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Development of the Analog ASIC for Miniaturized Waveform Receiver

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Since space plasmas are essentially collisionless, kinetic energies of the plasmas are exchanged via plasma waves. Observations of the plasma waves are very important to study space plasma physics. Waveform observation of the plasma waves have been conducted since the GEOTAIL satellite. The phase information of the plasma wave unveils various features of plasma such as structure of electric potential, and propagation velocity etc.

On the other hand, plasma wave receivers have been required to be miniaturized toward simultaneous multi-point observation missions, and deep space explorer missions. Although weight budget of the instruments in these missions are limited, the plasma wave receivers need high-sensitive, low-noise, and wide-dynamic range analog circuits which lead to heavy instruments in general.

We have developed analog Application Specific Integrated Circuits (ASICs) dedicated to the plasma wave receiver. The ASIC observes six-channel of plasma wave (each three channels for electric and magnetic fields, respectively) up to 100 kHz. The dimension of the ASIC and the package enclosing the ASIC are 5 mm by 5mm, and 15 mm by 15 mm, respectively. The single channel contains a band-limiting filter, a differential amplifier, and anti-aliasing filters. The ASIC have not only six-channel circuits for the waveform observation but also a compensation circuit for temperature drift. We also develop a business-card-size board. The board works as an instrument by which six analog differential input pairs are treated to six digital serial bit strings. The developed ASIC and the board lead to success of realization of the miniaturized waveform receiver for the-simultaneous multi-point observations, and the deep space explorer missions.

Keywords: Plasma Wave, Waveform, WFC, ASIC