High Performance Three Bands Receiver for Simultaneous Reception of RF Signals from Galileo and GPS Satellite Navigation Systems

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The simultaneous reception of signals from several global navigation satellite systems (GNSS) increases the accuracy and the reliability of the localization as well. The system presented here receives simultaneously from a single antenna, 3 frequency bands used by the European Galileo and the American GPS systems. This work is carried out in the framework of the European ECSEL project "Opportunity to Carry European Autonomous driviNg further with FDSOI technology up to 12nm node" (OCEAN12). One of the objectives of the project is to develop silicon IP blocks for high precision and reliable satellite navigation systems for use in autonomous cars. This receiver is designed to serve as a reference and test system for the various IP blocks under development (LNA, synthesizer, quadrature sampling mixer, integrated filters).

Figure 1 presents the receiver architecture. The receiver has two inputs channels. The first channel (LNA1) is with low gain and provides a power supply for an active antenna through a bias T. The second channel (LNA2) is with a high gain and is dedicated to work with a passive antenna. The received RF signal is split into three parallel channels. Each channel handles a specific GNSS frequency band. The SAW Channel filter defines the received band. The system is based on the direct conversion of the RF signal to a baseband signal. The switch SW calibrates the DC offset of the RF chain. The 1 dB step variable attenuator provides up to 16 dB dynamic range. Every channel has its synthesizer and ADC sampling clock. The data from the ADC are sent to the baseband GNSS processor. The baseband processor manages cannel gain, mixer frequencies, ADC sampling frequencies and offset calibration.

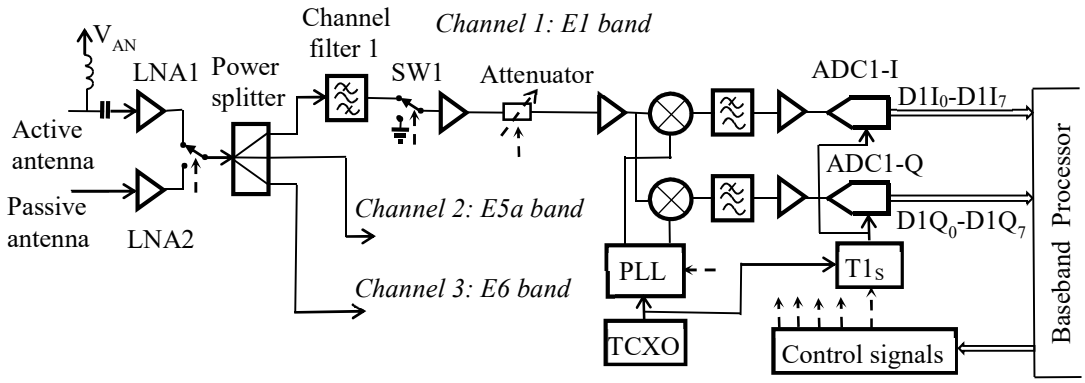

Figure 1. Three channels Galileo / GPS receiver structure

The system was designed to receive E1 (1575.42 MHz), E5a (1176.45 MHz), and E6 (1278.75 MHz) Galileo bands as well as the L1 and L5 GPS bands [1]. E1 and L1 are overlapped as well as E5a and L5. GNSS signals use spread spectrum modulation and the signal level on the earth's ground is under the receiver thermal noise. The noise figure of the passive antenna channel (LNA2) is 1 dB and he can proceed GNNS signals up to -135 dBm. LNA2 is designed for high linearity and offers an output 1dB compression point (OP1dB) of 19 dBm. Because of this high linearity, the receiver can work in the presence of strong disturbing signals, high-level co-channel or adjacent channel interference. The three-channel receiver has high RF performance and can is used for tests, research purpose as well as a standalone GNSS receiver.

References

[1] European GNSS (Galileo) open service, "Signal-in-space interface control document", European union, Issue 1.3, December 2016, www.gsc-europa.eu/sites/default/files/sites/all/files/Galileo-OS-SIS-ICD.pdf