

E5500 Series Phase Noise Measurement Solutions

With over 35 years of low phase noise, RF design, and measurement experience, Keysight solutions provide excellent measurement integrity, repeatability, and accuracy.

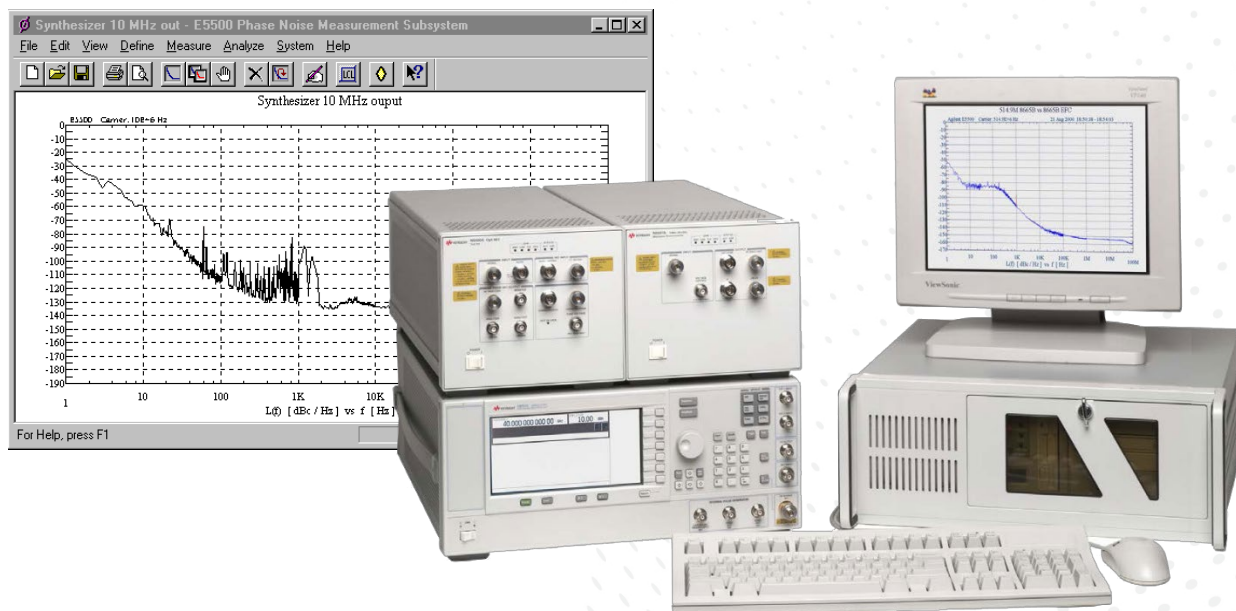


Table of Contents

| | |
|--|----|
| Model E5505A Configurations | 03 |
| Keysight E5500 Theory of Operation | 04 |
| Widest Measurement Coverage | 05 |
| Most Flexible Measurement Solution..... | 06 |
| Easiest Integration into the Production ATE Environment..... | 08 |
| Powerful Phase Noise Measurement Software..... | 10 |
| Measurement Expertise and Leadership | 12 |
| Keysight E5500 Solution Configuration | 13 |
| Specifications | 14 |
| Keysight N5500A (Included in all E5500 Systems) Specification Summary..... | 16 |
| Keysight N5500A Specification Summary | 17 |
| N5500A–001 AM Performance Summary | 18 |
| Keysight N5502A (Optional in E5500 Systems) Specification Summary | 19 |
| Keysight N5507A (Optional in E5500 Systems) Specification Summary | 20 |
| Keysight N5501A Specification Summary..... | 22 |

Model E5505A Configurations

| Carrier Frequency Ranges | Offset Frequency Ranges |
|--------------------------|-------------------------|
| 50 kHz to 18 GHz | 0.01 Hz to 2 MHz |
| 50 kHz to 26.5 GHz | 0.01 Hz to 100 MHz |

- Flexible set of measurements and configurations, widest offset range, and best reputation for the R&D workbench or production floor
- Measurements on one-port VCOs, DROs, crystal oscillators, and synthesizers and on two-port devices, including amplifiers and converters, plus CW, pulsed and spurious signals
- Absolute and residual phase noise, AM noise, and low level spurious signals
- Easy configuration for various measurement techniques, including PLL/reference source, residual and FM discriminator methods
- Wide offset range capability, from 0.01 Hz to 100 MHz
- Architecture combines standard instruments, phase noise components, and PC software flexibly, allowing reuse of assets (proprietary architectures are less flexible because the reference sources and analyzers selected can limit phase noise measurements)
- E5500 software enables many standalone instruments to work together within a system



Keysight E5500 Theory of Operation

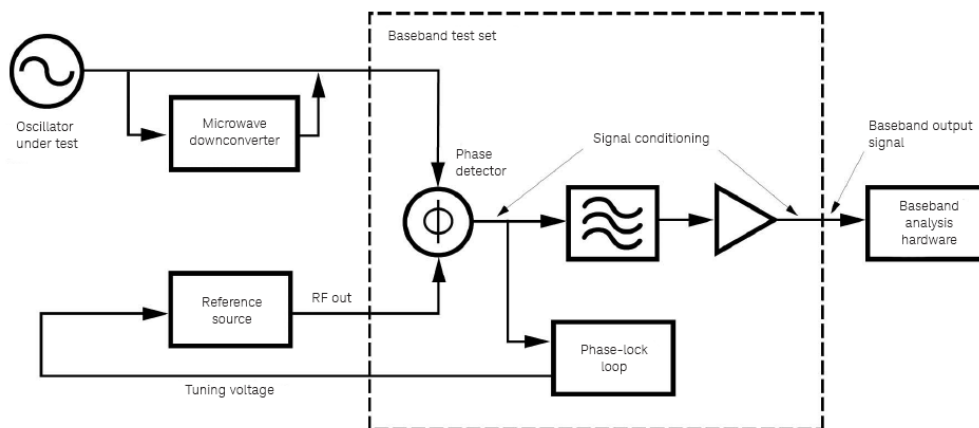
The “phase detector with reference source” technique is the most general-purpose and cost-effective measurement approach to measure the single sideband (SSB) phase noise characteristic of oscillators. This technique demodulates the noise sidebands of the device-under-test (DUT) oscillator to a baseband signal for a fast, easy measurement using off-the-shelf baseband analyzers.

With the reference source and the DUT in steady state quadrature, the phase detector generates a baseband signal proportional to the phase difference of the two sources. When the noise characteristics of the reference source signal are less than the DUT signal noise characteristics, the resulting baseband noise signal is effectively that of the DUT.

A narrow-band phase-lock-loop forces the two-phase detector input signals into quadrature and allows the reference source to track DUT frequency drift for drift rates within the loop bandwidth. Noise fluctuations within the loop bandwidth are suppressed by the operation of the phase-lock-loop. This suppression effect can be independently measured, and the noise data corrected automatically by the measurement software. Noise fluctuations outside of the phase-lock-loop bandwidth are unaffected.

When the oscillator-under-test has a frequency output in the microwave frequency range, it is difficult to find suitable, low noise, microwave frequency sources to use as the necessary reference signal. In this case, the solution is to use a low-noise downconverter to translate the DUT microwave output frequency to a lower RF/IF frequency, allowing the use of the same low-noise RF reference sources described previously.

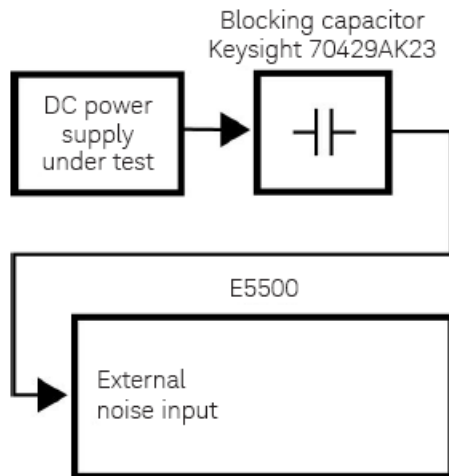
The phase noise of the RF reference or the microwave downconverter usually dominates the effective noise floor of this phase noise measurement. The noise contribution of the baseband test set is much lower than either and typically does not factor into the overall measurement noise floor.



Simplified phase noise measurement diagram

Widest Measurement Coverage

The E5500 has been tailored to meet the extensive needs of engineers, providing the most flexible and best measurements at the lowest possible cost. The modular instrument architecture takes advantage of standalone instrumentation for superior frequency offset range, broadest capability, best sensitivity, and excellent overall value for phase noise measurements. The E5500's low internal noise floor and measurement flexibility let you measure a wide variety of devices with one system.



Measuring noise using the external noise input port

Ability to test a wide range of devices

The E5500 Series measures the absolute, single sideband phase noise, the absolute AM noise, and the low level spurious signals of a wide range of one-port production devices with either CW or pulsed carrier signals:

- VCOs, DROs, and fixed oscillators
- Crystal oscillators and clocks
- High frequency synthesizers
- Low noise DC supplies

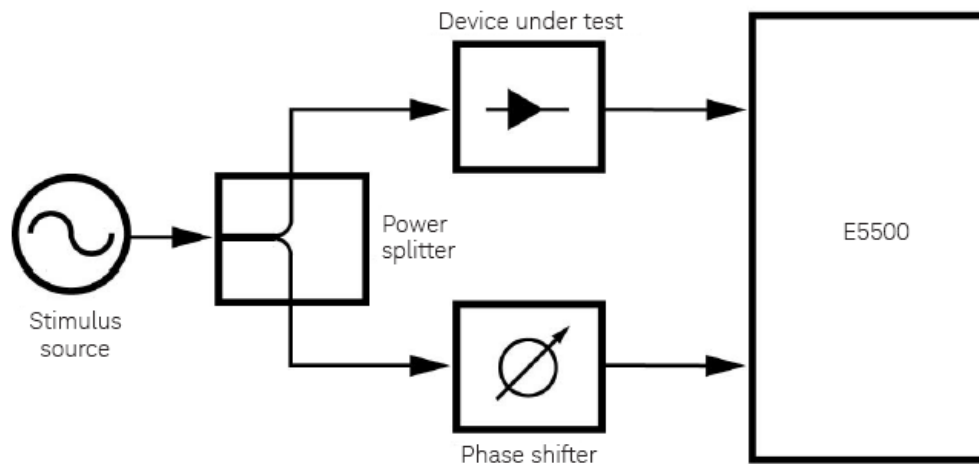
Measure AM noise directly

The E5500 Series can automatically measure the AM noise of RF and microwave devices. The internal AM detector and DC blocking filter provided within Keysight's N5500A-001 measures AM noise on carriers up to 26.5 GHz. AM noise of millimeter frequency devices can be measured with an external AM detector.

Additive noise measurements to two-port devices

The E5500 Series also measures the residual (additive) phase noise, AM noise, and low level spurious signals of two-port production devices with either CW or pulsed carrier signals:

- High power amplifiers
- Frequency dividers
- Frequency multipliers
- Mixers



Residual noise measurement of a two-port device

Most Flexible Measurement Solution

Superior frequency offset range

The E5500 comes standard with the capability to measure from 0.01 Hz to 2 MHz of offset range directly, or optionally measure offset ranges to 100 MHz and beyond. The wide offset range provides engineers with more information on the test device's performance close-to-carrier and far-from carrier. The E5500 provides complete 0.01 Hz to 100 MHz offset range measurement capability without the need for additional baseband analysis hardware. A PC digitizer, along with an optional broadband RF signal/spectrum analyzer, provides not only a complete phase noise measurement solution, but the signal/spectrum analyzer can also be used for many other independent R&D measurement functions. All of this for a price you might expect to pay for other, more limited, measurement solutions.

Handles carrier frequencies to 26.5 GHz

The E5500 solutions can include a low noise down-converter optimized for their respective frequency ranges. For example, the 18-GHz down-converter has a minimum input frequency of 1 GHz allowing you to select an RF reference source with a maximum output frequency of 1 GHz. This optimization helps reduce the total solution costs for

phase noise measurements because standalone low frequency signal sources are lower cost components. The addition of low-noise RF reference sources and microwave down-converters provide a complete phase noise measurement solution for a wide range of IF, RF, microwave, and millimeter frequency oscillators. Some low noise measurements could be configured with the N5500A phase noise test set's optional 26.5 GHz input. This requires a low noise microwave reference source because the E5500 does not down convert the signal.

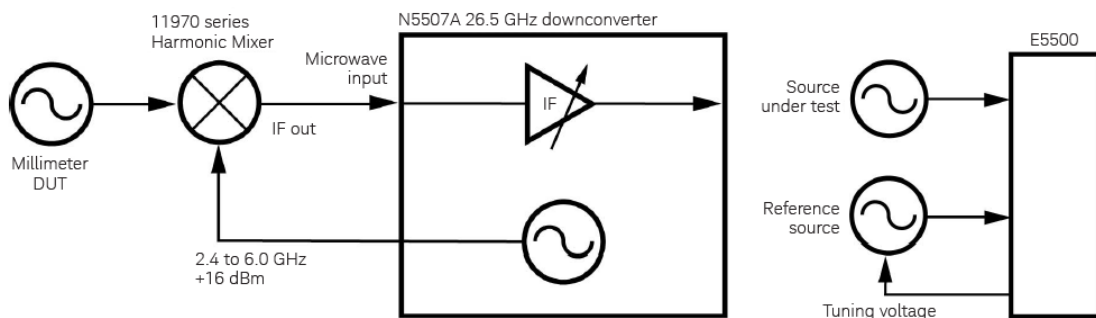
Expand carrier frequencies to 110 GHz

For absolute measurement of phase noise in the millimeter frequency bands, add the appropriate 11970 Series millimeter harmonic mixers to the E5500 solution with the 26.5-GHz microwave down-converter. The down-converter provides the high power, direct LO drive necessary to down-convert millimeter signals. The 45-dB variable gain IF amplifier is available to amplify the IF output of the harmonic mixer. The down-converter can also supply the DC bias to the harmonic mixer if appropriate.

Wide choice of reference sources

The E5500 offers a wide choice of low noise reference sources because this system component is critical to the overall phase noise measurement performance. One reference source might be needed to measure the best close-to-carrier phase noise and another reference could easily be used for the best far from carrier phase noise measurements. Unlike proprietary architectures that limit your choice to one or two reference sources, the E5500 offers numerous reference sources to fit your application. These standalone instruments will provide the best value and are easily reused on your bench or in your ATE systems.

The E5500 phase noise test set and downconverters have an internal noise floor well below the noise of most reference sources and do not require special phase detectors to lower the noise floor further. For situations where standard RF signal generators may not offer sufficient measurement sensitivity, the E5500 series can use any voltage tuneable source as a reference source. For example, the N5508A is an ultra-low-noise fixed frequency source that has a tunable option.



Left side: Block diagram for coverage up to 110 GHz. Right side: Use off-the-shelf RF signal generators or your own low-noise source as the reference source.

Easiest Integration into the Production ATE Environment

The E5500 Series of phase noise measurement solutions is tailored to meet the demanding needs of production ATE. With test times of less than 3 seconds (1 kHz to 100 kHz) and less than 30 seconds (10 Hz to 1 MHz) achievable, the E5500 Series meets the high throughput and over-all, low cost-offset needs for today's higher volume devices.

Key features for ATE are:

- Quick and easy integration into existing ATE systems using standard instruments and SCPI programming
- “Just-enough” measurement performance because of E5500 configuration flexibility
- Lowest overall cost of measurement by using standalone instruments likely to be included in your ATE system

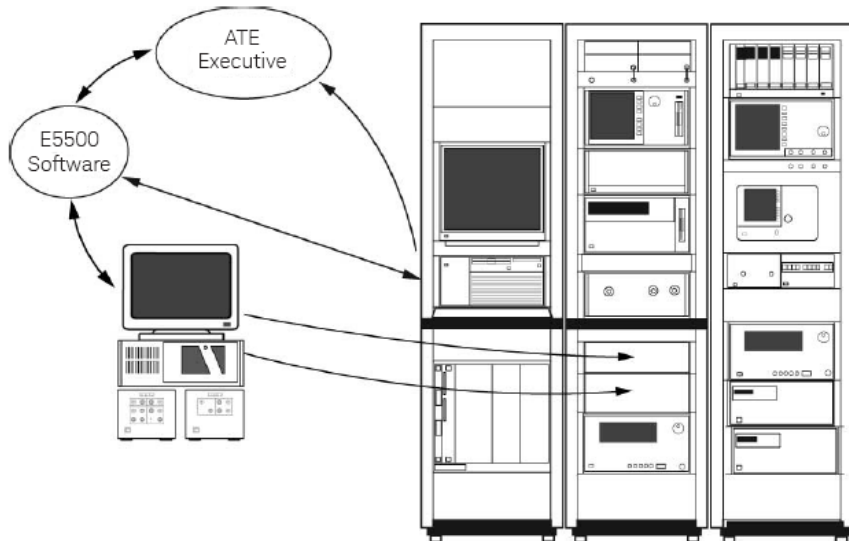
A configuration for ATE consists of a low noise baseband test set, a PC digitizer for baseband signal measurement, and measurement software. The baseband test set provides all the phase detectors, amplifiers, filters, switches, and attenuators necessary to measure phase noise over the IF, RF, and microwave frequency ranges directly. The PC digitizer samples the baseband noise signal and sends the digitized data to the measurement software for fast digital signal processing. The measurement software provides all the operator interaction, measurement coordination, calibration, data signal processing, and data results. The remote (SCPI) standard commands programmable instruments programming interface client provides quick and easy integration into new and existing production test environments.

Quick and easy integration into your ATE system

With a completely defined, industry standard SCPI programming interface client, the E5500 Series can be quickly and easily integrated into your specific ATE computing environment. If you choose to configure an E5500 Series solution to run on a separate computer, initiate a measurement over LAN or GPIB using the standard, remote, phase noise SCPI command language. Full measurement system control, including capturing measurement data, is included. If your production ATE computing environment runs under Windows, a separate computer is not necessary. Simply initiate a measurement using the multitasking capability and the remote SCPI interface to communicate with the E5500 series measurement software running concurrently on your ATE computer. Data is available in two ASCII formats: a spread sheet format and an XY graph format. Other data translators can be specified and provided.

Software summary

- Modular, object oriented, client/server architecture
- Windows-compliant graphical user interface and operating system
- Industry standard SCPI programming language
- Standard ASCII data formats



Integrating an Keysight E5500 solution into a production test environment.

A simple SCPI programming example:

```

SENSe:NOISe:MEASType ABSolute
CARRier:FREQuency:FIXed 10 MHz
REFerence:FREQuency:FIXed 10 MHz
SENSe:DETector:FREQuency 10 MHz
SENSe:DETector LFRequenc
SENSe:RANGe:OFFSet 10 Hz, 10 MHz
SENSe:RANGe:SEGTable:MEASurement:QUALity FAST
DISPlay GRAPh:TRANSform SSBNoise
INITiate:CALibrate
TTOTAL?
*WAI
*STB?
CALCulate:VIEW:XYDATA
CALCulate:DATA:HEADer: POINTs?
CALCulate:DATA?

```

Powerful Phase Noise Measurement Software

The Windows-compliant graphical-user interface of the E5500 system provides instant access to all measurement functions making it easy to configure a system, define or initiate measurements, and analyze data. The main icons are always displayed, allowing you simple and quick access to measurement information. The forms-based graphical interaction helps you define your measurement quickly and easily.

Easy set up for measurements

Each form tab is labeled with its content, preventing you from getting lost in the define and configure process. To obtain a quick look at the measurement data, select the “fast” quality level. If more frequency resolution to separate spurious signals is important, select the “high resolution” quality level. And if you need to customize the offset range beyond the defaults provided, tailor the measurement segment tables to meet your needs and save them as a “custom” selection. You can also place markers on the data trace. Select the marker icon and add up to nine data markers that can be placed and plotted with the measured data. Other features include:

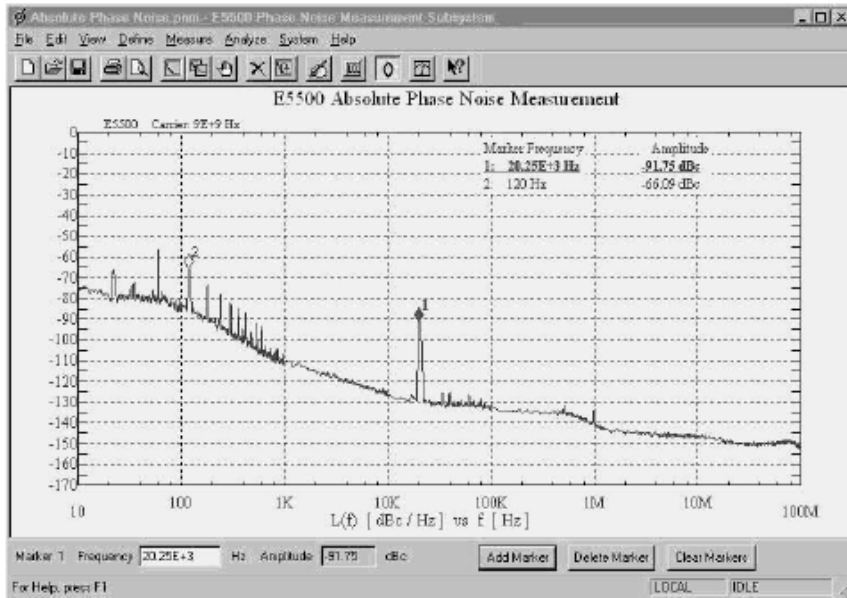
- Plotting data without spurs
- Tabular listing of spurs
- Plotting in alternate bandwidths
- Parameter summary
- Plotting several different measurements on the same displayed graph
- Color printouts to any supported color printer

Real-time monitoring of time and frequency noise data

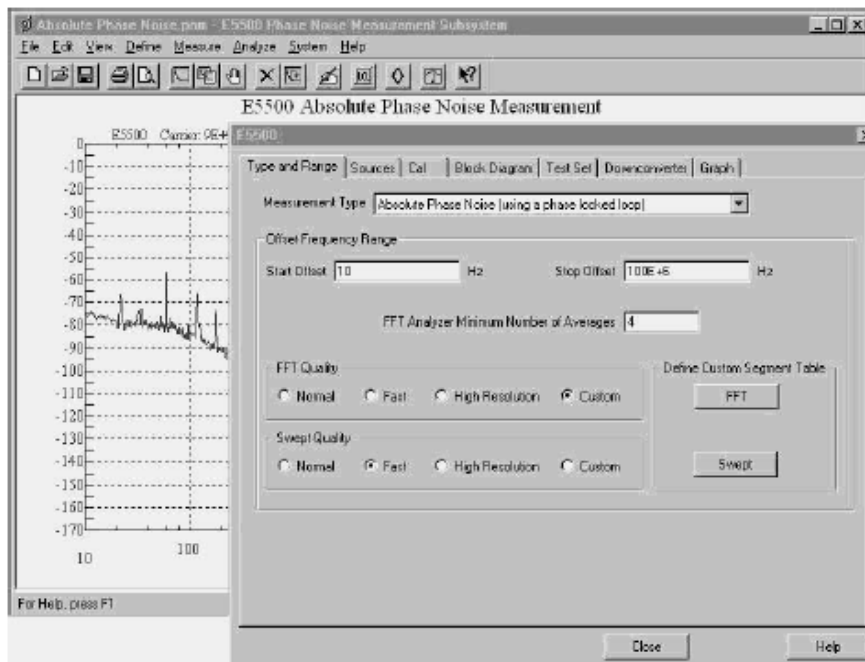
Real-time monitoring of the noise signal is fast and easy. Choose the real-time monitor measurement mode, define the offset range you wish to view, and select the appropriate baseband analyzer role control panel. These role control panels can also be used for measurement troubleshooting when measuring complex devices, direct manual control of reference sources, test set, or downconverters, and test development.

Share real-time data and results with other users

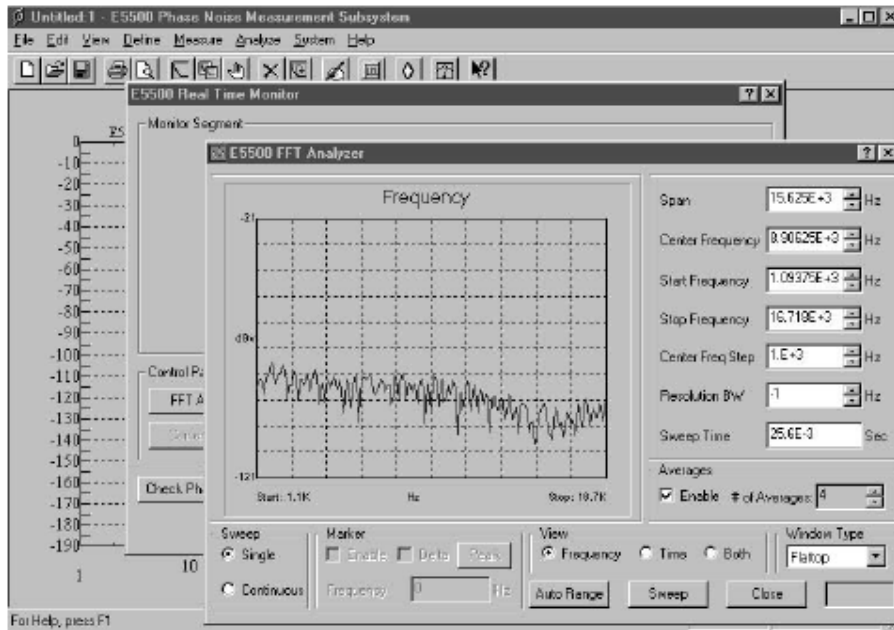
Users operating other computers can view your measurements directly through the E5500 Series software client-server structure. The software allows multiple GUI client connections even when those GUI clients are located on other computers. Being connected remotely allows users the opportunity to evaluate measurement results and configurations in real time.



Place markers directly on the measured data.



Easy-to-use forms allow fast and easy measurement configuring.



Real-time view of baseband FFT analysis can show both time domain and frequency domain data

Measurement Expertise and Leadership

The E5500 Series provides the kind of measurement integrity and leadership that you have come to expect from Keysight Technologies. The new software design provides exceptional flexibility, measurement integrity, and low overall cost-of-measurement. The new dedicated hardware modules provide improved measurement range, proven reliability, and excellent repeatability.

Worldwide application services and hardware support

Keysight has a complete, worldwide support services structure in place, providing regional hardware calibration and repair and local application expertise.

Trained phase noise application engineers will provide on-site training for up to six users. The training explains all operating modes of the E5500 Series, when each measurement technique is appropriate, and how to analyze the measured data. Additional application assistance focused on measuring your specific devices is also available. Support options include worldwide service and support, on-site training, applications assistance, access to E5500 system experts, and remote access to software updates and application information.

Keysight E5500 Solution Configuration

The E5500 solutions can easily be configured to meet the needs of bench R&D or production ATE environments. They include modular hardware including specific phase noise instruments, industry-standard instruments, and Windows PC for maximum test throughput, current and future measurement flexibility, and asset reuse. These solutions can easily include specific RF reference sources, additional baseband analysis hardware, and computers for complete production phase noise measurement solutions.

The Keysight E5500 hardware includes:

- 0.01 Hz to 2 MHz PC digitizer
- N5500A baseband test set
- Optional low noise downconverter

| Operating Characteristics | Description |
|----------------------------|---|
| Offset frequency range | 0.01 Hz to 2 MHz |
| System noise response | -180 dBc/Hz typically (> 10 kHz offsets) |
| System spurious response | < -120 dBc typically |
| Phase detector input power | (< 1.6 GHz carrier frequency) R input = 0 to +23 dBm L input = +15 to +23 dBm |
| Downconverter input range | 1 GHz to 18 GHz 1.5 GHz to 26.5 GHz |
| External noise input port | 0.01 Hz to 100 MHz |
| Measurement accuracy | ±2 dB (< 1.0 MHz offsets) ±4 dB (< 100 MHz offsets) |

Optional capabilities

- Extend offset range to 100 MHz
- Add RF reference source
- Add high power input capability (includes μ W phase and AM detectors)
- Extend carrier frequency to 110 GHz
- Add remote SCPI programming client for ATE environments

Specifications

Determining overall solution performance

Measurement accuracy

Measurement of all noise and spurious present at the phase detector inputs and system contribution, provided the following conditions are met:

- Source return loss > 9.5 dB (< 2:1 VSWR)
- Source harmonic distortion < -20 dB (or square wave)
- Nonharmonic spurious < -26 dBc (except for PM close to carrier)
- Supported measurement configuration (PLL verification)
- ±2 dB for < 1.0 MHz offsets
- ±4 dB for < 100 MHz offsets

Note: Measurement accuracy applies to high-resolution mode only.

Overall phase noise measurement system sensitivity is a combination of noise contributions from the baseband test set, the RF reference source, and the microwave downconverter used and is normally dominated by either the RF reference source or the microwave downconverter:

Baseband test set noise floor + RF reference noise floor + Microwave DC noise floor

When the dominant noise contributions (RF reference and the downconverter) are close to each other, a noise floor correction factor (dB) is added to the most dominant noise contributor in order to determine overall system noise floor:

| | | | | | | | |
|------------------------------|-----|-----|-----|-----|-----|-----|---|
| Magnitude difference (dB) | 16 | 10 | 6 | 3 | 2 | 1 | 0 |
| Noise correction factor (dB) | 0.1 | 0.4 | 1.2 | 1.8 | 2.1 | 2.5 | 3 |

| Offset frequency (Hz) | Baseband TS (dBc/Hz) | RF reference (dBc/Hz) | Microwave DC (dBc/Hz) | Difference (dB) | Factor (dB) | System total (dBc/Hz) |
|-----------------------|----------------------|-----------------------|-----------------------|-----------------|-------------|-----------------------|
| 1 | | | | | | |
| 10 | | | | | | |
| 100 | | | | | | |
| 1,000 | | | | | | |
| 10,000 | | | | | | |
| 100,000 | | | | | | |
| 1 Million | | | | | | |
| 10 Million | | | | | | |
| 100 Million | | | | | | |
| | | | | | | |
| | | | | | | |

Example 1:

Offset frequency = 1 MHz

RF reference = -140 dBc/Hz

Downconverter = -140 dBc/Hz

Mag difference (dB) = 0

Noise correction factor = 3 dB

Dominant + factor = -140 + 3

Overall noise floor = -137 dBc/Hz

Example 2:

Offset frequency = 1 MHz

RF reference = -130 dBc/Hz

Downconverter = -140 dBc/Hz

Difference (dB) = 10

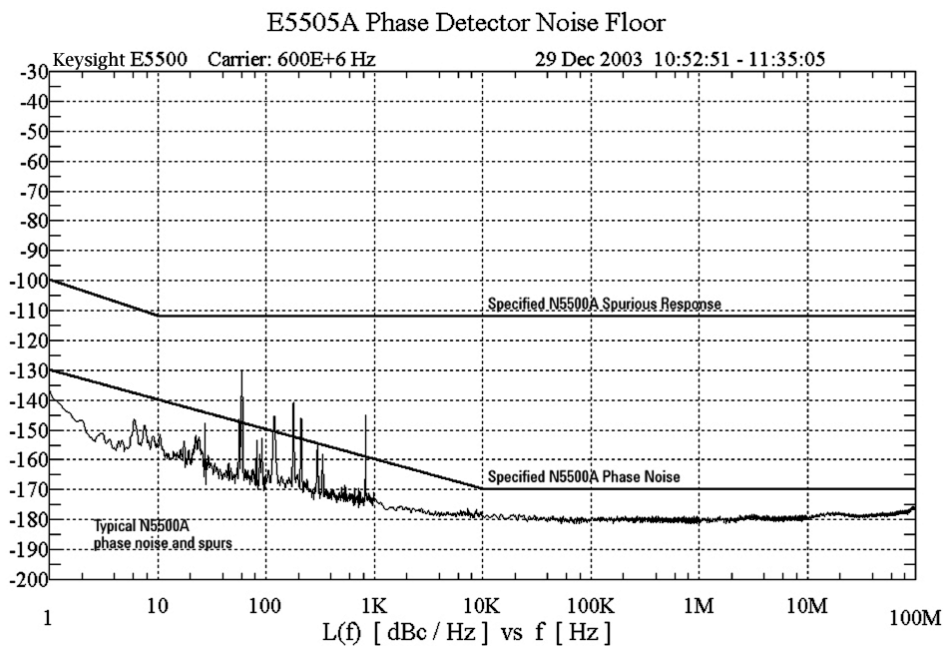
Noise factor = 0.4 dB

Dominant + factor = -130 + 0.4

Overall noise floor = -129.6 dBc/Hz

Keysight N5500A (Included in all E5500 Systems) Specification Summary

| | Low frequency inputs | Options 001 and 201 High frequency inputs | Options 001 AM noise |
|---|--|--|---|
| Carrier frequency range | 50 kHz to 1.6 GHz | 1.2 GHz to 26.5 GHz | 50 kHz to 26.5 GHz |
| R input power with Option 001 L input power | 0 dBm to +23 dBm 0 dBm to +30 dBm +15 dBm to +23 dBm | 0 dBm to +5 dBm 0 dBm to +30 dBm +7 dBm to +10 dBm | N/A 0 dBm to 30 dBm |
| Offset frequency range | | Noise input port | |
| Offset frequency | Detector input frequency | Frequency Amplitude Input impedance | 0.01 Hz to 100 MHz 1 volt peak max 50 Ω (typical), (DC coupled, RL > 9.5 dB (typical)) |
| 0.01 Hz to 20 kHz | 50 kHz to 500 kHz | | |
| 0.01 Hz to 200 kHz | 500 kHz to 5 MHz | | |
| 0.01 Hz to 2 MHz | 5 MHz to 25 MHz | | |
| 0.01 Hz to 20 MHz | 25 MHz to 250 MHz | | |
| 0.01 Hz to 100 MHz | 250 MHz to 26.5 GHz | | |
| Tuning voltage output | | Noise floor degradation | |
| Voltage range | ± 10 volts, open circuit | Degrade system noise floor 1 dB for every dB reduction in R input levels less than: | |
| Current | 20 mA, max | +15 dBm (low frequency input) | |
| Output impedance | 50 Ω , typical | +5 dBm (high frequency input) | |



Graph of typical test set noise floor from E5500 measurement software.

Keysight N5500A Specification Summary

Phase detector input ports

Residual phase noise and spurious responses

(Does not include phase noise and spurious signals from a reference source)

| Carrier frequency: 50 kHz to 1.6 GHz RF phase detector | | Carrier frequency: 1.2 GHz to 26.5 GHz Microwave phase detector Option 001 and 201 | |
|---|--------------------|---|--------------------|
| Offset frequency | System noise floor | Offset frequency | System noise floor |
| 0.01 Hz | -70 dBc/HZ | 0.01 Hz | -55 dBc/HZ |
| 1.0 Hz | -130 dBc/HZ | 1.0 Hz | -115 dBc/HZ |
| 10 kHz | -170 dBc/HZ | 32 kHz | -160 dBc/HZ |
| > 10 kHz | -170 dBc/HZ | > 32 kHz | -160 dBc/HZ |
| Offset frequency | System noise floor | Offset frequency | System noise floor |
| 0.01 Hz | -70 dBc | 0.01 Hz | -50 dBc |
| 0.1 Hz | -100 dBc | 0.1 Hz | -80 dBc |
| > 10 Hz | -112 dBc | > 10 kHz | -97 dBc |

Use the typical phase noise plot to determine specifications at other offset frequencies.

N5500A-001 AM Performance Summary

| AM noise accuracy | |
|---|--------------------------|
| For frequencies from 250 MHz to 26.5 GHz when using “internal automatic self-calibration” | |
| +3 dB | 0.01 Hz to 1 MHz offsets |
| +5 dB | 1 to 100 MHz offsets |
| For frequencies from 50 kHz to 26.5 GHz when using single- or double-sided spur calibration | |
| +2 dB | 0.01 Hz to 1 MHz offsets |
| +4 dB | 1 to 100 MHz offsets |
| AM detector noise floor | |
| (Tested at 600 MHz, input signal +10 to +20 dBm) | |

| Offset from Carrier (Hz) | AM Noise (dBc/Hz) | | | | | | | | | Spurious (dBc) | | |
|--------------------------|-------------------|------|------|------|------|------|------|------|------|----------------|-----|------|
| | 10 | 100 | 1k | 10k | 50k | 100k | 1M | 10M | 100M | 10 | 1k | 100M |
| Typical | -112 | -122 | -132 | -147 | -156 | -157 | -157 | -157 | -157 | -72 | -92 | -92 |
| Specifications | -105 | -115 | -125 | -140 | -149 | -150 | -150 | -150 | -150 | -65 | -85 | -85 |

General specifications

Operating temperature range: +0 °C to +55 °C

Warm-up time: 20 minutes

General considerations: The N5500A has low susceptibility to RFI and mechanical vibration. Care must be exercised however in making measurements in high RFI or vibration environments as spurious signals may be induced in the module.

Keysight N5502A (Optional in E5500 Systems) Specification Summary

| | |
|--|--|
| RF input | 1.0 GHz to 18 GHz (18 GHz to 20 GHz typical over range) |
| Input power | +15 dBm max 5 dBm min up to 12 GHz 10 dBm min 12 to 18 GHz |
| LO resolution | 600 MHz (1.8 GHz to 18 GHz) |
| IF output IF output power IF gain | 5 MHz to 1.2 GHz 0 to +5 dBm 0 to 45 dB (5 dB steps) |
| Mixing spurious < 6 GHz > 6 GHz | (-5 dBm at mixer) -50 dBc (except as noted) -70 dBc |

| Carrier frequency range (GHz) where a mixing spur will occur; < 40 MHz from carrier | Typical spurious (dBc) | |
|--|--|------------|
| 1.566 to 1.634, 1.060 to 1.200, 1.325 to 1.375, 1.775 to 1.825 | 1.166 to 1.234 1.274 to 1.303 1.420 to 1.460 | -10 |
| 1.013 to 1.043, 1.900 to 1.940, 1.112 to 1.138, 1.983 to 2.017, 2.483 to 2.517, 3.583 to 3.617 | 1.250 to 1.043 2.225 to 2.275 1.483 to 1.517 2.380 to 2.420 2.975 to 3.025 | -30 |
| 2.556 to 2.586, 3.071 to 3.101, 4.785 to 4.815, 3.580 to 3.620, 4.099 to 4.129, 2.042 to 2.072, | 2.983 to 3.017 2.860 to 2.900 4.183 to 4.217 1.487 to 1.513 3.483 to 3.517 2.087 to 2.113 | -50 -60 |

| Downconverter Noise Floor (all oscillators locked) | | | | | | | | | | | | |
|--|------|--------------------------|-----|-----|------|------|------|------|------|------|----------------|------|
| Input Frequency | | Offset from carrier (Hz) | | | | | | | | | Spurious (dBc) | |
| | | 1 | 10 | 100 | 1k | 10k | 100k | 1M | 10M | 100M | < 1k | > 1k |
| 1.0 to 3.0 GHz | Typ | -50 | -80 | -97 | -125 | -137 | -143 | -145 | -145 | -145 | -60 | -75 |
| | spec | -45 | -75 | -92 | -120 | -132 | -138 | -140 | -140 | -140 | -50 | -65 |
| 3.0 to 6.6 GHz | Typ | -44 | -74 | -91 | -119 | -131 | -143 | -145 | -145 | -145 | -50 | -80 |
| | spec | -39 | -69 | -86 | -114 | -126 | -138 | -140 | -140 | -140 | -44 | -70 |
| 6.0 to 12.0 GHz | Typ | -38 | -68 | -85 | -113 | -125 | -140 | -140 | -140 | -140 | -50 | -80 |
| | spec | -33 | -64 | -81 | -108 | -120 | -135 | -135 | -135 | -135 | -40 | -70 |
| 12.0 to 18.0 GHz | Typ | -34 | -64 | -81 | -109 | -121 | -131 | -131 | -131 | -131 | -47 | -70 |
| | spec | -29 | -59 | -76 | -104 | -116 | -126 | -126 | -126 | -126 | -37 | -60 |

General specifications

Operating temperature range: +0 °C to +55 °C

Warm-up time: 20 minutes

General considerations: The N5502A has low susceptibility to RFI and mechanical vibration. Care must be exercised however in making measurements in high RFI or vibration environments as spurious signals may be induced in the module.

Keysight N5507A (Optional in E5500 Systems) Specification Summary

| | |
|---|--|
| RF input Input power | 1.5 GHz to 26.5 GHz +30 dBm max -30 dBm min |
| LO resolution | 600 MHz (2.4 GHz to 25.8 GHz) |
| LO output power | 0 to +16 dBm (2.4 to 6.6 GHz) 0 to +10 dBm (7.2 to 25.8 GHz) |
| IF output IF output power IF gain | 5 MHz to 1.2 GHz 0 to +5 dBm (> -30 dBm input) 0 to 45 dB (5 dB steps) |
| Mixing spurious < 6 GHz > 6 GHz | (-5 dBm at mixer) -50 dBc (except as noted) -70 dBc |

| Carrier frequency range (GHz) where a mixing spur will occur; < 40 MHz from carrier | Typical spurious (dBc) |
|--|------------------------|
| 1.586 to 1.614 | -20 |
| 1.790 to 1.81, 1.912 to 1.928 2.392 to 2.408, 2.872 to 2.888, 2.990 to 3.000 | -30 |
| 1.708 to 1.720, 1.993 to 2.007, 2.240 to 2.260 2.493 to 2.507, 2.737 to 2.749, 3.592 to 3.600 | -40 |
| 2.051 to 2.063, 2.095 to 2.100, 2.565 to 2.578 2.793 to 2.807, 3.000 to 3.007, 3.080 to 3.092 3.493 to 3.507, 4.108 to 4.120, 4.193 to 4.200 | -50 |

| Input Frequency | | 1 | 10 | 100 | 1k | 10k | 100k | 1M | 10M | 40M | 10 to 100 | ≥1k |
|---|------|-----|-----|------|------|------|------|------|------|------|-----------|-----|
| 1.5 to 3.0 GHz | Typ | -50 | -80 | -100 | -124 | -135 | -145 | -145 | -145 | -145 | -60 | -80 |
| | spec | -45 | -75 | -95 | -120 | -131 | -100 | -100 | -100 | -100 | -50 | -65 |
| 3.0 to 4.2 GHz | Typ | -47 | -77 | -97 | -121 | -132 | -146 | -147 | -147 | -147 | -54 | -80 |
| | spec | -42 | -72 | -92 | -117 | -128 | -141 | -142 | -142 | -142 | -44 | -70 |
| 4.2 to 6.0 GHz | Typ | -44 | -74 | -94 | -118 | -130 | -144 | -145 | -145 | -145 | -54 | -80 |
| | spec | -39 | -69 | -89 | -114 | -126 | -139 | -140 | -140 | -140 | -44 | -70 |
| 6.0 to 7.8 GHz | Typ | -42 | -72 | -92 | -116 | -128 | -143 | -147 | -147 | -147 | -54 | -80 |
| | spec | -37 | -67 | -87 | -112 | -124 | -138 | -142 | -142 | -142 | -44 | -70 |
| 7.8 to 10.2 GHz | Typ | -40 | -70 | -90 | -114 | -126 | -141 | -145 | -145 | -145 | -50 | -80 |
| | spec | -35 | -65 | -85 | -110 | -122 | -136 | -140 | -140 | -140 | -40 | -70 |
| 10.2 to 12.6 GHz | Typ | -38 | -68 | -88 | -112 | -124 | -140 | -143 | -143 | -143 | -50 | -80 |
| | spec | -33 | -63 | -83 | -108 | -120 | -135 | -138 | -138 | -138 | -40 | -70 |
| 12.6 to 18.0 GHz | Typ | -35 | -65 | -85 | -109 | -121 | -137 | -140 | -140 | -140 | -47 | -70 |
| | spec | -30 | -60 | -80 | -105 | -117 | -132 | -135 | -135 | -135 | -37 | -60 |
| 18.0 to 26.5 GHz | Typ | -32 | -62 | -82 | -106 | -118 | -130 | -130 | -130 | -130 | -44 | -65 |
| | spec | -27 | -57 | -77 | -102 | -114 | -125 | -125 | -125 | -125 | -34 | -55 |
| mm bands (when adding the 11970 series harmonic mixers) | | | | | | | | | | | | |
| 18.0 to 26.5 GHz | Typ | -26 | -56 | -76 | -104 | -116 | -128 | -130 | -131 | -131 | -54 | -80 |
| | spec | -26 | -56 | -76 | -104 | -116 | -128 | -130 | -131 | -131 | -44 | -70 |
| 18.0 to 26.5 GHz | Typ | -23 | -53 | -73 | -101 | -113 | -125 | -127 | -128 | -128 | -50 | -80 |
| | spec | -23 | -53 | -73 | -101 | -113 | -128 | -127 | -128 | -128 | -40 | -70 |
| 18.0 to 26.5 GHz | Typ | -20 | -50 | -70 | -97 | -109 | -120 | -122 | -122 | -122 | -47 | -70 |
| | spec | -20 | -50 | -70 | -97 | -109 | -120 | -122 | -122 | -122 | -47 | -70 |

General specifications

Operating temperature range: +0 °C to +55 °C

Warm-up time: 20 minutes

General considerations: The N5507A has low susceptibility to RFI and mechanical vibration. Care must be exercised however in making measurements in high RFI or vibration environments as spurious signals may be induced in the module.

Keysight N5501A¹ Specification Summary

| | | |
|--|---|------------------------|
| RF input Input power | 1.0 GHz to 6.6 GHz +15 dBm max 5 dBm min | |
| LO resolution | 600 MHz (1.8 GHz to 6.0 GHz) | |
| IF output IF output power IF gain | 5 MHz to 1.2 GHz 0 to +5 dBm 0 to 45 dB (5 dB steps) | |
| Mixing spurious < 6 GHz > 6 GHz | (-5 dBm at mixer) -50 dBc (except as noted below) -70 dBc | |
| Carrier frequency range (GHz) where a mixing spur will occur; < 100 MHz from carrier | | Typical spurious (dBc) |
| 1.566 to 1.634 | 1.166 to 1.234 | -10 |
| 1.060 to 1.200 | 1.274 to 1.303 | -20 |
| 1.325 to 1.375 | 1.420 to 1.460 | |
| 1.775 to 1.825 | | |
| 1.013 to 1.043 | 1.250 to 1.043 | -30 |
| 1.900 to 1.940 | 2.225 to 2.275 | |
| 1.112 to 1.138 | 1.483 to 1.517 | -40 |
| 1.983 to 2.017 | 2.380 to 2.420 | |
| 2.483 to 2.517 | 2.975 to 3.025 | |
| 3.583 to 3.617 | | |
| 2.556 to 2.586 | 2.983 to 3.017 | -50 |
| 3.071 to 3.101 | 2.860 to 2.900 | |
| 4.785 to 4.815 | 4.183 to 4.217 | -60 |
| 3.580 to 3.620 | 1.487 to 1.513 | |
| 4.099 to 4.129 | 3.483 to 3.517 | |
| 2.042 to 2.072 | 2.087 to 2.113 | |

¹ N5501A has been discontinued and replaced by N5502A. The information on this page is primarily for customers who previously purchased the N5501A.

| Downconverter Noise Floor (all oscillators locked) | | | | | | | | | | | | |
|--|------|-----|-----|-----|------|------|------|------|------|------|------|------|
| Input Frequency | | 1 | 10 | 100 | 1k | 10k | 100k | 1M | 10M | 100M | < 1k | > 1k |
| 1.0 to 3.0 GHz | Typ | -50 | -80 | -97 | -125 | -137 | -143 | -145 | -145 | -145 | -60 | -75 |
| | spec | -45 | -75 | -92 | -120 | -132 | -138 | -140 | -140 | -140 | -50 | -65 |
| 3.0 to 6.6 GHz | Typ | -44 | -74 | -91 | -119 | -131 | -143 | -145 | -145 | -145 | -50 | -80 |
| | spec | -39 | -69 | -86 | -114 | -126 | -138 | -140 | -140 | -140 | -44 | -70 |

General specifications

Operating temperature range: +0 °C to +55 °C

Warm-up time: 20 minutes

General considerations: The N5502A has low susceptibility to RFI and mechanical vibration. Care must be exercised however in making measurements in high RFI or vibration environments as spurious signals may be induced in the module.

Learn more at: www.keysight.com

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