Agilent 89640A dc–2700 MHz Vector Signal Analyzer

Data Sheet

Specifications describe warranted performance over a temperature range from 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 non-warranted.

Except where noted, these specifications also apply to the Agilent 89600S RF vector signal analyzer systems, provided that all components meet their individual specifications, and that the system has been configured and assembled in accordance with the 89600S Configuration Guide and all other applicable documents.

Operation of the 89600 series vector signal analyzers requires a personal computer meeting at least the following requirements:

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

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

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

- >300 MHz Pentium, or AMD-K6, CPU
- One empty CardBus Type II slot (2 slots recommended)
- 192 MB RAM (256 MB recommended)
- 4 MB video RAM (8 MB recommended)
- Hard disk with 100 MB available space
- Microsoft Windows 2000
- CD-ROM drive (can be provided via network access)
- 3.5-inch floppy disk drive (can be provided via network access)
- Supported IEEE-1394-1995 interface

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

May not be available in all areas worldwide.

Definitions

dBc: dB relative to largest input signal.

dBfs: dB relative to full scale amplitude range setting. Full scale is approximately 10 dB below ADC overload.

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

RBW: Resolution bandwidth.

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

Frequency

The Agilent 89640A consists of two separate applications for Microsoft Windows NT or Windows 2000. The 89600 series vector signal analyzer (VSA) performs vector analysis of complex signals in the time, frequency and modulation domains. The 89600 VSA emulates a traditional spectrum analyzer, providing fast, high-resolution signal magnitude measurements while sweeping across a user-defined frequency span.

Frequency tuning	
Frequency range	
Band 1	36[2] to 2700 MHz
Band 2	dc to 36[3] MHz
Frequency spans	
Spectrum analyzer application	<1 kHz to 2700 MHz
Vector signal analyzer application	<1 Hz to 36[3] MHz
Center frequency tuning resolution	1 mHz
Frequency points per span	
Spectrum analyzer application	2–131,072
Vector signal analyzer application	
Calibrated points	51–102,401
Displayable points	51–131,072

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

Frequency stability (spectral purity)	
Phase noise, 10 MHz input[4]	
100 Hz Offset	<–108 dBc/Hz
1 kHz Offset	<–118 dBc/Hz
>10 kHz Offset	<–120 dBc/Hz
Phase noise, 1 GHz input[4]	
>20 kHz Offset	<–99 dBc/Hz
>100 kHz Offset	<–110 dBc/Hz

Resolution bandwidth	
Range	
Spectrum analyzer application	1 Hz to > 5 MHz
Vector signal analyzer application	<1 Hz to 10 MHz

The range of available RBW choices is a function of the selected frequency span and the number of calculated frequency points. Users may step through the available range in a 1-3-10 sequence, or directly enter an arbitrarily-chosen bandwidth.

2. In the vector signal analyzer application, 36 MHz is the minimum center frequency. With appropriate choice of frequency span, actual frequency coverage extends down to 20 MHz.
3. Overrange provided to 37.11 MHz
4. Specified for systems using Agilent E8408B VXI mainframe with options 001 and 918; for other mainframes, figures shown are typical.

RBW shape factor

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

Window	Selectivity (3:60 dB)	Passband flatness	Rejection
Flat top	0.41	0.01 dB	>95 dBc
Gaussian-top	0.25	0.68 dB	>125 dBc
Hanning	0.11	1.5 dB	>31 dBc
Uniform	0.0014	4.0 dB	>13 dBc

Amplitude

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

Vector signal analyzer application
Band 1 20–2700 MHz
Band 2 0–36 MHz

Spectrum analyzer application
Band 1 36–2700 MHz
Band 2 0–36 MHz

Input range

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

Input ports

Nominal impedance	50Ω
Connector	Type N
VSWR (return loss)	
Band 1 (–20 dBm to +20 dBm ranges)	1.8:1 (10.7 dB)
Band 1 (–45 dBm to –25 dBm ranges)	2.5:1 (7.3 dB)
Band 2 (all ranges)	1.5:1 (14 dB)

Amplitude accuracy

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

Absolute full-scale accuracy	
Band 1	
20–30° C	±2 dB
0–50° C (typical)	±2 dB
Band 2	
0–50° C	±0.8 dB
Amplitude linearity	
0 to –30 dBfs	±0.10 dB
–30 to –50 dBfs	±0.15 dB
–50 to –70 dBfs	±0.20 dB

Flatness

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

Bands 1, 2 (typical)	±0.2 dB

Dynamic range

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

Intermodulation distortion
(two input signals, each –6 dBfs to –10 dBfs, separation >1 MHz. Specified relative to either signal)

Third-order, bands 1 and 2	<–70 dBc
Second-order, band 1	–55 dBc (typical)
Second-order, band 2 (<30 MHz)	<–70 dBc

Harmonic distortion
(single input signal, 0 to –10 dBfs)

Band 1	–55 dBc (typical)
Band 2	<–70 dBc

Spurious responses
(full-scale input signal within analyzer frequency range)[5]

Bands 1, 2	<–70 dBc

Spurious sidebands
(full-scale input signal)[6]

Band 1 (>1 kHz offset)	<–65 dBc
Band 1 (>3 kHz offset)	<–70 dBc
Band 2 (>1 kHz offset)	< –70 dBc

Residual responses
(input port terminated and shielded, >10 kHz)

Bands 1, 2 maximum of:	–77 dBfs or –100 dBm

Input noise density (range ≥ –30 dBm)

Band 1 (< 1.2 GHz)	<–116 dBfs/Hz
Band 1 (> 1.2 GHz)	<–114 dBfs/Hz
Band 2 (> 0.1 MHz)	<–122 dBfs/Hz

Sensitivity
(most sensitive range)

Band 1 (< 1.2 GHz)	<–158 dBm/Hz
Band 1 (> 1.2 GHz)	<–157 dBm/Hz
Band 2	<–152 dBm/Hz

Phase
(vector signal analyzer)

Linearity

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

Band 1 (typical)	±8 ns
Band 2 (typical)	±2 ns

5. Specification reduced by approximately 10 dB for out of band input signals in the frequency range from 26 to 44 MHz above the analyzer's center frequency.
6. Specified for systems using Agilent E8408B VXI mainframes with options 001 and 918; for other mainframes, figures shown are typical.

Time and waveform
(vector signal analyzer)

Baseband versus zoom measurements

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

Most 89600 measurements are made with a non-zero start frequency, also 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 span 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.

Waveform accuracy

See "Amplitude accuracy"

Time record characteristics

In the 89600 VSA application, measurements are based on time records. For example, blocks of waveform samples from which time, frequency and modulation domain data is derived. Time records have these characteristics:

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

Time capture characteristics

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

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

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

	Bytes	Samples[7]	Samples[8]
Standard	18 M	6 M	3 M
Options 144, 145	144 M	48 M	24 M
Options 288	288 M	96 M	48 M
Option 001	1152 M	384 M	192 M

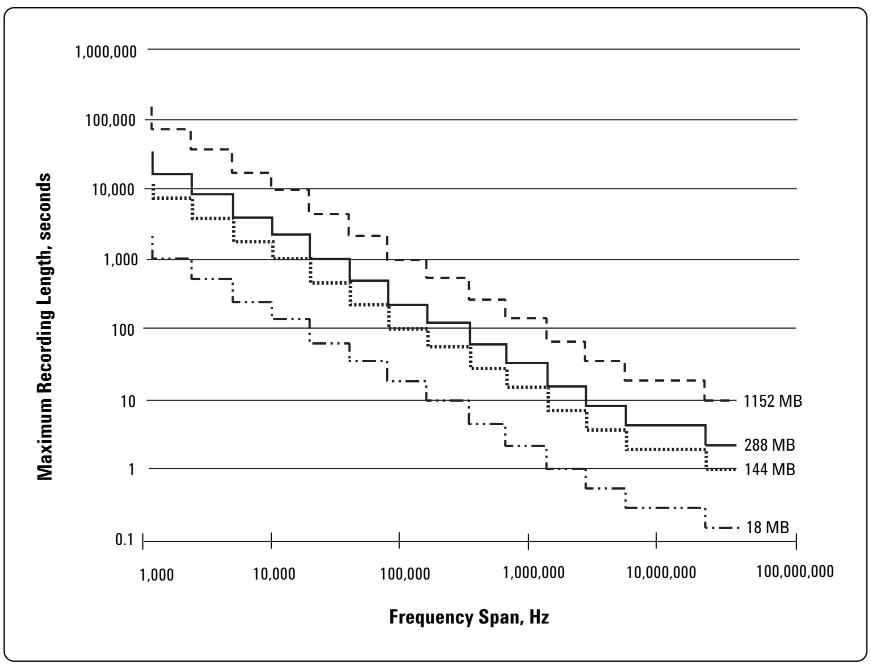
Time capture length = memory samples x time sample resolution

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

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

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

Time capture length versus span and capture memory size



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

Measurement, display and control

Triggering	
Trigger types	
Spectrum analyzer application	Free run, channel, external (separate trigger per frequency segment)
Vector signal analyzer application	Free run, channel, IF magnitude, external
Pre-trigger delay resolution	Same as time capture sample resolution
Pre-trigger delay range	Same as time capture length
Post-trigger delay resolution	Same as time capture sample resolution
Post-trigger delay range	0 to $2^{30} – 1$ time samples[9]
IF trigger	
Used to trigger on in-band energy, where the trigger bandwidth is determined by the measurement span (rounded to the next higher cardinal span).	
Amplitude resolution	<0.5 dB
Amplitude ranges	>3 dBfs to <–70 dBfs. Useable range is limited by the total integrated noise in the measurement span.
IF trigger hysteresis	1.5 dB
Trigger hold-off	
Used to improve trigger repeatability on TDMA and other bursted signals. Trigger hold-off prevents re-triggering of the analyzer until a full hold-off period has elapsed with no signals above the trigger threshold.	
Hold-off resolution	Same as time capture sample resolution
Hold-off range	0 to $2^{24} – 1$ time samples[9]
External trigger	
Works with analog and TTL signals.	
Type	ac-coupled comparator
Minimum pulse width	>300 ns
Minimum pulse amplitude	>100 mV
Slope	Positive, negative
Input impedance	1 kΩ

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

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

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

Time gating

Provides time-selective frequency-domain analysis on any input or analog demodulated time-domain data. When gating is enabled, markers appear on the time data; gate position and length can be set directly. Independent gate delays can be set for each input channel. See time specifications for main time length and time resolution details.

Gate length, maximum	Main time length
Gate length, minimum	= window shape / (0.3 x freq. span) where window shape is equal to: Flat-top window 3.8 Gaussian-top window 2.2 Hanning window 1.5 Uniform window 1.0

Marker functions

Peak signal track, frequency counter, band power

Band power markers

Markers can be placed on any time, frequency, or demodulated trace for direct computation of band power, rms square root (of power), C/N or C/No, computed within the selected portion of the data.

Trace math

Trace math can be used to manipulate data on each measurement. Applications include user-defined measurement units, data correction and normalization.

Operands	Measurement data, data register, constants, jω
Operations	+, –, x, /, conjugate, magnitude, phase, real, imaginary, square, square root, FFT, inverse FFT, windowing, logarithm, exponential, peak value, reciprocal, phase unwrap, zero

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

Trace formats	Log mag (dB or linear), linear mag, real(I), imag(Q), wrap phase, unwrap phase, I-Q, constellation, Q-eye, I-eye, trellis-eye, group delay
Trace layouts	1–4 traces on one, two or four grids
Number of colors	User-definable palette
Spectrogram display	
Types	Color – normal and reversed Monochrome – normal and reversed User colormap – 1 total
Adjustable parameters	Number of colors Enhancement (color-amplitude weighting) Threshold
Trace select	When a measurement is paused any trace in the trace buffer can be selected by trace number. The marker values and marker functions apply to selected trace.
Z-axis value	The z-axis value is the time the trace data was acquired relative to the start of the measurement. The z-axis value of the selected trace is displayed as part of the marker readout.
Memory (characteristic)	Displays occupy memory at a rate of 128 traces/Mbyte (for traces of 401 frequency points).

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

Remote displays

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

Remote programming

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

File formats

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

ASCII	tab-delimited (.txt), comma-delimited (.csv)
Binary	Agilent standard data format (.sdf, .cap, .dat)
Binary	Agilent E3238 time snapshot (.cap) and time recording (.cap) files under 2 GBytes in size. No additional calibration
MATLAB 5	MAT-file (.mat)
MATLAB 4 and prior	MAT-file (.mat)

Source

In source mode the 89600A VSA can control a signal generator via GPIB or LAN. Control is provided via the VSA GUI. Frequency and level control of CW signals is provided. Arbitrary signals may be downloaded from the time capture memory to the signal generator for replay. The same time record may be played over and over contiguously. A window function can be applied to smooth start-up and finish of replay.

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

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

Option AYA
Vector modulation analysis

Signal acquisition Note: Signal acquisition does not require an external carrier or symbol clock	
Data block length	Adjustable to 4096 symbols.
Samples per symbol	1–20
Symbol clock	Internally generated
Carrier lock	Internally locked
Triggering	Single/continuous, external, pulse search (searches data block for beginning of TDMA burst, and performs analysis over selected burst length)
Data synchronization	User-selected synchronization words

Supported modulation formats	
Carrier types	Continuous and pulsed/burst (such as TDMA)
Modulation formats	2, 4, 8 and 16 level FSK (including GFSK) MSK (including GMSK) QAM implementations of: BPSK, QPSK, OQPSK, DQPSK, D8PSK, $\pi/4$DQPSK, 8PSK, $\frac{3\pi}{8}$ 8PSK (EDGE) 16QAM, 32QAM, 64QAM, 128QAM, 256QAM (absolute encoding) 16QAM, 32QAM, 64QAM (differential encoding per DVB standard) 8VSB, 16VSB
Single-button presets for	**Cellular:** CDMA (Base), CDMA (mobile), CDPD, EDGE, GSM. NADC, PDC, PHP (PHS), W-CDMA **Wireless networking:** Bluetooth™, HIPERLAN/1 (HBR), HIPERLAN/1 (LBR), 802.11b **Digital Video:** DTV8, DTV16, DVB16, DVB32, 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 where α <0.2 20 symbols: all others
User-selectable alpha/BT	Continuously adjustable from 0.05 to 10
User-defined filters	User-defined impulse response, fixed 20 points/symbol Maximum 20 symbols in length or 401 points

Maximum symbol rate

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

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

* Maximum symbol rate doubled for VSB modulation format.

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

Measurement results (FSK)	
FSK measured	Time, spectrum
FSK reference	Time, spectrum
Carrier error	Magnitude
FSK error	Time, spectrum

Display formats

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

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

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

Error summary (formats other than FSK)

Measured rms and peak values of the following:	Error vector magnitude, magnitude error, phase error, frequency error (carrier offset frequency), I-Q offset, amplitude droop (PSK and MSK formats), SNR (8/16VSB 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.

Error summary (FSK)

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

Detected bits (symbol table)

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

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

Accuracy

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

Conditions: Specifications apply from 20 to 30° C, for a full scale signal, fully contained in the selected measurement span, random data sequence, instrument receiver mode of IF (0 to 36 MHz) or RF (20 to 2700 MHz), range ≥–25 dBm, start frequency ≥15% of span, alpha/BT ≥0.3* , and symbol rate ≥1 kHz. For symbol rates less than 1kHz accuracy may be limited by phase noise.

* 0.3 ≤ alpha ≤ 0.7 offset QPSK

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

Residual EVM	
span ≤100 kHz	<0.5% rms
span ≤1 MHz	<0.5% rms
span ≤10 MHz	<1.0% rms
span >10 MHz	<2.0% rms
Magnitude error	
span ≤100 kHz	0.3% rms
span ≤1 MHz	0.5% rms
span ≤10 MHz	1.0% rms
span >10 MHz	1.5% rms
Phase error (For modulation formats with equal symbol amplitudes)	
span ≤100 kHz	0.3° rms
span ≤1 MHz	0.4° rms
span ≤10 MHz	0.6° rms
span >10 MHz	1.2° rms
Frequency error (added to frequency accuracy if applicable)	symbol rate/500,000
I-Q/origin offset	–60 dB or better

Video modulation formats	
Residual errors (typical) 8/16 VSB: Symbol rate = 10.762 MHz, α = 0.115, instrument receiver mode of IF (0–36 MHz) or RF (20–2700 MHz), 7 MHz span, full-scale signal, range ≥–25 dBm, result length = 800, averages = 10	
Residual EVM	≤ 1.5% (SNR ≥ 36 dB)
16, 32, 64 or 256 QAM: Symbol rate = 6.9 MHz, α = 0.15, instrument receiver mode of IF (0–36 MHz) or RF (20–2700 MHz), 8 MHz span, full-scale signal, range ≥–25 dBm, result length = 800, averages = 10	
Residual EVM	≤ 1.0% (SNR ≥ 40 dB)

Adaptive equalizer	
Removes the effects of linear distortion (e.g. non-flat frequency response, multipath, etc.) from modulation quality measurements. Equalizer performance is a function of the setup parameters (equalization filter length, convergence, taps/symbol) and the quality of the signal being equalized.	
Equalizer type	
Decision-directed, LMS, feed-forward equalization with adjustable convergence rate	
Filter length	3–99 symbols, adjustable
Filter taps	1, 2, 4, 5, 10, or 20 taps/symbol
Measurement results provided	Equalizer impulse response
	Channel frequency response
Supported modulation formats	MSK, BPSK, QPSK, OQPSK, DQPSK, $\pi/4$DQPSK, 8PSK, D8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM 8VSB, 16VSB, $\frac{3\pi}{8}$ 8PSK (EDGE)

Option B7N
W-CDMA and cdma2000 modulation analysis
(requires option AYA vector modulation analysis)

W-CDMA modulation analysis	
Signal aquisition (characteristic)	
Result length	Adjustable between 1 and 64 slots
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length
Signal playback (characteristic)	
Result length	Adjustable between 1 and 64 slots
Capture length (gap-free analysis at 0% overlap; at 5 MHz span)	375 slots (standard) 3000 slots (option 144) 6000 slots (option 288) 24000 slots (option 001)
Supported formats (characteristic)	
Formats	Downlink, uplink
Single-button presets	Downlink, uplink
Other adjustable parameters (characteristic)	
Chip rate	Continuously adjustable
User-selectable alpha	Continuously adjustable between 0.05 and 1
Scramble code (downlink)	Continuously adjustable between 0 and 512
Scramble code (uplink)	Continuously adjustable between 0 and $2^{24} - 1$
Scramble offset (downlink)	Continuously adjustable between 0 and 15
Scramble type (downlink)	Standard, left, right
Sync type (downlink)	CPICH, SCH
Measurement results (characteristic)	
Composite (all code channels at once or all symbol rates taken together)	
Code domain power	All symbol rates together Individual symbol rates (7.5, 15, 30, 60, 120, 240, 480, 960 ksps)
Code domain error	Composite (all symbol rates taken together) Individual symbol rates (7.5, 15, 30, 60, 120, 240, 480, 960 ksps)
IQ measured	Time, spectrum
IQ reference	Time, spectrum
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference)
Composite errors	Summary of EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, Ttrigger, frequency error, IQ offset, slot number
Channel (individual code channel)	
IQ measured	Time
IQ reference	Time
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time (vector difference between measured and reference)
Symbol table and error summary	Summary of EVM, magnitude error, phase error, slot number, pilot bits, tDPCH

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

cdma2000 modulation analysis

Signal aquisition (characteristic)	
Result length	Adjustable between 1 and 64 PCGs forward link; 1 and 48 PCGs reverse link
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length
Signal playback (characteristic)	
Result length	Adjustable between 1 and 64 PCGs forward link; 1 and 4 PCGs reverse link
Capture length (gap-free analysis at 0% overlap; at 2.6 MHz span)	400 PCGs (standard) 3200 PCGs (option 144) 6400 PCGs (option 288) 25600 PCGs (option 001)
Supported formats (characteristic)	
Formats	Forward, reverse
Single-button presets for	Forward, reverse
Other adjustable parameters (characteristic)	
Chip rate	Continuously adjustable
Long code mask (reverse)	0
Base code length	64, 128
Measurement results (characteristic)	
Composite (all code channels at once or all symbol rates taken together)	
Code domain power	All symbol rates together Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
Code domain error	Composite (all symbol rates taken together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
IQ measured	Time, spectrum

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

Option B7R
802.11a OFDM and HIPERLAN/2 modulation analysis
(requires option AYA vector modulation analysis)

Signal acquisition	
Modulation format	Auto detect or manual override (BPSK, QPSK, 16QAM, 64QAM)
Search length	Minimum: result length +6 symbol times. Maximum: 6800 symbol times.
Result length	Auto detect or adjustable between 1 and 1367 symbol-times
Triggering	Single/continuous, free-run/channel/external
Measurement region	Interval and offset adjustable within result length
Signal playback	
Result length	Auto detect or adjustable between 1 and 1367 symbol-times
Capture length (gap-free analysis at 0% overlap; at 31.25 MHz span)	0.125 seconds (standard) 1.0 seconds (option 144) 2.0 seconds (option 288) 8.0 seconds (option 001)
Supported formats	
Formats	IEEE 802.11a, HIPERLAN/2
Single-button presets	IEEE 802.11a, HIPERLAN/2
Other adjustable parameters	
IQ normalize	On/Off
Sub-carrier spacing	Continuously adjustable
Symbol timing adjust	Adjustable between 0 and guard interval
Guard interval	1/4, 1/8 (HIPERLAN/2 only)
Pilot tracking	Phase, Amplitude, Timing
Carriers to analyze	All or Single Carrier
Demodulation measurement results	
IQ measured	All carriers over all symbol-times
IQ reference	All carriers over all symbol-times (ideal, computed from detected symbols)
Error vector	Time, Spectrum (for each carrier and symbol in the burst)
RMS error vector	Time, Spectrum
Common Pilot Error	Phase, Magnitude
Symbol table and error summary	Summary of EVM, pilot EVM, CPE, IQ offset, frequency 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, Averaged
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
Other	Same as option AYA

Residual EVM (independent of modulation format)	-40 dB max
Frequency error (relative to frequency standard)	
Lock Range	±624 kHz (± 2x subcarrier spacing)
Accuracy	±5 Hz

Option 105
Dynamic links to EESof ADS

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	Data: Timed Frequency Demod Errors Complex Scalar Float Scalar Integer Scalar Control: Data Gap Indicator
VSA input modes	Hardware Recording
VSA analysis range	Dependent on input mode and hardware installed
VSA component parameters (user settable)	VSATitle ControlSimulation OutputType Pause VSATrace TStep SetUpFile RecordingFile SetUpUse AutoCapture DefaultHardware AllPoints
VSA component parameters (passed to ADS, timed output only)	Carrier frequency TStep

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
Required ADS components	
EESof Design Environment	E8900A/AN
EESof Data Display	E8901A/AN
EESof Ptolemy Simulator	E8823A/AN
Recommended ADS configurations:	
EESof Communication System Designer Pro	E8851A/AN
EESof Communication System Designer Premiere	E8852A/AN

System hardware

General

A standard 89640A RF vector signal analyzer consists of the following hardware:

RF tuner module	E2730A
RF input module	89605
95 Msample/s ADC	E1439A
IEEE-1394 controller with PCI interface	E8491B option 001
4-Slot VXI mainframe	E8408A options 001, 918

Hardware interfaces (characteristics only)	
External trigger input	BNC connector; 1 KΩ impedance
External frequency reference	
Output	10 MHz at >+3 dBm into a 50Ω load
Input	10 or 13 MHz (±5 ppm) at >0 dBm into a 50Ω load. (89605B input module required.)
Safety and environmental	
Safety standards	EN 61010-1 (1993)
Radiated emissions	EN 61326-1
Electrostatic discharge	Perf Criteria B (when used with desktop PC) Perf Criteria C (when used with laptop PC, may require operator intervention after an ESD event)
Environmental	
Operating temperature	0–50° C; 20–30° C for warranted specifications
Humidity	10% to 90% at 40° C
Altitude	3000 m
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

Physical	
Weight	16 kg (36 lb)
Dimensions	
With protective bumpers	388 mm H x 152 mm W x 548 mm D
Without bumpers	362 mm H x 133 mm W x 540 mm D

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Printed in USA June 12, 2002
5980-1258E

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