

Noise Source Components

Mercury Noise Source Components enable the predictable operation of RF systems under real-world noise conditions.

The Problem: Noise is a random and unpredictable natural phenomenon that occurs everywhere. In RF communication systems, whether wireless, microwave, satellite, audio or video, noise emanates from every component inside the system, sending out undesired signals through the network. Since RF communication receivers often have to process weak signals, the unwanted noise, even if it comes from the smallest component in the system, can easily obscure a target signal, resulting in poor overall system performance.

The Solution: When designing a new system, or improving an existing one, noise itself can be a helpful tool for finding and measuring unwanted noise levels within the system design.

If a known level of noise is injected into an RF system, it becomes a reference point, or benchmark, against which to gauge unwanted noise levels. The difference between the known, injected noise level and the actual noise level provides the system "noise figure", which is critical for effective RF system design.

Once the noise figure is known, the overall system sensitivity is easily determined. Noise figures further provide the basis to evaluate one RF system to another. While there are many other measuring devices that characterize the entire RF system, noise is unique in that it can be used to characterize individual system components. In this way, noise can be used to seek out the biggest single contributors to overall system noise levels, giving system designers and engineers a practical starting point for designing RF systems that will perform well under real-world noise conditions.

Noise Source Selection Overview

Noise sources are divided into three major categories: packaged noise sources, amplified noise modules and noise diodes. These modules are listed in the various product families below.

Mercury Systems features a state of the art calibration laboratory to calibrate Mercury brand noise sources as well as sources from other manufacturers. We calibrate noise sources in many different configurations including coaxial, waveguide over frequencies from 10 MHz - 110 GHz.



Coaxial Noise Sources: These modules are deployed within microwave applications and increasingly, in lower frequency and millimeter wave systems. Coaxial noise sources contain all required biasing circuitry and need only a positive voltage to activate. Noise sources typically have no amplification, so the raw noise output from the diode is also witnessed at the module's output. Module output is up to ~35 dB over ambient thermal noise for a resistor at room temperature, known as Excess Noise Ratio (ENR) and is expressed as 35 dB ENR. These noise sources have two fundamental roles: lab standards calibration and integration in to systems. Noise sources used in the lab are broadband (i.e. 10 MHz - 26.5 GHz), and are calibrated to NIST standards with excellent VSWR, when the noise

is on and off. Very low power is needed, from 5 to 15 dB

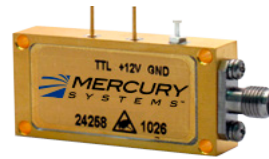


ENR for noise figure measurement. This is convenient because a pad is inserted in the module, which serves the dual purpose of lowering the amplitude from the raw noise circuit, which increases the return loss, by twice this amount, thus yielding a very low VSWR.

The Mercury 346 Series Noise Source is designed specifically for use with a noise figure meter. Noise sources when built into systems often require higher power as there may be substantial insertion loss in the RF path caused by some combination of, 10 or 20 dB coupler, splitter, filter, length of coaxial line, etc. When used in a live system, such as to calibrate a radar receiver's noise temperature, good VSWR and protection from potential high incident RF power is needed. For these applications, an isolator will solve both these problems. Fortunately, most systems are either narrow band or octave band and standard isolator designs are available. Some systems require the integrated noise sources to be calibrated. Others use an external noise source to calibrate the internal noise source and RF path to the measurement plane. Mercury's noise sources are offered with selectable and customizable pre-calibration options.

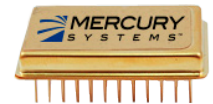
Waveguide Noise Sources: These are similar to coaxial noise sources and are equipped with modern hybrid coaxial construction. Modules up to 40 GHz are available with a coax-to-waveguide adaptor or adaptor/isolator termination. Waveguide noise sources are calibrated with the waveguide in place, removing the need to de-embed the insertion loss of the adaptor/isolator. Above 40 GHz, these noise sources have full waveguide construction for millimeter applications. Millimeter applications that require only the source to operate over a narrow band within the waveguide size frequency realize optimal cost advantage. Noise sources may be tuned anywhere in the overall frequency range, full-band tuning is iterative and as such cost advantage may further be leveraged if tuning is limited to the application's applicable frequencies.

Amplified Noise Modules: These modules not only have the noise diode circuitry built-in, but also one or several gain stages to boost the output power. Lower frequencies (under 2 GHz) are more common and applications of up to 6 GHz are gaining traction. Mercury produces powerful amplified noise modules up to 10 GHz. Applications vary for these modules, from setting up a signal, to noise ratio, to frequency



response measurement, to random number generation. Noise modules are available in coaxial, surface mount and pin type construction.

Surface Mount Noise Sources/Modules: A full suite of surface mount noise and amplified modules for today's modern circuits. These modules are easy to integrate into circuit boards without the cost of engineering associated with the deployment of raw noise diodes.



Noise Diodes: Noise diodes fall into four primary categories, surface mount, axial leaded, pill package and raw die form. The last three types represent traditional noise diodes. For modern, higher volume circuits, Mercury has a large selection of surface mount noise diodes to 3 GHz. These modules have very good unit-to-unit consistency without requiring screening, making them very cost effective. They are available in tape-and-reel for automated pick and place machines.

Pre-engineered, pre-packaged noise sources represent the efficient, expedient and cost effective solution to other forms of noise source implementation using discrete devices.

Learn more about the noise source products in more detail at <http://rf.mrcy.com>

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