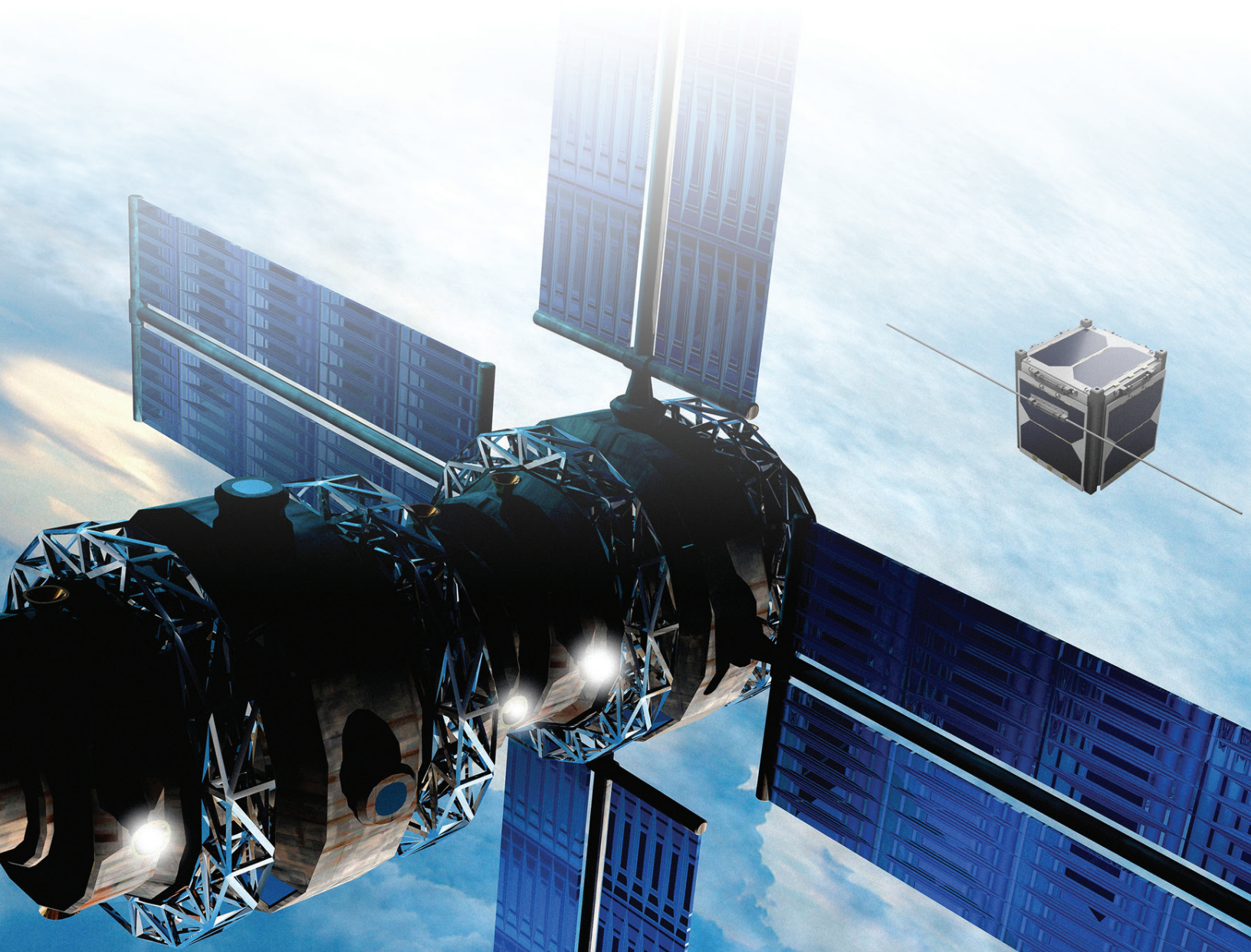
Noisecom

Satellite Communications Testing



Traditionally, the satellite industry has relied on geosynchronous earth orbit (GEO) satellites that take years to build and require very expensive launches to deliver them to orbit. Latency issues due to the distance of these orbits limit the ability of these satellites to be used for real-time communications like voice or live video transmissions. New technology is driving a wave of innovations and an evolution to smaller micro-sats deployed in low earth orbit (LEO) with reusable rockets delivering multiple satellites at a time with a single launch vehicle reducing deployment costs. These smaller satellites are deployed in mega-constellation arrangements to provide voice, video, imaging and data to commercial and military clients with higher data rates and lower latency than legacy GEO deployments.

Industry predictions show that large numbers of LEO micro-satellites will be launched due to performance and cost benefits of using the new technology. This increase in the number of satellite uplink and downlink stations will require systems to be designed to reject real-world RF interference from other uplink and downlink transmitters, as well as constellation communications between satellites as part of the relay network.

Micro-satellites use new technologies based on broadband modulation and spread spectrum schemes to provide secure, high speed data services for uplink and downlink to earth stations, as well as critical inter-satellite communications using millimeter wave frequencies. Noisecom noise generators and sources are broadband devices available in microwave and millimeter wave frequencies to help test and stress the RF signal integrity of all communication links.

For over 30 years Noisecom has been designing noise generation devices and instruments for Carrier-to-Noise, jamming, multipath fading, satellite test and calibration across a wide variety of industries. Noisecom has a depth of experience unmatched in the industry and works closely with technical end users to find the right product for their application with both off the shelf and customized solutions. This experience and close links to customers and markets has led to the development of noise generators and broadband noise modules specifically designed for the RF signal paths in satellite applications up to 110 GHz.

Customization

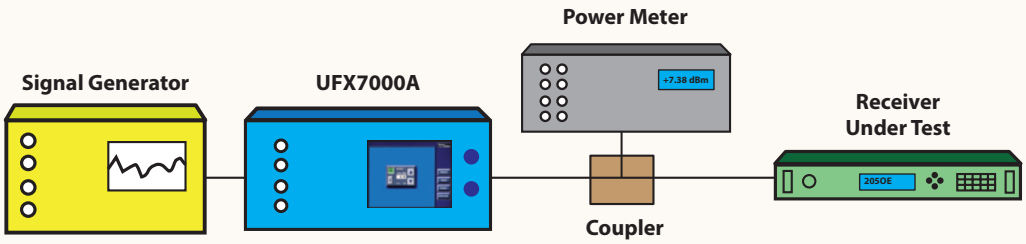
Each system is different and the set of RF interference challenges vary in every satellite deployment or communication link. This diverse range of unique testing requirements is why Noisecom carrier-to-noise generators and RF noise solutions are highly customizable. Generators and instruments can be designed for different noise power density, internal filtering, and remote control. Whether it is small modifications to frequency or power levels or a fully custom solution, Noisecom has a broad range of capabilities and solutions for every budget.

Receiver Sensitivity – Carrier-to-Noise Ratio Testing

Testing the performance of a satellite communications channel in the presence of noise and interference is critical, as a poor communications channel will limit the amount of data and range that can be communicated and the reliability of the communications. Modern modulation schemes significantly help reduce the impact of noise in the communications channel, but ultimately too much noise or interference can overpower the carrier and prevent the receiver from distinguishing it from noise. Carrier-to-noise (C/N) ratio is one of the most common parameters to test when determining the performance of a satellite communications channel. The more noise a channel can tolerate, the better the quality of the link, making the system more reliable.

Noisecom UFX7000A instruments provide a flexible architecture to create sophisticated noise signals enabling satellite system designers to test the unique characteristics of their RF uplink and downlink paths in the presence of noise. Precision components provide high output power and superior flatness while controllable attenuators, switches and filters ensure the right interference signal is being generated and then applied to test the system. The output from the UFX7000A is directly applied to the test signal allowing for full system performance analysis and stress testing to happen within existing test conditions, providing the full picture of how the system will perform in the presence of real-world interference.

Carrier-to-Noise Ratio Testing with the UFX7000A



The UFX7000A is a precision, programmable broadband noise generator. When used in conjunction with a power meter or spectrum analyzer a test engineer can create a specific carrier-to-noise ratio to evaluate system performance and receiver tolerance to interference testing. In this example the power meter is used to measure the signal power level and based on the noise bandwidth, a test engineer or technician can calculate the noise power required to create the desired carrier-to-noise ratio. The desired ratio is created by applying the test signal to the input of the UFX7000A and adjusting the noise attenuator to set the noise power. The combined test signal and broadband noise at the output of the UFX7000A will then be at the desired C/N ratio to test the receiver.

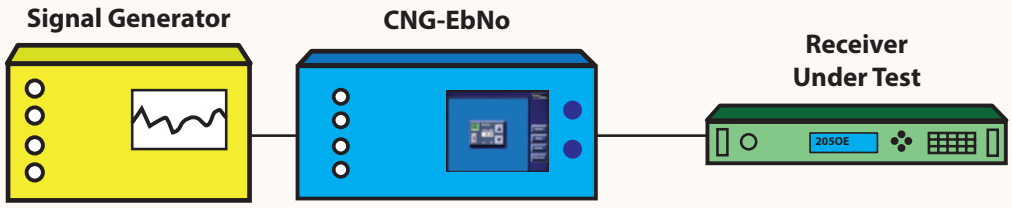
Receiver Testing – Carrier-to-Noise Ratio Generation

Carrier-to-noise ratio is one key parameter of receiver testing along with energy per bit-to-noise power density (Eb/No) and carrier-to-interference (C/I), combined key ratios like this give a full picture of what levels of interference or noise a channel or receiver can tolerate. Testing system performance for these different parameters and optimizing for desired performance levels is time consuming and error prone due to the manual trial and error process of measuring levels and resetting generators.

The CNG-EbNo instrument greatly simplifies satellite communications link testing by allowing engineers and technicians to simply enter a desired C/N, Eb/No or C/I ratio without the use of additional instrumentation such as power meters or spectrum analyzers. As an all-in-one measurement and noise generation solution the CNG-EbNo provides repeatability and reliability by eliminating the complexity of using multiple instruments to test receiver performance in the face of real-world noise or interference. Ratios like C/N, Eb/No or C/I are created by the instrument with use of an embedded power meter enabling the user to simply enter the desired ratio locally or remotely.

Often a multi-carrier transmission scheme is deployed in a satellite communications link. In these scenarios a system designer may want to test receiver performance at different C/N or C/I ratios at specific carriers as opposed to across the entire band. In this case the power meter embedded inside the CNG-EbNo is replaced with a spectrum analyzer. This internal change enables the power level of the carrier to be measured at a specific frequency and the corresponding C/N or C/I ratio to be set based on the incoming power level of any specific carrier.

Carrier-to-Noise Ratio Generation with the CNG-EbNo

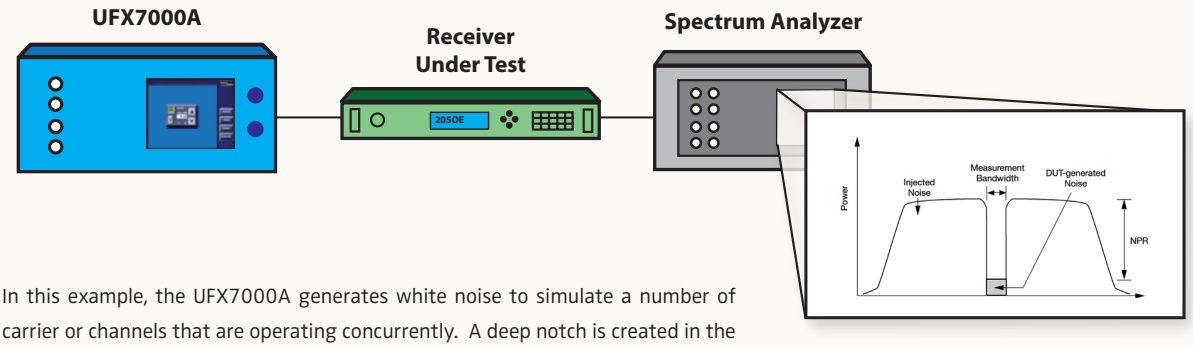


The CNG-EbNo greatly simplifies receiver tolerance testing by providing, reliable, repeatable C/N, Eb/No and C/I by adding precise noise levels directly to the test signal. This direct generation of the ratios used to test key parameters of a satellite communications link eliminates errors introduced by more complex systems using simpler broadband noise generators. In this example the test carrier signal is fed into the CNG-EbNo, the power level of that signal is measured and a noise level corresponding to the desired C/N ratio entered by the user is generated and then added to the carrier. The output of the CNG-EbNo is the carrier signal plus noise at the exact desired ratio programmed by the user.

Amplifier Linearity – Noise Power Ratio

Performance of power amplifiers that amplify a number of carriers at the same time is tested using a Noise Power Ratio (NPR) method. Amplifier performance is important in a system as non-linearities will reduce the dynamic range of the communications channel by limiting the lowest power level of a signal that can be received erroneously. Noise power ratio is a convenient way to test for non-linearities created in a system.

Noise Power Ratio Testing with UFX7000A

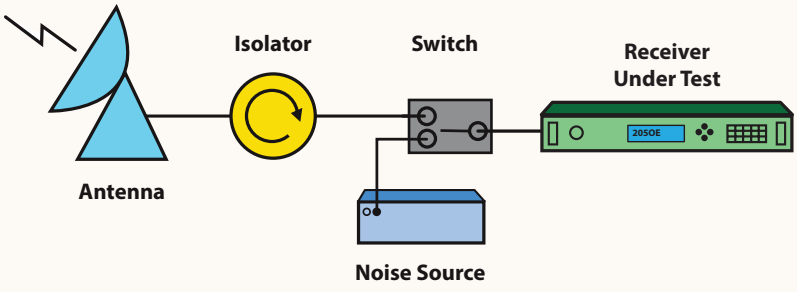


In this example, the UFX7000A generates white noise to simulate a number of carrier or channels that are operating concurrently. A deep notch is created in the band of noise, typically the center of the band, and the test signal is then applied to the device or system under test. The amount that the notch fills in gives an indication of the non-linearities generated in the device or system under test and is used to determine the noise power ratio of an active component in the system or the system as a whole.

Receiver Reference, Calibration and Performance Test

Noise is an excellent option to be used as a receiver reference or as built-in test equipment (BITE) to evaluate system performance. Switching in a noise source enables the receiver to collect spectral data of its front end and model the system. In these applications noise generation devices are typically packaged as discrete noise diodes (NC100 – NC400), PCB mountable noise modules (NC500) or calibrated coaxial noise sources (NC3000 – NC5000) depending on the level of integration required.

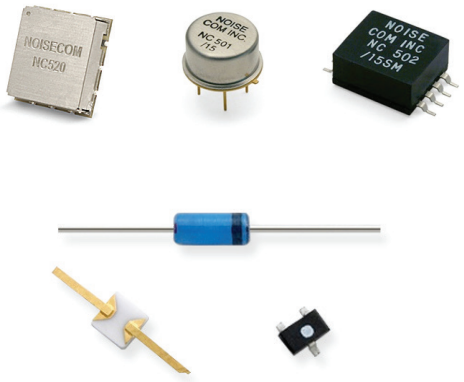
Built-in Test and Calibration



Using noise for receiver reference, calibration or test involves having noise available to be switched in as needed. For receiver reference the system switches to the noise source and based on the known excess noise ratio (ENR) the received signal level can be determined. For receiver performance test the system switches in the noise source to verify the receiver part of the system is operational.

Diodes and Built-in Test Equipment Modules

Noise diodes are the fundamental building blocks of analog noise generation and are categorized for performance characteristics that enhance their broadband noise output and flat spectral response. Built-in Test Equipment (BITE) modules are an economical solution for built-in test requirements and contain all necessary bias circuitry and require no external components. The modules have extremely flat output power versus frequency characteristics that are insensitive to temperature and voltage variations.



UFX7000A Series

The UFX7000A broadband noise generator has a powerful architecture used to create complex custom noise signals for advanced test systems. This versatile platform allows the user to meet their most challenging design requirements. Precision components provide high output power with superior flatness, and the flexible computer allows control of multiple attenuators, switches, and filter banks. The touch screen streamlines manual control, LAN, GPIB and RS-232 are available for remote control in ATE systems.

Specifications

UFX7000A Series			Output Characteristics	
Model	Frequency Band	Power	dBm / Hz (dBm)	Flatness (dB)
UFX7101A	10 Hz - 20 kHz	+13	-30	±0.5
UFX7103A	10 Hz - 500 kHz	+13	-44	±0.5
UFX7105A	10 Hz - 10 MHz	+13	-57	±0.5
UFX7107A	100 Hz - 100 MHz	+13	-67	±0.75
UFX7108A	100 Hz - 500 MHz	+10	-77	±1.0
UFX7111A	1 GHz - 2GHz	+10	-80	±1.5
UFX7113A	10 MHz - 3 GHz	0	-95	±2.5
UFX7116A	10 MHz - 6 GHz	-12	-110	±3.0
UFX7128A	10 MHz - 10 GHz	-17	-117	±3.5
UFX7218A	2 GHz - 18 GHz	-20	-122	±2.0
UFX7240A	2 GHz - 40 GHz	-20	-126	±4.0

UFX7900A Series (1 Watt output)			Output Characteristics	
Model	Frequency Band	Power	dBm/Hz	Flatness (dB)
UFX7905A	500 Hz - 10 MHz	+30	-40	±2
UFX7908A	1 MHz - 200 MHz	+30	-53	±2
UFX7910A	2 MHz - 500 MHz	+30	-57	±2
UFX7911A	5 MHz - 1 GHz	+30	-60	±3

CNG-EbNo

The CNG-EbNo is a fully automated instrument that sets and maintains a highly accurate ratio between a user-supplied carrier and internally generated noise, over a wide range of signal power levels and frequencies. Since the CNG-EbNo automatically compensates for parameters like bit rates and bandwidth, taking measurements is as simple as pressing a button. Operating modes include carrier-to-noise, carrier-to-noise density, carrier-to-interference, bit energy-to-noise density and more. The touch screen streamlines manual control, LAN, GPIB and RS-232 are available for remote control in ATE systems

Specifications

Operating Modes

Carrier-to-noise (C/N), carrier-to-noise density (C/N_o), bit energy-to-noise density (E_b/N_o), carrier-to-interferer (C/I), noise generator, power meter

Carrier Path

Input power range	-55 dBm to +5 dBm
Maximum input power	+21 dBm (with no damage)
Output power range	-55 dBm to +5 dBm
Nominal gain	±1.0 dB
Gain resolution	0 to -60 dB in 0.1 dB steps
Gain flatness	±0.2 dB for 70 MHz ±20 MHz ±0.3 dB for 140 MHz ±40 MHz ±0.4 dB for others
Group delay	±0.20 ns/40 MHz for frequencies above 20 MHz

Noise Path

Output power range	-55 dBm to +5 dBm
Flatness	
±0.2 dB/40 MHz	±0.3 dB/80 MHz
±0.4 dB/200 MHz	±0.5 dB/300 MHz
Attenuation range	60 dB (0.1 dB steps)
Ratio accuracy	±0.2 dB RSS, ±0.3 dB WCU
Power meter range	-55 dBm to +5 dBm
Power meter accuracy	±0.5 dB
Interferer input	-4 dBm ±2 dB, frequency range is equal to the noise bandwidth

Model Number	Frequency Range	Applications
CNG-EbNo-70	50 to 90 MHz	General purpose/SATCOM
CNG-EbNo-IF1	50 to 90 MHz 100 to 180 MHz	Intelsat, SATCOM
CNG-EbNo-105	65 to 75 MHz 50 to 90 MHz 100 to 180 MHz 10 to 200 MHz	Covers the same noise specs as HP3708A
CNG-EbNo-900	800 to 1000 MHz	Cellular
CNG-EbNo-750	650 to 850 MHz	Iridium, LTE
CNG-EbNo-1550A	950 to 2150 MHz	Single Band
CNG-EbNo-2050L	1700 to 2400 MHz	Cellular/PCS
CNG-EbNo-2450	2200 to 2700 MHz	PCS
CNG-EbNo-5500	5000 to 6000 MHz	802.11a Wireless LAN
CNG-EbNo-20000	18 to 22 GHz	Custom frequency ranges available
CNG-EbNo-70/1200	50-90 MHz 1120-1280 MHz	Multiple Carrier Input Capabilities

Noisecom

Noisecom is a leader of RF and microwave noise sources for signal jamming and impairment, reference level comparison and calibration,receiver robustness testing, and jitter injection. Electronic noise generation devices from Noisecom come in a variety of product types including, noise diodes, built-in-test modules (BITE), calibrated noise sources, jitter sources, cryogenic noise standards and programmable instruments. Calibrated noise sources are available from audio to millimeter wavelengths in coaxial or waveguide modules. Programmable instruments are highly configurable and able to generate precise Carrier-to-Noise, Signal-to-Noise and broad band white noise. Noisecom products arecustomizable to meet the unique needs of challenging applications and can be designed for high power, high crest factor, specific filter responses with a wide selection of input and output options.

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