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2018 RESOURCE GUIDE

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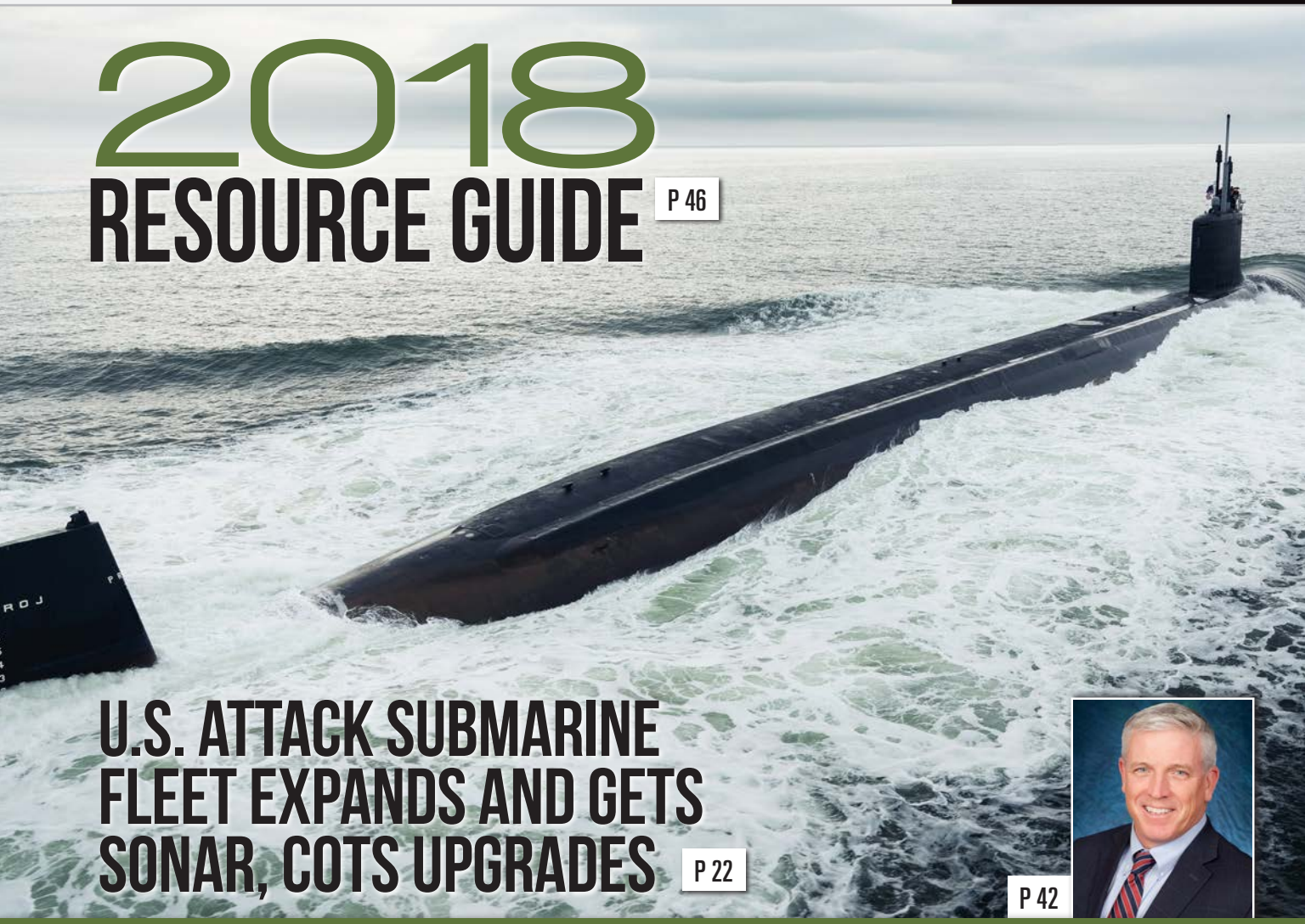

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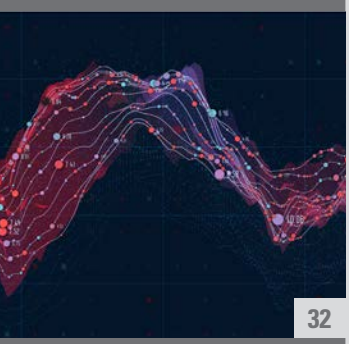

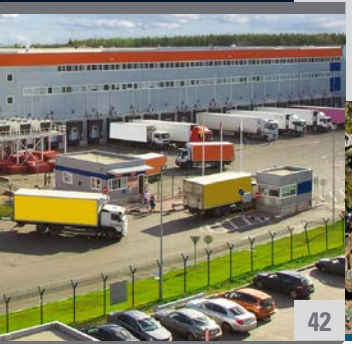

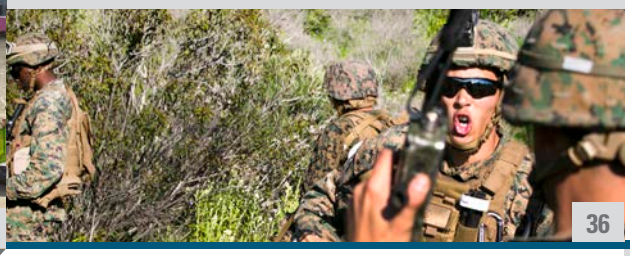

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ON THE COVER:

Top image: Embedded systems on the U.S. attack-submarine fleet need to be secured to protect against SATCOM vulnerabilities. The Virginia-class submarine USS Indiana departs for sea trials. Credit: Huntington Ingalls Industries.

Bottom image: A Marine calls instructions to his team during a tactical recovery of aircraft and personnel training mission at Camp Pendleton, California. Marine Corps photo by Lance Cpl. Frank Cordoba.

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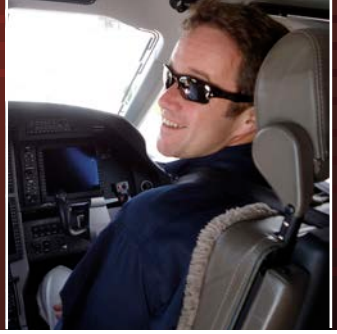

By John McHale, Editorial Director

Welcome to our September Resource Guide, which for the sixth straight year is at least 100 pages – a rare feat in print publishing today. So thank you, loyal readers and advertisers for all your loyalty and support. Not only for your support of our publications in print and online, but also for your support of the warfighters and the sacrifices they make.

This year's edition of our Resource Guide also set a record for advertising sales, which is a sign of the growth in the defense market thanks to increased funding coming out of the Department of Defense (DoD). Applications important to our audience such as radar, electronic warfare (EW), artificial intelligence (AI), command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), cyber, unmanned systems, etc., are all seeing an increase in research, development, test, and evaluation (RDT&E) funding.

In our Defense Market Analysis section on page 18, analysts from Frost & Sullivan detail this growth and how commercial-off-the-shelf (COTS) embedded hardware and software play a role.

While funding is definitely increasing and soldiers, airmen, sailors, and marines will see new technology and support, they likely won't see it quickly as the DoD acquisition process continues to lag behind commercial technology advances. In other words, this is why a general's teenage kids sometimes have better tech than his soldiers.

"The speed of acquisition needs to improve," Brad Curran, Industry Principal, Aerospace & Defense, Frost & Sullivan told me while speaking for our feature this issue. "The Obama administration made good improvements in this area, implementing various rapid acquisition programs and the current administration continues that effort, expanding some of those programs. There is a lack of U.S. defense industrial policy at the same time the DoD is pressing for more competition. DoD and industry need a complete understanding of the requirements, technology, program funding, and management stability."

Curran's colleague, Mike Blades, Research Director, North America for Frost & Sullivan, echoes him. "The procurement process has not increased in rapidity to meet with technological advances. The problem is that [the DoD has] been procuring things the same way for so long with legacy systems and then when you want to upgrade there is so much proprietary code that the old systems essentially can't talk to the new systems. That's why there is such a push toward open architectures for new software and hardware, so technology can be leveraged across platforms. This will reduce the cost of long-term upgrade and technology refresh cycles and in the end speed up the acquisition process. But, that will take time.

"The solution to a lot of these problems is software and commercial company involvement," he adds. You may see defense companies gobble up innovative AI firms because not only does AI enable autonomous platforms but also automates data capture, data processing, as well as filtering which data is needed to enable tactical decision-making.

Speaking of AI and machine learning, we are launching a new, monthly electronic newsletter, titled "Military AI." It focuses on AI technology in the defense and aerospace domain – from the plant floor to the battlefield. Coverage will focus on how engineers and warfighters will benefit from machine learning, predictive analytics, neural networks, and deep learning techniques leveraged in military and aerospace applications such as electronic warfare, radar, avionics, command and control, data mining, and more.

"Artificial Intelligence while not called out in programs of record per se is getting more funding in RDT&E," Curran says. "For example the RDT&E slated for the Next-Generation Jammer covers how EW and information operations will look to leverage AI for network centric warfare, information and communications, etc."

Embedded computing technology will enable AI systems such as cognitive EW, cognitive radio, cognitive radar etc. The DoD is only going to rely more on the COTS suppliers as they are the ones who take all those wonderful commercial processors, algorithms, etc., and enables it for use in rugged, mission critical military systems especially as the platform and component footprint continues to shrink.

Speaking right to our sweet spot, Blades says "innovation is still needed in embedded systems especially with thermal management and reducing size, weight, and power. Everything needs to be smaller. Innovation is also needed in extending battery life especially for sensors dispersed across thousands of miles in the ocean."

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Boron arsenide whisks heat away from electronics

By Sally Cole, Senior Editor

Move over, silicon: Defect-free boron arsenide offers far superior thermal conductivity than other semiconductors and metals, including silicon and copper.

If you haven't heard of boron arsenide (BAs) yet, you will soon: It's a new semiconductor "wonder" material that can draw and dissipate waste heat from electronics more effectively than any other known semiconductor or metal materials.

Boron arsenide isn't a naturally occurring material, so scientists synthesize it within the lab. The material requires a very specific defect-free structure and low density to achieve peak thermal activity, so crystals of it need to be grown in a strictly controlled way.

Defect-free boron arsenide was made for the first time by a team of University of California, Los Angeles (UCLA) engineers, led by Yongjie Hu, an assistant professor of mechanical and aerospace engineering. The material boasts a thermal conductivity that's more than three times faster at conducting heat than currently used materials such as silicon and copper. Its most promising superpower is that heat that tends to concentrate in hot spots in computer chips instead gets quickly flushed away with boron arsenide. (Figure 1.)

This feature is highly desirable, because high-power electronics must remain cool to operate reliably. Materials with high thermal conductivity are necessary to serve as substrates in high-power electronics, because without them the internal temperatures of these devices crank up and can cause programs to run slower, freeze up, or even shut down.

The way the boron arsenide actually dissipates heat is linked to the crystal's vibrations. This motion creates packets of energy called phonons, which whisk heat away from the crystal.

Boron arsenide "could help greatly improve performance and reduce energy demand in all kinds of electronics, from small devices to the most advanced computer data center equipment," Hu says. "It has excellent potential to be integrated into current manufacturing processes because of its semiconductor properties and the demonstrated capability to scale up this technology. It could replace current state-of-the-art semiconductor materials for computers and revolutionize the electronics industry."

The material has the potential to revolutionize thermal-management designs for computer processors and other electronics, or for light-based devices such as light-emitting diodes (LEDs), according to Hu and his graduate students Joonsang Kang, Man Li, Huan Wu, and Huuduy Nguyen; this team has spent years designing and making the materials, as well as doing predictive modeling and taking precision temperature measurements.

As computer processors continue to shrink down to nanometer sizes, it's not uncommon now to see billions of transistors on single chip. While each smaller generation of chips helps to speed up computers, as well as making them more powerful and capable of doing more work, it also means that the chips are generating more heat.

Today, most high-performance computer chips and high-power electronic devices are made of silicon, a crystalline semiconductor that does a good job of dissipating heat. But even silicon can handle only so much heat.

Diamond still holds the title of the highest known thermal conductivity – about 15 times that of silicon – but it has issues when it comes to thermal management of electronics: It's super-expensive, and it also happens to be an electrical insulator. When paired with a semiconductor device, diamond expands at a different rate than the device does when it heats up, which is less than desirable.

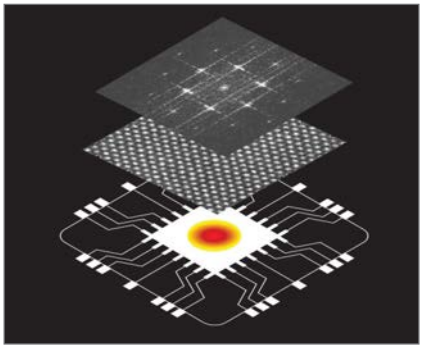

Figure 1 | This schematic shows a computer chip with a hot spot (bottom), an electron-microscope image of defect-free boron arsenide (middle), and an image showing diffraction patterns in boron arsenide (top). Credit: Hu Research Lab/UCLA Samueli.

Beyond its impact on electronic and photonics devices, the UCLA team's work has also revealed new fundamental insights into the physics of how heat flows through materials.

The work was funded by the National Science Foundation, the Air Force Office of Scientific Research, the American Chemical Society's Petroleum Research Fund, UCLA's Sustainable LA Grand Challenge, and the Anthony and Jeanne Pritzker Family Foundation.

Other researchers around the globe are also currently exploring boron arsenide crystals and announcing advances. A group of researchers from the University of Texas at Dallas and the University of Illinois at Urbana-Champaign recently grew boron arsenide crystals with a thermal conductivity in excess of 1,000 watts per meter-kelvin at room temperature (compared to copper's 400 watts and diamond's 2,000 watts) via chemical vapor transport. They're now working on other processes to improve the growth and properties of the material for large-scale applications.

Tackling Moore's Law goal of DARPA initiative

By Mariana Iriarte, Technology Editor

Defense Advanced Research Projects Agency (DARPA) officials kicked off the Electronics Resurgence Initiative (ERI) summit in July 2018 by selecting teams to tackle the three technology pillars – materials/integration, architectures, and design – that will ultimately address Moore's Law. The prediction by Intel cofounder Gordon Moore in 1965 that transistors were shrinking so fast that every year twice as many could fit onto a chip was adjusted in 1975 adjusted to a doubling every two years, and is now defined as a doubling every 18 months.

Dr. Bill Chappell, the director of DARPA's Microsystems Technology Office, explains that at this point "we are at an inflection point – Moore's inflection – which is what we termed it at DARPA."

That inflection point comes with the "skyrocketing costs of doing business in the electronics market mixed with the foreign investment that is flowing into the marketplace," Chappell continues. "On top of that, we have a value chain, which is pushing more and more of the value to the application and software level, away from some of the base semiconductor investments. DARPA decided, because of this confluence of events, we would have an increased concentration on the basics of electronics and the basics of semiconductors."

The launch of the ERI summit had sessions focusing on each pillar. Under the materials/integration thrust, DARPA program managers enacted the Three Dimensional Monolithic System-on-a-Chip (3DSoC) and the Foundations Required for Novel Compute (FRANC) programs. 3DSoC members include researchers from Stanford University, MIT, and Skywater Technology Foundry. On the FRANC team: HRL Laboratories; Applied Materials; Ferric, Inc.; UCLA; University of Minnesota; and University of Illinois at Urbana-Champaign.

HRL Laboratories is working alongside team members to produce neuromorphic circuit architectures. The end result has the potential to create a "computing architecture [that is] built entirely with biomimetic memristors, using no transistors or other common types of active devices," says Wei Yi, HRL Principal Investigator (PI).

"In this program we aim to develop efficient neuromorphic circuit architectures based on memristors instead of complementary metal-oxide semiconductor (CMOS) transistors," co-PI Jose Cruz-Albrecht says. "Neuromorphic processors that use just CMOS devices have difficulty efficiently merging memory and computation with very compact circuitry. Most require several transistors to implement just the memory portion of a single synapse, additional transistors for the most basic synaptic computation, and still more transistors for complex synaptic computations that include adaptation mechanisms. In this program we plan to develop all-memristor circuit architectures that efficiently merge memory and computation. An electronic synapse that includes memory, computation, and adaptation could be designed with as little as one memristor, which could enable more compact and energy-efficient neuromorphic processors."

For the architectures pillar, according to DARPA materials, teams selected for the Software Defined Hardware (SDH) program include Intel, NVIDIA, Qualcomm, STR, Georgia Institute of Technology, Stanford University, University of Michigan, University of Washington, and Princeton University. IBM, Oak Ridge National Labs, Arizona State University, and Stanford University will be working for the Domain-specific System on Chip (DSSoC) program.

The team is attempting to "build systems with self-introspection and data introspection so that both the chip can morph to be what it needs as the graph changes from a sparse problem to a dense problem, so it can analyze the data in real time and have the reconfigurability of the chip to change along with its data needs on the microsecond or millisecond timescales," Chappell says.

Lastly, the design area research teams will focus primarily in the Intelligent Design of Electronic Assets (IDEA) program and the Posh Open Source Hardware (POSH) program. Team members include the University of California, San Diego; Northrop Grumman Mission Systems; Cadence Design Systems; Xilinx; Synopsys; University of Southern California; Princeton University; and Sandia National Laboratories, per DARPA officials.

Under DARPA's IDEA program, NVIDIA will work with Cadence Design Systems to implement machine-learning algorithms to enable full automation. IDEA's complementary program, POSH, will "create an ethos of sharing in the hardware community that's similar to what the software community uses," Chappell explains. "Ultimately what that comes down to is trusting a design that you may have had many different contributors, which will only be done if we have a pretty radical revolution in the underpinnings of verification. Even though it's an open source hardware program, it's all about verifying the functionality of these hardware blocks … so it's very important that we have full knowledge of every design choice that went into an IP block.

"And one way to get there is through open source," Chappell continues. "We don't actually care if it's open source or not. We want to have full knowledge of how something is going to work before it is utilized in an electronics system."

Advances in switching bring rugged 1/10 GbE networking to embedded platforms

By Mike Southworth
An industry perspective from Curtiss-Wright Defense Solutions

As advanced network features and increasing speeds are added to next-generation rugged embedded switches, these products become even more useful for military applications by helping to reduce system size, weight, power, and cost (SWaP-C) through a reduction of cabling and the use of Layer 3 switches for basic network routing duties.

At the same time, there's increased use of 10 Gbps Ethernet network backbones on military platforms to handle new faster intelligence, surveillance, and reconnaissance (ISR) sensors, such as high-definition (HD) video cameras. HD video feeds have historically required H.264 or similar compression for transmission over a 1 GbE network interface. Now, with support for 10 Gbps data rates, the latest switches can handle multiple cameras and transmit uncompressed HD video at line rate.

What's more, 10 GbE can be delivered over fiber optics, providing additional cybersecurity benefits; since fiber is immune to electromagnetic interference (EMI), it can't be hacked. Bringing the latest performance advantages to deployed embedded applications, the networking world's industry standard, Cisco Systems, recently announced new embedded services switch (ESS) technology. With the introduction of Cisco's latest offering, truly rugged Cisco IOS-based networking technology can for the first time support 10 Gbps in harsh military environments with a roadmap towards Layer 3 routing switch software capabilities.

In the OSI [Open Systems Interconnection] model of computer networking, Layer 2 defines the "data link layer" where switches can connect one device to another using MAC [media access control] addresses within a local area network (LAN). The Layer 3 "network layer" is where routing, using Layer 3 protocols, takes place between different network IP addresses over a wide-area network (WAN, i.e., Internet). In short, for routing, networks connect to other networks, while switching instead links a device to an adjacent device on the same network. With the advent of the Layer 3 switch (also referred to as a routing switch), the paradigm shifts: A switch still primarily serves as a Layer 2 LAN device but adds some enhanced capabilities to support basic Layer 3 routing.

Dedicated network routers, which provide special services different from switches, won't all be replaced by Layer 3 switches. While routers and Layer 3 switches can both be used for IP routing, dedicated routers uniquely provide security and communications services, such as firewall/Virtual Private Network (VPN) encryption, intrusion detection and prevention services (IDS/IPS), and Voice over IP (VoIP) phone services, etc.

These network services and the IP routing process add overhead to routers, and can reduce router throughput speeds to something less than the line rate speeds (1 Gbps/10 Gbps) of switches. In fact, when dedicated routers are used to secure traffic over encrypted tunnels through commercial standards, like AES or NSA Suite B, their throughput can be reduced by 50 percent or more. Layer 3 switches deliver high switching speeds, but the sophistication of their Layer 3 connection is limited (i.e., which protocols and security capabilities they support). If these security/communications services are not needed, or routing requirements are less dynamic, a Layer 3 switch offers the advantage of high speed with support for Layer 3 routing protocols.

The new Cisco ESS technology brings high-speed switching to the embedded environment, with basic routing capabilities soon to follow. Like previous embedded and industrial products from Cisco, the new switch supports the wide operating temperature ranges required in military and aerospace applications. But unlike previous models, the new ESS module brings an enterprise-class, Cisco IOS-managed switch with 10 GbE support to deployed applications. It also supports IEEE-1588 high-speed precision timing, antitamper features (such as secure boot and IEEE 802.1AE MACsec encryption), Power over Ethernet (PoE), and PoE+ capabilities. PoE helps reduce SWaP, enabling both data and power to be sent over a single CAT5/6 cable and eliminating the need for a separate power connection to IP phones or cameras. For applications with basic routing needs, this new switch architecture roadmaps Layer 3 software support to handle routing protocols like OSPF, RIP, InterVLAN, EIGRP, etc.; such a setup means further savings because a single SWaP-optimized embedded device can handle both high-speed switching and basic routing duties.

Figure 1 | Curtiss-Wright's DuraNET 30-2020 and DuraMAR 5915 are examples of rugged embedded switch and router systems.

As the use of high-speed ISR sensors grows, the availability of 10 GbE Layer 3 switch technology will help eliminate data bottlenecks by bringing enterprise-class networking to the warfighter.

Mike Southworth *is product line manager for Curtiss-Wright Defense Solutions.*

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By Mariana Iriarte, Technology Editor

NEWS

GaN ground radar now operational for Marine Corps

Northrop Grumman has delivered the first AN/TPS-80 Ground/Air Task-Oriented Radar (G/ATOR) to the U.S. Marine Corps (USMC) that uses advanced high-power and high-efficiency gallium nitride (GaN) antenna technology, further improving the system's operational capabilities.

Delivery of the first GaN G/ATOR system to the Marine Corps follows the delivery of six low-rate initial production (LRIP) systems to the Marines that began in early 2017. Using two of those six systems, the Marine Corps achieved G/ATOR Initial Operational Capability (IOC) of the air surveillance system during February 2018. The remaining four systems will establish IOC for the counterbattery mission in late 2018.

Both the USMC and Northrop Grumman continue to plan the rollout of the full-rate production program, scheduled to begin in early 2019.

Figure 1 | Four G/ATOR systems preparing for fielding, located at Northrop Grumman's Stoney Run test range in Baltimore, Maryland. Photo courtesy of Northrop Grumman.

U.S. Navy satellite system gets go-ahead for expanded operational use

The U.S. Strategic Command approved use of a next-generation narrowband satellite communication system for the Navy. The five-satellite on-orbit system is called the Mobile User Objective System (MUOS).

U.S. Navy officials say that the full-suite MUOS payload, known as Wideband Code Division Multiple Access (WCDMA) waveform, adapts commercial cellular technology to enable warfighters to communicate beyond line of sight more securely and reliably than ever before, with 10 times the capacity compared to the older system's capability.

The MUOS system is expected to be declared fully operational following final test and evaluation in summer 2019.

EW contract through Harris Corp. gets $400 million ceiling increase

Harris Corp. won a $400 million increase to the ceiling value of a single-award indefinite delivery/indefinite quantity (ID/IQ) contract to supply electronic warfare (EW) systems for international F-16 fighters in a push to help protect allied aircraft against evolving radar and electronic threats. The new ceiling value is $491 million.

Under the terms of the increase, Harris will provide AN/ALQ-211 (V)4/9 Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS) systems, spares, and engineering support to several allied countries as part of a Foreign Military Sales contract through the U.S. Air Force.

The ALQ-211 detects and protects aircraft from lethal threats and provides multispectral – radio frequency, infrared, and laser – situational awareness.

Army tasks General Dynamics to upgrade 100 M1A1 Abrams tanks

U.S. Army officials selected General Dynamics Land Systems to upgrade an additional 100 M1A1 Abrams Main Battle Tanks to the M1A2 System Enhancement Package Version 3 (SEPv3) configuration.

The delivery order is part of an Army Requirements Contract signed in December 2017 through which the Army can upgrade up to 435 M1A1 Abrams tanks to the M1A2 SEPv3 configuration. The M1A2 SEPv3 configuration features technological advancements in communications, reliability, sustainment, and fuel efficiency, plus upgraded armor.

Work on this delivery order will be performed at Land Systems locations in Scranton, Pennsylvania, and Tallahassee, Florida, and at the Joint Systems Manufacturing Center in Lima, Ohio. Initial pilot M1A2 SEPv3 Abrams tanks were delivered to the Army in October 2017.

Figure 2 | M1A1 Abrams Tank. Photo courtesy U.S. Marine Corps/Cpl. Samuel J. Nieves.

DARPA selects BAE Systems to develop automated cyberdefense tools

Defense Advanced Research Projects Agency (DARPA) officials tapped BAE systems to develop data-driven cyber-hunting tools that detect and analyze cyberthreats to help protect extremely large enterprise networks. The contract for DARPA's Cyber-Hunting at Scale (CHASE) Phase 1, 2, and 3 is valued at approximately $5.2 million.

The goal of DARPA's CHASE program is to develop, demonstrate, and evaluate new, automated cyberdefense tools for use within and across these large networks. BAE Systems' solution, which combines advanced machine learning and cyber-attack modeling, intends to address this need by automatically detecting and defeating advanced cyberthreats that could currently go undetected.

The result could be better-defended commercial networks, using existing storage and existing resources. The technology could also be used to help protect government and military networks. The company's subcontractors and research partners on the program include Digital Operatives, Dr. Ruslan Salakhutdinov from Carnegie Mellon University, and Dr. Farshad Khorrami and team from New York University. BAE Systems' work for the program will be performed in Arlington, Virginia.

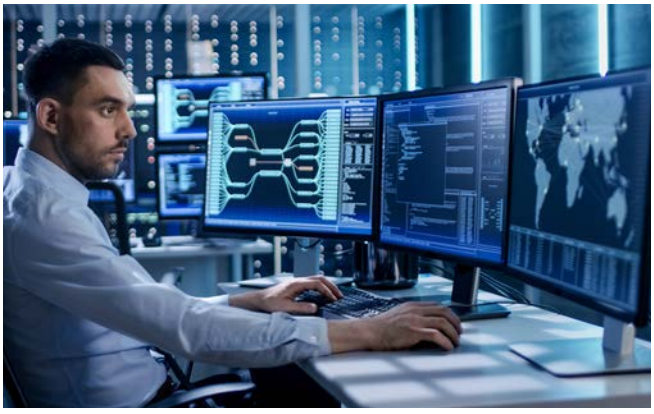

Figure 3 | The technology could potentially be used to help protect government and military networks. Photo courtesy BAE Systems.

Counter-UAS tech the focus of $48.5 million U.S. Navy contract with CACI

IT security firm CACI International won a $48.5 million single-award, ID/IQ contract from the U.S. Navy to provide integration, installation, sustainment, and engineering services to the Naval Air Systems Command Naval Air Warfare Center Aircraft Division (NAWCAD) AIRWorks Rapid Development Capabilities Integrated Product team.

Under the terms of the contract, CACI will support the deployment of new and existing counter unmanned aerial systems (C-UAS) capabilities and hardware to high-priority and sensitive government sites that protect assets vital to national security.

CACI will provide technical, engineering, and project-management support services, including modeling/simulation and hardware, software, and command-and-control integration.

Unmanned battlefield convoys to get prototypes, testing

Lockheed Martin won a contract with the U.S. Army's Tank Automotive Research, Development and Engineering Center (TARDEC) to act as the Integrated Systems Developer for its Expedient Leader Follower (ExLF) program.

Under contract, Lockheed Martin will lead a three-year effort to develop, integrate, and test unmanned prototype systems for supporting leader/follower convoy activities within an asymmetric threat environment. Soldiers testing the systems will conduct operational technology demonstrations using the prototypes developed in the ExLF program to establish operating procedures and shape future programs.

The ExLF program is of interest to the military, say Lockheed Martin officials, because soldiers must conduct resupply convoys within an asymmetric threat environment with the difficulty compounded by long sustainment missions, adverse weather or environment, and night operations. Earlier in the summer of 2018, Oshkosh Defense won a $49 million TARDEC contract to integrate existing palletized load system (PLS) vehicles with scalable autonomous technology as part of the ExLF program.

Neuromorphic digital synaptic supercomputer unveiled by IBM, AFRL

IBM and Air Force Research Laboratory (AFRL) officials recently showcased the world's largest neuromorphic digital synaptic supercomputer at AFRL's Information Directorate Advanced Computing Applications Lab in Rome, New York.

According to AFRL documents, the supercomputer is named Blue Raven. Its end-to-end IBM TrueNorth ecosystem aims to deliver the equivalent of 64 million neurons and 16 billion synapses of processing power while only consuming 40 watts, which is equivalent to a household light bulb.

Researchers believe that the brain-inspired neural network approach to computing will be far more efficient for pattern recognition and integrated sensory processing than systems powered by conventional chips, Air Force officials report.

Figure 4 | Mark Barnell (left), program manager of the Blue Raven project for AFRL, and Dr. Qing Wu (right), principal computer scientist for the project. Photo courtesy of AFRL.

NEWS

LONGBOW to deliver radar hardware for Army AH-64E helicopters

U.S. Army officials selected Longbow – a joint venture of Lockheed Martin and Northrop Grumman – to provide LONGBOW Fire Control Radar (FCR) hardware for Apache AH-64E helicopters, which will support the Army's Lot 7 and 8 production contracts plus three international customers.

The contract includes LONGBOW FCR Mast Mounted Assemblies (MMA), Radar Electronics Units (REU), and spares for the Army, as well as allies United Kingdom, Saudi Arabia, and Qatar; this order makes Qatar the 13th international customer to receive LONGBOW FCR. Production will extend through April 2021 at Lockheed Martin's Orlando and Ocala, Florida, facilities and at Northrop Grumman's Baltimore, Maryland, facility.

The LONGBOW FCR automatically searches, detects, locates, classifies, and prioritizes multiple moving or stationary targets on land or in the air, in clear or adverse weather, and in obscured battlefields – giving commanders the precision engagement capabilities necessary to win the battle, say Lockheed officials.

Figure 5 | AH-64 helicopters landing. Photo courtesy U.S. Army.

High-energy laser development ongoing for U.S. Army by Dynetics and partners

Engineering/IT company Dynetics, along with its partners, is operating under a $10 million contract to continue development for the next phase of the U.S. Army Space and Missile Defense Command's (SMDC) High Energy Laser Tactical Vehicle Demonstrator (HEL TVD) program, a 100-kilowatt class laser weapon system.

The team – with Dynetics as prime contractor and also including Lockheed Martin – completed a System Requirements Review and technical baseline update; the next step in the program is set to be the preliminary design review in January 2019.

Dynetics officials say that its HEL TVD system uses highly reliable subsystems to withstand the expected rugged operational conditions and that laser weapons are well-suited to address high-volume, low-cost threats.

NATO approves upgraded satellite control software

Viasat's commercial off-the-shelf (COTS) Visual Integrated Satellite Communications Information, Operation and Networking (VISION) software passed NATO's First Article System Test (FAST).

The software's testing and approval means that NATO can expedite the rollout of its ultra-high-frequency (UHF) satellite communications (SATCOM) modernization efforts. NATO is on the path to fully upgrading its legacy UHF communications network to Viasat's VISION planning and network management platform; VISION is the first commercially available software package to simultaneously support all 25-kHz legacy Demand-Assigned Multiple-Access (DAMA) and next-generation Integrated Waveform (IW) networks and services.

According to information from Viasat, the VISION platform provides a single, user-friendly network management interface for legacy DAMA and IW services, enables local or remote management and control of ground station networks, monitors status and system performance, tracks event/alarm management situations, and allows for addition or removal of services when missions change. Viasat officials say that by enabling interoperability between DAMA and IW platforms, NATO's use of VISION can double its channel efficiency without additional investment in the UHF space segment.

CPI division will replace radomes on USAF B-52 aircraft

Defense Logistics Agency (DLA) aviation officials selected the Radant Technologies Division of Communications & Power Industries (CPI) for a two-year contract to replace existing radomes on U.S. Air Force B-52 aircraft. The firm-fixed price contract is worth approximately $4.1 million.

These replacement radomes are expected to be higher performance and more supportable than the previous forward nose radomes on the long-range strategic bomber.

Headquartered in Stow, Massachusetts, CPI's Radant Technologies Division has provided radomes for the U.S. Air Force fleet of B-52 aircraft for several years. In 2011, DLA Aviation awarded Radant Technologies a seven-year, $45 million contract to replace aged and unsupportable radomes under the B-52 Radomes Replacement Program.

Figure 6 | A B-52 Stratofortress from Barksdale Air Force Base, Louisiana, touches down at Al Udeid Air Base, Qatar. Photo courtesy U.S. Air Force / Tech. Sgt. Nathan Lipscomb

Joint program aims to enable autonomous systems to learn for life

HRL Laboratories and the Defense Advanced Research Project Agency (DARPA) are teaming to develop a machine-learning architecture for autonomous systems. With funding from the Lifelong Learning Machines (L2M) program – led by Dr. Hava Siegelmann from DARPA – the proposed system will continually improve its performance and update its knowledge based on experience, performing these tasks without human supervision.

If successful, the system – dubbed Super Turing Evolving Lifelong Learning Architecture (STELLAR) project – will be a significant improvement over current technology, enabling autonomous systems to rapidly adapt to unforeseen situations, remember and learn from each experience, and consolidate new tasks with previously performed ones, according to HRL Laboratories. Currently used machine-learning systems forget old tasks when learning new ones and are incapable of learning online and responding to new situations.

The HRL team also has members at Stanford University, University of California Irvine, University of Texas Austin, Loughborough University (U.K.), IT University of Copenhagen, and The French Institute for Research in Computer Science and Automation.

Figure 7 | The STELLAR machine-learning architecture will emulate interactions of the hippocampus to consolidate lifelong learning. Photo courtesy HRL Laboratories.

NAVAIR signs $47 million ManTech contract for heavy-lift helicopter tech support

ManTech won a four-year, $47 million award with the U.S. Information Analysis Center (DoD IAC) Defense Systems Technical Area Task (DS TAT) to provide technical support and collaboration for the U.S. Navy Naval Air Systems Command (NAVAIR) H-53 heavy-lift helicopter program (PMA-261).

Under the contracted work, ManTech will enable the effective and optimized integration of legacy technical data into digital solutions, including maximizing the use of automation.

ManTech will provide PMA-261 and associated programs with digital technical data products including interactive electronic technical manuals (IETMs), common-source data tools, and integration capabilities for logistics technical data solutions in Aviation Logistics Environment (ALE) systems.

NASA selects 20 research and technology proposals from small businesses

NASA has chosen 20 research and technology proposals – valued at $15 million – from 19 small businesses in the U.S. Each of the businesses is partnering with research institutions for Phase II of NASA's competitive Small Business Technology Transfer (STTR) program.

The awards, say NASA, cover such critical technology needs as a distributed electric propulsion aircraft comprehensive analysis and design tool to help the agency test the next generation of electric propulsion aircraft; an autonomous power controller for mission-critical microgrid power systems; and multiphase modeling of a solid rocket motor internal environment.

The companies selected for Phase II of the program will focus on the development, demonstration, and delivery of the innovation. Contracts for these Phase II projects – chosen as a result of competitive evaluations and based on selection criteria provided in the solicitation – last for 24 months, with a maximum funding of $750,000.

USAF signs $29.8 million contract for KC-135 audio systems sustainment

Tracking-based communications company Orbit Communication Systems won a contract from the U.S. Air Force (USAF) for $29.8 million to provide systems sustainment for the several thousand ADAS [airborne digital-controlled audio system] units currently installed on USAF KC-135 aircraft.

The audio upgrade, part of a massive USAF project to refurbish its fleet of tankers, calls for the front panels of the audio systems to be made water-resistant for improved operability and reliability under harsh flight conditions.

Work will be performed by Orbit in its Deerfield Beach, Florida, facility; staged delivery of the new systems is expected to begin in 2018 and conclude in 2023.

Figure 8 | A KC-135R Stratotanker assigned to the 916th Air Refueling Wing takes off at Yokota Air Base. Photo courtesy U.S. Air Force/ Yasuo Osakabe.

VXWORKS 653:
Bringing Multi-core Systems on All Major Hardware Architectures

By Chip Downing

Tomorrow's virtualized infrastructure will gather countless applications, executing on an open virtualization platform that solves hard challenges such as affordability, safety certification, legacy software integration, and standards conformance.

As a supplier for the avionics industry, you not only need to provide solutions to these challenges, but you must also find a way to optimize your corporate investment across more product lines – from both existing products and new ones that drive greater revenue opportunities.

But today's avionics systems are comprised of many fixed-function, proprietary platforms, making them difficult to manage and expensive to maintain. These systems incur significant operating expenses and risk delays to market because developing each one takes months, maybe years to launch.

Now imagine your next system is built on a standards-based, open virtualization platform that runs multiple operating environments across ARM, Intel, and Power processor architectures – a platform capable of abstracting and running any type of workload, including legacy and new, on a certification-ready platform supporting multiple levels of safety.

With over 220 customers using VxWorks 653 in over 440 programs in over 80 global aircraft, Wind River is the leading provider of modern avionics software platforms. The VxWorks 653 open virtualization architecture can readily migrate proprietary, fixed-function devices across the system, while delivering outstanding performance with cost-saving innovations like robust partitioning for high multi-level safety and security assurance utilizing hardware virtualization assist on the latest multi-core processors.

Robust, open, multi-core avionics platforms are here today. Design for the future with your trusted partner – Wind River.

For more information on VxWorks 653, visit www.windriver.com/vxworks_653.

Electronics funding for radar, electronic warfare, C4ISR continues to rise

By John McHale,
Group Editorial Director

The defense market for embedded electronics designers continues to be a growth area. While increased use of commercial off-the-shelf (COTS) technology has lowered the cost and therefore the spending in unmanned systems, it is fueling more innovation, especially in small platforms.

Lockheed Martin received $1.58 billion from the Army for the AN/TPQ-53 Counterfire Target Acquisition Radar for low-rate initial production (LRIP). This radar is for Counter-Rocket Artillery Mortar (CRAM) systems.

The first two years of the Trump administration have seen greater investment in the Department of Defense (DoD) budget, especially in the area of research, development, test, and evaluation (RDT&E), which means more dollars focused on improving U.S. capability in radar, electronic warfare, cyber, C4ISR [command, control, communications, computers, intelligence, surveillance, and reconnaissance], and unmanned aircraft.

According to market analysts from Frost & Sullivan (www.frost.com) these applications are still excellent bets for designers of embedded hardware and software, with growth projected over the next five years as the DoD increasingly leverages open architectures to ease modernization and reduce the long-term life cycle costs of electronics.

Radar

Radar continues to be the hottest growth area for military electronics, especially with modernization efforts.

"In 2017, 65 new prime contracts were awarded for a total of $5.97 billion to 19 companies, with Raytheon leading after receiving $2.76 billion in contracts, with their largest being worth $1.5 billion for the transportable radar and sea-based band radar in the same contract," says Brad Curran, Industry Principal, Aerospace & Defense, Frost & Sullivan. "Joint programs let the highest contract value in 2017, with five contracts totaling $1.98 billion led by ground- and sea-based missile defense. Next is Lockheed Martin, which received $1.8 billion in 2017, the largest being $1.58 billion from the Army for the AN/TPQ-53 Counterfire Target Acquisition Radar for low-rate initial production (LRIP). This radar is for Counter-Rocket Artillery Mortar (CRAM) systems.

The 2019 DoD budget request echoes this data: "It calls for 57 radar line items totaling about $3.70 billion," Curran continues. "New platforms, repairs, and already programmed replacements/upgrades mean that radar spending will be even higher. Acquisition priorities are covering improvements to proven equipment, new build platforms, modifications, and replacement systems.

"RDT&E is the largest category, with $2.07 billion," he says. "Procurement is at $1.63 billion, with new platform builds of all types coming on line and current equipment is

being upgraded and replaced. The Navy/Marines have largest share of funding at $1.47 billion, due to investments in ship self-defense systems and G/ATOR ground air defense/surveillance/control radar. The Navy also benefits from jointly funded missile defense programs."

Staying competitive with adversaries in defense funding such as China and Russia is paramount for U.S. forces.

As a result, "R&D funding is being directed toward sensor fusion, open architectures, wideband millimeter wave, nonjammable, high-angular-resolution moving target indication, ground penetrating, and Next-Generation Over The Horizon radars," Curran says. "Also being developed is cognitive radar, which is based on knowledge-aided computer processing. This solution will enhance detection and target ID in the crowded frequency spectrum and the complex interference and clutter environment.

"Going forward there will be fewer platforms of all types," he continues. "Future buys will look away from high-end platforms toward proven and reliable designs that afford maximum jointness, mission flexibility, and the capability to be quickly and easily upgraded and integrated as COTS technology matures. Reduced spending growth rates, cuts for immature technologies, and less RDT&E all mean more COTS." For more on radar from Brad Curran view a webcast titled "Next-Generation Military Radar – Tech Outlook," here: http://ecast.opensystemsmedia.com/814.

Missile defense radar

"Missile Defense Agency (MDA) contracts are focusing in 2018 on how to track hypersonic weapons with sophisticated radar," Curran says. "So far this year, there are 38 contracts totaling $3.1 billion, with the biggest one again going to Raytheon for the Patriot Missile System upgrade. The Air Force awarded InDyne (Sterling, Virginia) $417 million for the Solid State Phased Array Radar System (SSPARS) for operations and maintenance.

"Under RDT&E funding, the MDA awarded Raytheon, Lockheed Martin, and Northrop Grumman $4.1 billion over five years to provide autonomous acquisition and persistent precision tracking and discrimination technologies," he adds. "This goes back to the hypersonic missiles threat from China and Russia. The DoD is tracking so much data more quickly than ever before so they want software that can help make those discriminations for predictive ballistics, track where the missile came from, see where it's going, and shoot it down."

Electronic warfare

"For electronic warfare (EW) applications, there were 58 contracts awarded in 2017 totaling $2.7 billion," Curran notes. "These included tech such as RF countermeasures, infrared countermeasures, etc. While ground-based EW funding dropped off, naval applications really picked up. For example, the Navy AN/SLQ-32 electronic warfare upgrades under the Surface Electronic Warfare Improvement Program (SEWIP) Block 2 netted Northrop Grumman about $566 million as the leader for 2017. Harris and Lockheed Martin were next, as each got $240 million then Sierra Nevada was fourth with $235 million. Lockheed Martin also has funding for AN/SLQ-32 upgrades totaling at least $100 million."

It's not all Raytheon and Lockheed Martin, however, as "BAE Systems also received funding for their radar warning receivers, commonly known as fuzz busters," he continues. "In total, there are 18 companies getting prime EW contracts, most involving many components. RF countermeasures totaled about $1 billion over 32 contracts."

C4ISR

"The total for C4ISR systems is about $73.1 billion for 2017," Curran says. "The reason that it's higher is because I included combat systems, such as the Aegis system, as well as other ground- and sea-based missile defense content. I also included the Army's $8.2 billion contract for Chemical, Biological, Radiation, Nuclear, and Explosive (CBRNE) solutions that are detection-based to stop terrorists, for example. It is a huge contract, with about 178 bids received.

"The Army also has a contract for $7.4 billion to a variety of companies, that's five years, at $1.48 billion a year to provide knowledge-based services for C4ISR-related requirements," he continues. "They are looking to get their C4ISR in order to improve survivability, especially after Russia demonstrated its capability in the Ukraine to coordinate EW systems with artillery attacks. That was deeply concerning for all U.S. forces. That big chunk of funding will help make sure all U.S. C4ISR systems work together and ensure that we have options. They need to better manage the frequency spectrum, vastly improve EW capability, and move toward integrating RF and EW into a new form of digital attack operations."

Growth is modest compared to other years. "C4ISR has a CAGR of about 3 percent, with about 1,232 new prime contracts awarded in 2017," Curran says. "The CAGR is lower because there is a push to buy more commercial technology that reduces cost, such as COTS hardware and software, cloud computing solutions, mobile networks and devices of all kinds, etc. At the same time, the DoD is also improving capability on the enterprise side, which leverages commercial computing technology and cybersecurity.

"Within the FY2019 DoD budget, C4ISR funding totaled about $41.2 billion with 636 line items," he continues. "This is for nonclassified content, of which a good portion will go to the new B-21 bomber. So if you add classified, you get to about $67.3 billion."

Cyber

"Cyber is a different category and harder to measure," Curran says. "In 2017 we saw $3.7 billion spent on cyber outright, but that is not exactly accurate, as all enterprise solutions, C4ISR line items, have about five to ten percent of their funding spent on cyber. Cyber is across everything."

Unmanned aircraft

Unmanned aircraft growth has slowed some for the larger platforms due to many being built out and because of more effective use of COTS technology.

"For military unmanned aircraft I have a about a 3 percent CAGR, but that does not include the 2019 budget OCO which could add another 2.7 percent," says Mike Blades, Research Director, North America for Frost & Sullivan. "The unmanned systems market is becoming more cost effective as the technology – electronic payloads and smaller drone aircraft – are coming down in price and in size. DoD wants smaller logistical footprints that can stay longer in the air for persistent surveillance missions.

"Reducing labor costs also factor into this trend," he continues. "For example, it takes nearly 150 Combat Air Patrol personnel to maintain several (three to four) MQ-9 Reaper aircraft, from the launch and recovery crew, takeoff and landing operators, the analysts, etc. Going with smaller drones with smarter onboard technology can greatly reduce labor costs."

Figure 1 | The Black Hornet PRS from FLIR Systems provides the nonspecialist dismounted soldier with immediate covert situational awareness, according to FLIR Systems.

Procurement may have slowed but RDT&E funding has increased. "Research funding is also being pumped into solutions such as MUM-T [manned/unmanned teaming], AI, drone swarming, data links, etc. Reduced SWaP with added capability factors into all of these," Blades says. "RDTE funding for unmanned aircraft nearly doubled to $4.2 billion, while procurement dropped slightly, from $2.85 billion to $2.1 billion. Of the $6.28 billion requested, about two-thirds is for RDT&E. One caveat with the increased RDT&E funding: Much of it is taken up by the B-21 bomber. R&D is increasing, as a lot of platforms are already decided upon.

"While it's not exactly a build-to-spec environment for industry, the funding is trending more toward RFPs where a little money is given to several competitors to build something to test against each other – with the winner getting the contract. Essentially, pick a few finalists and then have a fly-off," he explains.

Nano and micro UASs

"Nano and micro unmanned aerial system (UAS) platforms are getting more attention for missions such as personal reconnaissance (one troop or small group)," Blades says. "Urban environments and loitering munitions or LMAMS are ideal applications for this type of platform. An example of a nano drone would be the Black Hornet helicopter from FLIR Systems. [Editor's note: FLIR acquired the 1.3-kilogram UAS designer Prox Dynamics (FLIR) in 2016.] (Figure 1.)

"The DoD is also looking to leverage current small UAS capabilities across platforms and across applications such as having the small Black Wing UAS shoot from a submarine," he notes. "Raytheon also has a cool sensor they shoot into hurricanes and are now developing into LMAMS."

"One program focusing on nano drones is the Soldier Borne Sensor, an Army program with about $25 million in funding," Blades adds. "SBS plans to procure more than 1,000 nano drones in 2019. Nano and micro drones really have no clear definition. I suppose a nano/micro category would be less than two kilograms."

Larger platforms

"The Global Hawk is still flying missions and getting upgrades due to the Broad Area Maritime Surveillance (BAMS) mission," Blades says. "Combatant commanders

have them and don't want to give them up. In the FY 2019 request there was $71.6 million for BAMS D upgrades – that's for four aircraft. BAMS is a specific type of Global Hawk that only account for 4 platforms. There are millions more in upgrades to the overall Global Hawk program.

"The DoD sees a need to extend manned aircraft platforms for decades, with rumors swirling that they want the B-52 to last a century," he says. "Some of this thinking is now transferring to UAS platforms. For example, the Hunter UAS, long thought to be cancelled, is still getting funding, with $170 million in the FY 2019 request."

FMS and unmanned

"Regarding Foreign Military Sales (FMS) for unmanned systems, it's hard to forecast due to an inconsistent trade policy and price concerns," Blades says. "As the trade policy keeps fluctuating, it makes it difficult for friendly nations to get drones.

"There is also an affordability challenge, as many countries feel the U.S. platforms are too expensive and foreign competition is getting better," he explains. "While a Russian or Chinese system may only be 80 percent as effective as the U.S. aircraft, that becomes acceptable if the price is low enough. NATO countries are becoming motivated to develop their own capability in-house to save money and avoid the trade challenges."

The U.S. is making some efforts to ease the acquisition process in this case. "One thing that may help is a change in U.S. policy that in effect changes the speed requirements so that drones are labeled as missiles, making it easier to acquire U.S. drones in that category," Blades notes. [Editor's note: This comes under the U.S. Department of State's Missile Technology Control Regime (MTCR) Category 1 that lumps together missiles and drones. The change would essentially lessen restraints on drones that don't fly at missile speeds.]

"There are going to be more opportunities for FMS sales, but no guarantee as to who will get them," he says. "It boils down to cost and opening up the trade policies with friendly nations."

Counter-UAS

"Sales for the counter-UAS market for 2018 is at about $400 million to date with disclosed U.S. government contracts," Blades says. "It could likely near $1 billion as we are two thirds through the year."

For extensive information on the counter-UAS market, listen to the McHale Report podcast with Mike Blades titled "Deciphering the counter-UAS market:" http://mil-embedded.com/8490-podcast-deciphering-the-counter-uav-market/.

"There are interesting innovations being developed for counter-UAS operations such as laser weapons or high-power microwave counterweapons that essentially fry the drone's electronics," he continues. "In some scenarios, you don't want to shoot at it in case it is laced with something and will blow up. Military counterdrone solutions – The Blighter/Liteye AUDS and CACI Skytracker are two examples of this – look for multiple ways of mitigation." **MES**

U.S. attack submarine fleet expands and gets sonar, COTS upgrades

By Sally Cole, Senior Editor

More Virginia-class nuclear attack submarines enter "Silent Service" in 2018. While the subs are getting cool sonar and processing upgrades, any embedded systems need to be secured to protect against SATCOM vulnerabilities.

The Virginia-class submarine USS Indiana (SSN-789) departs for sea trials. Credit: Huntington Ingalls Industries.

The U.S. Navy is slowly replacing the 40 aging Los Angeles-class submarines currently in service with Virginia- and Columbia-class fast-attack submarines. The new submarines are designed to be capable of operating within both littoral and deep-water environments to seek and destroy enemy subs and surface ships; the new subs are also meant to project power ashore via Tomahawk cruise missiles and Special Operations forces, perform surveillance and reconnaissance missions, support battle-group operations, and engage in mine warfare.

In 2016, the Navy announced that its force level goal is to achieve and maintain a fleet of 66 SSNs [submersible ship nuclear]. Under its FY2019 plan, this should be completed by 2048. One of the reasons it will take so long to reach this goal is that each sub costs approximately $3 billion and takes, on average, at least 66 months to build in an advanced four-part modular construction.

When the USS Colorado – the 15th Virginia-class fast attack submarine and the fifth Block III submarine – was commissioned in March 2018, Secretary of the Navy Richard V. Spencer said, "USS Colorado is a true marvel of technology and innovation, and it shows the capability that our industrial partners bring to the fight. Today's world requires undersea platforms designed for dominance across a broad spectrum of regional and littoral missions." (Figure 1.)

The USS Indiana entered the fleet in April 2018, as the 16th; the USS South Dakota, the 17th, will be commissioned by the end of 2018.

Virginia-class subs are built under a teaming arrangement between General Dynamics Electric Boat and Huntington Ingalls Industries-Newport News. These subs weigh are 7,800 tons, are 377 feet long, have a beam of 34 feet, and can operate at more than 25 knots (28 mph) submerged.

Virginia-class Block III contract

As part of the Virginia-class Block III contract, the Navy redesigned approximately 20 percent of the subs to reduce acquisition costs. The main changes are found in the bow, where the traditional, air-backed sonar sphere has been replaced with a water-backed large aperture bow (LAB) array, which reduces acquisition and life cycle costs while providing enhanced passive detection capabilities.

The subs are equipped with a spherical sonar array that scans a full 360 degrees. With sonar detectors in the bow, fin, and flank, as well as one towed behind it, the Navy says these subs can detect large ships as far as 3,000 miles away.

Figure 1 | The christening of the submarine Colorado at General Dynamics Electric Boat in March 2018.

THE VIRGINIA-CLASS DESIGN FEATURES EXTENSIVE USE OF MODULAR CONSTRUCTION, AS WELL AS THE USE OF OPEN ARCHITECTURE SYSTEMS AND COMMERCIAL OFF-THE-SHELF (COTS) COMPONENTS SO THAT IT CAN "REMAIN AT THE CUTTING EDGE FOR ITS ENTIRE OPERATIONAL LIFE THROUGH THE RAPID INTRODUCTION OF NEW SYSTEMS AND PAYLOADS," ACCORDING TO THE NAVY.

One large, obvious change from the previous class is that these subs are equipped with a pair of extendable, nonpenetrating digital camera periscopes called "photonics masts" outside the pressure hull, which use thermal imaging and low-light cameras. While submarines have traditionally featured two classic-style periscopes, the new photonics masts host visible and infrared digital cameras atop telescoping arms that can be controlled via wired video game-style controllers. The Colorado is the first submarine to launch with the gaming controller feature aboard.

The Virginia-class design features extensive use of modular construction, as well as the use of open architecture systems and commercial off-the-shelf (COTS) components so that it can "remain at the cutting edge for its entire operational life through the rapid introduction of new systems and payloads," according to the Navy.

A-RCI and sonar

In terms of signal processing, the Virginia sonar systems use a variant of the Acoustic Rapid COTS Insertion

(ARCI, AN/BQQ-10) system, which is made almost entirely of COTS hardware and software.

Lockheed Martin launched the A-RCI back in the 1990s and the program continues to this day. Through the open architecture-based A-RCI the Navy can "take COTS software and hardware products and insert them into battle systems for sonar systems to communicate with surface ships and submarines and get data out to the new P-3s and then hit enemy contacts from the air, surface, and sub surface platforms," says Brad Curran, industry principal, Aerospace & Defense, Frost & Sullivan. (Figure 2.)

According to the Office of the Secretary of Defense, the A-RCI program includes the following:

- A sonar system for the Virginia-class submarine
- A replacement sonar system retrofitted into Los Angeles-, Ohio-, and Seawolf-class submarines
- Biannual software upgrades (called Acoustic Processor Builds [APBs]) and hardware upgrades (called Technology Insertions [TIs]). While using the same process and nomenclature, these APBs and TIs are distinct from those used in the AN/BYG-1 Combat Control System program. The Navy intends for the A-RCI upgrades to provide expanded capabilities for antisubmarine warfare (ASW), high-density contact management, and mine warfare, particularly in littoral waters and against diesel submarines.

A recent A-RCI contract award for sonar engineering was awarded to Lockheed Martin Rotary and Mission Systems in Manassas, Virginia, during mid-2017 for a $130,827,895 cost-plus-incentive-fee, cost reimbursement contract for the procurement of Technical Insertion 18-20 Acoustic Rapid Commercial-Off-The-Shelf Insertion engineering services. The Naval Sea Systems Command, Washington, District of Columbia, is the contracting activity (N00024-15-R-6267).

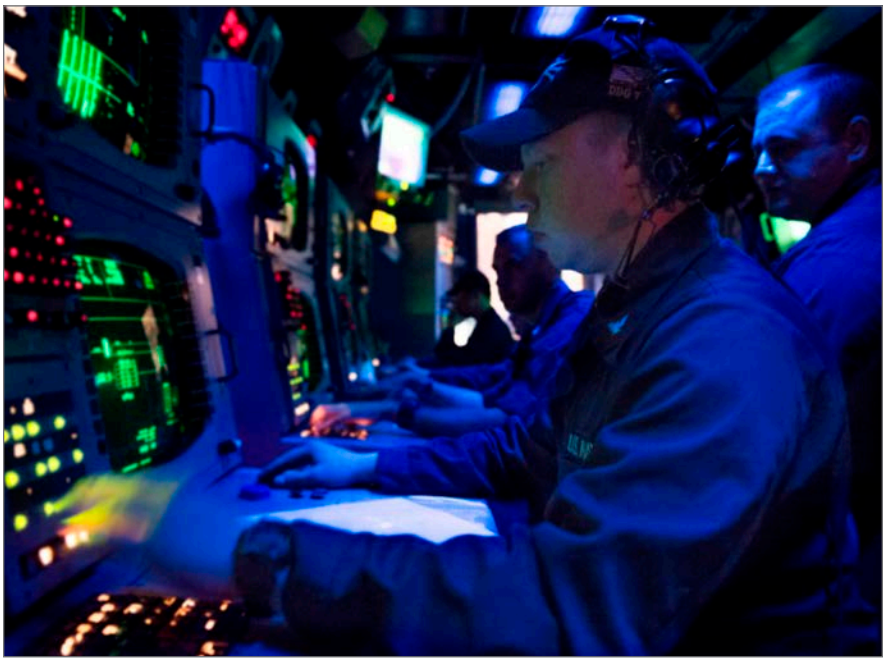

Figure 2 | Sailors monitor a sonar console for contacts during an antisubmarine warfare exercise. (U.S. Navy photo by Mass Communication Specialist Seaman Edward Guttierrez III/Released)

"In 2017 there were 31 prime sonar contracts awarded totaling $1.4 billion. The king in this arena is Lockheed Martin with $791 million," Curran continues. "Other primes providing sonar technology to the DoD include Thales and Qinetiq."

"The DoD is looking to increase their unmanned sonars and UUV [unmanned undersea vehicle] buoy deployments," Curran says. "There are hundreds out there already, and they want to link them to a central network. Even with increased UUV deployments and unattended sensors, challenges remain on how to enable low-frequency communications underwater. The frequencies are difficult, as is managing the power of the unattended vehicles as they suck up so much juice performing their tasks. Enabling sufficient power in the sensor systems and improving underwater comms remain key goals of the DoD programs."

Another interesting sonar program getting funding is DAPRA's Mobile Offboard Clandestine Communications and Approach (MOCCA) program, which looks to achieve significant standoff detection and tracking range of targets through the use of an active sonar projector deployed offboard a submarine and onboard a UUV, according to the solicitation in DARPA's Broad Agency Announcement. The submarine will need to be able to achieve reliable clandestine communications between the host submarine and supporting UUV without sacrificing the submarine's stealth. BAE Systems will be working on Phase 1 of the MOCCA project, which calls for designing efficient sonar capabilities to maximize detection range and improve target identification and tracking.

Overall, the new subs feature dozens of new technologies that increase firepower, maneuverability, and stealth while enhancing their warfighting capabilities, particularly within littoral operations.

The Columbia class is the next generation of subs that will follow the Virginia class. The Navy recently awarded General Dynamics Electric Boat a $5.1 billion contract to complete the design of the lead Columbia-class submarine. Construction is expected to get underway in the fall of 2020, and the Navy says it plans to build a fleet of 12 new SSBNs [submersible ship ballistic-missile nuclear].

SATCOM vulnerabilities a concern

Embedded systems play a key role in the Navy's ongoing shipboard and sub upgrades, but if not properly secured, they can also be a weakness.

Back in 2014, Ruben Santamarta, principal security consultant for security firm IOActive Inc. (Seattle, Washington), warned of major satellite communication and operating system (SATCOM) equipment vulnerabilities.

Now, four years later, he's demonstrated that the weak security posture of satellite communications products is making hundreds of in-flight aircraft, military bases, and maritime vessels accessible through vulnerable SATCOM infrastructure.

At Black Hat USA 2018 and DEF CON 26, Santamarta described the consequences of these vulnerabilities as "shocking." The theoretical cases he developed four years ago are no longer theoretical: He publicly demonstrated taking control, from the ground and through the internet, of SATCOM equipment running on an actual aircraft.

Santamarta tested other devices in his latest research (https://ioactive.com/wp-content/uploads/2018/08/us-18-Santamarta-Last-Call-For-Satcom-Security-wp.pdf) and examined attacks using SATCOM antennas. He found that several of the largest airlines in the U.S. and Europe had their entire fleets accessible from the internet with thousands of connections exposed. Maritime vessels around the world were also at risk of attack, because their SATCOM antennas can be used to expose the crew to RF radiation. Essentially, Santamarta concluded, it's possible to turn SATCOM devices into tools to cause radiation hazards and disrupt RF transmissions.

What are the biggest challenges for the U.S. military to close these attack surfaces? "The U.S. military can be viewed as any other organization or company with a complex structure and a significant amount of assets," Santamarta says. "In terms of cybersecurity, however, it might be possible that the procedures to locate the affected assets aren't fully developed, or at least aren't at the same level as other companies that are more used to dealing with this kind of issue."

Why is it urgent that the U.S. military address SATCOM vulnerabilities, and what threat does it pose to ships and subs? "SATCOM is a core functionality for the military," he explains. "By disrupting or controlling SATCOM channels within a military context, attackers gain the ability to impact the regular operations of the targeted unit, both from safety and nonsafety perspectives. Submarines and military vessels use SATCOM-On-The-Move equipment to maintain continuous connectivity. If this communication channel is compromised, the attacker has the ability to isolate the targeted unit and prevent them from either asking for support or transmitting vital messages to other units."

Also, any sensitive information being transmitted through these SATCOM channels "could potentially be compromised," he adds.

"Fortunately, in most cases, it's possible to address these vulnerabilities by installing a new firmware," Santamarta notes. "Deploying these firmware updates to thousands of embedded systems is certainly a challenge, but it's still doable,"

One big motivating factor to secure any embedded systems is that nation-states can hack vulnerable SATCOM systems. "To successfully complete a sophisticated attack without being detected, you need resources that usually are available only from the orbit of nation-states," Santamarta says. "But less sophisticated malicious actors can also leverage these issues to blatantly wreak havoc." **MES**

John McHale, *Group Editorial Director, also contributed to this article.*

Marine animals inspire a new mode of passive underwater GPS

Mantis shrimp and cephalopods use polarization of light to communicate, a method that has inspired a new underwater GPS technique based on imaging equipment sensitive to polarizing light. The imitation of the sea creatures has enabled more accurate long-distance navigation.

Researchers from the U.S. and Australia recently built polarization sensors that can determine the sun's position in the sky based on patterns of light underwater. While the underwater environment appears as a dull blue featureless space to humans, a landscape of polarization patterns appears when viewed through a camera designed to see the world through the eyes of marine animals.

Mimicking the photoreceptor-rich eyes of a mantis shrimp, researchers from the University of Illinois at Urbana-Champaign and Queensland Brain Institute developed a camera that collects polarization information. This first-known demonstration of passive underwater GPS using polarization properties of underwater light opens up new possibilities for undersea navigation.

"We studied marine animals because we believe some species could be using the polarization of light to navigate, and our new study is a proof of concept that this is possible," says Samuel Powell, a postdoctoral research fellow at Queensland Brain Institute. (Figure 1.)

The camera is a variation of a polarization imager named "Mantis Cam" after the shrimp that inspired it, and it takes advantage of how light refracts, or bends, when it passes through the surface of water and bounces from particles and water molecules. The researchers found that underwater polarization patterns are a result of the sun's position relative to the location where recordings were collected, and they also discovered that underwater polarization patterns can be tapped to estimate the sun's heading and elevation angle – which allows them to figure out their GPS coordinates by knowing the date and time of the filming.

"We tested our underwater GPS method by pairing our bio-inspired camera with an electronic compass and tilt sensor to measure the underwater polarization data at a variety of sites around the globe, depths, wind conditions, and times of day," says Viktor Gruev, a University of Illinois professor of electrical and computer engineering and a professor of the Carle Illinois College of Medicine. "We found that we can locate our position on the planet within an accuracy of 61 kilometers."

This new method could enable more accurate and cost-effective long-distance navigation: "Most modern navigation techniques don't work underwater. Satellite-based GPS, for example, only works to a depth of about 20 centimeters," explains Powell, who is working with Gruev. "Underwater visibility is also limited, so relatively old technology such as lighthouses don't work, because the farthest distance you can see is about 100 meters."

Research submarines currently use GPS systems at the surface, but when they descend they rely on dead reckoning to calculate their position. "The error in this case is unbounded; that is, the longer without GPS, the more erroneous your calculations can be. Using polarization sensors, our method would allow for real-time geolocalization underwater with more accurate long-distance results – without the need to resurface periodically," Powell adds.

Sidebar Figure 1 | Two peacock mantis shrimp wrestling. Credit: Marshall Laboratory/The University of Queensland.

The new technique could enable navigation at depths of up to 200 meters below the ocean's surface, and may open up new ways for people and robots to better navigate underwater using visual cues from polarized light. "We could use our underwater GPS method to help locate missing aircraft, or even create a detailed map of the seafloor," Powell says. "Robot swarms equipped with our sensors could provide a low-cost means of underwater remote sensing. It would certainly be more cost-effective than current methods."

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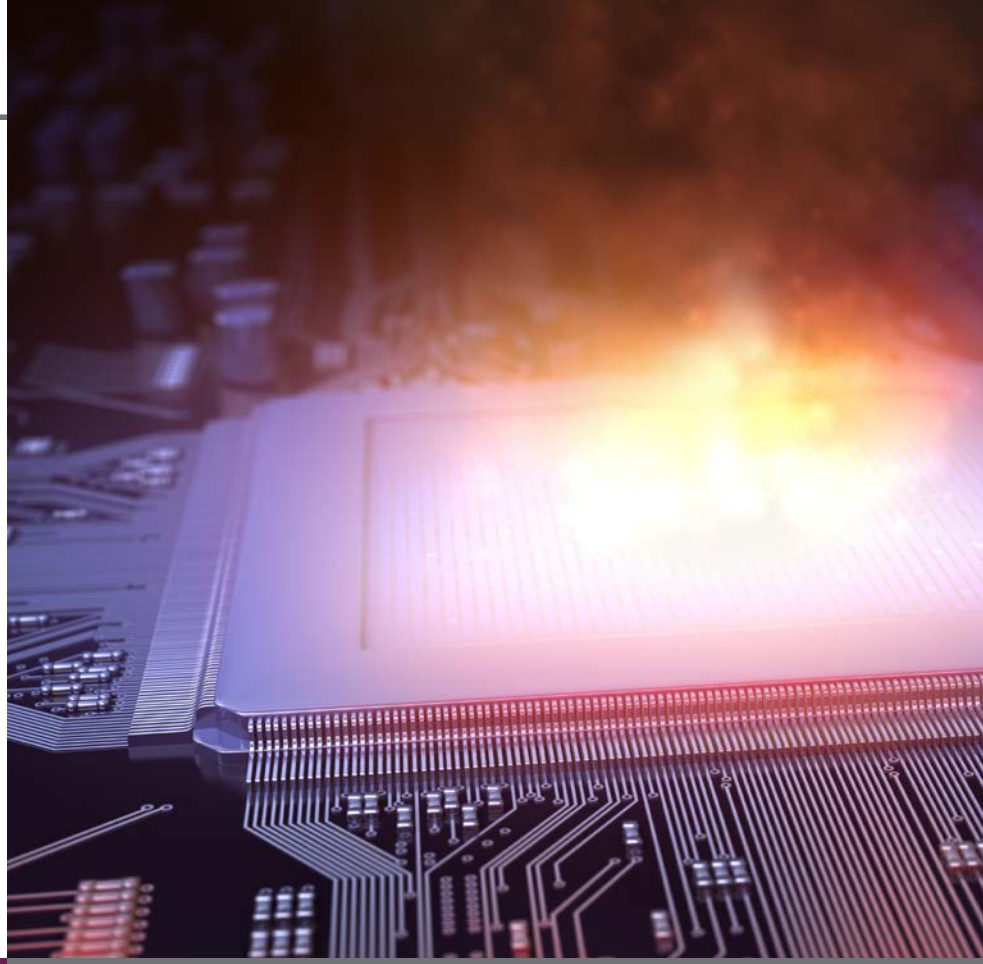

Cooling the beast: Heat-dissipation techniques for next-gen processors

By Jeremy Banks

The good news: Newer-generation processing devices offer hugely boosted capability for military applications such as airborne data processing, shipboard electronics, or ground vehicle systems. The bad news: Newer-generation processing devices offer much more capability. Is this really both good news and bad news? In a word, yes.

In the world of FPGA [field-programmable gate array] processing and I/O, a standard improvement on generation-to-generation advantage is typically 30 percent less power per gate, but the number of gates in the device doubles, which means that while there's a performance increase, there's also an increase in power and heat generated, assuming you're looking to use all of the functionality of the device. A mid- to high-range FPGA could easily be expected to consume 100 watts of power in a single device. If other power sources and power supply efficiencies are factored in, the overall power that needs cooling rises rapidly.

Power – or more specifically heat density – has increased, with more to come. Bottom line: Cooling challenges have increased, not decreased, for high-end computing. For other devices, similar functionality has been squeezed into a smaller package.

For example, some newer A/D converters have adopted serial interfaces like JESD204B, moving away from the original parallel ports in order to reduce the number of interface pins needed and use a smaller package. These devices use about the same amount of power, but the shrinking package advantage can be quite significant. Such a change could result in a heat density increase of between 200 and 400 percent. A typical high-speed A/D converter could be a few watts; while they're not the hottest devices, the heat density means that attention has to be paid to cooling – especially if a number of devices are stacked side-by-side.

In general, higher levels of integration is good news, as more can be fitted into a smaller overall system or board footprint leading to fewer cards. The overall solution is smaller and likely lower in cost. However, increased heat density – even with fewer cards and smaller devices – requires additional considerations for cooling the system, especially if this is a rugged system needed to work in wide-temperature-range environments. High-end, new-generation systems, such as those based on the VPX standard, especially need careful consideration. Even if all the necessary functionality fits on the minimum number of cards, it may still be worth spreading out this functionality to cool the system effectively. In the same vein, reaping the benefits of smaller, higher-performance systems means careful focus on efficient cooling. An example of a new 3U VPX card design from Curtiss-Wright squeezes in a large Virtex UltraScale+ FPGA, a Zynq UltraScale+ MPSoC (including quad A53 ARM CPUs), two 6 Gsps A/D converters, two 6 Gsps D/A converters, and a supporting ensemble of other functions. All deliver higher performance functionality, but such levels of integration require just as much effort for cooling as it does for RF speed I/O and high-end FPGA processing. (Figure 1.)

In the VPX board format world, the primary cooling methods are air cooling (AC) and conduction cooling (CC). AC relies on air being driven or pulled across cards with primary high-power devices, usually having a heat sink to help remove the heat. Both formats tend to use aluminum heat sinks and heat frames; but other materials are used as well, such as copper or other high-conductivity compounds, which improve thermal conduction. However, these materials also add weight and/or cost.

CC is usually used in high-altitude environments where there is low air pressure, or for use in systems that are sealed to external air sources. For a 3U VPX card, conventional cooling limits the power dissipation of a board to less than 100 watts and still be able to maintain an 85 °C card edge temperature. However, for higher-powered parts – say 150 to 200 watts – something more is needed if boards are required to operate in a high ambient temperature environment. There are a number of alternative cooling strategies to deal with these much higher power requirements – such as liquid cooling and spray cooling – but these have often been seen as exotic because of the 10 or even 20 times price premiums. These techniques still have their place (and quirks), but perhaps a more recent development that raises the bar is Air Flow Through (AFT).

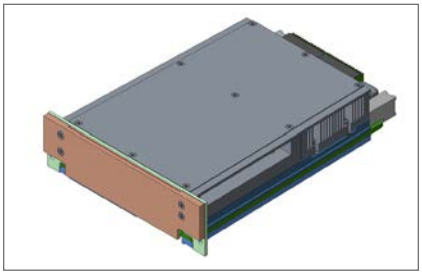

Figure 1 | VPX3-535 shows an example of a VITA 48.8 AFT design. Illustration courtesy Curtiss-Wright.

AFT for VPX is supported with variations ("dot specifications") through VITA 48. In some ways, AFT is a hybrid between air and conduction cooling, but with greater cooling capability. AFT relies on a heat frame that clamshells onto the entire board's electronics. An AFT heat frame includes a closed duct, which is embedded with fins. Air is routed through these ducts to provide cooling. Air does not blow across any of the board's electronics directly, which also ensures that there is no contamination. This efficient use of air for AFT schemes enables significantly increased cooling capabilities for only a modest increase in system infrastructure. AFT supports in the region of 200 watts of cooling capability needed to handle high density processing and I/O solutions.

One common trade-off – if it really is a trade-off because of the increased possibility of higher integration – is the increased slot pitch, which might typically be 1 to 1.5 inches. What makes AFT more efficient, compared with solutions like conduction cooling, is the lower thermal impedance. For a CC solution, air might be used to cool the chassis sidewalls. The CC module is positioned in card guides that are part of the sidewalls. Heat flow occurs from the electronic parts into the card's heat frame, across the card edges (which are retained in the card guides by wedge locks), into the card guides, and finally into sidewall air flows.

AFT is more direct, as the air is blown directly through the card's heat frame, though – like the conduction-cooled solution – the card's electronics are still sealed and protected from the outside world. The more direct cooling method provides lower thermal impedance, which means more heat can be removed for a given ambient air temperature, which in turn enables either high-power operation or tolerance of higher ambient temperatures. (Figure 2.)

Table 1 shows a comparison between similar cards with different cooling techniques and different materials analyzed through simulation to get the comparisons. The primary FPGA is used as a temperature reference as it is the hottest device and therefore the limiting factor. The ambient temperatures are equivalent when taking into account the temperature of air or effective card edge temperature for the conduction-cooled equivalent (air inlet +63 °C, card edge +71 °C). In all cases the FPGA is assumed to be dissipating 90 watts.

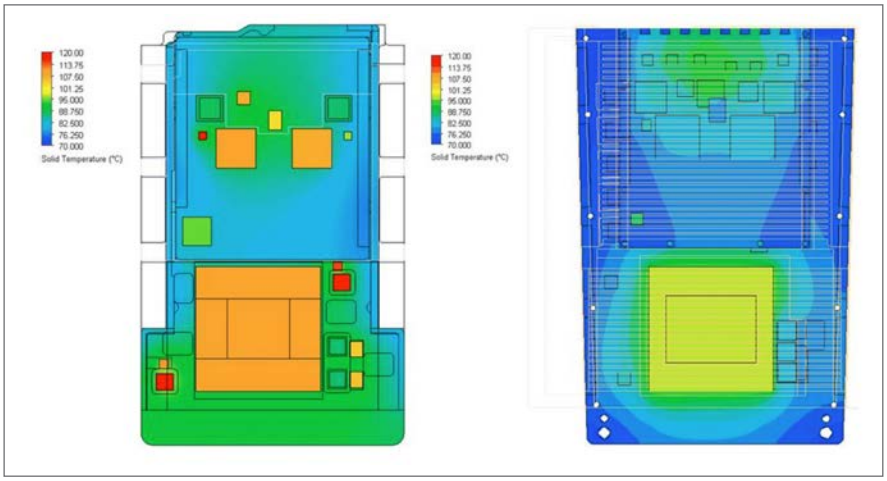

Figure 2 | Comparative thermal plots showing conduction and AFT cooling of a similar VPX3-535 design.

CASE	TJ OF FPGA
VPX3-535 CC L100 – aluminum frame	108.5 °C
VPX3-535 CC L100 – copper frame	99.2 °C
VPX3-535 AFT – aluminum frame	95.8 °C

Table 1 | Cooling comparison between a similar design in conduction and AFT variants.

In being able to squeeze the most performance out of a design, every degree counts. What's more, better cooling increases the part's in-service lifespan. It may seem that the design works at high ambient temperature, but for how long? Aluminum, the default material used for cooling, has a fair amount of capability; an immediate improvement can be gained from using copper, but that comes with a high weight penalty and increased cost. AFT using standard aluminum beats copper when all thermal impedances are taken into account.

Within the VITA domain, there are a number of AFT variants, differing in slot positions and some carrying proprietary IP and patents, but all essentially do the same thing, differing only in the mechanics of how the air flow is achieved. VITA 48.8 is simple and royalty-free, plus it does not require wedge locks (they reduce the air opening/duct size), so there is even more PWB real estate to use for the board design.

Different cooling techniques offer different advantages depending on the application's needs and environment. AFT offers a new option without outrageous cost implications and will meet the cooling demands of future rugged designs. **MES**

Jeremy Banks *is Product Marketing Manager, Curtiss-Wright Defense Solutions. He holds a BSc (Hons) in electronic and electrical engineering from the University of Surrey, UK.*

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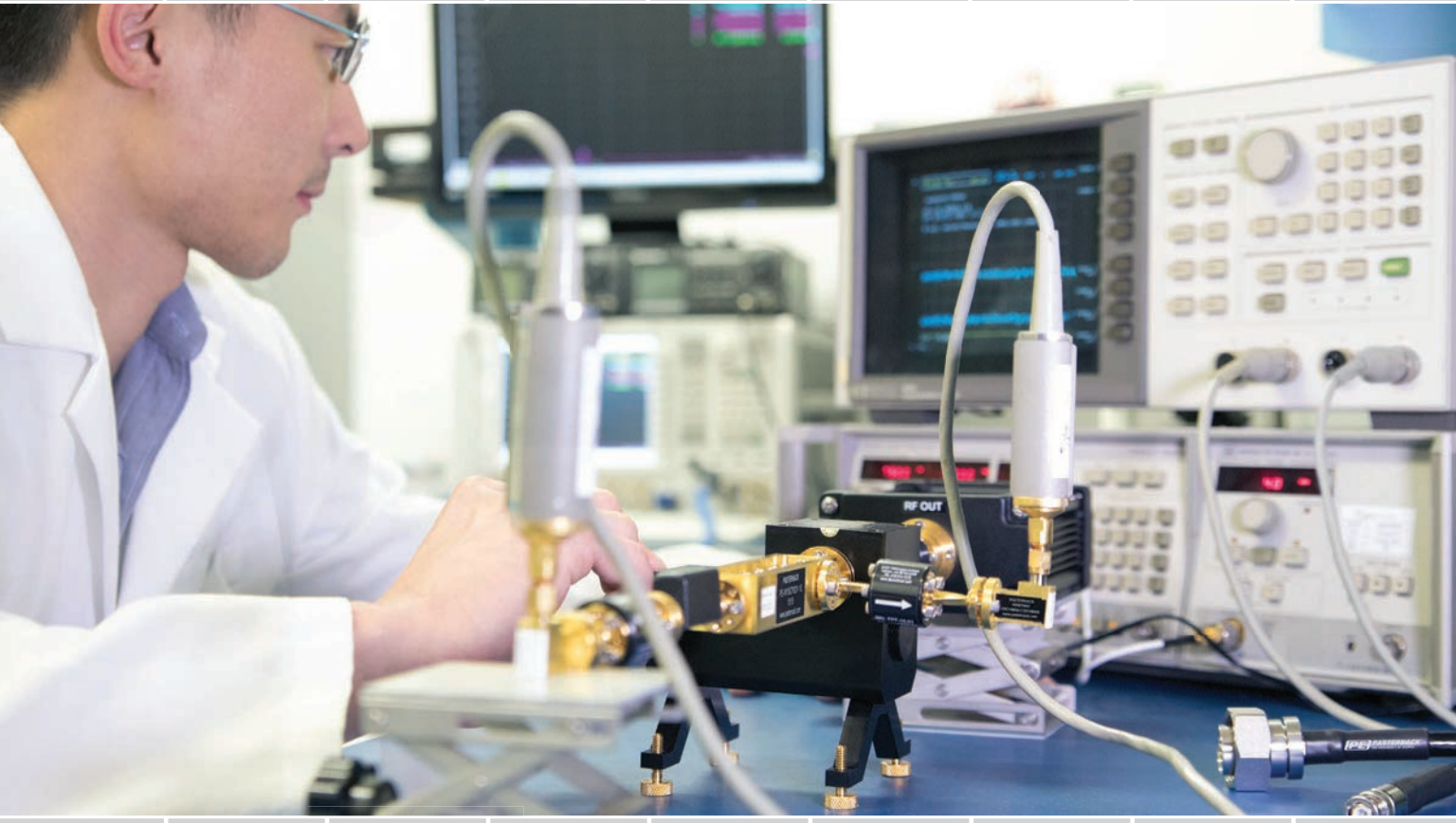

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Test and measurement sector grapples with standardization, complex systems

By Mariana Iriarte, Technology Editor

The Department of Defense (DoD) no longer wants one-off systems, but rather adaptable test systems to tackle current and emerging threats that can also be used across different platforms. End game: A software-defined solution that is easily upgradable, low-cost, and open source.

The test and measurement (T&M) sector is tackling these demands and at the same time dealing with testing more complex systems in the same timescales as their predecessors under the same budget. Software reuse will be the key to meeting these requirements.

"Key trends we are seeing from our military customers include portability, ease of use, commonality, and longevity," says Gary Tilley, senior director, sales and business development for Astronics Systems (Santa Rosa, California). "Through customer interaction and collaboration, we have found the latter two to carry the most significance."

Nicholas Butler, global marketing lead, Aerospace & Defense at National Instruments (Austin, Texas) agrees, pointing out that DoD officials are looking for "Quality, accuracy, reliability, and longevity. However, these test customers within defense and military organizations are more and more being asked to test increasingly complex assets."

The crux of the issue is not that test and measurement companies are being asked to test more complex systems, Butler asserts; DoD officials are also compounding the problem as these companies are "being asked to do it on the same schedules and the same budgets that they've always had before," he adds. "The complexity of the asset is increasing often exponentially, but the budgets and the time frames are not increasing along with that"

In addition, defense users are "looking less and less at boxed instruments and more and more at open test environments," says Patrick Turley, president and CEO, Ball Systems Technologies (Westfield, Indiana). PXI [an open specification for testing based on the CompactPCI bus] systems are becoming a much more prominent player than they have in the past. Also, more open software environments and less customization is at the fore of what military users are asking for."

A key DoD document that has influenced the industry is the DoD's Automatic Test Systems (ATS) Master Plan 2017. As stated in the document, "the DoD has

four primary objectives for its future ATE systems: Reduce the total cost of ownership of DoD ATS, realize interoperable ATS, reduce logistics footprint, and improve the quality of test while reducing the repair cycle time," says Joan Gibson, solutions business manager, A&D supply chain, at Keysight Technologies (Santa Rosa, California). "The key to attaining their goal of reducing the total cost of ownership of ATS for DoD is to stop the proliferation of unique test systems and instead standardize on designated ATS families.

"They are considering the cost and benefits over the complete system life cycle, not just the initial hardware and software cost," Gibson continues. "The flexibility required by warfighters in modern conflict scenarios requires that the services move toward the capability of interoperability among automatic test systems. However, the closed architectures of most legacy DoD ATS prohibit interoperability. The need to rapidly deploy support, along with weapons systems, requires that all logistics footprints be reduced."

To tackle the increase of complex systems on the battlefield and reduce system footprints, DoD users want more commonality among test systems, specifically "commonality among products, software, and processes between depot and field: [Users] want to leverage a superset/subset of test program sets (TPSs) to be able to correlate data between depot and field, maintaining a closed-loop ecosystem," Tilley says. "The depot needs the capability to take a deep dive into the product diagnostics while the field level must be powerful, but efficient, without unnecessary testing that may waste precious time."

TO TACKLE THE INCREASE OF COMPLEX SYSTEMS ON THE BATTLEFIELD AND REDUCE SYSTEM FOOTPRINTS, DOD USERS WANT MORE COMMONALITY AMONG TEST SYSTEMS

When it comes to the life cycle of a product, users also need to be modern and flexible, Tilley adds. "Currently, military customers are trying to mitigate this conflict as best as they can. They need many legacy products to continue to function properly, but advances in technology require additional capability. [Military industry] customers must be able to leverage their current investment in TPSs, but need to validate those on PXI instruments before making the jump from VXI [an older spec used in test situations needing high channel density or high-speed data acquisition]. Once all TPSs have been validated on the PXI instruments, a full transition can be made to a new card cage."

Ultimately, DoD users want it all: "They want a test platform that can adapt to these changing and evolving needs, these changing and evolving threats that sometimes can literally change on a week-to-week basis," Butler says. "I think that's one of the key and fairly recent trends or challenges that we are seeing from these customers."

With the kind of adaptability that the military needs, "Software takes the center stage," Butler adds. "Users need a software-defined platform where they can change functionality, adapt to new requirements, and meet evolving threats over time with the same hardware."

Keysight Technologies is "using a flexible combination of commercial off-the-shelf (COTS) PXI hardware together with customizable automation software with measurement science that provides

coverage for a broad range of military test programs simplifies testing needs by reducing proliferation of unique test systems which are difficult to manage and expensive to support," Gibson says (Figure 1). "The interoperable system provides flexibility of ATE function across programs and provides the opportunity to add new capabilities in technology – while continuing to support legacy programs and requirements."

Budget questions: reuse or standardize?

To meet all DoD requirements, Congress recently ratified the defense budget bill, opening pockets that were tightly controlled just two years ago. With the budget approved, funding has rolled down to the T&M sector where industry representatives now have to balance between reuse on the one hand and migrating users to new, standardized, open-source platforms on the other hand.

More specifically, the "DoD/MoD [Ministry of Defense] budgets are increasing worldwide driven by increased risk related to information warfare, asymmetric threat (e.g., terrorism), and the risk of simultaneous conflict in multiple geographies and domains," Gibson points out. "We expect high and continued growth in the U.S. for the next several years. The RDT&E (Research, Development, Test and Evaluation) portion of these budgets will grow faster than the overall defense budget due to need for more technologically advanced forces."

Some of the sectors mainly affected by the budget are "those orders for products with long lead times," Tilley says. "Big dollars are being allocated to more F-35 and weapons programs, but for programs that have traditionally trickled in over time, we are now seeing a shift to placing the full order up front, further in advance."

The market is dealing with new systems and ensuring legacy systems are up to date. For Ball Systems, the company has experienced less of a demand with legacy systems. "In terms of market for reuse or upgrading legacy systems, we haven't seen a lot of that, honestly," Turley says. "Where we have seen engagements, we've seen customers looking for new systems, not as interested, necessarily, in adapting legacy."

While the approved budget is still addressing some of the gaps in technology, for the warfighter to quickly see new tech on the battlefield, standardization is key. "We are seeing a pretty significant trend of these military defense customers wanting to standardize their test equipment," Butler comments. "They want test equipment that can be used on multiple assets across multiple programs. They want test equipment that is going to be serviceable for decades."

For that to happen, users have been taking a deeper look into systems that have been deployed for years. "They are constantly trying to figure out: How can I take all of these legacy systems and import them over to new technology that can test my legacy programs and my new programs?" Butler says.

"At the same time, there is certainly a growing market for reuse and upgrading legacy systems," Tilley adds. "We are seeing more dollars spent on sustainment and maintenance of legacy equipment versus new system builds."

Standardization efforts by the industry will work only by addressing all the areas, including "ensuring backwards compatibility with legacy assets," Butler says. "It's about getting reuse out of existing equipment. It's about providing modular architectures that can be flexible and modified over time. It's about being able to adapt to evolving needs and evolving threats."

The reality of the acquisition and procurement process has changed in the past 10 years in the military defense space, Turley explains. "It's become much more competitive, and overages are not tolerated from the government the way they used to be. So you couple that with the need to accelerate the utilization of new technologies as these threats emerge. Essentially, they need faster time-to-market solutions around test, and so there's a desire to find tools that enable that development more quickly. And reusability of subsets of test functionality are much more desirable and are being designed into requirements."

Figure 1 | The M9383A PXI vector signal generator. Photo courtesy of Keysight Technologies.

Figure 2 | Bus analyzer used in instrumentation and data collection. Photo courtesy of Ball Systems.

Security and adaptability of tools

Combating emerging threats that change as quickly as the days go by has been a core challenge over the last few years. "We've seen anecdotal discussion around security of information continuing to be a huge priority, both within the test systems and also as relating to testing that type of functionality in products," Turley says. An example Turley gives is a Ball Systems-designed handheld communications bus analyzer, for use in wide instrumentation and data-collection systems. (Figure 2.)

The reality is that "data has become critical for success in the battlefield – which begs the additional consideration of data security and fidelity," Tilley asserts. "Any piece of test and measurement equipment today needs that capability – but also the ability to support older

technologies that are still relevant to the warfighters."

Astronics Test Systems has a "radio test set family with the capability to test both legacy (SINCGARS), software-defined radios (Harris 117G), and modern waveforms such as MUOS and TSM-X, with room built in for future technology," Tilley adds (Figure 3).

In this environment, tools become really important. "The tool that these customers need most is an open software platform, where they can integrate existing code with brand-new code, where they can develop proficiency in-house, in multiple types of programming languages or software, so they can continue to evolve to meet these changing or evolving threats," Butler explains.

In addition to tools, Butler points out that there is also the service element. "I think that a lot of companies, NI included, are really starting to offer more

Figure 3 | ATS-300 radio test set is the depot/benchtop version of the test set family. Photo courtesy of Astronics Test Systems.

services in addition to tools to help these customers manage and maintain equipment and to proactively manage these technology insertion cycles," he adds.

NI's FlexRIO (Figure 4) product line is "high-performance instrumentation modules in our PXI platform," Butler adds. "They have large, onboard user-programmable FPGAs."

"This ability to abstract away different parts of your program is key, so that a

Figure 4 | National Instrument's PXIe-5785 FlexRIO transceiver features user-programmable FPGAs. Photo courtesy of National Instruments.

change in one part of the test set does not force you to recertify other parts," Butler states. "The better that you can compartmentalize or abstract or kind of modularize your test program sets, the better off you'll be as you define through software and limit the amount of recertification overhead work that you have to do." **MES**

Taking military communication to the next level with SIC

By Joel Brand

Mobile ad hoc networks (MANETs) have become the backbone of tactical military communication because of their exceptional flexibility, security, and reliability. While MANETs have many unique capabilities, however, they have not yet realized their full potential. A new technology, self-interference cancellation (SIC), could greatly enhance both the performance and functionality of MANETs.

A Marine calls instructions to his team while attempting to contact a downed pilot during a tactical recovery of aircraft and personnel training mission at Camp Pendleton, California. Marine Corps photo by Lance Cpl. Frank Cordoba.

One of the essential features of a MANET is that it has no fixed infrastructure and no single point of failure. A MANET can be deployed anywhere, at any time, and are self-configuring and self-healing. These capabilities make MANETs particularly attractive for tactical military communication.

The primary capability that enables mobile ad hoc networking is that every mobile device is dual-purpose: It is both an access device for the mobile user and a mesh node for relaying traffic. Ideally, the mobile user should be able to communicate even as that user's device is forwarding traffic to other nodes. In practice, however, it's difficult for the mobile device to receive other channels while it is transmitting because the roar of its transmitter desensitizes its receiver, severely limiting the receiver's ability to hear signals from remote nodes.

The essentials of MANETs

In fixed deployments, local access and network backhaul channels can be assigned different frequencies in different parts of the same band, and filters can be employed to provide isolation between the access and backhaul radios. However, MANETS are ad hoc networks and, consequently, frequencies can't be planned. Channels are assigned as needed based on current network topology and frequency availability. Every radio must be able to communicate on any channel in the MANET's operating band (typically in the UHF spectrum). Conventional filters are of little use, because conventional filters isolate specific frequencies.

The need for frequency agility applies to all mobile ad-hoc networks. Military MANETs, however, involve added complexity that makes segregating the band using traditional filters virtually impossible: They employ frequency-hopping technology to thwart jamming, mitigate multipath fading, and prevent eavesdropping. Military MANETS create "channels" by assigning specific (pseudorandom) hopping sequences to users. These channels can't be isolated using filters because the transmit and receive frequencies

are constantly changing. Nor can the hopping sequences be in any way coordinated to minimize interference; frequency-hopping is jam-proof precisely because the hopping sequences appear random to outside observers.

Inevitably, trade-offs are made so that each mobile unit can act both as an access device and mesh relay node. These concessions may negatively impact response times and throughput. That is a major problem as today's military MANETs are expected to handle a mix of voice, data, and video.

Empowering MANET devices with SIC

Self-interference cancellation technology was originally developed to enable what researchers call "in-band full-duplex" operation. SIC permits a two-way radio to transmit and receive on the exact same channel at the exact same time, doubling spectral efficiency. This feat is accomplished by canceling the noise that the transmitter in a two-way radio produces in its receiver. It works somewhat like a noise-canceling headset, except that SIC can handle much louder noises and is much more accurate. SIC observes and models the noise and uses the information gathered to produce an inverted copy of the noise. The noise is canceled out by combining it with a continually updated, inverted copy at the input of the receiver. (Figure 1.)

As useful as in-band full-duplex operation is, there are more immediately compelling applications, such as canceling the noise that a local transmitter produces on other channels in the same frequency band. (Figure 2.) This enables a device containing two or more radios to listen on other channels while one of the radios is transmitting. The ability to "listen while talking" can benefit not only military MANETs but also consumer products such as whole-home Wi-Fi networks.

All wireless mesh networks face the same basic challenge. How can unit "B" relay data from unit "A" to unit "C"? Unit "B" can't transmit to unit "C" while it is receiving from unit "A," because when unit "B" turns on its transmitter its receiver can no longer hear unit "A." Because of this limitation, large-scale wireless mesh networks have not been successful in commercial markets. There are small-scale wireless mesh networks on the market – such as those used to create whole-home Wi-Fi networks – that solve the problem using one of the following techniques:

1. A single radio switches rapidly between receiving from unit "A" and transmitting to unit "C": This store-and-forward approach avoids interference between the transmitter and receiver, but throughput is reduced 50 percent with each hop. Dual-band Wi-Fi mesh products typically use this approach. However, if there are multiple hops to the destination node, then end-to-end throughput falls off a cliff.
2. Two radios operate on different frequency bands: A mesh network can be configured so that neighboring nodes transmit and receive on different bands. For instance, unit "B" could listen on 2.4 GHz and transmit on 5 GHz. This approach was tried by a few wireless mesh vendors but never caught on. It is also a type of frequency planning and can't be employed by mobile ad hoc networks for the reasons mentioned earlier.
3. Two radios operate in different parts of the same band: So-called "tri-band" Wi-Fi routers typically use the UNII-1 and UNII-3 sub-bands in the 5 GHz band. The high-end Netgear Orbi home Wi-Fi system is an example of this approach. Again, this is a form of frequency planning, so it can't be used with MANETs.

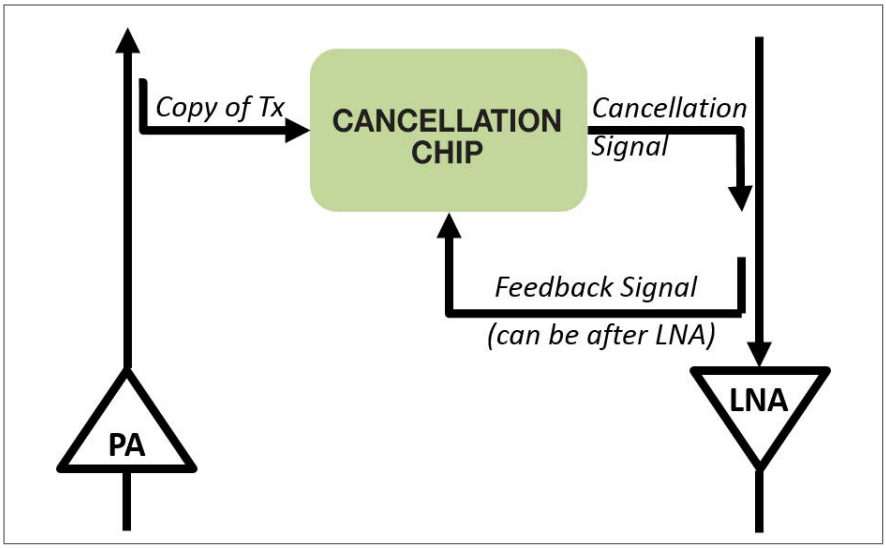

Figure 1 | SIC chip adds cancellation signal to the input of the receiver.

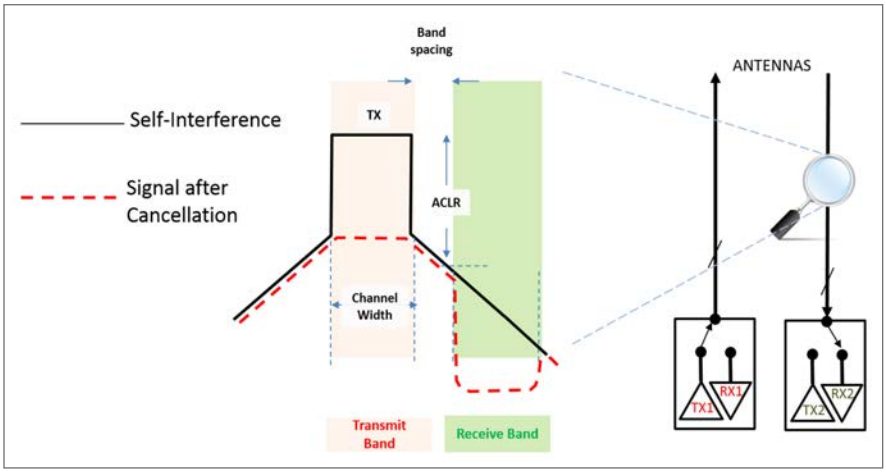

Figure 2 | SIC technology can eliminate the interference a transmitter creates on other channels in the same frequency band.

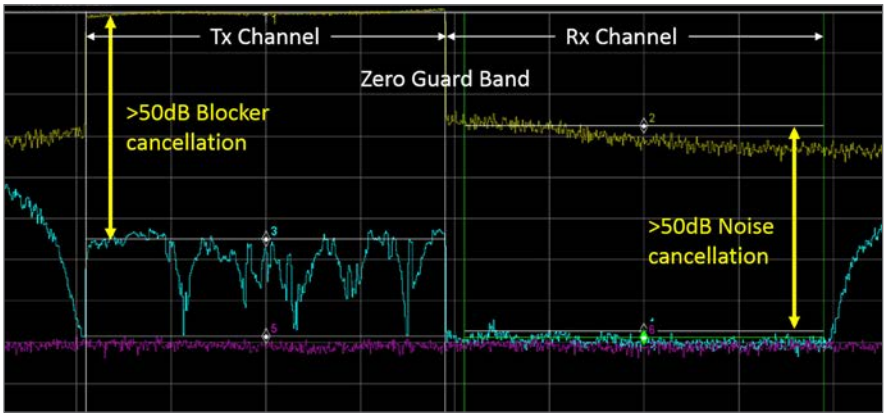

Figure 3 | SIC's uniquely sharp response enables use of immediately adjacent channel as shown by this spectrum analyzer screen shot.

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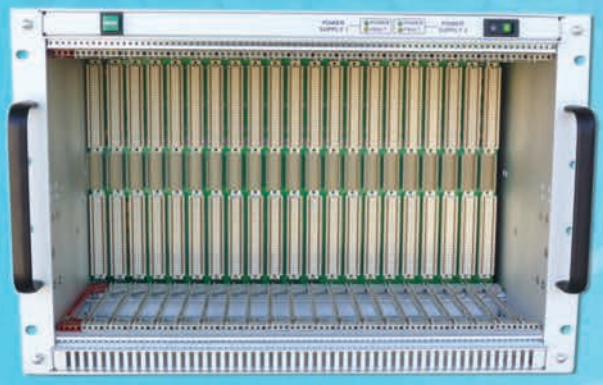

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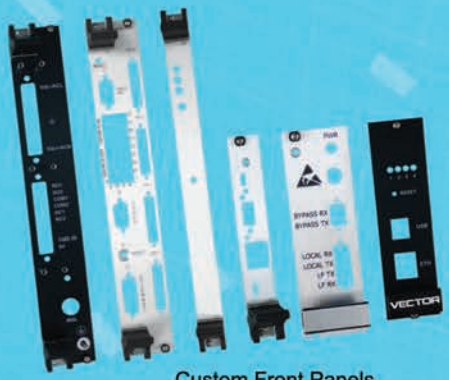

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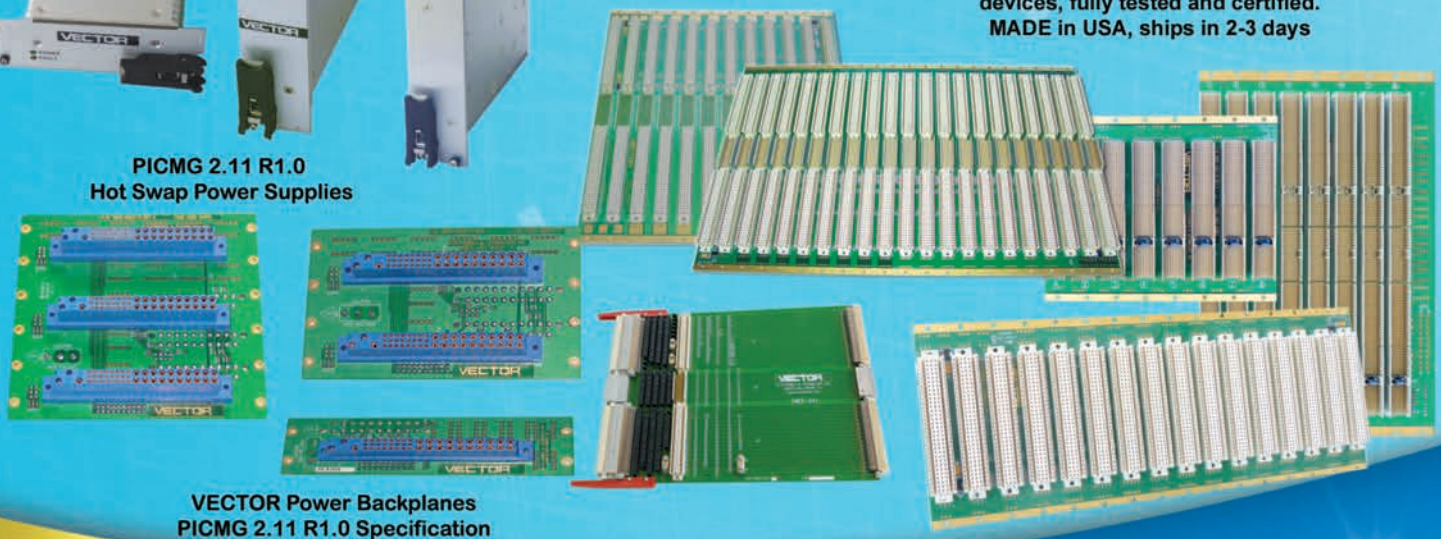

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None of the above approaches is suitable for large-scale ad hoc networks carrying time-sensitive voice, video, and data in military environments. However, self-interference cancellation solves the problem by providing a more flexible way to isolate transmit and receive channels. While conventional filters offer only fixed responses – high-pass, low-pass, or band-pass for specific frequencies – SIC offers a dynamic response under software control. Rather than blocking only predefined frequencies, it cancels the noise produced by a local transmitter on any channel, on command. Moreover, while conventional filters require a transition band – they can't suddenly go from blocking to passing signals as the frequency changes – SIC can produce a very sharp response, enabling the transmitter and receiver to operate even when they are on adjacent channels. (Figure 3.)

Employing self-interference cancellation offers three major advantages for military MANETs. First, by allowing a second radio to receive while the mesh radio is transmitting ("listen while talking"), SIC enables each node to act as both an access device for the mobile user and a mesh node for relaying traffic. Second, it minimizes latency and maximizes throughput by enabling every mesh node to transmit and receive at the exact same time. Third, SIC is the only approach that has the agility and speed to isolate frequency-hopping channels – an essential requirement for today's military communication.

SIC for on the move

Military MANETs promise exactly what military users need: a robust communication solution that can deploy anywhere at any time, and that is self-configuring and self-healing. However, interference between the two (or more) radios contained in each node limits their performance. While conventional filters can reduce interference in other environments, they are inappropriate for mobile ad hoc networks. Only self-interference cancellation technology can eliminate the interference with high precision and allow MANETs to finally achieve their full potential for military users on the move. **MES**

Joel Brand *is the VP, product management, for Kumu Networks. For more than 25 years Joel has actively participated in defining and building infrastructure solutions for the telecom and wireless industries. He previously held executive positions at ConteXtream (acquired by HP), Bytemobile (acquired by Citrix) and Ruckus Wireless (Now part of Arris). Joel holds a B.Sc. and M.Sc. in Engineering from the Israeli Institute of Technology (the Technion) and an MBA from National University in San Diego.*

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MANAGING SUPPLY CHAIN; OBSOLESCENCE; COUNTERFEIT PARTS

No room for compromise in supply chain security: New DoD initiative establishes benchmark for strategic ICT sourcing

By Phil Gallagher

In response to the growing nexus between physical risk (counterfeits) and cyber risk (infiltration of systems and exfiltration of data) the U.S. Department of Defense (DoD) has introduced a new policy adding security as a fundamental pillar of federal acquisition and supply chain risk management. Component manufacturers in the military and aerospace arenas – as well as those in all high-tech verticals – can adopt current and emerging best-practice approaches to mitigate both cybersecurity threats and counterfeit component exposures.

In June 2018, the U.S. Department of Defense (DoD) introduced a new security initiative called "Deliver Uncompromised." The program aims to improve the DoD's ability to deliver mission-critical weapons, equipment, and communications systems, free from either unintended or malicious defect, to the men and women protecting the United States and its interests around the world.

Although, for the most part, federal acquisition policies tend to lag commercial best-practice standards, the DoD is out front with this effort. Recognizing that legacy sourcing methods and ideology are no match for the ever-expanding array of vulnerabilities inherent in today's globally dispersed, digitally connected information and communications technology (ICT) supply chain, the "Deliver Uncompromised" initiative calls for a reimagining of the core principles of sourcing. Most notably, this proposed transformation recommends the addition of security as a fourth foundational pillar to the traditional golden triangle of sourcing: price, delivery, and performance.

The problem lies in the connections

The DoD program reflects the harsh reality that smart or Internet of Things (IoT)-connected devices – like computer networks, weapons systems, and aeronautical flight controls – are prime targets for intellectual property theft, data poaching, and/or tampering. Traditionally ascribed to a breakdown in IT security, these breaches are more frequently arising from exposures throughout the electronic component supply chain, which have grown exponentially as the IoT increases the attack surface and boosts the potential payoff for cyberattackers. Today, hackers need only breach one vulnerable third party to gain access to hundreds or thousands of connected organizations. As one cybersecurity expert stated, "Supply chains have become the gift that keeps on giving for cybercriminals." (Figure 1.)

This situation is something that, quite frankly, many members of the commercial and industrial supply chain tend to underestimate, particularly when it comes to the nexus between counterfeit components and cybersecurity. Beyond the obvious concerns

associated with quality and reliability, counterfeit components – whether they are factory overruns, quality control rejects, refurbished, or reverse-engineered – are not likely to include vital security features, leaving them at greater risk for a cyberbreach once deployed.

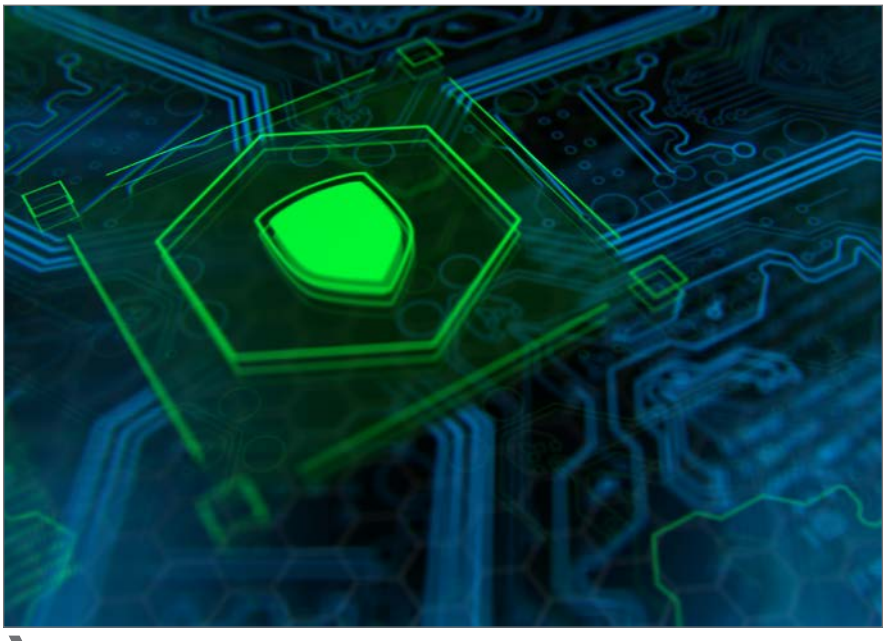


Figure 1 | Security breaches frequently arise from exposures throughout the electronic component supply chain; these exposures have grown exponentially as the IoT increases the opportunity to exploit vulnerabilities.

These substandard components are also more vulnerable during design and production to the insertion of malware, such as kill switches, viruses, or back doors that may be exploited to leak sensitive information, expose proprietary intellectual property, and/or enable an attacker to seize system control. Detecting this chip-level tampering is often described as searching for a needle in a stack of needles.

Life (cycle) insurance

Given the enormity of the economic, health, and safety implications, an effective supply chain security strategy must proactively minimize exposures throughout the entire product/system life cycle – from cradle (secure IC design, fabrication, and manufacturing) to grave (ethical e-waste disposal) and everything in between.

It must also take into account that economic gain – either for personal enrichment or to fund some other nefarious activities – may no longer be the prevailing motivator for counterfeiters or cybercriminals. There is, unfortunately, a growing cadre of adversaries seeking to exploit gaps in the security of the supply chain in order to carry out industrial or political espionage, cyberterrorism, or outright acts of cyberwarfare.

No gray area

The DoD's commitment to "Deliver Uncompromised" comes at a particularly critical time for the military parts sector. After years of sequestration that put vital equipment upgrades and new systems development on hold, defense spending is finally on the upswing. But with an ever-dwindling number of mil-spec suppliers around and ongoing parts shortages throughout the component supply chain, the progress of many of these programs could be in jeopardy. This is precisely the kind of scenario that has, in the past, driven buyers to the gray market – a well-documented source of counterfeit parts.

Of course, not all gray-market components are fake or substandard, but without a verifiable paper trail, there is no way to confirm that the parts have not been tampered with, purposely altered, refurbished, or otherwise fraudulently represented.

Defense systems engineers can help mitigate both counterfeit risk and the follow-on cybersecurity vulnerability by adopting a "security-by-design" mentality. Through more proactive technology planning and management, security is considered at the earliest stages of product development, rather than bolted on at the end. Designers can assure they are specifying products offering the greatest life cycle support and avoid suspect parts by using resources like the Government-Industry Data Exchange Program (GIDEP). *(Editor's note: GIDEP is a cooperative government/industry program that seeks to improve the total quality, reliability, and cost of systems and components during the acquisition and logistics phases of the product life cycle by sharing technical information essential during research, design, development, production, and operational phases.)*

Other opportunities to mitigate component-level obsolescence risk include designing with open architecture that enables easier part replacement, proactively planning new technology insertion through the production and support life of the program, and sourcing commercial off-the-shelf (COTS)-Plus parts with enhanced performance and extended product life cycle support.

Makers and distributors of mission-critical electronics recognize that every time a part changes hands, whether through the returns process, testing in an outside lab, warranty/repair work, or other physical value-add, it is vulnerable to tampering. The policy must be trust, but verify: Companies should maintain a robust materials-control process that includes traceability mechanisms such as bar codes and date coding, which provides assurance that the chain of custody remains secure. Companies can also audit the materials handling and return policies of their supplier partners.

To assure that customers can satisfy their bill-of-material requirements without exposing the supply chain to undue risk, suppliers can offer state-of-the-art inventory and product life cycle management support, execute end-of-life bridge buys to assure ongoing supply, and work with suppliers to develop product continuity programs assuring longer-term manufacture and supply of components.

Trust through technology

There is also a growing bounty of new technologies and processes under development by federal and civilian organizations that hold great promise for hardening the ICT supply chain.

For example, in a Forbes magazine article published during summer 2018, HP chief technology officer Shane Wall shared some details about HP's research into using blockchain to verify authenticity of components, particularly those produced via 3D printing: Wall noted that blockchain could not only assure

that the allotted output of a particular design spec is adhered to, but also serve as an "address book" of intellectual property for every single part produced.

In addition, while the concept of tracking provenance of raw materials, components, and subassemblies as they move throughout the supply chain via tagging is far from new, until recently most commercially available technology was not capable of producing a solution that was small enough without being cost-prohibitive. It appears that Defense Advanced Research Projects Agency (DARPA) scientists may have broken through this barrier: Researchers participating in the DARPA Supply Chain Hardware Integrity for Electronics Defense (SHIELD) program have reportedly developed a process for creating microscopic identification tags called "dielets" that can be implanted by chipmakers in their circuits as they are assembled. Fabricated in 14 nm CMOS, the process is said to yield approximately four million 100 by 100 by 20 micrometer "chiplets" per wafer. (Figure 2.)

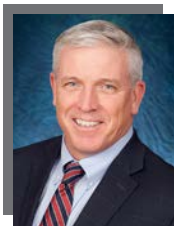
Figure 2 | The 100 micrometer by 100 micrometer dielet reportedly developed by DARPA is intended to act as a hardware root of trust, detecting any attempt to access or reverse engineer the dielet. The SHIELD dielet design consists of passive, unpowered sensors capable of capturing attempts to desolder, delid, or image the circuit; mechanical processes that make the dielet fragile and prevent intact removal from its package; a full encryption engine; and advanced near-field technology to power and communicate with the dielet. Photo courtesy DARPA.

Security blanket

By codifying security as a core requirement and "key differentiator," industry players can hope that this new DoD initiative will establish a set of clear-cut, sector-agnostic security protocols that will promote a more unified defense against those that wish to do us harm, just as the NIST [National Institute of Standards and Technology] Cybersecurity Framework created a baseline for more effective cyber risk management.

As massive and globally extended as the electronic components market is, there can also be a surprising amount of overlap in the various goods and services suppliers everyone deals with. No one can afford to be so naïve these days as to believe that something that dramatically impacts one vertical will not in some way affect all of them.

Coordinated actions across all the stakeholders within the global technology supply chain are essential to keeping ahead of the escalating security threats and assuring that, regardless of what verticals one may represent, all companies do their part to keep the supply chain secure and deliver uncompromised solutions to the end user. **MES**



Phil Gallagher *is president of Avnet's electronic components business. He leads the company's broadline distribution business globally, with four regional presidents reporting to him spanning the Americas, Europe, and Asia Pacific. Gallagher also has responsibility for supplier management, global procurement, and supply chain services teams. Readers may reach Phil's team at corporate.communications@avnet.com.*

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Military EMBEDDED SYSTEMS

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FEATURES

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Removable storage enables instant access to recorded data in a standard PC with a simple USB 3.0 or SATA connected docking station without the need to download the recorded data over a slow data drain interface. Industry standard solid-state drives are used to benefit from the ever increasing storage densities and cost reductions as the technology evolves. No data conversion is necessary, the video files can be played direct by a standard player like Windows media player or VLC. Currently up to 80TB of solid-state storage is offered per removable data cartridge, sufficient for very long mission duration even when recording uncompressed HD video.

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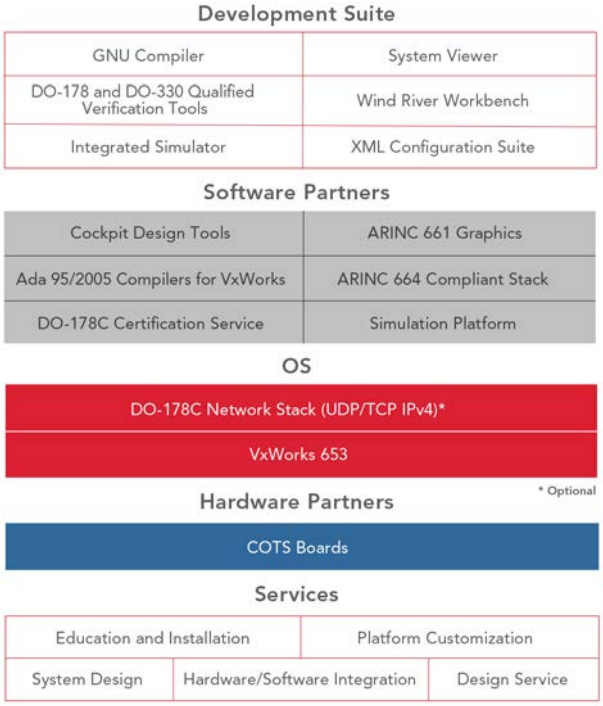

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  - Independent supplier build process, reducing the impact of code changes across multiple development teams
  - Wind River® Workbench development suite based on the Eclipse open tool architecture, enabling wide integration of industry toolchains
  - Wind River Simics® support for system simulation and automation
- ***Hardware support and availability:*** *VxWorks 653 Multi-core Edition supports ARM, Intel®, and Power processors architectures*
- ***Proven market excellence:*** *VxWorks 653 Multi-core Edition is built on the VxWorks and VxWorks 653 rich pedigree of single and multi-core development, proven in more than 550 programs delivered by over 350 customers in more than 90 aircraft*

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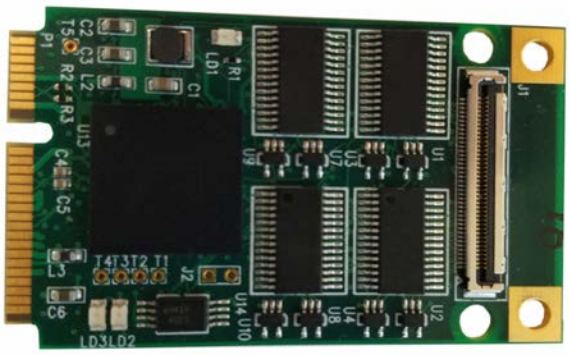
@windriver.com

ALPHI TECHNOLOGY CORPORATION

PCIe-Mini-COM-8 Octal PCI Express Mini UART



The **PCIe-Mini-COM-8** is an 8-channel PCI Express (PCIe) UART (Universal Asynchronous Receiver and Transmitter) optimized for higher performance. The PCIe-Mini-COM-8 serves as a single lane PCIe bridge to 8 independent enhanced 16550 compatible UARTs.

All 8 channels can be programmed in pairs with the required front-end interface:

- *Software selectable RS-232, RS-485 and RS-422*
- *Software selectable 120Ω termination for RS-422 and RS-485 interfaces*
- *Programmable data rates go up to 31.25Mb/s per channel for all channels*

Operating temperature is -40°C to +85°C.

FEATURES

› Eight independent 16C550-class UARTs
› 256-bytes Tx and Rx FIFOs
› Up to 31.25Mbps serial data rate per channel
› Selectable serial mode in pairs: RS-232, RS-485, and RS-422
› Full or half duplex configurations
› On board termination 120Ω software selectable
› Robust ±15KV ESD protection (IEC 61000-4-2 air gap)

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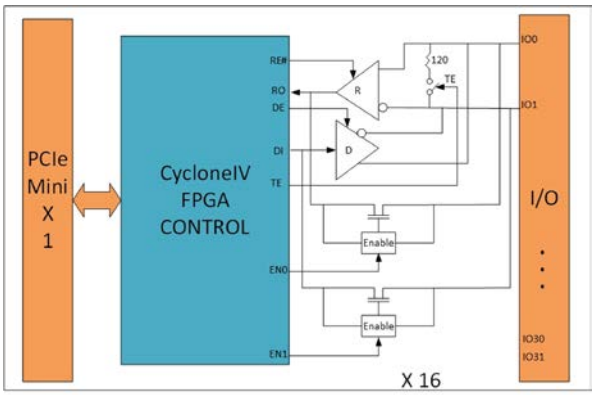
Communications

ALPHI TECHNOLOGY CORPORATION

PCIe-Mini-DIO16/32 PCIe Mini FPGA



The **PCIe-Mini-DIO16/32** incorporates a user reconfigurable Altera Cyclone IV FPGA with RS-422/485 and LVTTL I/O drivers in a small form factor PCI Express Mini package. It combines the speed and user programmability of an FPGA with versatile communications capability.

The PCIe-Mini-DIO16/32 provides 32 I/O channels, software selectable in groups of two, with the following options:

- *Up to 16 channel pairs RS-422/485, bidirectional, half or full duplex, up to 20Mb/s data rate per channel*
- *Software selectable 120Ω termination for RS-422 and RS-485 interfaces*
- *High input impedance supports 256 nodes per bus*
- *Up to 32 channels LVTTL*
- *Change-of-state/level interrupts, software programmable for change of state or level detection*

Operating temperature: -40°C to 85°C.

Standard size Mini PCIe Module (30mm x 50.95mm), with no separate transition module required.

FEATURES

› User configurable Altera Cyclone IV FPGA
› 32 I/O lines, configurable in pairs
› RS-422/485 and LVTTL I/O
› On board termination 120Ω, software selectable
› Full or half duplex configurations
› 20Mb/s data rate per RS-422/485 channel
› Robust ±25kV HBM ESD protection

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Dolphin
INTERCONNECT SOLUTIONS

Dolphin eXpressWare PCIe Software

eXpressWare software enables Military applications to easily migrate to a PCIe Networks. eXpressWare's complete software infrastructure enabling applications to network using standard PCI Express over cables and backplanes. Serveral interfaces and APIs are supported including standard TCP/IP networking – IPoPCIe driver, a low level direct remote memory access API – SISCI API and a sockets API – SuperSockets. Each API has its benefits and can be selected based on application requirements.

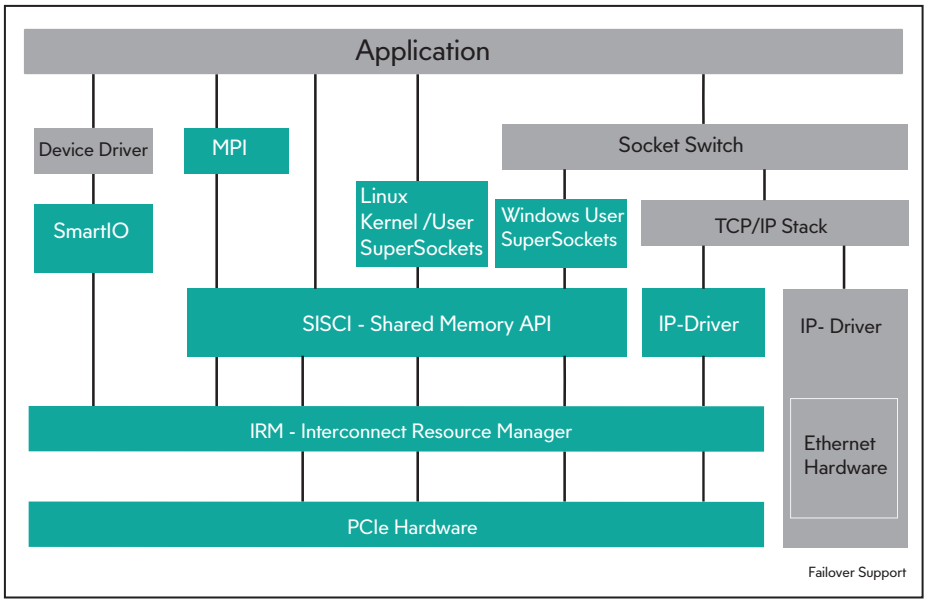
The SISCI API enables customers to fully exploit the PCIe programming model without having to spend months developing device drivers. The API offers a C programming API for shared/remote memory access, including reflective memory/multi-cast functionality, peer-to-peer memory transfers and RDMA capabilities. The SISCI API supports direct FPGA to FPGA, GPU to GPU, or any combination of communication with FPGA, CPUs, GPUs or memory over PCIe. SuperSockets enabled networked applications to benefit from a low latency, high throughput PCIe network without any modifications. With SuperSockets, a PCIe network can replace local Ethernet networks. The combination of Dolphin's PCIe host adapters and switches with SuperSockets delivers maximum application performance without necessitating application changes. The SISCI API supports Windows, Linux, VxWorks and realtime O/S such as RedHawk and RTX.

SuperSockets is a unique implementation of the Berkeley Sockets API that capitalizes on the PCIe transport to transparently achieve performance gains for existing socket-based network applications. Both Linux and Windows operating systems are supported, so new and existing applications can easily be deployed on future high performance PCIe networks.

Dolphin's performance optimized TCP IP driver for PCIe (IPoPCIe) provides a fast and transparent way for any networked applications to dramatically improve network throughput. The software is highly optimized to reduce system load (e.g. system interrupts) and uses both PIO and RDMA operations to implement most efficient transfers for all message sizes. The major benefits are plug and play, much high bandwidth, and lower latency than network technologies like 10Gbps Ethernet. The IPoPCIe driver is targeted for non-sockets applications and functions that require high throughput and performance.

FEATURES

- PCIe Gen 1, 2, 3 and beyond support
- Address based Multi-cast/reflective memory
- Point-to-point and switched network support
- Low latency direct memory transfers
- Operating systems – Windows, Linux, VxWorks, and RTX
- FPGA and GPU direct memory transfers
- Microsemi, IDT and Intel NTB
- Cross O/S low latency data transfers
- Peer-to-peer transfers
- Cascading of switches
- Network manager



The combination of API along with Dolphins new device lending SmartIO products will push the boundaries of next generation Military applications

eXpressWare, combined with the stability and longevity of PCI Express, is the ideal platform for next-gen Military applications.

mil-embedded.com/p374374

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MilesTek

Military | Aerospace | Communications | Industrial

IP68 Rated, Ruggedized Ethernet Cables

Introducing the most rugged and durable Cat5e assemblies MilesTek has ever offered. The line is designed for use in outdoor, industrial and military applications where the harshest environments exist. They are built using our IP68, transversely sealed, ruggedized RJ45 plugs and jacks.

The Category 5e cable used in the assemblies is double shielded, high-flex, UV and Oil resistant and made with a FR-TPE (Flame Retardant Thermoplastic Elastomer) jacket that is CMX outdoor rated. Superior shielding of both the cable and connectors ensures higher data transmission rates up to Gigabit Ethernet speeds. These cables offer complete moisture, dust, oil and UV protection for your military, outdoor or industrial application. To suit every need, we offer all plug and jack combinations off-the-shelf in both Zinc Nickel and Anodized Aluminum finishes. These new rugged IP68 cables, receptacles and plugs are in stock and available for immediate shipment.

– About MilesTek –

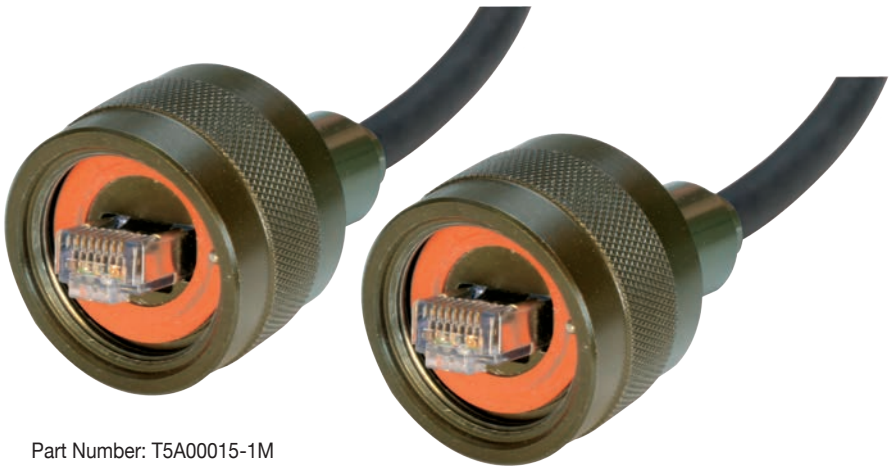
MilesTek has offered complete connectivity solutions since 1981. Our customers have come to expect more than just products – they expect answers that will help them solve their installation or project questions. We offer quality products, in-stock for same-day shipping and quick turnaround on your custom requirements. MilesTek manufactures specialized products for the Military Avionics, Broadcast and DS3/Telecom industries, Military and Industrial Networking connectivity solutions.

FEATURES

- Ruggedized Jacks are transversely sealed with or without a mated connector or dust cap to maintain an IP68 seal and rating at all times
- Category 5e cable used in assembly is Oil and UV resistant, Double Shielded, High-Flex and made using a CMX outdoor rated FR-TPE (Flame Retardant Thermoplastic Elastomer) jacket with a dynamic temperature range of -40°C to +80°C
- This assembly consists of a Ruggedized RJ45 Plug to a Ruggedized RJ45 Plug, both utilizing a Zinc-Nickel finish
- An internal compression nut establishes 10 lbs of cable strain-relief establishing robust cable strength for Ruggedized assemblies
- Ruggedized RJ45 Plugs are able to mate with MilesTek's line of Ruggedized Jacks

Applications

- Harsh environment
- Factory network
- Battlefield communication systems
- Industrial process control
- 10/100/1000 Base-T networks



Part Number: T5A00015-1M

IP68 Cat5e Cable, Ruggedized RJ45, Plug to Plug, ZnNi Finish w/FR-TPE Cable & Dust Caps, 1.0m

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MilesTek

Military | Aerospace | Communications | Industrial

Double Shielded Armored Ethernet Cables

MilesTek proudly offers GigE Vision connectors using Ethernet. The GigE connectors are built to the vision standard and are perfect for machine vision cameras and PoE applications. The screw mount hardware is beneficial in many applications where standard RJ45 connectors can become dislodged due to jolting, vibration, gravity, etc.

These assemblies are built with MilesTek's outdoor, industrial, high-flex cable for maximum robustness and are excellent for outdoor, industrial or heavy duty installations. This series is also given extra protection with 1500 PSI crush resistant stainless steel armor. Cables are also double shielded to minimize EMI/RFI interference. GigE Ethernet cables are available in GigE to GigE RJ45 connectors as well as GigE to standard RJ45 in either a Category 5e or a Category 6a rating.

Contact us today with all your application needs.

– About MilesTek –

MilesTek has offered complete connectivity solutions since 1981. Our customers have come to expect more than just products – they expect answers that will help them solve their installation or project questions. We offer quality products, in-stock for same-day shipping and quick turnaround on your custom requirements. MilesTek manufactures specialized products for the Military Avionics, Broadcast and DS3/Telecom industries, Military and Industrial Networking connectivity solutions.

FEATURES

- GigE RJ45 connectors are built to machine vision standards
- FR-TPE (Flame-Retardant Thermoplastic Elastomer) cable jacket is resistant to oil, sunlight (UV), weld spatter and cable is rated for 300v
- Cable is flex tested to 1 million cycles at 10x cable OD and 10 million cycles at 20x cable OD; Stainless Steel armor crush resistence is 1,500 PSI minimum
- Double shielded braid + foil design for maximum protection from EMI/RFI
- *Not finding the length you're looking for? Call us to create your own lengths*

Applications

- Industrial Ethernet
- Factory Automation
- Harsh Environment Applications
- PoE
- Machine Vision

Part Number: T5A00004-5M

Category 5e GigE Double Shielded Armored Ethernet Cable, GigE/GigE, 5M

mil-embedded.com/p374722

MilesTek
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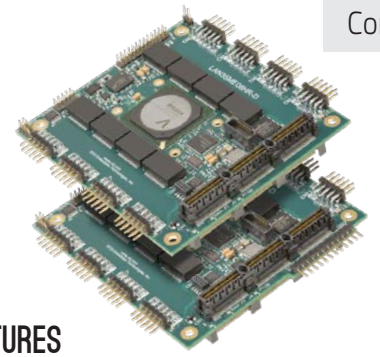
949-267-9734 or Toll Free 866-524-1553

Managed Scalable GigE Switch



The LAN35MH08HR is an 8-port 10/100/1000 Managed Ethernet switch. This switch module has a total of 10 ports: eight ports are provided to I/O connectors, one port is available to the host CPU through a x1 PCI Express GigE controller, and one port is used as a stacking switch expansion port allowing full compatibility with RTD's managed and unmanaged StackNET® Ethernet switch family. Additionally, this allows the CPU to use the switch without the need for external cables. The LAN35MH08HR can also be used as an expandable, standalone 8-port Ethernet switch.

The onboard CEServices Carrier Ethernet switching software provides a rich Layer 2 switching solution with Layer 3-aware packet processing. All of the industry-standard Managed Ethernet Switch features found in an enterprise rackmount switch are provided, such as VLANs, Spanning Tree, QoS, and SNMP. Additionally, the CEServices software provides features for carrier and timing-critical networks such as OAM, Synchronous Ethernet, and IEEE 1588. The switch may be configured via a web GUI interface, or a command-line console via USB, Telnet, or SSH.

FEATURES

- -40 to +85°C operation, passively cooled
- PCIe/104 stackable bus structure
- Eight 1000/100/10 Mbps Ethernet ports plus one host port and one stacking switch expansion port
- Onboard tri-color LED for each Ethernet Port
- RJ-45 jacks or 10-pin right-angle headers
- Fully-managed Layer 2 Ethernet Switch with Layer 3-aware packet processing
  - *Support for all major Enterprise switching features such as VLANs, Spanning Tree, QoS, and SNMP*
  - *Manageable via web GUI interface, SSH, Telnet, and Serial Console*
  - *Industry-standard CLI interface*
- Onboard PCI Express Ethernet Controller for interface to host cpuModule
- USB Device Port for Serial Console command-line interface
- Available in stackable, rugged enclosures

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RTD Embedded Technologies, Inc.
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sales@rtd.com 814-234-8087

Omnetics Nano-D Connectors

As the leading manufacturer of **Nano-D connectors**, Omnetics is ready to meet your light weight, small size, and high durability requirements for high reliability applications. They meet and exceed MIL-DTL-32139 and are available in a multitude of form factors, including single row, dual row, panel mount, and latching options. These connectors feature Omnetics' highly reliable gold-plated Flex Pin contact system and are available in standard sizes ranging from 5 to 51 positions, as well as custom configurations. Set on a .025" (.64mm) pitch, these rugged lightweight connectors are available with threaded mounting holes and retention screws, and they are suitable for the most demanding applications.

Proudly engineered and built in USA.

FEATURES

- Small size
- Light weight
- Rugged and durable
- 1 AMP per contact
- -55°C to 125°C (200°C with HTE)

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ACCES I/O PRODUCTS, INC.

ETH-DIO-48 Ethernet 48-Channel Industrial Strength Digital I/O

Designed for compact control and monitoring applications, this product features 48 or 24 industrial strength TTL digital I/O lines. This Ethernet device is an ideal solution for adding portable, easy-to-install, digital I/O to any Ethernet network, even wirelessly. The ETH-DIO-48 is excellent for use in applications sensing inputs such as switch closures, TTL, LVTTL, CMOS logic, and is ideal for controlling external relays, driving indicator lights, and more. Applications include home, portable, tablet, laboratory, industrial automation, and embedded OEM.

Available accessories include a broad range of ribbon cables, screw terminal boards, optically isolated adapters, electromechanical relay boards, and industry standard solid state module racks. Special order items such as conformal coating, custom software, right angle headers, and more are also available.

FEATURES

- Ethernet 10/100 RJ45 connector for interfacing to CPU or network
- 48 or 24 channel high-current TTL digital I/O lines
- Compatible with industry standard I/O racks such as Grayhill, Opto 22, Western Reserve Controls, etc.
- Eight-bit ports software selectable for inputs or outputs
- All 48 digital I/O lines buffered with 32 mA source/64mA sink current capabilities
- Jumper selectable I/O pulled up to 5V (via 10KΩ) for contact monitoring, pulled down to ground or floating
- Resettable 0.5A fused +5VDC output per I/O connector
- OEM version (board only), features PC/104 size and mounting compatibility
- Small, (4"x4"x1.7") rugged, steel industrial enclosure
- LVTTL (3.3V) and -40°C to +85°C industrial operating temperature available as factory options

mil-embedded.com/p372692

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Embedded Hardware

ACCES I/O PRODUCTS, INC.

mPCIe-COM Family PCI Express Mini Cards

ACCES I/O Products is pleased to announce the release of a new family of mini PCI Express (mPCIe) multi-port serial communication cards. These small, low-priced, PCI Express Mini cards feature a selection of 4 or 2-ports of software selectable RS-232/422/485 asynchronous serial protocols on a port by port basis. These cards have been designed for use in harsh and rugged environments such as military and defense along with applications such as health and medical, point of sale systems, kiosk design, retail, hospitality, automation, gaming and more. The small size (just 50.95mm x30mm) allows for maximum performance in applications where space is a valuable resource.

Each RS-232 port is simultaneously capable of supporting data communication rates up to 921.6 kbps. RS-422/485 modes support data communication speeds up to 3 Mbps. The cards provide ±15kV ESD protection on all signal pins to protect against costly damage due to electrostatic discharge. Existing serial peripherals can connect directly to industry standard DB9M connectors on the optional breakout cable accessory kits.

The mPCIe-COM cards were designed using type 16C950 UARTs and use 128-byte transmit/receive FIFO buffers to decrease CPU loading and protect against lost data in multitasking systems. New systems can continue to interface with legacy serial peripherals, yet benefit from the use of the high performance PCI Express bus. The cards are fully software compatible with current PCI and PCI Express 16550 type UART applications and allow users to maintain backward compatibility.

FEATURES

- PCI Express Mini Card form-factor (mPCIe) type F1, with latching I/O connectors
- 4 or 2-port serial communication cards with optional DB9M connectivity
- Software selectable RS-232, RS-422, and RS-485 protocols, per port stored in EEPROM
- High performance 16C950 class UARTs with 128-byte FIFO for each TX and RX
- Port-by-port field selectable termination for RS-422/485 applications
- Industrial operating temperature (-40°C to +85°C) and RoHS standard
- Supports data communication rates up to 3Mbps simultaneously, (RS-232 up to 921.6 kbps)
- Custom baud rates easily configured
- ±15kV ESD protection on all signal pins
- CTS, RTS, 9-bit data mode, and RS-485 full-duplex (4 wire) fully supported
- RS-232 only and RS-422/485 versions available

mil-embedded.com/p372691

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ACCES I/O PRODUCTS, INC.

mPCIe-ICM Family PCI Express Mini Cards

The mPCIe-ICM Series isolated serial communication cards measure just 30 x 51 mm and feature a selection of 4 or 2 ports of isolated RS232/422/485 serial communications. 1.5kV isolation is provided port-to-computer and 500V isolation port-to-port on ALL signals at the I/O connectors. The mPCIe-ICM cards have been designed for use in harsh and rugged environments such as military and defense along with applications such as health and medical, point of sale systems, kiosk design, retail, hospitality, automation, and gaming.

The RS232 ports provided by the card are 100% compatible with every other industry-standard serial COM device, supporting TX, RX, RTS, and CTS. The card provides ±15kV ESD protection on all signal pins to protect against costly damage to sensitive electronic devices due to electrostatic discharge. In addition, they provide Tru-Iso™ port-to-port and port-to-PC isolation. The serial ports on the device are accessed using a low-profile, latching, 5-pin Hirose connector. Optional breakout cables are available, and bring each port connection to a panel-mountable DB9-M with an industry compatible RS232 pin-out.

The mPCIe-ICM cards were designed using type 16C950 UARTS and use 128-byte transmit/receive FIFO buffers to decrease CPU loading and protect against lost data in multitasking systems. New systems can continue to interface with legacy serial peripherals, yet benefit from the use of the high performance PCI Express bus. The cards are fully software compatible with current PCI 16550 type UART applications and allow for users to maintain backward compatibility.

FEATURES

- PCI Express Mini Card (mPCIe) type F1, with latching I/O connectors
- 4 or 2-port mPCIe RS232/422/485 serial communication cards
- Tru-Iso™ 1500V isolation port-to-computer and 500V isolation port-to-port on ALL signals
- High performance 16C950 class UARTs with 128-byte FIFO for each TX and RX
- Industrial operating temperature (-40°C to +85°C) and RoHS standard
- Supports data communication rates as high as 3Mbps – 12MHz with custom crystal
- Custom baud rates easily configured
- ±15kV ESD protection on all signal pins
- 9-bit data mode fully supported
- Supports CTS and RTS handshaking

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Embedded Hardware

ACCES I/O PRODUCTS, INC.

USB3-104-HUB – Rugged, Industrial Grade, 4-Port USB 3.1 Hub

Designed for the harshest environments, this small industrial/military grade 4-port USB 3.1 hub features extended temperature operation (-40°C to +85°C), locking USB and power connections, and an industrial steel enclosure for shock and vibration mitigation. The OEM version (board only) is PC/104-sized and can easily be installed in new or existing PC/104-based systems as well. The USB3-104-HUB makes it easy to add USB-based I/O to your embedded system or to connect peripherals such as external hard drives, keyboards, GPS, wireless, and more. Real-world markets include Industrial Automation, Security, Embedded OEM, Laboratory, Kiosk, Military/Mission Critical, Government, and Transportation/Automotive.

This versatile four-port hub can be bus powered or self (externally) powered. You may choose from two power inputs (power jack and terminal block) to provide a full 900mA source at 5V on each of the downstream ports. Additionally, a wide-input power option exists to accept from 7VDC to 28VDC. All type A and type B USB connections feature a locking, high-retention design.

FEATURES

- Rugged, industrialized, four-port USB 3.1 hub
- USB 3.1 Gen 1 with data transfers up to 5Gbps (USB 2.0 and 1.1 compatible)
- Extended temperature (-40°C to +85°C) for industrial/military grade applications
- Locking upstream, downstream, and power connectors prevent accidental disconnects
- SuperSpeed (5Gbps), Hi-speed (480Mbps), Full-speed (12Mbps), and Low-speed (1.5Mbps) transfers supported
- Supports bus-powered and self-powered modes, accessible via DC power input jack or screw terminals
- LED for power, and per-port RGB LEDs to indicate overcurrent fault, High-Speed, and SuperSpeed
- Wide input external power option accepts from 7-28VDC
- OEM version (board only) features PC/104 module size and mounting compatibility

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Embedded Hardware

Acromag
THE LEADER IN INDUSTRIAL I/O

VPX6600 AcroExpress 3U VPX Processor Board

The **AcroExpress® VPX6600** is a high-performance 3U OpenVPX® embedded single board computer based on the 6th Generation Skylake Intel® Xeon® processor and PCH. Designed for COTS applications this Intel SBC utilizes the Intel C230 series PCH chipset for extensive I/O support. Heat is managed with a fully integrated heatsink for advanced cooling management.

This board can support either one or two DDR4 ECC SODIMMs, for a total of up to 32 GB. The SODIMMs are firmly attached to the module with screws and surrounded by heat sink material to provide a mechanically and thermally robust mechanism. Extended temperature models are available for operating in a -40°C to +85°C range.

The VPX6600 contains an M.2 expansion card slot to provide on-board storage capabilities. The M.2 slot supports the use of SATA III and PCIe Gen. 3 storage drives.

A two digit LED display is available for Power ON Self-Test (POST) codes, should a problem arise during the boot operation. This display is available for application software user codes after POST to aid in software debugging.

The optional VPX6600-RTM Rear-Transition Module is available to provide easy access to all of the P2 connector's I/O signals.

FEATURES

- 6th Generation Intel Xeon: Quad Core Xeon E3-1505M V5 (47W)
- Up to -40 to 85°C extended operating range
- Programmable CPU power for heat sensitive applications
- Intel C230 series CM236 PCH chipset
- Up to 32GB of high-speed DDR4 memory with SODIMM lock-down mechanism
- Front panel I/O includes: dual USB 3.0 ports and mini-display port
- Backplane I/O has many options

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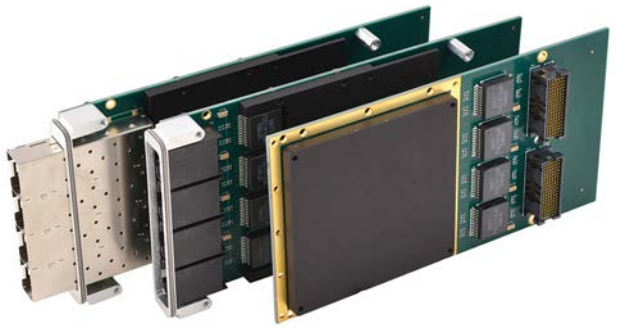
Embedded Hardware

Acromag
THE LEADER IN INDUSTRIAL I/O

XMC610 – 1GbE NIC Card with Quad RJ45, SFP, or Rear Ports

Acromag's new **XMC610 Series** modules provide four independent gigabit Ethernet interface ports when used on VME, VPX, PCIe or other embedded computing carrier boards. The industry-leading Intel® I350 Ethernet Controller interfaces with the PCIe bus via four high-speed serial lanes on the XMC P15 connector. ***Three models are available:*** The **XMC611** model offers four RJ45 connectors on the front panel for copper cabling while the **XMC612** substitutes four SFP connectors to additionally support fiber optic media. The rear I/O model **XMC613** routes four 1000BASE-T connections to the P16 connector and is compatible with conduction-cooling frames. Designed for COTS applications, these XMC modules are ideal for use in defense, aerospace, industrial, and scientific research computing systems.

Employing Intel's advanced I350 4-port gigabit Ethernet controller, these networking modules introduce new levels of performance including improved power management technologies, such as energy-efficient Ethernet and direct memory access coalescing. Other enhancements add flexibility for virtual functions and increased offload capabilities. Auto-negotiation supports 10/100/1000 Mbps data rates. A 3.3V low power design and extended temperature operation from -40 to 85°C further simplify system integration.



FEATURES

- Four independent 1-gigabit Ethernet interface
- Industry-leading Intel I350 Ethernet controller
- Front or rear I/O access (RJ45, SFP, or P16)
- XMC PCIe x4 Gen 2 interface
- Up to 5Gbps bus speed per lane
- Supports fiber optic or copper media
- 10/100/1000 Mbps data rates
- Software support available for embedded applications running on Linux®, Windows®, or VxWorks® operating systems

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Embedded Solutions
SMARTER BY DESIGN®

ADLMES9200 Series Rugged Chassis Systems

The **ADLMES9200** is a successor to ADL's popular ADLMES8200 rugged chassis system. Design improvements include lower weight, lower cost, quick and reliable IP67 integration as well as rugged features including MIL-STD 810G shock and vibration and MIL-STD 461F/704F/1275D compliance capability.

Our ADLMES9200 rugged chassis systems are ideal for SWaP-constrained military/defense applications for mobile, tactical, airborne and ground vehicles. Designed to survive MIL-STD 810 rugged environments, the ADLMES9200 can suit the needs of a broad range of rugged uses from the ground up.

Applications: *Military/Defense Ground Vehicles, Mission/Payload Computers, SWAP-constrained Embedded Systems for Mobile, Tactical, Airborne and Vehicle applications, Rugged industrial Oil and Gas, Mining and Construction and Commercial Unmanned Vehicles.*

FEATURES

- Two Size Profiles Available
- IP7-rated EMC-Compliance Gasket Kit
- Passive Fanless and High-Power Conductive-Cooled Designs
- Space for 3x or 5x PC/104 Cards
- Uni-body design
- SWaP-Optimized for Size, Weight, or Power Constrained Applications
- Customizable Front I/O Plate For Feature and Function

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Embedded Hardware

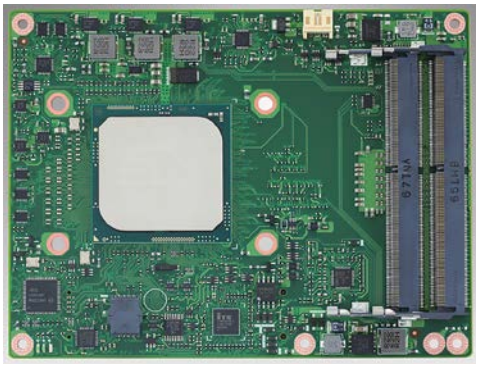
ADVANTECH

Enabling an Intelligent Planet

SOM-5992

SOM-5992 is the world's first COM Express powered by a server-grade processor with up to 16-core scalability and up to 64GB DDR4 memory (**up to 128GB coming soon**) ; it delivers amazing computing performance. Integrated with two 10GBASE-KR, it provides high bandwidth interfaces for data transmission and reception. The outstanding computing capability and low thermal design power deliver excellent power efficiency and make it very suitable for microservers, networking, and cloud storage. With maximum of 64GB memory, which puts it closer to server application scenarios, and makes it possible to take advantage of the extreme performance of the Intel® Xeon® 16-core processor in a 125mm x 95mm COM Express Basic module. This is the first COM Express designed for servers, and fully satisfies users who pursue maximum performance in order to process multiple complicated tasks in the system, and can cover thousands of data exchange demands from worldwide clients.

Since it is a standard form factor and ready to use, users can adopt it into their systems as usual, without taking additional time for customization, and there is no sacrifice of limited system space. The enhanced reliability, availability, and scalability allow for quick integration, easy platform upgrade, and hardware virtualization benefits.



FEATURES

- Intel® Xeon® Processor D-1500 Product Family
- PICMG COM.0 R3.0 type 7 COM Express Basic Module
- Up to 16 cores with TDP of 45W
- Support optional 802.11 a/b/g/n/ac & 4.0 BLE
- Dual DDR4 2400, 1.2V Low Power Memory, up to 64GB (up to 128GB coming soon)
- Configurable Gen3 PCIe x16, x8 and8x1 expansion
- Two 10GBASE-KR interfaces, and 1000BASE-T

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Aitech Defense Systems, Inc.

Embedded Computing *without* Compromise

VME & VPX SBCs Offer Up to 21% Lower Power Consumption

As embedded system size shrinks and electronics density increases, powerful multicore SBCs with cost-effective, lower cost-per-watt options enables system designers to meet the thermal profiles of today's highly integrated, embedded systems.

By further reducing power consumption within the board itself, Aitech helps designers meet the challenges of SWaP-C optimization throughout a number of rugged and mobile environments.

To offer the most flexibility in design options, Aitech has implemented NXP's new, low-power T4241, T4161 and T4081 PowerPC variants (collectively, the T4xx1 Series) on the company's QorIQ-based SBCs.

The low-power series is available on the C912 3U VPX SBC, which offers up to twelve e6500 PowerPC cores, as well as on the C111 6U VME and C112 6U VPX SBCs, all of which have NXP's Trust Architecture 2.0. This technology provides a high-trust Cybersecurity processing environment for sensitive data security and supervisory control, a typical requirement for manned and unmanned space, air and ground vehicles.

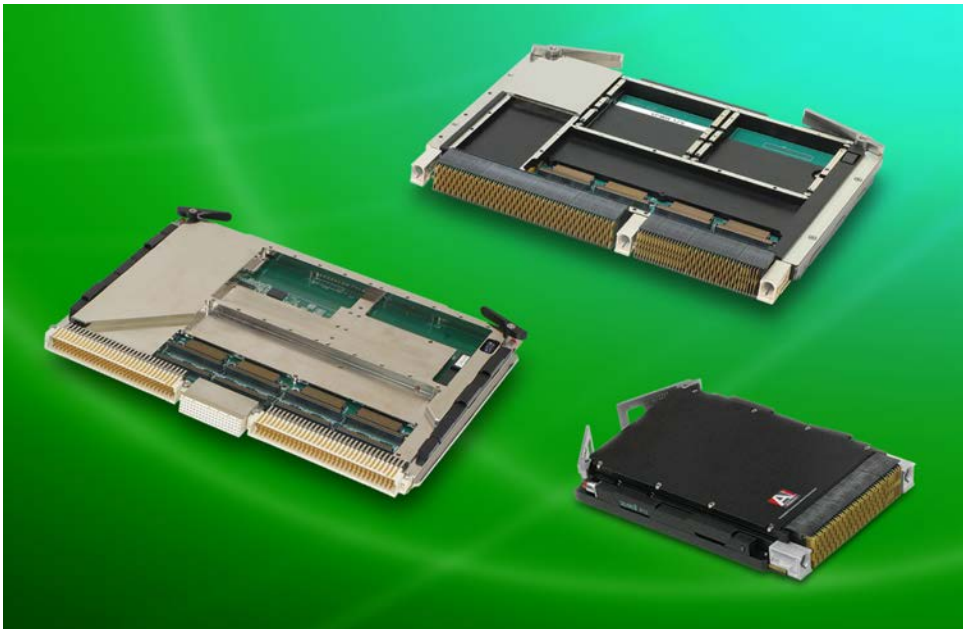
For those looking for an integrated HW/SW bundled platform that offers exceptional graphics computing, the CB912 VideoPaC also comes with the option of using a processor from the low-power T4xx1 Series. The CB912 combines a 3U VPX single-slot SBC with a video/graphics XMC mezzanine using AMD's E8860 Radeon GPU to create new dimensions of imaging, high-end graphics and data processing.

The T4xx1 Series is 100% software compatible with the original T4xx0 family, meaning designers can utilize either on the Aitech COTS SBCs, depending on their individual application requirements. The low-power processors offer an extended temperature range of -40°C to 105°C on all 1.8 GHz speed bins as well as thermal power reduction of up to 21% depending on the device and speed bin selected.

By providing greater energy efficiencies, the SBCs maximize available system power, while meeting the throughput and peak performance demands of modern embedded applications.

FEATURES

- Available in 3U or 6U VPX; 6U VME & 3U VPX HW/SW bundled SBCs
- Better manage thermal profiles and dense electronics requirements
- Extended temperature (-40°C to +105°C) on all speeds, up to 1.8 GHz
- Fully compatible with previous T4xx0 QorIQ Series



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ARTESYN™
EMBEDDED TECHNOLOGIES

ATCA – A Modular Open Systems Approach for Defense

ATCA technology is an open, standards-based bladed system architecture defined by PICMG® in 2002 with high availability (99.999%) as a core tenet. It has as a long life cycle planned to the next decade and beyond.

AdvancedTCA® or ATCA® technology has proven itself to be one of the most successful open, bladed architectures for high-performance, ultra-reliable network computing. Its compact, light and power-efficient design with moderate ruggedness now makes it the ideal choice for military, aerospace and security equipment makers.

ATCA technology embodies MOSA into system platforms by optimizing joint combat system performance and total cost of ownership (TCO) over the entire program life cycle. Its rich multi-vendor ecosystem ensures that the architecture is extensible and enables key technology refreshes into production programs over time, without the need for a full system upgrade. One of the specific benefits of ATCA technology is that it also enables forward and backwards systems compatibility via the use of standard system interfaces.

Artesyn offers an ATCA product portfolio that includes server blades, DSP blades, Ethernet fabric blades and fully integrated systems. We are committed to longevity and new technology insertions to span the next decade and beyond. Our products are deployed in defense applications worldwide in applications such as:

- ***Shipboard communications and data center consolidation***
- ***Naval tactical combat systems refresh***
- ***Airborne reconnaissance***
- ***Theater command centers***
- ***Mobile Tactical Operations Centers (TOCs)***
- ***Ground and airborne battle management systems***
- ***Net-centric converged solutions for voice, video, and data***
- ***C4ISR***

FEATURES

› Rich ecosystem of blades and systems with a strong history of deployment in defense applications

› Regular technology refreshes to enhance and extend applications

› Commitment to a long life cycle

› Support for real-time Linux

Visit our website
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Atrenne
A Celestica Company

COTS Rugged Chassis and Backplanes

Imagine being able to deploy your electronics design in the harshest military, aerospace and industrial environments in the world. Atrenne, a Celestica company, specializes in providing rugged, deployed chassis enclosures, backplanes, and related accessories and services. We have the industry's most extensive intellectual property library of chassis designs accumulated throughout our 40+ year history. If your application has challenging shock, vibration, size, temperature/cooling, altitude, humidity, safety, EMI/EMC, 10 Gbaud signaling or other requirements, chances are we already have a platform design that we can use as a starting point. Working with Atrenne lowers your lifecycle cost, reduces technical risk, shortens your schedule, converts fixed costs to variable and allows your team to focus precious resources on your unique value-add.

Our design library includes:

- *1/4, 1/2, 3/4, 1, 1.5+ ATR enclosures*
- *1U to 14U high Rackmount enclosures*
- *Small form factor enclosures*
- *Baseplate, forced-air, heat-exchanger, and liquid-cooled chassis supporting 3U/6U air and conduction-cooled modules*
- *Backplanes with 10 Gbaud signaling in a range of topologies and much more...*

Atrenne can also serve as your one-stop-shop partner for value-add, build-to-print manufacturing of board CCA's. We can design/build or manufacture fabricated metal components, custom I/O and cabling/wire harnesses. Additional services include connector obsolescence management, full assembly/integration and testing.

FEATURES

› **Benefits:**

- ATR, Rackmount, Small Form Factor, and Lab Development Chassis/Backplanes
- VPX /OpenVPX, VXS, VME64x, VME, CompactPCI and other embedded form factors
- 25+ VPX backplanes including pass-through backplanes ready for cabling to a desired topology
- From legacy wire-wrap backplanes to advanced 10 Gbaud signaling
- Backplanes with central switched, distributed, daisy chain and many other topologies

› **Technical Specs:**

- **Supported standards include:** ARINC 404A, MIL-STD-1275, MIL-STD-167, MIL-STD-461, MIL-STD-704, MIL-STD-810, MIL- STD-91403, RTCA/DO-160, etc.
- 110/120 VAC, 28/48 VDC Power Supplies
- Hybrid cooling methodologies
- Red/Black Tempest Compartments
- Lightening protection (bulk cable injection or pin injection)

› **Supported Architectures:**

- VPX, VME, CompactPCI and embedded form factors

› **Application Areas:**

- **Rugged enclosures/backplanes for mil-aero and industrial applications including:** C4ISR, EW, Avionics, Image Processing/Surveillance, Mobile Systems, Secure Communications, Rugged Servers, Sonar & Detection systems, Computing, Communications

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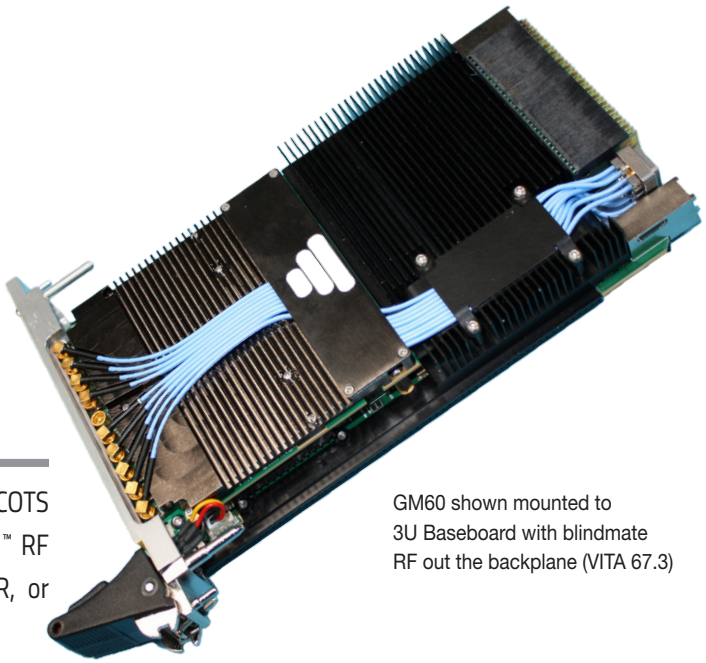
Annapolis Micro Systems



GM60 shown mounted to 3U Baseboard with blindmate RF out the backplane (VITA 67.3)

WILD FMC+ GM60 ADC & DAC with RFSoC

The WILD FMC+ GM60 ADC & DAC is the industry's first COTS Mezzanine to feature the new Xilinx® Zynq® UltraScale+™ RF System-on-Chip (RFSoC) technology (ZU25DR, ZU27DR, or ZU28DR).

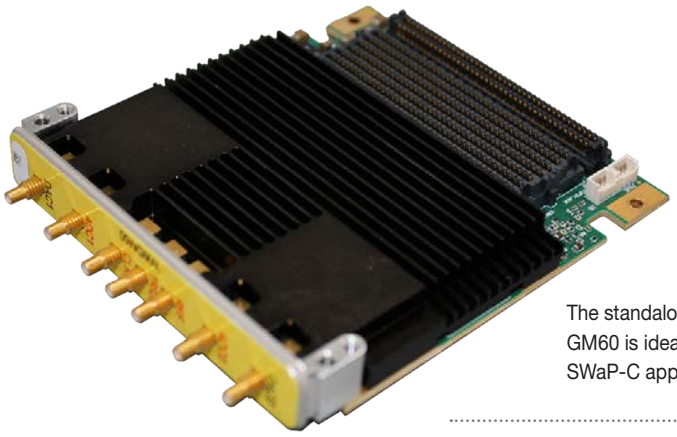
This breakthrough RFSoC combines FPGA processing and A/D and D/A Converters in a single chip, giving the GM60 card remarkable density and performance.

For maximum performance, pair one or two GM60 with an Annapolis WILDSTAR 3U OpenVPX Baseboard (1X) or 6U OpenVPX Baseboard (2X) or PCIe Baseboard (1X). Annapolis WILDSTAR Baseboards utilize up to three high-performance FPGAs, in addition to the GM60 Mezzanine's RFSoC.

Also designed for standalone use, the GM60 is ideal for applications limited by Size, Weight, Power, and Cost (SWaP-C). This WILD FMC+ card operates within a tight envelope; it is slimmer than a 3U OpenVPX board, with about 45% less depth.

FEATURES

- **ADC**
  - Channels: 4
  - Max Sample Rate: 4.0 GSps
  - Resolution: 12 bit
- **DAC**
  - Channels: 4
  - Max Sample Rate: 6.4 GSps
  - Resolution: 14 bit
- **I/O Connectors** (optional 50Ω SSMC or VITA 67)
  - Four analog outputs
  - Four analog inputs
  - One clock input
  - One trigger input
- **Mechanical and Environmental**
  - Integrated heat sink and EMI / crosstalk shields
  - Air- or conduction-cooled
- **Clock Synchronization**
  - Software-selectable external clock input or onboard PLL clock
  - All ADCs and DACs across multiple mezzanine cards easily synchronized



The standalone GM60 is ideal for SWaP-C applications

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Annapolis Micro Systems, Inc.
www.annapmicro.com/products/wild-fmc-gm60-adc-dac/

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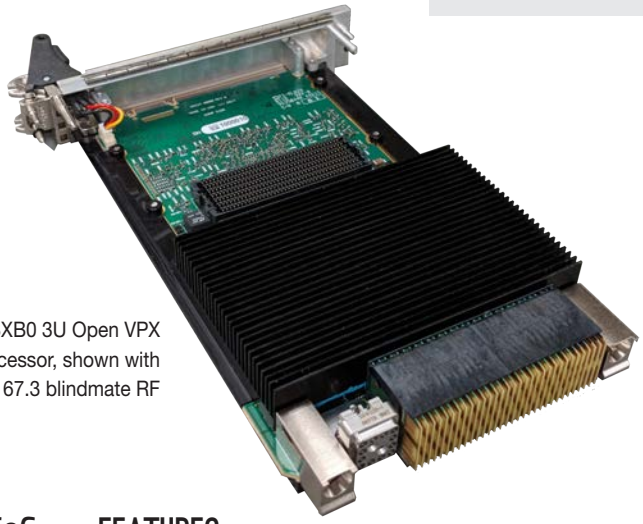

WILDSTAR 3XB0 3U Open VPX FPGA Processor, shown with optional VITA 67.3 blindmate RF

WILDSTAR™ FPGA Boards with Powerful MPSoC

These WILDSTAR FPGA Baseboards combine the latest Xilinx Kintex UltraScale or Virtex UltraScale+ FPGAs with a powerful Zynq UltraScale+ MPSoC. The quad-core ARM eliminates the need for a separate Single Board Computer (SBC) in many digital signal processing systems.

Secure

In addition to higher performance, the Zynq+ is Xilinx's most secure solution – it has multiple levels of hardware and software security.

Rugged

Annapolis rugged FPGA boards are designed from the ground up to perform at the highest levels in the harshest environments. They withstand a broad temperature range using air, conduction, or air-flow-through cooling.

Three Form Factors

These COTS boards are available in three form factors: 3U & 6U OpenVPX and PCIe.

Proven EcoSystem

WILDSTAR boards are all part of the WILD EcoSystem. The Eco-System is an interoperable portfolio of rugged high-performance OpenVPX and PCIe COTS boards and systems that are used for challenging data acquisition, digital signal processing, and data storage applications.

Designed & Manufactured in USA

All Annapolis products are engineered and manufactured under one roof in the United States. This co-location of engineering and manufacturing allows for more aggressive design, and better quality control and production flexibility.

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FEATURES

› **General Features**
- Up to two Xilinx® Kintex® UltraScale™ XCKU115 or Virtex® UltraScale+™ XCVU5P / XCVU7P / XCVU9P / XCVU11P / XCVU13P FPGAs
  - *Hard 4x (3U) or 8x (6U & PCIe) PCIe Gen3/Gen4 endpoint for DMA and register access*
  - *FPGAs programmable from attached flash or Annapolis-provided software API*
- Xilinx Zynq® UltraScale+ MPSoC Motherboard Controller XCZU3EG / XCZU7EV / XCZU9EG / XCZU11EG / XCZU15EG / XCZU19EG
- A Full Board Support Package using Open Project Builder for fast and easy Application Development
- System Management

› **OpenVPX Backplane I/O**
- 20 (3U) or 24/38 (6U) HSS I/O lanes to VPX backplane for 50 (3U) or 60/182 (6U) GB/s of full duplex bandwidth
- Backplane Protocol Agnostic connections support 10/40Gb Ethernet, IB capable, AnnapMicro protocol and user-designed protocols
- Radial Backplane Clock Support for OpenVPX backplane signals AUXCLK and REFCLK

› **Front Panel I/O**
- Wild FMC+ (WFMC+) next generation I/O site
  - *Accepts standard FMC and FMC+ cards (complies to FMC+ specification)*
  - *Supports stacking (2 I/O cards per site)*
  - *Up to 32 High Speed Serial and 100 LVDS pairs connections to FPGA*

› **Mechanical and Environmental**
- Available in Extended Temperature Grades
- Air, conduction, or air-flow-through cooled
- Integrated heat sink and board stiffener
- Optional blind mate optical and/or RF connections (VITA 66/67)
- RTM available for additional I/O

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Annapolis Micro Systems, Inc.
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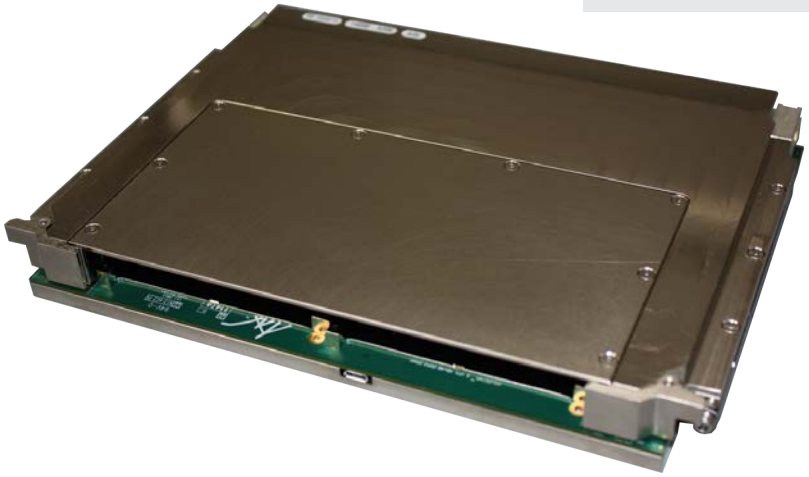
Annapolis Micro Systems



WILDSTAR™ UWB for 6U OpenVPX – WB6XBU

This breakthrough Ultra-Wide-Bandwidth (UWB) FPGA Board features a super-high-performance digitizer and processor in a single rugged 6U OpenVPX board. It is designed to handle full ADC input bandwidths in the most challenging data acquisition, processing, and storage applications.

All Annapolis FPGA boards are engineered for superior performance and maximum bandwidth. Both Altera and Xilinx FPGAs are leveraged to offer the best FPGA technology available and to fit customer preference, design requirements and production schedule.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

We offer training and exceptional special application development support, as well as more conventional support.

FEATURES

› **General Features**

- Processing
  - *Two Xilinx UltraScale+ Virtex (XCVU9P or XCVU13P) – 10GB of DDR4 DRAM per FPGA*
  - *On-Board Zynq+: Quad-core 64-bit ARM runs up to 1.3 GHz*
- Inputs
  - 2 Channels @ 32GSps
  - 4 Channels @ 16GSps
- Analog Specs
  - Resolution: 10 Bits
  - Analog Input Bandwidth: 13GHz per channel
- Digital Outputs
  - At least 24 I/O @ 28 Gbps each = 672Gbps
- A Full Board Support Package using Open Project Builder™ for fast and easy Application Development
- System Management

› **Mechanical and Environmental**

- Air, conduction, or air-flow-through cooled
- Optional blind mate optical and/or RF connections (VITA 66/67)
- RTM available for additional I/O

› **What Can the WILDSTAR UWB Board Do for You?**

If you need to acquire, process, and store a large volume of raw data in real time, this Ultra-Wide-Bandwidth FPGA Board is for you. Contact us today to request a block diagram and additional specifications.

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WILD Storage G2 for 6U OpenVPX – WB6SN0

Data Storage Solution Offers Highest Density

When storage capability is needed, Annapolis offers the highest density OpenVPX storage solutions on the market. Available in 6U and 3U form factors, the WILD Data Storage Solution features a removable hot swappable canister with a connector rated for 10,000+ mating cycles. The WILD Solution comes with standard images to support XAUI, 40GbE and AnnapMicro Protocol (Annapolis low FPGA utilization, full flow control protocol ideal for inter-FPGA communication).

The WILD Data Storage Solution is comprised of two pieces fitting in a single 1" OpenVPX slot: the "Storage Canister" and the "Storage Carrier" that plugs into the VPX backplane and holds the disk canister.

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FEATURES

- 3U boards feature 16 TB storage depth and 5-7 GB/s bandwidth
- 6U boards feature 32 TB storage depth and 10-14 GB/s bandwidth
- Backplane I/O using PCIe or 40Gb Ethernet
- Scalable depth and bandwidth using multiple Storage Cards
- Hot swappable Canister with 10,000 insertion cycles & hot swappable Carrier *(exclusive to WILD EcoSystem)*
- 6U/3U OpenVPX (VITA 65) compliant, 1" VITA 48.1 spacing
- Air- or conduction-cooled
- Proactive thermal management

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Embedded Hardware

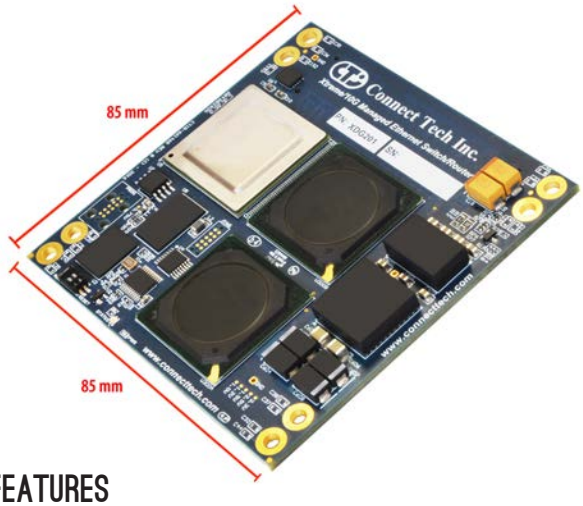
Connect Tech Inc.
Embedded Computing Experts

36-port Switch/Router from Connect Tech

The **Xtreme/10G Managed Ethernet Switch/Router** from **Connect Tech** targets managed Layer 2 and Layer 3 equipment in SMB, SME, and industrial applications where high port count 1G switching with 10G aggregation/uplinks are required.

This Managed 10G Ethernet Switch/Router is designed to act as a module allowing it to be mated to a Connect Tech off the shelf breakout board or with a custom designed breakout board to meet your exact application requirements.

Xtreme/10G Managed Ethernet Switch/Router provides a total of 36 switchable ports, with 4x 10G, 8x 1GbE (SGMII), and 24x 1GbE (Copper 10/100/1000Mbps) ports in an extremely small form factor 85mm x 85mm.



FEATURES

- 36 switchable ports (4x 10G; 8x 1GbE [SGMI]; 24x 1GbE)
- High-density board-to-board connector
- +4V to 14V input range
- 85mm x 85mm module
- Extended Temperature Range -40 °C to +85 °C

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Connect Tech Inc.
Embedded Computing Experts

V7G GPU System from Connect Tech

The **V7G GPU System** from **Connect Tech** combines Intel® Xeon® D (Server Class) and Intel® Atom™ C3000 x86 processors with high-end NVIDIA® Quadro® and Tesla® Graphics Processing Units (GPU) all into a small form factor embedded system. Choose from **highest-end, highest-performance** models or from low-powered models all ideal for high-end encode/decode video applications or **GPGPU CUDA® processing**, Deep Learning and Artificial Intelligence applications.

This embedded system exposes all of the latest generation interconnect including: 10GbE and Gigabit Ethernet, USB 3.0 and 2.0, HDMI, SATA III, GPIO, I2C, M.2, miniPCIe. The black aluminum enclosure has two mounting options: Half-rack rail mount or Standalone mounting brackets.

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FEATURES

- High-End GPUs with Intel® Xeon® D Server Class and Intel® Atom™ C3000 x86 Processors
- 4 independent display outputs or GPGPU processing system using CUDA® cores
- Black Aluminum Enclosure
- Mounting Options: Half-rack & Standalone
- Outer Dimensions without mounting rails installed: 228.6mm x 88.9mm x 181.0mm

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CRYSTAL™
A clear advantage.

RE1312 Rugged Embedded Computer

The **RE1312 Rugged Embedded Computer** is a lightweight, highly reliable computer with the capability to bring powerful compute processing to a variety of transportation platform applications.

The RE1312 Rugged Embedded Computer is a ruggedized system based on Intel® Core-i7 Gen6 Dual or Quad Core processors. The system can be configured with up to 32GB, non ECC DDR4 of memory. Along with six USB 3.0 ports the compact unit offers two 15mm SSD or three 9mm SSD storage options which are externally removable. The system's LGA 1151 socket supports HDMI and DVI-I video output options. A tough carbon fiber composite frame serves simultaneously as the entire system's structural backbone and EMI shield. The unit measures 12" wide, 4.5" tall, and 9" in depth and can be tray or bulkhead mounted with supplied bracket ears.

The RE1312 Rugged Embedded Computer operates over a wide temperature range from -40°C to 60°C and with 18V to 36V DC input. The computer is compatible with several industry standard operating systems such as Windows® 7/8.1/10, Windows Server 2012 R2®, RHEL® 6.6/6.7/7/7.1, SUSE SLES® 11, Ubuntu® 15/16, or Centos® 7.1. The unit complies with MIL-STD 461, CE102 and RE102 for EMC testing.

FEATURES

- Compact construction – 4.5"H x 12" W x 9"D footprint
- Compact composite construction provides low SWaP
- 7th Generation i7®/Broadwell-DE, Xeon®-D CPU technology
- Dual and Quad Core i7 CPU options, up to 16 cores Xeon-D
- 18-36 VDC power
- Up to 32GB unbuffered, non ECC DDR4 1.2V SO-DIMM or 128GB ECC DDR4 with Xeon-D offering
- Two 15mm SSD or three 7/9mm SSD storage options, removable drives

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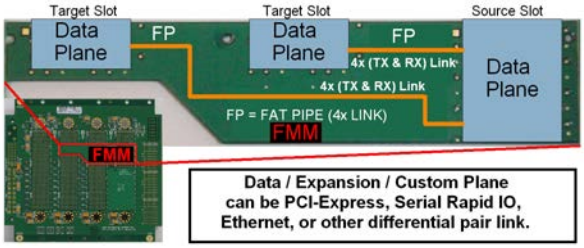
Dawn VME Products®

Fabric Mapping Modules

Dawn OpenVPX backplane **Fabric Mapping Modules** simplify topology customization. Dawn VME Products FABRIC MAPPING MODULES automate optimization of OpenVPX backplane topologies. Newly patented FMM micro-overlays quickly customize off-the-shelf OpenVPX backplanes to mission requirements.

Fabric Mapping Modules allow designers to work with flexible configurations of high speed links. Off-the-shelf backplanes can be quickly customized to mission requirements without the time and expense required for new backplane designs, a critical advantage when schedules are compressed by late system changes. Dawn engineers have successfully used Fabric Mapping Modules to solve many OpenVPX application problems in the design phase.

Fabric Mapping Modules provide a natural migratory development environment for moving from the lab to the field with high speed OpenVPX backplanes.



FEATURES

- Off-the-shelf backplanes can be quickly customized to mission requirements
- Optimize the communication topology between slots within a system's backplane
- Customize inter-slot communications to meet unique system requirements
- Improve signal integrity between system cards beyond requirements of PCI Express, Serial Rapid I/O and 10Gbit (XAUI) Ethernet standards
- Directly connect PCI Express or SerialRapid I/O to multiple cards or cards and switches
- Link SATA from a CPU card to a Solid State Drive (SSD) carrier
- Enable XMC cards to talk to other XMC cards or other I/O like PCI Express links
- Facilitate rear backplane I/O connections and low profile connector interface systems when normal transition modules do not fit the system application envelope

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EURESYS™
Excellence in vision

Coaxlink Duo PCIe/104

Transmission and acquisition of high-definition video over long coaxial cables

CoaXPress is a recent powerful standard providing a high speed interface between the camera and the PC frame grabber. High-frequency, real-time triggering, and exposure time adjustment to the low light situations can be accommodated.

Airborne ISR

Vision systems often integrate high resolution and high speed CoaXPress cameras for airborne intelligence, surveillance and reconnaissance missions.

Transport, security

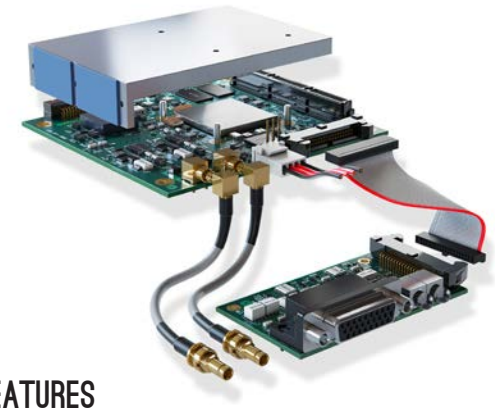
Thanks to a high resistance to extreme temperatures, shocks, vibrations and humidity, the Coaxlink Duo PCIe/104 board is particularly well suited for embedded security systems for rail and road transportation, police vehicles equipment or any mobile or outdoor video-surveillance applications.

Camera turrets for airborne surveillance or gun turrets

CoaXPress cameras can easily be integrated in 360° rotating stations with slip rings to allow continuous panning. High resolution video provides sharper images and a larger viewing area thereby potentially reducing the number of cameras required.

Unmanned applications, vehicle-based video capture

The CoaXPress standard allows video transfer to the PC in a few milliseconds. The very low latency of the system will allow the control of land vehicles or remote control of UAVs.



FEATURES

- Ruggedized COTS board for industrial and military embedded applications
- Small stackable PCIe/104 form factor
- Extended temperature range: -40 to +85°C / -40 to +185°F with conduction cooling (ambient temperature measured inside the enclosure)
- Sustained shock: 20 g/11ms (all axes – half-sine and saw tooth)
- Optional conformal coating
- Two CoaXPress CXP-6 connections: 1,250 MB/s camera bandwidth
- Feature-rich set of 10 digital I/O lines

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GENERAL MICRO SYSTEMS, INC.

S402-SW "Tiger"

The **S402-SW "Tiger"** is a third-generation, fan-less (conduction-cooled) fully rugged, low cost Intel® Xeon® E5 server. It is designed to provide the highest level of server-class performance possible in a fully ruggedized, conduction-cooled system, operating up to -40°C to +85°C. Tiger simplifies local data processing tasks that require an ultra-fast, Xeon®-class server with vast amounts of high-speed, ECC-protected RAM and storage in one ultra-rugged chassis.

S402-SW is ideal for the application that requires the horsepower of a high-performance server deployed onto a rugged platform with no fans required. When equipped with the Layer 2/3 intelligent Ethernet switch, Tiger becomes a rugged compact server, router, switch, NAS subsystem weighing only about 10 pounds.

The Tiger is an 8 to 22-core Xeon® E5 server intended for military/ defense/aerospace with greatest SWaP-Efficiency (SWaP-E) on the market due to its compact size and robust computing and I/O performance. Tiger is an ideal forwardly-deployed vehicle-mounted battlefield/airborne/shipboard server/router/switch/NAS that offers the greatest reliability in the smallest packaging. Tiger can also be used in industrial and commercial platforms since it has server-class performance, significant networking options, exceptional I/O capabilities and removable storage.

The S402-SW is fully compliant to MIL-STD-810G, MIL-STD-1275D, MIL-S-901D, DO-160D, MIL-STD-461F and has ingress protection up to IP67. This system may also be ordered from the factory with operating systems such as Windows® or Linux® pre-installed.

FEATURES

- Intel® Xeon® E5 v4 CPU with up to 22 cores
- Hyper-Threading on each core for total of 44 logical cores
- Supports up to 128 GB of DDR4 memory with ECC
- Up to two fixed mSATA SSD or SAM I/OTM
- Optional fixed M.2 or NVMe SSD for OS boot (Optional for I/O) – Up to four 10 GbE plus twelve 1 GbE Ethernet ports
- Two removable 2.5" SATA or NVMe SSD (four is optional)
- Drive(s) and SD card secured behind EMI/IP-rated door
- SSD drives support optional encrypt/Secure Erase/Write Protect
- Optional AMD® Radeon® GPU E8860, up to 768 GFLOPS
- Optional NVIDIA® Quadro® GPU M2200M, up to 1.32 TFLOPS
- Extended temp -40°C to +85°C

All of General Micro Systems Products are Trusted and Deployed Since 1979.

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GENERAL MICRO SYSTEMS, INC.

S1U-MD "Cyclone"

The **S1U-MD "Cyclone"** is a unique ultra-rugged, 1U rack-mount, lightweight multi-domain server system with two domains, each with up to 18 CPU cores, dual 10/40 Gigabit Ethernet ports, thirteen 1 Gb Ethernet ports, removable drives, add-in PCIe card, auxiliary power unit (APU) and exceptional I/O flexibility. It is designed to provide two fully-independent and isolated high-performance Intel® Xeon® E5 v4 servers, 26 Ethernet ports, dual add-in PCIe cards, as well as two sets of four removable SAS/SATA/NVMe drives – all in a 1U high box. It provides the highest level of server performance possible in a fully ruggedized, convection-cooled system, operating from -20° C to +75° C. Even the AC or DC smart power supplies and optional hold-up APUs are separated to assure full isolation. This system architecture simplifies deployable MIL-SPEC technology for Multiple Independent Levels of Security (MILS), NSA Red/Black network separation, or system redundancy, while integrating processing, storage and high speed I/O in a small, ultra-rugged 1U high rack-mount enclosure with the greatest possible performance per dollar and per watt.

The 1U rack-mount S1U-MD multi-domain Cyclone is two complete (up to) 18 core Xeon® server sub-systems packaged together but electrically isolated, including their separate power supplies and APUs. Cyclone is intended for commercial, industrial, military, defense, and aerospace Red/Black networks that also require storage – such as found on platforms with SIPR/NIPR networks. With the onboard 1, 10 or 40 Gigabit Ethernet ports, Cyclone is an ideal forwardly-deployed vehicle-mounted battlefield multi-domain or dual server that offers double performance or redundancy via the two domains. Alternatively, the S1U-MD is an ideal airborne network multi-domain server that can also drive operator consoles, such as in an ELINT platform, while recording data and distributing it to multiple Ethernet LANs. The choice of 10 Gb or 40 Gb Ethernet ports provide inter-box LAN connectivity, CPU-based bridging, and multi-node connectivity. Removable drives with optional encryption provide NAS and software-defined storage that scales with system requirements. Multiple add-in processing and I/O modules increase system connectivity and efficiency.

FEATURES

- Isolated dual CPU systems, multi-domain server in 1U rack-mount form factor
- Fully supports Multi-Domain, Red/Black NSA-secure architecture
- Dual fully isolated MIL-STD-1275 DC or 110/220 VAC power for each of the Red/Black domains
- Two fully-independent systems (Red/Black) each with:
  - *Intel® Xeon® E5 v4 with up to 18 Cores and 36 virtual machines*
  - *Up to 256 GB of DDR4 memory at 2133 MTS with ECC*
  - *Optional fixed M.2 or mSATA for OS boot (optional encrypt/Secure Erase/Write Protect)*
  - *Four removable 2.5" SATA/NVMe (PCIe) SSDs with twist latch (optional encrypt/Secure Erase/Write Protect)*
  - *Optional SD card reader carrier (can replace up to two 2.5" drive trays)*
  - *Intel® Virtualization Technology (VT-x/VT-d2) and Trusted ExecutionTechnology (TXT)*
  - *BMC system management and fan control via Ethernet (IPMI 2.0)*

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GENERAL MICRO SYSTEMS, INC.

S1202-HS "Golden Eye IV"

The **S1202-HS "Golden-Eye IV"** is a seventh generation ultra-rugged, low pro le, lightweight workstation/server/graphics processor with the latest Intel® E3 Xeon® processor, multi-head 4K graphics output, and one removable drive. It is designed to provide the highest level of workstation performance possible in a fully ruggedized, conduction-cooled, sealed system, operating from -40° C to +85° C.

This system architecture simplifies applications that require rugged high performance computing, high definition uncompressed long-reach video, storage and high speed I/O in a small, ultra-rugged enclosure with the greatest possible performance per dollar and per watt. Golden-Eye IV also offers Intel's very best embedded graphics performance with Intel's 3-head HD Graphics P630 controller, which is superior over any previous embedded Intel® graphics controller.

S1202-HS contains four standard variants: 1) 2x 10GbE, 2x USB 3.0 (shared power), 1x DisplayPort; 2) 1x 10GbE, 1x USB 3.0, 2x DisplayPort; 3) 2x 10GbE and 2x DisplayPort; and 4) 3x DisplayPort, 1x USB 3. Additional options are available and include VGA.

The S1202-HS "Golden-Eye IV" is a 4-core Xeon® E3-15xxM-based server/workstation/graphics processor that is intended for commercial, industrial, military, defense, and aerospace applications with greatest SWaP-Effeciency (SWaP-E) on the market due to its compact size and robust computing and I/O performance ports. Golden-Eye IV is an ideal forwardly-deployed vehicle-mounted battle eld workstation/server/graphics processor that offers the greatest reliability in the smallest packaging. Golden-Eye IV can also be used in industrial and commercial platforms since it has server-class performance, high performance workstation-like embedded graphics, exceptional I/O capabilities and removable storage.

The S1202-HS is fully compliant to MIL-STD-810G, MIL-STD-1275D, MIL-S-901D, DO-160D, MIL-STD-461F and has ingress protection up to IP67. This system may also be ordered from the factory with operating systems such as Windows® or Linux® pre-installed.

FEATURES

- 3.0 GHz Intel® Xeon® E3 (Kaby Lake, 7th Gen. CoreTM) (E3-15xxM V6)
- Up to 64 GB of DDR4 memory with ECC
- 3-head Intel® HD Graphics P630 with GT2
- Support for DirectX 11/12, OpenGL 4.3/4.4, ES 2.0, and OCL 2.x
- Up to 4096 x 2304 (4K and UHD) at 60Hz via Mini-BNC (optional)
- One removable 2.5" SATA or NVMe SSD with door
- Drive bay is sealed even when drive is removed
- Three USB 3.0 ports (shared power) and four USB 2.0 ports
- Optional fixed M.2 SSD for OS boot
- Two SAM™ sites add: 1553, Wi-Fi, GPS, LTE, mSATA
- Operating temperature range of -40° to 85°C

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GENERAL MICRO SYSTEMS, INC.

VPX450 "Phoenix II"

The **VPX450 "Phoenix"** is a dual slot OpenVPX module with front and rear I/O. Using Intel's most popular server processor, the CPU module supports dual Intel® Xeon® processors (E5-2699R v4), each with up to 22 physical cores with Hyper-Threading for a total of 88 logical cores operating at up to 2.2 GHz with the ability to TurboBoost up to 3.6 GHz. To harvest this incredible CPU performance, each CPU is coupled with up to 512 GB (1024 GB total) of RAM organized in four banks. Each RAM bank consists of two DIMM arrays with Error Correcting Code (ECC). The ECC RAM provides 2-bit error detection with 1-bit of correction, and supports up to 2133 Mega Transfers per Second (MTS) between CPU and memory, resulting in an incredible peak memory transfer rate of over 80 GB/s.

The CPU module also provides two 40 Gigabit Ethernet ports via QSPF+ connectors for Fiber or Copper support. Additionally, two Gigabit Ethernet ports, four USB 3.0 ports, and one HDMI video port are provided on the CPU module's front panel. For custom I/O, the SBC provides one XMC site with x8 PCIe Gen 3 with front and rear panel I/O, or a 2.5-inch enterprise class SSD device (on M.2) that is removable from the front with up to 2.4 GB/s read and 1.2 GB/s write speeds.

The SBC provides two Special Application Module (SAMTM) PCIe-mini sites, which support two mSATA SSD devices that may be used to boot the operating system (OS) with RAID functions. Additional SAM I/O devices such as GPS, MIL-STD-1553, CANBus, or other PCI Express-Mini cards may be used as well.

Other I/O functions of the CPU module include: Baseboard Management Controller (BMC) for health monitoring and reporting via a dedicated Ethernet port, Trusted Platform Module (TPM), eight GPI/O lines, 16 MB BIOS Flash, 2 Kb of Field Replacement Unit (FRU) for configuration data, Real Time Clock (RTC) with field replaceable battery, and voltage/temperature monitoring.

Zeroize (sanitize) support is included via optional front panel switch and built-in via BMC control. This function starts the Secure Erase process that removes data from non-volatile storage in all drives plus the BIOS.

The CPU module also provides an incredible 68 lanes of PCIe Gen 3 support for I/O expansion via its OpenVPX P1-P5.

FEATURES

- Rugged, 6U OpenVPX dual slot air-cooled module
- Dual 2.2 GHz Intel® Xeon® E5 each up to 22 cores
- Hyper-Threading on each core for up to 88 logical cores
- Supports up to 1024 GB of RAM with ECC up to 2133 MT/s – 55 MB unified instruction/data cache for each CPU
- Up to 80 lanes of Gen 3 PCIe
- Two 40 Gigabit Ethernet ports with Fiber/Copper
- Two Gigabit Ethernet ports with TCP/IP offload engine – Support for one Enterprise Class x4 PCIe SSD
- Add-In Cards: PCIe-Mini, XMC, M.2
- Operating Temperature Range -20 to +75°C

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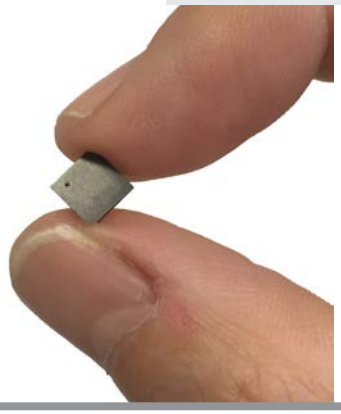
Embedded Hardware

HOLT INC.
INTEGRATED CIRCUITS

MIL-STD-1553 / MIL-STD-1760 Protocol IP Core

Holt's **HI-6300 MIL-STD-1553 IP Core** provides a complete and compliant single or multi-function interface between a host processor and the **Holt HI-1587 MIL-STD-1553 Bus Transceiver**. The IP Core includes Bus Controller (BC), Remote Terminal (RT), and Bus Monitor Terminal (MT) operating modes, any combination of which can be enabled for concurrent operation. All configurations are software compatible with Holt's hardware products HI-6130 and MAMBA™. The IP Core presents the host with a simple memory mapped synchronous 16-bit parallel interface that is compatible with the Xilinx IPIF standard.

The enabled terminals communicate with the MIL-STD-1553 buses through Holt's external dual bus transceiver, HI-1587 and an external MIL-STD-1553 transformer interface. The HI-1587 features an integrated IP security module necessary to enable the IP. This eliminates the need for a traditional external IP dongle chip, commonly used with other IP solutions. The HI-1587 is also the first MIL-STD-1553 transceiver to feature 1.8V, 2.5V and 3.3V compatible digital I/O, making it easier to interface with a broad range of FPGAs. The user allocates up to 64Kx22 of FPGA static RAM Blocks to suit application requirements.



FEATURES

- HI-6300 IP Core Family: BC/RT/MT functionality
- Software compatible with Holt's hardware products HI-6130 and MAMBA™
- No external IP dongle necessary
- 8K or 64K words error-correcting code (ECC) RAM with BIST
- High-Performance synchronous host interface for easy connection to AMBA AXI4 interface protocol or PCI-Express
- 50 MHz or 100 MHz input clock
- API software library supporting Linux, VxWorks and bare metal
- DO-254 Design Assurance Level A Compliant options

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Embedded Hardware

IC INTERFACE CONCEPT

ComEth4590a – VPX 10/40 GbE Layer 3 switch

The **ComEth4590a** is the first and only 3U VPX 10/40 Gigabit Ethernet Layer 3 switch currently on the embedded market which has two separate and independent on-board Ethernet switch matrices – one for the Data Plane and one for the Control Plane. These two separate switch matrices or packet processors are managed by two independent dual core processors. Each matrix supports separate instances of Interface Concept Switchware network management which allows independent network configuration for features such as network optimization, monitoring and security. In addition to offering the outstanding switching capabilities you've come to expect from Interface Concept, this high-performance Layer3 switch can be remotely configured by the Switchware web interface, SNMP or CLI interfaces. It features a total of 41 SerDes or Lanes routed to the rear VPX connectors as 1000Base-KX, 10GBase-KR or even 40GBase-KR4 ports and to the front panel as 10GBase-SR or 1000Base-SX fiber optical ports.

Moreover, the Cometh4590a is fully compatible with the Intelligent Platform Management Interface (IPMI) required by the most recent high performance VPX systems, and it supports Precision Time Protocol (PTP) IEEE 15888-2008 (v2) for networks requiring sub-microsecond synchronization capabilities throughout the IP network.

FEATURES

- 3U VPX 10/40 Gigabit Ethernet Layer 3 switch
- 2*on-board Ethernet switch matrices
- 2*dual-core processors
- Switchware network management
- 41*SerDes or Lanes
- 1000Base-KX, 10GBase-KR or even 40GBase-KR4 ports (rear)
- 10GBase-SR or 1000Base-SX fiber optical ports (front)

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Embedded Hardware

IC-FEP-VPX6e 6U OpenVPX UltraScale™ FPGA board with FMC+ sites

The **IC-FEP-VPX6e** is a 6U OpenVPX front end processing board, based on two Xilinx Virtex UltraScale FPGAs and one NXP QorIQ® TLS1046A quad 64-bit processor, for DSP intensive processing applications. The IC-FEP-VPX6e design is based on the Xilinx FPGA package B1204, providing the board with a high scalability level (Kintex® UltraScale™ KU115 standard configuration, or Virtex® UltraScale™/UltraScale+™ configurations). Each FPGA is coupled with two DDR4 SDRAM memory banks (supporting up to 2400 MT/s transfers), two optional DDRII SRAM memory banks and SPI Mirror flash memories for local bitstreams storage and for user parameters. The high-end IC-FEP-VPX6e is controlled by a QorIQ® LS1046A processor integrating quad 64-bit Arm® Cortex A72 cores with high-performance Data Path Acceleration Architecture (DPAA) and network peripheral interfaces. The on-board PCI Express advanced switch allows versatile coupling between the processor, the FPGAs and the fabric links of P1 VPX connector. The IC-FEP-VPX6e can be easily integrated into heterogeneous multi-domains PCIe architectures thanks to the Interface Concept MultiWare software package and its simplified API. Both FMC+ sites are compliant with VITA 57.4 standard. Boards are available in air-cooled and conduction-cooled grades.

FEATURES

- 1*QorIQ® LS1046A – quad 64-bit Arm Cortex®-A72 cores @1,8 MHz
- 4 GB DDR4 ECC
- 256 MBytes of NOR Flash
- On-board SSD (32GB)
- 2* Kintex® UltraScale™ KU115, Virtex® UltraScale™/ UltraScale+™
- 1* Gen2/3 PCIe switch
- 1*Giga Ethernet L2 switch

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Embedded Hardware

EnsembleSeries LDS3517 3U AI OpenVPX blade with BuiltSECURE

Mercury's EnsembleSeries LDS3517 combines Intel's Xeon D family of server-class processors with Xilinx's UltraScale family of FPGA devices in a compact 3U OpenVPX form-factor.

On-board platform capability for AI processing – Artificial intelligence (AI) applications are characterized by their processing power and massive memory and storage capabilities. AI applications require six times as much memory as a regular data center server and twice the storage. The LDS3517's Xeon D family processor is supported with a powerful FPGA and the most system memory in the industry (32GB in the current generation). As decision making shifts to on-platform processing, the LDS3517's ability to execute AI applications becomes critical.

Most rugged for the harshest environments – The EnsembleSeries LDS3517 uses the fastest Intel and Xilinx processors to deliver uncompromised processing capability in a small, 3U OpenVPX blade. Mercury MOTS+ technology equips these blades with the most rugged embedded packaging.

Embedded proven BuiltSECURE technology for FMS – Information assurance and system integrity are required for most military processing systems and a prerequisite for foreign military sales (FMS). BuiltSECURE technology is proven built-in, system-wide security across software, firmware and hardware within system security engineering (SSE), trust and cyber-hardening.

FEATURES

- Versatile, rugged, compact 3U OpenVPX blade
- Intel Xeon D, Xilinx UltraScale FPGA devices and huge system memory for AI processing
- XMC mezzanine site and Gen 3 PCIe support for versatility
- PCIe data and expansion plane for high speed I/O or module interconnect
- Proven BuiltSECURE technology for system integrity
- Designed, made, coded and supported in the USA

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Embedded Hardware

MPL
High-Tech • Made in Switzerland

Rugged Fanless Embedded Computers up to i7 QuadCore and Xeon

The **PIP Family, CEC,** and **MXCS Server** are powerful, highly integrated, robust and fanless embedded computer solutions. Selection of the components are purely made on the subject for long-term availability and low power consumption. The systems can be expanded in a very modular way and represent a unique solution for today's demanding and flexible defense requirements. The products are designed to operate under extreme and normal conditions without the need of fans. MPL solutions are designed and produced in Switzerland to meet MIL STD-810F as well as other MIL standards.

The systems include features like wide DC input power, reverse polarity protection and more. Additional GPGPU, GPS, WLAN, CAN, Sound, and UPS modules are available.

Think Long-Term – Think MPL

FEATURES

- Soldered CPU and ECCRAM
- Ethernet (up to 10Gbit), USB (3.0/2.0), Serial ports ...
- PCIe, PMC, XMC, mPCIe, PCI-104, MXM expansion
- Extreme low power consumption
- Certified: e.g. DO-160G, MIL-STD-461, -704E, -1275E
- Availability 10+ years (repair 20+ years)
- Optional -40°C to 85°C environment temperature

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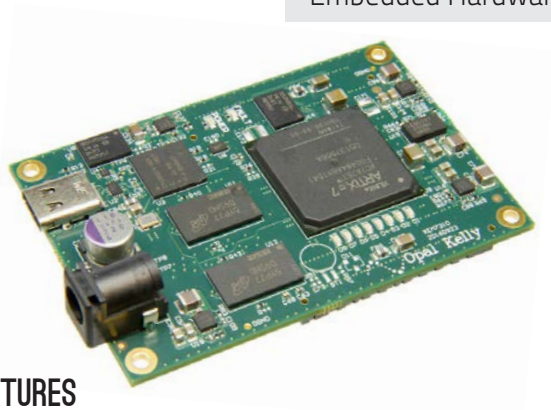
Embedded Hardware

Opal Kelly

XEM7310

Reduce time and effort on product development by integrating the **XEM7310** into your next design. A production-ready module with a highly-capable Xilinx Artix-7 FPGA, 1 GiByte DDR3 SDRAM, and SuperSpeed USB3.0 host interface utilizing Opal Kelly's FrontPanel SDK, the **XEM7310** offers a small form factor for easy integration with your product. With ample logic resources, 126 user I/O, and two 80-pin Samtec connectors for high-performance peripheral connectivity, this module is well-suited to applications including ASIC/hardware-based simulation and verification, image capture and processing, cryptography, data security, and bioinformatics.

Celebrating over 10 years of USB FPGA connectivity, Opal Kelly's Front-Panel SDK fully supports the **XEM7310** for real-world transfer rates in excess of 340 MiB/s. FrontPanel includes a multi-platform (Windows, Mac, Linux) API, binary firmware for the on-board Cypress FX3 USB controller, and atomic HDL modules to integrate into your design. FrontPanel is the industry's most full-featured, high-performance, turnkey solution for professional grade USB connectivity.



FEATURES

- Xilinx Artix-7 (A75 and A200 densities available)
- 1-GiByte DDR3 SDRAM, 2x 16-MiB serial flash
- 126 user I/O including 4 MRCC pairs, 4 SRCC pairs, and 1 XADC pair
- Self-powered by external DC source
- Low-jitter 200 MHz clock oscillator
- Two 80-pin 0.8mm Samtec board-to-board connectors (BSE-040)
- Small form-factor (smaller than a credit card) at 75mm x 50mm x 15.8mm (2.95" x 1.97" x 0.62")
- Complete Application Programmer's Interface (API) in C, C++, C#, Ruby, Python, and Java

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Opal Kelly

SYZYGY® Product Family

Introduced in 2017, Opal Kelly's **SYZYGY® Specification** defines an FPGA-agnostic peripheral interconnect standard that fits between low-performance, low-cost Digilent™ Pmod and high-performance, high-cost, high pin count FMC (VITA 57.1). The compromise enables low-cost systems with high performance peripherals in a compact form factor.

Applications include:

- *Data acquisition*
- *Software-defined radio*
- *Video input and output*
- *Machine vision*
- *Advanced sensing*
- *Robotics*

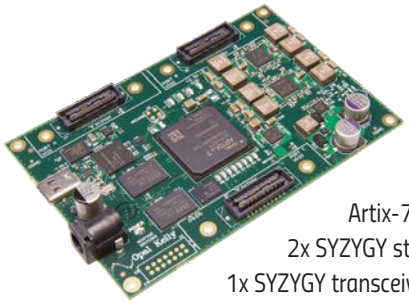
SYZYGY Features

- Standard and Transceiver-capable peripherals
- High-quality, low-cost cable options
- Compact 40-pin (standard) or 60-pin (transceiver) connectors
- Pin count optimized to economize FPGA I/O for multiple single-purpose peripherals
- +5v and +3.3v system voltages standard
- SmartVIO for programmable I/O voltages

Several carrier boards and peripheral modules are available in the growing ecosystem of the standard.

SYZYGY Carriers

The Opal Kelly **Brain-1** is an open-source hardware design with a Xilinx Zynq ARM+FPGA, 1 GiB DDR3, Gb ethernet, USB OTG, 3x SYZYGY standard and 1x SYZYGY transceiver ports. Introduced to encourage and support the adoption of the SYZYGY standard, schematics and reference sources are available through open source repositories.



The **XEM7320** is a FrontPanel-enabled SuperSpeed USB 3.0 system integration module with a Xilinx Artix-7 FPGA, 1 GiB DDR3, 2x SYZYGY standard ports, and 1x SYZYGY transceiver port. The XEM7320 is fully supported by the FrontPanel SDK for fast and easy high-speed communication with a host PC or embedded system.

SYZYGY Peripherals

SZG-ADC-LT2264 – Dual 40 MSPS, 12-bit ADC optimized for digital communications, software-defined radio, and medical imaging applications.

SZG-DAC-AD9116 – Dual 125 MSPS, 12-bit DAC for software-defined radio and direct digital synthesis.

SZG-SENSOR – Multi-sensor module with environmental, motion, light, and global position sensors.

SZG-CAMERA – High performance 3.4 Mpixel color CMOS sensor at up to 215 frames-per-second for machine vision, robotics, and digital imaging.

SZG-DUALSFP – Dual SFP+ cage supporting high-performance fiber and wired networking and communications.

More information about the SYZYGY standard may be found at http://syzygyfpga.io.

mil-embedded.com/p374720

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OSS
ONE STOP SYSTEMS

4U 400TB Flash Storage Array and Data Storage Unit

The **Ion Accelerator Data Storage Unit** brings the leading edge commercial PCI Express 3.0 NVMe flash technology to the warfighter. It replaces 400+lb traditional HDD shared storage systems required for airborne surveillance, ground station and mobile data centers with a 65lb, 4U, 19" rack mount MIL-STD-810F tested platform that reaches near-native NVMe storage speeds of over 24GB/s with millions of IOPS. This capacity and speed in a small space allows for unprecedented amounts of sensor, video and radar data to be stored and processed real-time. The OSS Ion Accelerator flash software (formerly Fusion-io), used by flash memory applications in many DoD programs over the last 6 years, runs in kernel space to provide the absolute maximum bandwidth with lowest latency available in large-scale rugged systems. The DSU allows unprecedented mission turn-around times and almost unlimited storage capacity because all 32 of the NVMe flash devices can be hot-swapped and replaced in seconds using four individual 8-drive magazines. Each 6.5lb, 100TB portable NVMe magazine can then move from system to system using OSS Follow Me technology where RAID data follows the magazine. With optional encryption, compression, provisioning and enterprise features, the data center easily moves with the troops.

This rugged, lightweight All-Flash Array deploys in extreme environments, provides up to 400TB of the fastest PCIe NVMe flash storage on the planet and is turbo-charged by the proven Ion Accelerator flash software. The user experience is unmatched because warfighters can move up to 100TB of storage in each magazine from an aircraft or vehicle mounted unit to a mobile data center, data safe or ground station unit just like moving a USB stick. With this large storage capacity in a small space at blazing speeds, surveillance missions can last longer, capture more data and keep the data safe. The array has up to 4 ports of flexible, leading edge 32Gb Fiber Channel, 100Gb Infiniband, 100Gb Ethernet or 128Gb PCIe connectivity for drop-in replacement to any legacy system or upgrade to the latest network speeds. Three hot-swap modular power supplies allow for installation in 24-270V DC or universal AC environments so installations can standardize on a single system. The tamper-proof, dual copy operating system ensures system reliability and security. Solid state operating system, boot loader and bulk data drives increase speed and reliability of the media. The optional Ion Accelerator in-line encryption eliminates separate encryption devices further reducing SWaP.

FEATURES

- 4U MIL-STD-810F ruggedized system
- Supports high-density PCIe NVMe flash up to 400 TB (usable)
- Four lightweight removable data magazines with capacities up to 100TB each
- Each data magazine weighs less than 6.5lbs
- Supports up to 5 million IOPS
- Provides up to 24 GB/second throughput
- Supports four 100Gb/s EDR Infiniband, 100Gb/s Ethernet or 32GbFC interfaces
- Supports iSCSI, FC and SRP protocols
- IPMI system management
- Supports OSS Ion Accelerator software

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Embedded Hardware

Opal Kelly

XEM7360

The **XEM7360** Kintex-7 based FPGA module offers a turnkey SuperSpeed USB 3.0 host interface using Opal Kelly's FrontPanel SDK. System integrators can build fully-operational prototype and production designs quickly by integrating this device into their product. Manufacturers of high-speed devices such as JESD-204B data acquisition devices can launch fully-functional evaluation systems without the costly design and maintenance of an evaluation platform.

With ample logic resources, the Kintex-7 is well-suited to signal processing, image processing, and other logic-heavy acceleration tasks. Memory-hungry applications enjoy access to 2 GiB of on-board DDR3 memory with a 32-bit wide data bus.

Celebrating over 10 years of USB FPGA connectivity, Opal Kelly's FrontPanel SDK fully supports the **XEM7360** for real-world transfer rates in excess of 340 MiB/s. FrontPanel includes a multi-platform (Windows, Mac, Linux) API, binary firmware for the on-board Cypress FX3 USB controller, and atomic HDL modules to integrate into your design. FrontPanel is the industry's most full-featured, high-performance, turnkey solution for professional grade USB connectivity.

FEATURES

- Xilinx Kintex-7 XC7K160T or XC7K410T
- 2 GiB DDR3, 2x 16 MiB serial flash
- Two Samtec QSH-090 expansion connectors
- Up to 193 user I/O + 8 Gigabit Transceivers
- Low-jitter 200 MHz and 100 MHz clock oscillators
- Integrated voltage, current, and temperature monitoring
- Small form-factor: 100mm x 70mm x 19.65mm

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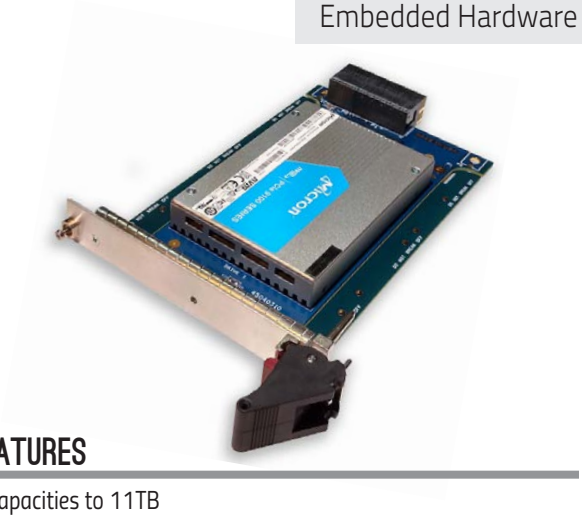
Embedded Hardware

PHOENIX INTERNATIONAL

NVMe VPX SSD Module



The VP1-250-eSSD is an Open VPX NVM Express (NVMe) SSD storage module that delivers extremely high performance via a single fat pipe (PCIe 4x). Designed from the ground up to remove legacy layers of hard drive interfaces such as SATA and SAS, it takes full advantage of the speed and parallelism of solid state nonvolatile memory. Streamlined efficient queuing protocol combined with an optimized command set register interface enables low latency and high performance.

NVMe is an industry standard registered interface designed to accelerate the performance of nonvolatile PCI Express (PCIe) SSDs. The NVMe protocol was established in collaboration by server industry leaders to standardize a scalable PCIe interface, making it easier for designers to unlock the full potential of PCIe. NVME provides opportunities for increased data throughput and reduced latency all while reducing the number of drives needed - both now and in the future. Adoption of this industry standard is driven by a strong consortium of storage technology providers and a robust ecosystem of drivers across multiple operating systems.

FEATURES

- Capacities to 11TB
- Optimized register interface and command set lowers latency
- Sequential 128KB read: 3.0 GB/s, write: 2.0 GB/s
- Random 4KB read: 750,000 IOPS, write 300,000 IOPS
- Streamlined protocol with efficient queuing mechanism to scale with multi-core CPUs
- 2,000,000 hours MTBF
- Available in air cooled and conduction cooled (VITA 48) configurations

Made in the USA

mil-embedded.com/p374361

Phoenix International
www.phenxint.com

info@phenxint.com 714-283-4800

PHOENIX INTERNATIONAL

PHALANX II NAS File Server

The **Phalanx II** is a rugged Small Form Factor (SFF) Network Attached Storage (NAS) File Server, specifically tailored for the avionics, military and rugged industrial market. The system offers the best utilization of Size, Weight and Power (SWaP) and adherence to Commercial Off the Shelf (COTS) standards in the industry.

Utilizing two military grade solid state disk storage devices (fixed or removable), the Phalanx II will support a variety of network based file systems that allow for multiple hosts to store and share information. Network connections are provided through four load balanced Gigabit Ethernet ports, and can support optional dual optical 10 Gigabit Ethernet ports for low EMI susceptibility.

Management is via a convenient web based GUI or CLI. System and storage health and performance monitoring capabilities include SMART, SNMP (read-only), and Email notification.

The optional dual removable storage bay is available for ready access to the storage media, allowing for fast data availability for ground station analysis, and quick mission turnaround and declassification.

FEATURES

- CPU: Intel Core i7-6822EQ
- FIPS 140-2 Validated AES 256 Encryption
- Two SSDs (fixed or removable) up to 8TB ea, 16TB total
- Network Services: NFS (V3/V4), SBM/CIFS, FTP, TFTP, RSYNC, SSH
- Temp: -40°C to +71°C (Op.), -40°C to +85°C (Non-Op.)
- MIL-STD-810F, MIL-STD-461F, MIL-STD-704F/1275D
- Weight: < 6lb with fixed SSDs

MADE IN THE USA

mil-embedded.com/p374369

Phoenix International
www.phenxint.com

info@phenxint.com

714-283-4800

Embedded Hardware

RED ROCK® TECHNOLOGIES

VPX SSD MODULES

Add SSDs to your VPX system!

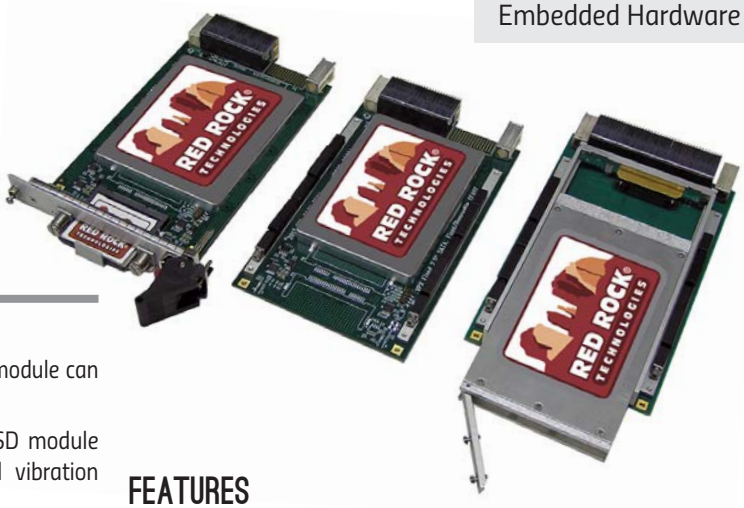
With transfer speeds of 2000 MB/S, our new VPX NVME module can be a lower cost alternative to expensive recording systems.

Red Rock Technologies provides a wide range of VPX SSD module options designed for extreme temperature, shock, and vibration environments. Interfaces include NVME, SATA and PCIe.

For applications requiring frequent insertion/removal of SSDs, our VPX Carrier with Removable Modules provides an SSD housed in a case with connectors rated for 100,000 insertion/removal cycles. The module can be easily removed from the VPX carrier board for secure storage.

For applications requiring two SSDs, there are VPX SSD modules for 1 fixed 2.5" SATA SSD and 1 removable CFast™; 2 fixed CFast™; or 1 fixed CFast™ and one removable CFast™.

Red Rock Technologies specializes in providing custom solutions for our customer's requirements.



FEATURES

- Uses COTS U.2 NVME SSDs, 2.5" SATA SSDs and/or CFast™
- MLC up to 8TB or SLC up to 640GB
- Air or conduction cooled
- Fixed and removable SSDs
- Discrete controlled military secure erase options
- -40°C to +85°C operational temperature

mil-embedded.com/p374571

Red Rock Technologies, Inc.
www.redrocktech.com

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PENTEK

8-Channel A/D & D/A Zynq UltraScale+ RFSoC Processor

The **Quartz Model 5950** is a high-performance 3U OpenVPX board based on the Xilinx Zynq UltraScale+ RFSoC FPGA. The RFSoC integrates eight RF-class A/D and D/A converters into the Zynq's multiprocessor architecture, creating a multi-channel data conversion and processing solution on a single chip. The Model 5950 brings RFSoC performance to 3U VPX with a complete system on a board. Complementing the RFSoC's on-chip resources are the 5950's sophisticated clocking section for single board and multiboard synchronization, a low-noise front end for RF input and output, up to 18 GBytes of DDR4, a PCIe interface, a gigabit serial optical interface capable of supporting dual 100 GigE connections and general purpose serial and parallel signal paths to the FPGA.

Board Architecture

The 5950 board design places the RFSoC as the cornerstone of the architecture. All control and data paths are accessible by the RFSoC's programmable logic and processing system. A full suite of Pentek developed IP and software functions utilize this architecture to provide data capture and processing solutions for many of the most common application requirements. For many applications the Model 5950 can be used with simply the built-in functions, requiring no FPGA IP to be developed.

Flexible Modular Design

While the Model 5950 follows the form factor of a standard 3U OpenVPX board, the unique modular design of Pentek's Model 6001 QuartzXM eXpress Module provides the flexibility to deploy this solution in many different situations. The heart of the QuartzXM is a system on module containing all of the key components including the RFSoC FPGA, DDR4 SDRAM, and power and clock management.

In the case of the 5950 the QuartzXM is mounted on a 3U OpenVPX carrier which complements the design with a timing bus generator, analog signal conditioning, a GPS receiver and an 8x 28 Gbps optical transceiver. As a module and carrier board set, the 5950 becomes a complete, ready to deploy 3U OpenVPX solution available for a range of operating environments from commercial to rugged and conduction cooled.

The Model 6001 QuartzXM can also be mounted on other carriers available from Pentek to support standard form factors, or for applications that require a non-standard footprint, Pentek supports the module with a design kit for users to engineer and build their own custom carrier. As a complete and tested module, the QuartzXM encapsulates best in class electrical and mechanical design, eliminating some of the most challenging aspects of embedded circuit design and allowing the user to focus on the application specific carrier design.

FEATURES

- Supports Xilinx Zynq® UltraScale+ RFSoC FPGAs
- 18 GB of DDR4 SDRAM
- On-board GPS receiver
- PCI Express (Gen. 1, 2 and 3) interface up to x8
- LVDS connections to the Zynq® UltraScale+ FPGA for custom I/O
- Optional VITA-66.4 optical interface for backplane gigabit serial communication
- Dual 100 GigE UDP interface
- Compatible with several VITA standards including: VITA-46, VITA-48, VITA- 66.4, VITA-57.4 and VITA-65 (OpenVPX™ System Specification)
- Ruggedized and conduction-cooled versions available
- Unique QuartzXM™ eXpress Module enables migration to other form factors

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Red Rapids

Red Rapids Product Families

Red Rapids offers a catalog of signal processing hardware products that target communication, telemetry, radar, electro-optic, and high-speed data acquisition systems. The products are available in multiple form factors for seamless integration into an embedded chassis or traditional server/desktop computing environment.

Red Rapids hardware is built around widely adopted open architecture standards. Direct connection to a host is achieved through a PCI Express bus interface while network connections are supported by 10 Gigabit Ethernet.

Analog Up/Down Converter Products

The **SigFront** product family offers high fidelity analog up/down converters with multiple IF bandwidth options. The up and down converter functions are supplied as individual products that cover two separate RF bands; 1 MHz to 3.9 GHz and 100 kHz to 6 GHz.

The 3.9 GHz RF converter is a triple-stage superheterodyne structure with a 70 MHz IF center frequency. The up/down converter can be configured with a 10 MHz, 18 MHz, or 40 MHz IF bandwidth. The 6 GHz RF converter is a triple-stage heterodyne structure with a programmable IF center frequency from 1 to 500 MHz. The up/down converter can be configured with an 80 MHz or 160 MHz IF bandwidth.

Digital Up/Down Converter Products

The **SigStream** product family digitizes and reproduces analog signals under software command from a host computer. The hardware offers a rich set of software programmable features that include selectable operating modes (continuous, snapshot, periodic), external or timed event triggers, programmable up/down converters, time-stamped data samples, data sizing, and data packing. Data can be organized as a continuous stream of samples or in data packets defined by the VITA 49 specification.

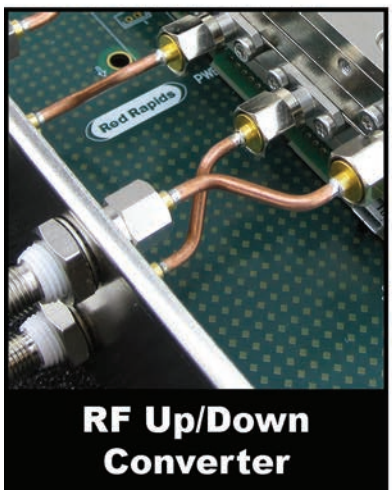
SigStream product options include a single channel 12-bit (1.5 Gsps) receiver, dual channel 16-bit (310 Msps) transceiver, quad channel 16-bit (250 Msps) receiver, and eight channel 16-bit (125 Msps) receiver.

ADC/DAC with FPGA Products

The **SigFPGA** product family provides the ideal platform to rapidly field application specific signal processing functions minus the expense of custom hardware development. The products share a common Xilinx FPGA processing architecture with multiple size and speed grade options. Two banks of QDR SRAM attached to the FPGA provide 32 Mbytes of local storage.

SigFPGA product options include a dual channel 12-bit (1.6 Gsps) receiver, dual channel 16-bit (310 Msps) transceiver, quad channel 16-bit (250 Msps) receiver, and eight channel 16-bit (125 Msps) receiver.

Wideband Signal Processing for Radios and Instrumentation



RF Up/Down Converter

Digital Up/Down Converter

High Speed ADC/DAC + FPGA

mil-embedded.com/p374690

Red Rapids
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972-671-9570

Intel Atom E3800-based SBC

The **CMX34BT** is an advanced PC/104 single board computer and controller with a PCIe/104 stackable bus structure. This Intel Atom E3800-based CPU is exceptionally suited for intelligent systems requiring low power consumption in harsh thermal conditions. The CMX34BT-series CPUs are available in quad-core, dual-core, and single-core configurations. Surface-mount Type 2 PCI Express connectors enable users to stack multiple peripheral modules above and below the CPU. All models include 4GB surface-mount single-channel DDR3 SDRAM and a 32GB industrial-grade surface-mount SATA flash drive.

mil-embedded.com/p373421

FEATURES

- PCIe/104 stackable bus structure
- Available in modular, rugged enclosures and eBuild systems
- Intel Atom E3800 Series Processor
  - *Clock Speed: 1.33 GHz, 1.46 GHz, and 1.91 GHz options*
  - *Max. Core Temperature: 110°C*
- 4GB Single-Channel DDR3 SDRAM (Surface-Mounted)
- 32GB Surface-mounted industrial-grade SATA flash drive
- 4 PCIe x1 Links, One SATA Port, 4 Serial Ports, 9 USB ports, Dual Gigabit Ethernet, Analog VGA, Embedded DisplayPort (eDP) 1.3 with Audio, on-board advanced Digital I/O, TPM encryption
- -40 to +85°C standard operating temperature
- Thermal-optimized passive heat sink included

RTD Embedded Technologies, Inc.
www.rtd.com/atom

sales@rtd.com 814-234-8087

Embedded Hardware

RTD Off-the-Shelf Mission Computer

RTD's standard HiDANplus® embedded computer system provides a robust Commercial-Off-the-Shelf (COTS) solution enabling rapid uptime for mission-critical applications. The system includes a rugged single board computer, power supply, and room for an additional peripheral module. Without increasing the enclosure size, functional upgrades can include high-performance data acquisition, versatile networking options, or enhanced capabilities from a variety of special-purpose add-in modules. Additional configuration options include a removable SATA drawer.

The milled aluminum enclosure with advanced heat sinking delivers passively-cooled performance from -40 to +85°C. Integrated tongue-and-groove architecture with EMI gaskets create a watertight solution with excellent environmental isolation. Keyed cylindrical connectors offer easy cable connections while maintaining the integrity of the environmental seal.

FEATURES

- -40 to +85°C standard operating temperature
- Designed for high ingress protection in harsh environments
- Milled aluminum enclosure with integrated heat sinks and heat fins
- Rugged Intel and AMD-based Single Board Computers
- High-performance, synchronized power supply
- Optional 2.5" removable drive
- Designed to include an additional PCIe/104, PCI/104-Express or PCI-104 peripheral module without increasing overall enclosure size

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RTD Embedded Technologies, Inc.
www.rtdstacknet.com/iot

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Rugged VPX Solutions for Land, Sea, Air, and Space

As warfare continues to grow more dependent on technology, we've seen an increased demand for solutions that are lighter, stronger, faster, and that use less energy. Our VPX components are engineered to meet the needs of the modern battlefield by enabling next-generation connection quality while cutting weight and reducing power usage.

VPX systems support 10 Gb/s today in a switched fabric architecture, providing data-intensive processing for harsh military and aerospace applications where durability and speed are critical. We are meeting the increased requirements for ruggedness with high-speed copper and fiber interconnect and cable assemblies. Designed for the flexible application of demanding protocols like Ethernet, RapidIO, InfiniBand, and HyperTransport, our VPX systems represent the superior solution for many ground, aerospace, and marine applications.

SCALABLE: VPX systems are highly scalable and flexible, supporting both 3U and 6U formats to meet a wide range of application needs.

OPEN ARCHITECTURE: As a widely used standard, OpenVPX promotes interoperability, a healthy choice of suppliers, and economies of scale that result from higher board volumes.

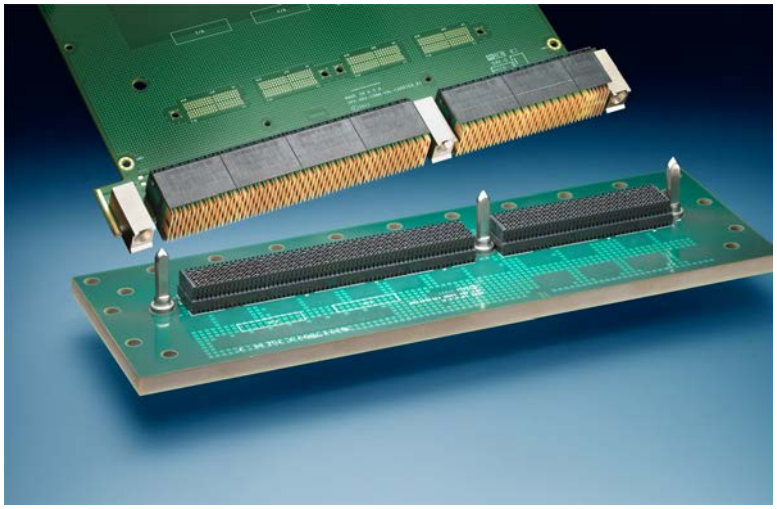
FLEXIBLE: Not only does VPX accommodate new technologies, it has expanded beyond backplane/daughterboard signaling to be used with mezzanine applications, power modules, and optical and RF connectivity – all with the goal of providing unmatched flexibility and capabilities for embedded computing.

MAXIMUM SPEED AND FLEXIBILITY IN MULTI-MEDIA: Our full portfolio of VPX products provides a complete array for high-speed data, optical, RF, power, and mezzanine connectivity. More choices mean more flexibility in achieving specific system architectures with standards-based solutions. Get the high-speed signal integrity that your advanced applications require with our rugged, reliable connectors.

ROADMAP: MULTIGIG RT 3 connectors, launching in 2018, enable increased speeds in OpenVPX systems. NanoRF and high-density optical modules significantly increase density in 3U and 6U systems. Our portfolio roadmap supports next-generation requirements while maintaining the OpenVPX form factor.

FEATURES

- **VITA 46 – MULTIGIG RT 2 and MULTIGIG RT 2-R Connectors**
  - Modular connector system features a protected backplane connector and quad-redundant contact system for reliability
  - Supports speeds up to 10 Gb/s
  - MULTIGIG RT 3 to launch later this year to support up to 25Gb/s
- **VITA 61 – Mezalok Connector**
  - 114 positions for XMC 2.0 with 500 mating cycle durability
  - Supports data rates to 10+ Gb/s with four points of contact
- **VITA 62 – MULTI-BEAM XLE Power Connectors**
  - 20 A and 50 A power contacts, plus signal contacts
  - 3-beam high-conductivity copper contact design
- **VITA 66 – Optical Modules**
  - Full (66.1) and half (66.4) modules feature MT connector
  - Ferrules are spring supported, with up to 24 fibers per MT ferrule
- **VITA 67 – RF Modules**
  - Float-mounted jack maintains positive RF connection with SMPM-based contact performance to 40 GHz
  - Higher density NanoRF solution to launch in 2018 for unprecedented density in a rugged RF interface



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Embedded Hardware

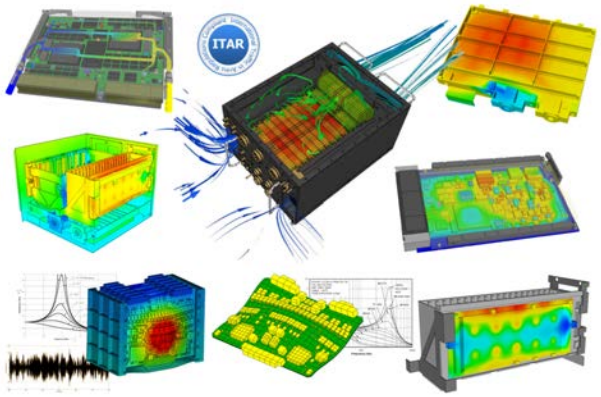
TENTECH LLC
Services & Solutions

Military Embedded Systems Modeling & Simulation SME

TEN TECH LLC is an ITAR-Registered, Woman-Owned Small business providing Subject Matter Expertise in Finite Element Analysis for Shock & Vibration, Fluid Dynamics and Thermal Analysis.

Our core competency is in shock, vibration and thermal analysis of Embedded Defense Electronics systems such as Single Board Computers, RF & Microwave Components as well as complete rugged chassis and subsystems for Avionics, Flight Data Recorders, Guidance & Navigation, Radar Processing, Electronic Warfare and C4ISR applications.

A perfect understanding of MIL-STD-810G, MIL-S-901D, RTCA/DO-160G, GR-487-CORE and other environmental specifications, along with decades of experience in the design and analysis of Embedded Systems allows TEN TECH LLC to support the largest and most complicated Air, Land, Sea, or Space programs.



FEATURES

- Shock & Vibration Analysis: sine, random, sine-on-random, DDAM, UNDEX
- Thermal Analysis: conduction, convection, radiation, liquid cooling
- Fatigue Life & Failure Analysis for high & low cycle fatigue
- Thermal Stress Analysis: CTE mismatch & thermal cycling
- Computational Fluid Dynamics & Coupled Heat Transfer Analysis
- Reliability & DfR Analysis of Electronics Components
- Electromagnetic Analysis: Signal Integrity, EMI & EMC

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Embedded Hardware

VERSALOGIC CORPORATION

Very small embedded computer!

"Bay Trail" Embedded Computer

This embedded computer board, in VersaLogic's EPU (Embedded Processing Unit) format, combines processor, memory, video, and system I/O into an extremely compact full function embedded computer. The "Osprey" computer has a footprint just slightly larger than a credit card!

The Osprey was engineered to meet the military and avionic industries' evolving requirements for smaller, lighter, and more powerful embedded systems. Roughly the size of a credit card and less than 1.08 inches thick, the Osprey is a highly-integrated embedded computer. It combines the Intel® Atom™ "Bay Trail" processor, with newer system interfaces, in a form factor designed to withstand extreme temperature, impact, and vibration.

Osprey is available in single-, dual-, and quad-core models. The single-core is suitable for lower power systems, while the quad-core is ideal for UAV video and control applications where higher performance and lower weight are important.

The Osprey is backed by VersaLogic's 5-year warranty and product life extension programs that can continue delivery well past the year 2025.

FEATURES

- Size: 55 x 95 x 27 mm
- Weight: 140 grams (< 5 oz.)
- Power: < 8W (quad core)
- -40°C to +85°C operation
- Gigabit Ethernet (2 ports)
- Mini PCIe expansion socket
- MIL-STD-202G Shock and Vibration

mil-embedded.com/p374347

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www.linkedin.com/company/versalogic-corporation

VECTOR
ELECTRONICS & TECHNOLOGY, INC.
A FINE TECHNOLOGY GROUP

cPCI, PXI, VME, Custom Packaging Solutions

VME and VME64x, CompactPCI, or PXI chassis are available in many configurations from 1U to 12U, 2 to 21 slots, with many power options up to 1,200 watts. Dual hot-swap is available in AC or DC versions. We have in-house design, manufacturing capabilities, and in-process controls. All Vector chassis and backplanes are manufactured in the USA and are available with custom modifications and the shortest lead times in the industry.

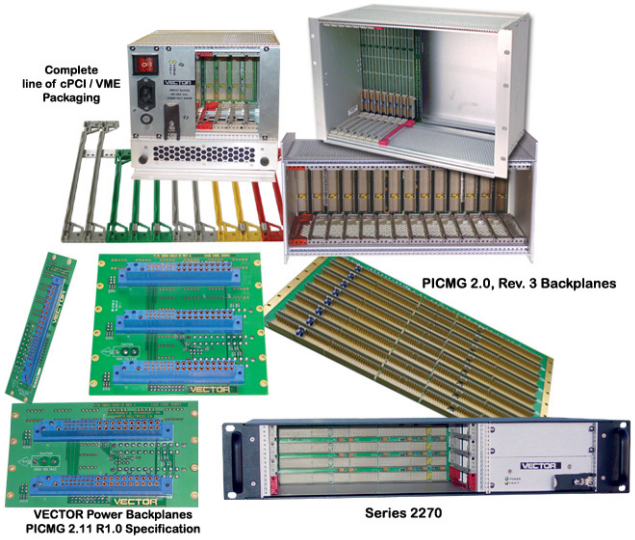
Series 2370 chassis offer the lowest profile per slot. Cards are inserted horizontally from the front, and 80mm rear I/O backplane slot configuration is also available. Chassis are available from 1U, 2 slots up to 7U, 12 slots for VME, CompactPCI, or PXI. All chassis are IEEE 1101.10/11 compliant with hot-swap, plug-in AC or DC power options.

Our Series 400 enclosures feature side-filtered air intake and rear exhaust for up to 21 vertical cards. Options include hot-swap, plug-in AC or DC power, and system voltage/temperature monitor. Embedded power supplies are available up to 1,200 watts.

Series 790 is MIL-STD-461D/E compliant and certified, economical, and lighter weight than most enclosures available today. It is available in 3U, 4U, and 5U models up to 7 horizontal slots.

All Vector chassis are available for custom modification in the shortest time frame. Many factory paint colors are available and can be specified with Federal Standard or RAL numbers.

For more detailed product information, please visit **www.vectorelect.com** or call **1-800-423-5659** and discuss your application with a Vector representative.



FEATURES

- Made in the USA
- Most rack accessories ship from stock
- Modified 'standards' and customization are our specialty
- Card sizes from 3U x 160mm to 9U x 400mm
- System monitoring option (CMM)
- AC or DC power input
- Power options up to 1,200 watts

VISIT OUR NEW WEBSITE!

WWW.VECTORELECT.COM

Made in the USA
Since 1947

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www.vectorelect.com

inquire@vectorelect.com
800-423-5659

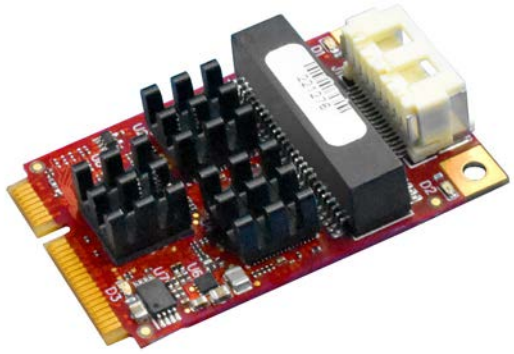
VERSALOGIC CORPORATION

Dual Gigabit Ethernet Mini PCIe Expansion Module

Connect your system to multiple networks with VersaLogic's new **Dual Gigabit Ethernet Mini PCIe card**. The built-in thermal solution ensures that it runs reliably over the full industrial temperature range (-40° to +85°C). Rugged and reliable, the MPEe-E5E is ideal for demanding applications.

The E5 board is completely self-contained with on-board magnetically coupled isolation. There is no need for off-board magnetics or special cabling. MIL-STD-202G shock and vibration testing and a latching connector ensure performance in demanding environments. Fully tested thermal management assures reliable operation over the full industrial temperature range (-40°C to +85°C). The E5 is compatible with Linux and Windows and supports network boot operation.

As with all VersaLogic products, the E5 expansion board is designed for high reliability and long-term availability. Add it to a rugged embedded computer board from VersaLogic for a one-stop solution to your embedded system needs. VersaLogic's proven design expertise makes the VL-MPEe-E5E a rock-solid solution for both standard and environmentally challenging applications.



FEATURES

- Dual Gigabit Ethernet
- On-board magnetically coupled isolation
- -40°C to +85°C operation
- MIL-STD-202G shock and vibration tested
- Industry standard Mini PCIe form factor
- Latching connector to prevent detachment failures
- Uses standard OS drivers

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VersaLogic Corporation
www.versalogic.com/E5

Sales@VersaLogic.com 503-747-2261 @versalogic
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Embedded Hardware

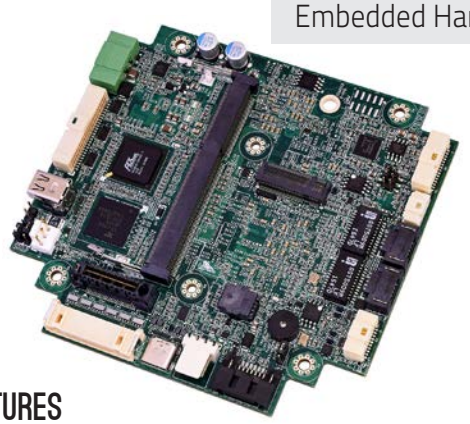
WinSystems®
The Embedded Systems Authority

PX1-C415

PC/104 OneBank™ Intel® E3900 Single Board Computer with Dual Ethernet

WinSystems' **PX1-C415** is a PC/104 form factor SBC with PCIe/104™ OneBank™ expansion and the latest generation Intel® Atom™ processor. Its small size, rugged design and extended temperature make it ideal for industrial IoT applications and embedded systems in industrial control, transportation, Mil/COTS, and energy markets. The PX1-C415 features the Intel Atom Apollo Lake-I Dual or Quad core SOC for processing and graphics. It includes a SODIMM socket with up to 8 GB of ECC capable DDR3-LV system memory and a non-removable eMMC device for solid state storage of an operating system (OS) and applications. In addition, the board supports M.2 and SATA devices. This full-featured SBC has onboard I/O and supports simultaneous DisplayPort and LVDS video. It provides dual Gigabit Ethernet interfaces, 8x USB 2.0 channels, 1x SuperSpeed USB 3.0 channel, 4x serial COM channels, 24 x GPIO lines, stereo audio, and a watchdog timer.

We Specialize in Custom Embedded Solutions



FEATURES

- PC/104 Small Form Factor
- Intel Apollo Lake-I Processor (Dual or Quad core)
- Up to 8 GB DDR3-LV ECC System RAM
- -40°C to +85°C Operating Temperature Range
- Shock and Vibration Tested ▪ Multiple Displays Supported
- Intel Low Power Gen9 Graphics Engine
- Full-HD and 3D Graphics acceleration
- ECC RAM ▪ Intel Security Engine ▪ Dual Ethernet
- USB Type C 3.0 and 8x USB 2.0
- PCIe/104™ OneBank™ ▪ M.2 Expansion Socket

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Embedded Hardware

WinSystems®
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ITX-P-3800

Pico-ITX Intel® E3800 Single Board Computer with Dual Ethernet

WinSystems' ITX-P-3800 series packs an impressive feature set into a small form factor Pico-ITX design. The Intel E3800 processor family delivers robust CPU and graphics performance. This SBC is a perfect choice for applications requiring low power and Intel performance in a small form factor package. The ITX-P-3800 series is packed with I/O features often lacking from larger SBCs, including dual 10/100/1000 Ethernet controllers based on the Intel i211 family with Wake-On-Lan and PXE capabilities, 4x USB 2.0, and 1x USB 3.1 Gen 1 enhanced host ports, and 4x RS/232 serials ports. Expansion options include 1x full-size and 1x half-size PCIe Mini Card slots along with the 5x USB ports. The full-size PCIe Mini-Card slot supports PCIe x1, mSATA and USB interfaces while the half-size supports mSATA and USB interfaces. The ITX-P-3800 is a very compact, PC-compatible SBC and a perfect fit for applications in UAV, energy, medical diagnostics, and industrial control.

We Specialize in Custom Embedded Solutions

FEATURES

- Pico-ITX Form Factor (102 x 73 mm)
- Intel Atom™ (formerly Bay Trail-I) E3800 Series Processor (Dual or Quad Core)
- Up to 4 GB DDR3L Onboard System RAM
- Dual Gigabit Ethernet ▪ 4x USB 2.0 ▪ 1x USB 3.1 Gen 1
- 4x Serial Ports ▪ 4x Digital Inputs ▪ 4x Digital Outputs
- Audio with amplifier
- -20°C to +70°C Operating Temperature Range
- Intel Low Power Gen7 Graphics Engine
- Full-HD and 3D Graphics acceleration
- VGA and Dual Channel LVDS/eDP Outputs

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Embedded Hardware

WOLF ADVANCED TECHNOLOGY

VPX & XMC Rugged Embedded NVIDIA® Pascal™ Modules

WOLF Advanced Technology designs and manufactures rugged video graphics VPX, XMC and small form factor modules for video capture, process, encode and display. WOLF's high-performance **NVIDIA Pascal GPU-based modules** can provide exceptional processing power to applications, which benefit from advanced parallel processing. Typical GPGPU applications include image processing, video stabilization, graphics overlay, terrain analytics, 3D visualization of geospatial data, object recognition, tracking and radar data processing. The latest generation modules also have enough processing power to be used for deep learning inference, where a processing module can use an optimized model to analyze new data.

WOLF's COTS products are designed using a modular approach. This allows WOLF to react rapidly to Modified COTS (MCOTS) requirements or full custom designs, tailored to unique requirements. Typical MCOTS MOQ is 10 units, typical full custom MOQ is 25 units.

mil-embedded.com/p374725

FEATURES

- Video capture, process, encode and display modules
- Chip-down WOLF design and fabrication meets military and aerospace specifications
- NVIDIA Pascal GPUs provide extremely high performance per watt
- Multiple video formats supported, including SDI, DP, DVI, CVBS/STANAG, etc.
- High bandwidth GDDR5 memory with NVIDIA GPUDirect™ DMA technology
- Flexible power requirements, tuned to meet the application requirements
- Wide operating temperature range: -40° to +85°C

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@WolfAdvTech

zmicro

ZM3 MISSION COMPUTER

FULL COMPUTING CAPABILITY IN A SMALL, RUGGED PACKAGE.

Focus on SWaP

The ZM3 rugged computer is designed specifically to minimize size, weight and power for airborne ISR applications. Built to provide advanced compute processing in the smallest form-factor possible, the ZM3 offers full server capability in a small, rugged packaging. The system supports double-wide COTS high-end graphics cards and an additional PCI Express card for custom user expansion. Utilizing an advanced Type 7 COM Express module, the ZM3 utilizes a 16 Core Intel® Xeon® Processor with up to 48G RAM.

Designed to Survive Airborne Environments

The ZM3 is carefully engineered to handle the extreme conditions of airborne environments. Designed and tested to DO-160D requirements for vibration, shock, temperature, humidity, dust and EMI/EMC, the ZM3 provides powerful compute capabilities with robust environmental design to ensure your missions will be a success.

NVMe Based Removable Storage Drives

Further reducing weight, the ZM3 can house up to two TranzPak 1 rugged storage drives (up to 4TB), which utilize the latest NVMe technology to provide storage read/write speeds up to 3x faster than SATA and only weigh 3 oz. each.

FEATURES

- 16 Core, 1.3GHz Base, 2.1GHz Max. Intel® Xeon® Processor
- Up to 48G RAM
- Removable NVMe storage drives (up to 4TB)
- x16 GPU Support; Up to NVIDIA P6000 class GPU; 3840 GPU Cores (or two PCIe slots x8 Gen3 slots)
- Additional x8 PCIe slot for user expansion
- 18-36V DC Power Input
- Status indicators for disk activity and fault detection
- Ultra-compact, lightweight aluminum construction
- 4.6"w x 5.6"h x 14"d ▪ Under 10lbs

***ZMicro** is a leading manufacturer of rugged deployable computing and visual solutions. Since 1986 we have been delivering reliable, high-performance MIL-Spec solutions that are custom tailored to perform at their highest capacity in harsh environments.*

Our ruggedized products include: displays, computers, servers, handhelds, data storage, video enhancement, video management resources, and much more.

mil-embedded.com/p374692

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Embedded Hardware

X-ES

Extreme Engineering Solutions

XPand6212

The **XPand6212** is a true Commercial-Off-The-Shelf (COTS) rugged system based on the Intel® Xeon® D-1500 family processors and a Gigabit Ethernet switch hosting an XPedite5205 Cisco IOS® Gigabit Ethernet Embedded Services Router. With a compact design, the XPand6212 maximizes processing and networking performance while minimizing SWaP. The XPand6212 provides a SWaP-optimized alternative to traditionally larger slot-based systems; it is an actual Small Form Factor (SFF) system based on COTS 3U VPX modules.

The first slot supports the XPedite7670 Intel® Xeon® D processor-based 3U VPX SBC. The second slot supports the XChange3013 3U VPX Gigabit Ethernet switch, which can be configured as a fully managed Layer 2 switch or Layer 3 router. The XChange3013 delivers full wire-speed across all of its ports and supports jumbo packets up to 12 kB. The XPedite5205 Cisco IOS® Router XMC can be installed on the XChange3013 to provide highly secure data, voice, and video communications to stationary and mobile network nodes.

The XPand6212 supports the rear I/O from the installed VPX modules with two 130-pin circular connectors. This fully ruggedized system is designed to meet the rigorous standards of MIL-STD-810 and DO-160, while integrating the latest power-saving and performance-enhancing technology.

Learn more: www.xes-inc.com/products/rugged-systems/xpand6212/

FEATURES

- Includes one XPedite7670 Intel® Xeon® D-1500 family based 3U VPX SBC
- Includes one XChange3013 Gigabit Ethernet switch with Layer 2/3 management
- Includes one XPedite5205 Cisco IOS® Gigabit Ethernet Embedded Services Router
- XPedite5205 is NIST FIPS 140-2 Overall Level 1 validated on certificate #2242 and NIAP Common Criteria Certified
- 11 10/100/1000BASE-T Gigabit Ethernet switch ports
- Three 10/100/1000BASE-T Gigabit Ethernet router ports
- Two 10/100/1000BASE-T Gigabit Ethernet SBC ports

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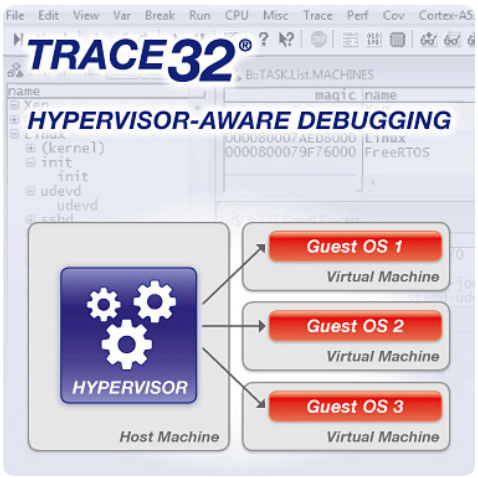
Embedded Software

LAUTERBACH
DEVELOPMENT TOOLS

Hypervisor Debugging with Lauterbach TRACE32 Debugger



Lauterbach provides support for seamless debugging of hypervisor based systems. The introduction of the unique Lauterbach Machine ID allows the debugger to identify any virtual machine in the system. This gives the debugger full visibility of the context of all active and inactive virtual machines and provides a supporting framework to load OS specific awarenesses for each virtual machine.

The most important objective of the TRACE32 hypervisor-awareness is a seamless debugging of the overall system. This means that when the system has stopped at a breakpoint, one can check and change the current state of every single process, all VMs, plus the current state of the hypervisor and of the real hardware platform.

The TRACE32 hypervisor-awareness provides the debugger with all of the hypervisor's information running on the hardware platform. After the OS-awareness is loaded for each guest/VM the debugger can display an overview of the overall system.

TRACE32 assigns each VM a number, the machine ID (mid column). The machine ID is a unique identifier that is used by TRACE32 and appears as an address extension; a concept already familiar to TRACE32 users.

The Global Task List represents the heart of the TRACE32 hypervisor-aware debugging. It lists all tasks/processes/threads of the guest OSes and the hypervisor. TRACE32 can visualize the context of any task in its GUI. Just double-click to on the task name.

The TRACE32 CORE List window displays in detail what is currently running on the individual cores of an SMP system.

The TRACE32 GUI visualizes the context of the current core/task by a double-click on the task name in the TRACE32 Global Task List.

TRACE32 allows the visualisation of any task, even if its VM is currently not active.

Since Lauterbach has systematically extended the well known concepts for OS-aware debugging to hypervisor debugging, it will be easy for TRACE32 users to get started with just a little practice.

FEATURES

- Seamless debugging of the total system in stop-mode
- Hypervisor-awareness as a loadable debug extension is provided by Lauterbach
- Machine ID allows the user to uniquely identify any virtual machine in the system
- Machine ID provides full visibility of context of active and inactive virtual machines
- OS-awareness can be loaded for each virtual machine

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LAUTERBACH
DEVELOPMENT TOOLS

Lauterbach Debugger for Intel x86/x64 Skylake/Kabylake

Lauterbach TRACE32 Debugger for Intel x86/x64:

In January of this year, Lauterbach introduced the new CombiProbe Whisker MIPI60-Cv2. The TRACE32

CombiProbe and TRACE32 QuadProbe now offer the same debug features for the Converged Intel® MIPI60 connector:

- *Standard JTAG, Intel® debug hooks with Pmode, and I2C bus*
- *Merged debug ports (two JTAG chains)*
- *Intel® Survivability features (threshold, slew rate, ...)*

However, these debug tools have different areas of application. The TRACE32 QuadProbe, which is expressly designed for server processors, is a dedicated debug tool that enables SMP debugging of hundreds of threads on targets with up to four debug connectors.

The TRACE32 CombiProbe with the MIPI60-Cv2 Whisker, designed for client as well as mobile device processors, can capture and evaluate system trace data in addition to its enhanced debugging features.

Trace capabilities include support of one 4-bit and one 8-bit trace port with nominal bandwidth.

The TRACE32 CombiProbe with the DCI OOB Whisker is specially designed for debugging and tracing of form factor devices without debug connectors. If the chip contains a DCI Manager, the target and the debugger can exchange debug and trace messages directly via the USB3 interface. The DCI protocol used to exchange messages supports standard JTAG and Intel® debug hooks as well as trace messages for recording system trace information.

FEATURES

- CombiProbe MIPI60-Cv2 provides debug and system trace capability
- Support for standard JTAG, debug HOOKs and I2C bus
- Support for merged debug ports (two JTAG chains per debug connector)
- Support for survivability features (threshold, slew rate, etc.)
- Support for system trace port with up to 8 trace data channels
- 128 MByte of trace memory
- SMP debugging (including hyperthreading)
- AMP debugging with other architectures
- BIOS/UEFI debugging with tailor-made GUI for all UEFI phases
- Linux- and Windows-aware debugging
- Hypervisor debugging

LEADING through Technology

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www.lauterbach.com/pro/pro_core_alt1.php?chip=COREI7-7THGEN

LAUTERBACH DEVELOPMENT TOOLS

TRACE32 Integration for Wind River Workbench

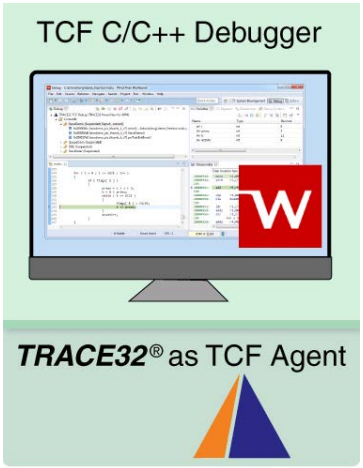
The Lauterbach TRACE32 Debugger now also operates as a TCF agent. This makes it possible to use the Wind River Workbench or the Eclipse debugger as an IDE and a TRACE32 debugger as a debugging back-end tool.

The Target Communication Framework (TCF) was developed by the Eclipse Foundation as a protocol framework with the goal of defining a uniform debugging communication protocol between an IDE and a target system.

TCF defines a series of standard services. At the same time, the framework is open for the definition of proprietary services.

After the TRACE32 software is started as a TCF agent, it provides its services to the Wind River Workbench or the Eclipse debugger via TCP/IP.

Using its TCF services, the TRACE32 debugger can now provide an open communication interface for debugging with Eclipse or the WindRiver Workbench for all processor architectures and compilers supported by TRACE32.



FEATURES

- TRACE32 operates as TCF agent
- Support for various launch mechanisms
- Support for all debug relevant TCF services
- Synchronized debugging between TRACE32 and TCF C/C++ Debugger in Wind River Workbenchd
- Support for multiple projects (multicore)
- Applicable for all processor architectures supported by TRACE32
- Based on Target Communication Framework (TCF)

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SIBORG SYSTEMS INC

LCR-Reader-MP

LCR-Reader-MP (Multipurpose) offers users unprecedented number of features, a record high 0.1% basic accuracy/measurement range and up to 100 kHz test frequency. It is the latest model in the LCR-Reader digital multimeter family.

The device can measure inductance in nH and capacitance in pF range. High test signal frequency furnishes a very high resolution of 0.001 pF and 0.1 nH. LCR-Reader-MP also provides the highest available measurement ranges: 5 mΩ to 20 MΩ, 1 pF to 680 mF, and 5 nH to 100 H. It measures AC/DC Voltage and Current and can be used as a low frequency Oscilloscope to display waveforms at different nodes on an active circuit board. In addition to all that, it can measure frequency, pulse duration, duty cycle and count pulses. Besides it can be used as a Signal Generator up to 400 KHz with sine, rectangle and triangular waveforms. The set includes a shielded two-wire probe connector allowing to use LCR-Reader-MP as a low frequency Kelvin probe station for active board debugging. Finally, it can test Diode/LED and continuity.

A budget model the LCR-Reader LCR-R1 with a reduced functionality is also available.

All devices are supplied with a NIST traceable Calibration Certificate.

FEATURES

- Automatic L-C-R, ESR and Diode/LED measurement, Continuity test
- Basic accuracy 0.1%
- AC/DC Voltage/Current measurement
- Oscilloscope Voltage waveform display for up to 100 kHz
- Measurement of Frequency, Pulse period, Duty Cycle up to 400 kHz
- Signal Generator: Sine, Rectangle, Triangle up to 100 kHz

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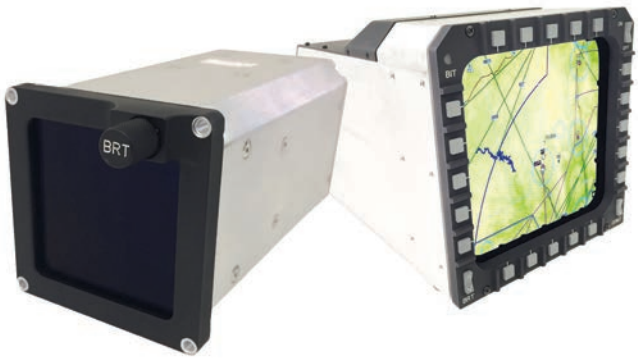
The Enhanced Display Experts

Avionics Display Replacements

The square aspect ratio family of displays from IEE are available for direct Cathode Ray Tube (CRT) and instrument replacement. Available in a wide range of sizes, video interface options and custom integrated switch bezels. These displays offer lifecycle and SWaP-C advantages over legacy CRT.

Video/Graphics Interface Options:

- *Stroke/Raster* ▪ *Composite (RS-170/343 NTSC, PAL)*
- *Analog RGB, VGA* ▪ *DVI, SMPTE-292 (HD-SDI)*
- *ARINC- 818* ▪ *ARINC- 661*



3 ATI

The display features a System on Module (SOM) with a microprocessor, Digital Signal Processor, and Graphics Accelerator, that together offer high levels of computing and advanced video performance. Many I/O configurations are available, including Ethernet, S-Video, RS-232/422, 1553, ARINC 429 and ARINC 818. The display luminance is controlled by a front panel rotary encoder under firmware control. Also available in 5 ATI and 6 ATI.

Product Features and Specifications:

- *Active display area: 2.41" x 2.41": 3.4" diagonal* ▪ *24-bit color*
- *300 x 300 pixel resolution, RGB vertical stripe arrangement*
- *Backlit LED* ▪ *Adjustable brightness control, day/night mode*
- *RS-422 serial interface; other interfaces available*
- *Processor: DM370 System on Module (SOM) with:*
  - *ARM® Cortex® -A8 at 800 MHz, 256/512 or 512/512 MB DRAM/Flash*
  - *TMS320C64x+™ DSP core at 800 MHz*
  - *POWER SGX™ graphics accelerator*
- *NVIS compliance: Type I & II, Class B Night Vision Goggles (NVG) per MIL-STD 3009 for a multi-colored display*
- *Viewing angle: ±65 H; -10/+30 V*
- *Optional video interfaces and integrated switch bezels*

6x6 Airborne Multi-Function Display (MFD)

The MFD accepts one NTSC video source multiplexed with a stroke signal to display both raster and vector images individually or simultaneously. The embedded micro-controller and FPGA convert and process the video for smooth and clear presentation in monochrome green or full color. Operator controls feature 20 bezel mounted variable function pushbuttons and three fixed function rocker switches.

This versatile display also features a full-featured RS232 control/status interface and can be upgraded for a variety of digital video inputs.

6x6 MFD Product Features and Specifications:

- *6"x6" 24-bit color AMLCD – selectable as monochrome Green on Black or full color*
- *983 x 983 pixel resolution*
- *High-bright sunlight readability (HACR ≥ 9.5:1) and NVIS backlight*
- *Integral heater and anti-reflective coating*
- *Brightness 315 fL (Green)*
- *Rugged construction for military fixed and rotary wing aircraft*
- *Video Interface: Stroke/Raster (525 or 875 line) standard*
- *Optional Video Interfaces: DVI, HD-SDI, ARINC-818*

12.1" Rugged Smart Display for Ground Vehicles

This Control and Display Unit (CDU) combines the flexibility of networked infrastructure and time critical video processing necessary for the next generation of ground vehicle and airborne architectures.

Low latency video processing from one of any seven inputs minimizes processing time in critical applications such as targeting or driver's vision enhancements. The CDU's Gigabit Ethernet connections allow for networked distribution of digital video information and data among displays and LRU's.

COTS and open architecture allow for selective configuration to meet the I/O and processing requirements for specific applications.

Adjustable brightness allows operation from night vision to direct sunlight; and an environmentally sealed enclosure ensures functionality in high humidity, rainy, sandy and dusty conditions. This rugged display is ideal for light armored vehicles and airborne displays (rotary or fixed wing).

FEATURES

- Intel® x86 dual-core E3825 processor
- Display Size: 12.1-inch TFT AMLCD
- Viewing angle: Horizontal: ±80°, Vertical: ±70°
- Resolution: XGA 1024 x 768 (4:3) 8-bit color display
- Brightness: 850 cd/m2 ▪ Contrast ratio: 700:1 typical
- Power consumption: 19 W typical, 23 W maximum at 24Vdc
- Operating temperature: -20°C to +60°C
- Video interfaces: (1) Analog RGB; (2) Composite; (2) FLIR; (3) S-Video
- Communication interfaces: 10/100/1000 Base T Ethernet, USB 2.0, RS-232, CAN Bus
- Armored 5-wire resistive touch-screen
- MIL-STD-810; MIL-STD-461; MIL-STD-1275, MIL-STD-704
- 32 perimeter bezel keys (optional)

Made in the USA

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www.ieeinc.com
rfq@ieeinc.com
1-800-275-1698

Rochester Electronics®

The Semiconductor Lifecycle Solution™

About Rochester Electronics

Rochester Electronics is the world's largest continuing source of semiconductors – 100% authorized and licensed by over 70 leading semiconductor manufacturers. Rochester manufactures and distributes EOL and active products for the industrial, transportation, military, medical, energy, civil aviation, automotive, and telecommunication markets. Rochester services Distributors, Original Equipment Manufacturers (OEM), Contract Manufacturers (CM) and Original Component Manufacturers (OCM). Rochester offers authorized semiconductor product replication/re-creation services – form, fit and functional drop in replacement with 100% software compatibility, no errata. With the capability to manufacture over 70,000 device types and 15 billion units in stock, Rochester is the **Semiconductor Lifecycle Solution™**, no other company compares to the breadth of Rochester's product selection, value-added services and manufacturing solutions.

Our Services

Rochester Electronics provides an extensive range of value added services through authorized distribution, licensed manufacturing and logistics. Our capabilities provide quick-turn delivery for our manufactured products and contracted assembly services. Our proven test protocol ensures the highest test quality with accuracy guaranteed; offering a wide variety of capabilities across multiple test platforms.

Our Solution

Rochester Electronics growing product and service portfolio continues to provide an authorized source of supply directly to customers around the world via our global sales offices, and our authorized distribution network. We thank our Suppliers, Customers, Distribution Channel Partners and valued global employees for enabling us to provide **The Semiconductor Lifecycle Solution™**.

Please visit **www.rocelec.com** to learn more about our comprehensive inventory and solutions.

FEATURES

- 100% Authorized and Guaranteed.
- Licensed by over 70 leading manufacturers.
- Capability to manufacture over 70,000 device types.
- Over 15 billion units in stock.

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www.linkedin.com/company/rochester-electronics/

ellisys
Better Analysis

Ellisys Bluetooth® Tracker™

Ultra-Portable BLE and Wi-Fi Protocol Analyzer

The pocket-sized (7.5 x 7.5 x 1.7 cm), bus-powered **Bluetooth Tracker** supports concurrent capture and analysis of Bluetooth Low Energy and Wi-Fi communications, as well as a wide variety of wired interfaces, including logic signals, host controller interface (HCI) protocols (UART and SPI), Audio I2S, and WCI-2, all visualized over the widely adopted Ellisys software suite.

With its innovative reconfigurable radio, the Ellisys sniffer can be updated by software to support changes in the specification, without any change to the hardware, and even without any interaction from the user. The Tracker comes with free lifetime software updates, so all customers can benefit from these great additions free-of-charge!

The Ellisys Bluetooth Tracker sniffer supports one-click concurrent capture of Bluetooth Low Energy, Wi-Fi 1x1 802.11 a/b/g/n, 2.4 GHz Spectrum, UART HCI and SPI HCI (2 ports), logic signals, and Wireless Coexistence Interface 2 (WCI-2).

FEATURES

- **All-in-One:** Concurrent capture of Bluetooth Low Energy, Wi-Fi 1x1, raw spectrum, HCI and logic, all synchronized to sub-microsecond precision
- **Wideband Capture:** Rock-solid capture of all Bluetooth Low Energy channels
- **Reprogrammable Digital Radio:** Support for new specifications with a simple software update, without hardware changes
- **Wi-Fi:** Debug your Wi-Fi a/b/g/n and BLE connections simultaneously, as well as coexistence
- **Raw 2.4 GHz Spectrum Capture:** Characterize the wireless environment and visualize interferences
- **Professional Software:** Use the acclaimed, widely adopted and highly flexible Ellisys multi-protocol analysis software
- **Logic Analysis:** Visualize digital signals such as GPIOs, interrupts, debug ports, etc. Concurrently and perfectly synchronized with your BLE and Wi-Fi traffic.

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Test

ellisys
Better Analysis

Ellisys Bluetooth® Vanguard™

Advanced Wireless Protocol Analysis System

The most advanced, most comprehensive Bluetooth protocol analyzer ever made. Building on a legacy of innovation, the **Bluetooth Vanguard** All-In-One Wireless Protocol Analysis System delivers new advances designed to ease the increasingly complex tasks of Bluetooth developers.

With its revolutionary wideband Digital Radio and integrated All-in-One hardware approach, Ellisys has changed the way Bluetooth protocol capture and analysis is done, by radically overcoming the drawbacks of legacy approaches. The Ellisys whole-band capture approach robustly records any packet, at any time, from any neighboring piconet, with zero-configuration and without being intrusive.

Vanguard provides synchronized capture and analysis of BR/EDR, Bluetooth Low Energy, Wi-Fi 802.11 a/b/g/n/ac (3x3), WPAN 802.15.4 (all 16 2.4 GHz channels), raw 2.4 GHz RF spectrum analysis, HCI (USB, UART, SPI), generic SPI/UART/I2C/SWD communications, WCI-2, logic signals, and Audio I2S.

FEATURES

- **All-in-One:** Fully hardware-integrated, time-synchronized, and truly one-click concurrent capture of BR/EDR, Bluetooth Low Energy, Wi-Fi, WPAN (IEEE 802.15.4), raw RF spectrum, HCI, logic/GPIO, generic I2C, UART, SWD, and SPI, Audio I2S, and WCI-2
- **Bluetooth Wideband Capture:** Easy and rock-solid capture of any traffic on all channels
- **Wi-Fi 802.11 a/b/g/n/ac (3x3) Capture:** Extremely accurate and perfectly synchronized Wi-Fi capture accelerated by Ellisys hardware
- **WPAN 802.15.4 Wideband Capture:** Concurrent capture of all 16 WPAN 2.4 GHz channels for an unmatched coexistence analysis capability
- **Connection / Power Flexibility:** Connect, control, and power the system locally or remotely via networkable GbE or USB 3.1 over Type-C™
- **Mesh Support:** Includes full support for Bluetooth Mesh

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Better Analysis

Ellisys Bluetooth® Explorer™

All-in-One Dual-Mode Bluetooth Protocol Analysis System

Industry's First All-In-One Wideband BR/EDR and Low Energy sniffer with concurrent capture of Wi-Fi 2x2 802.11 a/b/g/n, 2.4 GHz spectrum, HCI (USB, UART, SPI), WCI-2, logic signals, generic I2C/UART/SPI/SWD, and Audio I2S.

With its revolutionary whole-band Digital Radio, the **Bluetooth Explorer** lifts protocol capture and analysis to new heights, radically overcoming the drawbacks of legacy approaches to Bluetooth sniffing. The Ellisys all-in-one whole-band sniffer robustly records any packet, at any time, from any neighboring piconet, with zero-configuration and without being intrusive.

The Bluetooth Vanguard Explorer can uniquely be updated by software to support changes in the specification, without any change to the hardware, and even without any interaction from the user.

FEATURES

- **All-in-One:** Concurrent capture of BR/EDR, Low Energy, Wi-Fi, spectrum, HCI, logic, UART, SPI, I2C, SWD, Audio I2S, and WCI-2, all synchronized to nanoseconds precision
- **Bluetooth Wideband Capture:** Easy and rock-solid capture of any traffic, including discovery/connection traffic and SSP pairing
- **Reprogrammable Digital Radio:** Support for new specifications without hardware changes
- **Multi-Piconet Support:** See multiple piconets and scatternets, without limitations
- **All Protocols and Profiles:** Best-of-breed protocol decoding
- **Integrated Audio Analysis:** Listen to captured audio over-the-air, including HCI audio and I2S, within the software
- **Spectrum Display:** Characterize the wireless environment and visualize coexistence issues

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Dawn VME Products®

PSC-6238

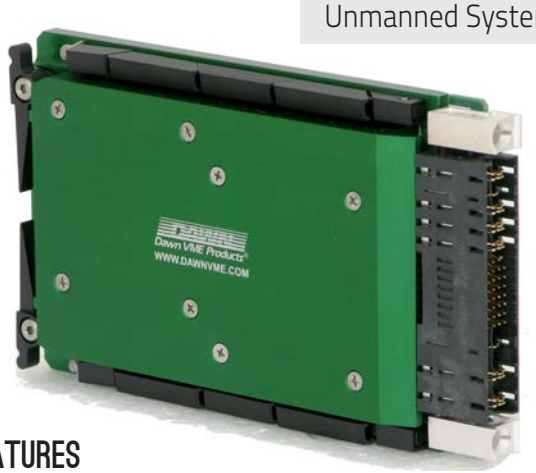
800 Watt 3U OpenVPX Conduction Cooled Power Supply

The **PSC-6238** is designed to operate in a military environment over a wide range of temperatures at high power levels, is extended shock and vibration compliant per MIL-STD-810F and features an onboard real-time clock with switchable Battleshort and NED (Nuclear Event Detect) functions.

Dawn's PSC-6238 is a wedge lock conduction cooled module on a 1 inch pitch with an operating temperature of -40°C to +85°C at the wedge lock edge. The up to 800 Watt power output true 6-channel supply provides full Open VPX support and is current/load share compatible with up to 4 PSC-6238 units.

The PSC-6238 front I/O panel includes a 3-color LED status indicator, VBAT battery access and a USB port for status display, access menu control and firmware upgrade.

Dawn's embedded RuSH™ Rugged System Health Monitor technology provides for intelligent monitoring and control of critical system performance parameters including voltage, current, temperature and control of power sequencing and shutdown of all voltage rails.



FEATURES

- True 6 Channel supply provides full OpenVPX support
- Wedge lock conduction cooled module
- Up to 800 Watts power output with 1 inch pitch form factor
- Onboard embedded RuSH™ technology actively monitors voltage, current, temperature and provides protective control
- Factory programmable power sequencing of all voltage rails
- Shutdown control for each power rail
- Over Voltage, Over Current and Over Temp protection

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Coverage areas include the latest, most innovative products and technology shifts that drive today's military embedded applications, such as SDR, avionics, AI, radar, cybersecurity, C4ISR, standards, and more. Each issue provides readers with the information they need to stay up to date on the embedded technology used by the military and aerospace industries and the newest, most exciting technologies in the pipeline.

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Blockchain for embedded systems (PART 2)

By Russ Doty, Red Hat

BLOG

Part 1 of this blog on blockchain for embedded systems (see July/August 2018 issue) explored one way of using blockchain technology for sensor data, especially where the integrity and provenance of the data must be verified. Blockchain is also useful for the other part of embedded systems: command and control.

In many cases, the "control" part of an embedded system is a series of commands to directly attached actuators. Some of these systems, such as flight controls, may be performance-sensitive – actually, latency-sensitive. Other cases, such as something like setting the chemical injection rate for groundwater remediation, might be changed on an hourly or daily basis. A common requirement for a controller is to be able to verify and validate commands as well as maintain a verifiable history of commands.

Consider the case of an autonomous drone. Critical commands issued to the drone would include a destination and whether or not to release a payload when it reaches the destination. The payload could be instrumentation or other high value items.

To make sure the drone is on a valid mission, there should be multiple authorizations. Parties authorizing a mission might include a science group, a funding or governance group, and an operations group. In a situation like this, there would be a system where all three of these groups have to approve and authorize a location before the drone accepts it. The system would need to be fake-proof or spoof-proof and ideally maintain a secure history of all commands.

Blockchain can provide this reassurance through validation, including validation servers and validation policies. Validation servers work by cryptographically signing a proposed transaction. In the autonomous drone example, a command to send a drone on a specific mission would be considered a transaction.

The simplest case is a single validation server that signs every transaction. Validation policies can create more complex authorizations, as in the example that would call for three validation servers with each server signing (approving) the transaction before it is valid. More complex situations are also possible: For example, a resilient system might have 20 validation servers and require signing by a majority (11 servers) or in a different case the same 20 validation servers require signing only by five for a valid transaction. A different system could have one primary validation server that must sign, plus any two out of five secondary servers signing.

A validation policy called Byzantine Fault Tolerance works even in the presence of failure of validation servers and the presence of compromised or hostile validation servers. Compromising a system using Byzantine Fault Tolerance requires compromising more than half of the validation servers, making this approach robust even in the presence of failure and hostile compromise of systems. The details of Byzantine Fault Tolerance are a bit too arcane to discuss here, but it is nonetheless an example of the power and flexibility of blockchain.

Validation servers work by cryptographically signing a transaction. This is done using a private-key/public-key pair, one that is different on each validation server. This crypto signing can be done in software, taking advantage of the performance of the host system. It can also be done using a Hardware Security Module (HSM), a specially hardened module that is dedicated to the security operations. An HSM can be a high-performance/high-cost module or a lower-performance/lower-cost unit such as a Trusted Platform Module (TPM) or even a smart card.

When using software signing, the private key is present on the system and can be compromised. Using an HSM, the private key is contained inside the hardware module and can't be compromised. (While this statement isn't completely true, modern HSMs are considered secure against anything short of a state-level actor.)

The beauty of blockchain in the drone example is that the drone verifies the validity of the commands it receives, verifies that the commands have been issued and validated by approved authorities, and confirm that they have been received in the proper order. These steps avoid the risks associated with modifying the commands in transit or even having the commands changed by the person entering them into the drone. In addition to the drone, everyone else in the blockchain ecosystem can verify the sequence of commands and who authorized and approved them.

Note that the actual command content need not be visible to everyone. The blockchain payload can be encrypted so that only authorized entities can actually read the contents. This action produces a very robust system where everyone can verify the sequence and authority of all commands, but only the entities needing to implement a specific command can determine what that command is.

One major concern about command and control systems is the ability to function in the presence of disrupted and degraded communications systems. A key strength of blockchain is that it is extremely tolerant of retransmission: A user can send (and receive) a block a thousand times and end up with a single command or transaction, not a thousand of them. There can be multiple partial transmissions of a block that then get reconstructed into a single verifiable block; blocks can come in out of order, as the blockchain enables the blocks to get assembled in the proper order no matter what order you receive them in.

This combination of properties makes blockchain a powerful tool for building robust, secure, high-trust systems. In addition to supporting low-performance applications, like the drone target destination in the previous example, blockchain can also support high-performance applications. The key to all of this? Enough computing power, ample network bandwidth, and sufficiently low latency to support the required performance.

Is blockchain the perfect technology for building invulnerable systems? Yes and no … If you follow the media, you know that cryptocurrency systems using blockchain are regularly compromised. If you dig into the failures, however, you discover that these failures are due to human error and faulty implementation. The actual blockchain algorithms and protocols are surprisingly robust. This is much like other applications of crypto: The algorithms are robust, but the people, software, and systems using them aren't necessarily robust.

These examples show how blockchain technology can be used to build more robust and secure distributed systems, including those that deliver a verifiable history of changes. Cryptography is a powerful tool with many real-world applications.

CHARITY

Operation Gratitude

Each issue in this section, the editorial staff of Military Embedded Systems will highlight a different charity that benefits military veterans and their families. We are honored to cover the technology that protects those who protect us every day. To back that up, our parent company – OpenSystems Media – will make a donation to every charity we showcase on this page.

This issue we are highlighting Operation Gratitude, a not-for-profit 501(c)(3) charitable organization that serves the U.S. military and first responder communities. Each year, the organization's volunteers send more than 300,000 individually addressed care packages to soldiers, sailors, airmen, Marines, and Coast Guard personnel deployed overseas; to their families and children at home; and to first responders, new recruits, veterans, wounded heroes, and military family caregivers stateside. Each volunteer-assembled package – holding donated products valued between $45 and $100 – contains snacks, hygiene products, entertainment, and handmade items, as well as personal letters of support.

Founder Carolyn Blashek started the charity in 2003 after a stint volunteering for a military organization drove home the point that many deployed service members needed to know that people back home were thinking of them. She also wanted to bridge the military/civilian gap and enable regular citizens to express their thanks to troops and first responders by giving their time to assemble and send care packages.

To meet the changing needs of its target population, since its inception Operation Gratitude has launched multifaceted programs including Battalion Buddies, which sends stuffed toys to the children of deployed troops; Wounded Warrior and Veteran Care Package programs; food and necessities through Military Family Packages for those facing hardship in difficult economic times; and First Responder Program disaster-relief packages for those who volunteer during disasters.

For more information on Operation Gratitude, please visit www.operationgratitude.com.

E-CAST

Affordable safety-critical systems: the basics

By Wind River Systems

As avionics suppliers' R&D budgets are reduced, the keys to greater affordability are greater flexibility and code reuse through common building blocks across the enterprise. In these situations, software components must be modular, upgradeable, and customizable to meet the needs of various hardware platforms.

In this webcast, get some guidance on the issues that must be addressed in order to achieve affordability targets and program profitability, learn how to optimize corporate investment by creating and developing standardized software products that can be reused on multiple platforms and customer environments, and discuss how to achieve long-term profitability by consolidating different platforms and understanding certification requirements. In addition, participants will learn how to enhance innovation by using technologies with high Technology Readiness Levels (TRLs).

View archived e-cast: ecast.opensystemsmedia.com/806

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WHITE PAPER

Evaluating connectors for Gigabit and 10 Gigabit Ethernet in military and aerospace applications

By Robert Moore, TE Connectivity

As applications move to high-speed Gigabit and 10 G Ethernet, designers need to carefully evaluate the link. How far, how fast, and how many disconnects in the link? What is the possibility of a disconnect being added, either late in the design cycle or in an upgrade?

Purpose-built connectors have a strong tradition of filling special needs, even if the special need is as commonplace as high-speed Ethernet. In many cases, purpose-built connectors like the CeeLok FAS-T are a combination of successful commercial technologies and rugged packaging. Sometimes it's not a case of reinventing the wheel as much as it is ruggedizing the wheel for harsh technologies.

Read the white paper: https://bit.ly/2KBuCmR

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