JUNE 2020

Military & Aerospace Electronics

RELEVANT. TRUSTED. ENABLING TECHNOLOGIES.

Electronics thermal management

Army wants electronics cooling for future avionics, electronic warfare pods, and laser weapons. PAGE 4

Radiation-hardened electronics

Commercially developed communications and remote-sensing satellites seeks to balance costs, capability, size, weight, and power consumption. PAGE 18

militaryaerospace.com

Military 3D printing

Additive manufacturing helps get replacement parts where and when they're needed. PAGE 8

ENDEAVOR BUSINESS MEDIA

Breakthrough Performance...

Weight No More!

Wideband RF Signal Recorders | Rugged ½ ATR | Built for SWaP

Designed for harsh environments and weighing only 18 pounds, the new Talon RTX SFF series captures real-time RF bandwidths of a gigahertz or more. Complete with a removable QuickPac™ drive pack holding terabytes of data, these units offer flexible I/O options and sustained real-time recording rates up to 4 GB/sec!

The RTX SFF series is the latest in our COTS Talon recording systems that deliver the industry's highest levels of performance in the harshest, space-constrained environments. You'll get high dynamic range, exceptional recording speeds and ample storage capacity for extended missions—all in this compact solution.

- **Sealed, rugged, ½ ATR chassis** for MIL-STD 810 and 461
- **Multi-channel recording,** A/Ds from 200 MS/s to 6.4 GS/s
- **Easily removable 61 TB SSD QuickPac** drive pack
- **Ideal for UAVs, military vehicles, aircraft pods** and more
- **Operating temperature** from -40°C to +60°C
- **sFPDP and Ethernet** models available

All this plus FREE lifetime applications support!

Model RTX 2589 with removable QuickPac drive

Download the FREE Development Tactics & Techniques for SFF Recorders White Paper

www.pentek.com/go/masff

PENTEK
Setting the Standard for Digital Signal Processing

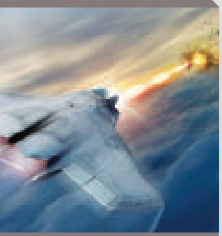
Pentek, Inc., One Park Way, Upper Saddle River, NJ 07458
Phone: 201-818-5900 • Fax: 201-818-5904 • email: info@pentek.com • **www.pentek.com**

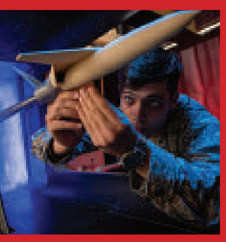
Worldwide Distribution & Support, Copyright © 2019 Pentek, Inc. Pentek, Talon and QuickPac are trademarks of Pentek, Inc. Other trademarks are properties of their respective owners.

Military & Aerospace Electronics

JUNE 2020

VOL. 31, NO. 6





COVER STORY

FOLLOW US

FACEBOOK.com /MilitaryAerospaceElectronics

TWITTER @MilAero

LINKEDIN.com /showcase/military-&-aerospace-electronics

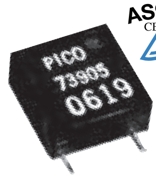
Military & Aerospace Electronics® (ISSN 1046-9079, print; 2688-366X, digital / USPS 005-901) is published 12 times a year by Endeavor Business Media, LLC, 1233 Janesville Avenue, Fort Atkinson WI 53538. Periodicals postage paid at Fort Atkinson, WI 53538 and at additional mailing offices. SUBSCRIPTION PRICES: USA $185 1yr., $327 2 yr., $466 3 yr.; Canada $280 1 yr., $479 2 yr., $618 3 yr.; International $335 1 yr., $638 2 yr., $834 3 yr. POSTMASTER: Send address corrections to Military & Aerospace Electronics, P.O. Box 3257, Northbrook, IL 60065-3257. Military & Aerospace Electronics is a registered trademark.

© Endeavor Business Media, LLC 2020. All rights reserved. Reproduction in whole or in part without permission is prohibited. We make portions of our subscriber list available to carefully screened companies that offer products and services that may be important for your work. If you do not want to receive those offers and/or information via direct mail, please let us know by contacting us at List Services Military & Aerospace Electronics, 61 Spit Brook Rd., Suite 501, Nashua, NH 03060. Printed in the USA. GST No. 126813153. Publications Mail Agreement no. 875376.

PICO

Transformers and Inductors

...think PICO small!



AS9100D CERTIFIED TUV

think... low profile from .18" ht.

Over 5000 Std. Ultra Miniature

Surface Mount (and Plug-In) Models

Audio / 400Hz / Pulse Multiplex Data Bus / DC-DC Converter Transformers / Power & EMI Inductors

See Pico's full Catalog immediately www.picoelectronics.com

PICO units manufactured and tested to MIL-PRF-27 requirements. QPL units are available. Delivery stock to one week for sample quantities.

VISIT OUR EXCITING NEW WEBSITE www.picoelectronics.com

Featuring our easy-to-use product Search Wizard!

PICO Electronics Inc.

143 Sparks Ave, Pelham, NY 10803

Call Toll Free: 800-431-1064

E Mail: Info@picoelectronics.com

FAX: 914-738-8225

VISA MasterCard AMERICAN EXPRESS

MILITARY•COTS•INDUSTRIAL TRANSFORMERS & INDUCTORS

BY **JOHN KELLER**, EDITOR IN CHIEF

The FFG(X) frigate will be right-sized and -armed for the crucial open-ocean escort role

THE MIL & AERO COMMENTARY U.S. Navy surface warfare experts took a big step in the right direction in April, as they followed through with a plan to develop a heavily armed blue-water surface warship purpose-built to escort carrier battle groups and high-value convoys.

The Naval Sea Systems Command in Washington announced a $795.1 million contract to Marinette Marine Corp. in Marinette, Wis., to design and build the FFG(X) class of multimission guided-missile frigates.

This new frigates will replace the Navy's Oliver Hazard Perry-class frigates — the last of which were retired in 2015 — and an abandoned plan to adapt the Navy's littoral combat ship (LCS) to the frigate's mission.

The yet-unnamed FFG(X) frigate will have the speed, range, endurance, and armament necessary for open-ocean escort duty and independent operations. It will be sized to fit into the naval surface fleet between the larger Arleigh Burke-class destroyers (DDG 51), and the two smaller varieties of littoral combat ship.

Retirement of the last Perry-class frigates five years ago left a big hole in the Navy's ability to shield valuable surface warships and cargo vessels.

The Perry frigateswere general-purpose escort vessels to protect amphibious landing forces, supply and replenishment groups, and merchant convoys from aircraft and submarines. The Navy built 55 of these ships, which also had the arms and equipment to operate independently.

The Perry-class warship was 445 feet long, 45 feet wide, displaced 4,100 long tons, could steam faster than 29 knots, and had a range of 4,500 nautical miles. The ship had anti-aircraft, anti-surface, and anti-submarine capabilities that included 40 missiles in above-deck launchers, as well as anti-submarine torpedoes.

Navy leaders planned to replace the Perry frigates with blue-water adaptations of the littoral combat ship. This vessel, with a top speed of 47 knots, was to be much faster than the older frigates, but is much smaller and relatively lightly armed.

The LCS, which comes in two variants, is 378 feet long, 57.4 feet wide, displaces 3,900 shorts, can steam as fast as 47 knots, and has a range of 3,500 nautical miles. It has different mission modules for anti-ship and anti-submarine warfare; mine countermeasures; and irregular and amphibious warfare.

The LCS is effective at what it was designed to do: operate near coastlines and harbors in a wide variety of flexible missions, but is lacking when it comes to the kind of open-ocean escort duty that frigates are intended for.

This raises the question: if the LCS isn't up to the job of escorting valuable ships, then why not press the Navy's blue-water-capable and plentiful Arleigh Burke-class destroyer into that role? The answer: the Burke-class destroyers are too expensive and over-qualified for escort duty. Plus, the Burke destroyers are filling the new role of global anti-ballistic-missile defense.

The Burke destroyers are 509 feet long, 66 feet wide, displace 9500 tons, can steam faster than 30 knots, and have a range of 4,4000 nautical miles. These ships also have the Aegis combat system for networked anti-aircraft warfare.

These ships are heavily armed, with room for 96 missiles in the Vertical Launch System (VLS), which include the BGM-109 Tomahawk land-attack missile; RIM-66M Standard anti-aircraft missile; RIM-161 Standard ballistic missile defense missile; Mk 141 Harpoon missile. The Burke destroyers also have 5-inch guns, 25-millimeter cannons; and anti-submarine torpedoes.

The FFG(X) will have space for 32 VLS-launch missiles, including the RIM-162 Evolved Sea Sparrow and RIM-174 extended-range Standard missiles; canister-launched over-the-horizon anti-ship weapons; RIM-116 Rolling Airframe Missile, deck gun, and machine guns. Plus, the new ship will accommodate one MH-60R Seahawk manned and one MQ-8C Fire Scout unmanned helicopter.

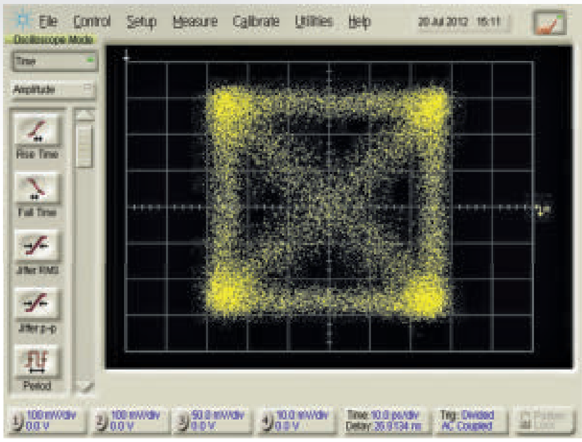
The FFG(X) will be sized, armed, and equipped for the crucial escort role, and will be a worthy replacement for venerable Perry-class frigate. ←

What is Your Constellation?

Configurable Coherent Optical Receiver Lab Buddy

- Dual or Quad Linear Balanced Receivers with Optical Hybrid (Single Polarization/Dual Polarization)
- Automatic (AGC) or Manual Gain Control
- User-adjustable RF Bandwidth for Optimum Signal to Noise Ratio (SNR)
- Plug and Play

- Versatile for your Multiple Coherent Applications : Telcom, Datacom, Spacecom & Avionics Platforms
- Industry Standard Firmware
- Easy to use Graphical User Interface (GUI)
- IoT Compatible



Live 25 Gbaud QPSK Constellation using Coherent Receiver Lab Buddy

Discovery Semiconductors, Inc.®

We Chip the Future®

www.discoverysemi.com

119 Silvia Street, Ewing, NJ 08628 U.S.A.

news

U.S. Aircraft designers are asking industry for electronics thermal management for tough-to-cool systems like avionics, laser weapons, and electronic warfare (EW) pods.

Army wants aircraft thermal management for future avionics and laser weapons

BY **John Keller**

FORT EUSTIS, Va. — U.S. Army aviation experts are reaching out to industry for new approaches to electronics thermal management for tough-to-cool systems like avionics, laser weapons, and electronic warfare (EW) pods.

These new thermal-management approaches should be suitable for future fixed-wing airplanes and helicopters — including the future vertical lift (FVL) aircraft — as well as for potential upgrades to existing airframes.

Officials of the Army Contracting Command Aviation Applied Technology Directorate at Fort Eustis Va., have issued a broad agency announcement (W911W6-20-R-0007) for the $2.6 million Power And Thermal Management - Component Development (PTM-CD) project.

This initiative seeks to develop and demonstrate thermal transport connections for a modular open-systems architecture able to support a digital backbone of upgradable and swappable mission equipment for Army airplanes and helicopters.

This architecture will involve distributed hardware mounts with independent adaptable cooling connections for localized control. Thermal transport connections should provide distributed cooling plate options for electronics equipment like avionics and computer processors.

In addition, these thermal connections should be able to supply direct-line coolant for difficult transient loads like electromechanical actuators, laser diodes, laser weapons, and electronic warfare (EW) jammers.

The goal is to reduce the size, weight, and power (SWaP) consumption of aircraft thermal management systems. Of desire are technology approaches which enable SWaP reductions of aircraft main cooling units and redundant thermal management systems by enabling the aircraft to provide cooling directly.

These systems could include EW pods, high-energy lasers, and air-based heat exchangers. Army officials espe-

Largest Selection of

High Power Amplifiers

Class AB High Power Amplifiers with Available Heatsinks

Pasternack brings you a broad offering of ready-to-ship high power amplifiers covering RF, microwave and mmWave bands:

- Saturated output power up to 200W
- Numerous heatsink options for high reliability
- Feature-rich: Class AB operation, temperature and power monitoring, TTL logic controls
- High efficiency, low distortion
- Latest GaN and GaAs pHEMT semiconductor technology
- Uniquely qualified for military radio, radar and communication systems, and test & measurement

In-Stock and Shipped Same Day

USA & Canada +1 (866) 727-8376
International +1 (949) 261-1920
pasternack.com

PASTERNACK® an INFINITE brand

cially are interested in sub-ambient temperature control to extend electronics life and provide the thermal regulation necessary for increased component performance.

The move to all-electric aircraft in the military by replacing hydraulic systems with electric motors and actuators is one of the biggest reasons for enhance electronics thermal management.

High-pulse-power systems depend not only on large amounts of electrical power to operate, but also on a strong capability to remove heat and move it around.

As more equipment switches to digital control, the aircraft requires more electricity, and different approaches to heat rejection. With the change of airframe materials to low-thermal-conductivity composite, and increased rotorcraft speed goals, mission equipment becomes more challenging to cool.

From industry, the Army wants thermal-control prototypes that could be validated in the laboratory or in simulated operating conditions.

Army officials would like to capitalize on promising prototype technologies for use in future vertical lift helicopters. Promising technologies may be integrated with those of other manufacturers in a systems integration lab. ←

Companies interested were asked to email 45-page technical proposals no later than 29 June 2020 to the Army's Thomas Helms at Thomas.m.helms6.civ@mail.mil, with a copy to Hope McClain at hope.a.mcclain.civ@mail.mil. More information is online at https://beta.sam.gov/opp/b81b8d402a564ba7b72f95ecdbb702f0/view.

Lockheed Martin to build 24 sensor-packed MH-60R ASW helicopters

U.S. Navy anti-submarine warfare (ASW) experts are asking Lockheed Martin Corp. to build 24 MH-60R ASW helicopters — three for the Navy and 21 for India — under terms of a $904.8 million order. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station are asking the Lockheed Martin Rotary and Mission Systems segment in Owego, N.Y., to build the new MH-60R helicopters, one of the latest version of the Sikorsky Seahawk, which is based on the U.S. Army Sikorsky UH-60 Black Hawk utility helicopter. The multimission MH-60R helicopter has sophisticated sensors, and is designed for anti-submarine and anti-surface warfare. The MH-60R is designed to operate from frigates, destroyers, cruisers, and aircraft carriers. It is an airborne multi-mission naval platform. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or Naval Air Systems Command at www.navair.navy.mil.

LCS maker Fincantieri Marinette to build new U.S. Navy frigate

The U.S. Navy has awarded Fincantieri Marinette Marine Corp. in Marinette, Wis., a $795 million contract to design and build a new class of guided-missile frigate known as FFG(X). The company will build as many as 10 new frigate surface warships, with a cumulative contract value of $5.6 billion if all options are exercised. Electronic sys-

tems aboard the new ship will include an Enterprise Air Surveillance Radar, Baseline Ten AEGIS Combat System, a MK 41 Vertical Launch System, communications systems, MK 57 Gun Weapon System countermeasures, and added capability for EW and information warfare area, with design flexibility for future growth. The vessel is expected to operate in the open ocean, as well as in shallow coastal waters and harbors, and handle anti-aircraft, anti-surface, and anti-submarine warfare (ASW). The FFG(X) will be longer, wider, heavier, and have a longer range than the Perry-class frigate.

Boeing to build hardware for high-speed fiber-optic shipboard networking

Military communications experts at the Boeing Co. will build new hardware for high-speed fiber-optic shipboard networking aboard U.S. Navy Arleigh Burke-class guided missile destroyers under terms of an $13.3 million order. Officials of the Naval Sea Systems Command in Washington are asking the Boeing Defense, Space & Security segment in Huntington Beach, Calif., to provide AN/USQ-82(V) hardware new-construction and upgrades for Burke-class destroyers, as well as for related support to Japan and Australia. The AN/USQ-82(V) fiber-optic control systems network transfers mission-critical data to and from users of combat, navigation, aviation, power, propulsion, steering, alarms and indicating, and damage-control systems. The AN/USQ-82(V) family of shipboard networking equipment transfers inputs and outputs for the Burke-class destroyer's machinery control systems, damage-control system, steering control system, Aegis combat system, navigation displays, and interior communications alarms and indicators. For more information contact Boeing Defense, Space & Security online at www.boeing.com, Argon ST at www.argonst.com, or Naval Sea Systems Command at www.navsea.navy.mil.

DARPA asks Stealth Software to help advance trusted computing and cryptography

Trusted-computing experts at Stealth Software Technologies Inc. in Los Angeles are helping U.S. military researchers enhance information security and trusted computing by advancing zero-knowledge proof technology to enable cryptography in complex military applications. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced an $8.5 million contract to Stealth Software for the first phase of a research project under the Securing Information for Encrypted Verification and Evaluation (SIEVE) program. Stealth Software joins Galois Inc. in Portland, Ore., on the SIEVE program. SIEVE will use zero knowledge proofs to verify military capabilities without revealing the sensitive details. The project also will focus on increasing the efficiency of zero knowledge proof technology to enable large, complex proof statements — such as billions of gates or more — where the statement consists of probabilistic and indeterminate-branching conditions. For more information contact Stealth Software Technologies online at www.stealthsoftwareinc.com, or DARPA at www.darpa.mil.

A Navy petty officer desolders a flex print assembly in the avionics shop of the aircraft carrier USS Dwight D. Eisenhower in the Persian Gulf.

The dawn of military 3D printing

Additive manufacturing, also called 3D printing, is having an influence on military logistics, and helps supply personnel get replacement parts where and when they're needed — even on the front lines.

BY **J.R. Wilson**

In some ways reminiscent of Star Trek's replicators, 3D printers seem to create something out of nothing, shaping a powdered construction material into whatever object the user needs. The possible applications keep growing as new materials, beyond plastics, become available for ever-larger 3D printers.

Although the technology is still in its early stages of development as something beyond its early years as a curiosity, it already is being used in aerospace and defense, primarily for prototyping under the term "additive manufacturing," but also for the temporary replacement of non-critical parts as 3D printing. According to GE Additive in Auburn, Ga., those are two of the pioneering sectors for additive manufacturing.

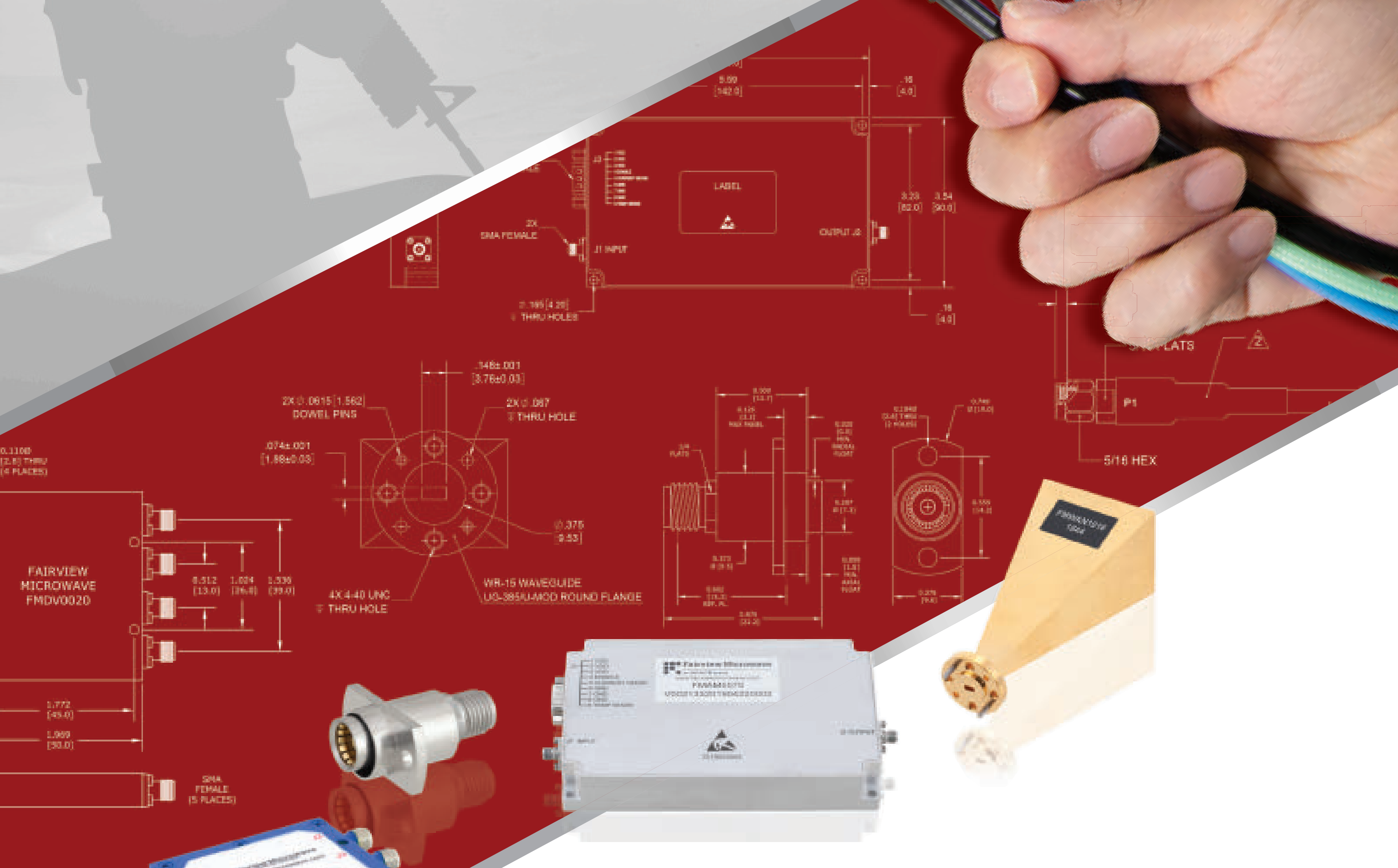
"These sectors are characterized by small batch sizes and manufacturer-specific adaptations. At the same time, these products are renowned for having very long life cycles, and extremely high safety requirements. High levels of thermal or mechanical loading, especially during take-off and landing or if there is air turbulence, are one of the special features of the requirements profiles for most components," according to the company.

When it comes to product longevity, 3D printed components may be used in passenger aircraft for more than 30 years.

In December 2019 the U.S. Air Force, within its Materiel Command's Rapid Sustainment Office at Wright-Patterson Air Force Base, Ohio, set up the first program office for agile manufacturing. The goal was to think about the strategy and overall adaptation of agile manufacturing throughout the Air Force; what are the manufacturing materials, processes and technologies

The Right RF Parts. Right Away.

As a leading provider of RF components to the military and its contractors, we understand that having the correct RF parts in a timely way for Mil/Aero system prototyping, testing, and field deployments can mean the difference between program success and failure. We're certain we've got the parts you need, with more than one million components in-stock and available to ship today.

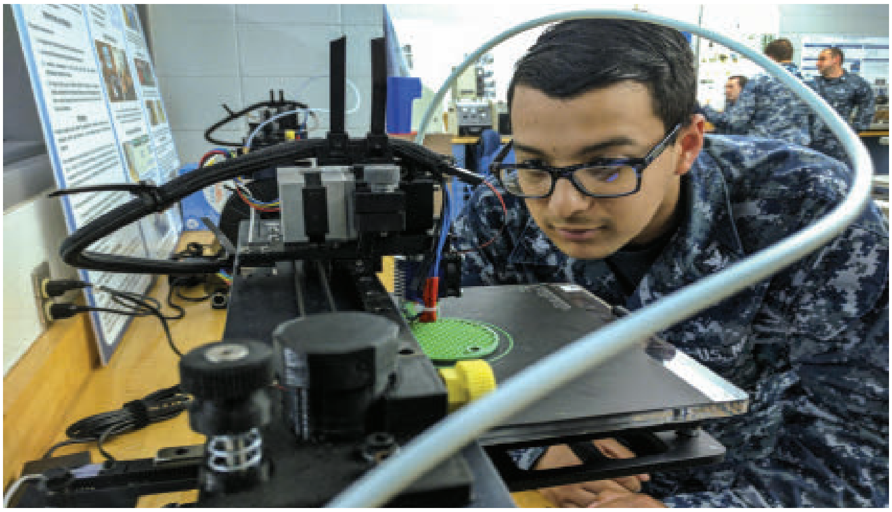


We've Got That!

The Source for Mil/Aero RF Components, Shipped Same Day.

fairviewmicrowave.com
+1-800-715-4396
+1-972-649-6678

Fairview Microwave™
an INFINITe brand



Navy Petty Officer 3rd Class Daniel Pastor examines a 3-D printer during a 3-D design and production course at Old Dominion University in Norfolk, Va., to service members how to design and print objects and parts that can help the fleet.

needed and how to deploy that across the service.

"The real need for us is 50 percent of the Air Force supply chain is provided by a single source or no source at all, so we're looking at additive manufacturing as a way to provide a new source," says Nathan Parker, Deputy Program Executive Officer in the Rapid Sustainment Office. "There are a lot of nodes in the value stream — from reverse engineering to material and machine quality to production and support, all of which we are involved in, to one extent or another."

Use of 3D printed parts is growing, Parker points out. "Looking at how we are doing, two to three years ago there were around 100 printed parts, today there are almost 2,000. Obviously, we want to continue to grow that and apply what we have learned across the enterprise."

Design challenges

Between metal and polymer, the Air Force has more than 130 machines, all in major fixed facilities in the U.S. The service has special needs, however. Some Air Force 3D printing needs only now are beginning to be addressed, some of which remain outside of today's most advanced technologies.

"The state-of-the-art for us is a bit of a challenge," says the Air Force's Parker. "Everything we do requires an air worthiness certificate, so we have to have a level of confidence that the part we print is the part we wanted. So for us, state-of-the-art is really about thinking how you deploy an enterprise solution across multiple platforms so multiple users can tap into and use that."

For the Air Force, production capability is the key. "It's helpful to think of these as individual nodes that have to grow in unison from a technology perspective," Parker says. "I can have a large quantity of qualified materials to print parts, but if I don't have production capacity, it won't really move the needle. So we're looking at what machines are needed and where and what materials are available to pull all that together. We've had a great improvement over a short period of time, but how do we continue to grow it? We need testing to ensure these parts are safe to fly. There are a lot of things in the overall process we have to work through — it's not just a matter of materials and machines."

The U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., also is heavily involved in advancing and improving 3D printing.

"Open Manufacturing was a very elaborate program — how do you get first time quality when you print something. The big problem with printing now is the materials properties are quite different from what you find in bulk material and they change during

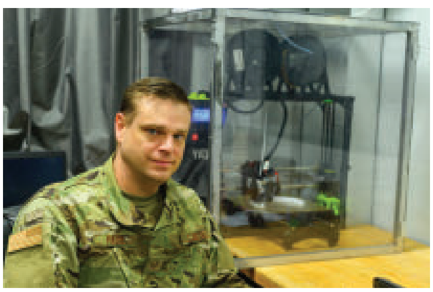
U.S. Air Force Academy Cadet Michael Higgins mounts a 3D printed model in a subsonic wind tunnel for testing at the academy in Colorado Springs, Colo.

the build of the part, primarily due to the thermal history," says Jan Vandenbrande, program manager in the DARPA Defense Sciences Office (DSO).

"The consequence is your final parts will have different properties through the entire build, so how do you satisfy the original requirements of structural integrity; how much energy should you deposit; how fast should we traverse; how much material should you lay down? We put together a computational system to tell how to set the machine to get first-end quality," Vandenbrande explains. "That means now we have shown you can actually use computational tools to figure out how to do something without having to do it many, many times to get a quality build."

Vandenbrande was DARPA's program manager for the now-completed Open Manufacturing program and heads the agency's Transformative Design (TRADES) program.

"3D printing allows some control over material properties at pretty much every point and the creation of very fine micro structures," Vandenbrande says. "If configured properly, you can create capabilities that don't exist in nature; you can create a structure with built-in resonators. The problem is trying to design something of this complexity is beyond what current CAD/CAM can handle. TRADES is trying to come up different ways of representing shape, compute strength and how to meet design objectives."



The West Virginia Air National Guard used 3D printing to design a face shield prototype for production to fulfill a statewide shortage caused by the COVID-19 outbreak.

State of the art

The state-of-the art in 3D printing enables the creation of components for a wide range of applications that cannot be made with other manufacturing methods. An example is the General Dynamics leak fuel nozzle. They created a printed fuel nozzle as a monolithic part, which eliminated

U.S. Navy deployed forces are starting to use 3D printed replacement parts to ease the logistics burden of maintaining aircraft like the MH-60 Sea Hawk helicopter aboard the amphibious assault ship USS Wasp.

all the internal brazing that was causing failures. The result was an intricate fuel nozzle with a lot of internal structures to mix air and fuel that no conventional manufacturing method can accomplish.

However, it is still very hard to control material properties and defects that may appear. Another problem is the accuracy is still not quite as good as desired. TRADES is investigating different ways of controlling the machines to ensure what is deposited is really what is wanted.

"It's a rapidly changing field with a lot of innovation happening. Several of our sites have 3D printers for plastic prototypes and we've started using other materials, such as metals. On the metal side, there is a lot of effort going on, especially by platform manufacturers, who have the resources to tune their processes and do materials research," says Ivan Straznicky, Chief Technology Officer for Advanced Packaging at the Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va.

"The main metal formation methods include direct metal laser centering, which is a subset of powder bed fusion, and directed energy deposition, which is not quite as developed. One of the main materials is aluminum silicon magnesium, which has good properties for being made into powder and laser meltability."

Curtiss-Wright is using 3D prototyping for fit checks. As for actual parts, that is still in the R&D stage, mostly on the research side. Even so, Straznicky agrees with Vandenbrande that, while not a high volume manufacturing process, 3D printing can create parts impossible with traditional manufacturing processes. That, he says, is one of the real advantages of metal 3D printing. Still, he admits, "not everything has worked as planned."

Some companies are using 3D printing for operational parts, however.

"We do additive manufacturing, using Ultem 9085, a high temperature, high strength thermal plastic, to build the air distribution system for our next generation inertial navigation, which is called WSN-12, for the Navy, replacing the WSN-7," Tom Disy, Manager for Strategy and Business Development at Northrop Grumman's Maritime Systems & Integration unit, says.

"Within the system is a requirement to have fairly small and elaborate duct-

The Stratays F900 3D industrial printer is certified by the U.S. Federal Aviation Administration for use on aircraft replacement parts.

ing for air to cool the system, a geometrically complex component where additive manufacturing is really useful," Disy says. "At first we were going to attempt that using sheet metal, but that would have involved a lot of welding. By using additive manufacturing instead, we have reduced the number of quality assurance inspections, reduced cost and improved on the performance."

Northrop Grumman also uses polymer based materials, such as nylon or plastics, to create custom tools or fixtures to improve the manufacturing process, and designing and printing needed tools rather than trying to use something not really designed for the task.

"It's easier to produce the printed component than to design, train and manufacture using traditional methods. However, 3D printed materials sometimes are not suited to stress or heat levels required for DoD applications, so it is not a panacea," Disy acknowledges. "It has a niche — and the one we have found is geometrically complex components. I think technology will naturally move toward better materials that will increase applications for DoD components. There are metallic additive manufacturing capabilities that someday could be of use, for example.

"The fact you don't have to retool and repurpose your line means you can just write new software, making it easier to keep up with advances in the technology," Disy continues. "Those are moving quickly and the workforce has to pay attention to make sure they are considering the latest technologies available."

Limitations on 3D printing

Technically and theoretically, with additive manufacturing, "anything can be printed" — across size scales from nano-scale to printing a building, and across a full gamut of material types: metals, polymers, biologic tissues, composites, concrete, etc. It also is a global technology, with advancements of the state-of-the-art rapidly occurring internationally. Europe, Asia, Australia, the U.S. — all are aggressively doing R&D in additive manufacturing.

But there are limitations, Curtiss-Wright's Straznicky warns.

"Very small is beyond the capability

HQA/FQ SERIES - MIL-COTS DC-DC & Filters

No need to take the rough with the smooth, TDK-Lambda's HQA series of DC-DC converters and FQA/FQB filters provide the ideal combination for MIL-COTS applications.

Offering compliance to MIL-STD-461; MIL-STD-1275; Sec 16-18 of RTCA/DO-160, with conduction cooling for operation in temperatures ranging from -55 to 115°C, your DC input power system development is now simplified and more reliable.

Contact TDK-Lambda for evaluation units or check our website for distribution inventory.

https://product.tdk.com/en/power/hqa
https://product.tdk.com/en/power/fqa

- Quarter Brick Footprints
- -55 to 115°C Operating Temperatures
- MIL Screening Options (M grade)
- Flanged or Non-Flanged Baseplates

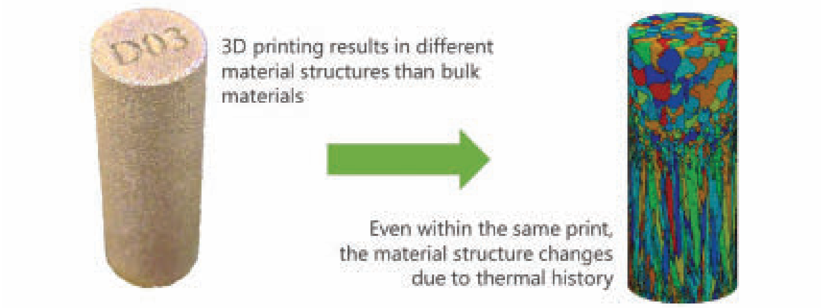
HQA DC-DC Converters
- 85W and 120W Output Power
- 9-40, 18-40 Vdc Input, 5-48V Outputs
- Up to 92% Efficient
- 2,250Vdc Isolation

FQA/FQB Filters
- 20A Rated
- Filtering for Compliance to MIL-STD-461F
- Spike suppression per MIL-STD-1275D and RTCA/DO-160G

Visit our new website! www.us.lambda.tdk.com

For more information on how TDK-Lambda can help you power your unique applications, visit our new web site at www.us.lambda.tdk.com or call 1-800-LAMBDA-4

TDK



DARPA is investigating computational methods including artificial intelligence to ensure that the specific material properties of every 3D-printed part are well-understood to ensure the part performs as designed.

of the direct metal laser centering process. Melting those little beads creates a relatively rough surface that needs machining or shock/laser peening. So the potential there is limited," he says.

"The economics are such it is not a high-volume process. There are only so many pieces you can create in a build effort compared to a traditional production process. In terms of cost, it won't necessarily create the lowest cost production piece. But if you are spending a lot of money to build and assemble a complicated piece, you might save money on those, depending on the size of the piece."

Size, weight and power consumption (SWaP) is practically a requirement in virtually all military programs today. But for the Air Force, it is superseded by necessity.

"It's a secondary factor. Size and weight we factor in on whether we can print it on the machines we have today. But the primary focus for us is a diminishing manufacturing issue, single source issue, long lead time on a part. One of our platform partners has parts that fit between the fuselage and the wing and it is a challenge to find replacement parts on those wedges, which, with age, can come lose in flight," Parker says.

"Through traditional manufacturing, because this material is hard to source, it can take up to 16 weeks. We had a plane land on a Thursday, the specs were sent to 3D printing over the weekend and the plane was back in the

Dual Channel mini PCIe
Reference Design for MIL-STD-1553

- Full size F2 mini PCI-Express Interface Card
- PCIe interface using small, cost effective Xilinx Artix-7 FPGA
- Includes Board Schematic/Layout, FPGA Source and Software Drivers/API
- Easily portable to any board design requiring PCI-Express
- 1 or 2 Dual Redundant MIL-STD-1553 channels
  – (BC, MT, 1 or 2 RTs)
- Uses Holt fully integrated HI-2130 MIL-STD-1553 terminals
- 64K Bytes of shared RAM with optional ECC

HOLT INC. INTEGRATED CIRCUITS
For further information on these and other Holt products contact:
(949) 859-8800 • sales@holtic.com • www.holtic.com
AS9100D: 2016 Registered

ULTIMATE SECURE CONNECTION

SMP-LOCK®

Designed for multiple markets, including space, Radiall's innovative SMP-LOCK® is a high-performance interconnect solution with a robust locking mechanism that dramatically increases the retention force of the interface and prevents accidental disconnection.

- Qualified up to 22 GHz
- Easy connect and disconnect
- Audible click and visible indication that plug is locked
- No torque wrench needed
- Compact size
- Reduced risk of equipment damage

https://www.radiall.com
Radiall | SIMPLIFICATION is our INNOVATION

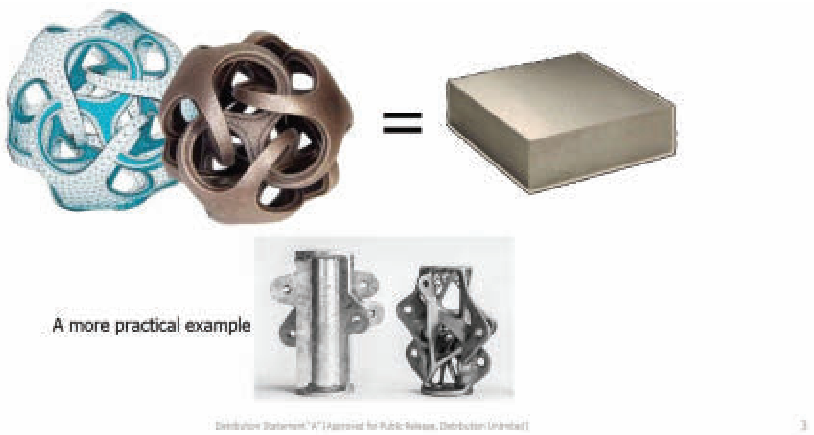
air within two weeks. There is a lot of discovery happening with respect to additive manufacturing as it is being used in the Air Force."

Northrop Grumman's Disy says there are a lot of advantages to using 3D printing, but also some disadvantages in aerospace and defense applications.

Complex requirements

"One advantage would be adapting to geometrically complex requirements. Something that traditionally requires a lot of metal bends and multiple components connected now can be one continuous piece," Disy notes. "Another benefit is speed-to-solution. With traditional manufacturing, you need drawings and templates and much more extensive efforts. You can do that much faster with 3D printing. Suitable materials is probably the biggest barrier in terms of strength and heat."

Although a lot of development remains to be done in many areas, Curtiss-Wright's Straznicky notes additive manufacturing is not just for structural parts.



DARPA is developing new design tools through the Transformative Design (TRADES) program to enable designers to harness the advanced complexity made possible by new additive manufacturing methods.

"3D printing also has a lot of work going on in ink jet materials to create circuit boards in an additive way rather than subtractive. Some of the circuits created are pretty remarkable," he says. "From an OEM perspective, you eventually buy one of the printers and create

Technician at a Northrop Grumman Corp. facility in Charlottesville, Virginia, inspecting a 3D printed manifold for one of their navigation systems.

a circuit overnight rather than waiting weeks or perhaps months for a board from a traditional manufacturer using a subtractive process. So the flexibility elements from an OEM perspective are pretty high. You can print a circuit board overnight and start working on a new component the next day.

"The plastic processes are quite mature, so not much more change there [in the next few years] and metal processes will be creating more and more production parts. 3D buildup is still a question. Some people are talking about actually printing components, but that won't happen in the next five years — it could be 20 to 50 years away. That is the area where I see the most change and growth, the printing of circuits using the ink jet process, which is a multimaterial printing system. That area is growing pretty quickly and has a lot of potential."

3D printing of metals and polymers is inexpensive compared to subtractive methods in low volumes; in higher volumes, legacy subtractive methods like injection molding and casting generally are still cheaper than 3D printing. However, as the industrial base for printing for heavy industries — such as aerospace and defense — ramps up, those costs will come down, as much of the cost is the input raw material, post-print processing and quality control.

While the Air Force has high hopes and expectations for 3D printing in the next five years, Parker acknowledges a lot still needs to be accomplished.

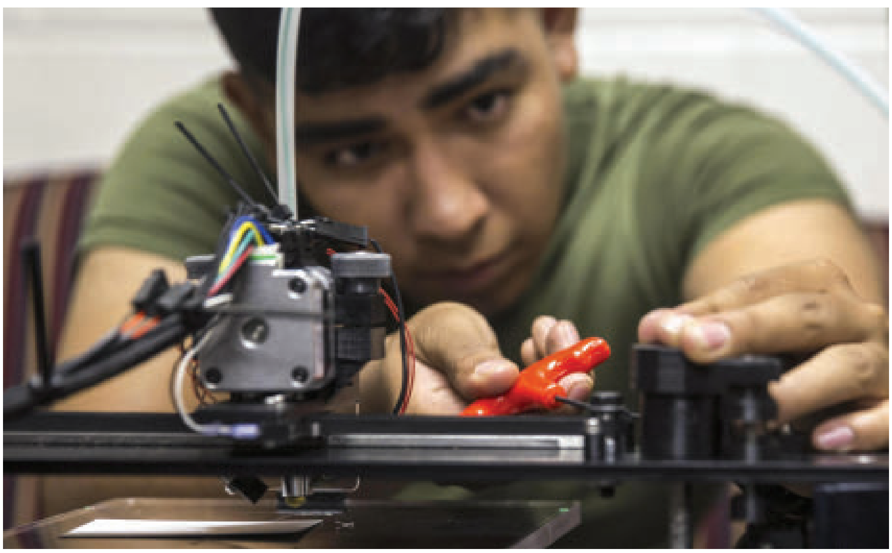
On-demand printing

"There are three categories we're looking at where we need to drive Air Force work," he says.

1 — "On demand printing capability. That's a major focus of the effort, moving from being used in a prototype phase to actual parts. That will help inform what machines we buy and where we use them.

2 — "Large scale parts. A lot of the machines are smaller than what we need for a lot of the parts on our aircraft. It's been really successful in printing small case parts, but we need to move to larger parts. We're working on a massive area manufacturing system, designed to get us to larger parts. We're working with AFRL and America Makes, which is a large DoD consortium that handles additive manufacturing across a lot of different industry areas.

3 — "Cyber security. Having net-



A U.S. Marine makes small adjustments to a 3D printer before loading a design during a class that enables Marines to produce parts quickly with exact specifications and at almost any location.

worked printers through some kind of connective network, there is a unique cyber threat associated with that. There are potentially some hard to detect flaws that could affect 3D parts, so it is essential we secure that network and have a really good, robust solution to mitigate those vulnerabilities. We're in the early stages of designing cyber security in from the beginning on our networks."

Curtiss-Wright's Straznicky says he believes 3D printing falls into what he calls "the 80-20 rule" as it evolves in the next five years.

"We've reached the 80 percent mark, where in many instances the promise is becoming reality, but the 20 percent for some applications will take a lot more work," he says. "Things like porosity is a problem. If you don't entirely melt the tiny beads, you're creating a porous material that will not have uniform properties. If those pores are close to the surface, you can create crack nitiation sites, which can be a real problem with things such as aircraft wings.

"Before the use of metal 3D printing becomes really widespread, those problems need to be solved," Straznicky continues. "We're working on approaches to shock peening — basically bombarding the surface with really hard metals that make it much harder to create a crack — and laser peening."

Industry experts agree 3D printing has changed the limits of design innovation. The potential for new designs is significantly higher than for traditional manufacturing. Metal printing enables the creation of shapes traditional metal fabrication processes cannot match. Even existing parts that require the joining of disparate pieces potentially can be made in a single shot with 3D printing.

It also offers the potential for improved thermal management in multimaterial systems, printing the side wall of a chassis with two different materials, for example — aluminum on the outside and a conductive material on the inside. Even ruggedization may be improved, from a design if not materials perspective. Creating a honeycomb design, for example, is quite difficult using traditional metal fabrication methods, but very easy with 3D printing, which creates a honeycomb structure that is both lightweight and quite strong.

WHO'S WHO IN 3D PRINTING

AddUp
Lyon, France
https://www.addupsolutions.com/en/

Conflux Technologies
Waurn Ponds, Australia
https://www.confluxtechnology.com

Cosine Additive Inc.
Houston
https://www.cosineadditive.com/en/home/

Curtis-Wright Defense Solutions
Ashburn, Va.
https://www.curtisswrightds.com

GE Additive
Auburn, Ga.
https://www.ge.com/additive

Northrop Grumman Corp. Maritime Systems & Integration unit
Charlottesville, Va.
https://www.northropgrumman.com/sea/

Oerlikon AM
Freienbach, Switzerland
https://www.oerlikon.com/am/en/

Poly-Shape
Salon-de-Provence, France
https://www.poly-shape.com/en/

SLM Solutions Group AG
Lübeck-Genin, Germany
https://www.slm-solutions.com

U.S. Air Force Materiel Command's Rapid Sustainment Office
Wright-Patterson Air Force Base, Ohio
https://www.afrso.com

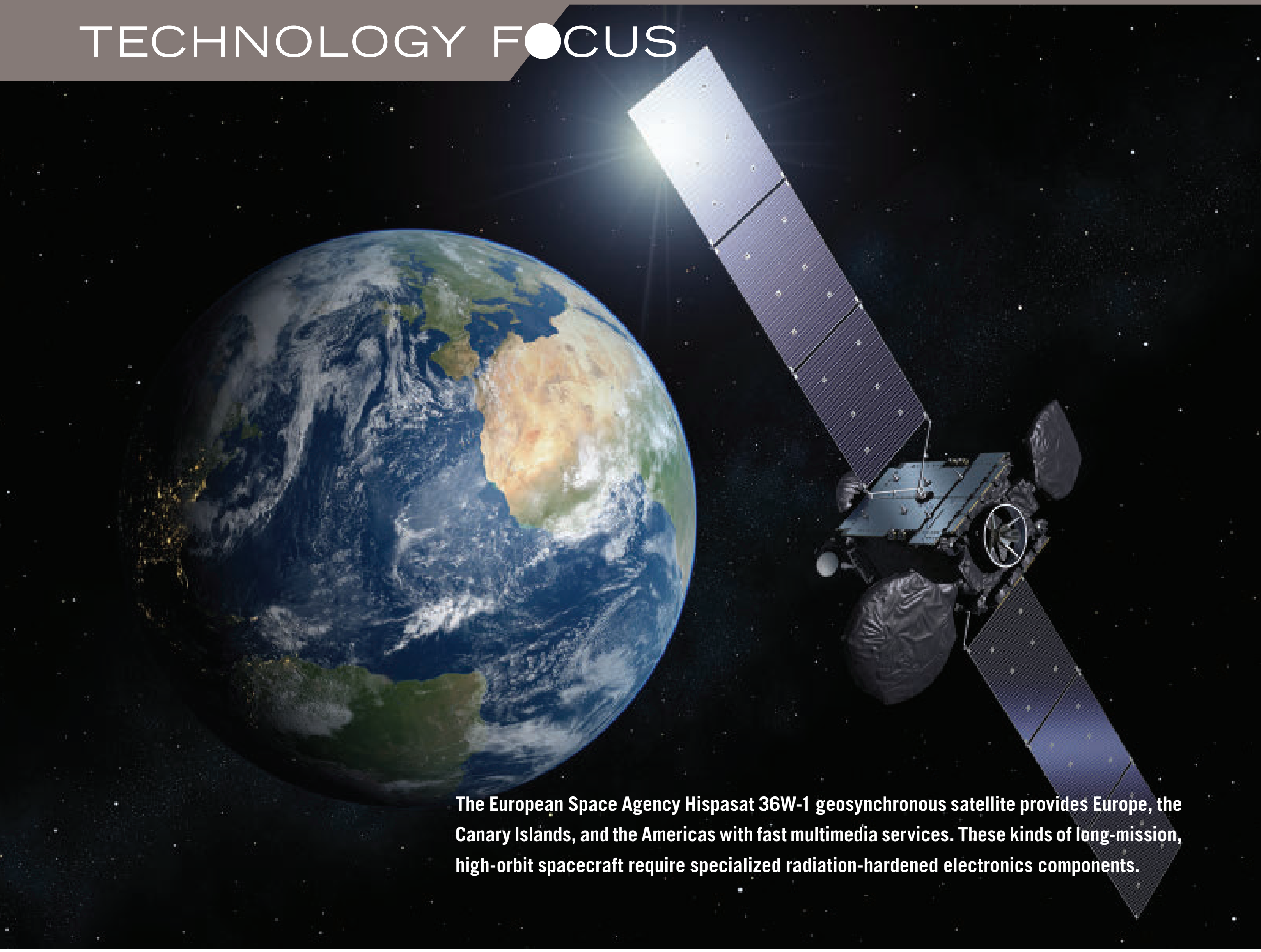
U.S. Defense Advanced Research Projects Agency (DARPA)
Arlington, Va.
https://www.darpa.mil

Still a new concept

Despite many successful applications of 3D printing, primarily in prototyping but increasingly in fieldable parts, it is still a relatively new concept that must overcome both its own current limitations and the doubts and questions of potential users. Vandenbrande says that is what DARPA hopes to accomplish with its TRADES program.

"New manufacturing technologies such as additive manufacturing have vastly improved the ability to create shapes and material properties previously thought impossible. Generating new designs that fully exploit these properties, however, has proven extremely challenging. Conventional design technologies, representations and algorithms are inherently constrained by outdated presumptions about material properties and manufacturing methods. As a result, today's design technologies are simply not able to bring to fruition the enormous level of physical detail and complexity made possible with cutting-edge manufacturing capabilities and materials," according to the TRADES entry on DARPA's website.

"DARPA's Transformative Design (TRADES) program aims to advance the foundational mathematics and computational tools required to generate and better manage the enormous complexity of design. TRADES intends to develop engineering tools to address design representation, analysis and synthesis. The final TRADES technologies should allow designers to more easily navigate the design space to discover non-intuitive — yet realizable — designs that fully leverage new materials and advanced manufacturing approaches, ultimately showing a way forward for future design systems and processes." ➔



The European Space Agency Hispasat 36W-1 geosynchronous satellite provides Europe, the Canary Islands, and the Americas with fast multimedia services. These kinds of long-mission, high-orbit spacecraft require specialized radiation-hardened electronics components.

Radiation tolerance meets commercial space

The wave of commercially developed communications and remote-sensing satellites seeks to balance costs, capability, size, weight, and power consumption in the latest new space designs.

BY **John Keller**

Demand for access to space — for communications, surveillance and reconnaissance, remote sensing, internet access, and space experimentation — never has been higher than it is today, and is expected to grow through the foreseeable future. Satellites are under construction ranging in size from softballs to 18-wheel tractor-trailer rigs, as potential sponsors ask for high performance, relatively low costs, and quick turnaround.

As this demand puts advanced electronics at a premium for space, there still are environmental constants that no one can change. Chief among these is the radiation that occurs naturally in space. Orbiting electronics must be able to withstand bombardment of radioactive particles at different levels, based on their intended orbits. This means that today's space electronics must be high-performance, radiation tolerant, and affordable.

Space electronics designers confront these challenges in a variety of ways, ranging from exhaustive testing, to enhancements and shielding, to designing electronic parts from the ground-up to function through space

Largest RF Selection

Available for Same-Day Shipping

The Engineer's Immediate RF Source

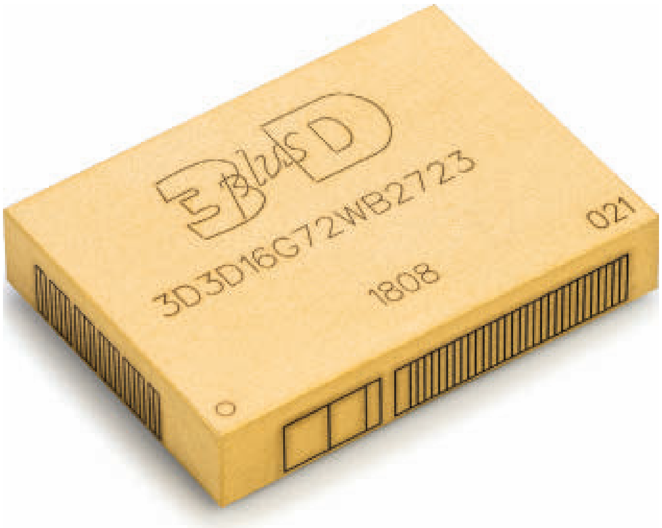
Pasternack meets the immediate needs of engineers who are building the future of RF communications.

- Over 40,000 RF, microwave, and mmWave components in 100+ categories of interconnect, passives, actives, and antennas
- 99.4% in-stock availability
- Shipped same day
- No minimum order required

In-Stock and Shipped Same Day

USA & Canada +1 (866) 727-8376
International +1 (949) 261-1920
pasternack.com

PE PASTERNACK®
an INFINITE brand



The 16-gigabyte 256Mx72 DDR3 module from 3D-Plus USA has radiation hardening for orbital space missions.

radiation for long durations. Test experts have come up with clever ways of screening commercial-grade electronics to separate those that can stand up to the rigors of space radiation, and those that can't.

While some semiconductor designers have found ways to alter commercial electronics designs to boost their radiation tolerance, there still are established integrated circuit manufacturers with long histories of designing special radiation-hardened parts for the most demanding space applications.

It all boils down to balancing requirements for electronics performance, costs, mission durations, and the radiation environment of chosen orbits. Low-Earth (LEO) orbit, for example, can be among the most benign space environments for radiation. High-altitude geosynchronous Earth orbit (GEO), on the other hand, can be among the most severe. High-altitude polar orbits can be the harshest radiation environments of all.

Low-cost parts

One of the biggest applications drivers in today's space electronics market is so-called "new space," which describes commercial endeavors to create large constellations of inexpensive small satellites for uses like cell phone communications and internet access. In this market cost is king. In addition, requirements for resistance to orbital radiation effects often can be relaxed because of relatively short mission durations.

"Radiation hardened and radiation tolerant are two different things," explains Jerry Festa, space product line manager for the Curtiss-Wright Corp. Defense Solutions activity in Newtown, Pa. Radiation tolerant, which is the target of most new space applications, represents using commercial off-the-shelf (COTS) parts as a foundation, and screening or enhancing these parts to survive the intended space orbit and duration. Radiation tolerant also can involve shielding sensitive components. "Radiation tolerant is an evolution from COTS parts and making them radiation tolerant, and we have focused on that for the past nine or 10 years," Festa says.

Going with radiation-tolerant, rather than pure commercial parts, in space applications has its price. Radiation-tolerant parts typically cost about five times the cost of the COTS parts on which they are based. Still, they are far less expensive than radiation-hardened-by-designed parts, which sometimes can be 100 times the price of pure commercial parts.

"Cost is a factor, and some applications are willing to live with less reliability, where it might be acceptable to lose one percent of your data over a mission," Festa says. "There is room for both."

New-space applications, in particular, are sensitive to parts costs. "We are seeing with the small-satellite and new-space markets a trend toward trying to qualify COTS components due to their being less expensive than the full-up rad-hard design," says Malcolm Thomson, president and general manager of Radiation Test Solutions Inc. in Colorado Springs, Colo.

"This is driven by cost per kilogram, and reduced mission lengths," Thomson says. "A lot of the new players are launching LEO constellations with hundreds or thousands of satellites with five-year mission lengths. That drives the need for radiation tolerance that costs less. It's a simple matter of economics: if they could afford to build thousands of satellites at millions of dollars each, they probably would do that, but they can't."

The market for affordable radiation-tolerant parts is so promising that even some of the industry's longtime rad-hard-by-design companies are plunging in. Enter Renesas Electronics Corp. in Milpitas, Calif., which through acquisitions assumes the legacy of rad-hard stalwarts Harris Semiconductor and Intersil.

"We are continuing the convergence of compromise in the interest of cost, and still meeting our reliability requirements," says Josh Broline, director of marketing and applications at the Renesas manufacturing center in Palm Bay, Fla. "We launched a low-cost radiation-tolerant plastic package integrated circuit a few years ago. We are coming out with solutions that are in the middle, to give some cost savings, yet still with the reliability that space designers need."

A key consideration for designing affordable radiation-tolerant parts is where to make the compromises, Broline says. "We don't necessarily have the NASA processor or FPGA [field-programmable gate array], but we have the power management that has to power those systems reliably. We need to have robust solutions, and our engineers are trying to figure that out."

Test and enhancement

Among the approaches for producing space electronics components that blend affordability and capability is screening and testing to uncover those commercial-grade parts that can withstand space radiation on their own, as well making some enhancements to electronics that testing identifies as already radiation tolerant.

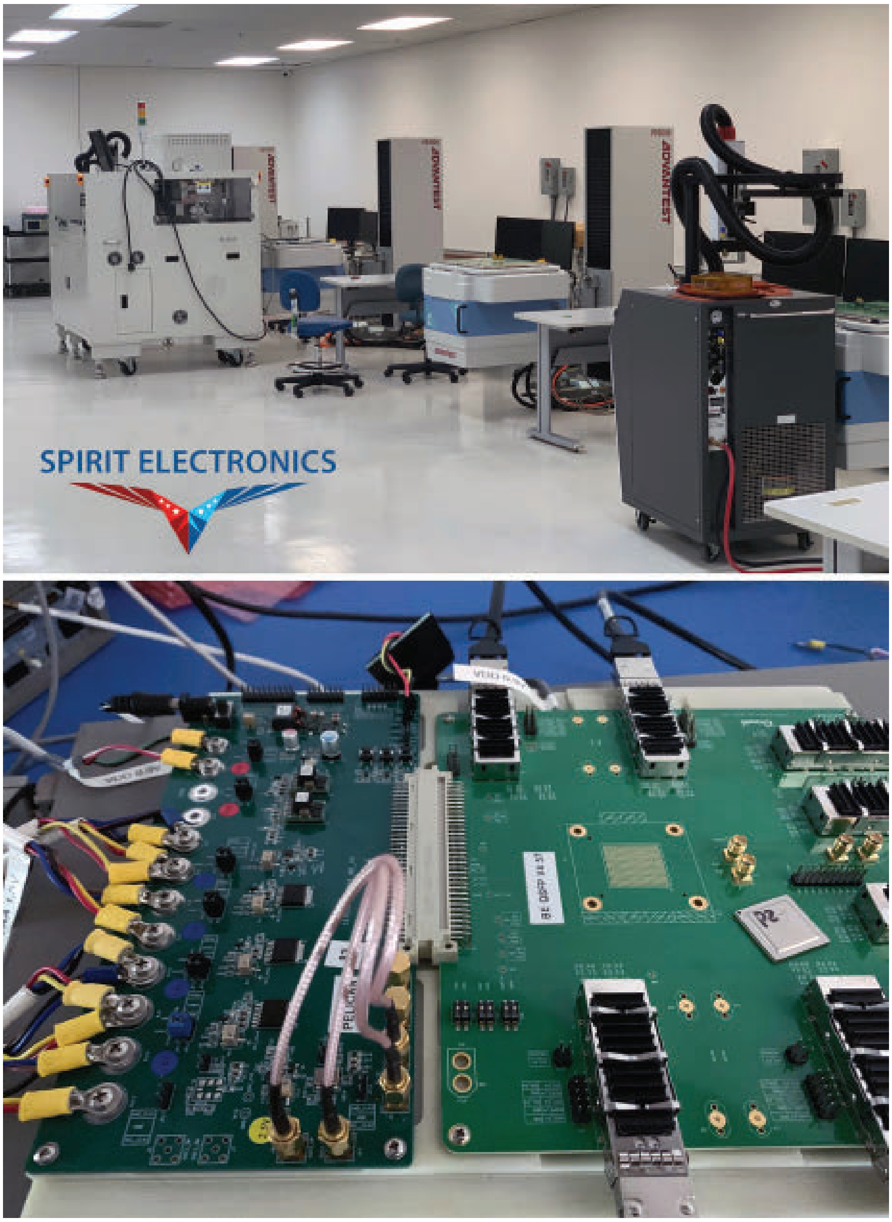
"We are on the test side, and can upscreen or do any value-add for the customer," says Marti McCurdy, owner and CEO of Spirit Electronics in Phoenix. "We offer a high-value proposition, and only operate in the mil-aero sector."

Sprit Electronics experts take their direction from their customers, who are trying to match anticipated operating environments, orbits, and mission durations with the most appropriate technologies. "We take a non-radiation-hardened component, because the customer doesn't want to invest in that kind of a product," McCurdy says. "We do screening and qualification to MIL-STD-883 Group E, and we do this as a service and as an add-on to drive our test floor."

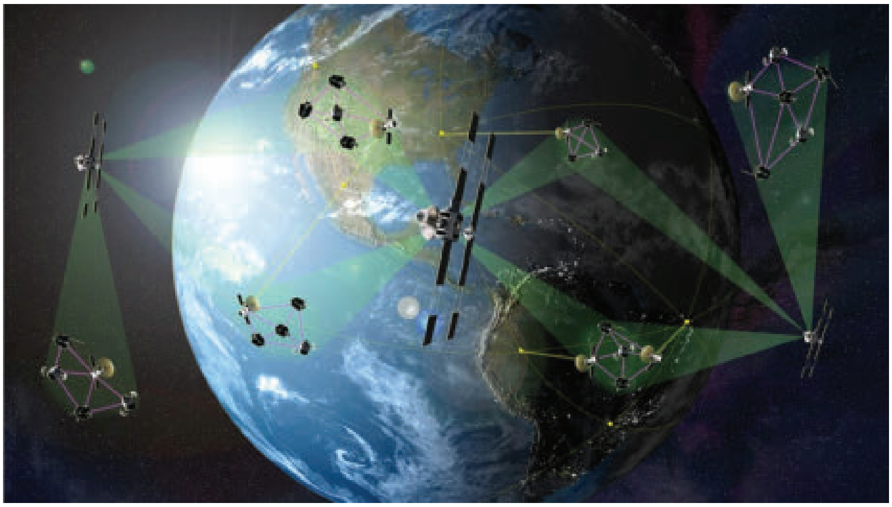
Matching technologies to operating environments is a core part of their business. "We screen for application-specific use," McCurdy says. "We have somebody with launch equipment, and their mission might be 10 minutes. They could have four times the redundancy in parts, and still save a lot of money. When we talk about screening, it really is about how much insurance do they want? We can calculate the risks of 10 minutes of exposure to space radiation."

The radiation test industry also is seeing a transition from parts-level to systems-level testing. "In the test world, we are starting to move away from component-level and into the systems world," McCurdy says. "The commercial world has been in this area for a few years now, and the aerospace and defense market is just getting there now."

As far as their customer base is concerned, McCurdy says demand for space electronics appropriate for low-Earth orbit is dominating, but needs for



Spirit Electronic tool kits, of the next generation Advantest Smart Scale ATE and hardware solutions, enable comprehensive radiation testing.



The future DARPA Blackjack satellite constellation seeks to capitalize on commercial space developments to demonstrate military surveillance and communications capability.

higher levels of radiation tolerance for higher orbits are not going away. "LEO is captivating the market, but GEO is still out there. There is a fine line between customers doing radiation tolerance, and the commercial companies putting up a constellation of tens to hundreds of satellites that are doing data mining. It's all about data collection."

For some commercial space companies considering short-duration missions, the risk might be worth it to have no radiation hardness or upscreening at all. When every dollar and every ounce of weight count, then using pure-commercial parts has its benefits. Experts say that commercial space is so new that reliable models of risks of on-orbit failures have yet to be crafted.

GSI Technology's Gemini Associative Processing Unit (APU) is designed for future autonomous satellites.

"Our specialty is in radiation testing," says Radiation Test Solutions's Thomson. "In new space we see companies that do radiation testing. We have seen a lot of growth because we are qualifying commercial parts to see how radiation tolerant they are. You don't really know until you test."

This kind of testing can be the key to balancing on-orbit capability and risk. "You have a lot of very large technology companies, such as social media companies, competing in this game that still need radiation testing to deploy a reliable constellation of satellites," Thomson says. "They can select from a much larger set of components than can traditional spacecraft manufacturers. They may evaluate five or six different memory manufacturers to see which one might meet their mission requirements."

Build to suit

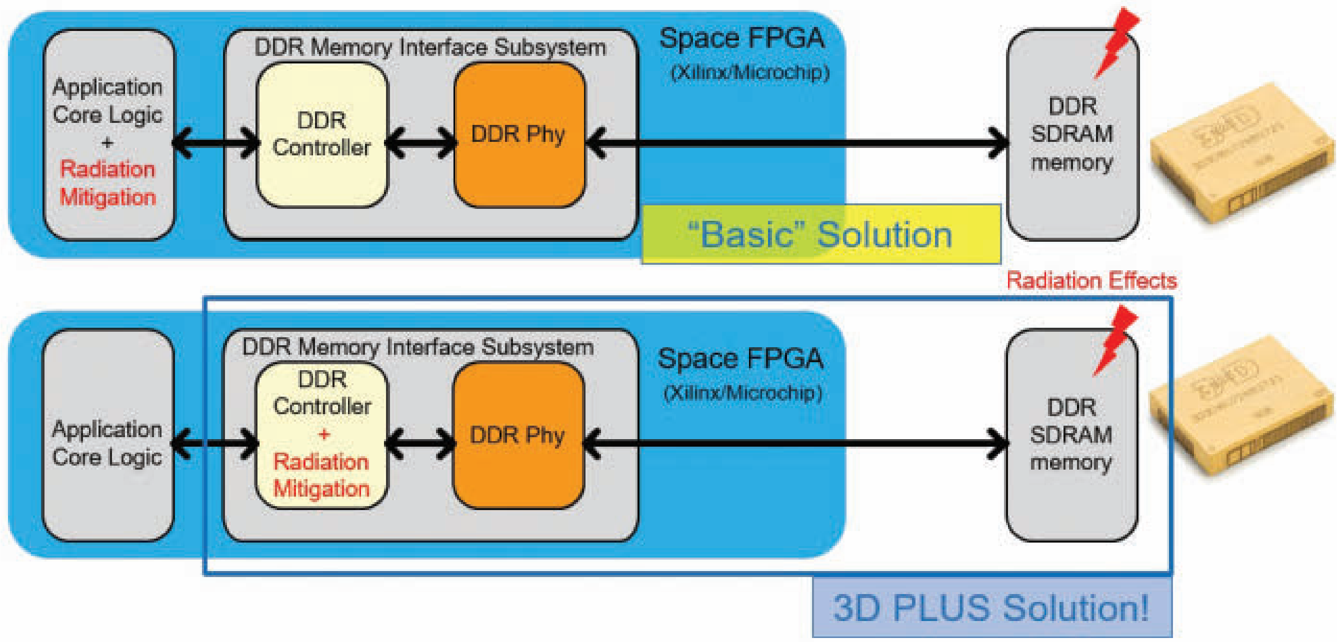
For some space missions, simply testing for radiation tolerance is not enough; sometimes enhancements are necessary. "In some cases we have value-add, where we can add shielding around the parts," says Timothee Dargnies, CEO of 3D-Plus USA in San Leandro, Calif.

"Our approach seeks to improve radiation with the combination of hardware and software. The hardware approach starts from existing silicon, and we add screening and qualification. What is new is we add a layer of software on top of the hardware layer, and a hardware intelligent memory controller."

The combination of software implemented in an FPGA and radiation-tolerant memory controller, perform error correction such that "we qualify the hardware, and the software makes it immune to single-event upsets," Dargnies says.

Curtiss-Wright also is involved in systems enhancements to improve radiation tolerance for space. "There are several ways you can make a design radiation tolerant to single-event latchups and single-event upsets like a bit flip," explains Curtiss-Wright's Festa. "There's no way to determine when a single-event effect will occur; you have to correct for these issues."

One way that Curtiss-Wright engineers mitigate single-event latchups is the company's Smart Backplane, which has parts designed for radiation hardness for critical functions such as monitoring for power changes to embedded computing modules. The company's Smart Backplane mitigates single-event latchup by detecting changes in the current into an embedded computing module. If that current drifts out of its present range, then the system resets the power to that module, and in so doing clears the memory and any lingering single-event latchup.



Radiation-tolerant electronic components such as the DDR3 memory from 3D-Plus USA capitalize on radiation-hardened technology, which can be applied to low-cost radiation-tolerant components.

"We use FPGAs, so the reset is very quick," Festa explains. You only lose one second of data in each module. The Curtiss-Wright Smart Backplane has been designed into a variety of space systems, including launch vehicles, re-entry vehicles like the U.S. Space Shuttle, as well as suborbital vehicles.

Radiation tolerance also is becoming an issue for commercial passenger and cargo aircraft that must operate at high altitudes for long-duration flights. In these applications charged particles can be as much of a threat as they are in space.

Curtiss-Wright engineers have found that today's commercially developed multicore processors are particularly well-suited for radiation tolerance in commercial aviation. "In our air data product the chip geometries are very small and might be susceptible to a single-event upset," explains Paul Hart, Curtiss-Wright's chief technology officer for avionics products.

"For every layer of execution there is a comparison," Hart explains. If there is a difference, you could surmise that a single event has occurred, and then you would do a memory self-test. We can have strategies to have duplicate cores, and instead of having a compare function for every line of code, you would have a comparison for every parameter you are running. This is a factor of high-criticality in avionics for passenger aircraft, so you need a mitigation strategy — particularly when using fly-by-wire systems."

Demanding applications

For many demanding space applications — particularly those intended for high orbits and long-duration missions — upscreening and enhancements doesn't fit the bill. These applications require specially designed electronic components to resist the rigors of radiation in space.

Increasingly, these applications also require some of the highest capabilities available in electronics. "We need spacecraft that can control themselves so they don't crash into other satellites, and to reposition themselves for communications. For this we have a need for artificial intelligence," says Paul Armijo, aerospace and defense business sector manager at GSI Technologies Inc. in Sunnyvale, Calif.

"We have developed an AI chip for space that is radiation tolerant to enable artificial intelligence, data fusion, automatic target recognition, and for recognizing weather events."

Apogee Semiconductor's radiation-tolerant logic components are for small satellites that will operate in low-Earth orbit.

The AI chip is single-event latchup immune to 100 kilorads of total-dose radiation exposure.

Today's sensor-intensive satellites require a lot of on-board processing because satellite uplinks and downlinks simply do not have the bandwidth for exchanging so much data with ground stations. "Satellites have so many sensors that it becomes untenable to push that data down to Earth, process it, and then tell the vehicle what to do," says GSI's George Williams, the company's director of data science. "That data could be optical imagery or synthetic aperture radar; these are massive data sets."

Demands for increased processing power on orbiting satellites will continue to grow, Williams says. "Five or ten years ago it became so easy and cheap to store data, but the challenge remains of making that data actionable. That has ushered in this new age of AI and machine learning. We need to take a data-driven approach to getting at that data."

It's a never-ending appetite for computing power among satellite systems integrators. "Satellites are getting smaller, and need high performance," says Anton Quiroz, CEO and co-founder of Apogee Semiconductor LLC in Plano, Texas.

Apogee manufactures radiation-tolerant as well as radiation-hardened electronics components. The company offers radiation-hardened complementary metal oxide semiconductor (CMOS) products, and is applying some of those rad-hard processes to commercially developed electronic components for radiation tolerance.

"We have been able to release a new family of components by leveraging commercial foundries to make them radiation tolerant," Quiroz says. "We can mix 5-volt parts with newer parts, and we need a part that bridges the gap between the old technologies and new technologies, between 1.8-volt parts and 5-volt parts. In that product family is a voter," Quiroz continues. "Even though it has triple-redundancy, we still need a rad-hard part that will vote on what is going on."

Apogee engineers have developed the ability to fine-tune the radiation-tolerance levels of their company's components, which helps the company serve a wide variety of radiation needs. "We have parts that are capable of 30 kilorads total ionizing dose performance, but we are developing a 300-kilorad part for the government geosynchronous market," Quiroz says. "It doesn't change the design difficulty too much. We can hit the standard geosynchronous levels; if you can hit the government market, you can hit the commercial market."

WHO'S WHO IN RAD-HARD ELECTRONICS

3D Plus USA
San Leandro, Calif.
https://www.3d-plus.com/index.php

Aitech
Chatsworth, Calif.
http://www.rugged.com

Apogee Semiconductor
Sachse, Texas
https://apogeesemi.com

BAE Systems
Manassas, Va.
https://www.baesystems.com/en-us/our-company/inc-businesses/electronic-systems/product-sites/space-products-and-processing

Cicoil Corp.
Valencia, Calif.
https://www.cicoil.com

Cobham Semiconductor Solutions
Colorado Springs, Colo.
https://ams.aeroflex.com/aboutus/au-cos.cfm

Curtiss-Wright Defense Solutions Aerospace Instrumentation
Newtown, Pa.
https://www.curtisswrightds.com/company/locations-newtown.html

Data Device Corp. (DDC)
Bohemia, N.Y.
http://www.ddc-web.com

GSI Technology Inc.
Sunnyvale, Calif.
https://www.gsitechnology.com

Honeywell Aerospace
Clearwater, Fla.
https://aerospace.honeywell.com/en/markets/space

Infineon Technologies
El Segundo, Calif.
https://www.infineon.com

Renesas Electronics Corp
Milpitas, Calif
https://www.renesas.com/us/en/

Maxwell Technologies
San Diego
http://www.maxwell.com

Mercury Systems
Phoenix
https://www.mrcy.com

Microchip Technology Inc.
Chandler, Ariz.
https://www.microchip.com

Microelectronics Research Development Corp.
Colorado Springs, Colo.
http://www.micro-rdc.com/index.htm

Micropac Industries Inc.
Garland, Texas
http://www.micropac.com/MII-Home.html

Microsemi
Aliso Viejo, Calif
https://www.microsemi.com

Nissha GSI Technologies
Burr Ridge, Ill.
https://www.gsitech.com

Northrop Grumman Corp.
Manhattan Beach, Calif.
http://www.northropgrumman.com/Pages/default.aspx

pSemi Corp.
San Diego
http://www.psemi.com

Radiation Test Solutions Inc.
Colorado Springs, Colo.
https://www.radiationtestsolutions.com/home

Renesas Electronics Corp.
Milpitas, Calif.
https://www.renesas.com/us/en/

Space Micro
San Diego
http://www.spacemicro.com/index.html

Spirit Electronics
Phoenix
https://www.spiritelectronics.com

Triad Semiconductor Inc.
Winston-Salem, N.C.
https://www.triadsemi.com

VPT Components
Lawrence, Mass.
https://www.vptcomponents.com

VPT Inc.
Blacksburg, Va.
http://www.vptpower.com

VPT Rad
Chelmsford, Mass.
http://www.vptrad.com

Xilinx Inc.
San Jose, Calif.
https://www.xilinx.com

DRS Laurel is building as many as many as 59 missile-defense radar systems to help protect U.S. Navy surface warships from missile attacks.

DRS Laurel to build shipboard missile-defense radar systems

BY **John Keller**

WASHINGTON — U.S. Navy missile-defense experts are asking the DRS Laurel Technologies segment of Leonardo DRS in Johnstown, Pa., to provide AN/SPQ-9B shipboard anti-ship missile defense (ASMD) radar systems to help protect U.S. Navy surface warships from enemy anti-ship missiles.

Officials of the Naval Sea Systems Command in Washington announced a $30.1 million order to DRS Laurel in late March to build as many as 59 AN/SPQ-9B radar systems.

DRS in April 2018 displaced Northrop Grumman Corp. as the Navy's AN/SPQ-9B shipboard radar contractor in a $64.3 million deal. That contract, which combined purchases for the Navy and the government of Japan, included options that could bring its cumulative value to $263 million.

The AN/SPQ-9B is an X-Band pulse-Doppler frequency-agile radar that scans out to the horizon and performs simultaneous and automatic air and surface target detection and tracking of low flying anti-ship cruise missiles, surface threats, low-and-slow-flying aircraft, unmanned aerial vehicles (UAVs), and helicopters.

The radar is designed for the littoral environment in harbors and along coastlines, and has high clutter improvement factor supporting a very low false track rate in the littorals and in high-clutter environments. Its design makes the most of commercial off-the-shelf (COTS) and non-developmental item (NDI) equipment.

The unattended radar consists of four air-cooled below-deck cabinets, a motor generator, and one above-deck antenna unit designed for low-radar-cross-section reflectivity appropriate for stealth ship design.

The AN/SPQ-9B is for aircraft carriers, amphibious assault ships, cruisers, Coast Guard maritime security cutters, Arleigh Burke-class destroyers, and allied cruisers and destroyers.

Above decks, the radar uses a mechanically rotating, electronically stabilized antenna. The 1,500-pound antenna consists of dual planar arrays mounted back-to-back, each connected to independent transmitters and receivers.

Below decks, the radar consists of processor, receiver/exciter, and transmitter cabinets; radar set control; and motor generator.

The processor cabinet performs signal processing, tracking, and interface functions. The receiver/exciter has three receivers, and generates system frequencies and clocks. The transmitter cabinet receives the RF pulses from the receiver/exciter and amplifies them for output to the antenna. The radar set control provides remote control and monitoring of radar operation in the ship's combat information center. The output of each receiver is converted to digital baseband I-Q data for Doppler processing in the processor cabinet. The system has an auxiliary antenna for electronic counter-countermeasures.

The AN/SPQ-9B radar has digital interfaces to the Aegis combat systems, the MK 34 gun weapon system (GWS), the MK 48 GWS, the Cooperative Engagement Capability, and ship self-defense system.

On this order DRS Laurel will do the work in Largo, Fla., and should be finished by March 2022. For more information contact DRS Laurel Technologies online at www.leonardodrs.com/locations/drs-laurel-technologies-johnstown-pa, or Naval Sea Systems Command at www.navsea.navy.mil.

Raytheon to provide secure SATCOM for shipboard communications and networking

SAN DIEGO — Shipboard communications experts at Raytheon Technologies Corp. will provide U.S. and allied naval forces with secure satellite communications (SATCOM) capability under terms of a $63.5 million order announced in late March.

Officials of the Naval Information Warfare Systems Command (NAVWARSYSCOM) in San Diego are asking the Raytheon Intelligence & Space segment in Marlborough, Mass., to build Navy Multiband Terminal (NMT) systems.

The NMT is a next-generation SATCOM system for the U.S. and allied navies that provides seamless assured connectivity between a ship's or submarine's computer network and the Global Information Grid.

It is a multiband secure SATCOM networking terminal that provides protected and wideband communications. It supports extremely high frequency (EHF); advanced EHF low data rate; medium data rate; extended data rate; super high frequency (SHF), Military Ka-band transmit and receive communications; and Global Broadcast Service receive-only communications.

The NMT is to be installed on about 300 U.S. Navy ships, submarines, and shore stations, replacing several existing SATCOM systems developed and maintained by Raytheon since the mid-1980s.

Raytheon is building Navy Multiband Terminal (NMT) secure satellite communications systems for use aboard surface ships.

The new system will provide naval commanders and warfighters with data throughput capacity and protection against enemy intercepts, Raytheon officials say.

Raytheon has achieved protected two-way networked SATCOM for shipboard computer networks using low-, medium-, and extended-data-rate waveforms under the extremes of shipboard motion.

On this order Raytheon will do the work in Largo, Fla.; and South Deerfield, Stow, and Marlborough, Mass., and should be finished by May 2022. For more information contact Raytheon Intelligence & Space online at www.rtx.com, or NAVWARSYSCOM at www.public.navy.mil/navwar/Pages/default.aspx.

Military issues industry solicitation for 5G cellular network prototypes to enhance military communications

The U.S. Department of Defense (DOD) in Washington released its fourth and final request for prototype proposals for 5G technology development. In the solicitation for the next-generation network, the DOD asks for industry input on a three-pronged 5G prototype project at Hill Air Force Base and Utah Test and Training Range, both in Utah. Like previous solicitations, the request is divided into three categories: the 5G network itself, enhancements to the network, and applications for a deployable spectrum-coexistence and -sharing system. The DOD wants a 5G prototype test bed to design, construct and operate a localized, private, full-scale 5G mobile cellular network to evaluate the impact of the 5G network on airborne radio systems; 5G prototype enhancements specifically to improve dynamic spectrum-sharing and spectrum coexistence capabilities; and 5G prototype applications to design, construct and deploy a spectrum coexistence and sharing (SCS) system to identify and demonstrate deployable SCS.

Computer miniaturization could enable fleets of small communications satellites

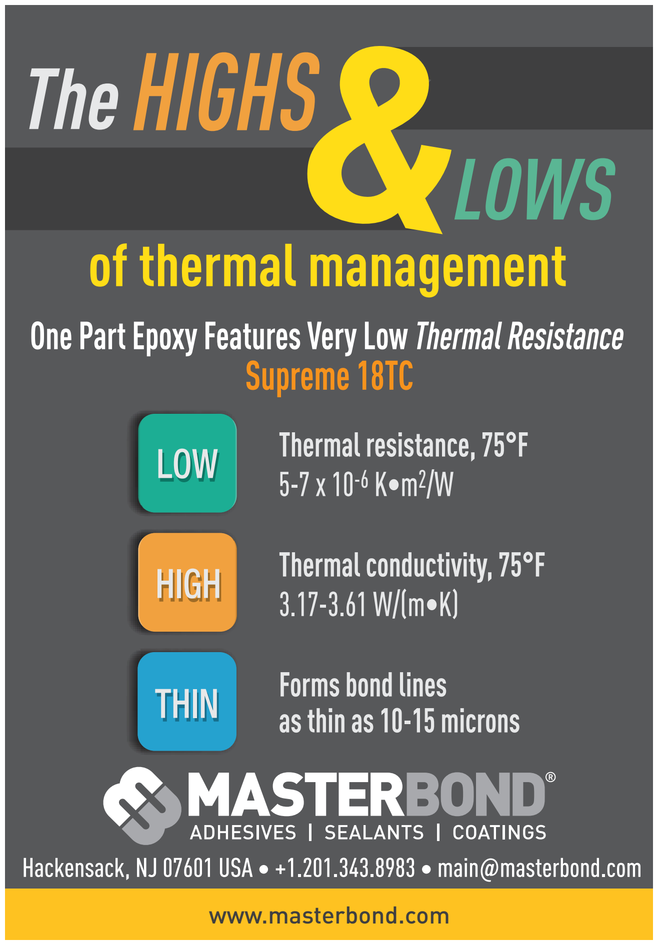
With much of the commercial space industry focused on putting small satellites into low Earth orbit (LEO), how quickly will the U.S. military follow? Companies are shifting away from traditional large satellites towards small satellites. cubesats in LEO have been increasingly used in space since the 1990s. In recent years, advances in camera technology and computer miniaturization have enabled companies to do optical imaging or radar observations using smaller and smaller satellites. This has led to the present day, where companies ranging from OneWeb to SpaceX and Planet have been deploying large fleets of satellites, which eventually could include thousands of individual satellites, for applications ranging from telecommunications and Earth observation, to military reconnaissance and tactical communications.

Border patrol radar system repurposed to monitor coronavirus patients

A radar system used by the IDF to secure Israel's borders from terrorist attacks and infiltrations has been adapted to monitor the vital signs of coronavirus patients. Two military radar systems developed by Elbit and Israel Aerospace Industries have been adapted by the National Emergency Team of the Defense Ministry's Directorate of Defense Research and Development to monitor and measure the vital signs remotely of coronavirus patients using a combination of radar and electro-optical sensors. The data is displayed in a graphic user interface that facilitates decision-making processes.

Orbital tracker radar from Lockheed Martin should be able to follow everything

The U.S. Space Force in Washington has announced that its Space Fence radar system is officially operational. The Space Fence actually is a radar system that aims to provide advanced tracking of on-orbit objects such as commercial and military satellites. The program will track the existing 26,000 orbital objects already accounted for in the existing Space Surveillance Network (SSN). The orbital tracker technology developed by Lockheed Martin Corp. on behalf of Space Force can pick up items roughly the size of a marble in low-Earth orbit, and eventually should catalog just about every active and passive potential observation, communication, and potentially militarized in-space assets operated by just about anyone.



SENSORS

Army orders ground-penetrating radar system from CSES

U.S. Army counter-land mine experts needed ground-penetrating radar systems to detect improvised explosive devices (IEDs) buried in roadways. They found their solution from Chemring Sensors and Electronics Systems (CSES) in Dulles, Va.

Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., have announced a $200.2 million order to CSES to develop and build Husky Mounted Detection System (HMDS) kits, spare parts, maintenance and training.

The HMDS is a counter-IED system able to detect underbelly IEDs and antitank land mines buried in primary and secondary roads. As a result, the HMDS is vital to route clearance packages (RCP). The system is a combination of the CSES VISOR 2500 ground-penetrating radar and the Husky vehicle from Critical Solutions International Inc. in Carrollton, Texas.

The HMDS helps the Army quickly clear roadways of anti-tank mines, roadside bombs, and other IEDs. The CSES VISOR 2500 ground-penetrating radar detects metallic and non-metallic explosive hazards, pressure plates, and antitank mines.

CSES's VISOR 2500 ground-penetrating radar is designed for buried mine and similar explosives detection using ultra-wideband ground-penetrating radar arrays and automatic target recognition. The system uses ultra-wide-bandwidth impulses, has a high signal to clutter ratio, low radar cross-section, is lightweight, and offers low power consumption, CSES officials say.

For more information contact CSES online at https://c-s-i.com/husky, or the Army Contracting Command-Aberdeen Proving Ground at https://acc.army.mil/contractingcenters/acc-apg.

EMBEDDED COMPUTING

Perspecta Labs to speed complex software by improving network interface cards (NICs)

Computer scientists at Perspecta Labs Inc. in Basking Ridge, N.J., are working with U.S. military researchers to explore ways of speeding-up complex application software like distributed training of machine learning classifiers.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. announced a $29.7 million contract to Perspecta Labs for a research project in the first phase of the DARPA Fast Network Interface Cards (FastNICs) program.

FastNICs seeks to find ways of improving network stack performance in military embedded computing systems to realize 100x or more throughput gains, and to accelerate distributed applications, such as training of deep neural networks.

Current network subsystems represent a bottleneck between multiprocessor servers and the network links that interconnect them, DARPA officials explain. This bottleneck has worsened dramatically over time because of the increasing use of parallelism in processor design aimed at increasing central processing unit (CPU) performance.

Although this design strategy can be effective for CPUs, it has limited overall computer performance because network link performance has

not matched processor gains; there is a performance imbalance between network links and other computer system components, researchers explain.

The separate evolutions of network and server technology have made network interface cards (NICs), which bridge the network/server boundary, an afterthought.

This can be a problem because network interface hardware imposes the upper bound for server throughput, as it limits a processor's data-ingest capability. Limitations in server memory technologies, software that exhibits excessive memory copying, and poor application design also can throttle computer throughput.

Network interface cards (NICs) typically operate at far slower rates than today's multicore multiprocessors and graphic processing unit (GPU)-equipped servers, which highlights the need for breakthrough approaches in increasing NIC speeds.

Applications seeks new software that fast server data paths enable by implementing at least one application that demonstrates a 100x speedup when executed on the hardware/software stack developed in the project's first phase. Independent test and evaluation seeks to provide objective and convincing evidence for the impact of FastNICs.

On this contract Perspecta Labs will do the work in Basking Ridge, N.J., and should be finished by May 2024. For more information contact Perspecta Labs online at www.perspectalabs.com, or DARPA at www.darpa.mil. ←

INTEGRATED CIRCUITS

Microcontroller for 5G data centers and unmanned vehicles introduced by Microchip

Microchip Technology Inc. in Chandler, Ariz., is introducing the CEC1712 trusted-computing cryptography-enabled microcontroller to stop malicious malware such as rootkit and bootkit for systems that boot from external Serial Peripheral Interface (SPI) flash memory. In addition to preventing malicious malware during pre-boot in 5G and data center operating systems, Microchip's CEC1712 and Soteria-G2 combination is a security enabler for connected unmanned vehicle operating systems, automotive Advanced Driver Assisted Systems (ADAS) and other systems that boot out of external SPI flash. The CEC1712 Arm Cortex-M4-based microcontroller has Soteria-G2 custom firmware, and provides secure boot with hardware root of trust protection in a pre-boot mode for operating systems booting from external SPI flash memory. In addition, the CEC1712 provides key revocation and code rollback protection during operating life to enable in-field security updates. Complying with NIST 800-193 guidelines, the CEC1712 protects, detects, and recovers from corruption, and protects against threats before they can load into the system. It only allows the system to boot using software trusted by the manufacturer. For more information contact Microchip online at www.microchip.com.

DATA STORAGE

Network-attached data storage for harsh-environments introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the Data Transport System (DTS1) network-attached data storage device for harsh-environment applications like high-altitude unmanned aerial vehicles (UAVs) that must operate as high as 40,000 feet. The DTS1 is a commercial off-the-shelf (COTS) data-at-rest storage solution that supports two layers of full disk encryption in one device. The data storage system has been tested and validated for operation in extended temperatures from -45 to 85 degrees Celsius per MIL-STD-810G. It is a Common Criteria-certified solution endorsed by the U.S. National Security Agency NSA and approved by NATO with two certified encryption layers. The DTS1 has two layers of AES 256-bit encryption, making protection of Top Secret data more cost effective and low risk than traditional NSA Type 1 device development. Its hardware and software full-disk encryption layers have been individually evaluated and certified against two Common Criteria protection profiles: collaborative Protection Profile for Full Disk Encryption — Encryption Engine; and collaborative Protection Profile for Full Disk Encryption — Authorization Acquisition. The DTS1 network-attached data storage device has also is approved to be on NATO Information Assurance Product List (NIAPC). For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com.

RUGGED COMPUTERS

Atom processor-based rugged computer for signal processing in military applications introduced by Acromag

Acromag in Wixom, Mich., is introducing the ARCX1100 rugged small form factor (SFF) rugged computer for defense, industrial, and mobile applications in test and measurement, data acquisition, communication, avionics, simulation, and signal processing. The ARCX1100 is optimized for size, weight, power, and cost (SWaP-C) with a COM Express Type 10 CPU and four slots for Acromag's plug-in AcroPack I/O modules. It offers modular I/O for signal processing, communication, and control functions. The fanless ARCX1100 comes with an integrated removable solid-state drive bay. It measures 7.6 by 7.6 by 3.25 inches, weighs 4.55 pounds, and operates in temperatures from -40 to 71 degrees Celsius. The embedded computer has the E3950 Intel Atom processor and four AcroPack I/O modules installed. Peripherals include two RJ45 gigabit Ethernet, two USB 3.0, two RS232, mini DisplayPort, and audio ports, plus M.2 and SATA data storage connectors. Four 68-pin VHDCI connectors route field I/O to the AcroPack modules without any loose internal cables to interface a mix of analog, digital, serial, FPGA, avionics, and other I/O signals. The Atom processor-based rugged design is engineered to withstand 50g shock and 5g vibration. More than 25 AcroPack modules are

available to perform A/D and D/A conversion, discrete I/O, RS232/485, MIL-STD-1553, CAN bus, Gigabit Ethernet, and other functions. For more information contact Acromag online at https://acromag.com.

EMBEDDED COMPUTING

Rugged Intel Cyclone V-based embedded computing system introduced by Aitech

Aitech Defense Systems Inc. in Chatsworth, Calif., is introducing the A174 I/O expansion subsystem to expand I/O capabilities of existing avionics systems with a standard Ethernet interface. The small add-on unit offers small form factor and low power dissipation to expand the I/O of any avionics embedded computing system. The A174 connects to a multiple-client/multiple-server system architecture with A174 servers and avionics

computer clients on an Ethernet network. Each client can access and control I/O resources on any of the A174 units on the network, and any of the clients on the network can access each A174 simultaneously. Each client can run processor architectures like PowerPC, ARM, Intel running any software operating system. The unit implements interfaces in a field-programmable gate array (FPGA), with only the physical layers acting as dedicated devices. This minimizes power consumption, and enables customization of the unit to specific applications. The avionics expansion unit's Intel Cyclone V system-on-chip (SoC) FPGA implements all I/O interfaces, and the A174 also includes built-in test. I/O interfaces include ARINC-429, analog and isolated discretes with optional RS-232/422/485 Serial and MIL-STD-1553B (BC/RT/MT) ports. System resources include temperature sensors and an elapsed time recorder as well as a pre-installed Linux Embedded operating system and drivers, server application, and test sample applications. For more information contact Aitech online at https://aitechsystems.com.

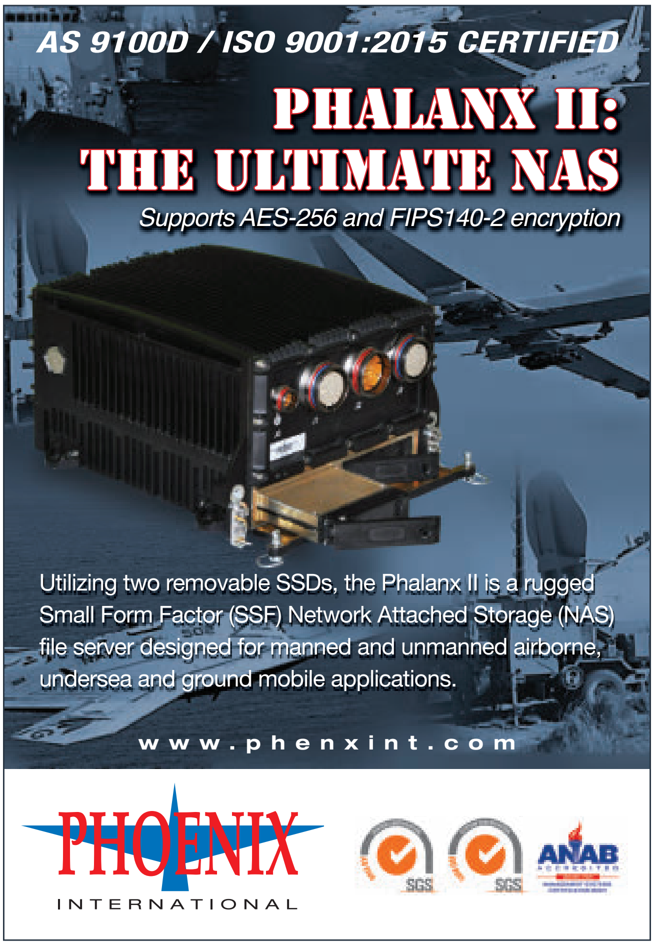
REAL-TIME SOFTWARE

Embedded computing network-management software for mission-critical applications introduced by Abaco

Abaco Systems in Huntsville, Ala., is introduc-

PRODUCT & LITERATURE SHOWCASE

ADVERTISERS INDEX



Military & Aerospace Electronics

SUBSCRIPTION INQUIRIES
Phone: 1-877-382-9187 / International Callers: +1-847-559-7598
E-mail: MAEM@omeda.com
Web: www.mae-subscribe.com

VICE PRESIDENT/GROUP PUBLISHER Paul Andrews
203 423-3963 / pandrews@endeavorb2b.com

EDITOR-IN-CHIEF John Keller
603 891-9117 / jkeller@endeavorb2b.com

ASSOCIATE EDITOR Jamie Whitney
603 891-9135 / jwhitney@endeavorb2b.com

CONTRIBUTING EDITOR WESTERN BUREAU J. R. Wilson
702 434-3903 / jrwilson@endeavorb2b.com

EDITORIAL ART DIRECTOR Kermit Mulkins

PRODUCTION MANAGER Sheila Ward

AUDIENCE DEVELOPMENT MANAGER Debbie Bouley
603 891-9372 / dbouley@endeavorb2b.com

MARKETING MANAGER Adrienne Adler
603 891-9420 / aadler@endeavorb2b.com

ENDEAVOR BUSINESS MEDIA
www.endeavorbusinessmedia.com

EDITORIAL OFFICES
Endeavor Business Media, LLC
Military & Aerospace Electronics
61 Spit Brook Road, Suite 501, Nashua, NH 03060
603 891-0123 / www.milaero.com

SALES OFFICES
EASTERN US & EASTERN CANADA & UK
Keith Gregory, Sales Manager
508 1/2 Ocean Park Ave., Bradley Beach, NJ 07720
732 897-9550 / Cell 917 993-3741
kgregory@endeavorb2b.com

WESTERN CANADA & WEST OF MISSISSIPPI
Maureen Elmaleh, Sales Manager
7475 Miller Street, Arvada, CO 80005
303 975-6381 / Cell 212 920-5051
melmaleh@endeavorb2b.com

REPRINTS Jessica Stremmel
717 505-9701 x2205 / Jessica.stremmel@theygsgroup.com

DIRECTOR LIST RENTAL Kelli Berry
918 831-9782 / kberry@endeavorb2b.com

For assistance with marketing strategy or ad creation, please contact Marketing Solutions
Kaci Wheeler
918 832-9377 / kwheeler@endeavorb2b.com

ENDEAVOR BUSINESS MEDIA, LLC
CHIEF EXECUTIVE OFFICER Chris Ferrell
CHIEF REVENUE OFFICER, CHIEF MARKETING OFFICER June Griffin
CHIEF FINANCIAL OFFICER William Nurthen
CHIEF OPERATING OFFICER Patrick Raines
CHIEF ADMINISTRATIVE AND LEGAL OFFICER Tracy Kane
CHIEF TECHNOLOGY OFFICER Eric Kammerzelt
EVP, TECHNOLOGY GROUP Lester Craft

BPA WORLDWIDE   Connectiv

ing the OpenWare V6.3 network-management software for the company's NETernity layer 2/3 Ethernet switches for mission-critical applications that demand security, speed, bandwidth, flexibility, and reliability. OpenWare V6.3 adds enhancements such as Port Wizard for reconfigurable port types; support for 10GBASE-KX4 by V6.3; display of the serial number of the switch by the OpenWare console; security common vulnerabilities and exposures (CVE) patches; password-controlled access at all levels; and very fast start-up. Installable as a plug-and-play switch environment, OpenWare software enables users to implement management, network, and protocol features progressively. OpenWare was developed in house by Abaco's Networking Innovation Center. Its multi-level military-grade security balances between protecting data and preventing unauthorized access on the one hand and accessibility and usability on the other. The OpenWare embedded computing software's GNU/Linux-based architecture blends open-source network switching and routing with Abaco's network management. It is based on industry standard layer 2/3 network protocols, management, and security technology, making OpenWare-based switches compatible with existing network infrastructures. For more information contact Abaco systems online at www.abaco.com.

DATA CONVERSION

Four-channel 1.25 GHz embedded computing XMC data converter introduced by Pentek

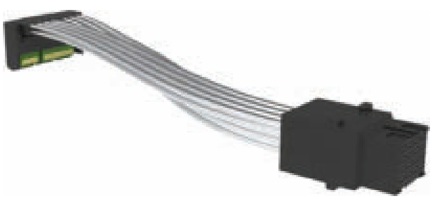
Pentek Inc. in Upper Saddle River, N.J., is introducing the Jade model 71871 four-channel 1.25 GHz D/A data converter Switched Mezzanine Card (XMC) for RF and IF waveform generation. The model 71871 combines two

Texas Instruments DAC3484 D/A converters to deliver four independent analog outputs each through its own digital upconverter and 16-bit D/A with sampling rates to 1.25 GHz. A Xilinx Kintex Ultrascale field-programmable gate array (FPGA) contains factory-installed functions that include a sophisticated D/A waveform generation IP module. It enables users to deliver waveforms stored in on-board memory or off-board host memory to the four D/As. The embedded computing XMC module can translate complex output waveforms, each with bandwidths to 250 MHz, to programmable IF frequencies. Users can configure the model 71871 with Kintex UltraScale FPGAs, spanning the entry-level KU035 (with 1,700 DSP slices) to the high-performance KU115 (with 5,520 DSP slices). The KU115 is for demanding beamforming, modulation, encoding, and encryption of the signals prior to transmission. Applications that do not need large DSP resources or logic can use a lower-cost FPGA. An optional P16 XMC connector adds an 8X gigabit link to the FPGA to support serial protocols. For more information contact Pentek online at www.pentek.com.

CONNECTORS

Cable receptacles for designing switches and routers introduced by TE

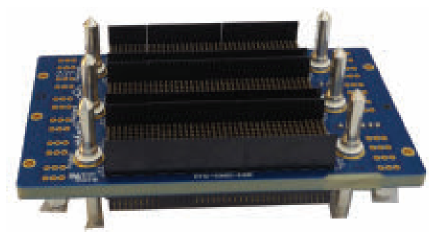
TE Connectivity in Harrisburg, Pa., is introducing the STRADA Whisper cable receptacles to enable engineers to start designing for up to 112G PAM-4 data rates in servers, switches, and routers. These cable receptacles incorporate STRADA Whisper connectors on one end and connect to other high-speed solutions on the other — including backplane, mid-board, or input/output (I/O) products. TE's STRADA Whisper cable receptacles are for maintaining optimized signal integrity at high frequencies. The cabled receptacles can also save space on the circuit board in dense equipment designs. The STRADA Whisper cable receptacle may be compatible with TE's backplane, mid-board, and I/O products including small-form-factor pluggable, quad small-form-factor pluggable, quad small-form-factor pluggable double density. For more information contact TE Connectivity online at www.te.com.



BACKPLANES

3-slot 3U OpenVPX embedded computing backplane introduced by Pixus

Pixus Technologies in Waterloo, Ontario, is introducing a three-slot 3U OpenVPX backplane with the ultra-rugged KVPX style connector for harsh-environment aerospace applications. Compliant to the VITA 63.0 Hyperboloid Alternative Connector for VPX standard, the backplane features a BKP3-CEN03-15.2.9 routing profile. Options include conformal coating and the installation of Rear Transition Module (RTM) connectors. The initial embedded computing design was built to support PCI Express Gen3 speeds, but Pixus offers versions of its standard OpenVPX backplanes as fast as 100 Gigabit Ethernet. For more information contact Pixus Technologies online at https://pixustechnologies.com. ←



RUGGEDIZED CONNECTIVITY SOLUTIONS KEEP NETWORKS OPERATING – ANYTIME. . .ANYWHERE.

SAME-DAY SHIPPING

CUSTOM CAPABILITIES

GLOBAL CONNECTIVITY

Available for Same-Day Shipping!

OPERATING IN A HARSH ENVIRONMENT?

Are you operating in a harsh environment where cabling and interconnectivity components must withstand temperature extremes, moisture, corrosive materials, shock and vibration? To address these challenges L-com delivers connectivity solutions to keep your networks operating – ***anytime…anywhere.***

- **Weatherproof and Waterproof**
- **Resilient to Temperature Extremes**
- **EMI and RFI Resistant**
- **Shock, Vibration, Corrosive Materials Protection**

Our ruggedized connectivity solutions are in stock and available for same-day shipping.

Learn more at:
www.L-com.com/ruggedized-solutions
+1 (800) 341-5266

L-com™ an INFINITE brand

RUGGED SERVERS, ENGINEERED TO SERVE.

RUGGED, EXPANDABLE 1U/2U, FANLESS INTEL® SCALABLE XEON® SERVER

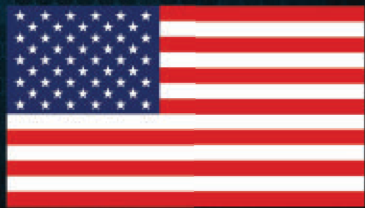
"TITAN" SMB

Dual/Quad Intel® Scalable	Removable Cartridges	8 Copper/Fiber	Air and Conduction Cooled
Xeon® CPUs	**16x SSDs**	**1/10/40 Gb**	**-20° to +55°C**
Up to 28 cores each	SATA/SAS/NVMe Gen 3	Ethernet Ports	Available Rugged Level 1-5

KEY FEATURES

- Dual or Quad Intel® Scalable Xeon® processors w/ up to 28 cores (2.50 GHz) and Turbo Boost (3.80 GHz) (server-class processors: Platinum and Gold)
- Air and conduction-cooled (sealed) versions with commercial (COTS) connectors or mil-circular 38999 connectors for ultimate reliability
- Available in 1U and 2U variants, with either dual (2S) or quad (4S) CPUs
- 3x UPI (10.4 GT/s) interconnects for HPEC, SMP, NUMA architecture
- Up to 1 TB DDR4 ECC memory (8 DIMMs) per CPU
- Up to 10 PCIe Gen 3 add-in cards (4x in 1U and 10x in 2U; factory-installed)
- Optional 20-port segregated Ethernet and 10GbE switch in TITAN-2U
- AI version > 400 TFLOPs supports up to 4x Nvidia V100 GPGPUs in 2U
- Encryption and security via Intel® AES-NI/Trusted Platform Module 2.0 (TPM)
- Dual-redundant MIL-STD-1275 500W power supplies
- Optional MIL-STD-704F power supplies with 50 ms hold-up
- Complete custom and COTS standard configurations available

100% AMERICAN MADE



"Server hardware exploits, banned Chinese electronics and a trade war are a wake-up call." *Ben Sharfi, GMS CEO*

BUY AMERICAN SERVERS AGAIN!

GMS

GENERAL MICRO SYSTEMS, INC.

TRUSTED AND DEPLOYED SINCE 1979

(800) 307-4863 / GMS4SBC.COM

All General Micro Systems, Inc. products are proudly designed and manufactured in the U.S.A.

All designs and logos are copyright © 2020 General Micro Systems, Inc. All rights reserved.