

Study on One-chip Analog Integration Circuit System for Miniaturized Plasma Wave Receivers

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In the magnetosphere of the earth a multitude of physical phenomena are arising. Plasma waves, ones of them, have several modes and different exciting mechanisms. It has been needed for the space development to explain their characters.

Therefore, a plasma wave receiver (PWR) was developed to observe plasma waves arising in the magnetosphere of the earth and the interplanetary space. Analog circuits of PWR consist of amplifiers and analog filters. Six channels of analog circuits are needed to observe electric and magnetic fields. It makes analog components of PWR bigger than other circuits. Since miniaturizing onboard instruments for scientific observation is demanded, we have studied on the integration of the analog components by application specific integrated circuit technology. Some of analog circuits consisting of PWR has been designed and manufactured. Their operations have also been checked in the past study.

In this study [1-4], we designed an anti-aliasing filter for eliminating waves with frequency higher than 100kHz to reduce aliasing effect by digitize. We also designed a circuit system combined a 20dB amplifier and the anti-aliasing filter. We examined their properties, temperature dependence, noise properties and so on. From these results, we confirmed the designed anti-aliasing filter operated as planned and the system had gain of about 20.3dB, input noise level of 400nV=√pHz at 10kHz and dynamic range of 90dB. We considered the designed circuits could be used for components of PWR from the results. Furthermore, we realized six channels of antialiasing filters in one chip which size is within 3mm × 3mm. This indicates PWR will be made much smaller than the past one.

For the next design, we have designed the one-chip analog integration circuits system including a differential amplifier, a low-pass filter, the 20dB amplifier and the anti-aliasing filter. From circuit simulation results for this system, we have obtained good results satisfying the specification of PWR. This system will change the style of observation in space.

References

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