Microsemi Power Matters. IS NOW MICROCHIP

Welcome to Edition 25 of Microchip's Space Brief newsletter. Written for design engineers and design managers, system engineers and system architects, component engineers, radiation effects scientists and program managers in the space industry, Space Brief is a quarterly newsletter in which we aim to bring you the latest news about Microchip's radiation-tolerant and radiation-hardened products. Space Brief provides information about new products, updates on qualification and radiation testing, links to formal customer notifications and news about workshops and conferences at which Microchip will be presenting or exhibiting.

Please forward Space Brief to your colleagues, and let them know they can register to receive their own copy direct to their email inbox by clicking here.

Space Forum 2019 Dates and Locations Announced

Please plan on joining Microchip for one of our bi-annual Space Forum events, being held in four different locations around the world this fall.

Microchip's technical experts and partners will present and showcase their most innovative space-related products, capabilities, and system solutions in this one-day technology forum. You will see demonstrations of how the interoperation of our latest products can accelerate your development time. You'll also gain a comprehensive understanding of how Microchip's Sub-QML and COTS-to-RT components help address the challenges of meeting system performance and reliability goals while also saving costs.

Highlights will include:

- A detailed update on the qualification and radiation characterization of Microchip's RTG4™ radiation-tolerant FPGAs
- How radiation-tolerant mixed-signal integrated circuits provide key functions for telemetry and motor control
- An overview of our radiation-hardened and radiation-tolerant microprocessors and microcontrollers with screening from extended temperature through to QML class V equivalent
- Details on how Microchip's discrete technology solves system-level issues
- An in-depth overview of our space power solutions including both hybrid and surface-mount technology
- How space-qualified crystal oscillators provide accurate frequency and timing required for navigation, radar and communication functions
- Innovations in the field of miniaturized atomic clocks, which provide high-precision timing with minimal form-factor and power consumption
- Demonstrations of the interoperation of RTG4 FPGAs with power, telemetry and motor control products from Microchip and from our partner companies and organizations

This is a must-attend space technology forum for system-level architects, R&D engineers, design and component engineers and other space industry professionals. Feel free to share this information with your space technology colleagues. Registration information will be provided soon. We look forward to seeing you there.

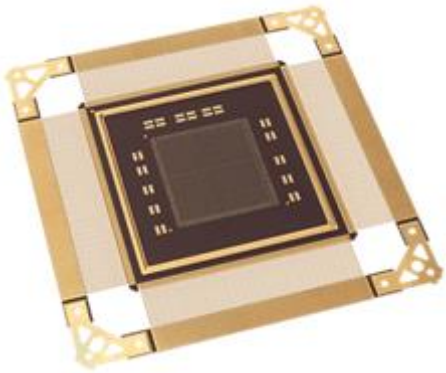
October 24 – Noordwijk, Netherlands
November 13 – Virtual event, web broadcast (North America time zone)
November 19 – Bangalore, India
November 21 – Ahmedabad, India

RTG4 CQ352 Qualified to MIL-STD-883B

RTG4 FPGAs in a ceramic quad flat pack (CQFP) package with 352 pins have achieved MIL-STD-883 Class B qualification. The B-flow and E-flow space flight units are available now, subject to lead time. RTG4 FPGAs in the CQ352 package provide a more cost-effective integration than higher pin count packages. CQFP is the industry-standard package for space applications with well-established board integration and inspection procedures.

As is our standard practice, Microchip will submit RTG4 CQ352 to the Defense Logistics Agency for QML Class Q and QML Class V qualifications. Microchip's EV-flow, which is the equivalent of the QML Class V per MIL-PRF-38535, for RTG4 CQ352 is on track for availability in January 2020.
The RTG4 device in the CQ352 package is immediately available in the Libero® SoC software tool set, allowing you to design with this new device-package combination. We recommend you download the latest version of Libero SoC software to take advantage of these recent RTG4 product family updates. The latest RTG4 product brief has also been updated to include the RTG4 CQ352 and the new RTG4 low-power devices for standard speed grade.

Contact Minh Nguyen, Sr. Product Marketing Manager, FPGA Group at Minh.Nguyen@microchip.com for questions and comments.



New SpaceFibre Standard Provides Very High-Speed Data Transfer Onboard Spacecraft

For the past decade, Microchip's partner STAR-Dundee has led the development of SpaceFibre, the next generation in SpaceWire technology. SpaceFibre is a high-performance, high-reliability, high-availability point-to-point and network technology for use onboard spacecraft.

STAR-Dundee's efforts in developing SpaceFibre were recently rewarded with the publication of the SpaceFibre standard by the European Cooperation for Space Standardization (ECSS), the European Space Agency's standardization body.

In combination with the high-speed SerDes of an RTG4 FPGA, STAR-Dundee SpaceFibre IP cores provide data signaling rates of 3.125 Gbps over electrical or fiber optic cables. SpaceFibre's unique multi-lane features can be used to combine multiple lanes into a single link, giving correspondingly higher data rates. SpaceFibre is capable of detecting, isolating and recovering from faults in the link where they occur, preventing faults from propagating and causing further errors. SpaceFibre provides galvanic isolation, transparent recovery from transient errors, error containment in virtual channels and frames, and "Babbling Node" protection. Versatile quality of service mechanisms applied to each virtual channel allow priority-based bandwidth allocation and scheduled, deterministic communication without wasting any network bandwidth.

These powerful capabilities mean that SpaceFibre is not only suitable for very high data-rate payloads such as synthetic aperture radar and multi-spectral imaging instruments, it can also be used for network and equipment management and for deterministic command and control applications. SpaceFibre allows each of these traffic types to share a single network, with each traffic stream operating independently within its own virtual network. SpaceFibre is currently being designed into its first spaceflight missions.

Steve Parkes, CTO of STAR-Dundee and formerly Chair of Spacecraft Electronic Systems at the University of Dundee, wrote the SpaceFibre standard with inputs from international spacecraft engineers. STAR-Dundee

has developed the first SpaceFibre interfaces and routing switches and was the first to demonstrate these in a radiation-tolerant FPGA: the Microchip RTG4 device.

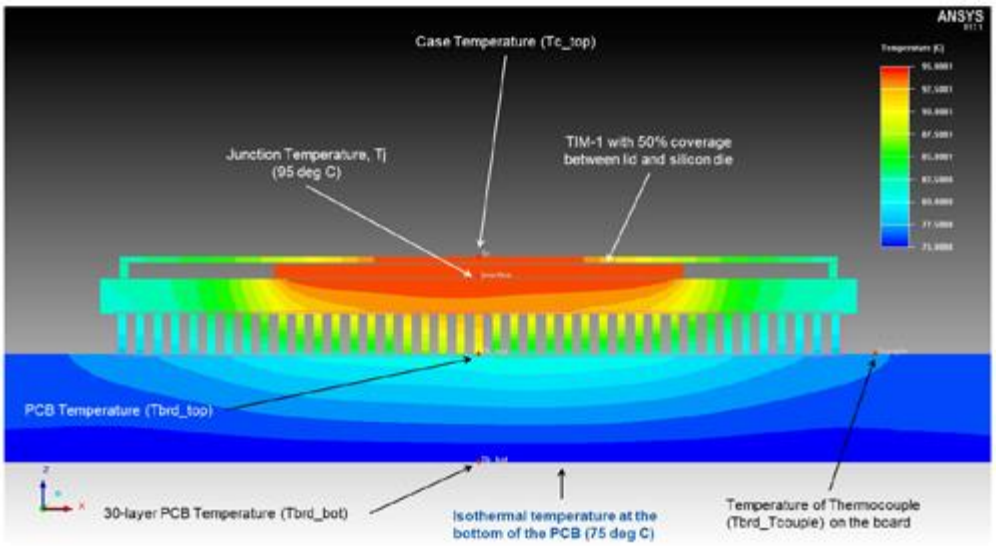
For more information, please refer to https://www.star-dundee.com/knowledge-base/spacefibre-microsemi-rtg4

Stuart Mills, Chief Executive Officer, STAR-Dundee Ltd.

RTG4 PXIe® board used to validate the SpaceFibre router

RTG4 Thermal Management in Space Applications

A new application note has recently been published for the RTG4 FPGA family, addressing thermal management in space applications. Vacuum conditions in space limit heat transfer to conduction only, making thermal dissipation considerations crucial for space applications. Further, special considerations need to be taken for column grid arrays, due to the mechanically stressful nature of space launches. The application note covers thermal management guidelines for both CCGA and CQFP packages in the RTG4 FPGA family. Please refer to application note AC 486 for details on Microchip's recommended solution.



Contact Minh Nguyen, Sr. Product Marketing Manager, FPGA Group at Minh.Nguyen@microchip.com for questions and comments.

Integrated FPGA-in-the-Loop Workflow with MATLAB® and Simulink® Supports RTG4 Development Board

System level engineers widely use MATLAB and Simulink to develop algorithms targeting FPGAs. Using MathWorks®' HDL Coder™ and HDL Verifier™, engineers can implement their MATLAB and Simulink designs directly on to FPGA boards and connect these boards directly to MATLAB and Simulink System Level testbenches. This helps engineers in validating mission-critical systems for space and other applications.

The new integrated Field Programmable Gate Array (FPGA)-in-the-loop (FIL) workflow with MathWorks' HDL Coder and HDL Verifier enables you to automatically generate test benches for hardware description language (HDL) verification, including VHSIC Hardware Description Language (VHDL) and Verilog, providing rapid prototyping and verification of designs.

The new workflow, available in MATLAB's R2019A release, enables you to integrate MathWorks' MATLAB, a multi-paradigm numerical computing environment, and MathWorks' Simulink, a graphical programming

environment, with Microchip's RTG4 development board. This integration allows the stimulation of designs through FIL verification workflow using Microchip's development board and the Libero SoC Design suite. The FIL verification workflow enables you to analyze the results back in MATLAB and Simulink.

Delivering the FIL feature for Microchip boards with MATLAB and Simulink, the collaboration provides a hardware support package for the RTG4 FPGA development board and an integrated workflow from algorithms to implementation. Leveraging MathWorks' HDL Verification, enabled by Microchip's Accelerate Ecosystem, makes Microchip's FPGAs ideal for a wide variety of applications within the aerospace market, including motor control and imaging, digital signal processing, communication systems, control systems and payloads.

For further information, please contact Puneet Kumar,

Defense Vertical Marketing Manager, Puneet.Kumar@microchip.com

RTG4 Customer Notification

The Customer Notification (CN) 19011 for RTG4 FPGA family was recently released. The CN includes the following topics:

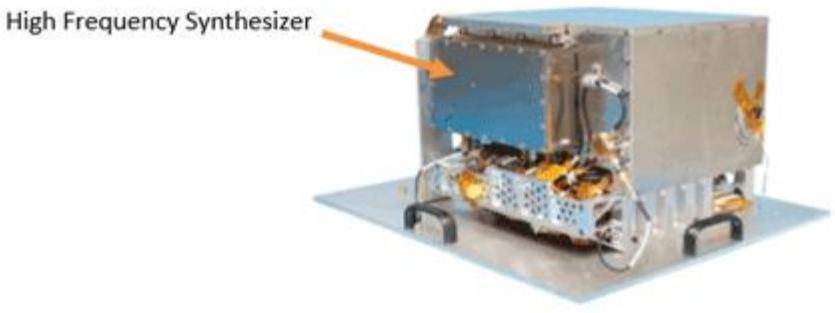
CN 19011.1 LSRAM BLK Select De-assertion Circuit for Pipelined ECC
CN 19011.2 I/O Driven High at the End of Programming

These topics are presented with a description and the action required for users. The complete CN 19011 can be downloaded here.

Microchip's Model 6600 High-Frequency Synthesizer Launches on JPL's Deep Space Atomic Clock

The Deep Space Atomic Clock, or DSAC, is a technology demonstration of a small, ultra-precise, mercury-ion atomic clock launched into Earth orbit June 25th to test its potential as a next-generation tool for spacecraft navigation, radio science and global positioning systems. DSAC is managed by NASA's Jet Propulsion Laboratory for the NASA Space Technology Mission Directorate. The technology, which is designed to improve navigation of spacecraft to distant destinations and enable collection of more data with better precision, is 50 times more accurate than today's best navigation clocks.

NASA's DSAC is built using technology elements provide by multiple suppliers. One critical element of the clock design is Microsemi's Model 6600 high-frequency synthesizer. Since DSAC is a mercury ion clock, a high-frequency synthesizer that is precisely tuned to provide a 40.5 GHz microwave field is required so that its frequency matches the natural frequency of the trapped mercury. Measurements of this tuned frequency form the basis of the DSAC. For more information on Deep Space Atomic clock see the JPL factsheet.



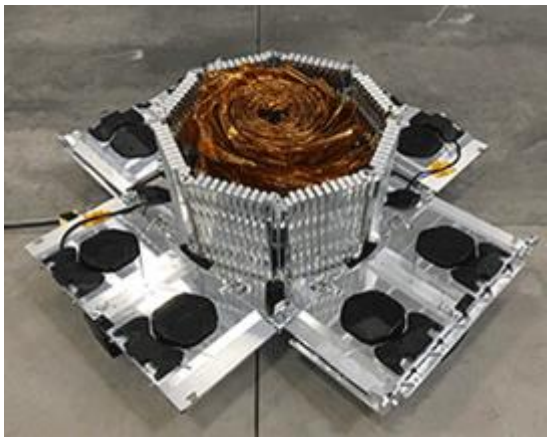
Deep Space Atomic Clock (DSAC) Demonstration Unit (shown mounted on a plate for easy transportation). Image Courtesy NASA/JPL-Caltech

For further information, contact Stewart Hampton, Product Line Manager, Clocks Group Stewart.Hampton@microchip.com

LX7730 Telemetry Controller Gets First Flight Heritage

Microchip's rad-hard-by-design LX7730 telemetry controller is now in orbit. The device is used on the R3D2 DARPA satellite that was launched on March 28, 2019.

R3D2 stands for RF Risk Reduction Deployment Demonstration prototype array. The R3D2 payload is packed inside a 330 lb (150 kg) satellite and includes a tissue-thin Kapton membrane antenna designed to expand to a size of 7.4 feet (2.25 meters) once in orbit. The antenna helps provide high data-rate communications to disadvantaged users on the ground.



DARPA's Radio Frequency Risk Reduction Deployment Demonstration (R3D2). *Image Courtesy of DARPA*

The LX7730 is used on the telemetry and control card designed to the ANSI-ratified 3U SpaceVPX specification and was selected based on the critical functions offered in the device. The 64-channel multiplexer inside the LX7730 is critical for acquiring numerous system sensor data. It is paired with a Microchip RTAX™ radiation-tolerant FPGA in the R3D2 to provide a true low-power telemetry processing solution. Information about where the LX7730 is used and why it was selected is provided in our press release.

Use these links for more information:
R3D2 Program
LX7730 Product Page

Please contact Dorian Johnson, HiRel Product Line Marketing Manager at dorian.johnson@microchip.com for more information.

New LX7712 Programmable Current Limiting Power Switch

Samples of our new LX7712 rad-hard-by-design programmable current-limiting power switch are now available. The LX7712 is designed for spacecraft applications and can be configured as a latch-able current limiter or a fold-back current limiter. It provides a means to turn on or off a DC load with current up to 5A and includes a solid-state P channel MOSFET switch and catch diode. Integration allows the temperature of the switch to trigger an optional thermal shutdown. The LX7712 can be programmed with just a few external components, and multiple devices can be paralleled in a master/slave arrangement to increase the current rating. It is packaged is a 48-pin hermetic HTF package.

Visit the LX7712 Product Page for more information on the LX7712 including the product datasheet

Please contact Dorian Johnson, HiRel Product Line Marketing Manager at dorian.johnson@microchip.com for more information.

Scale Space Applications with COTS-to-Radiation-Tolerant and Radiation-Hardened Arm®Core MCUs

From NewSpace to critical space missions, designers of space applications need to reduce design cycles and costs while scaling development across missions with different radiation requirements. To support this trend, Microchip introduced the space industry's first Arm-based microcontrollers (MCUs) that combine the low-cost and large ecosystem benefits of Commercial Off-the-Shelf (COTS) technology with space-qualified versions that have scalable levels of radiation performance. Based on the automotive-qualified SAMV71, the **SAMV71Q21RT radiation-tolerant** and **SAMRH71 radiation-hardened MCUs** implement the widely deployed Arm Cortex®-M7 System on Chip (SoC), enabling more integration, cost reduction and higher

performance in space systems.

To ease your design process and accelerate time to market, you can use the ATSAMV71-XULT evaluation board. The devices are supported by Atmel Studio Integrated Development Environment (IDE) for developing, debugging and software libraries.
The SAMRH71 in CQFP256 ceramic package is sampling today, and the SAMV71Q21RT is available today in volume production quantities in four derivatives:

- SAMV71Q21RT-DHB-E in ceramic prototype QFP144 package
- SAMV71Q21RT-DHB-MQ in ceramic space-grade QFP144 package, QMLQ equivalent
- SAMV71Q21RT-DHB-SV in ceramic space-grade QFP144 package, QMLV equivalent
- SAMV71Q21RT-H8X-HP in plastic QFP144 package, AQEC high reliability qualified

For additional information and to purchase products mentioned here, contact a Microchip sales representative or authorized worldwide distributor.

Please contact Nicolas Ganry, Product Marketing Manager, Aerospace Marketing at nicolas.ganry@microchip.com

Vectron, a Microchip Company, Responds to Official Release of MIL-PRF-55310, Revision F

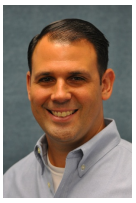
Anyone who specifies crystal oscillators is familiar with MIL-PRF-55310 as the primary governing authority for quality assurance and test requirements. But did you know that MIL-PRF-55310 received an official makeover in November 2018 regarding Product Level S, Class 2 (Hybrid), Crystal Oscillator requirements? As a result of the release of Revision F, the following changes must be adhered to when manufacturing Class S devices:

- Device Screening Changes
  - Temp Cycle test condition change from B to C
  - PIND test condition change from B to A
  - Seal tests (Fine/Gross) now mandate MIL-STD-883, Method 1014 (Kr-85 mandate for Gross Leak test)
  - Additional delta limit considerations apply to burn-in
- Group C Inspection Changes
  - Random Vibration test added to SG1
  - Seal tests must also comply with MIL-STD-883, Method 1014 requirements
  - Life test (1,000 hours @ +125°C) added as SG5 on 25% of test specimens

In April 2019, Vectron responded to these changes by revising all fourteen Hi-Rel Standards in order to add a new Screening code which reflects full compliance with Rev F Screening and Group C requirements for Class S devices. All Vectron Hi-Rel Standards eliminate the need for OEM Source Control Drawing creation and can be found by clicking here. The most up-to-date revision of each standard is:

- OS-68338, Rev O
  Hybrid Clock Hi-Rel Standard, ACMOS and TTL Output
- DOC200103, Rev H and DOC207139, Rev B
  Hybrid TCXO Hi-Rel Standard, CMOS/Sinewave or LVDS Output
- DOC203679, Rev E and DOC203810, Rev E
  Hybrid Clock Hi-Rel Standard, LVDS or LVPECL Output
- DOC204898, Rev D and DOC204899, Rev D
  Hybrid VCXO Hi-Rel Standard, LVPECL or LVDS Output
- DOC204900, Rev E
  Hybrid Clock Hi-Rel Standard, High Frequency ACMOS Output
- DOC206218, Rev C
  Hybrid VCXO Hi-Rel Standard, ACMOS Output, 9x14mm J-lead
- DOC206379, Rev B and DOC206903, Rev B
  300krad Hybrid Clock Hi-Rel Standard, ACMOS and LVDS Output

- DOC206559, Rev C and DOC206906, Rev C
  Hybrid VCSO Hi-Rel Standard, Sinewave or LVPECL Output
- DOC207753, Rev A
  Hybrid VCXO Hi-Rel Standard, High Frequency Sinewave Output



For further information, please contact Scott Murphy, Product Line Manager, Precision OsC, at scott.murphy@microchip.com

Events and Conferences

Since our last edition of Space Brief, Microchip has attended several events to provide important updates to our customers on our entire space portfolio:

Hardened Electronics and Radiation Technology (HEART) – San Diego, CA (April 8–12)

HEART provides a professional forum for classified research and development investigations. The concentration is on research and development in space radiation and solid-state physics. At this event, Microchip presented radiation results for the RTG4 radiation-tolerant FPGAs and Prompt Dose results for LX7730 Telemetry Manager.

Space Parts Working Group (SPWG), Torrance, CA, (April 30–May 1)

SPWG is sponsored by The Aerospace Corporation in cooperation with the U.S. Air Force Space and Missile Systems Center and the National Reconnaissance Office. In its 47th year, SPWG is an unclassified, international forum for disseminating information to the aerospace industry and for resolving problems with high-reliability electronic piece parts for space applications. Microchip provided an overview of current radiation-hardened and radiation-tolerant products to suppliers, manufacturers and government agencies.

For questions please contact Ken O'Neill, Director of Marketing, Space and Aviation, FPGA Group at ken.o'neill@microchip.com, Julian Di Matteo, Sr. Product Marketing Engineer, Space and Aviation, FPGA Group at Microchip at Julian.DiMatteo@microchip.com, or Dorian Johnson, HiRel Product Line Marketing Manager at Dorian.Johnson@microchip.com

Single Event Effects Symposium/Military and Aerospace Programmable Logic Design Conference (SEE/MAPLD) – La Jolla CA (May 20–23)

Microchip exhibited and provided demonstrations of Smart Embedded Vision (SEV) object recognition on 28 nm SONOS PolarFire® FPGA, and provided important updates on RTG4 FGPAs and LX7720:

- Jih-Jong Wang presented results on RTG4 Rad-Hard Flash based in-beam re-programming
- Mathieu Sureau presented results on Heavy Ion SEL/SEE testing of Microchip's LX7720 integrated motor controller

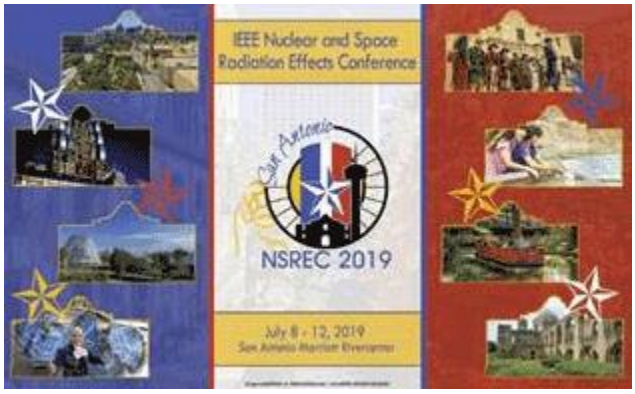
For questions please contact Julian Di Matteo, Sr. Product Marketing Engineer, Space and Aviation, FPGA Group at Microchip at Julian.DiMatteo@microchip.com, or Dorian Johnson, HiRel Product Line Marketing Manager at Dorian.Johnson@microchip.com

Nuclear and Space Radiation Effects Conference (NSREC), San Antonio, TX (July 8-12)

Microchip exhibited and provided demonstrations of Smart Embedded Vision (SEV) object recognition on 28 nm SONOS PolarFire FPGA. Microchip presented updates on the following topics:

- **Proton Characterization of RTG4 Flash-Based FPGA for LEO Environment**
- **Heavy Ion SEE Testing of Microchip Integrated Motor Controller LX7720**
- **ATmegaS128 8-bit Microcontroller Total Ionizing Dose and Single Event Effects**
- **ATmegaS64M1 8-bit Microcontroller Total Ionizing Dose and Single Event Effects**
- **A Summary of Mil Std 750, Method 1017 Neutron Irradiation Tests Performed on JANSR2N3700, JANSR2N2369, JANSR2N2222 and JANSR2N2907 BJTs**
- **Single Event Dielectric Rupture Characterization of Microchip High-Voltage Devices**

For questions please contact Ken O'Neill, Director of Marketing, Space and Aviation, FPGA Group at ken.o'neill@microchip.com, Julian Di Matteo, Sr. Product Marketing Engineer, Space and Aviation, FPGA Group at Microchip at Julian.DiMatteo@microchip.com, or Dorian Johnson, HiRel Product Line Marketing Manager at Dorian.Johnson@microchip.com.



IEEE Space Computing Conference, Pasadena, CA (July 30–August 1)

At this conference, Microchip presented an overview of the RISC-V open instruction set architecture, showed how the Microchip Mi-V ecosystem assists designers with the deployment of RISC-V processor cores in radiation-tolerant FPGAs, and provided benchmark data showing the efficiency gains in CoreMark®/MHz that RISC-V affords. The presentation also explored concepts of machine learning inference in the field of object detection and recognition and showed how neural networks are used to implement the "Smart Embedded Vision" systems using Microchip's PolarFire FPGAs. The Microchip PolarFire FPGA Smart Embedded Vision object detection demonstration, also shown at SEE/MAPLD and NSREC, was featured in our exhibition booth.

For further information, please contact Minh Nguyen, Sr. Product Marketing Manager, FPGA Group at Minh.Nguyen@microchip.comminh.nguyen@microchip.com or Ken O'Neill, Director of Marketing, Space and Aviation, FPGA Group at ken.o'neill@microchip.com.

AIAA/USU Conference on Small Satellites, Logan, UT (August 3–8)

The Microchip PolarFire FPGA Smart Embedded Vision object detection demonstration, also shown at SEE/MAPLD, NSREC and Space Computing, was featured in our exhibition booth. For further information, please contact Julian Di Matteo, Sr. Product Marketing Engineer, Space and Aviation, FPGA Group at Microchip at Julian.DiMatteo@microchip.comjulian.dimatteo@microchip.com or Ken O'Neill, Director of Marketing, Space and Aviation, FPGA Group at ken.o'neill@microchip.com.

Round Up of Published Articles on Microchip Space Products

Several articles from Microchip and interviews with Microchip personnel have been featured in industry publications over the past few months. Here's a short round up of these articles.

RTG4 FPGAs and RT and RH Arm Core MCUs in Military & Aerospace Electronics

The June 2019 issue of Military & Aerospace Electronics includes a feature on radiation-hardened space electronics, focusing on various traditional space and new space approaches. On page 25 Microchip's RTG4 FPGA received a nice endorsement from Mercury Systems as the product is described as, "…the heart of our (Mercury's) space drives now." Microchip is also included in the story on page 26 under the "Radiation tolerant" header, providing an overview of our radiation-tolerant solutions. Microchip's COTS-to-Radiation-Tolerant and

Radiation-Hardened Arm Core MCUs are mentioned.
Electronics in space: traditional market faces-off against new space

RH and RT Arm Processors in Military Embedded Systems

Responses from Eli Kawam and product information on the ATmegaS128 and SAMV71 Arm-based microprocessors are included in this space electronics feature in the June issue of Military Embedded Systems which focuses on COTS, reliability and rad-tolerant developments. New mission profile in space means COTS is now an acceptable risk

RTG4 FPGAs Featured in EE Times Spacecraft Communications Article

On May 3, EE Times published a feature which describes the challenges of communications between satellites and ground stations and how advanced signal processing in radiation tolerant FPGAs can be used to implement software-defined radios for higher bandwidth and lower power consumption in radio communications in space.
Spacecraft communications call for sophisticated data-transmission techniques

Component sourcing for commercial human spaceflight

On April 11, an article was published in EPS News examining the screening and sourcing choices for commercial human spaceflight. The advantages and disadvantages of traditional QML sourcing strategies are contrasted with COTS-based approaches, and a middle ground with the best of both worlds is proposed. Safe affordable space travel starts with sourcing

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