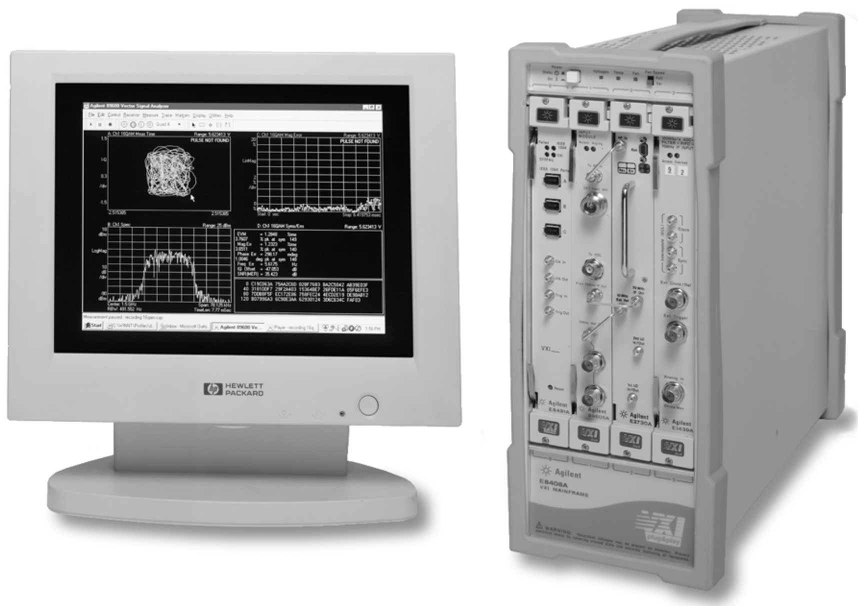
Agilent
89600 Vector Signal Analyzers

Data Sheet



The following specifications describe the warranted performance of standard 89600 Series VSA systems and equivalent 89600S systems integrated by Agilent Technologies. The performance of standard 89610S systems is specified in the E8408A[1] four-slot, E1421B[2] six-slot and E8403A[2] 13-slot VXI mainframe. The performance of standard 89611S, 89640S, and 89641S systems is specified in E8408A[1] four-slot, E1421B[2] six-slot and E8403A[2] 13-slot VXI mainframes. These specifications describe the nominal performance for other, non-standard 89600S configurations.

These specifications describe warranted performance over a temperature range of 20 to 30 °C and include a 30-minute warm-up from ambient conditions. Parameters identified as “typical” or “characteristic” are included for informational purposes only and are not warranted. To aid in understanding analyzer performance capabilities, measurement units and specification terms are provided in the glossary at the end of this document.

The Agilent 89600 Series vector signal analyzers come standard with two sets of application software: vector signal analysis and spectrum analysis. The vector signal analysis application software is used to analyze complex signals in the time, frequency, and modulation domains. The spectrum analyzer application software emulates a traditional spectrum analyzer, providing fast, high-resolution signal magnitude measurements while sweeping across a user-defined frequency span. Unless otherwise indicated, the specifications in this data sheet apply to both sets of application software.

1. With backplane connector RF shielding (Option E8408-80900) and enhanced current supply (Option E8408-100).
2. With backplane connector RF shielding (Option E1401-80918).

Table of Contents

Frequency

	89610A (DC – 40 MHz)	89611A (70 MHz ±18 MHz)	89640A (DC – 2700 MHz)	89641A (DC – 6000 MHz)
Frequency range				
Spectrum analysis mode				
RF/IF mode	—	See footnote 1	36 to 2700 MHz[5]	36 to 6000 MHz[5]
Baseband mode	DC to 40 MHz	See footnote 1	DC to 36 MHz[2]	DC to 36 MHz[2]
Vector analysis mode				
RF/IF mode	—	52 to 88 MHz[3]	36 to 2700 MHz[5]	36 to 6000 MHz[5]
Baseband mode	DC to 40 MHz	DC to 36 MHz[2]	DC to 36 MHz[2]	DC to 36 MHz[2]
Frequency tuning resolution	1 mHz	1 mHz	1 mHz	1 mHz
Frequency spans				
Spectrum analyzer application	< 1 kHz to 40 MHz	See footnote 1	< 1 kHz to 2700 MHz	< 1 kHz to 6000 MHz
Vector signal analyzer application				
1 channel mode	< 1 Hz to 39.06 MHz	< 1 Hz to 36 MHz	< 1 Hz to 36 MHz	< 1 Hz to 36 MHz
2 channel mode	< 1 Hz to 39.06 MHz	< 1 Hz to 36 MHz	< 1 Hz to 36 MHz	< 1 Hz to 36 MHz
Ch1 + j*Ch2 mode	< 2 Hz to 78 MHz	< 2 Hz to 72 MHz	< 2 Hz to 72 MHz	< 2 Hz to 72 MHz
Frequency points per span				
Spectrum analyzer application	2 – 131,072	See footnote 1	2 – 131,072	2 – 131,072
Vector signal analyzer application				
Calibrated points	51 – 102,401	51 – 102,401	51 – 102,401	51 – 102,401
Displayable points	51 – 131,072	51 – 131,072	51 – 131,072	51 – 131,072
Frequency accuracy	*Frequency accuracy is the sum of initial accuracy, aging, and temperature drift.*			
Initial accuracy	100 ppb	100 ppb	100 ppb	100 ppb
Aging	1 ppb/day 100 ppb/year	1 ppb/day 100 ppb/year	1 ppb/day 100 ppb/year	1 ppb/day 100 ppb/year
Temperature drift (0 – 50 °C)	50 ppb	50 ppb	50 ppb	50 ppb
Frequency stability				
Phase noise, baseband input at 10 MHz				
100 Hz offset	< –108 dBc/Hz	< –108 dBc/Hz	< –108 dBc/Hz	< –108 dBc/Hz
1 kHz offset	< –118 dBc/Hz	< –118 dBc/Hz	< –118 dBc/Hz	< –118 dBc/Hz
> 10 kHz offset	< –120 dBc/Hz	< –120 dBc/Hz	< –120 dBc/Hz	< –120 dBc/Hz
Phase noise, 80 MHz input				
100 Hz offset	—	< –92 dBc/Hz	—	—
1 kHz offset	—	< –102 dBc/Hz	—	—
> 10 kHz offset	—	< –110 dBc/Hz	—	—
Phase noise, 1 GHz input[4]				
> 20 kHz offset	—	—	< –99 dBc/Hz	< –99 dBc/Hz
> 100 kHz offset	—	—	< –110 dBc/Hz	< –110 dBc/Hz

1. No spectrum analysis mode available.
2. Over-range provided to 37.11 MHz.
3. The 89611A can be configured to display and accept frequency settings based on the user's RF analysis band.
4. < 0.05 Grms random vibration, 5 – 500 Hz.
5. Under-range provided to 30 MHz. Specifications are typical for center frequencies below 36 MHz.

Resolution Bandwidth Filtering

	89610A (DC – 40 MHz)	89611A (70 MHz ±18 MHz)	89640A (DC – 2700 MHz)	89641A (DC – 6000 MHz)
RBW range	*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 enter an arbitrarily chosen bandwidth directly.*			
Spectrum analyzer application	1 Hz to > 5 MHz	—	1 Hz to > 5 MHz	1 Hz to > 5 MHz
Vector signal analyzer application	< 1 Hz to 10 MHz	< 1 Hz to 10 MHz	< 1 Hz to 10 MHz	< 1 Hz to 10 MHz
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.*			
Flat top				
Selectivity (3:60 dB)	0.41	0.41	0.41	0.41
Passband flatness	0.01 dB	0.01 dB	0.01 dB	0.01 dB
Rejection	> 95 dBc	> 95 dBc	> 95 dBc	> 95 dBc
Gaussian top				
Selectivity (3:60 dB)	0.25	0.25	0.25	0.25
Passband flatness	0.68 dB	0.68 dB	0.68 dB	0.68 dB
Rejection	> 125 dBc	> 125 dBc	> 125 dBc	> 125 dBc
Hanning				
Selectivity (3:60 dB)	0.11	0.11	0.11	0.11
Passband flatness	1.5 dB	1.5 dB	1.5 dB	1.5 dB
Rejection	> 31 dBc	> 31 dBc	> 31 dBc	> 31 dBc
Uniform				
Selectivity (3:60 dB)	0.0014	0.0014	0.0014	0.0014
Passband flatness	4.0 dB	4.0 dB	4.0 dB	4.0 dB
Rejection	> 13 dBc	> 13 dBc	> 13 dBc	> 13 dBc

Amplitude

	89610A (DC – 40 MHz)	89611A (70 MHz ±18 MHz)	89640A (DC – 2700 MHz)	89641A (DC – 6000 MHz)
Input				
Full-scale range				
Baseband mode	–31 dBm to +20 dBm in 3 dB steps	–30 dBm to +20 dBm in 5 dB steps	–30 dBm to +20 dBm in 5 dB steps	–30 dBm to +20 dBm in 5 dB steps
IF/RF mode	—	–45 dBm to +20 dBm in 5 dB steps	–45 dBm to +20 dBm in 5 dB steps	–45 dBm to +20 dBm in 5 dB steps
Maximum safe input level	+24 dBm, ±5 VDC	+20 dBm, ±5 VDC	+20 dBm, ±5 VDC	+20 dBm, ±5 VDC
ADC overload (typical)				
Baseband mode	+10 dBfs	+9 dBfs	+9 dBfs	+9 dBfs
IF/RF mode	—	+10 dBfs	+10 dBfs	+10 dBfs
Input channels				
Standard	1	1	1	1
Optional	2 baseband	2 IF/baseband	2 IF/baseband	2 IF/baseband
Nominal impedance	50 ohms	50 ohms	50 ohms	50 ohms
Connector	BNC	Type N	Type N	Type N
Input coupling				
Baseband mode	AC or DC	AC or DC	AC or DC	AC or DC
IF/RF mode	—	AC	AC	AC
VSWR	*Return loss in measurement span.*			
Baseband mode				
All ranges	1.33:1 (17 dB)	1.5:1 (14 dB)	1.5:1 (14 dB)	1.5:1 (14 dB)
IF/RF mode				
+20 dBm to –20 dBm ranges	—	2.1:1 (9 dB)	1.8:1 (10.7 dB)	2.0:1 (9.5 dB)
–25 dBm to –45 dBm ranges	—	2.1:1 (9 dB)	2.5:1 (7.3 dB)	3.1:1 (5.8 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				
Baseband mode				
0 – 50 °C	±0.8 dB	±0.8 dB	±0.8 dB	±0.8 dB
IF/RF mode (≤ 2.7 GHz)				
20 – 30 °C	—	±0.8 dB	±2 dB	±2 dB
0 – 50 °C	—	±0.8 dB	±2 dB (typical)	±2 dB (typical)
RF mode (> 2.7 GHz)				
20 – 30 °C	—	—	—	±2 dB
0 – 50 °C	—	—	—	±2.25 dB (typical)
Amplitude linearity				
0 to –30 dBfs	±0.10 dB	±0.10 dB	±0.10 dB	±0.10 dB
–30 to –50 dBfs	±0.15 dB	±0.15 dB	±0.15 dB	±0.15 dB
–50 to –70 dBfs	±0.20 dB	±0.20 dB	±0.20 dB	±0.20 dB
Amplitude accuracy correction	—	See footnote 1	—	—
Residual DC (typical, 50 Ω)				
Baseband mode (input range > -20 dBm)	< -40 dBfs	< -40 dBfs	< -40 dBfs	< -40 dBfs

1. External amplitude correction is available to correct for down-converter RF signal path amplitude. The user must provide a calibration trace file. Details are given in the 89611A online Help (under "89611, Setup" in the index).

Amplitude – continued

	89610A (DC – 40 MHz)	**89611A (70 MHz ±18 MHz)**	**89640A (DC – 2700 MHz)**	**89641A (DC – 6000 MHz)**
Flatness	*Frequency response across the measurement span in vector signal analysis mode (included in amplitude specifications).*			
IF/RF mode (at center frequency ±10 MHz)	—	±0.2 dB (typical)	±0.2 dB (typical)	±0.2 dB (typical)
IF/RF mode (at center frequency ±18 MHz)	—	±0.2 dB (typical)	±0.2 dB (typical)	±0.3 dB (typical)
Baseband mode	±0.2 dB (typical)	±0.2 dB (typical)	±0.2 dB (typical)	±0.2 dB (typical)
Flatness correction	—	See footnote 1	—	—
Channel match	*Multiple channels are available as options.*			
Amplitude match (DC coupled, full-scale, matching input ranges)	±0.25 dB (baseband)	±0.25 dB (IF, baseband)	±0.25 dB (baseband) ±1.2 dB (RF)	±0.25 dB (baseband) ±1.2 dB (RF)[4]
Phase match (10 MHz input signal, full-scale, matching input ranges)	±4°	—	—	—
Group delay match (across measurement span, typical)	±2 ns (baseband)	±1.5 ns (IF)	±2.0 ns (baseband) ±5.0 ns (RF)	±2.0 ns (baseband) ±5.0 ns (RF)[4]
Stability (typical)				
Amplitude	—	0.006 dB/°C	0.006 dB/°C	0.006 dB/°C
Phase	—	1.0°/°C (baseband, IF)	1.0°/°C (baseband) 2.0°/°C (RF)	1.0°/°C (baseband) 2.0°/°C (RF)[4]
Dynamic range	*Dynamic range indicates the amplitude range that is free of erroneous signals within the measurement span.*			
Intermodulation distortion	*Two input signals, each –6 to –10 dBfs, separation > 1 MHz. Specified relative to either signal.*			
Third-order				
IF/baseband mode	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
RF mode	—	—	< –70 dBc	< –70 dBc
Harmonic distortion	*Single input signal, 0 to –10 dBfs.*			
IF/baseband mode	< –70 dBc	< –68 dBc	< –68 dBc	< –68 dBc
RF mode	—	< –70 dBc	– 55 dBc (typical)	–55 dBc (typical)
Spurious responses	*Full-scale input signal within analyzer measurement span.*			
IF/baseband mode	< –68 dBc	< –68 dBc	< –68 dBc	< –68 dBc
RF mode	—	—	< –65 dBc[2]	< –65 dBc[3]
	Full-scale input signal outside analyzer measurement span.			
IF/baseband mode	< –70 dBc	< –68 dBc	< –68 dBc	< –68 dBc
RF mode	—	—	< –52 dBc (typical)	< –50 dBc (typical)

1. Requires a manual procedure, see Help text. Required for external tuners only.
2. Typical specification degraded by 10 dB for input frequencies within ±10 MHz of 1890.6 MHz.
3. Typical specification degraded by 10 dB for input frequencies within ±10 MHz of 1890.6 MHz, 2909.4 MHz, 3709.4 MHz, 4509.4 MHz, 5309.4 MHz, 3200.0 MHz, and 3733.3 MHz.
4. For signal frequencies < 2.7 GHz.

Amplitude – continued

	89610A (DC – 40 MHz)	89611A (70 MHz ±18 MHz)	89640A (DC – 2700 MHz)	89641A (DC – 6000 MHz)
Dynamic range, continued				
Spurious sidebands	*Full-scale input signal.*			
Baseband mode (> 1 kHz offset)	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
RF mode (1 – 3 kHz offset)	—	< –70 dBc	< –65 dBc	< –65 dBc
RF mode (> 3 kHz offset)	—	< –70 dBc	< –70 dBc	< –70 dBc
Residual responses (> 10 kHz)	*Input port terminated and shielded*			
Baseband and IF/RF modes (maximum of)	–77 dBfs or –100 dBm	–77 dBfs or –100 dBm	–77 dBfs or –100 dBm	–77 dBfs or –100 dBm
Input noise density	*Range ≥ –30 dBm.*			
Baseband mode (> 0.1 MHz)	< –121 dBfs/Hz	< –121 dBfs/Hz	< –121 dBfs/Hz	< –121 dBfs/Hz
IF/RF mode (< 1.2 GHz)	—	< –118 dBfs/Hz	< –116 dBfs/Hz	< –116 dBfs/Hz
RF mode (1.2 – 2.7 GHz)	—	—	< –114 dBfs/Hz	< –114 dBfs/Hz
RF mode (> 2.7 GHz)	—	—	—	< –113 dBfs/Hz
Sensitivity	*Most sensitive range.*			
Baseband mode	< –151 dBm/Hz	< –151 dBm/Hz	< –151 dBm/Hz	< –151 dBm/Hz
IF/RF mode (< 1.2 GHz)	—	< –159 dBm/Hz	< –158 dBm/Hz	< –157 dBm/Hz
RF mode (1.2 – 2.4 GHz)	—	—	< –156 dBm/Hz	< –156 dBm/Hz
RF mode (> 2.4 GHz)	—	—	< –156 dBm/Hz	< –153 dBm/Hz

Phase[1]

	89610A (DC – 40 MHz)	89611A (70 MHz ±18 MHz)	89640A (DC – 2700 MHz)	89641A (DC – 6000 MHz)
Linearity (typical)	*Single channel group delay deviation across maximum measurement span[2], using flat-top window.*			
Baseband mode	±2 ns	±2 ns	±2 ns	±2 ns
IF/RF mode	—	±6 ns	±8 ns (RF)	±8 ns (RF)

1. Measurements apply to vector signal analyzer function.
2. ±17 MHz of center frequency (RF, IF), ≤ 35.5 MHz (baseband), ≤ 39.5 mHz (89610A).

Time and Waveform[1]

The 89600 series vector signal analyzers have two signal processing modes: baseband 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 powerful capability to examine the baseband components of a signal without the need to first demodulate it.

Baseband 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): (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 mode set to baseband
- 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 with in the originally captured span.

Time capture memory size

Zoom mode. For baseband mode, increase values by 2x.

	Option E143xA-144	Option E143xA-288	Option E143xA-001
Bytes	144 MB	288 MB	1152 MB
Samples (span ≤ 18.55 MHz)[2]	24 Msa	48 Msa	192 Msa
Samples (span > 18.55 MHz)[2]	48 Msa	96 Msa	384 Msa

Time sample resolution: 1/(k x cardinal span)

where:
- k = 2.56 for time data mode set to baseband (89610A only)
- k = 1.28 for all other modes (default) including zoom
- Cardinal span = max. span/2^n, for n = 0 to 17

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

1. Measurements apply to vector signal analyzer functions.
2. 19.53 MHz for the 89610A.

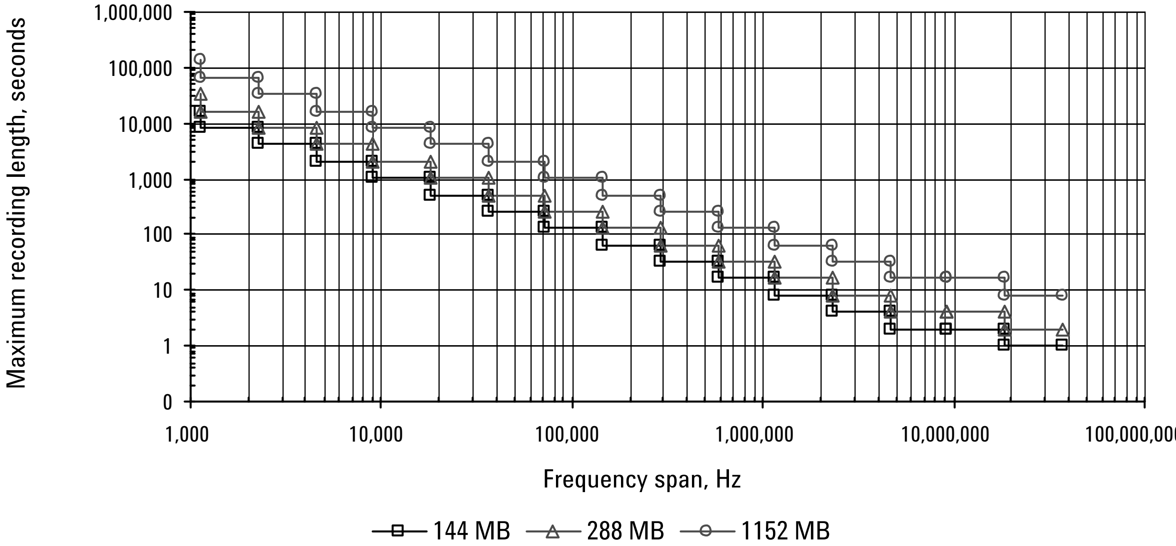


Figure 1. 89611A/89640/89641A maximum recording length

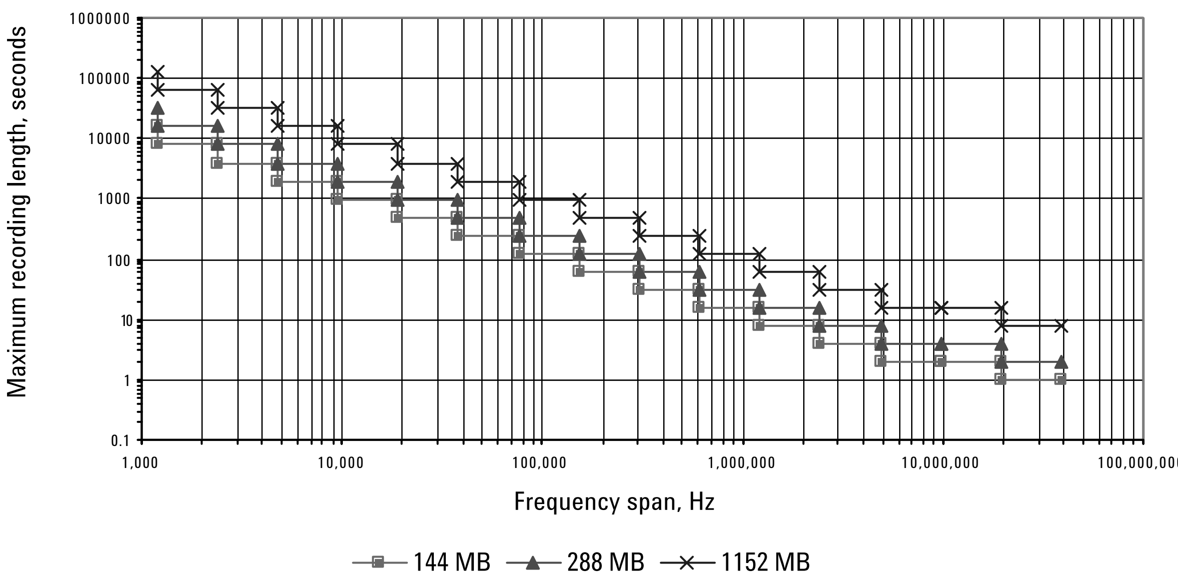


Figure 2. 89610A maximum recording length

Measurement, Display, and Control

Triggering	
Trigger types	
Spectrum application	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[1]
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 range	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 signal above the trigger threshold.*
Hold-off resolution	Same as time capture sample resolution
Hold-off range	0 to $2^{24} – 1$ time samples[1]
External trigger	*Works with analog and TTL signals*
Type	AC-coupled comparator
Slope	Positive, negative
Pulse width, minimum	> 300 ns
Pulse amplitude, minimum	> 100 mv
Input impedance	1 kΩ

Averaging	
Types	
Spectrum application	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.
Modulation index accuracy	±1%, (modulation ≤ 1 MHz)
Harmonic distortion	*Modulation index ≤ 95%.*
Modulation bandwidth ≤ 100 kHz	–60 dBc
Modulation bandwidth > 100 kHz and ≤ 1 MHz	–55 dBc
Spurious	*Relative to 100% modulation index.*
Modulation bandwidth ≤ 100 kHz	–60 dBc
Modulation bandwidth > 100 kHz and ≤ 1 MHz	–55 dBc
Cross demodulation	< 0.3% AM on an FM signal with 50 kHz modulation rate, 200 kHz deviation, cardinal spans

1. 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 seconds.

Measurement, Display and Control – continued

Analog demodulation, continued	
PM demodulation (typical)	
Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
Modulation index accuracy	±0.5° (deviation < 180°, modulation rate ≤ 500 kHz)
Harmonic distortion	*Deviation ≤ 180°.*
Modulation bandwidth ≤ 50 kHz	–60 dBc
Modulation bandwidth > 50 kHz and ≤ 500 Hz	–55 dBc
Spurious	*Relative to 180° deviation*
Modulation bandwidth ≤ 50 kHz:	–60 dBc
Modulation bandwidth > 50 kHz and ≤ 500 Hz	–55 dBc
Cross demodulation	< 1° PM on an 80% modulation index AM signal, ≤ 1 MHz modulation rate
FM demodulation (typical)	
Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
Modulation index accuracy	±0.1% of measurement span, deviation ≤ 2 MHz, modulation rate ≤ 500 kHz
Harmonic distortion (cardinal spans)	
Modulation rate ≤ 50 kHz, deviation ≤ 200 kHz	–60 dBc
Modulation rate ≤ 500 kHz, deviation ≤ 2 MHz	–55 dBc
Spurious (cardinal spans)	
Modulation rate ≤ 50 kHz, deviation ≤ 200 kHz	–50 dBc
Modulation rate ≤ 500 kHz, deviation ≤ 2 MHz	–45 dBc
Cross demodulation	< 0.5% of span of FM on an 80% modulation index AM signal, ≤ 1 MHz modulation rate

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
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 freq
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.

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

Measurement, Display and Control – continued

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 art 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 5 and prior	MAT-file (.mat)

Software Links for Sourcing and Analyzing

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

Sources	*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 baseband generator Option E4438C-001, -002, -601, or -602. E8267C vector signal generator with Option E8267C-002, or -602 internal baseband 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 and 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.

Vector Modulation Analysis (Option 89601A-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, π/4DQPSK, 8PSK, 3π/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
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/$(1 + \alpha)$ (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

Vector Modulation Analysis (Option 89601A-AYA) – continued

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
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]

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

Vector Modulation Analysis (Option 89601A-AYA) – continued

Accuracy (typical)	
(For formats other than FSK, 8/16 VSB, and OQPSK)	*These specifications apply to the signal at full-scale, fully contained in the measurement span, baseband, IF[1], or RF inputs, random data sequence, range ≥ –25 dBm, start frequency ≥ 15% of span, alpha/BT ≥ 0.3 (0.3 ≤ alpha ≤ 0.7 offset QPSK), averaging = 10 and symbol rate ≥ 1 kHz. For symbol rates < 1 kHz the accuracy may be limited by phase noise.*
Residual errors	Results = 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[2]	
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

Accuracy (typical)	
(Video modulation formats)	
Residual errors	
8/16 VSB residual EVM	≤ 1.5% (SNR ≥ 36 dB, symbol rate = 10.762 MHz, α = 0.115, IF or RF input modes, span = 7 MHz, full-scale signal, range ≥ –25 dBm, result length = 800, averages = 10)
16, 32, 64, 256 QAM residual EVM	≤ 1.0% (SNR ≥ 40 dB, symbol rate = 6.9 MHz, α = 0.15, IF or RF input modes, span = 8 MHz, full-scale signal, range ≥ –25 dBm, result length = 800, averages = 10)

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, 3π/8 8PSK (EDGE), 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 8VSB, 16VSB

1. For I+jQ analysis user must compensate for I/Q delay of each channel.
For information on using calibration constants, please see topic "calibration constants" in help text.
2. For modulation formats with equal symbol amplitude.

3G Modulation Analysis (Option 89601A-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)	
144 MB (Option E143xA-144)	3,000 slots
288 MB (Option E143xA-288)	6,000 slots
1152 MB (Option E143xA-001)	24,000 slots
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 $2^{24} – 1$
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*	2 HS-PDSCH with 6 DPCH, 4 HS-PDSCH with 14 DPCH, 8 HS-PDSCH with 30 DPCH
Gated modulation detection*	Off, On
Modulation scheme*	Auto, QPSK, 8PSK, 16QAM

*Parameter used only when HSDPA analysis is enabled

3G Modulation Analysis (Option 89601A-B7N) – continued

W-CDMA/HSDPA 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 (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 point)
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 format
Other measurement results	
Pre-demodulation	Time, spectrum

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

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 (pilot only)	≤ 1.5%
EVM floor (test model 1 with 16 DPCH signal)	≤ 1.5%
EVM floor (test model 5, 8 HS-PDSCH with 30 DPCH, HSDPA enabled)	≤ 1.5%
Frequency error	
Range (CPICH synch type)	±500 Hz
Accuracy	±10 Hz

3G Modulation Analysis (Option 89601A-B7N) – continued

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)	
144 MB (Option E143xA-144)	3,200 PCGs
288 MB (Option E143xA-288)	6,400 PCGs
1152 MB (Option E143xA-001)	25,600 PCGs
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 (0dBc to – 120dBc)
Enable 1xEV-DV analysis	Off, On
Gated active channel detection	Off, On
Multi-carrier filter	Off, On
PN offset	0x64 to 511x64 chips
Wash code QOF	0,1,2,3
Defined active channels*	Off, On
Walsh code column index*	0,1,2,3
Walsh mask*	0 to 1111111111111 (binary)
F-PDCH0/1 number of codes*	F-PDCH0 + F-PDCH1 ≤28
F-PDCH0/1 modulation scheme*	QPSK, 8PSK, 16QAM
Gated modulation detection*	Off, On
Modulation scheme*	Auto, QPSK, 8PSK, 16QAM

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

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

3G Modulation Analysis (Option 89601A-B7N) – continued

cdma2000/1xEV-DV modulation analysis – continued

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

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 (pilot only)	≤ 1.5%
EVM floor (9 active channels)	≤ 1.5%
EVM floor (16QAM, F-PDCH with 15 codes, 1xEV-DV enabled)	≤ 1.5%
Frequency error	
Range	±500 Hz
Accuracy	±10 Hz

3G Modulation Analysis (Option 89601A-B7N) – continued

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)	
144 MB (Option 143xA-1440	5,000 slots
288 MB (Option 143xA-288)	10,000 slots
1152 MB (Option 143xA-001)	40,000 slots
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

3G Modulation Analysis (Option 89601A-B7N) – continued

1xEV-DO modulation analysis – continued

Measurement results (characteristic), continued	
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

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)
Composite EVM	
EVM floor	1.5% max
Frequency error	
Lock range	±500 Hz
Accuracy	±5 Hz

3G Modulation Analysis (Option 89601A-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)	
144 MB (Option E143xA-144)	1,600 subframes
288 MB (Option E143xA-288)	3,200 subframes
1152 MB (Option E143xA-001)	12,800 subframes

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
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)

3G Modulation Analysis (Option 89601A-B7N) – continued

TD-SCDMA modulation analysis – continued

Measurement results (continued)

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

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)
Composite EVM	
EVM floor	1.5% max
Frequency error	
Lock range	±500 Hz
Accuracy	±25 Hz

WLAN Modulation Analysis (Option 89601A-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)	
144 MB (Option E143xA-144)	1.0 seconds
288 MB (Option E143xA-288)	2.0 seconds
1152 MB (Option E143xA-001)	8.0 seconds
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
Accuracy (typical)	
Residual EVM	
(20 averages, equalizer training=chan est seq and data)	≤ -45 dB[1]
Frequency error (relative to frequency standard)	
Lock range	±624 kHz (±2x sub-carrier spacing)
Accuracy	±8 Hz

1. For equalizer training=chan est seq ≤ -43 dB

WLAN Modulation Analysis (Option 89601A-B7R) – continued

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)	
144 MB (Option E143xA-144)	1.0 s
288 MB (Option E143xA-288)	2.0 s
1152 MB (Option E143xA-001)	8.0 s
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

WLAN Modulation Analysis (Option 89601A-B7R) – continued

DSSS modulation analysis – continued

Accuracy (typical)	*Measurement conditions: Input range within 5 dB of total signal power.*
Residual EVM	2.0% maximum, all modulation formats, 10 averages
Frequency error	*Relative to frequency standard.*
Lock range	±2.5 MHz
Accuracy	±8 Hz

Dynamic Link to EEsof ADS (Option 89601A-105)

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.

Source component

ADS version required	ADS 2001 or later
ADS output data types supported	Timed
Data	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

Dynamic Link to EEsof ADS (Option 89601A-105) – continued

Sink component

ADS version required	ADS 1.3 or later
ADS input 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} seconds
VSA component parameters (user settable)	VSATitle Tstep SamplesPerSymbol RestoreHW SetupFile Start Stop TclTkMode RecordMode SetFreqProp
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

General

Hardware interfaces (characteristic)	
External trigger input	BNC, 1 kΩ impedance
External frequency reference	
Output 10 MHz	> 3 dBm
Input	10 or 13 MHz (±5 ppm), > 0 dBm
Safety and regulatory compliance	
Safety standards	EN 61010-1 (1993)
Radiated emissions	EN 61326-1
Immunity[1, 2]	EN 61326-1
Environmental	
Operating temperature range	
Warranted operation	20 – 30 °C
Maximum operation	0 – 50 °C
Storage	–40° – 70°C
Humidity	10 – 90% at 40 °C
Maximum altitude	3,000 m
Warm up time	30 minutes
Calibration interval	2 year
Power requirements	
47 – 440 Hz operation	90 – 140 Vrms
47 – 66 Hz operation	90 – 264 Vrms
Maximum power dissipation	280 VA (E8408A 4-slot VXI mainframe)
(Mainframe maximum rating)	1500 VA (E8403A 13-slot VXI mainframe)
	450 W (E1421B 6-slot VXI mainframe)
Physical	
(Using E8408A 4-slot VXI mainframe)	
Weight	13 kg (29 lb)[3]
Dimensions (H x W x D mm)	
With protective bumpers	388 x 152 x 548
Without protective bumpers	362 x 133 x 540

1. Use of a desktop PC is recommended as it offers the best immunity to electrostatic discharge.
2. Electrostatic discharge: Performance criteria B (when used with a desktop PC)
   Performance criteria C (when used with a laptop PC, may require operator intervention after ESD event.)
3. 40 kg (87 lb) E8403A 13 slot mainframe with 2 RF channels.

Glossary

dBc	dB relative to largest input signal
dBfs	dB relative to full-scale amplitude range setting where full scale is approximately 10 dB below ADC overload
Fc or f_c	Center frequency; typically the center of a spectrum trace. This parameter is set in the Frequency menu
FS or fs	Full scale; synonymous with amplitude range or input range
ppb	Parts per billion
RBW	Resolution bandwidth

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Printed in USA February 24, 2004
5988-7811EN

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