

Miniaturization of Langmuir probe on board sounding rockets

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Possible miniaturization of Langmuir Probe on board sounding rockets is shown through adopting the Application Specific Integrated Circuit (ASIC) technology. The ASIC technology allows us to develop a small chip dedicated to Langmuir probe. The most critical part of Langmuir probe is a preamplifier connected to a sensor probe, because it has a key role in picking up faint currents in the order of nano-amperes as the front-end circuit. We manufactured the preamplifier on the ASIC chip and tested the performance in the viewpoint of Langmuir probe. Since the preamplifier needs to measure the weak currents flowing into the sensor probe, the input bias current at the input terminals should be suppressed. The measurement of the input bias current of the ASIC preamplifier showed it can be less than 0.7nA, that would be enough to measure plasma currents in the order of nano-amperes that are required by typical Langmuir probes on board sounding rockets. We also examined the linearity and efficiency of the preamplifier in converting faint input currents to amplified output voltages. Although the results showed some distortions due to insufficient linearity of the ASIC amplifiers, additional differential amplifier being put just after the preamplifiers improved the distortions of the output of the ASIC preamplifiers. Based on our design in adopting the ASIC, the feasibility of the miniaturized Langmuir probe was determined. In the current estimation, all of the analogue electronic circuits of Langmuir probe can be installed inside a chip with the size of 5mm x 5mm. Such a small chip can be located just close to the sensor probe. It is even possible to install the chip inside the sensor probe. This configuration is suitable in avoiding the effect of cable capacitance between the sensor probe and the preamplifier. The present paper introduces the feasibility of the miniaturized Langmuir Probe by using the ASIC technology.

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