

SimXona

Bringing Alternative Navigation Xona PULSAR Signals into the Most Trusted PNT Test Environment

Purpose of This Document

This data sheet describes the functionality of Keysight SimXona. SimXona is a powerful and versatile test solution designed to generate Xona PULSAR demonstration and production satellite signals using Keysight positioning, navigation, and timing (PNT) simulators.

This data sheet also provides technical data and configuration information.

Please speak to your Keysight sales representative before ordering to ensure your specific needs are met.

Introduction

Developing robust PNT systems requires comprehensive, highly sophisticated testing that encompass all the PNT signals that your application requires. In addition to GNSS, complementary alternative navigation signals are increasingly used to assure the operation of PNT systems in ever more challenging environments.

Keysight SimXona is a powerful and versatile test solution designed to generate Xona PULSAR LEO PNT demonstration and production signals using Keysight PNT simulators. SimXona is compatible with both PNT X and GSS7000. Apart from generating RF signals, SimXona also enables users to produce I/Q files. For the GSS7000 platform, a standalone, coupled I/Q generator will generate SimXona I/Q files that can then be replayed in conjunction with GNSS. For the PNT X, the I/Q generator is fully built into the platform, eliminating the interim step of I/Q files being generated.

The content of SimXona's user-defined scenarios allows for worldwide coverage within bounded timespans leveraging satellite information available from Xona Space Systems. This testing capability makes SimXona an ideal solution for all applications where accurate and realistic evaluation of GNSS receivers' performance is required.

Configurations

SimXona is able to support multiple operational configurations as defined by Xona Space Systems. These configurations are representative of distinct phases of Xona's LEO constellation development¹:

- **Demo Signal – Alpha 0 Configuration:** a two-satellite configuration, matching Xona's Alpha Mission, 2022.
- **Demo Signal – Phase 1 Configuration:** a 32-satellite configuration, in projection of Xona's future Phase 1 orbital deployment, featuring 1-in-view continuous coverage.
- **Demo Signal – Phase 3 Configuration:** a 258-satellite configuration, in projection of Xona's future Phase 3 orbital deployment, featuring at least 4-in-view continuous coverage.
- **Production Signal:** 258 satellite configuration.

This enables users to test the benefits of constellation across its different deployment stages ahead of time. Concurrent operation of demo and production signals is not generally foreseen but can be enabled. Please contact your Keysight representative for further details.

Keysight recommends that you discuss your current and future needs with your local sales representative. Keysight will provide specific configuration and pricing information to meet your needs.

¹ Xona Space Systems 2023, Addendum for Specification of Simulator Parameters 1.0, San Mateo, CA, USA.

Solution Overview

SimXona enables customers to explore and validate Xona PULSAR signals within Keysight's industry-leading PNT simulation platforms. The solution is available for both PNT X and GSS7000 users, with licensing options for XL, X1, and X5.

SimXona for PNT X

On PNT X, SimXona functionality is built directly into Keysight's next-generation simulation environment. A single PNT X system can natively create and output Xona signals alongside all GNSS constellations and additional RF elements such as spoofing.² Depending on baseline PNT X system functionalities, SimXona is either a pure software-only upgrade or requires the in-field upgrade of a further GPU into the C50 X.

By default, the PULSAR RF output is combined with the GNSS RF output.³ Unless otherwise specified, the radio cards generating PULSAR production signals are installed in up to two slots of the PNT X 8/2 split configuration. (See the PNT X data sheet.) An appropriately attenuated loopback cable merges the PULSAR signals into the primary GNSS RF path, ensuring that both GNSS and PULSAR signals are delivered together at the ICD-specified power levels. The dynamic range available for the PULSAR production signals is +20 dB/-30 dB relative to the ICD nominal values. For the demo signals, there will be no usage of a loopback cable or 8/2 split. The dynamic range available for the XL signals is +0 dB/-40 dB relative to the ICD nominal values.

SimXona for GSS7000

On the GSS7000, SimXona solution comprises two key components: the SimXona I/Q generator, which is responsible for generating all of the necessary baseband I/Q files required for the simulation process, and the SimXona signal generator, which has the capability to seamlessly replay the I/Q files containing the alternative navigation signals. Xona PULSAR demonstration and production signals can be also generated in conjunction and alignment with all other GNSS signals present within the simulation environment.⁴

The SimXona I/Q generator allows users to define their own Xona scenarios within certain time boundaries and generate the corresponding I/Q files. These scenarios can involve static or moving vehicles, providing users with extensive testing capabilities. The SimXona I/Q generator can be accessed from the host controller of the Keysight PNT simulation platform it is integrated with (either the SimXona signal generator or an existing Keysight GNSS simulator). Users can upload SimGEN scenarios to the SimXona I/Q generator to generate the corresponding I/Q files for the

² No additional separate chassis is required to add SimXona on a PNT X solution.

³ Can be delivered separately; please contact your representative if this is a requirement.

⁴ Due to the inherent difference in power level between standard GNSS and Xona PULSAR signals, a different RF output is required for each solution. This can be achieved by using the SimXona signal generator or by upgrading your existing GNSS simulator to a 2RF system.

required Xona PULSAR signals. To deliver RF signals, these I/Q files are transferred to the corresponding Keysight PNT simulation platform.

The SimXona signal generator converts Xona I/Q files into RF, generating the corresponding signals during simulation. This solution is compatible with existing Keysight GSS7000.⁵ An optional SimXona signal generator is available for generating the Xona PULSAR signals on a separate chassis. Both options can run the simulation alongside all other GNSS signals present in the scenario.

Figure 1 depicts a GSS7000-based system configuration featuring a SimXona I/Q Generator and a SimXona signal generator. This setup allows users to create Xona scenarios using the GSS7000 and schedule I/Q-generation tasks using the Keysight SimGEN interface. During simulation execution, the GSS7000 system provides GNSS RF inputs, which may include interference and spoofing signals, to the system under test (SUT).⁶ The SimXona signal generator provides the RF input to the SUT separately from the GNSS RF, thereby facilitating comprehensive testing capabilities for evaluating the performance of Xona-enabled receivers.⁷

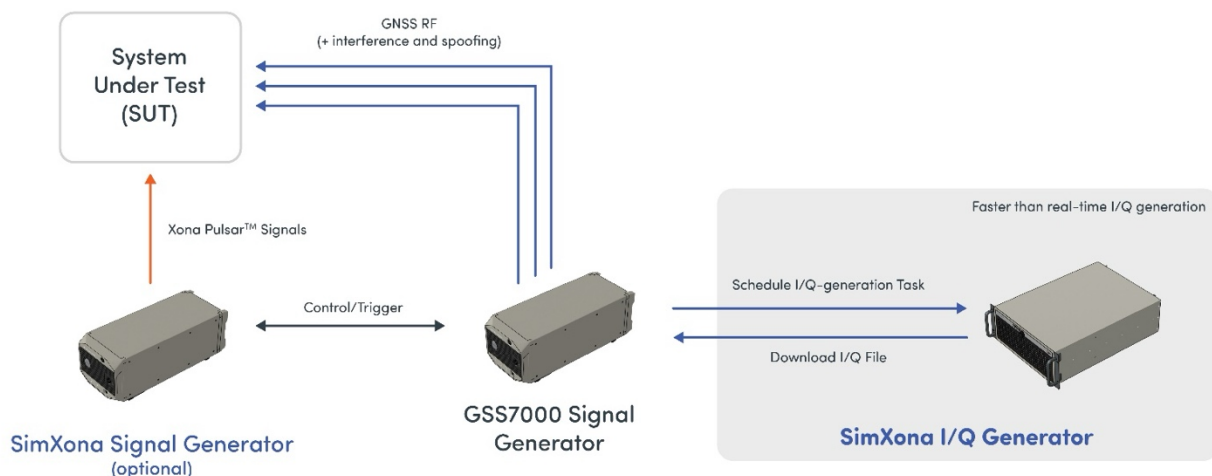


Figure 1. SimXona I/Q generator illustrative setup together with a GSS7000-based system and a SimXona signal generator

Upgrade Your Existing GSS7000 with SimXona Signal Generation

Your existing Keysight GSS7000 can be upgraded to support RF generation of Xona signals from I/Q files. With this upgrade, the GNSS simulator operates as a SimXona signal generator, delivering both GNSS and Xona PULSAR signals simultaneously.

⁵ Contact your local Keysight sales representative for further information.

⁶ Dependent on base system capability.

⁷ If you require a combiner is required to have the signals on the same SUT input, please contact your Keysight representative to discuss your requirements.

For production signals, a 2RF system is required to manage the power level differences between GNSS and PULSAR. In this configuration, the first RF port outputs GNSS signals, while the second port outputs Xona PULSAR signals. For demonstration signals, a 1RF system is sufficient.

All SimXona RF generation solutions require an additional channel bank to support RF output.

Software Control

SimXona features and capabilities are controlled by Keysight's SimGEN, the world's leading GNSS simulation software for test scenario definition, execution, data management, and GNSS RF constellation simulator command and control. With the fullest capability, features, and performance continuously developed in close consultation with GNSS system authorities over the last 35 years, SimGEN supports all the GNSS test parameters and control capabilities needed for comprehensive GNSS testing for research, development, and design of GNSS systems, services, and devices across any application.

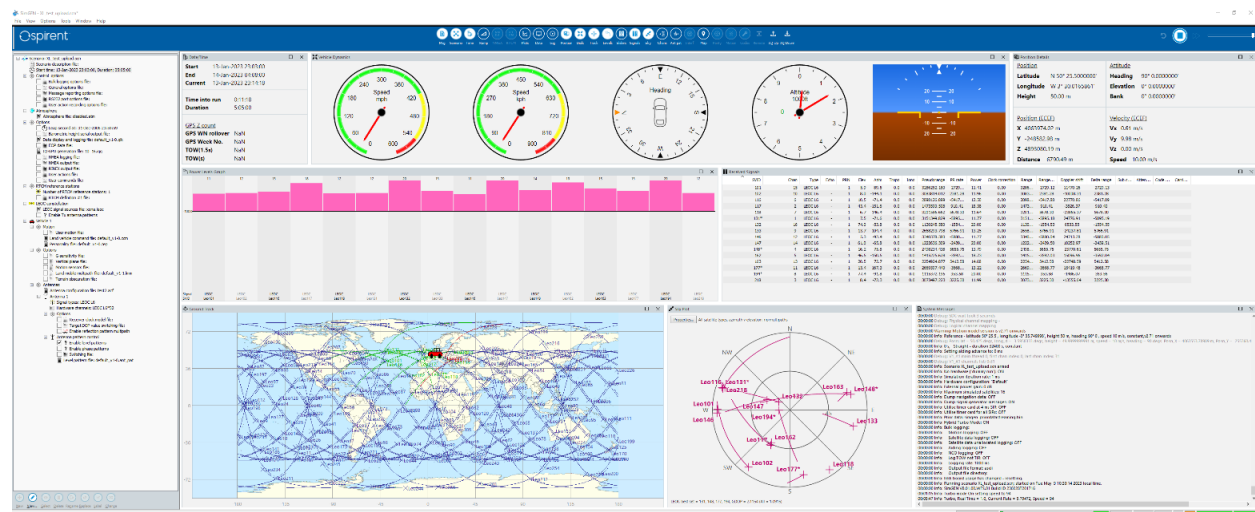


Figure 2. Keysight's SimGEN

Keysight has recently introduced new features to its SimGEN platform for SimXona users. These added functionalities provide users with the ability to access and manage the I/Q-generation service, which operates on either the SimXona I/Q generator or the C50 X. Users can easily upload scenario settings and schedule I/Q-generation tasks to generate the corresponding I/Q signals as well as set up the real-time RF generation if applicable. Additionally, users can download the files from completed tasks.

I/Q-Generation Tasks and Scenario Generation

Keysight's SimGEN and SimXona empower users to customize their own PNT scenarios, including editing the Xona constellation properties. The satellite orbits are defined using predefined SP3 files provided by Xona, which correspond to specific times (for further details, please refer to Table 2). Both, static and moving vehicles, are supported with SimXona.

In addition, our sophisticated I/Q-generation task scheduler allows for multiple tasks to be defined and queued up simultaneously. The simulation iteration rate for each task can also be specified, similar to Keysight's SimGEN scenarios. An overview of all tasks, including their status and progress, is readily available to the logged-in user via the monitoring window. This feature also enables users to delete tasks and download I/Q data from completed tasks.

Detailed Performance Specification

Xona I/Q Files and Scenarios⁸

The I/Q files generated are accompanied by a metadata file in the [Institute of Navigation \(ION\) Global Navigation Satellite System \(GNSS\) Software Defined Radio \(SDR\) Metadata Standard](#) format.⁹ These metadata files specify center frequency, bit depth, and sample rate. The ION SDR metadata format ensures compatibility with the replay capabilities on the Keysight PNT simulation platform. The supported data formats are listed in Table 1.

Table 1. Supported I/Q File Formats

Parameter	Supported Values
Center Frequency	Xona L-band demonstration signal (XL) or production signal X1 and X5
Bit depth	16
I/Q sample rate	30, 60 MHz

The validity of the scenarios is limited by the orbits of the Xona satellites defined on the SP3 files available from Xona Space Systems. The start time of the scenario set, together with the associated limitations, is shown on Table 2. Other scenario sets may be developed in the future.

Table 2. Time Boundaries for SimXona Scenarios

Description	Start Time [YYYY-MM-DD HH:MM:SS]	Scenario Validity ¹⁰
Scenario Set 1	2022-02-02 00:00:00	24 hours
Scenario Set 2	2023-08-01 00:00:00	24 hours

⁸ This section applies to PNT X and GSS7000 systems.

⁹ See reference: ION SDR Metadata format.

¹⁰ I/Q storage supplied limits total scenario duration. Please, contact your local Keysight representative if support for longer scenarios is required.

For each of the scenario sets included, SimXona can generate satellite data (according to the supported ICD specified in ICD Compliance) for the main operational configurations.

SimXona I/Q Generator Specification; Only for GSS7000 Extensions

Table 3. SimXona I/Q Generator Connectivity

Port	Type	Parameter
USB	I/O	Mouse, keyboard, and general file access (2 accessed from front + 2 on rear panel)
VGA	I/O	
Ethernet	I/O	RJ-45 Ethernet interface standard. Used for general network access

Table 4. Physical and Environmental Properties

Part	Parameter	Value
SimXona I/Q Generator	Height	4U 177.8mm / 7"
	Width	426.0mm/16.77" without Rack Mount installed (Fits standard 19" IT Rack) 482.0mm/18.98" with Rack Mount installed
	Depth	600.6mm/23.65" (Not including front handles and front bezel door closed)
	Typical Weight	Weight (excl. peripherals) <20kg (44lb)
	Operating Environment	+10 to +40°C (50 to 104°F) (40-90% RH, non-condensing) Altitude restriction of 2000m
	Storage Environment	-40 to +60°C (-90 to 140°F) (20-90% RH, non-condensing)
	Electrical Power	100-240V 15-7 A MAX 50 to 60Hz

Note(s): Physical and environmental properties such as the operating and storage environments apply to the SimXona I/Q Generator only. Associated equipment or other Keysight-supplied equipment may not extend to these environmental limits. Optionally the chassis can be mounted in an equipment rack; details available upon request.

SimXona Signal Generator Specification; Only for GSS7000 Extensions (Optional)

The performance characteristics of the SimXona signal generator are significantly influenced by the I/Q files utilized for signal generation. Notwithstanding the replayed I/Q files, the SimXona signal generator possesses the following general characteristics. For production signal customers, the signal generator will feature two radio cards and for demo signal customers there will only be one radio card.

Table 5. Performance Level for the SimXona Signal Generator

Parameter	Description	Units	Notes
RF Signal Level	Nominal RF Power Level XL	As per ICD	11
	Nominal RF Power Level X1	As per ICD	8
	Nominal RF Power Level X5	As per ICD	8
	Carrier Level Control Maximum	0 dB for XL 15 dB for X1 X5	
	Minimum	-40 dB for XL -30 dB for X1 X5	12
	Resolution	0.1 dB	
	Linearity 0 dB to -30 dB	<0.10 dB	
	-30.1 dB to -40 dB	<0.20 dB	
	Absolute Accuracy Run to Run Repeatability	±0.5 dB ±0.1 dB	13
Signal Stability	Internal 10.00MHz OCX Oscillator (after warm-up)	± 5 x 10 ⁻¹⁰ per day	

11 Absolute RF signal power level on the SimXona signal generator is dependent on the power level specified in the I/Q files. The nominal power level for the I/Q files provided with the system is set as per the specified RF signal level.

12 The control range extends to -99 dB but performance is unspecified below -30/40dB.

13 At 21°C ±5°C, 0 to -30dB. ±1.5dB 3-sigma all conditions.

Table 6. Signal Generator Connectivity

Port	Type	Parameter
Main RF Port	Output	N-type coax female, 50 Ohm, VSWR <1.2:1 AC coupled ± 50 V DC, maximum reverse RF 30 dBm
High Level RF Port, Nominal port for Xona Replay	Output	N-type coax female, 50 Ohm, VSWR <1.2:1 AC coupled ± 50 V DC, maximum reverse RF 30 dBm
Auxiliary RF	Input	N-type coax female, 50 Ohm, VSWR <1.4:1 0.5 to 2 GHz, Insertion Loss 14.5 dB typical
External Frequency Standard	Input	BNC coax socket, 50 Ohm -5 to +10 dBm at 1 MHz, 5 MHz, 10 MHz
Internal Frequency Standard	Output	BNC coax socket, 50 Ohm 10.00 MHz at +5 dBm nominal
1PPS IN	Input	BNC coax socket, 50 ohm, TTL level compatible
1PPS OUT	Output	BNC coax socket, 50 Ohm, TTL level compatible
Trigger IN	Input	BNC coax socket, 50 ohm, TTL level compatible

Table 7. Optional Monitor

Type	Type	Manufacturer
P2217H	22-inch	Dell

Table 8. Internal Controller Connectivity

Interface	Type	Parameter
USB (x4)	I/O	Mouse, keyboard, and general file access (2 accessed from front + 2 on rear panel)
Ethernet (x2)	I/O	RJ-45 Ethernet interface standard. Used for general network access and available for remote control
DVI	I/O	Video monitor port

Table 9. Physical and Environmental Properties

Part	Parameter	Value
Signal Generator	Approximate Dimensions (H x W x D) (9.25" x 4U chassis)	176.95mm x 235.2mm x 555mm 6.96" x 9.25" x 21.85"
	Typical Weight	<15kg (33lb)
	Operating Environment	0 to +50°C (32 to 122°F) (40-90% RH, non-condensing) Altitude restriction of 2000m
	Storage Environment	-40 to +60°C (-40 to 140°F) (20-90% RH, non-condensing)
	Electrical Power	100-240V 5A Max 50 to 60Hz

Note(s): Physical and environmental properties such as the operating and storage environments apply to the SimXona signal generator only. Associated equipment such as the monitor, keyboard, and mouse or other Keysight-supplied equipment may not extend to these environmental limits. Optionally the chassis can be mounted in an equipment rack; details available upon request.

Table 10. Safety and EMC Compliance

Compliance	Applicable Standard
Safety	Low Voltage Directive (LVD) 2014/35/EU IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013 Information technology equipment. Safety. General requirements
EMC	EMC Directive 2014/30/EU EN 61326-1:2013 Electrical equipment for measurement, control, and laboratory use. EMC requirements. General requirements

Calibration Requirements

The digital architecture of the signal generator requires only limited annual calibration, for which a detailed procedure is provided.

The SimXona signal generator is calibrated at the time of purchase. This calibration comes with a default 12-month calibration period.

For more information on Keysight's SimXona signal generator calibration service, please contact your local Keysight representative.

ICD Compliance

Table 11. SimXona ICD Compliance

Variant	Name	Version	Notes
Demo Signal	DD-PULS-ICD01-Xona- Navigation-Signal-ICD	v1.3.0	Encryption and authentication are not supported. Navigation data from file as per Error! Reference source not found.. Incl. the Addendum for Specification of Simulator Parameters v1.0
Production Signal	Xona PULSAR Navigation Signal Interface Control Document	V0.5.0	Nav data delivered by Xona from file as per Error! Reference source not found..

Glossary of Terms

1PPS	One Pulse-Per-Second
EMC	Electromagnetic Compatibility
GPS	Global Positioning System US GNSS system
GNSS	Global Navigation Satellite System
GUI	Graphical User Interface
ICD	Interface Control Document
LEO	Low Earth Orbit
RF	Radio Frequency
SUT	System Under Test
1PPS	One Pulse-Per-Second



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