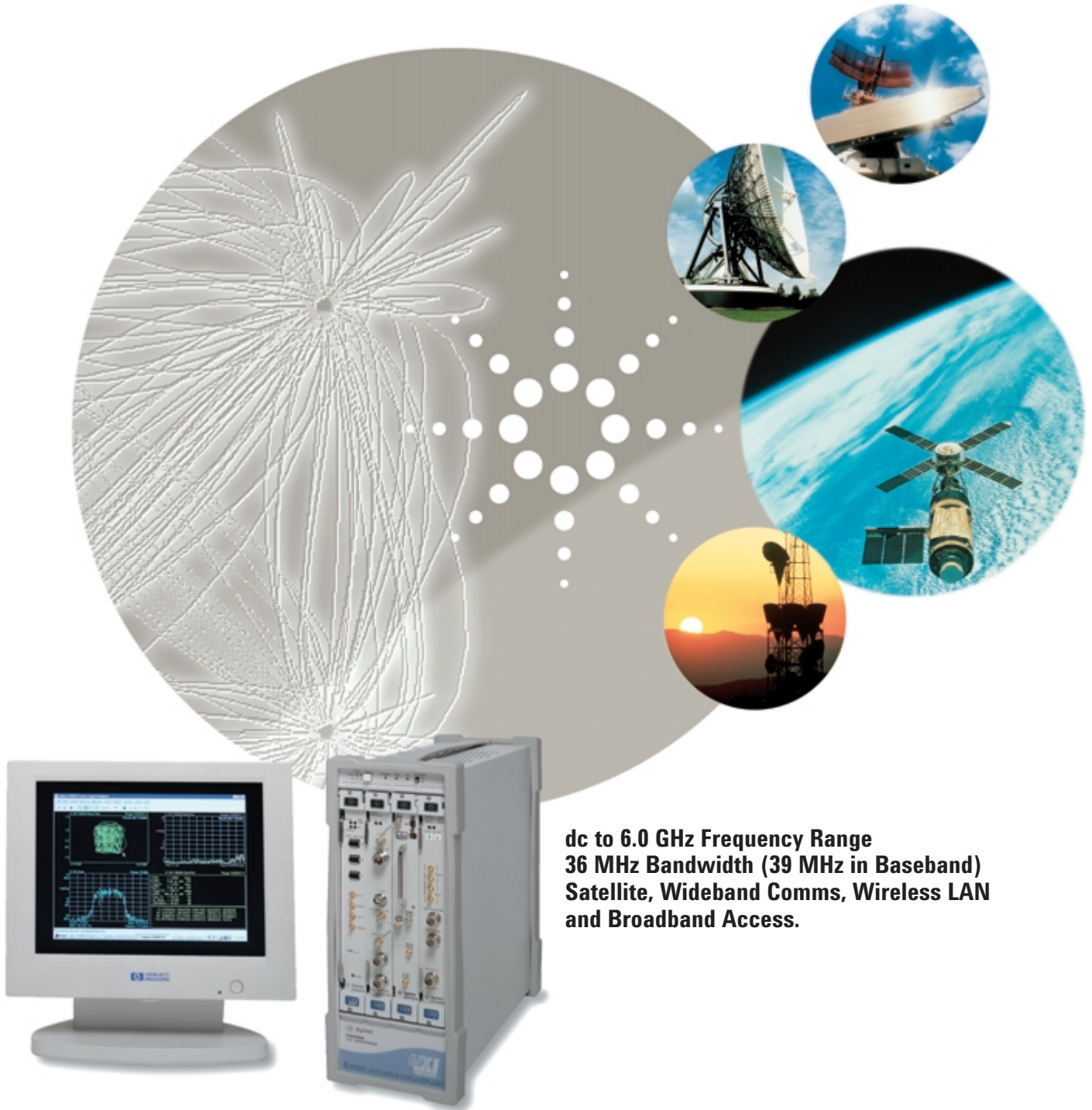


**Agilent**

**89600 Series**

**Wide Bandwidth Vector Signal Analyzers**



**dc to 6.0 GHz Frequency Range  
36 MHz Bandwidth (39 MHz in Baseband)  
Satellite, Wideband Comms, Wireless LAN  
and Broadband Access.**



# Troubleshoot RF and DSP problems

The Agilent Technologies 89600 series vector signal analyzer (VSA) facilitates faster and easier communication system design from initial design simulation to final hardware prototype. It offers 36 MHz bandwidth capacity for measuring signals up to 6.0 GHz such as cellular and satellite communications, digital video, wireless LAN, and local multi-point distribution service (LMDS).

Spectrum analyzers with demodulation capability are useful tools for highlighting an existing problem. However, many DSP or RF problems can create high adjacent channel power or poorly locked constellations. Using the VSA's sophisticated and unique error analysis tools, you can actually determine the root causes of the problems.

The 89600 series VSA dynamically links to Agilent's Advanced Design System (ADS), electronic design automation software. This tight linkage means you can use same tool to evaluate simulated data and measurement results from hardware – minimizing the time you need to learn a new tool and providing you confidence in results because the same measurement algorithms are used during simulation and test.

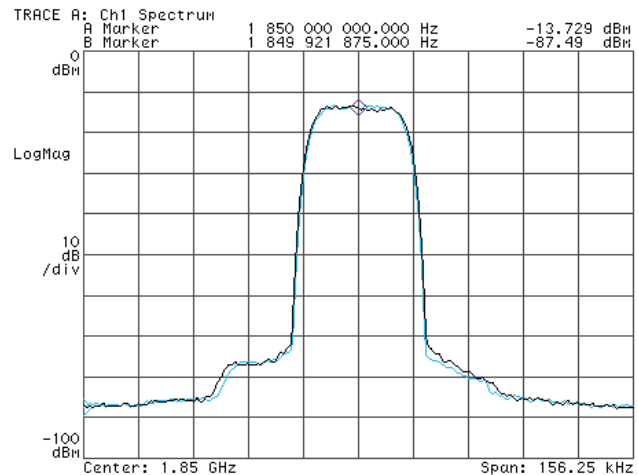
Links to the Agilent ESG series signal generators from both the ADS software and the 89600 VSA mean you no longer need to wait for all of

the hardware stages in a block diagram to come together in order to begin looking for system level problems. Now, the VSA can uncover RF and DSP problems throughout the radio block diagram – even before hardware exists.

Working with hard-to-measure signals – burst, hopped, modulated – is a fact of life for designers of today's high-performance communications systems. When creating a new design, it takes time to find the causes of system problems. The Agilent 89600 series VSAs combine time-, frequency- and modulation-domain analysis to provide measurements and displays that help you look in the right place sooner.

## More than a spectrum analyzer

VSA's provide traditional spectrum displays and measurements, but today a spectrum analyzer isn't enough. New digital formats require new measurements. Familiar tools such as spectrum analyzers with demodulation may indicate that a problem exists, but they can't help you understand what the problem is. For instance, incorrect filtering, spurious interference, incorrect interpolation, DAC overflow, symbol mistiming and other errors may all increase the adjacent channel power and distort the constellation. Only the VSA can identify which of these problems is the root cause.



These two signals appear almost identical when viewed with a spectrum analyzer. However, this radio will not transmit a bit. The second signal is off in its center frequency, symbol clock rate, and filter alpha. Spectrum analyzers with demodulation will all show high ACPR and a cloudy constellation, but only a VSA can identify these problems with a single screen using its EVM versus time display.

# The architecture for a new breed of signals

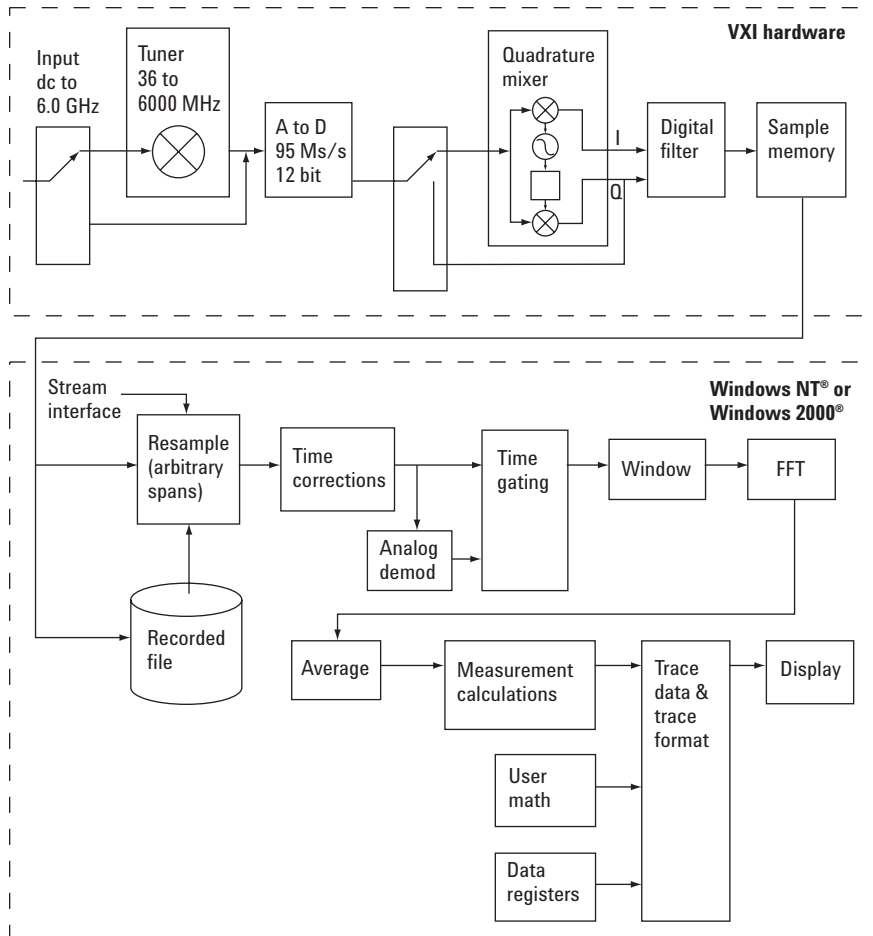
Vector signal analyzers possess an architecture similar to your own digital radio; they rely on DSP processing for most of their analysis, for example fast fourier transforms (FFT) for spectrum display or DSP algorithms for optional demodulation. Signals are digitized with careful attention to both magnitude and phase. Once digitized, the signals are available for manipulation by the built-in measurement and analysis capabilities of the 89600, or available for storage and eventual analysis by external means.

The VSA provides many measurement displays for analyzing continually changing phase, magnitude, and frequency. Some displays, like the constellation and vector diagrams, are familiar to radio designers.

The VSA architecture resembles a generalized digital radio. DSP demodulation algorithms with user control over modulation parameters provide flexible demodulation for a range of new and emerging formats, including 3G and WLAN.

Others, like the new spectrogram are new tools for qualitatively understanding system behavior.

The 89600 relies on the PC for its processing. Improvements in PC capabilities automatically mean improvements in the analyzer's performance. Also, because the VSA can analyze any data, whether from its own hardware or time series data from computational tools, new capabilities from integrating test instrumentation and design automation software are possible.



# The measurement performance to get the job done

## 89610A VSA (dc to 40 MHz)

### Outstanding baseband performance

The 89610A is a single-channel baseband VSA with a 39 MHz bandwidth and excellent phase noise, sensitivity, and amplitude accuracy. The 89610A has a 100 Msample/sec analog-to-digital converter with optional 768 Msamples (1152 MB) of memory.

The measurement hardware is housed in a VXI mainframe for easier transportability and is connected to the PC through an IEEE 1394 bus for maximum data transfer speed. All digital signal processing is done in the PC (Windows NT or Windows 2000), giving you the advantage of linking to other applications like Agilent's ADS, Math Works MATLAB, and Microsoft® Excel. The Agilent 89600 series VSAs can be programmed using COM API Active X programming.

## 89611A 70 MHz IF VSA (52-88 MHz)

### Great IF performance

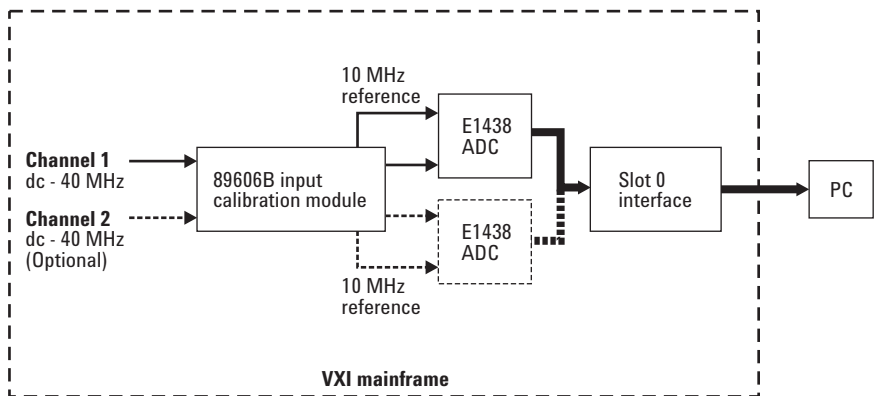
Use your own tuner with this high performance vector signal analyzer. The Agilent 89611A IF VSA works with any 70MHz IF center frequency tuner for IF bandwidths up to 36 MHz. The same 95 MSa/sec digitizer and deep capture memory found in the 89640A are used in the 89611A so you can handle wideband complex time varying signals with it also.

### Key 89600 specifications

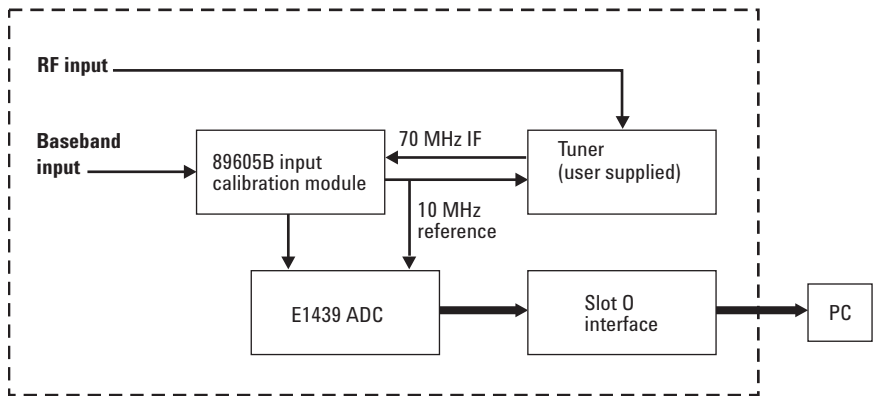
A second channel can be added (Option 102) to the 89610A. With a second channel the overall bandwidth is increased to 78 MHz (I +jQ). The calibration card, 89606B has two inputs and outputs supplying both channels.

	89610A	89640A	89611A*	89641A
<b>Amplitude accuracy</b>	±0.8 dB	±2.0 dB	±0.8 dB	±2.0 dB
<b>Spurious response</b>	< -70 dB	< -65 dB	< -70 dB	< -65 dB
<b>Sensitivity</b>	< -152 dBm/Hz	< -158 dBm/Hz	-157 dBm/Hz	< -154 dBm/Hz

\* Not including a tuner



89610A vector signal analyzer system

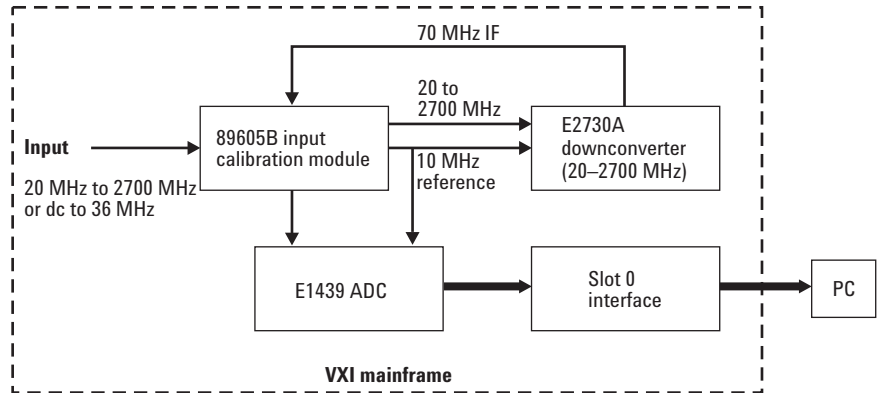


89611A IF vector signal analyzer system

## 89640A VSA (dc to 2.7 GHz)

### Excellent RF performance

To meet the needs of most wide-band development requirements, the Agilent 89640A VSA offers a very wide bandwidth of 36 MHz. With a 95 Msample/sec digitizer and optional deep 768 Msample signal capture memory, you can easily analyze complex time-varying signals. The 89640A, like the 89610A, has excellent phase noise, sensitivity and amplitude accuracy.

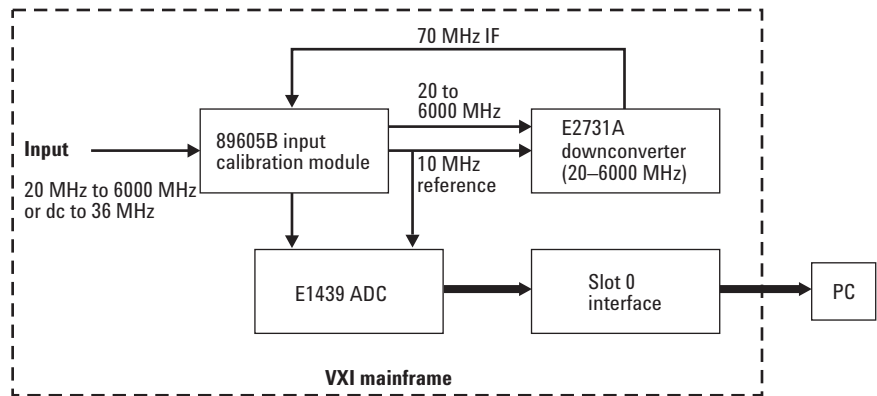


89640A vector signal analyzer system

## 89641A VSA (dc to 6.0 GHz)

### Extended RF performance

Analyze and troubleshoot digital communications signals, WLAN signals and more with Agilent's 89641A 6.0 GHz VSA. As with the 89640A, the 89641A offers 36 MHz of analysis bandwidth, enough to analyze even 2x bandwidth "turbo" mode WLAN chips. Combine this bandwidth with the excellent phase noise, sensitivity and amplitude accuracy to the 89641A and you have an exceptional tool for analyzing time-varying signals ranging from 802.11a to GSM and NADC.



89641A vector signal analyzer system

# Powerful vector modulation analysis (Option 896xxA-AYA \*)

The real power of a VSA is its ability to analyze complex, time-varying signals. The 89600 VSA analyzes a wide variety of standard formats, including the new enhanced data rates for GSM evolution (EDGE), and 802.11a wideband LAN as well as other generally used modulation formats

You can quickly evaluate and troubleshoot digitally modulated signals with both qualitative displays and quantitative measurements. Then, visualize system performance rapidly and intuitively with familiar display formats.

### Supported modulation formats

#### Available with Option 896xxA-AYA

APCO 25;	Bluetooth;
CDMA Base;	CDMA Mobile;
CDPD;	DECT;
DTV8;	DTV16;
DVB16;	DVB32;
DVB64;	EDGE;
GSM;	HIPERLAN/1 (HBR);
HIPERLAN/1 (LBR);	NADC;
PDC;	PHP (PHS);
TETRA;	WLAN (802.11b);
	VDL mode 3;

#### Available with Option 896xxA-B7N

W-CDMA (3GPP); Cdma 2000 (3GPP2);

#### Available with Option 896xxA-B7R

WLAN (802.11a) WLAN (HIPERLAN/2)

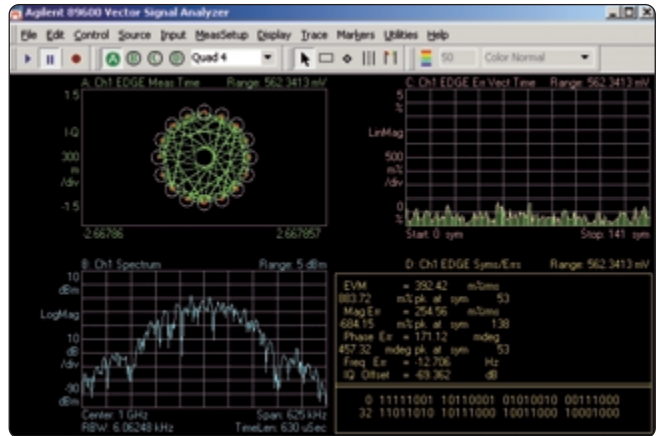
### General modulation formats

(with variable center frequency, symbol rate, filtering type and alpha/BT)

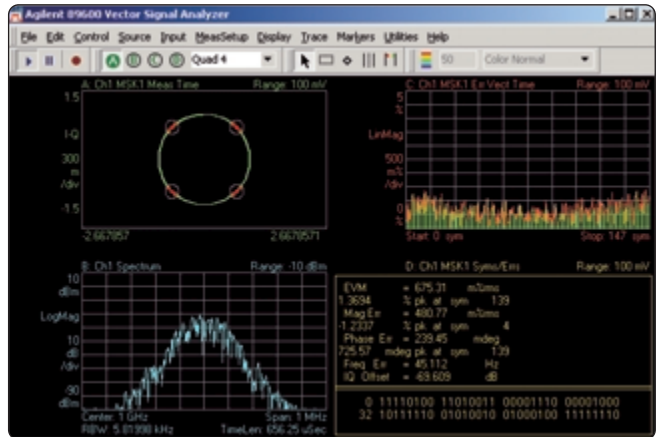
BPSK, 8PSK;	FSK 2-, 4-, 8-, 16-level;
QPSK;	DQPSK;
PI/4 DQPSK;	D8PSK;
MSK type 1, type 2;	Offset QPSK;
QAM 16-, 32-, 64-, 128-, 256-;	EDGE;
VSB 8-, 16-	DVBQAM 16, 32, 64;

\*Note: For 896xxA-AYA, xx = 01, 10, 11, 40, or 41.

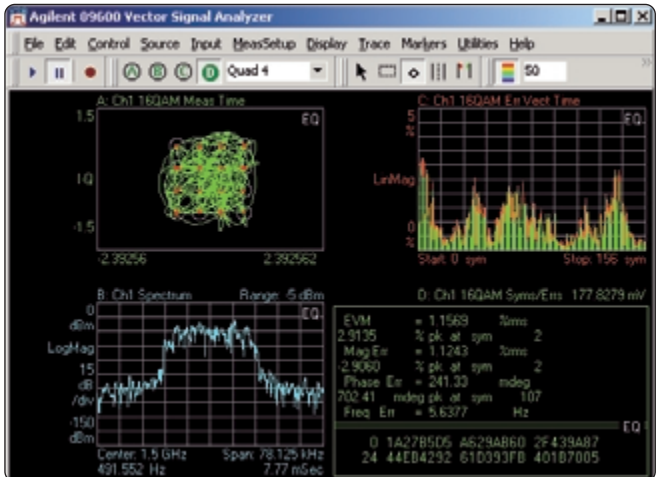
This EDGE constellation uses an innovative ISI compensation filter to provide a legible constellation display without compromising the integrity of the signal itself.



GSM signal MSK format with spectrum and EVM versus time.



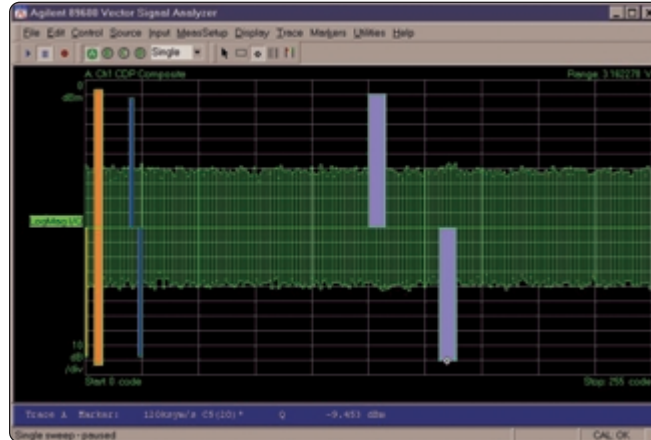
16QAM signal with spectrum and error vector magnitude versus time display.



## Measure new 3G formats (Option 896xxA-B7N)

Option 896xxA-B7N provides demodulation and measurement of new 3G formats such as W-CDMA and cdma2000. Both forward and reverse links are supported.

View composite measurements of the code domain power (CDP), time, spectrum, phase and magnitude code error. Or view these for an individual channel. In addition, a new code domain error measurement provides a histogram of EVM versus channel.

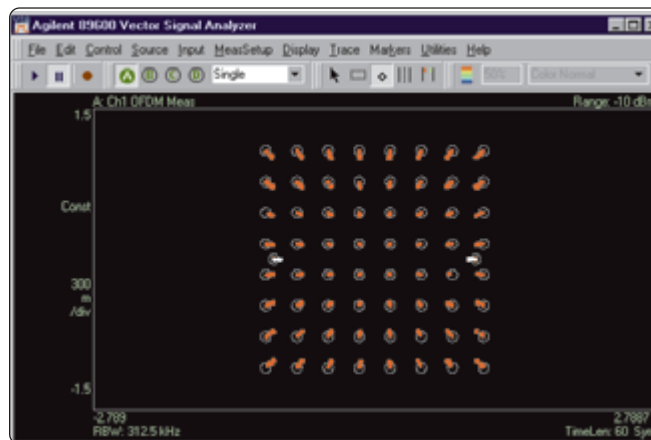


View the CDP of a W-CDMA uplink signal. Here the signal has been separated into I and Q branches. The I channels appear on the top half of the trace; Q channels appear inverted on the bottom half of the trace.

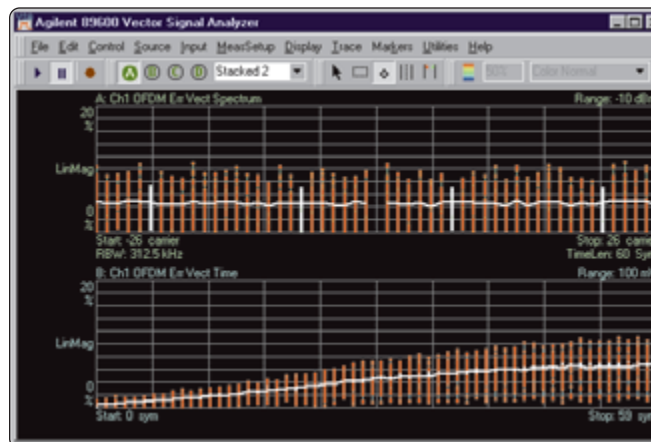
## Analyze wireless LAN (Option 896xxA-B7R)

### 802.11a OFDM modulation analysis (Option 896xxA-B7R)

Demodulate and analyze 802.11a and HIPERLAN/2 compatible signals with the 802.11a OFDM modulation analysis option to the 89600 series vector signal analyzers. This high performance option supports demodulating WLAN bursts down to the bit level. Use the compound constellation display to automatically determine and display all modulation formats (BPSK, QPSK, 16QAM, 64QAM) present in the signal. Evaluate modulation quality using Error Vector Magnitude (EVM) displays of the overall burst, of each symbol, or of each sub-carrier in a symbol. View the average phase and amplitude behavior of the pilot sub-carriers using the Common Pilot Error trace. These features and more, combined with the analysis tools already offered in the 89600 VSAs provide you a powerful package for analyzing and troubleshooting 802.11a OFDM signals.



View the constellations of all modulation formats in an 802.11a OFDM burst.



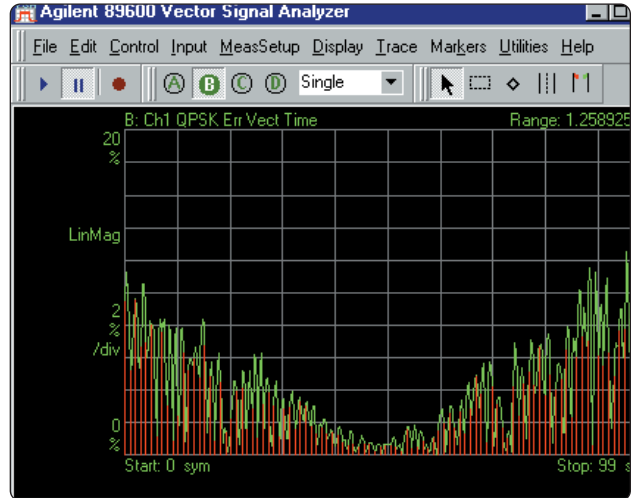
View the EVM of an 802.11a OFDM burst by sub-carrier (upper trace) or symbol (lower trace)



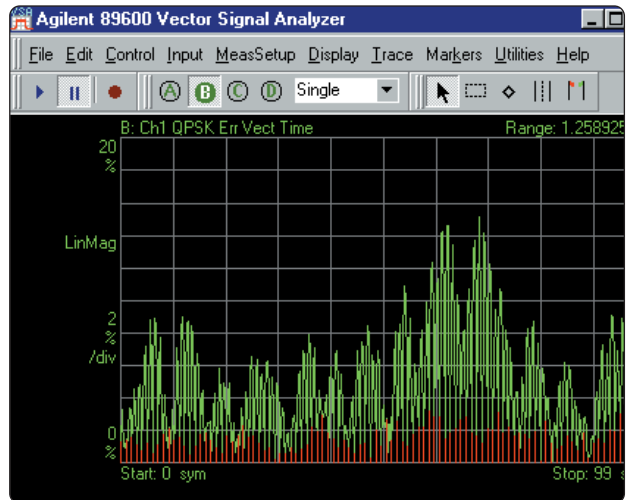
## Unique error analysis tools highlight problems

Only Agilent VSAs offer sophisticated error analysis that lets you see both RF and DSP problems. The key is the error vector magnitude (EVM) measurement. The EVM time-plots an error signal versus time diagram. With it, you can identify problems such as clock timing errors, DAC overflow, compensation errors and more—all with one screen. These tools include EVM time, EVM spectrum, and adaptive equalization.

The 'v' shape in the error vector magnitude versus time display indicates a symbol clock timing error. Trace math can help determine the approximate clock rate.

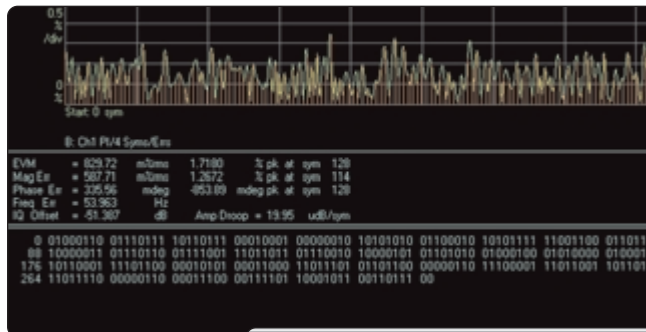


This signal shows higher EVM in between the symbols (shown in green) than at the symbol clock times (shown in red), a clear indication of filtering errors. Next, you can try and determine the correction needed by using the adaptive equalization feature.



## Error Vector Magnitude (EVM)

EVM is a powerful analysis tool that helps you pinpoint marginal conditions before they become system performance problems. EVM compares the phase and magnitude of the input signal with an ideal reference signal stream. The average error over time is displayed as a single percent, or the error can be viewed on a symbol by symbol basis.



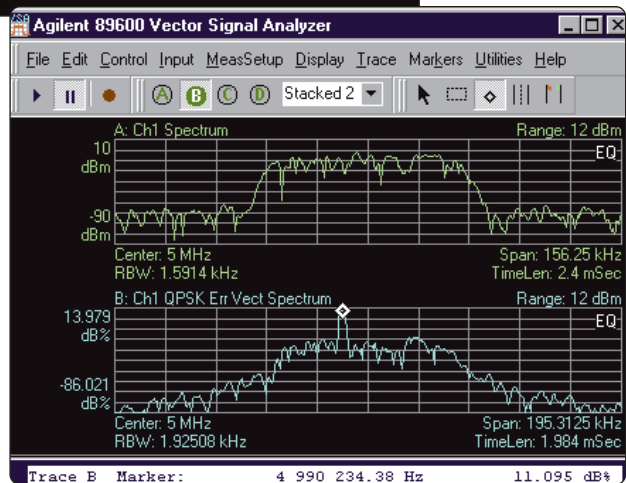
EVM versus time and the symbol table

Use the FFT of the EVM error signal to identify systematic impairments you couldn't otherwise see. Identify spurs coupling from other parts of the system by looking at the EVM spectrum for peaks.

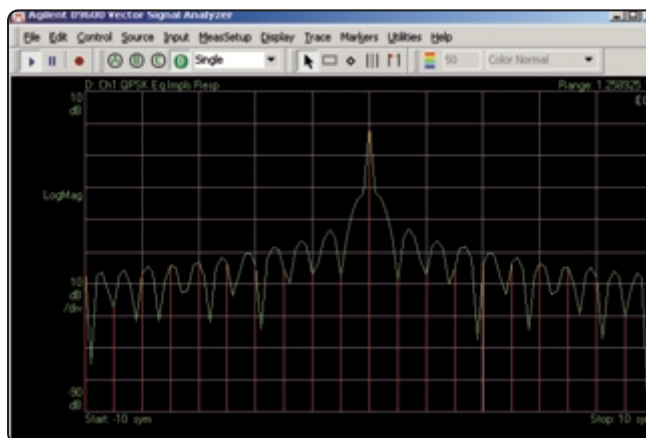
## Adaptive equalization

Adaptive equalization identifies and removes linear errors from I-Q modulated signals by dynamically creating and applying a compensating filter. These errors include group delay distortion, frequency response errors, and reflections or multipath distortion. You can also uncover DSP errors such as miscoded bits, or incorrect filter coefficients.

Equalization is a tool designers can use to identify and correct linear errors. Pre-distorting a signal to correct for linear errors can be simpler, faster, and cheaper than modifying hardware to make the corrections. Further, some wideband signals are almost impossible to measure without adaptive equalization.



The FFT of the EVM error signal shows a contaminating signal from an earlier stage's phase lock loop (PLL). Such an error would be impossible to see on a spectrum analyzer because it is riding under the modulation envelope.



Equalization filter impulse response coefficients can be downloaded to digitally correct an incoming signal with linear distortions. Here the equalizer corrected the signal for a missing Nyquist filter.

# Measurement displays

Display your results in constellation, eye, trellis, or spectrum diagrams. Detect intersymbol interference, quadrature balance and error, and spurious responses. Measure carrier peaks and state transitions in both time and amplitude. In addition to these common displays, you can also take advantage of the powerful spectrogram display. Its three-dimensional view lets you see the behavior of your signal over time with magnitude shown in color or grayscale.

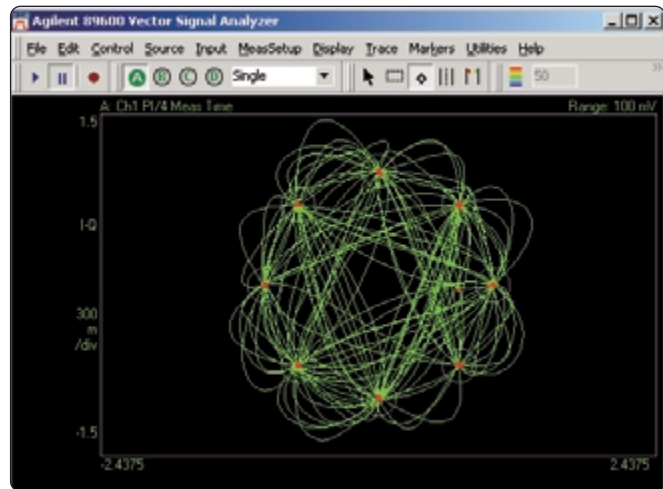
## Complementary Cumulative Distribution Function (CCDF)

Since digital signals are noise-like, statistical measurements provide a better description of system or component behavior. The power statistics of the signal can be characterized by performing several peak-to-average measurements and displaying the results in a graph known as the CCDF. The CCDF curve shows the probability that the power is equal to or above a certain peak to average ratio. The higher the peak-to-average power ratio, the lower the probability of reaching it.

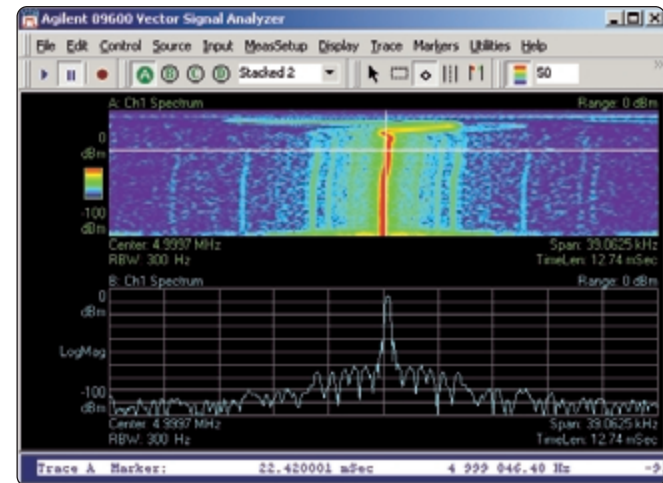
## View signal instabilities with analog demodulation error analysis

The 89600 VSAs feature AM, PM, and FM demodulation as standard tools. Use each of these to evaluate signal amplitude, phase, or frequency deviations. Calculating the FFT of these deviations often provides insight into signals coupling through from other parts of the circuit.

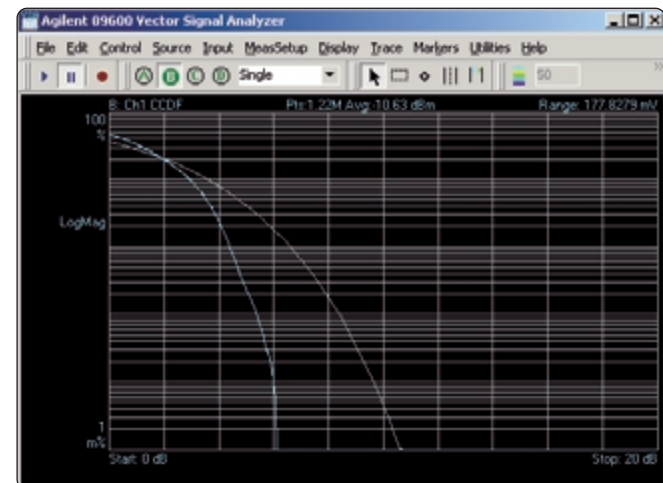
$\pi/4$  DQPSK IQ diagram



A spectrogram is a three-dimensional representation of a radio's signal over time at the antenna, where color represents magnitude. In this case the spectrogram shows a signal's frequency deviation over time.



CCDF curve of 16QAM signal



## Easy-to-use windows graphical user interface

Changing parameters such as center frequency, span, or scale, is easy. Simply place the cursor on the parameter and a hand will appear. Double click and enter the parameter or use the up/down arrows. If you are familiar with Microsoft Windows applications, you can quickly master the 89600 VSA.

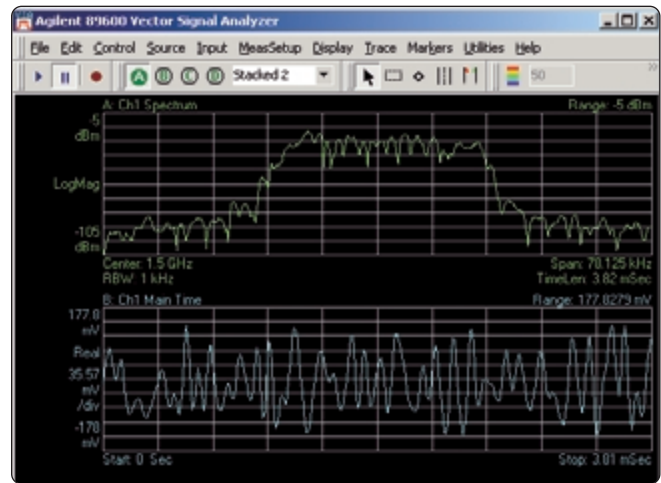
### Markers and band power measurements

To identify signals using the marker function, simply place a marker on the highest signal using the marker search functions. The marker parameters are shown at the bottom of the display. Use the offset marker to measure parameters between two points on the display.

### Signal zoom

For a closer look at a signal, use the highlight box to zoom in. Place the box around the signal of interest and select the desired scaling. You can scale both the X- and Y-axis, or scale each separately.

The top display is the frequency domain view and the bottom is the time domain view of a modulated signal.



# Uncover system problems even before hardware exists

The powerful, PC-based 89600 series VSA software enables tight, interactive integration with ADS to analyze computational data. The 89600 software can be dynamically linked to any point in the digital model to analyze data by simply dragging the VSA icon to the desired spot in the schematic.

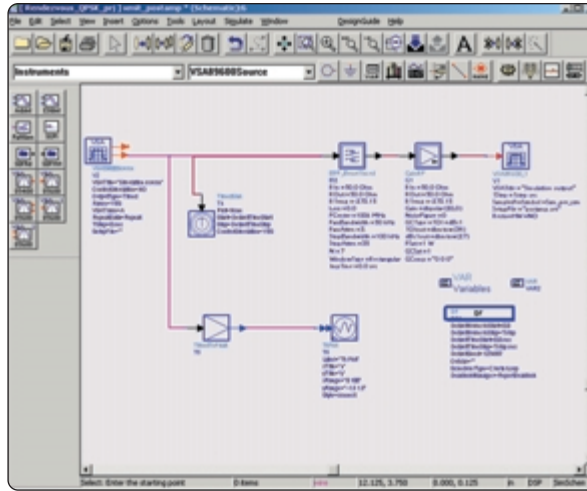
Since the VSA measurement software resides on a PC, it performs equally well analyzing measured data from the VXI mainframe or computational data produced by an ADS model.

You can record measured or computed data from ADS with the 89600 series software and play it back for further analysis. The playback can be continuously looped at reduced speeds for more in depth review. Individual recorded signals can be analyzed more closely by zooming in using the span and center frequency adjustments.

You can link real-world signals recorded with the 89600 to the ADS to provide an actual signal environment for your design stimulus.

With the new instrument links from ADS to the Agilent ESG series signal generators, you can take simulation output, download it to the ESG, and source it to your prototype hardware. The hardware can be measured with the 89600 VSA, and compared to the simulation if desired. Conversely, you can measure the output of prototype hardware with the 89600 VSA, and use it to stimulate a simulation. In this way you can evaluate your system even with missing hardware.

Use "virtual hardware" to make measurements and evaluate your system even when hardware is missing.



Measurements from actual prototype hardware can be fed into a design simulation.



Take a simulation output file and download it to the Agilent ESG series source to stimulate your device under test.

DUT

Use the Agilent 89600 to make measurements on your device. You can also compare it to measurements you made on the simulated DUT.



## Add world-class modulation analysis to Agilent spectrum analyzers, scopes and more.

Link the 89600 software to variety of Agilent instruments to enhance their modulation evaluation and troubleshooting capabilities. The software runs on a PC and connects to an Agilent instrument via GPIB or LAN.

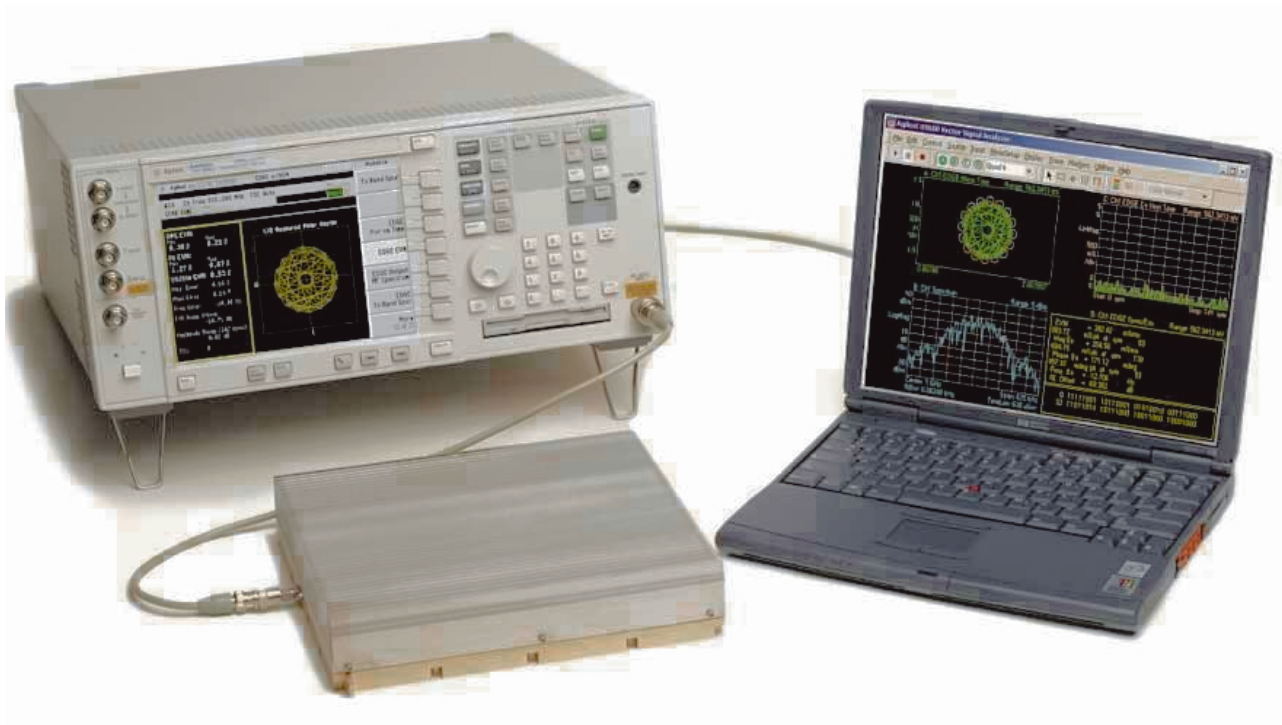
Team the 89600 software with Agilent's ESA-E series spectrum analyzers. This combination adds the flexible digital demodulation and analysis capabilities of the 89600A software to the frequency coverage and general-purpose spectrum analysis capabilities of the ESA spectrum analyzers.

Hook the 89600 software to Agilent's PSA high performance spectrum analyzer. All of the features of the PSA series: high performance spectrum analysis, one-button advanced power measurements, and standards based digital modulation analysis, are combined with the flexible demodulation and analysis capabilities of the 89600

software. This powerful combination provides a comprehensive solution to almost any communications systems problems.

Combine the software with Agilent's Infiniium scopes (some models) to analyze super wide bandwidth signals. The scopes provide up to 1.5 GHz of analysis bandwidth and are well suited to digitizing down-converted satellite, LMDS, and MMDS signals. The digitized signals are transferred via GPIB or LAN to the PC running the 89600 software where the frequency, time, and modulation analysis tools of the 89600 can be used to evaluate and troubleshoot the signal.

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.



## Ordering information

### 89610A dc to 40 MHz vector signal analyzer

Option 89610A-AYA	Vector modulation analysis
Option 89610A-B7N	W_CDMA and cdma2000 modulation analysis
Option 89610A-B7R	802.11a and HiperLAN2 OFDM modulation analysis
Option 89610A-001	1152 MB signal capture memory
Option 89610A-144	144 MB signal capture memory
Option 89610A-288	288 MB signal capture memory
Option 89610A-102	Second 40 MHz input channel
Option 89610A-145	Second 40 MHz input channel with 144 MB signal capture memory
Option 89610A-289	Second 40 MHz input channel with 288 MB signal capture memory
Option 89610A-002	Second 40 MHz input channel with 1152 MB signal capture memory
Option 89610A-105	ADS connectivity

### 89611A 70 MHz IF vector signal analyzer

Option 89611A-AYA	Vector modulation analysis
Option 89611A-B7N	W_CDMA and cdma2000 modulation analysis
Option 89611A-B7R	802.11a and HiperLAN2 OFDM modulation analysis
Option 89611A-001	1152 MB signal capture memory
Option 89611A-144	144 MB signal capture memory
Option 89611A-288	288 MB signal capture memory
Option 89611A-105	ADS connectivity

### 89640A dc to 2700 MHz vector signal analyzer

Option 89640A-AYA	Vector modulation analysis
Option 89640A-B7N	W-CDMA and cdma2000 modulation analysis
Option 89640A-B7R	802.11a and HiperLAN2 OFDM modulation analysis
Option 89640A-001	1152 MB signal capture memory
Option 89640A-144	144 MB signal capture memory
Option 89640A-288	288 MB signal capture memory
Option 89640A-105	ADS connectivity

### 89641A dc to 6000 MHz vector signal analyzer

Option 89641A-AYA	Vector modulation analysis
Option 89641A-B7N	W-CDMA and cdma2000 modulation analysis
Option 89641A-B7R	802.11a and HiperLAN2 OFDM modulation analysis
Option 89641A-001	1152 MB signal capture memory
Option 89641A-144	144 MB signal capture memory
Option 89641A-288	288 MB signal capture memory
Option 89641A-105	ADS connectivity

Minimum PC requirement: see the Agilent 89600 Series Configuration Guide, available on the web at: [www.agilent.com/find/89600](http://www.agilent.com/find/89600)

### **Agilent Technologies' Test and Measurement Support, Services, and Assistance**

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

#### **Our Promise**

Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

#### **Your Advantage**

Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

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

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[www.agilent.com/find/assist](http://www.agilent.com/find/assist)

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(fax) 905 282 6495

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(fax) (305) 269 7599

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(fax) 800 820 2816

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