specs

Satellite to Ground Station and Satellite to Satellite RF Link Testing

Satellite Link Emulator

SLE9072, 72MHz bandwidth
SLE9125, 125MHz bandwidth
SLE9250, 250MHz bandwidth

The Satellite Link Emulator from dBm provides a cost-effective, time-saving, repeatable total solution for satellite to ground station 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 an 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" stimulation of Doppler shift resulting from satellite overpass and aircraft movements.

dBm

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

Features

- Multipath Fading, 6 paths
- Digitally generated AWGN
- TCP/IP LAN standard

Multiple Orbit Models

Emulates earth-to-satellite-to-earth, or 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

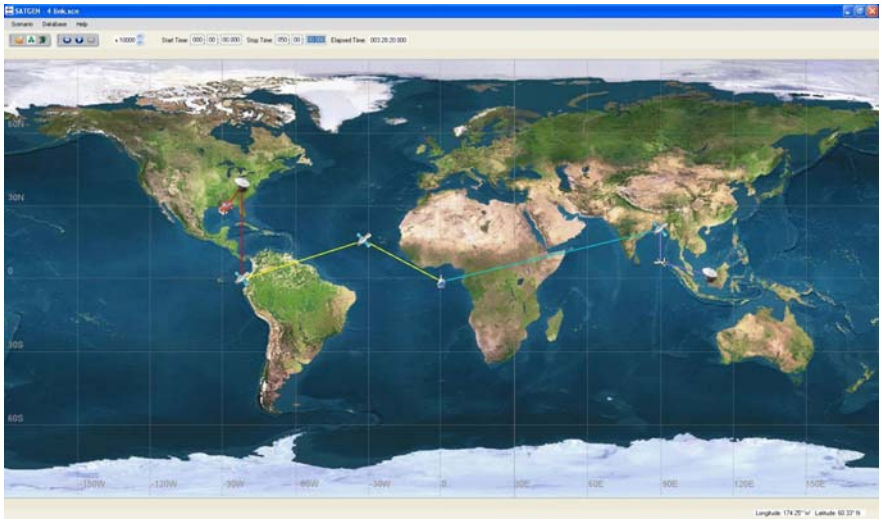
dBm's standard SATGEN software data generation package or Analytical Graphics STK™ package may be used to generate the necessary test data. SLEControl, a windows based applet will automatically format and download the test files for execution in dynamic mode.

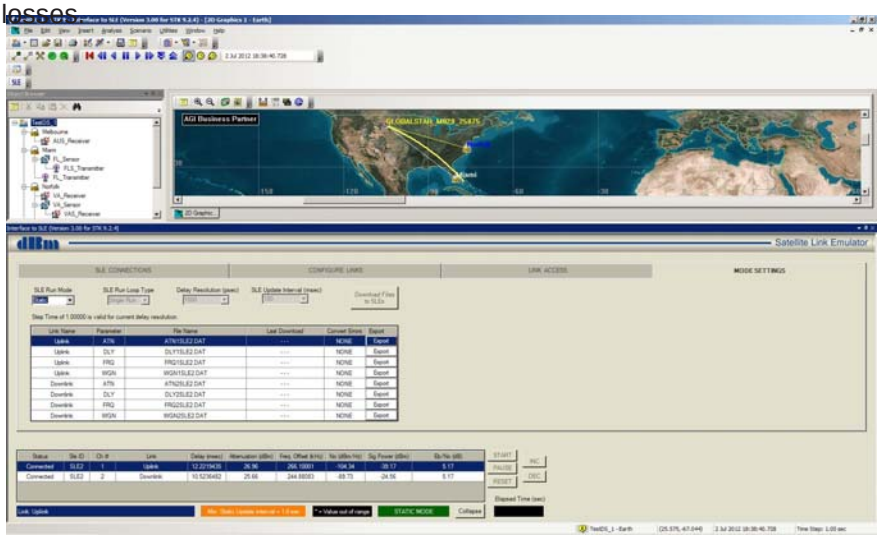
The Emulation Process

For each channel, the signal is demodulated into its I and Q components and directly digitized at baseband using 12 bit 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 16 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. The 72MHz bandwidth model supports IF of 70MHz or 140MHz. The 125MHz model supports IF of 140MHz and the ultra high bandwidth 250Mhz model operates at 1200MHz. Optional internal L-band RF up/down converters 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

dBm's latest satellite orbit modeling software, SATGEN II, generates link parameter files formatted specifically for the SLE. The new SATGEN offers an enchanced graphic interface which easily identifies when transceivers are within line sight communication. Up to 8 transceivers can be configured for each channel. Types of transceivers include fixed earth terminals, ground vehicles, ships, and aircraft, all which can be programmed to move along a defined path with variable velocity. The capability to model any satellite orbit is carried over from the previous SATGEN version. SATGEN generates files for delay, Doppler, and path loss. A new sophisticated path loss model includes atmospheric gas losses as a function of frequency, temperature and humidity, in additional to the free space losses.





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

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 for a wide variety of end to end testing at actual operational RF link frequencies.

All frequency converters have standard ethernet and IEEE-488.2 control interfaces. 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

Satellite Link Emulator

Specifications

Model number	SLE9072	SLE9125	SLE9250
Center frequency	70 & 140MHz	140MHz	1200MHz
1 dB RF bandwidth	72 MHz	125MHz	250MHz
Maximum delay per channel	1400ms	890ms	890ms

Number of independent channels	1,2, 3 or 4
RF input power	0 dBm max.
RF output power	0 dBm max
In-band spurious supression	-55 dBc typ, -45 dBc max (5 dB degradation with 250MHz bandwidth)
Noise floor	-141 dBm/Hz typical
Amplitude ripple	<0.5 dB p-p, 1.5 dB p-p with 250MHz BW
VSWR	<1.5:1 max into 50 ohms

Delay

Range:	0.1 ms to: 1400 msec@72MHz BW 890 msec@ 125MHz BW 890 msec @ 250MHz BW
Resolution:	
Static mode	0.1 ns
Dynamic mode	0.5 psec
Slew rate:	3x10-15 sec/sec up to 20 us/ms
Relative accuracy:	± 1 ns plus 10MHz reference

Frequency offset

Range:	± 3.0 MHz
Resolution:	0.01Hz
Absolute accuracy:	based on 10MHz, reference ± 0.01Hz

Attenuation

Range:	0 dB to 70 dB
Resolution:	0.10 dB
Slew rate:	>70 dB/ms
Accuracy:	± 0.20 dB

Phase Offset

Range:	0 to 180°
Resolution:	1°
Accuracy:	<1°

Additive White Gaussian Noise

Crest factor:	>16 dB
Repetition Interval:	> 24 hrs
PDF Accuracy:	<1% from theoretical Gaussian over 6.666σ
Noise bandwidth:	same as signal passband
Spectral density flatness:	<0.1 dB p-p max
Noise density amplitude range:	-95 dBm/Hz typ, to instrument noise floor
Noise density amplitude resolution:	<=0.01 dB
Noise density amplitude accuracy:	<+/- 0.2 dB

Eb/No

Ratio range:	-14 dB to +58 dB
Ratio resolution:	0.01 dB
Rate accuracy:	+/- 0.2

Specifications Con't

Satellite Link Emulator

Multipath Fading	
No. of paths:	6
Path characteristics	
Dynamic profile update rate:	1 sec, affecting Doppler, delay, AoA, and attenuation
Distribution types:	CW, Rayleigh, Rician, and off
Spectral distribution shape (Ray, Rice):	{SQRT {1-(f/fd)$^{-1}$ with 6 dB peak @ fd
PDF:	within 0.5 dB of theoretical from 10 dB above to 30 dB below mean
Level crossing rate:	<+/-2.5% from theoretical, -30 dB to +9 dB
Attenuation range:	0 to 30 dB
Attenuation resolution:	0.1 dB
Doppler spread:	0 to 10KHz
Doppler resolution:	1Hz
Delay range:	0 to 20 usec
Delay resolution:	1ns
Riccean K factor:	-10 to 20 dB
K factor resolution:	1 dB
Correlation:	0 to 100%, 1% steps
Angle of arrival range:	0 to 180°
Angle of arrival resolution:	1°
Dynamic mode	
Profile update rate:	1, 2, 5, 10, 20, 50, 100, 200, 500, and 1000 msec
Dynamic parameters:	Delay, Frequency offset, Attenuation, AWGN, Multipath Fading, *Note: Update rate for multipath fading is fixed at 1000 msec*
Update rate accuracy:	based on 10MHz reference
Triggering:	front panel keypad, LAN, or external signal
Triggering accuracy:	synchronized to begin on the 2nd update clock after trigger
Dynamic data file memory size:	>50 Mbytes
Control and Interface	
Local:	Front panel
Remote:	RJ45, IEEE-802.3
Internal Frequency refernce error	< 2.5 PPM
Primary power	
Voltage:	90 – 264 VAC autoranging
Frequency:	48 – 66Hz
Consumption:	300 VA max.
Fuse:	4A slow-blow
Operating ambient temp	+10°C to +40°C
Dimensions	17" W x 7.0" H x 21" D
Weight	
1 Channel:	32 lbs, with option L: 35 lbs
2 Channel:	33 lbs, with option L: 39 lbs
4 Channel:	35 lbs, with option L: 47 lbs

Distributor

RF Test Equipment for Wireless Communications

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