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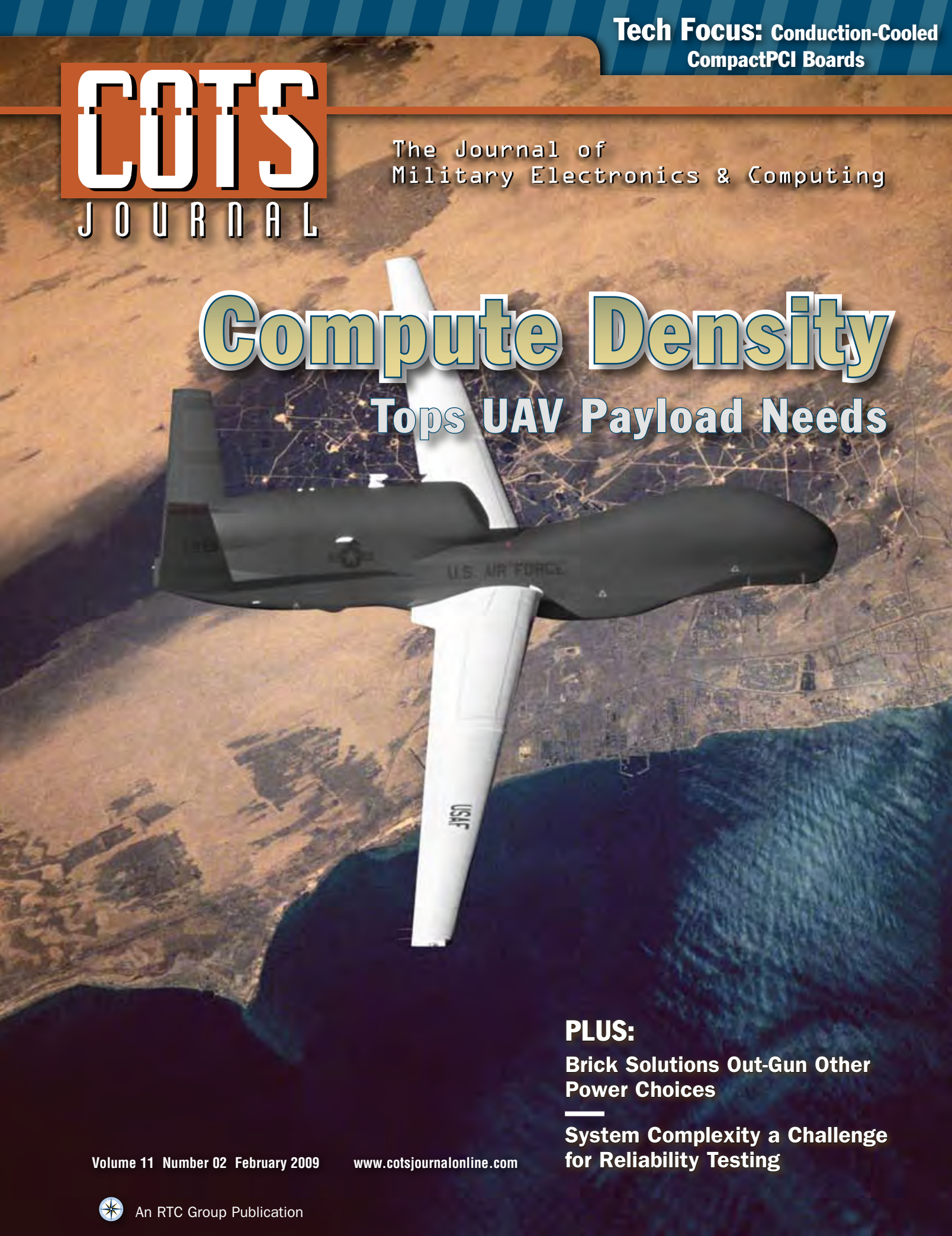
The Journal of Military Electronics & Computing

Tech Focus: Conduction-Cooled CompactPCI Boards

Compute Density Tops UAV Payload Needs



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Brick Solutions Out-Gun Other Power Choices

System Complexity a Challenge for Reliability Testing

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The Journal of Military Electronics & Computing

February 2009 Volume 11 Number 2

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COTS (kots), *n.* **1.** Commercial off-the-shelf. Terminology popularized in 1994 within U.S. DoD by SECDEF Wm. Perry's "Perry Memo" that changed military industry purchasing and design guidelines, making Mil-Specs acceptable only by waiver. COTS is generally defined for technology, goods and services as: a) using commercial business practices and specifications, b) not developed under government funding, c) offered for sale to the general market, d) still must meet the program ORD. 2. Commercial business practices include the accepted practice of customer-paid minor modification to standard COTS products to meet the customer's unique requirements.

——**Ant.** When applied to the procurement of electronics for the U.S. Military, COTS is a procurement philosophy and does not imply commercial, office environment or any other durability grade. *E.g., rad-hard components designed and offered for sale to the general market are COTS if they were developed by the company and not under government funding.*

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The Global Hawk UAV was responsible for acquiring over half of all time-critical data on air defense targets during Operation Iraqi Freedom (OIF). FPGA-based compute density is playing a role in MP-RTIP, a modular, active electronically scanned array radar system designed to be scalable. This radar is slated for the new RQ-4 Block 40 Global Hawk.

(Photo courtesy of Northrop Grumman)

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The Journal of Military Electronics & Computing

COTS Journal

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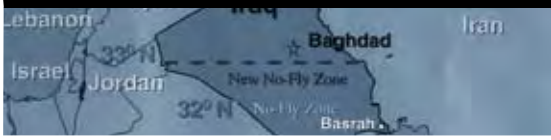

Lemmings, Outboards and Carriers

I've been told that I can be very opinionated, although I don't see it. I try not to follow trends like a lemming heading for the cliff—which is what I think many mainstream journalists have been doing for the last six months. Why weren't they pursuing or exploring warnings about impending problems that were issued by some experts to the public and Congress two years ago? It's like after 9/11. On 9/12 Congress wanted to hold a lynching party, but didn't want to admit its failure to act or fund requests to warnings that came long before 9/11.

So here I sit trying to get a pulse of the market to ensure the focus of *COTS Journal* stays on target. Daily, I'm talking to people and reading as many publications as I can about the military market—all in an effort to get a consensus view from as many sources as possible. More than 90% of the information I'm getting says that the military embedded computer market won't see any overall change for at least the next 18 months—no change resulting from action by the Administration or Congress, that is. No one really wants to speculate beyond the 18 months because everyone's waiting to get a feel for the Administration's post-election plans and abilities. After a change in administration or Congress, political commitments by everyone running for election result in some shuffling of the deck chairs with respect to military programs. So we will see that happening in the next 6 months.

One issue that only a few people are commenting on is the effect that the general economic climate may have on the embedded mil market. If we have layoffs, cut backs and plant closures in the general electronics industry, that will affect the military market. The military still relies heavily on what mainstream electronics would call "older technology." The larger wafer dice in the semi industry are one example. They're easier to package and harden for producing products that perform in extreme temperatures. In all this downsizing and cost-cutting, the older facilities and fabs are the ones that will be taken off-line and closed at a much quicker pace than we've seen in the past. So any last-time buy opportunities will be almost instantaneous. Companies that buy these wafers for speculation and hold on to them for future hardening and packaging may be much less eager to fund inventory purchases in the current economic climate. We will see this trend of trimming in all but the most productive process throughout the supplier chain.

Now that I've dragged you all into deep depression, let's see if we can all cheer each other up by considering some possibilities that may really have a very positive impact in our marketplace. Secretary of Defense Gates is a strong proponent of modernizing the military. That doesn't mean he's pushing for DDG-1000s, F-22s or FCS. Like Don Quixote, he's trying to get the old guard military leaders to accept the fact that their future concern will less likely be a peer-to-peer conflict, but rather more of the same we are encountering in Afghanistan. And, like it or not, the U.S. will be the country engaging these situations. Irrespective of how hard the new administration reaches out for closer ties and support from our allies and other nations, their response will be token at best. The rest of the world has become very aware that, when it comes to causes that we wish to pursue, we will carry the burden if they hold back.

Gates is also very aware of and concerned over the Pentagon's procurement philosophy of getting twice as much technology as a trade-off for half as many systems. This process puts us on a path for doom. By working the increased technology trade-off for decreased quantity scenario to some stupid conclusion we get down to one hellacious system that can do everything. But a small number of such systems is no match when combating tens of thousands of 1960-era technology systems or street fighters with RPGs in city rubble. You can't get away from the fact that sheer numbers reach a point of being able to defeat the highest capability.

So how is this all good for the military embedded computer market? It means that we can see an increase in retrofits and upgrades of older and current systems ensuring the availability of a larger number of systems. And, if we find real wisdom in the Administration and its new appointees, and they push the old guard into changing, then we will also see the potential for newer and a greater quantity of less-leading-edge systems using more standard off-the-shelf type of technology. Development money will shift from extreme sophisticated technology for finding solutions to more practical problems using available technology. These systems will not be in quantities of a few but quantities of thousands. This takes us right back to higher standard production numbers being more profitable than developing an extreme product to produce just a handful.

This philosophical change to modernizing the military requires a mind-set change by the old guard leaders. Here's an analogy I've used many times before: This is like trying to turn an aircraft carrier with an outboard motor. This can be an impossible task for an administration that does not have a Congress supporting the effort. The new administration appears to have a good relationship with Congress now. But we'll need to see if it can move Congress to support any positive changes. Otherwise we end up with just another aircraft carrier outboard motor analogy. ▮▮

Pete Yeatman, Publisher
COTS Journal

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FIELD-READY

The Inside Track

Boeing Gets Contract to Add Virtual Radar to Navy T-45 Trainers

The Boeing Company received a $28.3 million contract on Jan. 21 for two Virtual Mission Training System (VMTS) retrofit kits that will integrate low-cost, realistic radar training into the U.S. Navy's T-45 Training System for undergraduate military flight officers (UMFO). Flight officers are the "backseaters" who operate weapons and electronic warfare systems.

This phase of the VMTS program, which follows a requirements-definition phase, is scheduled for completion in September 2011. It calls for Boeing to finalize design, procure hardware, modify two aircraft and flight-test the system. VMTS provides an unclassified, mechanically scanned tactical radar that simulates air-to-air and air-to-ground modes as well as weapons and electronic warfare. These functions can be networked between the participating aircraft and instructor ground stations. The system will provide in-flight training against virtual enemy aircraft, including cooperative training with both real and virtual aircraft. Boeing is currently under contract for 221 T-45 Goshawk trainer aircraft (Figure 1) and recently rolled out the 215th from its St. Louis assembly facility.

Figure 1

The Virtual Mission Training System (VMTS) retrofit kits will integrate realistic radar training into the U.S. Navy's T-45 Training aircraft.

Boeing Integrated Defense Systems
St. Louis, MO.
(314) 232-0232.
[www.boeing.com].

Mercury Selected to Provide TFLOPS of Computing for Radar System

Lockheed Martin has selected Mercury Computer Systems to provide massive computing density and bandwidth for a new state-of-the-art radar system. Lockheed Martin's Scalable Solid State S-band Radar (S4R) engineering development model is an electronically scanned, active phase-array radar system designed to support multiple naval missions including air surveillance, cruise missile defense, sea-based ballistic missile defense, counter target acquisition and littoral, or shoreline, operations.

The S4R employs the compact, rugged Mercury PowerStream 7000 as the digital beamforming (DBF) signal processor, today's most advanced approach to phased-array antenna pattern control. DBF offers significant performance advantages over conventional analog beamforming, including the significantly increased radar timeline efficiency that is needed to support the simultaneous multi-mission capability.

Mercury Computer Systems
Chelmsford, MA.
(978) 256-1300.
[www.mc.com].

Quintron DICES IV Systems Used for Delta IV Launch

Quintron Systems supplied several of the critical communications systems for the recent Delta IV (Figure 2) launch operations, including launch audio (control room and pad areas), standard and infrared CCTV, and High-Speed Video. Quintron supplied a revised version of the pad area hazardous-operation communication station. This revision used reinforced internal integrated circuit carriers to provide increased resistance to loosening or damage due to the high energy levels experienced during a Heavy launch.

Figure 2

Quintron's DICES IV Systems were used for this recent Delta IV rocket launch at Cape Canaveral.

In addition, an expansion of an existing DICES IV audio system is in the final planning stages with ULA technical personnel. This project will provide expanded access in the Mission Director's Center, where many Air Force and other customer personnel participate in launch operations. A

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design enhancement to provide up to 48 key selections for these important ULA customers will be incorporated, along with a new user interface on existing computer monitors to simplify access and contribute to a more integrated work environment.

Quintron Systems
Santa Maria, CA.
(805) 928-4343.
[www.quintron.com].

General Atomics Test Shows Radar Able to Detect Slow Movers

General Atomics Aeronautical Systems announced that it has successfully demonstrated the ability to detect slow moving targets with a two-channel version of its Lynx Synthetic Aperture Radar (SAR). Its Dual Beam

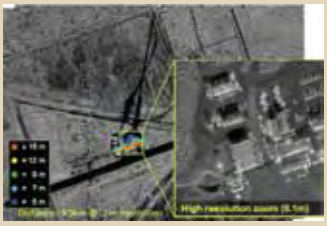

Figure 3

The IData HMI toolset will provide systems engineers a new way of developing graphical information shown on cockpit displays like this Merlin Mk1 helicopter.

feature enhances Lynx's GMTI (ground moving target indicator) (Figure 3) capability, enabling it also to identify 'slow movers' with greater precision accuracy than the existing configuration.

The Lynx radar was modified under the Defense Advanced Research Projects Agency's (DARPA's) Dual Beam Development Program. Under the program, a Space Time Adaptive Processing (STAP) upgrade to the baseline Lynx radar was developed in cooperation with BAE Systems to cancel the main beam GMTI clutter, thus enabling the detection of slow movers at tactically significant ranges. Flight tests confirm the Dual Beam Lynx radar's capability to perform STAP processing and detect actual and simulated movers in real-time.

General Atomics
San Diego, CA.
(858) 455-3000.
[www.ga.com].

Thermacore to Develop Active Heat Sink Technology

Thermacore has been awarded $9.5 million by the Defense Advanced Research Projects Agency (DARPA) for the development of Micro-technologies for Air-Cooled Exchangers (MACE). The successful development of this technology will significantly improve the thermal performance of military electronic systems such as telecommunications, active sensing and imaging, radar, and other platforms. The goal of the MACE program is the development and demonstration of micro-technologies that will enable thermal performance improvements and reduce electrical consumption of air-cooled heat exchangers. The MACE program is a two-phase effort designed to run 48 months through the fourth quarter of 2013.

According to Thermacore, conventional air-cooled heat sinks do not provide the necessary cooling for the existing or future high-performance DoD systems. Alternative cooling technologies such as pumped liquid cooling, spray cooling, submersion cooling and vapor-compression refrigeration cooling bring added complexity, fluid leakage concerns, long-term reliability problems and increased cost. At the completion of this program, Theramcore expects to enable these high-performance DoD systems with innovative air-cooled technologies rather than the more complex and costly alternative cooling technologies.

Thermacore
Lancaster, PA.
(717)569-6551.
[www.thermacore.com].

Lockheed Martin Selects Quantum3D for Avionics Display Solutions

Lockheed Martin selected Quantum3D's IData Human Machine Interface (HMI) toolset to support the simulation and embedded display of graphical information shown on cockpit displays. The IData HMI toolset will provide systems engineers at Lockheed Martin Systems Integration in Owego, NY, and at its facility in Havant, UK, with a breakthrough approach to developing graphical information shown on cockpit displays.

Figure 4

The Lynx SAR/GMTI system has a dual beam feature that lets it detect slow moving targets.

Instead of employing outdated code generation methods, the IData toolset outputs data defining the HMI's graphics and behavior.

This approach can significantly reduce the time and expense in each phase of the embedded display lifecycle, from prototyping and simulation through development and deployment of the embedded target application. The tools re-define how HMI rapid prototyping can be done by allowing engineers to try new HMI behaviors and "looks" without ever stopping the target system or needing to recompile code. Lockheed Martin Systems Integration in Owego will use the HMI toolset to more rapidly develop tactical and situational awareness information that is graphically displayed to military pilots and crew aboard a range of rotary wing and fixed wing aircraft, including the Merlin Mk1 helicopter (Figure 4).

Quantum3D
San Jose, CA.
(408) 361-9999.
[www.quantum3d.com].

COTS Websites

www.onvia.com/resourcecenter

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Onvia
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Special Feature

Slot-Cards in Large UAVs

FPGA Boards and Systems Boost UAV Payload Compute Density

With a goal toward improving radar capability, image processing and overall mission autonomy, developers of Large UAV payloads are shifting to FPGA-based computing solutions.

Jeff Child,
Editor-in-Chief

Large UAV platforms—like Global Hawk, Predator, Fire Scout, Taranis and others—have a seemingly endless appetite for greater onboard compute density. The payloads aboard those systems are enabling ever greater autonomy for the UAV and its mission. The movement is toward more capable radar systems that fit into the same space, and in some cases more compact radar electronics to make room for other payload electronics.

Next-generation UAVs have shifted their internal architectures from a scheme of multiprocessing of big, power-hungry boards based on general-purpose processors to a strategy of relying on more integrated boards sporting powerful DSP-capable FPGAs. The original Global Hawk, for example, embedded around 40 processor boards. At least 30 of those boards were replaced by a couple of FPGA-based cards.

It isn't just straight processing integration that the FPGAs provide. They're most efficient at the DSP-kinds of functions done on board like radar processing and SIGINT. When the earlier version of Global Hawk used a multicomputer system made up of only general-purpose processors, it was inefficient when it came to many of the computing tasks. By instead letting FPGAs concentrate operations like repetitive convolutions—such

Figure 1

For Northrop Grumman's MP-RTIP Radar System Level Performance Verification (RSLPV) flight testing, the radar sensor will be flown on the company's Proteus aircraft as a surrogate for the first Block 40 Global Hawk.

as data reduction and manipulation—the general-purpose CPUs are off-loaded to focus on data-dependent control operations, which they're good at.

Modular Radar System

An example of where this FPGA-based compute density is playing a role is the Multi-Platform Radar Technology Insertion Program (MP-RTIP). The MP-RTIP is a modular, active electronically scanned array radar system designed to be scaled in size so that it can be carried on board different platforms. Mezzanine form factors like PMCs and XMCs are well represented in the MP-RTIP program.

Earlier this month Northrop Grumman got approval to begin a portion of MP-RTIP Radar System Level Performance Verification (RSLPV) flight testing. The approval comes following a successful test readiness review for the MP-RTIP sensor's Synthetic Aperture Radar imaging mode. This radar is slated for the RQ-4 Block 40 Global Hawk currently in production. The goal of the RSLPV test program is to verify that the radar meets operational requirements established by the Air Force, including Synthetic Aperture Radar (SAR) Spot image capabilities, SAR Swath imaging wide area capability, and Ground Moving Target Indicator (GMTI) capability to detect and track moving vehicles on the ground.

For RSLPV, the sensor is being flown on Northrop Grumman's Proteus aircraft (Figure 1) as a surrogate for the first Block 40 Global Hawk. By verifying sensor performance on Proteus, the sensor testing has progressed without impact to production, significantly lowering the risk with regard to the Global Hawk's operational capability. The first Block 40 Global Hawk, AF-18, has been built at Palmdale, CA, and is undergoing testing in preparation for its first flight later this year.

Cooling Enables Use of Faster Processing

Another method of boosting compute-density aboard large UAVs is the concept of using advanced cooling solutions that enable integrators to use boards that are less environmentally rugged in and of themselves. The problem can be addressed by using sealed, air-conditioned or pressurized compartments. These include both the U-2 Dragon Lady (ASIP program—Air Force Signals Intelligence Payload) and RQ-4 Global Hawk UAV. In both cases, alternative cooling solutions were needed to accommodate the upgrades. Meanwhile, other UAV platforms such as the MQ-1 Predator and MQ-9 Reaper don't have any conditioned space, yet they had similar requirements for improved sensor capabilities and their designers likewise wished to leverage existing air-cooled board sets. The article "UAVs Embrace the Benefits of Direct Spray Cooling" in this section discusses how direct spray cooling enclosures help solve those problems.

Last summer Northrop Grumman's ISR Systems Division awarded SprayCool a contract to provide its liquid-cooled enclosures for the ASIP-1C program. The SprayCool enclosures will house SIGINT electronics for the Air Force's SIGINT-equipped MQ-1B Predator UAV (Figure 2) in support of Predator's tactical warfighting role, sometimes described as a hunter/killer/scout mission. Under this contract, the SprayCool Multi-Platform Enclosure (MPE) was selected as a component in the ASIP-1C sensor payload for SIGINT-equipped Predator aircraft.

Figure 2

The SIGINT-equipped MQ-1B Predator will be among the UAVs that will use a liquid-cooled enclosure for its ASIP-1C sensor payload.

One trend that exemplifies the U.S. military's direction for large UAVs is a move toward payloads that enable ever greater autonomy for the UAV and its mission. This includes doing more of that processing on the UAVso that a more refined set of information can be transmitted to war fighters on the ground. Traditionally almost all UAV-captured data has been transmitted to the ground and processed for interpretation and decision making. By boosting onboard processing muscle, UAVs should be able to relay the results of their data to the ground for decision making. The benefit is reduced reliance on data link rates in certain applications, particularly imagery collection.

Figure 3

The MQ-8B Fire Scout UAV is shown here with the new Airborne Surveillance, Target Acquisition and Minefield Detection System (ASTAMIDS). Aboard a Fire Scout, the ASTAMIDS can detect the presence of minefields and sight enemy locations without putting a single soldier at risk.

If processing of data and decision making can be performed on board the UAV itself rather than via a communication link with the ground, the more efficiently the craft can be used.

Onboard Image Processing

Along those lines, SRC Computers last fall shipped the first onboard signal data processor (SDP) for Lockheed Martin's Tactical Reconnaissance and Counter-Concealment Enabled Radar (TRACER) program. Using dual-band low frequency synthetic aperture radar, TRACER can immediately downlink images and processed results from Predator-class UAVs to ground units in all-weather, day or night conditions.

SRC's system features an architecture that provides compute-intensive reconfigurable processing in a compact form factor. It allows users to execute existing code, or easily develop and compile new code, to take advantage of the power of the reconfigurable MAP processors in the system. The SDP is comprised of a multi-MAP system that weighs 80 pounds and consumes less than 600W of power while being functionally equivalent to about 100 Power PCs for this application.

Another UAV that relies heavily on slot-card boards is the Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV). While not technically a Joint Army/Navy program, the two branches are cooperating closely on it. The Army has selected Fire Scout as its Class IV UAV for its Future Combat Systems program. The Navy version, much further along in its development, achieved first flight in January 2006. The event marked the first time a UAV performed vertical landings on a moving ship without a pilot controlling the aircraft. Embedded computers and the payload interface unit aboard the MQ-8B Fire Scout are 3U CompactPCI boards supplied by GE Fanuc Intelligent Platforms.

Payload Tests for Fire Scout UAV

Last fall Northrop Grumman accomplished a pair of key system test flights with its company-owned MQ-8B Fire Scout. In October it flew its new Airborne Surveillance, Target Acquisition and Minefield Detection System (ASTAMIDS) (Figure 3) for the first time aboard a UAV. Using a tactical common data link, the company team at the developmental Tactical Ground Segment, a ground-based payload control center, successfully operated the Payload Command and Control and Imagery Data Collection systems in ASTAMIDS while it was airborne. The test showed how a Fire Scout can carry ASTAMIDS far beyond the point of U.S. ground forces to detect the presence of minefields and sight enemy locations without putting a single soldier at risk.

In other tests, Northrop Grumman demonstrated continuous combined payload coverage on its MQ-8B Fire Scout by successfully downlinked simultaneous digital video from both a Telephonics RDR-1700B multi-mode maritime radar and a FLIR Systems, Inc. Star SAFIRE(r) III electro-optical/infrared sensor using its tactical common data link developed by Cubic Defense Applications. The multi-sensor Star SAFIRE(r) III provides domestic and international customers a state-of-the-art capability for meeting real-time video requirements for electro-optical and infrared imagery. The successful 40-minute flight took place at the Yuma Proving Ground in Arizona. ▮▮

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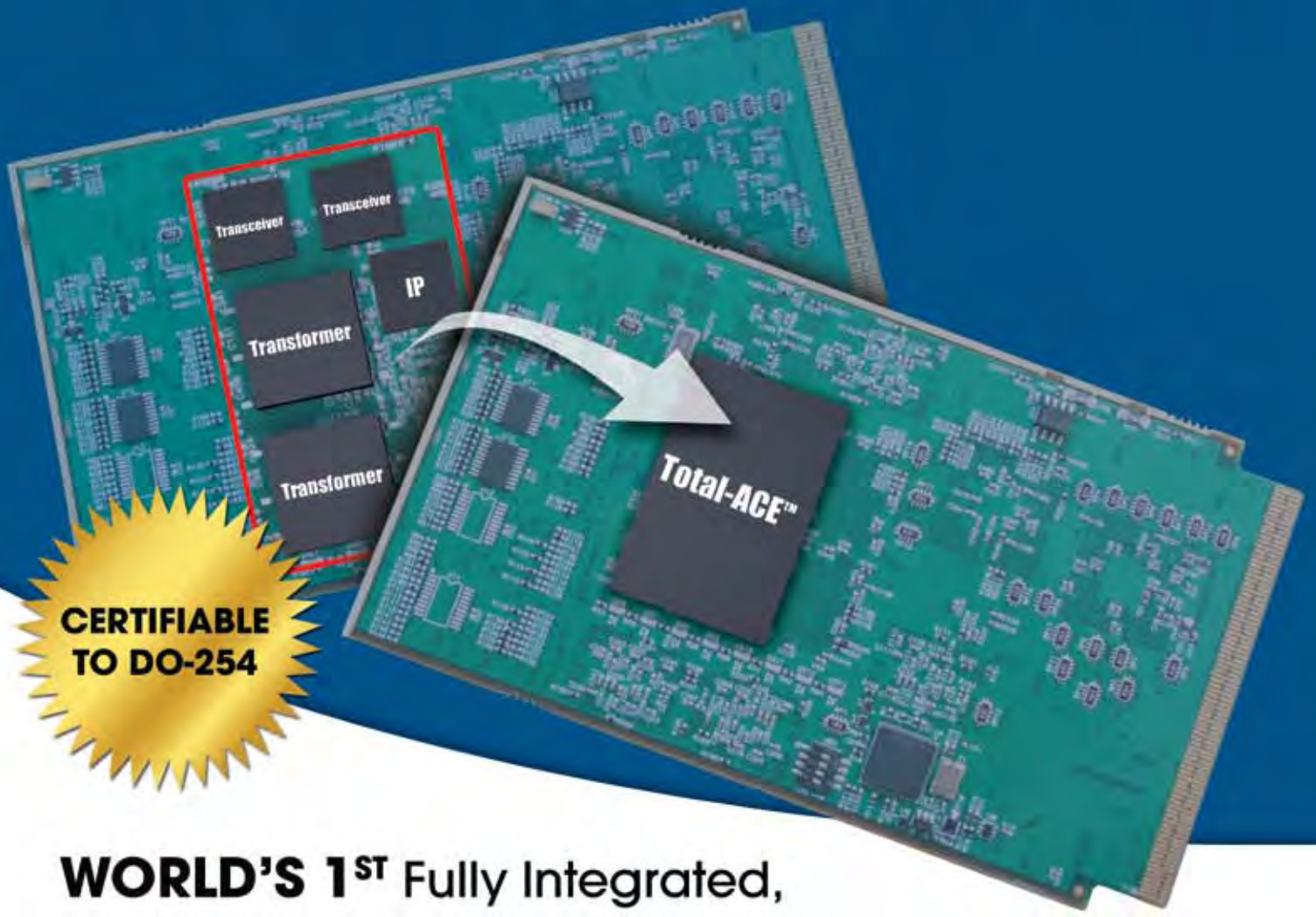

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Val Zarov, Senior Program Manager
Curtiss-Wright Controls Embedded Computing

The military's rapid move toward IP-based, network-centric architectures is driving a number of design considerations for current and next-generation embedded COTS subsystems deployed on Unmanned Aerial Vehicles. The push toward network-centric architectures is speeding the adoption of these UAV platforms and newer data communications interfaces such as Gbit Ethernet, PCI Express, Serial RapidIO, and with discussion about migrating over to 10 GigE in the future. Many of the newer payload sensors are designed with high-speed ports to quickly transfer high-density data that's captured during mission in real time. At the same time, practical budgetary reasons for supporting slower legacy interfaces such as 1553 on the protocol level to protect software application development investment encourages continued but transitional support of earlier, slower aerospace interface standards.

During this period of transition away from legacy interfaces, UAV system integrators have taken a "best of both worlds" approach by, for example, supporting the simulation of 1553 over Gbit Ethernet and other high-speed interfaces. This encapsulation approach enables the system to utilize the entire 1553 structure and retain the software hooks that have already been built, tested and qualified for in-flight applications.

Figure 1

The Sensor Management Unit subsystem aboard the Global Hawk UAV supports Gbit Ethernet and a high-speed Fibre Channel link while interfacing with legacy interfaces such as 1553, RS-422, ECL and Fast Ethernet. The SMU acts essentially as an interface fusion box, routing various interfaces and fusing them together.

In anticipation of future requirements related to network-centric architectures, next-generation UAV subsystems are being built today that incorporate the hardware piping that will utilize IP packet data in the upcoming future. This anticipatory step, essentially laying down high-speed "cables" while retaining support for application code that was written in legacy protocols, will ease the transition into adopting complete network-centric communications methodologies, including support for IPv6, when budgets allow and requirements demand the evolution.

As an example, Curtiss-Wright's SMU (Sensor Management Unit) (Figure 1) subsystem deployed aboard the Global Hawk UAV provides a fully modern platform with the capability to support Gbit Ethernet and High-Speed Fibre Channel links while interfacing with legacy interfaces such as 1553, RS-422, ECL and Fast Ethernet. In this way, the SMU works essentially as an interface fusion box, routing various interfaces and fusing them together.

The SMU's fully ruggedized aluminum chassis has also evolved from the original version (utilized in Global Hawk Block 20), adding significant ca-

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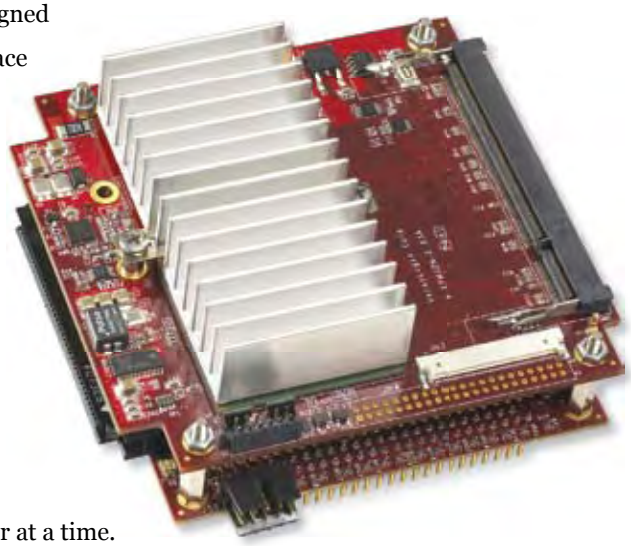

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pacity for system expansion (planned for BAMS Global Hawk) while addressing demanding environmental requirements. Helping to drive this evolution has been an increased demand for modularity and scalability. UAV system integrators are being called on to enable both scaling up and scaling down of particular subsystems as required by the mission and payload configuration of other UAV platforms. This trend has driven designs to utilize VPX-based I/O-centric processors with multiple and widely supported high-speed fabric I/O interfaces and expandable high-bandwidth memory. Subsystems for the BAMS variant of Global Hawk, for example, will most likely include similar features.

Going beyond the idea of interface fusion, another new trend in UAV subsystem design is the requirement for data fusion. In data fusion, sensory data is fused with control data, enabling a subsystem to take image, radar, audio or inertial data and from it derive a control signal to a particular module. For example, BAMS Global Hawk (Figure 2) may be used by National Oceanic and Atmospheric Administration (NOAA) to study development of tropical depressions.

Figure 2

Air Force maintainers perform maintenance on a Global Hawk UAV at Edwards Air Force Base, Calif. As part of the Combined Test Force, members of the 31st Test and Evaluation Squadron test drive the Global Hawk system for the Air Force.

For this project, the UAV will fly above the tropical storm and drop temperature and pressure sensors into the weather depression. The idea here is to employ data fusion and artificial intelligence algorithms to autonomously deploy sensors at the exact time and location without human interaction. The image and other sensor data is fed to the Sensor Management Unit, where the data is processed and appropriate control signals are generated to deploy a particular payload.

Net-Centric Architectures

Another trend in UAV subsystem design is being driven by the adoption of network-centric architectures and the move toward higher bandwidth computing architectures. Today's UAV subsystems frequently utilize VME and/or CompactPCI-based architecture and the growing VITA 46 architecture. Curtiss-

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Wright's SMU, for example, employs a hybrid architecture that supports multiple bus types. To support network-centric methodologies that support multiple COTS processors and system scaling, system integrators want to move away from buses such as CompactPCI, which require a single processor to function as a host, controlling a number of slave boards.

The CompactPCI/VME model, in which the system controller (host) manages all other subsystem cards, burdens the host with processing that could otherwise be spread around different processors. This requirement is driving next-generation UAV subsystems to utilize fabric interconnect architecture, which does not require a dedicated system controller. Next-generation SMU will utilize Gbit Ethernet, PCI Express and Serial Rapid I/O for interboard/interconnect in a VPX form factor to achieve higher bandwidth requirements of a network-centric subsystem.

Unlike CompactPCI and VME, VPX advanced connectorization has the physical bandwidth to support dedicated pins for fabrics such as Gbit Ethernet, PCI Express and SRIO, which will enable the parallel processing and shared memory arrangements needed to meet heavy processing demand in a network-centric architecture in the future. An additional advantage of the VPX form factor backplane is that it provides a standard approach to wiring for Gbit Ethernet and other fabric I/O, defining and reserving particular pins for future growth and board interchangeability to address scalability/modularity and provide physical architecture for obsolescence management. This enables integrators to add or upgrade VPX boards for system expansion or upgrade, to achieve higher processing or add more memory, for example, without having to change the subsystem backplane or invest in costly system redesign.

UAVs: Critical Platforms

UAVs are increasingly critical platforms, both in theatres of combat and for national security, including response to natural disasters here at home. The Global Hawk, for example, played a key role in helping to locate hotspots to get fire fighting teams where they were most needed quickly, minimizing the spread of damage during recent forest fires in California. As they become more fully integrated into today's rapidly evolving network-centric architectures, the valuable data they can capture and distribute will deliver immeasurable dividends. ▮▮

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UAVs Embrace the Benefits of Direct Spray Cooling

By enabling the use of non-rugged boards in harsh environments, direct spray-cooled enclosures are opening the door to more powerful embedded processing aboard large UAVs.

Dan Kinney, Director of Business Development
SprayCool

It goes without saying that Unmanned Aerial Vehicles (UAVs) are playing an ever expanding role in today's military operations. Not only are the numbers of UAVs exploding, but the capability that these aircraft can provide is growing at an even faster pace. Long gone are the days of just downloading pictures taken from UAVs. Today's UAVs carry an assortment of situational awareness capability including electro-optical/infrared (EO/IR) full-motion video sensors, signals intelligence sensors, video downlinks, self-protection systems, and "Blue Force" tracking systems to name a few. In fact, some UAVs have offensive capabilities including precise targeting systems and even missiles in some cases. This incredible capability has driven the demand for increased processing capability aboard the UAVs. Complicating matters, UAVs are predominately unpressurized and that challenges integrators to either ruggedize all the electronics or to isolate the more sensitive electronics from environmental extremes.

Figure 1

Large UAVs such as this Reaper UAV have extremely limited environmentally controlled space to install electronics. This forces integrators to look to alternative cooling solutions such as direct spray.

Off-the-shelf boards that target niche functions have either an air-cooled or conduction-cooled variant, but not always both. As a result, going with either an air-cooled or a conduction-cooled enclosure fails to accommodate the inevitable mix of cards. What's needed is a way to make less-rugged electronics possible to use on

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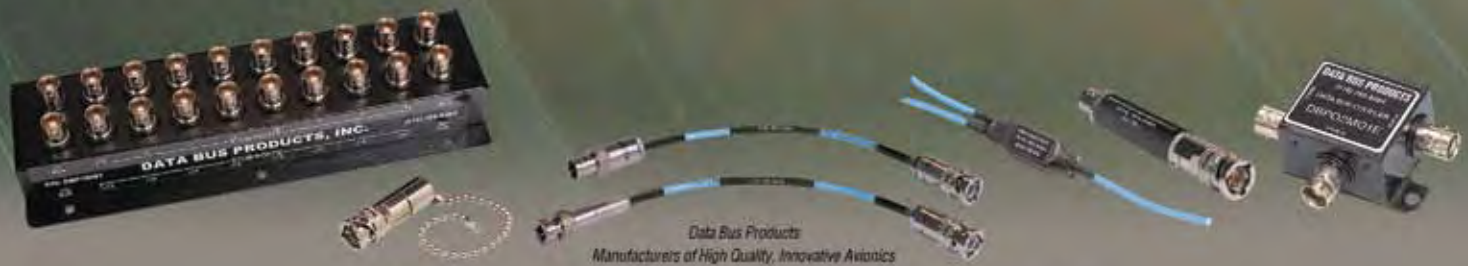

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unconditioned platforms. That entails a new approach to environmental isolation.

Deploying commercial-grade electronics in harsh environments brings a lot of advantages for military system integrators. These include reduced lifecycle costs, access to and faster sourcing of readily available technologies, and the reliability that comes with high-volume production.

Existing and emerging applications running on military embedded systems are demanding ever-increasing computational power and communications bandwidths. For example, UAVs running signal intelligence systems or executing real-time image processing are driving impressive power densities at the board, chassis and platform levels. At the same time, platform integrators are requiring smaller, lighter and more efficient board and chassis-level products.

Figure 2

Northrop Grumman's Airborne Signals Intelligence Payload (ASIP) program uses direct spray cooling technology. This ASIP-1C box for the Predator makes heavy use of FPGA computing.

The situation is compounded due to the fact that these new aircraft are "unmanned." The ability to move warfighters out of harm's way is a critical benefit provided by UAVs. However, this has lead to the elimination of environmental control systems (ECS) that were largely put in place for crews. These large systems once provided electronics with a more benign and controlled environment. Today's large UAVs such as RQ-4 Global Hawk and MQ-1 Predator have extremely limited environmentally controlled space to install electronics. Therefore, platform integrators are forced to look for alternative cooling solutions. Increasingly, direct spray is being viewed as an acceptable alternative to air-cooling.

ASIP Family of Sensors

One program that is deploying direct spray systems from SprayCool is the Air Force's Airborne Signals Intelligence Payload (ASIP) program. ASIP is the next-generation signals intelligence sensor developed by Northrop Grumman. The system detects, identifies and locates radar and other types of electronic and modern communication signals. The sensor first flew on RQ-4 Global Hawk in 2005 and last year completed extensive qualification flights on the U-2 Dragon Lady.

In addition to U-2s and Block 30 Global Hawks, the Air Force is now pursuing scaled versions of the ASIP for Predator and Reaper UAVs (Figure 1).

SprayCool chassis have enabled Northrop Grumman to install their high-end signals intelligence payload in unpressurized and uncontrolled environments (pods on the U-2 and unpressurized bays within the Global Hawk and Predator family of aircraft). For these applications, board count has not necessarily been reduced, but the performance and capability of the board sets have increased. The ability to configure dedicated hardware with task-specific software using FPGA and DSP products for a wide variety of applications was attractive to Northrop Grumman. In fact, commercially available FPGAs are used extensively in the ASIP-1C system (Figure 2) for the Predator.

Direct Spray Solution

In practice, direct spray systems operate similarly to other more common, less capable liquid-cooling systems. For all systems there are three fundamental functions of a cooling system: Heat acquisition, heat transport and heat rejection. Heat acquisition is accomplished by spraying a fine mist of non-conductive and non-corrosive coolant with atomizers directly onto electronics or within a cold plate. As the coolant vaporizes, heat is transferred from the electronics to the fluid-vapor mixture. Transport occurs when heat is moved away from the electronics to the heat exchanger.

Finally, heat rejection is accomplished via the heat exchanger that rejects the thermal load to ambient air or platform fluid. Several fluid options for heat rejection on military vehicles include Polyalphaolefin (PAO), fuel, engine bleed air, an Ethylene Glycol and Water (EGW) mixture, or ram air. System components are often connected by drip-less "quick disconnect" fluid connectors for ease of maintenance or reconfiguration.

Controlled Temperatures

Temperatures within SprayCool chassis are controlled to provide a stable operating environment for the electronics. This is accomplished through the combination of internal heaters and/or heat generated from the electronics and modulating the amount of fluid sent to the heat exchanger. This enables the use of off-the-shelf hardware at temperatures ranging from -65° to +71°C in the case of ASIP on Global Hawk.

Direct spray enclosures support the trend for more processing payloads co-located with the sensors on air platforms, especially for unpressurized, SWaP-constrained large UAVs. The ability to integrate and deploy commercial-grade electronics in extreme environments affords procurement lead time advantages and cost savings. ▮▮

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Brick Power Solutions: Still the Best Choice for Military Apps

As the consumer electronics realm moves to IC-based power solutions, the attributes of power converter bricks are still the best option for military applications.

Keith Nardone, Director Business Development, Aerospace & Defense, Vicor

The first generation of compact, high-power-density DC/DC converters using new technology and innovative packaging was introduced in 1984. This technology redefined converter standards for size, performance and reliability. The converters were packaged in a modular form factor, commonly referred to as a brick. This new building block approach simplified power system design and reduced the time it took to bring a product to market.

All that said, today—a full quarter century after their introduction—bricks are still being specified for many applications, commercial and military. But the attributes of bricks are especially well suited for military applications. These high-density power components have earned acceptance in military and defense applications where high performance, reliability and low cost are critical.

A Variety of Brick Formats

DC/DC converter modules (Figure 1), commonly referred to as bricks, are available in a range of sizes and formats—half bricks, quarter bricks and so on. Manufacturers of high-density DC/DC converters are providing power system architects with a wide range of choices. These converters—usually characterized by high-frequency operation allowing them to achieve their small size, high power density and efficiency—come in thousands of combinations of input voltage, output voltage and power level. Such a modular DC/DC converter, in combination with discrete components, can satisfy many unique power requirements. Because each module is a proven, prequalified performer, designers using these converters enjoy an advanced starting point toward a finished power supply.

Figure 1

DC/DC converters come in a number of physical sizes and a wide range of input and output voltages and power levels that satisfy a multitude of requirements.

Although the military commonly uses input voltages of 28 VDC for ground vehicles (Figure 2) and 270 VDC for airborne systems, modular components come in a great range of different voltages, powers and physical sizes. Modular components used for military applications satisfy other input characteristics as well, including low- and high-line conditions and the capability to handle voltage spikes, surges and excessive input ripple. Available output powers range from tens of watts to kW, from single outputs to 40 outputs. Most high-density DC/DC converter modules are qualified to stringent environmental requirements, and some standard bricks—those that are fully encapsulated—handle high-g forces. The building-block design approach is flexible, cost-effective and offers quick turnaround and reliable performance.

At one time designers had to supplement the capabilities of modular DC/

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Figure 2

The military uses input voltages of 28 VDC for ground vehicles like this Humvee, and 270 VDC for airborne systems. Most high-density DC/DC converter modules are qualified to stringent environmental requirements, and some standard bricks handle high-g forces.

DC converters by using discrete components to implement auxiliary power system features such as AC/DC rectification, filtering, power factor correction and so on. That option is still open to them, but now specialized accessory components are increasingly available. Together with the power components, these matched, compatible accessories—such as filters, holdup capacitors, heat sinks and AC front ends—allow users to quickly assemble complete power systems by selecting and interconnecting standard, modular parts to meet their design requirements. Compatible front-end accessories, for example, provide a number of performance features such as input transient protection, EMI filtering and inrush current limiting (Figure 3). In addition, they have international agency approvals and can accommodate the wide range of input source voltages necessary to reach worldwide defense markets.

DC/DC converters intended for military use typically satisfy U.S. Department of Defense definitions for non-develop-

ment items and off-the-shelf equipment. They meet key military performance specifications for input power quality (MIL-STD-704, 1275, 1399), EMI levels (MIL-STD-461), environmental requirements (MIL-STD-810, 202) and component derating. Full encapsulation of the "brick" package enables the modules to withstand severe environments of humidity, fungus, salt fog, explosive atmosphere, acceleration, vibration and shock.

Mature and Proven Technology

As a mature technology, bricks may not always be the first choice for some power designers, but they are a proven technology and a cost-effective, low-risk, quick way to get to market solution for these power engineers. Consider a few of these brick attributes individually:

Time to market. Bricks are the clear choice over a custom, discrete approach when time to market is an important criterion. Development time is shorter, less expertise is needed, and the modules represent an advanced starting point toward a final power solution. The power supply designer can even obtain rapid delivery of small prototype quantities in the final form factor well before the system design is finalized.

Everybody—whether they are designing commercial or military products—wants to get their products out there quicker, but the military often puts a higher value on that capability. In the case of the war in Iraq, for example, the model has been especially meaningful. Most of the power supplies used in support of the counter IED program utilize bricks—and were delivered in weeks, not years.

Mature trusted technology. Designers of military electronic systems have shown a preference for older tried and true architectures. The reasons are not hard to find: demonstrated reliability, long lifetimes, compatible accessories, experienced applications support. Bricks and brick-based power solutions offer rich options for designers of military power solutions. They're a good solution for a variety of aircraft and ground vehicle and naval applications, underwater-type applications, man-pack-type applications. These modular blocks are easy to use, provide the simplicity of plug and play, and can be put together to create a power system quickly.

Long time technical support. Obsolescence is always a big issue for military system desginers. Typically, a military program takes several years to get going and once finished is often in the field for several years. Support is going to be required. Businesses that are driven by hot new technologies may well offer commercial products, too. But many of them

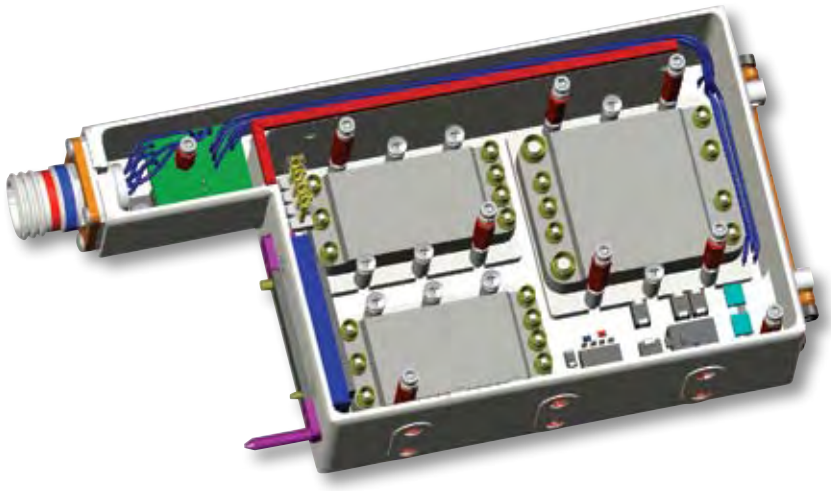

Figure 3

Shown here is a half-brick input filter with two 100W quarter bricks for a 28 VDC system.

are focused on the short term, including how long they will support their products. The proven brick technology with its onshore manufacturers already has a very long track record, which gives confidence that it is likely going to be here for the long haul. Incidentally, power component manufacturers in the MIL-COTS arena typically make their products onshore as opposed to those in the commercial arena that tend to be offshore. They also tend to be more financially stable.

Custom solutions. Brick manufacturers offer multiple sizes, common platforms with common components used within those platforms, and a large mix of customer-selectable voltages and powers to satisfy unique requirements. What's more, mass customization is now a reality. An online suite of an advanced power design tool is in place that enables power designers to specify and verify the performance and attributes of custom power design solutions in real time.

And bricks are quite easy to modify and semi-customize, which is a big part of the business. A big semiconductor company, for example, is unlikely to want to modify a semiconductor to suit a particular application for a defense contractor, which will buy quantities in tens, not tens of thousands.

Reliability. Reliability of high-density modular DC/DC converters continues to improve, with MTBFs being quoted in the hundreds of years.

In addition, for mission-critical applications, fault tolerance with bricks can be achieved by redundancy. That entails using at least one extra, or "redundant" converter in the system. Such a system of converters is commonly referred to as an N+M array, where N converters are required to satisfy the power requirements and M additional modules provide redundancy. All modules in the array must be capable of supplying undisturbed power in the event of shutdown or failure of one module, in spite of the sudden change in load current demanded of each. To satisfy these criteria, it is essential that the individual converters share the load current in order to minimize the dynamic response required of each. Bricks typically load share automatically.

Cost-effective. Although discrete components may have a cost advantage on a per-component basis, the cost-effectiveness of bricks versus discrete components is a real advantage. The power solution using discrete components requires the application—assuming the availability—of hard-to-come-by analog engineering man-hours. Such custom power solutions are usually expensive and risky and they require long lead times. Bricks reduce the long lead time and the risk, and they've already been qualified to meet these MIL standards, so final qualification can be reduced significantly. ▮▮

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Expansion Bus	PC/104 ISA Bus	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI-104 PCI Bus	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
	PCI Bus Masters	4	4	4	4	4		4	4	4	4	4	4		4
	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9	9	9	9	9	9		
CPU and BIOS	CPU Max Clock Rate (MHz)	1400	1400	1400	1400	1400	650	400	650	400	650	400	650	500	500
	L2 Cache (KB)	2048	2048	2048	2048	2048	256	256	256	256	256	256	256	128	128
	Intel SpeedStep Technology	✓	✓	✓	✓	✓									
	ACPI Power Mgmt	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0
	Max Onboard DRAM (MB)	512	1024	1024	1024	1024	512	512	512	512	512	512	512	512	512
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RTD Quick Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	ATA/IDE Disk Chip (MB)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
	Audio		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS				TTL	TTL	LVDS	LVDS	LVDS	
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	**RS-232/422/485 Ports**	4	4	2	4	2	2	2	2	2	2	2	2	2	2
	USB Ports	4	2	4	2	4	2	2	2	2	2	2	2	2	2
	10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1	1	1	2	1
	ECP Parallel Port		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO (Advanced Digital I/O)	14	18	18	36	36	18	18	18	18	18	18	18	18	18
	multiPort (aDIO, ECP, FDC)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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Bus	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA				ISA	ISA		PCI				ISA		PCI	ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
Analog Input	Single-Ended Inputs	16	16	16	16	16	16	16	16							
	Differential Inputs	8	8	8	8	8	8	8	8							
	Max Throughput (KHz)	1250	1250	500	100	1250	500	500	500							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Input Ranges/Gains	3/7	3/7	3/4	1/4	3/6	3/3	3/3	3/3							
	Autonomous Calibration	✓	✓													
	Data Marker Inputs	3	3	3		3										
Conversions	Channel-Gain Table	1K	1K	1K	1K	1K	1K	1K	1K							
	Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓	✓	✓							
	A/D FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Sample Counter	✓	✓	✓	✓	✓	✓	✓	✓							
	SyncBus	✓	✓			✓	✓	✓	✓							
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	16	48	18/9	64	48	48	48	48
	Bit Programmable I/O	8	8	8	8	8	8	8	8	24	6/0		48	48	48	✓‡
	Advanced Interrupts	2	2	2	2	2	2	2	2	2			2	2	2	✓‡
	Input FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Versatile Memory Buffer												4M	4M	4M	8MB
	Opto-Isolated Inputs											48				
	Opto-Isolated Outputs											16				
	User Timer/Counters	3	3	2	2	3	3	3	3	3	3		10	10	10	6
	External Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓‡
	Incr. Encoders/PWMs										3/9		4/8	4/8	4/8	✓‡
Analog Out	Analog Outputs	2	2	2	2	2	2	2	2							
	Max Throughput (KHz)	200	200	200	100	200	100	100	100							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Output Ranges	4	4	3	1	4	5	5	5							
	D/A FIFO Buffer	8K	8K			8K	8K	8K	8K							

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Case Study: Box-Level System Undergoes MIL-STD-901D Shipboard Test

MIL-STD-901D testing includes subjecting electronic systems to explosive detonations that approximate a torpedo hit. Analysis of a rugged box-level system's journey through that process sheds light on a variety of key rugged design challenges.

Colin McCracken, Director, Technical Marketing
ADLINK Technology

Over the last few decades, embedded computers based on desktop PC electronics have penetrated the defense market. Interest is now building for shipboard PCs that can withstand saltwater spray, wide temperature, and powerful low frequency shock and vibration. Attempting to "ruggedize" a design-for-cost motherboard by shock mounting at the system level has been proven inadequate. The challenge is to leverage off-the-shelf computing components in a manner that can withstand the unique challenges posed by marine environments.

With that in mind, engineers at Adlink put a mid-performance rugged computing solution through MIL-STD-901D system testing. Consideration was given for how to mount electronic components while isolating from the external ambient conditions. In addition to the usual FCC and CE testing, marine electronics need to withstand a battery of MIL-STD-901D testing. The test methodology subjects electronic systems to explosive detonations that approximate a torpedo hit (Figure 1). The shock profile simply cannot be accomplished accurately in a typical test lab environment. The MIL-STD-901D Heavyweight Shock Test is the most important test for compliance with 901D in terms of ruggedness of the equipment design. The test consists of subjecting the electronics to four explosions or "shots" using explosives placed 24 feet under the water.

Figure 1

The MIL-STD-901D Heavyweight Shock Test is the most important test for compliance with 901D in terms of ruggedness of the equipment design. The test methodology subjects electronic systems to explosive detonations that approximate a torpedo hit.

The project began with a brute-force approach to addressing the shock requirements. A typical industrial motherboard was placed inside a rugged enclosure with shock mounting and watertight gaskets. Prior to the actual 901D validation, several systems were deployed aboard nautical vessels to give some measure of confidence. However, the systems did not operate reliably in the modest environment of pounding waves and engine vibrations, so these systems could not proceed to 901D testing. A new approach was required from the ground up.

With the sensitivity of the computer electronics to shock and vibration, the next approach consisted of an SBC designed for ruggedness from the ground up. A thicker-than-standard circuit board with superior fiberglass and solder materials was selected, and its vibration response over frequency assessed in combined temperature and vibration environments as part of a standard Highly Accelerated Life Test (HALT).

The vibration frequency response is shown in Figure 2. The unit under test (UUT), the Adlink LittleBoard 800 SBC with 1.4 GHz Pentium M processor, was running continuously during the test, with results logged to a device outside of the test environment. To prevent intermittent contacts, the processor was soldered (ball grid array package) instead of socketed. The 0.093-inch thick circuit board remained stiff, while standard 0.062-inch boards would flex considerably under this type of load and transmit stresses to the solder joints of electronic components. Without the careful selection of solder paste, joints can crack and break. Hairline fractures can be hard to observe and may not fail consistently under mild testing.

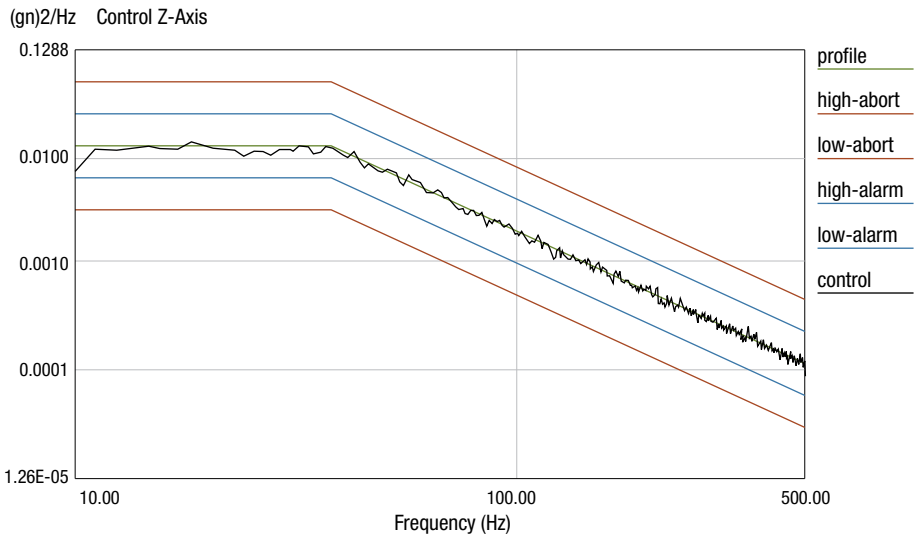

Figure 2

The graph tracks the unit's vibration testing over wide frequency range.

Figure 3

The explosion shown here subjected the RuffSystem to a MIL-STD-901D shock profile.

Taking All Axes into Account

Embedded computers can react differently to vibration along orthogonal axes (Longitudinal, Transverse and Vertical, or X, Y and Z). And clearly this particular application demanded compliance regardless of the vector components of vibration. The full test results confirmed that the SBC satisfies the requirements of MIL-STD-810F, Method 514.5, Category 4 over frequencies from 10 Hz to 500 Hz for the maximum specified duration. For shock, the SBC complies with MIL-STD-810F Method 516.5 withstanding 40 G shock for 6 mS.

Once a rugged-by-design SBC was confirmed to be up to the task, the next step was to engineer the system-level solution. A complete rugged computer was assembled using the rugged SBC. Adlink's RuffSystem 800 was designed from the ground up for this type of application. To withstand large amplitudes of shock and vibration from zero to ten Hertz, which is essential for naval and marine applications, the interior of the enclosure was de-

signed specifically for mechanical robustness across that spectrum.

The system was subjected to a full Barge Test where it was installed on a barge that was actually floating in water. Then underwater explosives (60 pounds of HBX-1) were discharged nearby, 24 feet beneath the surface, sending substantial shock waves through the barge. HBX-1 is short for Hexahydro-1, a form of high explosive made from TNT, RDX, aluminum, lecithin and wax.

Figure 4

The RuffSystem mechanical design and arrangement of components within the enclosure includes special features designed to reduce shock experienced by the internal components. Inside the enclosure, the I/O block is isolated from the SBC by the use of a separate I/O PCB.

Complex Motion Pattern

The forces of the explosions were powerful enough to send water shooting upward. Even after the water damped the amplitude of the shock wave, the camera that captured the photo in Figure 3 rocked violently. The distance from explosives to barge is varied over the shots, starting at 40 feet away, then reducing to 30 feet, 25 feet, and finally to 20 feet. In addition, the tests are performed in different orientations between barge and explosives. For the first 40-foot shot, the explosives are positioned underwater so that they are in-line with the ends of the barge—the fore-and-aft orientation, or front-to-back. For the remaining three closer shots the explosives are placed underwater at the sides of the barge—the athwartship orientation—in other words side-to-side rather than front-to-back.

Such explosive testing produces a very high peak shock on the barge in which the computer system is installed, and directly simulates an event such as a torpedo hit. A high level of shock is transmitted to the UUT mounted on the barge. The resulting shock experienced by the equipment is significantly higher than the most severe earthquake shock that would be experienced in a commercial environ-

ment. Benign lab verification tests cannot approximate the shock profile. The UUT passed the testing with flying colors.

Building a Better Box

Because commercial equipment and components are typically rated to withstand only mechanical shock up to 15 G or so, the system design must therefore reduce the shock exposed to any components used in the system—even though it is installed on a barge that is separated from the explosions. The RuffSystem mechanical design and arrangement of components within the enclosure includes special features designed to reduce shock experienced by the internal components.

Inside the enclosure, the I/O block is isolated from the SBC by the use of a separate I/O PCB. All connections between the external I/O and the main SBC are made using internal transition cables. External shock and vibration transmitted to the system by the I/O cables or applied to the enclosure directly is therefore absorbed by the I/O PCB and the attached cables, preventing it from reaching the SBC with any strength. The system is shown in Figure 4.

After the selection of an SBC and I/O connection arrangement, the next step was to extend the ruggedness to the system level. In addition to features that protect the system from electromagnetic or radio frequency interference, there are aspects of the mechanical enclosure design that specifically protect the system from shock and vibration. Movement of components due to externally applied shocks can quickly lead to physical damage to components and subsequent failure of the component and therefore failure of the overall system.

Enhancing Shock Resistance

To enhance resistance to shock, structures are incorporated into the SBC and inside of the enclosure to support certain components. These structures ensure that movement is confined during shock events. The materials used to attach the thermally efficient heatsink to the processor and chipset have a considerable amount of compliance, which increases ruggedness and resistance to shock, preventing damage to the chipset from movement of the bulky heatsink during a shock event. Clips were used to secure the mass of the heatsinks, without which the stick-on heatsinks would fly off during testing.

There was no large connector for the power supply, rather the power supply was attached directly to the main system board, preventing shock events from causing power transients. A solid-state drive (SSD) was used instead of a rotating hard disk, greatly improving the shock resistance of the system. Each of the mounting feet for the system box included compliant mounts that reduced the shock transmitted to the system box from the external surface, which it was fixed to, such as any shock transmitted from the structure of the ship. The result of all this careful mechanical design was the successful completion of the demanding MIL-STD-901D Type A test, demonstrating suitability for wartime and peacetime shipboard installations even in the most extreme shock environments, such as those occurring during torpedo hits.

Intel processors have been proven in a variety of military and avionics applications for decades. Now Pentium M has been qualified for marine deployment on a suitably designed and manufactured Extreme Rugged board. For higher performance shipboard installations, the next model features the Core 2 Duo processor. With up to 1.6 GHz dual core processing, the additional model meets the needs of applications with greater data crunching or I/O requirements, or even multiple OS and virtualization environments. MIL-STD-901D is the appropriate standard to understand when designing and validating embedded computers for shipboard deployments. ■■

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Solid-State Storage Faces Signal Integrity Challenges in Military Apps

Solid-State Drives (SSDs) offer key advantages in harsh environment defense systems. But in order to guarantee proper performance, an understanding of the unique signal integrity issues involved is critical.

Gary Drosell, Vice President of Product Planning
SiliconSystems

Parallel ATA (PATA) standards have been the dominant storage interface in military embedded systems for some time. The use of solid-state storage is a common solution for embedded systems because of its small form factor, reliability and ability to endure harsh environmental conditions. Whether deployed on the battlefield in a wearable computer or an Abrams tank or in a digital surveillance system in a Blackhawk helicopter (Figure 1), performance must be flawless in the harshest climates. As the need for more sophisticated and higher performing interfaces increases, proper design techniques must be applied to ensure that signal integrity is maintained to minimize potential noise or electromagnetic interference (EMI) issues, both initially and over the life of the product.

Signal integrity issues arise from the physical nature of the interconnecting wires. A real wire has resistance, capacitance to ground and to other wires, and inductance. At higher frequencies, the capacitance and inductance cause the wire to act like a transmission line, and antenna effects can cause crosstalk and EMI problems. It's important to understand the leading factors associated with signal integrity or noise interference. These include ringing, poor grounding, ground bounce, skew, slew rate, crosstalk, termination, overshoots, overdamping, rise time and propagation delay. Also key is understanding noise damping (or reduction) techniques related to military applications.

Figure 1

Military applications, like for example, a digital surveillance system in a Blackhawk helicopter, require solid-state storage that delivers high performance in the harshest conditions.

Signal Integrity Issues

Several factors can cause signal integrity issues and the result can be various degrees of problems including noise or EMI issues, especially when working

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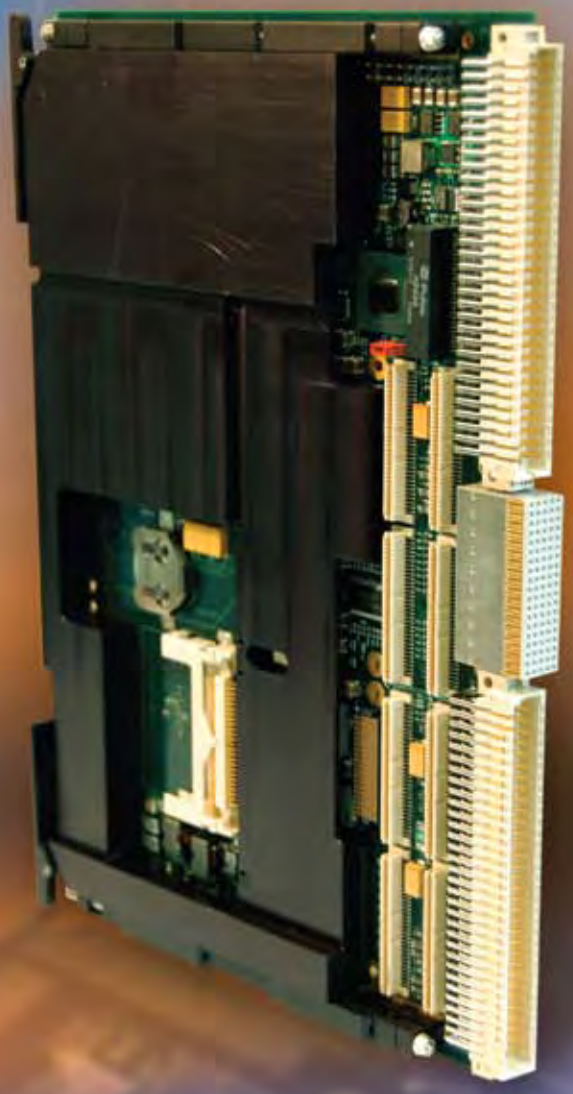

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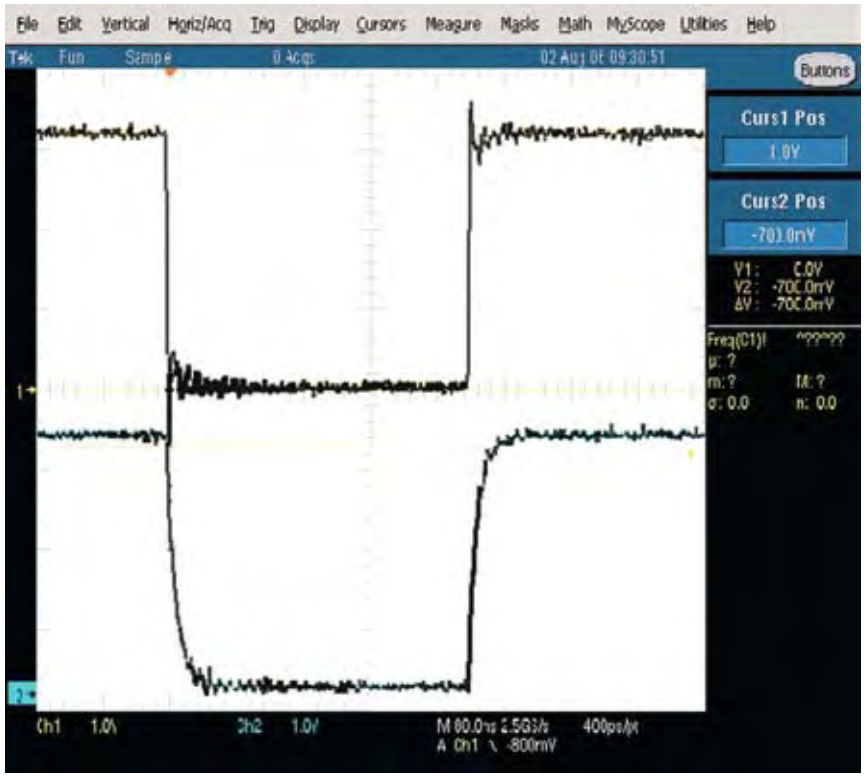

Figure 2

Illustrating an overshoot and over-damping example, shown here is a scope shot of the two Chip Select signals (CS0 and CS1) that should be identical in timing. There is no series termination on CS0 and 100 ohms on CS1. The results are some overshoot on the CS0 signal and some over-damping on the CS1 signal.

with military embedded systems. Ringing is an unwanted oscillation in a circuit, generally caused when an electrical pulse causes the parasitic inductances and capacitances in the circuit to resonate at their characteristic frequency. This is similar to an overshoot condition. The lack of proper ground plane technique can result in poor or noisy grounding in systems.

Poor or noisy grounding can lead to false signal triggering, unstable timing, and the latching of erroneous data and address signals. Ground bounce is a phenomenon associated with transistor switching where the gate voltage can appear to be less than the local ground potential, causing unstable operation of the logic gate. Similar to poor or noisy grounding, ground bounce can lead to false signal triggering, unstable timing, and the latching of erroneous data and address signals.

Skew is the difference in the total propagation delay between two signals as the signals transit the bus. Too much skew can result in improper latching of erroneous address or data signals. Large skews, which occur by not following the proper PCB trace specifications, can result in timing problems and the latching of erroneous data and address signals. Slew rate is the rate of the signal change in transition from low to high or high to low.

The slew rate is defined by the interface specification and is related to the impedance of the signal. The slew rate of signals that overshoot are steep, and the slew rate of signals that are over-damped are flat. Crosstalk is the unwanted capacitive of inductive coupling from one signal that causes an unwanted effect in another sig-

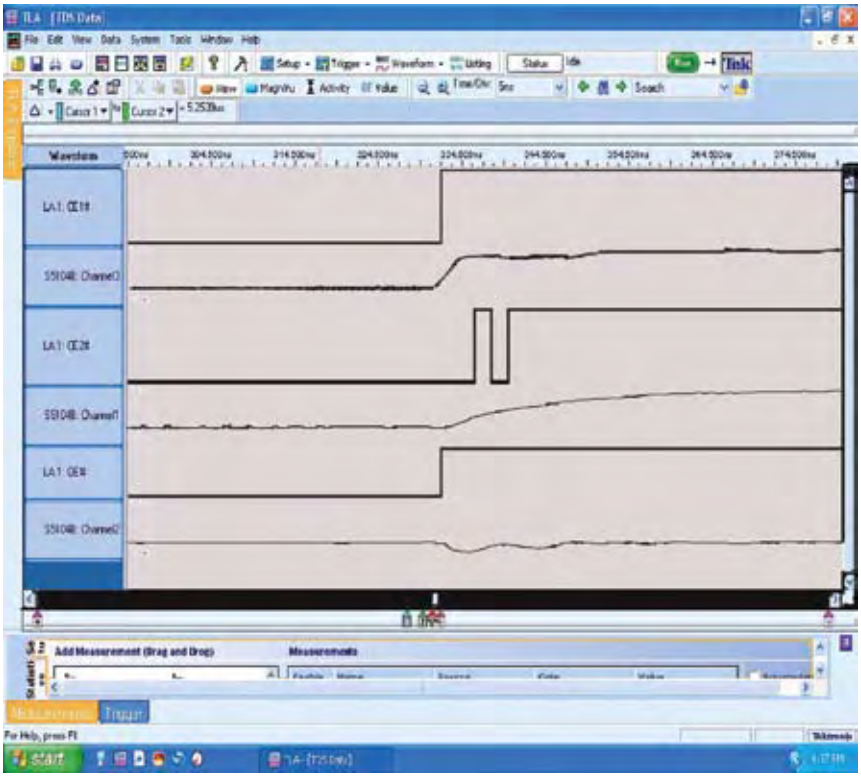

Figure 3

Shown here are the same Chip Select signals from Figure 2 when linked to the Logic Analyzer. Note the false logic level occurring on the CS1# signal due to the slow rise time or possibly a noisy ground during the transition period—a great example of two seemingly identical signals behaving differently because of the impedance mismatch.

nal, typically caused by improper grounding or not following proper PCB trace guidelines. Crosstalk can result in latching of erroneous address or data signals.

Termination, Overshoots and More

Additional signal integrity issues include termination, overshoots, over-damping, rise time and propagation delay. Termination is the need to put a resistor or resistor-capacitor network on a transmission line to prevent signal reflections due to the impedance mismatch between devices. Improper termination can result in overshoots, over-damping and signal reflections. Overshoots have steep slew rates and can become dangerous by causing device failures over time on a rising edge and ground bounce on a falling edge.

Each time an overshoot occurs on a rising edge, protection diodes turn on, and silicon junctions within the ICs (drivers and receivers) are stressed. If these stresses are large and repeated frequently, the product eventually fails, often in the field rather than during manufacturing testing. An undershoot, which typically occurs after the overshoot, can lead to false logic level triggering.

Over-damping has a more flattened slew rate and can lead to violations of setup and hold times because the threshold levels are more drawn out. The rise time is the time required for a signal to change from a specified low value to a specified high value. Typically these values are 10 to 90 percent of the step height. Propagation delay is the amount of time required for an input signal at one part of the system to

become stable and valid at another part of the system.

Some Examples

Showing an overshoot and over-damping example, Figure 2 shows a scope shot of the two Chip Select signals (CS0 and CS1) that should be identical in timing. There is no series termination on CS0 and 100 ohms on CS1. The results are some overshoot on the CS0 signal and some over-damping on the CS1 signal. Figure 3 shows the same Chip Select signals when linked to the Logic Analyzer. Note the false logic level occurring on the CS1# signal due to the slow rise time or possibly a noisy ground during the transition period. This is a great example of two seemingly identical signals behaving differently because of the impedance mismatch.

Meanwhile, illustrating ringing/overshoot and ground bounce, Figure 4 shows a Chip Select signal (CS0) with respect to a Data line (D4). Note the overshoots below ground (-600 mV) on the signals and the corresponding ground bounce absorbed into the D4 signal. Also note the undershoot to 380 mV on the D4 line. A value above 0.8V would violate the VIL specification.

Shared Bus Architecture

Sharing a bus is a method to allocate common signals across multiple devices for the purpose of saving board space, device pins, and so on. Shared bus architecture is a common method, but careful timing considerations must be made as to not violate the ATA specification. In addition, the UDMA specification clearly states that the host should not share signals between primary and secondary IDE ports. Figure 5 shows a standard type IDE configuration on a military embedded system that has dedicated address/data buses and control lines for each IDE port.

If sharing a bus, it is important to note that some designs are vulnerable to signal integrity issues and noise, and it is especially critical to remember this when designing for military embedded systems. For example, sharing chip select signals instead of read/write signals is not recommended because if the read/write signals are accessed, the device is susceptible to serious signal integrity and noise.

Understanding Noise Damping Techniques

It is imperative to understand noise damping (or reduction) techniques related to military applications. If a design does not take into account the possibility of noise or EMI issues, serious problems may occur that could compromise the integrity of the application. As bus speeds increase, designs become much more complex. Signals

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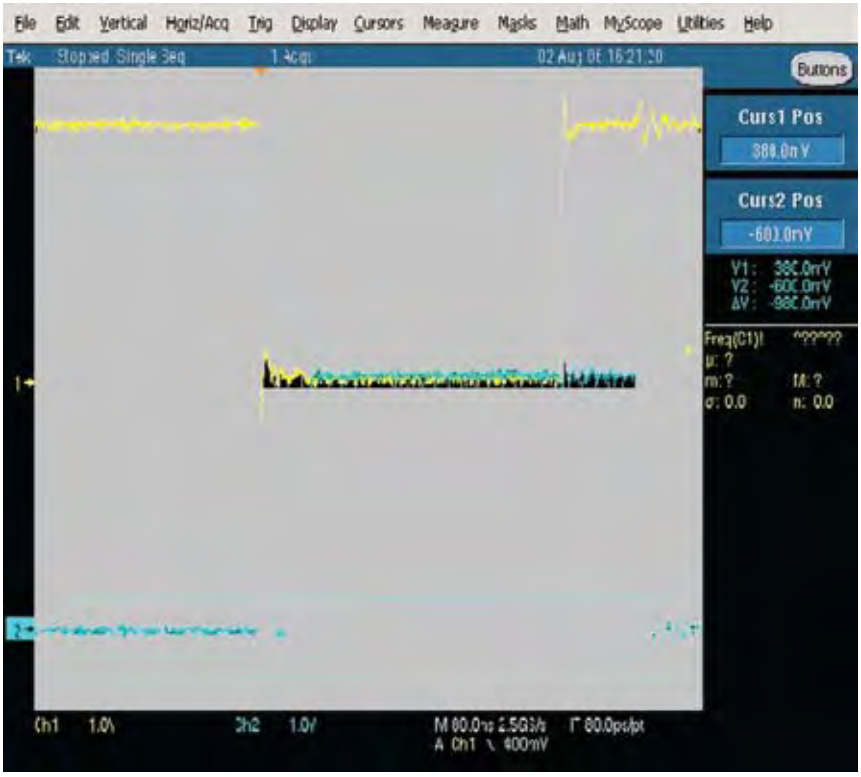

Figure 4

Illustrating ringing/overshoot and ground bounce, this shows a Chip Select signal (CS0) with respect to a Data line (D4). Note the overshoots below ground (-600 mV) on the signals and the corresponding ground bounce absorbed into the D4 signal. Also note the undershoot to 380 mV on the D4 line.

start to behave more like transmission lines, and impedance matching plays an important role that must be taken into consideration when designing the proper bus design for embedded military systems.

The following guidelines should be adhered to during the design development process. A thorough understanding of bus specifications is needed to provide the proper solution for the design. The best time to select termination is early in the design. If uncertain of the termination, always place 0 termination resistors in the design. It's important to observe the signals with an oscilloscope to verify that proper termination values are used. Make adjustments to the termination values if there is excessive overshoot or overdamping. If preferred, use Simulation Programming with Integrated Circuits Emphasis (SPICE) modeling, which is a general-purpose analog circuit simulator. SPICE is a powerful program that is used in IC and board-level designs to check the signal integrity of circuit designs and predict circuit behavior.

High-Speed Interface Trends

The on-going need to support higher data rates while at the same time reducing board space and providing improved data/signal integrity in military embedded systems, has necessitated a move toward a serial data transfer strategy with differential signaling. A serial transfer minimizes the pin count on devices, which helps to further reduce board space. The dif-

ferential signaling increases the data transfer rates as well as reduces the crosstalk and noise of the transfer, which helps to improve the data/signal integrity.

Differential signaling is a method for transmitting information over a pair of wires that reduces noise on the connection by rejecting common-mode interference. One wire (D+) carries the signal and the other wire (D-) carries the inverse of the signal. At the receiver end, D- is inverted and summed with D+, which effectively cancels out the noise created across the transmission line. Although differential signaling is more noise immune than single-ended signaling, it is very sensitive to slew rate and skew so special care must be given to layout design rules. Two such solutions are Universal Serial Bus (USB) and Serial ATA (SATA). The USB is a 480 Mbit/s interface with a single differential pair used for data communication. The SATA 1.0 is a 1.5 Gbit/s interface that is similar to the USB from an electrical standpoint with the exception that it uses two differential pairs used for data communication.

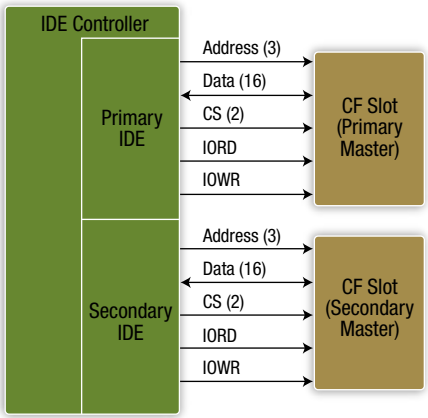

Figure 5
This shows a standard type IDE configuration on a military embedded system that has dedicated address/data buses and control lines for each IDE port.

Signal integrity and noise interference are serious issues to consider when working with solid-state storage in military embedded systems. It is important to first determine the cause of the interference and then utilize noise damping techniques to alleviate the possibility of failure. If designed well, solid-state storage can successfully fit the needs and future trends of sophisticated interfaces including high-performing military applications.

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Technology Focus

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Conduction-Cooled CompactPCI Steers a Steady Course

CompactPCI has secured a solid grip on the mindshare of military system designers. Conduction-cooled cPCI are, even now, entering deployment on numerous land, sea and airborne systems.

Jeff Child,
Editor-in-Chief

The acceptance of CompactPCI—particularly in its 3U size—is no longer in question for any military application where the mix of size constraints and demand for sturdy slot-card style ruggedness is called for. In many case, 3U CompactPCI is delivered to customers in complete integrated systems—a trend that melds nicely with the emergence of "stand-alone rugged box systems" as a product category among military embedded board vendors. Also fueling that trend is consolidation in this industry to the point were the larger corporations can provide all the computer, I/O and enclosure needs themselves.

The past decade and a half have seen an expanding set of conduction-cooled CompactPCI boards emerge, some even from outside the usual crowd of conduction-cooled board makers. With over seventeen years of history under its belt, CompactPCI now boasts the elements that attract military decision makers. There's now a rich and growing collection of cPCI products that are available from a variety of vendors in every category including single board computers, I/O boards, slot-card power supplies, storage subsystems, mezzanine carriers, DSP engines and many others. The "Conduction-Cooled cPCI Boards Roundup" on the following pages showcases some examples of the current crop of cPCI SBC products, including a number of Core 2 Duo-based boards that have emerged in the past year.

The PCI Industrial Manufacturers Group (PICMG), meanwhile, continues to develop performance upgrade paths for cPCI, such as PICMG 2.16 and CompactPCI Express. All those factors lead to a perception that cPCI will be around for the long haul—an essential characteristic to win adoption in military and other high-reliability, long life-cycle applications.

In the past couple of years, a growing number of vendors have made public announcements of military and aerospace design wins for their conduction-cooled cPCI products. And keeping in mind that many such wins aren't made public, it's clear that cPCI adoption in military and aerospace system designs is strong. CompactPCI achieved a win in the U.S. Army's Non-Line-Of-Sight Launch System (NLOS-LS) platform. The NLOS-LS is part of "spin-out one" within the Army's Future Combat Systems (FCS) program. NLOS-LS is being developed for the U.S. Army by Netfires LLC, a joint venture between Lockheed Martin and Raytheon. The cPCI processing subsystem from GE Fanuc Embedded Systems was selected by Lockheed Martin for the program. The subsystem comprises an adapted version of one of the GE Fanuc company's standard rugged enclosures, together with a Compact PCI 6U CP1A single board computer fitted with some I/O and networking PMC modules.

Figure 1

Ticonderoga-class cruisers, like the USS Cape St. George (CG 71), are among the vessels included in the Navy's Aegis Modernization (AMOD) program. Shown here, a Tomahawk Land Attack Missile (TLAM) is launched from the vessel. The ship was the first surface warship certified to use only digital nautical charts (DNC), instead of paper charts.

CompactPCI is also playing a major role in the Navy's Aegis Modernization (AMOD) program. The effort involves both software and technology insertion hardware upgrades running through fiscal year 2012. AMOD is an upgrade to the Aegis Weapon System (AWS), the automated segment of the Aegis Combat System (ACS), which will satisfy the anti-air-warfare and ballistic-missile-defense (BMD) mission requirements on Aegis cruisers (Figure 1) and destroyers. General Micro Systems' 2.16 GHz conduction-cooled cPCI board was chosen as a processor for the program. ▮▮

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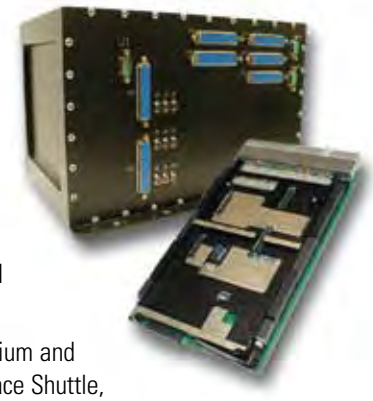

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Aitech Defense Systems, Inc.
19756 Prairie Street
Chatsworth, CA 91311
email: sales@rugged.com
Toll Free: 888-Aitech8 - (888) 248-3248
Fax: (818) 718-9787
www.rugged.com

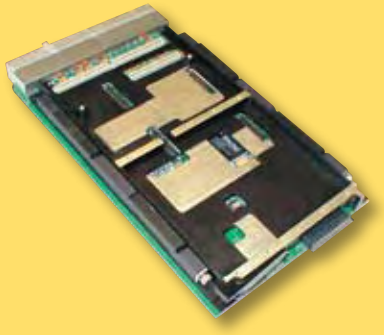
Technology Focus:

Conduction-Cooled cPCI Boards Roundup

Rad-Tolerant SBC Boasts Low Operating Power

Space-based applications require a level beyond the typical definition of ruggedness. Aitech Defense Systems offers a high-performance, single-slot SBC that allows the user to initiate different power-saving options, depending on application requirements. Specifically designed for mission-critical space environments, the new 3U CompactPCI radiation-tolerant S950 functions using as little as 13.5W in full operation, less than 8W in nap mode and less than 10W with limited performance for less intense processing requirements, all based on a core processor speed of 733 MHz.

The S950 offers extreme protection against single event upsets (SEUs). The board incorporates the low-power PowerPCT 750FX Processor with a maximum power dissipation

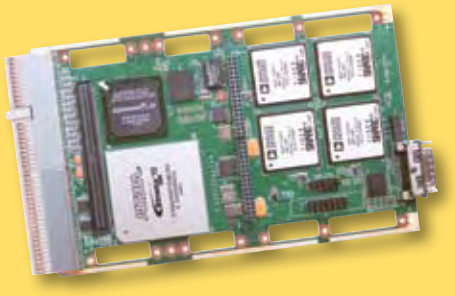


of less than 8W, 128 Mbytes of SDRAM arranged in a bit-wise triple voting architecture and 1 Mbyte of dual-redundant boot flash to store the onboard Boot firmware. The 32 Kbyte L1 cache includes a parity check for both tags and data, while the 512 Kbyte L2 cache provides a parity check on tags and ECC protection on data. A rad-tolerant anti-fuse FPGA maintains the memory controller to ensure data integrity for secure system reliability in harsh space environments. Also implemented on the FPGA is additional ECC protection for the board's 64 Mbytes of user flash memory. Pricing for the S950 starts at $24,200.

Aitech Defense Systems
Chatsworth, CA.
(888) 248-3248.
[www.rugged.com].

DSP Card Marries TigerSHARCs and FPGA

FPGAs and DSPs working together form a powerful weapon for advanced signal processing applications. Exemplifying that trend is BittWare's GT-3U-cPCI (GT3U), a ruggedized 3U CompactPCI board that has been designed for demanding multiprocessor-based applications. The GT3U features a large Altera Stratix II GX FPGA, one cluster of four ADSP-TS201S TigerSHARC processors from Analog Devices, a front panel interface supplying four channels of high-speed SerDes



transceivers, and a back panel interface providing RS-232/RS-422 and 10/100 Ethernet. Simultaneous on-board and off-board data transfers can be achieved at a rate of 2 Gbytes/s via BittWare's ATLANTiS framework implemented in the Stratix II GX FPGA. The board also provides a large amount of onboard memory including 1 Gbyte of DDR2 SDRAM or 64 Mbytes of QDR SDRAM, as well as 64 Mbytes of flash memory for booting the FPGA and DSPs.

The GT3U features a single cluster of four ADSP-TS201S TigerSHARC DSPs, which are interconnected by a 64-bit cluster bus running at up to 100 MHz. The ADSP-TS201 processor operates at up to 600 MHz, providing 3.6 Gflops of peak processing power. Because of its superscalar architecture, the ADSP-TS201 is also efficient at fixed-point processing, with each DSP supporting 14.4 Bops of processing. Along with 24 Mbits of on-chip RAM, each DSP also boasts four high-speed LVDS link ports. Each full-duplex link port is comprised of a 4-bit transmit and a 4-bit receive channel, and can support up to 500 Mbytes/s in each direction for a total maximum throughput of 1 Gbyte/s.

BittWare
Concord, NH.
(603) 226-0404.
[www.bittware.com].

SBC Serves Up Dual PMC/XMC, Core 2 Duo

The Core 2 Duo processor is quickly assuming the status of most designed-in CPU for embedded computer boards. Exemplifying that trend, Concurrent Technologies offers their latest single-slot CompactPCI dual-core processor, dual PMC/XMC, single board computer. The PP 452/03x uses a popular mobile dual-core processor from the Intel embedded roadmap, the 1.5 GHz or 1.06 GHz Intel Core 2 Duo processor. The board is ideal for low-power intensive processing applications where the dual processor cores can access up to 4 Gbytes of soldered DDR2-400 ECC SDRAM at up to 6.4 Gbytes/s. For I/O flexibility there are 2 PMC/XMC sites supporting both front and rear I/O, plus 2 SATA150, 1 RS232, 3 USB 2.0 and dual Gigabit Ethernet interfaces. The board also supports PICMG 2.16 (Ethernet fabric), PICMG 2.9 (IPMI) and PICMG 2.1 (hot swap). Commercial and extended temperature

versions are now available, and ruggedized, conduction-cooled or air-cooled versions will be available shortly.

Each PMC site supports up to 66 MHz PCI-X operation as well as x4 PCI Express XMC interfaces, XMC site 1 can also support x8 PCI Express. This high-functionality board offers an array of functions—plus rear I/O consisting of 2 SATA150, 1 RS232, 3 USB 2.0 and dual Gbit Ethernet interfaces. To cater for embedded applications, there is an onboard 4 Gbyte flash disk. For a wider range of applications there is an onboard EIDE option for CompactFlash modules. As well as the industry standard PC interfaces, other features available include a watchdog timer, long duration timer and LAN boot firmware.

Concurrent Technologies
Woburn, MA.
(781) 933 5900.
[www.gocct.com].

Flexible I/O Scheme Enhances 3U Board

Space and weight constraints for embedded technology in military and aerospace applications have created difficult compromises between size and a full complement of I/O. The SCP/DCP-124P from Curtiss-Wright Controls Embedded Computing takes advantage of the compact 3U CompactPCI SBC format and I/O flexibility to overcome these challenges. Utilizing PICMG 2.3, the SCP/DCP-124P routes I/O signals and supports mapping of PMC I/O through the backplane. It features Freescale's

Altivec-enhanced 7448 PowerPC supported by 1 Mbyte of internal ECC L2 cache running at core processor speed and up to 1 Gbyte of ECC DDR SDRAM.

The board's cPCI bus operates at 33/66 MHz and supports both 3.3V and 5V signaling. System expansion is provided by an onboard 64-bit, 100 MHz PCI-X-capable PMC site. The SCP/DCP-124P is available in both conduction-cooled and air-cooled versions with optional rear transition cable sets to facilitate system integration and development. Conduction-cooling is rated up to -40° to +85°C (Level 200). Ruggedization levels available include L0 and L100 air-cooled, and L100 and L200 conduction-cooled. Storage temperature is -50° to +100°C, and humidity rating is 10 to 95 percent RH non-condensing. Software support includes BSPs for VxWorks 5.5.x/Tornado 2.2.x and 6.x/Workbench 2.x for PowerPC, CWCEC Linux and Integrity. Support is also provided for SSSL, Curtiss-Wright's Altivec-optimized signal processing library. Pricing starts at $6,030.

Curtiss-Wright Controls
Embedded Computing
Leesburg, VA.
(703) 779-7800.
[www.cwcembedded.com].

6U SBC Delivers 2.16 GHz Core 2 Duo

Compute-density is the goal of many of the latest military embedded computer applications. Along those lines, Dynatem is now shipping the Intel Core2 Duo based CRD CompactPCI/PICMG 2.16 SBC. The CRD is a 6U single-slot CompactPCI-compatible platform based on the Intel low-power Core2 Duo processor. The CRD takes advantage of the L7400 Core2 Duo's low power consumption as a rugged SBC. Versions supporting the T7400 2.16 GHz Core2 Duo are also available. The CRD is a conduction-cooled module with wedge locks and a full-board heat sink for high shock/vibration environments and temperature extremes. Extended temperature and versions with conformal coating are available.

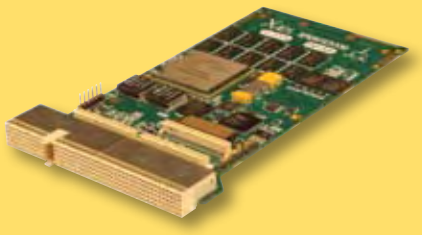
The CRD comes installed with 2 Gbyte or 4 Gbyte DDR2-400 memory, supporting ECC. Memory is BGA for the best shock/vibration spec. The E7520 Memory Controller Hub (MCH) and 6300ESB I/O Controller Hub (ICH) chips support PCIe and PCI-X expansion, respectively. Two or four onboard Gbit Ethernet ports are controlled by two PCI Express-based 82571EB dual 10/100/1000BaseTX controllers. Two Ethernet PICMG 2.16-compliant Gbit Ethernet ports are routed to the backplane. Standard conduction-cooled CRD boards have no front panel I/O due to the cooling plates. A special version has been developed with additional 2 Gbits of Ethernet routed through the front cooling-plates. The two onboard PMC mezzanine card interfaces are accessed through the 6300ESB's 64-bit PCI-X bus. One of the two PMC sites also accommodates an XMC module supported by x8 PCIe. Pricing for the CRD starts at $6,938 in single quantity.

Dynatem
Mission Viejo, CA.
(949) 855-3235.
[www.dynatem.com].

Low-Power 3U cPCI SBC Targets Freescale MPC8572E

A new 3U CompactPCI single board computer is based on Freescale Semiconductor's MPC8572E PowerQUICC III processor. In addition to the MPC 8572E dual core processor, the XPedite5330 from Extreme Engineering Solutions provides a PMC/XMC site along with Gigabit Ethernet and the traditional PCI bus. To provide a system designer with multiple hardware options, the XPedite5330 is available in a full range of convection- or conduction-cooled configurations.

The XPedite5330 operates with two 1 .5 GHz e500 cores based on Power Architecture technology, and supports two separate DDR2-800 ECC SDRAM channels with up to 2 Gbytes per channel as well as up to 4 Gbytes of NAND flash and 256 Mbytes of redundant NOR flash. It also provides two Gigabit Ethernet ports.



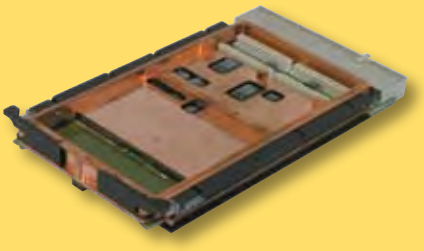
The J2 connector I/O includes GPIO, I2C, PMC I/O and two RS-232/RS-422/RS-485 serial ports. Operating system support includes board support packages (BSPs) for Wind River VxWorks, QNX Neutrino and Green Hills Integrity as well as Linux 2.6.

Extreme Engineering Solutions
Middleton, WI.
(608) 833-1155.
[www.xes-inc.com].

3U Card Blends Dual PowerPCs, 1 Gbyte DRAM

3U CompactPCI continues to be a favored architecture in military applications where high performance is required in a constrained space. Feeding that need, GE Fanuc Intelligent Platforms offers the rugged CM6 3U CompactPCI single board computer. Featuring a Freescale PowerPC MPC8641 operating at up to 1.33 GHz with either a single- or dual-core processor, the CM6 supports up to 1 Gbyte of DDR2 SDRAM ECC memory. Designed for applications including military/aerospace and simulation/training, both system mode and non-system mode are supported.

The CM6 provides two Gigabit Ethernet ports and two serial ports (RS-232 and RS-422/RS-485) together with eight general-purpose I/Os and flash memory. That mix of I/O frees the user to leverage the capabilities of the 64-bit/100 MHz PMC interface for application-specific purposes. In either the single core or dual core version, AltiVec support is provided



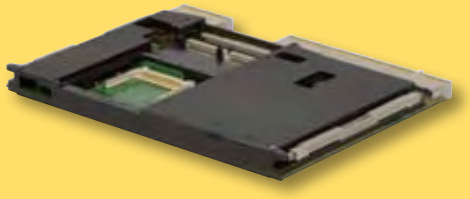
for advanced floating-point applications. Each core is provided with its own Level 1 and Level 2 cache, allowing for a high degree of parallelism. To enable operation in harsh environments, the CM6 is available in three ruggedization levels with an extended temperature range of -40° to +85°C and optional conformal coating. Shock and vibration immunity is designed in with stiffener bars and wedge locks; conformal coating can also be applied on request.

GE Fanuc Intelligent Platforms
Charlottesville, VA.
(800) 368-2738.
[www.gefanucembedded.com].

Health Monitoring Featured on 6U 2.16 GHz Core 2 Duo Board

An increasing number of military applications are requiring computing that can operate autonomously. That means the system has to monitor its own health. With that in mind, General Micro System's "2nd Coming" is the industry's first 6U, 2.16 GHz Core 2 Duo, Conduction-Cooled cPCI SBC to provide full System Health Monitoring and reporting to meet all PICMG 2.9 specifications, while adding a slew of additional health monitoring and reporting system status to an external device.

The C276 supports up to 4 Gbytes of 667 MHz DDR-2 memory and vast onboard I/O. The standard I/O included are dual Gbit



Ethernet on PCIe bus with TCP/IP Offloading Engine, dual IDE, quad SATA with RAID (0, 1, 5, 10 and 50) capabilities, five USB-2.0, 1 Mbyte of user/Boot flash and two serial ports. Additional standard I/O included are: one PMC/XMC site with rear I/O, 16 bidirectional Digital I/O lines and dual COM ports with RS-232/422 buffers (jumper selectable). The C276 module is fully compliant to IEEE Std. 1101.2 and ANSI/VITA 2-0 2001. The 2nd Coming operates from -40° to +85°C at the rails with relative humidity of 5-95 percent at 40°C, and may be exposed to shocks of up to 100g for 5 ms, or 40g for 11 ms in 3 axis. The 2nd Coming supports extremes; vibrations range from 5 Hz to 2 KHz for up to 30 minutes at 15g RMS in each axis.

General Micro System
Rancho Cucamonga, CA.
(909) 980-4863.
[www.gms4sbc.com].

Dual 1.4 GHz PowerPCs Reside on 6U CompactPCI

CompactPCI has passed the test of longevity and maturity, making it one of the accepted form-factors in today's military applications. Feeding that trend, Interface Concept has unveiled a high-performance 6U CompactPCI board, the IC-xe6-cPCIb, powered by one or two Freescale 1.4 GHz MPC7448 PowerPC processors. This new single or dual processor SBC is PICMG 2.16-compliant and blends low power consumption and large communications capabilities. The board implements a Marvell Discovery III chipset (MV64460).

The memory banks are made of up to 2 Gbytes of DDR-ECC SDRAM, up to 256 Mbytes of mirror flash and up to 1 Gbyte of soldered NAND flash. A quad UART provides four additional asynchronous channels available on P2 connector. The 64-bit PCI/PCI-X bridge allows the IC-xe6-cPCIb to handle two PMC

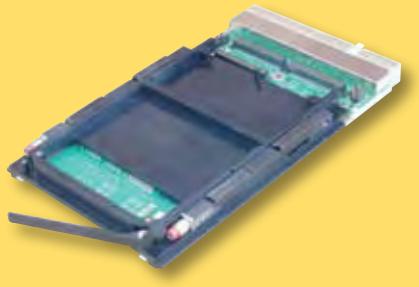
slots with PnIO routed to J3/J5. Thanks to its SATA controller, the IC-xe6-cPCIb can manage directly four storage devices. The IC-xe6-cPCIb provides one Gbit Ethernet, one console, one USB-2 and two SATA ports on the front panel. This board has been designed to meet the most severe environments—standard, extended and rugged grades. Prices start at $3,950.

Interface Concept
Briec de l'Odet, France.
+33 (0)2 98 57 30 30.
[www.interfaceconcept.com].

Rugged Conduction-Cooled 3U cPCI Board Sports PowerPC

CompactPCI, particularly in its 3U flavor, is now entrenched as an accepted military embedded computer form factor. Kontron offers a new PowerPC-based Rugged Conduction-Cooled (RC) board. The Kontron CP3210 provides a faster clock rate of 733 MHz, accelerated DDR SDRAM (266 MHz, + 33.3 %), double the amount of system and user flash and a Gigabit Ethernet port for faster data throughput and overall greater system performance. The Kontron CP3210 CompactPCI CPU board is an enhanced version of the highly reliable and powerful Kontron PowerEngineC7.

The Kontron CP3210 CompactPCI CPU board offers an extensive range of standard functions and expansion options including the new powerful PowerPC G3 750FX RISC processor clocked at 733 MHz, onboard user memory of 512 Mbytes DDR SDRAM with ECC clocked at 266 MHz, 128 Mbytes of system flash



memory, 256 Mbytes of user flash memory and 128 Kbytes of nvSRAM with realclock. It also offers two onboard serial lines, two Ethernet channels—one Gigabit and one 10/100 as well as one 33/66 MHz PMC expansion slot. The Rugged Conduction-Cooled (RC) design of the Kontron CP3210 enables reliable operation in temperatures ranging from -40° to +85°C according to VITA 47 recommendations.

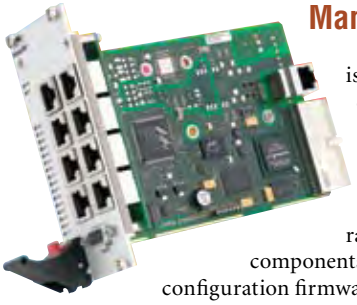
Kontron America
Poway, CA.
(858) 677-0877.
[www.kontron.com].

2 GHz Pentium M CPU Rides 6U SBC

Military and aerospace applications such as aircraft monitoring, visualization and control all have something common. They demand a blend of high-performance compute muscle, with a ruggedness suited to harsh environments. Along those lines, MEN Micro offers an Intel-based conduction-cooled cPCI SBC that employs a low-power Pentium M processor operating at up to 2 GHz and a 915GM chipset. Called the D601, this 6U card components are soldered directly to the board, eliminating the need for socketed components and providing exceptional temperature, shock and vibration properties according to the current DIN, EN and IEC industry standards.

In addition, the versatile SBC only needs one bus slot and can be used in fanless embedded computing systems. Other Intel processors, such as the low-voltage 1.4 GHz Pentium M or the ultra-low-voltage 1 GHz Celeron M, can be used on the D601, enabling operation at an extended temperature range of -40° to +85°C (-40° to +185°F). The board's rear I/O includes graphic support via VGA connectors for display of the same or different images on several monitors, two Gbit Ethernet interfaces connected via PCI Express and three USB 2.0 interfaces. The board also features two SATA interfaces for mass storage connection, and a PATA to connect a robust IDE-driven CompactFlash device, providing nearly unlimited space for user applications. Pricing for the D601 is $6,644.

MEN Micro
Ambler, PA.
(215) 542-9575.
[www.menmicro.com].



Managed Ethernet Switch Rides 3U CompactPCI

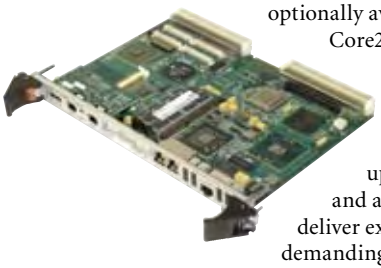
Attracted by its ubiquity and longevity, the military is growing ever more fond of Ethernet. And switched Ethernet is becoming as popular an interconnect scheme as many of the switch fabric alternatives available. MEN Micro has extended its line of managed Ethernet switches to include a new 3U CompactPCI version. The F302 features eight Fast Ethernet channels on the front via RJ45, M12 or D-Sub connectors, depending upon the application, and an optional channel accessible through the rear J1 connector for exceptionally fast and secure communication within an embedded system.

Designed for rugged, communication-intensive applications, the new F302 is compliant with the EN 50155 railway standard and offers an operating temperature of -40° to +85°C (-40° to +185°F) as well as soldered components to resist the effects of shock and vibration. The switch uses an FPGA-based low-power CPU that integrates the configuration firmware and keeps the entire board's power consumption to less than 7W. As with all MEN Micro Ethernet switches, the F302 supports full and half duplex, high-speed non-blocking store-and-forward switching and auto-negotiation as well as Layer 2 switching. The card is ready for conformal coating and has a guaranteed minimum availability of five years. Pricing for the F302 is $987.

MEN Micro, Ambler, PA. (215) 542-9575. [www.menmicro.com].

2.53 GHz Core 2 Duo Climbs Aboard 6U VME

VME, combined with VXS, is an ideal way to marry the legacy of installed VME with the performance of fabric-based VXS. Doing exactly that, GE Fanuc Intelligent Platforms announced the V7875 SBC with extensive I/O capability and advanced graphics. VITA 41.3 (VXS) for Gigabit Ethernet across the backplane is also optionally available. Featuring the Intel Core2 Duo T9400 processor running at 2.53 GHz, the V7875 also provides up to 6 Mbytes of L2 cache. Use of the Intel GM45 chip set provides fast access to up to 4 Gbytes of DDR3 SDRAM and a x16 PCI Express interface to deliver exceptional performance for demanding applications.

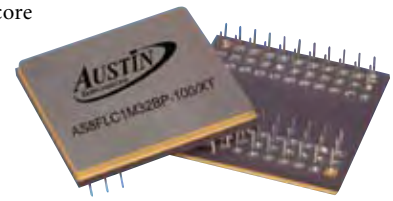


The V7875 provides support for a PCI-X XMC/PMC site, but also a connector to the EXP237 mezzanine board to deliver an optional three additional XMC/PMC sites. Additional connectivity is provided by a dual SATA disk interface, two Gbit Ethernet ports routed to the front panel, four USB 2.0 ports and two serial ports. For applications not requiring the XMC/PMC site, even further I/O—one eSATA port, one USB 2.0 port and two Gbit Ethernet ports (when VITA 41 is not available)—can be provided via the front panel.

GE Fanuc Intelligent Platforms, Charlottesville, VA. (800) 368-2738. [www.gefanucembedded.com].

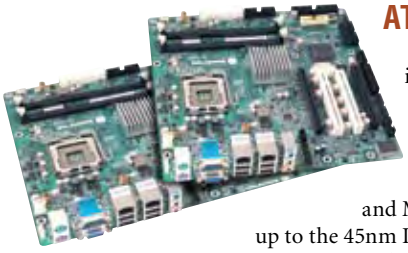
Hermetic Flash MCMs Are DSCC Approved

Solid-state flash-based storage has numerous advantages over rotating disk storage. Austin Semiconductor has added two new DSCC approved hermetic flash multi-chip modules (MCM) to their line of products. The 32 Mbit and 64 Mbit flash multi-chip modules are available in a 66PGA or 68CQFP low profile ceramic package, and feature a reliable non-volatile high-speed memory access of less than 70ns, very low operating (120 mA max) and Std-by power (150 uA), -55° to 125°C temperature operation and boot block sector architecture. Ideal applications for the MCM's are core program boot code storage, navigation / GPS / radar, missile control & guidance as well as weapons control and guidance.



The devices are DSCC SMD 5962-09205 Approved (1M x 32) and DSCC SMD 5962-08245 Approved (2M x 32). They have a bottom boot block (sector) architecture and operate with single 3.3V supply. Available in multiple access time variations, the devices feature 100,000 Erase/Program Cycles and a minimum 100,000 Program/Erase Cycles per sector guaranteed. Embedded erase and program algorithms are included along with an erase Suspend/Resume function and support for reading data from or programming data to a sector not being erased.

Austin Semiconductor, Austin, TX. (512) 339-1188. [www.austinsemiconductor.com].



ATX Motherboards Serve Up 45nm Quad-Core Processors

Bus-less SBCs are capturing a greater share of military acceptance now that complete system functionality is possible on a single board. With that mind, Kontron offers two new variants on a family of basic motherboards that are based on the 45nm Intel Core 2 Quad processor. The KTG41/ATX and the KTG41/ATXU Micro-ATX basic motherboards from Kontron use the Intel G41 Express chipset and LGA 775 socket for Intel processors up to the 45nm Intel Core2 Quad processor Q9650.

The KTG41/ATX ATX and KTG41/ATXU Micro-ATX basic motherboards feature the Intel Graphics and Memory Controller Hub as well as the Intel I/O Controller Hub (Intel ICH7R) and support Intel processors up to the 45nm Intel Core2 Quad processor Q9650 with 3.0 GHz, 12 Mbyte L2 cache and a FSB of up to 1,333 MHz. For data processing intensive applications, the Kontron KTG41 boards support up to 8 Gbytes of dual channel DDR3 SDRAM with one DIMM module per channel. Both Kontron KTG41 basic motherboards offer 2 x Gbit Ethernet, one PCI Express x4 slot, 8 x USB 2.0 ports and 2 x serial ports. Compared with the Micro-ATX version (9.6 x 9.6 inches) that offers 2 PCI connectors, the slightly larger ATX motherboard (12 inch x 9.6 inch) offers 5 PCI connectors with bus master capabilities.

Kontron, Poway, CA. (888) 294-4558. [www.kontron.com].

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MIL-STD-1553 Terminal Is Fully Integrated

The decades-old 1553 interface shows little sign of fading from the plans of many military system designers. Even when high-bandwidth alternatives emerge, the demand for supporting legacy 1553 connections is still strong. Data Device Corp. has introduced the first fully integrated 1553 terminal, the Total-ACE, consolidating all the necessary MIL-STD-1553 components within a single, small, cost-effective PBGA package. The BU-64843T Total-ACE comprises a complete interface between a host computer and a MIL-STD-1553 bus that simplifies design, procurement and qualification processes.

The Total-ACE integrates dual transceivers, dual transformers, protocol engine and 4K words of internal RAM, and is fully software and hardware compatible with DDC's Enhanced Mini-ACE series of devices. The BU-64843T is powered entirely by +3.3 volts, and offers an extended -40° to +100°C industrial temperature range. Additionally, the Total-ACE is DO-254 certifiable, and is available in RoHS-compliant versions.

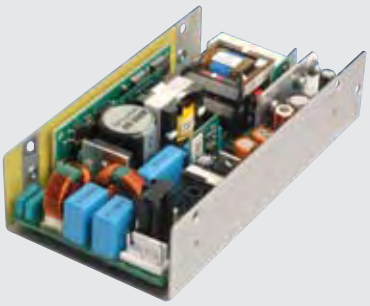
Data Device Corp. Bohemia, NY. (631) 567-5600. [www.ddc-web.com].

Integrated Radar Input and Scan Converter Rides VME

Advanced radar image processing and distribution is a complex process. Anything to help system developers hide that complexity from the user is helpful. With that in mind, Curtiss-Wright Controls Embedded Computing has announced Cougar, a powerful new radar input and scan converter VME board set. Cougar provides an open standards-based high-performance solution for capturing, converting and mixing radar video. Designed for demanding military radar applications, Cougar speeds and simplifies the integration of advanced radar image processing and distribution functionality into deployed embedded systems.

The flexible, two-slot VME modular Cougar system provides the complete functionality required to integrate and implement a wide range of radar input/scan conversion configurations. Its four PMC/XMC expansion slots are used to host the user-selected mix of mezzanine modules appropriate for their particular application. Available mezzanine modules supported by Cougar include Curtiss-Wright's Osiris B radar video input card, XMC-710 video capture & graphics display card, Eagle-2 radar scan conversion module and an optional PMC-659 mixer card. Pricing for Cougar configurations start at $19,000.

Curtiss-Wright Controls Embedded Computing, Leesburg, VA. (703) 737-3660. [www.cwcembedded.com].

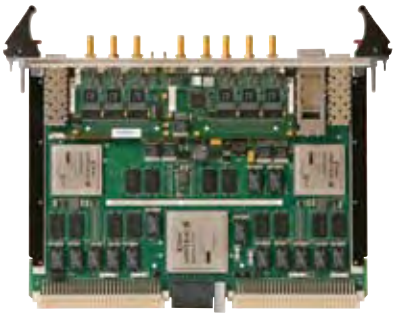


300W Power Supply Features Digital Control

Digital control is the latest technology wave to sweep over the power supplies realm. TDK-Lambda has introduced their new digitally controlled 300-watt power supplies that are designed specifically with medical applications in mind. With a 4kVAC reinforced input to output isolation and other specifications such as an output-to-ground isolation of 1500VAC, the EFE300M meets the rigorous international safety standards of IEC 60601-1 for medical equipment, making it suitable for use in B and BF type medical applications. Regulated DC outputs of 12V or 24VDC are standard and other voltages can be provided.

With a 3 x 6 inch footprint with less than a 1U profile, the EFE300M can be incorporated easily into designs where space is limited so end equipment can be smaller and cooler. TDK-Lambda's control of the EFE300M allows the power supply's performance, such as current limit and start-up characteristics, to be optimized digitally—this feature eliminates the hardware changes usually required in analog designs. The EFE300M delivers 300W continuous power (400W peak for 10 seconds) with nominal outputs of 12V/25A or 24V/12.5A. The EFE300M series is available now with prices starting at $183 each in 500 piece quantities.

TDK-Lambda, San Diego, CA. (619) 575-4400. [www.lambdapower.com].



VXS Card Blends FPGAs and Multi-Channel A/D and D/A

Fast, high channel count signal processing is critical for a wide range of applications such as RADAR, signals and electronic intelligence (SIGINT/ELINT) and Electronic Warfare (EW). Feeding just those needs, TEK Microsystems has announced the new QuiXilica Tarvos-V5 VXS. This 6U ANSI/VITA 41 (VXS)-compliant high-speed digitizer board combines high-density FPGA processing with six 16-bit A/D input channels at 185 Msamples/s along with a coherent 16-bit D/A output channel. By employing three Xilinx Virtex-5 FPGAs, the Tarvos-V5 offers unmatched FPGA processing density per channel, along with a measured signal-to-noise ratio (SNR) of 72 dBFS and Spurious Free Dynamic Range (SFDR) in excess of 95 dB.

The Tarvos-V5 features high-bandwidth, low-latency interconnect paths between its FPGAs, which have been carefully specified to ensure that data from any analog channel can be broadcast to all FPGAs to support processing that relies on simultaneous access to data from all channels. For offboard communication, the Tarvos-V5 employs the latest flexible I/O communication modules (SFP+ and QSFP). The Tarvos-V5 VXS is available now.

TEK Microsystems, Chelmsford, MA. (978) 244-9200. [www.tekmicro.com].

Wireless Pair of I/O Modules Are Optically Isolated

As data acquisition gets smaller, more integrated and wireless-cable, military system designers now have a whole new range of test set up options. ACCES I/O Products has added the Model WWP-IIRO-8 to its offerings. This product features a pair of intelligent 16-channel digital I/O units that communicate directly with each other. Each unit contains 8 Form C (SPDT) electromechanical relays and 8 optically isolated digital inputs. When an isolated input is toggled on one of the units it will cause the corresponding relay to switch on the other unit. No software or PC connection is required as this solution is completely self-contained and operates autonomously. The units are packaged in small, rugged, NEMA4 enclosures; perfect for remote installations in harsh atmospheric or marine applications.

The units can operate at distances up to 7 miles line-of-sight via a 900 MHz wireless connection (up to 20 miles with optional high-gain antenna). The 8 isolated inputs can be driven by either DC sources of 3-31V (or higher by special order) or AC sources at frequencies of 40 Hz to 10 kHz and are not polarity sensitive. The WWP-IIRO-8 is useful for monitoring controllers and equipment status without needing an available auxiliary contact.

The WWP-IIRO-8 is priced at $795, with OEM and volume pricing available.

ACCES I/O Products, San Diego, CA. (858) 550-9559. [www.accesio.com].

Ethernet Copper-to-Fiber Media Converter Has Flexible SFPs

The military has warmed to Ethernet in a big way. A new Ethernet Media Converter family performs copper-to-fiber conversion and features a versatile design that allows different combinations of fiber and copper LAN port. The TX2FX from MPL is an Ethernet media converter that translates transmission signals from a twisted-pair 10/100/1000BASE-TX cable to a 100BASE-FX or 1000BASE-X fiber optic cable. It expands network data transmission distances beyond the 100 meter limitation of copper wire to over ten kilometers by using single-mode fiber optic cable.

For the optical port the TX2FX supports Small Form-factor Pluggable (SFP) transceivers. SFPs enable adaptability to different fiber types, distances and wavelengths, providing maximum flexibility across a variety of network architectures and topologies. SFP ports are ideal for flexible choices of the transceiver distance needed. On the copper side the TX2FX offers a 10/100/1000 Mbit port accessible on a standard RJ45 connector. Of course, the port supports "auto-crossover" and "auto-negotiation" to enable attaching any 10 Mbit, 100 Mbit, or 1 Gigabit device to them. The products are available in two basic versions that differ in the mechanical port adjustment. Either the copper and fiber optical ports are placed side by side or opposite each other.

MPL AG, Dättwil, Switzerland. +41 56 483 34 34. [www.mpl.ch].

Fanless EPIC SBC Targets Wired and Wireless Comms

Wireless networking is a key element of the military's penchant for system connectivity. Along those lines, WinSystems offers an EPIC-compatible 1 GHz ultra-low-power SBC with two Ethernet and four USB ports plus four COM channels on board. The EPX-855-G is a full-featured SBC based on Intel's 855GME chipset with the ICH4 communications controller and integrated Extreme Graphics 2 video 3D controller. The EPC-855-G features an Intel 1 GHz Celeron-M. An optional 1.8 GHz Pentium M processor with a fan is available for very high-performance applications.

As a population option, it supports 802.11 wireless Ethernet, GSA/GPRS cellular modem, CDMA cellular modem, ZigBee wireless RF modules and 56 Kbph global-compliant dial-up modem. In addition to one Gigabit and one 10/100 wired Ethernet port, it also has SVGA and dual channel LVDS flat panel video, CompactFlash socket, Ultra-ATA disk interface, 24 lines of digital I/O, AC97 audio (5.1 codec), LPT interface and a PS/2 port for keyboard and mouse. The software-programmable 24-line digital I/O controller provides input, output, or output with readback for each I/O line. The board measures 115 mm x 165 mm (4.5 x 6.5 inches) and is compatible with the Embedded Platform for Industrial Computing (EPIC) board standard. Quantity one pricing starts at $695.

WinSystems, Arlington, TX. (817) 274-7553. [www.winsystems.com].

Antenna System Supports Ku-band SATCOM

Broadband wireless data communications is the heart of the military's network-centric future. TECOM Industries has rolled out the newest addition to its SATCOM product line: "KuStream 1000." The KuStream is comprised of three line replaceable units (LRUs): a fuselage-mounted Satellite Antenna Assembly (SAA) consisting of a highly efficient array that is mounted on a two (2) axis low-profile positioner; an advanced microprocessor-based Antenna Control Unit (ACU); and a state-of-the-art High Power Transceiver (HPT) unit. The unit operates in the frequency band of 11.7 to 12.75 GHz for receive, and 14 to 14.5 GHz for transmit.

In recent weeks, TECOM has successfully conducted satellite over-the-air trials that demonstrated system capabilities such as Web browsing and general Internet usage over a commercial satellite service. Preliminary data taken indicates the antenna can support 4 Mbyte/s data rate up and 2 Mbyte/s down in communications with a Ku band satellite.

TECOM Industries, Thousand Oaks, CA. (805) 267-0100. [www.tecom-ind.com].

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StackableUSB Flash Boards Work in Extended Temps

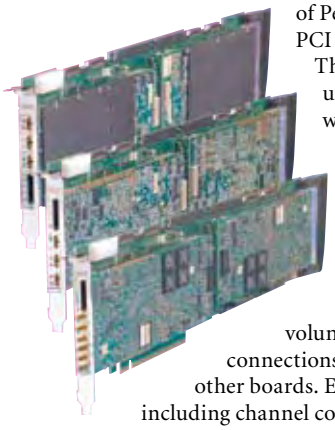
USB got official sanction by the DoD some years ago. But it still took a while for USB to make inroads in the general embedded computing realm, let alone the defense portion of it. Helping to accelerate USB's acceptance, Micro/Sys offers two new boards that address the need for maximum storage at high-speed data transfer rates. At only 1.85 x 1.78 inches—one-quarter the size of the PC/104 form factor—the USB1411 and the USB1410 from Micro/sys fill the role as true space-saver devices. Built with ruggedness in mind, the USB1411 is a RoHS-compliant, solid-state version of a hard drive that provides OEMs with up to 2 Gbytes of NAND flash storage at transfer speeds up to 30 Mbytes/s and operates from -40° to +85°C (ET version). Designed for slightly less hostile environments, the USB1410 can accommodate micro SD removable media cards of up to 32 Gbytes while still maintaining transfer speeds up to 35 Mbytes/s.

Both the USB1410 and USB1411 can connect via StackableUSB, or the traditional Type B mini-USB connector, making them ideal desktop solutions. The basic USB1411 starts at $85 in single quantity. An extended temperature (-40° to +85°C) version of the USB1411 is also available. The basic USB 1410 starts at $105 in single quantity.

Micro/sys, Montrose, CA. (818) 244-4600. [www.embeddedsys.com].

Family of PCIe Cards Is Designed for SDR

PCI Express was by no means the first switched fabric technology to hit the scene, but it has inevitably become the most widely used. As a result, it's finding its way into a variety of military embedded board designs. Exemplifying that trend is the 7700 family of Pentek software defined radio products, the first to feature the PCI Express (PCIe) form factor with advanced connectivity options. This new family is comprised of five products—each offers a unique set of software radio features in a full-length PCIe board with the very latest Gen 2 PCIe x16 interface. This emerging standard for high-end PCs, blade servers and enterprise computers delivers fast interconnect links for economical, high-performance system solutions.



Since the 7700 family offers full-length PCIe boards, they incorporate up to two PMC/XMC modules, all within a single PCIe envelope. This doubles the channel count of earlier models and delivers a lot of performance in a very small volume. Customers can use the PCIe interface for motherboard connections and XMC interfaces for gigabit links between modules and other boards. Each of the five software radio boards offers specific resources including channel count, bandwidth, FPGA population and more. This allows customers to choose exactly what they need for very cost-effective, high-density solutions. Pricing for boards in Pentek's 7700 series begins at $13,490.

Pentek, Upper Saddle River, NJ. (201) 818-5900. [www.pentek.com].

Pico-ITXe Card Is First with SUMIT Connectors

The new Stackable Unified Module Interconnect Technology (SUMIT) connectors integrate common high- and low-speed, legacy and serial expansion buses, including, most notably, PCI Express, LPC, SPI and USB 2.0. Supporting up to four customizable I/O expansion modules, the EPIA-P710 Pico-ITXe board from Via Technologies enables a highly flexible and affordable implementation of serial connectivity options. Designed as the perfect baseboard, the Via EPIA-P710 uses an intelligent board layout to allow efficient module stacking and to aid heat dissipation.

The Via EPIA-P710 board features two SUMIT connectors. SUMIT is an open standard administered by the SFF-SIG. Measuring a mere 10 cm x 7.2 cm, the Via EPIA-P710 uses a 1 GHz Via C7 processor and the latest Via VX800 advanced all-in-one media system processor, which features the integrated Via Chrome9 IGP with DX9 Graphics and MPEG-2/4, WMV9 and VC1 video decoding acceleration. The board supports up to 2 Gbytes of DDR2 system memory, one IDE channel, two S-ATA channels and the Via Vinyl HD Audio. I/O configurations include two SUMIT QMS connectors that provide I/O support for up to three USB, one LPC, two PCIe x1, a PCIe x4, SMBus and SPI buses. Pin headers provide Gigabit LAN, VGA, LVDS, audio and front panel LED.

VIA Technologies, Fremont, CA.
(510) 683-3300. [www.via.com.tw].

Small Rugged PC Flight Qualified to Mil Specs

Complete, packaged systems are the newest trend in today's military market. Along those lines, Parvus offers the DuraCOR 820, a rugged, ultra-small tactical mission computer measuring less than 3.0 inches in height and 3.0 lbs in weight. Fully qualified to MIL-STD-810F environmental specifications (altitude, thermal, shock, vibration, humidity), the DuraCOR 820 serves as an ideal high-performance computing subsystem for space/weight-conscious manned and unmanned systems.

The DuraCOR 820 features a conductively cooled 1.4 GHz Intel Pentium-M processor and solid-state disk pre-loaded with a Linux or Windows XP Embedded operating system. This corrosion/splash-resistant unit is qualified to reliably operate in ambient temperatures of -40° to +71°C, 15G operating shock, 95% humidity, 60,000 ft altitude, and aircraft/helicopter vibration profiles. Rugged watertight ultra-miniature mil-spec performance connectors bring out dual 10/100 Fast Ethernet network connections, MIL-STD-704E power input, analog video, 3x USB, 2x RS-232, DIO, keyboard and mouse. The DuraCOR 820 is now available off the shelf and has a list price of $9,995.

Parvus, Salt Lake City, UT. (801) 483-1533. [www.parvus.com].

AC Power Strip Family Targets Military Apps

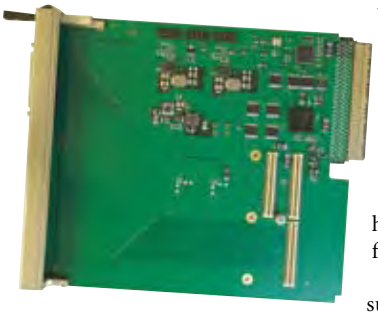
Military applications face unique AC power needs. The range of power sources and conditions can vary a great deal, and reliability is mission critical. With that in mind, Spectrum Power Management Systems has released a full product line of rugged off-the-shelf AC power strips for a variety of military applications. The line includes 1U to 4U horizontal power distribution units, 33- and 66-inch vertical power strips, as well as 14-inch vertical mount satellite units that can also be mounted horizontally with adaptor brackets. The portfolio of power strips features a variety of power inputs and outputs, which enables the user to mix and match components to accommodate most power distribution needs. Both NEMA and IEC receptacles and plugs are utilized. Hybrid outlet mixes are also available to allow for variety in the cabinet.

Designs are offered with a choice of power monitoring (inclusive of visual display) or without monitoring. The units also feature UL-listed 489 circuit breakers, LED power-on indicators, and a rugged frame construction with a black powder coat finish. Spectrum Power Management Systems' AC power strips can be used in a wide variety of industries and applications. Typical applications include communications base stations, portable deployable communications racks, transit cases, test and simulation equipment, and network operating centers. Prices for these units range between $50 and $4,500.

Spectrum Power Management Systems, State College, PA. (814) 272-7767. [www.specpower.com].

Carrier Board Marries PMCs into the AMC Realm

PMC ranks as the most widely used and supported mezzanine form factor of all time. There's a rich ecosystem of products in PMC format that the military has been using for decades. Leveraging that trend, Tews Technologies has announced the TAMC260, a double-width full-size PMC carrier for AMC that supports one single-width PMC module. The TAMC260 is a versatile solution to upgrade well known legacy PMC I/O solutions to the high-performance AMC form factor.



32-bit PCI accesses are supported on the PCI bus at both 33 MHz and 66 MHz. The PLX8112 PCIe-to-PCI bridge provides the real connection between the primary PCIe link and the secondary PMC slot. The bridge controls all PCI accesses and sets the frequency for the PMC access. The TAMC260 supports front panel I/O, and additionally a 68-pin SCSI-V type connector provides access to the PMC P14 back I/O lines. In compliance with specification AMC.0, the TAMC260 provides an IPMI-compliant Module Management Controller (MMC) with temperature monitoring and hot-swap support.

Tews Technologies, Halstenbek, Germany. +49 (0) 4101-4058-19. [www.tews.com].

Ruggedized MicroTCA ATR Chassis Boasts Dual Cooling

MicroTCA is rapidly gaining mindshare amongst military system designers. Along those lines, Elma Electronic offers a new MicroTCA chassis that is an ARINC 404A Full-Size ATR Long Enclosure. The 19-inch subrack chassis is 5U in height with a depth of 200 mm. Two MicroTCA Carrier Hubs (MCH), two power modules for – 48V / – 60V and two cooling units enable the tested system platform to be fully redundant. The cooling units feature five high-performance fans and have PWM (Pulse Width Modulation) control. The Blu!box MicroTCA chassis from Elma Electronic can hold a maximum of 12 single module AMCs—8 full size and 4 compact size modules. All components are hot-swappable and Intelligent Platform Management Interface (IPMI) controlled.

The backplane has a 20-layer structure that guarantees optimum signal integrity and supports all FRU (Field Replaceable Unit) functions. It holds six AMCs, one MCH and one power module. Dual Star technology with high-speed connectors specially developed for high-speed data transfer ensures high-speed routing. Blu!box meets the MIL-STD-810E shock/vibration requirements and MIL-STD-461 for electromagnetic interference. The Chassis has also undergone the IEC 61587-1 and VITA 47 standards vibration and shock tests in six axes.

Elma Electronic, Fremont, CA. (510) 656-3400. [www.elma.com].

ATCA Blade Sports Dual Quad-Core AMD Opteron

ATCA is finding a niche in military systems where communications and networking are involved and where ATCA's large form factor makes sense. With that in mind, the ATC6239 from Diversified Technology is a PICMG 3.0-compliant processor blade equipped with dual AMD Opteron Socket F (1207) 1.8 GHz quad-core processors, each with 2 Mbyte L2 cache (1 Mbyte per core) and support for up to 16 Gbytes of memory. It utilizes a high I/O bandwidth Broadcom HT2100 and HT1000 server-class HyperTransport link interface chipset.

I/O peripherals located on board are a 10/100/1000 Mbits/s auto-negotiating with dual-port Ethernet controller for the Base interface, a 10G dual port Ethernet controller for the Fabric interface, a 10/100/1000 Mbits/s auto-negotiating with dual-port Ethernet controller for one front panel interface, one AMC site for user configuration (the Fabric is x4 PCI-Express, Common Options Region supports a SATA drive port), and other peripherals. The board fully supports the AdvancedTCA concept of separate data and control plane traffic when paired with DTI's ATCA switch boards.

Diversified Technology, Ridgeland, MS. (800) 443-2667. [www.diversifiedtechnology.com].

AMC Pair Pack in a Wealth of Comms Capabilities

The military's migration to Network-centric operations boosts demand for a variety of comms gear. Two new AMC communication controllers, the AMC304 and AMC305 from Performance Technologies, feature four individually selectable T1/E1/J1 connections and provide the ability to deliver a wide range of Voice-over-IP and wireless elements. Both feature a Freescale MPC8560 PowerQUICCIII processor running at 833 MHz and up to 1 Gbyte of SDRAM. PCI Express and Gigabit Ethernet enable rapid exchange of payload information. TDM traffic can be transmitted to other modules in a system via an I-TDM-over-Ethernet interface that is available on the AMC305 model only.

Both AMCs are fully integrated with the company's NexusWare, a Carrier Grade Linux OS and development environment, as well as a complete suite of integrated communications protocols including MTP2 (SS7), HDLC, ISDN, X.25 and Frame Relay. The combination of the company's tightly integrated hardware and NexusWare provides equipment manufacturers with a highly cost-effective approach to rapid product integration and deployment that can help improve bottom-line results.

Performance Technologies, Rochester, NY. (585) 256-0200. [www.pt.com].

Rugged Box-Level System Features Mil Connectors

The stand-alone rugged box trend has touched nearly every corner of the military embedded computer market. ADLINK Technology, for its part, has weighed deeper into that game with the MilSystem 800 Extreme Rugged COTS military computer. MilSystem 800 leverages the proven design of the RuffSystem 800 and uses MIL-STD-D38999 connectors instead of PC-style connectors to maximize the reliability of connections between the computer system and peripherals for the most extreme environmental conditions.

MilSystem 800 consists of the Ampro by ADLINK LittleBoard 800 single board computer (SBC) in a MIL-STD-810 tested RuffSystem enclosure. The system supports up to a 1.4 GHz Pentium M CPU and provides conductive cooling, requiring no fans or holes for ventilation. MilSystem 800 is dust-proof and splash-proof. MilSystem 800 comes in a 8- x 10- x 3-inch conductive-cooled enclosure that has been tested to MIL-STD-810 for shock and vibration, and tested over a wide temperature range of -40° to +75°C. The short height allows installation under seats and in other locations where cube-shaped and rackmount systems cannot fit. Built-in I/O includes Gbit Ethernet, 10/100 Ethernet, four USB 2.0 ports, four serial ports, video, audio and PS/2 keyboard-mouse all on two MIL-STD-D38999-style 55-pin connectors. A third connector is available for an additional 55 I/O signals. Samples of the MilSystem will be available in late Q1.

ADLINK Technology, San Jose, CA. (408) 360-0200. [www.adlinktech.com].

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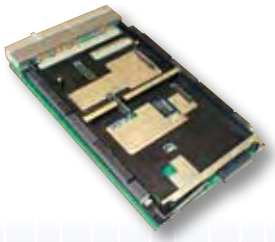

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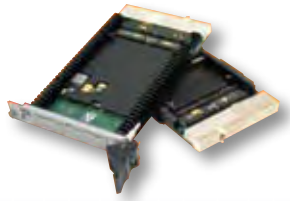

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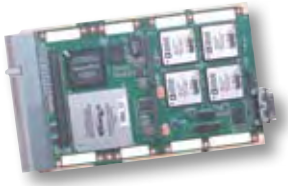

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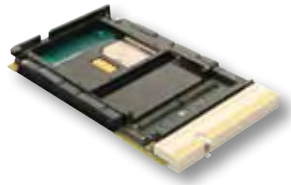

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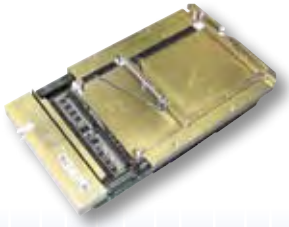

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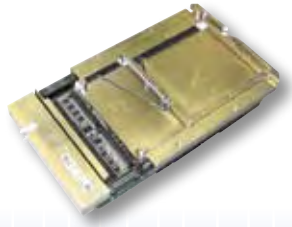

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Lithium-ion cells have moved from niche to major importance in military systems, as portable, rechargeable electronics become a fixture on the battlefield. Data Translation offers a series of precision voltage measurement instruments for lithium-ion cell-by-cell determination. Each VOLTpoint is a stand-alone box offering 48 separate 24-bit resolution inputs over a complete sampling range of +/-100 volts, each with its own A/D converter for direct connection to a PC via USB or Ethernet (LXI compatible).

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Data Translation, Marlboro, MA. (508)481-3700. [www.datatranslation.com].

Fanless PC/104 SBC Operates up to 800 MHz

Fans aren't welcome in most military applications. Feeding those needs is a new PC/104 SBC from Diamond Systems running the Vortex86SX/DX CPU at up to 800 MHz. Ruggedized and operating fanless over the extended temperature range of -40° to +85°C, Helios is a suitable choice for low-cost, embedded applications operating in harsh environments. Helios combines a low-power, highly integrated x86-based CPU with high-accuracy autocalibrating data acquisition circuitry on a single PC/104 board. Helios has up to 256 Mbytes of RAM soldered on board. The module offers standard PC peripheral features, including four USB 2.0 ports, one 10/100Base-T Ethernet interface, four RS-232 ports, an IDE interface and VGA/LCD graphics.

Helios' optional onboard data acquisition circuitry includes sixteen 16-bit analog inputs, four 12-bit analog outputs, up to 40 digital I/O lines, a 512-sample FIFO and two counter/timers. The analog I/O circuit includes Diamond Systems' industry-leading autocalibration circuitry, which ensures accurate analog I/O performance to within +/- 2LSB over the entire industrial operating temperature range of -40° to +85°C. Helios features 256 Mbytes of soldered DRAM, -40° to +85°C fanless operation and low power consumption under 5W. The Helios single board computer is available immediately both with and without data acquisition, priced from $225 to $550 depending on processor speed and options.

Diamond Systems, Mountain View, CA. (650) 810-2500. [www.diamondsystems.com].

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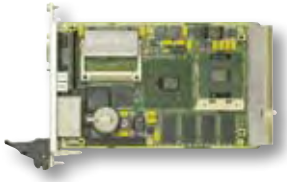

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- *Special Feature: Impact of FPGAs, Radar and SIGINT:* Waveform-intensive applications like sonar, radar, SIGINT and software radio seem to have an endless appetite for signal processing power. Faster DSPs coupled with a broader range of IP cores and development tools for FPGAs are joining forces to form new DSP system architectures. Using those building blocks, board-level subsystems must quickly acquire and process massive amounts of data in real time. Articles in this section examine the upper echelons of signal processing challenges and the products available to address them.
- *Tech Recon: VPX, VXS and VME: Balancing Legacy vs. Leading Edge:* VME has earned an enduring role as the most popular embedded computer form factor for defense applications. Next-generation, fabric-based flavors of VME are coming together in the form of specs such as VXS (VITA 41) and VPX (VITA 46). This section updates readers on the progress of those implementations and displays a sampling of the current crop of VME, VXS and VPX single board computer (SBC) products.
- *System Development: Annual EOL Directory:* Its unique coverage of key military technology issues in a way that you can't find elsewhere: that's what *COTS Journal* is known for. Exemplifying that unique character is our Annual End-of-Life Directory. Now in its 10th year, the EOL Directory lists both key DoD organizations and commercial firms involved in solving the problems of component obsolescence. The section also examines how the troubled general electronics market is affected by obsolescence issues for the defense market.
- *Tech Focus: Rugged Ethernet Switch Boards:* Ethernet is becoming entrenched as a favorite interconnect fabric in compute-intensive applications like sonar, radar or any application that networks sensor arrays together. This section updates readers on the product and technology trends driving board-level Ethernet switch products, and will include a product album of representative Ethernet switch board products in form factors such as VME, cPCI, MicroTCA and more.


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Editorial

Jeff Child, Editor-in-Chief

A Shortcut in the Road to VPX?

Developers of military systems have a close eye on VPX—formerly known as VITA 46. VPX is aimed specifically at defense applications and brings the performance of switched fabric interconnects such as PCI Express, RapidIO, InfiniBand and 10 Gbit Ethernet into a rugged slot-card architecture similar to legacy VME. The VITA 46.0 VPX Base Standard and VITA 46.1 VMEbus Signal Mapping on VPX were ratified a few years ago and have seen some design wins in major programs. Today some programs are even mandating the use of VPX. One well-known problem facing VPX is that, with the large number of open pins and the variety of fabric options available to it, it's difficult to ensure any compatibility between VPX products of different vendors.

With an eye toward just that problem, Mercury Computer Systems caused a bit of a stir late last month with its announcement of its OpenVPX Industry Working Group. OpenVPX is an independent association whose members include Aitech, GE Fanuc, Hybricon and Tracewell Systems. The group also includes a number leading defense prime contractors, although as this goes to print the names of those contractors have yet to be revealed. OpenVPX's ultimate goal is to craft a System Design Guide that will include predefined system profiles for 3U and 6U VPX-based systems.

What's surprising is that OpenVPX is an effort outside VITA and its standards body, the VITA Standards Organization (VSO). The absence of Curtiss-Wright and ELMA from the ranks of OpenVPX is also surprising considering that together Curtiss-Wright and ELMA have probably shipped more VPX products than any other vendor. According to Mercury, the partners they decided to work with were ones that had participated in the PICMG ATCA Design Guide work—GE Fanuc for example—the idea being that the ACTA Design Guide is a good model for what the group wants to get to in terms of system specifications for VPX.

Apparently the OpenVPX group was actually kicked off in secret several months ago, so there's already much work done toward their goal. I do understand the underlying motivation for keeping a group like this small during its "development" phase. It's a notion that's not new to the world of technology spec development. The ubiquitous PCI bus, for its part, was defined and developed in private by only a handful of companies. Only when it was up and running did Intel open PCI up to the general market as an open standard.

A example that's more recent—and more similar to the VPX example—is the Embedded Platform for Industrial Computing (EPIC), which is a computer form factor standard put forth by a combined effort from five vendors in the small form factor segment of the embedded computer market: WinSystems, VersaLogic, Octagon Systems, Micro/sys and Ampro. The five companies developed EPIC in secret—and released it in 2004. I remember being quite impressed that a group of competitors could pull that off without news of it leaking out during the months it took to craft it. Could it have been developed in a matter months like that if the whole PC/104 Consortium community participated? Not likely. The EPIC spec was later put under the auspices of the PC/104 Embedded Consortium.

At the other extreme, an example of the design-by-committee peril is the IEEE 802.11 specification, or what we now commonly call "Wi-Fi." IEEE standards are notorious for the openness of their development process—and the result is that it typically takes years for such standards to get completed. I remember vividly back in 1997 being on a conference call when the IEEE announced the completion and adoption of 802.11—after a long nine years of development. I firmly believe that, had a less "design-by-committee" group created wireless LAN technology, the world would have enjoyed Wi-Fi a good deal sooner.

On the surface, the contrasting examples above of the PCI bus, the EPIC form factor and the 802.11 standard seem to paint a picture that developing a design spec within a small group is the better path. And normally that's an argument I'd agree with. The twist in the VPX case is that VITA and its VSO arm aren't the typical "design-by-committee" organizations. The VSO actually has a pretty good track record of developing technology specs and at reasonable pace—a bit slower than that of a tighter group perhaps—but its results are usually of superior quality and they lead to products that the military market accepts and is pleased with. In favor of keeping VPX spec development within VITA is Curtiss-Wright. "We believe that OpenVPX is a redundant exercise that will be duplicating work already underway in the VPX Working Group," said Mike Hornby, director of marketing, Curtiss-Wright Controls Embedded Computing. "It would be far better to leverage the open and cooperative infrastructure of the VSO rather than putting significant resources into creating a new less open external process outside of VSO oversite." A number of other non-OpenVPX vendors I talked to shared a similar view.

Ultimately, I think the market will sort out where this VPX squabble leads. In this era of complete integrated systems, it's likely that the majority of VPX systems will be put together by one vendor and its partners—in which case compatibility between vendor boards isn't an issue, at least in the short term. In the longer term, I hope the efforts of VITA and OpenVPX move in concert and not in conflict, because there's a lot riding on VPX as the military makes its next embedded computer technology transition. ▮▮

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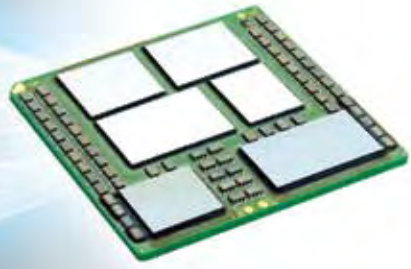

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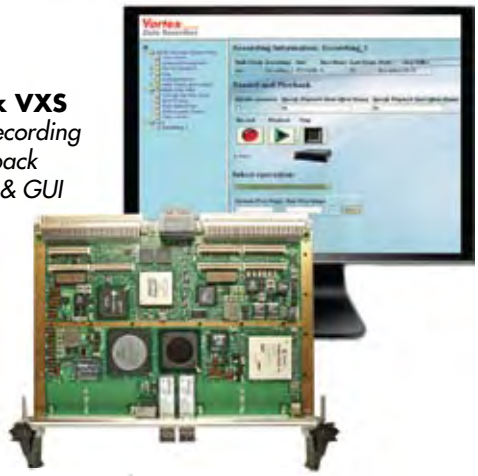

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