SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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DESIGN OF A SPACEBORNE MINIATURE ATOMIC CLOCK

Abstract

Atomic clock is the core component of Time & Frequency systems while the spaceborne atomic clocks with high performance play an important role in navigation, communication and timing applications. Passive atomic clock based on coherent population trapping phenomenon without the microwave cavity can be designed as miniature and even chip-scale atomic clock to meet the miniaturization development requirements of the space electronic systems. The clock units and the frequency sources of the payload of the small/micro-satellite can be constituted to improve the performance of time synchronization, time/frequency difference measurement, distance/velocity measurement and communication based on the CPT atomic clocks. According to the application requirements of micro-satellites, the design of a miniature CPT atomic clock based on 133Cs is proposed. The physics design of the clock is provided with low power dissipation and high stability. The design of integrated miniaturized physics package based on MEMS vapor cell is implemented. The digital phase-locked loop frequency multiplication technology and digital servo circuit based on a high performance MCU is adopted in the electrical system. The 4.6GHz microwave impedance matching technology and other key technologies were resolved, as a result, low power dissipation is realized. The prototype of the clock is designed and implemented. The test results indicate the volume less than 100mL, the power dissipation less than 2W and the stability superior to 6e-11τ-1/2(1-100s) .