

# GSG WF GEN2

## Software-Defined GNSS

### CRPA Antenna Simulation System



#### A Powerful and Field-Proven Platform

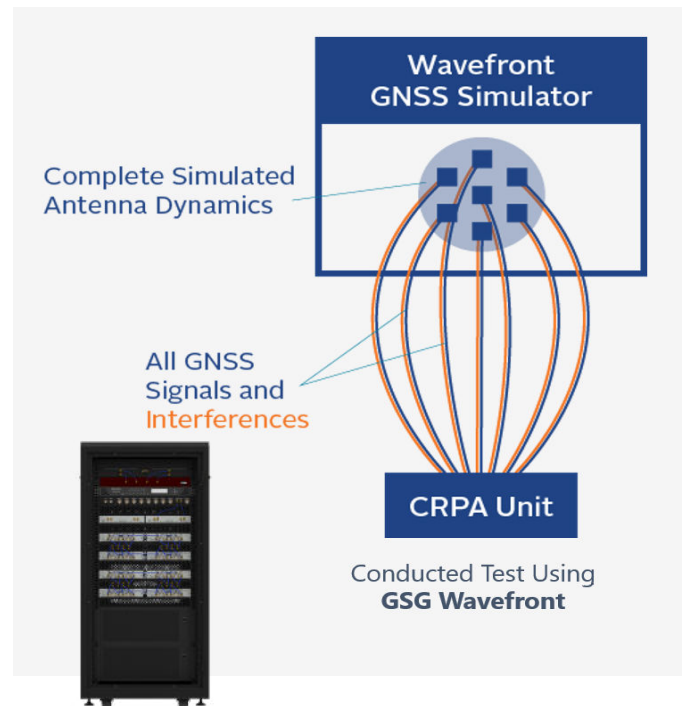
Protecting your GNSS systems from jamming and spoofing is more critical now than ever. This type of resilience is accomplished with an advanced GNSS Simulator capable of generating dedicated RF signals to test CRPA (Controlled Reception Pattern Antenna) architecture.

Leveraging its field-proven software-defined architecture, Safran has developed GSG WF Gen2, an affordable, “off-the-shelf”, and easy-to-use CRPA receiver testing platform.

#### What is a Wavefront simulator?

GSG WF Gen2 simulators emulate and generate the GNSS and interference signals as outputs of the antennas elements.

The GSG WF Gen2 approach is different from classical anechoic CRPA Tester systems: it simulates multi-element antennas by providing as many RF outputs as antenna elements – all phase-aligned, consistent and synchronized, to test the CRPA unit.



Safran GSG WF Gen2 GNSS simulator CRPA test scenario

**Safran Electronics & Defense is with you every step of the way, building in the intelligence that gives you a critical advantage in observation, decision-making and guidance.**

## GSG WF Gen2 Features\*

- Scalable antenna configuration, supporting 2 to 16 multi-frequency antenna elements.
- Up to 800 signals per element (accurate and complex use cases).
- Capable of supporting up to 4 GNSS bands simultaneously.
- All GNSS bands: L1, L2, L5, E6, S band.
- Interference: Jamming, spoofing, and meaconing.
- Simultaneously simulate multiple threats.
- High dynamics to adapt every type of vehicle.

## High performances

- High phase alignment and stability (due to shared LO, RF chain quality and Safran timing server and distribution experience).
- High power accuracy and alignment
- Equipped with Safran's SecureSync 2400

Element ID	IP Address	Skydel Instance ID	AP Lock	Master Lock	Band	Phase	Time	Gain
1	192.168.71.2	0	0	0	L1	0.220	0.000	0.016
2	192.168.71.2	0	0	0	L2	0.055	0.000	0.008
3	192.168.71.2	0	0	0				
4	192.168.71.2	0	0	0				

To Calibrate	Element	Band	Type	Phase Offset	Time Offset	Gain Offset	Last Modified
	1	L1	GNSS	0.000	0.000	0.000	2021-08-24 12:00
	1	L1	Interference	0.000	0.000	0.000	2021-08-24 12:00
	1	L2	GNSS	0.000	0.000	0.000	2021-08-24 12:00
	1	L2	Interference	0.000	0.000	0.000	2021-08-24 12:00
	2	L1	GNSS	0.220	0.000	0.000	2021-08-24 12:00
	2	L1	Interference	0.220	0.000	0.000	2021-08-24 12:00
	2	L2	GNSS	0.055	0.000	0.000	2021-08-24 12:00
	2	L2	Interference	0.055	0.000	0.000	2021-08-24 12:00
	3	L1	GNSS	0.000	0.000	0.000	2021-08-24 12:00
	3	L1	Interference	0.000	0.000	0.000	2021-08-24 12:00
	3	L2	GNSS	0.000	0.000	0.000	2021-08-24 12:00
	3	L2	Interference	0.000	0.000	0.000	2021-08-24 12:00

GSG WF Gen2 includes a calibration tool as well as continuous monitoring capabilities.

## Technical Specifications

RF Performance
Typical phase alignment bias : $< \pm 1^\circ$
Typical phase alignment deviation : $0.5^\circ$ ( $1\sigma$ )
Power accuracy on each element: $\pm 0.5$ dB
Power alignment between elements : $\pm 0,5$ dB
Signal purity <ul style="list-style-type: none"> <li>• Spurious : - 65 dBc</li> <li>• Harmonics : - 80 dBc</li> <li>• Phase noise : <math>&lt; 0.002</math> rad (RMS)</li> </ul>
Power management <ul style="list-style-type: none"> <li>• GNSS power level range : -175dbm to -100dbm</li> <li>• Jamming default maximum power : -10dbm. Optional: separate GNSS and interference outputs and add extra amplifier on the interference RF chain.</li> <li>• Jamming to GNSS Signal ratio : up to + 130dB</li> </ul>

time server.

- Automatic Phase Alignment

## Modular

- Highly configurable product.
- Possibility to add elements / signals during the lifecycle.

## Easy to use

- Powered by user-friendly Skydel software simulation engine.
- On-site annual calibration by end-user.
- No specific calibration needed after power cycle.
- Quiet operation during simulation.
- Simulation from cold start time:  $< 90$  seconds.

## Reduced form factor & price

- Single 24U unit rack for a typical system with up to 8 elements including interference generation.
- Leverages COTS hardware and Safran components.



\*: Specific requirements are possible and available upon request, e.g.: five frequencies, additional signals, etc.

Scenarios
800 signals / element
1kHz iteration
Dynamics : <ul style="list-style-type: none"> <li>• Maximum velocity : 1500 km/s</li> <li>• Acceleration : no limits</li> <li>• Jerk: no limits</li> </ul>
HIL latency under 10 ms
Multipaths

Signals
GPS open services: L1-C/A, L1C, L1-P, L2-P, L2C, L5;
GPS-AES restricted signals: M-code (L1, L2) ; Y-code (L1, L2) (on Broadsim hardware)
GLONASS: G1, G2
Galileo open services: E1, E5a, E5b, E5AltBOC, E6 HAS, OSNMA
Galileo restricted signals: PRS (E1, E6)
BeiDou: B1, B2, B1C, B2A, B3I
QZSS: L1-C/A, L2C, L5, L6
Navic : L1, L5, S-band
SBAS: WAAS, EGNOS, MSAS, GAGAN, SDCM
Xona : PULSAR XL
Custom Signals
IQ reader

Interferences
Integrated into the software (GUI and API) and hardware
Simultaneously simulate multiple threats with different positions and/or trajectories (Optional: customized number of jammers or spoofers)
Dynamic transmitters, user-defined waveforms
Jamming, spoofing, meaconing

Interfaces
One combined RF output / element (Customizable : N-type or SMA connectors)
Timing : <ul style="list-style-type: none"> <li>• PPS out : BNC</li> <li>• PPN In : BNC</li> <li>• 10MHz out : BNC</li> <li>• 10MHz in : BNC</li> <li>• GPS connector for clock calibration</li> </ul>
Interfaces for monitor, keyboard, USB, and ethernet. Option to include monitor and keyboard.

## Timing Specifications

Internal Oscillator	LPN OCXO	LPN Rubidium (option)
Accuracy (average over 24 hours when GPS locked)	$3 \times 10^{-12}$	$1 \times 10^{-12}$
Medium Term Stability (without GPS after 2 weeks of GPS lock)	$2 \times 10^{-10}/\text{day}$	$5 \times 10^{-11}/\text{month}$ ( $3 \times 10^{-11}/\text{month typ}$ )
Short Term Stability (Allan Deviation)		
1 sec	$1 \times 10^{-11}$	$1 \times 10^{-11}$
10 sec	$9 \times 10^{-12}$	$1 \times 10^{-11}$
100 sec	$8 \times 10^{-12}$	$5 \times 10^{-12}$
Temperature Stability (peak-to-peak)	$2 \times 10^{-9}$	$1 \times 10^{-10}$
Phase Noise (dBc/Hz)		
@1 Hz	-100	-100
@10 Hz	-128	-128
@100 Hz	-148	-148
@1 KHz	-150	-150
@10 KHz	-150	-150
Signal Waveform & Levels: +13 dBm $\pm$ 3 dB into 50 ohm, BNC		
1 PPS Timing Output	LPN OCXO	LPN Rubidium (option)
Accuracy to UTC (locked to GPS @ 1 sigma)	$\pm 50$ ns	$\pm 50$ ns
Holdover (constant temp after 2 weeks GPS lock)		
After 4 hours	12 $\mu$ s	3 $\mu$ s
After 24 hours	450 $\mu$ s	100 $\mu$ s
Signal Waveform & Levels: TTL ( $5 V_{P-P}$ ), into 50 ohm, BNC		

Full timing specifications from [Safran Securesync 2400 datasheet](#).

Possibility to use and external clock, distribute the clock and PPS outside of the system and calibrateclock.

Common CRPA Simulator Challenges	With GSG WF Gen2
<ul style="list-style-type: none"> <li>• Calibration takes hours and is not automated.</li> <li>• Physically large and not scalable.</li> <li>• Custom one-off solutions.</li> <li>• Limited spoofing and repeating capabilities.</li> <li>• Limited number of signals.</li> <li>• Lack of phase synchronization monitoring during simulation.</li> </ul>	<ul style="list-style-type: none"> <li>• Automated calibration process takes minutes and is not required after each power cycle.</li> <li>• GSG WF Gen2 system simulates in less than 90 seconds from cold start.</li> <li>• Modular design: Safran can perform a quick on-site upgrade without changing entire rack.</li> <li>• A typical 8 element systems fits into a single 24U unit rack.</li> <li>• Jamming, spoofing, and meaconing: software-defined architecture allows the simulation of many offensive systems.</li> <li>• Ability to perform increased number of signals per element (more satellites simulated, ready for LEO PNT, ability to simulate complex use cases with multipaths, and more...).</li> <li>• Integrated phase continuous synchronization and monitoring graphs</li> </ul>

### Best in Class Support

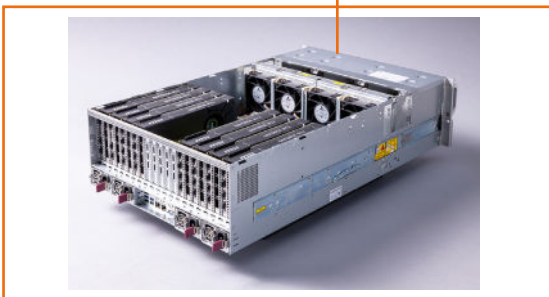
All Safran systems are provided with an extendable one-year hardware warranty and an extendable one-year software support which includes:

- Expert training
- On-site installation
- Software updates
- Engineering support
- Email support
- Phone support
- Self-paced online certification course
- Access to User Forums: (<https://learn.safran-navigation-timing.com/>)

### Resources

To learn more about Safran's CRPA-related products, here are some useful resources:

- [Article: What is CRPA, and how to test it?](#)
- [White paper: Engineer's Guide to CRPA Testing](#)



Pictured top: 5-Element GSG WF Gen2 System.  
Pictured Above: Wavefront Node, generates IQ data per each element.

Images shown in this document may differ from final product and are not considered binding.

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BY TRUST**

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