Signal Hound®

PN400 Phase Noise And VCO Tester
Product Manual

Signal Hound PN400 Product Manual

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Contents

1 Overview

The PN400 pairs with two SM-series spectrum analyzers to add cross-correlated phase noise and VCO characterization measurements. Adding cross-correlation enables phase noise measurements much lower than an SM200 / SM435 are capable of alone. The low noise power supply and tune voltage enable VCO characterization such as tuning sensitivity and VCO pushing.

The PN400 is controlled over USB. On USB power, the PN400 can generate triggers for the SM200s/SM435s, but an external 30V power supply is required for the VCO power supply and tune voltages. The status LED shows green when powered up and ready to trigger the analyzers, and red when VCO tune and supply voltages are active.

1.1 Applications

The primary application for the PN400 is making cross-correlated phase noise measurements using the SM-series analyzers. Phase noise of down to -179 dBc/Hz at a 1-10 MHz offset can be measured. See appendix for typical test limits.

Additionally, VCO testing, using the 1-15 VDC power supply, and -1 to +28V tune voltage, allow you to plot VCO frequency vs. voltage, tuning sensitivity, and measure VCO pushing (frequency change from power supply voltage change).

These tests can be automated using SCPI, for production testing or automated characterization of your device under test.

1.2 Software and Installation

Install the latest version of Spike software, which includes support for the PN400. An additional software license may be purchased to enable the updated phase noise and AM noise measurement tools.

The Spike software can be downloaded from the following link, https://signalhound.com/spike/.

All Signal Hound APIs can be downloaded in our software development kit with the following link, https://signalhound.com/software/signal-hound-software-development-kit-sdk/.

1.3 Front Panel

The front panel has the status LED and all of the connections to your device under test:

- The RF input to the resistive splitter (2.92 or 2.4mm F)
- The status LED
- The VCO tune voltage (SMA F)
- The optional VCO power supply (BNC F)

1.3.1 LED States

OFF – PN400 is not powered.

RED – PN400 is generating VCO power and tune voltages

GREEN – PN400 is powered on but VCO power and tune votages are disabled.

1.4 Rear Panel

The rear panel has the power, control, and spectrum analyzer connections:

- Lemo power connector for the external 30V supply. Only required when VCO power or tune voltages are used.
- USB2.0 type B connector to PC / laptop
- TRIG 1 and TRIG 2 (SMA-F) to the SM-series spectrum analyzers
- RF OUT 1 and RF OUT 2 (2.92 or 2.4mm F) to the SM-series spectrum analyzers

1.5 Connecting the PN400

1.5.1 Cross-correlated Phase noise only

On the rear panel, the USB must be connected to the PC or laptop running the Spike software. The two RF outputs must be connected to two separate SM-series spectrum analyzers, using 2.92 mm RF cables of the same length. The two trigger outputs must be connected to the trigger inputs on the SM-series spectrum analyzers using the included SMA cables. RF cables should be kept reasonably short (1 meter or less) to reduce loss. See the Spike (Phase Noise Measurements) manual for more information on the measurement process.

1.5.2 Adding VCO power and tune voltages

On the rear panel, also connect the 30V supply. From the front panel, use a BNC cable to connect the VCO power supply, and/or an SMA cable to connect the tune voltage. See the Spike manual for more information.

2 Specifications

When using a spectrum analyzer for cross-correlated phase noise measurements, there is no error from IF gain, so close-in phase noise accuracy depends on the spectrum analyzer's relative accuracy, and the gain indicator. The relative accuracy of the SM-series analyzers is typically quite good, better than +/- 0.25 dB in most cases. The gain indicator shows the difference between the potential gain from cross-correlation, and the measured gain. Where this difference is greater than 10 dB, the predicted accuracy is typically better than ±0.5 dB. A difference of only 3 dB indicates your actual phase noise may be up to 2 dB lower, and little to no separation indicates the actual phase noise may be considerably lower.

Please note that for signals under +10 dBm input to the PN400, the phase noise from thermal noise (-177 dBm/Hz at room temperature) will add to your measurement. Signal level, minus insertion loss up to where the signal splits (typically 3 dB + 0.1 dB/GHz), sets this noise floor.

2.1 PN400 Preliminary Specifications

	Min	Typ	Max
Frequency	100 kHz		40 GHz
Impedance		50 ohms	
VSWR (RF ports) < 20 GHz		< 1.5	1.6
VSWR (RF ports) > 20 GHz		< 2.0	2.5
RF Splitter Insertion Loss		6.5 dB + 0.25dB/GHz	8 dB + 0.3dB/GHz
Input power	-22 dBm		+20 dBm
Operating Temperature	-40°C	+25°C	+65°C
DC voltage on RF ports	-0.2V		0.2V
Vsupply voltage (volts)	0.5		15
VSupply current (mA)	0		500
VSupply resolution		5 mV	
VSupply accuracy		+/- 10 mV	
Vsupply current readback accuracy		+/- 2 mA	
VSupply settling time		500 mS/V	
Vsupply noise		2 nV/√Hz @10 kHz	
Vtune setting range	-1 V		+28 V
Vtune resolution		1 mV	
Vtune accuracy		+/- 10 mV	
Vtune settling time		100 ms/V	
Vtune impedance		50 ohms into 240 uF	
Vtune noise		1.3 nV/√Hz @10 kHz	
External Power Supply		30V	
Power consumption			10 W
Interface	USB 2.0 type B		
System Requirements	Windows / Linux, x64_86. System must support two SM435s and have an extra USB port for the PN400.		

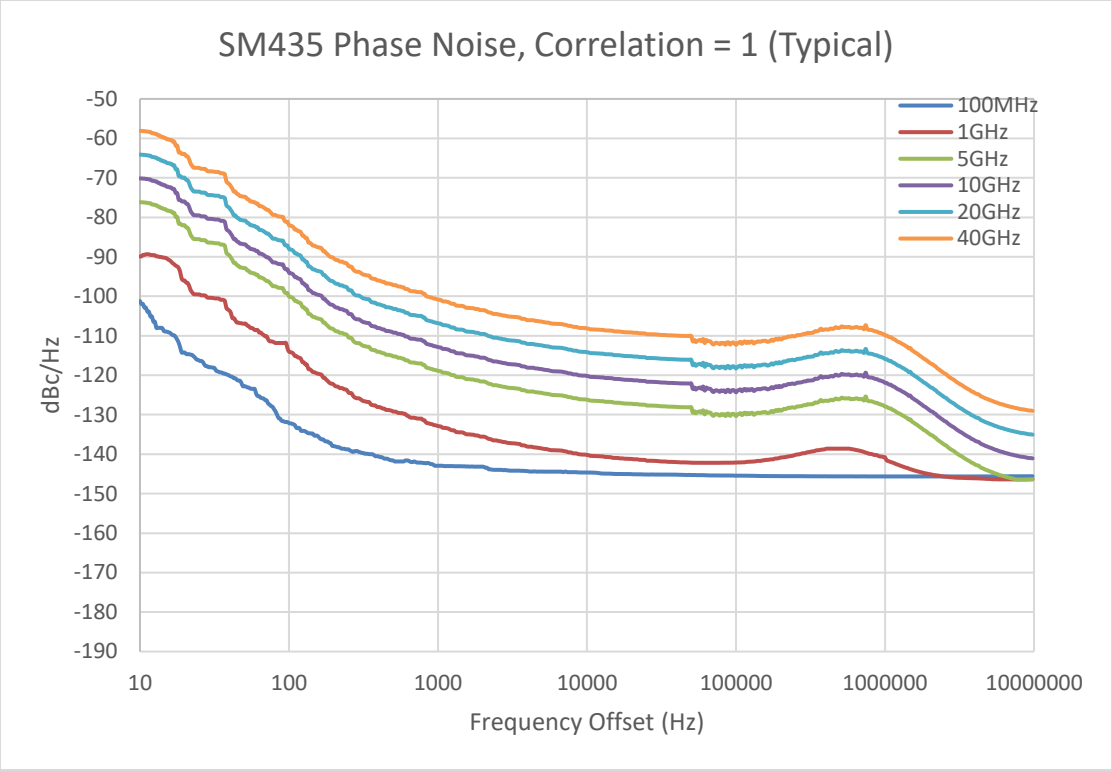
RF Connectors: 2.92mm is standard

2.2 Typical Correlation Time

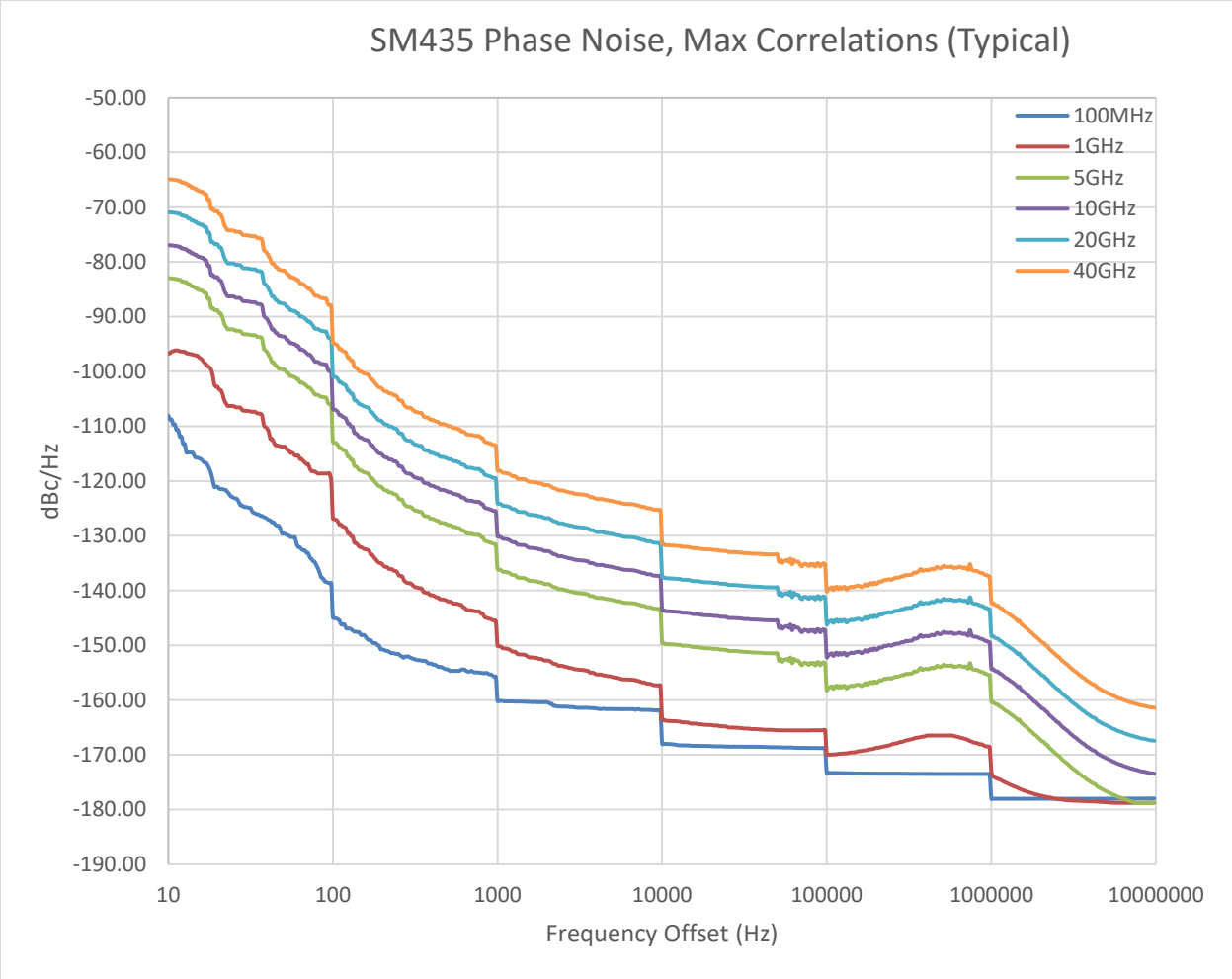
Decade	Time (ms) per correlation	Maximum number of correlations	Maximum Correlation Gain (dB)
10 - 100 Hz	1960	100	10
100 Hz - 1 kHz	392	500	13.5
1 – 10 kHz	32	6100	19
10 – 100 kHz	1.9	102k	25
100 kHz – 1 MHz	0.24	819k	30
1 – 10 MHz	0.03	6.5M	34

3 Typical Performance

3.1 Single Correlation (+10 dBm in to PN400)



3.2 Max Correlations (+10 dBm in to PN400)



4 Warranty and Disclaimer

4.1 Warranty

The information contained in this manual is subject to change without notice. Signal Hound makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Signal Hound shall not be liable

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4.2 Warranty Service

For warranty service or repair, this product must be returned to Signal Hound. The Buyer shall pay shipping charges to Signal Hound and Signal Hound shall pay UPS Ground, or equivalent, shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes, to and from Signal Hound, for products returned from another country.

4.3 Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper use by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product. No other warranty is expressed or implied. Signal Hound specifically disclaims the implied warranties or merchantability and fitness for a particular purpose.

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The remedies provided herein are the Buyer's sole and exclusive remedies. Signal Hound shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

4.5 Certification

Signal Hound certifies that, at the time of shipment, this product conformed to its published specifications.