NASA SBIR/STTR Technologies

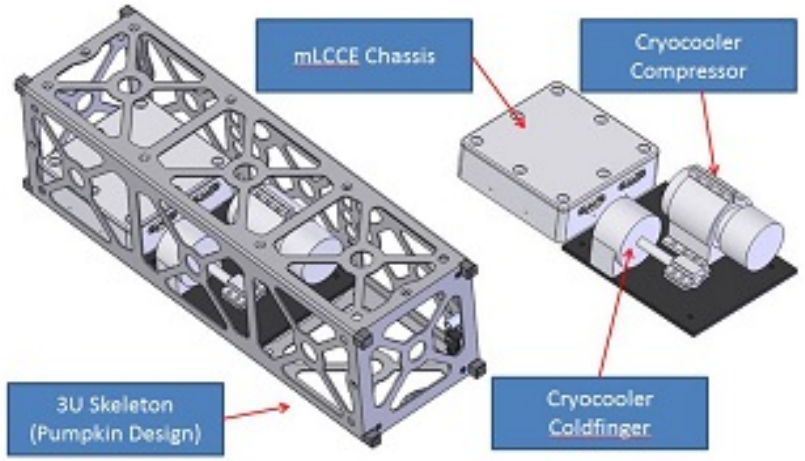
S1.10-9837 - CubeSat Cryocooler System (CCS)

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Identification and Significance of Innovation

The CubeSat Cryocooler System (CCS) provides an enabling technology for detectors and sensors requiring cryogenic cooling aboard CubeSat platforms. The system is comprised of a novel high efficiency, low power, two-stage coldhead pulse tube cryocooler and a miniature low-cost cryocooler electronics board to drive it. The cryocooler would enable a cooling capacity on the order of 0.2W at 50K-80K with less than 5W power input. The miniature electronics will incorporate high reliability COTS components were applicable, and have demonstrated a modular "plug-and-play" capability, resulting in a significant cost and time savings.

The CCS will help NASA meet the objective of allowing science measurement capabilities with smaller, more affordable spacecraft while concurrently reducing system risk, cost, size and development time consistent with SBIR Science Subtopic S1.10.



Estimated TRL at beginning and end of contract: (Begin: 1 End: 3)

Technical Objectives and Work Plan

The primary objectives of Phase I will be to demonstrate the feasibility of fabricating a suitable mLCCE platform, and to prepare a paper study on the feasibility of a two-stage pulse tube coldhead cryocooler concept.

The Phase I approach will start by establishing requirements in consultation with the stakeholders, namely Lockheed Martin, and NASA. The feasibility study of a two-stage pulse tube coldhead cryocooler TMU will be sub-contracted to Lockheed Martin. During Phase I, the thermodynamic design of the coldhead will be completed along with a packaging trade to accommodate a CubeSat envelope. The TMU development efforts will culminate in a final Phase I review that will summarize the analysis results, present the mechanical design, and outline next steps for follow-on development.

In parallel with the TMU efforts, the baseline mLCCE will be updated to accommodate additional telemetry requirements of the two-stage pulse tube cryocooler. The electronics design will preserve a path to space flight by choosing integrated circuits with rad-hard equivalents to be swapped-in during Phase II of the program. The resulting design will be supported with a bottoms-up reliability analysis. The brassboard CCS cryocooler electronics that is developed in Phase I will be tested with a suitable cryocooler to ensure integrity of design.

NASA Applications

The CCS is targeted at NASA applications requiring miniature spacecraft or unmanned aerial vehicles for science gathering missions. More specifically, the CCS can support the Science Mission Directorate by enabling research in the areas of Astrophysics, Earth Science, Heliophysics and Planetary Science. The CCS enables any instrumentation requiring cryogenic cooling.

Non-NASA Applications

The growing UAV and CubeSat markets are ideal non-NASA CCS applications. Lockheed Martin has expressed interest in mini cryocooler systems to support future UAV missions. Commercial CubeSats are being used for Earth-imaging and geostationary tracking, which are great applications for the CCS. Small satellites satisfy a growing range of data gathering missions that require high-accuracy sensors.

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NON-PROPRIETARY DATA