
ABSTRACTS (MASTER THESIS)

Development of the miniaturized waveform receiver system with the built-in preamplifier and onboard measurement system

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Plasma waves in space plasma transport kinetic energies of plasma particles through wave-particle interactions, because the space plasma is collisionless. Since plasma wave receivers onboard scientific satellites provide significant information on energy exchange processes between waves and particles, they are the essential onboard instruments in science missions, which target the exploration of electromagnetic environments in space. The present paper introduces the development of the very small waveform receiver system with the built-in preamplifiers. The necessary analogue components of the system were realized inside a small chip with the size of 5mm x 5mm using the ASIC (Application Specific Integrated Circuits) technology. The developed system also has the onboard calibration circuit. The low noise preamplifier is very significant for plasma wave receivers. It decides the sensitivity of the waveform receiver system. Since the target frequency range is below 100 kHz in the waveform receiver system, the flicker noise is dominant in the MOSFET relative to the thermal noise. In order to overcome the MOS disadvantage on the flicker noise, we designed the operational amplifier having the input MOS with a large gate area. The preamplifier manufactured under our design shows that the noise level is $25\text{nV}/\sqrt{\text{Hz}}$ at 1kHz. The D/A converter takes a role in converting model waveform data stored on the onboard memory into analogue waveforms. We designed the 10-bit D/A converter inside a chip. The output signal of the D/A converter is fed into the input of the preamplifier in order to execute the calibration of the receiver system including the effect of the impedance of the electric field sensor. After the function and performance tests of each component implemented inside a chip, we conducted the comprehensive tests under the combination of the preamplifier, waveform receiver, and onboard calibration system. The results showed that the system has the high performance enough for future science missions.