



# Agilent N4010A Wireless Connectivity Test Set Performance Guide Using the 89601A Vector Signal Analysis Software and the 89607A WLAN Test Suite Software

Application Note



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## Introduction

This guide characterizes the performance of the N4010A wireless connectivity test set and the 89601A vector signal analysis (VSA) software combination. The N4010A/89601A combination adds the flexible digital demodulation and analysis capabilities of the 89601A software to the frequency coverage and capabilities of the N4010A. This guide also characterizes the performance of the N4010A and the 89607A wireless LAN (WLAN) test suite software combination. The N4010A/89607A combination allows for quick and accurate standards-based transmitter testing for IEEE 802.11b/g formats.

## Product Overview

### **N4010A wireless connectivity test set**

The N4010A is a test set designed to quickly and accurately measure emerging wireless connectivity formats in the 2.4 GHz band. The N4010A offers two bandwidth selections of 5 and 22 MHz, making the N4010A an ideal test platform for *Bluetooth™* and WLAN RF measurements. The N4010A with *Bluetooth* Option 101 is an effective measurement tool for development, integration, pre-qualification, and volume manufacturing. Use Option N4010A-101, with eight different *Bluetooth* RF cases, for making transmitter and receiver measurements as defined in the *Bluetooth* 1.1 RF test specification. The *Bluetooth* test set also includes an internal test sequencer to shorten test and development time. The N4010A with WLAN Option 102 includes integrated source and receiver hardware to verify that 802.11b/g modules and devices meet their RF design requirements.

### **89601A VSA software**

The 89601A VSA software provides flexible tools for making RF and modulation quality measurements on digital communication signals.

Analyze a wide variety of standard and non-standard signal formats with the 89601A software. Standard signal presets cover GSM, EDGE, cdmaOne, cdma2000, W-CDMA, *Bluetooth*, 802.11a/b/g, and more. For emerging standards, the 89601A software series offers 24 digital demodulators with variable center frequency, symbol rate, filter type, and filter alpha/BT. A user-adjustable adaptive equalizer is also provided.

Quickly evaluate and troubleshoot digitally modulated signals with the modulation analysis tools in the 89601A software. Examine symbol behavior with trellis/eye diagrams. Use the constellation and vector diagrams for an overall indication of signal behavior and to obtain clues to the cause of the problem. Take advantage of the EVM, EVM spectrum, and EVM time capabilities for more sensitive examination of signal errors.

Perform time domain analysis using the 89601A software RF scope capability. Evaluate pulse shape with the main time display, select specific portions of a burst for analysis with the time gating feature, and use statistical tools such as CCDF and CDF to characterize the noise-like behavior of your modern communication signal.

Simplify the characterization of your signal with the zero-span spectrum analysis tools in the 89601A analysis software. With the wide selection of spans available in the 89601A software, match your measurement span to your signal bandwidth, to maximize signal-to-noise ratio (SNR) analysis. FFT-based resolution bandwidths down to less than 1 Hz provide all the resolution needed for frequency domain investigations. A power spectral density (PSD) function is useful for estimating the level of the noise floor when calculating SNR. Additionally, a spectrogram display is provided for monitoring the wideband behavior of hopping signals over time.

### **89607A WLAN test suite software**

The 89607A standards-based test suite provides the convenience of automatic, one-button test set-up and execution. It also provides you with the confidence of knowing your design is being tested based on the techniques, parameters, and specifications set down in the IEEE 802.11a/b/g standards.

The 89607A WLAN test suite software is ideal for characterizing overall physical (PHY) layer performance of your WLAN transmitter. Evaluate your transmitter design against the IEEE standards. Take advantage of its standardized tests to qualify parts or do acceptance testing. Use the software for manufacturing test; you can even modify the pass/fail limits to add some margin between what IEEE requires and what test you do.

### **N4010A/89601A/89607A combination**

In the N4010A/89601A combination, the N4010A can be used as a wireless connectivity test set to link with other *Bluetooth* devices and check for correct operation by making parametric measurements on the device under test. Use the 89601A to extend the testing capabilities of the N4010A by measuring and graphically displaying modulation quality of your *Bluetooth* signal.

With the N4010A and Option 89601A-B7R or 89607A software, the N4010A/89601A/89607A combination can be used to test and troubleshoot WLAN modules and devices. The N4010A with Option 89601A-B7R can be used for flexible modulation analysis to quickly locate design problems. The N4010A with the 89607A software can be used test WLAN modules to the specifications set down in the IEEE 802.11b/g standards with one-button pass/fail testing.

This combination can measure active signals or signals captured in the N4010A's memory. The N4010A or the N4010A/89601A combination can examine active signals. Switching between the two products is facilitated by an easy disconnect/restart menu selection in the 89601A user interface.

The 89601A/89607A software runs on a PC connected to the N4010A via LAN, USB, or GPIB and provides hardware control, modulation analysis, evaluation, and troubleshooting along with complete results displays. The controls and display of the N4010A are disabled while operating the 89601A/89607A software.

## N4010A/89601A Features

The N4010A/89601A combination requires a PC for the software's operation. Detailed configuration requirements for the N4010A, the software, and the PC are provided in the appendix.

### N4010A feature availability

When the N4010A is controlled by the 89601A software, users have control of the following features via the 89601A software

**Frequency:** the center frequency of the N4010A is controlled and the 89601A software displays its current setting

**Span:** zero-span only. Maximum setting is 22 MHz. Zero-span control and the display of its current setting are provided by the 89601A software

**Triggering:** IF magnitude, external TTL, level, delay, and slope

**External reference:** 10 MHz

**Disconnect/restart:** pause the 89600 software to gain immediate, direct access to all of the N4010A's features by using the disconnect capability on the VSA software's control menu

### 89601A feature availability

When the 89601A software is used with the N4010A, almost all of the features of the 89601A and its options are available. (See the appendix for details.)

These features include

- recording of time waveforms, allowing you to re-analyze signals and store them for future comparisons
- 24 flexible digital demodulators settable in center frequency, symbol rate, filter type, and filter  $\alpha$ /BT
- a complete set of vector signal analysis and modulation analysis displays including: constellation, eye diagram, EVM spectrum, EVM spectrum, EVM time, error screens, multiple trace displays, and a spectrogram display
- flexible marker capabilities including time gating, integrated band power, and offset (delta) markers
- a link to Agilent signal sources for download and playback of signals in the signal capture memory
- complete save and recall of your signals, trace data, and measurement screens
- easy cut and paste to other PC applications

The 89601A software's swept spectrum analysis capability is not supported.

## Performance Summary

The following is a summary of the features and capabilities provided by the N4010A in combination with the 89601A software. **These are nominal values and are not warranted.**

<b>Frequency range</b>	Option N4010A-101 or 102	2.381 to 2.519 GHz (for 22 MHz span)		
<b>Center-frequency tuning resolution</b>	1 MHz			
<b>Frequency span range</b>	< 10 kHz to 22 MHz			
<b>Frequency points per span</b>	Calibrated points	51 to 102,401		
	Displayable points	51 to 131,072		
<b>Resolution bandwidth (RBW)</b>				
The range of available RBW choices is a function of the selected frequency span and the number of calculated frequency points. Users may step through the available range in 1-3-10 sequence or directly enter an arbitrarily chosen bandwidth.				
<b>RBW range</b>	< 100 Hz to > 1.68 MHz			
<b>RBW shape factor</b>				
The window choices below allow you to optimize the RBW shape as needed for best amplitude accuracy, dynamic range, or response to transient signal characteristics.				
	<b>Window</b>	<b>Selectivity (3:60 dB)</b>	<b>Passband flatness</b>	<b>Rejection</b>
	Flat top	0.41	0.01 dB	> 95 dBc
	Gaussian top	0.25	0.68 dB	> 125 dBc
	Hanning	0.11	1.5 dB	> 31 dBc
	Uniform	0.0014	4.0 dB	> 13 dBc
<b>Input range</b>	2.37 to 2.53 GHz	-70 to +23 dBm		
<b>Amplitude accuracy</b>	±0.5 dB			
<b>S/N ratio</b>	0 dBm input	> 44 dB (22 MHz bandwidth)		> 50 dB (5 MHz bandwidth)

# Time and Waveform

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## Time record characteristics

In the 89601A software, measurements are based on time records (for example, blocks of waveform samples from which time, frequency and modulation domain data is derived.) Time records have these characteristics:

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<b>Time record length</b>	= (number of frequency points – 1)/span, with RBW mode set to arbitrary, auto-coupled
<b>Time sample resolutions</b>	= 1/(k x span) Where k = 1.28 for time data = zoom

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## Time capture characteristics

In time capture mode, the 89601A software captures the incoming waveform in real time (i.e. gap free) into high speed time capture memory. This data may then be replayed through the software at full or reduced speed, saved to mass storage, or transferred to another software application.

When post-analyzing the captured waveform, users may adjust measurement span and center frequency in order to zoom in on specific signals of interest, as long as the new measurement span lies entirely within the originally captured span.

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<b>Time capture memory size</b>	500 ksamples (complex samples for spans ≤ 5 MHz; real samples for spans > 5 MHz)
<b>Time capture length versus span</b>	5 ms, 5 MHz < span ≤ 22 MHz 50 ms, spans ≤ 5 MHz

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# Measurement, Display, and Control

<b>Triggering</b>	
<b>Trigger types</b>	
Vector signal analyzer	Free run, IF magnitude, external TTL
Internal trigger range	-65 to +23 dBm for 5 MHz bandwidth -60 to +23 dBm for 22 MHz bandwidth
Pre-trigger delay range	4.5 ms or time capture length, whichever is shorter
Post-trigger delay range	5.2 ms
Trigger hold-off	20 ns to 0.65 ms
<b>Averaging</b>	
<b>Number of averages, maximum</b>	> 10 <sup>8</sup>
<b>Overlap averaging</b>	0 to 99.99%
<b>Average types</b>	
Vector signal analyzer application	rms (video), rms (video) exponential, peak hold, time, time exponential
<b>Time gating</b>	
<p>Provides time-selective frequency-domain analysis on any input or analog demodulated time-domain data. When gating is enabled, markers appear on the time data; gate position and length can be set directly. Independent gate delays can be set for each input channel. See time specifications for main time length and time resolution details.</p>	
<b>Gate length, maximum</b>	Main time length
<b>Gate length, minimum</b>	= window shape/(0.3 x freq. span) where window shape is equal to: Flat-top window           3.8 Gaussian-top window       2.2 Hanning window            1.5 Uniform window            1.0

<b>Marker functions</b>	Peak signal track, frequency counter, band power
<b>Band power markers</b>	
Markers can be placed on any time, frequency, or demodulated trace for direct computation of band power, rms square root (of power), C/N, or C/No, computed within the selected portion of the data.	
<b>Trace math</b>	
Trace math can be used to manipulate data on each measurement. Applications include user-defined measurement units, data correction, and normalization.	
<b>Operands</b>	Measurement data, data register, constants, $j\omega$
<b>Operations</b>	+, -, x, /, conjugate, magnitude, phase, real, imaginary, square, square root, FFT, inverse FFT, windowing, logarithm, exponential, peak value, reciprocal, phase unwrap, zero
<b>Trace formats</b>	Log mag (dB or linear), linear mag, real (I), imag (Q), wrap phase, unwrap phase, I-Q, constellation, Q-eye, I-eye, trellis-eye, group delay
<b>Trace layouts</b>	1 to 4 traces on one, two, or four grids
<b>Number of colors</b>	User-definable palette
<b>Spectrogram display</b>	
Types	Color – normal and reversed Monochrome – normal and reversed User colormap – 1 total
Adjustable parameters	Number of colors Enhancement (color-amplitude weighting) Threshold
Trace select	When a measurement is paused any trace in the trace buffer can be selected by trace number. The marker values and marker functions apply to the selected trace.
Z-axis value	The z-axis value is the time the trace data was acquired relative to the start of the measurement. The z-axis value of the selected trace is displayed as part of the marker readout.
Memory	Displays occupy memory at a rate of 128 traces/MB (for traces of 401 frequency points)

## Software Interface

The 89601A software appears to other Windows® software as an ActiveX® object. Implemented according to the industry-standard Component Object Model (COM), the software exposes a rich object model of properties, events, and methods, as fully described in the 89601A documentation.

Software development environments that are capable of interacting with COM objects include Agilent VEE, Microsoft® Visual Basic®, Microsoft Visual C++®, MATLAB®, National Instruments® LabVIEW, and others.

In addition, many end-user applications are able to interact directly with COM objects using built-in macro languages such as Visual Basic for Applications (VBA). For example, in Microsoft Excel®, a VBA macro could be used to set up the instrument, collect the measurement data, and automatically graph the results.

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### Macro language

The 89601A's built-in Visual Basic script interpreter allows many types of measurement and analysis tasks to be easily automated. Scripts may be developed using any text editor, or may be recorded automatically from a sequence of menu selections. Completed scripts may be named and integrated onto the analyzer's toolbar, allowing them to be launched with a single button press.

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### Remote displays

To operate the 89601A/N4010A combination or view its displays from a remote location, the use of commercially-available remote PC software such as Microsoft NetMeeting® or Symantec pcAnywhere® is recommended.

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### Remote programming

Beginning with Microsoft Windows NT® 4.0, COM objects on one PC are accessible from software running on another PC. This capability, known as Distributed COM (DCOM), makes the 89600 object model fully programmable from any other PC having network connectivity to the N4010A's host PC.

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### File formats

For storage and recall of measured or captured waveforms, spectra, and other measurement results:

ASCII	Tab-delimited (.txt), comma-delimited (.csv)
Binary	Agilent standard data format (.sdf, .cap, .dat)
Binary	Agilent E3238 time snapshot (.cap) and time recording (.cap) files under 2 Gsa in size. No additional calibration.
MATLAB 5	MAT-file (.mat)

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### Source

In source mode the 89601A software can control a signal generator via GPIB or LAN. Control is provided via the VSA GUI. Frequency and level control of CW signals is provided. Arbitrary signals may be downloaded from the time capture memory to the signal generator for replay. The same time record may be played over and over contiguously. A window function can be applied to smooth start-up and finish of replay.

Compatible sources	ESG-D or ESG-DP (firmware version B.03.50 or later), with the Option E44xA-UND internal dual arbitrary waveform generator (firmware version 1.2.92 or later). E4438C with internal baseband generator Option E4438C-001 or E4438C-002. E8267C vector signal generator with Option E8267C-002 internal baseband generator.
Signal types	CW (fixed frequency sinewave) Arbitrary
Frequency range	Determined by signal generator
Level range	-136 to 20 dBm in 0.02 dBm steps

For all other specifications see the technical data sheet for the signal generator used.

## Vector Modulation Analysis (Option 89601A-AYA)

Note that analysis and presets are only valid over the frequency range of the N4010A-101/102.

<b>Signal acquisition</b>	
Note: Signal acquisition does not require an external carrier or symbol clock	
<b>Data block length</b>	Adjustable to 4096 symbols
<b>Samples per symbol</b>	1 – 20
<b>Symbol clock</b>	Internally generated
<b>Carrier lock</b>	Internally locked
<b>Triggering</b>	Single/continuous, external, pulse search (searches data block for beginning of TDMA burst and performs analysis over selected burst length)
<b>Data synchronization</b>	User-selected synchronization words
<b>Supported modulation formats</b>	
<b>Carrier types</b>	Continuous and pulsed/burst (such as TDMA)
<b>Modulation formats</b>	2, 4, 8, and 16 level FSK (including GFSK)  MSK (including GMSK)  QAM implementation of BPSK, QPSK, OQPSK, DQPSK, D8PSK, $\pi/4$ DQPSK, 8PSK, $\frac{3\pi}{8}$ 8PSK (EDGE)  16QAM, 32QAM, 64QAM, 128QAM, 256QAM (absolute encoding)  16QAM, 32QAM, 64QAM (differential encoding per DVB standard)  8VSB, 16VSB
<b>Single-button presses for</b>	
<b>Cellular</b>	CDMA (base), CDMA (mobile), CDPD, EDGE, GSM, NADC, PDC, PHP (PHS), W-CDMA
<b>Wireless networking</b>	<i>Bluetooth</i> , HIPERLAN/1 (HBR), HIPERLAN/1 (LBR), 802.11b
<b>Digital video</b>	DTV8, DTV16, DVB16, DVB32, DVB64
<b>Other</b>	APCO 25, DECT, TETRA, VDL mode 3
<b>Filtering</b>	
<b>Filter types</b>	Raised cosine, square-root raised cosine, IS-95 compatible, Gaussian, EDGE, low pass, rectangular, none
<b>Filter length</b>	40 symbols: VSB, QAM, and DVB-QAM where $\alpha < 0.2$
<b>User selectable alpha/BT</b>	Continuously adjustable from 0.05 to 10
<b>User-defined filters</b>	User-defined impulse response, fixed 20 points/symbol  Maximum 20 symbols in length or 401 points

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**Maximum symbol rate**

Symbol rate is limited only by the measurement span; that is, the entire signal must fit within the analyzer's currently selected frequency span.  
Example: with raised-cosine filtering

$$\text{Max symbol rate}^* = \frac{\text{frequency span}}{1 + \alpha}$$

\*Maximum symbol rate doubled for VSB modulation format

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**Measurement results (formats other than FSK)**

<b>I-Q measured</b>	Time, spectrum (filtered, carrier locked, symbol locked)
<b>I-Q reference</b>	Time, spectrum (ideal, computed from detected symbols)
<b>I-Q error versus time results</b>	Magnitude, phase (I-Q measured versus reference)
<b>Error vector</b>	Time, spectrum (vector difference between measured and reference)
<b>Symbol table and error summary</b>	Error vector magnitude is computed at symbol times only
<b>Instantaneous</b>	Time, spectrum, search time

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**Measurement results (FSK)**

<b>FSK measured</b>	Time, spectrum
<b>FSK reference</b>	Time, spectrum
<b>Carrier error</b>	Magnitude
<b>FSK error</b>	Time, spectrum

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**Display formats**

The following trace formats are available for measured data and computed ideal reference data, with complete marker and scaling capabilities, and automatic grid line adjustment to ideal symbol or constellation states.

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**Polar diagrams**

Constellation	Samples displayed only at symbol times
Vector	Display of trajectory between symbol times with 1 – 20 points/symbol

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**I or Q versus time**

Eye diagrams	Adjustable from 0.1 to 40 symbols
Trellis diagrams	Adjustable from 0.1 to 40 symbols
Continuous error vector magnitude versus time	
Continuous I or Q versus time	

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**Error summary** (formats other than FSK)

Measured rms and peak values of the following:

Error vector magnitude, magnitude error, phase error, frequency error (carrier offset frequency), I-Q offset amplitude droop (PSK and MSK formats), SNR (8/16VSB and QAM formats), quadrature error, gain imbalance

For VSB formats, VSB pilot levels is shown in dB relative to nominal. SNR is calculated from the real part of the error vector only.

For DVB formats, EVM is calculated without removing IQ offset.

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**Error summary** (FSK)

Measured rms and peak values of the following:

FSK error, magnitude error, carrier offset frequency, deviation

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**Detected bits** (symbol table)

Binary bits are displayed and grouped by symbols. Multiple pages can be scrolled for viewing large data blocks. Symbol marker (current symbol shown as inverse video) is coupled to measurement trace displays to identify states with corresponding bits. For formats other than DVBQAM and MSK, bits are user-definable for absolute states or differential transitions.

Note: Synchronization words are required to resolve carrier phase ambiguity in non-differential modulation formats.

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**Accuracy (nominal)**

Formats other than FSK, 8/16VSB and OQPSK

*Conditions: Specifications apply for a full scale signal at 2.4 GHz, 0 to -55 dBm signal level*

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**Residual EVM**

span = 5 MHz	< 2.0% rms
span = 22 MHz	< 2.0% rms

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**Frequency error**

(added to frequency accuracy if applicable)	symbol rate/500,000
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**Adaptive equalizer**

Removes the effects of linear distortion (e.g. non-flat frequency response, multipath, etc.) from modulation quality measurements. Equalizer performance is a function of the setup parameters (equalization filter length, convergence, taps/symbol) and the quality of the signal being equalized.

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**Equalizer type**

Decision-directed, LMS, feed-forward equalization with adjustable convergence rate

Filter length	3 to 99 symbols, adjustable
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Filter taps	1, 2, 4, 5, 10, or 20 taps/symbol
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**Measurement results provided**

Equalizer impulse response

Channel frequency response

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**Supported modulation formats**

MSK, BPSK, QPSK, OQPSK, DPQPSK,  $\pi/4$ QPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 8VSB, 16VSB,  $3\pi/8$  8PSK (EDGE), D8PSK

## WLAN Modulation Analysis (Option 89601A-B7R)

Note that analysis is only valid over the frequency range of the N4010A-101/102.

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### OFDM modulation analysis

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#### Signal acquisition

Supported standards	802.11a, HiperLAN2, and 802.11g (OFDM)
Modulation formats	BPSK, QPSK, 16QAM, 64QAM (auto detect or manual override)
Search length	
Minimum	Result length + 6 symbol times (28 $\mu$ s)
Maximum	5.18 ms
Result length	Auto detect or adjustable from 1 to 1289 symbols
Triggering	Single/continuous, free-run/channel/external
Measurement region	Length and offset adjustable within result length
Signal playback	
Capture length	~5 ms (5MHz < span $\leq$ 22 MHz)

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#### Adjustable parameters

Data format	IEEE 802.11a/g OFDM, IEEE 802.11g DSSS-OFDM HiperLAN2
Single button presets	IEEE 802.11a/g OFDM, IEEE 802.11g DSSS-OFDM HiperLAN2
I-Q normalize	On/Off
Sub-carrier spacing	Continuously adjustable
Symbol timing adjust	Adjustable between 0 and guard interval
Guard interval	1/4, 1/8 (HiperLAN2 only), adjustable between 0 and 1 in 1/64 increments
Pilot tracking	Phase, amplitude, timing
Carriers to analyze	All or single

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#### Demodulation measurement results

I-Q measured	All carriers over all symbol times
I-Q reference	All carriers over all symbol times (reference computed from detected symbols)
Error vector	Time, spectrum (for each carrier and symbol in the frame)
RMS error vector	Time, spectrum
Common pilot error	Phase, magnitude
Symbol table and error summary	EVM, pilot EVM, CPE (common pilot error), IQ (origin) offset, frequency error, symbol clock, sync correlation, number of symbols, modulation format, code rate, bit rate

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**Equalizer measurement results**

Equalizer impulse response	Computed from preamble
Channel frequency response	Computed from preamble

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**Pre-demodulation measurement results**

Time	Instantaneous
Spectrum	Instantaneous, average
Search time	Instantaneous

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**Display formats**

Error vector spectrum	Error values for each symbol time plotted for each carrier
Error vector time	Error values for each carrier plotted for each symbol time

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**Accuracy (nominal)**

Residual EVM	< 2% rms
Residual constellation error	-34 dB

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**Frequency error (relative to frequency standard)**

Lock range	$\pm 624$ kHz ( $\pm 2$ x sub-carrier spacing)
Accuracy	1 kHz

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**DSSS modulation analysis**

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**Signal acquisition**

Modulation format	Auto detect or manual override: Barker1, Barker2, CCK5.5, CCK11, PBCC11, PBCC22, PBCC33
Preamble	Auto detect (short, long)
Search length	Adjustable between result length and 5.19 ms
Result length	Auto detect or adjustable from 1 to 5718 chips
Triggering	Single/continuous, free-run, channel, external
Measurement region	Interval and offset adjustable within result length
Signal playback	
Capture length	~5 ms (5MHz < span ≤ 22 MHz)

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**Supported formats**

Formats	IEEE 802.11b including optional short preamble and optional PBCC modes  IEEE 802.11g/D3.0 including PBCC22 and PBCC33 modes
Single-button presets	DSSS/CCK/PBCC

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**Adjustable parameters**

IQ normalize	On/Off
Mirror frequency spectrum	On/Off
Chip rate	Continuously adjustable
Clock adjust	Continuously adjustable between ±0.5 chips
Equalizer	On/Off
Equalizer filter length	3 to 99 chips
Descrambler mode	On/Off, preamble only, preamble, header only

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**Demodulation measurement results**

IQ measured	IQ measured time, IQ measured spectrum, instantaneous IQ measured spectrum
IQ reference	IQ reference time, IQ reference spectrum, instantaneous IQ reference spectrum
Other IQ error traces	IQ magnitude error, IQ phase error
Error vector	Error vector time, error vector spectrum, instantaneous error vector spectrum
Despread symbols	Preamble, header, data
Symbol and error table summary	802.11b 1,000-chip peak EVM, EVM, magnitude error, phase error, IQ offset, frequency error, sync correlation, burst type, bit rate, number of data octets, data length

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**Equalizer measurement results**

Equalizer impulse response	Computed from preamble
Channel frequency response	Computed from preamble

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**Pre-demodulation measurement results**

Time	Main raw, search
Spectrum	Instantaneous
Other	CCDF, CDF, PDF

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**Display formats**

Error vector spectrum	Error values for each symbol time plotted for each carrier
Error vector time	Error values for each carrier plotted for each symbol time

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**Accuracy (nominal)**

Residual EVM	$\leq 2\%$ rms
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**Frequency error (relative to frequency standard)**

Lock range	$\pm 2.5$ MHz
Accuracy	1 kHz

## WLAN Test Suite Software (89607A)

Speed standards-based testing of your 802.11b/g WLAN transmitter with the 89607A WLAN test suite software and the N4010A. This standards-based test suite provides the convenience of automatic one-button test set-up and execution with the confidence of knowing your design is being tested based on the techniques, parameters, and specifications set down in the IEEE 802.11b/g standards.

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### Specifications (nominal)

Standard	IEEE 802.11g	IEEE 802.11b
Total power accuracy	$\pm 0.5$ dB <sup>1,2</sup>	$\pm 0.5$ dB <sup>1,2</sup>
Center frequency tolerance	$\pm 1$ kHz <sup>2</sup>	$\pm 1$ kHz <sup>2</sup>
Clock frequency tolerance	$\pm 0.5$ ppm <sup>2</sup>	$\pm 0.5$ ppm <sup>2</sup>
Residual constellation error	-34 dB	—
Residual RMS EVM	—	< 2%
Residual center frequency leakage	-70 dBm	-70 dBm
Spectral flatness	$\pm 0.5$ dB	$\pm 0.5$ dB
Maximum burst length	1288 symbols	5.19 ms
Estimated test time (with/without spectral mask test) <sup>3</sup>	22 s / 6 s <sup>4</sup>	19 s / 8 s <sup>5</sup>

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### 802.11a/b/g WLAN tests

The WLAN test suite software provides all of the IEEE 802.11a/b/g WLAN transmitter tests. Test set-up is easy. Click on the WLAN standard you want, select the tests you want to use, then click "▶". The software does the rest. Whether you want to use all of the tests to assure complete assessment, or use a few tests to reduce overall test time and speed device evaluation, the 89607A WLAN test suite makes the process of test selection easy.

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#### IEEE 802.11a/g tests

- transmit power
- transmit center frequency tolerance
- transmit clock frequency tolerance
- transmit modulation accuracy
- transmit spectral mask

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#### IEEE 802.11b tests

- transmit power
- transmit center frequency tolerance
- chip clock frequency tolerance
- transmit RF carrier suppression
- transmit modulation accuracy
- transmit power up ramp
- transmit power down ramp
- transmit spectral mask

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1. For a power range between +23 and -70 dBm, frequency range 2.381 to 2.519 GHz.
  2. For a temperature range of 20 to 30 °C.
  3. Using USB 2.0 interface. Assumes 3 GHz Pentium® 4 computer running Windows XP. Increased CPU performance improves test time.
  4. Measured 20 frames with 16 data symbols, and spectral mask test with 2 ms of capture and 80 MHz total span.
  5. Measured one packet with 282  $\mu$ s packet length, and spectral mask test with 2 ms of capture and 80 MHz total span.

## Appendix

### Required hardware and software

#### Ordering an N4010A wireless connectivity test set

The following options must be installed in the N4010A.

**Table 1. Options required in the N4010A**

Option	Description	89601A software revision
101	Bluetooth	5.20 or greater
or		
102	Wireless LAN	5.20 or greater
and		
110	I/O connectivity	

#### 89601A vector signal analysis software

The N4010A/89601A combination works with 89601A vector signal analysis software version 5.20 or greater.

The following options must be installed with 89601A software

**Table 2. 89601A required options**

Option	Description
200	Basic vector analysis software
and	
300	Hardware connectivity

The following options are recommended for use with the 89601A software

**Table 3. Recommended options for 89601A software**

Option	Description
AYA	Vector modulation analysis
B7R	WLAN Modulation Analysis (OFDM and DSSS/CCK/PBCC)

#### 89607A WLAN test suite software

The N4010A/89607A combination works with 89607A WLAN test suite software version 5.20 or greater. 89601A VSA software is not required with the purchase of 89607A.

#### PC for 89601A/89607A software

The 89601A/89607A requires a PC connected via LAN or USB to the N4010A in order to run. USB 2.0 interface is recommended for fastest measurement speed. Either a laptop or desktop PC may be used as long as it meets or exceeds the following minimum requirements<sup>1</sup>:

- > 300 MHz Pentium or AMD-K6
- 128 MB RAM (256 MB recommended)
- 4 MB video RAM (8 MB recommended)
- Hard disk with 100 MB of available space
- Microsoft Windows 2000, NT 4.0 (service pack 6a, or greater required), or XP Professional®
- CD ROM drive (can be provided via network access), 3.5 inch floppy disk drive (can be provided via network access)
- LAN or USB interface

1. For best immunity from electronic discharge (ESD), use a desktop PC.

## Related Literature

*N4010A Bluetooth Test Set*,  
data sheet, literature number  
5989-0251EN

*N4010A Wireless LAN Tx/Rx Custom  
Option*, technical overview,  
literature number 5988-0145EN

*89600 Series Wide-Bandwidth  
Vector Signal Analyzer*, brochure,  
literature number 5980-0723E

*89607A WLAN Test Suite Software*,  
technical overview, literature  
number 5988-9547EN



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