

# Agilent PSA Series Spectrum Analyzers Phase Noise Measurement Personality

## Product Overview

The PSA series is Agilent Technologies' highest performing spectrum analyzer family. In addition to offering advanced and comprehensive RF and microwave measurement capability, you can add the Phase Noise Measurement Personality (Option 226) to transform the PSA into a one-button phase noise tester. Whether you're in R&D or manufacturing, the PSA's phase noise personality provides a comprehensive measurement solution to characterize the phase noise behavior of your systems and components easily, quickly, and accurately.



# Phase Noise



## **Phase noise measurements made easier, faster, and more accurate**

High-purity, high-stability signals have become more important to the modern communications, aerospace, and defense industries. Phase noise is one of the most crucial measures to evaluate the short-term stability of a signal. Therefore, an accurate, fast, and easy-to-use phase noise measurement tool is critical in the R&D and manufacturing environments.

In addition to its superior combination of speed, accuracy, flexibility, and dynamic range, the Agilent PSA series offers a Phase Noise Measurement Personality - providing an ideal tool for design verification and troubleshooting, as well as production-line testing. By adding this measurement personality, you integrate a phase noise tester and a high-performance spectrum analyzer into one box.

- Expand design possibilities with powerful measurement capability and flexibility.
- Expedite troubleshooting and design verification with an intuitive user interface and numerous features.
- Streamline manufacturing with speed, reliability, and ease of use.
- Maximize yields with accurate measurements and operator independent results.

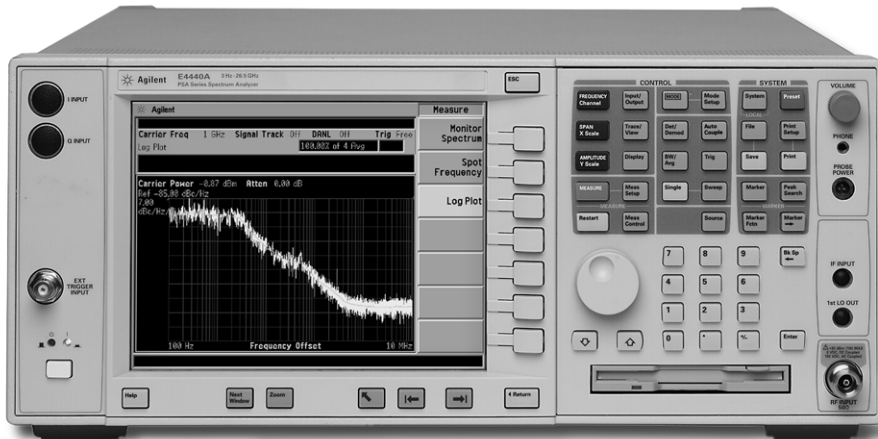
In particular, the Phase Noise Measurement Personality offers all the features you need to make quick, accurate phase noise measurements.

- Display the single-sideband phase noise across a wide range of offset frequencies.
- Monitor phase noise deviation at a user-specified single offset frequency in a real time.
- Optimize displayed average noise level (DANL) and view DANL floor with the phase noise plot.
- Calculate root-mean-square (rms) phase deviation/jitter, and residual FM at a user-specified offset frequency bandwidth.
- Generate measurement results quickly – measurements are ten times faster than Agilent's popular 86571A phase noise measurement utility implemented on the 8560E series spectrum analyzers.
- Cancel internal phase noise and make more accurate measurements using a new, innovative phase noise cancellation feature.
- Switch easily between spectrum analysis and phase noise measurements with the touch of a button.

# Phase noise measurements

With a single button press, the PSA with the Phase Noise Measurement Personality performs phase noise measurements automatically. You no longer need to spend time tuning your spectrum analyzer to multiple offset frequencies or drawing phase noise plots manually. In addition, to help you optimize measurements, the Phase Noise Measurement Personality allows you to control measurement parameters through a user-friendly interface.

- Log plot phase noise
- Phase noise at single offset frequency
- Integrated noise measurements
  - rms phase deviation
  - rms phase jitter
  - residual FM



- DANL optimization and DANL floor measurement
- Phase noise cancellation

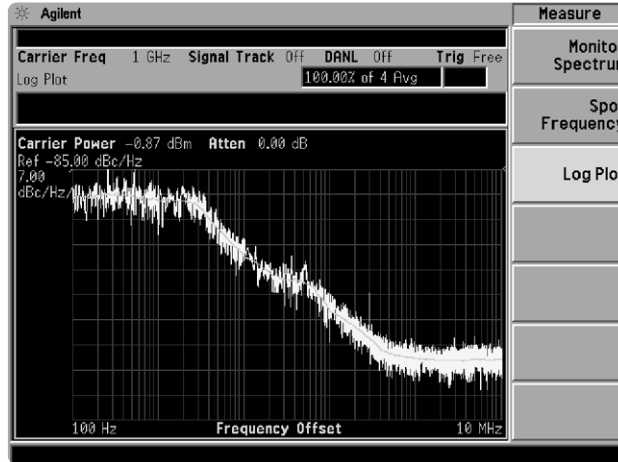


Figure 1. Log plot phase noise: averaged data superimposed with a smoothed trace

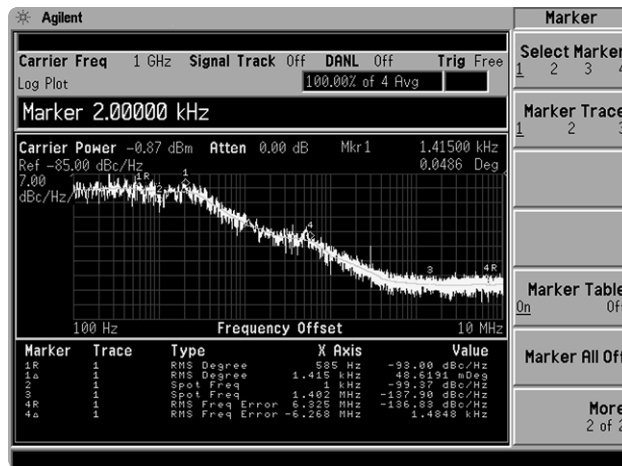


Figure 2. Log plot phase noise with marker table showing different types of measurement results

## Log plot phase noise (frequency domain)

- view entire phase noise behavior across a wide range of offset frequencies (10 Hz to 100 MHz)
- simultaneously display up to seven decades of offset frequency in logarithmic scale
- measure phase noise with a user-specified number of averages
- perform trace smoothing with user-adjustable smoothing segment length
- utilize a suite of comprehensive PSA marker functions
- search carrier frequency automatically
- apply multilevel video filtering
- make single and continuous measurements

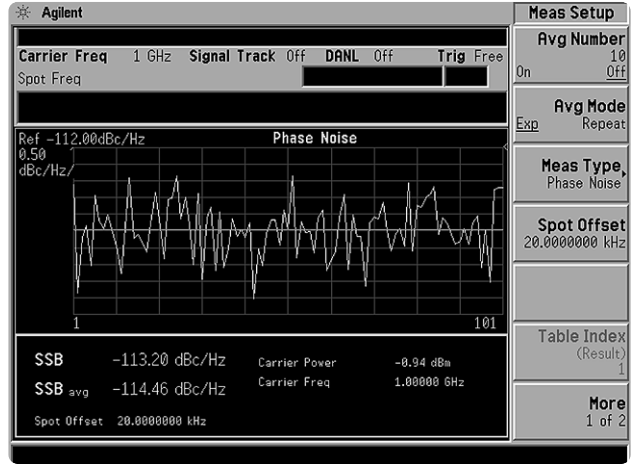


Figure 3. Phase noise at a single offset frequency with numerical readouts

### Phase noise at a single offset frequency (time domain)

- monitor phase noise fluctuation versus time at a user-specified single offset frequency (between 100 Hz and 100 MHz)
- use the PSA's phase noise optimization feature to minimize the analyzer's internal phase noise
- check carrier frequency drifting with carrier signal tracking
- search carrier frequency automatically
- view results in graphic and numeric list formats

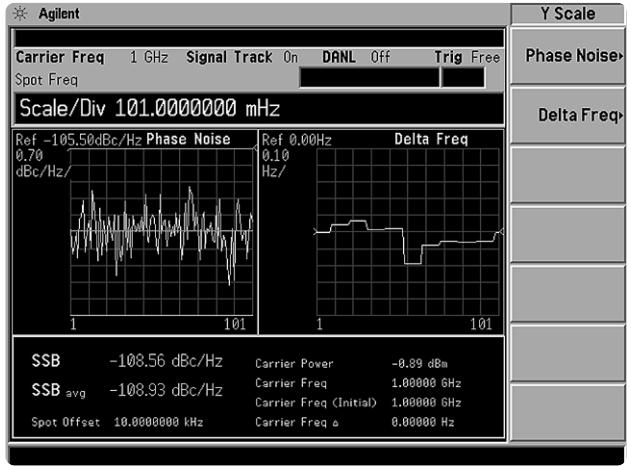


Figure 4. Phase noise at a single offset frequency and carrier drifting (the right panel)

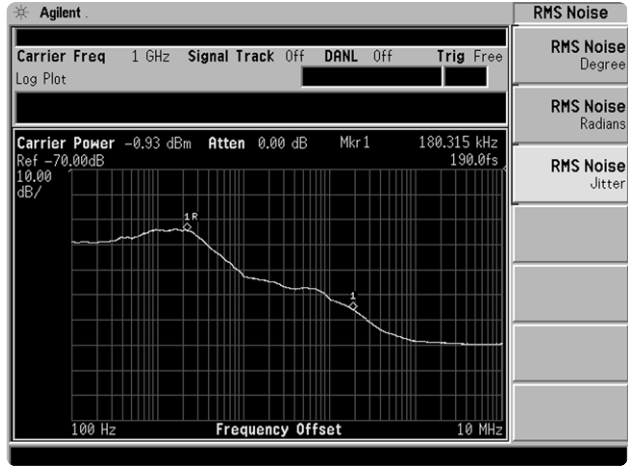


Figure 5. rms phase jitter in seconds calculated between two markers

### Integrated noise measurements

- characterize phase noise related behaviors from different angles for various applications
- adjust integration bandwidth by positioning a pair of markers on the log plot
- calculate rms phase deviation/jitter in degrees or radians
- calculate rms phase jitter in seconds
- calculate the residual FM in Hz
- view numeric marker readings for calculated results

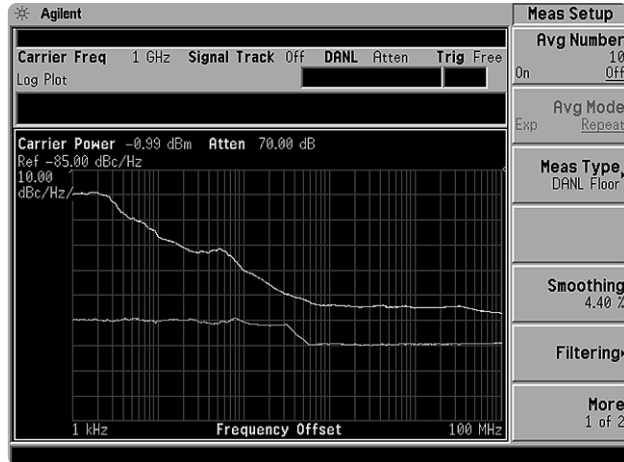


Figure 6. Log plot phase noise displayed with an optimized DANL floor (the lower trace)

## DANL optimization and DANL floor measurement

- optimize the PSA input attenuation levels at different offset frequency segments for the best measurement sensitivity in far-out offset frequencies
- measure and reference the DANL of the PSA to the carrier amplitude
- display the DANL floor together with the log plot phase noise
- store and record traces easily

## Phase noise cancellation

- measure the PSA's internal phase noise using a source with low phase noise
- eliminate the influence of the PSA's internal phase noise on measurement results in close-in offset frequencies
- improve measurement accuracy and sensitivity
- make the best trade-off between cancellation effectiveness and computation time with user-selectable thresholds

## Key specifications<sup>1</sup>

	<b>E4443A/E4445A/E4440A</b>	<b>E4446A/E4448A</b>
<b>Frequency range</b>	3 Hz to 6.7/13.2/26.5 GHz	3 Hz to 44/50 GHz
<b>Speed</b>		
Sweep time, span ≥ 10 Hz	1 ms to 2000 s	1 ms to 2000 s
Sweep time span = 0 Hz	1 μs to 6000 s	1 μs to 6000 s
Local measurement update rate	≥ 50 measurements/sec	≥ 50 measurements/sec
Remote measurement update rate	≥ 22 measurements/sec	≥ 22 measurements/sec
<b>Resolution</b>		
Resolution bandwidth range, swept and FFT	1 Hz to 3 MHz (10% steps), 4, 5, 8 MHz	1 Hz to 3 MHz (10% steps), 4, 5, 8 MHz
Variable sweep (trace) point range	101 to 8192	101 to 8192
Phase noise at 1 GHz		
10 kHz offset	-114 dBc/Hz	-114 dBc/Hz
1 MHz offset	-117 dBc/Hz (typical)	-117 dBc/Hz (typical)
10 MHz offset	-144 dBc/Hz	-144 dBc/Hz
	-148 dBc/Hz (nominal)	-148 dBc/Hz (nominal)
	-151 dBc/Hz	-151 dBc/Hz
	-157 dBc/Hz (nominal)	-157 dBc/Hz (nominal)
Residual FM	< (1 Hz x N2) p-p in 1 s	< (1 Hz x N2) p-p in 1 s
<b>Dynamic range</b>		
Displayed average noise level (DANL)		
10 MHz to 3 GHz	-152 dBm	-151 dBm
3 GHz to 20 GHz	-146 dBm	-144 dBm
20 GHz to 26.5 GHz	-143 dBm	-140 dBm
26.5 GHz to 44 GHz	N.A.	-131 dBm
44 GHz to 50 GHz	N.A.	-126 dBm
Preamplifier (DANL) - 10 MHz to 3 GHz	-166 dBm	-164 dBm
1 dB gain compression		
200 MHz to 3 GHz	+3 dBm (+7 dBm nominal)	+3 dBm (+7 dBm nominal)
Input attenuator range	0 to 70 dB in 2 dB steps	0 to 70 dB in 2 dB steps
TOI - 1.7 GHz to 3.0 GHz	+17 dBm (+19 dBm typical)	+18 dBm (+21 dBm typical)
SHI - 400 MHz to 1.25 GHz	+52 dBm	+51 dBm
ACPR, W-CDMA (5 MHz offset)		
Dynamic range	-74.5 dB (typical)	-74.5 dB (typical)
Dynamic range w/noise correction	-81 dB (typical)	-81 dB (typical)
<b>Accuracy</b>		
Absolute amplitude accuracy	±(0.24 dB + frequency response) ±(0.06 dB + frequency response), (typical)	±(0.24 dB + frequency response) ±(0.06 dB + frequency response), (typical)
95% confidence, 3 Hz to 3 GHz	±0.24 dB	±0.24 dB
Frequency response, 3 Hz to 3 GHz	±0.38 dB (±0.10 dB typical)	±0.38 dB (±0.10 dB typical)
Frequency accuracy at 1 GHz and a stable temperature	±100 Hz	±100 Hz
Span accuracy	±0.2% + span sweep points - 1	±0.2% + span sweep points - 1
W-CDMA ACPR accuracy (5 MHz offset)		
Mobile station	±0.12 dB	±0.12 dB
Base station	±0.22 dB	±0.22 dB
<b>Warranty</b>	3 years (standard)	3 years (standard)

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

2. N is harmonic mixing mode.

## Phase noise measurement personality

<b>Measurement modes</b>	Spectrum monitor Log plot Spot frequency
<b>Offset frequency range</b>	
Minimum offset frequency	10 Hz
Maximum offset frequency	100 MHz
<b>Maximum number of decades</b>	7
<b>Maximum input signal level</b>	+20 dBm
<b>Minimum input signal level</b>	-50 dBm
(for optimum dynamic range)	
<b>Measurement accuracy</b> (nominal)	
Amplitude accuracy	< ±0.29 dB (RSS value, based upon a 1-GHz signal at 0 dBm while running the log plot measurement, with all other measurement and instrument settings at their factory defaults.)
Amplitude repeatability	±0.34 dB (with 1 GHz carrier at 10 kHz offset, 4% smoothing and medium video filtering)
<b>Video filtering</b>	Four levels: None (VBW/RBW = 1.0) Little (VBW/RBW = 0.3) Medium (VBW/RBW = 0.1) Maximum (VBW/RBW = 0.03)
<b>Smoothing</b>	Fine-adjustable between 0% and 16%
<b>rms noise calculation</b>	rms phase deviation, rms phase jitter, and residual FM are calculated over a user-specified integration interval
<b>System phase noise</b>	See figures 7 and 8

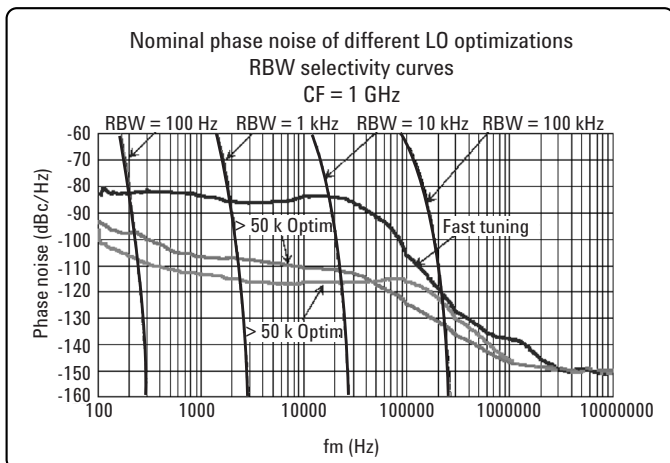


Figure 7. Nominal phase noise of different LO optimizations

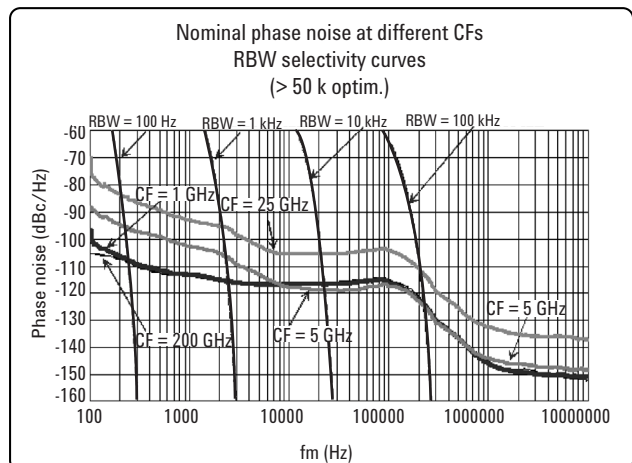


Figure 8. Nominal phase noise at different carrier frequencies (CFs)



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## 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

### Digital demodulation hardware

E444xA-B7J	Digital demodulation hardware (required for digital demodulation measurement personalities)
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### Digital demodulation measurements

E444xA-BAF	W-CDMA measurement personality
E444xA-202	GSM w/ EDGE measurement personality
E444xA-B78	cdma2000 measurement personality
E444xA-204	1xEV-DO measurement personality
E444xA-BAC	cdmaOne measurement personality
E444xA-BAE	NADC, PCD measurement personality

### Phase noise measurement

E444xA-226	Phase noise measurement personality
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### Amplifiers

E444xA-1DS	100 kHz to 3 GHz built-in preamplifier
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### Inputs and outputs

E4440A-BAB	Replaces type "N" input connector with APC 3.5 connector
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### Connectivity software

E444xA-230	BenchLink Web Remote Control Software
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### Code compatibility

E444xA-266	HP 8566B/8568B code compatibility measurement personality
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### 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

### Documentation

E444xA-0B1	Extra manual set including CD ROM
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### Calibration documentation

E444xA-UK6	Commercial calibration certificate with test data
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### Warranty and service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

R-51B	Return-to-Agilent warranty and service plan
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### Calibration<sup>1</sup>

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001	Standard calibration
R-50C-002	Standards compliant calibration
E444xA-0BW	Service manual and calibration software

1.Options not available in all countries.

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## Product literature

*PSA Series - The Next Generation*, brochure, literature number 5980-1283E

*PSA Series*, data sheet, literature number 5980-1284E

*Phase Noise Measurement Personality*, product overview, literature number 5988-3698EN

*W-CDMA Measurement Personality*, product overview, literature number 5988-2388EN

*GSM with EDGE Measurement Personality*, product overview, literature number 5988-2389EN

*cdma2000 Measurement Personality*, product overview, literature number 5988-3694EN

*1xEV-DO Measurement Personality*, product overview, literature number 5988-4828EN

*cdmaOne Measurement Personality*, product overview, literature number 5988-3695EN

*NADC/PDC Measurement Personality*, product overview, literature number 5988-3697EN

*PSA Series Spectrum Analyzers, Option H70, 70 MHz IF Output*, product overview, literature number 5988-5261EN

*Self-Guided Demonstration for Spectrum Analysis*, product note, literature number 5988-0735EN

*Self-Guided Demonstration for Phase Noise Measurements*, product note, literature number 5988-3704EN

*Self-Guided Demonstration for W-CDMA Measurements*, product note, literature number 5988-3699EN

*Self-Guided Demonstration for GSM and EDGE Measurements*, product note, literature number 5988-3700EN

*Self-Guided Demonstration for cdma2000 Measurements*, product note, literature number 5988-3701EN  
*Self-Guided Demonstration for 1xEV-DO Measurements*, product note, literature number 988-6208EN

*Self-Guided Demonstration for cdmaOne Measurements*, product note, literature number 5988-3702EN

*Self-Guided Demonstration for NADC and PDC Measurements*, product note, literature number 5988-3703EN

*PSA Series Demonstration CD*, literature number 5988-2390EN

*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

*PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software*, product note, literature number 5988-5015EN

*Selecting the Right Signal Analyzer for Your Needs*, selection guide, literature number 5968-3413E

*8 Hints for Millimeter Wave Spectrum Measurements*, application note, literature number 5988-5680EN

*PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software*, product note, literature number 5988-5015EN

*89600 series + PSA, 802.11A and HiperLAN2 OFDM Measurements*, product note, literature number 5988-4094EN

*N4256A Amplifier Distortion Test Set*, product overview, literature number 5988-2925EN

*BenchLink Web Remote Control Software*, product overview, literature number 5988-2610EN

*HP 8566B/68B Programming Code Compatibility for PSA and ESA-E Series Spectrum Analyzers*, product overview, literature number 5988-5808EN

*IntuiLink Software*, Data Sheet, Literature Number 5980-3115EN

*Agilent Technologies Wireless/GSM Solutions*, application note, literature number 5968-2320E

*Measuring EDGE Signals - New and Modified Techniques and Measurement Requirements*, application note, literature number 5980-2508EN

*Selecting the Right Signal Analyzer for Your Needs*, selection guide, literature number 5968-3413E  
*8 Hints for Millimeter Wave Spectrum Measurements*, application note, literature number 5988-5680EN

*85671A Phase Noise Measurement Utility*, product overview, literature number 5091-7089E

For more information on the PSA series, please visit:

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



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