

One-chip plasma wave observation system

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Plasma waves are important observational targets for scientific missions investigating space plasma phenomena. Thus plasma wave receivers are commonly used in space explore scientific missions; however, a size of the receivers is the common issues. Since plasma wave receivers require high-performance analog circuit such as low-noise filter, high order filter, and high gain amplifier, the area of the analog part of the receiver tend to be large. In addition, recent plasma wave receivers perform various digital processing onboard, and it leads to an increase in size and power consumption. We propose a one-chip plasma wave observation system. Plasma wave receiver is composed of three parts: analog part, analog to digital converter (ADC), and digital part. In the conventional receiver, analog part is realized by discrete electronic circuits, and digital part is realized by using FPGAs or CPUs. The one-chip plasma wave observation system aims to realize both analog and digital part in a chip as an analog-digital mixed Application Specific Integrated Circuits (ASIC). It allows miniaturizing plasma wave receiver extremely.

Figure 1 shows the block diagram of the one-chip plasma wave observation system. The system includes two types of plasma wave receivers: waveform and spectrum receivers. Since two types of plasma wave receivers have complementary characteristics, using both types of receivers is recommended for plasma observations. We plan that the system includes six channels of waveform receivers and two channels of spectrum receivers on a 10 mm x 10 mm chip. Two receivers require different analog and digital circuits. We succeeded in developing the analog circuit for waveform receiver, the analog circuit for spectrum receiver, and ADC, and the dimensions of each circuit were 2.9 mm x 0.7 mm, 4.2 mm x 1.2 mm, and 3.2 mm x 0.8 mm, respectively. Regarding digital circuits, waveform compression circuit for waveform receiver and fast Fourier transform circuit and the controller for spectrum receiver are required. We address to realize one-chip receiver by developing digital part as an ASIC and combine analog and digital part into one ASIC chip.

In the presentation, we will introduce the detailed design of the one-chip plasma wave observation system, especially the spectrum receiver that uses our new method that can overcome the disadvantage of conventional spectrum receiver.

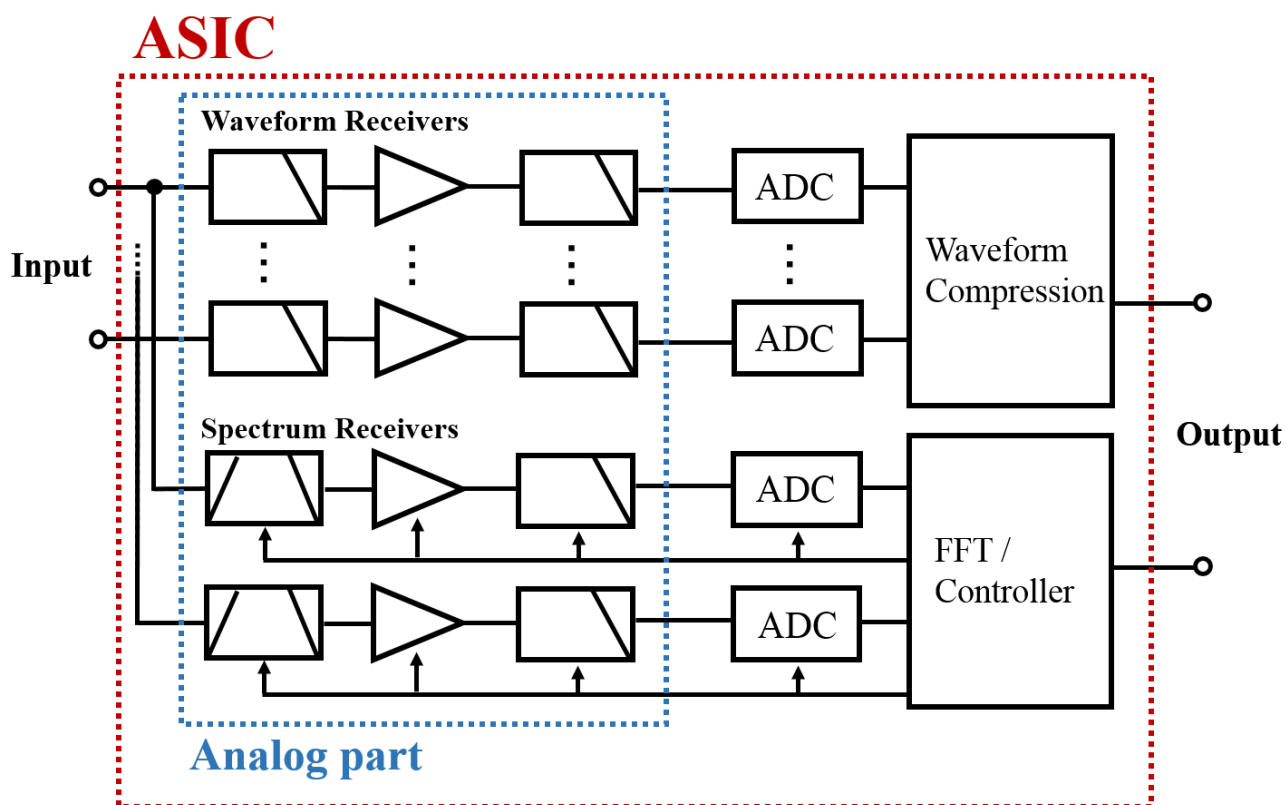


Figure 1. Block diagram of the one-chip plasma wave observation system.