Military EMBEDDED SYSTEMS

June 2014
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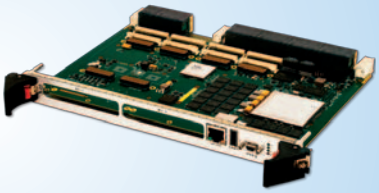

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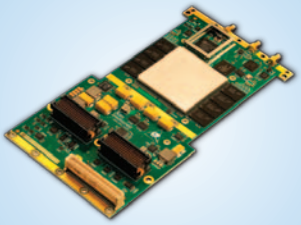

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ON THE COVER:

Top photo: Sentinel-1, the first of the European Space Agency's Copernicus satellites, will monitor aspects of Earth's environment, from mapping sea ice to detecting and tracking oil spills to monitoring movement in land surfaces. Photo courtesy of the European Space Agency (ESA)/ATG medialab.

Bottom photo: The molecular beam epitaxy process is one of the steps in producing Monolithic Microwave Integrated Circuits (MMICs) for Advanced Extremely High Frequency (AEHF)-protected satellite communication payloads at Northrop Grumman Aerospace Systems' semiconductor wafer fabrication facility in Manhattan Beach, CA. Photo courtesy of Northrop Grumman.

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What's in a name? Some company names are better than others

By John McHale, Editorial Director

Ever think about changing your name? Seriously, if you had a choice, would it be the one your parents gave you or would you prefer to pick your own when you are at the height of your powers and use the name that best represents who you are and/or what you do? Would your friends still talk to you if you insist on being called Teddy instead of Johnny? And what if 15 years later you decide to switch back to your given name? Would you still be the same Johnny?

Wives have been changing their surnames for centuries for marriage or at least hyphenating it with that of their spouse so they can maintain their personal "brand." Then if it doesn't work out they revert back to their maiden name. Embedded computing companies aren't really any different in that sense. When they merge with a larger or equal entity they change their names or become ABC Company, a subsidiary of such and such. Some change their name because their product line has expanded beyond what their name represents. Others change their names to take advantage of a hot trend or new technology like an open source operating system.

Which brings us to LynuxWorks in San Jose, CA. At the turn of this century they were known far and wide as Lynx Real-Time Systems, supplying real-time POSIX-based Real-Time Operating Systems (RTOSs) for military applications. Had quite a bit of success too, but they chucked their Lynx name to jump on the Linux bandwagon with a product called BlueCat Linux 1.0 as part of a suite of products called LynuxWorks, which obviously became the company name as well.

Others and myself thought they were crazy to abandon a strong brand in the steady, if niche, defense market. However, the promise of riches and Initial Product Offerings (IPOs) in much higher volume commercial markets led them and others to pursue profits from Linus Torvalds' brainchild. In an article titled "Linus Torvalds gives the military a new secret weapon" that I wrote back in 2000 for *Military & Aerospace Electronics* magazine, then Lynx Real-Time Systems CEO Inder Singh said Linux was "generating momentum due to the growing number of vendors porting their products to Linux," and that "Linux has the potential to develop a large market capacity." Singh later told me after the name change that other industry CEOs all thought that companies who pursued Linux would be on the fast track to IPOs.

"Fast-forward about 15 years later to 2014. The hoped-for IPO never happened and no other RTOS vendors rebranded themselves with Linux."

Fast-forward about 15 years later to 2014. The hoped-for IPO never happened and no other RTOS vendors rebranded themselves with Linux. However, the POSIX-based RTOS supplier still retained a product line mostly branded with the Lynx name and a loyal military customer base. So company leaders brought back the Lynx brand and re-named themselves Lynx Software Technologies.

The potential growth with a move toward Linux was too hard to ignore back then, says Robert Day, Vice President of Marketing at Lynx Software Technology. "As a POSIX/UNIX company we had to do it for fear of being eaten alive and left behind by the competition. However, today the Linux branding does not always mesh with a defense market where our customers know us by our proprietary Lynx product lines."

While the company name had become well known the last 15 years, it was time for a change, and as fortune would have it the Internet domain of www.lynx.com was still available, Day continues. "So the change, while a lot of work, could have been much more complicated if we had to rebrand our products to match the name." Going with Lynx should also "help us in growing our cyber security business" as open source products are not often synonymous with cyber security, he adds.

"The military still uses Linux, but what the Department of Defense gets concerned about is how to protect the stuff that surrounds Linux, so we've seen a lot of our Lynx Secure designs running Linux on top of Lynx Secure to take away potential backdoors, etc.," Day explains. "Now we separate using virtualization and the processor power is such that one board can have multiple OSs doing different jobs. Fifteen years ago you could only have one."

It is difficult to make money solely as a Linux company in the military embedded system market, Day continues. Red Hat has success in the embedded industry because of the familiarity of their desktop Linux solutions, he adds.

I asked Day if it was intentional that they and MontaVista Software had Linux product names back then that rhymed with Red Hat – BlueCat and Hard Hat respectively. "I wasn't here then, but I'm sure it's unlikely," he replied.

Hmmm, I think it quite likely was more than coincidental. Regardless, the change back to the Lynx brand was long overdue and still familiar. Nice play, Mr. Day.

Gaming chip changes mil/aero game

By Charlotte Adams

A GE Intelligent Platforms perspective on embedded military electronics trends

GTC – the Graphics Processing Unit (GPU) Technology Conference – used to be the preserve of the video gaming mavens, but as General Purpose GPU (GPGPU) computing has taken off in the wider world, attendees now hail from a far wider background. Lately these non-gamer aficionados have become even more excited. What's going on?

The answer is NVIDIA's new Tegra K1 System-on-Chip (SoC). This "superchip" combines a quad-core Central Processing Unit (CPU) with 192 parallel processing GPU cores. Intended for mobile devices such as gaming units, cell phones, and tablet computers, the Tegra scored an amazing 60 frames per second in the GFXBench at 1920x1080 resolution. But the new SoC's most compelling feature is that it can achieve this performance while consuming less than 10 watts of power.

What does that mean to non-gamers? Designers of High Performance Embedded Computing (HPEC) systems in the military/aerospace domain, for example, scent major benefits. Tegra K1's combination of high performance and small power appetite could open a wealth of new applications and bring vastly improved reconnaissance capabilities to small formations and individual soldiers. That's because its Size, Weight, and Power (SWaP) equation will tell most powerfully in the smallest platforms, which previously have been extremely limited in processing power.

Historically, the bandwidth of the downlink from an unmanned vehicle to its ground station has limited the vehicle's sensor capability. Why put a high-definition video sensor on a vehicle if the onboard processor could not crunch the sensor data fast enough to get information down the pipe to the user within tactical timelines? The performance limitation meant, for example, that instead of reducing sensor data to an area of interest, the whole image might have to be streamed down and be processed on the ground, adding latency to the process. The number of sensors and the resolution of the sensors were limited. If there were multiple sensors – such as a visible light and an infrared sensor – they might have to be used consecutively rather than simultaneously.

By the same token, however, if processor resources could be shrunk and their power requirement reduced, more could be achieved onboard within the downlink's bandwidth constraints. More sensors – higher-resolution sensors – could be added. This advanced processing technology could also be retrofitted to the underserved population of small platforms.

Game changer?

The Tegra K1 chip promises to enable these changes (see Figure 1). Its sub-10-watt power budget is an order of magnitude less than what is often required today for a GPU subsystem.

Figure 1 | NVIDIA's Tegra K1 promises to bring the high performance graphics processing capability of subsystems like GE's MAGIC1 to a new generation of smaller, lighter, more portable platforms.

An image processing system today, in a 3U VPX format, might require two cards: a single board computer card and a GPGPU card, burning a combined 100 watts. Tegra K1, however, could potentially consolidate that capability into a single 3U VPX board at a fraction of the power budget. The smaller batteries required at this power level would intensify the SWaP tradeoff for smaller platforms.

Algorithm agnostic

Unlike NVIDIA's predecessor Tegra3 mobile GPU chip, the Tegra K1's GPU cores are capable of being programmed via the CUDA model, which means that algorithms developed for applications running on more complex, power-hungry processing subsystems can be adapted to the simpler hardware. These include image processing algorithms such as stabilization, fusion, tracking, and ground moving target indicator.

GPUs have been attractive to mil/aero developers, especially since the invention of GPUDirect Remote Direct Memory Access (RDMA), a method of transferring sensor data directly from a data aggregator like an FPGA to the GPU memory. Under GPUDirect the CPU still initiates the request and collects the results but has much less work to do in transferring the data to GPU memory. A three-step data transfer process is condensed to two steps, freeing the CPU to manage more GPGPUs and accelerating the data processing cycle.

While these developments aren't earth shaking for large platforms with power to spare for image processing, the implications of the new chip for small platforms are likely to have a significant and lasting effect, benefiting the most vulnerable and underserved users in the field.

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Bringing enterprise-class Ethernet networking to rugged deployed systems

By Mike Southworth

An industry perspective from Curtiss-Wright Defense Solutions

As the demand continues to grow for network connectivity all the way out to the individual warfighter at the network's edge, aerospace and defense system designers must choose between alternative approaches for architecting their Ethernet switch and router environment. One option, the least costly at the outset, is to "roll your own" Linux router to provide basic routing functionality. One downside is that the Linux router can't supply advanced enterprise-class features that are becoming increasingly desirous, such as mobile technologies.

One of the industry leaders for enterprise-quality networking is Cisco Systems. According to the company's market research, more than 69 percent of all Ethernet switches worldwide are Cisco-based. What's more, Cisco supplies 51 percent of all network routers. There are suppliers of "Cisco-like" or "industry-standard-like" network technologies that can address unique rugged system requirements unmet with current rugged Cisco offerings, such as very high Gigabit or 10 Gigabit Ethernet (GbE) port counts, but they bring the added task of managing software from a non-standard vendor. Sticking with Cisco provides a familiar interface. Because there are more than 10,000 Cisco networking academies in 165 countries where every year more than 700,000 students get trained and certified to support, maintain, and configure Cisco equipment, the acquisition of experienced technicians is greatly eased. With thousands of certified Cisco network engineers available to support an Ethernet environment, the U.S. government has shown a preference for those Cisco technologies that are suitable for tactical use.

Because Cisco is the de facto industry standard for Ethernet networks, it's logical for system designers to leverage Cisco's technology in defense and tactical edge applications. Responding to the demand for mobility at the network edge, Cisco now supports voice services (for example, Voice over IP (VoIP)) and related applications in their embedded routing products. In addition to the cost and support advantages associated with deploying enterprise-compatible networking in tactical environments, other significant advantages include the benefits derived from having the same familiar Cisco IOS look and feel, configuration, and command files.

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Headquartered in Geneva, Switzerland, CES - Creative Electronic Systems SA has been designing and manufacturing complex high-performance avionic, defense and communication boards, subsystems and complete systems for thirty years (such as ground and flight test computers, ground station subsystems, radar subsystems, mission computers, DAL A certified computers, video platforms, as well as test and support equipment). CES is involved in the most advanced aerospace and defense programs throughout Europe and the US, and delivers innovative solutions worldwide.

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Figure 1 | Curtiss-Wright's Parvus DuraMAR 5915 is a rugged COTS Cisco IOS-managed mobile router integrated with Cisco's 5915 Embedded Services Router (ESR) card in a rugged chassis.

Compared to homegrown or Cisco-like alternatives, the Cisco IOS software takes a "kitchen sink" approach and includes all the features a network architect may want, and then some. For example, Cisco Embedded Services Routers include features for mobile applications that one isn't likely to find in a traditional network switch designed for use in a fixed network. One advanced enterprise networking capability built into Cisco IOS is Communications Manager Express, which supports in-the-field voice or video conferencing. Another attractive enterprise feature is support for Mobile Ad Hoc Networking (MANET), which enables a router to deploy a self-configuring, infrastructure-less network and connect to various wireless links while in motion. In the *Military Embedded Systems*' February 2011 article "Top technologies for the warfighter," Radio Aware Routing (RAR) was named as one of the most desired technologies. RAR technologies is integrated into MANET capabilities in Cisco mobile routers. It enables a user to maintain high quality video or voice capabilities even if the quality of the radio is highly variable. It looks at the quality metrics of the network and anticipates the lowest cost and strongest routes. If the signal is fading or failing it enables the router to react in milliseconds instead of waiting for the link to timeout, which would take tens of seconds to reconnect to another link.

Another key reason that makes Cisco network technology attractive to the government is the investment the company makes in Information Assurance (IA) certifications to ensure that its products don't introduce vulnerability into the network. Cisco puts its products through a number of government-sponsored IA compliance tests, such as FIPS 140-2, Common Criteria Evaluation, and the DISA Approved Product List (APL).

There are a variety of Cisco partner Commercial-Off-The-Shelf (COTS) hardware vendors in the embedded market today that offer Cisco technology in a rugged form factor. While some offerings aren't rugged enough for aircraft or ground vehicle applications, with packaging better suited for 19" rackmount naval or ground station applications or backpack-based communication portable kits, some vendors provide Cisco technology in the Size, Weight, and Power (SWaP)-optimized form factors rugged enough to be used in extreme dust, water immersion, high altitude, and extreme shock and vibration environments.

One example of a rugged Cisco mobile router is Curtiss-Wright's Parvus DuraMAR 5915 router (see Figure 1). This mobile IP router LRU is integrated with Cisco's 5915 Embedded Services Router (ESR) card in a rugged chassis designed for unmanned vehicle installations in harsh environments. It features dual WAN uplinks and is available as either a standalone 5-port network router or with an integrated GbE switch.

Mike Southworth
Product Marketing Manager, Curtiss-Wright Defense Solutions
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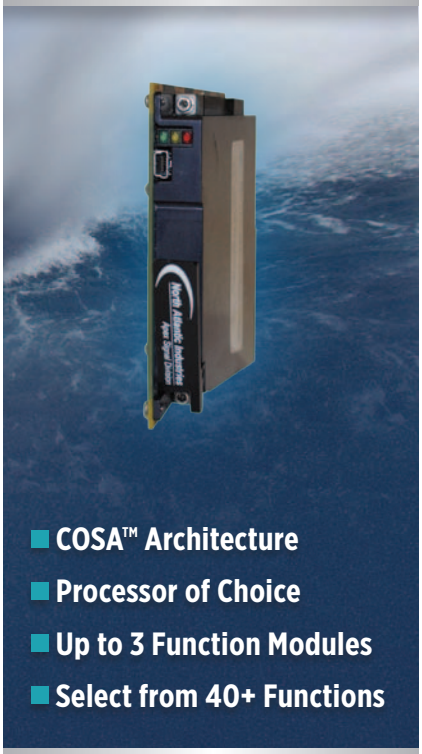

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By Amanda Harvey, Assistant Editor

NEWS

Spacecraft for next Mars mission set to begin construction

Lockheed Martin engineers have begun construction of InSight, the Mars mission's spacecraft, which will study how Earth-like planets form. InSight is set to launch in the spring of 2016 and touch down on Mars about six months later. The stationary lander's robotic arm will then use surface and burrowing instruments to explore the planet's interior.

The next milestone for the program is delivery of the hardware to system integration starting in November 2014. InSight will adapt a Lockheed Martin spacecraft design from the previous NASA Phoenix Mars Lander, and will investigate a different aspect of planetary history with instruments that have never been used on Mars. The mission will look at how Earth and other rocky planets developed their layered inner structure of mantle, core, and crust, and then gain data about those interior zones.

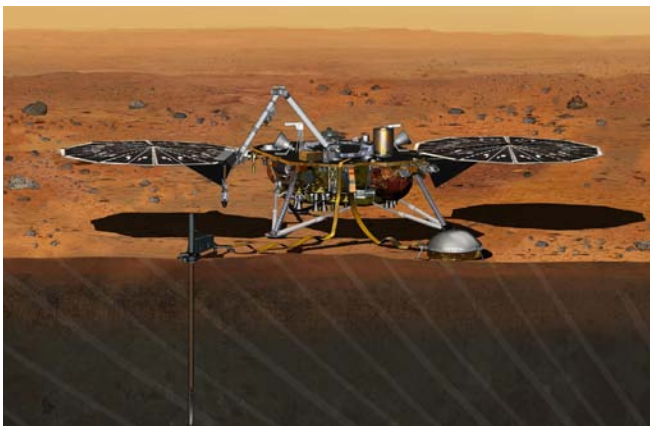

Figure 1 | An artist rendering of the InSight stationary lander, which will burrow into Mars' surface to investigate the planet's interior structure. Photo courtesy of NASA.

Lockheed Martin Kestrel, Indago no longer under ITAR

Lockheed Martin officials announced that the Kestrel autopilot and a version of the vertical takeoff and lift Indago system are no longer restricted by International Traffic in Arms Regulations (ITAR); they are now controlled under the Export Administration Regulations. The Kestrel 3.0 autopilot integrates data from GPS and a suite of sensors to create an accurate estimate of the vehicle's location and orientation. Data is sent to the motors to position and stabilize the vehicle and payload at a high rate and with low latency. Lockheed Martin submitted a commodity jurisdiction request to obtain approval for exports, which led to the Kestrel 3.0 autopilot and Indago system's availability for sale to international customers.

FAA to expedite limited commercial UAS operations

Jim Williams, FAA Manager of Unmanned Aircraft System Integration, announced at AUVSI Unmanned Systems 2014 in Orlando, FL that the FAA is currently working with several industries to expedite limited commercial operations of unmanned systems before the rules are finalized. Williams says the FAA is expected to approve limited commercial Unmanned Aircraft System (UAS) operations for powerline inspection, precision agriculture, flare stack inspection, and filmmaking. These specific industries approached the FAA for expedited approvals. These industries represent the examples of commercial potential that were featured in the AUVSI 2013 economic report. According to the report, in the first decade following integration, the UAS industry would create more than 100,000 jobs and $82 billion.

First flight for Boeing AH-6i attack/recon helicopter

The Boeing AH-6i light attack/reconnaissance helicopter was flown in its product configuration for the first time during a recent test flight. Boeing pilots flew the aircraft for approximately 20 minutes at low speeds in forward, rearward, and sideward flight. Future tests are soon to follow to improve the helicopter's attack capabilities and close-air support. The AH-6i is an advanced variant of the AH-6M helicopter operated by the U.S. Army Special Operations Forces, and is designed to provide close-air support for land-based forces and also to serve as an attack platform for abolishing enemy armored vehicles, tanks, and fortifications.

Figure 2 | The Boeing AH-6i helicopter is designed to serve as an attack platform for abolishing enemy vehicles. Photo courtesy of Boeing.

Sikorsky to implement Matrix Technology on Black Hawk helicopters for autonomous capabilities

Sikorsky Aircraft officials announced at the AUVSI show that the company intends to develop its first product featuring Matrix Technology on a retired UH-60A Black Hawk helicopter, to be converted into an aircraft with autonomous capabilities. Sikorsky plans to utilize the Matrix Technology and Manned/Unmanned Resupply Aerial Lifter (MURAL) autonomy programs to deliver a new level of mission flexibility. Refurbishing retired Black Hawks will reduce costs in the long term. The autonomous Black Hawk will employ the strength to lift as much as 9,000 pounds, will have the flexibility of internal and external cargo capability, and the productivity of high cruise speeds. The design of a prototype autonomous system has been underway for over a year, and the introduction of the first refurbished Black Hawk helicopter will begin later this year.

Figure 3 | Retired Black Hawk helicopters get an autonomous makeover. Photo courtesy of Sikorsky Aircraft.

UAS operations in Australia to be studied by Northrop Grumman, RMIT University

Northrop Grumman officials are joining hands with the Royal Melbourne Institute of Technology (RMIT) University, to look at airworthiness requirements for operating UASs in Australia. The collaboration will involve developing solutions for safely and efficiently operating UASs in all airspace environments, with a specific focus on larger systems that are the size of small commercial jets. In 2001, Northrop Grumman's Global Hawk UAS became the first unmanned, powered aircraft to cross the Pacific Ocean in a 23-hour flight from Southern California to Australia. RMIT's Sir Lawrence Wackett Aerospace Research Centre is dedicated to aerospace in Australia and has expertise in the design, manufacture, and certification of advanced aerospace systems.

Ground-based laser takes out small boats in demonstration

Lockheed Martin engineers recently tested a prototype laser system – the Area Defense Anti-Munitions (ADAM) system – which disabled two boats at a range of about one mile. These were the system's first tests against maritime targets. The transportable, ground-based system is being developed to demonstrate a practical, affordable defense against short-range threats, such as Qassam-like rockets, UASs, and small boats.

In less than 30 seconds, the ADAM system's high-energy laser burned through multiple compartments in the rubber hull of the military-grade small boats. Lockheed Martin engineers previously demonstrated the system's capabilities for countering representative airborne targets in flight; the system can precisely track moving targets at a range of more than 3.1 miles, and its 10-kilowatt fiber laser can engage targets as far as 1.2 miles away. The ADAM design combines commercial hardware components with Lockheed Martin's laser beam control architecture and software to provide the performance needed for close-in threats, along with an almost unlimited "magazine" at a low cost per engagement.

ATK, KADDB deliver first modified CASA-235 light gunship to Jordan

ATK, in cooperation with King Abdullah II Design and Development Bureau (KADDB), has delivered the first modified CASA-235 light gunship aircraft to the Hashemite Kingdom of Jordan. ATK began the U.S.-based flight and gun test program in 2013, to validate and test the performance of the gunship, including sensor and weapons testing. ATK was then awarded a contract by KADDB to modify two of Jordan's CASA-235 transport aircraft into highly capable and cost-effective special mission aircraft. Modifications included the installation of aircraft self-protection equipment, an electro-optical targeting system, a laser designator, a Synthetic Aperture Radar (SAR), and an armaments capability that provides sustained firepower.

Figure 4 | ATK modified Jordan's CASA-235 transport aircraft into a special mission aircraft. Photo courtesy of ATK.

Rockwell Collins showcases new FMC-4000 mission computers at ILA Berlin Air Show

Rockwell Collins launched its FMC-4000 series of flight and mission computers at the ILA Berlin Air Show, from May 20-25. The series is available for fighter, tanker, trainer, transport, rotary-wing, and unmanned systems aircraft.

The FMC-4000 series uses the latest multicore processor and hardware, in addition to accelerated signal processing, compression functions, and video. The computers are suitable for dual-use applications and comply with both commercial and military environmental requirements. "Our FMC-4000 flight and mission computers seamlessly connects systems and applications on board, allowing pilots to control overall aircraft functionality," says Claude Alber, Vice President and Managing Director of Europe, the Middle East, and Africa, for Rockwell Collins.

The FMC-4000 series features flexibility and scalability across various platforms, delivering high-performance functionality while decreasing Size, Weight, Power, and Cost (SWaP-C).

Figure 5 | The FMC-4000 series of flight and mission computers comply with both commercial and military requirements. Photo courtesy of Rockwell Collins.

Intel's 8XC196 family re-introduced by Rochester Electronics

Rochester Electronics officials announced that the company is now a fully-authorized continuing source for the Intel 8XC196 family of microcontrollers. These MCUs, introduced in 1982 as the Intel MCS-96 family, are most commonly used in modem, motor control, printer, and pattern recognition applications within embedded systems. In 2007 Intel discontinued this family of microcontrollers, but Rochester Electronics acquired the intellectual property of these devices to continue supporting Intel's customer base for this specific product line. Through its Extension-of-Life (EOL) programs, Rochester Electronics currently offers this family in a variety of packages, temperature ranges, and speeds, including military versions for the 80C196KB, 87C196KC, and KD. All devices manufactured by Rochester Electronics are replications of the original semiconductor devices, featuring the exact form, fit, and function.

HALE upgrade program to use Curtiss-Wright subsystems

Curtiss-Wright Defense Solutions won a contract from Northrop Grumman to deliver the Integrated Mission Management Computer (IMMC) for use in Northrop Grumman's High Altitude, Long Endurance (HALE) Enterprise IMMC upgrade program.

The HALE Enterprise upgrade designates a new baseline architecture for HALE UAS platforms to cut down maintenance and inventory costs, ease ongoing obsolescence management, and increase operational availability for Global Hawk platform derivatives. The dual redundant architecture IMMC brings fault-tolerant flight control for the Global Hawk UAS and interfaces with all necessary sensors to enable safe aircraft flight within mission requirements. Curtiss-Wright engineers are providing two onboard flight subsystems – the IMMC, which controls the aircraft's flight, and the Advanced Mission Management System (AMMS), which communicates with the onboard sensors and relays information back to the ground station.

Ruggedized briefcase receiver for unmanned systems

Integrated Microwave Technologies (IMT) highlighted its new Briefcase Receiver (BCRx) at the AUVSI show. The BCRx is a diversity receiver/monitor integrated into a ruggedized, portable IP66-rated briefcase. BCRx ensures reliable reception of COFDM-modulated microwave transmissions via maximal-ratio combining technology that uses its integrated dual antennas to identify and quickly switch over to the best signal received. It also contains an AES decryption circuit and a built-in MPEG-4/MPEG-2 decoder, and can receive either HD or SD video transmissions and display them on a built-in LCD monitor. IMT's BCRx also includes 500 GB of built-in solid-state storage and field-replaceable battery packs that enable a minimum of three hours of runtime. It can also be plugged into a vehicle's 12V power outlet or a stand-alone 120/240VAC power supply. The BCRx is well-suited for public security monitoring and video tracking applications.

Figure 6 | The BCRx is a diversity receiver/monitor integrated into a ruggedized, portable IP66-rated briefcase. Photo courtesy of Integrated Microwave Technologies.

QUALIFIED TO PERFORM

Effective tactical Communications on the Move (COTM) depends on proven, secure Mobile Ad Hoc Network (MANET) routing technologies. With Parvus' DuraMAR 5915, tactical radios and satcom gear now interface with a MIL-STD qualified, SWaP-optimized mobile router/switch subsystem. This integrates Cisco Systems IOS management, information assurance, and mobile IP routing capabilities.

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U.S. rolls out big export policy changes for satellite industry

By Sally Cole, Senior Editor

The U.S. State Department and U.S. Department of Commerce are making big changes to long-standing export control policies as part of an effort to improve the international competitiveness of the U.S. space industrial base.

Sentinel-1, the first of the European Space Agency's Copernicus satellites, will monitor aspects of Earth's environment, from mapping sea ice to detecting and tracking oil spills to monitoring movement in land surfaces. Photo courtesy of the European Space Agency (ESA)/ATG medialab.

For many years, the U.S. space industrial base has faced challenges competing for international contracts – forced to compete against foreign manufacturers not constrained by U.S. export controls. To move beyond this roadblock, the U.S. space industry and government are collaborating to fundamentally change the nature of U.S. export controls on most commercial, scientific, and civil satellites, as well as related technology such as radiation-hardened Integrated Circuits (ICs).

On May 13, 2014, the U.S. Department of State amended the International Traffic in Arms Regulations (ITAR) to revise the spacecraft and satellite category of the U.S. Munitions List (USML) by more precisely describing the articles warranting control in that category and moving them to the U.S. Department of Commerce's Control List (CCL).

For national security reasons, all items on the USML require the U.S. Department of State's authorization prior to export. Until now, this has made it extremely difficult for U.S. manufacturers of spacecraft and satellite parts and components to compete in the international market.

The U.S. military relies on the commercial satellite industry to manufacture its military satellites and systems, according to the Satellite Industry Association (SIA; Washington, D.C.; www.sia.org), while commercial U.S. satellite owners and integrators provide 80 percent of the Department of Defense's (DoD's) communications.

In 2010, the DoD and Department of State published a report for Congress, known as the "1248 Report," which assessed the risks of removing non-satellites and related components from the USML. The report concluded that keeping non-critical satellites and related components on the USML and monitoring low-risk launch activities provides only limited national security benefits.

The 1248 Report states, in part: *"This practice places the U.S. space industrial base at a distinct competitive disadvantage when bidding against companies from other advanced satellite-exporting countries that have less stringent export control policies and practices. Transferring select items from the USML to the CCL would allow for controls consistent with other technologies and help enhance the competitiveness of the U.S. space industrial base, while continuing to protect U.S. national security needs. It would also provide the flexibility needed to apply U.S. export control personnel and resources to higher-priority issues, increasing protection of those items that do provide the U.S. with significant military or intelligence advantages."*

The 1248 Report also determined that the U.S. is the only space-faring nation that controls all commercial satellites and related items – including technology – as munitions items.

remote-sensing satellites with high-performance parameters; any spacecraft parts, components, accessories, attachments, equipment, or systems not specifically identified in the revised category; and most radiation-hardened microelectronic microcircuits.

The changes to the export controls on radiation-hardened microelectronic microcircuits take effect June 27, 2014, while the rest begin November 10, 2014.

A key companion rule, published by the U.S. Department of Commerce's Bureau of Industry and Security (BIS) on the same day as the Department of State's ITAR revision, enables satellites controlled by the CCL that use certain parts and components controlled by the USML to remain CCL-controlled, if certain conditions are met. It also removes certain spacecraft from the USML, while supporting the U.S. National Space Policy by creating conditions that allow the U.S. government to more easily

To put the financial impact into perspective, U.S. manufacturers lost approximately $21 billion in satellite revenue during 1999 to 2009, according to estimates by the Aerospace Industries Association (AIA; Arlington, VA; aia-aerospace.org), once USML controls were applied to commercial satellites.

The satellite industry is now poised for tremendous growth, with AIA predicting that the international market outside the U.S. for satellite manufacturing and launch services through 2021 will reach $132 billion – thanks to developing markets in South America and the Middle East, which are experiencing steady growth.

This means it's never been more critical for U.S. companies to be able to compete in the international market. In a move to make it easier, several key items are being removed from the USML, including: communication satellites that don't contain classified components;

host payloads on commercial satellites (see Figure 1.)

Combined industry and government effort

Most people would be surprised by the many factions of government that came together to make these export rule changes happen, according to Chuck Tabbert, Vice President of Sales and Marketing for Ultra Communications Inc. (Vista, CA; www.ultracomm-inc.com), a company that creates fiber optics for harsh environments.

"There were several meetings with the industry during the writing of the 1248 Report, so they got a good sense of what's going on and what needed to change from the business community," he says. "The entire food chain of industry associations lobbied for these changes."

What was the first indication that the export rule changes would actually happen? "It was the move by Congress giving the President the authority to take satellite technology and transfer it from the USML to Commerce," Tabbert says.

Congress had to return to the President the authority to determine the export control jurisdictional status of satellites and related items before any of the other changes could proceed.

"Once the President decided to go ahead with export reforms, the Department of State and Department of Commerce worked closely on the changes, and handled it well. This gave Congress the confidence that we weren't trying to move toward decontrol – it was simply a shift of control."

Another giant hurdle was, of course, the DoD's finding in the 1248 Report that moving generic satellite technology from State to Commerce was a low risk to national security. "If we hadn't gotten it in writing for Congress, the entire export reform initiative would have been sunk," he adds.

Immediate implications of the rules

The rule changes are significant for the U.S. companies involved, in large part because the amount of business coming from the U.S. military has been steadily declining.

"To continue to be profitable, these companies need to be able to put more money into R&D, so this means they need to be able to sell abroad and compete as freely in international markets as their non-U.S. competitors," says Marwa M. Hassoun, an associate who specializes in export and import regulations for Arent Fox LLP (Los Angeles, CA; www.arentfox.com).

Allies have been buying U.S. satellite-related parts for 30 years, and many have already established relationships with many manufacturers. But the export policy changes should now make it much easier to obtain good quality parts at better prices than they could achieve with in-house manufacturing.

"Most satellites are in a one-year build cycle, so we might see the full effects of the new policy within two to three years," Tabbert notes. "It could be immediate, based on existing relationships, but my sense is that it'll be more like two to three years."

This makes it important for U.S. manufacturers – especially those within the IC realm – to begin marketing right away, as Tabbert points out. He expects an immediate increase in demand for space-qualified ICs in the European, Japanese, and Brazilian markets.

Learning curve

The satellite industry has been subject to ITAR for so long that a learning curve is to be expected. There are also certain license exceptions now available, so there will be a period of time when everyone needs to learn how to use exemptions and do licensing under the BIS's Export Administration Rules (EAR) – and this may be a significant challenge.

The EAR license exception, Strategic Trade Authorization (STA), eliminates the license requirement for transfers to or among the 36 countries specifically designated for the exception (see Figure 2).

"Manufacturers will be able to use the Strategic Trade Authorization Exemption that was written for the Department of Commerce, which essentially allows us to ship – with a little bit of paperwork involved – satellite technology from the U.S. to 36 countries," Tabbert says. "They, in turn, can now ship within the group of 36 without being required to request U.S. permission."

For those struggling with the export policy changes, Hassoun recommends

Further reading on export issues

To view the State Department's revised rules for the satellite industry, visit http://1.usa.gov/1iQJ897.

To view the Commerce Department's revised rules for the satellite industry, visit http://1.usa.gov/1g3lK9e.

To view the 1248 Report to Congress, visit http://www.defense.gov/home/features/2011/0111_nsss/docs/1248_Report_Space_Export_Control.pdf.

For more on last year's revisions affecting the defense industry, visit http://bit.ly/1aDPt5V.

To see the latest ITAR fines levied by the State Department, visit www.pmddtc.state.gov/compliance/consent_agreements.html.

To read "Export compliance in 15 steps" by Kay Georgi of Arent Fox LLP, visit http://bit.ly/1jNPR4a.

To purchase the "Handbook of Export Controls & Economic Sanctions," published by the American Bar Association's (ABA's) Export Controls and Sanctions Committee and co-edited by Georgi and Paul Lalonde, visit http://bit.ly/10FDGtN.

Figure 1 | Further reading on export issues.

Authorized countries for export of satellite technology

Countries authorized for Export Administration Rules (EAR) license exception are listed within the 740.20 License Exception Strategic Trade Authorization (STA), which states:

(1) Multiple reasons for control. Exports, re-exports, and in-country transfers in which the only applicable reason(s) for control is (are) national security (NS); chemical or biological weapons (CB); nuclear nonproliferation (NP); regional stability (RS); crime control (CC), and/or significant items (SI) are authorized for destinations in or nationals of Argentina, Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, or the United Kingdom.

(2) Controls of lesser sensitivity. Exports, re-exports, and in-country transfers in which the only applicable reason for control is national security (NS) and the item being exported, re-exported or transferred (in country) is not designated in the STA paragraph in the License Exception section of the ECCN that lists the item are authorized for destinations in or nationals of Albania, Hong Kong, India, Israel, Malta, Singapore, South Africa, or Taiwan."

Countries still proscribed under the ITAR from doing business with U.S. satellite suppliers are:

Afghanistan, Belarus, Central African Republic, Cuba, Cyprus, Eritrea, Fiji, Iran, Iraq, Cote d'Ivoire, Lebanon, Libya, North Korea, Syria, Vietnam, Myanmar, China, Haiti, Liberia, Rwanda, Somalia, Sri Lanka, Republic of the Sudan (Northern Sudan), Yemen, Zimbabwe, Venezuela, and the Democratic Republic of the Congo.

Figure 2 | List of countries proscribed for export of satellite technology, and those still proscribed under ITAR.

"attending an event with others experiencing the same challenges. A huge overhaul of a significant set of regulations doesn't happen every day. Learning by attending conferences and seminars – especially ones hosted by the Commerce Department's Bureau of Industry and Security – will be helpful to companies both large and small."

Avoid enforcement actions

Everyone will need to get up to speed quickly and continue working to avoid enforcement actions, which Hassoun points out will be a continuing theme related to maintaining ITAR authorizations and agreements.

"If you obtain authorizations from the State Department, be sure that the people who actually need to live under them understand the limits to ensure they don't exceed them – whether it involves exporting or providing defense services not under the scope of the agreement or exceeding its authorized value," Hassoun says. "A lot of work needs to be done to manage those authorizations, and several companies have been penalized recently. It's critical to stay on top of it, because other companies are

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reluctant to do business with noncompliant companies."

If you repeatedly show up on the State Department's radar, it can be detrimental to business. "Giving a U.S. facilities tour to a People's Republic of China delegation, for example, may not go unnoticed," she notes.

The more mistakes a company makes, the more closely they'll be watching, "because it's a strong indicator that you're not in compliance with U.S. export rules," explains Hassoun. "The government's goal is to ensure that U.S. national security interests are maintained and enforced, since these companies are working on technologies and products considered sensitive to national security."

Unintended consequences?

Again, these export policy changes are rewriting rules that have been in place for 30 years, so it's possible that unintended consequences may emerge.

While the Department of State says it believes that "substantial national security benefits will flow from the changes to the controls on spacecraft and related items," it acknowledges that further analysis is warranted for control thresholds for remote-sensing satellites.

"The industry is working to determine whether or not anything is covered now that wasn't before," Tabbert says. "Also, is it too difficult to understand how to use the license exemptions now?"

Another key question – still to be determined – is what do our allies think of the new rules? "The international space community may be a little leery because this is a big step for the U.S., and they need to trust that we're not going to revert back to the way things were," Tabbert notes.

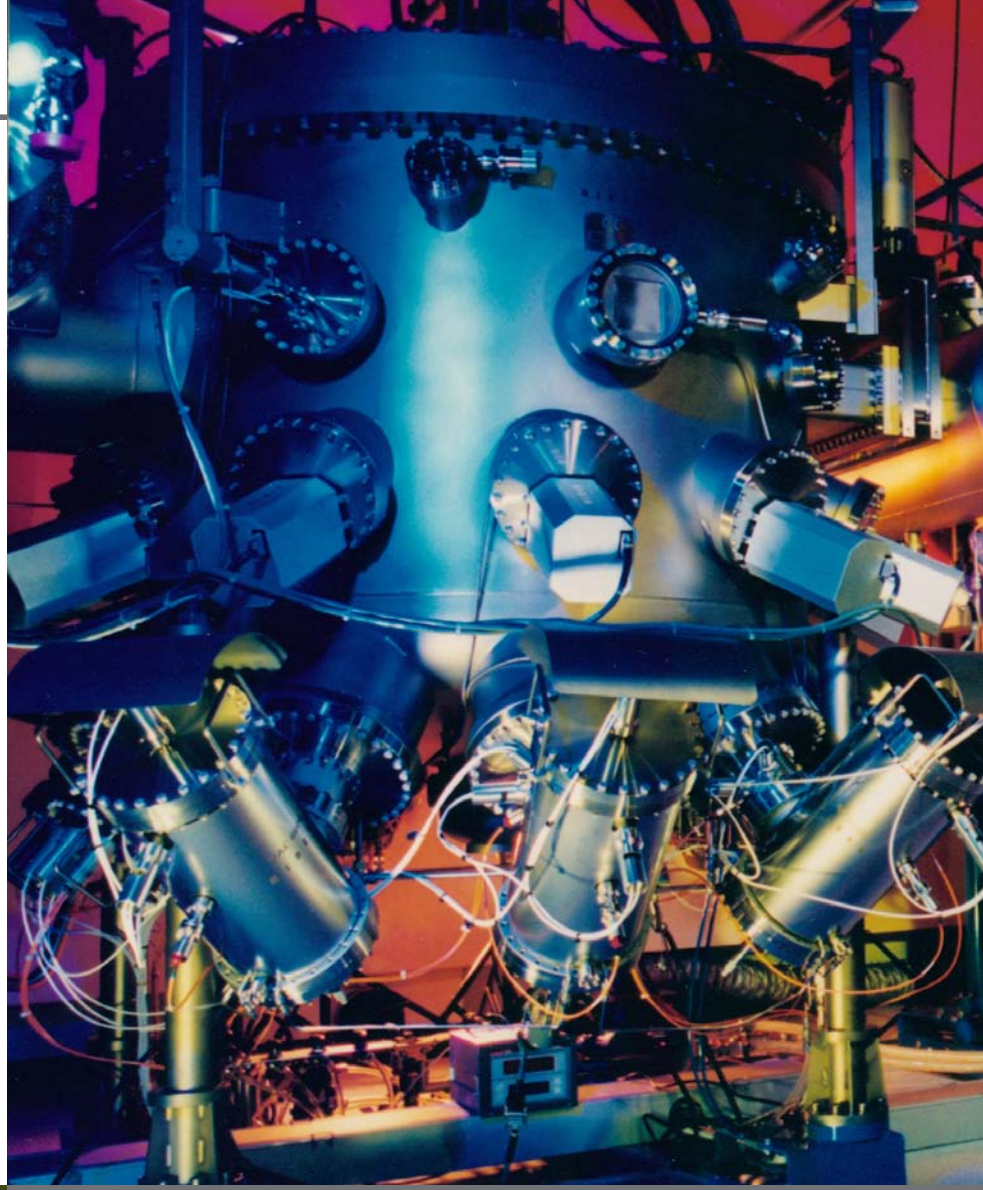
If consequences emerge as a result of the changes, a process is in place to deal with them. "Things will inevitably come up, and hopefully this process will work in the future if we need to make further changes," he adds. **MES**

TRENDS IN RADIATION-HARDENED ELECTRONICS

Budget cuts pressuring rad-hard designers to maintain quality while cutting costs

By John McHale, Editorial Director

A lack of new programs and delayed funding for others has created a demand in military space circles to extend the life of platforms and look for ways to reduce funding in less critical systems by pursuing more commercial parts and manufacturing processes. Meanwhile, high-speed processors are creating thermal management challenges for radiation-hardened Integrated Circuit (IC) designers.



The molecular beam epitaxy process is one of the steps in producing Monolithic Microwave Integrated Circuits (MMICs) for Advanced Extremely High Frequency (AEHF)-protected satellite communication payloads at Northrop Grumman Aerospace Systems' semiconductor wafer fabrication facility in Manhattan Beach, CA. Photo courtesy of Northrop Grumman.

Budget constraints put in place by military leaders on Earth over the last few years are finally affecting the designs of satellites and other spacecraft at the component level. The long life cycles of space products typically lag behind terrestrial systems by about two to five years just due to the rigorous qualification requirements for electronics in the high radiation environments of space. The uncertainty about what will be funded in the long run is also making it difficult for suppliers to plan future development strategies.

While some programs such as NASA deep space missions and manned spacecraft platforms will still require the utmost in radiation-hardening of their electronic components, military leaders are crunching numbers to see where they may able to get by with less protection in less critical applications. This puts pressure on radiation-hardened (rad-hard) electronics suppliers to find ways to meet these cost reduction demands while maintaining the reliability of their parts for space missions.

"The overall market is down from the last couple of years primarily due to the poor financial situation in the U.S. and Europe," says Larry Longden, Vice President and General Manager for Microelectronics at Maxwell Technologies in San Diego, CA. "This situation has led the U.S. to cut most major space programs and the associated new technology developments. This will have a long-term negative impact on the U.S. space market."

"We are seeing related rad-hard budget pressures for military space satellites," says Siobhan Dolan, Vice President of Business Development, Commercial Air/Space at Microsemi Corp. in Aliso Viejo, CA. (See Figure 1.) "They want longer life out of their existing designs as new funding for new programs is reduced or delayed. In the past, designs were typically required to last for 15 years, but now military program managers want to extend them as long as 18 years. That puts pressure on the component and system suppliers to guarantee technology can reach those expectations, particularly for military systems looking for an extension of legacy designs. The component manufacturers need to provide a higher level of radiation guarantee and prove it."

"Sequestration is still in place and funding for many programs is being delayed," says Doug Patterson, Vice President of Military & Aerospace

Figure 1 | The GPS III satellite from Lockheed Martin makes uses of radiation-hardened electronics for its payload and control systems. Photo courtesy of Northrop Grumman, whose Astro Aerospace business unit supplies self-deploying, monopole JIB antennas for the satellite.

Business Sector at Aitech Defense Systems in Chatsworth, CA. "Many of the big primes are buying components for prototyping designs via their internal research and development dollars. Classified programs are still steady, with many programs let years ago moving into production. Full production essentially means one or two satellites."

NASA funding also is not expected to increase for some time. The President's Fiscal Year 2015 total budget request for NASA – $17.460 billion – is essentially flat from last year's request of $17.646 billion in 2014. It is not forecasted to exceed $18 billion until 2019 when NASA expects it to be $18.169 billion.

Engineers at Aeroflex Microelectronics Solutions also are seeing activity in the classified markets as well as in commercial telecommunications satellites and civil platforms, says Tony Jordan, Vice President of Product Marketing and Applications Engineering at Aeroflex Microelectronics Solutions in Colorado Springs, CO. "Classified programs are moving along with good activity in hosted payloads, where a box rides on the satellite as a secondary payload. The hottest area for us is still our standard products such as microprocessors, memory, serial bus products, voltage supervisors, power conversion, etc.

"Commercial weather needs seem to be heading down the host payload approach as well, leveraging commercial satellites as host for weather instruments that will deliver data for forecasting models," he continues. "These instruments are built by commercial companies leveraging technology, developed by the government, to gather weather forecasting data. There are a couple initiatives in this area regarding instruments and hosted payloads."

"While [Low Earth Orbit] LEO missions may have more latitude in being able to accept lower level radiation performance, they typically have shorter lifetimes," Dolan says. "We see most of our high-tech military customers and Geosynchronous Earth Orbit (GEO) telecommunication missions require minimum 100 krad-type radiation performance guaranteed as mission life is typically getting longer."

"A communications satellite being sent up for 10 to 15 years still needs full space-qualified parts, but for shorter life platforms even NASA is looking to do more with less," Patterson says. NASA Jet Propulsion Laboratory (JPL) has been flying 30 krad Commercial Off-The-Shelf (COTS) boards in satellite experimental platforms for years, he adds.

Reducing costs while maintaining reliability

"The budget-constrained environment is forcing program managers to look closely at each program and try to be smarter about which really needs megarad or 100 krad protection and which ones might get by with, say, 30 krad protection such as unmanned platforms with shorter mission times," Patterson continues. "This can result in huge savings."

"I think there are two changes that are occurring in the market," Longden says. "First, programs are faced with reduced budgets which has led to many customers reducing the quality level of products that they are procuring for space systems. Second, due to reduced program budgets and the need to perform more data processing in space there has been an increase in the number of programs requiring higher processing performance such as is available from our SCS750 Single Board Computer (SBC)."

Figure 2 | VPT's SVR series products are qualified to 100 krad(Si) and 85 MeV-cm2/mg SEE performance with displacement damage performance.

"I think the most demand is for lower radiation [like VPT's] SV series because of the cost differentials," says Leonard Leslie, Manager of Space Programs at VPT in Blacksburg, VA. "When some customers really sit down and run the numbers they discover they don't need higher radiation levels for total dose and SEE performance in certain applications. However, not every application or program falls in one camp or the other. For example, unlike general satellite applications, launch vehicles have no total dose requirements, but have a high single event requirement. Each application and mission is different.

"We still get orders for programs with high radiation requirements, but the majority fall typically in the 30 krad(Si) range. Our SV series devices are generally qualified to 30 krad(Si) and we do offer models that are not read-tested for prototyping. For full up requirements we have the SVR families qualified to 100 krad(Si) and 85 MeV-cm2/mg SEE performance with displacement damage performance. Those parts are tested for high radiation environments and designed with more stringent worst-case analysis because in general they are used for longer missions in high-radiation environments." (See Figure 2.)

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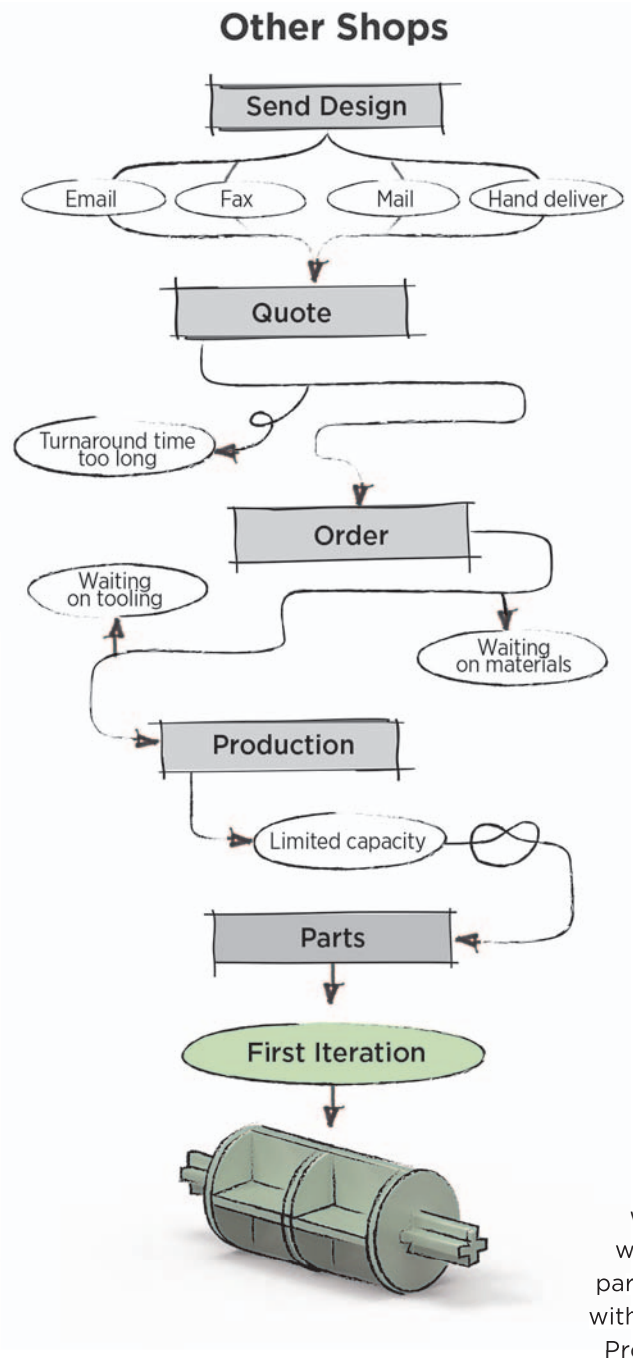

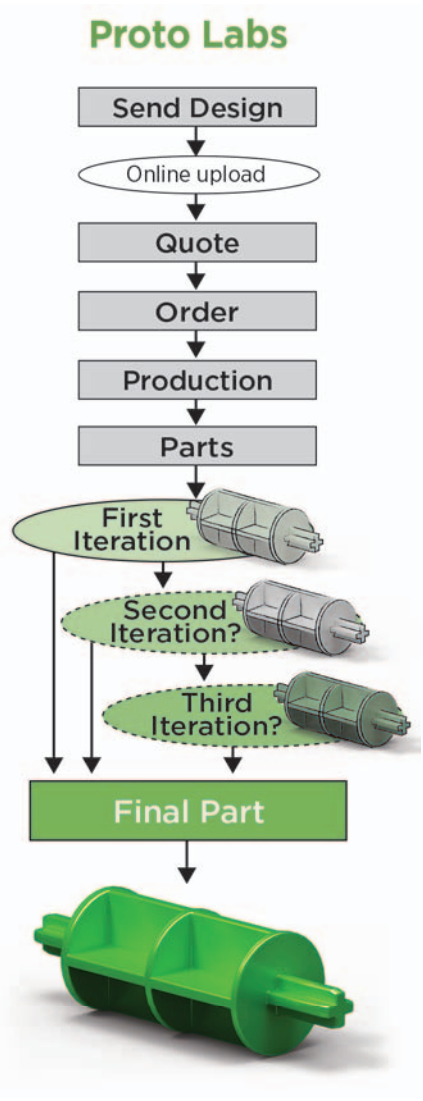

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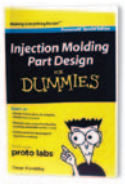

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Aitech's next generation SP0 3U CompactPCI product now features a PowerPC 8548 processor. Radiation testing on the board has been completed and the SP0 is now qualified for 100 krad(Si) LEO, Medium Earth Orbit (MEO), and GEO. Testing has begun for deep space mega-rad environments, Patterson says. "The next generation of the company's computer for space applications will have a serial VPX architecture with a processor that is yet to be determined. It will be a multicore processor, but there is still work to do as well as some preliminary testing. Patterson says he expects the product to be available sometime in 2015. The 3U form factor is the perfect size for the growing number of small satellite applications and their payloads, he adds.

For the next generation of Maxwell's space SBC product "we are currently evaluating market needs for high-speed processing, high-speed data throughput, and standardization efforts to select the next generation of high-speed interfaces," Longden says. (See Figure 3.) "We are currently developing a new model of our SCS750 that will include two full speed SpaceWire ports capable of simultaneous, bi-directional communication. In the component area we have just introduced new products" in Maxwell's Rad-Pak technology: the 512Mb NOR Flash; a 16-bit, 200kSPS, analog-to-digital converter; a 16-bit, 30MSPS, digital-to-analog converter; and later this year will have prototypes ready for the company's new 256Gb NAND Flash product. A flight-level NAND product will be available early in 2015.

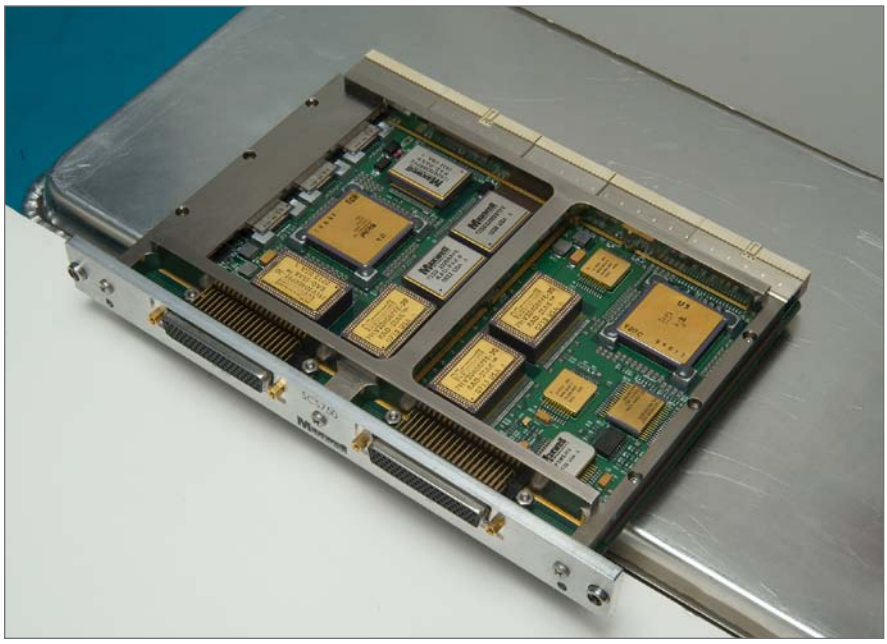

Figure 3 | Maxwell's SCS750 single board computer will include two full speed SpaceWire ports capable of simultaneous, bi-directional communication.

Uncertain future

Constrained economics combined with upcoming changes in political leadership and philosophy for investment in space technology also makes it hard to forecast where the opportunities will be beyond the next couple years.

"This market definitely is not real-time tied to the budgets because often the programs are funded well before any political or economic changes," VPT's Leslie says. "On the other hand, that also makes it hard to predict long term on whether it will move up or down. While we are more military focused at this time, we see a lot of potential in commercial spaceflight down the road."

"There is a great deal of uncertainty from the political leadership – a new administration is only two years away – as to what the budget level and the resulting procurement path for space classified programs will be," Dolan says. "The uncertainty of the customer about what they want makes it hard for industry to forecast beyond the next couple years. We have good visibility on system requirements for programs funded and launches scheduled in the next 1-2 years. After 2017 there is some uncertainty on how the military will go about procuring payloads. There is a lot of dialogue now about the potential to pursue a policy of disaggregation whereby the military may use hosted payloads on commercial systems for less critical aspects of the mission.

"Therefore, in the meantime, the military leadership wants their money to go further and we are doing different things to make that happen," Dolan continues. "One is to help them reduce their total cost of ownership by increasing levels of radiation testing during the design process, which also helps them reduce risk in the long term. We have invested in ELDRS [Enhanced Low Dose Rate Sensitivity] testing capability on products such as our space grade BiPolar Small Signal transistors as well as our mixed signal integrated circuit devices to better indicate how they will perform in extended missions. In fact, we have redesigned some of our older technologies to significantly improve the radiation performance for ELDRS. At Microsemi we spend a considerable amount of money characterizing our

standard products for these radiation effects. Without this available characterization data there would be no market for us. Specific orbits (LEO, MEO, and GEO) require different levels of data that must be supplied to the customer before they can design a part.

"As far as the military is concerned, risk reduction also goes hand in hand with flight heritage," she explains. "They want the extended radiation testing of products and components that have flown before on similar platforms and similar missions. This helps them speed up their choice of technology, which in turn enables shorter development times. We continue to see increasing adoption of our RT FPGAs for the full range of space applications. Also we are seeing increasing adoption of our first flash-based FPGAs for radiation applications, RT ProASIC3. RT ProASIC3 now has flight heritage on several science missions, including the International Space Station and two NASA missions: IRIS (LEO) and LADEE (Lunar orbit). RT ProASIC3 also has flight heritage on several international LEO remote sensing missions, and will be deployed in commercial communications missions in the near future. We expect relatively easy adoption of RTG4, our next generation FPGA family for radiation environments. It uses a 65nm low-power flash process, which is immune to changes in configuration due to radiation effects." (See Figure 4.)

Figure 4 | The RT ProASIC3 from Microsemi has flight heritage on several science missions, including the NASA IRIS mission (pictured) for low Earth orbit. Photo of Orbital Sciences team engineers monitoring the connection of the payload fairing over the IRIS spacecraft courtesy of NASA.

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International challenges

While the U.S. market is shrinking, export controls and improved competition overseas make it difficult for U.S. companies looking to make up for those losses in the international market. The U.S. government is bringing reforms to the International Traffic in Arms Regulations (ITAR) to make it easier for U.S. companies to compete in the satellite industry, but some feel it may not be enough to overcome damage already done.

"Over the last couple of years Europe has taken a stronger position related to removing all ITAR products from their systems," Maxwell Technologies' Longden says. "This has led to directives to eliminate U.S. ITAR products even if it means reducing performance and quality. Finally, due to the critical situation with Russia, one of our largest growing space market segments is no longer available due to export restrictions. The Russian space market has been very quick to react and is currently looking for non-U.S. alternatives, similar to what Europe is doing."

"Export controls have always been there and have gotten tighter over the years," Patterson says. "The U.S. used to import data into the country, but not export data outside of the U.S. Now we are seeing other countries putting in similar export practices, making it twice as complicated to do business internationally.

"Export reform has been long in coming to a horrendously restrictive and slow process," he adds. "Even after reforms that are quite welcome, we still need to do a lot of paperwork and still need export licenses." (For more on ITAR reforms see Special Report on page 16.)

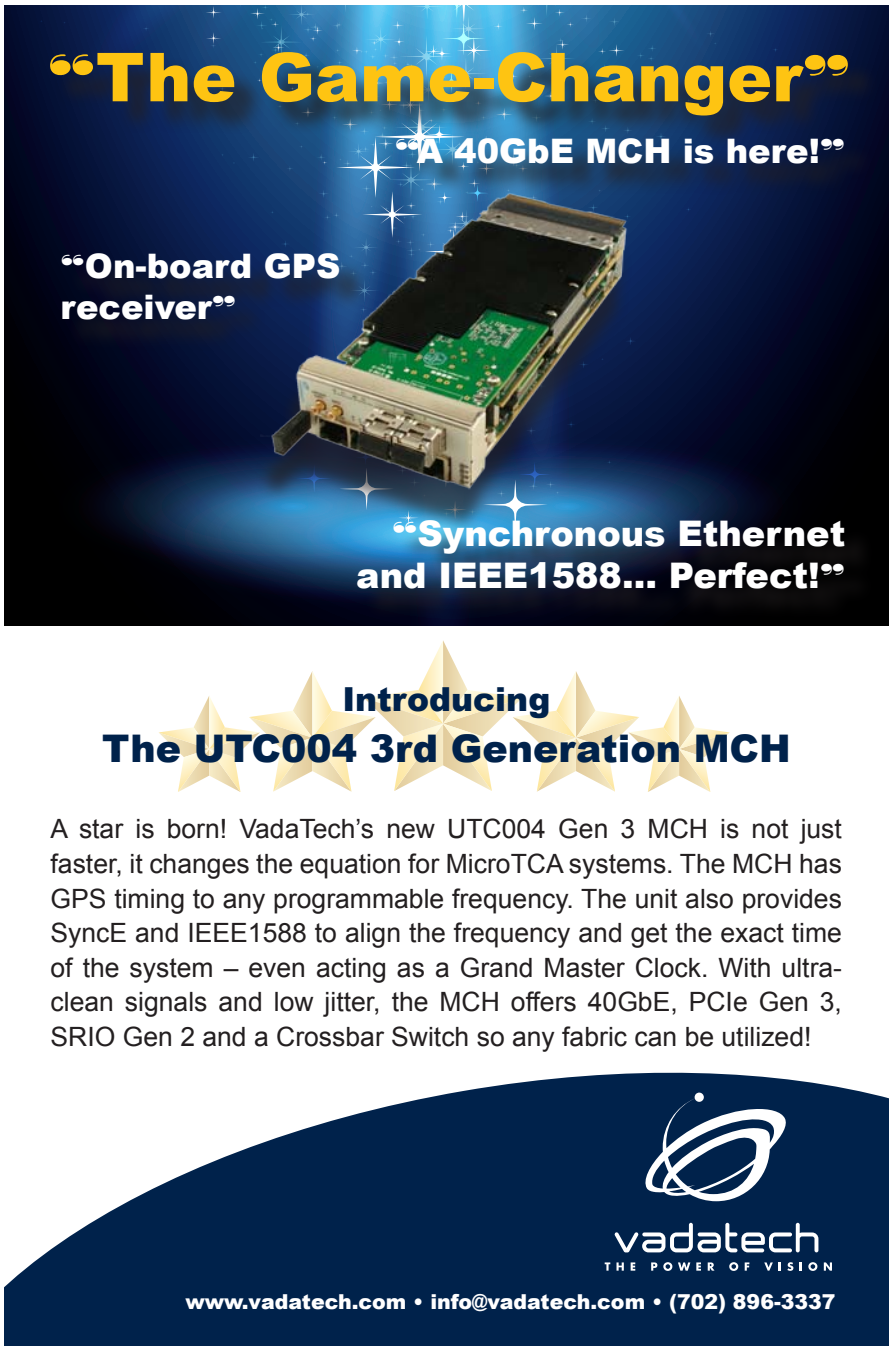
Cost savings through manufacturing

System integrators and suppliers can also meet the cost cutting demands of customers by being more efficient on the manufacturing end.

Engineers at Northrop Grumman in Redondo Beach, CA implemented commercial best practices to generate cost savings in fabricating 36,000 ICs for the U.S. Air Force's fifth and sixth Advanced Extremely High Frequency (AEHF) satellites, enabling production to ramp up on a broad scale for both payloads. Each payload has about 18,000 high-frequency Monolithic Microwave Integrated Circuits (MMICs) for frequency conversion, amplification, and switching. They are integrated throughout the AEHF's major subsystems that enable real-time mobile, global access such as secure crosslinks, anti-jam uplinks and downlinks, and super high gain Earth coverage antennas.

"The Air Force procured these advanced, high-frequency MMICs through block buys early in the payload development cycle. Along with cost and schedule savings, the parts were more efficient to produce," says Stuart Linsky, Vice President of Communication Programs, Northrop Grumman Aerospace Systems.

"While Northrop Grumman adopts commercial practices where helpful, its



primary emphasis is to take the best practices from the commercial world and adapt them to meet the unique requirements of hi-rel military," says Tom Block, Director of Microelectronics Products and Services at Northrop Grumman.

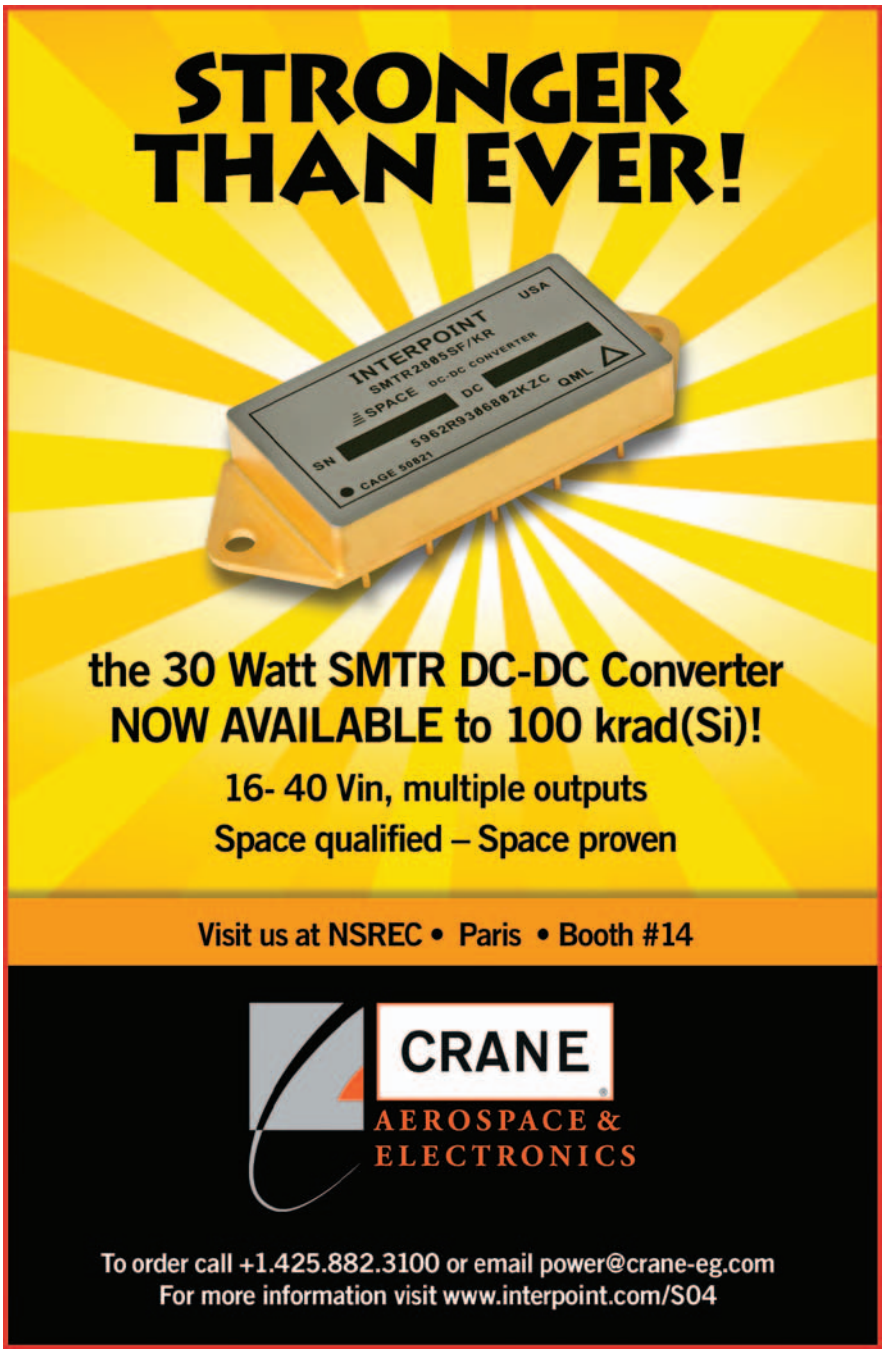
"[We develop] advanced military IC capabilities to [provide] space systems performance that is not achievable with commercially available technologies. While this initial cost may be initially higher, these technologies can be used, in turn, to address commercial needs after they have been developed and proven for military applications," he continues. "The most prominent example of this is Northrop Grumman's development of GaAs [Gallium Arsenide] transistors for its space systems that were, in turn, used to develop cellular phone power amplifiers. This technology was key to reducing the power consumption of the cellular phone, enabling it to be operated with much smaller batteries and thus be physically much smaller." (For more on the AEHF MMICs see sidebar on page 30.)

Enhanced performance and thermal issues

Advanced electronics bring more performance and speed but also create engineering challenges as Size, Weight, and Power (SWaP) requirements get reduced. "Military users want next generation systems and capabilities, whether in big major programs or smaller disaggregated systems," Aeroflex's Jordan says. "We are seeing a demand for more processing capability, higher density in memories, and bigger pipes for data communications. Typical requirements include multi-gigabits per second of data transmission, gigaflops of processing capability, low power, and dense, high-speed memories. The challenge is to fit it all into a very small space, remove the heat, and/or manage the power.

"Heat removal has always been a problem," Jordan continues. "But now as we pack more logic and memory into a unit area we have to remove that heat. That's the big hurdle right now for the industry to deal with, not just Aeroflex. A lot of heat is generated with multiple lanes of +10 gigabits per second SerDes and 10s of millions of ASIC gates that need heat removal or power management."

"There is a major Aeroflex initiative along these lines and it calls for maximizing thermal heat dissipation using flip chip assembly technology and heat sinks in an FPGA pin-compatible footprint. It will meet MIL-PRF-38535 Rev K requirements for Class Y non-hermetic packages space applications," says Jay Johnson, Product Marketing Engineer at Aeroflex Microelectronics Solutions. "Aeroflex is currently using this technology to develop a 1752 I/O flip chip ceramic CGA package – the UT1752FC – for implementing a high performance UT90nHBD 90nm custom ASIC with a 3.125 Gbps High Speed SerDes IP. The UT1752FC package scheme uses a heat sink attached to the backside of the flip chip-assembled die that enables efficient heat transfer from the package. Aeroflex is currently working towards



Class Y qualification for its flip chip assembly technology, which will in turn allow for qualification of the UT1752FC package." (See Figure 5.)

"Aeroflex also released a new Bus Switch family targeted for high-speed, bi-directional Mux/Demux and bus isolation applications," says Michelle Mundie, Product Marketing Engineer at Aeroflex Microelectronics Solutions.

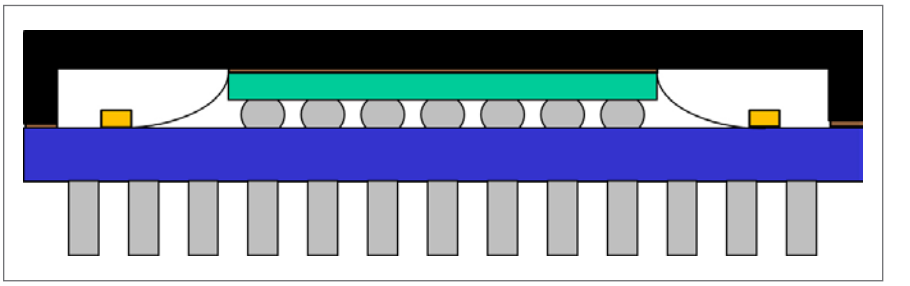


Figure 5 | The UT1752FC Class Y package scheme from Aeroflex enables more efficient heat removal.

Rad-hard MMICs for AEHF satellites

The radiation-hardened (rad-hard) Monolithic Microwave Integrated Circuits (MMICs) designed by Northrop Grumman in Redondo Beach, CA, for the fifth and sixth Advanced Extremely High Frequency (AEHF) satellites are integrated throughout the AEHF's major subsystems that enable real-time mobile, global access such as secure crosslinks, anti-jam uplinks and downlinks, and super high-gain Earth coverage antennas.

"Northrop Grumman's III-V semiconductor MMICs made from [Gallium Arsenide] GaAs, [Indium Phosphide] InP, or [Gallium Nitride] GaN offer frequency performance from DC to over 1 THz," says Tom Block, Director of Microelectronics Products and Services (MPS) at Northrop Grumman. "They form the critical link in high frequency amplifiers and analog-to-digital/digital-to-analog convertors. They are ideally suited for space applications because they are inherently more rad-hard than the more common [Silicon] Si-based electronics. In addition, they offer a variety of other advantages over Si-based electronics, including lower power dissipation, better noise performance, and higher output power. They are often used in conjunction with Si-based electronics to provide optimal system performance."

The MMIC-based components operate at microwave frequencies between 300 megahertz to 300 gigahertz and beyond, according to a company release. They have benefits when compared with those used in other communication satellite payloads, such as discrete transistors and passive components. "A single MMIC-based component the size of a quarter, for example, handles as many functions as a traditional, brick-size electronic black box. They're one reason AEHF payloads are half the size and weight of previous-generation MILSTAR satellite payloads while providing 10 times the capacity," Block continues.

The devices range in size from 1 mm x 1 mm to 10 mm x 10 mm, Block says. "Individual feature sizes of the transistors can be as small as 35 nm."

For reduced size, weight, and power requirements "rad-hard space applications benefit from the use of both Si electronics and III-V materials such as GaAs and InP working together," he explains. "The Si electronics typically require extensive shielding and complex circuit redundancy to achieve the required rad-hard performance, but are necessary for high transistor count applications such as computation. The use of III-V semiconductors typically require little to no special shielding or circuit redundancy. These materials can also operate at much lower power dissipation compared to Si electronics as well as operating at much higher frequency, but are limited to much lower transistor counts. The advantages of both are used to make a complete system."

Sidebar Figure 1 | Pictured is the Northrop Grumman wafer fabrication facility in Manhattan Beach, CA, where company engineers manufactured the MMICs for the Air Force AEHF program.

The company "specializes in manufacturing III-V compound semiconductors such as GaAs and InP," Block continues. "These materials are inherently more rad-hard than Si circuits due to the nature of the materials they are composed of. In addition, circuit redundancy techniques are used to increase the component's rad-hard characteristics if needed.

Northrop Grumman provides AEHF payloads for Lockheed Martin Space Systems in Sunnyvale, CA, prime contractor for the next generation of protected military communications satellites. Three Advanced AEHF satellites are on-orbit currently and three more are in production by the Lockheed Martin-Northrop Grumman industry team. Northrop Grumman manufactured the specialty compound semiconductors at the company's advanced microelectronics wafer fabrication facility in Manhattan Beach, CA. A Department of Defense (DoD) Trusted Foundry, the facility is dual-use, producing commercial integrated circuits in large volumes for more than 20 years (see Sidebar Figure 1).

"It will increase bus speeds and data throughput for digital and analog applications. The technology can also be used for power management, cold sparing, and redundancy applications. Commercial bus switches exist on the market, but this is the only rad-hard one available and works quite well where we isolate a microprocessor from very large memory arrays, which have a tendency to load the microprocessor or FPGA down."

Rad-hard power ICs

Reduced SWaP demands place pressure on all electronic component designers, but especially those who make power devices.

"There is still a great deal of demand for distributed architectures, which means more demand for Point Of Load (POL) regulators with high efficiency at low voltage," says VPT's Leslie. "We are also seeing a lot of big requests for low power converters at five watts and below. We receive a significant number of requests for low power converters for sensors and other analog and digital circuitry. Right now we are offering our SVSA 5 watt family and the SVHF and SVRHF 15 watt families for isolated converters to meet these demands.

"Processing power is going up, and as a result voltage requirements are going down. There is a big drive for high current at a low voltage," he continues. "The challenge is providing a small package while keeping efficiency high at low voltage and high current. VPT offers the SVGA and SVRGA families of non-isolated point of load DC-DC converters to cover applications at low voltage and high current and high efficiency." **MES**

Rad-hard listing

Aeroflex Microelectronics Solutions
Colorado Springs, CO
www.aeroflex.com/radhard

Aitech Defense Systems
Chatsworth, CA
www.rugged.com

Aldec
Henderson, NV
www.aldec.com

Atmel
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BAE Systems
Arlington, VA
www.baesystems.com

Corwil Technology Corp.
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Crane Aerospace & Electronics
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Curtiss-Wright Defense Solutions
Ashburn, VA
www.cwcdefense.com

Data Device Corp. (DDC)
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Harris
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Honeywell Microelectronics
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Integra Technologies
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Intersil Corp.
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Modular Devices
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Northrop Grumman
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Novocell Semiconductor
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www.novocellsemi.com

Peregrine Semiconductor Corp.
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Ridgetop Group
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Robust Chip, Inc.
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Rochester Electronics
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Semicoa
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Silicon Space Technology
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www.siliconspacetech.com

Silvaco
Santa Clara, CA
www.silvaco.com/government/index.html

STMicroelectronics
Geneva, Switzerland
www.st.com

Synopsys
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Synova
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Teledyne Microelectronic Technologies
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Texas Instruments
Dallas, TX
www.ti.com/home_p_hirel

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Ultra Communications
Vista, CA
www.ultracomm-inc.com

VPT
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www.xilinx.com

The requirement of ELDRS-free components in hybrids

By Brian Bennett

Trends in space missions are requiring increased rounds of testing – particularly Enhanced Low Dose Rate Sensitivity (ELDRS) testing – of components in hybrid parts. These ELDRS requirements may not be necessary, however, as they fail to account for the whole picture of the complex interactions of electronics devices within a hybrid.

ELDRS testing came about as a way to more accurately characterize electronics for the space environment of Earth orbit such as those used on satellites and the International Space Station. Photo from International Space Station of tropical storm Katia courtesy of NASA.

Over the years, requirements for space missions have become more detailed and intricate. One aspect of these increased requirements has led to an uptick in requests for Enhanced Low Dose Rate Sensitivity (ELDRS) analysis on individual components inside of hybrids. With high-level customers outsourcing various parts of their project to subcontractors, these ELDRS requirements become demands for ELDRS-free components in order to check off a requirement in a list of many requirements for a program. This checklist mentality may be an easy route to take, but it can lead to unnecessary testing and more stringent requirements than are really needed. In addition, these stringent requirements may impede the art of designing hybrids to be radiation-hardened (rad-hard).

History of ELDRS

ELDRS testing came about as a way to more accurately characterize electronics for the space environment of Earth orbit. Historically, testing was done at dose rates greater than 50 rad(Si)/sec. However, in Earth orbit, the dose rate will not exceed 10 mrad(Si)/sec. To account for this difference, test samples would be annealed for a specified time and temperature after Higher Dose Rate (HDR) testing, per MIL-STD-883 test method 1019. The ELDRS test was devised after studies trying to correlate the high dose rate (with anneal) tests and low dose rate tests showed differing radiation effects in bipolar devices.

What is ELDRS?

ELDRS is a test to determine the capability of a part for a varying radiation environment; either a part has ELDRS, or a part is free of ELDRS. Per MIL-STD-883 test method 1019 condition D, samples are irradiated at a HDR between 50 and 300 rad(Si)/sec, and at a Low Dose Rate (LDR) of less than 10 mrad(Si)/sec. If the change in a measured parameter of the LDR samples is more than 1.5 times the change in the measured parameter of the HDR samples, the parts are considered to have ELDRS; if there is a ratio of shifts less than 1.5, or the part passes all pre-irradiation test limits for LDR, the parts are considered ELDRS-free.

Is it necessary to go ELDRS-free?

Just because a component is not ELDRS-free does not mean it cannot still be used; the use must be examined. Take, for example, the LM136-2.5 voltage reference manufactured by National Semiconductor. The LM136-2.5 is an adjustable voltage reference, up to 2.49V. There is an ELDRS-free version produced by National, but the original HDR-hardened version can be sufficient for use in many cases. Figure 1 shows that, in an HDR-hardened LM136, the LDR drift in Zener voltage is more significant than the HDR drift.

As seen in Figure 1, the 30 krad(Si) LDR Total Ionizing Dose (TID) level, the unbiased sample showed less than 20mV of drift. With a 2.49V average set point, this leads to an error of 0.8 percent (0.02V/2.49V). The ELDRS-free version of the LM136-2.5,

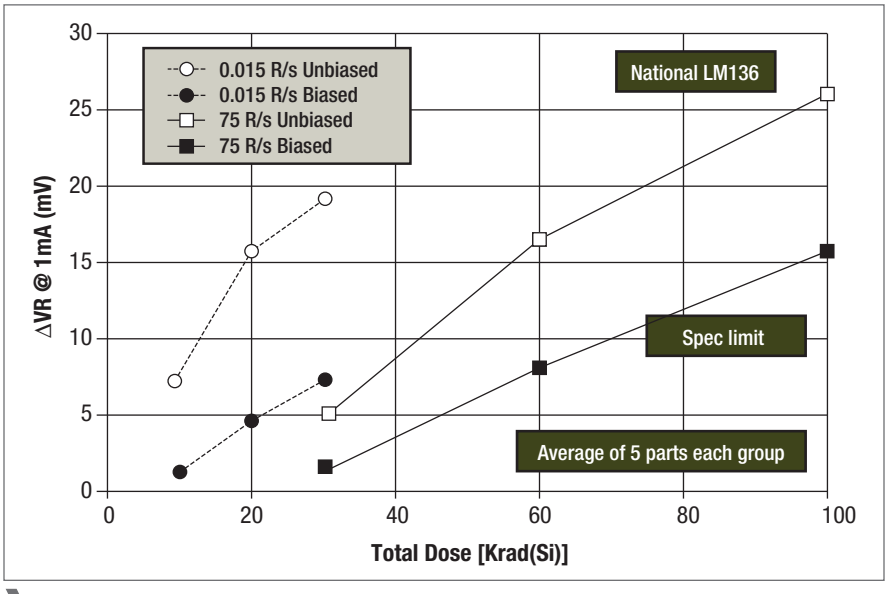

Figure 1 | Zener voltage drift versus total ionizing dose for a HDR-hardened LM136-2.5. [1]

irradiated to 100 krad(Si) as referenced in Table 1, leads to a 0.12 percent error (with the Vadj open). Depending on the application, this error may be tolerable.

After characterizing a device at LDR and HDR, assuming the device is not ELDRS-free, the end use should determine whether the part can be used and whether the radiation damage can be accounted for. As many applications for rad-hard devices are within Earth orbit, the effects of LDR damage will usually be of greater concern.

Examine the functional blocks

Coming back to the hybrid level, the greater concern with radiation testing should be at the hybrid level. Just because one component exhibits ELDRS does not mean it will fail in circuit. The real test is whether the hybrid-level parameters meet specifications post-irradiation. In-circuit interactions can counteract LDR degradation, or parameters that were thought to be important may not affect the hybrid level parameters; in the similar but opposite scenario, if ELDRS-free parts are used, a parameter that was thought to be unimportant may become important when the LDR drift does not counteract drift in another part of the circuit.

Test	Conditions	Units	Average reading at 0 rad	Average drift all lots
Zener voltage	Vadj = 0.7 V	mV	2442.88	-2.197
Zener voltage	Vadj = 1.9 V	mV	2604.33	-2.152
Zener voltage	Vadj = Open	mV	2495.84	-2.896
Adjust current	Vadj = .0.7 V	uA	-10574.4	0.138
Delta zener voltage	400 uA < IR < 10 mA	mV	1915.88	0.746

Table 1 | ELDRS-free LM136-2.5 parameter drift with 100 krad(Si) TID at LDR. [2]

Going back to the LM136-2.5, one example of its use is in a feedback loop as a reference to generate an error signal via an op-amp. If the op-amp is characterized with TID, one will likely see a distinct direction in input offset voltage (either it will tend to drift positive or negative with TID). With a known input offset voltage drift direction, one can place the LM136-2.5 on the appropriate input, inverting or non-inverting, to counteract both the Zener voltage shift of the reference and the input offset voltage shift of the op-amp (depending on which pin the reference is placed on, an inversion may be necessary somewhere after the initial error signal). This may not perfectly cancel out, depending on the magnitude of the chosen op-amp's drift, but this compensating technique can reduce what was a 0.8 percent error on the HDR-designed

LM136-2.5. Further, if a design were using this HDR-designed LM136-2.5 and switched to the ELDRS-free design in order to meet a customer's requirements, the error signal would show more drift with TID due to the lack of compensation.

In the previous example, one could use an ELDRS-free reference and an ELDRS-free op-amp to minimize both drifts, but the cost of using these ELDRS-free parts can dramatically increase the cost of the whole hybrid. Purchasing an ELDRS guarantee on a component can boost the cost of a part from several dollars to a few hundred dollars. Further, when a company works to LDR-harden a design, attributes of the original design can be overlooked (e.g. op-amp bandwidth can be overlooked when focusing on offset voltages and bias current hardening). The more elegant solution is available and is lower cost, but many procurers of hybrids do not have free rein to delve into the design to verify the radiation drift; their hands are often tied by requirements dictated to them by their customers.

Evaluate and test before moving to ELDRS-free

In summary, the major design concern should really be at the hybrid or functional block level, not necessarily at the component level. Individual components within a functional block may counteract each other's radiation effects, or the effects of a component may not cause a large impact on the hybrid-level parameters. Transitioning to ELDRS-free components will add cost without necessarily improving performance. When evaluating whether a hybrid can be used in a low-dose environment, ELDRS-free components should be a guideline rather than a strict rule. **MES**

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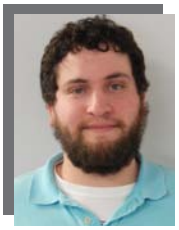
[2] K. Krickmeyer, L. McGee, B. Brown, L. Miller, "Low dose rate test results for National Semiconductor's ELDRS-free LM136-2.5 bipolar reference," 2009 IEEE Radiation Effects Data Workshop, pp. 47-50.



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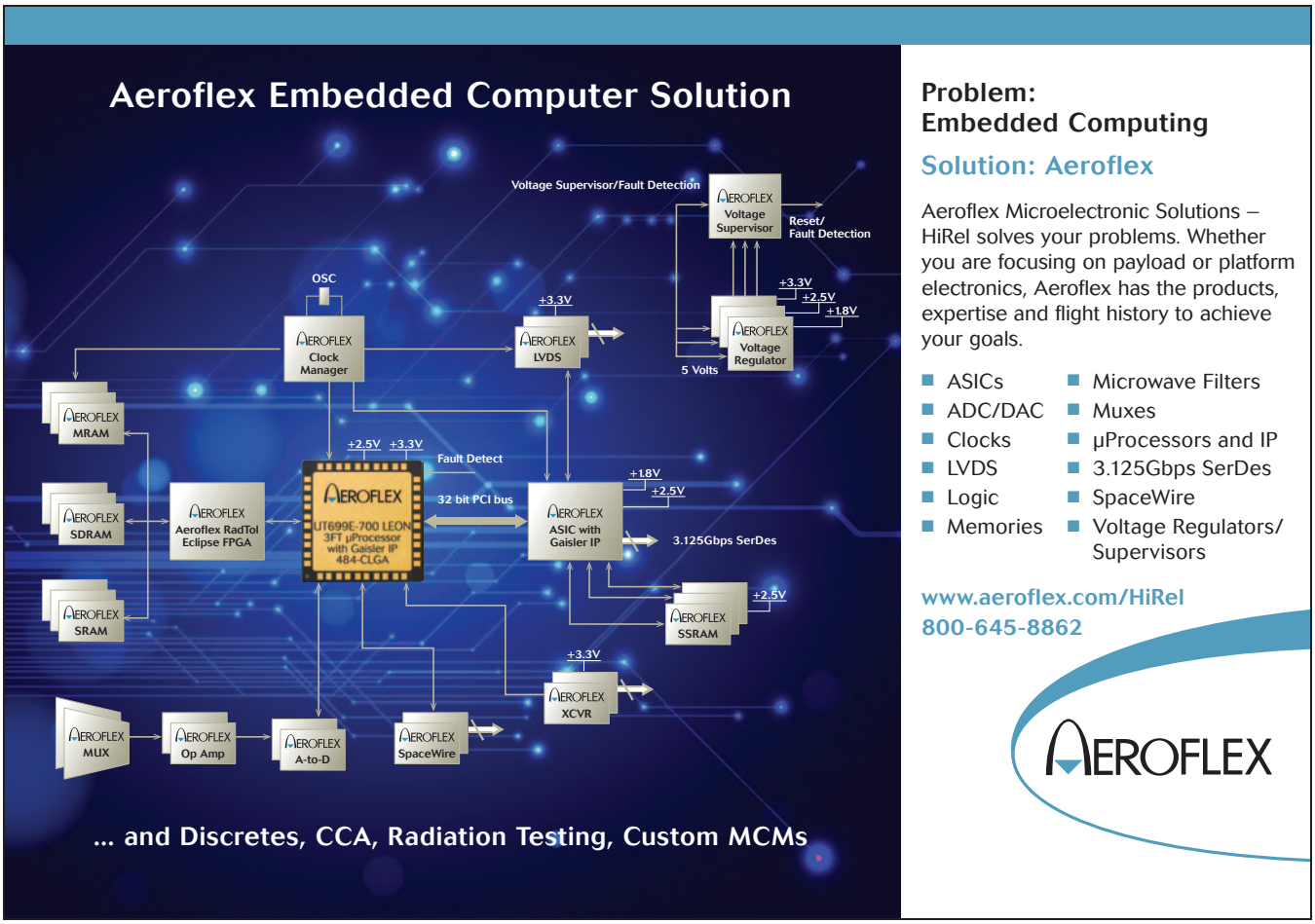

Future-proofing your high-density encrypted storage solution

By Paul Davis

Encrypted storage designers must plan ahead – taking into consideration the probable "creep" in requirements for storage, I/O, and encryption – when architecting a new system that requires data storage. The likelihood of needing to accommodate increased demands makes it prudent to choose a Network Attached Storage (NAS) device or recorder that can grow with those demands.

Secure storage solutions will be the norm on platforms such as this KC-130J Super Hercules tanker assigned to a U.S. Marine Corps Reserve squadron. Photo courtesy of Lockheed Martin.

It's not news that the amount of critical digital data coming into, being moved, and stored on air, ground, and naval vehicles continues to grow quickly as those platforms take on more sensors and expand their onboard networks. Much of the data needs to be stored and archived, and much of what needs to be stored must be encrypted, depending on its sensitivity, in a range of security levels. System designers seeking a high-density encryption-capable data recorder solution need to consider both current and future needs as protocol types, storage densities, bandwidth, and security requirements continually evolve and expand.

In the past, designers who needed to add additional recording capability for some new data type, such as audio or video, had no option but to source and find room in their already burdened platform for a dedicated recorder for that type of data input. Such a "stovepipe" approach results in additional cost, size, weight, and power dissipation, none of which are desirable.

A better approach, one that takes advantage of the parallel trend toward network-centric platform architectures, is to combine support for all data types in a compact, modular, and scalable system designed for expandability and evolution. This approach eliminates the need for dedicated recorders, and when remote booting is used – such as that supported by PXE (Preboot eXecution Environment) booting – can also eliminate the need for the numerous solid-state drives that each network client currently requires for their Operating System (OS) and application software. A scalable system also builds in the confidence that the multiprotocol data recorder will be able to handle increased future requirements, such as the rapidly approaching demand for 10 Gigabit Ethernet (GbE).

Protocols and I/O

Until recently, most digital recorder solutions focused on NAS to support Ethernet-based networks, primarily for GbE, the most popular data communications protocol. These recorders, designed for GbE, didn't provide the I/O front-end or protocol support for video, audio, or other types of data.

Today, sensors onboard platforms are capturing a wide range of data types such as radar, Forward Looking Infrared (FLIR), side-aperture radar, video, and audio in the cockpit for post-flight analysis. Handling these different data types required separate dedicated recorders. Now, however, with the advent of networked platforms, users increasingly demand NAS devices. Providing a NAS digital recorder with the additional I/O interfaces and protocol support to handle audio and video, for example, boosts that recorder's value because it eliminates

the need for multiple devices and helps mitigate Size, Weight, Power, and Cost (SWaP-C) constraints.

In a networked environment, the many different network clients – including mission computers, sensor-management computers, and other types of control subsystems and computers – will each likely have its own processor and some particular OS running on it.

With the old stovepipe approach, a recorder hooked up to a Linux client only needed to support that particular client. Part of the challenge for a single-unit multiprotocol recorder is to support all likely network protocols. For example, a Windows-based environment/machine/client will typically support CIFS, while NFS protocol is expected for Linux or VxWorks clients. Other clients may expect FTP or HTTP.

A multiprotocol NAS recorder needs to support a wide variety of industry-standard protocols, including CIFS, NFS, HTTP, FTP, and PXE. The NAS device doesn't have to be limited to the most common interface and protocols, however; using an expansion card, the multiprotocol recorder can support additional clients as well. For example, if support is required for Fibre Channel (FC), a carrier card can be used to make the recorder act like an FC target disk.

MISSION-CRITICAL I/O SOLUTIONS:
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- CAN-USB
- Digital I/O
- A-to-D and D-to-A
- FPGA (firmware design also available)

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- PMC, PMC-X, XMC
- Custom form factors and embedded systems

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- PCIe x1 Lane
- One Channel Dual Redundant 1553
- Two Independent ARINC 429 Receiver and one Transmitter

PCIe-Mini-CAN-USB
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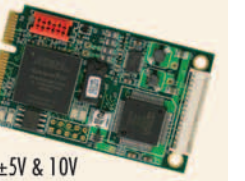

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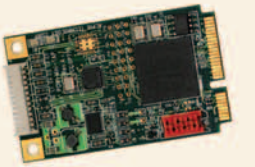

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More data requires more bandwidth

Another challenge for system designers is that in addition to the increased number of sensors generating data that must be recorded, modern sensors also tend to operate at higher bandwidths, generating more data per second. In many cases, the platforms themselves, such as unmanned aircraft, are staying in the air longer, which again increases the amount of storage required. This ramp-up means that a recorder must provide scalable storage if it is to be "future-proofed" and not rendered obsolete in a short number of years as requirements inexorably increase. Today's recorders must be able to support upwards of 8 TB and provide a method to handle even more storage as the applications evolve and grow.

Remote booting reduces SWaP-C

Another significant reduction in cost, weight, and power aboard platforms can be achieved through use of the PXE boot protocol to enable remote booting of clients in a net-centric environment. Typically network clients, like a mission computer, have had their own hard drive, which hosts that client's OS and unique application. That drive (typically solid-state) has resided inside the client's ATR chassis and required its own power supply. Moreover, because these drives are located physically inside each client, they are more difficult to access for OS or software updates.

> "Providing a NAS digital recorder with the additional I/O interfaces and protocol support to handle audio and video boosts that recorder's value because it eliminates the need for multiple devices and helps mitigate Size, Weight, Power, and Cost (SWaP-C) constraints."

The power dissipated by these drives, as well as the space they require, can be eliminated through the use of a multiprotocol recorder that supports PXE boot. The client need only have a small boot-up program hosted in Programmable Read-Only Memory (PROM).

Upon power up, the client requests the OS and application file from the central recorder via PXE protocol. The recorder then provides the network address and the appropriate OS and application to the client. Since such recorders have removable drives, the OS and application file can be the latest version, which may fix bugs or provide new important features. With this setup, updates are delivered quicker and more efficiently.

Encryption

An ideal multiprotocol recorder is designed around three conceptual pillars: 1) scalable storage, 2) flexible I/O, and 3) support for a variety of cryptographic levels. Encryption is required to protect the stored data from being accessed and used by adversaries. In some cases, no encryption is required if the data is not critical and will reside in an unclassified environment. In that case, a bypass module can be used so that data moves through the recorder unchanged. As security requirements change, the appropriate encryptor, for Secret and Below Information (SABI) or Top Secret and Below Information (TSABI) can be installed using an inline media encryptor with the bypass module removed.

Example solution

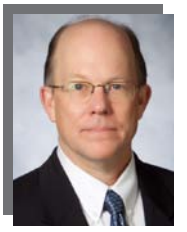
An example of a new generation of NAS device that meets these needs is Curtiss-Wright's Compact Network Storage 4-Slot (CNS4) subsystem (see Figure 1). It supports NSA Type 1 cryptography to ensure the integrity of critical "data-at-rest" in military environments such as those endured by transports, helicopters, Unmanned Aerial Vehicles (UAVs), and mobile

Figure 1 | The Curtiss-Wright Compact Network Storage 4-Slot (CNS4) subsystem provides high-density storage capacity, support for network protocols, and flexible encryption capabilities.

radar systems. The device eliminates the need for multiple recorders by providing high-density storage capacity, support for multiple network protocols and expansion, and flexible encryption capabilities.

Data protection with Type 1 encryption

In addition to its VPX I/O slot, the CNS4 chassis also accommodates a 3U VPX Inline Media Encryptor (IME) certified for SABI-level data in attended systems. A Crypto Ignition Key (CIK) is mounted on the device's front panel when this IME is used. By the end of this year, the IME is expected to support Pre-Placed Keys (PPK) and four SATA lanes. Via a DS101 key-fill port, the PPKs can be loaded so the IME can be left in place. **MES**



Paul Davis *has 30 years of professional experience, holding positions in Product Management, Sales Management, Engineering, and Engineering Management for a variety of technical product companies. Paul has been with Curtiss-Wright for 16 years and has served as Director of Engineering, Director of Sales and Marketing, and Product Manager. He currently serves as Director of Product Management. Paul earned a BSEE from the University of Cincinnati and an MBA from Indiana University. Readers may reach him at defensesales@curtisswright.com.*

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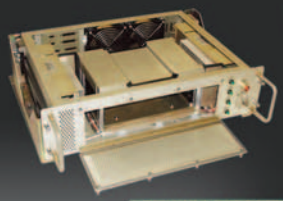

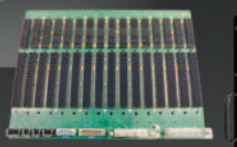


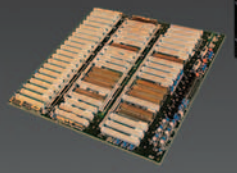

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Networked rifles from Colt Canada enable data exchange with C2 platforms

Engineers at Colt Canada are integrating their Variable Message Format (VMF) interface from General Dynamics Canada into the Soldier Weapon & Observer Reconnaissance Devices (SWORD) system to improve Command and Control (C2) communications. This will extend the data exchange capability down to the dismounted soldier. SWORD was created as an alternative to radio-centric individual soldier systems. It marries ruggedized smartphone technology with weapon-mounted surveillance and targeting devices, enabling situational awareness data to be sent directly to the warfighter via their weapon. Integrating VMF into the SWORD system will enable compatibility with higher-level C2 systems such as Canada's Land Command Support System (LCSS). VMF is a standard method that has been adopted by several nations, including Canada, to provide critical information directly to soldiers, according to General Dynamics Canada.

The system is based on Commercial Off-The-Shelf (COTS) components and enables power, data, and navigation infrastructure inside the weapon, such as GPS and inertial navigation for GPS-denied situations. The networked rifles are now enhanced with modern smartphone technology and an ability to host battle management applications. The smartphone capability provides a familiar interface for soldiers – most of whom own a smartphone.

Colt Canada Corporation • www.coltcanada.com • www.mil-embedded.com/p9917529

Thermal testing of electronic components

Designed for power cycling and thermal testing of electronics components to simulate and measure lifetime performance, the MicReD Industrial Power Tester 1500A from Mentor Graphics Corporation combines power cycling and thermal transient measurements with structure function analysis while providing data for real-time failure-cause diagnostics. Power components are used for applications where electrical energy is generated, converted, or controlled and also where high reliability is necessary during long operational lifetimes. The Mentor Graphics solution enables electronic manufacturers to test reliability by examining the thermally induced degradations within the module stack-up. Measurements are conducted on the MicReD Power Tester 1500A, without having to remove the components from the test environment. A technician or engineer is able to see the failure as it progresses and determine the exact time/cycle and cause.

The MicReD Power Tester 1500A can power modules through tens of thousands – potentially millions – of cycles while delivering real-time failure-in-progress data for diagnostics, which reduces test and lab diagnosis time and eliminates the need for post-mortem or destructive failure analysis. The Power Tester 1500A analyses thermally-induced mechanical failures such as die-attach wire bond separations, die, package stack-up delamination and cracks, and solder fatigue. The product can perform power cycling tests of Insulated-Gate Bipolar Transistors (IGBTs), Metal-Oxide Semiconductor Field-Effect Transistors (MOSFETs), and power diodes

Mentor Graphics Corporation • www.mentor.com • www.mil-embedded.com/p9915498

Small, rugged carrier board for unmanned systems, digital mapping

Engineers at Connect Tech developed their CCG010 COM Express Type 10 Mini Carrier Board for rugged Small Form Factor (SFF) applications in unmanned systems, avionics, military ground vehicles, digital mapping, and others with high performance processing needs in constrained Size, Weight, and Power (SWaP) environments. The CCG010 is the smallest of the Connect Tech CCGxxx line of COM Express Carrier Boards. The device features rugged, locking connectors and supports extended temperature ranges of -40 °C to +85 °C.

The CCG010, which supports the latest generation of low-powered CPUs from Intel and others, is module agnostic, supporting a wide range of module vendors. It is 84 mm x 55 mm and weighs only 49 grams. It has two mini PCIe, mSATA, SATA, two GBE, six USB, LVDS, DisplayPort/HDMI/DVI/VGA, HD audio, and two RS-232/422/485. Both sockets have PCIe and USB signaling and one socket can be configured as mSATA. It has one DisplayPort++ (DDI) interface and can also be used for HDMI, DVI, or VGA. The device has one LVDS interface (18-bit, three data pairs), two Gigabit (10/100/1000) Ethernet ports, one from COM Express, and one from the onboard Intel 825741 PHY/controller.

Connect Tech Inc. • www.connecttech.com • www.mil-embedded.com/p9917525

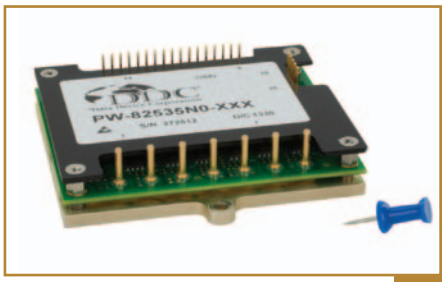
Heavy duty drive for harsh environments

Experts at maxon motor developed a heavy duty motor program that contains 22 mm-32 mm diameter brushless motors with shock, vibration, and temperature tolerances necessary for the exceptionally high requirements in space technology or far below the Earth's surface where extreme operating conditions are prevalent. The company has different variants of the motors designed for operation in air or submerged in oil (flooded in hydraulic fluid).

Each assigned power rating depends on the surrounding medium and averages 80-220 Watts in air and, due to a higher heat dissipation, 240-480 Watts in oil. Every motor is designed to withstand ambient temperatures of more than 200 °C (390 °F) and atmospheric pressures of as high as 25'000 psi. It has also been successfully demonstrated to resist impulse and impact forces of 100G. The motor's efficiency of 88 percent in air and above 70 percent in oil makes it useful for battery-powered applications. The motor's detent-free running characteristics deliver regulation behavior, enabling their suitability for high-precision positioning tasks, even at low speed. Common applications for the motors include space technology, power plants, vehicle manufacturing, the aircraft industry, and in mining or other industries with highly dynamic movements.

maxon motor • www.maxonmotorusa.com • www.mil-embedded.com/p9917530

DSP technology used for BLDC speed and torque motor controller



A new speed and torque Brushless DC (BLDC) motor controller from Data Device Corporation (DDC) uses advanced Digital Signal Processing (DSP) to provide a solution that can be easily tuned for use with various motors and loads. The device's programmability enables parameters such as speed or torque mode, number of motor poles, maximum speed, current limit, Pulse Width Modulation (PWM) frequency, and Proportional Integral Derivative (PID) control constants to be tuned during system development. This reduces the time-to-market efforts and costs, and enables the controller to be subsequently re-tuned to support multiple or evolving applications.

The PW-82535N0 has trapezoidal motor commutation and PWM switching, and can operate in either torque or nested speed/torque control modes using Hall Effect sensor feedback, that makes it useful for variable speed applications such as fans, pumps, compressors, and rotating antennas. It is a common design that can be used across multiple applications and its complementary four-quadrant drive provides reduced power dissipation, supports driving and braking in either direction, and holds torque for high-performance applications. The DDC device has a 100V, 10 amp output and a -40 °C to +100 °C operating temperature range.

Data Device Corporation (DDC) • www.ddc-web.com • www.mil-embedded.com/p9917526

Secure M2M command and control communications

FreeWave Technologies engineers released a family of command and control solutions targeted at unmanned systems and other military and government applications. The WavePoint solutions are based on a wireless Machine-to-Machine (M2M) communications architecture that offers high-speed connectivity for broadband wireless communications and also provides military-grade security capabilities. The product family is comprised of the multi-channel WavePoint 10e platform and a number of single channel WavePoint 20e modules that will be released throughout 2014. In addition to command and control of unmanned systems, the products will support: dismounted soldier and vehicle tracking; nuclear, biological, and chemical; remote sensing; guided parachutes for supply drops; unattended ground sensors; perimeter security; remote military infrastructure monitoring; remote target acquisition; and others.

The WavePoint 20e single channel modules come in various packages – enclosed and board level – and its data links are capable of operation in the frequency band that best suits application needs – whether 900 MHz, 1.3 GHz, 2.4 GHz, 4.4 GHz, or other spectrums. The WavePoint networks use OFDM technology to provide wireless communications in license-free radio spectrum. It enables real-time data collection for industrial applications, delivering as much as 200 Mbps with low latency. WavePoint is scalable and supports mesh, point-to-point, and point-to-multipoint networks. The products also have security and encryption features.

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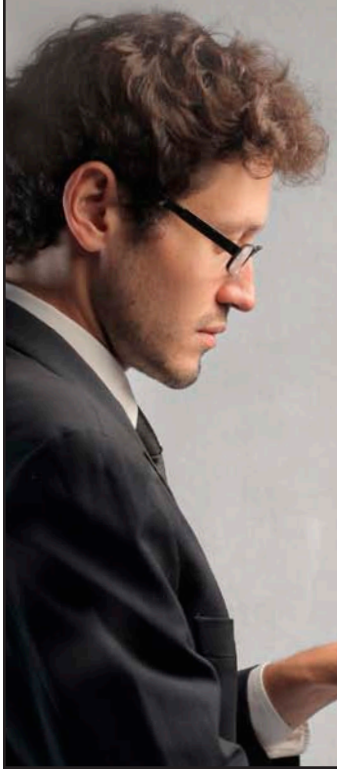

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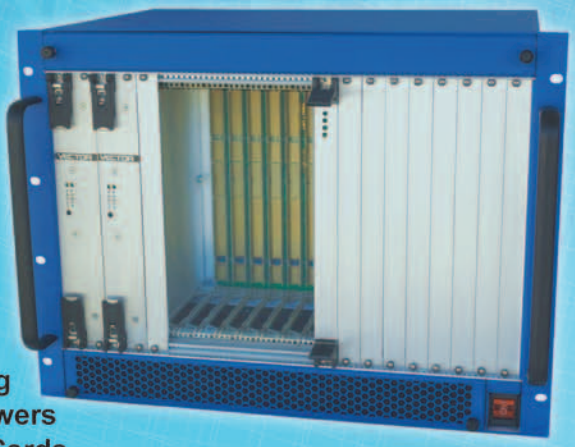

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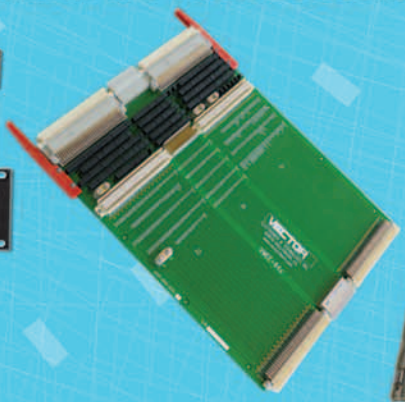

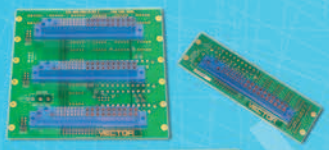

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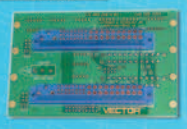

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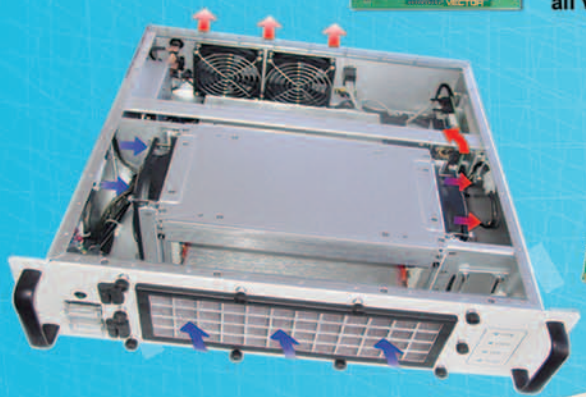

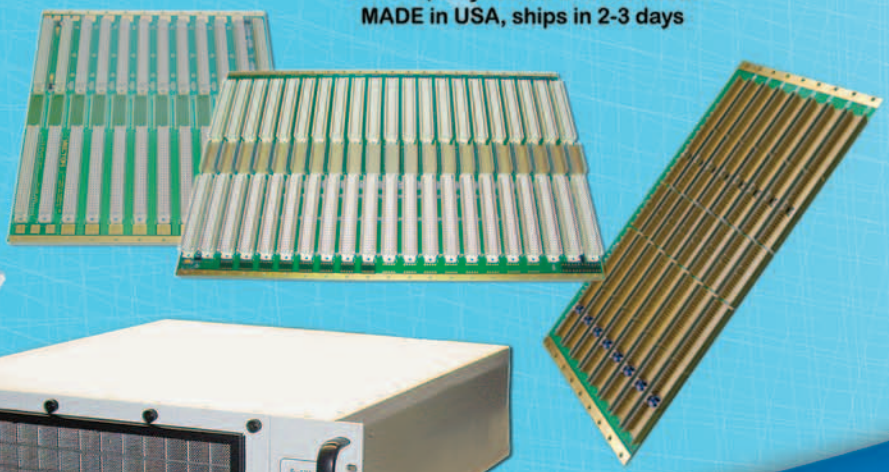

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BLOG **Before & After Market (BAM) Blog**

Who is watching out for your repair needs?

By George Karalias, Rochester Electronics

Most markets don't realize a key product is in short supply until an Original Equipment Manufacturer (OEM) places an order that cannot be fulfilled. Shortages usually occur because of a spike in demand or something that interrupts production, such as a natural disaster.

Sometimes even a market's growth can be hindered due to short supply: PC makers in 2011 sold fewer units during the all-important holiday season because disk drives were scarce due to flooding in Thailand. A recent report by researcher TechNavio (www.researchandmarkets.com/research/2h63df/global_thermal) has concluded the market for thermal imaging products is lagging due to a shortage that's unusual in the electronics market. Thermal imaging systems, which include a camera using five components – an optic system, detector, amplifier, signal processing, and display – aren't operating at peak efficiency because of a lack of regular support and services.

"Some vendors are unable to meet this demand, thus leading to customer dissatisfaction," the report states. "Further, the third-party service providers are not closely monitored by the market vendors. This deters end users from even adopting the effective and efficient thermal imaging cameras. Hence, vendors need to select the right vendor for obtaining constant support to attain operational excellence and enhanced convenience."

Maintenance, Repair, and Operations (MRO) is a key service in any industry, enabling customers to look for product warrantees and service options, especially for high-cost equipment. In electronics, many OEMs have outsourced this function to contract manufacturers or even third-party logistics providers such as UPS.

The availability of spare parts in electronics can get dicey sometimes because of an industry practice called End-Of-Life (EOL). Original Component Manufacturers (OCMs) often stop manufacturing devices so they can use capacity for a new product or because a device has reached the end of its lifecycle. Many OCMs have programs in place to support these parts – others don't. That's why customers buying expensive equipment should consider a vendor's supply chain and MRO.

Some OCMs will sell residual devices leftover from a production run to those distributors authorized to resell these goods. Authorization means the devices are handled exactly the way the OCM would to maintain the component's integrity. Other OCMs may put EOL devices up for sale in the open market in which companies bid – and possibly pay top dollar – for devices that will eventually become scarce. A savvy OCM will have a couple of options in place: the authorized purchase of EOL products and availability of the necessary subassemblies to manufacture them if the need arises. In the semiconductor industry, this includes the die, mask, and IP associated with the original component. Companies such as Rochester Electronics are part of this supply chain to ensure parts don't run out.

These companies not only buy and maintain EOL devices, but purchase die, masks, and programming software from OCMs. This ensures that EOL components are maintained to OCM spec, or they can be remanufactured exactly as suppliers intended. If that's not possible the device can be recreated to perform exactly to OCM specs and then support that product throughout its lifespan. With this type of supply chain, users will never be left without the parts or support necessary for their device.

The thermal imaging market is expected to grow at a rate of 20.5 percent through 2016. That's a healthy pace. The only thing holding it back is the need for predictive maintenance of electrical systems, the TechNavio report states: "The global thermal imaging market has also been witnessing the emergence of the incorporation of communication interfaces. However, the need for increased investment could pose a challenge to the growth of this market."

More and more, customers are considering a vendor's entire supply chain when selecting a product. Even the best-quality equipment can break down or require maintenance. A vendor that does not have a system in place to service devices could lose a customer if unprepared for the demand of MRO. Smart vendors will have the right relationships in place from the start – even if their equipment never needs repair.

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CHARITY

Folds of Honor Foundation

Each month in this section the editorial staff of *Military Embedded Systems* will highlight a different charity that benefits military veterans and their families. We are honored to cover the technology that protects those who protect us every day and to back that up, our parent company – OpenSystems Media – will make a donation to each charity we showcase on this page. This month we focus on the Folds of Honor Foundation, which provides scholarships to spouses and children of fallen or wounded soldiers from the recent wars in Iraq and Afghanistan. According to the organization's website, as of January 1, 2014, more than 1.4 million dependents of deceased or disabled military personnel require aid.

The foundation was born seven years ago, when its founder, Maj. Dan Rooney, a retired F-16 pilot turned PGA golf professional and golf course owner, witnessed a U.S. soldier's funeral procession while onboard a flight home from his second tour. When the aircraft landed, its pilot announced the flight carried a hero's remains and requested all passengers remain seated while the casket deboarded. As he watched, Rooney was especially moved by the presence of a young boy, who was the deceased's, Cpl. Brock Bucklin's, son.

Rooney kept Bucklin's son and family in mind and used his resources to organize a benefit golf tournament, which then led to a partnership with PGA and the USGA to create Patriot Golf Day, which is now held every year over Labor Day weekend. Rooney asked all golf participants to simply add one dollar to their greens fees for the charity. In its inaugural year, more than $1.1 million was raised, and in the last six years that number has climbed to more than $17.1 million. This has resulted in more than 5,000 scholarship recipients, according to the organization's website. The Folds of Honor Foundation has now grown to include the Patriot Cup tournament, Patriot Range Days, and Patriot Boating and Bowling Days.

The first scholarship ever raised by Folds of Honor was awarded to Jacob Bucklin, who inspired Rooney back in 2007. For more information on the charity and how to donate or participate in its events, visit www.foldsofhonor.org.

E-CAST

Unmanned system ISR sensor payloads innovation through signal processing

Presented by: GE Intelligent Platforms, Curtiss-Wright, and Pentek

Unmanned Aircraft System (UAS) program managers want their Intelligence, Surveillance, and Reconnaissance (ISR) payloads to see further at lower weight and in more compact packages than previous designs. Multi-mission payloads involving radar, signals intelligence, multi-spectral, hyperspectral, and other sensors are requiring intensive signal processing capability next to the sensor in the payload to get around the data link bottlenecks and filter important data before it is sent to the ground. This e-cast of industry experts will cover how embedded hardware and software designers are solving the signal processing design challenges in UAS payloads.

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WHITE PAPER

Computer system design for critical applications

By: Sealevel Systems, Inc.

"Industrial computer" is a widely used term that unfortunately can be quite ambiguous, often applied to computers that have little real advantage over commercial PCs but may outwardly appear rugged. Before you select a vendor for your next industrial computer design, carefully consider the factors that affect system performance, reliability, and longevity. A heavy metal enclosure may look the part, but without careful attention to the details described in this white paper, a system will not live up to the description industrial. Paying special attention to heat management, component selection, testing, and other factors described in this white paper will greatly increase the success of your next project.

Read the white paper: http://mil-embedded.com/white-papers/white-system-design-critical-applications/

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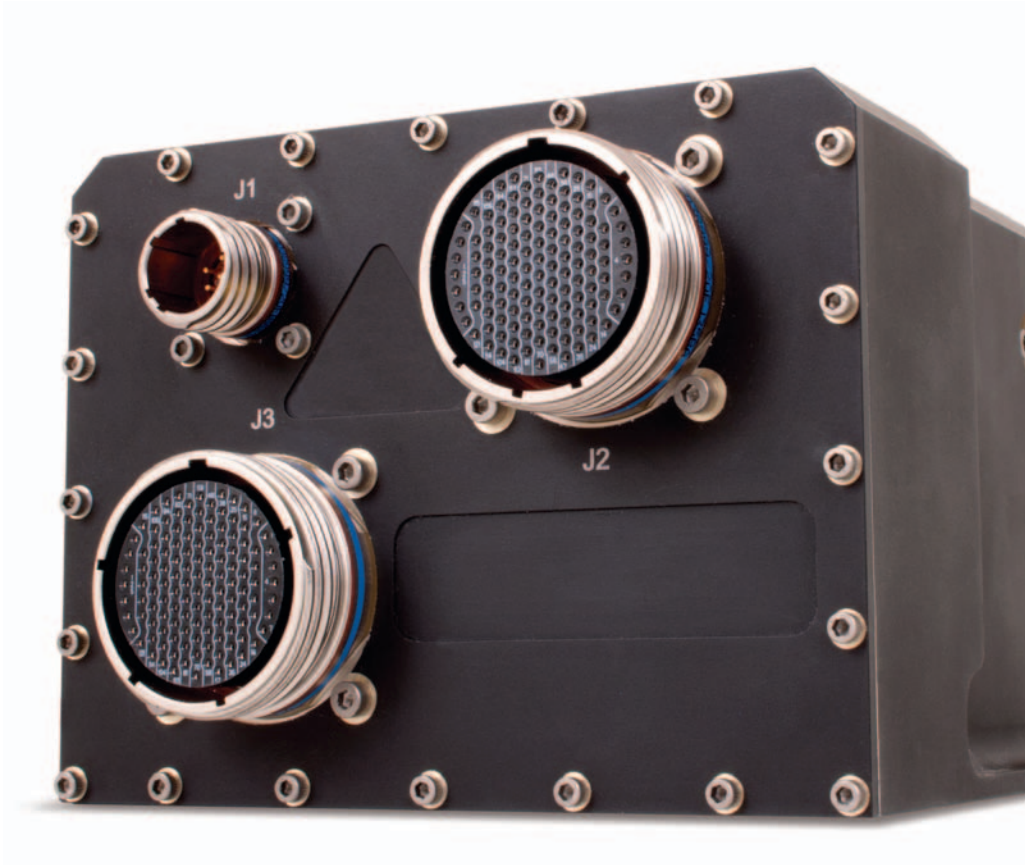

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