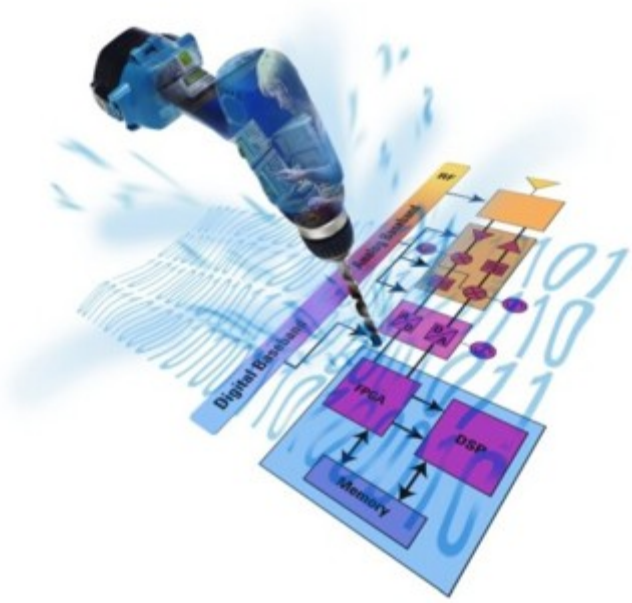
Agilent Technologies

N5110B Baseband Studio for Waveform Capture and Playback

Technical Overview

Quickly drill down and cut baseband verification time from weeks to days



Key applications

- Baseband modem design verification
- Digital components and baseband subsystem performance characterization
- High speed ADC, DAC, and hybrid component performance characterization
- "Digital in/RF out" radio unit (RU) testing
- MCPA digital pre-distortion performance calibrations

Key benefits

- Qualify baseband performance and identify issues early in the design cycle
- Gain confidence in your baseband modem design and reduce costly rework
- Verify baseband coding algorithms and correlate baseband performance to RF performance
- Simplify your test setup and save time by easily performing verification tasks

Accelerate Your Baseband Design Verification Process

Whether you design commercial or military communications systems, you use digital components to build your baseband subsystem. The digital subsystem is a major contributor to the success of your final design for two reasons: 1) baseband performance influences RF performance, and 2) the majority of signal intelligence resides in the digital subsystem. For these reasons, it is critical to verify your design characteristics at the digital baseband level to avoid costly rework later in the development process.

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 you need to efficiently and effectively verify your baseband design at the digital plane. 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 analyzer (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 signals to test your radio at different stages in design with a common test stimulus.

Baseband Studio for waveform capture and playback is a power tool for baseband design verification that will help you:

- cut performance verification time from weeks to days
- gain confidence in your baseband design
- reduce costly rework later in the development process

Baseband Studio for waveform capture and playback software seamlessly connects with a variety of Agilent design and analysis tools, including the N5101A Baseband Studio PCI card and the N5102A Baseband Studio digital signal interface module to perform digital capture, and the 89600 Series VSA software for analysis. You can play back custom or captured waveform files from the PCI card memory (2 GB RAM) or from the PC's hard disc drive (HDD), combined with the PCI card memory to generate digital baseband signals with the digital signal interface module or analog I/Q and RF/MW signals with the E4438C ESG or E8267D PSG vector signal generator.

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Main Features

Capture and play back using the speed and memory depth that fit your needs

- Capture or play back digital IQ/IF signals up to 200/400 MSa/s
- Use the 2 GB memory (512 MSa) to play back long time records of unique test scenarios
- Play back custom I/Q waveform files to generate digital IQ, analog IQ or RF test stimuli

Versatile connection capabilities

- Connect with the 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

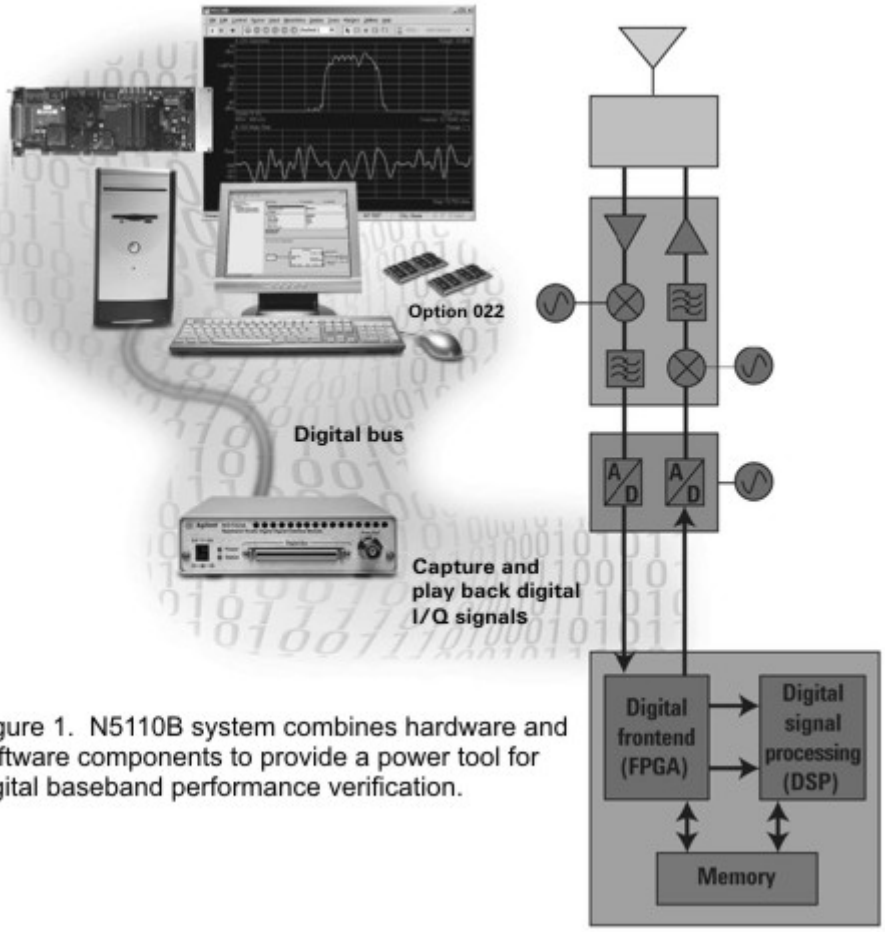

Figure 1. N5110B system combines hardware and software components to provide a power tool for digital baseband performance verification.

Digitally Capture and Playback IQ Waveforms with the Deepest Memory and the Fastest Speed Available

Facing stringent requirements in today's modern communications system design, you must optimize your baseband design to meet performance demands. Starting with the early prototyping of your system, you need to test each functional block as you build it, characterizing the performance of your design by injecting a digital IQ signal stimulus into the circuit and measuring the response. Different test stimuli may be required to stress your design under a variety of test configurations to meet your performance requirements. For example, a long signal scenario or a large number of frames are needed to perform bit error rate (BER) or frame error rate (FER) tests. You need a test solution that provides flexibility, deep memory, and fast speed to perform the test accurately. The test set-up below consists of the Baseband Studio for capture and playback software, the N5101A Baseband Studio PCI card with Option 022, and the N5102A digital signal interface module.

Figure 2. N5110B performs capture or playback of digital IQ/IF signals directly through an N5102A digital signal interface module connected to the DUT.

Analog IQ and RF Signals for Receiver Test

After you have integrated the baseband modem with the RF section to complete the radio, you need to test it again to verify overall performance. The capture and playback system can connect with an E4438C ESG or E8267D PSG to up-convert the digital IQ signals directly to RF or MW frequencies. Since these are the same signals that you used in baseband verification, you can easily compare the results and pinpoint the trouble spots. You can also use the RF signals to test the performance of your entire RF section or a component such as ADC or power amplifier.

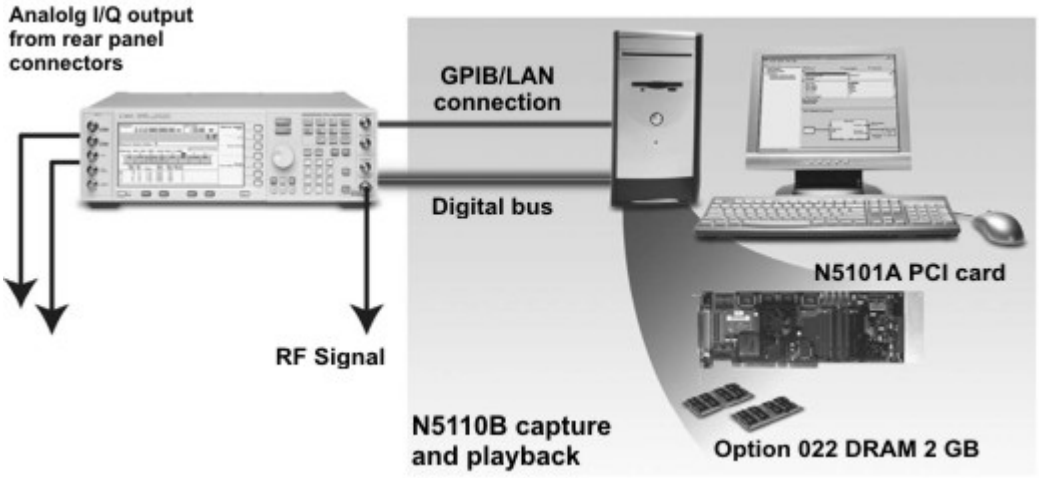

Figure 3. By connecting to an ESG or PSG vector signal generator, the N5110B can play back the same custom IQ waveform file to generate analog IQ and RF signals.

System Configuration Wizard Makes Operation Easy

Baseband Studio for waveform capture and playback provides a flexible, intuitive graphical user interface that makes operation easy and straightforward. The built-in system configuration wizard takes you through the steps of detecting, selecting and setting up various configurations. The pre-configured quick setups can be customized easily to save time and avoid unnecessary errors. A hardware control panel for the N5102A digital interface module and ESG/PSG signal generator is accessible in the same user interface, so you can assign waveform files for playback or for capture. You can also choose to transfer the waveform samples directly to the 89600 Series VSA software installed in the same PC for baseband performance characterization.

Figure 4. Hardware configuration wizard guides you through the hardware setups.

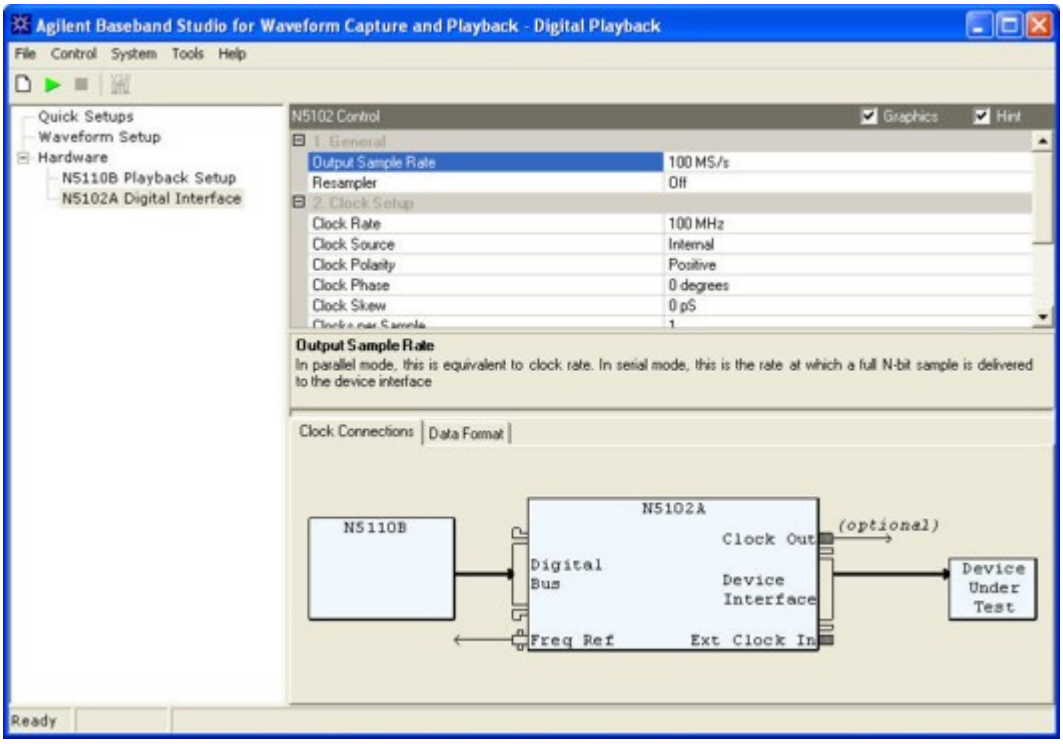

Figure 5. N5102A hardware control panel makes it easy to connect with your DUT.

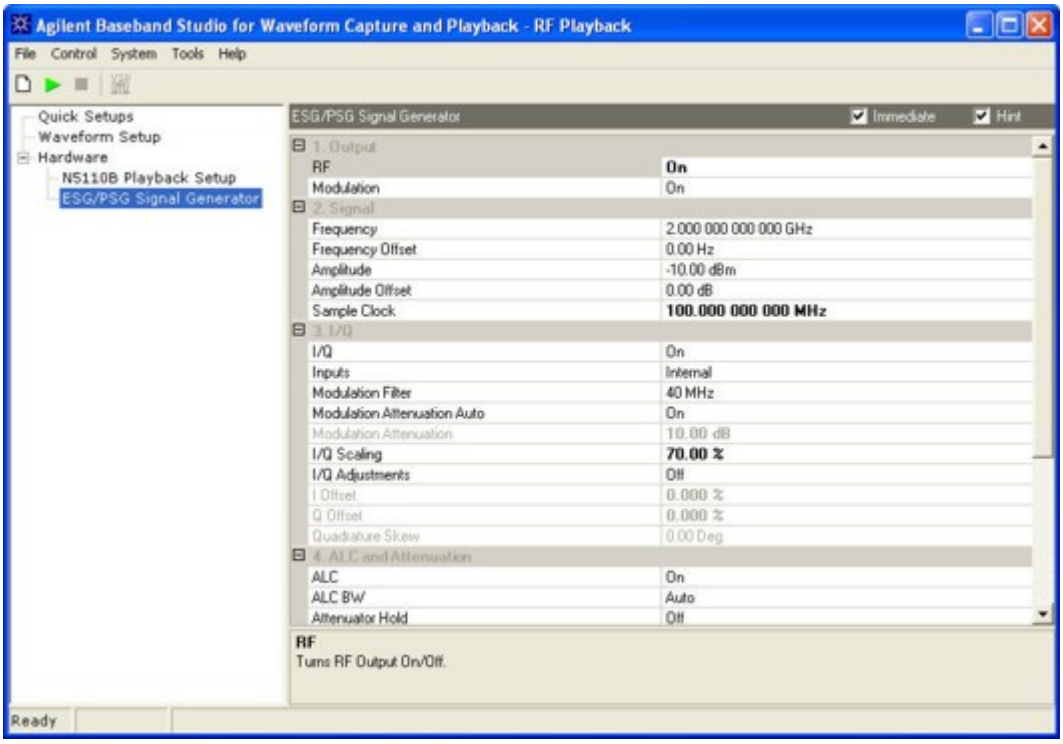

Figure 6. ESG/PSG control panel allows you to set up vector signal generator parameters.

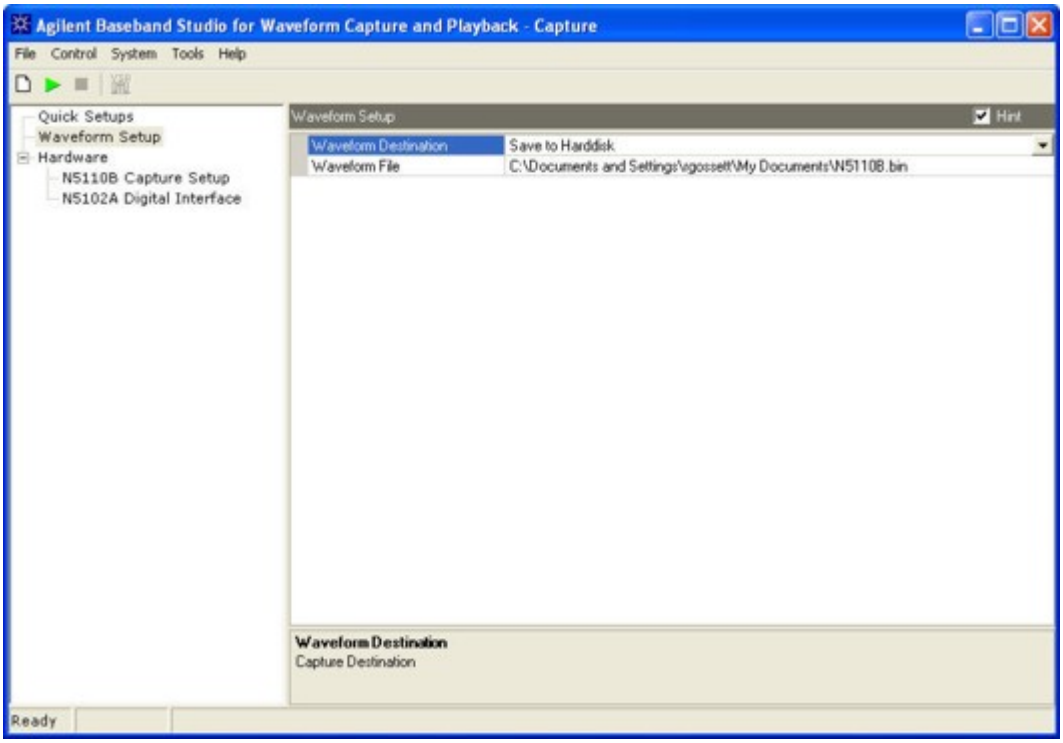

Figure 7. Captured waveform can be sent to a file or 89600 Series VSA software directly.

Link to the 89600 Series VSA Software for Modulation Performance Analysis

Understanding the performance of your baseband modem is essential because it directly affects RF performance and is where most of the intelligence resides. You can easily achieve this understanding using Baseband Studio for capture and playback. By linking directly into the 89600 Series VSA software, you can make on-line measurements or post-process the data after it is captured. Modulation accuracy such as error vector magnitude (EVM) and phase and amplitude deviations can be measured directly from the digital IQ signals, which means you obtain the true performance of the baseband modem without distortion from the RF chain.

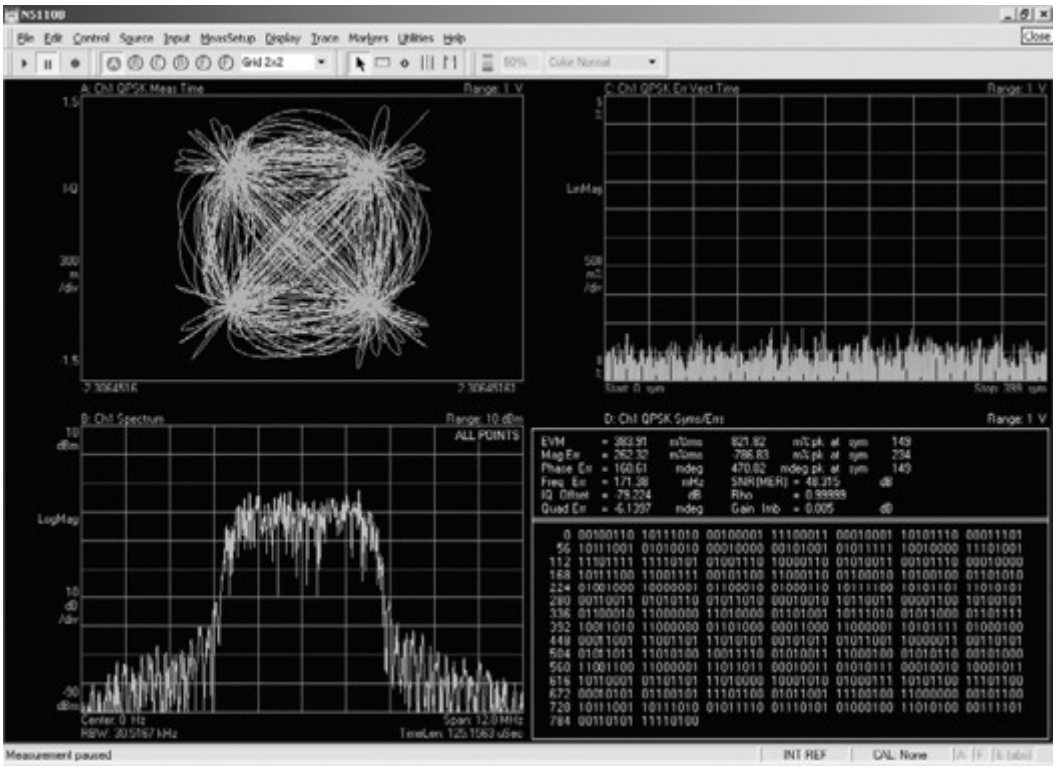

Figure 8. VSA software makes accurate measurements from the captured digital IQ signals to reveal the true design performance without added RF distortions.

Feature and Performance Characteristics[1]

Capture or playback

Option 194	Play waveform from N5101A Option 022 PCI Card
Option 195	Capture waveform to N5101A Option 022 PCI Card

Maximum data rate

Option 130	40 MSa/s	32 MHz BW[3]	Rate available with on-board memory and PC hard disk drive.[2] Requires N5101A with option 022, N5102A or ESG, PSG.
Option 132	100 MSa/s	80 MHz BW[3]	Rate available with on-board memory only. Requires N5101A with Option 022, N5102A or ESG, PSG.
Option 134	200 MSa/s	160 MHz BW[3]	Rate available with on-board memory only. Requires N5101A with Option 022, N5102A (not compatible with ESG or PSG)

Example waveform playback time (4 bytes/sample)

From 512 MSa on-board memory at 100 MSa/s approximately = 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 signal generators

Agilent E8267C PSG (firmware C.03.78 and above)
Agilent E8267D PSG (firmware D.04.04 and above)
Agilent E4438C ESG (firmware C.03.74 and above)

Supported PC operating systems

Windows® 2000 Professional, service pack 2 or 3

API

Microsoft® .NET-based

1. Performance characteristics are not warranted

2. The actual speed of capture to or playback from the PC hard disk drive will depend on its performance. Agilent does not provide any guarantee on the speed of the operation. Please consult with your PC provider for the disk drive performance characteristics.

3. Equivalent RF bandwidth when used with a 2.5x sample rate.

Configurations and Ordering Information

N5110B Baseband Studio for waveform capture and playback software works with the N5101A Baseband Studio PCI card and the N5102A digital signal interface module to perform digital capture and playback tasks. When connecting with an E4438C ESG or E8267D PSG, it can play back the custom waveform file from the on-board memory (N5101A Option 022) that resides in the N5101A PCI card or PC hard disk drive with N5101A Option 022 through the signal generator and produces signals at RF or MW frequencies.

Model/Option	Description	Notes
Required software		
N5110B	Baseband Studio for waveform capture and playback	Software is delivered via download from the Agilent website; a CD-ROM is not provided
Option 194	Play waveform from Baseband Studio PCI Card	
Option 195	Capture waveform to Baseband Studio PCI card	
Option 130	40 MSa/s sample rate	
Option 132	100 MSa/s sample rate	
Option 143	200 MSa/s sample rate	
Required hardware		
N5101A	Baseband Studio PCI card	
Option 022	512 MSa memory	Required with N5110B to guarantee the selected rate for playback using PC and HDD, and playback using dual instance of N5110B.
N5102A	Baseband Studio digital signal interface module	The N5102A is required for capture interface module operation. For waveform playback, use either the N5102A, E4438C ESG, or E8267D PSG.
Recommended ESG configuration		
E4438C	ESG vector signal generator	Requires firmware C.03.74 or later
E4438C-506	250 kHz to 6 GHz frequency range	Recommended, can substitute E4438C-501, -502, -503, or -504 (lower frequencies)
E4438C-UNJ	Enhanced phase noise	Required with Option 506
E4438C-005	6 GB hard drive	Recommended
E4438C-602	Internal baseband generator, 64 MSa	Required, can substitute E4438C-601 (8 MSa).

Model/Option	Description	Notes
Recommended PSG configuration		
E8267D	PSG vector signal generator	Requires firmware C.04.04 or later.
E8267D-520	250 kHz to 20 GHz frequency range	Recommended, can substitute with E8267D-532, -544 (higher frequency)
E8267D-005	6 GB hard drive	Recommended
E8267D-602	Internal baseband generator, 64 MSa	Required, can substitute E8267D-601 (8 MSa).

Recommended 89600 Series analysis software

R89601A/AN	Vector signal analysis (VSA) software
Option 200	Basic VSA software
Option 300	Hardware connectivity
Option AYA	Flexible vector modulation analysis
Option B7N	3G modulation analysis
Option B7R	WLAN modulation analysis
Option B7S	802.16 modulation analysis

Recommended PC configuration for DRAM capture and playback

CPU	Pentium® III or above, 800 MHz or higher
Operating System	Windows XP Professional (service pack 1 or later) Windows 2000 (service pack 3 or later) Microsoft .NET Framework 1.1
Memory	Minimum 256 MB RAM (512 MB or higher recommended)
Disk Space	200 MB free disk space is recommended
Display	Minimum 1024x768 screen resolution with normal font size
PCI slot	Available PCI slot(s) that meet the 2.2 PCI/ISA (or later) specifications
PCI Card	N5101A PCI card with Option 022 (2 GB DRAM)
GPIB or LAN connection to E4438C or E8267D (when performing playback through signal generator)	

Recommended PC configuration for HDD playback[1]

Processor	Pentium® 4, 2 GHz or greater (dual processors recommended)
Front side bus	533 MHz
Memory (size, type)	1 GB, PC2700

Available PCI slots	64-bit/66-MHz or 64-bit/133-MHz and an additional PCI slot opening
PCI Card	N5101A PCI card with Option 022 (2 GB DRAM)
HDD controller	Ultra 320 SCSI RAID controller (capable of RAID 0 configuration)
Hard disks	SATA 150, 10000 RPM Four Ultra 320 SCSI, 15000 RPM (RAID 0 required, 64-KB block size)
HDD configuration	Dedicated OS drive, data on RAID 0
Operating system	Windows® XP Professional

1. Factory tests at Agilent achieved a HDD playback rate of 40 MSa/s over an 8+ hour duration using the following PC configuration: HP XW8200 workstation, Adaptec 2230 SLP RAID controller, 74-GB SATA 150 HDD (10000 RPM), and four 73-GB U320 SCSI HDD (15000 RPM, RAID 0 required, 64 KB block size).

Additional Resources

Signal Creation Products

For more information about Signal Studio software and Baseband Studio products including release notes, user interface descriptions, tutorials, and installation information, read the online documentation at the following websites:

Signal Studio Software
www.agilent.com/find/signalstudio

Baseband Studio Software
www.agilent.com/find/basebandstudio

Related Literature

N5102A Digital Signal Interface Module, technical overview, literature number 5988-9495EN

E4438C ESG Vector Signal Generator, configuration guide, literature number 5988-4085EN

E8267D PSG Vector Signal Generator, configuration guide, literature number 5989-1326EN

89600 Series Vector Signal Analysis Software, VXI, configuration guide, literature number 5968-9350E

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Phone or Fax

United States:
(tel) 800 829 4444
(fax) 800 829 4433

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

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

Europe:
(tel) 31 20 547 2111

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

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

Latin America:
(tel) (305) 269 7500

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

Other Asia Pacific Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com

Contacts revised: 09/14/06

Agilent Technologies