

Spirent GSS7765 Interference Simulation System



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Spirent GSS7765 Interference Simulation System

About this Document

The information contained in this document is the sole source of technical performance specification for contractual purposes in relation to the **GSS7765 Interference Simulation System** for the Spirent range of GNSS RF Constellation Simulators.

Introduction

The Spirent GSS7765 Interference Simulation System (ISS) is a solution that fully integrates commercial-off-the-shelf (COTS) signal generators as interference sources with Spirent SimGEN™-based satellite navigation simulators, such as the Spirent PNT X, GSS9000, and GSS7000. Figure 1 shows a typical solution with the GSS9000:



Figure 1: GSS7765 shown with GSS9000

The ISS is designed for testing interference immunity of GNSS devices in a simulated environment.

Currently, up to 4 interference signal generators may be controlled via Ethernet from the simulator's SimGEN host controller. The interference signal is defined, along with all the other scenario parameters, from within the SimGEN for Windows GUI environment.

The GSS7765 supports continuous wave (CW), swept CW, stepped CW, pulsed CW, AM, and FM. The unit can also supply band-limited white Gaussian noise with a maximum bandwidth of up to 48 MHz.

Each interference source can operate independently using either fixed or modeled signal power level. It can be programmed to have any of the interference types and characteristics described in the **Technical Performance** section of this specification.

Each signal generator produces one signal. This means that two sources would be required to generate noise at GPS L1 and L2 frequencies simultaneously, for example.

The RF outputs are combined with the GNSS signals in the GSS8366 Interference Combiner Unit (ICU), which is a calibrated unit manufactured by Spirent. The ICU has two outputs to support differential systems. Each output is the combination of up to four interferer inputs and one GNSS input. The four-way combiner in the ICU may be optionally bypassed when only one source is required, reducing the insertion loss and increasing the interference/signal ratio available. For simulation systems with more than two antenna outputs, ICU units can be combined as necessary.

The ISS has a flexible architecture and supports a wide range of options, from single-source/single-antenna to complex interference for multiple antennas.

The ISS is controlled via the same instance of SimGEN as the GNSS simulator. Alternatively, the user may directly control ISS sources independently either via their front panel controls or from a separate controller using their native command set.

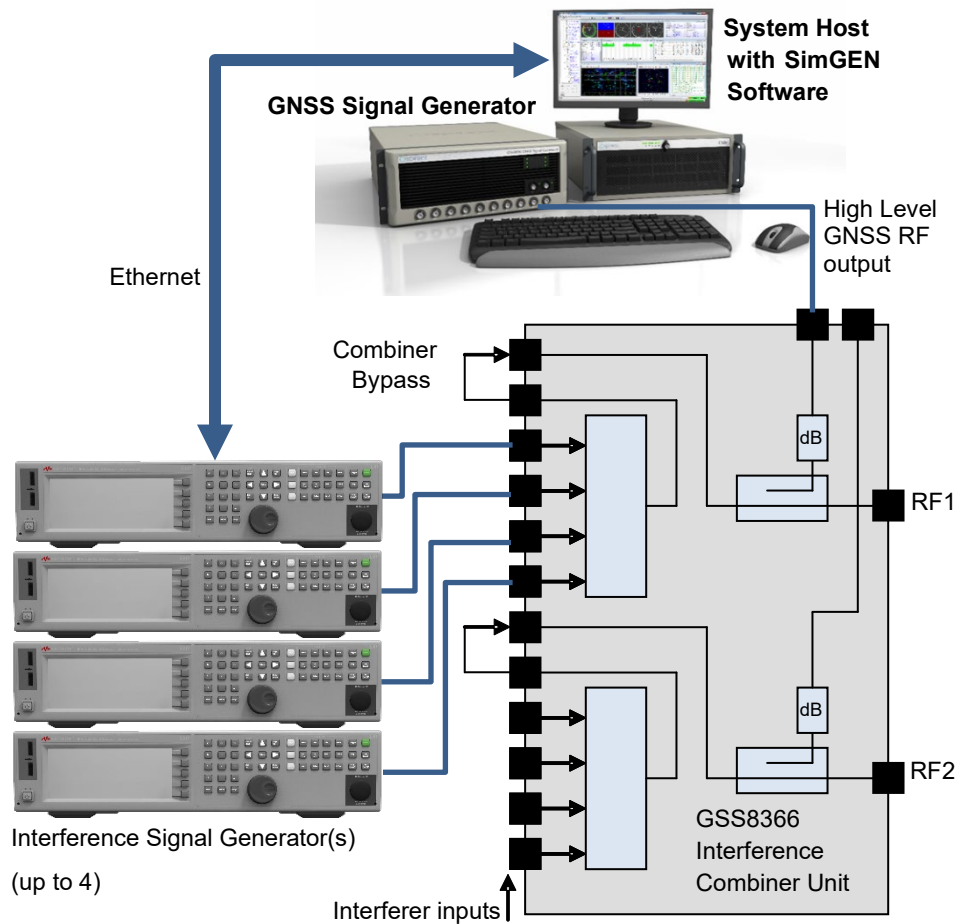


Figure 2: A 4-generator GSS7765 system with a GSS9000

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Compatible GNSS Simulator Platforms

The GSS7765 is compatible and fully qualified with the Spirent GNSS simulator platforms listed in the following table.

GNSS Simulator Model	Description
PNT X	PNT simulation system
GSS7000	GNSS simulator
GSS9000	GNSS simulator

The GSS7765 is compatible with the Spirent GNSS simulator platforms listed in the following table. However, these are obsolete platforms and ongoing release testing/qualification is no longer carried out.

GNSS Simulator Model	Description
GSS6560	GPS/SBAS simulator (L1)
GSS6700	GNSS simulator
GSS8000	GNSS simulator
GSS7700	GPS/SBAS simulator (L1, L2, L5)
GSS7800	Galileo simulator (E1, E5, E6)
GSS7900	GPS + Galileo simulator
GSS4760	GPS/SBAS simulator (L1, L2)
GSS4750	GPS simulator L5
GSS4780	GLONASS simulator
STR4790/GSS7790	GPS/SBAS simulator (L1, L2) multi-output

Operating Mode

GSS7765 is controlled via SimGEN or SimREPLAYplus™ to provide the following functionality for each interference channel:

- Interference type and characteristics (e.g., CW or FM, center frequency, etc.)
- Fixed interferer position (latitude, longitude, altitude)
- Interferer initial or base RF power level. (The interferer is assumed to transmit from an omnidirectional antenna.)
- Programmable interferer 'ON' and 'OFF' periods

The interference type and/or characteristics may be changed during the scenario using a file containing a time ordered script of events. The output level is further controlled by the specified operating mode, FIXED or MODELED. The operating mode can change as required during the scenario. Both of the operating modes are also compatible with operation from the SimREMOTE remote control option.

Fixed Level Mode

- In fixed level mode, the interferer power is set by an explicit user command and does not change. It is the default mode where a time-ordered script file controls the RF power level.
- The power level is maintained until commanded to change by the script and is independent of any other scenario elements such as simulated vehicle motion and modeling of the receiver's reception antenna gain pattern.

Modeled Mode

- The modeled mode simulates interference power level variation due to realistic relative vehicle motion with respect to the fixed interference source locations.
- The power level presented by the interference source varies in accordance with an inverse-square-law characteristic related to the range between the simulated host vehicle and the interferer.
- The power level is also varied to simulate the effects of the receiver's reception antenna gain pattern.
- In modeled mode, scripts are used to set initial power levels and interferer types. In this mode, the power level is updated at maximum of **100Hz** signal iteration rate (SIR) via Ethernet connection and 10Hz via GPIB connection.

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Technical Performance

Each interference source of the ISG is independently capable of generating signals with the following characteristics:

CW Interference

Signal Type

A continuous wave or unmodulated carrier.

CW signals from multiple generators can be selected to be coherent or non-coherent via the SimGEN GUI. Note: For coherent sources, the interference generators require a common, external 10MHz reference.

Frequency

Frequency Range	0.5 to 2 GHz
Frequency Resolution	0.01 Hz
Frequency Stability	$< \pm 1 \text{ ppm/yr}$, $\pm 1 \text{ ppm}$ typical over 0 to $+55^\circ\text{C}$

Spectral Purity

Harmonics	$< -30 \text{ dBc}$
Non-harmonics	$< -66 \text{ dBc}$
Sub-harmonics ¹	$< -82 \text{ dBc}$

Swept CW Interference

Signal Type

The user defines the center frequency and frequency span plus a sweep rate using the FM type.

Carrier:	as CW
Frequency Span:	to 20MHz (1.5 to 2 GHz band) to 10MHz (0.75 to < 1.5 GHz band) to 5MHz (0.5 to < 0.75 GHz)
Sweep type (cyclic):	Sine
Sweep rate:	0.1 Hz to 2 MHz
Additional frequency error ²	$< \pm 0.2\%$ of set deviation + 2Hz

¹ CW mode

² The following comment from the Keysight documentation applies: "Specification valid for temperature changes of less than $\pm 5^\circ\text{C}$ since last DC FM calibration."

Stepped CW Interference

Signal Type

Generated as a sequence of CW frequency steps. The user defines the start and stop frequencies, together with the number of steps and dwell time. The overall pattern is that of a saw-tooth ramp.

Carrier:	as CW
Number of frequency step points:	2 to 65535
Dwell time at each step:	100 μ s to 100s

AM Interference

Carrier:	as CW
AM Depth:	0 to 90% in 0.1% steps (nominal) ³
Distortion (1kHz rate):	<0.2%, typical at 1kHz rate
Modulating signal:	
Waveforms:	sine, square, ramp, and triangle
Rate:	0.1 Hz to 10 kHz (typical)
Resolution:	0.1 Hz
Frequency accuracy:	same as RF reference source, typical

FM Interference

Carrier:	as CW
Maximum deviation:	20MHz (1.5 to 2.0 GHz band) 10MHz (0.75 to <1.5 GHz band) 5MHz (0.5 to <0.75 GHz)
Resolution:	0.1% of deviation or 1Hz, whichever is greater (nominal)
Distortion:	<0.4% ⁴
Additional frequency error:	< \pm 0.2% of set deviation + 2Hz ⁵

³ Peak of AM envelope must not exceed the maximum available power.

⁴ The following comment from the Keysight documentation applies: "1kHz rate with deviation 100kHz for carrier >1.5GHz or deviation 50kHz for carrier 0.75 to <1.5GHz."

⁵ The following comment from the Keysight documentation applies: "Specification valid for temperature changes of less than ± 5 °C since last DC FM calibration."

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Modulating signal:

Waveforms:	sine, square, ramp, and triangle.
Rate:	5 Hz to 2 MHz (sine) 0.1 Hz to 10 kHz (square, ramp, triangle)
Resolution:	0.1 Hz
Frequency accuracy:	same as RF reference source, typical

Noise Interference

Carrier:	as CW
Bandwidth (3dB):	1 Hz to 48 MHz
Resolution on bandwidth:	0.1Hz

Pulse Modulation

Pulse may only be applied to CW, Stepped CW, and noise interference types.

Pulse:

Period:	2.01 μ s to 42s
Width:	2 μ s to pulse period -10ns (typ), resolution 10ns
On/Off Ratio:	>80dB
Rise/Fall Time:	<10ns (typ)
Square wave rate:	0.1Hz to 10 MHz, resolution 0.1 Hz (nom)

RF Level (Per Source) From ICU Output

GPS signal level (L1 P, nominal, per SV):	-163.0 dBW
GPS signal level control (about nominal):	±20 dB
GPS signal level accuracy;	±1.0 dB RSS
I/S ratio relative to any GPS L1 P-code signal at nominal GPS signal level	
All modes:	-1 to +136 dB
Interference level expressed as absolute power ⁶	
All modes:	-164 to -27 dBW
Interference accuracy (CW) ⁷	
- I/S 63 to 136 dB	±1.0 dB RSS
- I/S 16 to 63 dB	±1.1 dB RSS
- I/S -1 to 16 dB	±1.6 dB RSS
Interference level resolution:	0.02 dB (nom)

Increase all interferer ICU output levels by approximately 7 dB if the option to bypass the four-way combiners in the ICU is exercised.

External Frequency Standards

It is possible to lock the interference signal generator(s) to an external 10 MHz reference frequency.

Each generator provides a 10MHz output that may be used as a reference source for other elements of the simulation system.

⁶ Specified maximum interferer level in ambient +20 to +30 °C. Typically the maximum level reduces by 0.2 dB/°C outside of this range.

⁷ These values assume ISS uncertainty between 20 and 30 °C. For temperatures outside of this range, the accuracy degrades by 0.01 dB/°C.

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Performance Extensions

Baseline performance can be enhanced to offer custom waveform modulations and FIR (finite impulse response) filters for use with the GSS7765. Note specific options exist to facilitate these only for N5172B instruments.

The specific 'custom' modulation type is based on Keysight Technologies' binary waveform format, and its associated parameters will be configurable during the simulation run using the SimGEN GUI.

FIR filter coefficients are loadable in ASCII format as defined by Keysight Technologies and stored alongside the binary waveforms.

In order to realize these capabilities, there are specific options required on the given GSS7765 along with a system specific license within SimGEN.

Instrument Security Feature

Optionally for N5172B based systems, there is an instrument security feature including removable memory to allow for removal from secure environments.

Operational Performance

Physical Form

The GSS7765 Interference Simulation System consists of a Spirent ICU single chassis together with a number of commercial signal generator chassis. All units are rack-mountable in the industry standard 19-inch format. The GSS7000 chassis requires additional hardware.

Dimensions (H x W x D):

COTS generators:	88 H ⁸ x 458 W x 508 L mm (3.46"x18"x20")
Weight:	≤ 15.9 kg (35 lb.)
ICU:	89 H x 426 W x 200 L mm (3.5"x16.8"x7.9")
Weight:	≤ 4 kg (9 lb.)

Environmental

The equipment is suitable for operation only in a typical office or laboratory environment.

Operating Conditions:

Temperature: 0°C to +55°C

The equipment employs forced-air cooling.

Relative Humidity: 75% max

Mechanical: Not exposed to vibration, shock, or bump.

Storage Conditions: -40°C to +70°C

Power Requirements (each generator):

- 100 to 120 VAC, 50 to 60 Hz
- 220 to 240 VAC, 50 to 60 Hz
- 300 W maximum

EMC: Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-001

⁸ H does not include the removable feet. With feet removed, the unit can be accommodated in 2U.

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Safety: Complies with European Low Voltage Directive 2006/95/EEC

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL 61010-1
- German Acoustic statement

Deliverables

ITEM	QTY	DESCRIPTION	COMMENT
1	1	GSS8366 Interference Combiner Unit	One required per system
2	1 set	Interconnection cables <ul style="list-style-type: none"> • One Ethernet cable per generator (2m) • One RF cable per generator (1.5m RG142 N to N) • One GNSS RF cable (1.5m RG142 N to N) • One synchronization cable per generator (1m BNC to BNC) • Two link cables (15cm BNC to BNC) 	Appropriate for target system
3	up to 4	Digital signal generator	Can be customer furnished ⁹
4	1	Printed user manual	
5	1	Printed calibration procedure	
6	1	CD	Utilities and manuals

⁹ If a customer furnished signal generator is used, its serial number must be supplied to Spirent to allow a license key to be generated. All other deliverables remain unchanged.

Signal Generator Procurement Details

Manufacturer

Equipment manufacturer: Keysight Technologies

Signal Generator Description

Equipment description: 9kHz – 3GHz, EXG Vector Signal Generator.

Product Code

Manufacturer’s product code: N5172B

Options

The equipment is to include the following optional features:

Order Item	Description	GSS Code
N5172B-503	Frequency range 9 kHz to 3 GHz	GSTE-0009
N5172B-UNW	Narrow pulse modulation	GSTE-0011
N5172B-UNT	AM, FM, and phase modulation	GSTE-0013
N5172B-1EM	Move RF output to the rear panel	GSTE-0014
N5172B-653	Internal baseband generator (75 Msa/s, 32 Msa)	GSTE-0015
N5172B-403	Calibrated AWGN	GSTE-0016
N5172B-1CP	Rackmount and front handle kit	GSTE-0017

Software License Key (Required)

It should be noted that a license key enables each specific signal generator. In order that customers can purchase the license key(s) and cable set(s), the serial number of any customer furnished signal generators needs to be supplied to Spirent. Each signal generator will also need a unique Ethernet address.

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Environmental Social & Governance (ESG)

Spirent's Positioning Technology Business Unit has been committed to ESG good practice and improvement since achieving ISO14001:2015 Environmental Management System certification in 2004.

We take ESG seriously across all aspects of our business from sustainable buildings, sustainable product design to sustainable supply chain, manufacturing, and shipping/exports.

Many of Spirent's Test Solutions rely on physical test equipment used in situ by our customers. We are working to reduce the lifecycle impacts of our products and the environments they are used in through a range of ways:

- Designing for environment and end of life, including compliance with all legal requirements;
- Reducing the size, weight, noise, and power use of our products;
- Virtualization and the development of Test-as-a-Service via PNT Professional Services;
- Improving utilization and automation
- In-field servicing and upgrades.

We use formal sustainability metrics in the product development process.

For more specific information on how ESG applies to our PNT Test Solutions, please contact your Spirent Federal representative.

For more information visit, <https://corporate.spirent.com/sustainability>.

For More Information

For more information on any aspect of GSS7765, please contact Spirent Federal.

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Why Spirent?

Across five decades Spirent has brought unrivaled power, control, and precision to positioning, navigation and timing (PNT) simulation. Spirent partners with the leading developers and integrators to consult and deliver on innovative solutions, using the highest quality hardware and the most flexible and intuitive software on the market.

Spirent delivers

- Simplified testing accelerates the innovation cycle and deployment of robust PNT systems
- Proven track record of being first-to-market with new signals and ICDs
- Unrivaled investment in customer-focused R&D
- World-leading expertise, redefining industry expectations
- Powerful, flexible, and customizable SDR technology for future-proofed test capabilities
- Signals built from first principles — giving reliable and precise truth data

About Spirent Positioning Technology

Spirent enables innovation and development in the GNSS and additional PNT technologies that are increasingly influencing our lives. Our clients promise superior performance to their customers. By providing comprehensive and tailored test and assurance solutions, Spirent assures that our clients fulfill that promise.

About Spirent Federal Systems

Spirent Federal Systems provides the world's leading PNT test solutions to the US Government and contractors to enable resilient PNT under any conditions and outpace evolving navigation warfare threats. As a US proxy company, Spirent Federal enhances Spirent's commercial offerings with classified and other sensitive military signal emulation capabilities.

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