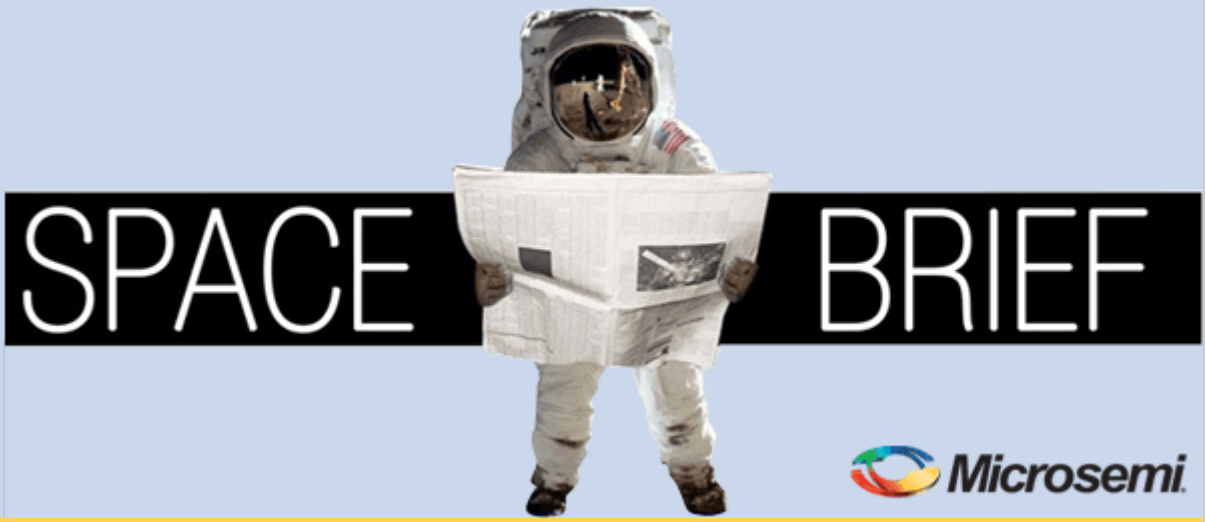


Articles in this edition:

Welcome to Microsemi's Space Brief quarterly newsletter. In this edition, highlights include Microsemi announcing the preliminary testing of the new I²MOS™ product line of Rad-Hard MOSFETs for Space applications and Rad-Hard environments, our recent space industry news and an update on the events Microsemi is attending and organizing throughout the year. We hope you find our newsletter useful and encourage you to pass this edition to your colleagues. Instructions for registering to receive this quarterly space brief are included at the end of the newsletter.

Recent Product News

Microsemi will begin Prototype sampling of I²MOS™ Rad-Hard MOSFETs

Microsemi's new I²MOS™ product line of Rad-Hard MOSFETs provides the industry with the latest technology improvements in Rad-Hard MOSFET's for Space applications and Rad-Hard environments. Preliminary testing of the I²MOS™ products has yielded significant improvements in SEE and TID performance vs. competing technology. These products will have Single Event LET ratings from 85-90 MeV. I²MOS™ MRH20N22U3, 200V product passed Single Event testing with Au ions at the full rated Bvdss of 200V and Vgs= -5 V and -10 V. The Prototype samples for the following four products will be available from December 2013.

Similar QPL #	Microsemi #	BVdss	Package	Channel
JANSR2N7479U3	MRH03N22U3	30v	SMD 0.5	N
JANSR2N7480U3	MRH06N22U3	60V	SMD 0.5	N
JANSR2N7587U3	MRH10N22U3	100V	SMD 0.5	N
JANSR2N7591U3	MRH20N16U3	200V	SMD 0.5	N

The production release of these products is expected throughout the 2014 calendar year. Going forward, additional package styles (TO-39, TO-257) will be added to the portfolio. All products exhibit superior excellent electrical and radiation performance characteristics. For more information, please email Al Ortega at Al.Ortega@microsemi.com.

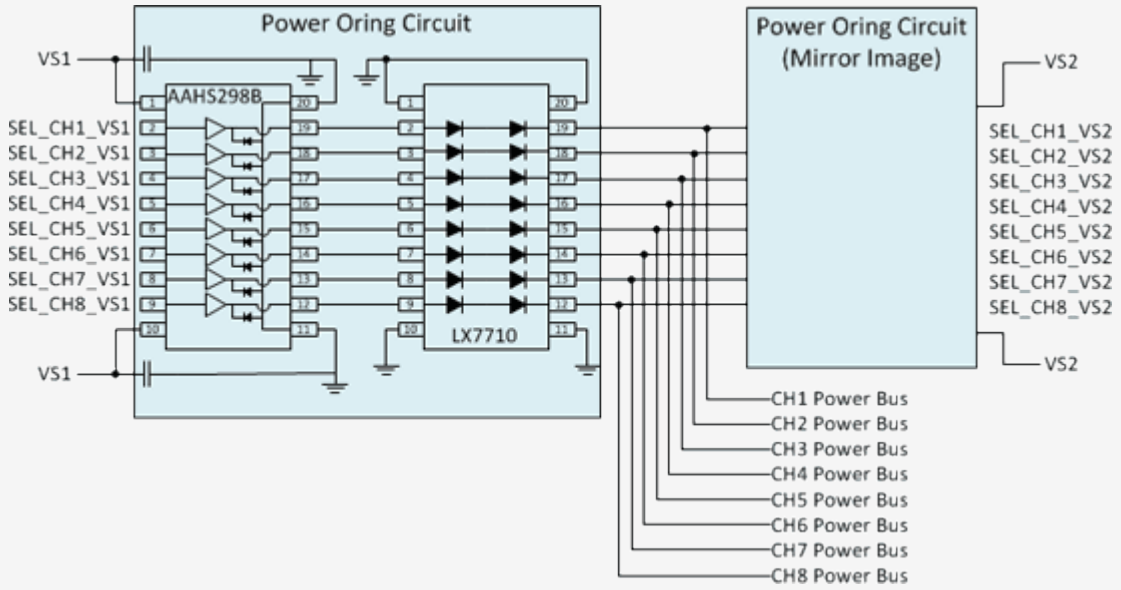
Al Ortega
Product Line Manager, High-Reliability Group

Redundant Power Switching using AAHS298B and LX7710

Microsemi will be sampling our new LX7710 Radiation Tolerant Octal Series Diode Array in Q1 2014. LX7710, AAHS298B, and the 8-Channel Source Driver currently in production, can be used together to implement logic controlled redundant power switching as described in the following application note.

AAHS298B provides the logic level controlled power switching and LX7710 facilitates power OR-ing and prevents reverse current flow through AAHS298B, if either redundant power source is shut down. AAHS298B can source 700 mA per channel and a combined package total sourcing of 2800 mA. AAHS298B has a maximum voltage rating of 75 V, so with a voltage derating factor of 80 %, it can switch voltage rails in the 28 V to 60 V range. Each output has a clamp diode that provides an inductive current path when the switch turns off abruptly. AAHS298B has a switch voltage drop of 1.8 V at 500 mA.

LX7710 consists of eight channels of two 700 mA, 125 V diodes in series. Should one diode in a channel fail in a short, the second diode provides redundancy to keep the channel active. A second bond-out option with non-redundant single diode channels is available on request. The voltage drop across the dual diodes is 1.9 V at 700 mA. LX7710 is rated for 1 A of continuous channel current so it can carry the maximum output current of AAHS298B. The circuit below provides six 700 mA power channels that are powered from two redundant power sources, VS1 and VS2 and one high current channel. The selection logic inputs are TTL compatible, as well as 3.3 V and 5.0 V CMOS compatible.



For more information on this article please email Bruce Ferguson at BFerguson@microsemi.com.

Bruce Ferguson
Chief Engineer, Analog Mixed Signal Group

Recent Product Updates and Notifications

Core1553 IP Updated and Certified

Core1553 is Microsemi's Direct Intellectual Property (IP) core, commonly used in bus communication for aerospace applications. Core1553 is based on MIL-STD-1553 supporting various bus protocols, such as Remote Terminal (RT), Bus Controller (BC) and Monitor Terminal (MT). Core1553BRT and Core1553BRM have gone through a major update with enhancements to the cores as well as their documentations. In November 2013, the latest version of Core1553BRT v4.0 and Core1553BRM v4.0 received updated Certification per RT Validation Test Plan outlined in MIL-HDBK-1553 Appendix A. Core1553BRT v4.0 and Core1553BRM v4.0 now support the latest families of SmartFusion®2 and IGLOO®2 FPGAs in addition to existing FPGA families. The certification of these two IP cores was also done on SmartFusion2 devices.

Microsemi Core1553 IP has been flown on a scientific instrument, SOPHIE of the Aeronomy of Ice in the Mesosphere (AIM) mission. Core1553 IP is also onboard the Commercially Orbital Transportation Service (COTS) for the International Space Station (ISS). We look forward to having flight heritage for Core1553 IP on many more programs, including but not limited to James Webb Space Telescope (JWST) and Joint Polar Satellite System (JPSS). Microsemi continues to provide the highest quality and reliability aerospace solutions by seeking and updating qualification and certification, not only for our devices but also the IP cores which help customers design with these devices.

The updated IP cores and documentations will be posted in January 2014. A SmartFusion2 device reference design and Core1553 Development Kit supporting SmartFusion2 devices, will follow at a later time to help demonstrate Core1553 capability in Microsemi's latest FPGA technology.

For more information on Core1553 and Microsemi IP Cores, refer to http://www.microsemi.com/products/fpga-soc/design-resources/ip-cores.

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

Microsemi's new family of Radiation-Tolerant Linear ICs is here!

These products are enhancements to our heritage line of high reliability PWM Controllers, Linear Voltage Regulators and Interface Circuits. All devices are form-fit-function equivalents of our proven heritage product family with the added feature of post radiation performance after TID, ELDR and SEL exposure. We are currently sampling our SGR1825C, SGR1845 and SGR1846 PWM controllers, and our SGR117 and SGR137 voltage regulators. The SGR117 and SGR1846 are in production now and we will continue our launch by releasing several devices per quarter. QML-V certification is underway and is planned for Q2 2014. Prior to certification, this product will be screened per Microsemi's internal S-Level flow.

For more information on SG linear IC's, please email Dorian.Johnson@microsemi.com or contact a local Microsemi sales representative by going to http://www.microsemi.com/products/0.

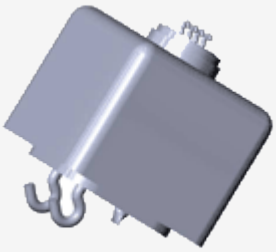
Dorian Johnson
Senior Product Marketing Engineer, AMSG Hi-Rel Products

Space Industry News

Microsemi developing Space Grade Hermetically sealed Ultra high vacuum Latching Relays

Getting a satellite from the launch pad into orbit is just part of the story. The launch vehicle delivers the satellite to its orbit. That's when the propulsion system starts its job. With 20,000 pieces of tracked space junk, the satellite must maneuver out of the way to avoid damage. Each satellite contains many tiny rocket engines to move in X, Y and Z directions. Each thruster needs an ignition voltage delivered to start the burn. This is accomplished through a HV relay.

The specifications for these devices are no small matter:



10 KV standoff voltage, 40+ amps, operating temperature rating up to 220 ^{o}C ,life span of 25 years, 20,000 cycles minimum.

This family of relays is designed to meet the requirements of MIL-DTL-83725 and MIL-PRF-6106.

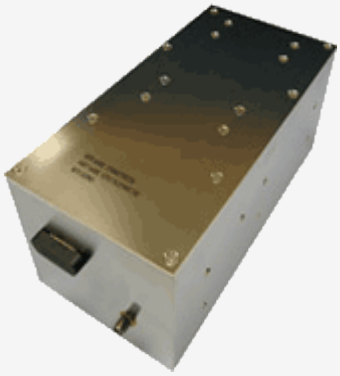
Microsemi's Power Management Group is in development of just such a relay. Building relays for space since 1957, we work closely with our customers developing a space grade latching relay to perform in this extreme environment. If your company has special needs, please contact pmgsales@microsemi.com or Kent Brooten at Kent.Brooten@microsemi.com.

Kent Brooten
National Sales Manager, Power Module Group

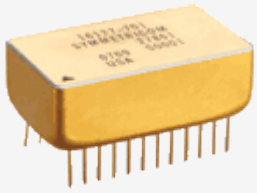
Microsemi Announces the availability of Space Qualified Crystal Oscillators

Microsemi's Frequency and Time division, formerly Symmetricom located in Beverly Massachusetts, has an extensive legacy of high-performance voltage controlled, temperature compensated and oven controlled crystal oscillators and atomic clocks. Microsemi has delivered more 675 crystal oscillators and 70 Cesium atomic clocks for numerous commercial, scientific and military space programs over the past 42 years. These programs have included GPS I through III, SBIRS, EOS, MUOS, PAN, INTELSAT, TELSTAR, World View, MESSENGER, STEREO, and US government missions.

The **9600B, 9700B** and **9800B** family of ovenized oscillators provide an output of 1 to 200 MHz with exceptional frequency stability, phase noise, temperature coefficient in a compact package with low power consumption. The oscillators are radiation hardened to greater than 100 krad (Si), capable of operating under neutron and SEU environments with SEL immunity. Internal vibration and shock isolation systems provide the capability of operation during 40 grms of random vibration and 3000 g's pyrotechnic shock. Component quality levels range from class B (level 2), through class S (level 1) with optional tailoring for program requirements. These oscillators have been fully analyzed for space reliability requirements and qualification tested. Options exist for low acceleration sensitivity oscillators.



The **9500B** is a family of ultra-stable crystal oscillators that demonstrate the highest level of performance available for crystal oscillators. The performance includes Allan Deviation of less than 1 x 10-13 for time intervals of 1 to 100 seconds. 9500 provides output frequencies to 600 MHz with options for multiple outputs and digital frequency control. These oscillators have been thoroughly analyzed and tested for numerous environmental conditions including EMI/EMC, random and sine vibration, pyro-technic shock, and radiation. Radiation testing has included low dose rate (proton and gamma), SEE, high dose rate, and prompt dose testing. 9500B is optionally available with internal power supplies for operation from secondary or primary power supplies.



The **9900** family of oscillators use hybrid circuits to reduce the size of voltage controlled and/or temperature compensated crystal oscillators. The 9900 oscillators have frequency outputs up to 600 MHz with sine wave, TTL, CMOS, PECL and CML types of outputs. The oscillators exhibit excellent phase noise, temperature stability and aging. Manufacturing and tests are performed at Class K certified facilities. Packaging includes dual in line (DIP) or surface mount versions, depending on the choice of crystal packaging.

Microsemi is scheduled to release a space qualified version of the revolutionary CSAC (Chip Scale Atomic Clock) in March of 2014. The CSAC has the frequency accuracy and stability of an atomic clock with power consumption of less than 125 mW in a 16 cm3 package.

For more information, please email pcash@symmetricom.com

Peter Cash
Director of Space, Defense and Avionics, Government Programs Group

Special Feature

In this issue of Space Brief, we look at introducing a new customer perspective section to our newsletter. We would like to thank **Dr.Rajan Bedi,** Head of Mixed-Signal Design, EADS Astrium Ltd for contributing to this edition. If you are interested in contributing to our newsletter or writing an article please contact SpaceBrief@microsemi.com.

Hardware Design Considerations when using FPGAs for Spacecraft Avionics

The capability of space-grade FPGAs has improved significantly since the launch of six Microsemi A1020-CQ84Bs on-board the Sampex spacecraft in 1992. The A1020 was fabricated on a 2 µm process, contained 547 logic cells each comprising a 4:1 MUX and an OR gate.

The next generation of space-grade FPGAs will be manufactured using 65 nm, deep, sub-micron technologies offering thousands of logic cells, almost 1000 I/O, high-speed serial links, dedicated multiply-accumulate blocks, megabits of embedded memory, as well as reusable IP cores.

Regardless of whether FPGAs are being used to channelize and route beams on-board a telecommunication satellite, generate the L-band carriers for a navigation payload, process Earth-observation data, or control critical functions on a launcher or Martian rover, the task of using FPGAs for spacecraft avionics does not stop once the required functionality has been implemented and timing closure achieved within Libero SoC.

The actual hardware development of designing-in a space-grade FPGA onto a flight PCB presents a number of significant challenges: the latest devices are complex, high-pin count, high speed, power consuming and very expensive, and proper decisions must be taken before and during the development of the hardware to ensure designs are right-first-time.

Reflow soldering a one-time-programmable, flight-grade FPGA onto a poorly-designed, non-functioning PCB is a very expensive mistake!

The initial stage of hardware development involves defining the architecture for the FPGA implementation in response to the overall systems requirements for the mission. The final design may vary for different applications, for example, the hardware design of an FPGA-based subsystem for a launcher will most probably differ to that of a GEO telecommunication satellite which has to operate continuously for fifteen years.

FPGA device selection will be one of the earliest and most important hardware-level design decisions to be taken. The choice of part will be dictated by the logic resources required to meet the mission's processing requirements, as well as other factors such as cost, legacy of use, package size and ease of assembly, power consumption, prototyping options, the number of power rails and the design of the resulting power-distribution architecture, the number and type I/O, configuration architecture and reliability rate. Operational and radiation considerations specific to the mission may also influence the choice of FPGA.

Once the FPGA has been selected, the power-distribution network must be architected. The latest devices consume significant amounts of quiescent and dynamic power requiring low-voltage, high-current, correctly-sequenced, clean rails. A combination of switching POLs and LDOs may be required to achieve an efficient power-distribution network that can be thermally managed by the hardware design. Microsemi provides power estimation spreadsheets that help to bind the design of the power-distribution architecture. The predicted power dissipation provides some indication whether the FPGA will meet reliability, derating rules on the maximum allowable junction temperature, which can be a real challenge for the latest devices and high-processing applications.

Once all the components have been selected, a reliability analysis is performed to provide a failure rate and determine the level of hardware redundancy that may be required to support the mission.

The hardware design must also consider how the board and its performance will be verified at power-up, and how engineering and qualification builds that may ultimately contain one-time programmable FPGAs are prototyped. Aldec Inc. offers prototyping adaptors for Microsemi devices.

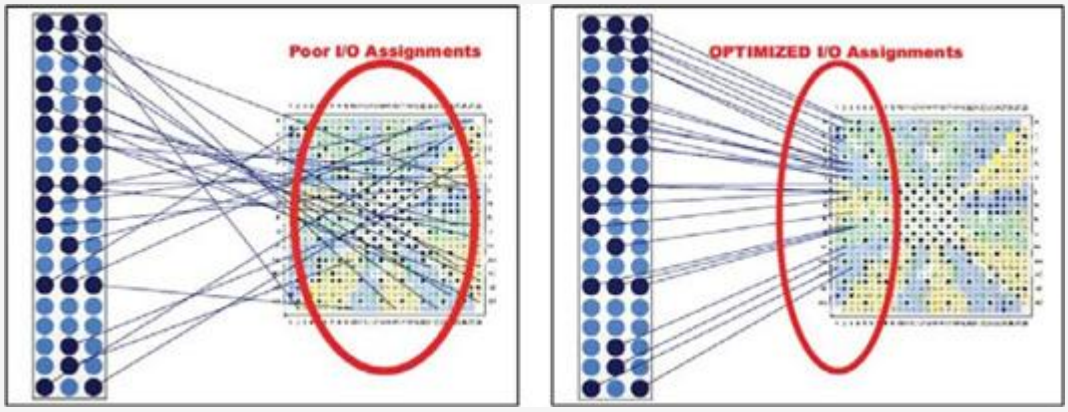
The floor-planning and placement of all the components on the PCB is one of the most critical areas in achieving the performance required from the system. If the card also contains mixed-signal or RF blocks, careful partitioning and routing will be required to ensure the noisier FPGA logic does not affect the more sensitive analogue circuitry.

The design of the PCB and the correct allocation of signal, return, power and reference layers within the stack is critical to ensure the hardware functions correctly. Current FPGAs are high-speed devices and fast signals must be routed on controlled-impedance tracks and terminated appropriately. The latest parts contain on-die termination which means that the physical space around the FPGA will not be as busy with passives, reducing the complexity of the transmission lines while maintaining characteristic impedance. Design-for-EMC best practices are essential to achieve the required performance!

Microsemi RTAX4000S FPGAs

Placing a 1 mm pitch, 1272-pin RTAX4000S onto a PCB, qualifying the assembly for space applications and keeping such devices cool, are key mechanical and thermal challenges that have to be overcome. Daisy-chain samples are available to assist with package qualification.

To assist the assignment of I/O to specific banks and pins, EDA tools can be used to automatically optimise the allocation of pins to signals to reduce the number of layer transitions, vias and the length of tracks. This ability to optimise breakout and escape paths lowers PCB costs, improves signal integrity and reduces EMI. In the bad, old days, this manual process consumed many weeks of work, today, routing changes to meet timing closure and/or PCB layout can now be achieved in seconds.



Automatic optimized allocation of pins to signals.

Once the PCB has been routed but before the artwork is sent to the PCB manufacturer, it's important to verify the post-layout signal integrity of the key interfaces. Power integrity is used to validate the design of the power planes, the effectiveness of the decoupling strategy and identify any current-density hot spots. The latest FPGAs can have hundreds of high-frequency, fast-edge signals changing at the same time and the post-layout effects of simultaneous-switching noise and GND/VCC bounce are checked. 3D EM modelling ensures that the final hardware will not become an emitter of RFI nor susceptible to external EMI.

The above analyses are performed for worst-case mission conditions to understand the changes in performance towards end-of-life due to ageing and environmental drifts. An FPGA on a GEO telecommunication payload has to operate continuously for at least fifteen years with any downtime affecting the revenue generating capability of the operator.

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I'd like to take this opportunity to thank Microsemi for inviting me to write this short article. As an end user of space-grade FPGAs, I have only just skimmed the surface of designing-in such devices and will elaborate in a future post next year: http://www.edn.com/electronics-blogs/4406636/Out-of-this-World-Design.

Dr.Rajan Bedi
Head of Mixed-Signal Design, EADS Astrium Ltd.

Appearances and Events

RADECS 2013 - Radiation Effects on Components and Systems

Microsemi participated in the Radiation Effects on Components and Systems (RADECS) conference and exhibition in Oxford, UK on September 23-27, 2013. The conference featured a technical program consisting of technical sessions of contributed papers describing the latest observations in radiation effects, short courses on radiation effects, a radiation effects data workshop, and an industrial exhibit. Microsemi exhibited in the common booth area where we were able to meet with many global industry experts. For further information visit: http://www.radecs2013.com/.

JAXA (Japan Aerospace Exploration Agency) - The 26th Microelectronics Workshop

Microsemi attended the 26th JAXA Microelectronics Workshop October 24-25, 2013 at the Tsukuba International Congress Center in Japan. This was a highly technical workshop discussing the current status of future trends in the space industry. Brian Wilkinson of Microsemi presented a paper titled; Microsemi - Your Partner for Space Systems Solutions. For further information and to view this presentation please visit: Microsemi - Your Partner for Space Systems Solutions

MRQW 2013 - Microelectronics Reliability and Qualification Working Meeting

Microsemi participated in the Microelectronics Reliability and Qualification Working (MRQW) meeting in El Segundo, CA on December 10-12, 2013. MRQW provided a forum for discussion of microelectronics reliability and qualification issues for microelectronics targeted for use in space systems. Microsemi presented a paper titled; Certification Update on MIL-STD-1553 IP for Microsemi FPGAs. For further information visit: http://www.cvent.com/events/2013-microelectronics-reliability-qualification-working-meeting-mrqw-/event-summary-9fc30f05eda94bf09763e25c89463df5.aspx.

Microsemi's Commitment to Space

Space Forum Noordwijk (Holland) and Moscow (Russia) - November 19 & 21, 2013

Over 250 industry partners attended Microsemi's Space Forums held in Noordwijk, Holland and Moscow, Russia in November and the event was extremely well received and appreciated by all participants. These space forums are designed to provide a comprehensive view of the space market as it pertains to Microsemi offerings and to assist customers with understanding the key technology benefits.

Microsemi presented a systems view of product definition and development now employed within Microsemi, where we look to apply our system knowledge to help define integrated roadmaps to leverage our breath in applications.

Microsemi presented a very broad portfolio of technologies to help our customers design their products, updates on the most recent products and the depth of processes and capabilities now available for space, driving a very broad range of new products in the development pipeline.

Thank you again to our partners for presenting at this year's Space Forum who really added to the value for those in attendance.

For more information on the event please visit http://www.microsemi.com/spaceforum/sessions-europe2013 or email Sylvia.Keane@microsemi.com.

Merry Christmas from the Aerospace Team

We would like to take this opportunity to wish you and yours a very Happy and Peaceful Christmas and New Year.

We would also like to thank you for all your support in 2013 and we look forward to working with you in 2014.

Best Wishes
The Aerospace Team

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If you enjoyed reading this Space Brief you can register to receive your own personal copy, delivered directly to your inbox. Follow this link: http://www.microsemi.com/soc/interact/default.aspx?p=E402.

For more information on how Microsemi is serving the space market, please 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, please email me at SpaceBrief@microsemi.com or click on the “Feedback” link above. Thank you for your assistance in ensuring Space Brief continues to serve the space market and all employees.

Sylvia Keane
Marketing Executive, Aerospace and (Space Brief Editor-in-Chief)