specs

Satellite to Ground Station RF Link Testing

Satellite Link Emulator

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 a center frequency of 140 MHz (optional 70 MHz, and L, C, S and K-band with optional RF converters)

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

The SLE simplifies VSAT earth terminal testing and satellite channel impairment testing for Low Earth Orbit, Medium Earth Orbit, Geostationary and Geosynchronous systems and has been deployed on all the major satellite programs worldwide. The SLE is also optimized to operate with dBm's CNG series of precision carrier to noise generators, thereby allowing precisely controlled noise to be added to the RF link.

Phase Continuous Delay

The propagation delay of the SLE may be changed under Dynamic program control and will maintain phase continuity (crucial for CDMA applications) 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.

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

Features

Precision Test Models

Test scenarios are user-defined, based on ephemeris data or satellite orbit models.

Multiple Orbit Models

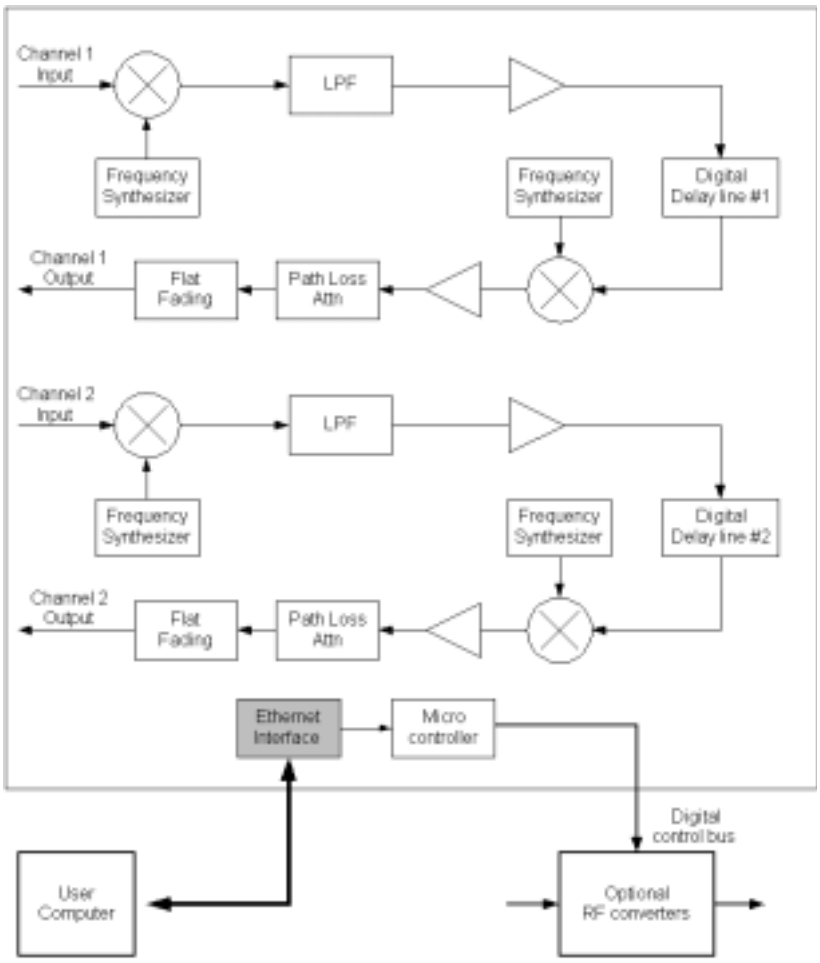
Emulates earth-to-satellite-to-earth, or earth-to-satellite links; Low Earth Orbit; Medium Earth Orbit, Geostationary and Geosynchronous

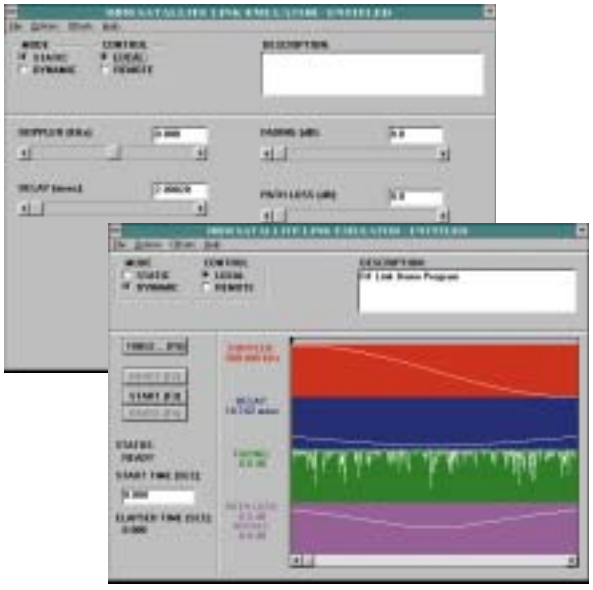
Two Operating Modes

In Static mode, link parameters are set to fixed values. In Dynamic mode, data files are used to vary the link parameters in real time.

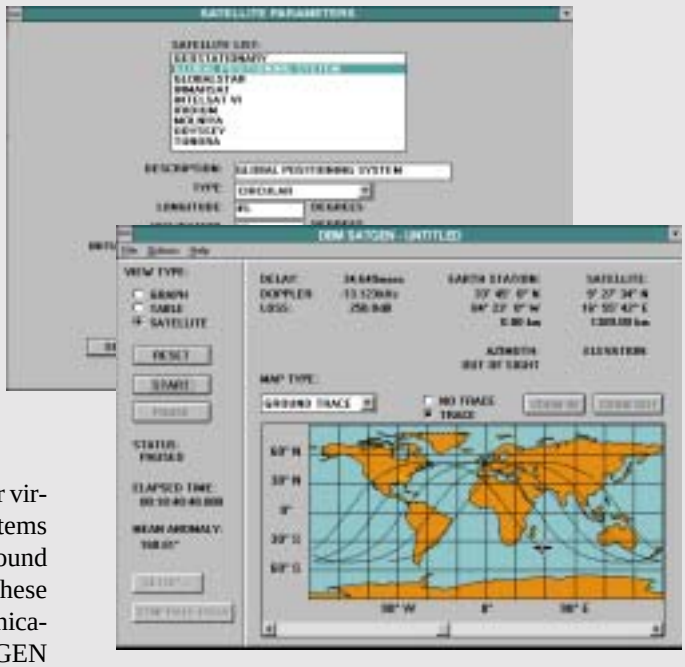
The Emulation Process

For each channel, as shown in the block diagram, the input RF signal is down converted using a DDS based synthesized local oscillator. The resulting baseband signal is then filtered and fed to a 12-bit A/D converter. The digital signal passes through FIFO memory to achieve the desired delay emulation. The delayed signal is applied to a 12-bit D/A converter. Alias components from the D/A converter are filtered and sin (X)/X compensation is achieved with a passive amplitude equalization network. 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 RF 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. optional RF converters may be added to provide L,C,S Ku/Ka band operation.





Typical SLE control Screens



Typical SATGEN Screens

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 the SLE or on any Windows® based computer.

Standard Instrument style shown

- Four independent RF channels
- Built-in microcomputer
- VFD Display
- Ethernet 10BaseT interface
- 10 MHz reference source input
- Up to Four delay channels
- Timing control interface
- Control interface for optional RF converters

RF Converters

dBm manufactures a wide range of RF Frequency Converters with optional AGC, AFC and internal or external local oscillators. Utilizing single, double, or triple conversion techniques, the dBm RF converter product line is ideally suited for rigorous satellite applications. The converter shown on the right is used to interface a satellite payload directly to an earth station modem. It translates over 2 GHz of bandwidth, at K-band, to a fixed 140 MHz IF. Dual frequency synthesizers allow separation of the uplink and downlink frequencies.

Carrier to Noise Generators

dBm offers a range of single and dual channel precision Carrier/Noise Generators to simulate noise impairments using AWGN. The power ratio of the carrier to noise (Eb/No) may be precisely and automatically programmed.

Turnkey Satellite Channel Simulator

dBm can provide a complete turnkey Satellite Channel Simulator System comprised of the SLE, Carrier/Noise Generator and an OEM multipath fading emulator to simulate real-world signal impairments between satellites and ground transceivers, handheld subscriber units, gateways and base stations. Up to four independent channels may be configured with each channel having up to six paths. Each path can be programmed for relative path delay, relative path attenuation and/or statistical fading models including Rayleigh and Rician.

Specifications

Center frequency option	70 or 140 MHz up thru K-band available with converter option
3 dB RF bandwidth	45 MHz
Number of independent channels	1,2, or 4
RF input power	-10 dBm max.
RF output power	-10 dBm max. @ 0 dB attenuation
In-band spurious suppression	>50 dBc
Noise floor	-125 dBc/Hz
Phase linearity	<5° p-p
Amplitude flatness	<1.0 dB p-p
VSWR	<1.2:1 max into 50 ohms
Delay	
Range	0.1 ms to 700 ms
Resolution	1 ns
Slew rate	$3x10^{-15}$ sec/sec up to 20 us/ms
Relative accuracy	± 1 ns plus 10 MHz reference error
Doppler	
Range	± 1.0 MHz
Resolution	1 Hz
Absolute accuracy	based on 10 MHz reference
Relative accuracy	± 0.1 Hz
Attenuation	
Range	0 dB to 40 dB
Resolution	0.25 dB
Slew rate	>40 dB/ms
Accuracy	± 0.5 dB/dB max.
Control and Interface	
Local	Front panel
Remote	RJ45, IEEE-802.3
Real time update	1 ms to 1 sec
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 +40°C
Dimensions	17”W x 5.25”H x 21”D

Ordering Information

Model No.	Frequency	Bandwidth
SLE700-1-70	70MHz	20 MHz
SLE700-2-70	70MHz	20 MHz
SLE700-4-70	70MHz	20 MHz
SLE700-1-70HBW	70MHz	45 MHz
SLE700-2-70HBW	70MHz	45 MHz
SLE700-4-70HBW	70MHz	45 MHz
SLE700-1-140	140MHz	20 MHz
SLE700-2-140	140MHz	20 MHz
SLE700-4-140	140MHz	20 MHz
SLE700-1-140HBW	140MHz	45 MHz
SLE700-2-140HBW	140MHz	45 MHz
SLE700-4-140HBW	140MHz	45 MHz

Options	Description
SATGEN	SLE data generation software

Satellite Link Emulator

Distributor

rev. 11/03-3

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