Keysight R4453A Constellator™

Multi-constellation & multi-frequency GNSS simulator

GNSS Simulator that Grows with Your Needs

For design, validation, and production

The history of Constellator™ started more than 20 years ago with the first simulator for Galileo. Its singularity lies in the tight coupling of Software Defined Radion (SDR) and state-of-the-art RF analog front end.

Today, RTGS4 represents Syntony's 4th generation of simulators. It is designed to meet the highest requirements in terms of fidelity, performance, flexibility, and ease of use at an affordable cost.

Powerful & high-fidelity

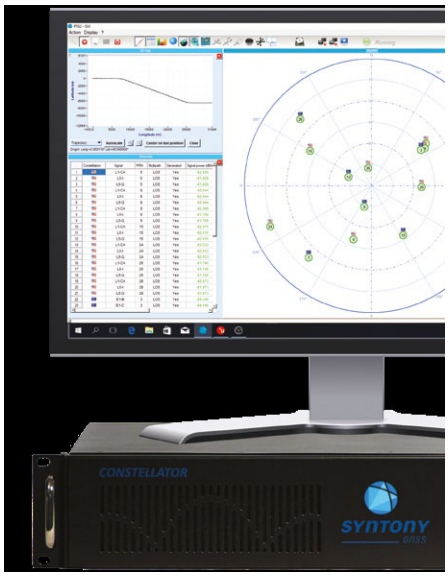
- Realtime, multi-constellation, and multi-frequency

  GPS, Galileo, GLONASS, QZSS, IRNSS/NavIC, BeiDou, SBAS, Encrypted signals
- Powerful with 1 200 L1C/A equivalent signals

  All satellites from all GNSS constellations on all frequencies for real-world simulation
- From simple trajectories to complex extreme dynamics

  Create trajectories in seconds, on Earth, in the air, or even in space
- Hardware-in-the-loop with zero effective latency

  Even with 6 DoF, up to 1000 Hz iteration rate



SYNTONY GNSS

KEYSIGHT

Extremely configurable for advanced simulations

- Rich multipath and terrain obscuration, with one click presets
  Leverage our library of customizable models (urban, suburban, highway…)
- All standard ionospheric & tropospheric models +Advanced 3D space dedicated models
  UNB, Klobuchar, Nequick, customizable grid, etc.
- On-the-fly scenario modifications & extensive simulation options
  Easily test the effect of errors in satellite position, clock, and messages
- Leverage extensive testing reports in real-time as a source of truth data
  Leverage 25+ environment variables and 20+ variables per satellite in view
- Ready for jamming and spoofing tests
  Simulate up to 20 sources of jamming or spoofing with configurable waveforms and signals

Figure 1. Used in space & defense, aviation, telecom & 5g, and automotive applications.

Easy to setup and use

- Simple local or remote control & quick integration
  User-friendly GUI or control via commands
- Smooth hardware setup, ready for multi-antenna or multi-receiver
  Interfaces: 100 MHz clock reference (IN & OUT), triggers, PPS IN & OUT
- Extensive documentation, scenario library available & local support
  User guides, ICD, Python script examples & .xls tools for data structure

Built to evolve with your testing requirements

- Software-defined-radio architecture allowing remote updates
  Most of the new signals and features are software updates only
- Do you need a specific feature? We are flexible & can build it custom
  Space agencies & industry leaders already benefit from our custom services

RTGS4 – Specifications

	RTGS4 - PRO - IC: Real-Time GNSS Simulator 4th Generation Infrastructure & Civil Keysight R4453A-3SD (3 channels) or R4453A-6SD (6 channels)	RTGS4 – PRO – DS: Real-Time GNSS Simulator 4th Generation Defense & Space Keysight R4453A-3UD (3 channels) or R4453A-6UD (6 channels)
Simulation		
Constellations & signals		
GPS | L1C/A, L1C, L2C, L5, L1P(Y), L2P(Y)	Yes	Yes
Galileo | E1, E5a, E5b, E6HAS	Yes	Yes
GLONASS | L1OF, L1OC, L2OF, L2OC, L3OC	Yes	Yes
QZSS | L1C/A, L1C, L2C, L5	Yes	Yes
IRNSS/NavIC | L5, S	Yes	Yes
BeiDou | B1I, B1C, B2a, B3I	Yes	Yes
SBAS | L1, L5 (EGNOS, WAAS, GAGAN, MSAS, SDCM, SNAS)	Yes	Yes
Performance		
Computation power (equiv. L1C/A signals)	1200 signals	1200 signals
RF Channels	3 or 6	3 or 6
Pseudorange accuracy for all bands simultaneously	<1 mm	<1 mm
Trajectories		
Static/dynamic ground & airborne	Yes	Yes
Replay rate	100 Hz	1000 Hz
Hardware-in-the-loop (HWIL) live	No	1000 Hz
Max. Velocity altitude / acceleration / jerk	<600 m/s No limitation	No limitation No limitation
Environment		
Multipath / obscuration / earth masking	Yes	Yes
Ionospheric models (incl. 3D) and tropospheric models	Yes	Yes
GNSS transmitting antenna gain patterns, specific for each signal & satellites, to model side lobes	Yes	Yes

Error sources simulation: orbits, clocks, and ionosphere	Yes	Yes
Preconfigured and live commands	Yes	Yes
Jamming simulation *(CW, Pulsed-CW, Spectrum-matching noise, Band-Limited White Gaussian Noise)*	No	Up to 20 sources *Up to 10 interferences per source*
Spoofing simulation *Configurable physical & spoofed position, RF powers, delays, list of signals*	No	Up to 20 spoofers
Advanced signals *Control of low-level signal parameters (power, delay, phase, and their drifts)*	No	Yes *1000 Hz, replay & live*
PRN link *Input card for encrypted signals*	No	Yes

Simulator

Connectivity & synchronization interfaces	
RF output connector	3xSMA mono-band and 1xN female multi-band or 6xSMA mono-band and 2xN female multi-band
Int. 10 MHz reference output	BNC female
Ext. 10 MHz reference input	BNC female
External trigger In/Out	BNC female, TTL Level, 5V DC, configurable timing & pulse widths
PPS in, PPS out	BNC female, 1Hz rate | PPS-In 5V, PPS-out 5V, +/- 5 ns from RF output
GUI/Network connector	RJ45 (1 Gbps)
Dedicated HWIL connector	RJ45 (1 Gbps)
PRN link	RJ45 (10 Gbps)

RF front end

RF output	
Frequency range	From 1 100 MHz to 1 610 MHz and from 2 450 to 2 550 MHz
RF bandwidth	20 up to 25 MHz
RF Power (@50 Ohm)	From -55 to -120 dBm 0.1 dB resolution +/- 0,1 dB power accuracy
RF signal level (Jamming)	Up to +80 dB J/S with signal (S) reference power at -120 dBm
Output VSWR	< 1.3
Supported VSWR	∞ (Permanent)
RF quality	
Harmonic spurious	< -65 dBc min
Non-harmonic spurious	< -55 dBc (SF dependent)
RMS jitter	104 fs
Group delay variation	< 15ns @ BW = 55 MHz
Group delay stability	< 10ps/°C @ BW = 55 MHz
Phase noise Noise floor level	$< 5.10^{-3}$ Noise floor level < -193 $dBW.Hz^{-1}$
Synthesizer – Internal 10 MHz reference	
Signal	Sinus
Stability	5.10^{-9} from +10°C to +40°C
Aging	0.5 ppb/day and 50 ppb/year the first year, then 10 ppb/year

Allan variance (1s)	$2x10^{-12}$
Synthesizer – Internal 10 MHz reference output	
Signal	Sinus
Impedance	50 Ohm
Level	6 dBm
Hardware	
Input voltage range	100 to 240 V AC +/-10%
Input frequency range	50 to 60 Hz
Power consumption	120 W
Operating temperature range	0 °C to +50 °C
Storage temperature range	-20 °C to +70 °C
Relative humidity (Operating/storage/transit)	10-93%, @ 40 °C, Non-condensing
Operating altitude	5000 m
Shock (according to EN 60068-2-27)	Operating: 15 G 11 ms duration | Non-operating: 30 G 11 ms duration
Vibration (according to EN 60068-2-6)	Operating: 10-150 Hz: 1G/3 axis | Non-operating: 10-150 Hz: 2G/3 axis
MTBF	> 50.000 hrs
Dimensions	430 x 177 x 472 mm | 17 x 7 x 18.5 in
Weight	20 kg | 44 lb

The future of navigation is software

Since 2015 syntony has become a leader in the GNSS industry. Syntony offers unique location solutions allying Software-Defined Radio (SDR) and state-of-the-art RF analog front end.

Easy to setup and use, the Syntony solutions are built to evolve with our client's needs and inherit from 20 years of R&D and collaboration with space agencies and industry leaders.

For more information

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