

# 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 89610A systems is specified in the E8408A four-slot VXI mainframe.<sup>1</sup> The performance of standard 89611A, 89640A, and 89641A systems is specified in E8408A<sup>1</sup> four-slot, and E8403A<sup>2</sup> 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).



**Agilent Technologies**

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## Frequency

	89610A (DC – 40 MHz)	89611A (70 MHz ±18 MHz)	89640A (DC – 2700 MHz)	89641A (DC – 6000 MHz)
<b>Frequency range</b>				
Spectrum analysis mode				
RF/IF mode	—	See footnote 1	36 to 2700 MHz	36 to 6000 MHz
Baseband mode	DC to 40 MHz	See footnote 1	DC to 36 MHz <sup>2</sup>	DC to 36 MHz
Vector analysis mode				
RF/IF mode	—	52 to 88 MHz <sup>3</sup>	36 to 2700 MHz	36 to 6000 MHz
Baseband mode	DC to 40 MHz	DC to 36 MHz	DC to 36 MHz	DC to 36 MHz
<b>Frequency tuning resolution</b>	1 mHz	1 mHz	1 mHz	1 mHz
<b>Frequency spans</b>				
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
<b>Frequency points per span</b>				
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
<b>Frequency accuracy</b> <i>Frequency accuracy is the sum of initial accuracy, aging, and temperature drift.</i>				
Initial accuracy	100 ppb	100 ppb	100 ppb	100 ppb
Aging	1 ppb/day	1 ppb/day	1 ppb/day	1 ppb/day
	100 ppb/year	100 ppb/year	100 ppb/year	100 ppb/year
Temperature drift (0 – 50 °C)	50 ppb	50 ppb	50 ppb	50 ppb
<b>Frequency stability</b>				
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 <sup>4</sup>				
> 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 G vibration.

## Resolution Bandwidth Filtering

	<b>89610A</b> <b>(DC – 40 MHz)</b>	<b>89611A</b> <b>(70 MHz ±18 MHz)</b>	<b>89640A</b> <b>(DC – 2700 MHz)</b>	<b>89641A</b> <b>(DC – 6000 MHz)</b>
<b>RBW range</b>	<i>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.</i>			
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
<b>RBW shape factor</b>	<i>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.</i>			
<b>Flat top</b>				
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
<b>Gaussian top</b>				
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
<b>Hanning</b>				
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
<b>Uniform</b>				
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)
<b>Input</b>				
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
<b>VSWR</b> <i>Return loss in measurement span.</i>				
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)
<b>Amplitude accuracy</b> <i>Accuracy specifications apply with flat-top window selected. Amplitude accuracy is the sum of absolute full-scale accuracy and amplitude linearity.</i>				
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	—	—

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)
<b>Flatness</b>	<i>Frequency response across the measurement span in vector signal analysis mode (included in amplitude specifications).</i>			
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	—	—
<b>Channel match</b>	<i>Multiple channels are available as options.</i>			
Amplitude match (DC coupled, full-scale, matching input ranges)	±0.25 dB	±0.25 dB	±0.25 dB	±0.25 dB
Phase match (10 MHz input signal, full-scale, matching input ranges)	±5° (typical)	—	—	—
Group delay deviation (across measurement span)	—	±2.5 ns (typical)	±2.5 ns (typical)	±2.5 ns (typical)
<b>Stability</b>				
Amplitude	—	0.006 dB/°C (typical)	0.006 dB/°C (typical)	0.006 dB/°C (typical)
Phase	—	1.0°/°C (typical)	1.0°/°C (typical)	1.0°/°C (typical)
<b>Dynamic range</b>	<i>Dynamic range indicates the amplitude range that is free of erroneous signals within the measurement span.</i>			
Intermodulation distortion	<i>Two input signals, each –6 to –10 dBfs, separation &gt; 1 MHz. Specified relative to either signal.</i>			
Third-order				
Baseband mode	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
IF/RF mode	—	< –70 dBc	< –70 dBc	< –70 dBc
Second-order				
Baseband mode	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
IF/RF mode	—	< –67 dBc	–55 dBc (typical)	–55 dBc (typical)
Harmonic distortion	<i>Single input signal, 0 to –10 dBfs.</i>			
Baseband mode	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
IF/RF mode	—	< –70 dBc	–55 dBc (typical)	–55 dBc (typical)
Spurious responses	<i>Full-scale input signal within analyzer measurement span.</i>			
Baseband mode	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
IF/RF mode	—	< –70 dBc	< –65 dBc <sup>2</sup>	< –65 dBc <sup>3</sup>
	<i>Full-scale input signal outside analyzer measurement span.</i>			
Baseband mode	< –70 dBc	< –70 dBc	< –70 dBc	< –70 dBc
RF mode	—	< –70 dBc	< –52 dBc (typical)	< –50 dBc (typical)

1. Requires a manual procedure, see Help text. Required for external tuners only.
2. Specification degraded by 10 dB (typical) for input frequencies within ±10 MHz of 1890.6 MHz.
3. Specification degraded by 10 dB (typical) 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.

## Amplitude – continued

	<b>89610A</b> <b>(DC – 40 MHz)</b>	<b>89611A</b> <b>(70 MHz ±18 MHz)</b>	<b>89640A</b> <b>(DC – 2700 MHz)</b>	<b>89641A</b> <b>(DC – 6000 MHz)</b>
<b>Dynamic range, continued</b>				
Spurious sidebands	<i>Full-scale input signal.</i>			
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	<i>Input port terminated and shielded &gt; 10 kHz.</i>			
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	<i>Range ≥ -30 dBm.</i>			
Baseband mode (> 0.1 MHz)	< -121 dBfs/Hz	< -121 dBfs/Hz	< -121 dBfs/Hz	< -121 dBfs/Hz
IF/RF mode (< 1.2 GHz)	—	—	< -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	<i>Most sensitive range.</i>			
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<sup>1</sup>

	<b>89610A</b> <b>(DC – 40 MHz)</b>	<b>89611A</b> <b>(70 MHz ±18 MHz)</b>	<b>89640A</b> <b>(DC – 2700 MHz)</b>	<b>89641A</b> <b>(DC – 6000 MHz)</b>
<b>Linearity (typical)</b>				
	<i>Group delay deviation across maximum measurement span, using flat-top window.</i>			
Baseband mode	±2 ns	±2 ns	±2 ns	±2 ns
IF/RF mode	—	±6 ns	±8 ns	±8 ns

1. Measurements apply to vector signal analyzer function.

## Time and Waveform<sup>1</sup>

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.

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### 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

$1/(k \times \text{span})$

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

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### Time capture characteristics

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

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

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### Time capture memory size

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

Bytes

Option E143xA-144

Option E143xA-288

Option E143xA-001

144 MB

288 MB

1152 MB

Samples (span  $\leq$  18.55 MHz)<sup>2</sup>

24 Msa

48 Msa

192 Msa

Samples (span  $>$  18.55 MHz)<sup>2</sup>

48 Msa

96 Msa

384 Msa

Time sample resolution

$1/(k \times \text{cardinal span})$

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.

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1. Measurements apply to vector signal analyzer functions.

2. 19.53 MHz for the 89610A.



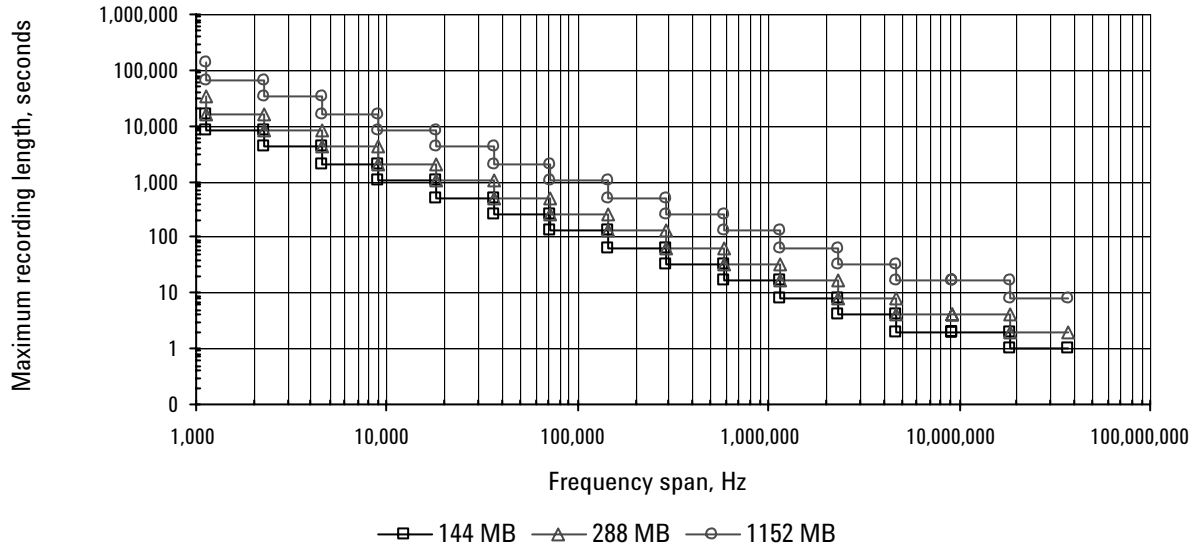


Figure 1. 89611A/89640/89641A maximum recording length

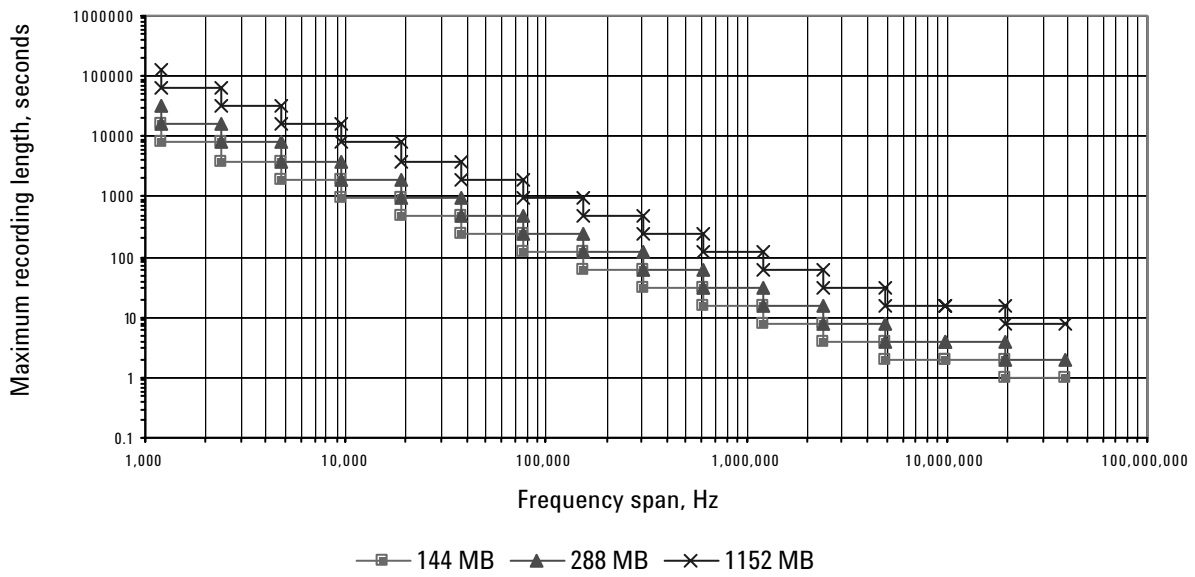


Figure 2. 89610A maximum recording length

## Measurement, Display, and Control

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### 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 <sup>1</sup>
IF trigger	<i>Used to trigger on in-band energy, where the trigger bandwidth is determined by the measurement span (rounded to the next higher cardinal span).</i>
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	<i>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.</i>
Hold-off resolution	Same as time capture sample resolution
Hold-off range	0 to $2^{24} - 1$ time samples <sup>1</sup>
External trigger	<i>Works with analog and TTL signals</i>
Type	AC-coupled comparator
Slope	Positive, negative
Pulse width, minimum	> 300 ns
Pulse amplitude, minimum	> 100 mv
Input impedance	1 k $\Omega$

### 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	$\pm 1\%$ , (modulation $\leq 1$ MHz)
Harmonic distortion	<i>Modulation index <math>\leq 95\%</math>.</i>
Modulation bandwidth $\leq 100$ kHz	-60 dBc
Modulation bandwidth > 100 kHz and $\leq 1$ MHz	-55 dBc
Spurious	<i>Relative to 100% modulation index.</i>
Modulation bandwidth $\leq 100$ kHz	-60 dBc
Modulation bandwidth > 100 kHz and $\leq 1$ MHz	-55 dBc
Cross demodulation	< 0.3% AM on an FM signal with 50 kHz modulation rate, 200 kHz deviation, cardinal spans

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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

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### Analog demodulation, continued

#### PM demodulation (typical)

Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
Modulation index accuracy	$\pm 0.5^\circ$ (deviation $< 180^\circ$ , modulation rate $\leq 500$ kHz)
Harmonic distortion	<i>Deviation <math>\leq 180^\circ</math>.</i>
Modulation bandwidth $\leq 50$ kHz	-60 dBc
Modulation bandwidth $> 50$ kHz and $\leq 500$ Hz	-55 dBc
Spurious	<i>Relative to <math>180^\circ</math> deviation</i>
Modulation bandwidth $\leq 50$ kHz:	-60 dBc
Modulation bandwidth $> 50$ kHz and $\leq 500$ Hz	-55 dBc
Cross demodulation	$< 1^\circ$ PM on an 80% modulation index AM signal, $\leq 1$ MHz modulation rate

#### FM demodulation (typical)

Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
Modulation index accuracy	$\pm 0.1\%$ of measurement span, deviation $\leq 2$ MHz, modulation rate $\leq 500$ kHz
Harmonic distortion (cardinal spans)	
Modulation rate $\leq 50$ kHz, deviation $\leq 200$ kHz	-60 dBc
Modulation rate $\leq 500$ kHz, deviation $\leq 2$ MHz	-55 dBc
Spurious (cardinal spans)	
Modulation rate $\leq 50$ kHz, deviation $\leq 200$ kHz	-50 dBc
Modulation rate $\leq 500$ kHz, deviation $\leq 2$ MHz	-45 dBc
Cross demodulation	$< 0.5\%$ of span of FM on an 80% modulation index AM signal, $\leq 1$ MHz modulation rate

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### 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

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### 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.

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### 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

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## Measurement, Display and Control – continued

<b>Trace formats</b>	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
<b>Trace layouts</b>	1 – 4 traces on one, two, or four grids
Number of colors	User-definable color palette
<b>Spectrogram display</b>	
Types	Color – normal and reversed Monochrome – normal and reversed User colormap – 1 total
Adjustable parameters	Number of colors Enhancement (color-amplitude weighting) Threshold
Trace select	When a measurement is paused any trace in the trace buffer can be selected by trace number. The marker values and marker functions apply to 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 part 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.*

<b>Macro language</b>	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.
<b>Remote displays</b>	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.
<b>Remote programming</b>	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.
<b>File formats</b>	<i>For storage and recall of measured or captured waveforms, spectra and other measurement results.</i>
ASCII	Tab delimited (.txt), comma delimited (.csv)
Binary	Agilent standard data format (.sdf, .cap, .dat), Agilent E3238 search system time snapshot (.cap), and time recording (.cap) files under 2 GB in size. No additional calibration.
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.*

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<b>Sources</b>	<i>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.</i>
Compatible sources	ESG-C, ESG-D, or ESG-DP (firmware version B.03.50 or later), with the internal dual arbitrary waveform generator Option E44xx-UND (firmware version 1.2.92 or later), and E8267C vector signal generator with Option E8267C-002 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

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<b>Signal acquisition hardware</b>	The 89600 VSA software can be linked to Agilent's ESA-E series spectrum analyzers, PSA series spectrum analyzers, most of the Infiniium scopes, 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.
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## Vector Modulation Analysis (Option 89601A-AYA)

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### Signal acquisition

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

---

### Supported data formats

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

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### Single button pre-sets

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

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### 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

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<b>Display formats</b>	<i>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.</i>
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	<i>Measurements of modulation quality made automatically and displayed by the Symbol/Error trace type. RMS and peak values.</i>
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 <i>For VSB formats:</i> VSB pilot level is shown in dB relative to nominal. SNR is calculated from the real part of the error vector only. <i>For DVB formats:</i> 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. <sup>1</sup>

---

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<sup>1</sup>, or RF inputs, random data sequence, range  $\geq -25$  dBm, start frequency  $\geq 15\%$  of span,  $\alpha/BT \geq 0.3$  ( $0.3 \leq \alpha \leq 0.7$  offset QPSK), averaging = 10 and symbol rate  $\geq 1$  kHz. For symbol rates  $< 1$  kHz the accuracy may be limited by phase noise.*

Results = 150 symbols, averages = 10

#### Residual errors

##### Residual EVM

span $\leq 100$ kHz	$< 0.5\%$ rms
span $\leq 1$ MHz	$< 0.5\%$ rms
span $\leq 10$ MHz	$< 1.0\%$ rms
span $> 10$ MHz	$< 2.0\%$ rms

##### Magnitude error

span $\leq 100$ kHz	0.3% rms
span $\leq 1$ MHz	0.5% rms
span $\leq 10$ MHz	1.0% rms
span $> 10$ MHz	1.5% rms

##### Phase error<sup>2</sup>

span $\leq 100$ kHz	0.3° rms
span $\leq 1$ MHz	0.4° rms
span $\leq 10$ 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

$\leq 1.5\%$  (SNR  $\geq 36$  dB, symbol rate = 10.762 MHz,  $\alpha = 0.115$ , IF or RF input modes, span = 7 MHz, full-scale signal, range  $\geq -25$  dBm, result length = 800, averages = 10)

16, 32, 64, 256 QAM residual EVM

$\leq 1.0\%$  (SNR  $\geq 40$  dB, symbol rate = 6.9 MHz,  $\alpha = 0.15$ , IF or RF input modes, span = 8 MHz, full-scale signal, range  $\geq -25$  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,  $\pi/4$ DQPSK, 8PSK, D8PSK,  $3\pi/8$  8PSK (EDGE), 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 8VSB, 16VSB

1. For I+jQ analysis user must compensate for I/Q delay and DC offset 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 modulation analysis

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#### 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
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 offset (downlink)	Adjustable from 0 to 15
Scramble type (downlink)	Standard, left, right
Sync type (downlink)	CPICH, SCH

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

### W-CDMA modulation analysis – continued

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#### Measurement results

Composite	<i>All code channels at once or all symbol rates taken together.</i>
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, Ttrigger, frequency error, IQ (origin) offset, slot number
Channel	<i>Individual code channels.</i>
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
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)

	<i>Input range within 5 dB of total signal power.</i>
Code domain	
CDP accuracy	$\pm 0.3$ dB (spread channel power within 20 dB of total power)
Symbol power versus time	$\pm 0.3$ dB (spread channel power within 20 dB of total power averaged over a slot)
Composite EVM	
EVM floor (pilot only)	$\leq 1.5\%$
EVM floor (test model 1 with 16 DPCH signal)	$\leq 1.5\%$
Frequency error	
Range (CPICH synch type)	$\pm 500$ Hz
Accuracy	$\pm 10$ Hz

---

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

### cdma2000 modulation analysis

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#### 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

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#### Adjustable parameters

Format	Forward, reverse
Single button presets	Forward, reverse
Chip rate	Continuously adjustable
Long code mask (reverse)	0
Base code length	64, 128

---

#### Measurement results

Composite	<i>All code channels at once or all symbol rates taken together.</i>
Code domain power	Composite (all symbol rates together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksp/s)
Code domain error	Composite (all symbol rates together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksp/s)
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, Ttrigger, frequency error, IQ (origin) offset, PCG number
Channel	<i>Individual code channels.</i>
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
Other measurement results	
Pre-demodulation	Time, spectrum

---

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

### cdma2000 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	$\pm 0.3$ dB (spread channel power within 20 dB of total power)
Symbol power versus time	$\pm 0.3$ dB (spread channel power within 20 dB of total power averaged over a PCG)
Composite EVM	
EVM floor (pilot only)	$\leq 1.5\%$
EVM floor (test model 1 with 16 DPCH signal)	$\leq 1.5\%$
Frequency error	
Range	$\pm 500$ Hz
Accuracy	$\pm 10$ Hz

---

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

### 1xEV-DO modulation analysis

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#### 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 0x3FFFFFFF

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

### 1xEV-DO modulation analysis – continued

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#### Measurement results (characteristic), continued

<b>Composite</b>	<i>All code channels at once or all symbol rates taken together.</i>
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
<b>Channel</b>	<i>Individual code channel, reverse only.</i>
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
<b>Other</b>	
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)

	<i>Input range within 5 dB of total signal power.</i>
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

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#### 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

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#### Supported formats

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

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#### 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

Code domain power	<i>All code channels at once or all symbol rates taken together.</i> 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

IQ measured	<i>Individual code channel.</i> 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

Code domain power	<i>All code channels at once.</i> 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)

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

### TD-SCDMA modulation analysis – continued

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#### 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

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#### 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 $\mu$ s)
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

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#### 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

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#### 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 (all modulation formats, 20 averages)	$\leq -40$ dB
Frequency error (relative to frequency standard)	
Lock range	$\pm 624$ kHz ( $\pm 2 \times$ sub-carrier spacing)
Accuracy	$\pm 8$ Hz

---

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

### DSSS modulation analysis

<b>Signal acquisition</b>	
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
<b>Signal playback</b>	
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
<b>Supported formats</b>	
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
<b>Adjustable parameters</b>	
IQ normalize	On/Off
Mirror frequency spectrum	On/Off
Chip rate	Continuously adjustable
Clock adjust	Continuously adjustable between $\pm 0.5$ chips
Equalizer	On/Off
Equalizer filter length	3 – 99 chips
Descrambler mode	On/off, preamble only, preamble, header only
<b>Demodulation measurement results</b>	
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
<b>Equalizer measurement results</b>	
Equalizer impulse response	<i>Equalizer impulse response, channel frequency response.</i> Computed from preamble.
Channel frequency response	Computed from preamble.
<b>Pre-demodulation measurement results</b>	
Time	Main raw, search
Spectrum	Instantaneous
Other	CCDF, CDF, PDF,
<b>Display formats</b>	
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

---

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

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## Dynamic Link to EEsos ADS (Option 89601A-105)

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*This option links the 89600 VSA with design simulations running on the Agilent EEsos 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

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<b>ADS version required</b>	ADS 2001 or later
<b>ADS output data types supported</b>	Timed
Data	Frequency
	Demod errors
	Complex scalar
	Float scalar
	Integer scalar
Control	Data gap indicator
<b>VSA input modes</b>	Hardware, recording
<b>VSA analysis range</b>	Dependent on input mode and hardware installed
<b>VSA component parameters</b> (user settable)	VSATitle ControlSimulation OutputType Pause VSATrace Tstep SetUpFile RecordingFile SetUpUse AutoCapture DefaultHardware AllPoints
<b>VSA component parameters</b> (passed to ADS, timed output only)	Carrier frequency Tstep

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## Dynamic Link to EEs of ADS (Option 89601A-105) – continued

### Sink component

<b>ADS version required</b>	ADS 1.3 or later
<b>ADS input data types supported</b>	Float Complex Timed – baseband Timed – ComplexEnv
<b>VSA input modes</b>	Single channel, dual channel, I + jQ
<b>VSA analysis range</b>	
Carrier frequency	DC to > 1 THz
Tstep (sample time)	< 10 <sup>-12</sup> to > 10 <sup>3</sup> seconds
<b>VSA component parameters</b> (user settable)	VSATitle Tstep SamplesPerSymbol RestoreHW SetupFile Start Stop TclTkMode RecordMode SetFreqProp
<b>VSA component parameters (passed from ADS)</b>	Carrier frequency Tstep Data type
<b>Number of VSAs that can run concurrently</b>	
ADS version 1.5 and later	20
ADS version 1.3	1
<b>ADS components</b>	
<b>Required ADS components</b>	
EEs of Design Environment	E8900A/AN
EEs of Data Display	E8901A/AN
EEs of Ptolemy Simulator	E8823A/AN
<b>Recommended ADS configuration</b>	
EEs of Communication System Designer Pro	E8851A/AN
EEs of Communication System Designer Premier	E8852A/AN

## General

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### Hardware interfaces (characteristic)

External trigger input	BNC, 1 k $\Omega$ impedance
External frequency reference	
Output 10 MHz	> 3 dBm
Input	10 or 13 MHz ( $\pm$ 5 ppm), > 0 dBm

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### Safety

Safety standards	EN 61010-1 (1993)
Radiated emissions	EN 61326-1
Immunity <sup>1, 2</sup>	EN 61326-1

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### Environmental

Operating temperature range	
Warranted operation	20 – 30 °C
Maximum	0 – 50 °C
Humidity	10 – 90% at 40 °C
Altitude	3,000 m

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### Calibration interval

2 year

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### Power requirements

47 – 440 Hz operation	90 – 140 Vrms
47 – 66 Hz operation	90 – 264 Vrms

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### Maximum power dissipation

(Using E8408A 4-slot VXI mainframe)

280 VA

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### Physical

(Using E8408A 4-slot VXI mainframe)

Weight	13 kg (29 lb)
Dimensions (H x W x D mm)	
With protective bumpers	388 x 152 x 548
Without protective bumpers	362 x 133 x 540

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1. Use of a desktop PC is recommended as it offers the best immunity to electrostatic discharge.

2. Electrostatic discharge: Pref criteria B (when used with a desktop PC)

Pref criteria C (when used with a laptop PC, may require operator intervention after ESD event.)

## 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
F <sub>c</sub> or f <sub>c</sub>	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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