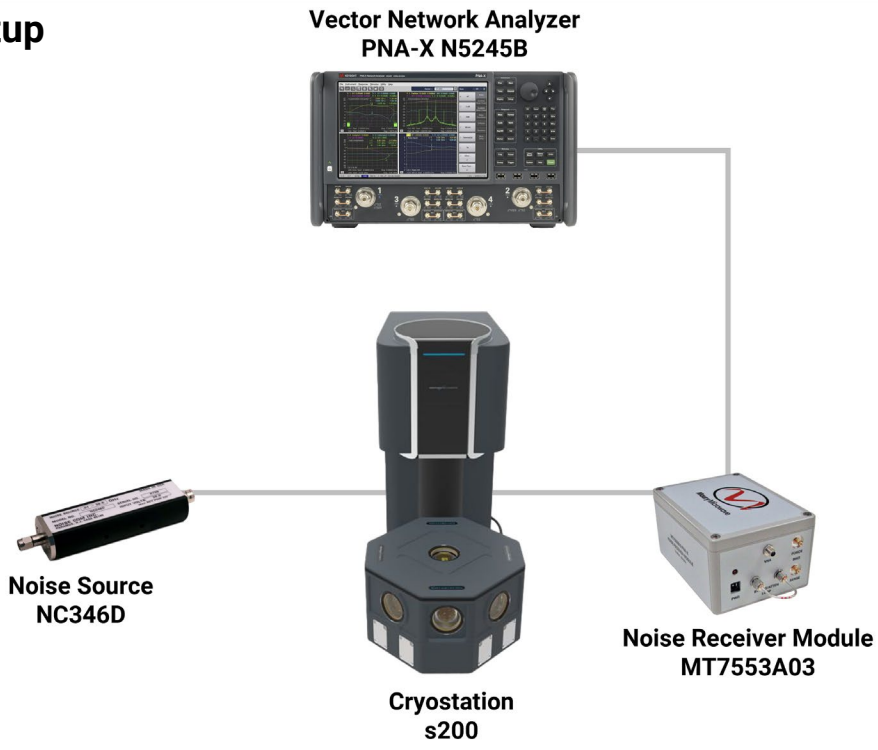
Cryogenic Noise Parameters

Naturally occurring noise in active devices or circuits sets a lower limit on useful signals, underscoring the importance of designing circuits that mitigate noise and minimize its effects. While noise figure is typically measured in a 50-ohm environment, a device's noise figure varies with the presented source impedance. This variation can be expressed in terms of noise parameters, which are essential to know when designing low-noise amplifiers (LNA) using highly mismatched devices. LNA design is even more critical in applications such as quantum computing and radio astronomy that operate at cryogenic temperatures, necessitating advanced and reliable noise parameter measurement capabilities even under such extreme, low-temperature conditions.

This demonstration features the Maury Microwave MT7553A03 noise receiver module in a cryogenic noise parameter system. This system is the industry's first commercial tool to extract noise parameters down to 4 Kelvin at cryogenic temperatures while utilizing a cryogenic solid-state tuner to achieve non-50 ohm environments at the DUT input. These noise parameter measurements are an essential tool to optimize LNA for minimum low noise figure at these temperatures.

Demo Setup



Target Users

Target users include LNA designers that require accurate and reliable noise parameter measurements at cryogenic temperatures.

Product Overview

MT7553 Series Noise Receiver Modules

The MT7553-series of coaxial noise receiver modules enhance the typical noise system measurement accuracy, reducing the total system noise figure by adding an integrated switch and wideband LNA close to the DUT. The noise switching module integrates the entire input network while the noise receiver module integrates the entire output network of a typical noise parameter measurement system into a turnkey solution. The MT7553A03 noise receive module, in particular, covers 0.1 GHz – 26.5 GHz and is designed to operate with either a standalone noise analyzer or combined VNA/NFA up to 26.5 GHz.

The noise receiver consists of the component chain from the DUT output to, and including, the noise analyzer. The noise receiver's minimum noise figure (Fmin) will affect the minimum accurately measurable noise figure of the DUT by increasing the sensitivity of the receiver. Therefore, it is critical to provide a noise receiver with the lowest Fmin possible. In addition, noise analyzers may not be available at the frequencies of interest and in these cases, it is common to use a downconverter chain to lower the frequency of the signal to one that can be measured by the noise analyzer. The Maury Microwave family of MT7553-series noise receiver modules address these critical considerations with low noise figure and integrated downconverter, wideband LNAs to improve the sensitivity of the noise receiver, RF switches to switch between VNA and NFA paths, and wideband bias tees to provide bias to the DUT.

KEY SPECIFICATIONS AND FEATURES:

- Banded measurements from 50–75 GHz, 60–90 GHz, and 75–100 GHz
- Automates noise parameter measurement systems
- Replaces external banded components
- Integrated downconverter, bias tees, LNAs, and switches
- Low noise figure for improved system calibration accuracy and repeatability

More Resources

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