GHz)	SWR 50 Ω Nominal	Insertion Loss	Isolation	Switching Speed	Repeat-ability[2]	Life[3]	RF Connectors	Dimensions W x H x D (mm)	Shipping Weight (g)
8761A SPDT Unterminated	DC to 18	<1.2 to 12.4 GHz <1.25 to 18 GHz	<0.5 dB to 12.4 GHz <0.8 dB to 18 GHz	>50 dB to 12.4 GHz >45 dB to 18 GHz	35 to 50 mS	0.03 dB	1 x 10[6]		38 x 41 x 38	300
8761B SPDT Unterminated	DC to 18	<1.2 to 12.4 GHz <1.25 to 18 GHz	<0.5 dB to 12.4 GHz <0.8 dB to 18 GHz	>50 dB to 12.4 GHz >45 dB to 18 GHz	35 to 50 mS	0.03 dB	1 x 10[6]		38 x 41 x 38	300
8762A SPDT Terminated	DC to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10[6]	SMA (f)	53 x 14 x 54	220
8762B SPDT Terminated	DC to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10[6]	SMA (f)	53 x 14 x 54	220
8762C SPDT Terminated	DC to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 dB to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB to 18 GHz 0.05 dB to 26.5 GHz	1 x 10[6]	3.5 mm (f)	53 x 14 x 54	220
8762F SPDT, 75 Ω Terminated	DC to 4	<1.15 to 1 GHz <1.3 to 4 GHz	<0.4 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10[6]	75 Ω, SMB (m)	53 x 14 x 54	300
8763A Coaxial Terminated	DC to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10[6]	SMA (f)	53 x 14 x 54	220
8763B Coaxial Terminated	DC to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10[6]	SMA (f)	53 x 14 x 54	220
8763C Coaxial Terminated	DC to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB to 18 GHz 0.05 dB to 26.5 GHz	1 x 10[6]	3.5 mm (f)	53 x 14 x 54	220
8764A Coaxial Unterminated	DC to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10[6]	SMA (f)	53 x 14 x 54	220
8764B Coaxial Unterminated	DC to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10[6]	SMA (f)	53 x 14 x 54	220
8764C Coaxial Unterminated	DC to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 dB to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB to 18 GHz 0.05 dB to 26.5 GHz	1 x 10[6]	3.5 mm (f)	53 x 14 x 54	220
8765A SPDT Unterminated	DC to 4	<1.2 to 4 GHz	0.2 + 0.025 f (GHz) max <0.2 to 4 GHz[1]	110 – 2.25 x f (GHz) min >120 dB to 4 GHz	<15 mS	0.03 dB	5 x 10[6]	SMA (f)	33 x 14 x 45	200
8765B SPDT Unterminated	DC to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.2 + 0.025 f (GHz) max <0.2 to 4 GHz[1] <0.5 to 20 GHz[1]	110 – 2.25 x f (GHz) min >120 dB to 4 GHz >90 dB to 20 GHz	<15 mS	0.03 dB	5 x 10[6]	SMA (f)	33 x 14 x 45	200
8765C SPDT Unterminated	DC to 26.5	<1.25 to 4 GHz <1.45 to 18 GHz <1.7 to 26.5 GHz	0.25 + 0.027 f (GHz) max <0.2 to 4 GHz[1] <0.5 to 20 GHz[1] <0.7 to 26.5 GHz[1]	110 – 2.25 x f (GHz) min >120 dB to 4 GHz >90 dB to 20 GHz >60 dB to 26.5 GHz	<15 mS	0.03 dB	5 x 10[6]	3.5 mm (f)	33 x 14 x 45	200
8765D SPDT Unterminated	DC to 40	<1.25 to 4 GHz <1.45 to 26.5 GHz <1.7 to 40 GHz	0.2 + 0.23 f (GHz) max <0.2 to 4 GHz[1] <0.5 to 20 GHz[1] <0.7 to 26.5 GHz[1] 0.75 + 00.023 f (GHz) max <1.0 to 40 GHz[1]	110 – 2.25 x f (GHz) min >120 dB to 4 GHz >90 dB to 20 GHz >60 dB to 26.5 GHz >50 dB to 40 GHz	<15 mS	0.03 dB	5 x 10[6]	2.4 mm (f) 2.92 mm (f)	33 x 14 x 45	200
8765F SPDT, 75 Ω Unterminated	DC to 4	<1.15 to 1 GHz <1.20 to 4 GHz	<0.18 dB to 1 GHz <0.24 dB to 2 GHz <0.40 dB to 4 GHz	>100 dB to 1 GHz >90 dB to 4 GHz	<15 mS	0.03 dB	5 x 10[6]	75 Ω, SMB (m)	33 x 14 x 45	200

[1] Typical insertion loss.
[2] Measured at 25°C.
[3] Cycles per section minimum.

For more information, visit our web site: **www.agilent.com/find/mta**

- **Guaranteed repeatability of 0.03 dB up to 2 million cycles**
- **Operating life of 5 million cycles typical**
- **Unmatched isolation, 90 dB minimum at 12 GHz**
- **Economically priced**

Transfer – Economical High Performance

L Series – L7222C

The L7222C 4-port coaxial transfer switch provides flexibility and simplification of design in signal routing and conditioning applications. Operating from DC to 26.5 GHz, these switches provide exceptional 0.03 dB insertion loss repeatability warranted for 2 million cycles. The L7222C's high isolation between ports, typically >90 dB, reduces the influence of signals from other channels and system measurement uncertainties, making them ideal for use in large, multitiered switching systems. The L7222C can be used in a variety of applications, such as a drop-out switch, switching two inputs and two outputs, or signal reversal switching.

L7104C

L7222C

L7106C

Multiport – Economical High Performance, Terminated

L Series – L7104A/B/C and L7106A/B/C

L7104A/B/C and L7106A/B/C multiport switches are available in 3 models up to 26.5 GHz. These switches offer a warranted repeatability of 0.03 dB for 2 million cycles. The L7104A/B/C single-pole-4-throw (SP4T) and L7106A/B/C, SP6T operate from DC to 26.5 GHz with excellent isolation, VSWR, 1.2 maximum, and with an input power of 1 W avg./50 W peak (15 s max). These switches provide the life and reliability required for automated test and measurement, signal monitoring and routing application at an economical price.

Multiport – Economical High Performance, Unterminated

L Series – L7204A/B/C and L7206A/B/C

L7204A/B/C and L7206A/B/C are unterminated multiport switches which operate at frequency range up to 26.5 GHz. These switches offer a warranted repeatability of 0.03 dB for 2 million cycles. The L7204A/B/C, SP4T and L7206A/B/C, SP6T operate from DC to 26.5 GHz with excellent isolation, VSWR, 1.2 maximum, and with an input power of 1 W avg./100 W peak (15 s max). These switches provide the life and reliability for automated test and measurement, signal monitoring and routing application at an economical price.

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

L7104A DC to 4 GHz, SP4T, terminated
L7104B DC to 20 GHz, SP4T, terminated
L7104C DC to 26.5 GHz, SP4T, terminated
L7204A DC to 4 GHz, SP4T, unterminated
L7204B DC to 20 GHz, SP4T, unterminated
L7204C DC to 26.5 GHz, SP4T, unterminated
L7106A DC to 4 GHz, SP6T, terminated
L7106B DC to 20 GHz, SP6T, terminated
L7106C DC to 26.5 GHz, SP6T, terminated
L7206A DC to 4 GHz, SP6T, unterminated
L7206B DC to 20 GHz, SP6T, unterminated
L7206C DC to 26.5 GHz, SP6T, unterminated
L7XXX-100 Solder Terminals to replace Ribbon Cable
L7XXX-UK6 Commercial Calibration Test Data with Certificate
L7XXX-T24 TTL/5 V CMOS Compatible Option
L7222C DC to 26.5 GHz Transfer Switch

11713B/C Attenuator Switch Driver
Drives up to 10 sections of switches or attenuators

5061-0969 Accessory Cable
Viking connector to bare tinned wires (60 inches long). Use to connect 11713B to L7104/204/106/206 with Option 100. One required with L7104/L7204 Option 100; two required with L7106/L7206 Option 100

Model	Frequency Range (GHz)	SWR	Insertion Loss (db)	Isolation	Switching Time (max)	Repeatability (max)	Life	Connector	Dimension W x H x D (mm)
L7104/L7204A L7106/L7206A	DC to 4 GHz	1.2 maximum	0.3 + 0.015 x frequency (GHz)	90 dB minimum	15 ms	0.03 dB	2 million	SMA (f)	57.15 x 71.53 x 57.15
L7104/L7204B L7106/L7206B	DC to 20 GHz	1.2 maximum, DC to 4 GHz 1.35 maximum, 4 to 12.4 GHz 1.45 maximum, 12.4 to 18 GHz 1.7 maximum, 18 to 20 GHz	0.3 + 0.015 x frequency (GHz)	90 dB minimum, DC to 12 GHz 70 dB minimum, 12 GHz to 15 GHz 65 dB minimum, 15 to 20 GHz	15 ms	0.03 dB	2 million	SMA (f)	57.15 x 71.53 x 57.15
L7104/L7204C L7106/L7206C	DC to 26.5 Hz	1.2 maximum, DC to 4 GHz 1.35 maximum, 4 to 12.4 GHz 1.45 maximum, 12.4 to 18 GHz 1.7 maximum, 18 to 26.5 GHz	0.3 + 0.015 x frequency (GHz)	90 dB minimum, DC to 12 GHz 70 dB minimum, 12 GHz to 15 GHz 65 dB minimum, 15 to 20 GHz 60 dB minimum, 20 to 26.5 GHz	15 ms	0.03 dB	2 million	SMA (f)	57.15 x 71.53 x 57.15
L7222C	DC to 26.5	1.65 maximum at 26.5 GHz	0.2 + 0.025 x frequency (GHz)	110 dB – 2.0 x frequency (GHz)	15 ms	0.03 dB	2 million	SMA (f)	31.75 x 56.80 x 23.11

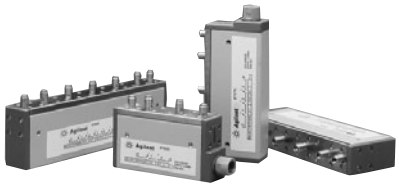
87104
87106
87204
87206
87222
87406B
87606B
8766
8767
8768
8769

- **Guaranteed repeatability of 0.03 dB up to 5 million cycles**
- **Operating life of 10 million cycles, typical**
- **Low SWR**
- **Low insertion loss**
- **High isolation – >90 dB at 12 GHz**


87222C/D/E


87406B


87204B


8766

Transfer Switches – High Performance

The 87222C/E 4-port, coaxial transfer switches offer versatility in a number of applications from drop-out to signal reversal. They provide exceptional repeatability <0.03 dB, a low insertion loss and high isolation. The 87222C operates from DC – 26.5 GHz, 87222D to 40 GHz, and are warranted for 5 million cycles. The 87222E operates from DC – 50 GHZ. The option 161 87222C/D/E provides a 10-pin connector while Option 100 includes solder terminals. Option 201 provides a mounting bracket.

Matrix Switches – High Performance, Terminated

87406/606 Series

The 87406B and 87606B 6-port, coaxial matrix switches will provide a valuable tool for 3 x 3, 2 x 4, and 1 x 5 configurations. These high performance matrix switches offer excellent repeatability and life greater than 5 million cycles. The 87406B, 87606B operate from DC to 20 GHz with excellent isolation, VSWR <2.0:1, and with an input power of 1 W avg./50 W peak (10 μs max).

Multiport – High Performance, Terminated

87104/106 and 87204/206 Series

87104A/B/C and 87106A/B/C multiport switches are available in 3 models up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. 87104 is a Single-Pole-4-throw (SP4T) and 87106 is a SP6T function. Both switches have internal solid-state logic that automatically programs the non-used ports to a matched load when any one port is programmed to "on." This relieves the user from having to provide external logic drive pulses.

Multiport – Low Profile, Unterminated

8766/67/68/69K Series

8766/67/68/69K series switches are modified versions of the 8494/95/96/97 series step attenuators (DC – 26.5 GHz) for applications requiring a single-pole, 3-throw, 4-throw, 5-throw or 6-throw coaxial switch. The switch ports are unterminated. These switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. The switches are available with several optional cables and connectors to make them compatible with standard 14-pin DIP sockets. Isolation and insertion loss vary with frequency, and depend upon the port selected.

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

87104A[1] SP4T, DC to 4 GHz
87104B[1] SP4T, DC to 20 GHz
87104C[1] SP4T, DC to 26.5 GHz
87106A[1] SP6T, DC to 4 GHz
87106B[1] SP6T, DC to 20 GHz
87106C[1] SP6T, DC to 26.5 GHz
87204A SP4T, DC to 4 GHz
87204B SP4T, DC to 20 GHz
87204C SP4T, DC to 26.5 GHz
87206A SP6T, DC to 4 GHz
87206B SP6T, DC to 20 GHz
87206C SP6T, DC to 26.5 GHz
87222C Transfer, DC to 26.5 GHz
87222D Transfer, DC to 40 GHz
87222E Transfer, DC to 50 GHz
87406B Matrix, DC to 20 GHz
- **87406B-100** Solder Terminals
- **87406B-161** 16-pin DIP with Ribbon Cable
- **87406B-T24**[2] TTL/5 V CMOS Compatible Logic
- **87406B-024** 24 Vdc without TTL Logic
- **87406B-UK6** Commercial Calibration Test Data with Certificate

87606B Matrix, DC to 20 GHz
- **87606B-100** Solder Terminals
- **87606B-161** 16-pin DIP with Ribbon Cable
- **87606B-024**[2] 24 Vdc without TTL Logic
- **87606B-UK6** Commercial Calibration Test Data with Certificate

8766K, 8767K, 8768K, 8769K Coaxial Switches
Specify RF connectors (and frequency), supply voltages, DC connectors by option number. Standard unit is 24 Vdc, 3.5-mm (f) RF connectors (DC to 26.5 GHz), and Viking-type DC connector
8766K SP3T Multi-Port Switch
8767K SP4T Multi-Port Switch
8768K SP5T Multi-Port Switch
8769K SP6T Multi-Port Switch
- **876xK-002** SMA (f) Connectors
- **876xK-004** 3.5 mm (f)
- **876xK-008** 8-inch Ribbon Cable w/DIP Connector
- **876xK-011** 5 Vdc Supply Voltages
- **876xK-015** 15 Vdc Supply Voltages
- **876xK-016** 16-inch Ribbon Cable w/DIP Connector
- **876xK-024** 24 V Solenoids
- **876xK-060** 5 foot DC Control Cable, 12 pin "Viking"
- **876xK-UK6** Commercial Calibration Test Data with Certificate

[1] Provides sensing capability with 87130A.
[2] Not available with 87204, 87206, or 87606 switches.

87104/6, 87204/6, 87222C/E, 87406B/606B, 8766/7/8/9 Series Specifications

Model	Frequency Range (GHz)	SWR (50 Ω Nominal)	Insertion Loss (db)	Isolation (db)	Switching Time (max)	Repeat-ability[1]	Life (min.)	RF Connectors	Dimensions W x H x D (mm)	Shipping Weight (g)
87104A/204A SP4T	DC to 4	<1.2 to 4 GHz	0.3 + 0.015 x f (GHz)	>100 to 4 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87104B/204B SP4T	DC to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.3 + 0.015 x f (GHz)	>100 to 12 GHz >80 to 15 GHz >70 to 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87104C/204C SP4T	DC to 26.5	<1.7 to 20 to 26.5 GHz	0.3 + 0.015 x f (GHz)	>65 20 to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106A/206A SP6T	DC to 4	<1.2 to 4 GHz	0.3 + 0.015 x f (GHz)	>100 to 4 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106B/206B SP6T	DC to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.3 + 0.015 x f (GHz)	>100 to 12 GHz >80 to 15 GHz >70 to 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106C/206C SP6T	DC to 26.5	<1.7 to 20 to 26.5 GHz	0.3 + 0.015 x f (GHz)	>65 20 to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87222C	DC to 26.5	<1.1 to 2 GHz <1.15 to 4 GHz <1.25 to 12.4 GHz <1.4 to 20 GHz <1.65 to 26.5 GHz	0.2 + 0.025 x f (GHz)	120 – 2.0 x f (GHz) at DC to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	32 x 69 x 32	100
87222D	DC to 40	<1.3 to 12.4 GHz <1.4 to 25 GHz <1.7 to 40 GHz	0.2 + 0.025 x f (GHz)	120 – 2.0 x f (GHz) at DC to 26.5 GHz >60 at 26.5 to 40 GHz	15 ms	0.03 dB	5,000,000 cycles	2.92 mm (f)	32 x 69 x 32	100
87222E	DC to 50	<1.3 to 12.4 GHz <1.4 to 20 GHz <1.5 to 30 GHz <1.6 to 40 GHz <1.7 to 50 GHz	0.15 + 0.020 x f (GHz)	120 – 2.0 x f (GHz) at DC to 26.5 GHz >60 at 26.5 to 50 GHz	15 ms	0.03 dB DC to 26.5 GHz 0.05 dB 26.5 to 50 GHz	5,000,000 cycles	2.4 mm (f)	32 x 69 x 32	100
87406B/606B	DC to 20	<1.21 to 4 <1.35 to 10 <1.5 to 15 <1.7 to 18 <1.9 to 20	0.34 + 0.033 x f (GHz)	>100 dB to 12 GHz >80 dB to 15 GHz >70 dB to 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
8766K SP3T	DC to 26.5 or DC to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 1: 0.2 dB + 0.05 dB/GHz Port 2: 0.2 dB + 0.06 dB/GHz	Consult Technical Data Sheet	20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 82	178
8767K SP4T	DC to 26.5 or DC to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 3: 0.2 dB + 0.08 dB/GHz Port 4: 0.25 dB + 0.095 dB/GHz		20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 105	235
8768K SP5T	DC to 26.5 or DC to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 5: 0.25 dB + 0.108 dB/GHz Port 6: 0.25 dB + 0.12 dB/GHz		20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 133	292
8769K SP6T	DC to 26.5 or DC to 18 for Option 002	<1.3 to 8 GHz <1.55 to 12.4 GHz <1.8 to 18 GHz <2.05 to 26.5 GHz			20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 160	349

[1] Measured at 25°C.

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High-Performance Programmable Step Attenuators – DC to 50 GHz

84904K/L/M (0 – 11, 1 dB steps)

84905M (0 – 60, 10 dB steps)

84906K/L (0 – 90, 10 dB steps)

84907K/L (0 – 70, 10 dB steps)

84908M (0 – 65, 5 dB steps)

The 84904/905/906/907/908 family of programmable step attenuators offers unmatched attenuation performance to 50 GHz. The K model brings superior accuracy and reliability to 26.5 GHz, while the L model offers unparalleled performance to 40 GHz and the M to 50 GHz.

Agilent step attenuators consist of 3 or 4 cascaded sections of specific attenuation values, e.g., 1, 2, 4, 5, 10, 20 and 40 dB. These families offer the selection, performance, accuracy and reliability expected from Agilent attenuators: attenuation ranges of 11, 70, or 90 dB, 1 dB and 10 dB step sizes, 5 million cycles per section, better than 0.03 dB repeatability, connector size options and the choice of male or female connectors.

Programmable step attenuators feature electromechanical designs which achieve 20 milliseconds switching time, including settling time. The permanent magnet latching allows automatic interruption of the DC drive voltage to cut power consumption and simplify circuit design. They are equipped with 10-pin DIP sockets (m) with interconnect cables available.

84904/6/7K and L

84904/6/7K/L Specifications

Model	Frequency Range (GHz)	Attenuation Range	Maximum SWR Std (Option 006)	Insertion Loss 0 dB Setting	Repeat-ability[1]	Life[2]	Shipping Weight
84904K **84904L**	DC to 26.5 DC to 40	0 to 11 dB 1 dB steps	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz	0.8 dB + 0.04 dB/GHz	0.03 dB	5×10^6	291 g (10.3 oz)
84906K **84906L**	DC to 26.5 DC to 40	0 to 90 dB 10 dB steps	1.3 (1.5) to 12.4 GHz 1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz	0.8 dB + 0.04 dB/GHz	0.03 dB	5×10^6	291 g (10.3 oz)
84907K **84907L**	DC to 26.5 DC to 40	0 to 70 dB 10 dB steps	1.25 (1.4) to 12.4 GHz 1.5 (1.7) to 34 Gz 1.7 (1.9) to 40 GHz	0.6 dB + 0.03 dB/GHz	0.03 dB	5×10^6	229 g (8.1 oz)

Sensitivity Power: dB/watt (temperature dB/°C): 0.001 (0.0001)
Power Rating: 1 W ave, 50 W peak, 10 µs max. pulse width
Supply Voltage/Speed/Power: 20 to 30 V/<20 ms/2.7 W

[1] Measured at 25°C.
[2] Cycles per section minimum.

Attenuation Accuracy DC to 26.5 GHz	26.5 to 40 GHz
1 dB: 0.4 dB	1 dB: 0.6 dB
2 dB: 0.5 dB	2 dB: 0.6 dB
3 dB: 0.7 dB	3 dB: 0.8 dB
4 dB: 0.7 dB	4 dB: 0.8 dB
5 dB: 0.7 dB	5 dB: 0.8 dB
6 dB: 0.7 dB	6 dB: 0.9 dB
7 dB: 0.8 dB	7 dB: 1.1 dB
8 dB: 0.8 dB	8 dB: 1.1 dB
9 dB: 0.85 dB	9 dB: 1.2 dB
10 dB: 0.9 dB	10 dB: 1.3 dB
11 dB: 1.10 dB	11 dB: 1.5 dB
10 dB: 0.5 dB	10 dB: 0.5 dB
20 dB: 0.6 dB	20 dB: 0.6 dB
30 dB: 0.7 dB	30 dB: 0.7 dB
40 dB: 1.0 dB	40 dB: 1.0 dB
50 dB: 1.2 dB	50 dB: 1.2 dB
60 dB: 1.6 dB	60 dB: 1.6 dB
70 dB: 1.9 dB	70 dB: 1.9 dB
80 dB: 2.7 dB	80 dB: 2.7 dB
90 dB: 2.9 dB	90 dB: 2.9 dB

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

Attenuators
84904K 0 to 11 dB, 1 dB steps, 26.5 GHz
84904L 0 to 11 dB, 1 dB steps, 40 GHz
84904M 0 to 11 dB, 1 dB steps, 50 GHz
84905M 0 to 60 dB, 10 dB steps, 50 GHz
84908M 0 to 65 dB, 5 dB steps, 50 GHz
84906K 0 to 90 dB, 10 dB steps, 26.5 GHz
84906L 0 to 90 dB, 10 dB steps, 40 GHz
84907K 0 to 70 dB, 10 dB steps, 26.5 GHz
84907L 0 to 70 dB, 10 dB steps, 40 GHz
- **84907L-006** Female 2.92-mm Connectors (L models only)
- **84907L-011** 5 Vdc Supply Voltage
- **84907L-015** 15 Vdc Supply Voltage
- **84907L-024** 24 Vdc Supply Voltage
- **84907L-100** Male 2.4-mm Connector (L models only)
- **84907L-104** Male 3.5-mm Connector (K models only)
- **84907L-106** Male 2.92-mm Connector (L models only)
- **84907L-UK6** Commercial Calibration Test Data with Certificate

Agilent 84904/5/8 M Attenuation Data Uncertainties

Attenuation (dB)	DC to 2 GHz	2 to 20 GHz	20 to 40 GHz	40 to 50 GHz
0	±0.0305	±0.0546	±0.1256	±0.1597
1 – 11	±0.0297	±0.0515	±0.1238	±0.1699
15	±0.0342	±0.0516	±0.1263	±0.1968
20	±0.0334	±0.0521	±0.1240	±0.1849
25	±0.0358	±0.0522	±0.1251	±0.1997
30	±0.0432	±0.0535	±0.1283	±0.2219
35	±0.0729	±0.1050	±0.2521	±0.3918
40	±0.0729	±0.1050	±0.2521	±0.3918
45	±0.0774	±0.1051	±0.2546	±0.4187
50	±0.0766	±0.1056	±0.2523	±0.4068
55	±0.0790	±0.1057	±0.2534	±0.4216
60	±0.0864	±0.1070	±0.2566	±0.4438
65	±0.1161	±0.1585	±0.3804	±0.6137

Attenuation Setting

Attenuation Accuracy (±–dB; referenced from 0 dB setting):

Model Number 84904M

Attenuator Setting (dB):	1	2	3	4	5	6	7	8	9	10	11
Frequency Range											
DC to 18 GHz	0.35	0.45	0.55	0.55	0.55	0.55	0.60	0.60	0.65	0.70	0.80
18 to 26.5 GHz	0.40	0.50	0.70	0.70	0.70	0.70	0.80	0.80	0.85	0.90	1.10
26.5 GHz to 40 GHz	0.60	0.60	0.80	0.80	0.80	0.90	1.10	1.10	1.20	1.30	1.50
40 to 50 GHz	0.60	0.70	0.80	0.80	0.80	0.90	1.10	1.10	1.20	1.30	1.50

Model Number 84905M

Attenuator Setting (dB):	10	20	30	40	50	60
DC to 40 GHz	0.5	0.6	0.7	1.0	1.2	1.6
40 to 50 GHz	0.7	0.8	1.0	1.3	1.5	1.8

Model Number 84908M

Attenuator Setting (dB):	5	10	15	20	25	30	35	40	45	50	55	60	65
DC to 40 GHz	0.5	0.5	0.6	0.6	0.7	0.7	1.0	1.0	1.2	1.2	1.6	1.6	1.8
40 to 50 GHz	0.7	0.7	0.8	0.8	1.0	1.0	1.3	1.3	1.5	1.5	1.8	1.8	2.0

Note: Step-to-step accuracy is the maximum variation from the nominal step size when changing attenuation values. It is a second specification on accuracy, and is used in combination with the absolute accuracy specifications to limit maximum allowable variation from nominal. Typical step-to-step accuracy for the 84905M and 84908M is ±1.0 dB to 50 GHz; for the 84904M is ±0.5 to 50 GHz.

Specifications

Maximum Insertion Loss	84904M	84905M	84908M
DC to 40 GHz (in dB 0 dB position, f = frequency in GHz)	(0.8 + 0.04*f)	(0.6 + 0.03*f)	(0.8 + 0.04*f)
40 to 50 GHz	3.0	2.6	3.0

Note: At 75°C, increase insertion loss by 0.006*f (where f = frequency in GHz).

SWR			
DC to 12.4 GHz	1.3	1.25	1.3
12.4 to 34 GHz	1.7	1.5	1.7
34 to 40 GHz	1.8	1.7	1.8
40 to 50 GHz	3.0	2.6	3.0

Attenuation Temperature Coefficient: Less than 0.0001 dB/dB/°C
Power Sensitivity: 0.001 dB/Watt
RF Input Power (Maximum): 1 Watt average, 50 Watts peak (10 microseconds max. pulse width)
Life (Minimum): 2 million cycles per section
Repeatability: 0.03 dB, typical
Environmental Capabilities: (Up to 2 million cycles)
Temperature, Operating: –20°C to +75°C
Temperature, Non-operating: –55°C to +85°C
Altitude, Operating: 4,570 meters (15,000 feet)
Altitude, Non-operating: 137,000 meters (50,000 feet)
Humidity: Cycling 10 days, 65°C at 95% RH
Shock, Operating: 10 Gs, 6 ms, on six sides, three blows
Shock, Non-operating: 500 Gs, 0.5 ms, in six directions
Vibration, Operating: 5 Gs, 34 to 500 Hz; 2 Gs, 500 to 2000 Hz

EMC: Radiated interference is within the requirements of MIL-STD-461 method RE02, VDE 0871 and CISPR Publication II

Mechanical Information

Net Weight
84904M: 291 grams (10.3 oz)
84905M: 229 grams (8.1 oz)
84908M: 291 grams (10.3 oz)

Mounting Position (any)

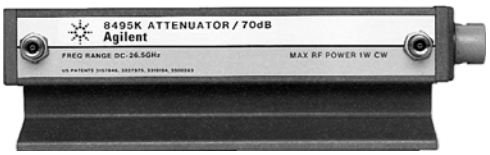
RF Connectors
2.4 mm female connectors (Option 101)
2.4 mm female and 2.4 mm male (Option 100)

Switching Speed
Maximum 20 milliseconds including settling time

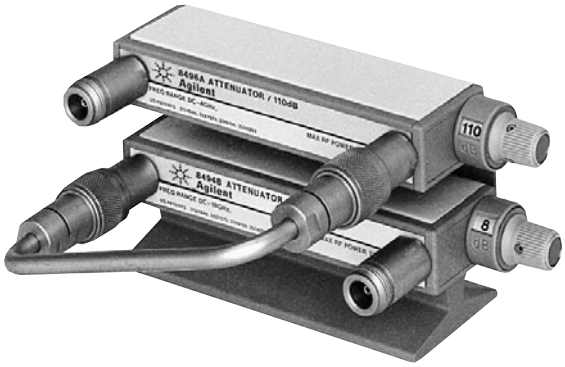
Solenoids	Coil Voltage	Switching Current	Nominal Coil Impedance
Option 024	24 V (20 to 30 V)	125 mA (at 24 V)	185 Ohms
Option 015	15 V (13 to 22 V)	188 mA (at 15 V)	80 Ohms
Option 011	5 V (4.5 to 7 V)	325 mA (at 5 V)	17 Ohms

Switching current is current per section; approximately 10 ms duration before internal contacts open the coil circuit

8495D



8495K



11716A

Programmable and Manual Step Attenuators DC – 26.5 GHz

8494A/B/G/H (0 to 11 dB, 1 dB steps)
8495A/B/D/G/H/K (0 to 70 dB, 10 dB steps)
8496A/B/G/H (0 to 110 dB, 10 dB steps)
8497K (0 to 90 dB, 10 dB steps)

The 8494/95/96/97 family of step attenuators offer fast, precise signal level control in three frequency ranges, DC to 4 GHz, DC to 18 GHz and DC to 26.5 GHz. They feature exceptional repeatability and reliability in a wide range of frequency, attenuation and connector options.

Attenuation repeatability is specified to be less than 0.03 dB (0.05 dB, 18 to 26.5 GHz) for 5 million cycles per section. This assures low measurement uncertainty and high user confidence when designed into automatic test systems. Electromechanical step attenuators offer low SWR, low insertion loss and high accuracy required by high-performance test and measurement equipment.

Precision plated leaf-spring contacts remove attenuator sections (miniature tantalum nitride thin-film T-pads on sapphire and alumina substrates) from the signal path. Unique process controls and material selection ensure unmatched life and contact repeatability.

Programmable Models

Miniature drive solenoids in the programmable models keep switching time, including settling, down to less than 20 milliseconds. Once switched, strong permanent magnets hold the solenoids (and attenuation value) in place. Current interrupts automatically disconnect solenoid current, simplifying driver circuit design and minimizing heat dissipation. Programming is done through a 12-pin Viking socket or optional ribbon cables with DIP plugs.

11716A/C Attenuator Interconnect Kits

Quickly and conveniently connect 1 dB step and 10 dB step attenuators together to achieve greater dynamic range with 1 dB steps. The 11716A/C interconnect kits contain a rigid RF cable, mounting bracket, and necessary hardware to connect any pair of 8494/95/96/97 attenuators in series (see photo above). Attenuators must be ordered separately.

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

11716A Interconnect Kit (Type-N)
11716C Interconnect Kit (SMA)

8494/5/6/7 Series Specifications

Model (Switching Mode)	Frequency Range (GHz)	Attenuation Range (dB)	Maximum SWR	Insertion Loss @ 0 dB	Attenuation Accuracy	Power Rating, Minimum Life	Solenoid Voltage Speed Power	Size, Shipping Weight	Connector Options
8494A (Manual)	DC to 4	0 to 11 1 dB steps	1.5	0.6 dB + 0.09 dB/GHz	±0.2 dB: 1 to 2 dB ±0.3 dB: 3 to 6 dB ±0.4 dB: 7 to 10 dB ±0.5 dB: 11 dB	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003
8494G (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	See Note 1
8494B (Manual)	DC to 18	0 to 11 1 dB steps	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.6 dB + 0.09 dB/GHz	**DC to 12.4 GHz** ±0.3 dB: 1 to 2 dB ±0.4 dB: 3 to 4 dB ±0.5 dB: 5 to 6 dB ±0.6 dB: 7 to 10 dB ±0.7 dB: 11 dB	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003 See Note 1
8494H (Programmable)					**12.4 to 18 GHz** ±0.7 dB: 1 to 5 dB ±0.8 dB: 6 to 9 dB ±0.9 dB: 10 to 11 dB		20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	
8495A (Manual)	DC to 4	0 to 70 10 dB steps	1.35	0.4 dB + 0.07 dB/GHz	Refer to technical data sheet*	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	73 mm W x 43 mm H x 130 mm D (2.9 in x 1.7 in x 5.1 in) 0.9 kg (2 lb)	001 002 003
8495G (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 141 mm D (3.1 in x 1.7 in x 5.5 in) 0.9 kg (2 lb)	See Note 1
8495B (Manual)	DC to 18	0 to 70 10 dB steps	1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	0.4 dB + 0.07 dB/GHz	Refer to technical data sheet*	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	73 mm W x 43 mm H x 130 mm D (2.9 in x 1.7 in x 5.1 in) 0.9 kg (2 lb)	001 002 003
8495H (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 141 mm D (3.1 in x 1.7 in x 5.5 in) 0.9 kg (2 lb)	See Note 1
8495D (Manual)	DC to 26.5	0 to 70 10 dB steps	1.25 to 6 GHz 1.45 to 12.4 GHz 1.9 to 18.0 GHz 2.2 to 26.5 GHz	0.4 dB + 0.09 dB/GHz	Refer to technical data sheet*	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	52 mm W x 43 mm H x 159 mm D (2.1 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	004 3.5 mm See Note 1
8495K (Programmable)							20 to 30 V <20 ms 2.7 W	52 mm W x 43 mm H x 168 mm D (2.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	
8496A (Manual)	DC to 4	0 to 110 10 dB steps	1.5	0.6 dB + 0.09 dB/GHz	Refer to technical data sheet*	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003
8496G (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	See Note 1
8496B (Manual)	DC to 18	0 to 110 10 dB steps	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.6 dB + 0.09 dB/GHz	Refer to technical data sheet*	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003
8496H (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	See Note 1
8497K (Programmable)	DC to 26.5	0 to 90 10 dB steps	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18.0 GHz 1.8 to 26.5 GHz	0.4 dB + 0.09 dB/GHz	Refer to technical data sheet*	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	5 V or 24 V	52 mm W x 43 mm H x 143 mm D (2.1 in x 1.7 in x 5.6 in) 0.9 kg (2 lb)	004 3.5 mm See Note 1

Note 1: 8494/5/6/7 orders must specify connector option. See ordering example.
Option 001 N(f)
Option 002 SMA(f)
Option 003 APC-7
Option 004 3.5 mm (8495D/K, 8497K only)
Option UK6 Commercial Calibration Test Data with Certificate

* **www.agilent.com/find/mta**

How to Order the 8494/5/6/7 Series Attenuators

Each order must include basic model number, suffix letter, and connector option.

Ordering example: 849**4** **A** Option **001**

4	**A**	**001**
4 (1 dB step, 11 dB max)	**A** (Manual, DC to 4 GHz)	**001** (N female)
5 (10 dB step, 70 dB max)	**B** (Manual, DC to 18 GHz)	**002** (SMA female)
6 (10 dB step, 110 dB max)	**D** (Manual, DC to 26.5 GHz)[1]	**003** (APC-7)
7 (10 dB step, 90 dB max)	**G** (Programmable, DC to 4 GHz)	**004** (3.5 mm female)[1]
	H (Programmable, DC to 18 GHz)	
	K (Programmable, DC to 26.5 GHz)[1]	

[1] Option 004 is only available on D and K models, other options not available on D/K models.

8490D

8493A/B/C Series

8490G

8498A High Power Attenuator

The 8498A Option 030 is designed to meet the needs of high-power attenuation applications in the RF and microwave frequency range. It is a 25-watt average, 30 dB fixed attenuator with a frequency of DC to 18 GHz. The maximum peak power specification is 500 watts (DC to 5.8 GHz) and 125 watts (5.8 to 18 GHz). Available only in a 30 dB version, the unit offers a 1.3 SWR and ±1 dB accuracy at 18 GHz. Large heat-dissipating fins keep the unit cool even under continuous maximum input power conditions.

8491A/B, 8493A/B/C Fixed Attenuators

Agilent coaxial fixed attenuators provide precise attenuation, flat frequency response, and low SWR over broad frequency ranges. Attenuators are available in nominal attenuations of 3 dB and 6 dB, as well as 10 dB increments from 10 dB to 60 dB. These attenuators are swept-frequency tested to ensure they meet specifications at all frequencies. Calibration points are provided on a nameplate chart attached to each unit.

8490D/G High-Frequency Fixed Attenuators

Agilent coaxial fixed attenuators have been the standard for accurate flat response and low SWR. The 8490D offers an exceptional performance to 50 GHz using 2.4 mm connectors and the 8490G to 67 GHz using 1.85 mm connectors. Attenuation values available are 3, 6, 10, 20, 30 and 40 dB. Ideally suited for extending the range of sensitive power meters, or for use as calibration standards, these broadband attenuators are manufactured with the same meticulous care as their lower frequency counterparts.

8490D/G, 8491A/B/C, 8492A, 8493A/B/C, 8498A Specifications

Model	Frequency Range (GHz)	SWR (max.)	Input Power (max.)		Attenuation Accuracy (±dB) 3 dB Opt 003	6 dB Opt 006	10 dB Opt 010	20 dB Opt 020	30 dB Opt 030	40 dB Opt 040	50 dB Opt 050	60 dB Opt 060	Connectors
8490D	DC to 50	DC to 26.5 GHz: 1.15 (1.08 Opt 040 only) 26.5 to 40 GHz: 1.25 (1.15 Opt 040 only) 40 to 50 GHz: 1.45 (1.25 Opt 040 only)	1 W avg. 100 W peak	DC to 26.5 26.5 to 50	+0.9 –0.5 +1.8 –0.5	+0.9 –0.6 +1.8 –0.6	+0.9 –0.6 +1.3 –0.6	+1.3 –0.8 +1.7 –0.8	+1.3 –0.8 +1.7 –0.8	+2.5 –1.8 +2.5 –1.8	—	—	— 2.4 mm
8490G	DC to 67	DC to 26.5 GHz: 1.15 (1.10 Opt 040 only) 26.5 to 50 GHz: 1.25 (1.15 Opt 040 only) 50 to 67 GHz: 1.45 (1.25 Opt 040 only)			±0.3	±0.3	±0.3	±0.3	±0.3	±0.6	—	—	1.85 mm
8491A 3 to 30 dB 40 to 60 dB	DC to 12.4	1.2 to 8 GHz[1] 1.3 to 12.4 GHz[1]	2 W avg. 100 W peak		0.3	0.3	0.5	0.5	1.0	1.5	1.5	2	N (m,f)
8491B 3 to 30 dB 40 to 60 dB	DC to 18	1.2 to 8 GHz[2] 1.3 to 12.4 GHz[2] 1.5 to 18 GHz[2]	2 W avg. 100 W peak		0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	1.5	1.5	2	N (m,f)
8493A 3 to 20 dB 30 dB	DC to 12.4	1.2 to 8 GHz[1] 1.3 to 12.4 GHz[1]	2 W avg. 100 W peak		0.3	0.3	0.5	0.5	1.0	—	—	—	SMA (m,f)
8493B 3 to 20 dB 30 dB	DC to 18	1.2 to 8 GHz[2] 1.3 to 12.4 GHz[2] 1.5 to 18 GHz[2]	2 W avg. 100 W peak		0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	—	—	—	SMA (m,f)
8493C 3 to 30 dB 40 dB	DC to 26.5	1.1 to 8 GHz 1.15 to 12.4 GHz 1.25 to 26.5 GHz[3]	2 W avg. 100 W peak		0.5 to 18 GHz 1.0 to 26.5 GHz	0.6 0.6	0.3 to 18 GHz 0.5 to 26.5 GHz	0.5 0.6	0.7 1	1.0 1.3	— —	— —	3.5 mm (m,f)
8498A 30 dB	DC to 18	1.15 to 8 GHz 1.25 to 12.4 GHz 1.30 to 18 GHz	25 W avg. 500 W peak (DC to 5.8 GHz) 125 W peak (5.8 to 18 GHz) 500 W/ms max. per pulse		—	—	—	—	1.0	—	—	—	N (m,f)

[1] For 3 dB, SWR is 1.25 to 8 GHz, 1.35 to 12.4 GHz. [2] For 3 dB, SWR is 1.25 to 8 GHz, 1.35 to 12.4 GHz and 1.5 to 18 GHz. [3] For 6 dB option, SWR is 1.27 at 12 GHz to 26.5 GHz.

11581A, 11582A Attenuator Sets

A set of four Agilent attenuators – 3, 6, 10, and 20 dB – are furnished in a handsome walnut accessory case. The 11581A set consists of 8491A attenuators and the 11582A of 8491B attenuators. These sets are ideal for calibration labs or where precise knowledge of attenuation and SWR is desired. Also includes commercial calibration certificate with test data.

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

8491A, 8491B, 8493A, 8493B, 8493C, 8498A
Opt UK6 – Commercial Calibration Test Data with Certificate
11581A 3, 6, 10, 20 dB 8491A Set
11582A 3, 6, 10, 20 dB 8491B Set

N9355B
N9356B
N9355C
N9356C
N9355F

- **Maximum input power of 3 Watts**
- **Maximum insertion loss of 2.75 dB**
- **Minimum return loss of 15 dB (SWR of 1.43)**
- **Integrated DC block**
- **Bi-directional functionality**

N9355 & N9356 Series

N9355/56 Power Limiter Series

Agilent offers a series of industry-leading limiters, specifically designed to provide input protection for RF and microwave instruments and components used in telecommunication, component test, aerospace and defense industries. This product includes five unique designs with different frequency ranges and limiting thresholds. The N9355/56 series of high performance limiters will safe-guard your investments from damage due to excess RF power, DC transients and electro-static-discharge.

N9355B and N9356B Power Limiters

The Agilent N9355B and N9356B power limiters operate at frequency ranges from 10 MHz to 18 GHz with a limiting threshold of 10 and 25 dBm respectively. Both are furnished with a pair of premium quality male and female Type-N connectors.

N9355C & N9356C Power Limiters

The Agilent N9355C and N9356C wideband limiters operate from 10 MHz to 26.5 GHz with a limiting threshold of 10 and 25 dBm respectively. Both are furnished with a pair of premium quality male and female 3.5 mm connectors.

N9355F Power Limiter

The Agilent N9355F is an ultra-broadband limiter operating from 10 MHz to 50 GHz with a limiting threshold of 10 dBm. It is furnished with a pair of premium quality male and female 2.4 mm connectors.

Specifications

Model Number	N9355B	N9356B	N9355C	N9356C	N9355F
Frequency Range	0.01 to 18 GHz	0.01 to 18 GHz	0.01 to 26.5 GHz	0.01 to 26.5 GHz	0.01 to 50 GHz
Frequency Response Insertion Loss	<1.75 dB	<1.75 dB	<2 dB	<2.25 dB	0.01 to 26.5 GHz <2 dB 26.5 to 40 GHz <2.75 dB 40 to 50 GHz <3.5 dB
Return Loss (VSWR)>	15 dB[1]	15 dB[1]	15 dB[1]	15 dB[1]	10 dB[1]
Impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal	50 Ω nominal	50 Ω nominal
Maximum Input Power Levels Continuous	1 W	6 W	1 W	4 W	0.63 W
Limiting Threshold	10 dBm typical	25 dBm typical	10 dBm typical	25 dBm typical	10 dBm typical
Max. Leakage Power[2]	24 dBm	27 dBm	24 dBm	27 dBm	24 dBm
Maximum DC Voltage **@25 °C** **@85 °C**	 30 V 16 V	 30 V 16 V	 30 V 16 V	 30 V 16 V	 30 V 16 V
Turn on Time	<100 ps	<100 ps	<100 ps	<100 ps	<100 ps
Connectors	Type-N	Type-N	3.5 mm	3.5 mm	2.4 mm

[1] Return loss specification from 10 MHz to 30 MHz is 8.5 dB (VSWR: 2.2).
[2] At maximum continuous input power level.

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

N9355B 0.01 to 18 GHz Power Limiter, 10 dBm Limiting Threshold
N9355C 0.01 to 26.5 GHz Power Limiter, 10 dBm Limiting Threshold
N9356B 0.01 to 18 GHz Power Limiter, 25 dBm Limiting Threshold
N9356C 0.01 to 26.5 GHz Power Limiter, 25 dBm Limiting Threshold
N9355F 0.01 to 50 GHz Power Limiter, 10 dBm Limiting Threshold

N9398C
N9398F
N9398G
N9399C
N9399F

N9398C/F/G and N9399C/F

N9398/N9399 Series

The N9398C/F/G and N9399C/F DC blocks offer a new level of blocking with a broadband performance specified from 50 KHz right up to 67 GHz. They are designed to apply AC drive signals to a device while eliminating any DC voltage or current components, these DC blocks feature a broad frequency range, excellent return loss, very low insertion loss and excellent temperature stability.

Specifications

	N9398C	N9399C	N9398F	N9399F	N9398G
Frequency Range	50 KHz to 26.5 GHz	700 KHz to 26.5 GHz	50 KHz to 50 GHz	700 KHz to 50 GHz	700 KHz to 67 GHz
Insertion Loss	0.9 dB	1.2 dB	0.9 dB (50 KHz to 26.5 GHZ) 1.0 dB (26.5 to 50 GHz)	1.2 dB	0.9 dB (700 KHz to 26.5 GHz) 1.0 dB (26.5 to 67 GHz)
Return Loss	10 dB (50 to 300 KHz) 17 dB (300 KHz to 26.5 GHz)	10 dB (50 to 2 MHz) 17 dB (2 MHz to 26.5 GHz)	10 dB (50 to 300 KHz) 15 dB (300 KHz to 50 GHz)	10 dB (700 KHz to 2 MHz) 15 dB (2 MHz to 50 GHz)	10 dB (700 KHz to 2 MHz) 15 dB (2 MHz to 67 GHz)
Rise Time	3 ps (typical)	3 ps (typical)	2 ps (typical)	2 ps (typical)	2 ps (typical)
Group Delay	118 ps (typical)	118 ps (typical)	78 ps (typical)	78 ps (typical)	76 ps (typical)
Max DC Working Voltage	16 V	50 V	16 V	50 V	16 V
Connector Type	3.5 mm (m-f)	3.5 mm (m-f)	2.4 mm (m-f)	2.4 mm (m-f)	1.85 mm (m-f)

Key Literature & Web Link

For more information, visit our web site: **www.agilent.com/find/mta**

Ordering Information

N9398C DC Block, 16 V, 50 KHz to 26.5 GHz, 3.5 mm
N9399C DC Block, 50 V, 700 KHz to 26.5 GHz, 3.5 mm
N9398F DC Block, 16 V, 50 KHz to 50 GHz, 2.4 mm
N9399F DC Block, 16 V, 700 KHz to 50 GHz, 2.4 mm
N9398C DC Block, 16 V, 700 KHz to 67 GHz, 1.85 mm

8474 Series

8471D/E

83036C

Planar-Doped Barrier Detectors

8471D/E

The 8471D/E are economy detectors based on the Planar-Doped Barrier (PDB) diodes. The PDB diodes give them superior frequency response, square-law response, and temperature performance. The 8471D has a BNC (m) input connector and a frequency range of 100 kHz to 2 GHz, making it ideal for use in RF and low microwave applications. The 8471E has a SMA (m) input connector and a SMC (m) output connector. Its frequency range is 10 MHz to 12 GHz. Both models come with a negative polarity output, option 301; a positive polarity output can be specified as Option 103.

8473D

The 8473D detector was the first gallium arsenide PDB diode introduced. It features broadband performance and excellent flatness vs. frequency, along with superior temperature stability. The 8473D is available with a 3.5-mm (m) RF connector and a BNC (f) output connector.

High-Performance Planar-Doped Barrier Detectors

8474B/C/E

Utilizing a gallium arsenide PDB diode as the detecting element, these detectors offer superior performance when compared to earlier detector designs. They feature extremely flat frequency response over their entire band of operation (typically better than ±1 dB to 50 GHz) and very good frequency response stability versus temperature.

The 8474 detectors are available with BNC(f) (0.01 to 18 GHz), Type N (0.01 to 18 GHz), 3.5 mm (mates with SMA, 0.01 to 33 GHz), or 2.4 mm (0.01 to 50 GHz) connectors.

Broadband Directional Detector

83036C

The 83036C is a broadband microwave power sampler that operates in much the same way as a directional coupler and detector combination. It is composed of a resistive bridge and PDB diode that yields a very broadband device with excellent frequency response, superior temperature response and square-law response characteristics.

The maximum SWR is 1.7 above 50 MHz on both the input and output ports. Directivity of 14 dB matches that of most miniature couplers currently available. The maximum insertion loss is 2.2 dB.

Low-Barrier Schottky Diode Detectors

423B, 8470B, 8472B, 8473B/C

These Low-Barrier Schottky Diode (LBSD) detectors have been widely used for many years in a variety of applications including leveling and power sensing. They offer good performance and ruggedness. Matched pairs (Option 001) offer very good detector tracking. A video load option (Option 002) extends the square-law region to at least 0.1 mW(–10 dBm).

Key Literature

For more information, visit our web site: **www.agilent.com/find/mta**

Planar-Doped Barrier Diode Detectors Specifications

Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR	Low-level Sensitivity	Max. Input (Peak or Average)	Short-term Max. Input (<1 min.)	Optimum Square-Law Load[2]	Positive/ Negative Polarity Output	Input/ Output Connector
8471D	0.0001 to 2	±0.2 to 1 GHz ±0.4 to 2 GHz	1.23 to 1 GHz 1.46 to 2 GHz	>0.5 mV/µW	100 mW	0.7 W	Opt. 102	Opt. 103 Opt. 301	BNC (m) BNC (f)
8471E	0.01 to 12	±0.23 to 4 GHz ±0.6 to 8 GHz ±0.85 to 12 GHz	1.2 to 4 GHz 1.7 to 8 GHz 2.4 to 12 GHz	>0.4 mV/µW	200 mW	0.75 W	No	Opt. 103 Opt. 301	SMA (m) SMC (m)
8473D	0.01 to 33	±0.25 to 14 GHz ±0.40 to 26.5 GHz ±1.25 to 33 GHz	1.2 to 14 GHz 1.36 to 26.5 GHz 2.96 to 33 GHz	>0.4 mV/µW	200 mW	1 W	No	Opt. 003 Opt. 301	3.5 mm (m) BNC (f)
8474B[1]	0.01 to 18	±0.35 to 18 GHz	1.3 to 18 GHz	>0.4 mV/µW	200 mW	0.75 W	Opt.102	Opt. 103 Opt. 301	Type N (m) BNC (f)
8474C[1]	0.01 to 33	±0.45 to 26.5 GHz ±0.70 to 33 GHz	1.4 to 26.5 GHz 2.2 to 33 GHz	>0.4 mV/µW	200 mW	0.75 W	No	Opt. 103 Opt. 301	3.5 mm (m) SMC (m)
8474E	0.01 to 50	±0.4 to 26.5 GHz ±0.6 to 40 GHz ±1.0 to 50 GHz	1.2 to 26.5 GHz 1.6 to 40 GHz 2.8 to 50 GHz	>0.4 mV/µW	200 mW	0.75 W	No	No	2.4 mm (m) SMC (m)

[1] Octave band options available (see Data Sheet).
[2] Defined as ±0.5 from ideal square law response.

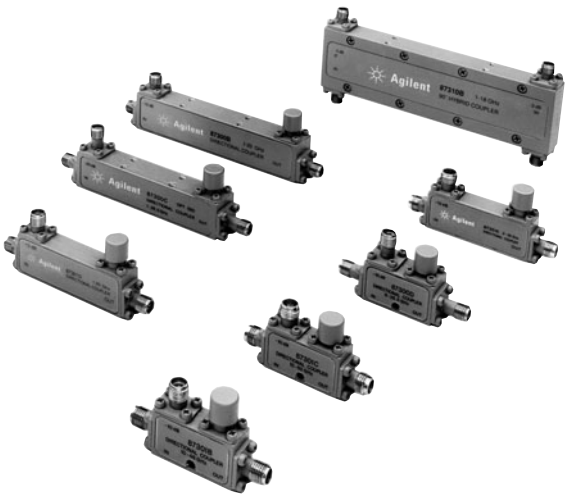
Broadband Directional Detector Specifications

Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR Input/Output (50 Ω Nom.)	Max. Thru Line Loss (dB)	Low-level Sensitivity	Min. Directivity (dB)	Max. Input (Into 50 Ω Load) w/ 2:1 Source Match	Max. Input (Into Open) w/ 2:1 Source Match	Input/ Output Connector
83036C	0.01 to 26.5	±1.0	1.7	2.2	18 mV/µW	14	32 dBm	21 dBm	3.5 mm (f)

Low-Barrier Schottky Diode Detectors Specifications

Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR (50 Ω Nom.)	Low-level Sensitivity (mV/µW)	Max. Input (Peak or Average)	Short-term Max. Input (<1 min.)	Matched Response Opt. 001[2]	Optimum Square-law Load[1]	Positive/ Negative Polarity Output	Input/ Output Connector
423B	0.01 to 12.4	±0.3 to 12.4 GHz	1.15 to 4 GHz 1.3 to 12.4 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz	Opt. 002	Opt. 003 Opt. 301	N (m) BNC (f)
8470B	0.01 to 18	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	1.15 to 4 GHz 1.3 to 15 GHz 1.7 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003 Opt. 301	APC-7 BNC (f) N (m) BNC (f)
8472B	0.01 to 18	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	1.15 to 4.5 GHz 1.35 to 7 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003 Opt. 301	SMA (m) BNC (f) SMA (m) OSSM (f)
8473B	0.01 to 18	±0.3 to 12.4 GHz ±0.6 to 18 GHz	1.2 to 4 GHz 1.5 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003 Opt. 301	3.5 mm (m) BNC (f)
8473C	0.01 to 26.5	±0.3 to 12.4 GHz ±0.6 to 20 GHz ±1.5 to 26.5 GHz	1.2 to 4 GHz 1.5 to 18 GHz 2.2 to 26.5 GHz	>0.5 to 18 GHz >0.18 to 26.5 GHz	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz ±0.5 to 26.5 GHz	Opt. 002	Opt. 003 Opt. 301	3.5 mm (m) BNC (f)

[1] Defined as ±0.5 from ideal square law response.
[2] Option 001 provides two matched detectors.



87300B/C/D, 87301B/C/D/E, 87310B

87300 Series Directional Couplers

This line of compact, broadband directional couplers is ideal for signal monitoring, or when combined with a coaxial detector, for signal leveling. Available in a variety of frequency ranges, they can be matched to specific applications. The Agilent 8474 series coaxial detectors are recommended if output detection is desired. The 87300B is supplied with SMA (f) connectors, the 87300C/D has 3.5-mm (f) connectors, and the 87301D has 2.4-mm (f) standard or optional 2.92-mm (f) connectors.

87310B Hybrid Coupler

87310B is a 3 dB hybrid coupler, intended for applications requiring a 90 degree phase difference between output ports. In that sense, it is different from typical power dividers and power splitters, which have matched signal phase at their output ports. The 87310B features SMA (f) connectors.

87300 Series Specifications

Model	Freq. Range (GHz)	Nominal Coupling & (dB) Variation	Directivity (dB)	Max. SWR	Insertion Loss (dB)
87300B	1 to 20	10 ± 0.5	>16	1.35	<1.5
87300C	1 to 26.5	10 ± 1	>14 to 12.4 GHz >12 to 26.5 GHz	1.35 to 12.4 1.5 to 26.5	<1.2 to 12.4 <1.7 to 26.5
87300D	6 to 26.5	10 ± 0.5	>13	1.4	<1.3
87301B	10 to 46	10 ± 0.7	>10	1.8	<1.9
87301C	10 to 50	10 ± 0.7	>10	1.8	<1.9
87301D	1 to 40	13 ± 1	>14 to 20 >10 to 40	1.5 to 20 1.7 to 40	<1.2 to 20 <1.9 to 40
87310B	1 to 18	3 ± 0.5	—	1.35	<2.0
87301E	2 to 50	10 ± 1	>13 to 26.5 >10 to 50	1.5 to 26.5 1.8 to 50	<2.0

773D Directional Coupler and 772D Dual-Directional Coupler

The 772D and 773D are high-performance couplers designed for broadband swept measurements in the 2 to 18 GHz range. The 773D is ideal for leveling broadband sources when used with an 8474B detector. (See also the 83036C directional detector.) For reflectometer applications, the 772D is the best coupler to use with power sensors and power meters. Forward and reverse power measurements on transmitters, components or other broadband systems are made simpler using the 772D. The broadband design allows the use of a single test setup and calibration for tests spanning the entire 2 to 18 GHz frequency range.

772D and 773D

775D to 779D Dual-Directional Couplers

The economical 775D-778D couplers cover octave frequency spreads of more than 2:1, each centered on one of the important VHF/UHF bands. With their high directivity and mean coupling accuracy of ±0.5 dB, these are ideal couplers in reflectometer applications. The close tracking of the auxiliary arms makes these couplers particularly useful for reflectometers. Power ratings are 50 W average, 500 W peak.

772-779D, 11691D, 11692D Specifications

Model	Freq. Range (GHz)	Nominal Coupling (dB)	Max. Coupling Variation (dB)	Min. Directivity (dB)	SWR Primary Line Max. (50 Ω Nom.)
772D	2 to 18	20	±1.0	2 to 12.4: 30 12.4 to 18: 27	2 to 12.4: 1.28 12.4 to 18: 1.4
773D	2 to 18	20	±1.0	2 to 12.4: 30 12.4 to 18: 27	1.21 1.27
775D[1]	0.45 to 0.94	20	±1	40	1.15
776D[1]	0.94 to 1.9	20	±1	40	1.15
777D	1.9 to 4	20	±0.4	30	1.2
778D	0.1 to 2	20	±1.5	0.1 to 1 GHz: 36[2] 1 to 2 GHz: 32[2]	1.1
779D	1.7 to 12.4	20	±0.75	1.7 to 4 GHz: 30 4 to 12.4 GHz: 26	1.2
11691D	2 to 18	20	±1.0	2 to 8 GHz: 30[4] (supplies only at 8 GHz to 15 GHz) 8 to 18 GHz: 26[3]	1.3 1.5
11692D	2 to 18	20	±1 incident to test port	2 to 8 GHz: 30[5] 8 to 18 GHz: 26[3]	2 to 12.4 GHz: 1.3 12.4 to 18 GHz: 1.4

[1] Maximum auxiliary arm tracking: 0.3 dB for 776D; 0.5 dB for 777D.
[2] 30 dB, 0.1 to 2 GHz, input port.
[3] 24 dB with Type-N connector on the test port (11692D) or on the input port (11691D).
[4] Directivity at input port.
[5] Directivity at test port; at input port directivity is 21 dB; 2 to 18 GHz.

87302C, 87303C, and 87304C Hybrid Power Dividers

The 87302C, 87303C, and 87304C power dividers are compact, hybrid microwave couplers designed for power splitting applications that require minimal insertion loss and high isolation.

The 87302C covers the entire 0.5 to 26.5 GHz frequency range with a maximum insertion loss of 1.9 dB. The 87303C and 87304C cover the frequency range of 1 to 26.5 GHz and 2 to 26.5 GHz with an even lower insertion loss of 1.6 dB and 1.4 dB, respectively. These hybrid power dividers are excellent for any application requiring low loss power division. They typically exhibit an insertion loss that is 1 to 2 dB lower than an equivalent resistive power divider.

Model	Freq. Range (GHz)	Band Segments	Insertion Loss (dB)	Isolation (dB)
87302C	0.5 to 26.5	0.5 to 18 GHz 18 to 26 GHz	1.5 1.9	19 19
87303C	1.0 to 26.5	1.0 to 18 GHz 18 to 26.5 GHz	1.2 1.6	19 21
87304C	2.0 to 26.5	2.0 to 18 GHz 18 to 26.5 GHz	1.1 1.4	19 18

Power Rating: 10 W, CW (2:1 maximum SWR)
Connectors: 3.5 mm (f), SMA compatible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Manufacturer	Model No.	Serial No.	Asset No.	Job type	Status	Agilent service order	Agilent service request
AGILENT	54751A	US34371044	TD12048	Agilent Cal	Logged on 29/09/2006. Unit must arrive on 26/10/2006	1-474427116-1	1-474427099
AGILENT	83481A	US35480317	TD7627	Agilent Cal	Logged on 09/10/2006. Unit must arrive on 02/11/2006	1-478577413-1	1-478577356
AGILENT	83486A	US37200457	TD9932	Agilent Cal	Received on 03/11/2006. In progress (Expected completion on 09/11/2006)	1-488166386-1	1-488166379

Services that Complement the Utilization of your Equipment

- **Get up and running quickly**
- **Optimize your equipment performance and utilization**
- **Maintain your competitive edge**
- **Expert coaching to enhance your application**

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- Parts and accessories identification
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- Functional support (how to use the features and functions)
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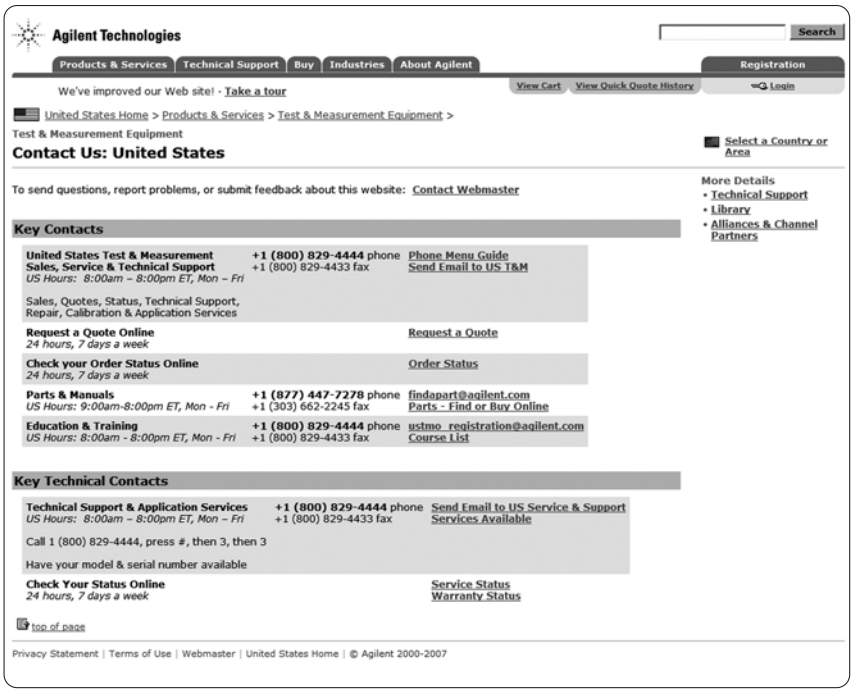

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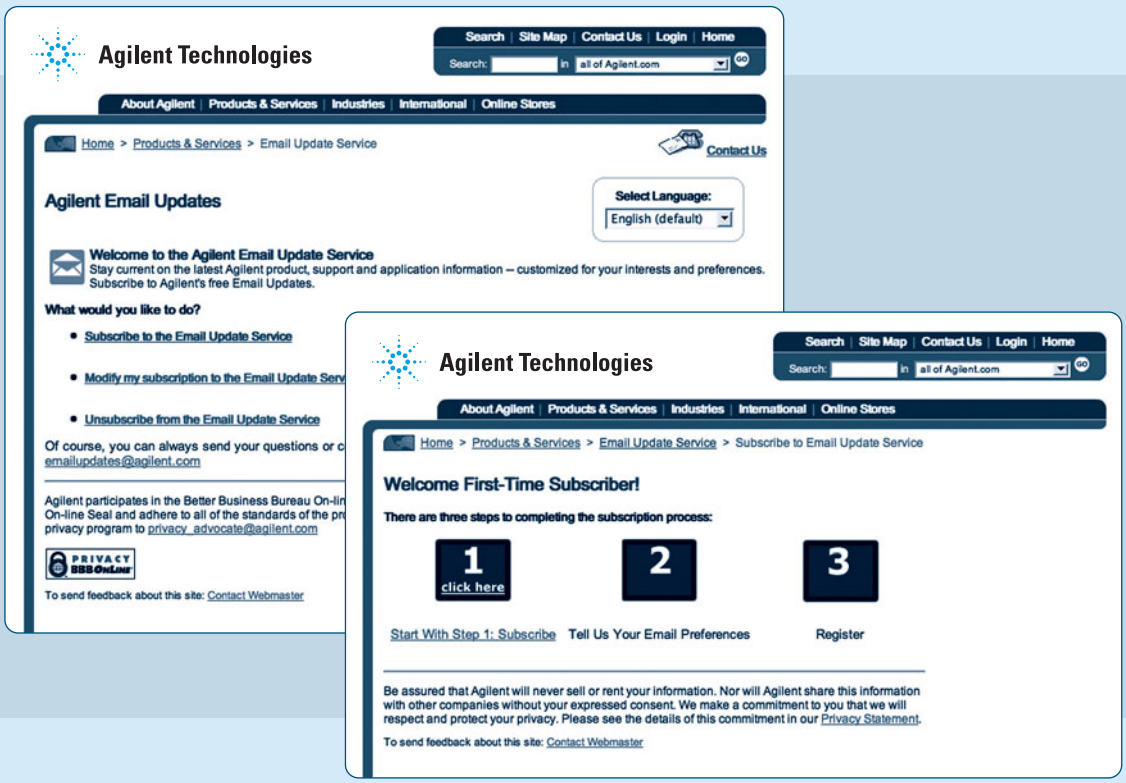

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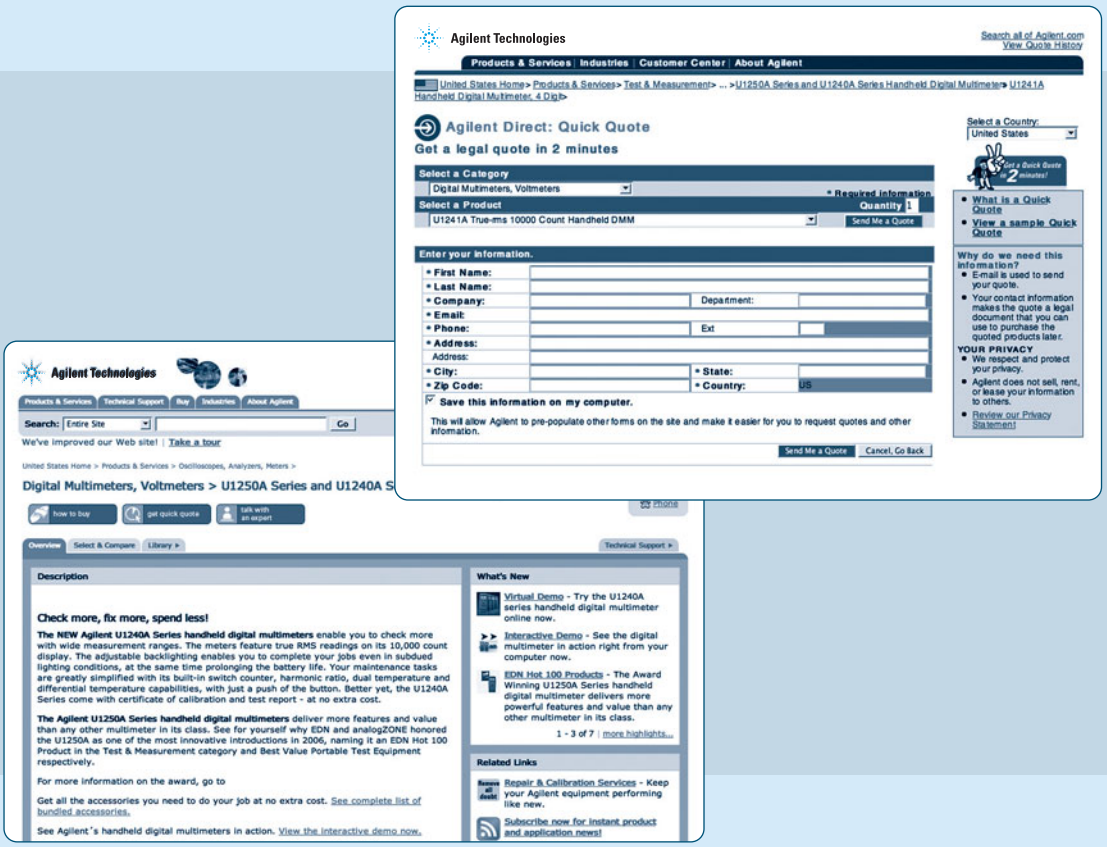

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