Agilent
PSA Series Spectrum Analyzers
40 and 80 MHz Bandwidth Digitizers

Technical Overview with
Self-Guided Demonstration

- 40 MHz Bandwidth Digitizer, Option 140
- 80 MHz Bandwidth Digitizer, Option 122
- Switchable µW Preselector Bypass, Option 123

Industry's First Spectrum Analyzer with a 14 Bit, 80 MHz Bandwidth Digitizer

The PSA Series, Agilent Technologies' highest performing spectrum analyzers, set a new standard in data acquisition. Options 140 and 122 offer wide bandwidth measurements up to 80 MHz with excellent dynamic range using Agilent's advanced digital IF technology. The result is digital I/Q conversion of complex wide-bandwidth signals.

Options 140 and 122 add a separate IF path, to provide an industry leading 200 MHz 14 bit digitizer with 40 or 80 MHz of analysis bandwidth and 78 dB of distortion-free dynamic range. Real-time calibration ensures optimum IF phase and amplitude flatness.

Option 123 allows the microwave preselector to be bypassed, for improved performance above 3 GHz.

Agilent Technologies

Evaluate Your Broadband Designs With 40 and 80 MHz Bandwidth Digitizers

Analyze designs requiring measurement of wide bandwidth signals with high dynamic range and low levels of EVM.

Commercial and military communications are placing greater demands on data rates. Greater data rates translate to wider bandwidths. The PSA meets those needs with 40 and 80 MHz bandwidth digitizers, Options 140 and 122.

Extra bandwidth alone is not enough to analyze today's broadband signals; they demand the performance of low residual EVM, including excellent amplitude and phase flatness, plus high dynamic range.

These measurements may include:

- Satellite communications with 72 MHz of bandwidth
- Analysis of pulse Doppler and chirp radar signals
- WiMAX 802.16d (OFDM) and 802.16e (OFDMA) with bandwidths up to 28 MHz
- WLAN requiring very low residual EVM analysis tools for fast data rate signal analysis up to 40 MHz bandwidth
- Multi-carrier power amplifiers requiring wide bandwidths (>60 MHz) and high dynamic range to perform predistortion and 3rd order intermodulation distortion measurements

40 and 80 MHz BW digitizer features

Agilent's PSA with its 200 Msample/sec[1], 14 bit digitizer and advanced digital IF technology captures and preserves the instantaneous phase and amplitude relationships on broadband signals with up to 80 MHz analysis bandwidth while providing 78 dB of distortion-free and 76 dB of image-free dynamic range.

Powerful on-board DSP hides the complexity of digitization and provides more useful and accurate I/Q data.

- Low residual EVM of 0.3 to 2% through extensive "real time" internal magnitude and phase corrections provides fully calibrated and accurate demodulation data for analysis in applications with critical EVM requirements.
- Fully image-protected IF minimizes confusion between desired and image signals. Image suppression is typically 68 to 82 dBc.
- Decimation with arbitrary resampling provides almost infinitely variable sample rates and analysis bandwidths from 10 Hz to 40 or 80 MHz to reduce the data analysis load or improve digitizer performance.
- Selectable channel filters with variable alpha and bandwidth enable over-sampling your signal and still allow for removal of unwanted signals or noise.
- The triggering suite includes external trigger for syncing with external clocks, periodic/frame trigger for vector averaging, pre-trigger for recording and playback, plus a video trigger for triggering on the IF envelope.
- Exceptionally fast vector hardware averaging with built-in periodic trigger can lower the noise floor up to 30 dB to uncover spurs and harmonics. Minimal repetitive trigger uncertainty (as low as ±1.5 ns) combined with contiguously sampled data blocks removes the dead time between periods to enhance measurement speed.
- 128 Msamples (512 MB) of deep memory capture with record and playback capabilities to closely examine transient events or signal anomalies that may otherwise go unnoticed.

1. Effective sample rate – Agilent's 40/80 MHz digitizers utilize two 100 MHz ADC's operating in tandem.

In-depth modulation analysis of the I/Q data

- Perform modulation analysis using either the PSA Option 241 Flexible Digital Modulation Analysis Measurement Personality or Agilent's 89601A Vector Signal Analysis software in combination with the 40 or 80 MHz BW Digitizer options.
- Take advantage of these powerful tools for both pre- and post-demodulation analysis of broadband signals.

Additional capabilities to support your wide bandwidth needs

- Optional microwave (MW) preselector bypass provides improved bandwidth, phase and amplitude flatness and stability for measurements above 3 GHz (Option 123).
- When bypassing the MW preselector is not desirable, or improved flatness is required beyond the internal alignments, or when you want to include an external device in the calibration path, an external calibration wizard employing an external source is available through Agilent 89601A VSA or PSA Option 235 software.

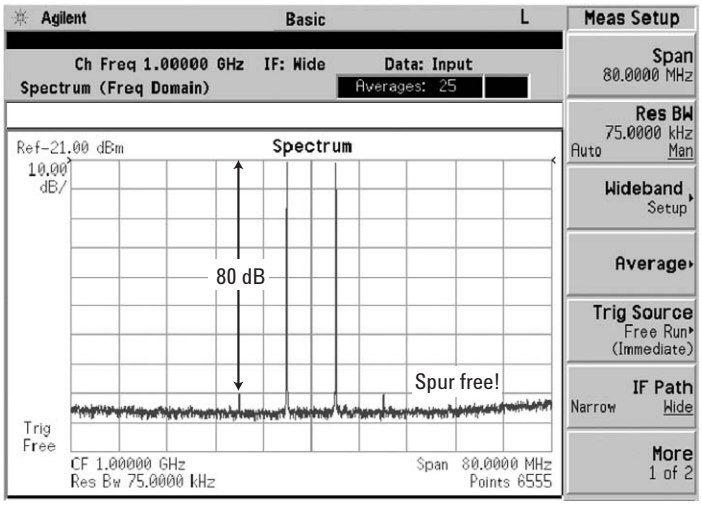

Figure 1: 80 MHz BW digitizer two tone intermodulation distortion.

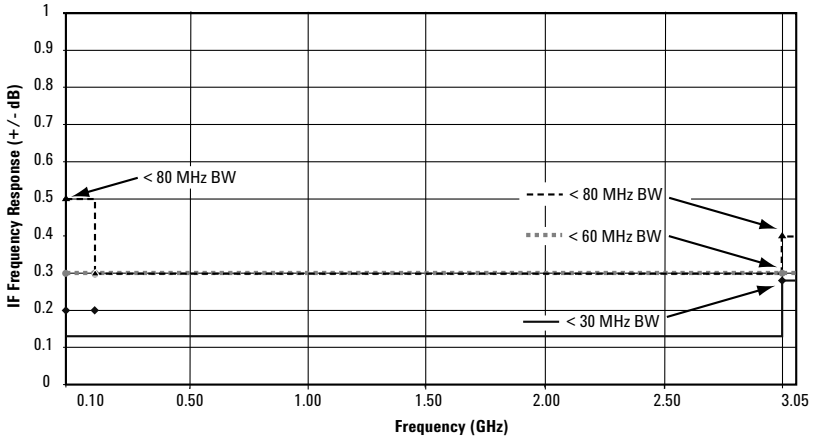

Figure 2: 40/80 MHz BW digitizers typical IF frequency response < 3 GHz.

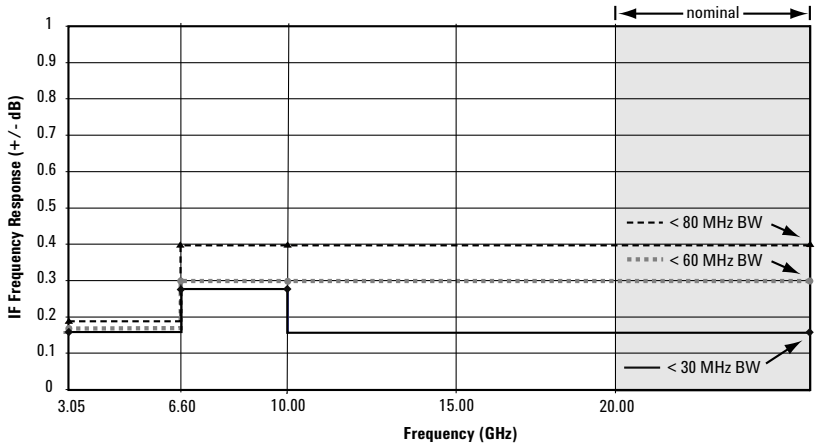

Figure 3: 40/80 MHz BW digitizers typical IF frequency response > 3 GHz (with Option 123).

Example Measurements and Demonstrations

Demonstration preparation

All demonstrations use the PSA E4443A, E4445A or E4440A spectrum analyzers and the E4438C ESG vector signal generator. Keystrokes surrounded by [ ] indicate front-panel hard keys. Keystrokes surrounded by { } indicate soft keys on display.

The listed options are required for the ESG and PSA in order to perform these demonstrations.

To configure these instruments, connect the ESG's RF output to the PSA RF input with a 50 Ω Type "N" cable. Connect the event 1 out of the ESG to external trigger in on the PSA front panel. Connect the 10 MHz time base out of the PSA to the ESG. Switch the PSA 10 MHz Out on by pressing [System], {Reference} and {10 MHz Out On}.

80 MHz bandwidth digitizer (Option 122) demonstrations

Product type	Model number	Required options
ESG	E4438C	503 or 504 or 506; 602 or 602 baseband generator, 400 W-CDMA
PSA	E4440A, E4443A, E4445A	122 80 MHz bandwidth digitizer 123 Switchable MW preselector bypass 241 Flexible digital modulation analysis measurement personality

Spectrum and waveform measurements demonstration

Instructions	Keystrokes
ESG setup: 4 carrier W-CDMA signal	[Preset] [Frequency 1GHz] {Amplitude –30 dBm} [Mode] {W-CDMA} {Arb W-CDMA} [Mode] {W-CDMA}{Arb W-CDMA} {Multicarrier On} {W-CDMA Select} {4 Carriers} {W-CDMA On} [RF On] [Mod On]
PSA setup: Basic mode, spectrum measurement, 10 MHz BW digitizer	[Preset] [Frequency 1 GHz] [Mode] {Basic} [Measure] {Spectrum} [View/Trace] {Spectrum} [Zoom] [Meas Setup] {Res BW 50 kHz} {IF Path Narrow} [Amplitude] {Ref Value –32 dBm}
PSA: Spectrum measurement, 80 MHz BW digitizer	[Meas Setup] {IF Path Wide}
ESG: Single carrier W-CDMA signal	[Mode] {W-CDMA} {Arb W-CDMA} {Multicarrier Off}
PSA: Waveform measurement, 80 MHz BW digitizer	[Measure] {Waveform} [Meas Setup] {IF Path Wide} {IF BW 80 MHz}
PSA: I/Q measurement with markers, 80 MHz digitizer	[View/Trace] {I/Q Waveform} [Meas Setup] {Meas Time 2 us} [Amplitude] {Scale/Div 4 mV} [Marker] {Normal} {Trace} {I/Q Waveform}

Spectrum and Waveform Measurements

The standard 10 MHz BW digitizer and the optional 40/80 MHz BW digitizers can be accessed from the front panel through the basic mode. Measurements made in the basic mode capture complex vector time domain data from the RF signal contained within the selected digitizer span/BW at the analyzer's fixed-tuned center frequency.

Within the basic mode, frequency domain, time domain and I/Q measurements are available as initial analytical tools.

The spectrum measurement provides a display of power versus frequency with current (yellow trace) and average (blue trace) data. In addition, an I/Q waveform is provided for the 40/80 MHz BW digitizers.

Observe the display of the 4-carrier W-CDMA signal using the 10 MHz BW digitizer (Fig. 4) compared to the 80 MHz BW digitizer (Fig. 5). The 10 MHz BW digitizer captures two of the four carriers while the 80 MHz BW digitizer captures all four carriers plus potential 2nd and 3rd order intermodulation distortion.

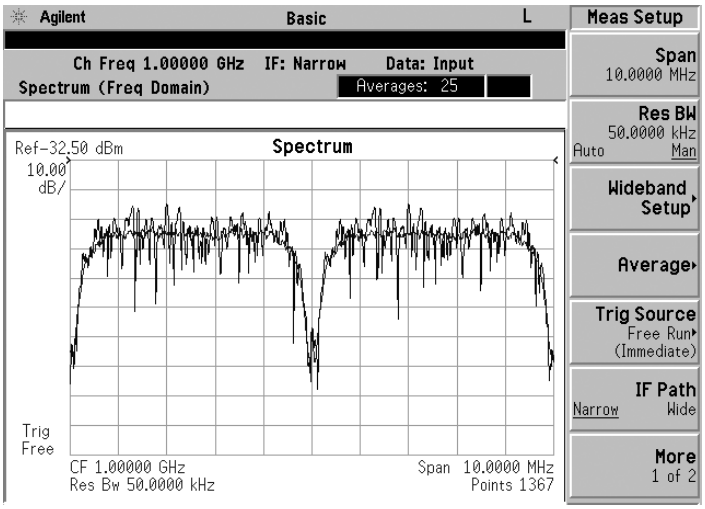

Figure 4: 10 MHz bandwidth digitizer (spectrum measurement).

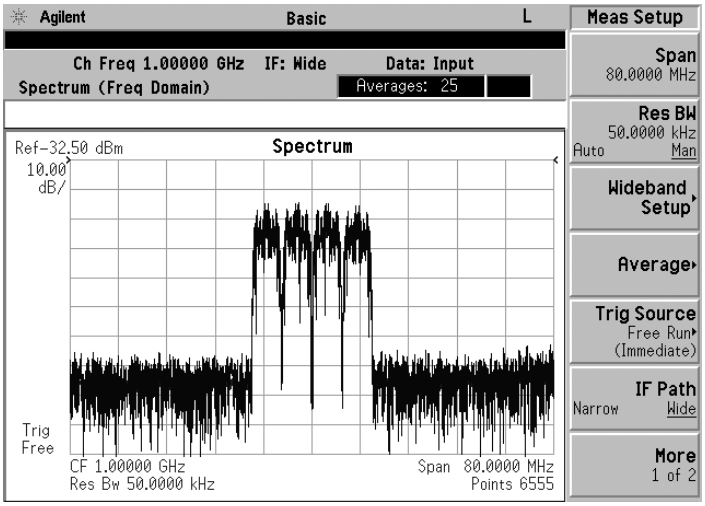

Figure 5: 80 MHz bandwidth digitizer (spectrum measurement).

The waveform measurement provides a display of power versus time with metrics for mean and peak-to-mean power shown in the text window (Fig. 6). Waveform mode is used primarily for transferring complex I/Q data to external analysis software such as the Agilent 89601A Vector Signal Analyzer software.

The I/Q measurement provides a display of voltage versus time for the I and Q waveforms (Fig.7). Markers are available to measure the individual values of I and Q.

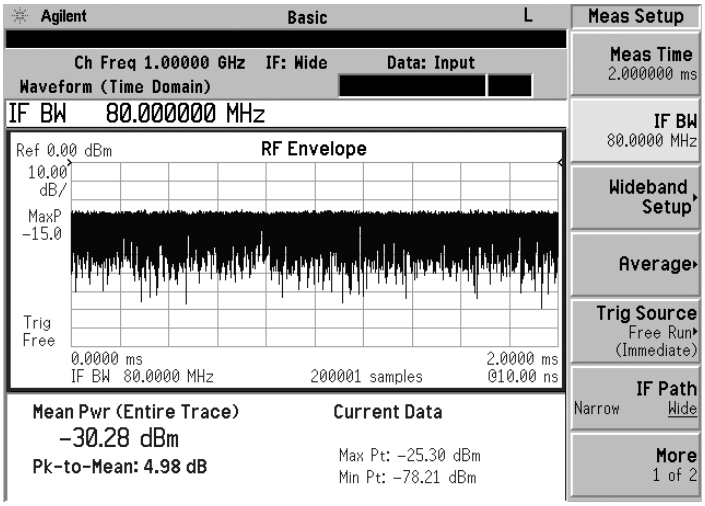

Figure 6: Time domain display (waveform measurement).

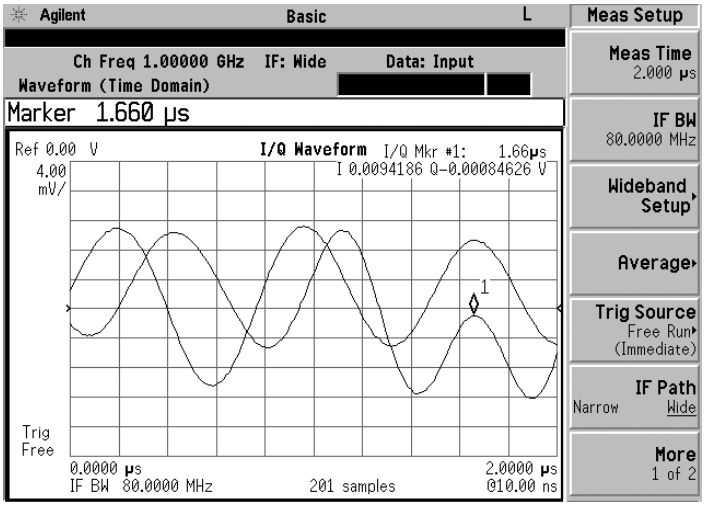

Figure 7: I/Q display (waveform measurement).

Fast Hardware Averaging for Noise Reduction

Options 140 and 122 have the ability to decrease the effective noise density using vector time averaging. The noise reduction is accomplished using very accurate and stable periodic triggering. Get greater than 30 dB noise reduction, allowing for noise density reduction of more than 30 dB. The time bases of the source generating the test signal and the PSA must be tied together. Averaging is done real-time in DSP hardware 10 to several hundred times faster compared to other methods.

With the noise greatly reduced, you can view side bands spectral re-growth and other repetitive signals previously hidden in the noise.

The signal to be tested must be repetitive and the repetition rate must be known. In the demonstration the repetition rate is 10 ms. To determine the repetition rate of a signal, divide the sample rate by the number of points used to generate the signal in the arbitrary waveform generator.

Fast hardware averaging demonstration

Instructions	Keystrokes
Connect the 10 MHz time base out to the ESG 10 MHz in and switch the PSA 10 MHz time base out to on	[System] {Reference} {10 MHz Out On}
ESG setup: W-CDMA signal	[Frequency 1 GHz] [Amplitude –20 dBm] [Mode] {W-CDMA} {Arb W-CDMA}{W-CDMA On} [RF On] [Mod On]
PSA setup: Basic mode, spectrum measurement, 80 MHz digitizer with 40 MHz span	[Preset] [Frequency 1 GHz] [Mode] {Basic} [Measure] {Spectrum} [Meas Setup] {IF Path Wide} {Res BW 50 kHz} [Span 40 MHz]
Trigger setup	[Meas Setup] {Trig Source} {Frame}
Frame period setup	[Trig] {Frame Timer} {Period 10 ms} [Amplitude] {Ref Value -35 dBm}
Zoom in on the spectrum window:	[View/Trace] {Spectrum} [Zoom] [View/Trace] {Trace Display} {Current}
Average the trace 100 times to reduce random noise by approximately 20 dB in less than 2 seconds	[Meas Setup] {Average} {Avg Number Off} {Time Avg Num 100} [Enter]

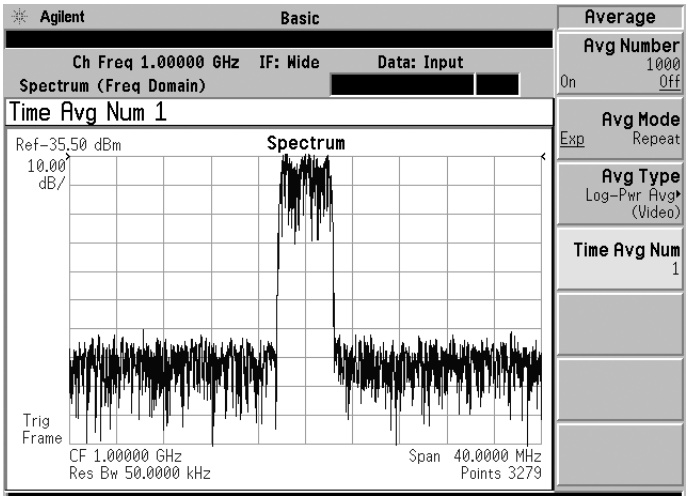

Figure 8: Noise density prior to fast hardware averaging.

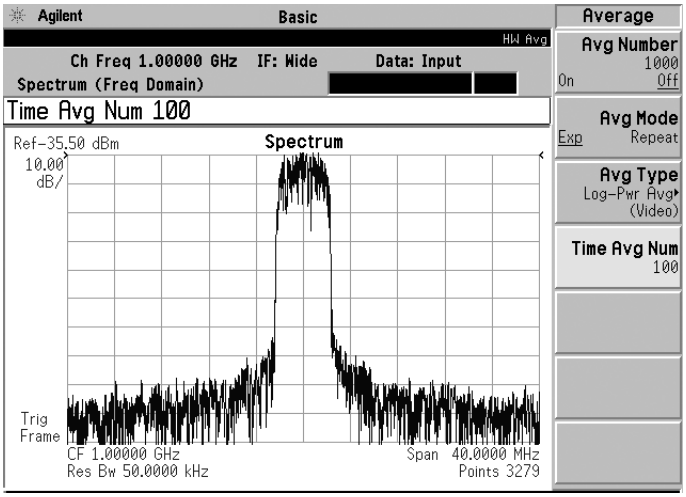

Figure 9: Noise density reduction after 100 fast hardware averages.

Deep Memory Capture

This feature allows the user to view 128 Msamples of captured data on the display before transferring the data out of the PSA to analyze it using an external program for record and playback such as the 89601A Vector Signal Analyzer

Deep memory capture demonstration

Instructions	Keystrokes
ESG setup: Frequency modulation	[Preset] [Frequency 1 GHz] [Amplitude -30 dBm] [FM] {FM On}{FM Dev 1 MHz} {FM Rate 10 kHz} [RF On] [Mod On]
PSA setup: Basic mode, spectrum measurement, 80 MHz BW digitizer	[Preset] [Frequency 1 GHz] [Mode] {Basic} [Measure] {Spectrum} [Meas Setup] {IF Path Wide} {Span 40 MHz} {Average} {Avg Number Off} [Amplitude] {Ref Value –20 dBm} [View/Trace] {I/Q Waveform} [Amplitude] {Scale/Div 4 mV}
Capture FM signal into memory (in this case 102.5 ms) Captured signal is in the playback mode. Disconnect the input to the PSA and the signal continues to be displayed	[Meas Control] {Fill Capture}
Pause signal	{Pause}
Exit capture mode	[Input/Output] {Data Source Input}

Wideband Channel Filtering

In many instances, interfering signals or spurs are close to the signal of interest. However, it may be desirable to minimize the measurement impact of the interference, while maintaining the original measurement span, in order to over-sample the desired signal.

The PSA has a wideband channel filter available. The filter is adjustable about the center frequency, from full span to a fraction of full span. Choose from a wide range of filters including raised cosine, root raised cosine, Nyquist, root Nyquist, Gaussian, or no filter.

Wideband channel filtering demonstration

Instructions	Keystrokes
ESG setup: Set the center frequency and amplitude	[Preset] [Frequency] {1.0005} {GHz} [Amplitude] {-25} {dBm}
Configure a 2-carrier EDGE signal	[Mode] {Custom} {Arb Waveform Generator} {Multicarrier On} {Multicarrier Define}
Select EDGE as the modulation format	{Initialize Table} {Carrier Setup} {EDGE}
Setup 2 carriers with 1 MHz spacing	{# of Carriers} {2} {Enter} {Freq Spacing} {1} {MHz} {Done} {Apply Multicarrier} [Return] {Digital Modulation On} [Mod On] [RF On]
PSA setup: Setup Basic mode	[Preset] [Mode] {Basic} [Meas Setup] {IF Path Wide} [Meas Setup] {Span} {4 MHz}[Meas Setup] {Res BW} {15 kHz} [Amplitude] {Ref Value} {-25 dBm} [Amplitude] {Scale/Div} {15 dB}
Adjust the I/Q Waveform display	[View/Trace] {I/Q Waveform} [Amplitude] {Scale/Div} {5 mV}
Configure the wideband filter	[Meas Setup] {Wideband Setup} {Wideband Filtering} {Filter Type} {Gaussian}
Note the filtering of adjacent channel and impact on I/Q waveform	{Filter BW} {0.03} [Enter]

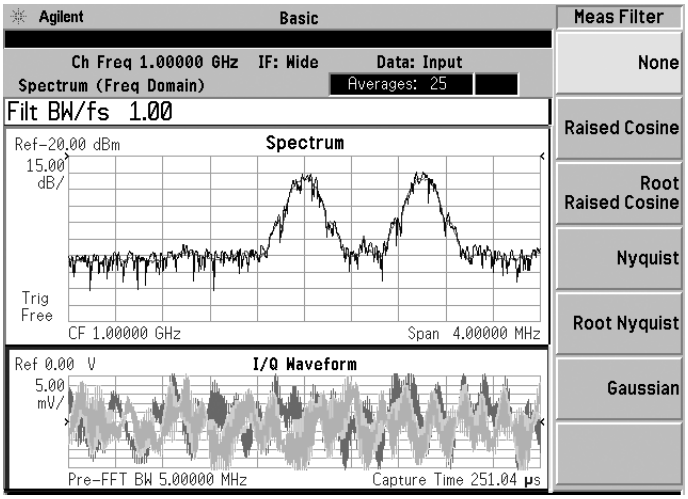

Figure 10: Adjacent channel interference prior to wideband channel filtering.

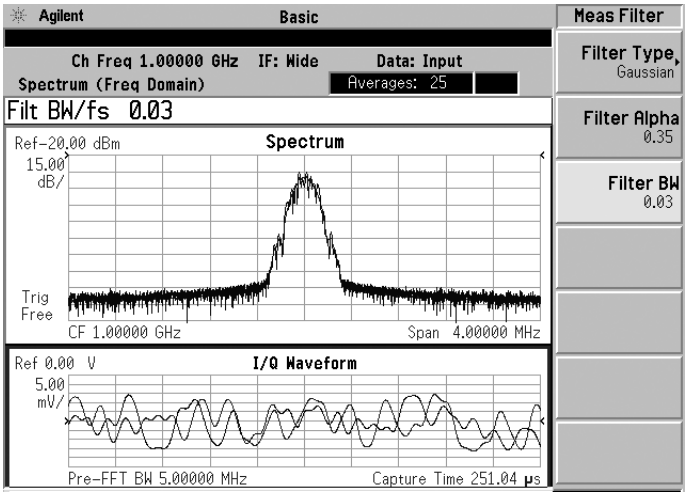

Figure 11: Adjacent channel interference removed after wideband channel filtering.

Internal Flexible Digital Modulation Analysis with Option 241

Option 122 80 MHz bandwidth digitizer enables the analysis of digitally modulated signals with symbol rates in excess of 50 Msymbols/sec. This can be done within the PSA, using Option 241 Flexible Digital Modulation Analysis measurement personality, or externally with Agilent 89601A VSA software.

This demonstration shows a 16QAM signal with a symbol rate of 50 Msymbols/sec occupying over 70 MHz of bandwidth. Modulation analysis is first done using the internal flexible digital modulation analysis measurement personality, and later done using Agilent 89601A VSA software.

Internal flexible digital modulation analysis with Option 241 demonstration

Instructions	Keystrokes
ESG setup: 16 QAM, 50 Msymbol/sec wide bandwidth signal	[Preset] [Frequency 1.2 GHz] [Amplitude -20 dBm] [Mode] {Custom} {Real Time I/Q Baseband} {Modulation Type} {Select} {QAM} {16QAM} [Return] {Symbol Rate} {50 Msps} [Return] {Custom On} [RF On] [Mod On]
PSA setup: Demodulate and measure EVM on 16 QAM, 50 Msps wide bandwidth signal	[Preset] [Mode] {Digital Modulation} [Measure] {Modulation Analysis} [Frequency 1 GHz] [Meas Setup] {Demod} {Modulation Format} {More 1 of 4} {16QAM} {Alpha/BT 0.35} {Symbol Rate 50 MHz} {Meas Interval} {512} [Enter]

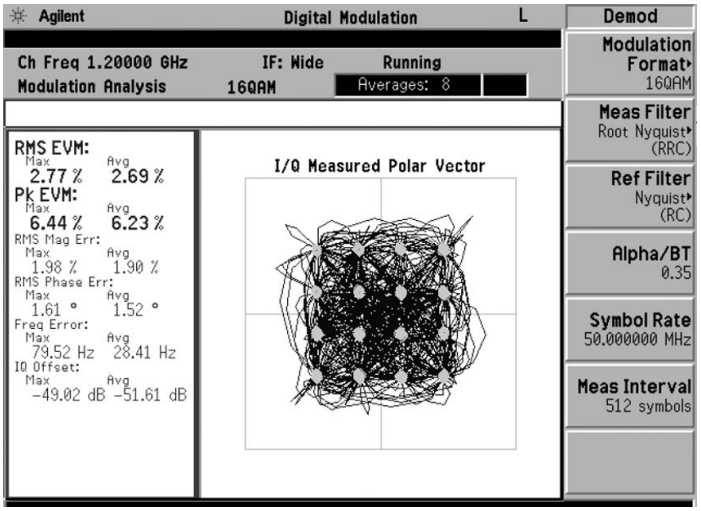

Figure 12: 16QAM, 50 Msymbols/sec modulation showing less than 3% EVM with non-optimized source using Option 241 flexible digital modulation analysis.

Modulation Analysis with 89601A VSA Software

Open the Agilent IO Libraries Configuration window (blue IO icon). In the window there are two columns: Available Interface Types and Configured Interfaces. Select an interface of VISA Type TCPIP and click “Configure”. Click OK to close the Configured Interfaces area of the window. Next, highlight the configured TCPIP interface and select Edit VISA Config. Select Add Device in the window that appears and enter the IP address of your Configuration window.

Now start the 89600 Series software. If the hardware was not configured to link on startup, then click on Utilities->Hardware and select the PSA under the ADC1 tab. Now you are ready to capture I/Q data from the PSA.

PSA settings are controlled using 89601A software. If Option 122, 80 MHz bandwidth digitizer, is installed then the span is set to 80 MHz. Reduce the span to include the signal of interest but not the noise on either side.

The 89601A vector analyzer software is an extremely powerful tool for analyzing signal problems and uncovering their root cause.

Choose from a wide range of preset standards in cellular including 3G, wireless networking and video formats. The power is in the ability to analyze nonstandard formats. Select formats from QPSK to 256 QAM, bursted or nonbursted, at very high symbol rates. Use compensation to improve EVM. Analyze the compensation
filter to determine predistortion requirements

Modulation analysis with Option 241 demonstration

Instructions	Keystrokes
ESG setup:	
Setup four carrier W-CDMA signal.	[Mode] {Custom} {Arb waveform generator} {Digital mod define} {Modulation type 16 QAM} {Symbol Rate 50 MHz}
Set frequency of 1 GHz and amplitude of –10 dBm.	[Amplitude –10 dBm] [Frequency 1 GHz]
PSA setup:	
Setup the mode, frequency and the span.	[Mode] {Basic} [Frequency 1 GHz] [Span 50 MHz]
Initiating and setting up 89601A software	
Open up the VSA software.	Click on the VSA icon, once the two window display appears, change the range to –17 dBm
Setup the VSA to view constellation, EMV and spectrum.	On the VSA software press measSetup, Demodulator, Digital Demodulator Setup the properties by pressing Demod Properties, Format 16 QAM, symbol rate 50 MHz Then filter, measure, root raised; reference, raised cosine; alpha 0.35 Go to four displays by pressing display dropdown window and selecting Grid 2x2

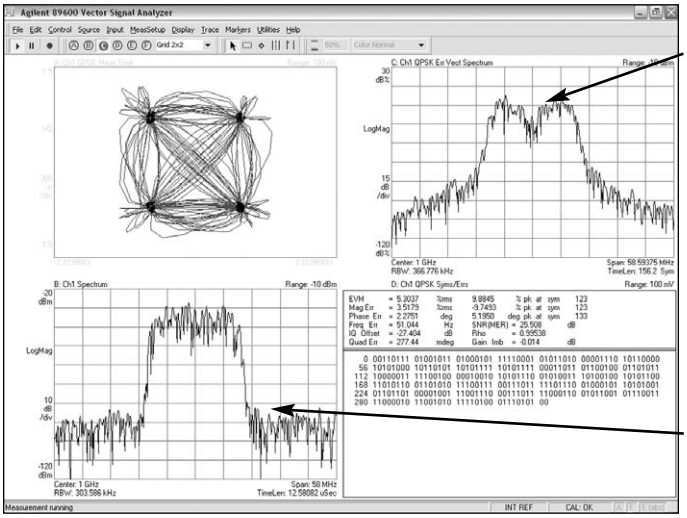

Figure 13: Impaired QPSK 15 MSymbols/Sec indicating 5.0% EVM.

Wide Bandwidth Measurements Above 3 GHz

Switched MW preselector bypass Option 123

The preselector is used to reject mixing images and prevent mixer overload.

However, microwave preselectors are not completely predictable. They are susceptible to bandwidth, thermal drift and changes in phase and amplitude flatness versus tune frequency. For optimum performance, it is recommended that the preselector be bypassed for operation above 3 GHz. Option 123 gives the operator the choice of bypassing the preselector. To switch the microwave preselector on or off, press [Input/output] and {microwave preselector on/off}

PSA wide band calibration wizard, Option 235

The PSA has a microwave preselector employed for frequencies above 3.05 GHz. Preselectors add magnitude and phase errors into the measurements. These errors can be calibrated out using an external calibration wizard and an external source.

In addition, the calibration wizard can be used to calibrate out errors caused by external devices such as amplifiers attached to the input of the PSA.

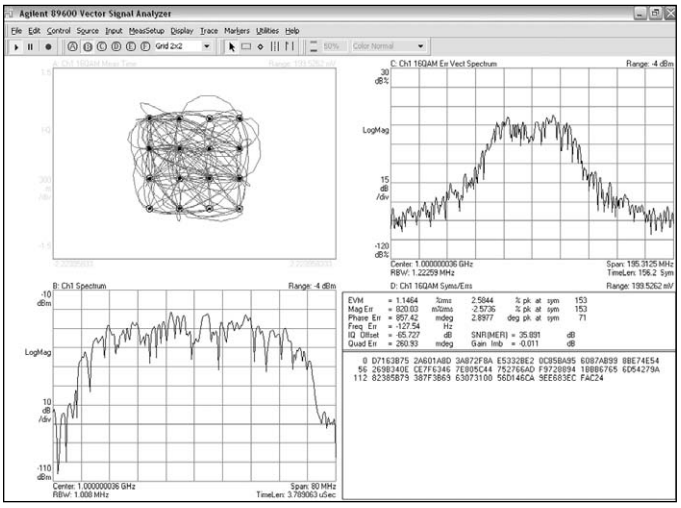

Figure 14: 16QAM 50 mSymbols/Sec example showing 1.1% EVM with optimized ESG sourced corrected with Signal Studio Toolkit[1].

1. EVM will be approximately 4.5% without ESG source optimization.

PSA Series Option 140/122 Key Specifications[1]

40/80 MHz bandwidth digitizer specifications

The following specifications apply to the listed PSA models, when using basic mode, and "Wide IF" is selected.

Frequency range	
E4443A	10 MHz to 6.7 GHz
E4445A	10 MHz to 13.2 GHz
E4440A	10 MHz to 26.5 GHz
Maximum analysis bandwidth	
Option 140	40 MHz[2]
Option 122	80 MHz[2]
ADC resolution	14 bits
Third order intermodulation distortion	-78 dBc (typical)
Residual EVM	< 1% (nominal)
IF flatness (magnitude/phase)	± 0.13 dB / 1.2° (typical)
Capture memory	128 Msamples (512 MB)

Absolute amplitude accuracy

At 50 MHz		
20 to 30 °C	± 0.30 dB	
0 to 55 °C	± 0.42 dB	
Input coupling	AC only	
RF frequency response		
Relative to 50 MHz, measured at center span, 10 dB input atten		
	Span ≤ 36 MHz	Span > 36 MHz
50 MHz to 3 GHz, 20 to 30 °C	± 0.52 dB (± 0.22 dB typical)	± 0.51 dB (± 0.11 dB typical)
50 MHz to 3 GHz, 0 to 55 °C	± 0.71 dB	± 0.64 dB
With MW preselector (Option 123) on		
3.05 to 6.6 GHz	± 0.4 dB typical	
6.6 to 13.2 GHz	± 1.2 dB typical	
13.2 to 19.2 GHz	± 0.7 dB typical	
19.2 to 26.5 GHz	± 2.0 dB typical	
With MW preselector (Option 123) off		
3.05 to 6.6 GHz	± 0.15 dB typical	± 0.7 dB typical
6.6 to 13.2 GHz	± 0.25 dB typical	± 0.9 dB typical
13.2 to 19.2 GHz	± 0.5 dB typical	± 0.9 dB typical
19.2 to 26.5 GHz	± 0.8 dB typical	± 1.0 dB typical

1. See PSA Series spectrum analyzers data sheet for more specification details (Literature number 5980-1284E).
2. Option 123 switchable microwave preselector bypass is required for maximum analysis bandwidth above center frequencies of 3 GHz.

PSA Series
Key Specifications[1]

IF frequency response

Frequency (GHz)	Span	Option 123	
≤ 3.00	≤ 30 MHz	n/a	± 0.47 dB, ± 0.13 dB typical
3.00 to 3.05	≤ 30 MHz	n/a	± 0.57 dB, ± 0.28 dB typical
≤ 3.00	≤ 60 MHz	n/a	± 0.65 dB, ± 0.30 dB typical
3.00 to 3.05	≤ 60 MHz	n/a	± 0.73 dB, ± 0.30 dB typical
0.100 to 3.00	≤ 80 MHz	n/a	± 0.73 dB, ± 0.30 dB typical
3.00 to 3.05	≤ 80 MHz	n/a	± 0.93 dB, ± 0.40 dB typical
3.05 to 6.6	≤ 30 MHz	off	± 1.1 dB nominal
6.6 to 26.5	≤ 30 MHz	off	± 1.3 dB nominal
3.05 to 6.6	≤ 30 MHz	on	± 0.40 dB, ± 0.16 dB typical
6.6 to 10	≤ 30 MHz	on	± 0.58 dB, ± 0.28 dB typical
10 to 26.5	≤ 30 MHz	on	± 0.56 dB, ± 0.16 dB typical
3.05 to 6.6	≤ 60 MHz	on	± 0.43 dB, ± 0.17 dB typical
6.6 to 26.5	≤ 60 MHz	on	± 0.96 dB, ± 0.30 dB typical
3.05 to 6.6	≤ 80 MHz	on	± 0.63 dB, ± 0.19 dB typical
6.6 to 26.5	≤ 80 MHz	on	± 1.13 dB, ± 0.40 dB typical

IF phase linearity

Relative to mean phase linearity

Frequency (GHz)	Span	Option 123	
≤ 3.05	≤ 30 MHz	n/a	± 1.2° typical
≤ 0.3	≤ 60 MHz	n/a	± 3.2° typical
0.3 to 3.05	≤ 60 MHz	n/a	± 2.5° typical
< 0.3	≤ 80 MHz	n/a	± 10.0° typical
0.3 to 3.05	≤ 80 MHz	n/a	± 7.0° typical
3.05 to 6	≤ 20 MHz	off	± 7.0° nominal
6 to 20	≤ 30 MHz	off	± 10.0° nominal
3.05 to 26.5	≤ 30 MHz	on	± 0.8° typical
3.05 to 26.5	≤ 60 MHz	on	± 1.2° typical
3.05 to 26.5	≤ 80 MHz	on	± 2.5° typical

Third order intermodulation distortion

Two tones of equal magnitude, 0 dB IF gain

Frequency	Span	Tone level		
(GHz)	(MHz)	(dBfs)	(dBm)	
≤ 3.05	≤ 30	–9	–25	–75 dBc, –80 dBc typical
≤ 3.05	≤ 60	–9	–25	–74 dBc, –78 dBc typical
≤ 3.05	≤ 80	–9	–25	–78 dBc nominal
≤ 3.05	≤ 30	–6	–22	–72 dBc, –77 dBc typical (+16.5 dBm TOI)
≤ 3.05	≤ 60	–6	–22	–70 dBc, –74 dBc nominal
≤ 3.05	≤ 80	–6	–22	–74 dBc nominal
> 3.05	≤ 30	–6	–22	–68 dBc nominal
> 3.05	≤ 30	–6	–22	–70 dBc nominal (Option 123 on)

1. See PSA Series spectrum analyzers data sheet for more specification details (Literature number 5980-1284E).

PSA Series
Key Specifications[1]

– continued

EVM

EVM measurement floor for an 802.11g OFDM signal, using 89601A software equalization, channel estimation and data EQ.

2.4 GHz	0.35% (nominal)
6.0 GHz	0.56% (nominal)

EVM measurement floor for a 62.5 Msymbol/sec QPSK signal, non-equalized, with 80 MHz occupied bandwidth

	Options 1DS, B7J	Option 1DS (nominal)	No options
750 MHz	2.2%	1.5%	1.1%
2.5 GHz	2.1%	2.2%	2.0%

Microwave preselector Off[2]

3.05 GHz	1.6% (nominal)
7.5 GHz	1.9% (nominal)
10 GHz	1.5% (nominal)
12.5 GHz	1.5% (nominal)
18 GHz	1.6% (nominal)

Input noise density

Frequency (GHz)	(MHz)	Span (dB)	IF gain
≤ 3.05	≤ 30	–12	–136 dBfs/Hz
≤ 3.05	≤ 60	–12	–133 dBfs/Hz
≤ 3.05	≤ 30	0	–133 dBfs/Hz
≤ 3.05	≤ 60	0	–130 dBfs/Hz
3.05 to 6	≤ 30	0	–130 dBfs/Hz

The following are nominal specs

	Option 123 off ≤ 30 MHz span	Option 123 on ≤ 60 MHz span
3.05 to 6.6	–135 dBfs/Hz	–135 dBfs/Hz
6.6 to 13.2	–132 dBfs/Hz	–128 dBfs/Hz
13.2 to 19.2	–132 dBfs/Hz	–123 dBfs/Hz
19.2 to 26.5	–128 dBfs/Hz	–116 dBfs/Hz

Input sensitivity (noise level)

Input terminated, log average, 0 dB input attenuation
Frequency (3.05 GHz, preamp off)
Maximum IF gain –152 dBm

Residual response

Relative to input mixer	–100 dBm
Relative to full-scale	
CF ≤ 3.05 GHz, ≤ 80 MHz	–90 dBfs
CF ≤ 3.05 GHz, span ≤ 30 MHz	–85 dBfs
CF ≤ 3.05 GHz, span ≤ 80 MHz	–75 dBfs nominal

1. See PSA Series spectrum analyzers data sheet for more specification details (Literature number 5980-1284E).
2. If the microwave preselector is required for measurements, then an external source and the wide bandwidth digitizer external calibration wizard (Option 235) should be used. A complete description of the calibration wizard software can be found in Application Note 1443.

PSA Series
Key Specifications[1]
– continued

Frequency stability

Phase noise sidebands		
Center frequency 1 GHz		
IF Gain = –12 dB		
Offset frequency		
100 Hz	–91 dBc/Hz (nominal)	
1 kHz	–100 dBc/Hz (nominal)	
10 kHz	–106 dBc/Hz	
100 kHz	–119 dBc/Hz	
1 MHz	–137 dBc/Hz	

Triggering types

Free run, video, external front, external rear and framed (periodic)

Data acquisition

Time record length		
Spectrum measurement	32 to 180,000 samples	
Waveform measurement		32 to 10^6 samples (nominal)
Deep time capture		
Analysis BW > 20 MHz	1.2 x 10^8 samples	128 Msamples
Analysis BW ≤ 20 MHz	6 x 10^7 samples	64 Msamples

Option 123, switchable MW preselector bypass

Frequency range	3.05 to 26.5 GHz	
Displayed average noise level (DANL)		
> 3.05 to 6.6 GHz	–150 dBm	–153 dBm typical
6.6 to 13.2 GHz	–142 dBm	–146 dBm typical
13.2 to 19.2 GHz	–137 dBm	–140 dBm typical
19.2 to 26.5 GHz	–131 dBm	–134 dBm typical
Frequency response	20 to 30 °C	
> 3.05 to 6.6 GHz	± 0.77 dB	± 0.15 dB typical
6.6 to 13.2 GHz	± 0.97 dB	± 0.15 dB typical
13.2 to 19.2 GHz	± 1.39 dB	± 0.35 dB typical
19.2 to 26.5 GHz	± 2.07 dB	± 0.40 dB typical

1. See PSA Series spectrum analyzers data sheet for more specification details (Literature number 5980-1284E).

PSA Series
Ordering Information

PSA Series spectrum analyzer

E4443A 3 Hz to 6.7 GHz
E4445A 3 Hz to 13.2 GHz
E4440A 3 Hz to 26.5 GHz
E4446A 3 Hz to 44 GHz
E4448A 3 Hz to 50 GHz

Options

To add options to a product, use the following ordering scheme:
Model E444xA (x = 0, 3, 5, 6 or 8)
Example options E4440A-B7J, E4448A-1DS

Measurement Personalities

E444xA-226	Phase noise	
E444xA-219	Noise figure	Requires 1DS
E444xA-241	Flexible modulation analysis	
E444xA-BAF	W-CDMA	Requires B7J
E444xA-210	HSDPA	Requires B7J and BAF
E444xA-202	GSM w/ EDGE	Requires B7J
E444xA-B78	cdma2000	Requires B7J
E444xA-214	1xEV-DV	Requires B7J and B78
E444xA-204	1xEV-DO	Requires B7J
E444xA-BAC	cdmaOne	Requires B7J
E444xA-BAE	NADC, PCD	Requires B7J
E444xA-211	TD-SCDMA	
E444xA-266	Programming code compatibility suite	

Hardware

E444xA-1DS	100 kHz to 3 GHz built-in preamplifier	
E444xA-B7J	Digital demodulation hardware	
E4440A-122	80 MHz bandwidth digitizer	E4440A only, excludes H70
E444xA-123	Switchable MW preselector bypass	E4440A/43A/45A only, excludes AYZ
E444xA-124	Y-axis video output	
E444xA-AYZ	External mixing	E4440A/46A/48A only, excludes 123
E4440A-BAB	Replaces type-N input connector with APC 3.5 connector	E4440A only
E444xA-H70	70 MHz IF output	Excludes 122

Connectivity Software

E444xA-230	BenchLink Web Remote Control Software	
E4440A-235	Wide BW digitizer external calibration wizard & license (supports Option 122 only)	Requires 122

Accessories

E444xA-1CM	Rack mount kit
E444xA-1CN	Front handle kit
E444xA-1CP	Rack mount with handles
E444xA-1CR	Rack slide kit
E444xA-045	Millimeter wave accessory kit
E444xA-0B1	Extra manual set including CD ROM

Warranty & Service

Standard warranty is one year.

R-51B-001-3C	1-year Return to Agilent Warranty extended to 3-years

Calibration[1]

R-50C-011-3	Inclusive calibration plan, 3 year coverage
R-50C-013-3	Inclusive calibration plan and cal data, 3 year coverage
E444xA-0BW	Service manual and calibration software
E444xA-UK6	Commercial calibration certificate with test data

1. Options not available in all countries.

Related Literature

- *PSA Series,* brochure, literature number 5980-1283E
- *PSA Series,* data sheet, literature number 5980-1284E
- *Self-Guided Demonstration for Spectrum Analysis,* product note, literature number 5988-0735EN
- *Phase Noise Measurement Personality,* technical overview, literature number 5988-3698EN
- *Noise Figure Measurement Personality,* technical overview, literature number 5988-7884EN
- *External Source Measurement Personality,* technical overview, literature number 5989-2240EN
- *Flexible Modulation Analysis Measurement Personality,* technical overview, literature number 5989-1119EN
- *W-CDMA and HSDPA Measurement Personalities,* technical overview, literature number 5988-2388EN
- *GSM with EDGE Measurement Personality,* technical overview, literature number 5988-2389EN
- *cdma2000 and 1xEV-DV Measurement Personalities,* technical overview, literature number 5988-3694EN
- *1xEV-DO Measurement Personality,* technical overview, literature number 5988-4828EN
- *cdmaOne Measurement Personality,* technical overview, literature number 5988-3695EN
- *NADC/PDC Measurement Personality,* technical overview, literature number 5988-3697EN
- *TD-SDCMA Measurement Personality,* technical overview, literature number 5989-0056EN
- *80 MHz Bandwidth Digitizer,* technical overview, literature number 5989-1115EN
- *Programming Code Compatibility Suite,* technical overview, literature number 5989-1111EN
- *PSA Series Spectrum Analyzers, Option H70, 70 MHz IF Output,* product overview, literature number 5988-5261EN
- *Optimizing Dynamic Range for Distortion Measurements,* product note, literature number 5980-3079EN
- *PSA Series Amplitude Accuracy,* product note, literature number 5980-3080EN
- *PSA Series Swept and FFT Analysis,* product note, literature number 5980-3081EN
- *PSA Series Measurement Innovations and Benefits,* product note, literature number 5980-3082EN
- *Signal Analysis Basics,* application note 150, literature number 5952-0292
- *8 Hints for Millimeter Wave Spectrum Measurements,* application note, literature number 5988–5680EN
- *Spectrum Analyzer Measurements to 325 GHz with the Use of External Mixers,* application note 1453, literature number 5988-9414EN
- *EMI,* application note 150-10, literature number 5968-3661E
- *Vector Signal Analysis Basics,* application note 150-15, literature number 5989-1121EN
- *Using Extended Calibration Software for Wide Bandwidth Measurements, PSA Option 122 & 89600 VSA,* application note 1443, literature number 5988-7814EN
- *PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software,* product note, literature number 5988-5015EN
- *89650S,* technical overview, literature number 5980-0723E
- *N5530S,* technical overview, literature number 5989-1113EN
- *Selecting the Right Signal Analyzer for Your Needs,* selection guide, literature number 5968-3413E
- *BenchLink Web Remote Control Software,* product overview, literature number 5988-2610EN
- *IntuiLink Software,* data sheet, literature number 5980-3115EN

For more information on the PSA Series, the E4406A VSA, or to view the above-listed literature, please visit:

www.agilent.com/find/psa
www.agilent.com/find/vsa

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Product specifications and descriptions in this document subject to change without notice.

Printed in USA, January 25, 2006
5989-1115EN

Agilent Technologies