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## C1Po1B-02: 1 W@28.2 K micro single-stage coaxial pulse tube cryocooler operating at 52 Hz using precooling

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With the advancement of deep cryogenic detection technology, spacecraft are required to operate at a background temperature of 100 K or lower, necessitating the use of pulse tube cryocooler as a critical support component. Traditionally, the compressor and hot-end heat exchanger of pulse tube cryocooler function at an ambient temperature of 300 K. Multi-stage pulse tube cryocooler typically require precooling to a temperature range of 80 K to 100 K before the second stage can commence operation. The transient regenerator serves as the thermal buffer between the ambient temperature compressor and the secondary pulse, leading to significant PV power losses and reduced cryocooler efficiency. Additionally, two-stage pulse tube cryocooler often exhibit low operating frequencies, large volumes and weights, and high launch costs. This paper presents the design of a micro single-stage coaxial pulse tube cryocooler capable of direct operation in the 80 K temperature zone. The cryocooler is powered by liquid nitrogen precooling and a linear compressor, with a total mass of 2 kg. It employs inertial tube and gas reservoir as phase shifters. The cold finger has a diameter of 14 mm and a fill length of 55 mm. Preliminary experiments yielded the following results: at a working frequency of 60 Hz, an input power of 20 W, a hot-end temperature of 80 K, and a working pressure of 1.5 MPa, the minimum no-load temperature achieved was 13 K, and a cooling capacity of 1 W at 28.2 K was obtained at 52 Hz.

Keywords: pulse tube cryocooler · liquid nitrogen · 80 K · micro · 52 Hz

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