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Articles in this Edition:

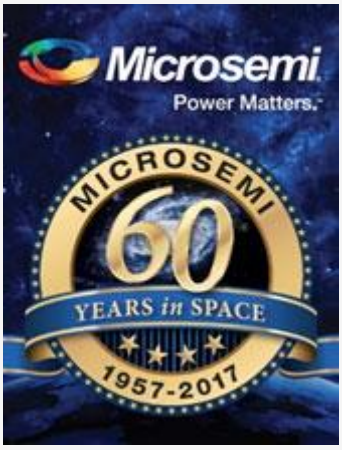
Welcome to Edition 21 of Microsemi's quarterly Space Brief newsletter, featuring news about the expansion of our space portfolio for timing applications and precision crystal, SAW, and LC filters, our space power solutions, next-generation RTG4™ FPGA family, and radiation-tolerant analog mixed-signal ICs, as well as a discussion of "New Space."

We will highlight the upcoming space events Microsemi will attend, and look forward to seeing you there.

We hope you find our newsletter useful and encourage you to share this edition with your colleagues. Instructions on how to subscribe are included at the end of the newsletter.

Microsemi's Commitment to Space

Space power solutions when you need them



Aerospace companies doing space satellite designs sometimes use a technique called rolling wave planning, which involves planning each phase of the program in manageable chunks. This is especially useful in large, complex programs where you really need to manage the life of the project. One aspect of this planning technique is to purchase long-lead or "at-risk" components early in the process. At-risk components are selected from past experience based on issues, criticality to the program (i.e. single source), column attach for FPGA, or, potentially, programming development. These components may consist of digital FPGAs, ASICs, analog-to-digital convertors, and digital-to-analog convertors.

As the digital architectures are finalized to allow order placement, power levels can fluctuate, from mA on an analog power rail to 10s of amps on a digital payload. Due to this variation, power designs are often shifted in the plan till the digital design is somewhat fixed. This creates multiple dilemmas for the power team: limited time to complete their design, limited area remaining to "fit" the power solution in the box, and limited time to order long-lead power and discrete components once the design is finalized.

Microsemi understands this, and has invested significantly in our manufacturing capacity and are planning to enable significant reductions in lead times. We have over 600,000 burn-in sockets available in our Ennis facility for screening MIL-PRF-19500-qualified discretes, which is the largest in the world.

Currently, our shipments are exceeding >96.0% on-time performance to customer-promised delivery dates with consistent year over year improvement for multiple years running! Considering our portfolio consists of over 2500 JANs-qualified devices and we have shipped over 500,000 JANs devices this past year, that is impressive. For high-running products or programs, we have also created supply models that maintain a specific amount of buffer stock to ensure our customers' manufacturing lines are not delayed.

However, we are not stopping there. We want to continue to improve our on-time delivery metric to over 98% and ensure our customers have the space power devices they need for every satellite design. We love being able to say if its flying in space for the last 60 years, then Microsemi is flying on it.

For more information, contact Chris Hart at Chris.Hart@microsemi.com with any questions.

Chris Hart
Aerospace Director, Discrete Products Group (DPG)

Product Updates

RTG4 In-system Programming Solution using DirectC Available Now

Setup of the RTG4 source board (bottom) programming the RTG4 target board (top) using DirectC v4.0 and RISC-V microprocessor

The latest version of DirectC v4.0 programming software now supports in-system programming for RTG4 FPGAs. The DirectC solution enables a microprocessor to program an RTG4 device through the JTAG interface by providing a set of C-code designed to support RTG4 in-system programming.

To use DirectC v4.0, users can make modifications to the source code, add the necessary application programming interface (API), and compile the source code plus API to create a binary executable. The binary executable is then downloaded to the target system along with the programming data file, which is another binary file generated by Libero SoCdesign software containing programming data for the RTG4 device being programmed.

Included in the JTAG-DirectC v4.0 download for RTG4 are sample projects to demonstrate programming of the target RTG4 development kit with a source RTG4 development kit, or a SmartFusion2/IGLOO2 evaluation kit. In the SpaceForum.zip file, users will find the source RTG4 board sample project, which uses a RISC-V microprocessor soft IP to program an RTG4 device on the target board. The RISC-V open instruction set architectures (ISA) offer numerous benefits, including portability as well as enabling the open source community to test and improve cores at a faster pace than closed ISAs. Microsemi now offers a comprehensive software tool chain and IP core for RISC-V FPGA designs with the recently-introduced Mi-V ecosystems.

In addition, the JTAG-DirectC v4.0 download for RTG4 also includes UARTHostLoader, which is a new application to provide easy demonstration of programming the RTG4 development kit using a SmartFusion2 or IGLOO2 evaluation kit. DirectC v4.0 is available free of charge, and can be downloaded here.

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

Minh U. Nguyen
Marketing Manager, Space FPGAs, SoC Products Group

RTG4 FPGA Radiation Testing Update

Scientists from the Microsemi radiation effects team presented new radiation test data on Microsemi's RTG4 FPGAs at conferences throughout the year, at Radiation Effects in Components and Systems (RADECS) in Geneva, Switzerland. The following papers were presented at RADECS:

- "Total Ionizing Dose Testing (X-Ray and Gamma) on RTG4 FPGAs."
  This paper describes the effect of both x-ray and gamma radiation on reprogramming, propagation delay, and current consumption in RTG4 FPGAs.
- "Reprogramming of RTG4 FPGAs in Heavy Ion Radiation"
  This paper describes the effects of a heavy ion test environment on reprogramming operations on RTG4 FPGAs. It concludes the risk of an upset in space during the reprogramming operation is very low.

The papers may be obtained from ken.oneill@microsemi.com or minh.u.nguyen@microsemi.com. In addition, we have recently completed a new heavy ion test campaign on the phase locked loop (PLL) and the on-chip RC oscillator in RTG4 FPGAs. The report may be obtained from the Microsemi web site, or by request from ken.oneill@microsemi.com or minh.u.nguyen@microsemi.com.

RTG4 FPGA Customer Advisory Notice

Customer Advisory Notice (CAN) 18002 for RTG4 FPGAs was recently published. The CAN addresses the following topics:

- CAN 18002.1 Vref Output Enable Tie-off
- CAN 18002.2 I/O Output Data and Output Enable Inversion
- CAN 18002.3 LSRAM Timing Marginality
- CAN 18002.4 LVPECL DC Voltage Specification
- CAN 18002.5 B-LVDS and M-LVDS DC/AC Specification

These topics are presented with a description. The complete CAN 18002 can be viewed here.

RTG4 Production Datasheet

The latest RTG4 datasheet (v3.0) is now posted here. This is the production datasheet, which includes production data for AC and DC electrical characteristics. Please refer to the revision history for a summary of changes from the preliminary datasheet v2.0.

Ken O'Neill
Director of Marketing, Space and Aviation, SoC Products Group

Space CSAC Completes Radiation Characterization Milestones

Development of a space-rated version of the chip scale atomic clock (CSAC) has passed critical milestones for radiation characterization to demonstrate a minimum of 20 krad TID and a lack of SEL damage at a level of 64 MeV-cm2/mg..

CSAC is an extremely low power atomic clock (< 120 mW) that provides stable frequency and time that surpasses conventional crystal oscillators. Performance of the space CSAC is anticipated to be identical to the commercially available device (Microsemi SA45).

The space CSAC is footprint compatible with the commercial SA45, enabling designers to begin prototyping activities in anticipation of release, which is scheduled for June 2018.

For more information, contact Peter Cash at Peter.Cash@microsemi.com

Peter Cash
Director of Product Management, Clocks, Frequency and Time Division

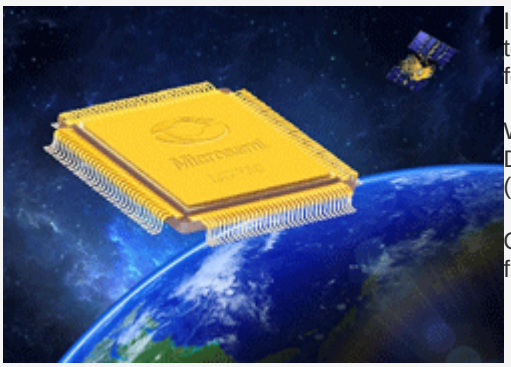
Product Notifications

Mixed-Signal Integrated Custom Space Solutions

Microsemi has over 20 years of mixed-signal custom ASIC development experience with expertise in space applications that boast many years of flight heritage. Our custom engagements cover specification to production and include mixed-signal solutions integrating complex analog functions with logic circuitry up to 10,000 gates. We focus on ICs designed for challenging operating conditions and provide solutions with typical radiation tolerances to a minimum of 100 krad TID and 50 krad ELDRS. Our designs are also immune to single event effects and feature cold-sparing on I/Os for redundant applications. We offer screening to MIL-PRF requirements, whether it be Class Q, Class V, or a customer-specified flow.

As your supply partner for electronic systems in space, Microsemi can solve problems at all stages of design and implementation. We invite you to explore Microsemi's solutions and engage with us to help solve your most difficult space system design challenges and participate in our future standard product roadmap by providing input to our product definitions.

LX7730 Radiation-Tolerant Telemetry Controller Achieves QML Certification



In our last Space Brief Newsletter, we announced that the LX7730 radiation-tolerant telemetry controller had successfully completed qualification requirements for both Class Q and Class V flows.

We are pleased to announce that we have also achieved certification by the U.S. Defense Logistics Agency (DLA) and are listed on the Qualified Manufacturers List (QML) for both Class V and Q.

Ordering part numbers and the corresponding SMD number for both screening flows are:

Microsemi Part Number	SMD	Flow
LX7730MFQ-V	5962-1721901VXC	QML-V
LX7730MFQ-Q	5962-1721901QXC	QML-Q

A press release announced this achievement. Our latest datasheet that cross-references the SMD numbers along with the latest radiation test results and conference papers can be found on the product webpage, here.

Mixed-Signal Radiation Testing Update

Numerous radiation tolerance tests have been performed on the LX7730 telemetry controller. In addition to the required TID testing for Class V flow, we have also performed ELDRS and single event tests on the device. The results were presented at NSREC 2017 in July and at RADECS 2017 in October.

The results exhibit the hardening goals for the device. The TID performance at 100 krad and ELDRS performance at 50 krad of the different blocks of this highly integrated device are consistent with the pre-radiation results. The design is SEL immune up to 87 MeV.cm2/mg and 125 ℃ (fluence of 1e8 particles/cm2).

In addition, the LX7730 shows strong performance under the beam up to 83 MeV.cm2/mg of all evaluated blocks, including the internally regulated currents and voltages as well as the complete telemetry chain. To view the radiation results and conference papers, please visit the LX7730 product webpage.

For more information, contact Dorian Johnson at Dorian.Johnson@microsemi.com

Dorian Johnson
Product Marketing Manager, Mixed-Signal and ASIC High-Reliability ICs

Microsemi Announces Extended Space Portfolio for Timing Applications and Precision Crystal, SAW, and LC Filters

Microsemi is proud to announce the opening of Piezo Oscillator Products, formerly known as Vectron International, as its newest segment. Located within and critical to the success of the Piezo oscillator products segment is an extensive portfolio of crystal and SAW-based oscillator products for space and Hi-Rel applications. This product line includes space-qualified, radiation-tolerant clocks, VCXOs, TCXOs, OCXOs, EMXOs, VCSOs, and crystals that are manufactured at the Space Center-of-Excellence in Mount Holly Springs, PA an AS9100 facility that boasts more than six decades of spaceflight heritage.

The United States' first successful space exploration mission, the 1958 launch of a Jupiter-C rocket carrying the Explorer satellite, included frequency control devices built and tested at the Mount Holly Springs plant. Today, we draw on the experience and expertise gained in those early years to remain the leading supplier of frequency control devices for defense, exploration, and commercial satellite programs, utilizing state-of-the-art design, manufacturing, and control systems to meet and exceed customer requirements for reliability, performance, and value. In addition to our world-class hybrid manufacturing capabilities, we offer a full line of technical services including engineering design analyses and program management, and we are one of only two MIL-PRF-55310 Class S QPL suppliers in the world.

The Teltow facility is a manufacturer of precision crystal, SAW, and LC filters for the military and space markets. Most of our filters are considered custom, and we have thousands of successful designs in our files. The space SAW family offers high reliability under the most stringent environmental conditions, from 30 MHz to 2.7 GHz.

For more information on space SAW products, contact Jon Rhan at Jon.Rhan@microsemi.com

For more information, on space and Hi-Rel oscillator products, contact Scott Murphy at Scott.Murphy@microsemi.com

Scott Murphy
Space Product Line Manager, Piezo Oscillator Products

Space News

Lowering the Cost of Global Communication: "New Space"

Many companies are working on building satellite networks to provide high-bandwidth communication services to areas of the world that are not presently well served by conventional wireline voice and data communications infrastructure.

Several different development themes are in play—one theme is to build larger, more powerful communications satellites in geosynchronous earth orbit (GEO) with greater capacity for high-bandwidth communications channels. These high-throughput satellites handle many gigabits of data per second and differ from prior generations of fixed satellite services communications satellites not just in the volume of data that passes through them, but also by incorporating greater flexibility for the satellite operator to reallocate communication channels to different customers with different geographical territories after the satellite has been launched. The greater throughput and more flexible bandwidth allocation doesn't solve one major drawback of geosynchronous communications satellites, which is the time taken for radio signals to travel from earth to the satellite and back to earth again.

This round trip of at least 72,000 km takes a minimum of 0.24 seconds. For communications applications such as voice traffic or data traffic that requires real-time responsiveness, this latency is unacceptable. To solve this problem, companies are looking for ways to deploy high-bandwidth satellites in low earth orbit (LEO). Because of the proximity to the earth's surface, latency is dramatically reduced, however many more satellites are required in LEO to achieve global coverage than with a GEO constellation. As we all know, satellites are expensive to design, build, and launch, and this expense presents a significant barrier to the introduction of constellations of LEO communications satellites.

Back in the 1990s, several constellations of LEO communications satellites were planned, and to reduce costs, some constellations planned to use commercial electronics components without QML qualification and screening (in some cases, with plastic packaging). Not all of these constellations reached production, but at least two—Iridium and Globalstar—were fully deployed and have been operating successfully since launch. With advances in microcircuit technology and with a reduction in launch costs due to increased competition in the launch vehicle market, today we see a resurgence in interest in developing and deploying constellations of LEO communications satellites. Indeed, today's programs have greater scope than the most ambitious plans from the 1990s, with constellations of many hundreds of satellites currently in assembly, and constellations of thousands of satellites in advanced design.

Microsemi is dedicated to serving our space customers around the world with the highest quality, highest reliability products, qualified to QML levels including QML class K and class V, with fully characterized radiation effects. That is not changing. However, to serve customers who need to deploy large quantities of satellites requiring large quantities of components, Microsemi is looking at ways to offer products that meet the less-stringent screening and radiation requirements of New Space programs. We have several initiatives in progress, ranging from reduced screening flows on existing products, plastic packaging to reduce cost on existing products, and new product designs in which a lower level of radiation performance is acceptable in order to reduce cost.

Please reach out to your local Microsemi sales team if you have a need for radiation-tolerant components in higher volume and at lower cost than traditional space applications, or contact Microsemi's space marketing team:

Chris Hart: discrete diodes and transistors, power modules, and solutions

Peter Cash: clocks and oscillators

Scott Murphy: clocks and oscillators

Jon Rhan: SAW filters

Minh Nguyen: FPGAs

Ken O'Neill: FPGAs, mixed-signal, cocks and oscillators, and general inquiries

Dorian Johnson: mixed-signal standard products and custom mixed-signal ASICs

Appearances and Events

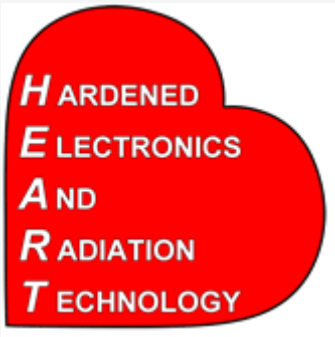
Satellite Conference

Microsemi will participate in the Satellite Conference and Exhibition from March 12–15, 2018 in Washington D.C, led by professionals in the community who have their finger on the pulse of satellite-enabled communications to ensure you experience the most relevant topics and receive actionable solutions. Thousands of professionals will participate from the satellite community to explore next-generation products and technology and to discuss solutions for today's challenges with experts, thought leaders, and veterans from the field. Microsemi representatives, Scott Murphy and Stewart Hampton, will be available during exhibition hours at booth 1050 to provide any information you may need.

Space Parts Working Group - SPWG

The Space Parts Working Group (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 46th 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. Microsemi will be presenting our new product introductions to suppliers, manufacturers, and government agencies. For further information visit.

HEART Technical Interchange Meeting



Microsemi radiation effects scientists will be presenting a paper covering total ionizing dose (TID) and single event effects (SEE) testing on Microsemi's RTG4 radiation-tolerant FPGAs at the Hardened Electronics and Radiation Technology (HEART) conference in Tucson, Arizona from April 16–20, 2018. HEART provides a professional forum specifically for classified research and development investigations. The concentration is on research and development in space radiation and solid-state physics.

Microsemi representatives, Ken O'Neill and Dorian Johnson, will be available during exhibition hours to provide information on Microsemi's solutions. For further information visit

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For more information on how Microsemi is serving the space market, access our Microsemi Space Solutions Brochure and our space webpage at 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 on 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