Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PCG14-12 Room:202 Time:May 23 14:45-15:00

The Development of the Miniaturized Antenna Impedance Measurement System using ASIC

ISHII, Hiromune[1*], Hajime Fukuhara[1], Hirotsugu Kojima[1], Hiroshi Yamakawa[1]

[1]Research Institute for Sustainable Humanosphere, Kyoto University, Japan

Space is filled with plasmas. Since space plasmas are essentially collisionless, plasma wave is one of the most essential physical quantities in the solar terrestrial physics. There are two kinds of plasma wave receivers, the sweep frequency analyzer and the waveform capture. While the sweep frequency analyzer provides plasma wave spectra, the waveform capture provides waveforms of plasma waves with wave phase information. Electric field sensors in plasmas show different features from in vacuum. Since plasma is a dispersive medium, the antenna impedances are various complex numbers in the frequency domain. Consequently, in order to calibrate the observed plasma wave data we have to measure not only the antenna impedances but also the transfer functions of plasma wave receiver's circuits precisely. The impedances of the electric field antennas are affected by surrounding plasma density and temperature. However, these states of plasmas change from moment to moment. Thus, we precisely should measure the antenna impedances onboard spacecraft and convert the observed waveform data into the calibrated data. On the contrary, we can obtain the plasma density and temperature from the antenna impedances.

Various systems for measuring the antenna impedance were proposed. A synchronous detection method is used on the Bepi-Colombo Mercury Magnetospheric Orbiter (MMO), which will be launched in 2014. MMO has the onboard digital synthesizer, as a signal source. The synthesized waveforms are fed to the preamplifiers of electric field sensors through a fixed resistor after the D/A conversion.

We can obtain a transfer function of the circuit by applying the synchronous detection method using output waveform, and digitalized signal source. This system is also useful to check the behavior of the waveform capture receiver. The size of this system is same as an A5 board. In recent years, Application Specific Integrated Circuit (ASIC) is in attention which is a technique to integrate large scale and complicated circuits. Lots of ASICs have been applied to high energy astrophysics, though there are few applications in the solar terrestrial physics.

In this paper, we present our attempt to miniaturize the antennas impedances measurement system and Waveform Capture. We design 8bits segment D/A converter synchronized with waveform captures. We improve input logic of the D/A converter to generate a very weak signal accurately.

Keywords: Miniaturized satellite, Plasma wave reciever, Analogue ASIC