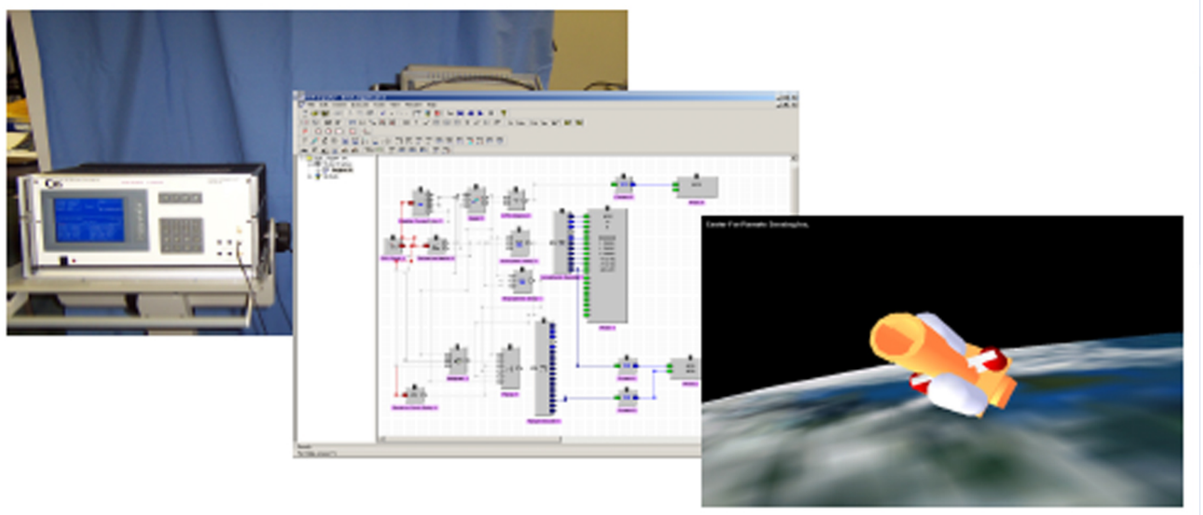
GNSS SIGNAL GEMERATORS

(GNSS/GPS-00X-0Y)



CRS provides the most advanced signal simulators for current and modernized GPS, Galileo, Glonass, and other navigation signals (EGNOS, SBAS) in space. These signal generators produce the most accurate generation of RF signals at the receiving antenna ports. The simulators provide far superior performances compared with any other RF signal simulator. The superiority of performance is evidenced in terms of accuracy, flexibility, comprehensiveness, versatility, upgradeability, and ease of operation and maintenance.

These simulators were developed to meet the challenging requirements of current and future navigational systems associated with new and flexible waveforms, precise wavefront simulation (accuracy of 1 mm), high dynamics (20,000 g), versatile platform motions, complex environments associated with multipaths, interfering sources, and ionospheric scintillations, plasma effects, and so-on. In spite of these complexities, these simulators provide almost instantaneous response (latency less than 2 msecs) to hardware based inputs enabling hardware in the loop (HWIL) simulation of complex systems.

All of these RF signal generators simulate real time RF signals using software radio architectures and techniques pioneered by CRS. All the signal parameters are modeled with extremely high precision and the analog portion is kept at a minimum. The exceptional performance (at the lowest cost) is attained by the use of most recent electronics, which was impossible even a few years ago.

These signal generators provide flexibility and capabilities to the user by leveraging a novel graphical user interface to configure, control, and monitor the operation real-time signal generator with fast multiprocessors that can be reconfigured.

In order to meet the diverse requirements, these simulators are configured in various forms—with civilian signals, military signals with encryptions, single antenna to multi-antenna outputs, etc. These simulators/signal generators also provide the lease expensive simulators and at the same time maintain the highest

USES OF THE GNSS SIGNAL GENERATORS

The advantage of software-based simulation over traditional hardwarebased methods is that software is readily adaptable. The software-based system allows for the insertion of various signal conditions and degradations that are not possible with conventional simulators. The flexible software based system also provides unprecedented accuracies, performances, and capabilities and ensures continuity and future upgrades. Modular approach allows various signal generators (simulators to be provided with common and similar performances and user interfaces.

These simulators simulate signals from multiple satellites and it can be used to synthesize the signals at any location on Earth or in space with unlimited dynamics. Multiple platforms with precise phase relationships can also be simulated in the dual platform or wavefront simulators.

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GNSS SIGNAL GENERATORS

They can be used for DGPS and A/J system testing.

The simulator can model various effects such as:

- Scintillations
- Interference and jamming; narrowband, wideband, directional
- High-dynamics; specified orbits
- Plasma effects; re-entry bodies
- Obscuration
- Multipath effects
- Ocean scattering
- Ionospheric Effect

The full GNSS constellation at multiple frequencies is available. All the necessary modules for the userdefined systems are provided. The user can configure the signal simulator using a schematic-based GUI and simple menu-driven instructions. The signal simulator permits the access of various intermediate test points in the GNSS signal chain (this is not possible with hard-wired simulators) and allows the user to introduce various specialized situations that include (but are not limited to): directional jamming, different waveforms, degraded signal conditions reentry plasma forms, space-based GNSS signals in LEO, GEO orbits, cluster missions, networking, formation flying, ocean scattering, variety of multipath effects, and GNSS and INS integration.

These signal generators are modular and allows one to develop comprehensive simulation of different constellations (GPS, Galileo, Glonass, EGNOS, SBAS, etc.), their interactions and navigation using multiple constellations.

An independent jammer/interface simulator module is available, enabling integration of different modules and provide performance metrics. Some of the simulators provide multiple outputs representing simulation of phase array antennas. The most notable features of these simulators are:

- Precision and accuracies of code and phase
- Versatility, comprehensiveness, and flexibility of the user inter face.
- Operational ease and convenience
- Adaptation for specialized situations
- Comprehensive models for UUT, environment, and constellations.
- Ionospheric Effect

This family of simulators excel in providing:

- Performance
  - Flexible Software-based Design
    - 12 (or more) independent channels
    - GPS – L_1, L_2, and L_5: all C/A, P(Y), M, and L_2C signals
    - SBAS – support at L_1, WAAS, EGNOS
    - GLONASS – all signals in L_1
    - Galileo – all signals (L_1, E5, and E6)
    - Jammer – 24 independent jammer signals with selectable waveforms and dynamics
    - LAAS
- High Accuracy
  - Code: < 1 mm
  - Differential Phase: < 0.1 mm
- Complex Scenarios
  - High Dynamics – suitable for EKV, satellite, projectiles, aircrafts (600 km/s; 20,000 g)
  - Arbitrary motion (6 DOF)
  - Wavefront Simulation
  - Independent controls over all aspects of antennas and plat forms
- HWIL control – latency between 2 to 5 mss
- Comprehensive Models
  - Constellation
    - Full Control; definition and modeling
    - Navigation message bits, HOW, TLM, and sub-frame error data.
  - Waveforms
    - Full controls (independent) over waveform errors, nav bits
    - Clock errors
-
  - Environment
    - Ionosphere/Troposphere/Scintillation
  - Antenna
    - Gain and Phase (3-D), Real-time, Lever Arms
  - Multipath
    - Dynamic
  - Terrain Obscuration
    - Dynamic
- Operation and Control
  - Manual
    - Menu-based
    - Script file based
    - Interactive (Real-time)
  - HWIL
    - Real-time execution (2 ms latency)

  Remote Control
    - External control via Ethernet
- Real-time Display
  - Satellite Constellation
  - Ground Trajectory
  - User motion parameters (6 DOF)
  - Individual Antennas
- Other Facilities
  - Comprehensive Logging
  - Remote Control via Ethernet
  - Digital Output
  - 1 PPS in/out
  - 10 MHz / 10.23 MHz operation
  - Large Dynamic Range ~ 120 dB

Various types of Signal Generator units are available to meet the demands of a wide spectrum of GNSS users.

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GNSS SIGNAL GENERATORS

SINGLE CHANNEL GPS/WAAS SIGNAL GENERATOR
(C/A Code) (GPSS-CA-001-04)

The single channel GPS/WAAS signal generator is a complete, high fidelity, low-cost signal generator that uses a standard PC as its host platform at 1575 MHz. It generates GPS L_1 (at 1575 MHz), C/A code signal, and a Wide Area Augmentation System signal, and can test and help simulate GPS systems. The signal generator is a PCI card that can plug into a host PC. The user can control all aspects of its signal including PRN power level, Doppler, and signal/message content. It uses the software-based architecture from our other simulators and receivers for unprecedented accuracy and flexibility. It offers an unlimited vertical upgrade.

The supplied software reflects this flexibility, allowing an operator-interactive mode or fully integrated mode using the supplied C programming libraries. It supports synchronization to other systems. All the signals and internal signal structures can be monitored in real-time.

MULTICHANNEL GPS/WAAS SIGNAL GENERATOR
(C/A Code) (GPSS-CA-002-04)

This self-contained unit simulates high-fidelity C/A code signal for up to 12 satellites at any time. IT generates GPS L_1 C/A code signal and WAAS signal and can test and help simulate GPS systems. The signal generator is available in both rack-mountable and tabletop configurations.

DUAL FREQUENCY MULTICHANNEL RF SIGNAL SIMULATOR FOR C/A, P(Y), AND M-CODES
(C/A Code) (GPSS-CA-002-04)

These self-contained units provide high-fidelity multichannel C/A, P(Y), and M-code signals at L_1 and L_2 bands. Its control is available over all aspects of the signal generated including PRN, Power Level, Doppler, and signal/message content.

The signal generator utilizes the software-based architecture hallmark of CRS's other simulators and receivers. It provides unprecedented accuracy and flexibility, and offers unlimited vertical and horizontal upgrades.

The flexibility is reflected in the supplied software that allows an operator interactive mode or fully integrated mode using the supplied 'C' programming libraries. It supports synchronization to other systems. All the signals and internal signal structures can be monitored in real-time.

(DASR--HD--003--05)

MULTIBAND (L_1,L_2,L_5), MULTICHANNEL RF SIGNAL SIMULATOR FOR C/A, P(Y), L_2C, L_5 AND M-CODE
(GPSS-DF-003-04/GPSS-DF-004-04)

These units are similar to the dual frequency units with additional L_5 band and L_2C signals.

DUAL FREQUENCY WAVEFORNT SIMULATOR
(GPSS-DFW-005-04)

These units are available for dual frequency C/A, P(Y), and M-codes (optional). They provide simulated wavefronts at multiple (4, 6, 8, 12) antenna ports. These simulators provide extreme high-fidelity wavefront simulation with accuracies better than mms. Built-in calibrators ensure the phase accuracies. These simulators, like our other units, are software programmable and provide high dynamics and HWIL performances.

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GNSS SIGNAL GENERATORS

MULTIBAND GPS WAVEFRONT SIMULATOR
(GPSS-MBW-008-06)

These units are similar to the dual frequency wavefront simulators with the additional bands at L_5 and L_2C signals.

GALILEO SIGNAL SIMULATORS
(GALS-MF-009-06): E5AB, L1, E6, SINGLE ANTENNA
(GALS-MF-010-07): E5AB, L1, E6, WAVEFRONT

Galileo signal simulators (for single antenna and multiple port wavefront generation) provide the same class of performance in terms of accuracy, flexibility, versatility, and user friendliness as in our GPS systems. The phase accuracy is held at the1 mm level. These simulators provide RF signals in all the three bands. The RF ports are available separately. A combined RF output with reasonably high dynamic range is also available at the front panel (7 such outputs are provided in the wavefront generator).

FEATURES

- Full GPS Satellite Constellation with pseudolite capability.
- L_1/L_2, L_5, C/A, P(Y), and M-code generation
- Galileo waveforms E5ab, L1, E1, flexible constellation, and other parameters to keep pace with evolution.
- Complete Glonass constellation and waveforms
- Modular structures enabling comprehensive simulation for all signals in space
- Wavefront simulation with unprecedented accuracy of 1 mm
- Highly flexible architecture enables future upgrade and prevention from obsolescence
- Multiple antenna models and multipath simulation
- Atmospheric effects
- 96-bit internal precision
- Flexible motion input system including TCP/IP, file-based and HWIL capability at 1000 Hz update rate.
- User-defined plots and scenario visualization
- High dynamics capability (> 100 g)
- Fast response (1 ms)
- Hardware interface for vehicle dynamics inputs
- Simulation of satellite errors; clock error, orbital effects, and many others

(DASR--HD--003--05)

MULTIBAND GNSS WAVEFRONT SIMULATOR
(GNSS-MFW-011-07)

This modular simulator provides comprehensive signal coverage for all GNSS signals in space. Modular units for GPS, Galileo, Glonass, EGNOS, SBAS, etc. are provided in order to seamlessly integrate with each other in both digital and analog domains. Additional modules such as LAAS, IMU emulator, high dynamics jammer/interferer, etc. also integrate with the system providing a truly comprehensive simulation system never attempted before. The simulator is housed in a 19 inch rack and different modules are interfaced through versatile combination modules, providing both digital and RF outputs at multiple antenna ports. A built-in calibrator ensures the precision to unprecedented accuracy of 1 mm.

The entire simulator is operated using a highly evolved software
interface enabling a variety of platform maneuvers, complex environmental simulation, receiver and satellite anomalies, and almost every possible modifications in the signal structure. Yet the user interface is extremely simple and intuitive with comprehensive graphical displays.

THE MOST ADVANCED NAVIGATION SIMULATION

- Comprehensive
- Accurate
- Flexible
- Versatile
- User Friendly
- Modular

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