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Author: Mr. Tobias Niederwieser
University of Colorado Boulder, United States

FRIDGE – THE NEXT GENERATION FREEZER / REFRIGERATOR / INCUBATOR FOR FOOD
AND EXPERIMENT CONDITIONING ONBOARD THE ISS**Abstract**

The Freezer / Refrigerator / Incubator Device for Galley and Experimentation (FRIDGE) is a mid-deck locker-sized unit developed by BioServe Space Technologies for use within the Galley rack of the International Space Station (ISS) for food storage as well as in the EXPRESS rack for science experiment support. FRIDGE was optimized to provide a large temperature control compartment (TCC) volume with the final dimensions of 41.9 x 27.9 x 19.4 cm (16.6" x 11.1" x 7.8", DxWxH), which can be temperature-controlled from -12.5 to +48 C. Temperature control of the TCC is accomplished using a total of four thermoelectric coolers (TECs) mounted to the top and bottom surfaces of the SRM. FRIDGE utilizes the ISS-provided Moderate Temperature Loop (MTL) as a thermal sink for the TECs and avionics. FRIDGE is based and improved on the Space Automated Bioproduct Lab (SABL) that has been in continuous operation onboard the ISS for over 4 years. Thermal improvements include the addition of vacuum panels into the isolation, optimized heat exchanger heat distribution and removal, improved door design, as well as the use of novel multistaged TECs. FRIDGE was designed without a single rotating part to minimize any maintenance work. This paper focuses on the thermal, mechanical, electrical, and software design of the payload compared to the initial test results from the verification testing. Thermal feedback control and safety monitoring is implemented using a suite of sensors that interface to an NI sbRIO-9636 data acquisition and control computer. Performance of the engineering unit was characterized to verify thermal models of operation, cooling/heating times, and robustness against uneven internal heat loads and off-nominal operation. After starting development at the end of 2018, the first two out of eight FRIDGE units are manifested to launch to the ISS onboard SpaceX-21 in the fall of 2020.