

Satellite to Ground Station and Satellite to Satellite RF Link Testing

Satellite Link Emulator 9000 series

SLE9072, 72MHz bandwidth

SLE9125, 125MHz bandwidth

SLE9250, 250MHz bandwidth

The latest Satellite Link Emulator from dBm provides a cost-effective, time-saving, repeatable total solution for satellite and aircraft RF link testing. Accurate simulation of propagation delays, flat fading, path loss, phase shift and Doppler shifts let systems engineers create realistic, full-duplex path scenarios for closed-loop testing of satellites, ground processing equipment, and mobile transceivers. The SLE may be configured with up to four independent channels and operates at IF of 70 or 140MHz (L-band for the high bandwidth model) . Optional internal L-band and external C, S, X and Ku, Ka band RF converters may be added to expand the frequency range.

Test parameters can be entered via the touch sensitive graphical front panel, by downloading files from internal flash memory or by downloading data through the Ethernet port.

The powerful DSP engine in the SLE9000 series allows optional Rayleigh and Rician multipath fading (up to six paths per channel) and digital additive White Gaussian Noise impairment to be added to the link. The propagation delay of the SLE may be changed under program control and will maintain phase continuity under varying delay conditions. Time varying delay creates carrier frequency shift and chip period variations, allowing “real-world” simulation of Doppler shift resulting from a satellite overpass and aircraft movements..



RF Test Equipment for Wireless Communications



Applications

Typical applications for the SLE include:

- ◆ Earth terminal testing
- ◆ Satellite payload testing
- ◆ Satellite system integration test beds
- ◆ Mobile transceiver testing
- ◆ UAV Testing

Optional

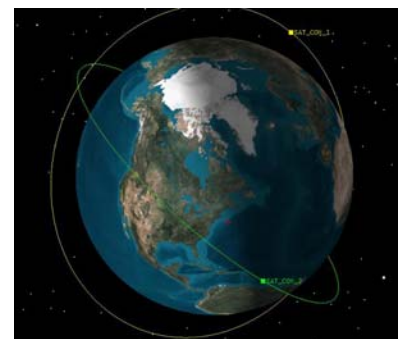
- ◆ Multipath Fading, 6 paths
- ◆ Digitally generated AWGN

Multiple Orbit Models

Emulates earth-to-satellite-to-earth, earth-to-satellite links; Low Earth Orbit; Medium Earth Orbit, Geostationary and Geosynchronous, satellite to satellite links and satellite to UAV testing.

Test Data Generation

dBm's standard SATGEN software data generation package or Analytical Graphics STK™ package may be used to generate the necessary test data. SLEControl, a windows based applet will automatically format download the test files for execution in dynamic mode.



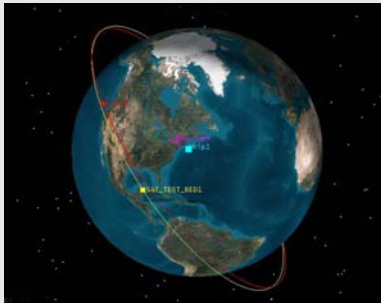
The Emulation Process

For each individual channel, the signal is demodulated into its I and Q components and directly digitized at baseband using 12 bit (10 bit for ultra bandwidth model) A/D conversion. The digital signal passes through FIFO memory to achieve the desired delay emulation. A powerful DSP engine is employed to add other optional impairments such as Rayleigh and Rician multipath fading (six paths per channel) and digitally generated additive White Gaussian Noise (AWGN) for BER testing. The delayed digital I and Q signals are then applied to a 12-bit D/A converters. The analog I and Q signals are then remodulated and a DDS based synthesized local oscillator is used to create frequency offsets and phase shifts as the signal is up converted back to its original IF frequency. The output signal is filtered to remove the local oscillator and other spurious signals. Finally, a variable RF attenuator is used to emulate path loss and flat fading. The 72MHz bandwidth model supports IF of 70MHz or 140MHz. The 125MHz model supports IF of 140MHz and the ultra high bandwidth 250MHz model is directly upconverted back to tunable L-band IF. Optional internal L-band RF up/down may be configured and a wide range of external RF up/down converters can also be used to provide C,S, X, Ku/Ka band operation.

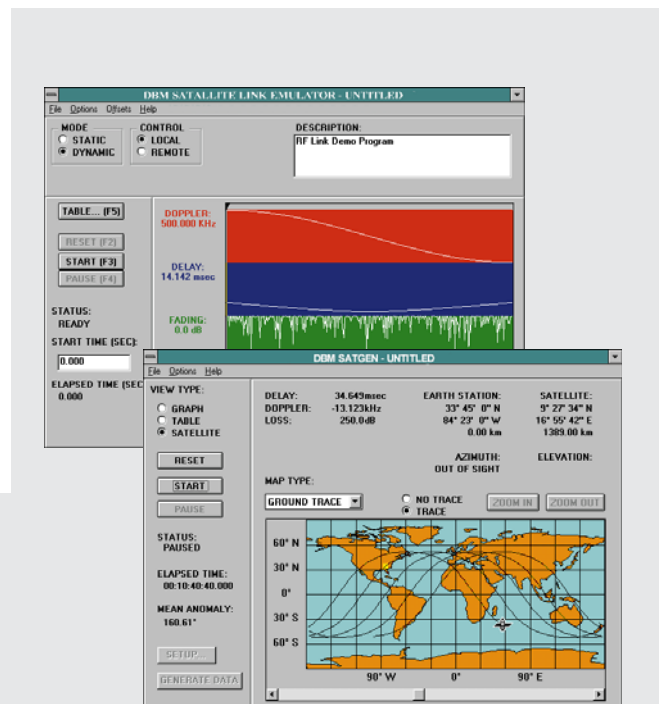
Modeling Software

SATGEN, a GUI-based data generation program, is programmable for virtually any orbit and ground station coordinates. Popular satellite systems such as Iridium®, Globalstar®, ICO® and Inmarsat®, plus multiple ground station coordinates and path loss models are pre-set. SATGEN uses these models to generate data files for the SLE to simulate complex communications paths between an orbiting satellite and a ground station. SATGEN also generates files for satellite coordinates and velocity and runs directly on any Windows® based computer.

In addition The SLE9000 series can also use the STK™ satellite modeling software from Analytical Graphics to generate sophisticated modeling data files for emulation of satellite to satellite communications, UAV's, and other moving terminals such as ships and COM's on the move.



Typical STK™ graphics



Typical SATGEN Screens

RF Converters

dBm offers an extensive range of external multi-channel RF Up/Down frequency converters to extend the use of the SLE9000 satellite link emulator to operate at a wide variety of end to end testing at actual operational RF link frequencies.

All frequency converters are controlled via ethernet and IEEE-488 control as standard. The converters come with dBm's UDCControl software to allow seamless and easy integration for a powerful test solution.



RF Test Equipment for Wireless Communications

Specifications

Model Number	SLE9072	SLE9125	SLE9250
Center frequency	70 & 140MHz	140MHz	950-1450MHz
1 dB RF bandwidth	72 MHz	125MHz	250MHz
Maximum delay per channel	1490ms	890ms	447ms
Number of independent channels	1,2, 3 or 4		
RF input power	-10 dBm max.		
RF output power	-10 dBm max. @ 0 dB attenuation		
In-band spurious suppression	>40 dBc @ -10 dBm input, 50 dBc typical		
Noise floor	-148 dBm/Hz typical		
Amplitude ripple	<1.0 dB p-p		
VSWR	<1.2:1 max into 50 ohms		
Delay			
Resolution Static	0.1 ns		
Dynamic	0.5ps		
Slew rate	3×10^{-15} sec/sec up to 20 us/ms		
Relative accuracy	± 1 ns plus 10 MHz reference error		
Doppler			
Range	± 3.0 MHz		
Resolution	0.01 Hz		
Accuracy	based on 10 MHz reference ± 0.01 Hz		
Attenuation			
Range	0 dB to 40 dB		
Resolution	0.1 dB		
Slew rate	>40 dB/ms		
Accuracy	$\pm (0.25 \text{ dB} + 3\% \text{ of setting})$		

Additive White Gaussian Noise (Option)

Crest Factor	> 16 dB
Repetition Interval	>24 hrs
PDF accuracy	< 0.2 % from theoretical Gaussian over ± 7 sigma
Noise Bandwidth	exceeds IF bandwidth
Spectral Density Flatness	< 0.1 dB p-p max
Noise Density Amplitude Range	Full scale to -42dB and off
Noise Density Amplitude Resolution	≤ 0.01 dB
Noise Density Amplitude Accuracy	$\leq \pm 0.01$ dB



Specifications Con't

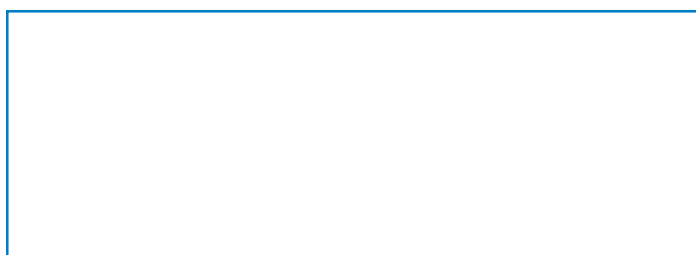
Multipath Fading (Option)

# of Paths	6
Path Characteristics	
Probability Distribution Types	CW, Rayleigh, Ricean, Crane and off
Spectral Distribution Shape (Ray, Rice)	$\{\text{SQRT}\{1-(f/f_d)^2\}^{-1}$ with 0 dB, 3 dB and 6 dB peak @ f_d
monotonic rolloff	less than -30 dB @ $2f_d$
PDF	within 0.5 dB of theoretical from 10 dB
	above to 30 dB below mean
Level Crossing Rate	$< \pm 2.5\%$ from theoretical, -30 dB to +9 dB
Correlation	0 to 100%, 1% steps
Ricean K factor	0 to 15 dB
Attenuation Range	0 to 30 dB
Attenuation Resolution	≤ 0.1 dB
Doppler Spread	0 to 12 kHz
Doppler Resolution	≤ 0.1 Hz
Delay Range	0 to 15 usec
Delay Resolution	1 ns

Control and Interface

Local	touch sensitive graphical Front panel display and keypad
Remote	RJ45, IEEE-802.3
Real time update	
(using data file)	1 ms to 1 sec
(using TCP/IP command)	10ms
Data file size	to 1.8 million samples/file
Primary power	
Voltage	90 – 264 VAC autoranging
Frequency	48 – 66 Hz
Consumption	300 VA max.
Fuse	4A slow-blow
Operating ambient temperature	+10°C to +50°C
Dimensions	17.625"W x 7"H x 21"D

Distributor



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