

ABSTRACTS (MASTER THESIS)

Study on the integration of waveform capture-type plasma wave receivers

**(Graduate School of Engineering,
Laboratory of Space Electromagnetic Environment Exploration,
RISH, Kyoto University)**

Shunsuke Kamata

The Waveform capture(WFC) type plasma wave receiver is commonly used in recent space missions, because it can acquire all properties of plasma waves except their wave numbers. The size of a plasma wave receiver on board satellites is generally large to satisfy the desired scientific requirements. The miniaturization of the WFC-type plasma wave receiver as a chip is meaningful in the future nano-/micro-satellite missions. In this study, we miniaturized the WFC-type receiver using the Application Specific Integrated Circuit (ASIC) technology. We improved the switched capacitor filter (SC filter) for an anti-aliasing filter. We modified the circuit not only to reduce the noise level, but also to expand the observation frequency range of the SC filter. We experimentally demonstrated by the prototype chip of SC Filter that optimizing parameters of circuit elements in WFC receiver has significant effects on noise suppression and wider bandwidth. We implemented interferometry functions on the WFC chip. The interferometry function allows us to identify phase velocities of plasma waves. The implementation of this function on the WFC chip is very reasonable, because it consumes lots of resources when we realize that function using discrete parts. With a parallel circuit, we achieved small and lightweight interferometry circuits for WFC receiver. Implementing digital filter used for data compression of the WFC receiver with ASIC, we achieved miniaturization of the digital filters with the same performance as that of existing circuit with FPGA. We connect the improved analogue parts and the newly developed digital part as the unit system of the small WFC receiver. We obtained desired responses from the new system, which suggests the interference of noise between individual modules are negligible. The developed miniaturized WFC receiver appears promising for future space missions.

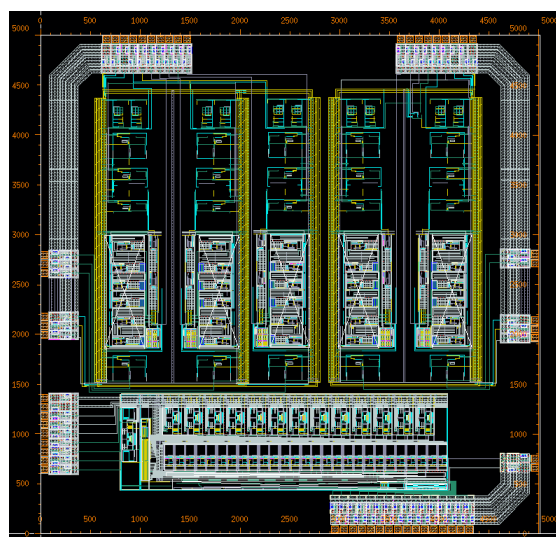


Figure 1. Developed WFC chip. The size is 5mm x 5mm. The chip contains 4 waveform receivers that have the capability of the interferometry mode.