Agilent 89611A 70 MHz IF Vector Signal Analyzer

Data Sheet

Specifications describe warranted performance after a 30-minute warm-up from ambient conditions. Parameters identified as “typical” or “characteristic” are included for informational purposes only, and are non-warranted.

Except where noted, these specifications also apply to the Agilent 89600S vector signal analyzer (VSA) systems, provided that all components meet their individual specifications, and that the system has been configured and assembled in accordance with the *Agilent 89600 Series Vector Signal Analyzers Configuration Guide* (literature number 5968-9350E) and all other applicable documents

The 89611A is designed to be used with an external, user-supplied downconverter having a nominal 70 MHz IF output. The following specifications do not include the effects of this downconverter. However, the 89611A provides mechanisms to correct for down-converter signal path imperfections. See the 89611A online Help (under “calibration, external IF” in the index), also available on the demo CD (literature number 5980-1989E), for more information.

Operation of the 89611A requires a personal computer meeting the following requirements:

Minimum requirements for a user-supplied desktop PC[1]:

- 180 MHz Pentium, or AMD-K6 CPU (>300 MHz CPU recommended)
- One empty PCI-bus slot (2 slots recommended)
- 192 MB RAM (256 MB recommended)
- 4 MB video RAM (8 MB recommended)
- Hard disk with 100 MB available space
- Microsoft® Windows NT® 4.0 (Service Pack 5 or greater required) or Windows® 2000
- CD-ROM drive (can be provided via network access)
- 3.5-inch floppy disk drive (can be provided via network access)

Minimum requirements for a user-supplied laptop PC[1]:

- > 300 MHz Pentium, or AMD-K6 CPU
- One empty Cardbus Type II slot (2 slots recommended)
- 192 MB RAM (256 MB recommended)
- 4 MB video RAM (8 MB recommended)
- Microsoft Windows 2000
- CD-ROM drive (can be provided via network access)
- 3.5-inch floppy disk drive (can be provided via network access)
- Supported IEEE 1394-1995 interface (may not be available in all areas worldwide)

For a list of supported interfaces, go to **www.agilent.com/find/iolib** or contact your local Test and Measurement Call Center or sales office.

Definitions

dBc: dB relative to largest input signal

dBfs: dB relative to full-scale amplitude range setting. Full scale is approximately 10 dB below ADC (analog-to-digital converter) overload.

FS or fs: Full scale; synonymous with amplitude range or input range.

RBW: Resolution bandwidth

Vector signal analysis only

The Agilent 89611A consists of a single application for Microsoft Windows NT or Windows 2000, the vector signal analyzer of the 89600 series vector signal analyzers. This application performs vector analysis of complex signals in the time, frequency and modulation domains.

The following specifications apply only to the vector signal analyzer application. The 89611A does not support the spectrum analyzer application.

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

Frequency

Frequency tuning	
Actual frequency tuning display is possible via user-settable parameter entry.	
Frequency range	
Band 1	70 MHz ± 18 MHz[2]
Band 2	dc to 36 MHz[3]
Frequency spans	<1Hz to 36 MHz[3]
Center frequency tuning resolution	1 mHz
Frequency points per span	
Calibrated points	51–102,401
Displayable points	51–131,072

Frequency accuracy	
Frequency accuracy is the sum of initial accuracy, aging, and temperature drift (ppb = parts per billion)	
Initial accuracy	100 ppb
Aging	1 ppb/day 100 ppb/year
Temperature drift, 0 – 50 °C	50 ppb

Frequency stability (spectral purity)	
Phase noise, 10 MHz input (typical)[4]	
100 Hz offset	<-108 dBc/Hz
1 kHz offset	<-118 dBc/Hz
>10 kHz offset	<-120 dBc/Hz
Phase noise, 70 MHz input (typical)[4]	
100 Hz offset	<-92 dBc/Hz
1 kHz offset	<-102 dBc/Hz
>10 kHz offset	<-110 dBc/Hz

Resolution bandwidth (RBW)	
Range	<1 Hz to 10 MHz

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 a 1-3-10 sequence, or directly enter an arbitrarily chosen bandwidth.

2. The analyzer can be configured to display and accept frequency settings based on the user's RF analysis band.
3. Overrange provided to 37.11 MHz
4. Characterized for systems using Agilent E8408B VXI mainframe with Options 001 and 918; for other mainframes, figures shown are typical.

RBW shape factor

The window choices below allow the user to optimize the RBW shape as needed for best amplitude accuracy, best dynamic range, or best response to transient signal characteristics. See the user manual for descriptions.

Window	Selectivity (3:60 dB)	Passband flatness	Rejection
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

Amplitude

Except as noted, specifications apply within the following frequency ranges:

Band 1	70 MHz ±18 MHz
Band 2	0–36 MHz

Input range

Full scale range

Band 1	-45 dBm to +20 dBm in 5 dB steps
Band 2	-30 dBm to +20 dBm in 5 dB steps
Maximum safe input level	+20 dBm, ±5 VDC
ADC overload (typical)	
Band 1	+10 dBfs
Band 2	+9 dBfs

Input ports

Nominal impedance	50Ω

Connector
Type N (SMA and BNC adapters provided)

VSWR (return loss)

Band 1 (all ranges)	2.1:1 (9 dB)
Band 2 (all ranges)	1.5:1 (14 dB)

Amplitude accuracy
Accuracy specifications apply with flat-top window selected. Amplitude accuracy is the sum of absolute full-scale accuracy and amplitude linearity.

Absolute full-scale accuracy

Band 1

0-50 °C	±0.8 dB

Band 2

0-50 °C	±0.8 dB

Amplitude linearity

0 to -30 dBfs	±0.10 dB
-30 to -50 dBfs	±0.15 dB
-50 to -70 dBfs	±0.20 dB

Flatness
Frequency response across the measurement span in vector signal analysis mode (included in amplitude accuracy specifications).

Bands 1,2 (typical)	±0.2 dB

Amplitude frequency correction

External frequency correction is available to correct for downconverter signal path imperfections. The user must provide a calibration trace file. Details are given in the 89611A online Help (under “89611, setup” in the index), also available on the demo CD (literature number 5980-1989E).

Dynamic range

Dynamic range indicates the amplitude range that is free of erroneous signals within the measurement bandwidth

Intermodulation distortion

(Two input signals, each -6 dBfs to -10 dBfs, separation >1 MHz. Specified relative to either signal, 20–30 °C)

Third-order, bands 1 and 2	<-70 dBc <-67 dBc, 0 – 50° C
Second-order, band 1	<-64 dBc, 0 – 50° C
Second-order, band 2 (<30 MHz)	<-70 dBc

Harmonic distortion

(Single input signal, 0 to -10 dBfs, 20 – 30° C)

Band 1, 2	< -70 dBc

Spurious responses

(Full-scale input signal within analyzer frequency range)

Bands 1,2	<-70 dBc

Spurious sidebands

(Full-scale input signal) [5]

Band 1 (>1 kHz offset)	<-70 dBc
Band 2 (>1 kHz offset)	<-70 dBc

Residual responses

(Input port terminated and shielded, >10 kHz)

Bands 1,2	maximum of -77 dBfs or -100 dBm

Input noise density

(Range ≥-30 dBm)

Band 1	<-118 dBfs/Hz
Band 2 (>0.1 MHz)	<-122 dBf/Hz

Sensitivity

(Most sensitive range)

Band 1	<-159 dBm/Hz
Band 2	<-152 dBm/Hz

Phase

(Vector signal analyzer application)

Linearity

Group delay deviation across maximum measurement span, using flat-top window.

Band 1 (typical)	±6 ns
Band 2 (typical)	±2 ns

5. Specified for systems using Agilent E8408B VXI mainframes with Options 001 and 918; for other mainframes, figures shown are typical.

Time and waveform
(Vector signal analyzer)

Baseband versus zoom measurements

These two signal processing modes affect the appearance and the duration of input waveforms as they are captured and displayed on the 89600 series VSAs.

Most 89600 series VSA measurements are made in the zoom mode, which has a non-zero start frequency. In this mode, 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 powerful capability to examine the baseband components of a signal without demodulating it.

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

Waveform accuracy

See "Amplitude accuracy"

Time record characteristics

In the 89600 series VSA application, 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 the following characteristics:

Time record length	= (number of frequency points – 1)/span, with RBW mode set to arbitrary, auto-coupled.
Time sample resolution	= 1/(k x span), where k = 2.56 for time data = baseband, and k = 1.28 for time data = zoom.

Time capture characteristics

In time capture mode, the 89600 series VSA captures the incoming waveform in real time (that is, 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 post-analyzing the captured waveform, users may adjust measurement span and center frequency to zoom in on specific signals of interest, as long as the new measurement span lies entirely within the originally captured span.

Time capture memory size (zoom mode)
For baseband mode increase values by 2x.

	Bytes	Samples[6]	Samples[7]
Standard	18M	6M	3M
Opt 144	144M	48M	24M
Opt 288	288M	96M	48M
Opt 001	1152M	384M	192M

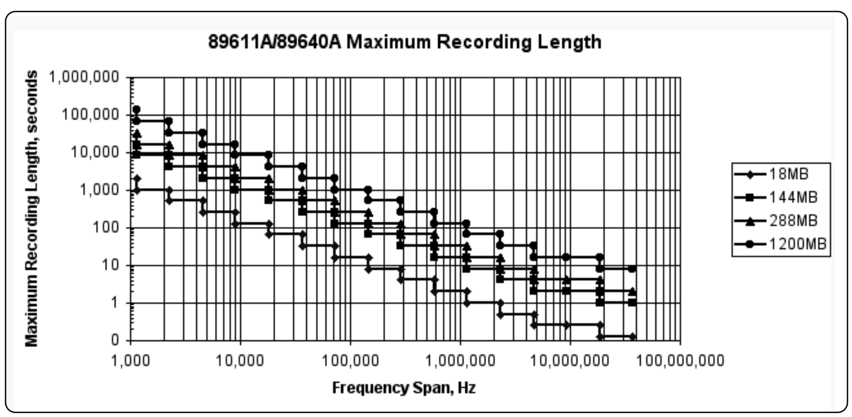
Time capture length: = memory samples x time sample resolution

Time sample resolution: = 1/(k x cardinal span)
where k = 2.56 for time data = baseband,
and k = 1.28 for time data = zoom.

Cardinal frequency spans are those related to the maximum span by an integer power of two, for example = 37.109375 MHz/2^n.

During the time capture, the analyzer is internally set to the next highest cardinal span that equals or exceeds the currently displayed frequency span.

Time capture length versus span



6. Frequency spans >18.56 MHz
7. Frequency spans <18.56 MHz

Measurement, display and control

Triggering	
Trigger types	
Vector signal analyzer 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 [8]
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).	
Amplitude resolution	<0.5 dB
Amplitude ranges	>3 dBfs to <–70 dBfs. Usable range is limited by the total integrated noise in the measurement span.
IF trigger hysteresis	1.5 dB
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 signals above the trigger threshold.	
Hold-off resolution	Same as time capture sample resolution
Hold-off range	0 to $2^{24} - 1$ time samples [8]
External trigger	
Works with analog and TTL signals.	
Type	ac-coupled comparator
Minimum pulse width	>300 ns
Minimum pulse amplitude	>100 mV
Slope	Positive, negative
Input impedance	1 kΩ

Averaging	
Number of averages, maximum	$>10^{8}$
Overlap averaging	0% to 99.99%
Average types	
Vector signal analyzer application	rms (video), rms (video) exponential, peak hold, time, time exponential

8. Time sample length is a function of measurement span, as described under "Time and waveform" specifications. In actual operation, trigger parameters are set and displayed in time units (seconds).

Analog demodulation

Demodulation types	AM, PM, FM, with auto carrier locking provided for PM or FM
Demodulator bandwidth	Same as selected measurement span
AM demodulation (typical)	
Accuracy	±1%
Dynamic range	60 dB (100%) for a pure AM signal
Cross demodulation	< 0.3% AM on an FM signal with 10 kHz modulation, 200 kHz deviation
PM demodulation (typical)	
Accuracy	±3 degrees
Dynamic range	60 dB (rad) for a pure PM signal
Cross demodulation	< 1 degree PM on an 80% AM signal
FM demodulation (typical)	
Accuracy	±1% of span
Dynamic range	60 dB (Hz) for a pure FM signal
Cross demodulation	< 0.5% of span FM on an 80% AM signal

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 specifications for main time length and time resolution details.

Gate length, maximum	Main time length	
Gate length, minimum	= 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

Marker functions

Peak signal track, frequency counter, band power

Band power markers

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.

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

	Display formats				
Trace Data	Vector signal analysis (demodulation OFF)	Vector signal analysis (analog demodulation)	Vector modulation analysis (Option AYA)	W-CDMA and cdma2000 modulation analysis (Option B7N)	802.11a OFDM and HiperLAN2 modulation analysis (Option B7R)
Autocorrelation	•	•			
Complementary cumulative distribution function	•	•			
Cumulative distribution function	•	•			
Channel frequency response			•		•
Code domain error				•	
Code domain power				•	
Common pilot error					•
Composite errors				•	
Coherence					
Correction	•	•	•		•
Error vector spectrum			•	•	•
Error vector time			•	•	•
RMS error vector time					•
RMS error vector spectrum					•
Equalizer impulse response			•		•
Gate time	•	•			
Instantaneous main time	•	•			
Instantaneous spectrum	•	•	•		•
IQ mag error			•	•	
IQ measurement					•
IQ measurement spectrum			•	•	
IQ measurement time			•	•	
IQ phase error			•	•	
IQ reference					•
IQ reference spectrum			•	•	
IQ reference time			•	•	
Main time	•	•			
Probability density function	•	•			
Power spectral density	•	•			
Search time			•		•
Spectrum	•	•	•	•	•
Symbols/errors			•	•	•
Time			•	•	•

Trace formats	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
Trace layouts	1–4 traces on one, two or four grids
Number of colors	User-definable 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.
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 (characteristic)	Displays occupy memory at a rate of 128 traces/MB (for traces of 401 frequency points).

Software interface

The 89600 series 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 fully described in the 89600 series VSA documentation.

Because all functionality is implemented within the VSA 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 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.

Remote displays

To operate the VSA 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.

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 series 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)
Binary	Agilent E3238 time snapshot (.cap) and time recording (.cap) files under 2 GB in size. No additional calibration
MATLAB 5	MAT-file (.mat)
MATLAB 4 and prior	MAT-file (.mat)

Source

In source mode, the 89600 series VSAs can control a signal generator via GPIB or LAN. Control is provided via the VSA GUI (graphical user interface). 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 series signal generators (firmware version B.03.50 or later) with Option UND, internal dual arbitrary waveform generator (firmware version 1.2.92 or later)
Signal types	CW (fixed frequency sinewave) Arbitrary
Frequency range	Determined by signal generator
Level range	–136 dBm to 20 dBm in 0.02 dBm steps

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

Option AYA
Vector modulation analysis

Signal acquisition	
Note: Signal acquisition does not require an external carrier or symbol clock	
Data block length	Adjustable to 4096 symbols.
Samples per symbol	1–20
Symbol clock	Internally generated
Carrier lock	Internally locked
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 modulation formats	
Carrier types	Continuous and pulsed/burst (such as TDMA)
Modulation formats	2, 4, 8 and 16 level FSK (including GFSK)
	MSK (including GMSK)
	QAM implementations of: BPSK, QPSK, OQPSK, DQPSK, D8PSK, $\frac{\pi}{4}$ DQPSK, $\frac{3\pi}{8}$ BPSK (EDGE)
	16QAM, 32QAM, 64QAM, 128QAM, 256QAM (absolute encoding)
	16QAM, 32QAM, 64QAM (differential encoding per DVB standard)
	8VSB, 16VSB
Single-button presets for	
Cellular:	CDMA (base), CDMA (mobile), CDPD, EDGE, GSM, NADC, PDC, PHP (PHS), W-CDMA
Wireless networking:	Bluetooth™, HiperLAN1 (HBR), HiperLAN1 (LBR), 802.11b
Digital video:	DTV8, DTV16, DVB16, DVB32, DVB64
Other:	APCO25, DECT, TETRA, VDL mode 3

Filtering	
Filter types	Raised cosine, square-root raised cosine, IS-95 compatible, Gaussian, EDGE, lowpass, rectangular, none
Filter length	40 symbols: VSB; QAM and DVB-QAM where α <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

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 is doubled for VSB modulation format.

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 measured	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 or constellation states.

Polar diagrams

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

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	

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), error, SNR (8/16VSB and QAM formats), quadrature 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.

Error summary (FSK)

Measured rms and peak values of the following:	FSK error, magnitude error, carrier offset frequency, deviation

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.

Accuracy (typical)

Formats other than FSK, 8/16 VSB and OQPSK.
Averaging = 10

Conditions: Specifications apply from 20–30° C for a full-scale signal, fully contained in the selected measurement span, random data sequence, instrument receiver mode of band 2 (0 – 36 MHz) or band 1 (70 MHz ±18 MHz), range ≥-25 dBm, start frequency ≥15% of span, alpha/BT ≥0.3*, and symbol rate ≥1 kHz. For symbol rates less than 1 kHz, accuracy may be limited by phase noise.

* 0.3 < alpha <0.7 offset QPSK

Residual errors (result = 150 symbols, averages = 10)

Residual EVM	
span ≤100 kHz	<0.5% rms
span ≤1 MHz	<0.5% rms
span ≤10 MHz	<1.0% rms
span >10 MHz	<2.0% rms

Magnitude error	
span ≤100 kHz	0.3% rms
span ≤1 MHz	0.5% rms
span ≤10 MHz	1.0% rms
span >10 MHz	1.5% rms

Phase error	
(For modulation formats with equal symbol amplitudes)	
span ≤100 kHz	0.3° rms
span ≤1 MHz	0.4° rms
span ≤10 MHz	0.6° rms
span >10 MHz	1.2° rms

Frequency error (Added to frequency accuracy if applicable)	symbol rate/500,000
I-Q/origin offset	–60 dB or better

Video modulation formats	
Residual errors (typical)	
8/16 VSB: Symbol rate = 10.762 MHz, α = 0.115, instrument receiver mode of band 2 (0–36 MHz) or band 1 (70 MHz ±18 MHz), 7 MHz span, full-scale signal, range ≥-25 dBm, result length = 800, averages = 10	
Residual EVM	≤1.5% (SNR ≥36 dB)
16, 32, 64 or 256 QAM: Symbol rate = 6.9 MHz, α = 0.15, instrument receiver mode of band 2 (0–36 MHz) or band 1 (70 MHz ±18 MHz), 8 MHz span, full-scale signal, range ≥-25 dBm, result length = 800, averages = 10	
Residual EVM	≤1.0% (SNR ≥40 dB)

Adaptive equalizer	
Removes the effects of linear distortion (for example, non-flat frequency response and multipath) 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.	
Equalizer 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, D8PSK, π/4DQPSK, 8PSK, 16QAM, 32QAM, 64QAM, 256QAM, 128QAM, 8VSB, 16VSB, $\frac{3\pi}{8}$ PSK (EDGE)

Option B7N W-CDMA and cdma2000 modulation analysis

(requires Option AYA, vector modulation analysis)

W-CDMA modulation analysis	
Signal aquisition (characteristic)	
Result length	Adjustable between 1 and 64 slots
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length
Signal playback (characteristic)	
Result length	Adjustable between 1 and 64 slots
Capture length (gap-free analysis @ 0% overlap; at 5 MHz span)	375 slots (standard) 3000 slots (Option 144) 6000 slots (Option 288) 24000 slots (Option 001)
Supported formats (characteristic)	
Formats	Downlink, uplink
Single-button presets	Downlink, uplink

Other adjustable parameters (characteristic)	
Chip rate	Continuously adjustable
User-selectable alpha	Continuously adjustable between 0.05 and 1
Scramble code (downlink)	Continuously adjustable between 0 and 511
Scramble code (uplink)	Continuously adjustable between 0 and $2^{24} - 1$
Scramble offset (downlink)	Continuously adjustable between 0 and 15
Scramble type (downlink)	Standard, left, right
Sync type (downlink)	CPICH, SCH

Measurement results (characteristic)	
Composite (all code channels at once or all symbol rates taken together)	
Code domain power	All symbol rates together Individual symbol rates (7.5, 15, 30, 60, 120, 240, 480, 960 ksps)
Code domain error	Composite (all symbol rates taken together) Individual symbol rates (7.5, 15, 30, 60, 120, 240, 480, 960 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)
Composite errors	Summary of EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, Ttrigger, frequency error, IQ offset, slot number
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	Summary of EVM, magnitude error, phase error, slot number, pilot bits, tDPCH
Other	
Pre-demodulation	Time, spectrum

Display formats (characteristic)	
CDP measurement results	I and Q shown separately on same trace for uplink
Channel measurement results	I and Q shown separately
Code order	Hadamard, bit reverse
Other	Same as Option AYA

Accuracy (typical) (Input range within 5 dB of total signal power)	
Code domain	
CDP accuracy	±0.3 dB (spread channel power within 20 dB of total power)
Symbol power versus time	±0.3 dB (spread channel power within 20 dB of total power averaged over a slot)

Composite EVM	
EVM floor	1.5% or less for pilot only
EVM floor	1.5% or less for test model 1 with 16 DPCH signal
Frequency error	
Range (CPICH sync type)	±500 Hz
Accuracy	±10 Hz

cdma2000 modulation analysis	
Signal aquisition (characteristic)	
Result length	Adjustable between 1 and 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 (characteristic)	
Result length	Adjustable between 1 and 64 PCGs forward link; 1 and 4 PCGs reverse link
Capture length (gap-free analysis at 0% overlap; at 2.6 MHz span)	400 PCGs (standard) 3200 PCGs (Option 144) 6400 PCGs (Option 288) 25600 PCGs (Option 001)
Supported formats (characteristic)	
Formats	Forward, reverse
Single-button presets for	Forward, reverse
Other adjustable parameters (characteristic)	
Chip rate	Continuously adjustable
Long code mask (reverse)	0
Base code length	64, 128
Measurement results (characteristic)	
Composite (all code channels at once or all symbol rates taken together)	
Code domain power	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 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)
Composite errors	Summary of EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, T trigger, frequency error, IQ offset, PCG number

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	Summary of EVM, magnitude error, phase error, PCG number
Other	
Pre-demodulation	Time, spectrum
Display formats (characteristic)	
CDP measurement results	I and Q shown separately on same trace
Channel measurement results	I and Q shown separately
Code order	Hadamard, bit-reverse
Other	Same as option AYA
Accuracy (typical) (Input range within 5 dB of total signal power)	
Code domain	
CDP accuracy	±0.3 dB (spread channel power within 20 dB of total power)
Symbol power versus time	±0.3 dB (spread channel power within 20 dB of total power averaged over a PCG)
Composite EVM	
EVM floor	1.5% or less for pilot only
EVM floor	1.5% or less for test model 1 with 16 DPCH signal
Frequency error	
Range	±500 Hz
Accuracy	±10 Hz

Option B7R 802.11a OFDM and HiperLAN2 modulation analysis

(requires Option AYA, vector modulation analysis)

Signal acquisition	
Modulation format	Auto detect or manual override (BPSK, QPSK, 16 QAM, 64 QAM)
Search length (minimum search length is result length + 24 μs)	Adjustable between 66 and 6800 symbol-times; 264 μs to 27 ms
Result length	Auto detect or adjustable between 1 and 1367 symbol-times
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 1367 symbol-times
Capture length (gap-free analysis at 0% overlap; at 31.25 MHz span)	0.125 seconds (standard) 1.0 seconds (Option 144) 2.0 seconds (Option 288) 8.0 seconds (Option 001)

Supported formats	
Formats	IEEE 802.11a, HiperLAN2
Single-button presets	IEEE 802.11a, HiperLAN2
Other adjustable parameters	
IQ 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)
Pilot Tracking	Optionally phase, optionally amplitude, optionally timing
Carriers to Analyze	All or Single Carrier
Demodulation measurement results	
IQ measured	All carriers over all symbol-times
IQ reference	All carriers over all symbol-times (ideal, computed from detected symbols)
Error vector	Time, Spectrum (vector difference between measured and reference)
RMS error vector	Time, Spectrum
Common pilot error (CPE)	At all symbol-times
Symbol table and error summary	Summary of EVM, pilot EVM, common pilot error, IQ offset, freq error, sync correlation, number of symbols, modulation format, code rate, bit rate
Equalizer measurement results (Shows effects of downconverter IF flatness if left uncorrected)	
Equalizer impulse response (computed from preamble)	
Channel frequency response (computed from preamble)	
Pre-demodulation measurement results	
Time	
Spectrum	Instantaneous, Averaged
Search time	
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
Other	Same as Option AYA
Residual EVM (independent of modulation format)	-40 dB max
Frequency error (relative to frequency standard)	
Lock range	± 625 kHz
Accuracy	± 1 Hz

Option 105
Dynamic links to EEsof ADS

This option links the 89600 series VSAs 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 series 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.

VSA sink component specifications (ADS 1.3 or later)	
ADS data types supported	Float Complex Timed – baseband 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 $>10^{3}$ s
VSA component parameters (user-settable)	VSATitle TStep SamplesPerSymbol RestoreHW SetFreqProp SetupFile Start Stop TclTkMode RecordMode
VSA component parameters (passed from ADS)	Carrier frequency TStep Data type

VSA source component specs (ADS2001 or later)		
ADS output data types supported	Data	Timed Frequency Demod errors Complex Scalar Float scalar Integer Scalar
	Control	Data gap indicator
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

Number of VSAs that can run concurrently	
ADS version 1.5 and later	20
ADS version 1.3	1
Required ADS components	
EEsof Design Environment	E8900A/AN
EEsof Data Display	E8901A/AN
EEsof Ptolemy Simulator	E8823A/AN
Recommended ADS configurations:	
EEsof Communication System Designer Pro	E8851A/AN
EEsof Communication System Designer Premier	E8852A/AN

General

System hardware	
A standard 89611A vector signal analyzer consists of the following hardware:	
RF input module	89605
95 MSa/s ADC	E1439
IEEE 1394 controller w/ PCI interface	E8491B Option 001
4-slot VXI mainframe	E8408A Options 001, 918
Cable and adapter set	89605B Option 611

Hardware interfaces (characteristics only)	
External trigger input	BNC connector; 1 KΩ impedance
External frequency reference	
Output	10 MHz at >+3 dBm into a 50Ω load
Input	10 or 13 MHz (±5 ppm) at >0 dBm into a 50Ω load. (89605B input module required)

Safety and environmental	
Safety standards	EN 61010-1 (1993)
Radiated emissions	EN 61326-1
Electrostatic discharge	Perf Criteria B (when used with desktop PC) Perf Criteria C (when used with laptop PC, may require operator intervention after an ESD event)
Environmental	
Operating temperature	0–50° C; for warranted specifications except as noted
Humidity	10% to 90% at 40° C non-condensing
Altitude	3000 m; above 2285 m, derate operating temperature by -3.6° C
Calibration interval	2 years
Power requirements	
47–440 Hz operation	90–140 Vrms
47–66 Hz operation	90–264 Vrms
Maximum power dissipation	280 VA

Physical	
Weight	14 kg (31 lb.)
Dimensions	
With protective bumpers	388 mm H x 152 mm W x 548 mm D
Without bumpers	362 mm H x 133 mm W x 540 mm D

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 use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

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 on-site 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.

By internet, phone, or fax, get assistance with all your test & measurement needs

Online assistance:
www.agilent.com/find/assist

Phone or Fax

United States:
(tel) 1 800 452 4844

Canada:
(tel) 1 877 894 4414
(fax) (905) 282 6495

China:
(tel) 800 810 0189
(fax) 1 0800 650 0121

Europe:
(tel) (31 20) 547 2323
(fax) (31 20) 547 2390

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

Korea:
(tel) (82 2) 2004 5004
(fax) (82 2) 2004 5115

Latin America:
(tel) (305) 269 7500
(fax) (305) 269 7599

Taiwan:
(tel) 080 004 7866
(fax) (886 2) 2545 6723

Other Asia Pacific Countries:
(tel) (65) 375 8100
(fax) (65) 836 0252
Email: tm_asia@agilent.com

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

Printed in USA June 12, 2002
5988-4092EN

Agilent Technologies