

# 5120A

## High-Performance Phase Noise and Allan Deviation Test Set with Ultra-Low Noise Floor



### Key Features

- Simultaneous phase noise and Allan deviation requirements
- 1 MHz–30 MHz frequency range
- Industry-leading accuracy ( $\pm 1.0$  dB)
- Allan deviation measurements (to over 300 days)
- Phase noise measurements as close as 0.1 mHz from the carrier
- Real-time noise floor displayed
- Optional internal reference oscillator
- Intuitive remote network management and data acquisition
- Phase noise measurements down to  $-175$  dBc/Hz

### Key Benefits

- Measurement results displayed within seconds (no external data processing required)
- Supports measurements with input and reference at different frequencies
- No measurement calibration required (saves time)
- Best price/performance solution
- Easy-to-use graphical user interface

### Accurate, Cost-Effective Measurements in Seconds

Making accurate phase noise and Allan deviation measurements has never been easier or more cost effective. The all-digital 5120A high-performance phase noise and Allan deviation (ADEV) test set with ultra-low noise floor transforms the way these measurements are made. Traditional measurement instruments require an external phase-lock loop, turning these types of measurements into a complicated and costly endeavor. Compare this with the 5120A, which makes fast yet accurate single sideband (SSB) phase noise and ADEV measurements at the click of a button, all at a fraction of the cost of alternative solutions.

The Microsemi 5120A is easy to use: simply connect the device under test (DUT) and reference signal (which can be at a different frequency than the DUT) and press the 5120A's Start button. Seconds later, valid measurement data appears on the unit's high-resolution display. With the all-digital 5120A, tedious multi-step configuration and calibration routines are no longer required.

The 5120A leverages the extensive knowledge and experience obtained by Microsemi during the development of the industry standard for ADEV measurements. In addition to top-of-the-line ADEV measurement capability, the 5120A provides phase noise

measurement accuracy to previously impossible levels of  $\pm 1.0$  dB. This, combined with the best-in-industry phase noise and ADEV measurement floor, means that you can characterize even your lowest noise references more accurately than ever before with the 5120A.

Microsemi's mastery of phase noise and ADEV measurement techniques as well as recent advances in high-speed, low-noise analog-to-digital converters has allowed the combination of multiple measurement tools to be integrated into a single one-box solution. This enables the 5120A to make more accurate measurements while remaining cost effective.

For further convenience, Microsemi has added an internal reference oscillator option for the 5120A. This one-box solution, known as the 5120A-01, saves you the time of procuring and calibrating an external reference. After making just one connection from the DUT to the 5120A-01, you can begin making accurate measurements.

The 5120A brings a paradigm shift to the way that phase noise and ADEV measurements are made. With the 5120A, measurements that used to be complicated and costly are now faster, easier, more accurate, and most cost effective in both R&D and production environments.

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### Established Leadership in Time and Frequency Measurements

Years of research at the National Institute of Standards and Technology (NIST) and in private industry has come to fruition in the 5120A. This multi-purpose test set combines the benefits of the industry standard for ADEV measurements, with best-in-class phase noise measurement capabilities.

### Unparalleled Accuracy

The 5120A is an extremely accurate test set, thanks to its digital phase detector. NIST calibrated a sample 5120A and confirmed its accuracy to be better than  $\pm 1.0$  dB. At  $< 3 \times 10^{-15}$ , the 5120A's ADEV specification at 1-second averaging time is also an industry leader.

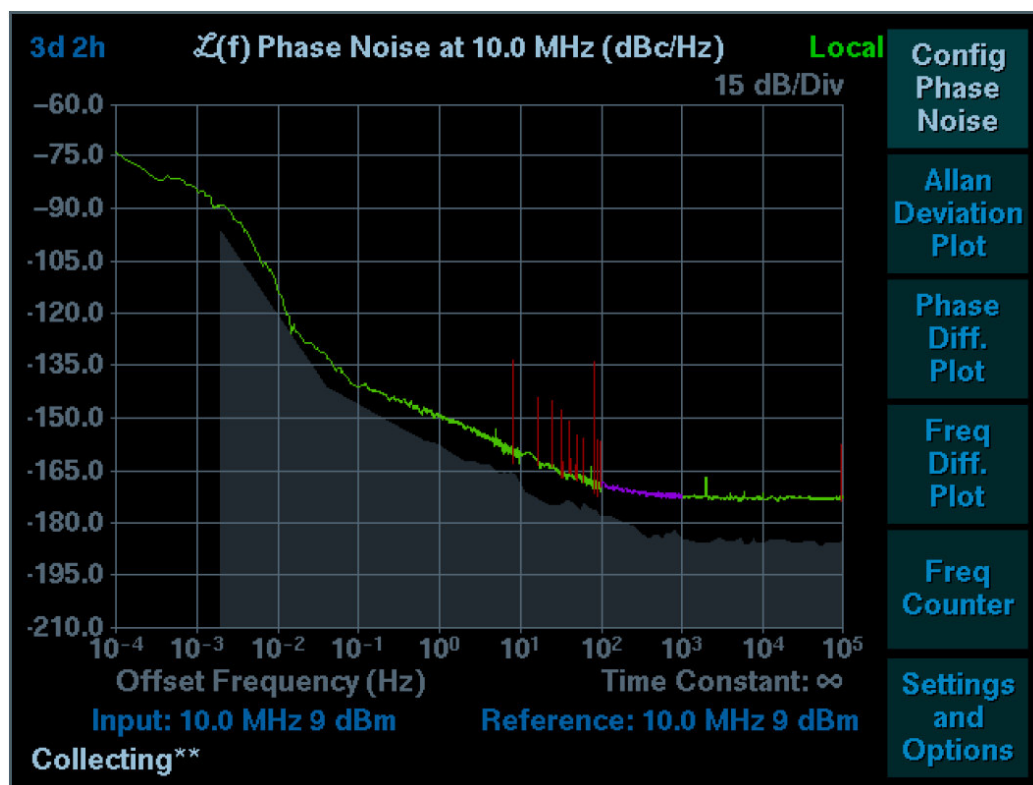
### Extremely Wide Range Measurement Capability

The 5120A supports a wide range of phase noise and ADEV measurements. By converting the DUT and reference signals to their digital representation as a first step, the patented all-digital design in the 5120A has eliminated the need for carrier suppression when making measurements, enabling phase noise measurements at smaller frequency offsets than previously possible (to below 0.1 mHz).

This same technology enables ADEV measurements to over 300 days. Technical advances like these provide customers the ability to characterize their high-performance sources better than ever before.

### Advanced Spur Detection

The 5120A is equipped with sophisticated algorithms that detect and highlight spurs in real-time. Internally, spurs are detected by using



**5120A Sample Display Capture: Phase Noise**

Spurs are highlighted in red. The instrument's real-time noise floor, shown in gray, provides the user with a way to estimate the 5120A's internal noise bias on the current measurement.

a matched filter to compare the shape of the spurious response with the Fourier transform of the window function. With the 5120A, you can rely on Microsemi's expertise in spur detection.

### Easy to Use

Microsemi has combined its extensive knowledge in phase noise and ADEV measurement techniques into a single, one-box solution with an intuitive, easy-to-learn GUI. Because all configuration and calibration is done by the 5120A, extremely accurate measurements can be made without a highly-trained engineer having to oversee the measurements. As is shown in the 5120A-01 configuration diagram,

making measurements is as simple as connecting the DUT and pressing the green Start button.

### No Longer Must the Reference and DUT Be at the Same Frequency

Unlike traditional measurement systems, the 5120A does not require that the frequency of the reference be the same as the DUT. Enablers for this advance are that the 5120A synthesizes the two input frequencies for conversion to broadband, and the 5120A's phase detector has infinite range that doesn't require the two inputs to be phase locked. This allows accurate measurements to be made on a DUT at any frequency, with a single low-noise reference.

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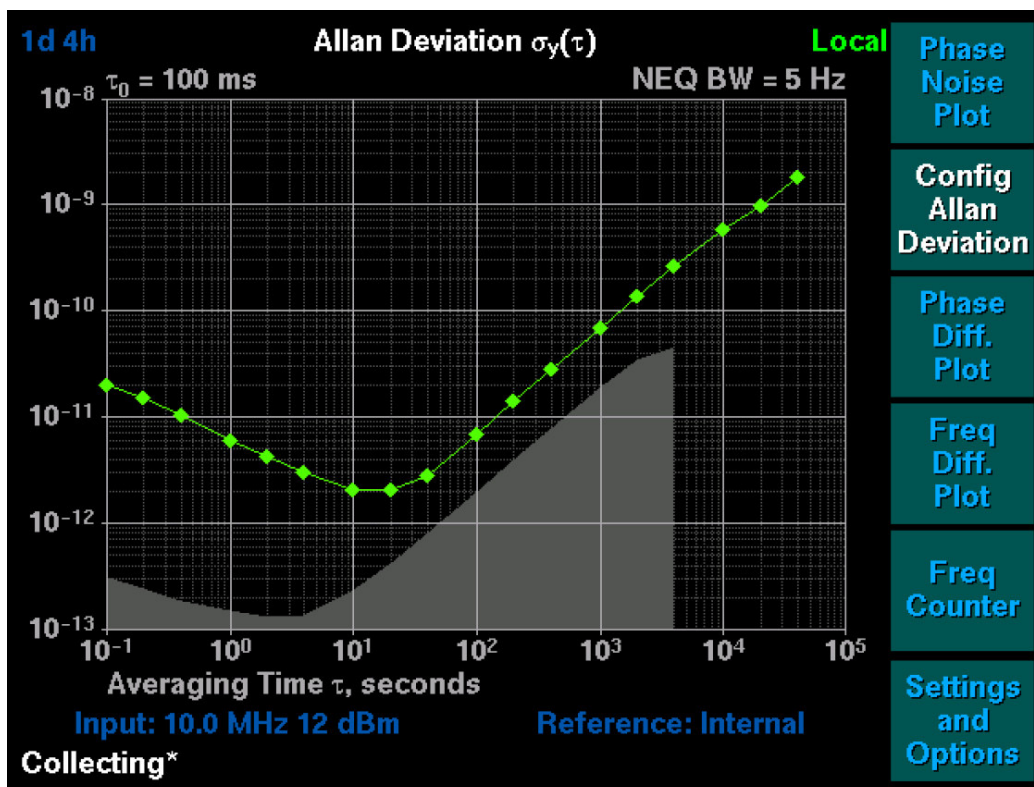
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### Output Options to Suit Your Needs

The 5120A meets the needs of applications requiring printing or further data analysis. To print data directly from the 5120A, simply connect a PostScript-compatible printer to the 5120A, configure the printer, and then press the clearly labeled Print button on the 5120A's front panel. If further data analysis or data archival is required, simply export the measurement data to a remote computer using the Ethernet connection. This data can then be easily imported into industry-standard software for frequency stability analysis, like Stable32.

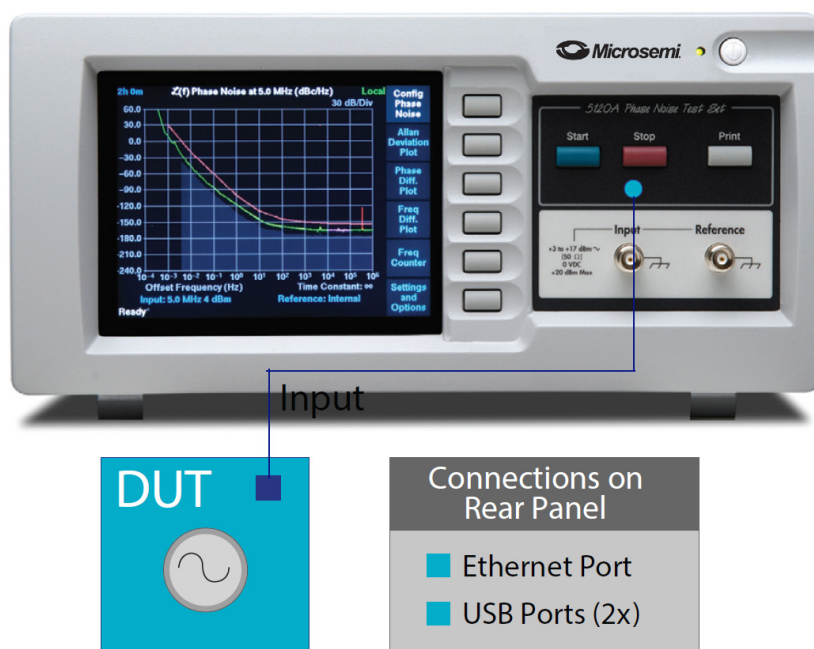
### Accurate Measurements Without an External Reference

Phase noise measurements have never been easier than with the high-performance internal reference oscillator option for the 5120A. This unit employs cross correlation noise subtraction between two internal reference oscillator channels to make measurements significantly below the noise floor of either. With the 5120A-01, accurate measurements down to  $-170$  dBc/Hz are possible at a much lower cost than with a single external reference oscillator with these specifications. Rather than spending time procuring and characterizing external references, you can now rely on the verifiable performance of the 5120A-01.



### 5120A Sample Display Capture: Allan Deviation

The instrument's real-time self-calculated noise floor, which can be used to estimate the 5120A's internal noise bias, is shown in gray. Allan deviation measurements to over 300 days are supported.

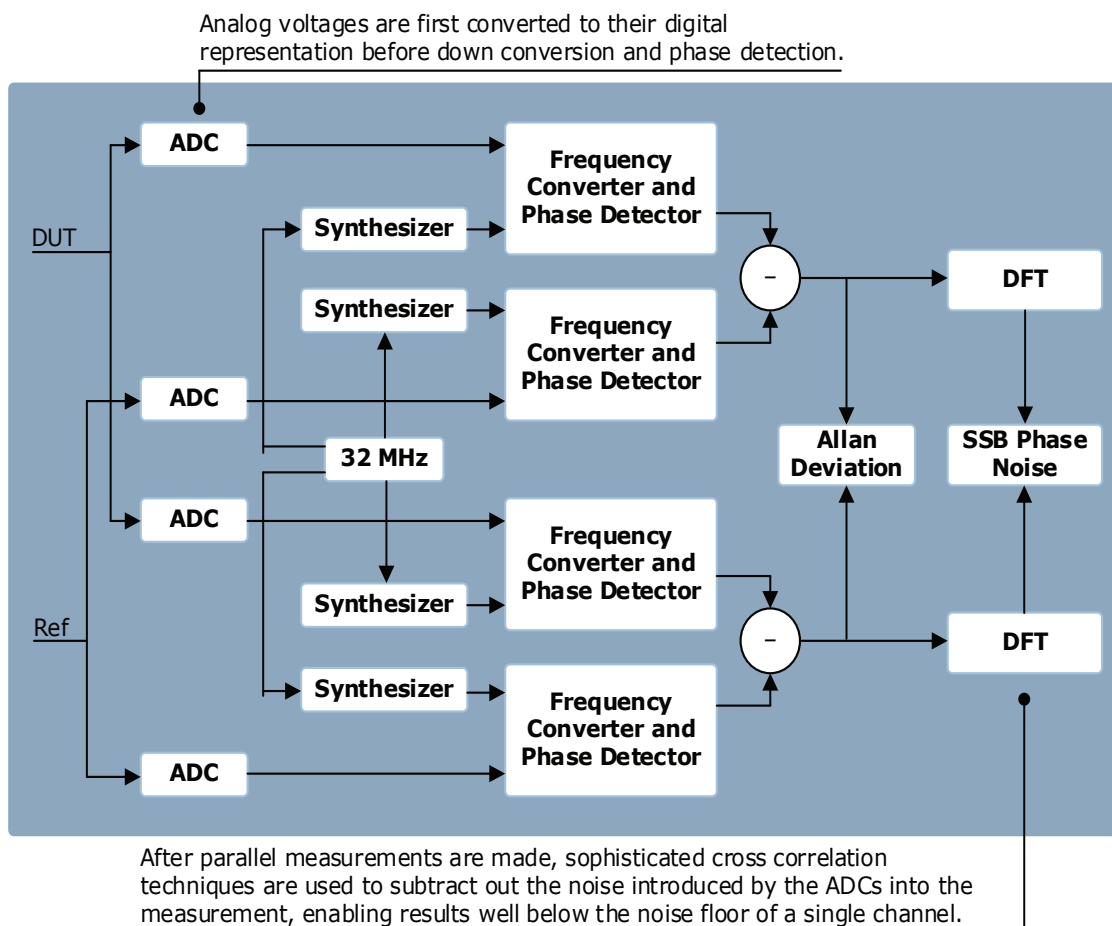


### 5120A-01 Configuration Diagram

To make a measurement with the 5120A-01, which includes an internal reference oscillator, simply connect the DUT and press the green Start button.

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**5120A Block Diagram**

### Benefits of an All-Digital Test Set

The 5120A combines sophisticated timing technologies into a single advanced measurement instrument containing Microsemi's patented phase measurement algorithm. As is shown in the block diagram, the DUT and reference signals are immediately converted to their digital representations upon entry to the 5120A. This allows the 5120A to make accurate measurements without the need for an external phase-lock loop, enabling calibration-free measurements. Additionally, the all-digital 5120A does not require that the frequency of the reference be the same as the DUT.

### Benefits of Cross-Correlation

The parallel upper and lower channels in the 5120A block diagram illustrate the unit's innovative cross correlation technique. After making simultaneous measurements in parallel, the 5120A cross correlates the discrete Fourier transform from the two channels to estimate the noise of the input devices while rejecting the independent noises of the two measurement sub-systems. This enables the end result to be well below the noise floor of a single channel instrument.

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### Specifications

#### Performance

- Frequency range: 1 MHz–30 MHz (sinewave)
- Allan deviation:  $<3 \times 10^{-15}$  at 1 sec (0.5 Hz bandwidth)

#### Phase Noise

- Measurement accuracy:  $\pm 1.0$  dB
- Offset frequency range: 0.1 mHz to 1 MHz

#### System Noise Floor (for 10 MHz input)

Offset	L(f) Phase Noise
1 Hz	-145 dBc/Hz
10 Hz	-155 dBc/Hz
100 Hz	-165 dBc/Hz
$\geq 10$ kHz	-175 dBc/Hz

#### System Noise Floor (for 10 MHz input) When Using 5120A-01 Internal Reference

Offset	L(f) Phase Noise
1 Hz	-120 dBc/Hz
$\geq 10$ kHz	-170 dBc/Hz

#### Electrical

- Input signal level: 3 dBm–17 dBm
- Input impedance: 50  $\Omega$
- Input connectors: TNC (supplied with two BNC adapters)

#### Mechanical and Environmental

- Size: 34 cm  $\times$  17 cm  $\times$  44 cm (13"  $\times$  7"  $\times$  17")
- Power: 100 VAC–240 VAC, 47 Hz–63 Hz, 60 W (max), IEC 320 connector, power switch
- Operating temperature: 15  $^{\circ}$ C to 40  $^{\circ}$ C
- Storage temperature: -25  $^{\circ}$ C to 55  $^{\circ}$ C
- Unit weight: 9 kg (20 lbs)
- Shipping package weight: 12 kg (26 lbs)

#### Options

- Internal reference oscillator option (5120A-01)—factory upgrade
- Rack mount tray kit (option 001)

#### Product Includes

- 5120A test set, 2 TNC-BNC adapters, manual (on CD), and power cord
- One-year warranty

#### Front Panel

- Display: sharp, high-resolution 640  $\times$  480 RGB LCD
- Buttons: 6 SoftKeys, Start, Stop, Print, Power
- TNC (2x): input, reference (3 dBm–17 dBm)
- LED: power

#### Rear Panel

- USB (2x): supports mouse, keyboard, and select PostScript-compatible printer connections
- Network: RJ-45 10/100BASE-T Ethernet

