科学衛星搭載用プラズマ波動観測器における小型波形捕捉・周波数掃引型受信器の開発

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Development of Miniaturized waveform capture/sweep frequency analyzer of plasma wave receivers onboard scientific spacecraft

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Plasma wave receivers onboard scientific spacecraft have an important role to understand microscopic physical phenomena in space plasmas. Since plasma wave receivers observe very weak plasma waves in the wide frequency range, analog circuits with high-sensitivity and low-noise characteristics are indispensable. However, it was difficult to miniaturize the analog circuits and to trim the weight of plasma wave receivers only using discrete parts and general-purpose integrated circuits.

We miniaturize some analogue circuits of the plasma wave receivers with ASIC (Application Specific Integrated Circuit) technology. The target of our attempt is the typical plasma wave receiver, so-called Waveform Capture (WFC) and Sweep Frequency Analyzer (SFA). It is perspective that the ASIC technology enables to realize the WFC or SFA inside a 3 mm-by-3 mm chip. The WFC which contains Gm-C low-pass filter, differential amplifier, and anti-aliasing filter is designed and shows enough performance for observation. The board size of WFC implemented with ASIC is going to be 50 mm-by-90 mm. Besides component circuits of a new SFA using FFT (Fast Fourier Transform) are developed. The SFA can improve signal-to-noise ratio and time resolution by wide sweep steps of frequency and transforming the wide band signal. We introduce PLL in the SFA which is to observe plasma waves in frequency band up to several kilohertz.