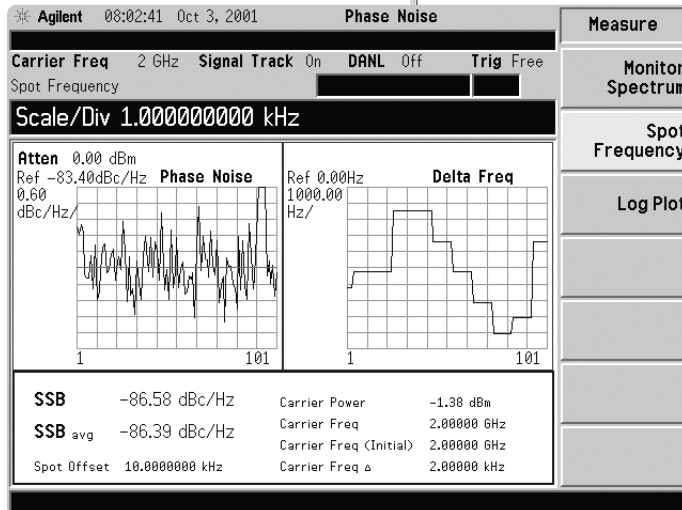
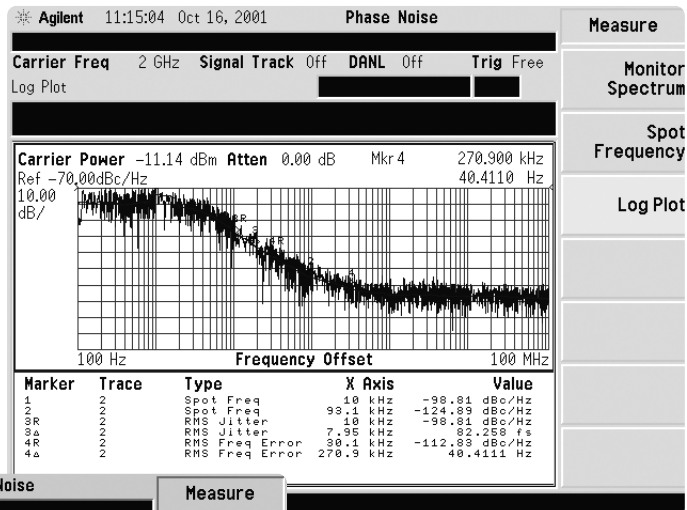


# Phase Noise Measurement Personality for the Agilent ESA-E Series Spectrum Analyzers

## Product Overview

Now the ESA-E series spectrum analyzers have one-button phase noise measurements, including log plot, spot frequency, carrier drift-ing, rms phase deviation, rms phase jitter, and residual FM.



The rugged, affordable and portable full featured spectrum analyzer series made even more capable!



Agilent Technologies

# An accurate, efficient phase noise measurement solution for R&D and manufacturing environments

**The Agilent ESA-E series spectrum analyzers provide flexible general-purpose spectrum analysis and the newly enhanced one-button phase noise measurement capability all in a mid-priced package.**

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.

Phase noise measurements can be complex and time-consuming. The previously available phase noise measurement personality (Option 226, version A) on ESA-E series simplified the measurements. By migrating Option 226 from version A to version B, we have enhanced its performance, added more features, and substantially improved the user-interface to make your phase noise measurements easier, faster and more reliable.

## Comparisons between version A and version B for ESA-E/Option 226

Features/measurements	Option 226 (version A)	Option 226 (version B)
Log plot phase noise	Yes	Yes (enhanced)
Minimum offset freq.	100 Hz	10 Hz (with Options 1D5/1DR)
Maximum offset freq.	100 MHz	100 MHz
Maximum number of decades	5 (whole decades only)	7 (whole decades only)
Measurement speed*	1x	4x
Smoothing segment	4 discrete levels	Fine-adjustable
Marker functions	Limited	Fully ESA marker functions
DANL optimization	No	Yes
DANL floor display	No	Yes
Phase noise cancellation	No	Yes
Spot frequency phase noise	Yes	Yes (enhanced)
Carrier freq. drifting	No	Yes
Graphics/tabular display	No	Yes
Residual FM	No	Yes
rms phase deviation	No	Yes
rms phase jitter	No	Yes
User interface	Configuration table driven	ESA standard, very intuitive

\*The measurement was performed for a log plot measurement from 100 Hz to 10 MHz offset frequency with 4% smoothing and the maximum video filtering on.

# Here is how the Agilent ESA-E Series spectrum analyzer benefits you:

## Fully featured phase noise measurement capability

### Phase noise measurements made simple:

- View your system's phase noise behavior across a wide range of offset frequencies with the log plot measurement.
- Monitor phase noise in real time at your specified single offset frequency.
- Verify and troubleshoot your signal source design with the residual FM measurement.
- Characterize high-frequency digital clock with the rms phase jitter measurement.
- Maximize your confidence in phase noise measurements at the far-out offset with the displayed average noise level (DANL) optimization and at the close-in with the phase noise cancellation.

### With spectrum analysis

#### Maximize measurement capability and confidence:

- 99 dB third order dynamic range to view low level distortion and inter-modulation.
- 1 Hz digital resolution bandwidth up to 220 times faster than analog.
- Phase noise optimization that improves the instrument's inherent phase noise.
- Continuous automatic background alignment that guarantees repeatability over varying temperatures.

### Easy-to-use

#### Verify and troubleshoot your design efficiently:

- One-button phase noise measurements to save your time for setting up the instrument.
- One-button, built-in power measurement suites enables quick and accurate power-related evaluation for 2G/3G comms applications.
- Built-in help key for quick reference with out manuals.

### Upgradeable

#### Ready for other applications:

- Versatile card-cage architecture for hardware expansion.
- Instrument firmware and software upgrades available over the Web.

### Flexible

#### Include just the options that you need now or in the future:

- GSM/GPRS, cdmaOne and Bluetooth measurement personalities are three of many available.
- Over 30 hardware options also available.

### PC connected

#### Speed measurement data analysis and enable remote instrument control:

- Industry standard SCPI instrument language for remote control.
- GPIB (Option A4H), RS-232 (Option 1AX) interface available.

### Fast

#### Finish your job quicker:

- Five-minute instrument warm-up for full accuracy.
- Quick phase noise measurement set-ups.
- Phase noise measurements made 4x faster than its preceding version (Option 226, version A)

### Portable

#### Sophisticated measurement performance anywhere:

- Rugged case, water resistant front panel.
- Snap-on battery (E1779A) or 12 Vdc adapter (Option A5D).
- Carrying/operating case (Option AYT/AYU).

# Phase noise measurements

The Agilent ESA-E series spectrum analyzer with built-in phase noise measurement personality provides you tools to help you characterize phase noise behavior of your design and troubleshoot problems.

## Log plot phase noise (frequency domain)

- View entire phase noise behavior across 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 user-specified number of averages.
- Perform trace smoothing with user-adjustable smoothing segment length.

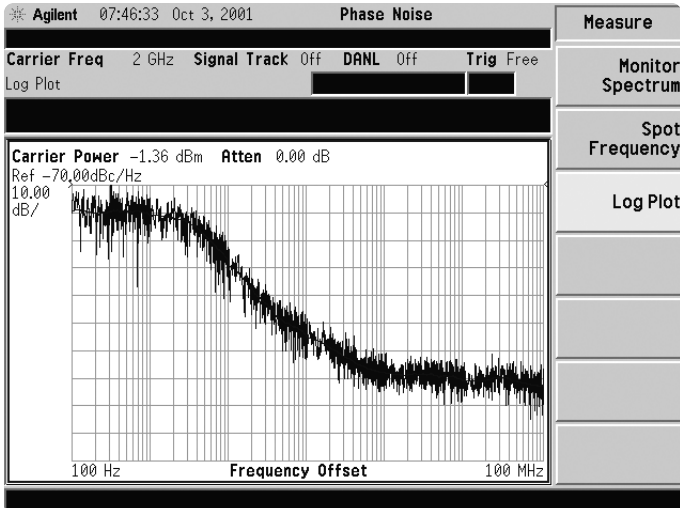


Figure 1. Log plot phase noise: averaged data superimposed with a smoothed trace

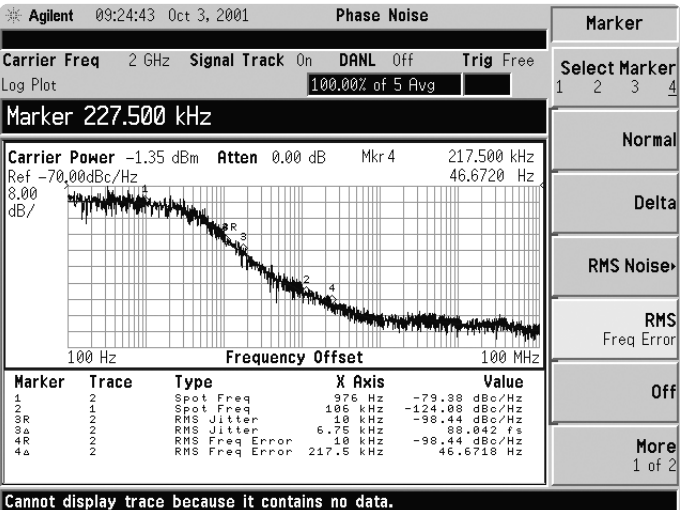


Figure 2. Log plot phase noise with marker table showing different types of measurement results

- A suite of comprehensive ESA marker functions.
- Automatic carrier search.
- Multi-level video filtering.
- Single and continuous measurements.

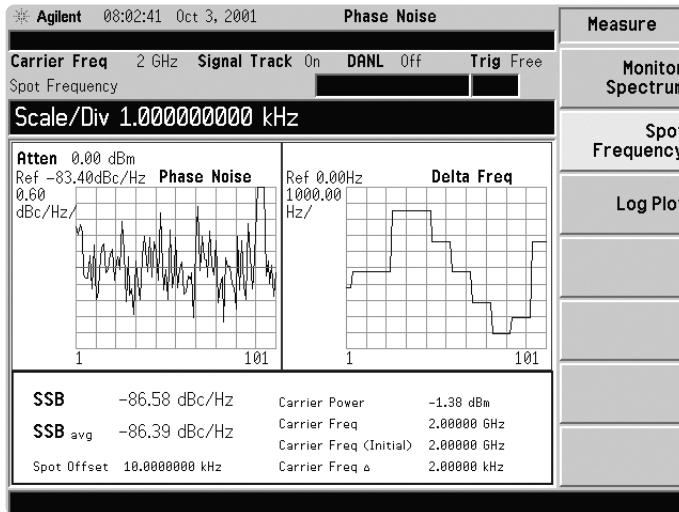


Figure 3. Phase noise at a single offset frequency and carrier drifting (the right panel)

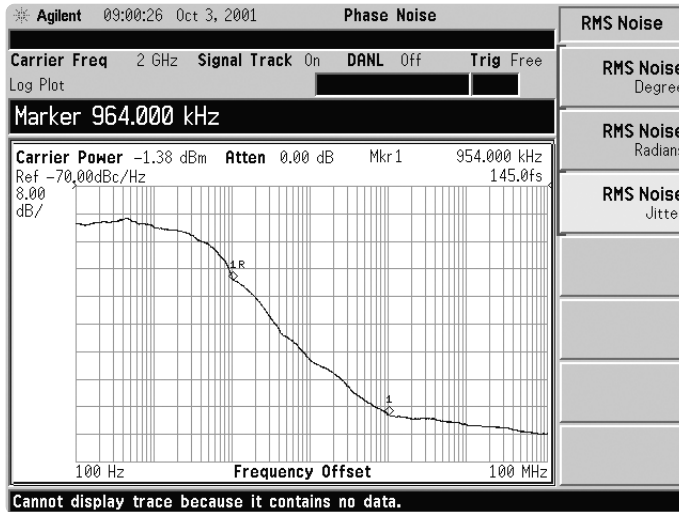


Figure 4. rms phase jitter in seconds calculated between two markers

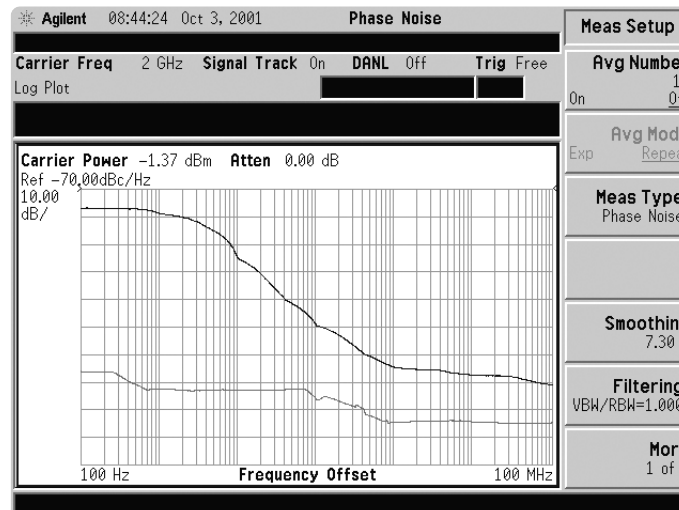


Figure 5. Log plot phase noise displayed with an optimized DANL floor (the lower trace)

## 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).
- Check carrier frequency drifting with carrier signal tracking.
- Automatic carrier search.
- View results in graphic and numeric list formats.

## Integrated noise measurements

- Characterize phase noise related behaviors from different angles for various applications.
- Adjust integration interval by positioning a pair of markers on the log plot.
- Calculate rms phase deviation (or residual PM) in degrees or radians
- calculate rms phase jitter in seconds.
- Calculate the residual FM in Hz.
- Numeric marker readings for the calculated results.

## DANL optimization and the DANL floor measurement

- Optimize the ESA input attenuation levels at different offset frequency segments for the best measurement sensitivity.
- Measure and reference the DANL of the ESA to the carrier amplitude.
- Display the DANL curve together with the log plot phase noise.
- Easy trace management.

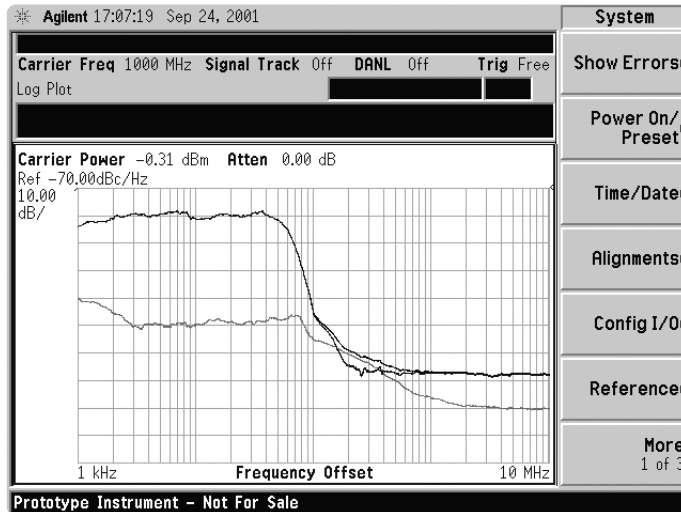


Figure 6. Display of the internal phase noise (the lower trace), the manifested and the corrected phase noise of the signal under test (the upper and the middle trace, respectively)

## Phase noise cancellation

- Measure the ESA's internal phase noise using a source with low phase noise.
- Eliminate the influence of the ESA's internal phase noise on measurement results.
- Improve measurement accuracy and sensitivity.
- Make the best trade-off between cancellation effectiveness and computation time with user-selectable thresholds.

## Here is how you order your ESA-E spectrum analyzer

First, choose your frequency range.

E4401B	9 kHz* to 1.5 GHz
E4402B	9 kHz** to 3.0 GHz
E4404B	9 kHz** to 6.7 GHz
E4405B	9 kHz** to 13.2 GHz
E4407B	9 kHz** to 26.5 GHz

Now, choose your option configuration.

### ESA-E series spectrum analyzer plus options:

**226** – Phase noise measurement personality (Version B)

**B72** – Memory extension

Recommended options:

**1DR**† – Narrow resolution bandwidth

**1D5**†† - High stability frequency reference

\*: 1 MHz for analyzers with Option 1DP, 75 Ohm Input Impedance

\*\*: 100 Hz for analyzers with Option UKB, 100 Hz Low Frequency Extension

†: Required if the minimum offset frequency to be measured is 100 Hz.

††: Required with 1DR if the minimum offset frequency to be measured is 10 Hz.

# Specification summary

## Phase noise measurement personality

<b>Measurement modes:</b>	spectrum monitor log plot spot frequency
<b>Carrier frequency range:</b>	
E4401B	1 MHz* to 1.5 GHz
E4402B	1 MHz* to 3.0 GHz
E4404B	1 MHz* to 6.7 GHz
E4405B	1 MHz* to 13.2 GHz
E4407B	1 MHz* to 26.5 GHz
<b>Offset frequency range</b>	
Minimum offset frequency	
With Options 1DR and 1D5	10 Hz
With Option 1DR only	100 Hz
Without Option 1DR	10 kHz
<b>Maximum offset frequency</b>	100 MHz
<b>Maximum number of decades</b>	Seven (whole decades only)
<b>Maximum input signal level</b>	20 dBm
<b>Minimum input signal level</b> (for optimum dynamic range)	-50 dBm
<b>Measurement accuracy (nominal)</b>	
Amplitude accuracy	< ±1.52 dB (RSS value, based upon a 1 GHz, 0dBm signal while running the Log Plot measurement, with all other instrument settings at their factory defaults)
<b>Amplitude repeatability</b>	0.44 dB (with 0.3 VBW/RBW, 4% smoothing. The measurements were made at 100 kHz offset frequency for a 1 GHz, 0 dbm signal)
<b>Video filtering</b>	four levels available
<b>Smoothing</b>	fine-adjustable between 0% and 16%
<b>rms noise calculation</b>	rms phase deviation, rms phase jitter, and residual FM is calculated over a user specified integration interval.

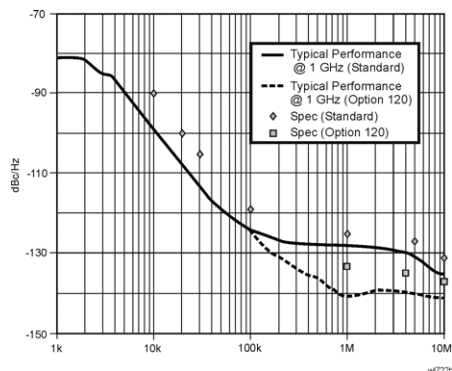


Figure 7. System phase noise

\* The phase noise measurement performances are not specified for a carrier signal with its center frequency being lower than 1 MHz.

## Product literature

*ESA-E Series Spectrum Analyzers*,  
Brochure, literature number  
5968-3278E

*ESA-E Series Spectrum Analyzers*,  
Technical Specifications, literature  
number 5968-3386E

*Select the Right Spectrum Analyzer  
for Your Needs*, Selection Guide,  
literature number 5968-3413E

*ESA Snap-on Battery Pack*, Product  
Overview, literature number  
5966-1851E

*Intuilink Software*, Data Sheet,  
literature number 5980-3115EN

### For further information

For the latest news, product, and literature and support information, application literature and more, visit our Web page at:

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

### 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 and measurement needs

### Online assistance:

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

Phone or Fax  
**United States:**  
(tel) 1 800 452 4844

**Canada:**  
(tel) 1 877 894 4414  
(fax) (905) 282-6495

**China:**  
(tel) 800-810-0189  
(fax) 1-0800-650-0121

**Europe:**  
(tel) (31 20) 547 2323  
(fax) (31 20) 547 2390

**Japan:**  
(tel) (81) 426 56 7832  
(fax) (81) 426 56 7840

**Korea:**(tel) (82-2) 2004-5004  
(fax) (82-2) 2004-5115

**Latin America:**  
(tel) (305) 269 7500  
(fax) (305) 269 7599

**Taiwan:**  
(tel) 080-004-7866  
(fax) (886-2) 2545-6723

**Other Asia Pacific  
Countries:**  
(tel) (65) 375-8100  
(fax) (65) 836-0252  
Email: [tm\\_asia@agilent.com](mailto:tm_asia@agilent.com)

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

© Agilent Technologies, Inc. 2001  
Printed in USA, November 01, 2001  
5988-4348EN



**Agilent Technologies**