

Study on Integration of Analog Circuits for Plasma Wave Instruments

Hiroshi Imakubo

Laboratory of Space Radio Science, RISH, Kyoto University

Recently, on space environment measurement missions, it has been the main stream to conduct multiple point observations at the same time by formation flight of satellites. In addition, the investigations of deep space environment have been needed. These streams in space missions lead to the increase of demands for Plasma Wave Instruments (PWI). Especially, the restriction for the size and the weight comes to be severer and severer, the downsizing and light-weighting of the analog parts that occupies quite large area on PWI are necessary. Therefore, we develop the one-chip analog parts of PWI using the Analog Specific Integrated Circuit (ASIC) technology.

Of the analog parts, we design and develop the integration of the Gm-C filter for the frequency band restriction low pass filter, the folded cascade op-amps for a main amplifier and the switched capacitor filter for an anti-aliasing filter. Using the 0.36 (μ m) process of Taiwan Semiconductor Company (TSMC). Finally, we also evaluate the performance of the developed chips. As a result, Gm-C filters on the developed chips showed lower cut-off frequency and higher noise level characteristics than we expected. These filters also displayed low Common Mode Rejection Ratio (CMRR) as 40dB. Those points, however, can be solved by the design based on thoughtful consideration of elements' fluctuation. The folded cascade op-amps showed the good gain characteristic. Although the noise level is higher than the specification, it can be improved by the modification, especially for MOSFET gate size. We apply the op-amps for a switched capacitor. We design and check the performance by the transient analysis. We confirm the output signals reflected the input as disintegration signals and the op-amps and the switch circuits act normally.

Finally, we estimate the size and the weight of the integration chip as PWI analog parts. Compared with A4 size and 400g of a conventional PWI printed circuit board, the size and the weight were only several square meters and several g. About those prospects, it is inevitably possible to answer the demands of missions in the future.

REFERENCES

- [1] K. Hirotsugu, Study on the Plasma Waves in the Geomagnetic Tail Region Via Spacecraft Observations, Faculty of Engineering, Kyoto University Ph.D. thesis, 1998.