Advancing Small Satellite Electronics Heritage for Microfluidic Biological Experiments

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DLR's Eu:CROPIS (Euglena and Combined Regenerative Organic-Food Production in Space) mission, launching in 2017, will carry multiple biological payloads into a sun-synchronous orbit, including NASA Ames' PowerCell experiment. PowerCell will attempt to characterize the viability of synthetic biology at micro-g, Lunar, and Martian gravity levels.

PowerCell experiment requirements demand an electronic system similar to previous microfluidic biology payloads, but with an expanded feature set. As such, the system was based on PharmaSat (Diaz-Aguado et al. 2009), a previous successful biology payload from NASA Ames, and improved upon. Newer, more miniaturized electronics allow for greater capability with a lower part count and smaller size.

Two identical PowerCell enclosures will fly. Each enclosure contains two separate and identical experiments with a 48-segment optical density measurement system, grow light system, microfluidic system for nutrient delivery and waste flushing, plus thermal control and environmental sensing/housekeeping including temperature, pressure, humidity, and acceleration.

Electronics consist of a single Master PCB that interfaces to the spacecraft bus and regulates power and communication, plus LED, Detector, and Valve Manifold PCBs for each experiment. To facilitate ease of reuse on future missions, experiment electronics were designed to be compatible with a standard 3U small sat form factor and power bus, or to interface with a Master power/comm PCB for use in a larger satellite as in the case of PowerCell's flight on Eu:CROPIS.

Figure 1 – PowerCell Payload

References

M. Diaz-Aguado, S. Ghassemieh, C. VanOutryve, C. Beasley, A. Schooley (2009); Small Class D Spaceraft Thermal Design, Test and Analysis – PharmaSat Biological Experiment; 2009 IEEE Aerospace Conference, 7-14 March 2009, Big Sky, MT; doi: 10.1109/AERO.2009.4839352