

A Cost Effective System Design Approach for Critical Space Systems

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Abstract: Universal Mini-Controller:

NASA-JSC required an avionics platform capable of serving a wide range of applications in a cost-effective manner. In part, making the avionics platform cost effective means adhering to open standards and supporting the integration of COTS products with custom products. Inherently, operation in space requires low power, mass, and volume while retaining high performance, reconfigurability, scalability, and upgradability.

The Universal Mini-Controller project is based on a modified PC/104-*Plus* architecture while maintaining full compatibility with standard COTS PC/104 products. The architecture consists of a library of building block modules, which can be mixed and matched to meet a specific application. A set of NASA developed core building blocks, processor card, analog input/output card, and a Mil-Std-1553 card, have been constructed to meet critical functions and unique interfaces.

The design for the processor card is based on the PowerPC architecture. This architecture provides an excellent balance between power consumption and performance, and has an upgrade path to the forthcoming radiation hardened PowerPC processor. The processor card, which makes extensive use of surface mount technology, has a 166 MHz PowerPC 603e processor, 32 Mbytes of error detected and corrected RAM, 8 Mbytes of Flash, and 1 Mbytes of EPROM, on a single PC/104-*Plus* card. Similar densities have been achieved with the quad channel Mil-Std-1553 card and the analog input/output cards. The power management built into the processor and its peripheral chip allows the power and performance of the system to be adjusted to meet the requirements of the application, allowing another dimension to the flexibility of the Universal Mini-Controller.

Unique mechanical packaging allows the Universal Mini-Controller to accommodate standard COTS and custom oversized PC/104-*Plus* cards. This mechanical packaging also provides thermal management via conductive cooling of COTS boards, which are typically designed for convection cooling methods.