NOVELSAT

SAT-SIM SATELLITE CHANNEL SIMULATOR

For Satellite and
Network Validation

PRODUCT SHEET

EMULATE. VALIDATE. DEPLOY WITH CONFIDENCE.

The SAT-SIM delivers practical, physics-based satellite link emulation for developers, integrators, and test labs seeking to accelerate SATCOM system validation without the complexity and cost of over-the-air infrastructure. Built on a software-defined platform, SAT-SIM enables real-time simulation of satellite RF propagation conditions, including delay, Doppler, attenuation, noise, phase noise, and linear and non-linear effects, allowing for high-fidelity, repeatable test scenarios in a controlled lab environment.

Designed to ensure performance across diverse SATCOM systems, SAT-SIM supports up to 600 MHz of bandwidth and offers both static and dynamic modeling capabilities. SAT-SIM is ideal for evaluating link performance, stress-testing modems and waveforms, and verifying end-to-end system behavior. Compact, flexible, and easy to deploy, SAT-SIM delivers reliable, cost-effective validation capabilities for engineering labs, system integrators, and mission-critical testing workflows.

ADVANCED TOOLS FOR SATELLITE & NETWORK VALIDATION

SAT-SIM integrates key test and validation tools into a single compact platform—streamlining lab setups and enhancing precision, repeatability, and insight across SATCOM test environments. The system key features include:

- Satellite Channel Simulator
- Programmable Noise Generator
- Integrated Spectrum Analyzer
- Digital IF (future support)

With these tools, SAT-SIM provides real-time emulation and measurement of the full satellite link conditions, enabling high-fidelity simulation of key propagation effects, including:

- **Delay** – for modeling round-trip latency or variable propagation timing
- **Doppler Shift** – to simulate motion-induced frequency variation
- **Noise** – for degraded link testing and SNR stress evaluation
- **Signal Attenuation** – to simulate fading, path loss, or link degradation scenarios
- **Linear Filter effect** – for shaping distortion and channel selectivity
- **Non-Linear Effect** – such as compression, saturation, or amplifier distortion
- **Phase Noise** (future support) – for modeling oscillator instability and signal degradation

HIGHLIGHTS

- Real-time emulation of satellite channel impairments
- SDR-based platform with remote control and script automation
- Programmable AWGN noise generator
- Integrated spectrum analyzer
- Digital IF interface (future support)
- Up to 600 MHz channel bandwidth
- Static and dynamic modeling of delay, Doppler, noise, attenuation, linear and non-linear effects, and phase noise
- STK integration for dynamic trajectory-based channel simulation
- Single or dual-channel operation with high dynamic range and built-in amplifiers
- Internal and external clock reference support
- Compact, cost-effective solution for performance testing and validation

FLEXIBLE TEST SCENARIOS & OPERATION

SAT-SIM operates in the L-band and supports one RF channel with up to 600 MHz bandwidth, or two independent channels with up to 300 MHz each, allowing flexible simulation setups for a wide range of waveform and modem configurations. The advanced signal processing and wideband capabilities enable engineers to emulate diverse link conditions and behaviors for different waveform and modem configurations.

To support dynamic satellite modeling, SAT-SIM also integrates with Ansys STK, allowing direct use of satellite and terminal trajectory data for realistic, time-varying simulation scenarios.

In Noise Generator Mode, SAT-SIM digitally injects Additive White Gaussian Noise (AWGN) with a control range of up to 40 dB, and with a bandwidth of up to 600MHz (dual or single channel), depending on configuration. Engineers can use this feature to simulate degraded link conditions, interference environments, and signal resilience at varying signal-to-noise ratios.

SAT-SIM also includes a range of built-in tools to support comprehensive test workflows:

- Integrated amplifiers provide selectable 10 dB and 20 dB gain options for operating with low input signals
- High dynamic range input control using variable attenuators with up to 60 dB attenuation
- Graphical spectrum analyzer for real-time RF signal visualization and monitoring
- Support for both external and internal clock references
- Extended frequency range: while standard interfaces operate in L-band, optional front-end modules allow operation from 10 MHz to 6 GHz

With its broad configurability and advanced emulation capabilities, SAT-SIM empowers SATCOM developers to simulate, stress-test, and validate satellite system performance with precision and repeatability.

OPERATIONAL MODES

SATSIM supports three primary operating modes, designed to match a wide range of use cases:

- **Satellite Channel Simulator Mode**
  - **Static Mode** – Apply fixed values for delay, Doppler, attenuation, and noise to replicate constant link conditions. Ideal for benchmarking, regression testing, and waveform validation.
  - **Dynamic Mode** – Continuously update delay and Doppler based on real or simulated orbital and user movement. This mode supports realistic modeling of satellite motion (e.g., LEO passes) and dynamic channel behavior, including path loss variation and frequency offset changes.
- **Noise Generator Mode**
  Generate programmable AWGN with up to 40 dB control range, injecting noise into test paths to simulate degraded link conditions, interference environments, and validate overall system robustness.
- **Digital IF Mode (future support)**
  Enables sampling and streaming of digitized RF signals over 100 GbE, allowing integration with external hardware and signal processing platforms. Ideal for integration with high-speed digital systems, hardware-in-the-loop setups, or external channel modeling engines.

ROBUST TESTING CAPABILITIES

Ensure Your System Performance with a lab-grade solution built for:

- **Versatile Testing Scenarios** – SATCOM waveform validation, link stress analysis, modem interoperability, interference simulation, and dynamic propagation emulation
- **Optimizing Reliability and Efficiency** – Performance, resiliency, and real-world validation under mission-relevant conditions
- **Advanced Software-Defined Radio** – Flexible architecture supporting waveform evolution, multi-mode operation, and script-driven scenario automation
- **Wideband Channel Emulation** – Up to 600 MHz of emulated channel bandwidth in L-band, with optional future expansion across extended frequency range
- **Flexible Deployment** – 3U rack-mountable chassis with web-based GUI and integrated spectrum analyzer, ideal for automated lab environments and test suites

INTUITIVE WEB-BASED CONTROL

SAT-SIM features a modern, browser-based user interface designed for ease of use and full control. Users can configure, monitor, and operate all simulation parameters—delay, Doppler, noise, and attenuation—from any connected workstation, with no software installation required. Real-time visualization and status feedback streamline test setup, execution, and troubleshooting, making SAT-SIM ideal for integration into automated lab environments and multi-user workflows.
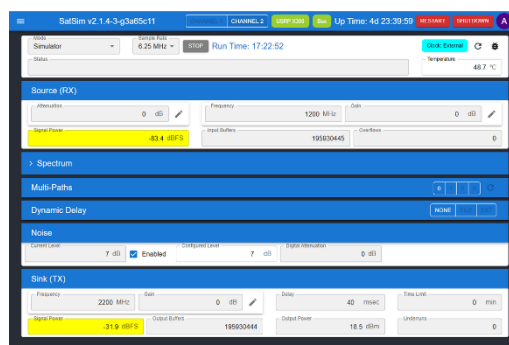
SAT-SIM SATELLITE CHANNEL SIMULATOR – SPECIFICATIONS

RF CHANNEL SIMULATION

Supported Bandwidth:
300 MHz (dual channel)
600 MHz (single channel)
Attenuation / Fading Range:
Up to 40 dB in 0.1 dB steps
Digital Attenuation Range:
Up to 60 dB in 0.1 dB steps
Output Signal Propagation Delay – Static:
1 µs to 500 ms in 40 µs steps
Output Signal Propagation Delay – Dynamic:
Up to 1 µs/sec
Output Signal Doppler Shift – Static:
±2 MHz in 0.1 Hz steps
Output Signal Doppler Shift – Dynamic:
Up to ±30 KHz/sec
Interference Generator:
Additive White Gaussian Noise (AWGN)
Channel Model:
AWGN (default)
Optional fading channel model for cellular-like scenarios
In-band Spurious Suppression:
< –50 dBc
External Trajectory Input:
Ansys STK integration for dynamic modeling

CHANNELS & FREQUENCY BANDS

Number of Channels:
1 or 2
RF Input Frequency Range:
L-band: 950 – 2150 MHz
Extended Range: 10 MHz – 6 GHz
RF Output Frequency Range:
L-band: 950 – 2150 MHz
Extended Range: 10 MHz – 6 GHz
Input RF Signal Power Range to Processing:
–40 dBm to –5 dBm
Output RF Signal Power Range:
–40 dBm to –5 dBm in 0.1 dB steps

PLATFORM & INTERFACES

Platform Type:
Software-defined radio (SDR)
Chassis:
19" rackmount, 2U, 40 cm depth
User Interface:
Web-based GUI
Management Port:
Ethernet 10/100/1000
Digital IF Interface:
100 GbE optical interface to external systems
RF Ports:
CH1 In/Out: SMA
CH2 In/Out: SMA
Clock & Timing Inputs:
10 MHz IN (sine, 0 dBm ±3 dB), SMA
1PPS IN (optional), SMA
Line Amplifiers:
Integrated 10 dB and 20 dB amplifiers

ENVIRONMENTAL & POWER

Operating Temperature Range:
+10°C to +40°C
Power Input:
230 VAC / 50 Hz

For more information visit
www.novelsat.com