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High-performance electric field detector for space-based measurements

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We present the prototype of a new electric field detector (EFD) for space applications developed in the framework of the CSES-Limadou collaboration. The CSES-1 (China Seismo-Electromagnetic Satellite) mission launch is scheduled for February 2nd, 2018. The payload of these satellite includes several instruments to measure electric fields in a broad frequency band along with magnetic field, plasma parameters and high energy particles fluxes with the main objective of studying the electromagnetic, plasma and particle perturbations caused by seismicity in the ionosphere, magnetosphere and inner Van Allen belts, prosecuting the exploratory investigation performed by the Demeter satellite. This task will be carried out through a detailed investigation of the ionospheric plasma perturbations, anomalous electromagnetic field fluctuations and instabilities accompanying earthquakes of moderate and strong magnitude, as observed by numerous satellites. The detector consists of four spherical probes to be installed on four booms deployed from the 3-axes stabilized satellite. The instrument has been conceived for space-borne measurements to investigate in general on lithosphere-atmosphere-ionosphere EM coupling and in particular to study electromagnetic phenomena such as magnetospheric waves, seimo-electromagnetic perturbations, anthropogenic electromagnetic emissions.
The proposed instrument can measure electric field in a wide band of frequencies extending from quasi-DC up to about 4 MHz. The resolution in the ULF band is better than 1μV/m with a dynamic range of 120 dB. With these bandwidth and precision, the described electric field detector represents a very performing and updated device for electric field measurements in space.
The development of the EFD has also been accompanied by studies on environmental conditions in the plasma, such as the definition of the range of expected potentials, the optimal range of bias currents to be applied to the probes to minimize the impedance of contact between the probes and ionospheric plasma, in order to improve the accuracy of the instrument.
We present the description of the EFD instrument electronics and the results of the tests performed on the prototype in laboratory.