GSS9000 Series
GNSS Constellation Simulators

Delivered | Proven | Trusted
The Spirent GSS9000 Multi-Frequency, Multi-GNSS RF Constellation Simulator Series sets a new standard of excellence in GNSS RF Simulation for R&D and performance test. The GSS9000 produces a comprehensive range of emulated multi-GNSS, multi-frequency RF signals with ultimate class-leading flexibility, coherence, fidelity, performance, accuracy and reliability.

The GSS9000 provides numerous benefits to all those working in high-end GNSS technology and application development, including comprehensive and feature-rich simulation and full control of all aspects of the GNSS operating environment, inherent repeatability and the ability to apply systematic errors and incidents that are impossible to realise using actual satellite signals.

A GSS9000 system comprises a Spirent C50r Host running Spirent’s powerful simulation software SimGEN™ and a highly-configurable signal generator able to meet all test needs. Multiple chassis can be combined to form an integrated, coherent signal generator if more signals or outputs are required. An extensive range of system extensions allows users to tailor the system to their specific needs, today and in the future.

**Ultimate Flexibility, Capability and Performance**

The GSS9000 supports an extensive range of constellation configurations, from GPS L1 through to multi-GNSS, multi-frequency systems including classified/restricted signals. Configurations are available that support multi-antennas and multi-vehicles, for example differential-GNSS, attitude determination, interference/jamming and spoofing and Controlled Reception Pattern Antenna (CRPA) testing.

The GSS9000 generates all carriers, ranging codes and data streams for the GPS, GLONASS, Galileo and BeiDou GNSS systems, plus SBAS, QZSS and IRNSS regional/augmentation systems. Additionally, data/messages for RTCM differential, GBAS/LAAS and A-GNSS are supported.

**Some of the GSS9000’s Key Attributes are:**

- Class-leading 1000Hz Simulation Iteration Rate (SIR) and Hardware update Rate (HUR) enabling real-time remote control and trajectory delivery with extremely low latency and simulation of ultra-high dynamic motion
- 160 channels plus 640 embedded multipath channels across 10 independent frequencies in one chassis
- Single RF version and dual RF version for differential-GNSS and multi-vehicle simulation
- 0.3mm RMS Pseudorange Accuracy, 120,000 m/s Relative Velocity
- Up to 10 outputs in one chassis for CRPA applications
- Highly flexible configurations selectable via a ‘cabinet’ of licence keys
- Complete portability of Spirent SimGEN™ scenarios
- In-field upgradeability of principal GNSS functionality and capability
- On-the-fly re-configuration of constellation and signal configurations
- Fully future-proofed for all advances in GNSS technology

**Comprehensive Modelling**

- Extensive multipath modelling
- Antenna gain and phase pattern
- Lever arm effects modelled
- Ionosphere and Troposphere modelling
- DGPS corrections
- Pseudorange ramps for RAIM testing
- ISCN support

**Unmatched Pedigree and Support**

- Regional support centre network
- E-mail, online and telephone support
- Regular software upgrades
- Knowledge base and on-line tracking system
- Every system includes deep and comprehensive features from nearly 30 years of GNSS testing experience
- Application notes and test methodologies
Complete Control
• Complete constellation and vehicle control
• Extensive motion and propagation models
• Highly flexible, with full defaults and error models
• Trajectory from internal vehicle models, from file or real-time external source
• Start/stop on external event trigger

Extensions and Options
• IMU and EGI testing: SimINERTIAL™
• Classified testing with: AES M-code* and SDS M-Code via server* to ICD-GPS-700x: SimMCODE™, Y code*: SimSAASTM (US), SimCLASS™ and Galileo PRS*: SimPRS™
• Jammer and interference emulation: GSS7765 and GSS7725
• Spoofing Vulnerability Testing: SimSAFE™
• Automotive In Vehicle Navigation System (IVNS) testing: SimAUTO™
*Available to authorised users only

SimREMOTE™ Real-Time Control and Motion API
• Comprehensive API for real-time 1000Hz remote control and trajectory delivery
• Real time, high-rate data streaming aids analysis
• Real-time, zero-effective latency hardware in the loop (HWIL) testing
• Extensive commands for precision manipulation of signal parameters such as carrier and code phase & amplitude

The Spirent Advantage
With experience amassed over 30 years of supporting GNSS development, our systems are delivered, proven and trusted. Spirent is your best choice for comprehensive performance and support.

Spirent Offers:
• Comprehensive features as standard, built up over 30 years of development
• High fidelity simulation across the full dynamic range
• Top quality systems, backed by regional support network
• An assurance of continued investment in new GNSS technologies and systems
• Most variants available as standard “COTS” commercial systems
• Tailored solutions available to support special applications and configurations

Current and future needs can be met with the highly extensible GSS9000. Invest with confidence in a changing world, knowing that your GSS9000 system can grow as your GNSS test needs evolve.

Standard features enabled by SimGEN™ include simulation of multipath reflections, terrain obscuration, antenna reception gain patterns, differential corrections, trajectory generators for land, air, sea and space vehicles and comprehensive error generation and system modelling. Also supplied as standard is a low-latency, high-rate hardware-in-the-loop capability.
GSS9000 Series
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Comprehensive constellation editor

Import or define orbits

Real-time remote 6-DOF trajectory and simulation control

Sky plot

Flexible vehicle models
Comprehensive Modelling

Standard capabilities enabled through SimGEN™ include simulation of atmospheric effects, multipath reflections, terrain obscuration, antenna reception gain and phase patterns, differential corrections, trajectory generation for land, air, sea and space vehicles and comprehensive error generation.

An easy to use Graphical User Interface (GUI) allows modification of a wide range of variables from pre-set defaults, enabling the user to focus their time on the areas of test important to them.

Complete scenarios are readily shared between systems, supporting collaborative activities and speeding the R&D cycle.

Complete Control

SimGEN™ works in real-time, compiling the required data stream that drives the RF signal generator and on-screen displays.

During scenario run, the user has extensive, interactive access allowing changes to predefined conditions. These ‘User Actions’ are recorded to a script file to aid post-run analysis or to allow the same actions to be replayed in subsequent runs of this or other simulations.

Data generated during scenario run-time may be displayed or saved to a file for subsequent analysis.

Also incorporated as standard is a low-latency, high-rate remote control capability permitting the use of external sources for trajectory, enabling testing within control loops.

Antenna Signal Types

Simple signal selection

Antenna pattern and multipath mask editors
**GSS9000 Series**  
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**Multiple Signals Combined**

Whether testing with multiple signals from a single constellation or testing hybrid systems with signals from multiple constellations, the GSS9000’s modular design and flexibility means it is easily user-reconfigurable to meet all your needs.

GSS9000 systems are configurable to meet your requirements from combinations of the following signals:

<table>
<thead>
<tr>
<th>Constellation</th>
<th>Carrier</th>
<th>Standard Signal Types</th>
<th>Optional Signal Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>L1</td>
<td>L1c Data/Pilot, P, M Noise, Pseudo Y, GTx</td>
<td>Y*, AES-M* and SDS M-Code via data server*</td>
</tr>
<tr>
<td></td>
<td>L2</td>
<td>P, M Noise, Pseudo Y, GTx</td>
<td>Y*, AES-M* and SDS M-Code via data server*</td>
</tr>
<tr>
<td></td>
<td>L5</td>
<td>I, Q</td>
<td></td>
</tr>
<tr>
<td>Galileo</td>
<td>E1</td>
<td>PRS Noise, OS Data/Pilot</td>
<td>PRS*</td>
</tr>
<tr>
<td></td>
<td>E6</td>
<td>PRS Noise, CS Data/Pilot (without encryption)</td>
<td>PRS*, CS Data/Pilot (with encryption)*</td>
</tr>
<tr>
<td></td>
<td>E5ab</td>
<td>E5a Data/Pilot, E5b Data/Pilot</td>
<td></td>
</tr>
<tr>
<td>GLONASS</td>
<td>L1</td>
<td>C/A, P (Chan No. -7 thru +6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L2</td>
<td>C/A, P (Chan No. -7 thru +6)</td>
<td></td>
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<tr>
<td>SBAS</td>
<td>L1</td>
<td>C/A</td>
<td></td>
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<tr>
<td></td>
<td>L5</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>BeiDou</td>
<td>BDS-2 B1</td>
<td>B11</td>
<td></td>
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<tr>
<td></td>
<td>BDS-2 B2</td>
<td>B2i</td>
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<td></td>
<td>BDS-3 B1</td>
<td>B1C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BDS-3 B2</td>
<td>B2A</td>
<td></td>
</tr>
<tr>
<td>QZSS</td>
<td>L1</td>
<td>SAIF, C/A, L1c, L1s</td>
<td></td>
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<tr>
<td></td>
<td>L2</td>
<td>L2c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L5</td>
<td>I, Q</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L6</td>
<td>L6D/E</td>
<td></td>
</tr>
<tr>
<td>NavIC (IRNSS)</td>
<td>L5</td>
<td>BPSK</td>
<td>S, RS*</td>
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</tbody>
</table>

Your GSS9000 can be subsequently field upgraded to meet your evolving test needs.

**Extensions and Options**

Increasingly, GNSS receivers and sensors do not operate in isolation. If development and verification testing of integrated systems is required then it is essential that other sensors are emulated and other signals are reproduced coherent with the GNSS signals.

The GSS9000 has been designed to operate with all of Spirent’s extensive range of options and system extensions. For example: Inertial sensors can be emulated by SimINERTIAL™. Wheel tick sensors and VSS signals are reproduced by SimAUTO. Noise and channel interference can be reproduced by the GSS7765 or GSS7725. Spoofing vulnerability and resilience can be tested with Spirent’s SimSAFE™ software suite.

*Available to authorised users only*
GPS + Inertial Testing Example

- SimINERTIAL™/N Controller with RS422 Data Interface
- C50r SimGEN™ Host
- Ethernet UDP
- SimBARO™ (RT)
- Spirent GSS9000
- GPS RF
- 1553B Instrumentation Bus
- 1pps
- Delta Data $d_0$, $d_0$ (variant specific)
- Timing Signal
- Unit Under Test
- GNSS Antenna
- Ref RxA Monitoring Real GNSS
- RF Splitter
- Real GNSS
- GNSS observations

SimSAFE™ Vulnerability & Spoofing Testing

- Spirent SDS M-Code Server with Buffer Card and LVDS Mux Card
- (Ethernet) Code Streams
- Server MNAV & Supplemenary Data
- C50r SimGEN Host
- Ethernet
- User Rx Under Attack
- GSS9000 RF Generator with Buffer Card
- Spirent GSS9000

- User Analysis Software

SimSAFE™

- SIGNAL CONTROL MODULE
- GSS9000 & SimGEN™
- Ref RxB Monitoring Attack
- GNSS INTERFERENCE DETECTOR (GID) MODULE

High Level:
RF path access for high level output

Combiner Input Port:
For interference or other signal injection

Data Access:
High speed access for special applications

Host Interface:
Proprietary high-speed data bus

Control & Communication Ports:
Control and data logging

Timing & Synchronisation:
Soft configurable timing, reference and trigger capability

Ethemet UDP
<table>
<thead>
<tr>
<th>Related Product, Option or System Extension</th>
<th>Data-sheet / Specification Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSS9000</td>
<td>MS9000</td>
</tr>
<tr>
<td>GSS7725</td>
<td>MS7725</td>
</tr>
<tr>
<td>SimGEN™</td>
<td>MS3008</td>
</tr>
<tr>
<td>SimGEN with SE-NAV</td>
<td>MS3103</td>
</tr>
<tr>
<td>SimINERTIAL™</td>
<td>MS3030</td>
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<tr>
<td>SimBARO™</td>
<td>MS3056</td>
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<tr>
<td>SimAUTO™</td>
<td>MS3023</td>
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<tr>
<td>SimDATA™</td>
<td>MS3034</td>
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<td>SimPRS™</td>
<td>MS9042</td>
</tr>
<tr>
<td>SimCLASS™</td>
<td>MS9020</td>
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<tr>
<td>SimMCODE™</td>
<td>MS9018</td>
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<tr>
<td>SimREMOTE™</td>
<td>MS3015</td>
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<td>GSS7765</td>
<td>MS3055</td>
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<tr>
<td>TestBench GNSS Automation Tool</td>
<td>MS3097</td>
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<td>SimSAFE™</td>
<td>MS3092</td>
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About Spirent Communications
Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks.

We help bring clarity to increasingly complex technological and business challenges.
Spirent’s customers have made a promise to their customers to deliver superior performance. Spirent assures that those promises are fulfilled.

For more information, visit: www.spirent.com

Contact Us
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