Miniaturization of Sweep Frequency Analyzer for Plasma Wave Observation by using ASIC

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Plasma filling the space is very rarefied. They don’t exchange their kinetic energy through their collision but through plasma waves. Hence observing plasma wave is essential for studying the electromagnetic environment in space. In the view point of observing plasma waves with electric field components, the typical frequency range is less than 10MHz. Their signal dynamic range is more than 120dB. So the plasma wave receiver should have the high sensitivity in the wide frequency band as well as the enough dynamic range for target phenomena. The typical plasma wave receiver is likely to be large, because it consists of a lot of analog circuits such as low noise amplifier and various filters. However, in recent years, missions that require miniaturization of onboard instruments are proposed. In this study, we will try to miniaturize the spectrum receiver, which is one of the types of plasma wave receivers, using ASIC(Application Specific Integrated Circuit).

SFA(Sweep Frequency Analyzer) is the spectrum receiver. It has the capability to observe plasma wave spectra in good S/N ratios. However, since it makes use of the superheterodyne method, the size of the electrical circuit is much larger than other type of plasma wave receivers. Because of this size issue of the SFA, it is not used in the recent space missions. Our attempt is to miniaturize the SFA by designing the ASIC. The ASIC contains the PLL synthesizer, band pass filters and frequency mixers. Furthermore, based on the ASIC SFA, we propose a new type of the SFA. In usual SFA, it sweeps the frequency band at very fine frequency step, so it takes long time to sweep all frequency range and time resolution becomes worse. However, new SFA which we design, is the combination of the analogue frequency conversion and digital FFT frequency analyses. By using this method, we can realize both good frequency resolution and good time resolution. In our presentation, we will show you our attempt in developing the miniaturized new-type SFA.