Noise Figure Test Solution Using a Spectrum Analyzer

SIGLENT TECHNOLOGIES CO.,LTD

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⎍ 1 Overview

Noise Figure (NF) is a fundamental characteristic parameter of RF/microwave components. It is an important metric for evaluating amplifiers, receivers, and even systems, representing a traditional RF/microwave test item. Noise Figure describes the internal noise level of a Device Under Test (DUT) and its degradation of the Signal-to-Noise Ratio (SNR), i.e., the ratio of input SNR to output SNR.

$$F = \frac{SNR_{in}}{SNR_{out}}$$

Alternatively, it can be expressed as the ratio of output noise to input noise multiplied by gain.

$$F = \frac{N_{out}}{G * N_0}$$

When defining Noise Figure, the input noise N_0 is the electronic thermal noise of an ideal device at 290K.
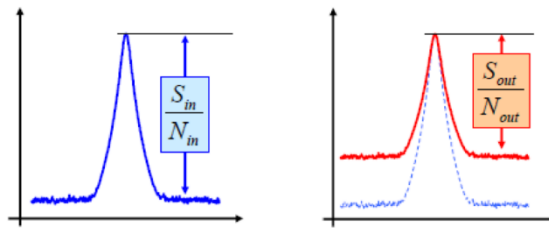
The Noise Figure of microwave components determines the overall receiver sensitivity.

⎍ 2 Challenges

There are many methods for testing Noise Figure. The main methods currently are:

- Y-Factor Method
- Cold Source Method (Power Method)
- Added Phase Noise Method

⎍ 3 Solution

3.1 Y-Factor Method

The SIGLENT SSA5000A-NF Noise Figure Measurement Option uses the common Y-Factor method, providing engineers with a simple tool to perform high-quality Noise Figure measurements quickly and effectively. It describes the Noise Figure and gain of the DUT and system modules using line graphs and table views. Additionally, it supports measuring parameters such as Noise Factor, Y-Factor, Equivalent Noise Temperature, Hot Noise Floor, and Cold Noise Floor.

The Y-Factor method is the most universal test method, suitable for the vast majority of scenarios, and is currently the commonly used standard test method. The SSA5000-NF Noise Figure application utilizes the Y-Factor method to calculate Noise Figure. By using a noise source, the SSA5000A series Signal Analyzer

can quickly determine the noise of the device under test. This method is very simple as it utilizes the power ratio when the noise source is turned on (hot) and when it is turned off (cold).

• Suitable for DUT gain range: -20 to 60 dB, Noise Figure range: 0 to 35 dB.

• Applied to equipment such as Spectrum Analyzers and Noise Figure Analyzers.

• Requires a suitable standard noise source.
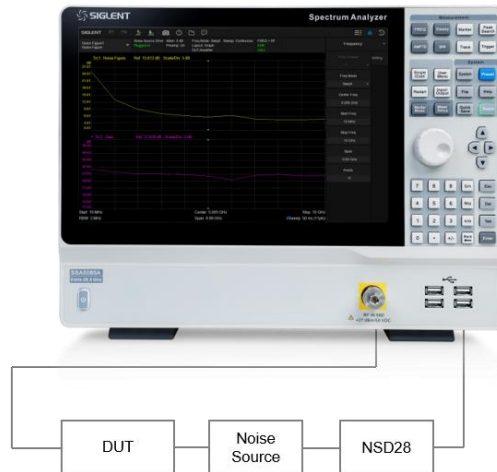
Since the noise source operates on 28V DC and requires switching between high (hot) and low (cold) states during testing, SIGLENT provides the NSD28 Noise Source Driver Module. The SSA5000-NF Noise Figure application controls this module via USB to automatically implement switching control.

Support for intelligent noise sources will be added in the future, allowing automatic loading of their ENR (Excess Noise Ratio) information. The SSA5000A preamplifier reduces the uncertainty of Y-Factor Noise Figure measurements.

3.2 Graphical Display of Noise Figure and Gain

The SSA5000A-NF Noise Figure Measurement Option provides accurate Noise Figure and gain measurements. Users can freely select the frequency range and number of test points, with an intuitive display of Noise Figure and gain at each frequency point. Users can input an ENR table and save it internally to the instrument.
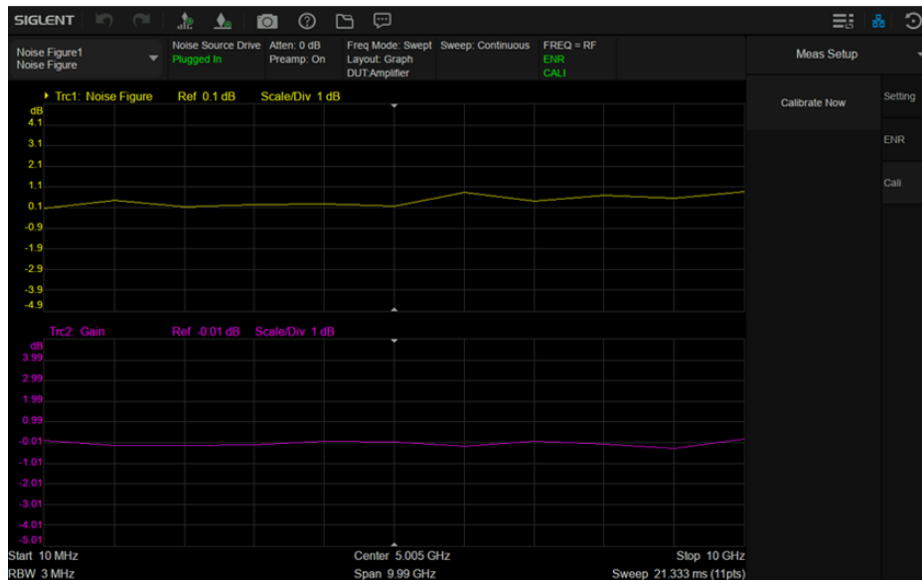
3.3 Table Display of Noise Figure and Gain

The SSA5000A-NF Noise Figure Measurement Option also provides results in a table view, displaying Noise Figure, Gain, and Equivalent Noise Temperature at each frequency point.

📈 4 Summary

The SSA5000A-NF Noise Figure Measurement Option, based on the SSA5000A series Spectrum and Signal Analyzers, provides engineers with a tool for performing Noise Figure measurements quickly and effectively. It is an ideal solution for Noise Figure and gain measurements of RF components, modules, and complete units.

About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

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