Successful COTS Solution for Space Vehicle Onboard Recording and Audio Handling



DEFENSE SOLUTIONS

Challenge

- Radiation environment
- Keeping costs low
- Meeting a tight schedule

Solution

- Radiation tolerant approach
- Commercial off-the-shelf system
- Modular system design

Results

- System performed as required
- Solution met tight budget
- A late change request was completed without causing delay

Challenge

A space vehicle designer was looking for a data acquisition solution that could collect all of the data from the onboard computers. Given that the vehicle was designed for applications such as resupplying the international space station, it was necessary that the equipment important for the mission met stringent reliability requirements, including predictable operation in a low earth orbit (LEO) radiation environment. Of particular harm is a <u>Single Event Latchup (SEL</u>) which occurs when an ionizing particle creates an unexpected path for current to flow in the semiconductor material of the IC device. This self-maintaining current path manifests as an increase in current drawn by the circuit, which can lead to excessive heat dissipation in an electronic component and can cause permanent damage if the SEL is not mitigated by power cycling. Similar to other spacecraft systems designers, the space vehicle manufacturer needed to operate within the scope of limited budgets while adhering to the overall Mission Safety Assurance requirements. Radiation hardened electronics, i.e. electronics designed to resist the effects of radiation, were evaluated, but they had a big drawback – high cost. Due to the enhanced competitive market for space transportation, keeping costs as low as possible was a key consideration.

Another consideration was the tight schedule they needed to keep, which was compounded by an additional requirement later in the program to consolidate an audio processing unit into the data acquisition system to save space and weight.









Solution

The solution was to use a COTS system from Curtiss-Wright with enhanced radiation mitigation design features. For the last 10+ years, Curtiss-Wright has been supplying modular rugged data acquisition and recording systems into space applications. These COTS systems evolved from the flight test industry and consist of chassis with modules that accept a large variety of data acquisition cards. Inherent to the system design are features that increase reliability to meet most of the requirements for LEO applications, at least for short periods. However, to mitigate against SELs, Curtiss-Wright developed the <u>'Smart Backplane'</u> chassis; a rugged 12 slot chassis that has been designed for data acquisition in a radiation-intensive environment. Its design allows the use of COTS interface plug-in modules while preventing against the harmful effects of ionizing radiation. To mitigate against SEL effects, it functions in such a way that it can detect an SEL event on a user-module and correct for that event before damage can be done, thereby ensuring normal data acquisition is resumed without component damage and with minimal data loss. The system recovers from the SEL, and normal operation of the entire data handling subsystem is not compromised, thereby meeting the mission assurance requirements of a space vehicle.

This system also met other common requirements for space equipment such as high reliability and a small form factor. The modular COTS based design of the system also allowed for the rapid development of an audio module that was used to process audio for both internal and external use. Even though the scope of the project changed, the flexibility of the modular COTS system allowed for the additional development without resulting in program delays.

Results

The COTS system from Curtiss-Wright met program specific qualification requirements for which compliance was validated by a set of extensive functional and environmental tests, including radiation with high energy protons. It also functioned as expected during testing and is on course to do the same in operational use in the near future.

CURTISS

The use of COTS allowed for a lower cost solution compared to using more traditional space qualified electronics, which were believed to be in the region of three times more expensive. The use of a flexible, modular system with an established library of modules also allowed for the rapid development of a suitable system with most of the desired functionality fulfilled by existing cards. This modularity also allowed Curtiss-Wright to accommodate a late requirement that had no existing off-the-shelf solution. Since the system was modular, all that was needed was the addition of a custom module rather than a complete redesign of the electronics.