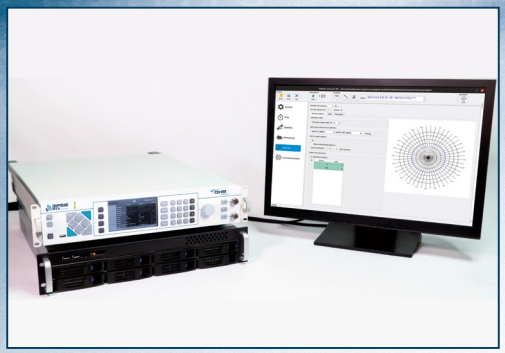
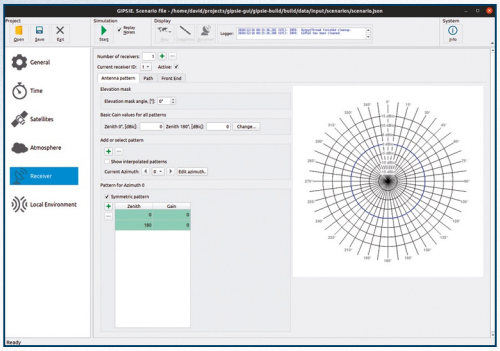
OHB DIGITAL





GIPSIE-RTX

GNSS Signal Generator
Real-Time E**x**tension

OHB Digital Solutions GmbH develops systems for simulating various GNSS constellations and signals including several degradation effects and disturbances.

GIPSIE-RTX is a fully featured GNSS signal generator with real-time streaming functionality including real-time control of the simulation environment. It consists of a high-quality signal simulator as hardware platform and the flexible and powerful GNSS simulation environment **GIPSIE**.

The multi-system and multi-frequency capable **GIPSIE-RTX** simulates arbitrary satellite orbits using a sophisticated orbit integrator and is able to model all error sources, delays and propagation effects. These include various models for satellite clock offsets, ionosphere and troposphere, multipath, signal power, antenna patterns and noise. In addition, multiple types of signal interference, like jamming and spoofing, can be defined. Customized navigation message formats and contents can be used to simulate future GNSS signal features.

GIPSIE RTX Real Time eXtension

Supported GNSS signals	**GPS:** L1 C/A, L2C, L5 **Galileo:** E1 B/C, E5a-I/Q, E5b-I/Q **GLONASS:** G1 C/A, G2 C/A **BeiDou:** B1, B2 **SBAS:** L1 C/A
Bandwidth	up to **120 MHz** per RF output
Constellation Update Rate	up to **250 Hz**
Resolution:	up to **2x16 bit** (complex I/Q)
Operating system	Linux (Windows)
Number of channels	Up to 128 (depending on selected signal components)
Simulation	- **Satellite orbits** based on ephemeris or orbit integration - **Satellite clock model** - **Atmospheric delays** - **Ionospheric delay** models (Klobuchar, Nequick-Gal, IONEX input) - **Tropospheric delay** models (Saastamoinen, Hopfield, GPT2w) - **Multipath models** (statistical and deterministic) - **Noise models** for all delays customizable and highly (bit-true) reproducible - **Antenna gain pattern** and **obstruction mask** - **IF signal parameters** including RFFE simulation - User-configurable **navigation message** - Receiver **movement** simulation (input through GUI, user file or API) - Simulation of **multiple receivers** within one simulation
Frequency Range	2x RF Tuner, **9kHz – 3 GHz** (0.001 Hz resolution)
Accuracy between RF1, RF2	lower than **100us**
Reference accuracy	OCXO ±5 x 10-8 ageing per year <±1 x 10-8 temperature stability 10 min warm-up time
Power level	Maximum power output: +20 dBm typical Resolution: 0.1 dB Uncertainty: ±0.5 dB: +10 dBm – -50 dBm Range: ±1.0 dB: below -50 dBm Dynamic range: -134 dBm – +20 dBm (peak); ‹75 dB typical
Spectral purity	Harmonics f >30 MHz: <-30 dBc at +10 dBm Harmonics f <30 MHz: <-40 dBc at +10 dBm Non harmonics >30 MHz: <-75 dBc typical Non harmonics <30 MHz: <-80 dBc typical
Output IP3	‹30 MHz @ 10 dBm dualtone, 2 MHz spacing: 35 dBm typical 100 MHz @ 10 dBm dualtone, 2 MHz spacing: 40 dBm typical 1575 MHz @ 10 dBm dualtone, 2 MHz spacing: 34 dBm typical 2332.5 MHz @ 10 dBm dualtone, 2 MHz spacing: 32 dBm typical
Continuously operation	supported
Simulation iteration rate SIR	250Hz, 100Hz, 50Hz, 10Hz
Simulation update rate of trajectory	250Hz, 100Hz, 50Hz, 10Hz, 1Hz
Simulation of hardware in the loop HIL	250Hz, 100Hz, 50Hz, 10Hz, Latency to RF output < 2ms
Simulation of receiver Antenna	gain
Simulation of transmit Antenna	gain, phase
Logging capabilities	- **Time** related parameters - Simulated **vehicle trajectory** parameters - **Receiver antenna** parameters - **Satellite trajectory** parameters - Satellite transmit **antenna parameters** - **Received signal** parameters

esa Acknowledgement: GIPSIE-RTX has been developed within the project GSGSE, which was carried out under a program of and funded by the European Space Agency. The view expressed herein can in no way be taken to reflect the official opinion of the European Space Agency.

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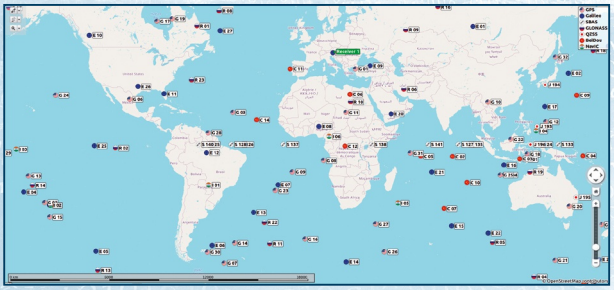
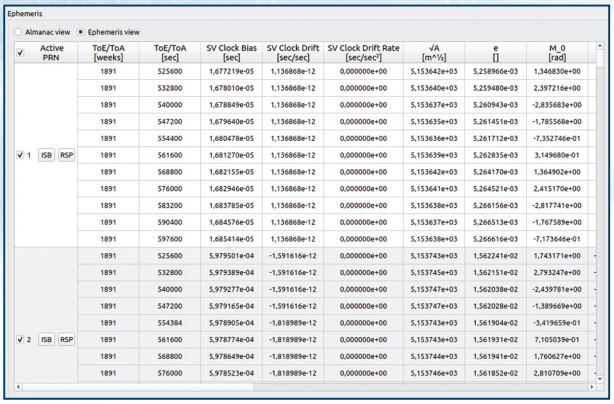
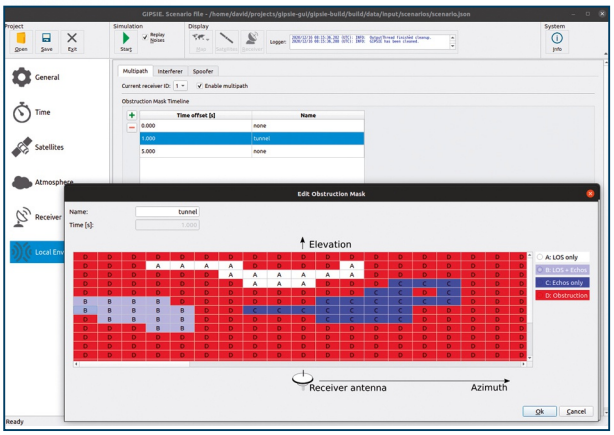
GIPSIE-RTX

GNSS Signal Generator - **R**eal **T**ime E**x**tension







The software **GIPSIE** (GNSS multisystem performance simulation environment) provides the possibility to generate simulated GNSS constellations and signals for various user-defined scenarios including complex trajectories and environments. All settings can be made within the user-friendly and intuitive graphical user interface or within an easy-to-read configuration file.

GIPSIE provides the following features:

- Orbit integration module based on earth gravitational models including gravitational effects of sun and moon
- Simulation of complete GNSS constellations including all satellites based on default almanac or accurate ephemeris information and clock parameters
- Simulation of accurate models for ionospheric and tropospheric delays
- Simulation of user-defined receiver antenna characteristics including reception gain patterns and multipath effects
- Navigation message simulation based on GNSS ICDs or customized user-defined message formats
- 100% reproducible noise and signal degradation simulations
- Graphical user interface
- Comprehensive data logging of all intermediate results for detailed analyses and debugging support

Besides generating RF signals, **GIPSIE-RTX** is also capable of directly simulating digital signals taking into account user-defined modelling of a radio-frequency front-end.
In combination with a high-quality signal simulator a real-time and streaming mode is offered, while keeping the flexibility, performance and distinguished features of **GIPSIE**.

GIPSIE-RTX provides a real-time input interface and thus supports hardware-in-the-loop (HIL) testing, e.g. for automotive applications.

Features of the Signal Generator:

- One device – 31 Virtual Signal Generators of highest RF quality
- Two phase-synchronous RF outputs for diversity testing
- Synchronization of multiple GNSS simulators
- Variable sample rate converters
- Replaying RF signals
- Versatile real-time impairment simulation
- Universal ARB function
- Variable signal emission at defined timeslots
- Smooth external synchronization
- Simulation of PPD jamming effects
- Real-time impairment simulation
- Automated testing for development and production

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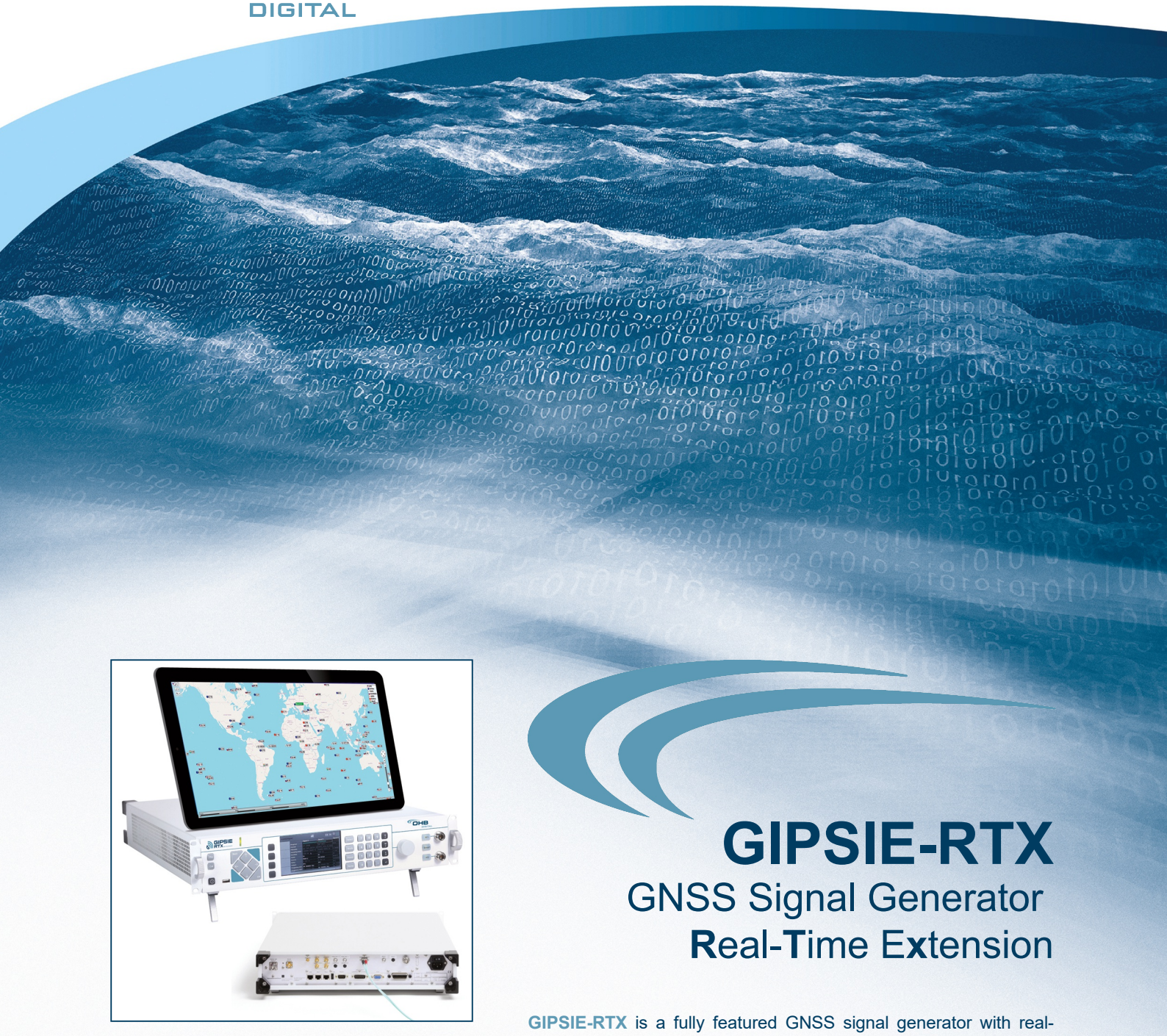

GIPSIE-RTX

GNSS Signal Generator
Real-**T**ime E**x**tension

GIPSIE-RTX is a fully featured GNSS signal generator with real-time streaming functionality including real-time control of the simulation environment.

- All civil GNSS constellations
- Highly reproducible scenarios
- Modelling of all error sources, delays and propagation effects
- Interference (jamming and spoofing) simulation
- HIL (Hardware in the Loop) simulation
- Synchronization of multiple simulators for advanced testing (e.g. array antenna)
- 2 separate RF outputs per device

Applications

- GNSS receiver and application testing, e.g. testing eCall systems
- Record and Playback

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