November 2024, Revision 2

LEO100 GNSS-SDR

Dual-Antenna Triple-Frequency Software-Defined GNSS Receiver with Integrated Inertial Navigation System

Secured-Centimeter Resolution GNSS Positioning

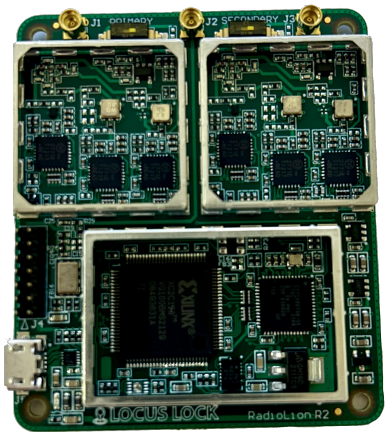
The LEO100 GNSS-SDR receiver is comprised of Locus Lock's proprietary Radio-Frequency (RF) hardware and software. The dual-antenna, triple-frequency RF front-end, RadioLion, captures raw GNSS signals that can be used for positioning, navigation, and timing (PNT). Our software-defined GNSS processing suite, GRID, processes these raw GNSS signals from RadioLion to provide secured-centimeter resolution location data for military and enterprise products. Locus Lock's precise positioning receiver incorporates innovative signal processing with robust estimation techniques, offering advanced spectral signal situational awareness while maintaining high-fidelity positioning.

Advanced Technology

The LEO100 GNSS-SDR can be configured in multiple ways for maximum flexibility. Our RF front-end, RadioLion, has dual-antenna capability, allowing our positioning engine to compute a high precision position, velocity, and attitude solution. The onboard inertial measurement unit (IMU) enables our fused GNSS-INS technology, ensuring high-fidelity positioning even in harsh signal blockage and multipath urban areas. For centimeter-accurate positioning, LEO100 GNSS-SDR employs a high-fidelity Carrier-Phase Differential GNSS (CDGNSS) technique, otherwise known as real-time kinematic (RTK) positioning. To do this, our software utilizes GNSS observables from a static reference station to aid our rover receiver's positioning solution precision.

Future-Oriented

LEO100 GNSS-SDR is compatible with L1, L2, and L5 GNSS bands. This allows our software to track both global and regional GNSS constellations in those frequencies - including GPS, Galileo, BeiDou, and SBAS. Due to our product's software-defined nature, new satellite specifications are added to the software as they become available.



Capabilities

- ✓ Integrated digital radio and inertial measurement front-end designed for use with software-defined GNSS and GNSS-inertial fusion systems
- ✓ Multi-constellation and multi-frequency heading and positioning solution
- ✓ Supports coherent dual-antenna triple-frequency real-time and post-processing operation
- ✓ USB connectivity with computer
- ✓ Real-Time Kinematic (RTK) GNSS positioning engine
- ✓ Small form factor for seamless product integration
- ✓ Supports spectral diversity in contested or denied environments with direct acquisition of signals on multiple GNSS bands, with zero dependence on GPS L1.
  - Direct to Galileo E1
  - Direct to Galileo E5a
  - Direct to GPS L2
  - Direct to GPS L5

RF Specifications

Primary & Secondary RF Compatibility

Global

GPS L1C/A, L2C, L5
Galileo E1b, E1c, E5a
SBAS L1, L5
BeiDou B1C

Regional

BeiDou B2A
QZSS ..... L1C/A[1], L1C, L2C, L5
NavIC L5

Frequency Range[2]

Primary Antenna

L1 ..... 1573.99–1576.56 MHz
L2 ..... 1225.33–1229.47 MHz
L5 ..... 1172.08–1181.39 MHz

Secondary Antenna

L1 ..... 1574.00–1576.78 MHz
L2 ..... 1225.13–1229.59 MHz
L5 ..... 1172.12–1181.36 MHz

Sampling Rate

L1 ..... 10 MHz
L2 ..... 10 MHz
L5 ..... 20 MHz

Physical

Dimensions .. 56 × 65 × 9.6 mm
Weight ..... 24.5 g

Electrical

Supply Voltage

USB ..... 5 V_{DC}

Current

Connected ..... 0.36 A
Connected, streaming .... 0.43 A[3]

Antenna Bias Output

Voltage ..... 0 / 3.3 V_{DC}
Current ..... $\leq$ 50 mA

Ports

RF Input ..... 2× MMCX female
USB ..... Type B Micro USB
Expansion ..... 14-pin DF11 male socket

GNSS Receiver Performance [4]

Note: CEP (Circular Error Probable) 50% refers to the radius of a circle within which 50% of the position measurements are expected to fall.

Open Sky, Static [5]

CEP 50% (Horizontal) .... < 0.3 m
CEP 50% (Vertical) ..... < 0.6 m
Integer Fix Availability 99.9%

Open Sky, Low Speed [6]

CEP 50% (Horizontal) ..... < 0.5 m
CEP 50% (Vertical) ..... < 1.5 m

Light Urban, Low Speed [7]

CEP 50% (Horizontal) ..... < 1.2 m
CEP 50% (Vertical) ..... < 0.9 m

Light Urban, High Speed [8]

CEP 50% (Horizontal) ..... < 1.5 m
CEP 50% (Vertical) ..... < 0.5 m

Time to First Fix

Cold Start ..... ~30 sec
Warm Start ..... ~1 sec

GNSS Receiver Outputs

Navigation Solution

- 3D position, 3D velocity, clock bias and drift, attitude quaternion and angular rate, and accelerometer and gyroscope biases

GNSS Observables

- Psuedorange, received Doppler, carrier-phase, carrier-to-noise ratio, Tropospheric parameters, and Ionospheric parameters

Evaluation Kit

- LEO100 GNSS-SDR is comprised of RadioLion (Dual-Antenna, Triple-Frequency RF Front-End) and the GRID GNSS-SDR processing suite deployed on general purpose processor
- GRID is a mature C++ GNSS software suite that is portable (desktop & embedded) and modular, with easy configuration and extensibility, scintillation-robust tracking loops, real-time and replay capabilities, and data bit wipe-off
- Evaluation kit can be tailored to static, desktop testing using a high performance Intel NUC or can be tailored to a smaller embedded form factor, such as an Odroid C4 or Raspberry Pi 5

Key Features

- RadioLion contains an onboard consumer-grade IMU and high quality MEMS TCXO
- Configurable to use an external clock source instead of on-board internal clock source (switching requires minimal rework)
- Configurable to use an external high-grade IMU instead of on-board consumer-grade IMU
- Generates a configurable 1-pulse-per-second (PPS) output synchronized to GPS time: a valuable feature for sensor synchronization, vehicle coordination, and system integration
- Software-reconfigurable, high-rate data streaming at up to 196 Mbits per second

Optional Accessories

- Compact GNSS antennas
- SMA to MMCX connectors

[1] Hardware compatible, not yet compatible with software
[2] Frequency range where signal is within 3dB of the peak value
[3] RadioLion is actively streaming raw intermediate frequency (IF) GNSS data to a connected general purpose processor
[4] Typical performance. Performance specifications subject to GNSS system characteristics, ionospheric and tropospheric conditions, satellite geometry, baseline length, multipath effects, and the presence of interference.
[5] No obstructions or blockage. Using L1/L2/L5 GPS, E1/E5 Galileo, and SBAS. Static antenna mounting.
[6] No obstructions or blockage. Using L1/L2/L5 GPS, E1/E5 Galileo, and SBAS. Average speed <25 mph.
[7] Some obstructions, including buildings and trees. Using L1/L2/L5 GPS, E1/E5 Galileo, and SBAS. Average speed <25 mph.
[8] Some obstructions, including buildings and trees. Using L1/L2/L5 GPS, E1/E5 Galileo, and SBAS. Average speed >50 mph.