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A 4 K Tactical Cryocooler Using Reverse-Brayton Machines

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Superconducting electronics and spectral-spatial holography have the potential to revolutionize digital communications, but must operate at cryogenic temperatures, near 4 K. Liquid helium is undesirable for military missions due to logistics and scarcity, and commercial low temperature cryocoolers are unable to meet size, weight, power and environmental requirements for many missions. To address this need, Creare is developing a reverse turbo-Brayton cryocooler that provides refrigeration at 4.2 K and rejects heat at 77 K to an upper-stage cryocooler or through boil-off of liquid nitrogen. The cooling system is predicted to reduce size, weight, and input power by at least an order of magnitude as compared to the current state-of-the-art 4.2 K cryocooler, and for systems utilizing nitrogen boil off, the boil-off rate is reasonable, permitting long-duration missions. This paper will review the design of the cryocooler, the key components and component test results.

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