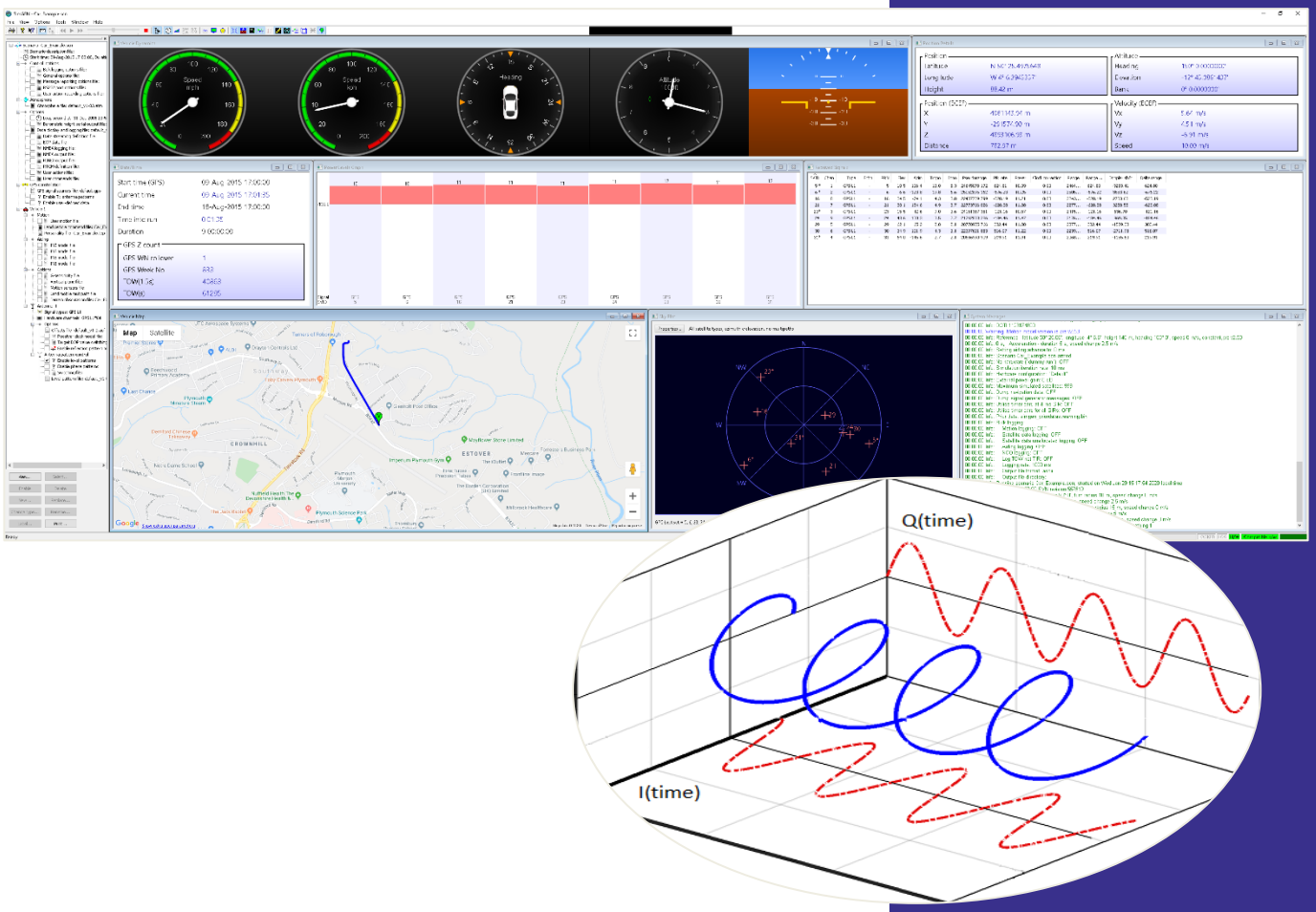
DATASHEET



SimIQ Datasheet

Software-In-the-Loop and I/Q File Replay Solution

Spirent SimIQ Datasheet

Purpose of this Document

This datasheet describes the functionality of Spirent SimIQ, a software solution that will capture and/or replay I/Q data files using Spirent GSS7000 and Spirent GSS9000 GNSS simulators.

This datasheet also provides technical product specification data and configuration information. Please speak to your Spirent sales representative to discuss your requirements.

Table of Contents

Spirent SimIQ Datasheet

List of Tables

List of Figures

Glossary

AGC	Automatic Gain Control
ASIC	Application-Specific Integrated Circuit
COTS	Commercial Off-The-Self
DMA	Direct Memory Access
FPGA	Field Programmable Gate Arrays
GA	General Availability
GNSS	Global Navigation Satellite Systems
HW	Hardware
Hz	Hertz
IF	Intermediate Frequency
ION	Institute Of Navigation
I/Q	In-phase and Quadrature
MB	MegaByte
MHz	MegaHertz
MIL	Model-In-the-Loop
OS	Operating System
PCIe	Peripheral Component Interconnect express
PosApp	Positioning Application
RAID	Redundant Array of Independent Disks
RF	Radio-Frequency
SIL	Software-In-the-Loop
SIR	Simulation Iteration Rate
SSD	Solid-State Drive
TB	TeraByte
USB	Universal Serial Bus

Spirent SimIQ Datasheet

Definitions

Capture

Licensable SimIQ mode of operation in which I/Q data is generated by a designated channel bank and stored in a user specified file (DMA'ed over PCIe), at a given bit-depth and sample rate on the host PC. In this mode of operation, no RF is generated.

Replay

Licensable SimIQ mode of operation in which an I/Q data file generated by the user (external to our system), with a user specified bit-depth and sample rate residing on the host PC is streamed to a designated channel bank (DMA's over PCIe). The I/Q data from the file can also be mixed with I/Q data generated natively by Spirent's simulator hardware for upconversion to RF.

Introduction

SimIQ is a software feature available on Spirent GNSS simulators, GSS7000 and GSS9000, which enables the capture and replay of I/Q data files. SimIQ has 2 modes of operation: **SimIQ Capture** and **SimIQ Replay,** each of them enabled by their respective licence keys.

SimIQ Capture allows the recording of I/Q data into a file stored in the host PC. RF is disabled during the simulation and, instead, the generated I/Q data by the signal generators is saved as a binary file into an internal or external SSD (see Figure 1). In this mode of operation, the user can create and run scenarios with the different constellations and frequencies specified in the SimIQ licence feature, regardless of the RF licencing.

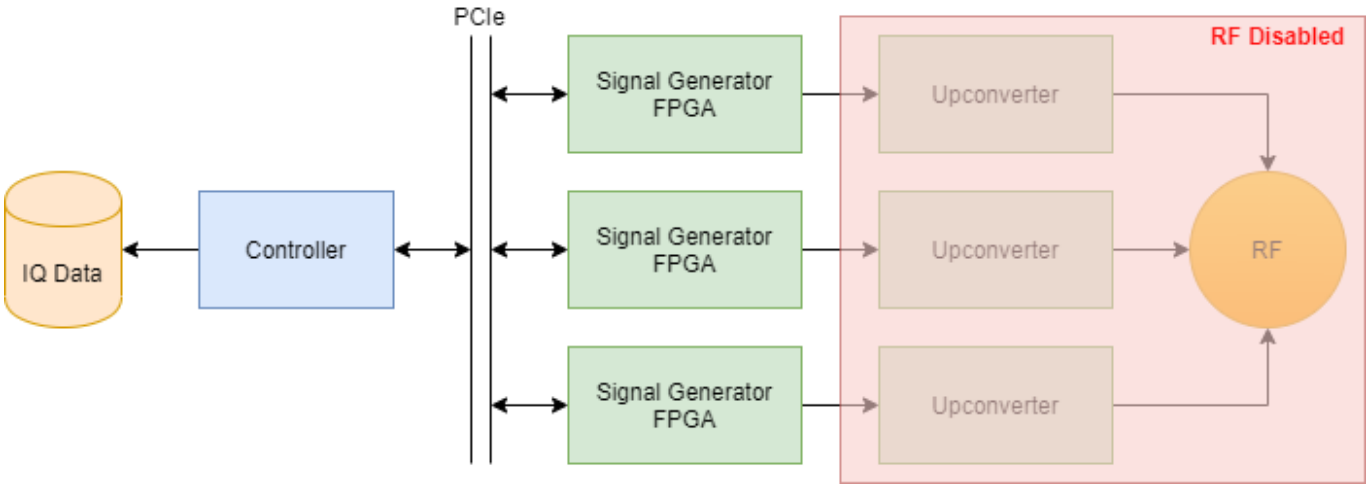


Figure 1: SimIQ Capture – Overview

SimIQ Replay allows customers to read I/Q data from a file stored in the host PC and generate the corresponding RF. In this mode of operation, **SimGEN** streams I/Q data from the SSD controllers to the signal generators over the PCIe bus. The streamed I/Q data is mixed with all the other standard **PosApp** scenario signals generated by the FPGAs (see Figure 2).

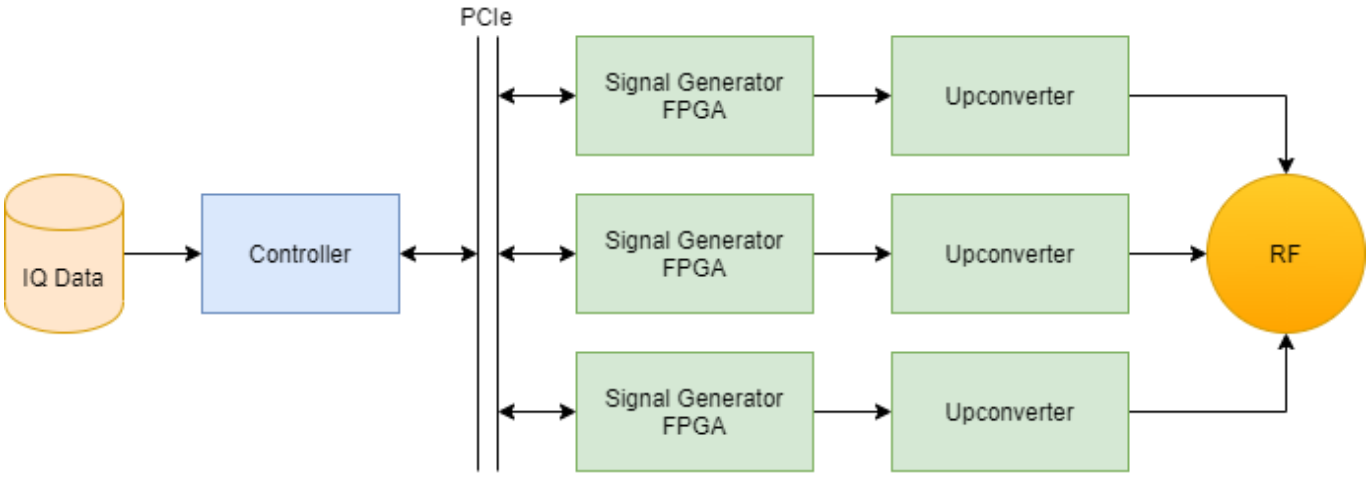


Figure 2: SimIQ Replay - Overview

As **SimIQ Capture** does not generate RF, these modes of operation are mutually exclusive (see Table 1). However, both features, **SimIQ Capture** and **SimIQ Replay**, can be licenced together under the same **SimGEN** licence.

Spirent SimIQ Datasheet

Table 1: SimIQ Runtime Compatibility

SimIQ Runtime Compatibility	SimIQ Capture (e.g. L1)	SimIQ Replay (e.g. L1)	RF Generation
SimIQ Capture (e.g. L2)	✓	✗	✗
SimIQ Replay (e.g. L2)	✗	✓	✓
RF Generation	✗	✓	✓

Features and Benefits

SimIQ Capture

Spirent GNSS simulators can now generate I/Q files with **SimIQ Capture** containing all the GNSS signal data required to test the algorithms, conformance, and performance of software receivers. This allows Spirent to support its customers with their testing needs across the whole product development cycle, including MIL, SIL, HIL and VIL testing.

Validation of receiver algorithms (MIL)

As GNSS receivers become more complex early testing is essential to avoid expensive errors and delays, being able to identify inaccuracies or issues in their receiver models prior to ASIC design and hardware implementation may help reduce development cost and potential delays. **SimIQ Capture** and **SimIQ Replay** help developers and testers to validate their models and software before hardware is involved, with the same realistic scenarios that they use to validate their hardware receivers in a later stage of their design cycle.

Testing GNSS software receivers (SIL)

Certain applications, such as autonomous vehicles, require an extensive amount of testing to ensure the robustness and reliability of the proposed solution. To optimise their time for testing and ensure a timely release in the market, developers are including virtual testing into their product roadmap. Some of them are keen to reduce the amount of hardware required for their virtual tests using software models instead. **SimIQ Capture** enables the possibility to test GNSS software receivers by injecting the generated I/Q data, removing RF real-time constraints while allowing massive parallel simulation.

SimIQ Replay

Spirent GNSS simulators can now generate RF from I/Q files using **SimIQ Replay**. The flexibility and reliability of the hardware enables the generation of RF signals from I/Q files while maintaining the fidelity and quality of the solution, thanks to Spirent's unrivalled signal generation architecture.

Injection of externals signals

SimIQ Replay can generate any RF signals given a centre-frequency (L1, L2, L5 or L6) and bandwidth within spec. This enables our customers to not only generate the well-known GNSS signals, but also custom waveforms, custom noise, or even interference and jamming events. In addition to the replay of the I/Q files, users can still generate, simultaneously, GNSS signals as usual with Spirent GSS7000 and GSS9000.

Compatibility with Spirent GSS6450

I/Q files are compliant with the ION metadata standard and are compatible and exchangeable among Spirent GNSS products. Files recorded with Spirent GSS6450 Record & Playback system can now be used to generate RF using our GSS7000 and GSS9000, and vice versa.[1]

Subscription Model

SimIQ introduces a new and flexible subscription model[2].

SimIQ Capture customers can choose between 4 different licences, depending on frequency (see Table 2), to create I/Q files from all constellations available over the subscribed period of time.

SimIQ Replay customers only need to purchase a licence to replay I/Q data from any frequency available (i.e. L1, L2, L5 and L6) with their system. This licence enables the replay of a single I/Q file with a compatible I/Q channel bank. To simultaneously replay several I/Q files, customers can subscribe to up to 3 **SimIQ Replay** licences per system depending on hardware compatibility.

1 Support for Spirent GSS6450 is available for 4 and 8 bits, and 30.69 and 51.15 MHz of bandwidth.
2 Perpetual licenses also available for all SimIQ features.

Spirent SimIQ Datasheet

SimIQ Contents

The new licencing scheme allows customers to capture GNSS data from all the constellations supported based on the centre frequency selected (see Table 2).

Table 2: SimIQ Licences and Content

Description	Content	PosApp Version Supported
SimIQ Capture L1	GPS L1 Glonass L1 Galileo E1 Beidou B1I Beidou B1C QZSS L1 SBAS L1	SimTEST, SimREPLAY+, SimGEN
SimIQ Capture L2	GPS L2 Glonass L2 Beidou B2I QZSS L2	SimTEST, SimREPLAY+, SimGEN
SimIQ Capture L5	GPS L5 Galileo E5 Beidou B2a QZSS L5 SBAS L5	SimTEST, SimREPLAY+, SimGEN
SimIQ Capture L6	Beidou B3I QZSS L6	SimTEST, SimREPLAY+, SimGEN
SimIQ Replay	All signals	SimGEN

Operation

SimIQ Capture and **SimIQ Replay** modes are editable from PosApp's scenario tree (see Figure 3). These modes of operation are mutually exclusive, i.e. only one can be selected at a time.

From the scenario tree, the user can enable the modes by selecting an I/Q file and ticking the corresponding box.

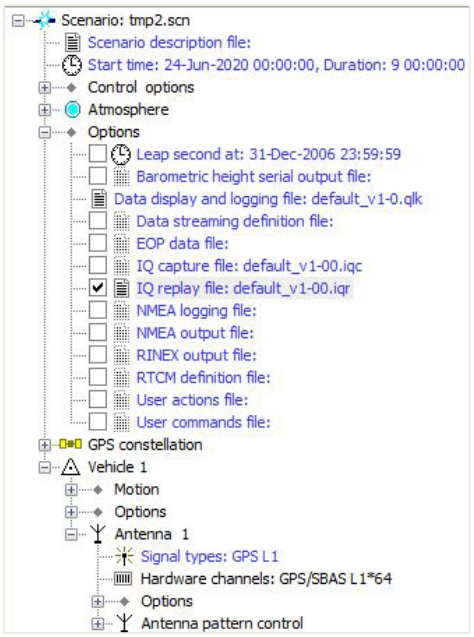


Figure 3: SimIQ Scenario Tree

SimIQ Capture

SimIQ Capture is supported by all PosApp versions, i.e. SimTEST, SimREPLAY+ and SimGEN. When this mode is selected by the user, a compatible hardware configuration will be automatically selected by PosApp (see Figure 4). The compatible hardware configuration automatically enables the appropriate constellations and frequencies, these being dependent upon the user's license.

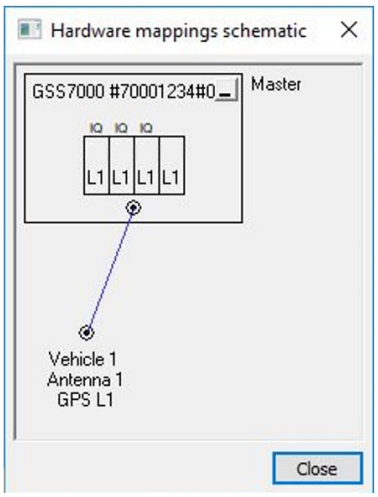


Figure 4: SimIQ Capture Hardware Configuration

User can configure certain parameters of the I/Q file before capturing the data. These are: frequency band or channel bank assigned, file format, sample rate and bit-depth. PosApp can also display instant feedback in order to optimise the simulation parameters (see Figure 5).

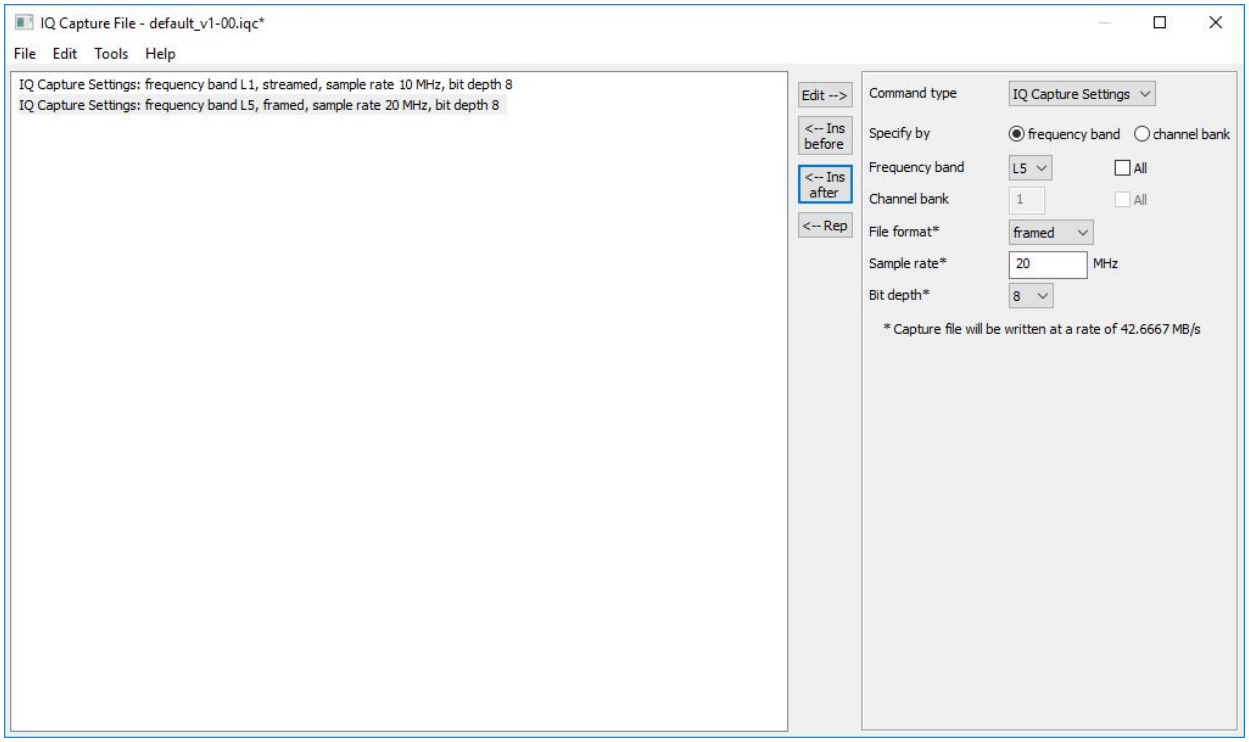


Figure 5: SimIQ Capture Edit Window

SimIQ Capture allows the configuration per frequency band and per channel bank:

- Per frequency band (default): configuration can be different for each frequency band, e.g. L5 files could require a larger bandwidth than L1.
- Per channel bank: Finer control as user can have two L1 channel banks with different configurations.

Spirent SimIQ Datasheet

SimIQ Replay

SimIQ Replay is only supported by SimGEN. When this mode is selected by the user, PosApp can read I/Q files and generate the corresponding RF. PosApp has no knowledge of the signals, modulation, channels or waveforms that are defined within the I/Q file. The only knowledge PosApp has is the information contained in the associated metadata file. This file contains information regarding the centre frequency of the I/Q data, which is used by the system to automatically select the right channel bank to output the I/Q file. **SimIQ Replay** can be thought of as an extra channel that can replay I/Q data within spec.

User can configure the frequency offset of each I/Q file to be replayed before starting the scenario (see Figure 6).

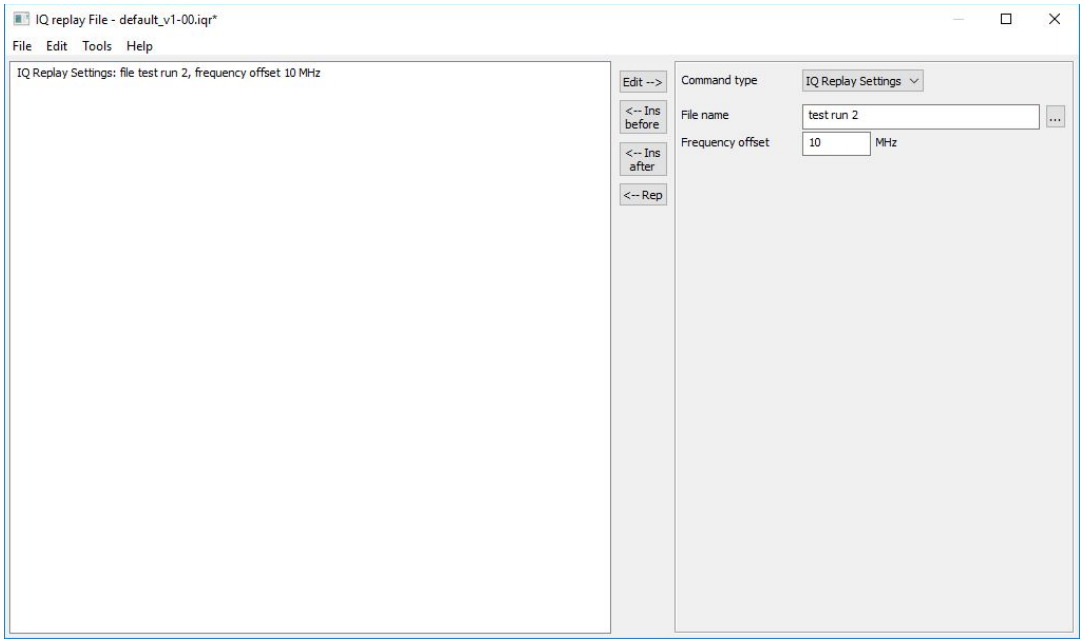


Figure 6: SimIQ Replay Edit Window

Performance Specification

Common Features

Table 3 SimIQ Performance Specifications

Parameter	Value	Note
Supported constellations	GPS L1, L2, L5. GAL E1, E5a. GLO L1, L2. BD B1, B2, B3. QZSS L1, L2, L5, L6.	Constellations are available via purchase of appropriate Spirent licensing.
Supported codes	GPS L1: C/A, L1c Pilot, L1c Data, P. GPS L2: L2c or C/A, P. GPS L5: I, Q. GAL E1: E1-B, E1-C. GAL E5ab: E5aI + E5aQ + E5bI + E5bQ. GLO L1: C/A, P. GLO L2: C/A, P. BD B1: B1I, B1C. BD B2: B2I, B2a. BD B3: B3I. QZSS L1: C/A, L1S, L1c Data + Pilot. QZSS L2: L2c. QZSS L5: I + Q. QZSS L6: L61/L62.	Capture frequencies are available via purchase of appropriate Spirent licensing.
Supported simulator	GSS9000 GSS7000	GSS9000: Supported SIR with SimIQ: Up to 1 kHz GSS7000: Supported SIR with SimIQ: Up to 100 Hz
Maximum number of vehicles in PosApp scenario	Max supported by PosApp	
Maximum number of antennas in PosApp scenario	Max supported by PosApp	
Type of vehicle supported in PosApp scenario	Any supported by PosApp	

Table 4: SimIQ System Iteration Rate

Parameter	Value	Note
Supported PosApp Iteration Rate	100 ms - 10Hz 10 ms - 100Hz 1 ms - 1kHz*	The rate at which PosApp computes the required data and updates the hardware. *GSS7000: Up to 10 ms (100 Hz) *GSS9000: Up to 1 ms (1 kHz)
Supported PosApp Logging Rate	100 ms - 10Hz 10 ms - 100Hz 1 ms - 1kHz	The rate at which PosApp logs the data.
Supported Third-Party Application Iteration Rate	Up to 1 ms - 1kHz	The rate at which the third-party application computes the vehicles dynamics and sends a vehicle motion message to PosApp.

Spirent SimIQ Datasheet

SimIQ Capture

Table 5: SimIQ Capture Performance Specifications

Parameter	Value	Note
Software Level	SimTEST SimREPLAY+ SimGEN	**SimIQ Capture** is an editable feature in all software levels.
Configuration Type	Per channel bank Per frequency band	
Bit-Depth	4, 8, 16	Please, contact Spirent for other bit-depths.
Bandwidth	Up to 120 MHz	Please, contact Spirent for other bandwidths.
Optional Noise Generation	Gaussian-like	
No. I/Q channel banks supported	Up to 3*	*Depending on the customer's hardware (see Table 6).

Table 6: SimIQ Capture – Supported Bandwidths and Bit-Depths for GSS9000[3]

Bandwidth (MS/s)	Bit depths	System	No. I/Q Channel Banks supported	Notes
120	16	Updated GSS9000 Series	1	RAID0 system required.
		GSS9000 Series	-	
		GSS7000	-	
80	16	Updated GSS9000 Series	1	RAID0 system required.
		GSS9000 Series	-	
		GSS7000	-	
60	16/8/4	Updated GSS9000 Series	3	RAID0 system required.
		GSS9000 Series	1	
		GSS7000	3	
51.15	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
30.69	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
30	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	2	
		GSS7000	3	

3 Processor, SSD and PCIe Generation dependent.

SimIQ Replay

Table 7: SimIQ Replay Performance Specifications

Parameter	Value	Note
Software Level	SimGEN	
Carrier Offset	± 40 MHz	Increments of 100 Hz.
Bit-Depth	4, 8, 16 bits	
Bandwidth	Up to 120 MHz	
No. I/Q files per channel bank	1	Each licenced I/Q channel bank is able to run an I/Q file and 32 additional channels (if licenced) for a given frequency.
No. I/Q channel banks supported	Up to 3	Depending on the customer's hardware.

Table 8: SimIQ Replay – Supported Bandwidths and Bit-Depths for GSS9000[4]

Bandwidth (MS/s)	Bit depths	System	No. I/Q Channel Banks supported	Notes
120	16	Updated GSS9000 Series	1	RAID0 system required.
		GSS9000 Series	-	
		GSS7000	-	
80	16	Updated GSS9000 Series	1	RAID0 system required.
		GSS9000 Series	-	
		GSS7000	-	
60	16/8/4	Updated GSS9000 Series	3	RAID0 system required.
		GSS9000 Series	1	
		GSS7000	3	
51.15	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
50	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
40	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
30.69	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
30	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
20	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	
10	16/8/4	Updated GSS9000 Series	3	
		GSS9000 Series	1	
		GSS7000	3	

4 Processor, SSD and PCIe Generation dependent.

Spirent SimIQ Datasheet

Deliverables

With the purchase of any **SimIQ Capture** part number, the following items are delivered (see Table 9).

Table 9: Delivery Items for SimIQ Capture

Item No.	Quantity	Description	Notes
1	1	Base Image	
2	1	I/Q FPGA Image	Upgrade required to use any **SimIQ Capture** or **SimIQ Replay** feature (up to 3)
3	1	SimIQ Capture Licence	SimIQ Capture L1 – only 1 required per system. SimIQ Capture L2 – only 1 required per system. SimIQ Capture L5 – only 1 required per system. SimIQ Capture L6 – only 1 required per system.

With the purchase of any **SimIQ Replay** part number, the following items are delivered (see Table 10).

Table 10: Delivery Items for SimIQ Replay

Item No.	Quantity	Description	Notes
1	1	Base Image	
2	1	I/Q FPGA Image	Upgrade required to use any **SimIQ Capture** or **SimIQ Replay** feature (up to 3)
3	1	SimIQ Replay Licence	SimIQ Replay – Up to 3 licences/channel banks per system.

A second SSD, with 1TB of storage capacity, can be fitted into the system to save the files used by SimIQ Capture and SimIQ Replay. With the purchase of the SimIQ SSD part number, the following items are delivered (Table 11)

Table 11: Delivery items for SimIQ Hardware

Item No.	Quantity	Description	Notes
1	1	Second Internal 1TB SSD	Return to factory required to perform the internal installation with the purchase of this part number. External support does not require a return to factory.

For more information

For more information on any aspect of the GSS7000, please contact your Spirent representative or Spirent directly:

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About Spirent Positioning Technology

Spirent enables innovation and development in the GNSS (global navigation satellite system) and additional PNT (positioning, navigation and timing) technologies that are increasingly influencing our lives.

Our clients promise superior performance to their customers. By providing comprehensive and tailored test solutions, Spirent assures that our clients fulfil that promise.

Why Spirent?

Over five decades Spirent has brought unrivalled power, control and precision to positioning, navigation and timing technology. Spirent is trusted by the leading developers across all segments to consult and deliver on innovative solutions, using the highest quality dedicated hardware and the most flexible and intuitive software on the market.

Spirent delivers

- Ground-breaking features proven to perform
- Flexible and customisable systems for future-proofed test capabilities
- World-leading innovation, redefining industry expectations
- First-to-market with new signals and ICDs
- Signals built from first principles — giving the reliable and precise truth data you need
- Unrivalled investment in customer-focused R&D
- A global customer support network with established experts

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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

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