

# UFX-EbNo Series Precision Generators



**Precision  $E_b/N_o$  (C/N)  
Generators**

# UFX-EbNo Series Precision $E_b/N_o$

The UFX-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.

The UFX-EbNo gives system, design, and test engineers in the cellular/PCS, satellite and military communication industries a cost-effective means of obtaining higher yield through automated testing, plus increased confidence from repeatable, accurate test results.

## Features

### Multiple Operating Modes

The UFX-EbNo provides five 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), and power meter. The instrument can also be used as a precision noise generator.

### Custom Configurations

The UFX-EbNo is available in a variety of configurations to meet your specific testing needs. Applications include: military communications, WCDMA, SATCOM, NASA TDRSS, CableTV, HDTV, IS-95, CDMA, TDMA, UMTS, GPRS L-band modems, Milstar, Inmarsat, Intelsat, and general purpose.

### Direct Display of $E_b/N_o$ , C/N, C/I, or $C/N_o$

The 4 x 20 VFD screen provides simultaneous readout of all significant input and output signal levels relating to the chosen operating mode, including carrier-to-noise ratios.

### Accuracy of 0.2 dB RSS

A special, large-dynamic-range power meter measures both the signal and the noise, which allows the UFX-EbNo to set the desired ratio to within  $\pm 0.2$  dB. Special configurations can provide improved accuracy.

### Bit Rate Entry of 1 bps to 999 Mbps and above

In bit energy-to-noise density testing ( $E_b/N_o$ ), the instrument automatically calculates noise density based on the user-specified bit rate.

### Variable Output Power

Output power is user-specified and can be set within the range of  $-55$  dBm to  $+5$  dBm.



### True RMS Power Meter

The digital power meter is custom designed to cover the frequency range of the particular instrument. It can measure signals and noise accurately with Gaussian Noise crest factors up to 18 db.

### Direct Testing at both RF and Microwave Frequencies

In configurations that cover two separate frequency ranges, measurements can be made directly without the need for special conversion circuitry.

### Optional Tracking Feature

This function is intended for users with an unstable input signal source who wish to perform accurate long-term testing at a specified  $E_b/N_o$  ratio. The tracking option works as an automated gain control (AGC) device, correction for input signal drift up to 0.2 dB resolution. The carrier output level is kept constant and, therefore, so is the  $E_b/N_o$  ratio.

## Setting Precision C/N Ratios

The UFX-EbNo accurately sets carrier-to-noise ratios using the substitution calibration method. This method eliminates the effects of any non-linearity in the measuring device, in this case the power meter, by setting the signal and the noise to the same power level at the power meter input. (See the functional block diagram). The noise power is then offset by the desired ratio. The primary source of inaccuracy within the unit is the attenuator that varies the noise power, and Noise Com uses the most accurate components available. Secondary effects such as thermal drift are negligible since the noise and the power are measured within a very short time frame.

Active components in the instrument that could be attributed to long-term drift are common to both the signal and noise path, so variations in these components do not affect the calibrated ratio. The unit's linear phase and amplitude signal path ensures that the desired signal passes through undistorted.

# (C/N) Generators

Since the UFX-EbNo automatically compensates for parameters like bit rates and bandwidth, taking measurement is as simple as pressing a button.

Operating modes, function and parameters are set using the front panel controls.

**Meter** – In this mode, the instrument functions as a true RMS power meter, and uses various averaging methods to ensure more accurate readings. Measurements are made through couplers, allowing the signal to pass through to the output connector unaltered by the meter circuitry.

**$E_b/N_0$**  – The instrument automatically sets up a desired  $E_b/N_0$  quickly and accurately. Based on the user-specified carrier output level, output  $E_b/N_0$  ratio, and bit rate, the instrument automatically calculates the required noise density.

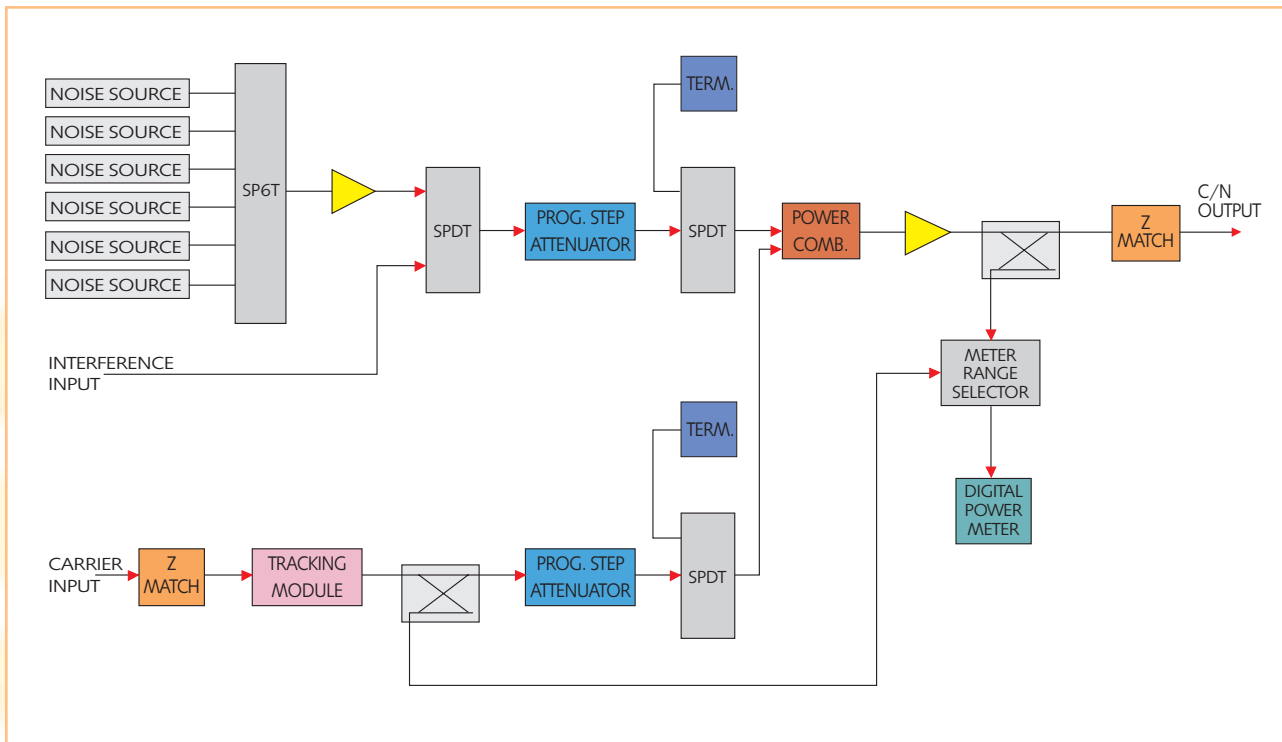
**C/N** – This mode sets the specified carrier output level and the total noise power in the system bandwidth to the desired ratio.

**C/N<sub>0</sub>** – To obtain a specific C/N<sub>0</sub> ratio, set the instrument to  $E_b/N_0$  mode and enter zero for the bit rate. All other functions are the same as the  $E_b/N_0$  mode.

**GEN** – The instrument can also function as a precision noise generator. Simply select the mode and enter the required noise density. The unit's internal noise source provides the desired signal.

**Status Indicators and Display Screen** – Front panel indicators and the 4 x 20 VFD display provide constant feedback on the instrument state and settings.

**Data Entry and Function Selection** – Instructions and data are easily entered through the front panel keypad. The instrument can also be controlled through the standard rear panel IEEE-488-2, optional Ethernet, TCP/IP, or optional RS-232C, RS-422 or RS-423 interfaces.



**Simplified Functional Block Diagram**

The internal AWGN precision noise source is summed with the user supplied carrier signal. The unit generates extremely precise  $E_b/N_0$  ratios over a broad range of input or output power.



# Specifications

## Operating modes

Carrier-to-noise (C/N), carrier-to-noise density (C/N<sub>0</sub>), bit energy-to-noise density (E<sub>b</sub>/N<sub>0</sub>), 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<br>±0.3 dB for 140 MHz ±40 MHz<br>±0.4 dB for others |
| Group delay:                 | ±0.20 ns/40 MHz for frequencies above 20 MHz                                    |
| Third-order intercept point: | +29 dBm typical   |
| Tracking range (Ubopt01):    | +4 dB to -4 dB  |
| Tracking update rate:        | 100 milliseconds, nominal   |

## Noise path

|                     |  |
|---------------------|--|
| Output power range: | -55 dBm to +5 dBm  |
| Flatness:           | ±0.2 dB/40 MHz<br>±0.3 dB/80 MHz<br>±0.4 dB/200 MHz<br>±0.5 dB/300 MHz |
| Attenuation range:  | 60 dB in 0.25 dB steps<br>(0.1 dB steps with Ubopt06)                  |

|                       |                          |
|-----------------------|--------------------------|
| <b>Ratio accuracy</b> | ±0.2 dB RSS, ±0.3 dB WCU |
|-----------------------|--------------------------|

|                          |                   |
|--------------------------|-------------------|
| <b>Power meter range</b> | -55 dBm to +5 dBm |
|--------------------------|-------------------|

|                             |         |
|-----------------------------|---------|
| <b>Power meter accuracy</b> | ±0.5 dB |
|-----------------------------|---------|

|                              |   |
|------------------------------|---|
| <b>Power meter averaging</b> | 10 to 65,535. Each sample requires approximately 2.2 milliseconds |
|------------------------------|---|

|                |                    |
|----------------|--------------------|
| <b>Control</b> | Local and IEEE-488 |
|----------------|--------------------|

|                            |  |
|----------------------------|--|
| <b>Baud rate (Ubopt04)</b> | 150, 300, 600, 1200, 2400, 4800, and 9600 to be used with optional serial interface ports (8 data bits, no parity, 1 stop bit) |
|----------------------------|--|

|                         |  |
|-------------------------|--|
| <b>Interferer input</b> | -4 dBm ±2 dB. Frequency range is equal to the noise bandwidth. |
|-------------------------|--|

|                      |  |
|----------------------|--|
| <b>RF connectors</b> | BNC-75Ω below 800 MHz, N-type female 50Ω above 800 MHz |
|----------------------|--|

|                            |                  |
|----------------------------|------------------|
| <b>DC on RF connectors</b> | 0 volts, maximum |
|----------------------------|------------------|

## Primary power

|             |                 |
|-------------|-----------------|
| Voltage     | 85 to 264 VAC   |
| Frequency   | 47 to 63 Hz     |
| Consumption | 2 amps, maximum |
| Fuse        | 2 A             |

|                              |             |
|------------------------------|-------------|
| <b>Operating temperature</b> | 0° to 50° C |
|------------------------------|-------------|

|                   |                           |
|-------------------|---------------------------|
| <b>Dimensions</b> | 17" W x 5.25" H x 17.5" D |
|-------------------|---------------------------|

Specification values apply following a 30 minute warmup. Specifications subject to change without notice.

# Ordering Information

| Model Number*                    | Frequency Range                                      | Applications                   |
|----------------------------------|--|--------------------------------|
| UFX-EbNo-45                      | 5 to 90 MHz  | General Purpose                |
| UFX-EbNo-70                      | 50 to 90 MHz   | General purpose/<br>SATCOM     |
| UFX-EbNo-IF1                     | 50 to 90 MHz and<br>100 to 180 MHz                   | Intelsat, SATCOM               |
| UFX-EbNo-IBS/IDR                 | 50 to 90 MHz,<br>68 to 72 MHz, and<br>100 to 180 MHz | Intelsat, SATCOM               |
| UFX-EbNo-255                     | 240 to 270 MHz                                       | SATCOM                         |
| UFX-EbNo-370                     | 350 to 390 MHz                                       | NASA TDRSS                     |
| UFX-EbNo-CATV                    | 50 to 860 MHz<br>in 4 bands                          | Cable TV                       |
| UFX-EbNo-750                     | 650 to 850 MHz                                       | Iridium                        |
| UFX-EbNo-892                     | 822 to 962 MHz<br>IS-136 (TDMA)                      | IS-95 (CDMA),<br>IS-136 (TDMA) |
| UFX-EbNo-892/1850                | 822 to 962 MHz<br>& 1710 to 1990 MHz                 | Dual-band CDMA                 |
| UFX-EbNo-1200                    | 950 to 1210 MHz<br>& 1190 to 1450 MHz                | L-band modems                  |
| UFX-EbNo-1545                    | 1530 to 1560 MHz                                     | Inmarsat                       |
| UFX-EbNo-1850                    | 1710 to 1990 MHz                                     | J-STD-008 (CDMA)               |
| UFX-EbNo-2050                    | 1900 to 2200 MHz                                     | Wideband CDMA                  |
| UFX-EbNo-2442                    | 2400 to 2484 MHz                                     | 802.11b Wireless LAN           |
| UFX-EbNo-5500                    | 5000 to 6000 MHz                                     | 802.11a Wireless LAN           |
| UFX-EbNo-20000                   | 18 to 22 GHz   | Military                       |
| Custom Frequency Ranges to 44GHz |  |                                |

| Option Number | Description  |
|---------------|--|
| UEopt01       | Automatic gain control to maintain constant carrier power level (Tracking) |
| UEopt03       | 50Ω input and output impedance**   |
| UEopt04       | RS-232C, RS-422, or RS-423 interface***                                    |
| UEopt05       | 230 VAC, 50 Hz   |
| UEopt06       | 0.1 dB/step on output noise and C/N  |
| UEopt07       | Uninterrupted Carrier during E <sub>b</sub> /N <sub>0</sub> calibration    |
| UEopt08       | Dual Channel   |
| UEopt09       | Ethernet, TCP/IP remote interface  |
| UEopt10       | 0.01dB attenuation, E <sub>b</sub> /N <sub>0</sub> resolution****          |

\* Call Noise Com regarding custom configurations

\*\* Below 800 MHz, standard impedance is 75Ω. Above 800 MHz, 50Ω is assumed.

\*\*\* In addition to standard IEEE-488-2

\*\*\*\* Not available on all models

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