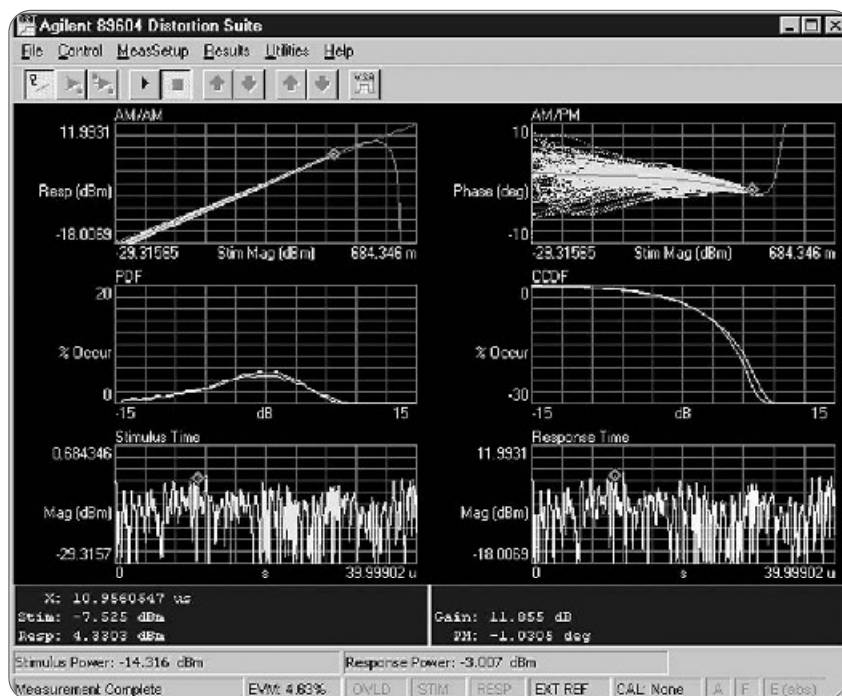


# Agilent 89604A/89604AN Distortion Test Suite Software

## Technical Overview



- Measures complex stimulus signals
- Exports time-aligned stimulus/response data
- Displays AM/AM, AM/PM, "delta" EVM results
- PC-based software
- Works with a variety of Agilent analyzers



Agilent Technologies

## Distortion Test Suite Software

Meeting the linearity goals set for today's advanced multichannel power amplifier (MCPA) designs is a challenge. Measuring the linearity of such a wide bandwidth device is nearly as challenging. Using traditional narrow-band techniques to measure wideband designs can produce inaccurate and even misleading results (Figure 1).

The 89604A distortion test suite works with complex modulated wideband signals to accurately measure AM/AM and AM/PM distortion of MCPAs with up to 80 MHz measurement bandwidth. This wideband measurement technique helps assure that even subtle distortion mechanisms like memory effects and local heating are stimulated and measured.

### Powerful measurements

AM/AM and AM/PM measurement results are displayed together with a linear performance line and a curve fit to the results (Figure 2). Use these displays to examine how far from ideal your MCPA behaves as it approaches saturation.

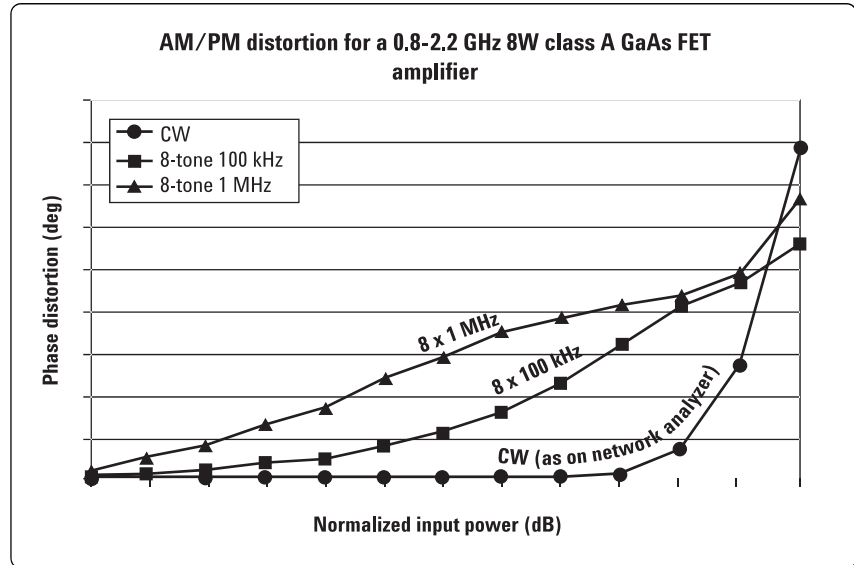


Figure 1: Results vary - AM/PM curves of an 8W class A amplifier derived using single and multiple narrowband signals

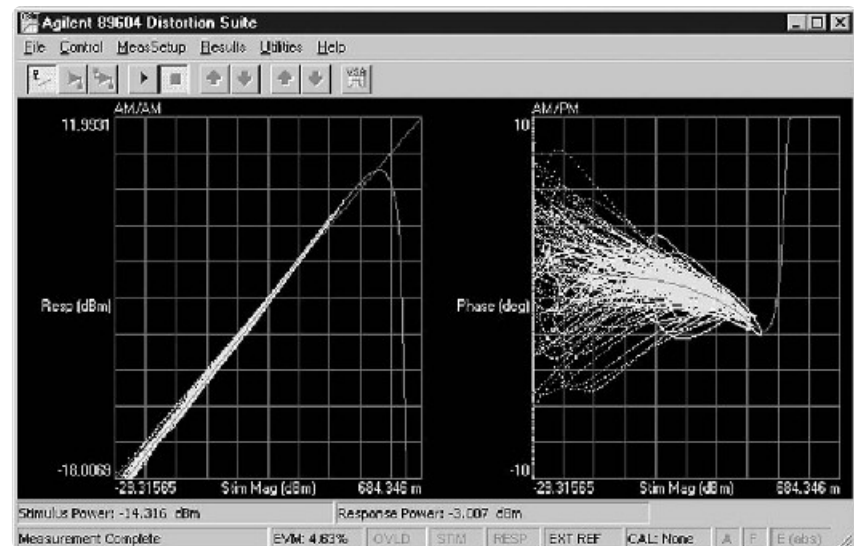


Figure 2: AM/AM and AM/PM traces with linear reference lines and polynomial curves fit to the data

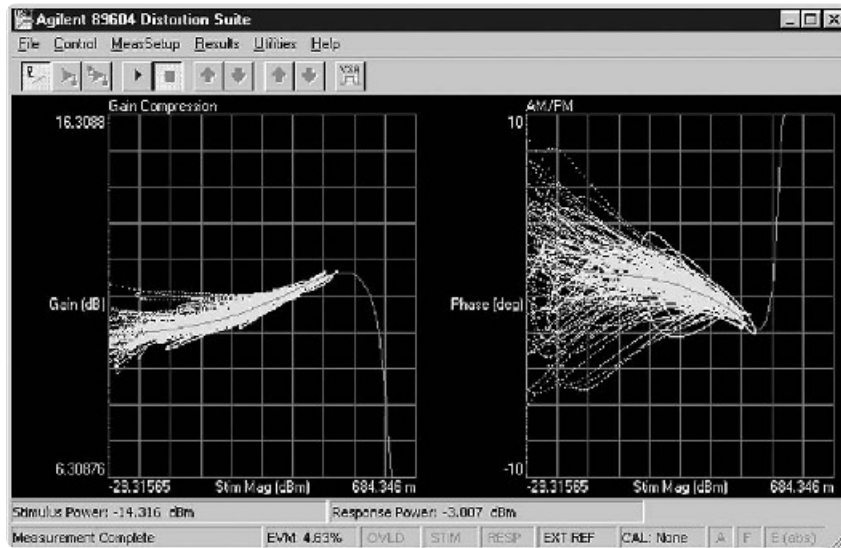


Figure 3: Gain compression display. This amplifier's gain actually increased as it neared saturation

For yet more information on your results, call up the gain compression display (Figure 3). Particularly useful with very linear amplifiers, this display scales the AM/AM (gain) curve to emphasize variations in gain.

Use the probability distribution function (PDF) and complementary cumulative distribution function (CCDF) curves provided by the distortion suite to monitor the statistical distribution of power in your complex stimulus and response time-waveforms (Figure 4). Examine the PDF to assure the stimulus and response signals have the expected distribution around their means. Use the CCDF to study the headroom available in your design.

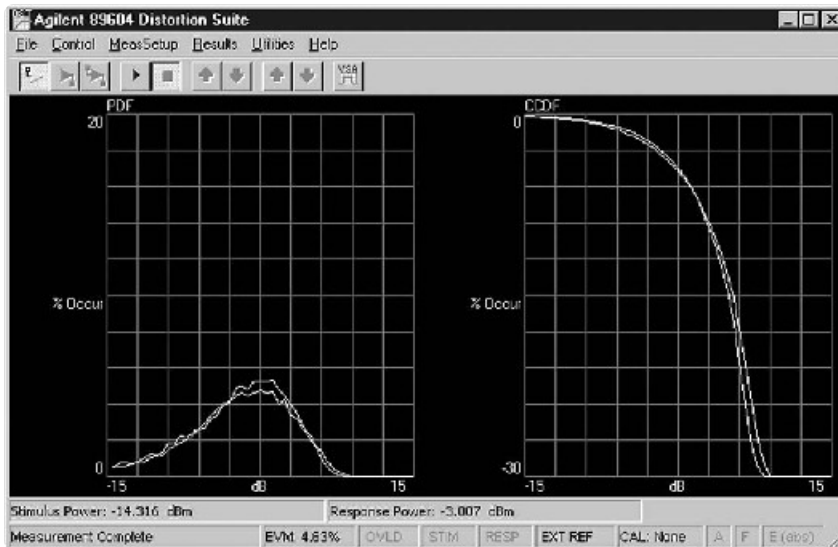


Figure 4: PDF and CCDF curves for the stimulus and response signals

Non-linear distortion mechanisms do more than degrade adjacent channel performance. They also degrade the modulation on the signal, that is, they increase the EVM of the signal. Use the distortion test suite to estimate how much your MCPA will increase a signal's EVM as it passes through. This "delta" EVM is a standard measurement in this software package and works on any signal (Figure 5).

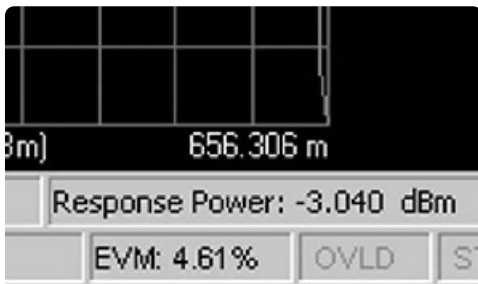


Figure 5: "Delta" EVM, a standard measurement

Use the results summary to view the basic parameters of your measurement: gain, delay, stimulus, and response power (Figure 6). The polynomial coefficients provided in this table are the coefficients used by the AM/AM, AM/PM display curve-fitting algorithm and can be used to set up your pre-distortion curve fitter.

### Access sampled waveforms

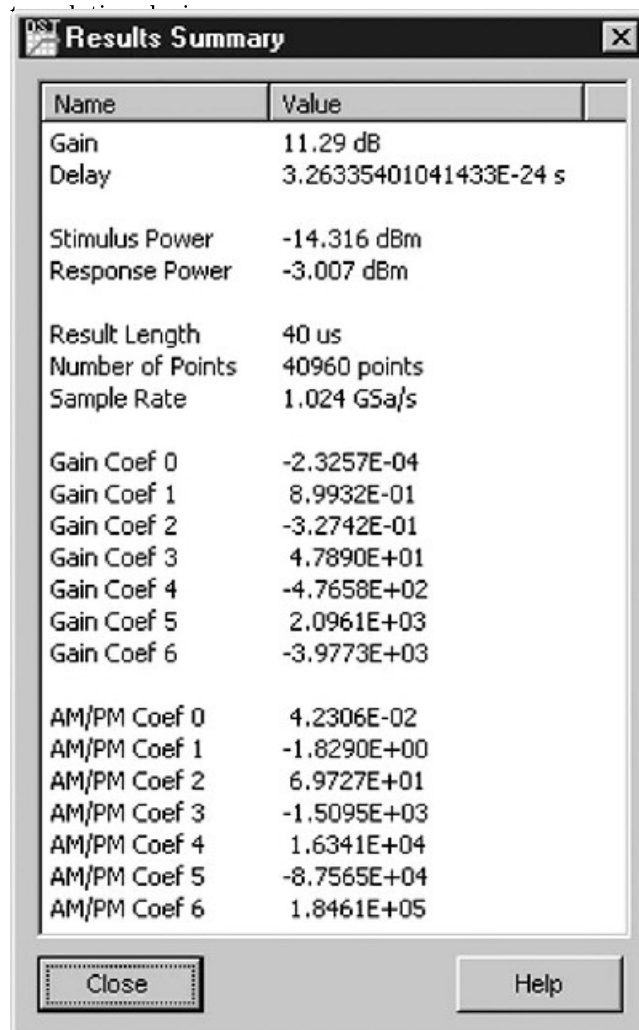
Sometimes all you need is the raw data. The distortion test suite provides the digitized stimulus and response waveforms in several file formats so you can process them using proprietary algorithms or curve fitters. These are corrected files. The samples are precisely aligned in time, amplifier induced delay and phase offsets are removed, and the amplitude is scaled and corrected for padding attenuators. A resample algorithm in the distortion test suite lets you select an arbitrary sample rate for the output file to match the requirements of your curve fitting algorithms. The result is time-aligned I/Q data you can use in your MCPA pre-distortion processor.

### Flexible measurement setup

Make single-channel manual measurements or two-channel automatic measurements with the 89604A distortion test suite software.

For single-channel measurements, you first measure the stimulus signal, then move the test lead to the MCPA output and measure the response signal. A repeatable signal and a synchronizing trigger signal from the signaling source are required to make single-channel measurements.

Two-channel measurements do not require moving test leads, a repeatable signal, or a synchronizing trigger<sup>1</sup>. And, the input and output signals can be at different frequencies so you can measure frequency



Name	Value
Gain	11.29 dB
Delay	3.26335401041433E-24 s
Stimulus Power	-14.316 dBm
Response Power	-3.007 dBm
Result Length	40 us
Number of Points	40960 points
Sample Rate	1.024 GSa/s
Gain Coef 0	-2.3257E-04
Gain Coef 1	8.9932E-01
Gain Coef 2	-3.2742E-01
Gain Coef 3	4.7890E+01
Gain Coef 4	-4.7658E+02
Gain Coef 5	2.0961E+03
Gain Coef 6	-3.9773E+03
AM/PM Coef 0	4.2306E-02
AM/PM Coef 1	-1.8290E+00
AM/PM Coef 2	6.9727E+01
AM/PM Coef 3	-1.5095E+03
AM/PM Coef 4	1.6341E+04
AM/PM Coef 5	-8.7565E+04
AM/PM Coef 6	1.8461E+05

Figure 6: Results Summary display provides the basic measurement results parameters and curve fit coefficients

Measurement setup is simple regardless of the number of channels. Enter the center frequency and measurement span, number of measurement channels, input range, size of external attenuators, and trigger delay (if any), then press start. The 89604A software does the rest.

The 89604A software works equally well with real-world signals provided by a base station, test signals provided by a signal generator, or even noise-like signals. Agilent's ESG, PSG, or MXG Series signal generators offer a wide variety of complex modulation types in a package that provides flexible tuning range, accurate high power out and calibrated performance.

1. Depending on the measurement hardware used, a trigger signal may still be required to align the measurement with the stimulus signal.



Figure 7. Use the distortion suite software with an ESG, PSG, or MXG vector signal generator and an ESA-E Series, PSA Series, or MXA spectrum analyzer. To examine your sampled system performance, you may also use an Agilent 16800/16900 logic analyzer (not shown).

## Fit the Hardware to your Measurement Needs

Use the PC-based 89604A distortion test suite software with any of Agilent's ESA-E, PSA Series, or MXA spectrum analyzers, Agilent's modular VSI analysis hardware, or the E4406A Transmitter Tester.

### ESA-E Series spectrum analyzers

The ESA-E Series general-purpose, portable spectrum analyzers offer a wide range of performance, features, and flexibility with up to 26.5 GHz tuning range and 10 MHz of analysis bandwidth for use with the 89604A distortion test suite software. Measurement control is via GPIB.

### PSA Series high-performance spectrum analyzers

The Agilent PSA Series offers high-performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, a leading-edge combination of flexibility, speed, accuracy, dynamic range and up to 80 MHz of analysis bandwidth for use with the 89604A software. Measurement control is via LAN or GPIB.

### Modular VSI analysis hardware

Used as part of Agilent's 89600 Series vector signal analyzer family, this versatile combination of modules offers 36 MHz of analysis bandwidth and 6 GHz tuning range in a compact 4-slot VSI mainframe.

### E4406A VSA transmitter tester

Connect Agilent's E4406A VSA transmitter tester with the 89600 software and you have two high-performance instruments: a superior multi-format standards-based transmitter tester and a high-performance flexible digital demodulation and analysis tool.

### MXA signal analyzer

The MXA signal analyzer drives signal and spectrum analysis to the next generation, offering the highest performance in a mid-range analyzer. Innovative breakthroughs enable the MXA signal analyzer to achieve the industry's fastest signal and spectrum analysis, eliminating the compromise between speed and performance.

### Two channel operation

For faster measurements and to work with non-burst signal types, the distortion suite supports two-channel configurations based on the PSA Series spectrum analyzers using the standard 8 MHz IF digitizer or VSI modular hardware.

### Agilent 16900 and 1680/1690 Series logic analyzers

Analyze the digital portions of your designs with the distortion test suite. The logic analyzer provides the physical connection into your circuits, and streams out the logic signal corresponding to I and Q. You no longer need to download to an external math program, or develop your own display and measurement algorithms. Use the distortion test suite with both a logic analyzer and another front end to make cross-domain measurements. For more information, see *Direct Digital Measurements*, literature number 5989-2382EN.



### Use your own PC

Load the 89604A distortion test suite on your PC, connect to the measurement hardware and start making measurements. The 89604A runs on any PC running Windows® 2000 or XP Professional platform with GPIB, LAN, USB, or IEEE-1394 interface to connect to the hardware.

### Additional software when you need to do more

For engineers working with today's emerging broadband communication systems, Agilent's 89601A vector signal analysis (VSA) software is an indispensable tool for basic research, product development, manufacturing and field-testing.

Working with the same hardware front-ends as the 89604A distortion test suite software, the 89601A VSA

software provides high-performance RF and modulation troubleshooting tools to complement the distortion suite. It offers traditional RF spectrum displays, baseband (I/Q) analysis, signal capture and playback, RF and IF triggering, a wide variety of analog and digital demodulators, and an extensive set of time, frequency and modulation analysis tools. These capabilities make the VSA software ideal for evaluating narrowband and broadband digital communication signals.

## Specifications<sup>1</sup>

### MXA signal analyzer

Model numbers	N9020A	
Residual delta EVM (Center frequency ≤ 3.6 GHz)		
Analysis bandwidth	< 10 MHz	< 25 MHz
One-channel measurement		
Range ≥ -30 dBm	0.4% rms	0.6% rms

### ESA-E Series spectrum analyzers

Model numbers	E4402B, E4404B, E4405B, E4407B	
<b>Residual delta EVM</b> (Center frequency ≤ 3 GHz, alias protect = on)		
Analysis bandwidth	<u>&lt; 5 MHz</u>	< 10 MHz
One-channel measurement		
Range > -20 dBm	0.6% rms	0.9% rms
Two-channel measurement		
Range > -20 dBm	1.1% rms	1.1% rms

### PSA Series spectrum analyzers

Model numbers	E4440A, E4443A, E4445A, E4446A, E4447A, E4448A (with no Option E444x-140 or E444x-122, where x = 0,3,5)	
Residual delta EVM (Center frequency ≤ 3 GHz)		
Analysis bandwidth	< 5 MHz	< 8 MHz
One-channel measurement		
Range -44 to -24 dBm	0.4% rms	0.5% rms
Range ≥ -24 dBm	0.3% rms	0.3% rms
Two-channel measurement		
Range -44 to -24 dBm	0.5% rms	0.6% rms
Range ≥ -24 dBm	0.4% rms	0.5% rms

### E4406A VSA transmitter tester

Model number	E4406A	
<b>Residual delta EVM</b> (Except 314 to 329 MHz and 628 to 658 MHz)		
Analysis bandwidth	< 5 MHz	< 8 MHz
One-channel measurement		
Center frequency ≤ 2.5 GHz	0.6% rms	0.7% rms
Center frequency > 2.5 to 4.0 GHz	1.1% rms	1.5% rms
Two-channel measurement		
Center frequency ≤ 2.5 GHz	0.6% rms	0.7% rms
Center frequency > 2.5 to 4.0 GHz	1.1% rms	1.4% rms

### 89604AN floating license for network sharing

Floating license capability allows many users to share licenses. A license installed on the license server is available to any PC that is connected to the network. Install the distortion suite software on as many PCs as you like, and the number of licenses that reside on the network determines the number of users at any moment.

When one user exits the software, that license becomes available for another user. Permanent floating licenses facilitate sharing of software so you can:

- Reduce cost by getting more usage from fewer licenses
- Maximize the use of each software license
- Increase productivity with all users operating the software from their own PC

1. Stimulus/response signals must be within 6 dB of top of input range. 99.9 percent of signal power must be within the measurement span. Stimulus source must be referenced locked to analyzer for single channel measurements.

**VXI analysis hardware** (see 89600 vector signal analyzer configuration guide)**Model numbers** Using E1439 ADC and E2731A or E2730A VXI RF tuner**Residual delta EVM**

<i>Analysis bandwidth</i>	<i>&lt; 15 MHz</i>	<i>&lt; 25 MHz</i>	<i>&lt; 36 MHz</i>
One-channel measurement Range $\geq -25$ dBm	0.6% rms	0.7% rms	0.8% rms

**Model numbers** Using E1439 ADC and any PSA spectrum analyzer with Option H70**Residual delta EVM** (Center frequency  $\leq 6.0$  GHz)

<i>Analysis bandwidth</i>	<i>&lt; 15 MHz</i>	<i>&lt; 25 MHz</i>	<i>&lt; 36 MHz</i>
One-channel measurement Range $\geq -22$ dBm	0.5% rms	0.8% rms	0.9% rms
Two-channel measurement Range $\geq -22$ dBm	<i>With 89604A extended calibration</i> 0.7% rms	1.0% rms	1.3% rms

**Model numbers** Using E1439 ADC only**Residual delta EVM**

<i>Analysis bandwidth</i>	<i>&lt; 15 MHz</i>	<i>&lt; 25 MHz</i>	<i>&lt; 36 MHz</i>
One-channel measurement Range $\geq -25$ dBm	0.5% rms	0.7% rms	0.8% rms
Two-channel measurement Range $\geq -25$ dBm	0.4% rms	0.6% rms	0.7% rms

**General information**

<b>Display formats</b>	AM/AM, AM/PM, gain compression, PDF, CCDF, power vs. time, delta EVM, stimulus power, response power
<b>Marker results</b>	Gain, phase, stimulus power, response power
<b>Data scaling</b>	None, peak = 1, mean = 1
<b>Curve fit</b>	3 to 15 coefficients for AM/AM and AM/PM, user-settable
<b>Summary results</b>	Gain, delay, stimulus power, response power, result length, number of points, sample rate, gain coefficients, AM/PM coefficients
<b>File</b>	
Save	Setup, results summary, results data, stimulus data, response data
Recall	Setup, stimulus data, response data
Formats (save/recall)	csv, .txt, .mat (MAT-file version 4 and later)
<b>Requirements</b>	
PC (minimum)	> 600 MHz Pentium®, 512 MB RAM, 4 MB video RAM, 500 MB available on hard disk, I/O slot for interface to signal acquisition hardware (if required), CD-ROM drive desirable.
Operating system	Windows 2000, SP2, or XP Professional (Do not install 89604A on a PC with Agilent vector signal analysis software model 89601A V3.02 or lower already installed. Contact Agilent for information on upgrading your 89601A software.)

**Related Literature**

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

*89600 Series Vector Signal Analysis  
Software 89601A/89601AN/89601N12*,  
*Technical Overview*, literature num-  
ber 5989-1679EN

*89600 Series Vector Signal Analysis  
Software 89601A/89601AN/  
89601N12, Data Sheet*, literature  
number 5989-1786EN

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

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

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

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

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

## Web Resources

For more information on the 89604A distortion test suite, please visit: **[www.agilent.com/find/distortionsuite](http://www.agilent.com/find/distortionsuite)**

For more information on compatible hardware, please visit: **[www.agilent.com/find/spectrumanalyzers](http://www.agilent.com/find/spectrumanalyzers)**

For more information visit: **[www.agilent.com/find/89600](http://www.agilent.com/find/89600)**



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