

A SYSTEM-ON-CHIP RADIATION HARDENED MICROCONTROLLER ASIC WITH EMBEDDED SPACEWIRE ROUTER

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Long Paper

Richard Berger, Laura Burcin, David Hutcheson, Jennifer Koehler, Marla Lassa,
Myrna Milliser, David Moser, Dan Stanley, Randy Zeger

BAE Systems, 9300 Wellington Road, Manassas, Virginia 20110 USA

Ben Blalock, Mark Hale

University of Tennessee, 1508 Middle Way Drive, Knoxville, Tennessee 37996 USA

*E-mail: richard.w.berger@baesystems.com, laura.burcin@baesystems.com,
david.hutcheson@baesystems.com, jennifer.koehler@baesystems.com,
marla.lassa@baesystems.com, myrna.milliser@baesystems.com,
dave.moser@baesystems.com, dan.stanley@baesystems.com,
randy.zeger@baesystems.com, bblalock@ece.utk.edu, mhale1@utk.edu*

ABSTRACT

A mixed-signal radiation hardened computer ASIC that includes a four port SpaceWire router is currently in development. Based on the RAD6000TM microprocessor currently flying on numerous space missions and commanding the Mars Exploration Rovers, this massively integrated system-on-chip is capable of performing flight computer and instrument controller functions and can reuse existing RAD6000 software and test infrastructure. The ASIC will be manufactured in a 150nm radiation hardened CMOS technology. Initiated in 2005 as a NASA technology project, development has continued with funding from the Air Force Research Laboratory.

The ASIC incorporates an enhanced version of the reusable SpaceWire router core with four SpaceWire links and dual internal ports that was previously created for the BAE Systems SpaceWire ASIC. This newer version reduces both die area and power dissipation while improving link performance. The ASIC employs a flight-proven reusable core architecture with a common bus medium. In addition to the RAD6000 microprocessor and SpaceWire cores, the ASIC includes a pipelined 12-bit A/D converter with a programmable multiplexer, three channels of 12-bit D/A conversion, 192KB of on-chip SRAM, 32KB of chalcogenide-based C-RAMTM non-volatile memory, a 64-bit PCI interface, a 1553 interface, a DMA controller, and an external memory controller. A 2nd smaller microcontroller core called the EMC has also been incorporated on the ASIC. It is supported by a compiler developed by BAE Systems and software supporting the SpaceWire transport layer has already been developed.

This paper discusses the architecture and functions of the microcontroller ASIC, including the SpaceWire core implementation and features. Operational configurations matched to a variety of applications will also be shown.