Test Solutions

Automated Noise Generators

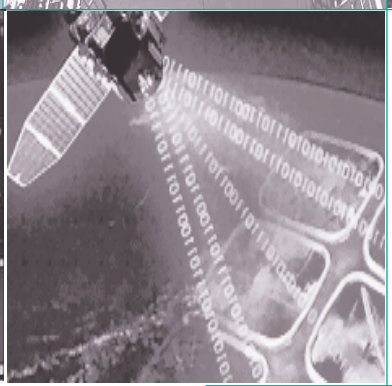
Automated Noise Generators

The ANG Series of Automated Noise Generators yield calibrated noise power output to a user settable amplitude. These intuitive instruments are microprocessor controlled and feature front panel and remote (GPIB and optional RS/232) control. They are used in applications ranging from Bit Error Rate (BER) vs. Signal:Noise to radar jamming simulation. Due to the wide range of usages, the ANG series product line is user configurable with a wide range of standard option packages. This allows the user to take advantage of many useful features without paying for ones not needed.

Applications:

Micronetics' ANG Series is designed for benchtop and ATE applications in:

- Satellite and earth terminal testing
- Wireless communication systems
- Digital TV distribution systems
- Data transmission modems
- Radar testing
- Electronic countermeasures
- Broadband jamming

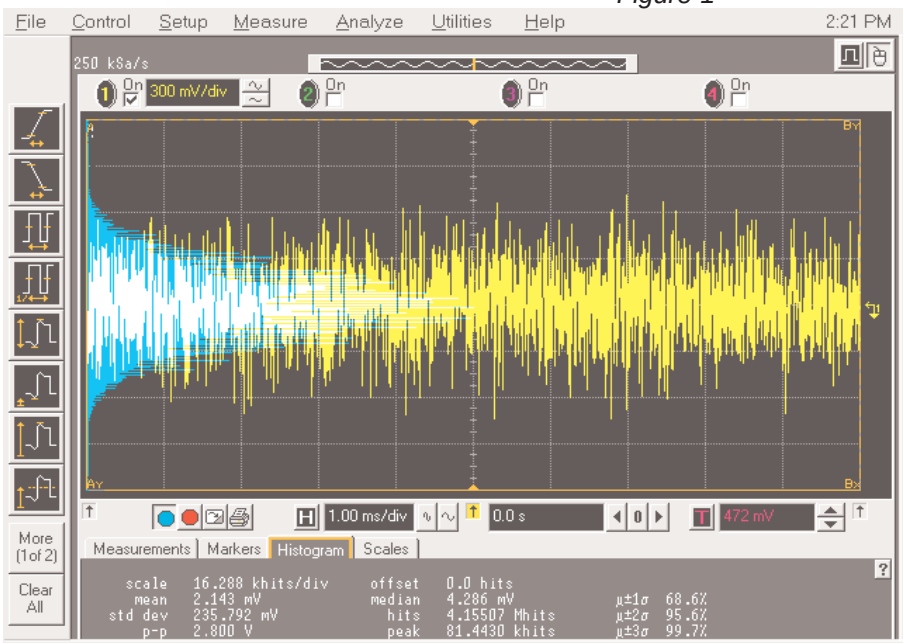


MICRONETICS
TEST SOLUTIONS

The ANG Series Noise Generators - A Cut Above

Truly Gaussian High Power Noise Module: Micronetics, the pioneer of solid-state noise technology, uses only true Gaussian noise sources, not microprocessor generated pseudo-random noise (PN). The E_b/N_o vs. BER and other tests assume an ideal Gaussian source. Micronetics measures this as well as conformance to the bell shaped curve by making histogram measurements of the amplified noise module inside the ANG. Fig 1 is a screen capture of such a measurement. In addition Micronetics designs the most stable noise sources available leveraging off its rugged airborne military design architecture.

Figure 1



Calibrated Noise Output:

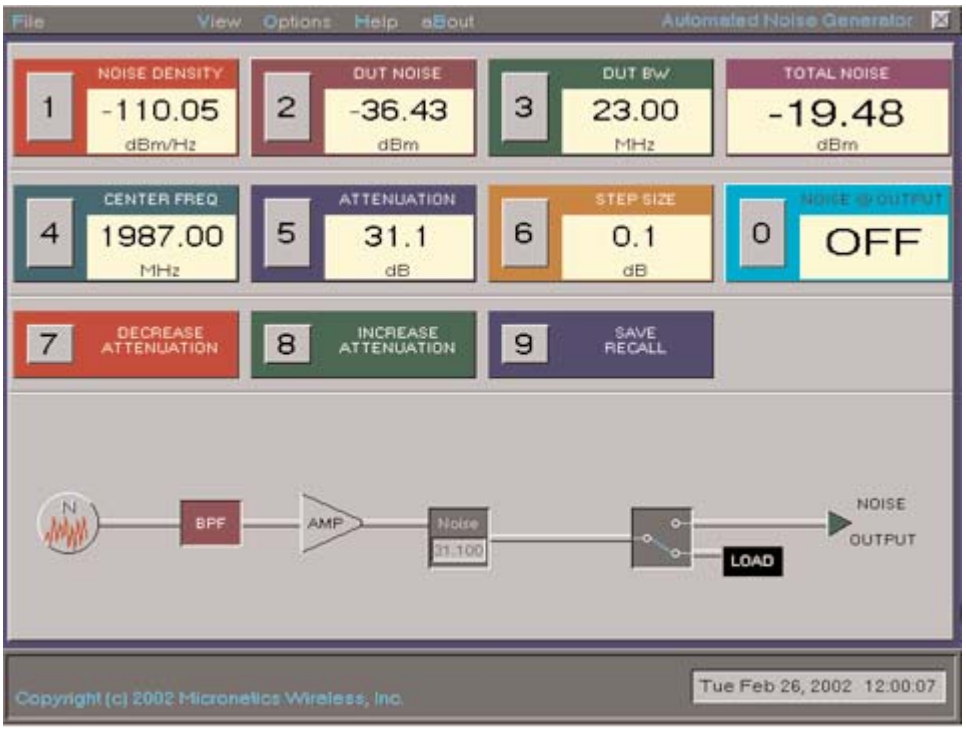
The ANG noise generators deliver precisely the noise amplitude that the user sets. This value is stated on the front panel or available over the GPIB bus. Each ANG noise generator is characterized spectrally to allow the user to dial in the specific desired frequency within the noise generators broadband noise output for the exact in-band noise amplitude. Lesser noise generators simply have an attenuator following a noise source, which only allows the user to raise and lower the amplitude on a relative basis without knowing the absolute amplitude.

Easy to Use - Powerful Features:

The large intuitive graphical user interface allows the user to easily set the ANG and read current status with minimal learning curve.

Service:

Micronetics uses a modular design with a floppy disk drive for easy software upgrades. Micronetics regularly develops new algorithms and options which can be installed by simply downloading a file and installing into the floppy drive of the ANG. Other noise generators require sending the instrument back to the factory.



Flexible Architecture - Our ANG Series Standard Options Include:

OPT001: 0.1 dB noise amplitude control resolution: This allows the user to set the noise amplitude to within 0.1 dB. Standard is 1.0 dB

OPT002: Carrier Signal input and built in combiner for S+N output. This is useful for interference tests that require adding noise to a carrier signal.

OPT002A: This is similar to OPT002, but utilizes a resistive combiner in order to preserve the low baseband frequency specification of those models which have a low frequency specification of 100 Hz. This combiner has more insertion loss than that of OPT002, so if frequencies below 10 MHz are not required, then OPT002 makes more sense.

OPT003: Signal Path Attenuator. This option allows the user to control the amplitude of the carrier signal. The range and resolution is 0 - 127 dB in 1.0 dB Steps.

OPT003A: This option is as OPT003 but the step size is 0.1 dB instead of 1.0 dB

OPT003B: This option is similar to OPT003 but the signal amplitude is "make before break" meaning the carrier signal is perpetually transmitted through the attenuators even in the short transition from one attenuation state to the next. This allows the user to change the amplitude in the signal path without losing lock; especially useful in modem loop back testing where a break in the IF connection from the modulator to the demodulator requires the entire test to be reset.

OPT003C: Similar to OPT003B except step size is 0.1 dB.

OPT004: "Zero dB loss" signal Path: This option utilizes a high 3rd order intercept, low distortion amplifier in the signal though path to make up for the insertion loss. This loss is caused by a combination of the path components that includes the coupler which sends a portion of the signal to the power meter, the combiner which adds noise to the signal, the attenuator (if ordered) and the impedance transformer (if ordered). The magnitude of the loss is from 5 to 12 dB depending on the model and option package ordered. Generally, if the loss does not pose a problem, this option should probably not be ordered. Despite the high quality amplifier used, it is not generally recommended to have any unnecessary active devices in the test signal path.

OPT005: 75 Ohm Impedance instead of 50 Ohm. Typical loss is 1 to 2dB from base model

OPT005A: Switchable Impedance 75 Ohm/50 Ohm

OPT005B: 75 ohm Impedance using internal resistive impedance matching pad for low frequency models to preserve the low end frequency limit of 100 Hz. Loss is 6.0 dB from base model.

OPT005C: Switchable Impedance 50 Ohm/75 Ohm using resistance matching pad for 75 Ohm setting.

OPT006: RS/232 Interface This option allows the ANG to be operated remotely using an RS/232 serial connection in addition to the GPIB bus.

OPT007: Automatic C/N, Eb/No, C/No ratio mode: This option sets up a user specified Signal:Noise ratio automatically. The user connects a signal to the S input port of the ANG. The user needs to externally measure the signal power referenced to the SIN port of the ANG. The user then enters the signal power and the desired signal to noise ratio, and the ANG automatically sets it up calibrated accurately to the S+N output port. This option is discussed in more detail in appendix A. (This option requires a combiner, therefore, OPT002/A is automatically included). This option can be combined with the noise and signal attenuator options OPT001 and OPT002/A for higher range/smaller resolution radius.

OPT007A: Similar to OPT007 but with the added feature that a power sensor for measuring the signal power can be connected directly to the PM port of the ANG unit. The user simply enters the power reading from the external power meter into the ANG along with the desired signal:noise ratio. The ANG automatically sets this ratio up accurately calibrated to the S+N output port. A directional coupler is employed to send coupled power from the signal input path to the PM port. This allows the signal power to be perpetually monitored without a break in the signal path with only small loss in the test signal through path. As with OPT007, this option can be combined with the noise and signal attenuator options OPT001 and OPT002/A for greater ratio range/resolution.

OPT007A1: This option is similar to OPT007A except it enables the ANG to remotely control the power meter via RS/232 port. With this option, the ANG automatically polls the power meter for signal power and uses the data to set up and maintain the user specified S/N ratio. Because the power readings perpetually available, useful features such as "Ratio Track" and "Signal Track" are available. For more description of these, *see Appendix A.* The power meter must utilize SCPI commands. Not all power meter make/models are supported. Contact factory for details.

Available Models:

Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5107		100 Hz	100 MHz	+10 dBm	-70 dBm/Hz	2 dB P-P	NA
OPT001	0.1 dB Noise Step Size	100 Hz	100 MHz	+10 dBm	-70 dBm/Hz	2 dB P-P	NA
OPT002	Signal Input and Combiner	10 MHz	100 MHz	-4 dB *	-4 dB *	2 dB P-P	4 dB
OPT002A	Sig-in W/Resistive Combiner	100 Hz	100 MHz	-7 dB *	-7 dB *	2 dB P-P	7 dB
OPT003	0.1 dB Carrier Step Size	100 Hz	100 MHz	+10 dBm	-70 dBm/Hz	2 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	10 MHz	100 MHz	NA	NA	NA	0 dB
OPT005	75 ohm Z	5 MHz	100 MHz	-1 dB *	-1 dB *	2 dB P-P	1 dB
OPT005A	50/75 ohm Switchable	5 MHz	100 MHz	-1 dB *	-1 dB *	2 dB P-P	1 dB
OPT005B	75 ohm Z (resistive pad)	100 Hz	100 MHz	-6 dB *	-6 dB *	2 dB P-P	6 dB
OPT005C	50/75 switchable (resistive)	100 Hz	100 MHz	-6 dB *	-6 dB *	2 dB P-P	6 dB
OPT007	C/N Option	100 Hz	100 MHz	0 dB *	0 dB *	2 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	100 kHz	100 MHz	-1 dB *	-1 dB *	2 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5108		100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	3 dB P-P	NA
OPT001	0.1 dB Noise Step Size	100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	3 dB P-P	NA
OPT002	Signal Input and Combiner	10 MHz	300 MHz	-4 dB *	-4 dB *	3 dB P-P	4 dB
OPT002A	Sig-in W/Resistive Combiner	100 Hz	300 MHz	-7 dB *	-7 dB *	3 dB P-P	7 dB
OPT003	0.1 dB Carrier Step Size	100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	3 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	10 MHz	300 MHz	NA	NA	NA	0 dB
OPT005	75 ohm Z	5 MHz	300 MHz	-1 dB *	-1 dB *	3 dB P-P	1 dB
OPT005A	50/75 ohm Switchable	5 MHz	300 MHz	-1 dB *	-1 dB *	3 dB P-P	1 dB
OPT005B	75 ohm Z (resistive pad)	100 Hz	300 MHz	-6 dB *	-6 dB *	3 dB P-P	6 dB
OPT005C	50/75 switchable (resistive)	100 Hz	300 MHz	-6 dB *	-6 dB *	3 dB P-P	6 dB
OPT007	C/N Option	100 Hz	300 MHz	0 dB *	0 dB *	3 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	100 kHz	300 MHz	-1 dB *	-1 dB *	3 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5109		100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	4 dB P-P	NA
OPT001	0.1 dB Noise Step Size	100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	4 dB P-P	NA
OPT002	Signal Input and Combiner	10 MHz	300 MHz	-4 dB *	-4 dB *	4 dB P-P	4 dB
OPT002A	Sig-in W/Resistive Combiner	100 Hz	300 MHz	-7 dB *	-7 dB *	4 dB P-P	7 dB
OPT003	0.1 dB Carrier Step Size	100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	4 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	10 MHz	300 MHz	NA	NA	NA	0 dB
OPT005	75 ohm Z	5 MHz	300 MHz	-1 dB *	-1 dB *	4 dB P-P	1 dB
OPT005A	50/75 ohm Switchable	5 MHz	300 MHz	-1 dB *	-1 dB *	4 dB P-P	1 dB
OPT005B	75 ohm Z (resistive pad)	100 Hz	300 MHz	-6 dB *	-6 dB *	4 dB P-P	6 dB
OPT005C	50/75 switchable (resistive)	100 Hz	300 MHz	-6 dB *	-6 dB *	4 dB P-P	6 dB
OPT007	C/N Option	100 Hz	300 MHz	0 dB *	0 dB *	4 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	100 kHz	300 MHz	-1 dB *	-1 dB *	4 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5200		100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	4 dB P-P	NA
OPT001	0.1 dB Noise Step Size	100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	4 dB P-P	NA
OPT002	Signal Input and Combiner	10 MHz	300 MHz	-4 dB *	-4 dB *	4 dB P-P	4 dB
OPT002A	Sig-in W/Resistive Combiner	100 Hz	300 MHz	-7 dB *	-7 dB *	4 dB P-P	7 dB
OPT003	0.1 dB Carrier Step Size	100 Hz	300 MHz	+10 dBm	-77 dBm/Hz	4 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	10 MHz	300 MHz	NA	NA	NA	0 dB
OPT007	C/N Option	100 Hz	300 MHz	0 dB *	0 dB *	4 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	100 kHz	300 MHz	-1 dB *	-1 dB *	4 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5250		100 Hz	1500 MHz	+10 dBm	-77 dBm/Hz	5 dB P-P	NA
OPT001	0.1 dB Noise Step Size	100 Hz	1500 MHz	+10 dBm	-77 dBm/Hz	5 dB P-P	NA
OPT002	Signal Input and Combiner	10 MHz	1500 MHz	-4 dB *	-4 dB *	5 dB P-P	4 dB
OPT002A	Sig-in W/Resistive Combiner	100 Hz	1500 MHz	-7 dB *	-7 dB *	5 dB P-P	7 dB
OPT003	0.1 dB Carrier Step Size	100 Hz	1500 MHz	+10 dBm	-77 dBm/Hz	5 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	10 MHz	1500 MHz	NA	NA	NA	0 dB
OPT005B	75 ohm Z (resistive pad)	100 Hz	1500 MHz	-6 dB *	-6 dB *	5 dB P-P	6 dB
OPT005C	50/75 switchable (resistive)	100 Hz	1500 MHz	-6 dB *	-6 dB *	5 dB P-P	6 dB
OPT007	C/N Option	100 Hz	1500 MHz	0 dB *	0 dB *	5 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	100 kHz	1500 MHz	-2 dB *	-2 dB *	5 dB P-P	2 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5111		1000 MHz	2000 MHz	+10 dBm	-80 dBm/Hz	4 dB P-P	NA
OPT001	0.1 dB Noise Step Size	1000 MHz	2000 MHz	+10 dBm	-80 dBm/Hz	4 dB P-P	NA

** denotes: Noise Spectral Density = dB from base model*

Additional models continued on the next page

Available Models - Continued:

OPT002	Signal Input and Combiner	1000 MHz	2000 MHz	-4 dB *	-4 dB *	4 dB P-P	4 dB
OPT003	0.1 dB Carrier Step Size	1000 MHz	2000 MHz	+10 dBm	-80 dBm/Hz	4 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	1000 MHz	2000 MHz	NA	NA	NA	0 dB
OPT005	75 ohm Z	1000 MHz	2000 MHz	-2 dB *	-2 dB *	4 dB P-P	2 dB
OPT005A	50/75 ohm Switchable	1000 MHz	2000 MHz	-2 dB *	-2 dB *	4 dB P-P	2 dB
OPT007	C/N Option	1000 MHz	2000 MHz	0 dB *	0 dB *	4 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	1000 MHz	2000 MHz	-1 dB *	-1 dB *	4 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5112		10 MHz	2000 MHz	+10 dBm	-83 dBm/Hz	3 dB P-P	NA
OPT001	0.1 dB Noise Step Size	10 MHz	2000 MHz	+10 dBm	-83 dBm/Hz	3 dB P-P	NA
OPT002	Signal Input and Combiner	10 MHz	2000 MHz	-4 dB *	-4 dB *	3 dB P-P	4 dB
OPT003	0.1 dB Carrier Step Size	10 MHz	2000 MHz	+10 dBm	-83 dBm/Hz	3 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	10 MHz	2000 MHz	NA	NA	NA	0 dB
OPT007	C/N Option	10 MHz	2000 MHz	0 dB *	0 dB *	3 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	10 MHz	2000 MHz	-1 dB *	-1 dB *	3 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5113		950 MHz	2250 MHz	+10 dBm	-80 dBm/Hz	3 dB P-P	NA
OPT001	0.1 dB Noise Step Size	950 MHz	2250 MHz	+10 dBm	-80 dBm/Hz	3 dB P-P	NA
OPT002	Signal Input and Combiner	950 MHz	2250 MHz	-4 dB *	-4 dB *	3 dB P-P	4 dB
OPT003	0.1 dB Carrier Step Size	950 MHz	2250 MHz	+10 dBm	-80 dBm/Hz	3 dB P-P	NA
OPT004	"0 dB" Carrier Path Loss	950 MHz	2250 MHz	NA	NA	NA	0 dB
OPT005	75 ohm Z	950 MHz	2250 MHz	-2 dB *	-2 dB *	3 dB P-P	2 dB
OPT005A	50/75 ohm Switchable	950 MHz	2250 MHz	-2 dB *	-2 dB *	3 dB P-P	2 dB
OPT007	C/N Option	950 MHz	2250 MHz	0 dB *	0 dB *	3 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	950 MHz	2250 MHz	-1 dB *	-1 dB *	3 dB P-P	1 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5270		500 MHz	8000 MHz	+10 dBm	-80 dBm/Hz	5 dB P-P	NA
OPT002	Signal Input and Combiner	500 MHz	8000 MHz	-5 dB *	-5 dB *	5 dB P-P	5 dB
OPT004	"0 dB" Carrier Path Loss	500 MHz	8000 MHz	NA	NA	NA	0 dB
OPT007	C/N Option	500 MHz	8000 MHz	0 dB *	0 dB *	5 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	500 MHz	8000 MHz	-2 dB *	-2 dB *	5 dB P-P	2 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5280		2000 MHz	10000 MHz	+10 dBm	-80 dBm/Hz	4 dB P-P	NA
OPT002	Signal Input and Combiner	2000 MHz	10000 MHz	-5 dB *	-5 dB *	4 dB P-P	5 dB
OPT004	"0 dB" Carrier Path Loss	2000 MHz	10000 MHz	NA	NA	NA	0 dB
OPT007	C/N Option	2000 MHz	10000 MHz	0 dB *	0 dB *	4 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	2000 MHz	10000 MHz	-2 dB *	-2 dB *	4 dB P-P	2 dB
Model#	Option Description	Start Freq	Stop Freq	Noise Power	Noise Spectral Density	Noise Flatness	Signal Loss
ANG5300		2000 MHz	18000 MHz	-10 dBm	-80 dBm/Hz	6 dB P-P	NA
OPT002	Signal Input and Combiner	2000 MHz	18000 MHz	-5 dB *	-5 dB *	6 dB P-P	5 dB
OPT004	"0 dB" Carrier Path Loss	2000 MHz	18000 MHz	NA	NA	NA	0 dB
OPT007	C/N Option	2000 MHz	18000 MHz	0 dB *	0 dB *	6 dB P-P	0 dB
OPT007A	C/N & Power Sensor Port	2000 MHz	18000 MHz	-1 dB *	-1 dB *	6 dB P-P	1 dB

** denotes: Noise Spectral Density = dB from base model*

General Specifications:

- Operating Temp: 0 to +70° C
- Supply Voltage: 90-240V, 50/60 Hz, (auto sensing)
- Temp. Stability: 0.025 dB/°C
- Output Impedance: 50 ohm
- Crest Factor: 15 dB
- Attenuation: 0 to 100 dB, in 1 dB steps (optional 0.1 dB steps)
- Dimensions: 20" x 17" x 5.25" (3U rack)
- Weight: 25 lbs maximum
- Dimensions: 12" x 19" x 5.25”
- CE Compliant: ISM 1-A

Appendix A

Ratio Modes:

E_b/N_o: This is the most commonly used ratio for systems using digital modulation. Most digital modulation schemes are conventionally specified in terms of theoretical BER vs. E_b/N_o performance. Modems typically have a spec in which actual performance must be within some amount of theoretical. E_b is calculated by the following expression:

E_b= C/(data rate) Eqn 1: (linear expression)
E_b= C-10log(data rate) Eqn 2: (decibel expression)

The ANG requires the operator to enter in the data rate.
The ANG measures the signal power, normalizes it to the output port and displays the results. The user enters in the desired ratio and the instrument automatically makes the conversion using Eqn 2. As both E_b and N_o are expressed in units of dBm/Hz, the ratio is dimensionless and is expressed simply in dB. Typical testing requires set ratios in the range of 3 to 12 dB.

C/N Mode: This mode of operation is traditionally used in analog radios where N is the receiver or channel noise equivalent bandwidth. In this mode, the operator enters in the noise equivalent bandwidth of the channel under test. The operator then enters in the desired ratio of the carrier power C to the noise power N in this channel bandwidth. The ANG automatically normalizes the noise to the user's entered channel bandwidth to achieve the correct ratio. Mathematically, the expression is:

$N = N_o$ * Bandwidth Eqn 3: (linear expression)
$N = N_o$ +10 log(Bandwidth) Eqn 4: (decibel expression)

As in E_b/N_o mode, the ratio is dimensionless and is expressed simply in dB. Typical ratio ranges are in the range of 10 to 40 dB.

C/N_o Mode: In this mode, there are no operator dependent variables. The C is measured and N_o is independent of bandwidth. As C is in units of power in dBm and N_o is in units of spectral density or dBm/Hz, the ratio is not dimensionless and in decibel form is expressed as dB*Hz.

Additional Handy Ratio Features:

1)* Dynamic display of signal power at the S+N output port
2) Display of bit energy, noise density, noise power in user specified BW, signal power, and E_b/N_o ratios, and S+N total power
3) Noise, Carrier and data rate increment function (one touch operation)
4)* Ratio Scaling: When enabled, dynamic ratio-scaling automatically preserves E_b/N_o (also C/N or C/N_o) ratio even if carrier power amplitude is fluctuating.
5) Noise on/off toggle button: At any time noise can be turned on/off (one touch operation)
6) User settable defaults for configuring the GUI
7) Duty Cycle feature: when selected, the user can enter in a duty cycle percentage and the instrument automatically scales the noise power to match the “signal on” state

* *denotes: requires OPT007A1*

How To Order

ANG5XXX - X

Instrument

Model:
(reference model chart)

Connector Type:
A= N (Female)
B= BNC (Female)
C= SMA (Female)

Options

ANG5XXX - OPTXXX

Model

Options

Below is an example of how to order an ANG5107 with BNC connectors and configured with 0.1dB attenuator and combiner options. This requires three separate line items.

Item #	Model #	Description	Qty
#1	ANG5107-B	ANG 100 Hz to 100 MHz	1
#2	ANG5107-B-OPT001	0.1dB Noise Step Size	1
#3	ANG5107-B-OPT002	Signal Input and Combiner	1

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