
 ABSTRACTS (MASTER THESIS)

**Study on Integration of Analog Downconversion Circuits
toward Small Plasma Wave Spectrum Receivers**

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Space plasma is essentially collisionless, and its kinetic energy is transferred through plasma waves. Therefore, plasma waves reflect variations of electromagnetic environments in space. Plasma wave receivers, which capture the plasma waves, contribute to the investigations of the electromagnetic phenomena occurring in space. Sweep frequency analyzer (SFA), one of the types of the plasma wave receivers, provides spectral information of plasma waves with high frequency resolution and good signal-to-noise ratio. The plasma wave receivers, including SFA, are required to have low noise, high sensitivity, and wide dynamic range in wide band. These requirements lead analog circuits in the receiver to be large and heavy. Then, it is difficult to realize small and lightweight receivers with discrete devices and commercial integrated circuits. We use ASIC (Application Specific Integrated Circuit) technology to downsize the analog part of the SFA. The objectives of the present thesis are to investigate the problem in development of the SFA downconversion circuits with ASIC technology, and to obtain perceptions to complete integration of the SFA into one chip. We design high gain main amplifier, mixer, and image rejecting Band Pass Filter (BPF) for the SFA. Each performance of the circuits is checked by simulations and trial productions of ASICs. First, the high gain amplifier is designed. 40 dB of the gain is confirmed by trial chips. Second, the mixer is designed. The Gilbert cell is applied to the mixer. The linearity and inter-modulation distortions are evaluated. Third, the BPF is designed and evaluated with the trial chips. The BPF requires rapid reduction response, and high accuracy for manufacturing. The switched capacitor filter is employed to realize the BPF. Since the layout design is very important for the development of switched capacitor BPF, we discuss variations of frequency responses caused by parasitic capacitors and measures to reduce the effects. Finally, we examine expected characteristics of the analog downconversion system to be obtained by combining the designed mixer and the BPF. We also discuss how to enhance the performance as the analog downconversion system.

References

[1] Fukuhara, H., H. Kojima, S. Okada, H. Ikeda, H. Yamakawa, Temperature Compensated Gm/C Filter for Plasma Wave Receivers Onboard Scientific Spacecraft, IEICE, Vol. J94-C, No. 6, pp. 155-162, 2011. (in Japanese)