

# “EVIL” SIGNAL SATELLITE SIMULATOR.



The “Evil” Signal Satellite simulator, originally developed in conjunction with Thales Avionics Ltd. and NovaTel Inc. for the EGNOS RIMS C development is now available from WED Ltd

## The “Evil” Signal Satellite Simulator.

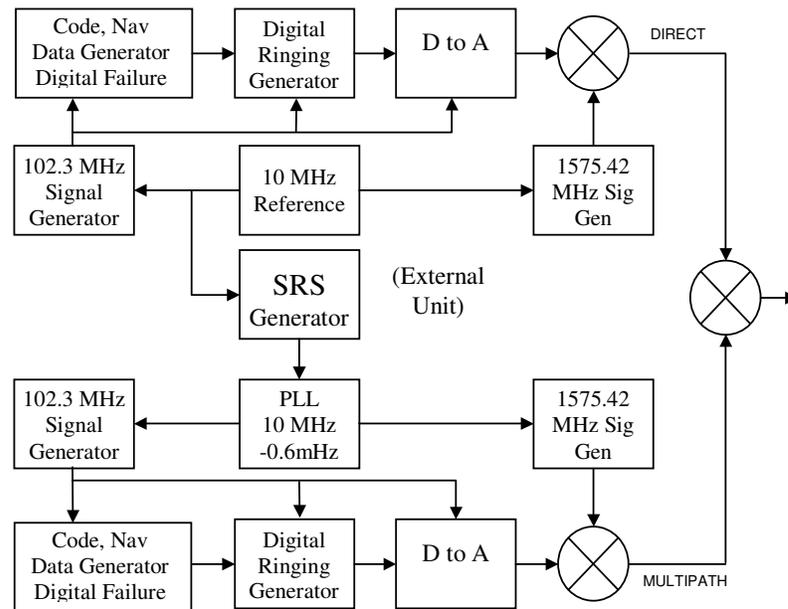
The “Evil” signal satellite simulator generates a single Navstar GPS satellite L1 C/A code only signal that can be degraded with simulated fault conditions in both the digital and analogue domains as defined in ICAO SARPS. The system comprises a 2U 19” rack unit and PC based control software designed to run in a Window 95, 98 or NT environment. The software offers complete control over the hardware functions and the definition of “evil” waveform threat models.

The simulator generates a single satellite signal of any chosen PRN ID. and the “evil” waveforms required are chosen by entering the variables of  $\Delta\tau$ ,  $\sigma$  and  $f_d$ , which are implemented directly and can be set to any value (or beyond) those conditions defined within ICAO SARPS. A simple navigation data message is generated from a file produced from “off air” data. The TOW and Week No., however, can be initialised to any values for test runs and will update continuously. The L-band signal also has two inputs for the addition of L-band noise or other interference. Programmable attenuators allow wide ranges of signal output levels and external input levels to be accommodated.

The simulator also incorporates a second generator system to allow for variable rate, delayed phase, multipath simulation with usable stability for phase rates of  $\geq 0.1$  Hz. at 1575.42 MHz. Separate programmable attenuators on each channel allow full variation of direct/delayed signal strengths with 1dB resolution over a 127dB range.

The 19” rack mount unit has I/O to output 1 pps synchronising signals, frequency reference input and output, noise inputs etc. The hardware is connected to the PC control software via a standard RS232 port. This interface also uses a proprietary programming algorithm to reconfigure the logic within the unit by using high speed FPGA technology. This will enable most hardware upgrades to be implemented by simply updating a PC file.

The simplified functional block diagram below shows the main aspects of signal generation in the design.



The simulator has comprehensive signal monitors:-

**Baseband Monitors A and B** - monitor the baseband waveform generated from both the direct and multipath signals.

**RF Monitors A and B** – monitor the L-band signals prior to combining noise or other inputs. The level is dependent on the channel A and B attenuator settings.

**1 pps monitors A and B** – output a 1 pulse per second signal associated with their channel. This signal is synchronised to the respective PRN generators.

**Noise inputs A and B** – are two inputs for external noise or other interference at L-band. They are not associated with channels A and B and only affect the main L-band output.

## Software

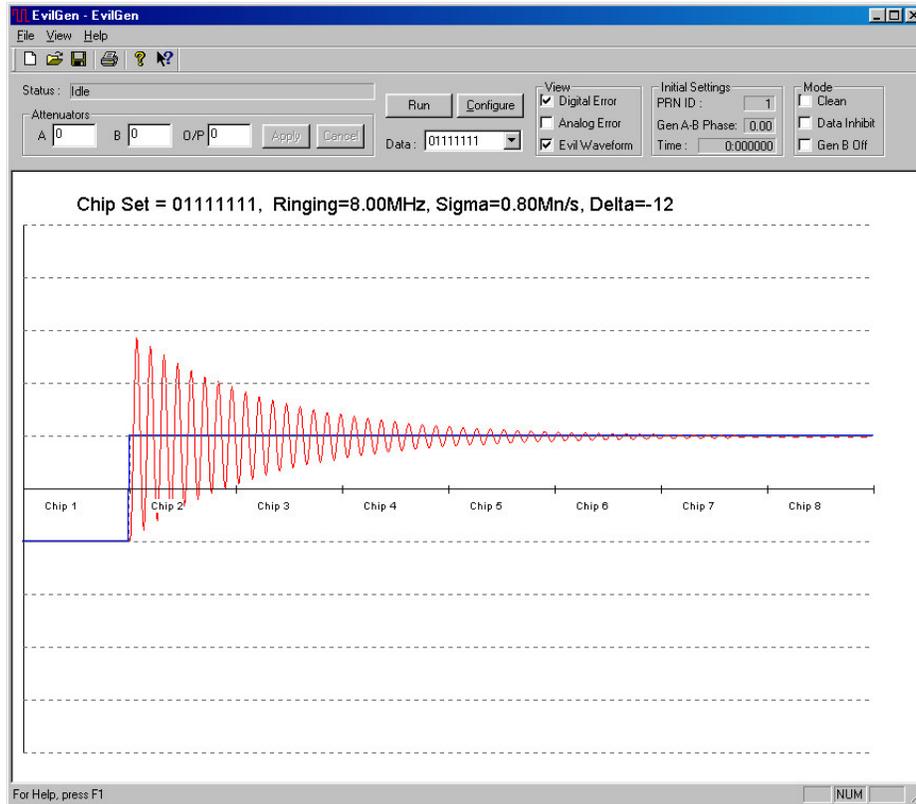
The software included in the system comprises a simple executable file with ancillary files for navigation data, FPGA programming etc. The software does not require registry installation and can simply be run from any Windows 95,98 or NT platform. A free serial port is required.

The software allows complete set up of the hardware and definition of the “Evil” waveform. The actual analogue waveforms and digital delays are calculated and transferred to memory in the 19” rack unit on commencement of tests. Certain data is fixed for the duration of any test but many other parameters can be changed dynamically, E.g. Attenuator settings, Multipath (Generator B) on/off, Nav data on/off and Evil or clean waveform selection.

A sample pseudo random waveform can be entered up to 8 bits in length, which can be viewed on screen to see the effects of the various “evil” parameters. The transition energy (ringing) is calculated for 6 bits of the PRN so that waveforms may accumulate more amplitude than a single transition. The remaining energy after 6 bits

duration is ignored as it's level is minimal. This display may be printed to any windows installed printer. In addition the waveform data can be written to a CSV file so that it can be analysed by other software. Test parameter sets may also be saved for future use.

The start up screen is shown below.



The configuration of the “evil” waveform is entered in the dialogue box shown below. This also allows for an initial delay between generators A and B. This is useful if a problem is identified at a particular delay so it can be reproduced quickly (rather than possibly several hours into a test).

The 'Configure Waveform generator' dialog box contains the following fields and options:

- Ring Frequency: 8 MHz  Enable
- Sigma: 0.8 M Nepers/second
- Delta %: -12
- PRN ID: 1
- Port:  COM1,  COM2,  COM3,  COM4
- Initial Conditions:
  - Time of Week: 0
  - Week No.: 0
  - Gen A-B Phase: 0

Buttons: Cancel, OK

## Technical Specifications

Power Input.	85 to 264 Vac. 47 to 440 Hz.
Frequency Accuracy.	1 part in $10^7$ (recalibrate each year)
Int. Reference Stability.	1 part in $10^{11}$ (1s and 10s)
Int. Reference output.	10 MHz. @ +7dBm, 50 Ohm.
Ext. Reference input.	10 MHz. @ +3 to +13dBm, 50 Ohm
Baseband monitor output.	20mV Nominal square wave @ 50 Ohm in “clean” mode
L-band monitor outputs.	Max. -60dBm nominal @50 Ohm. Level depends on attenuator settings.
Noise input.	Max input +5dBm @ 50 Ohm. Much lower levels will be normal!
1ppS.Output.	3.3 Volt CMOS output. Rising edge is delayed 2 chips from PRN start.
R.F. Output.	Max. output -40dBm nominal @50 Ohm. Level depends on attenuator settings.
LED Monitors	PLL lock - Red LED    Power on. - Green LED
Channel B Stability.	Dependent on function generator. SRS DS345 generator permits good stability for phase rates of $\geq 0.1$ Hz. at 1575.42 MHz.

## Options.

Option A.	Modifications to allow generation of GEO satellites. Please contact for further information.
Option B.	Dedicated function generator design to allow slower multipath phase rates. Target usable phase rates $\geq 0.005$ Hz. at 1575.42 MHz. Please contact for further information.

## Contact.

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