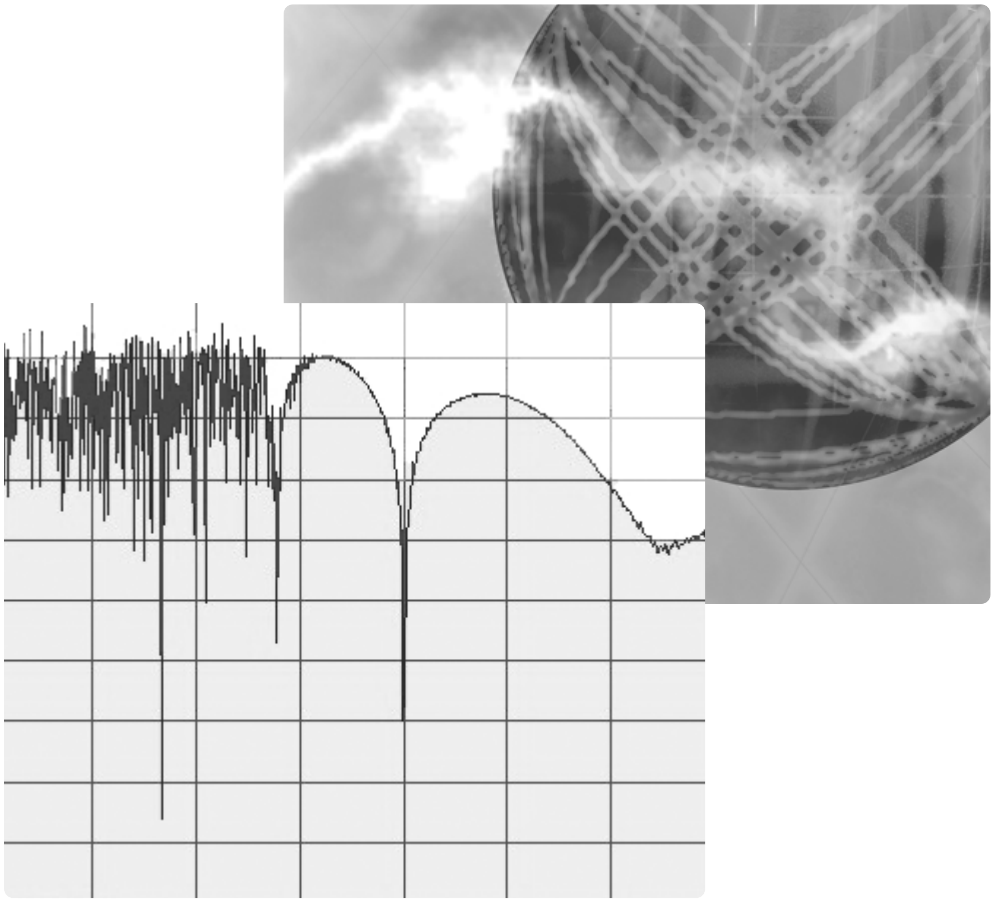
Agilent
89600 Series Vector Signal Analysis Software
89601A/89601AN/89601N12

Data Sheet



Agilent Technologies

Table of Conents

Introduction	2
Basic Vector Signal Analysis (Option 200)	3
Time and waveform	3
Measurement display and control	3
Software interface	6
Hardware Connectivity (Option 300)	7
Vector Modulation Analysis (Option AYA)	7
3G Modulation Analysis (Option B7N)	9
W-CDMA/HSDPA modulation analysis	9
cdma2000/1xEV-DV Modulation Analysis	11
1xEV-D0 Modulation Analysis	12
TD-SCDMA Modulation Analysis	14
WLAN Modulation Analysis (Option B7R)	16
OFDM modulation analysis	16
DSSS modulation analysis	17
802.16 OFDM Modulation Analysis (Option B7S)	18
Dynamic Link to EEsof ADS (Option 105)	19
Source component	19
Sink component	20
Ordering Information	22
Product Upgrades	23
Product Support and Training	23
User-Supplied PC Requirements	23

Introduction

The 89600 Series vector signal analysis software is designed to help baseband and RF design engineers measure, evaluate and troubleshoot complex (I/Q) modulated signals.

This software runs on a PC and works with a variety of hardware measurement platforms. These platforms include the 89600 VXI based vector signal analysis systems, the 89650S 26.5GHz vector signal analyzer, the PSA high performance spectrum analyzers, the ESA general-purpose spectrum analyzers, and the E4406A transmitter tester. These platforms down convert and digitize the signal, provide signal capture capability, and move the data to the PC in a sequential stream of data blocks. The 896000 Series software processes the data in the time, frequency and modulation domains.

The following tables describe the capabilities of the 896000 Series vector signal analysis software and its options on these platforms and with the EEsof Advance Design System RF and microwave design and simulation software. Refer to the *Hardware Measurement Platforms for the 89600 Series Vector Signal Analysis Software, Data Sheet* for performance specifications.

Basic Vector Signal Analysis (Option 200)

Time and waveform

The 89600 series vector signal analyzers have two signal processing modes: base band and zoom. These two processing modes affect the appearance and the duration of input waveforms displayed by the 89600s. Most 89600 measurements are made with a non-zero start frequency, called the Zoom mode. In these cases, the time domain display shows a complex envelope representation of the input signal – that is, the magnitude and phase of the signal relative to the analyzer's center frequency. This provides a powerful capability to examine the base band components of a signal without the need to first demodulate it.

Base band mode refers to the special case where the measurement begins at 0 Hz. Here, the input signal is directly digitized and the waveform display shows the entire signal (carrier plus modulation), very much as an oscilloscope would.

Time record characteristics

In the 89600 VSA application, measurements are based on time records. A time record is a block of samples of the signal waveform from which time, frequency, and modulation domain data is derived. Time records have these characteristics:

Time record length (main time)

$$\frac{\text{(Number of frequency points} - 1)}{\text{span with RBW mode set to arbitrary, auto-coupled}}$$

Time sample resolution

1/(k x span)
Where:
k = 2.56 for time data mode set to base band
k = 1.28 for all other modes (default) including zoom
Span = Currently selected frequency span

Time capture characteristics

In time capture mode the 89600 VSA application captures the incoming waveform gap-free into high-speed time capture memory. This data may then be replayed through the analyzer at full or reduced speed, saved to mass storage, or transferred to another software application.

When time analyzing the captured waveform, users may adjust measurement span and center frequency in order to zoom in on a signal, as long as the new measurement span lies entirely within the originally captured span.

Time capture memory size

Memory size is dependent on the hardware used. See hardware specifications for more information.

Measurement display and control

Triggering

Trigger types	
Spectrum application	(VXI hardware only) Free run, channel, external (separate trigger per frequency segment)
Vector signal analysis application	Free run, channel, IF magnitude, external
Pre-trigger delay resolution	Same as time capture sample resolution
Pre-trigger delay range	Same as time capture length
Post-trigger delay resolution	Same as time capture sample resolution
Post-trigger delay range	0 to $2^{30} - 1$ time samples
IF trigger	Used to trigger on in-band energy, where the trigger bandwidth is determined by the measurement span (rounded to the next higher cardinal span). *Specifications are dependent on the hardware used. See hardware specifications for more information.*
Trigger hold-off	Used to improve trigger repeatability on TDMA and other bursted signals. Trigger hold-off prevents re-triggering of the analyzer until a full hold-off period has elapsed with no signal above the trigger threshold.

Measurement Display and Control—continued

Hold-off resolution	Same as time capture sample resolution
Hold-off range	0 to $2^{24} - 1$ time samples
External trigger	*External trigger is dependent on the hardware used. See hardware specifications for more information.*

Averaging

Types	
Spectrum application (VXI hardware only)	RMS (video), RMS (video) exponential, peak hold
Vector signal analysis application	RMS (video), RMS (video) exponential, peak hold, time, time exponential
Number of averages, maximum	$> 10^8$
Overlap processing	0 – 99.99%

Analog demodulation

AM demodulation (typical)	
Demodulator bandwidth	Same as selected measurement span
PM demodulation (typical)	
Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
FM demodulation (typical)	
Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span

Time gating

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 and waveform" specification for main time length and time resolution details.

Gate length, maximum	Main time length
Gate length, minimum	Window shape/(0.3 x frequency span) where window shape is: • Flat-top window 3.8 • Gaussian window 2.2 • Hanning window 1.5 • Uniform window 1.0

Markers

Types	Marker, offset, spectrogram, gate time
Search	Peak, next peak left, next peak right, peak lower, peak higher, minimum
Copy marker to	Start freq, stop freq, center freq, ref level, despread chan, offset to span, counter to center frequency
Marker functions	Peak signal track, frequency counter, band power, couple
Band power	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.
Occupied bandwidth (OBW)	Placed on spectrum traces only to dynamically compute the bandwidth required to provide x% of power in the band. User selectable from 0-100%
OBW results	Total Power in Span Power in OBW Power ratio (OBW/Span) OBW lower frequency OBW higher frequency OBW Centroid frequency Offset frequency (measurement center freq – centroid freq)

Measurement Display and Control—continued

Adjacent channel power	Placed on spectrum traces only
User-settable parameters	Center frequency and bandwidth of the carrier channel Offset frequency and bandwidth of each offset channel
ACPR results	Pass/fail limits for each offset (applied to both lower and upper result) Carrier band power Power in both lower and upper offset bands for each frequency offset Power in both lower and upper offset bands for each frequency offset, relative to the carrier power (ACPR) Worst case (of the upper and lower offsets) ACPR for each frequency offset Pass/fail condition relative to user supplied thresholds
Trace math	*Trace math can be used to manipulate data on each measurement. Applications include user-defined measurement units, data correction, and normalization.*
Operands	Measurement data, data register, constants, $j\omega$
Operations	+, -, x, /, conjugate, magnitude, phase, real, imaginary, square, square root, FFT, inverse FFT, windowing, logarithm, exponential, peak value, reciprocal, phase unwrap, zero
Trace formats	Log mag (dB or linear), linear mag, real (I), real (Q), wrap phase, unwrap phase, I-Q, constellation, I-eye, Q-eye, trellis-eye, group delay
Trace layouts	1- 6 traces on one, two, four, or six grids
Number of colors	User-definable color palette
Spectrogram display	
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 selected trace.
Marker	Display of frequency, amplitude, and time since trigger for any point on selected trace. Offset marker displays difference in frequency, amplitude, and time between any points on two selected traces.
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 the start of the marker readout.
Memory (characteristic)	Displays occupy PC memory at a rate of 128 traces/MB (401 frequency point traces).

Software Interface

The 89600 VSA 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 described in the 89600 documentation.

Because all 89600 functionality is implemented within its software, direct programmatic access to the measurement front-end hardware is never necessary and is not supported. 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.

Macro language

The analyzer's built-in Visual Basic script interpreter enables easy automation of many types of measurement and analysis tasks. 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.

Remote displays

To operate the 89600 or view its display from a remote location, the use of commercially available remote PC software such as Microsoft NetMeeting or Symantec pcAnywhere is recommended.

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 analyzer's host PC.

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), Agilent E3238 search system time snapshot (.cap), time recording (.cap) files under 2 GB in size. Agilent N5010 signal generator files (.bin) under 2 GB in size.
MATLAB 4 and later	MAT-file (.mat)

Hardware Connectivity (Option 300)

Sources

The 89600 software can send signal capture files to external signal generators and analyze data from several types of signal acquisition hardware.

In source mode the 89600 VSA can control an Agilent 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 the start-up and finish of replay.

Compatible sources	ESG-D or ESG-DP (firmware version B.03.50 or later), with the Option E44xxA-UND internal dual arbitrary waveform generator (firmware version 1.2.92 or later). E4438C with internal base band generator Option E4438C-001, -002, -601, or -602. E8267C vector signal generator with Option E8267C-002, or -602 internal base band generator.
Signal types	CW (single frequency sine wave), arbitrary
Frequency range	Same as the signal generator used
Level range	–136 dBm to 20 dBm, 0.02 dBm steps

Signal acquisition hardware

The 89600 VSA software can be linked to Agilent's ESA-E series spectrum analyzers, PSA series spectrum analyzers, most of the Infiniium scopes, the N4010A, the E4406A transmitter tester via GPIB or LAN. Control is via the VSA GUI on a PC. Full VSA functionality is provided within the signal acquisition capabilities of the hardware with which it is working. See hardware specifications for more information.

Vector Modulation Analysis (Option AYA)

Signal acquisition

Data block length	10 – 4,096 symbols, user adjustable
Samples per symbol	1 – 20, user adjustable
Symbol clock	Internally generated
Carrier lock	Internally generated
Triggering	Single/continuous, external, pulse search (searches data block for beginning of TDMA burst and performs analysis over selected burst length)
Data synchronization	User-selected synchronization words

Supported data formats

Carrier types	Continuous, pulsed (burst, such as TDMA)
Modulation formats	FSK: 2, 4, 8, 16 level (including GFSK) MSK (including GMSK) BPSK, QPSK, OQPSK, DQPSK, D8PSK, $\pi/4$DQPSK, 8PSK, $3\pi/8$ 8PSK (EDGE); QAM (absolute encoding): 16, 32, 64, 128, 256 QAM (differential encoding per DVB standard): 16, 32, 64 VSB: 8, 16

Single button pre-sets

Cellular	CDMA (base), CDMA (mobile), CDPD, EDGE, GSM, NADC, PDC, PHP (PHS)
Wireless networking	*Bluetooth*™, HiperLAN1 (HBR), HiperLAN1 (LBR), 802.11b
Digital video	DTV8, DTV16, DVB16, DV32, DVB64
Other	APCO 25, DECT, TETRA, VDL mode 3

Vector Modulation Analysis (Option AYA), continued

Filtering

Filter types	Raised cosine, square-root raised cosine, IS-95 compatible, Gaussian, EDGE, low pass, rectangular, none
Filter length	40 symbols: VSB, QAM, and DVB-QAM for $\alpha < 0.2$ 20 symbols: all others
User-selectable alpha/BT	Continuously adjustable from 0.05 to 10
User-defined filters	User-defined impulse response, fixed 20 points/symbol Maximum 20 symbols in length or 401 points

Maximum symbol rate — Frequency span/(1 + α) (maximum symbol rate doubled for VSB modulation format). Symbol rate is limited only by the measurement span; that is, the entire signal must fit within the analyzer's currently selected frequency span.

Measurement results (formats other than FSK)

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

Measurement results (FSK)

FSK measurement	Time, spectrum
FSK reference	Time, spectrum
Carrier error	Magnitude
FSK error	Time, spectrum

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 and constellation states.*

Polar diagrams	
Constellation	Samples displayed only at symbol times
Vector	Display of trajectory between symbol times with 1 – 20 points/symbol
I-Q versus time	
I or Q only	Continuous versus time
Eye diagram	Adjustable from 0.1 to 40 symbols
Trellis diagram	Adjustable from 0.1 to 40 symbols
Error vector magnitude	Continuous versus time
Errors table	Measurements of modulation quality made automatically and displayed by the symbol/error trace type. RMS and peak values.
Formats other than FSK	Error vector magnitude, magnitude error, phase error, frequency error (carrier offset frequency), I-Q/origin offset, amplitude droop (PSK and MSK formats), SNR (8/16 VSB and QAM formats), quadrature error, gain imbalance *For VSB formats:* VSB pilot level 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
FSK format	FSK error, magnitude error, carrier offset frequency, deviation

Vector Modulation Analysis (Option AYA), continued

Display formats, continued

Symbols table (detected bits)	Bits are displayed in binary and grouped by symbol. Multiple pages can be scrolled for viewing large data blocks. The symbol marker (current symbol shown in inverse video) is coupled to measurement trace displays to identify states with corresponding bits. For modulation formats other than DVBQAM and MSK, bits are user-definable for absolute or differential symbol states.[1]

Adaptive equalizer

Removes the effects of linear distortion (i.e. 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.

Type	Decision directed, LMS, feed-forward, equalization with adjustable convergence rate
Filter length	3 – 99 symbols, adjustable
Filter taps	1, 2, 4, 5, 10, or 20 taps/symbol
Measurement results provided	Equalizer impulse response, channel frequency response
Supported modulation formats	MSK, BPSK, QPSK, OQPSK, DQPSK, π/4DQPSK, 8PSK, D8PSK, 3 π/8 8PSK (EDGE), 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 8VSB, 16VSB

3G Modulation Analysis (Option B7N)

W-CDMA/HSDPA modulation analysis

Signal acquisition

Result length	Adjustable from 1 to 64 slots
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length

Signal playback

Result length	Adjustable from 1 to 64 slots
Capture length (gap-free analysis at 0% overlap; at 5 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*

Adjustable parameters

Data format	Downlink, uplink
Single button presets	Downlink, uplink
Chip rate	Continuously adjustable
Measurement filter type	RRC, none
Filter alpha	Adjustable from 0.05 to 1
Scramble code	
Downlink	Adjustable from 0 to 511
Uplink	Adjustable from 0 to $2^{24} - 1$

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

3G Modulation Analysis (Option B7N), continued
W-CDMA/HSDPA modulation analysis, continued

Adjustable parameters, continued

Scramble code offset (downlink)	Adjustable from 0 to 15
Scramble code type (downlink)	Standard, left, right
Sync type (downlink)	CPICH, SCH, antenna-2 CPICH, symbol-based
Test models supported (downlink)	Test models 1-5
Sync type (uplink)	DPCCH (slot format 0-5), PRACH message
Channel modulation scheme (downlink)	Auto-detect, QPSK, 16-QAM
Active channel threshold	Auto, Manual (0 dBc to -120 dBc)
Enable HSDPA analysis	Off, On
Gated active channel detection	Off, On
Test model	
None (Auto active channel detection)	
Test Model 1	16 DPCH, 32 DPCH, 64 DPCH (with or without S-CCPCH)
Test Model 2	With or without S-CCPCH
Test Model 3	16 DPCH, 32 DPCH (with or without S-CCPCH)
Test Model 4	With or without P-CPICH
Test Model 5[1]	2 HS-PDSCH with 6 DPCH, 4 HS-PDSCH with 14 DPCH, 8 HS-PDSCH with 30 DPCH
Gated modulation detection[1]	Off, On
Modulation scheme[1]	Auto, QPSK, 8PSK, 16QAM

Measurement results

Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	Composite (all symbol rates together) Individual symbol rates (7.5, 15, 30, 60, 120, 240, 480, 960 ksps)
Code domain error	Composite (all symbol rates together) Individual symbol rates (7.5, 15, 30, 60, 120, 240, 480, 960 ksps)
I-Q measured	Time, spectrum
I-Q reference	Time, spectrum (reference computed from detected symbols)
I-Q error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference symbol
Symbol table and error summary	EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, trigger, frequency error, IQ (origin) offset, slot number
Code domain offset table	Timing and phase offset for each active code
Channel	*Individual code channels*
I-Q measured	Time
I-Q reference	Time (reference computed from detected symbols)
I-Q error versus time	Magnitude and phase (IQ measured versus reference symbol)
Error vector	Time (vector difference between measured and reference symbol)
Symbol table and error summary	EVM, magnitude error, phase error, slot number, pilot bits, tDPCH, modulation
Other measurement results	
Pre-demodulation	Time, spectrum

1. Parameter used only when HSDPA analysis is enabled.

3G Modulation Analysis (Option B7N), continued

W-CDMA/HSDPA modulation analysis, continued

Display formats

CDP measurements results	I and Q shown separately on same trace for uplink
Channel measurement results	I and Q shown separately
Code order	Hadamard, bit reverse

cdma2000®/1xEV-DV modulation analysis

Signal acquisition

Result length	1 to 64 PCGs forward link; 1 and 48 PCGs reverse link
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length

Signal playback

Result length	Adjustable from 1 to 64 PCGs, forward link; 1 to 4 PCGs, reverse link
Capture length (gap-free analysis at 0% overlap; 2.6 MHz span)	*Capture length is dependent on hardware. See hardware specifications for more information.*

Adjustable parameters

Format	Forward, reverse
Single button presets	Forward, reverse
Chip rate	Continuously adjustable
Long code mask (reverse)	0
Base code length	64, 128
Channel modulation scheme (forward)	Auto, QPSK, 8PSK, 16QAM
Active channel threshold	Auto, manual (0 dBc to – 120 dBc)
Enable 1xEV-DV analysis	Off, On
Gated active channel detection	Off, On
Multi-carrier filter	Off, On
PN offset	0 x 64 to 511 x 64 chips
Wash code QOF	0,1,2,3
Defined active channels[1]	Off, On
Walsh code column index[1]	0,1,2,3
Walsh mask[1]	0 to 1111111111111 (binary)
F-PDCH0/1 number of codes[1]	F-PDCH0 + F-PDCH1 ≤ 28
F-PDCH0/1 modulation scheme[1]	QPSK, 8PSK, 16QAM
Gated modulation detection[1]	Off, On
Modulation scheme[1]	Auto, QPSK, 8PSK, 16QAM

1. Parameter is only used when 1xEV-DV analysis is enabled.

3G Modulation Analysis (Option B7N), continued
cdma2000/1xEV-DV modulation analysis, continued

Measurement results

Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	Composite (all symbol rates together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
Code domain error	Composite (all symbol rates together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
I-Q measured	Time, spectrum
I-Q reference	Time, spectrum (reference computed from detected symbols)
I-Q error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference symbol point)
Symbol table and error summary	EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, Trigger, frequency error, IQ (origin) offset, PCG number
Code domain offset table	Timing and phase offset for each active code
Channel	*Individual code channels*
I-Q measured	Time
I-Q reference	Time (reference computed from detected symbols)
I-Q error versus time	Magnitude and phase (IQ measured versus reference symbol)
Error vector	Time (vector difference between measured and reference symbol)
Symbol table and error summary	EVM, magnitude error, phase error, PCG number, modulation format
Other measurement results	
Pre-demodulation	Time, spectrum

Display formats

CDP measurements results	I and Q shown separately on same trace
Channel measurement results	I and Q shown separately
Code order	Hadamard, bit reverse

1xEV-DO modulation analysis

Signal acquisition

Result length	
Forward link	1 – 64 slots
Reverse link	1 – 64 slots
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region (applies to CDP results)	Interval and offset adjustable within result length

Signal playback

Result length	
Forward link	1 – 64 slots
Reverse link	1 – 64 slots
Capture length (gap-free analysis at 0% overlap at 1.5 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*

3G Modulation Analysis (Option B7N), continued
1xEV-DO modulation analysis, continued

Supported formats

Formats	Forward (BTS), reverse (AT)
Single-button presets	Forward, reverse

Other adjustable parameters

Chip rate	Continuously adjustable
Analysis channel (forward)	Preamble, pilot, MAC, data
PN offset (forward)	Continuously adjustable from 0x64 to 511x64 chips
Preamble length (forward)	Adjustable from 0 to 1,024 chips or auto detection
Data modulation type (forward)	QPSK, 8PSK, 16QAM
Long code masks (reverse)	Continuously adjustable from 0x0000000000 to 0x3FFFFFFFFF

Measurement results

Overall	
Error summary (forward)	Overall 1 and overall 2 results for: rho, EVM, magnitude error, phase error, frequency error, slot number, and IQ offset

Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	All symbols taken together Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
Code domain error (reverse)	All symbols taken together Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
IQ measured	Time, spectrum
IQ reference	Time, spectrum
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference)
Error summary (forward)	EVM, magnitude error, phase error, rho, frequency error, IQ offset, slot number, preamble length
Error summary (reverse)	EVM, magnitude error, phase error, rho, frequency error, IQ offset, slot number, peak CDE, pilot, RRI, ACK, DRC, data power

Channel	*Individual code channel, reverse only.*
IQ measured	Time
IQ reference	Time
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time (vector difference between measured and reference)
Symbol table and error summary	EVM, magnitude error, phase error, slot number

Other

Pre-demodulation	Time, spectrum

Display formats (characteristic)

CDP measurement results	I and Q shown separately on same trace
Channel measurement results (reverse)	I and Q shown separately
Code order	Hadamard, bit reverse

3G Modulation Analysis (Option B7N), continued

TD-SCDMA modulation analysis

Signal acquisition

Result length	1 – 8 subframes
Start boundary	Sub-frame, 2 frames
Time reference	Trigger point, downlink pilot, uplink pilot
Samples per symbol (code channel results)	1
Samples per chip (composite results)	1
Triggering	Single/continuous, external
Measurement region	Analysis timeslot selectable within first sub-frame

Signal playback

Result length	1 – 8 subframes
Capture length (gap-free analysis at 0% overlap at 1.6 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*

Supported formats

Formats	Downlink, uplink
Single-button presets	TSM (v3.0.0)

Other adjustable parameters

Chip rate	Continuously adjustable
Filter alpha	Continuously adjustable between 0.05 and 1.0
Downlink pilot sequence	0 – 31
Uplink pilot sequence	0 – 255 or limited to code group
Scramble sequence	0 – 127 or limited to code group
Basic midamble sequence	0 – 127 or limited to code group
Max users (selectable for each timeslot)	2, 4, 6, 8, 10, 12, 14, 16
Midamble shift	1 – max users

Measurement results

Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	All symbol rates and code channels taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
Code domain error	All symbol rates and code channels taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
IQ measured	Time, spectrum
IQ reference	Time, spectrum
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference)
Error summary	EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, frequency error, IQ offset, IQ skew, slot amplitude droop
Channel	*Individual code channel*
IQ measured	Time
IQ reference	Time
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time (vector difference between measured and reference)
Symbol table and error summary	EVM, magnitude error, phase error, data bits

3G Modulation Analysis (Option B7N), continued

TD-SCDMA modulation analysis, continued

Layer	*All code channels at once*
Code domain power	All symbol rates taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
Code domain error	All symbol rates taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
Overall	
Time	Aligned analysis region; active timeslots highlighted
Filtered time	IQ time, RRC filtered, resampled to 4x chip rate
Gate time	Gated IQ time
Gate spectrum	Averaged and instantaneous
Gate PDF, CDF	PDF, CDF of gate time magnitude
Error summary	Timing error, total power, midamble power, and data power for each timeslot
Other	
Analysis timeslot	CCDF
Pre-demodulation	Time, spectrum, correction
Display formats	
Overall time measurement results	Active timeslots highlighted with background color
CDP and CDE measurement results	Active code channels highlighted by CDP layer color

WLAN Modulation Analysis (Option B7R)

OFDM modulation analysis

Signal acquisition

Supported standards	802.11a, HiperLAN2, and 802.11g (OFDM)
Modulation format	BPSK, QPSK, 16QAM, 64QAM (auto detect or manual override)
Search length	
Minimum	Result length + 6 symbol times (24 µs)
Maximum	6,800 symbol times
Result length	Auto detect or adjustable from 1 to 1367 symbol times
Triggering	Single/continuous, free-run/channel/external
Measurement region	Length and offset adjustable within result length

Signal playback

Result length	Auto detect or adjustable from 1 to 1,367 symbol times
Capture length (gap-free analysis at 0% overlap; at 31.25 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*

Adjustable parameters

Data format	IEEE802.11a, HiperLAN2
Single button presets	IEEE802.11a, 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

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 error, sync correlation, number of symbols, modulation format, code rate, bit rate

Equalizer measurement results

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

Pre-demodulation measurement results

Time	Instantaneous
Spectrum	Instantaneous, average
Search time	Instantaneous

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

WLAN Modulation Analysis (Option B7R)

DSSS modulation analysis

Signal acquisition

Modulation format	Auto detect or manual override: Barker1, Barker2, CCK5.5, CCK11, PBCC5.5, PBCC11, PBCC22, PBCC33
Preamble	Auto detect (short, long)
Pulse search length	Adjustable between result length and 25 ms
Result length	Auto detect or adjust between 1 and 275,000 chips (25 ms)
Triggering	Single/continuous, free-run, channel, external
Measurement region	Interval and offset adjustable within result length

Signal playback

Result length	Auto detect or adjustable between 1 and 275,000 chips (25 ms)
Capture length (gap free analysis at 0% overlap; 34.375 MHz span)	*Capture length is dependent on hardware. See hardware specifications for more information.*

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

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 – 99 chips
Descrambler mode	On/off, preamble only, preamble, header only

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

Equalizer measurement results	*Equalizer impulse response, channel frequency response*
Equalizer impulse response	Computed from preamble
Channel frequency response	Computed from preamble

Pre-demodulation measurement results

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

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

802.16 OFDM Modulation Analysis (Option B7S)

General specifications

Signal acquisition

Supported standards	IEEE 802.16-2004
Supported modes	Uplink and downlink; continuous and burst; TDD, FDD, H-FDD
Modulation formats	BPSK, QPSK, 16QAM, 64QAM (auto detect, manual input)

OFDM parameters

Bandwidth	Settable, nominal per standard
Fs/BW ratio	Settable to 8/7, 57/50, 86/75, 144/125, 316/275, or arbitrary between 0.5 and 2.0
Equalizer training	Via channel estimation sequence in preamble; or estimation sequence plus data
Sub carrier selection	Selectable all; or one of sub carrier # -100 to +100 (0 not allowed); or pilot sub carriers only
Subchannel index	1 to 31 (for uplink signal analysis)

Measurement parameters

Result length	Auto-detected, or manually adjustable
Search length	Adjustable, limits may depend on input hardware
Pilot sub carrier tracking	Amplitude, phase, timing
Symbol timing	Adjustable from –(guard interval)/100 to 0
Averaging	RMS, RMS exponential
Span	Constrained to within approximately 10x signal bandwidth

OFDM trace results

Burst info	Text table containing information on burst power, modulation format, EVM, and length in symbols
Common pilot error	One point analyzed per OFDM symbol
Equalizer channel frequency response	One point per sub carrier; frequency response shown dependent on equalizer training value selected
Equalizer impulse response	Result length = 4 x FFT length
Error vector spectrum	One point per sub carrier per analyzed OFDM symbol time
Error vector time	One point per sub carrier per analyzed OFDM symbol time
IQ measured data	One point per sub carrier per analyzed OFDM symbol time; all modulation formats shown
IQ reference data	One point per sub carrier per analyzed OFDM symbol time; all modulation formats shown
Preamble frequency error	Frequency error vs. time, during the preamble (including during all the long preamble)
RMS averaged error vector spectrum	One point per sub carrier
RMS averaged error vector time	One point per OFDM symbol analyzed
Symbols/error	Error summary with raw OFDM detected symbols
Tx2 Eq Chan Freq Resp	If space-time coded (STC) preamble detected, equalizer channel frequency response for the second transmit antenna
Tx2 Eq Imp Resp	If STC preamble detected, equalizer impulse response for the second transmit antenna

Additional trace results

CCDF	Cumulative complementary distribution function of time trace; extra time data before start and after end of burst not included
CDF	Complementary distribution function of time trace; extra time data before start and after end of burst not included

802.16 OFDM Modulation Analysis (Option B7S), continued

General specifications, continued

Correction	Frequency domain correction applied to raw measured time data
Instantaneous spectrum	Frequency spectrum of the time trace
PDF	Probability density function of time trace
Raw main time	Block data acquired by hardware, including extra data for filter settling
Search time	Block data acquired and searched for an RF burst
Spectrum	Frequency spectrum of time trace, or averaged time if averaging on
Time	Block data detected by pulse search

Error information/results

CPE RMS	RMS level of (CPE-1), where CPE is the complex correction value detected during pilot tracking
RCE RMS	RMS level of the relative constellation error vector, % or dB
RCE peak	Peak level of the relative constellation error vector, % or dB
RCE peak symbol	OFDM symbol number where RCE peak was detected
Frequency error	Averaged measured carrier frequency minus analyzer center frequency
IQ gain imbalance	Ratio of I (in-phase) to Q (quadrature phase), dB
IQ offset	Carrier leakage measured during channel estimation sequence portion of preamble, dB
IQ quadrature error	Quadrature skew, degrees
Pilot EVM	RMS EVM level for pilot sub carriers, averaged over all analyzed OFDM symbols
Preamble type	Detected preamble: short, long, STC, AAS; also will display non-standard preamble consisting of optional P4x64 sequence followed by one of the P_{even}, P_{odd}, P_{aas}, or P_{all} sequences
Symbol clock error	Timing error, ppm
Sync correlation	Correlation coefficient between measured and ideal preamble

Dynamic Link to EEsof ADS (Option 105)

Source component

This option links the 89600 VSA with design simulations running on the Agilent EEsof Advanced Design System providing real-time, interactive analysis of results. It adds vector signal analyzer sink and source components to the Agilent Ptolemy simulation environment. When a simulation is run, the 89600 software is automatically launched.

The VSA sink component analyzes waveform data from a simulation. Its user interface and measurement functions are the same in this mode as for hardware-based measurements. The VSA source component outputs measurement data to a simulation. Its input data can be from a recording or hardware. Front-end hardware need not be present when using either component unless live measurements are to be sourced into a simulation.

ADS version required

ADS 2001 or later

ADS output data types supported

Data	Timed
	Frequency
	Demod errors
	Complex scalar
	Float scalar
	Integer scalar
Control	Data gap indicator

Dynamic Link to EEsof ADS (Option 105), continued

VSA input modes	Hardware, recording
VSA analysis range	Dependent on input mode and hardware installed
VSA component parameters (user settable)	VSATitle ControlSimulation OutputType Pause VSATrace Tstep SetUpFile RecordingFile SetUpUse AutoCapture DefaultHardware AllPoints
VSA component parameters (passed to ADS, timed output only)	Carrier frequency Tstep

Sink component

ADS version required	ADS 1.3 or later
ADS input data types supported	Float Complex Timed – base band Timed – ComplexEnv
VSA input modes	Single channel, dual channel, I + jQ
VSA analysis range	
Carrier frequency	DC to > 1 THz
Tstep (sample time)	$< 10^{-12}$ to $> 10^{3}$ seconds
VSA component parameters (user settable)	VSATitle Tstep SamplesPerSymbol RestoreHW SetupFile Start Stop TclTkMode RecordMode SetFreqProp

Dynamic Link to EEsof ADS (Option 105), continued

VSA component parameters (passed from ADS)	Carrier frequency Tstep Data type

Number of VSAs that can run concurrently

ADS version 1.5 and later	20
ADS version 1.3	1

ADS components

Required ADS components

EEsof Design Environment	E8900A/AN
EEsof Data Display	E8901A/AN
EEsof Ptolemy Simulator	E8823A/AN

Recommended ADS configuration

EEsof Communication System Designer Pro	E8851A/AN
EEsof Communication System Designer Premier	E8852A/AN

Ordering Information

89601A	Vector signal analysis software, including 1-year of software update subscription service
Options	Option 200 required
89601A-200	Basic vector signal analysis software
89601A-300	Hardware connectivity
89601A-AYA	Flexible modulation analysis
89601A-B7N	3G modulation analysis
89601A-B7R	WLAN modulation analysis
89601A-B7S	802.16 OFDM modulation analysis
89601A-105	Dynamic link to EEsof/ADS
89601AN	Vector signal analysis software (floating license for 1 server)
Options	Note: multiple quantities of one option may be ordered per each server. Option 200 required. Every user must have Option 200, so the maximum quantity of any option may not exceed the quantity of Option 200. For multiple servers, order additional 89601AN.
89601AN-200	Basic vector signal analysis software
89601AN-300	Hardware connectivity
89601AN-AYA	Flexible modulation analysis
89601AN-B7N	3G modulation analysis
89601AN-B7R	WLAN modulation analysis
89601AN-B7S	802.16 OFDM modulation analysis
89601AN-105	Dynamic link to EEsof/ADS
89601N12	Vector signal analysis software, 12-month limited-term package floating license for 1 server, Includes 1-year software update subscription.
Options	Option 801 required. Multiple 801 options may be ordered per server. For multiple servers, order additional 89601N12
89601N12-801	Twelve-month floating license software package including VSA software options -200, -300, -105, -AYA, -B7N, -B7R, -B7S
89601AS	Additional software update subscription service
Options	Twelve-month minimum required (12 Option 0RU). Twenty-four-month maximum coverage, total. Since 1-year is included at initial purchase, there is a 12-month maximum at initial purchase. Renewal orders have a 24-month maximum.
89601AS-0RU	One-month software coverage
89601ASN	Software update subscription service for 1 server (floating license)
Options	Options 875 and 0RU required. The number of 875 options must match the number of Option 200 installed on server. Option 0RU: 12-month minimum required per Option 875. Twenty-four-month maximum coverage.
89601ASN-875	Subscription service for one 89601AN-200 floating license
89601ASN-0RU	One-month software coverage

Product Upgrades

You may order any of the options after purchase. For future options or to get the most current versions of these options, you must be at the current shipping revision of software. If you are not, purchase of 1-year of 89601AS/ASN is required (qty 12 –0RU). When purchasing an upgrade, please indicate to your sales representative that you are doing so.

Product Support and Training

Agilent provides both product-specific and application training, as well as specialized consulting services. Of particular interest are the following:

PS-S20-01	One day of start-up assistance **(recommended)**
PS-S10	Phone assistance **(6 hours recommended)**
PS-T10-896xx	89600 users' course
PS-T11-896xx	Digital radio troubleshooting
PS-T12-896xx	Wireless LAN technology fundamentals
R1362A-250 V	SA wireless LAN measurements

The 89600 users' course and W-LAN technology fundamentals are classes available on-site at your location. The VSA wireless LAN measurements and productivity assistance products are consulting services tailored to your needs.

User-Supplied PC Requirements

The 89600 Series VSAs require a PC to control the hardware and display results. You can use your PC for this task. The following are the minimum requirements for a user-supplied PC. For best immunity to electrostatic discharge (ESD), use a desktop PC.

	Desktop	**Laptop**
CPU	180 MHz Pentium® or AMD-K6 (> 300 MHz recommended)	> 300 MHz Pentium or AMD-K6
Empty slots	1 CardBus Type II slot (Two recommended)	1 CardBus Type II slot (Two recommended)
RAM	192 MB (256 MB recommended)	192 MB (256 MB recommended)
Video RAM	4 MB (8 MB recommended)	4 MB (8 MB recommended)
Hard disk space	200 MB available	200 MB available
Operating system	Microsoft Windows 2000, SP2, or XP Professional	Microsoft Windows 2000, SP2, or XP Professional
Additional drives	CDROM or 3.5 inch floppy (if no network access available)	CDROM or 3.5 inch floppy (if no network access available)
Interface support	IEEE-1394-1995[1]	IEEE-1394-1995[1]

1. For a list of supported interfaces, see **www.agilent.com/find/iolib** or contact your local Agilent call center or sales office. IEEE-1394 interface required for VXI hardware only.

Related Literature

5988-1679EN *89600 Series Vector Signal Analysis Software 89601A/89601AN/89601N12, Technical Overview*

5980-1989E *89600S Vector Signal Analyzer, CD*

5989-1753EN *Hardware Measurement Platforms for the 89600 Series Vector Signal Analysis Software oftware, Data Sheet*

5968-9350E *89600 Series Vector Signal Analyzers, VXI Configuration Guide*

5989-0871EN *89650S Wideband Vector Signal Analyzer System with High Performance Spectrum Analysis, Technical Overview*

5989-1435EN *89650S Bandwidth Vector Signal Analyzer System with High Performance Spectrum Analysis, Configuration Guide*

5988-9574EN *89607A WLAN Test Suite Software, Technical Overview*

5988-7812EN *89604A Distortion Test Suite Software, Version 4.0, Technical Overview*

Related Web Resources

For more information, visit: www.agilent.com/find/89600

Agilent Email Updates

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

Agilent Technologies' Test and Measurement Support, Services, and Assistance
Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you receive your new Agilent equipment, we can help verify that it works properly and help with initial product operation.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and onsite education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

Agilent T&M Software and Connectivity
Agilent's Test and Measurement software and connectivity products, solutions and developer network allows you to take time out of connecting your instruments to your computer with tools based on PC standards, so you can focus on your tasks, not on your connections. Visit **www.agilent.com/find/connectivity** for more information.

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

www.agilent.com/find/contactus

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: 9/17/04

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, November 1, 2004
5989-1786EN