



NCS TITAN

The most powerful GNSS Simulator available

Scalability



Fidelity



Reliability



Usability



Extendability



Flexibility



Upgradability

Features

Signal Capabilities

- Support of all global (GNSS) and regional satellite navigation systems (RNSS) as well as satellite based augmentation systems (SBAS)
- 32 - 256 signal channels (up to 8 RFSIM signal generation modules)
- Each RFSIM engine of 32 channels is divided into 4 blocks of 8 channels each
- Each block of eight channels is fully configurable in terms of frequency and signal modulation
- Additional multipath channels
- In-field extension of signal capability and GNSS functionality by software license
- On-the-fly re-configuration of constellation and signal configurations
- All GNSS constellation types and all frequencies (up to 16 with 16 SVs each) brought into a single chassis
- Multi-RF output options available, with up to 4 independent RF outputs per chassis
- RF Switch Matrix allows the user to assign each block of 8 channels to any RF output

Connectivity

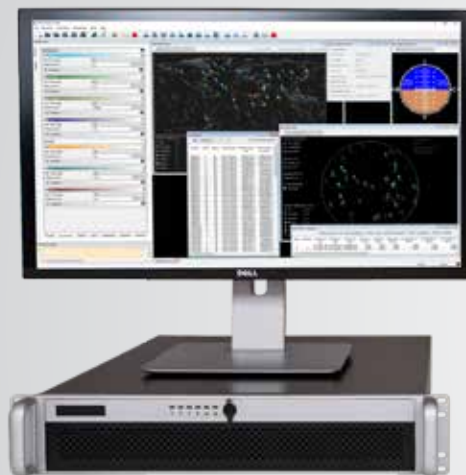
- Remote control capability via Ethernet interface
- 1 PPS in & out
- 10 MHz reference in & out
- External trigger input
- External interference signal input

NCS TITAN GNSS Simulator

System Setup

The NCS TITAN GNSS Simulator is a powerful high-end satellite navigation testing and R&D solution. It is fully capable of multi-constellation, multi-frequency simulations for a wide range of GNSS applications. The NCS TITAN GNSS simulator consists of the RF Signal Generation Unit, the Control Unit running the 'Control Center' simulation software on MS Windows® or Linux OS.

Control Center software



Control Unit



RF Signal Generation Unit

System Support for all GNSS Signals

The NCS TITAN GNSS Simulator is the leading solution providing all signals for GPS, GLONASS, Galileo, BeiDou, IRNSS, QZSS, SBAS and beyond in one box. All signals are available using a flexible licensing scheme.

System	Frequency Band	Signal(s)
GPS	L1	C/A Code, P-Code, L1C, M-Noise
	L2	C/A Code, P-Code, L2C, M-Noise
	L5	I, Q
Galileo	E1	OS Data/Pilot, PRS Noise
	E5	E5a Data/Pilot + E5b Data/Pilot, AltBOC
	E6	CS Data/Pilot (unencrypted), PRS Noise
GLONASS	L1	Standard and high accuracy
	L2	Standard and high accuracy
	L3	L3 ready (pending ICD availability)
BeiDou	B1	B1-I
	B2	B2-I (as B1-I)
	B3	B3-I (as B1-I) / B3-Q
IRNSS	L5	SPS, RS-Noise
	S-Band	SPS, RS-Noise
QZSS	L1	C/A Code, SAIF, L1C
	L2	L2C
	L5	I, Q
	LEX	LEX
SBAS (WAAS, EGNOS, MSAS, GAGAN, SDCM)	L1	C/A Code
	L5	I



► Control Center Software - Customer focused Usability

The user friendly NCS Control Center simulation software provides the user with full control over all aspects of the test scenario configuration, interactive control, monitoring and data logging. The feature rich and easy to use Control Center operating software is the result of IFEN listening and implementing changes requested by multiple customers from a wide variety of applications. This is an ongoing process and IFEN continue to enhance the software as customer needs evolve.

A very comprehensive set of simulation parameters can be modified by the user to build up the desired scenario. Various graphical widgets are used to visualize the simulated data in a very clear way. The NCC allows the user to log a variability of simulated parameters in real-time to corresponding files.

► Control Unit - Selectable OS, flexible Remote Control and HIL

The Control Unit as a dual-boot system enables the customer to select MS Windows or Linux as the preferred operating system. The integrated GPU acceleration also enables the simulation of demanding advanced multipath models.

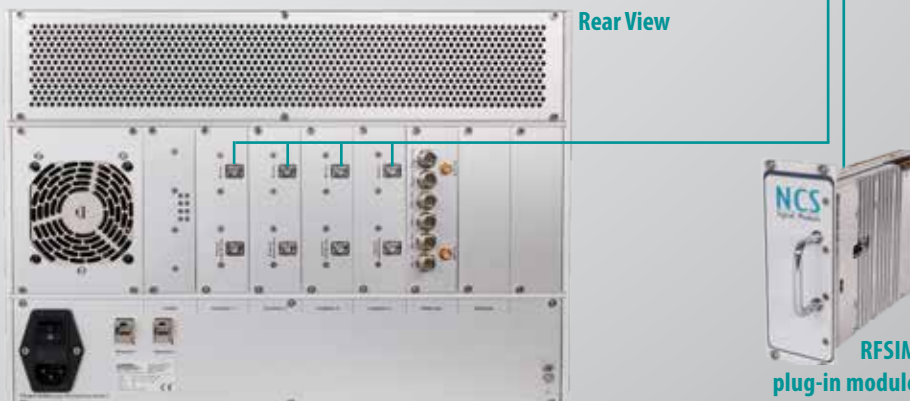
For Hardware-In-The-Loop (HIL) testing or for integration with vehicle motion simulators, user trajectories (user position and attitude plus their derivations) can be streamed in real-time asynchronously at any rate up to 1000 Hz into the simulator via Ethernet using UDP datagrams.

The Remote Control capability allows the user to load, modify, start and control scenarios from a remote PC via a simple TCP/IP client (e.g. Telnet, Hyperterm) or by using a scripting language with TCP/IP module (e.g. Perl, Python). The Remote Control capability allows for full featured batch processing of several scenarios and, above all, an enhanced interactive control of the generated signals.

► RF Signal Generator Unit - Fully upgradeable in the Field

The system design of the NCS TITAN GNSS Simulator allows the user to easily enhance system capabilities by simple SW licensing or easy HW plug-in on-site to match changing user needs or new test specifications, without the need to return the equipment.

- Additional GNSS signals at any time by easy SW licensing
- On-site addition of RFSIM modules with 32 channels each (up to 8 modules, 256 channels per NCS RF signal generation unit)
- Enable additional RF combiner on-site (up to a maximum 4 RF per unit)
- Integrated noise generator by on-site exchange of RF combiner modules



Features

Usability and Control

- Advanced graphical user interface (GUI) for scenario definition, simulation configuration and control
- Easy modification of variables
- Full constellation, user and vehicle motion control
- Flexible user trajectory generation (pre-defined, from file, via editor or remote motion data)
- Real-time data logging of a range of simulation parameters during scenario run-time for analysis

Comprehensive Simulation

- Real-time simulation of space and user segment
- Extensive signal propagation modelling and realistic user environment configuration (multipath, ionosphere, troposphere, scintillation, terrain/earth obstruction, antenna characteristics, ect.)
- Support of Differential GNSS (DGNSS) test scenarios, including generation of DGNSS correction data in RTCM format.
- Real-time external user trajectory streaming for hardware in the loop (HIL) applications
- Enhanced simulation capabilities for space applications and very high signal dynamics for simulation of spinning vehicles / objects to support aerospace and defense applications
- Optional IMU/Sensor Emulation Package (SEP)
- Optional Automotive Test Platform (ATP)
- Optional internal noise generator for realistic signal-to-noise ratio (S/N) simulations

Features

RFSIM Signal Modules

- 1 - 8 RFSIM plug-in signal modules
- Every RFSIM module is grouped into 4 RF signal banks, with 8 channels per RF signal bank (up to 32 signal banks)
- Free assignment of GNSS signals (frequency & modulation) to RF signal banks

Up to 8 RFSIM signal generation modules

- RFSIM Module 1
- RFSIM Module 2
- RFSIM Module 3
- RFSIM Module 4
- RFSIM Module 5
- RFSIM Module 6
- RFSIM Module 7
- RFSIM Module 8

Sample configuration with all existing GNSS systems in one NCS TITAN

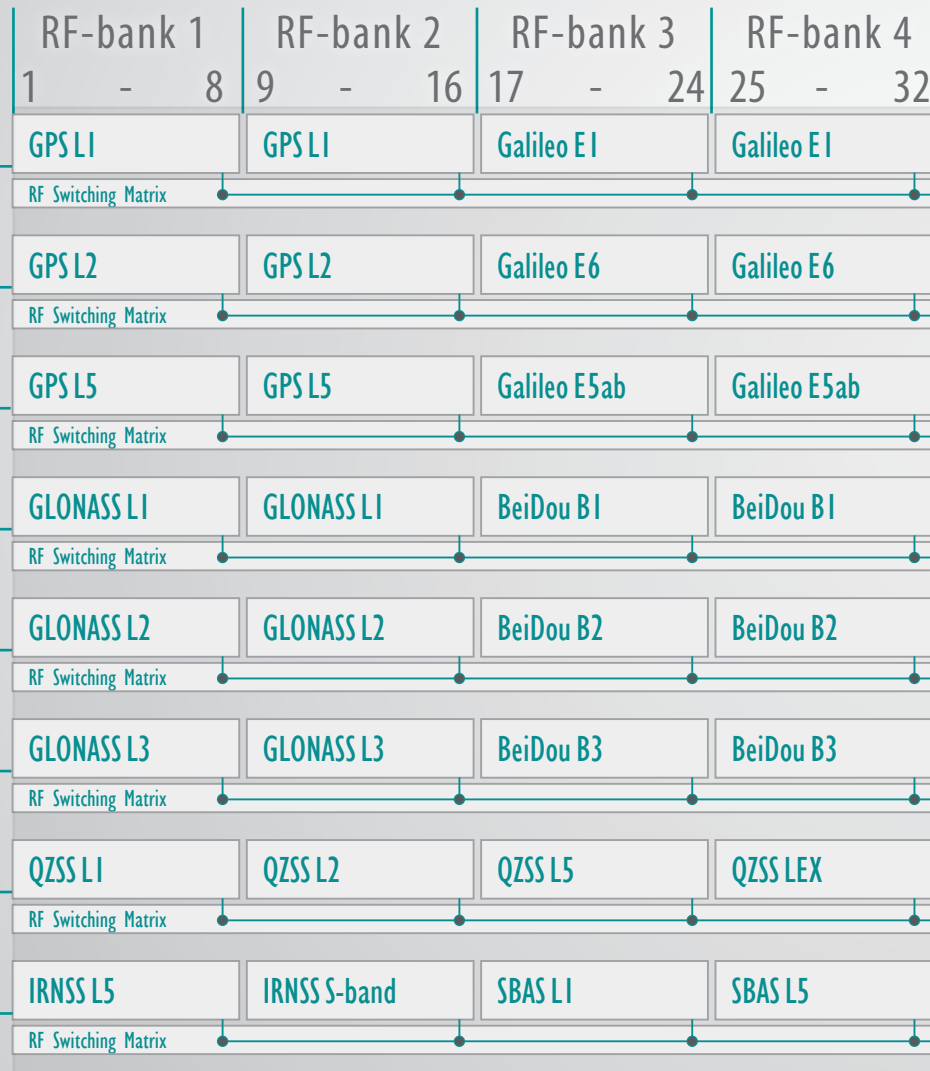


RFSIM module

▶ Leading Signal Generation Flexibility

The core of NCS TITAN are the RFSIM signal generation modules, with every RF-SIM signal generation module consisting of 4 RF signal banks with 8 channels per signal bank. Each RF signal bank may simulate any GNSS signal, selectable by the user.

Every RFSIM module includes a RF switching matrix for routing the signals from RF signal bank to the selectable RF signal combiner 1 to 4.

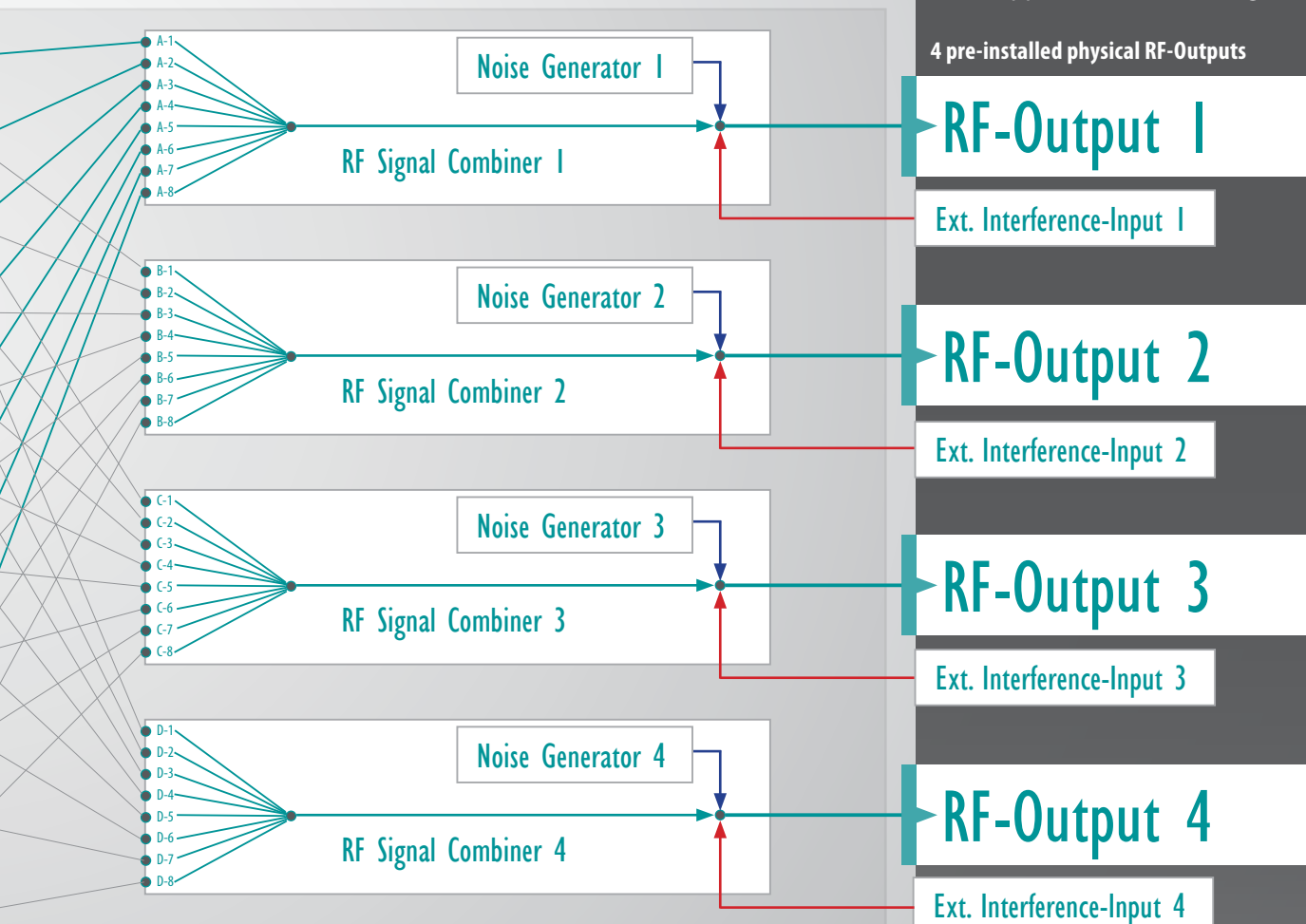


Example configuration of RFSIM modules with up to 32 RF-out signals

▶ Leading RF-Signal Combination Flexibility

The NCS TITAN may be equipped with up to 4 RF signal combiner modules, each connected to one of the 4 pre-installed physical RF-outputs. Every RF signal combiner is linked to all RFSIM module, thus enabling free assignment of signals from each of the 32 signal banks to each final RF-outputs (1 - 4) according to the user configuration, offering maximum configuration flexibility to the user.

The RF signal combiner also considers additional signal input from the optional noise generator (per RF combiner). Furthermore, also an external interference signal (per signal combiner) may be added to the RF signal combiner.



Up to 4 RF signal combiner (and optional noise generator) in one NCS TITAN

▶ Typical Multi-RF Configuration Example for CRPA Application

RFSIM 1	GPS L1 (16 channels)	GPS L5 (16 channels)	RF-Combiner 1
RFSIM 2	Galileo E1 (16 chann.)	Galileo E5ab (16 chann.)	
RFSIM 3	GPS L1 (16 channels)	GPS L5 (16 channels)	RF-Combiner 2
RFSIM 4	Galileo E1 (16 chann.)	Galileo E5ab (16 chann.)	
RFSIM 5	GPS L1 (16 channels)	GPS L5 (16 channels)	RF-Combiner 3
RFSIM 6	Galileo E1 (16 chann.)	Galileo E5ab (16 chann.)	
RFSIM 7	GPS L1 (16 channels)	GPS L5 (16 channels)	RF-Combiner 4
RFSIM 8	Galileo E1 (16 channels)	Galileo E5ab (16 chann.)	

The 4 physical RF-Outputs at the front side



Features

RF Signal Combiner

- Up to 4 RF signal combiner modules
- With optional noise generators
- Support of f external IF signals

4 pre-installed physical RF-Outputs

RF-Output 1

Ext. Interference-Input 1

RF-Output 2

Ext. Interference-Input 2

RF-Output 3

Ext. Interference-Input 3

RF-Output 4

Ext. Interference-Input 4

Applications

Discover the perfect test solution for all GNSS applications. The innovative multi-constellation/multi-frequency simulation capability in combination with the Multi-RF output option sets new standards in the field of GNSS simulation.

Extensions

If your application requires an advanced test setup, select the available extensions or ask for your specific customization.

Dual-RF Output Applications

- **Antenna Diversity**
Two antennas of the same type but with different orientation at the same receiver.
- **Heading Determination**
Two antennas with the same orientation at one receiver.
- **Differential GNSS**
Static reference receiver and mobile rover.
- **Dual Tracking**
Two antennas with different gain patterns optimised for special visibility at the same receiver.

Multi-RF Output Applications

- **Attitude Determination**
3 or 4 antenna based attitude determination.
- **Formation Flying**
Spacecraft formation flying with up to 4 spacecrafts.
- **Radio Occultation (RO) and Precise Orbit Determination (POD)**
3 antenna approach with Dual-Frequency and Multi-GNSS capability. 1 zenith antenna for POD, 1 velocity-direction antenna and 1 anti-velocity antenna for RO.
- **CRPA Applications**
Test your steered antenna beam array applications with 4 antennas for multipath mitigation, interference suppression, anti-spoofing and more. You need more than 4 antennas for your sophisticated CRPA application? Ask us for a solution.

Applications and Extensions

► The Solution for all GNSS Applications



► IMU/Sensor Emulation Package (SEP) Extension

The real-time IMU/Sensor Emulation Package enhances the NCS TITAN with emulation capability of Inertial Measurement Units (IMU) and inertial sensors, such as micro electro-mechanical system (MEMS) sensors, and of other common aiding sensors.

► Automotive Test Platform (ATP) Extension

The Automotive Test Platform provides a complete solution to test integrated vehicle navigation systems, which combines GNSS with emulated vehicle sensor data (e.g. wheel ticks), CAN-bus data and a rate table (2-D rotations). Future “Emergency Call” (eCall) and advanced driver assistance systems (ADAS) for the automotive sector can be tested based on this platform in a simple way.

► Multi-Signal Generator Configurations for Advanced Multi-RF Applications

For applications which require more than 4 RF outputs (e.g. CRPA testing), signal generator units may be combined and synchronized, offering unlimited scalability.

RF Signal Generation Unit 2



Cabling for Synchronisation



RF Signal Generation Unit 1



Control Unit with Control Center SW

Control TCP/IP

Advanced configuration providing 8 RF-Outputs



Key Specification

Parameter / Notes	Detail / Value
Channels, Modules, Signal Banks and Frequencies	
Signal channels per signal generator unit	Up to 256 (grouped in up to 8 modules)
Signal channels per signal generator module	32 channels (grouped into 4 signal banks)
Signal channels per signal bank	8 (and multipath channels)
Signal generator modules per signal generator unit	Up to 8 RFSIM modules
Signal banks per signal generator module	4 (with modulation & frequency selectable)
Frequencies generated simultaneously (max. signal banks) per signal generator unit	Up to 32 (32 signal banks with frequencies ranging from 1 GHz to 2,6 GHz)
Power Levels	
RF Signal Power	-90 dBm to -177 dBm
Dynamic Range	87 dB
Resolution	0.1 dB
Linearity (over total Dynamic Range)	<0.1 dB
Absolute Accuracy	±0.3 dB
Run-to-Run Repeatability	±0.1 dB
Signal Accuracy	
Simulation (Iteration) Rate	250 Hz (up to 1000 Hz optionally)
Hardware Update Rate	> 200 MHz
Pseudorange Accuracy	< 0.1 mm RMS
Pseudorange Rate Accuracy	< 0.1 mm/s RMS
Pseudorange Uncertainty (due to Interchannel Bias)	0 mm RMS
Deltarange Accuracy	< ±0.5 mm RMS
Signal Dynamics	
Max. Velocity (LOS)	± 1,460,000 m/s
Max. Acceleration (LOS)	± 667,000 m/s ²
Max. Jerk (LOS)	± 6,600,000 m/s ³
Angular Rates (indicative) (at 1.5 m lever arm) (at 0.5 m lever arm)	> 15π rad/s > 60π rad/s
Spectral Purity	
Harmonics	< -40 dBc
In-band Spurious (relative value) (absolute value)	< -70 dBc ≤ -190 dBW
Phase Noise	< 0.005 rad RMS
Frequency stability	< ± 5 * 10 ⁻¹⁰
Inter-Carrier Phase Coherence	
Inter-Carrier Bias	< ± 1.0 ns
Carrier Phase Coherence (@ Rf Output)	< 0.5°

Contact your local IFEN sales representative for expert advice regarding the optimum simulator configuration to meet your current and future needs



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