



SPACE BRIEF

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Welcome to Microsemi's quarterly Space Brief newsletter, Edition 18. This edition includes news about the expansion of our Space portfolio with radiation-tolerant analog mixed signal ICs for telemetry and motor control, as well as our next-generation RTG4™ FPGA family. Also featured is a discussion of how we are building a quality culture and the space events Microsemi has participated in throughout the year.

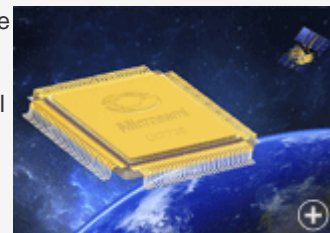
We hope you find our newsletter useful, and we encourage you to pass this edition on to your colleagues, or click the archive link to explore past editions. Instructions for registering to receive this quarterly Space Brief are included at the end of this newsletter.

Recent Product News

Microsemi Expands Radiation-Tolerant Space Product Portfolio with Highly-Integrated LX7720 Motor Controller

Microsemi is now sampling the [LX7720 radiation-tolerant motor controller](#), the newest member of its [Space System Manager \(SSM\) product family](#). As the industry's first highly-integrated radiation-tolerant motor control IC, the LX7720 significantly reduces weight and board space relative to conventional discrete motor control circuits, offering a unique solution for [satellite](#) manufacturers sensitive to area and weight challenges.

For more information, visit the [product page](#) or view the [datasheet](#). Contact Dorian.Johnson@microsemi.com with any questions.



Dorian Johnson

Product Marketing Manager, Analog Mixed Signal High-Reliability ICs



RTG4 Now Qualified to MIL-STD-883 Class B

RTG4 The RTG4 high-speed radiation-tolerant FPGAs have achieved MIL-STD-883 Class B qualification, meeting the industry's standard for microelectronic devices suitable for use within aerospace and defense electronic systems. To achieve the new qualification, RTG4 FPGAs passed a series of environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding defense and space operations, as well as mechanical and electrical tests. RTG4 units from multiple wafer lots successfully completed 1,000-hour high-temperature life tests, proving the high reliability of RTG4 flash cells in extreme conditions.

The MIL-STD-883 Class B qualification paves the way for RTG4 FPGAs to secure QML Class Q and QML

Class V qualifications in the near future. Microsemi is a QML-certified manufacturer of high reliability FPGAs for space applications. Achieving this important qualification reinforces our commitment to providing the highest quality and reliability solutions for our customers to meet the increasing demands of modern satellite systems.

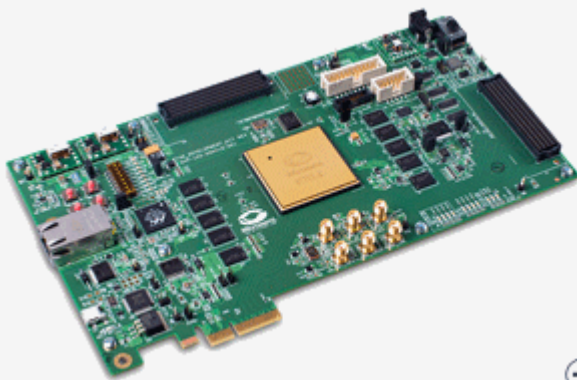
Customers can now procure RTG4 space flight FPGAs screened to B Flow per MIL-STD-883 Class B and Microsemi's Extended Flow (E Flow), making it easy for customers to select RTG4s for programs requiring the highest performing FPGAs. Microsemi's E Flow offers additional testing for space applications that require screening beyond the MIL-STD-883 Class B standard.

First RTG4 EV Space Flight Units Shipped

The first [RTG4](#) flight units screened to the highest "EV" screening flow were shipped to customers for an operational space flight program. This was an important milestone for the RTG4 high-speed radiation-tolerant FPGA family, showing customer's confidence in RTG4 technology and Microsemi's achievement in meeting the customer's aggressive schedule.

The Microsemi EV screening flow includes all screening and processing steps equivalent to the QML Class V per MIL-PRF-38535. The EV screening flow is available until QML Class V qualification completion, which is targeted for early 2018. The MIL-STD-883 Class B qualification has been completed since October 2016.

RTG4 PROTO and Development Kit Now Available



The RTG4 [PROTO](#) FPGAs have identical timing and functionality to the space flight models, but without having completed flight model tests in order to reduce costs for customers. The prototype devices are available now, enabling lower cost prototyping and design validation for RTG4 FPGA family. These devices use the same silico and packaging as flight model FPGAs, and are tested to full military temperature from -55 °C to 125 °C.

Development kits with RTG4 PROTO devices are also available now, providing space designers a comprehensive evaluation and design platform.



The [RTG4 development kits](#) are the industry's first radiation-tolerant FPGA kit, providing customers ease-of-design with the references needed to quickly evaluate and adopt RTG4 technology. [STAR-Dundee](#), a Microsemi's partner focused on spacecraft on-board data handling technology, successfully demonstrated their SpaceWire and SpaceFibre intellectual property (IP) cores using a RTG4 development kit. The SpaceWire IP is now approaching 400 Mbps in RTG4 PROTO FPGAs. STAR-Dundee's next-generation SpaceFibre IP is running at 3.125 Gbps on single lane, and at 6.25 Gbps per second on two lanes. These results demonstrate RTG4's excellent communications capabilities for data-handling on-board spacecraft.

For more information on RT FPGAs, please contact minh.u.nguyen@microsemi.com

Minh U. Nguyen

Marketing Manager, Space FPGAs, SoC Products Group



Product Updates and Notifications

Export Control Classification Number for RTSX-SU FPGAs

Following discussions with the US Department of Commerce, we have determined that the Export Control Classification Number (ECCN) for the RTSX-SU family of FPGAs will change from 3A001.A.1.B to 9A515.E.1, effective immediately. We expect this to have minimal impact on business transactions, as customers purchasing RTSX-SU FPGAs are required to submit the same export license paperwork for 9A515.E.1 as they have been doing for 3A001.A.1.B. The only difference is that the new category has more restrictive *de minimis* rules, which permit re-export of controlled products if the value of the controlled products is very small in comparison to the value of the finished equipment.

The new ECCN (9A515.E.1) for RTSX-SU is the same category which RTAX and RTG4 FPGAs fall under. Please refer to the following web site to see current ECCNs for Microsemi FPGAs:

<http://www.microsemi.com/products/fpga-soc/radtolerant-fpgas/military-aerospace-certifications>

Please address any questions to compliance@microsemi.com or ken.oneill@microsemi.com.

Ken O'Neill

Director of Marketing, Space and Aviation, SoC Products Group

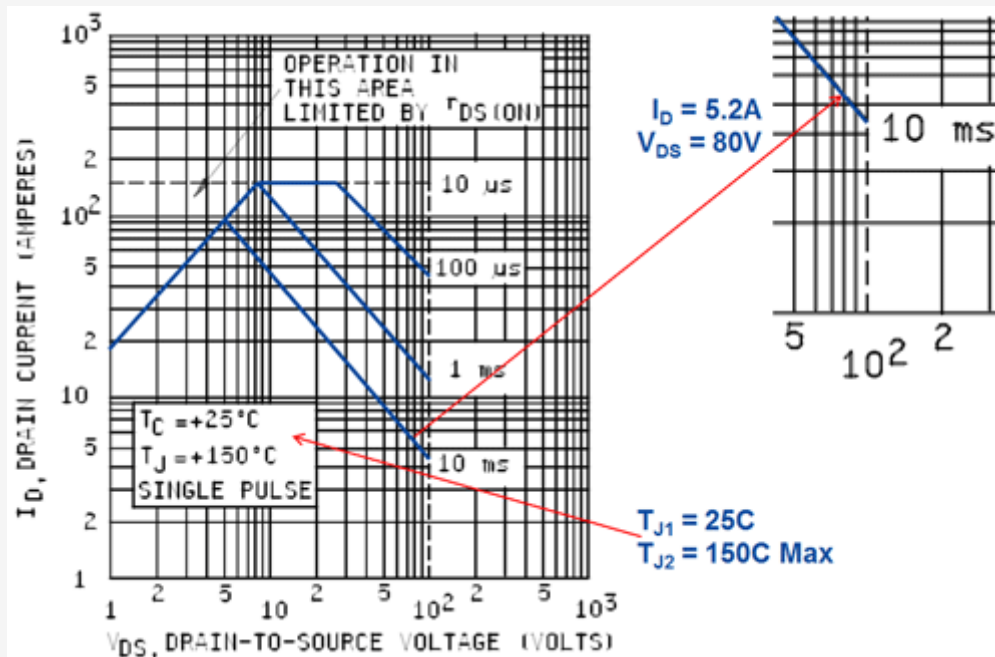


Evaluating the Reliability of Power Transistors with New Theta: SOA

For power semiconductor devices such as BJTs, MOSFETs, or IGBTs, the safe operating area (SOA) is defined as the voltage and current conditions over which the device can be expected to operate without self-damage. Space and military discrete power transistors have two significant goals:

1. pass the SOA graphs in the slash sheet
2. receive 100% thermal impedance testing. Microsemi can now say that both of these goals have been met.

The problem was that the two goals were never linked, so lots with excellent thermal impedance yields might be harboring an undetected potential SOA failure. Most SOA graphs in the slash sheets usually have a test condition that replicates the same time sample that conventional thermal impedance testing requires. Microsemi has begun using the $T_j=1500\text{ }^\circ\text{C}$ SOA graph (usually $t_H=10\text{ ms}$) at the same current and voltage as the 80% point on the published SOA graph. Because T_j must not exceed $1500\text{ }^\circ\text{C}$ by definition, and testing begins at $250\text{ }^\circ\text{C}$, we have the bonus of having a thermal impedance maximum limit with voltage, current, and time clearly specified and a "free" 100% SOA test as well. Both power MOSFETs and power bipolar transistors are finally closing this open loop between the two tests while giving all users a test they too can replicate and apply to their program application.



Example from Space Transistor 2N7268 per Mil-Prf-19500/603

Please address any questions to rdibugnara@microsemi.com

Ray DiBugnara
Engineering Fellow, DPG



Special Feature

In past editions of Space Brief, we introduced a customer perspective section to our newsletter. This was well received in the space market and after a strong response, we have decided to extend this feature to our partner companies. We would like to thank Arrow Electronics' Zeus Aerospace and Defense group for contributing to this issue of Space Brief. If you are interested in contributing to our newsletter or writing an article, contact SpaceBrief@microsemi.com.

Arrow Electronics' Zeus Aerospace and Defense group is the only broad line distributor in North America with Sales, Operations, and Quality resources exclusively dedicated to the Aerospace and Defense market. Why is that important? Aerospace and Defense customers have unique requirements and needs, very different from those in other industries. Zeus operates under strict compliance and anti-counterfeit guidelines. When you launch a satellite, it is critical that the systems on-board do exactly what they need to make it an uneventful flight that completes its lengthy deep-space mission. Zeus knows the needs of the military aerospace supply chain, and offers a number of different solutions that enable its customers to succeed.

Zeus offers technical design services, component modification, turnkey assembly, alternative financing to help bring your products to market, and other specialized services. Supply assurance offers a greatly

extended lifecycle for hard-to-get, obsolete products, complete with traceable pedigree. With our engineering resources, we help bring advanced technology to our Space-level customers through partners like Microsemi, while addressing the quality, supply chain, and complex operational needs of Space requirements.

For all Microsemi needs, call your local Arrow sales representative or contact us at www.arrow.com.

Steve Wagner
Director, Sales- Zeus Aerospace and Defense



Space News

Microsemi Wins Prestigious Supplier Trust and Recognition Award



Microsemi is honored to receive the Jet Propulsion Laboratory (JPL)'s Supplier Trust and Recognition Award for outstanding Electro Static Discharge (ESD) and Foreign Object Debris (FOD) quality control programs, demonstrating our commitment to maintaining the highest quality standards across all product lines.

As the representative for all NASA sites, U.S. government agencies, and their key suppliers and customers, the Joint Audit Planning Committee (JAPC) in collaboration with JPL's Procurement Quality Assurance department presented the award to Microsemi during a ceremony at our San Jose, California facility.

This award validates Microsemi's legacy of quality assurance and our team's commitment to providing exceptional processes for our product development, manufacturing, and delivery. For more information, please view the [press release](#).

Microsemi Power Solutions for Aerospace and Defense

With the announcement of the divesture to Mercury Systems, Microsemi's Discrete Products Group (DPG) integrated the Space and Power Management (SPM) team based in Garden Grove, California into the DPG family. This further cements the relationship we have been cultivating between this team and the Power Discretes and Modules (PDM) business unit (BU) over many years as we work collectively to develop solutions for the aviation, space, and defense markets.

Our capabilities and product offerings enable our vision of providing complete technological solutions from the chip level, to discretes and modules, right up to full power system solutions. This newly enhanced power capability in Microsemi DPG together with our Radio Frequency/Microwave Discretes (RFMW) BU, which addresses high-frequency communications and radar market applications, gives us a unique value proposition in the markets we serve.

Siobhan Dolan Clancy
Vice President & General Manager, Discrete Products Group (DPG)



Microsemi's Commitment to Space

Building a Quality Culture

Microsemi has been building and screening high-reliability discrete semiconductors for space markets for over 50 years. Many competitors have come and gone, but Microsemi continues to provide the largest portfolio of quality products in today's market. To facilitate this niche market with broad offerings and maintain its high level of quality with minimal obsolescence presents a significant challenge, a challenge that Microsemi has risen to by building a quality culture and not just relying on the more traditional tools prescribed in standards such as AS9100, ISO9001, and MIL-PRF-19500.



Space products for Microsemi's High-Reliability Discrete Solutions (HRDS) are assembled in Lawrence, MA and screened in Ennis, Ireland. The Ennis screening facility is the largest screening house in the world for discrete semiconductors and has been screening space-grade product since 1996. The quality system is built around the previously mentioned standards, but the goal is to move beyond compliance and understand and implement the spirit of the specification. From their first day on the job, every employee is introduced to our quality ethos. The induction program explains the markets into which we sell our products and highlights in understandable terms the importance of reliability. A sense of personal quality and ownership is instilled throughout induction, training, and on-the-job, and is subsequently reinforced through frequent communication and leadership.

Regular oversight by customers and the Defence Logistics Agency (DLA) means our facilities have to be audit ready all of the time. Lean, 5S, and continuous improvement are all programs used to drive the quality culture. To monitor our progress, we have leveraged both local and corporate IT resources to build custom systems to capture meaningful metrics. Analysis of the data allows us to measure our success and tailor our continuous improvement programs to bring the maximum benefit, but it is the culture and the behaviour of people in the organisation that ultimately drive Microsemi to the highest level of quality. The Quality Culture program is now in its second year, and evidence of its success has come in the form of increased and improved employee communication, reduced customer complaints and product returns (RMA's were 33% in Q3 2016 of what they were in Q1 2015) and exceptional results in both the AS9100 and DLA audits (less than half the number of findings).

Microsemi will continue to drive this quality ethos with the aim of nurturing a quality culture throughout the organisation and changing the Quality function from one of policing to one of promoting quality. The vast experience already gained by the Discrete Products Group and the benefits now recognised by the development of the quality culture can now be integrated throughout the broader organisation to solidify a quality system that will keep Microsemi as a leader in the supply of Intelligent Power Solutions.

Please address any questions to fdowney@microsemi.com

Feargal Downey

QA and Systems Director, Microsemi Ireland



We'll do it your way

In 1974, Burger King introduced the "Have it Your Way" marketing campaign with an emphasis on giving customers what they want. (modifying the burger to suit the needs of the customer). The Space and Power Management group at Microsemi applies the same philosophy using SMT components on a PWB, making it easy to modify the input voltage and output voltages of our DC-to-DC converters.

We are in the process of releasing three new modified versions of our standard products. The SB30-100-5-10D is a modified 2-output version of the 30 watt SB30-100-2R5-3R3-5T device. It is two independent 10 W converters in one package that share a common input EMI filter. With this product, Microsemi was able to provide exactly what the customer wanted in the smallest possible package.

The SA50-50-5R5 and SA50-50-5R5-12T are modified from the SA50-120 family with 50 W output, 50 V in, and 5.5 V out for the single version. The second part in this new family is a triple output 5.5 V and ± 12 V. Each device includes an integrated EMI filter. These two parts (single output and triple output) form the basis for a new 50 V family. Some customers want a 70 VIN family, and it is a natural migration to include it.

Please contact Kent.Brooten@microsemi.com with any questions.

Kent Brooten

National Sales Manager, Power Management Group

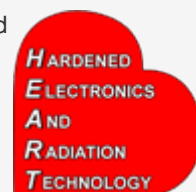


Appearances and Events

RTG4 Radiation Test Results Published

Microsemi radiation effects scientists presented a [paper](#) at the Hardened Electronics And Radiation Technology (HEART) Conference in Monterey, CA in April of this year, covering total ionizing dose (TID) and single event effects (SEE) testing on Microsemi's RTG4 radiation-tolerant FPGAs.

Melanie Berg from NASA's Goddard Space Flight Center presented a paper on



[Independent Single Event Effect Testing of the Microsemi RTG4: Preliminary Data](#) at the Single Event Effects Symposium held in La Jolla, CA in May 2016 and NASA Electronic Parts and Packaging (NEPP) 2016 Electronics Technology Workshop held in Greenbelt, MD in June 2016.

LX7720 Motor Control Space System Manager Featured at AMICSA Conference



Microsemi was a featured speaker and exhibitor at the Analog Mixed-signal ICs for Space Applications (AMICSA) conference held in Gothenburg, Sweden in June. The topic of the presentation was “Challenges of Designing a Radiation Tolerant Motion Control System on Chip” and focused on our new Space

System Manager, the LX7720. The LX7720 is a radiation-tolerant motor/position control IC and it exemplifies meeting these design challenges with a combination of chip partitioning, process selection, code development, and test engineering. As with our first Space System Manager (the LX7730 Telemetry Controller), it operates in conjunction with our RT FPGAs. Development kits using the LX7720 or LX7730 with our new RTG4 FPGA are also available.

Sampling of the LX7720 is scheduled with production in calendar Q3 of 2017. For more information, check out the web page at <http://www.microsemi.com/product-directory/radiation-tolerant-devices/3574-space-system-managers> or contact dorian.johnson@microsemi.com.



IEEE Nuclear and Space Radiation Effects Conference

Microsemi participated in [IEEE's Nuclear and Space Radiation Effects Conference \(NSREC\)](#), held in Portland, Oregon from July 11th to 15th. The company's experts showcased its [high-speed signal processing RTG4](#) radiation-tolerant FPGAs along with a variety of [radiation-hardened DC-to-DC converters](#), [space system managers](#), [precision time and frequency solutions](#), [linear and point of load \(POL\) hybrids](#), [custom hybrid solutions](#), and [radiation-hardened discretes](#) (including the broadest portfolio of JANS Class diodes and bipolar products).



In addition, Dr. J.J. Wang, chief engineer at Microsemi, explained the effects of radiation during a poster presentation titled “Combined X-ray and Gamma Ray Testing to Investigate the TID Tolerance of RTG4,” as well as a data workshop poster presentation titled “Heavy-Ion Testing on SEU of Flip-Flops, PLLs and SERDES in RTG4 Flash FPGA.”

LX7730 Telemetry Controller Radiation Hardening paper presented at RADECS



RADIATION EFFECTS ON COMPONENTS & SYSTEMS CONFERENCE SEPTEMBER 19TH - 23RD

Microsemi participated in the 2016 RADECS conference held in Bremen, Germany from September 19–23. Total dose and single event effects hardening and testing of our radiation-hardened analog mixed-signal

telemetry controller integrated circuit, the LX7730, were presented in a paper titled “Total Dose and Single Event Effects Hardening and Testing on Mixed Signal Telemetry LX7730 Controller.” Test results included total dose testing (TID) and the SEU and SET of the telemetry scan chain, analog input MUX to ADC chain, and supporting circuitry, as well as the SEL of the entire module. A copy of the presentation and the test results are posted on the LX7730 webpage at <http://www.microsemi.com/product-directory/space-system-managers/3575-telemetry-controller-ic#documentation>.

European Space Power Conference



Microsemi was a featured speaker and exhibitor at the European Space Power Conference (ESPC) conference held in Thessaloniki, Greece

from October 3–7, while also chairing a workshop discussion on the reliability aspects of commercial parts and processes for Space.

Pat Franks, Director of Engineering at Microsemi, explained how satellite digital processing systems present demanding requirements for power distribution from the vehicle's main power bus down to regulated power rails on FPGA devices such as RTG4 FPGAs (Microsemi's fourth-generation flash-based FPGAs). The paper, titled “Efficient Point of Load Conversion from the Satellite Main Bus,” discussed these

regulation issues and the solutions offered by Microsemi's SB30 bulk POL DC-DC power converter. Please address any questions to Patrick.Franks@microsemi.com

Pat Franks

Director of Engineering, Power Management Group



Microelectronics Reliability and Qualification Working Meeting – MRQW 2017

Microsemi will be presenting reliability and qualification updates on RTG4 FPGAs and Space System Managers in the next Microelectronics Reliability and Qualification Working (MRQW) meeting in El Segundo, CA from February 7–9, 2017. MRQW provides a forum for discussion of microelectronics reliability and qualification issues for microelectronics targeted for use in space systems. Our Microsemi representative, Minh U. Nguyen, will be available during the meeting.



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For more information on how Microsemi is serving the space market, access our brochure at [Microsemi Space Solutions Brochure](#) and our space webpage at <http://www.microsemi.com/applications/space>.

If you have any feedback or content suggestions for the Space Brief Newsletter, send an email to SpaceBrief@microsemi.com or click the "[Feedback](#)" link. Thank you for your assistance in ensuring the Space Brief continues to serve the space market and all employees.

Sylvia Keane

Senior Marketing and Communications Specialist (DPG) and Space Brief Editor-in-Chief



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