APRIL 2021

Military & Aerospace Electronics

RELEVANT. TRUSTED. ENABLING TECHNOLOGIES.

5G in space

U.S. Space Force searches companies to adapt 5G wireless networking to space uses. **PAGE 6**

The latest trends in power electronics

Power systems designers tackle power density, thermal management, open-architecture standards, and obsolescence management. **PAGE 23**

militaryaerospace.com

ARTIFICIAL INTELLIGENCE FOR UNMANNED VEHICLES

New enabling technologies to help unmanned systems swarm and make decisions without human intervention. **PAGE 14**

ENDEAVOR BUSINESS MEDIA

The Next Big Thing in RFSoC is Here.

(And it's only 2.5 inches wide!)

Now Available with Gen 3 RFSoC!

Small | Powerful | Deployable

Pentek's Model 6001 Gen 1 and 6003 Gen 3 RFSoC QuartzXM® modules let you quickly develop and deploy RFSoC technology, while optimizing your system for SWaP.

Mounted on your custom carrier or Pentek's proven 3U VPX, SOSA Aligned 3U VPX, PCIe and SFF platforms, both QuartzXM modules come pre-loaded with a full suite of IP modules, robust software, and fully integrated hardware — all geared to shorten time to market and reduce design risk.

And at only 4"x2.5", it can be deployed in extremely compact environments, including aircraft pods, unmanned vehicles, mast-mounted radars and more.

- **QuartzXM eXpress Module** speeds migration to custom form factors
- **Powerful Zynq® Ultrascale+™ RFSoC** with built-in wideband A/Ds, D/As and ARM processors
- **Dual 100 GigE** interfaces for extreme system connectivity
- **Robust Factory-Installed IP** for synchronous real-time data acquisition, waveform generation and more
- **Board Resources** include PCIe Gen.3 x8 and 16 GB DDR4 SDRAM
- **Navigator® Design Suite** BSP and FPGA design kit for seamless integration with Xilinx Vivado®

RFSoC Gen 3 Product Family

QUARTZ NAVIGATOR Design Suite

All this plus FREE lifetime applications support!

Unleash the Power of the RFSoC. Download the FREE White Paper!
www.pentek.com/go/marfsoc

SOSA Sensor Open Systems Architecture

30 YEARS

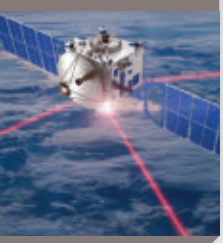
PENTEK
Setting the Standard for Digital Signal Processing

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

APRIL 2021
VOL. 32, NO. 4

Military & Aerospace Electronics

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.

BY **JOHN KELLER**, EDITOR IN CHIEF

How to build sensors rugged enough to withstand the extreme heat of hypersonic flight

One of the toughest design challenges of next-generation hypersonic munitions is developing navigation, guidance, sensors, and communications subsystems that are rugged enough to operate through the extreme heat, shock, and vibration of hypersonic flight.

Fortunately design trends are heading in the right direction with a U.S. military research program called High Enthalpy Aperture Technology (HEAT).

Hypersonics experts at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have chosen three U.S. technology companies to develop rugged RF radomes and infrared windows able to withstand the environmental extremes that future hypersonic missiles and aircraft must endure.

Hypersonic flight is unlike almost any other kind, as structures fly through the air faster than five times the speed of sound. How fast is MACH 5? It's 3,836 miles per hour; that's faster than one mile per second, and when it comes to future generations of hypersonic vehicles, MACH 5 will be at the slow end.

Experts are talking about future munitions that eventually could travel at speeds approaching MACH 20. That's 15,345 miles per hour, or more than four miles per second.

At those speeds the atmosphere at or near sea level imposes tremendous drag and friction on the structure of a missile, and creates a fiery environment akin to a spacecraft re-entering the Earth's atmosphere. Remember the 2003 disintegration of the Space Shuttle Columbia? It burned up on re-entry because some heat shielding failed, and killed seven crew members. A hypersonic munition must operate through even hotter conditions from firing to impact.

A missile traveling at MACH 5 must withstand temperatures hotter than 1,800 degrees Celsius (3,272 degrees Fahrenheit) at the leading edges like nose cones and wings. That's about 30 percent hotter than a blast furnace designed to melt steel.

It's one thing for a missile body to withstand hypersonic flight without burning up. It's quite another for sensitive navigation and guidance systems, electro-optical sensors, and radar systems to operate reliably in such difficult conditions.

That's where the DARPA HEAT program comes in. HEAT seeks to demonstrate new materials and design approaches to enable RF and infrared apertures on hypersonic missiles and aircraft to withstand extremes in heat and dynamic pressure.

So far three companies are developing materials to shield sensors from heat and vibration as part of the HEAT program: the General Electric GE Global Research Division in Niskayuna, N.Y.; the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla.; and the Georgia Tech Research Corp. in Atlanta.

Lockheed Martin won a $2.5 million HEAT contract on 11 Feb., Georgia Tech won an $8.3 million HEAT contract on 3 Feb., and GE Global Research won a $7.5 million contract on 4 March.

The HEAT program is a four-year, two-phase effort, which is divided into three technical areas: integrated RF aperture materials; infrared aperture materials; and next-generation aperture materials.

Lockheed Martin, Georgia Tech, and GE Global Research experts are looking into new materials that combine metals, ceramics, and coatings for high-performance structures, as well as new computational capabilities necessary to develop these materials.

The program's first phase, in progress now, is developing integrated aperture materials, and the future second phase will involve ground testing.

So it's clear that hypersonics isn't just about speed; it's about enabling electronic and electro-optical sensors to operate reliably in some of the harshest environments known. The HEAT program will take a big step in ensuring the success of future hypersonic munitions programs.

PASTERNACK®
an INFINITE brand

COTS High -Reliability RF Components

for Mission-Critical Applications

Pasternack serves the specialized needs of the military & defense sector with a large selection of COTS RF components and cable assemblies. These components are used in a wide range of Mil/Aero applications, from R&D and testing to missile systems, radar, and SATCOM.

Our wide selection of connectors, adapters, cable assemblies, electromechanical switches, amplifiers, and attenuators are in-stock and ready for same-day shipment—all orders placed by 6 PM CT ship the same day.

pasternack.com
+1 (866) 727-8376
+1 (949) 261-1920

In-Stock and Shipped Same-Day

Navy researchers are asking industry to develop a hypersonic weapon for the carrier-based F/A-18E/F jet fighter-bomber to attack high-priority targets.

Navy wants hypersonic weapons for carrier-based F/A-18E/F combat jet

BY **John Keller**

ARLINGTON, Va. — U.S. Navy aviation experts are asking industry to develop a prototype hypersonic missile to enable the carrier-based F/A-18E/F Super Hornet jet fighter bomber to attack high-priority targets while giving the enemy little time to deploy countermeasures.

Officials of the Office of Naval Research (ONR) in Arlington, Va., issued a special notice (N00014-21-S-SN06) for the Screaming Arrow project to arm the Navy Super Hornet with hypersonic weapons.

This project seeks to develop about three prototype Super Hornet-compatible hypersonic weapons for demonstration from F/A-18E/F combat aircraft that are operating aboard aircraft carriers. The prototype should consist of a cruiser, inter stage, and booster.

Demonstration will involve captive carriage, air launch separation, controlled flight, booster ignition, booster operation, separation the cruiser from the booster, cruiser-controlled flight, cruiser engine start, cruiser acceleration to cruise condition, cruiser at cruise condition, cruiser turndown, cruiser terminal phase flight trajectory, and cruiser flight impact of the hypersonic prototype.

The idea is to capitalize on previous and current hypersonic air-vehicle and propulsion developments to develop and field near-term hypersonic weapons for air-to-surface attack enemy surface warships and capital ships.

To make the hypersonic weapon compatible for deployment from aircraft carriers, the weapon must be no more than 15 feet long, 3.3 feet wide, and 3.75 feet high.

After initial design, the Screaming Arrow project will have three phases. The 7-month first phase will design a critical design of the all-up round. The 15-month second phase will fabricate components and subcomponents, and the 13-month third option will integrate the prototype with a Super Hornet aircraft for testing.

Companies interested were asked to submit full proposals by 8 April 2021 to FedConnect at www.fedconnect.net. The Navy will make three separate contract awards, which should be awarded by September. Email questions or concerns to the Navy's Kenneth Heeke at kenneth.heeke@navy.mil, or Jerome Kong at jerome.kong@navy.mil. Email business questions to James Farnsworth at james.farnsworth@navy.mil. More information is online at https://beta.sam.gov/opp/3425631c508e-439382f1a9dbafda110c/view.

The mainstream Multiprocessor CPU with a Built-in AI Accelerator 2nd Gen Intel® Xeon® Scalable Processors

FOR THE EDGE

NEW INTEL® XEON® GOLD 6238T PROCESSORS

UP TO 3.2X

AI INFERENCE PERFORMANCE WITH INTEL® DL BOOST

Compare to Intel® Xeon® Gold 6152 Processor

56 CHANNELS

VIDEO DECODE CAPABILITY

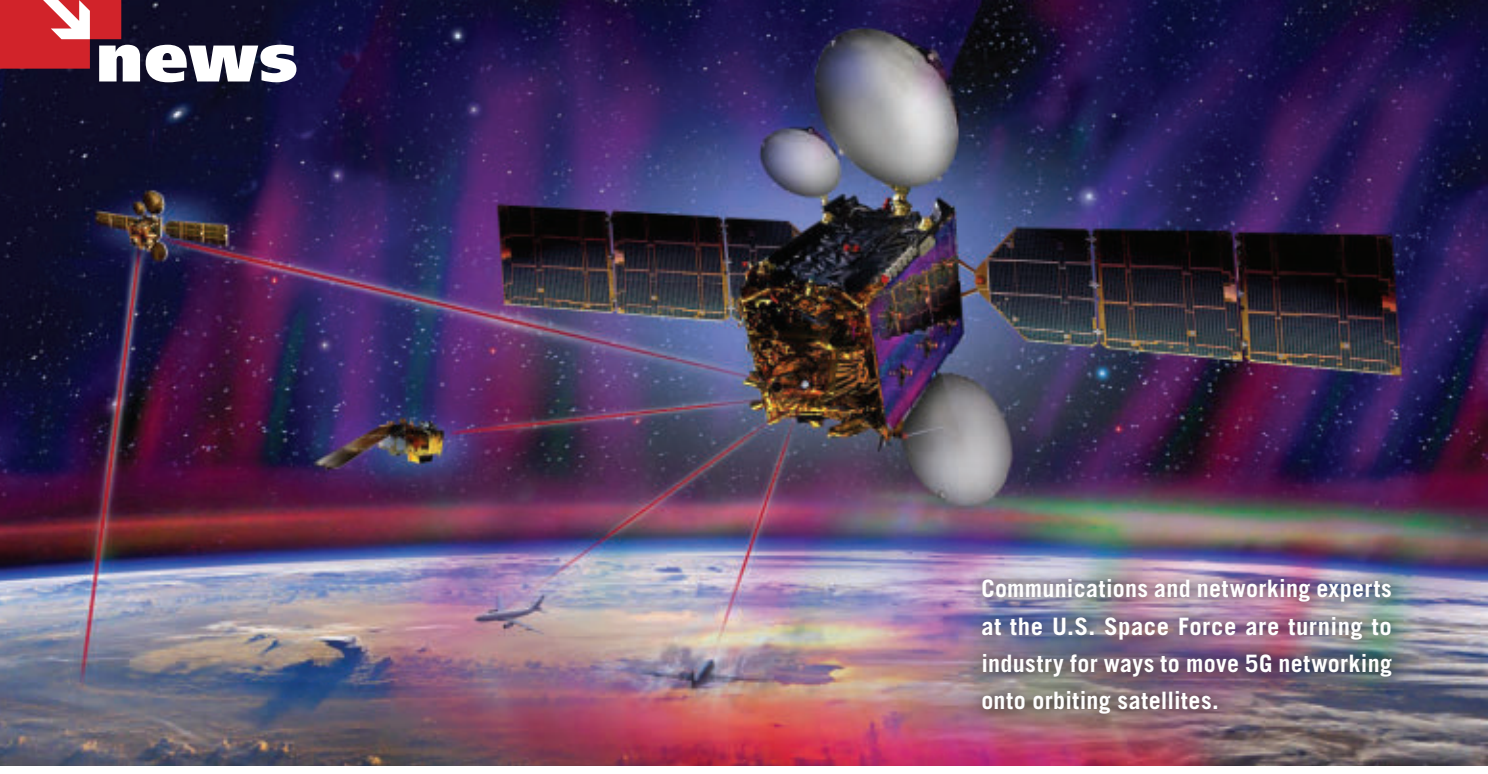
1080p30 Resolution, H.264/H.265

intel®

HARNESS THE POWER OF DATA INSIGHTS WITH INTEL® DEEP LEARNING BOOST

Performance results are based on testing as of dates in configuration and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks. Refer to http://software.intel.com/en-us/articles/optimization-notice for more information regarding performance and optimization choices in Intel software products. Results have been estimated or simulated.

Find out more about how Intel® Xeon® Scalable Processors bring AI Accelerator to the Edge at Intel.com/Processors



Communications and networking experts at the U.S. Space Force are turning to industry for ways to move 5G networking onto orbiting satellites.

U.S. Space Force reaches out to industry for companies able to adapt 5G wireless networking to space uses

BY **John Keller**

EL SEGUNDO, Calif. — U.S. Space Force communications experts are reaching out to industry to find companies able to adapt 5G networking, RF and microwave access, mobility support, and related big-data functions to U.S. orbiting satellites.

Officials of the Cross Mission Ground and Communications Enterprise (ECX) of the U.S. Space Force's Space and Missile Systems Center at Los Angeles Air Force Base in El Segundo, Calif., have issued a request for information (FA8806) for the 5G for Space Data Transport (SDT) project.

Space Force experts are looking for ways to capitalize on rapidly emerging 5G technologies to move data quickly and securely among military forces and command authorities through space networks.

Of particular interest are technologies involving 5G multiple-input and multiple output (MIMO); space millimeter waves; radio-access network slices; network slice orchestration; artificial intelligence (AI), machine learning, and deep learning; trusted autonomous networks; cyber security; 5G internet of space things (IoST); multi-tenant edge computing (MEC); 5G space-to-ground networks; and space network topologies.

MIMO seeks to enhance communications links between Earth and U.S. satellites, as well as communications links among satellites. Millimeter wave technology seeks to determine how small and inexpensive high-gain array antennas and 5G data links operating from 24 to 71 GHz provide data networking in space.

Radio access network slicing seeks to determine how to adapt 5G network slicing to connecting a space operations center through ground-based networks into a space network and then to specific satellites.

Network slice orchestration seeks to find ways for the government to employ 5G cloud-based and hybrid network slices to manage dozens, hundreds, or potentially even thousands of space network slices.

AI, machine learning, and deep learning seeks to determine which 5G AI and machine-learning tools could recognize message streams and analyze content to rank data streams by content type. This could enable experts to store data in a multi-tenant edge computing node and send it later.

Trusted autonomous networks seeks to enable Space Force experts to look ahead to 6G intelligent radio, cognitive radio, autonomic networking, and network orchestration.

Cyber security seeks to determine which 5G cyber security could protect complex space networks from unauthorized access and manipulation. Space Force officials also want to learn industry capabilities in 5G Internet of Space Things enabling technologies.

Multi-tenant edge computing seeks to discover the best opportunities for this technology in space and in ground-support networks. Network topologies, meanwhile, seek to determine the right mix of copper, optical fiber and free-space lasers for building-out ground networks.

Companies interested were asked to email responses by 18 March 2021 to the Space Force's Lakisha Porter at Lakisha.porter@spaceforce.mil. Email questions or concerns to Lakisha Porter at Lakisha.porter@spaceforce.mil, or to Helen Bloomfield at helen.bloomfield.2@us.af.mil. More information is online at https://beta.sam.gov/opp/8edcadbb-56764ca1a53f7cf6322c76d5/view.

GE Global Research to enable sensors to withstand the shock and heat of hypersonic flight

U.S. military researchers are asking General Electric Co. to develop rugged RF radomes and infrared windows able to withstand the severe heat, shock, and vibration of hypersonic flight. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced a $7.5 million contract to the General Electric GE Global Research Division in Niskayuna, N.Y., for the High Enthalpy Aperture Technology (HEAT) project. HEAT seeks to demonstrate new material approaches and solutions to enable RF and infrared apertures on hypersonic missiles and aircraft to withstand extremes in heat and dynamic pressure. Hypersonic vehicles typically fly faster than five times the speed of sound. GE Global Research joins the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla., and the Georgia

Continued on page 9

Military wants uncooled longwave infrared sensors for high-resolution surveillance

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry to develop uncooled longwave infrared imaging sensors for applications like security, surveillance, industrial monitoring, and autonomous vehicle navigation.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) opportunity for the Extreme Photon Imaging Capability-Long Wave Infrared (EPIC-LWIR) project.

Developmental infrared sensors resulting from this project should be based on advanced nanocrystalline materials with low noise equivalent difference temperature (NEDT), high pixel density, and frame rates exceeding those of typical microbolometers.

Sensors developed should have noise equivalent difference temperature of less than 20 microKelvin; pixel sizes smaller than 20 microns; offer resolutions of 2,048 by 2,048 pixels or better; and frame rates of at least 120 Hz.

Nanocrystalline and low dimensional materials such as quantum dots have gained substantial interest because of their desirable properties like tunable bandgap energies, quantum confinement, multi-exciton generation, and phonon quenching, DARPA researchers explain.

Such materials hold promise as high-performance photon absorbers operating at room temperature and can be tailored to the longwave infrared region of the electromagnetic spectrum where many applications of interest exist.

In addition, these materials often are amenable to solution processing techniques that could lead to low-cost imagers with small pixel sizes while avoiding hybridization with silicon-based complementary metal oxide semiconductors or other forms of readout circuitry.

Yet many challenges remain in using such materials to produce practical devices such as poor charge transport, high dark currents, limited scalability of assembly processes, limited lifetimes, or poor stability.

DARPA researchers want industry to develop materials and processes culminating in the production of Technology Readiness Level (TRL) 5 prototype devices and the generation of test object images. TRL-5 refers to developmental technologies.

The project's first phase will last for six months, and will demonstrate the feasibility of the technology. The second phase will last for three years and will produce a developmental prototype. the third phase, if pursued, will involve technology applications in security, autonomous systems, safety, energy conservation, and equipment monitoring.

DARPA wants to push the bounds of longwave infrared sensors to enable high-resolution surveillance with uncooled devices.

Companies interested were asked to submit 20-page phase-one proposals by 20 April 2021 to the DOD SBIR/STTR Proposal Submission website at www.dodsbirsttr.mil/submissions. Email questions or concerns to DARPA at HR001121S0007@darpa.mil, with BAA HR001121S0007-04 in the subject line. More information is online at https://beta.sam.gov/opp/ad4182d8822149858e69c2706f819273/view.

Continued from page 7

Tech Research Corp. in Atlanta on the HEAT project. Lockheed Martin won a $2.5 million HEAT contract on 11 Feb., and Georgia Tech won an $8.3 million HEAT contract on 3 Feb. High-speed aerospace systems like hypersonics require RF radomes or infrared windows to protect sensitive electronics from the environmental extremes of high-speed flight while providing transparency for radar and RF communications transceivers and infrared sensors used for guidance, communications, and sensing.

Raytheon to redesign and recertify embedded computing in ageing AMRAAM missile

Airborne weapons designers at Raytheon Technologies Corp. will redesign and recertify embedded computing components in one of the nation's most sophisticated radar-guided air-to-air missiles for the U.S. Air Force, Navy, and military allies under terms of a $17.9 million order. Officials of the Air Force Life Cycle Manager Center at Eglin Air Force Base, Fla., are asking the Raytheon Missiles & Defense segment in Tucson, Ariz., to recertify a new synchronous dynamic random-access memory (SDRAM) on the AMRAAM's central processor circuit card. The air-to-air missile contract also asks Raytheon to make lifetime buys of known obsolete components to keep the missiles operational for the foreseeable future. Although AMRAAM is one of the world's most advanced radar-guided air-to-air missiles, it's not a new system. It has been in service for three decades, first seeing deployment in 1991. Over the course of the missile's lifetime, some of its electronic components have gone obsolete, which makes them difficult to obtain for repairs and upgrades. Raytheon will make lifetime buys of all known obsolete AMRAAM components from integrated circuit manufacturers and electronics distributors, and will stockpile them to accommodate future needs.

Air Force searches for ways to protect critical infrastructure from EMP attack

A U.S. Air Force base in Texas is getting ready to test its infrastructure against an electromagnetic pulse (EMP) attack and needs to do preliminary site

Continued on page 13

Navy needs new materials for microwave vacuum tubes used in radar

BY **John Keller**

CRANE, Ind. — U.S. Navy radar experts are approaching industry to find alternative electronic manufacturing and materials for microwave vacuum tubes because existing materials are expensive and difficult to obtain.

Officials of the Naval Surface Warfare Center Crane Division (NSWC-Crane) in Crane, Ind., have issued a request for information (N0016421SNB27) for the Thoriated Tungsten Replacement for High Power Microwave Vacuum Tubes project.

Navy experts are trying to find companies able to develop alternative domestic manufacturing processes for thoriated tungsten wire or develop wires with alternative chemistries and equivalent operational characteristics to replace thoriated tungsten wire.

Processes that companies can develop under this process will help the Navy build and sustain high-power microwave devices that use thoriated tungsten wire until 2045, and potentially longer, officials say.

NSWC-Crane is responsible for sustaining deployed Navy radar. Experts note that several deployed radar systems rely on microwave vacuum tubes containing an emissive thoriated tungsten filament cathode to amplify the radar signal.

As vacuum tubes operate over time, the emissivity of the thoriated tungsten filaments decays due to the evaporation of the thorium. Technicians can restore the quality of thoriated tungsten by taking the tubes apart and replacing the filament.

The Thoriated Tungsten Replacement for High Power Microwave Vacuum Tubes project seeks alternative domestic manufacturing processes for materials found in radar vacuum tubes.

Radar designers use thoriated tungsten in tube filaments because of its outstanding electron emission capabilities. The thorium oxide within the wire provides an effective source of electrons, and the tungsten enables the wire to operate at high temperatures without deforming.

Today, however, the traditional supply of high reliability, high temperature, thoriated tungsten wire is dwindling, hence the need to find new ways to manufacture it, or find environmentally friendly new materials that can substitute for it in microwave vacuum tube designs.

Navy experts are looking for new ways to produce thoriated tungsten with a minimal amount of hazardous waste, or find a new non-hazardous manufacturing process to produce a near-equivalent to today's thoriated tungsten chemistries.

Current versions of the wire are about one percent thorium oxide, and the rest is high-quality tungsten. Thorium oxide is finely distributed throughout the wire to provide consistent electron emission, yet surface coatings with the same lifetime and performance are acceptable. The wire must have a low work function and resist deformation under temperatures hotter than 1,600 degrees Celsius.

Finding new chemistries may involve alloys cerium and lanthanum with tungsten wire, and other chemistries with equivalent performance and lifetime also are of interest.

Proposed solutions must have about the same performance as thoriated tungsten wire; measure 0.006 to 0.010 in diameter; be able to handle six to eight volts AC and 93 to 106 amps; and operate in temperatures as high as 1,500 to 1,700 C.

Companies interested were asked to email six-page responses by 26 Feb. 2021 with pertinent company information, which of the two kinds of solutions they will pursue, and specifics of their solutions to the Indiana Innovation Institute at TechBridge@IN3Indiana.com. More information is online at https://beta.sam.gov/opp/a54892a040e14f558f0aec00b324e6fa/view.

PICO

The big name in miniature components.

Transformers & Inductors, DC-DC Converters, AC-DC Power Supplies

The most demanding applications require the world's most reliable components. For over 50 years PICO Electronics has been providing innovative COTS and custom solutions for Military, Commercial, Aerospace and Industrial applications. Our innovative miniature and sub-miniature components are unsurpassed in any industry. PICO Electronics' products are proudly manufactured in the USA and are AS9100D Certified.

To learn more about our products and how you can benefit from our expertise visit our website at picoelectronics.com or call us today at 800-431-1064.

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

TRANSFORMERS & INDUCTORS

Think Pico Small - Over 5000 std Ultra Miniature

- Ultra Miniature Designs
- MIL-PRF 27/MIL-PRF 21038
- DSCC Approved Manufacturing
- Audio/Pulse/Power/EMI Multiplex Models Available
- For Critical Applications, Pico Continues to Be the Industry Standard

Surface Mount & Thru Hole

Military • COTS • Industrial

DC-DC CONVERTERS

2V to 10,000 VDC Outputs — 1-300 Watt Modules

- MIL/COTS/Industrial Models
- Regulated/Isolated/Adjustable Programmable Standard Models
- New High Input Voltages to 900VDC
- AS9100C Facility/US Manufactured
- Military Upgrades and Custom Modules Available

AS9100D CERTIFIED TUV

VISA MasterCard

PICO Electronics Inc.

143 Sparks Ave, Pelham, NY 10803

Call Toll Free: 800-431-1064

E Mail: Info@picoelectronics.com • FAX: 914-738-8225

VISIT OUR EXCITING NEW WEBSITE: www.picoelectronics.com

Wanted: exoskeleton technologies to boost endurance and lift heavy loads

BY **John Keller**

Photo (above): U.S. Army leaders are taking another look at exoskeleton technology to enable soldiers to traverse difficult terrain and lift heavy loads.

NATICK, Mass. — U.S. Army robotics experts are reaching out to industry to find companies able to develop exoskeleton technologies to improve soldier performance during repetitive tasks on the battlefield or in moving cargo.

Officials of the Army Natick soldier Systems Center in Natick, Mass., released a request for information (W911QY-21-R-CDDC-EXO) in February for the Powered and Unpowered Exoskeletons for Human Performance Augmentation During Maneuver or Logistics Support Activities project.

Army experts see exoskeletons as a promising way to improve soldier strength, endurance, and ergonomics safely and while reducing the risk of physical injury while lifting heavy loads, traversing challenging terrain, or carrying out repetitive motion.

This notice is to help Army researchers evaluate the state of the exoskeleton market and its enabling technologies. Researchers primarily are interested in exoskeleton solutions at technology readiness level (TRL) 5, which describes breadboard technology that can be in simulated or real-life environments.

Army experts say they particularly are interested in exoskeleton technologies for the automotive industry, other government agencies, or in related applications.

Exoskeleton technologies should be able to augment soldier strength and productivity, or reduce risk of injury during lifting, loading, unloading, and transporting. Proposed solutions should be compatible with tools or other common military service load interfaces.

Solutions should be for lightweight but ergonomically challenging jobs like tool use or overhead work from a variety of postures. Experts also want exoskeleton technologies that enable one soldier to lift more than

50 pounds, or several soldiers to load and unload objects larger than 100 pounds.

Technologies may enable multi-person load handling tasks to be performed safely by one warfighter. Solutions should reduce workloads to enable soldiers to carry heavy loads for long distances at quick speeds.

Researchers are interested in exoskeletons that help soldiers walk and march while carrying loads as heavy as 99 to 136 pounds. Technologies also should help soldiers carry loads as large as 75 to 90 pounds while in crouched postures, climbing stairs, or crawling in tight spaces, or maneuvering on the battlefield.

Exoskeletons also should be able to help soldiers break down doors, carry out close-quarters battle maneuvers, dig and fill sandbags, carry injured warfighters who weigh as much as 270 pounds, load and unload pallets, maintain aircraft or vehicles at overhead heights, jump from high places, and recover quickly after parachuting.

Companies interested were asked to email five-page white papers in .PDF form to the Army's Chad Haering by 12 March 2021 to chad.w.haering.civ@mail.mil. More information is online at https://beta.sam.gov/opp/943d1bc778ac4eac818b251a898be0f7/view.

Continued from page 9

surveys to design future tests. Officials at Joint Base San Antonio in San Antonio, Texas, have issued a solicitation for an EMP-tailored survey of how to protect the installation's petroleum, oil, and lubrication complex — several buildings in two areas of the base connected by an underground pipeline. The Air Force is conducting this test in adherence with an executive order requiring the military and key agencies involved in securing critical infrastructure to put more resources into defending against EMP attacks, in which electromagnetic waves have the potential to knock out all electronic components. The initial tests won't include actual electromagnetic waves, but instead will review engineering plans, schematics and other documentation to determine which infrastructure is vulnerable to EMP. That work will go into a report to inform the next stage of EMP vulnerability testing.

Navy asks L3Harris for 19 AN/ALQ-214 A(V)4 airborne electronic warfare (EW) jammers for the F/A-18 aircraft

Airborne electronic warfare (EW) experts at L3Harris Technologies Inc. will provide the U.S. Navy with 19 sophisticated EW systems designed to protect Navy combat aircraft from incoming radar-guided missiles. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $72.4 million order to L3Harris Technologies in Clifton, N.J., to build 19 lot 18 AN/ALQ-214 A(V)4 onboard jammers for the F/A-18 carrier-based jet fighter-bomber aircraft. The AN/ALQ-214(V)4/5 is an electronic jammer component of the integrated defensive electronic counter measures system (IDECM) avionics, which comes to the Navy from a joint venture of Harris and BAE Systems. It protects Navy fighter-bombers from radar-guided surface-to-air and air-to-air missiles by jamming the enemy missile guidance systems. The ALQ-214 component of the airborne IDECM EW system has been delivered to the Navy as well as to the Royal Australian Air Force for contemporary versions of the Boeing F/A-18 fighter-bomber. The system blends sensitive receivers and active countermeasures to form an electronic shield around the aircraft, Harris officials say. The RF countermeasure system aboard the Navy's F/A-18 jet fighter-bombers engages incoming missiles autonomously with a series of measures designed to protect the aircraft from detection.

Military considers non-lethal weapons like laser dazzlers and high-power microwaves

The U.S. military wants to arm small drones and manned vehicles with non-lethal weapons like low-power lasers and high-power microwaves, stun grenades, and stink bombs for unmanned aircraft, ground vehicles, surface ships, and submarines. Armies have traditionally only had a two options: use lethal force or don't use force at all. Yet a new generation of non-lethal weapons offers new options for armies preparing for information operations, cyber attacks, state-sponsored terrorism, and special forces operations. U.S. commanders who dread social media video of American troops firing bullets at a mob, would like a robot that can disperse rioters with non-lethal lasers or microwave cannon.

Artificial intelligence and machine learning for unmanned vehicles

Military experts are developing new enabling technologies to help unmanned aircraft, ground vehicles, submarines, and surface vessels swarm and make decisions without human intervention.

BY **Jamie Whitney**

What was once the realm science fiction writers is growing as unmanned vehicles are given more capability for autonomous decision making thanks to improvements in artificial intelligence (AI) and machine learning.

First, unmanned aerial vehicles (UAVs) took to the skies. In fact, the British military developed the first radio-controlled unmanned aircraft during World War I — a scant 14 years after the Wright Brothers' first flight in 1903. UAVs really came into their own during the Vietnam War and have become even more prevalent and essential since then.

As UAVs proved themselves more invaluable over the years, the Department of Defense (DOD) asked industry experts to bring the unmanned revolution down to Earth in the form of unmanned ground vehicles (UGVs) and even to the seas with unmanned underwater vehicles (UUVs).

Though each domain had unique problems to solve, the difficulty communicating from the surface to UUVs meant a greater need for machine autonomy — the ability to make decisions without direct human input — made possible with artificial intelligence (AI) and machine learning (machine learning).

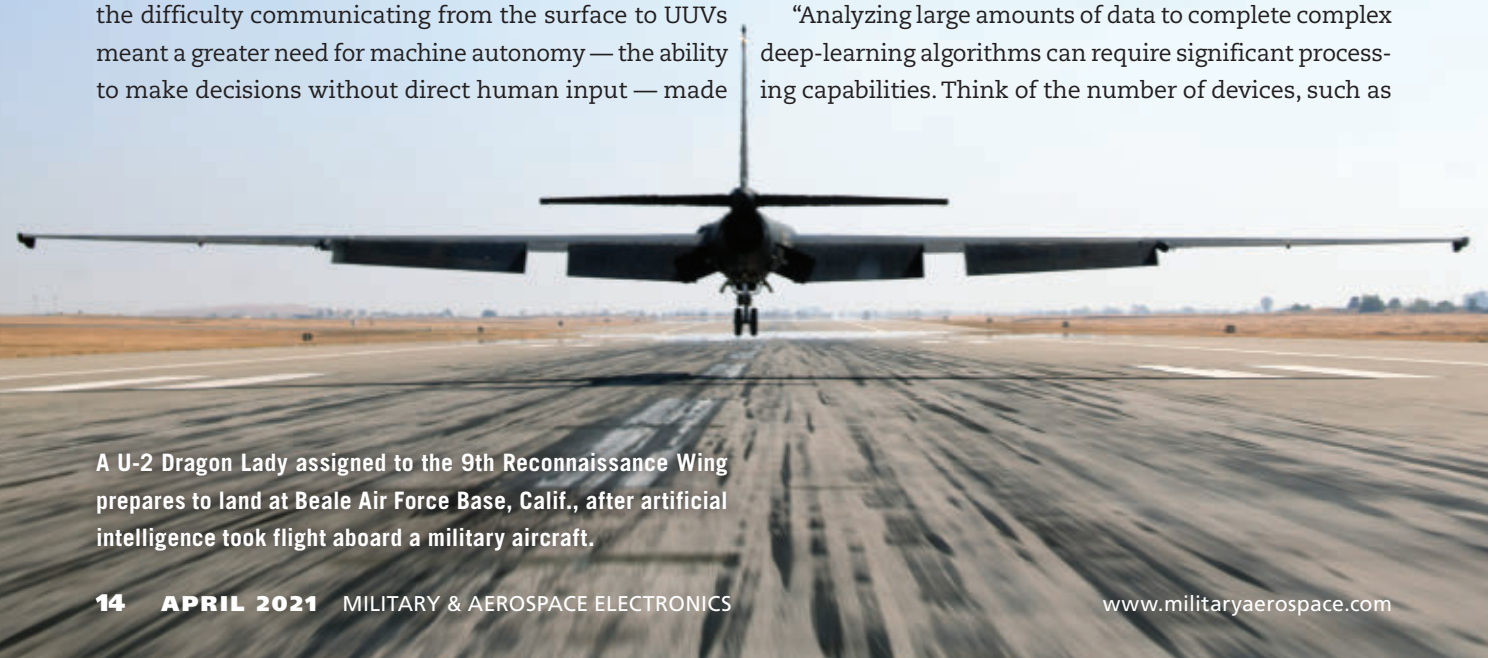
Even though radio frequency (RF) and satellite communications (SATCOM) methods allow for relatively easy contact with UGVs and UAVs, the prospect of "smart" unmanned systems on the ground and in the sky also is helping drive the autonomous revolution.

Processing power

The ability for unmanned systems underwater, on the ground, and in the skies with full autonomy requires a lot of processing power.

Mike Southworth, the senior product manager at Curtiss-Wright Defense Solutions division in Salt Lake City notes that tying together all the different technologies needed to make a vehicle autonomous is a large source for the need for big computing power.

"Analyzing large amounts of data to complete complex deep-learning algorithms can require significant processing capabilities. Think of the number of devices, such as



A U-2 Dragon Lady assigned to the 9th Reconnaissance Wing prepares to land at Beale Air Force Base, Calif., after artificial intelligence took flight aboard a military aircraft.

COTS High Reliability RF Components

Fairview Microwave serves the specialized needs of the military & defense sector with a large selection of in-stock RF components and cable assemblies. These components are used in a wide range of Mil/Aero applications, from R&D and testing to missile systems, radar, and SATCOM.

Our wide selection of connectors, adapters, cable assemblies, electromechanical switches, amplifiers, and attenuators are in-stock and ready for same-day shipment. All orders placed by 6 PM CT ship the same day.

The Right RF Parts Right Away

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

Fairview Microwave™
an INFINITE brand

An XQ-58A Valkyrie low-cost unmanned aerial vehicle launches at the U.S. Army Yuma Proving Ground, Ariz., to demonstrate new communications ability to exchange information with other aircraft.

cameras and sensors, that are required for an autonomous vehicle to safely drive without human intervention, for example," Southworth says. "The more devices there are collecting data, the higher the competition for bandwidth. That's why so much of today's data processing for AI takes place within traditional computer data centers.

"Relying on centralized processing exclusively at the data center has inherent limitations, however, including bandwidth, security, and availability," Southworth continues. "Consider the paradigm where all of the sensor data is uploaded to a centralized data center for processing, and then edge computers wait for a response from the data center to execute a command. If relying on the cloud alone, there could be a tangible delay or latency, comparing when an application issues an instruction and when it receives a response. Autonomous vehicles may need real-time vision and perception for safe navigation, path planning, or active protection. Imagine the consequences in a battlefield scenario where an incoming threat is detected, but there's a measurable network delay before any countermeasures can be taken. Lives may be lost while threats are not eliminated. High-performance embedded computing integrated onto vehicle platforms can potentially overcome those obstacles and enable deep learning on the battlefield."

Airmen watch a test of an unmanned ground vehicle at Tyndall Air Force Base, Fla., as part of a plan to use the "computerized canines" to aid in reconnaissance and enhanced security patrolling operations across the base.

Embedded computing

When it comes to unmanned systems — no matter the domain — size matters. With the need for many integrated technologies to fit into something with a finite footprint, high-performance embedded computing (HPEC) helps make it all possible.

"As an industry, we are always trying to get more out of the systems we develop. HPEC computing, when coupled with AI capabilities, brings forth a powerful computing

solution in a SWaP [size, weight, and power]-optimized form factor," says Valerie Andrew, who manages strategic marketing and communication for embedded computing specialist Elma Electronic Inc. in Fremont, Calif. "With the large number of data points in use within any given embedded system, having the high-performance infrastructure to manage and process that information, which in turn fuels AI and deep learning, gives unmanned systems access to on-demand intelligence that can be used for operational activities."

Andrew, who also is the Sensor Open Systems Architecture Consortium Business Working Group Outreach Lead, notes that the DOD's move to interoperability through a common modular open systems architecture (MOSA), can remove barriers to development — even in unmanned systems built around AI.

"Advanced learning technologies will become even more critical, not just, 'do these systems work together,'" Andrew says. "This will be exponential in terms of system functionality, where more rapid development and deployment of unmanned systems will start to take place. For the DOD, this means having access to best-in-class technologies fast and affordably. For the warfighter, it means increased knowledge and decision-making abilities during a mission."

There are twofold benefits of using HPEC in independent or partially independent embedded supercomputers, says Dan Mor, director of video and general-purpose graphic processing unit (GPGPU) product line at Aitech Defense Systems Inc. in Chatsworth, Calif.

"HPEC systems enable far more functionality to be housed in a smaller framework, so that processing of larger datasets can happen closer to the sensor, where it is needed most," Mor says. "And ruggedizing these HPEC systems means computing power can be used in a wider number of remote and mobile locations. As these processing demands increase, SFF systems using GPGPU technology and AI-based solutions are providing a path to next generation embedded systems, poised to tackle the growing field of mobile, unmanned and autonomous vehicle technologies, bringing computing power to areas never-before conceivable."

Small form factor

Aneesh Kothari, vice president of marketing at Systel Inc. in Sugar Land, Texas, says that unmanned systems can take advantage of on-board AI and machine learning to reduce liabilities brought on by the realities of operating in a contested environment.

"High-performance embedded edge computing is critical to deployed AI mission success. Operating in a contested environment with restricted bandwidth and degraded communications make the tactical use of cloud-based computing and AI a liability. Computational processing capability must reside on-premise to ensure the low latency and near real-time speed demanded of AI-based applications. Advances in COTS (commercial off-the-shelf) technologies in recent years have allowed for practical embedded edge computing use in unmanned vehicles," Kothari says. "Systel's rugged embedded systems such as Kite-Strike and Raven-Strike integrate commercial hardware components such as video capture cards and encoders, and the latest NVIDIA Ampere-based and Jetson Xavier GPUs in small-form factor (SFF) rugged embedded computers, making them ideal for use in unmanned vehicles."

With high-powered embedded computers providing the processing power needed to run the "smarts" of the AI and machine learning technology keeping UAVs, UUVs, and UGVs on the move, there is a need to keep everything in the vehicle cool.

Mercury Systems in Andover, Mass., provides several processing solutions for the military-aerospace sector. Mercury's Karen Haigh, who is the company's chief technologist, says that cooling is key for unmanned systems.

"Higher, bigger processing power is needed for these unmanned systems, so when you compute, you generate heat. So, the better you can control the heat through a cooling system, the more you can get done in a smaller space. As things get smaller, it gets hotter in a more compact space. So you need to be able to cool it more effectively. And if you've got a system that you can't stick a fan on the back of the computer to make it not get hot, you need to be able to do these things in these tiny spaces under high difficulty.

"So, at the bottom of the sea bed, you're not going to be wanting to have anywhere near the same kinds of solutions that you would like on your desk at home," Haigh continues. "The more you militarize, the more you need a cooling breakthrough in there to come together nicely, to be able to give the capability to those systems."

Sagetech Avionics in White Salmon, Wash., provides transponder and UAS situational awareness solutions to the unmanned aerial sector in both the military and civilian market. The company's CEO, Tom Furey, agreed about the importance of keeping unmanned systems cool.

"Microelectronics continue to evolve and enable innovation in shrinking both the size and heat generated by high power electronics. For example, Sagetech achieves dramatic SWaP reductions with advanced microelectronics design that includes creative heat channeling to enable better thermal performance without relying on large, heavy heat sinks or low reliability components such as fans," Furey says.

"Heat dissipation is one of the most critical aspects to consider when designing an enclosure," agrees Elma's Andrew. "Because of the modularity of small-form-factor (SFF) systems, there is no one-size-fits-all, which increases the complexity of thermal management in today's embedded computing systems. Relying on well-established design principles, based on a holistic systems approach, allows manufacturers to

Marines participate in a command and control exercise at the Marine Corps Air Ground Combat Center at Twentynine Palms, Calif. Command and control is one area of military operations that's being looked at for enhancement with artificial intelligence.

produce custom-tailored enclosures for modern electronics applications, while keeping design costs to a minimum and heat profiles stable."

AI and the warfighter

The principal advantage of technology enabling autonomous unmanned systems is in the name — warfighters are kept further from harm's way. Sending a UUV out to waters that are potentially mined means it is far less likely for a ship and her crew to be put in a dangerous situation. The same goes for recognizance work in the air and on the ground.

"There is growing creativity in the defense community for how man-unmanned teaming may play out," says Curtiss-Wright's Southworth. "UUVs, for example, will be helping larger maritime vessels with detecting mines, doing rapid environment assessments (REAs), intelligence, surveillance, and reconnaissance (ISR), oceanographic data gathering, and harbor and coastal surveillance and protection. UGVs are also being developed for medical evacuation of injured warfighters. A downed soldier or ally could signal that an ambulance is needed, and an armored autonomous vehicle could then be dispatched, plan the safest route in and out of the area, and come to the rescue of the wounded.

Capt. Lee M. Todd, an engineer at the Air Force Research Laboratory, briefs media during the release of the Small Unmanned Aircraft System Flight Plan at the Pentagon Conference Center.

"Autonomous weapon systems may detect enemies or potential threats. Once a threat has been identified and queued, the system could fire back automatically or rely on a human-in-the-loop to make the decision, Southworth continues.

Sailors prepare an unmanned underwater vehicle in the Persian Gulf during Mine Countermeasures Exercise 19-1, a training event with the British Royal Navy.

"The same is true of equipment or supply transport."

AI and unmanned vehicles particularly are useful to protect groups of ships. "Convoys historically have been at risk of improvised explosive devices (IEDs) that can gravely injure soldiers," Curtiss-Wright's Southworth says. "Autonomous vehicles can now patrol ahead of convoys to detect IEDs, identify them, and mark the area. Having an unmanned vehicle in the front of a convoy could end up saving thousands of lives. Eventually, the entire convoy could be made up of unmanned vehicles."

Swarms of unmanned vehicles communicating and working together is another big potential payoff of unmanned and AI technologies. "Another application for unmanned vehicles involves swarm intelligence where a group of drones, usually UAVs, self-organize into a coherent swarm, flying in synchrony without colliding," Southworth says. "Multiple drones, for example, can survey an area of the battlefield and identify any enemy threats within the view of any one of the vehicles. Rather than flying a pre-programmed route and following a pre-programmed position, each drone tracks its own position and velocity, sharing that information with the rest of the swarm. This way they can self-navigate around obstacles, avoid enemy fire, and explore areas where they might notice a large contingent of enemy warfighters."

Persistent surveillance

Aitech's Mor says artificial intelligence helps the warfighter by providing real-time information persistently.

"There are several military applications already employing AI-based supercomputers, such as situation awareness systems, EW systems and drones as well as smart soldier and man-portable systems and augmented reality, but especially noteworthy is the growing set of UAVs using this technology," Mor says. With some AI-based SWaP-optimized supercomputers offering an ultra-compact footprint, roughly the size of a cell phone, unmanned systems can achieve incredibly high performance with remarkable levels of energy efficiency. They can operate longer during a mission, offer better reliability and provide real-time data inputs by processing and transmitting that data back the main command center."

Other areas of unmanned systems innovation include building on existing vehicle platforms to extend the function of a single vehicle, Mor continues. "For example, a fighter jet may have several UVS synced up to its inflight control center, extending its reach from one large aircraft to include several smaller units that act as a mini army, all working together and controlled by the pilot of the larger aircraft. This effectively extends the amount of airspace one craft can cover."

Mercury's Haigh notes that the small sizes achieved by unmanned systems coupled with high endurance keeps people out of danger.

"Broadly speaking, if you've got an unmanned device, you can go into spaces that the human can't. That might be, for example, going into Fukushima or Chernobyl or going down to the seabed and spending a lot of time there without having to worry about the limits of the human body. You've got these amazing sensor systems that you can expand your eyes and ears outside of where the human body can go and in a much safer fashion, even when it's in the air, for example, and you're just extending the reach of the sensing, but you still have the communications and it's not necessarily dangerous to the human being."

In addition, rapidly-disseminated information helps commanders give orders faster than if they were relying on a warfighter with binoculars and a radio.

"Adding AI/machine learning capabilities enhance rapid decision making at the front," says Alex Wilson, the director of aerospace and defense industry solutions for real-time software specialist Wind River Systems in Alameda, Calif. "This provides the warfighter an advanced tool that can augment information and improve decision making speed and accuracy."

Elma's Andrew agrees about autonomous systems are helping to drive the ability to make better informed decisions.

"The military computing ecosystem, itself, is going through an evolution," Andrew informs. "Take the joint efforts between the DOD, government agencies and industry over the past two years that have resulted in a collaborative effort to adopt a common platform through the development of an open standard. The Open Group Sensor Open Systems Architecture has enabled collaboration across different industry boundaries that were not achievable before. These are the same principles throughout military electronics development: the sharing of information and working together to provide a more sound and secure system to be able to make more informed decisions. Autonomous systems will help contribute to this intelligence as well.

Wind River's Wilson also says the combination of autonomous and swarming systems with traditional warfighters "will rapidly increase the force projection allowing a smaller force to engage over a wider front. This enables greater flexibility in engagements and provides warfighter options to prosecute the mission effectively."

Beyond safety

AI and machine learning enables unmanned and manned systems like main battle tanks to offload some of the more monotonous situational work away from the crews at base or in the field.

"If you think about a group of humans doing a task, if they're well-coordinated, you can have a group of people accomplish something that a single individual can't," Mercury's Haigh says. "If you're thinking about looking for bodies in the World Trade Center, you can send your autonomous vehicles in to look for victims while the human is making the executive decision and making sure that everything is coordinated with the human response teams. So, your emergency response teams are focused once a victim has been found to go in and help that victim while the unmanned vehicles are doing the searching, the monotonous, unpleasant stuff that the humans aren't necessarily going to be wanting to do."

AI can help offload some of the military's more mundane activities, says Sandeep Neema, a program manager in U.S. Defense Advanced Research Projects Agency (DARPA) Information Innovation Office (I2O) in Arlington, Va. "The navigation functions for that tank should be reasonably offloadable. The warfighter is free from those burdens and focus more on the technical aspects of the battle. The autonomous future may be far in the future, but in the near horizon, it's not difficult to drive from point a to point b. What's rea0lly hard is getting a situation understanding."

Trustworthy autonomy

Neema's primary role at DARPA is as a part of the agency's Assured Autonomy program. He says DOD experts must ensure that military unmanned systems operate safely, and are constantly monitored, updated, and evaluated.

WHO'S WHO IN AI-BASED UNMANNED VEHICLES

Aitech Defense Systems, Inc.
Chatsworth, Calif.
aitechsystems.com/

Aurora Flight Sciences
Manassas, Va.
www.aurora.aero

Curtiss-Wright Corp. Defense Solutions
Ashburn, Va.
www.curtisswrightds.com

Elma Electronic
Chatsworth, Calif.
www.elma.com/

EpiSys Science Inc.
Poway, Calif.
www.episci.com

Eurotech
Amaro, Italy
www.eurotech.com/en

General Atomics Aeronautical Systems, Inc.
Poway, Calif.
www.ga-asi.com/

General Dynamics
Reston, Va.
www.gd.com/

Heron Systems Inc.
California, Md.
heronsystems.com

Leidos Innovations Center (LInC)
Reston, Va.
www.leidos.com/company/our-business/leidos-innovations-center

Lockheed Martin Corp.
Bethesda, Md.
www.lockheedmartin.com

Mercury Systems Inc.
Andover, Mass.
www.mrcy.com

Perspecta Labs
Basking Ridge, N.J.
www.perspectalabs.com

physicsAI
Pacifica, Calif.
physics-ai.com

Sagetech Avionics
White Salmon, Wash.,
sagetech.com/

SoarTech
Ann Arbor, Mich.
soartech.com

Systel
Sugar Land, Texas
www.systelusa.com/

U.S. Defense Advanced Research Projects Agency (DARPA) Information Innovation Office (I2O)
Arlington, Va.
www.darpa.mil/about-us/offices/i2o

U.S. Naval Air Systems Command Aircraft Division
Patuxent River Naval Air Station, Md.
www.navair.navy.mil

Neema cites a trio of factors currently impeding the deployment and development of autonomous systems.

First is that operator involvement is still necessary. "This not only severely limits operational gains but creates significant new challenges in the areas of human-machine interaction and mixed initiative control," writes Neema explaining the Assured Autonomy program for the DARPA website. The second impediment is, "Achieving higher levels of autonomy in uncertain, unstructured, and dynamic environments, on the other hand, increasingly involves data-driven machine learning techniques with many open systems science and systems engineering challenges."

Finally, Neema writes that the third impediment is "Machine learning techniques widely used today are inherently unpredictable and lack the necessary mathematical framework to provide guarantees on correctness, while DOD applications that depend on safe and correct operation for mission success require predictable behavior and strong assurance."

Another concern is raised by unmanned systems acting autonomously when tasked with taking the lives of enemy combatants or destroying enemy vehicles, materiel, or infrastructure in unmanned vehicles that are currently remotely piloted like the MQ-9 Reaper UAV.

"As AI technologies become increasingly sophisticated and prevalent it can be tempting to think of AI as a 'silver bullet,' says Systel's Kothari. "While AI can offload a majority of the burden of the operator, achieving sensor fusion and automating analysis tasks that are essential when dealing with enormous amounts of raw data, and even as we move from 'kill chains' to more complex 'kill webs,' humans still very much need to remain in the loop."

Aitech's Mor says, "Ethical questions are always peoples' concern, especially in the defense industry, which is why the U.S. Department of Defense officially adopted a series of ethical principles for the use of artificial intelligence following recommendations provided to Secretary of Defense, Mark T. Esper, by the Defense Innovation Board. The recommendations came after 15 months of consultation with leading AI experts in commercial industry, government, academia and the American public that resulted in a rigorous process of feedback and analysis among the nation's leading AI experts, with multiple venues for public input and comment. The adoption of AI ethical principles aligns with the DOD AI strategic objective directing that the U.S. military lead in AI ethics and the lawful use of AI systems.

Mor continues, "AI is relatively new field in the defense market, and we are expecting a step-by-step fusion of AI into existing or new systems:

- human-controlled systems with partially AI implementations;
- AI-control systems with partial human interaction;
- AI-control systems with redundant human decision control; and
- AI autonomous systems.

It will take some time to be able to count on these kinds of systems; in parallel, we will see more standardized AI implementations and ethical principle definitions. The European commission also is working on a 'Trustworthy AI' definition.

The latest trends in power electronics

It's not just about stand-alone devices anymore, as power systems designers tackle power density, thermal management, open-architecture standards, systems integration, and obsolescence management.

BY **John Keller**

Power electronics has come a long way since its dominance several years ago by discrete power devices and esoteric design approaches that usually required close involvement from experienced power engineers.

Nowadays power electronics is entering the realm of systems integration by combining with high-speed networking, microprocessors for smart power designs, and innovative approaches for thermal management to help keep electronics cool.

Power electronics — the control and conditioning of electrical power for ever-smaller and more sensitive electronics components — is following technology trends in power density and small size, weight, and power consumption (SWaP); innovative cooling and thermal management; adherence to open-architecture industry standards; high levels of systems integration; obsolescence management; and a reliance of commercial off-the-shelf designs.

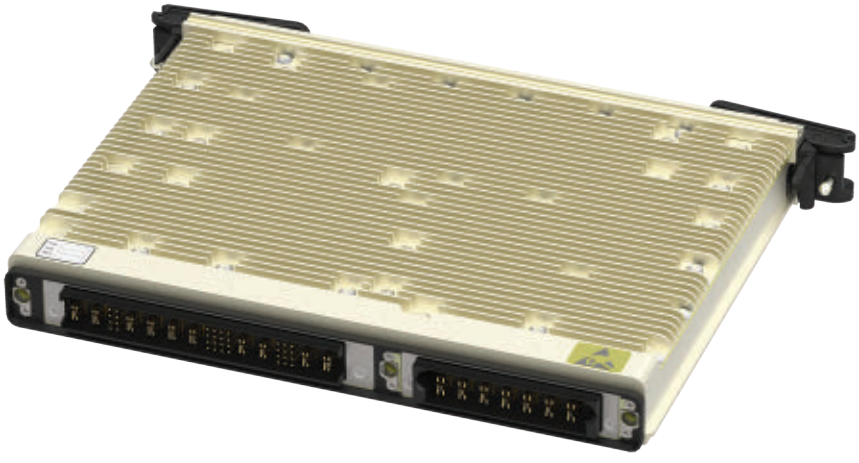
Power density

"We operate in three different markets: North America, Europe, and Asia," points out John Imaz, vice president of sales and marketing at power electronics specialist Gaia Converter in Le Haillan, France. "The common denominator is an increasing need for high density and efficiency. SWaP is the most common trend we are seeing. We are trying to get as much power density in the smallest possible package with good thermal performance."

Providing ever-more power in small power electronics packages is a challenge that all power electronics companies face when serving the aerospace and defense market. "I see remote-control drones for military and civil applications that have been driving some of these weight challenges," Imaz says. "VTOL [vertical takeoff and landing] is coming up as the next big trend in commercial aerospace power."

Also driving power density in these kinds of devices are electric vehicles and aircraft, Imaz says. "We are trying to get closer to the electric motor, so when you think about anything related to electric vehicles, power density is critical," he says.

One of Gaia's biggest customers, a European aircraft designer, is considering hydrogen-power propulsion as one way of driving the electronification of the entire airplane, Imaz says. In applications like this, small size and light weight can spell the



The M4706 6U three-phase AC power supply from MilPower Source is a VITA 48.8-qualified 6U VPX power supply with Air-Flow-By cooling for military mission computing applications in rugged environments.

The MGDD ultra-wide input DC-DC converters from Gaia Converter operate from 6 to 80 Watts and offer dual-isolated outputs ranging from 3.3 to 48 volts DC. They come in two grades for military and high-end industrial applications

difference between a successful or an unsuccessful design. The same rules apply to satellite designs — also a growing driver in power electronics technologies.

"Our customers are asking for us to get them power devices that are very small, very light, very high performance, and long-lasting capacity — all at a more competitive price point," Imaz says. Amid intense competition among systems integrators, "we need to make sure money is used wisely, Imaz says. "Our customers need availability and performance, and a competitive edge."

The need for power density runs across the board — especially for military applications, says Howard Schrier, vice president of marketing at Nova Electric in Bergenfield, N.J., an autonomous division of Technology Dynamics Inc. (TDI). "Everybody wants smaller and lighter; that's what the military wants," Schrier says.

Nova Electric offers rugged solid state frequency converter systems for military, industrial, and commercial applications, and can build to military environmental and electrical standards such as MIL-STD-810, MIL-S-901, MIL-STD-167, MIL-STD-1399, and MIL-STD-461. Nova's frequency converters come in rackmount, freestanding, or wall-mount NEMA cabinet versions, as well custom enclosure configurations.

Space power

Space "is a very exciting market, and our customers need high-density power," says Rob Russell, vice president of product marketing at Vicor Corp. in Andover, Mass. Vicor specializes in high-reliability DC-DC converters for radar, vetronics, and satellite applications.

Vicor traditionally provides power electronics for terrestrial military, industrial, and commercial applications, and is expanding into the so-called "new space" market for affordable radiation-tolerant power converters.

In January Vicor announced the launch of the company's first radiation-fault-tolerant DC-DC converter power modules aboard the Boeing Co. O3b mPOWER satellite, part of a constellation for telecommunications and data backhaul from remote locations. The satellites will operate in medium-Earth orbit.

Vicor's power electronics devices aboard the satellites are housed in the Vicor plated SM-ChiP package, and can power low-voltage application-specific integrated circuits (ASICs) with as much as 300 Watts from a 100-volt nominal power source.

Boeing tested the Vicor's power devices to resist the effects of 50 kilorads of total ionizing dose radiation, and to be immune to single-event upsets using a redundant architecture in which two identical and parallel

The NGL4.5K60-270 lightweight DC-AC Inverters from Nova Electric are high-reliability power sources designed for demanding applications in extreme shock, vibration, humidity, temperature, and EMI environments in compliance to RTCA/DO-160 Environmental and MIL-STD-461F EMI standards.

PASTERNACK®
an INFINITE brand

Largest Selection of

In-Stock, Ready-to-Ship RF Components

Pasternack has been serving the immediate RF needs of engineers for over 45 years. Our wide selection of connectors, adapters, cable assemblies, electromechanical switches, amplifiers, and attenuators are in-stock and ready for same-day shipment. We are passionate about providing our customers with high-quality products, endless selection, and custom cables required to drive their innovation and backing it with technical service expertise.

Give us a call or order online at pasternack.com by 6 PM CT to have your parts shipped today!

pasternack.com
+1 (866) 727-8376
+1 (949) 261-1920

In-Stock and Shipped Same-Day

The Gaia Converter LHUG 150 input bus conditioner combines hold-up and limiter to enable relatively simple designs that address quality, performance, space, and cost. It fits architecture buses ranging from 10 to 150 Watts.

powertrains with fault-tolerant control circuitry operate in one high-density package.

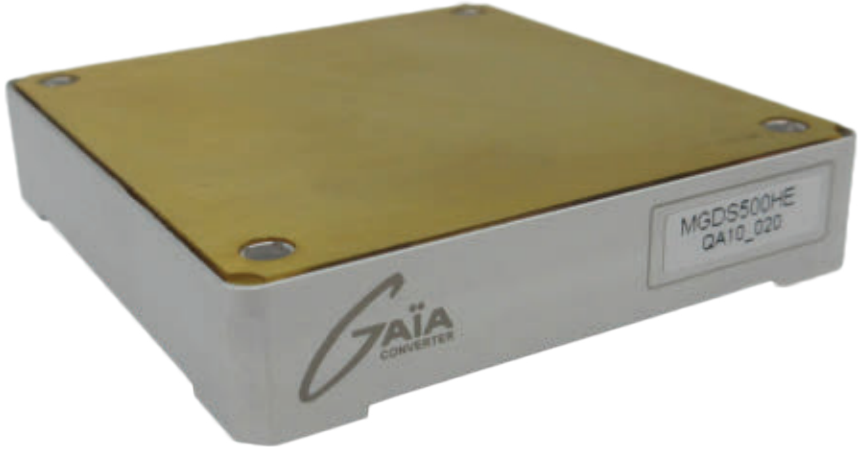
Thermal management

There's a potentially damaging byproduct of shrinking power devices while increasing their capacities: heat. As such, thermal management and electronics cooling are among the biggest challenges for today's power engineers. "How people meet the thermal-management issues is a big part of power design, and how efficient your device is," says Vicor's Russell. "That will be the biggest trick for all the vendors out there."

Take military ground vehicles, which are expected to operate in some of the world's hottest deserts, where electronics temperatures can soar — especially in tightly packed electronics systems. "In ground applications like armored vehicles, operating temperatures are becoming critical issues," says Gaia's Imaz. "Electronics must operate in harsh environments where temperatures are critical."

Applications like these are where new and emerging open-architecture industry standards — developed originally for new generations of high-performance embedded computing — are coming into their own.

"Conduction cooling designers are starting to consider other modes of cooling than conduction," says Brian Paul, general manager at power specialist MilPower Source in Belmont, N.H. Still, an expertise in thermal management, as well as in power density, can help power electronics companies gain a competitive edge in their markets.



The MGDM-500 DC-DC converter series from Gaia Converter offers a wide input range and 500 Watts of power from a 9-volt DC input, and is a reliable power solution for harsh environments.

The MILTECH404 power and data management system (ISPDS) from MilPower Source is a networking product that combines networking and power management capabilities together.

MilPower designers are starting to use VITA industry-standard VPX Air Flow-By cooling for some of their products, Paul says. "We are seeing much more of an Air Flow-By cooling trend in our industry. We are offering our M4706 three-phase AC input device with holdup. It also provides 1,100 Watts of power in a VPX power supply. This helps integrators separate themselves from their competitors."

Industry standards

One substantial trend in power electronics technologies today is adherence to open-architecture standards like VITA OpenVPX and the Sensor Open Systems Architecture (SOSA) standard. "More and more, system-level solutions are using common standards," says Gaia's Imaz. "We do see that requirements are somewhat different in our different markets, but we need to make sure our products are compatible with the largest number of standards."

Moving toward standard products and away from custom products also has other implications, Imaz explains. "It's a trend to move away from the

traditional role of a power engineer, and more of a shift to project managers who are looking for ready-to-use solutions that meet common industry standards."

That trend should hold for quite some time, he adds. "In the next one to five years we are seeing people moving more toward system-level solutions and common standards," Imaz says. "There is more and more competition coming up from players moving up the food chain."

Open-systems standards are becoming part of the landscape in power electronics, as they are in embedded computing and other technologies. "A big trend is open-architectures, and how open architecture standards are impacting systems designs," says MilPower's Paul. "We are seeing a lot of engagement from industry in minute detail of how to put together power-management solutions. Industry must operate under mandates for open architectures."

MilPower is offering the company's M4162 one-inch-pitch power holdup module that is designed to align with SOSA requirements, Paul says. "Everybody is trying to do something unique and different, yet stay in open architectures."

The SOSA standard, itself, is helping power systems designers come up with new designs to meet evolving customer demands. "We have heard from customers that the 28-volt bus has no more capacity. With SOSA, if you want something that takes more power, there is a 270-volt bus that is available. We are seeing that on legacy aircraft. It provides SOSA solutions to meet that need."

Vicor experts see enough importance in SOSA standards to join with the SOSA Consortium, which is under aegis of The Open Group in San Francisco. "SOSA is another coming trend," says Vicor's Russell. "There are many more designers today who want that technology, and I see that being a clear-cut trend that is happening now."

Systems integration

In a growing number cases, it's not enough simply to provide power supplies; instead, customers are asking power companies for more, such as networking capability, smart power systems, and the like. As a result, companies that at once time specialized

WHO'S WHO IN POWER ELECTRONICS

Absopulse Electronics Ltd.
Ottawa
https://absopulse.com

Advanced Energy Industries Inc.
Fort Collins, Colo.
www.advanced-energy.com

Aegis Power Systems Inc.
Murphy, N.C.
www.aegispower.com

AMETEK VTI Instruments
Irvine, Calif.
www.vtiinstruments.com

Analytic Systems Ware Ltd.
Delta, British Columbia
www.analyticsystems.com

Anaren Inc.
Syracuse, N.Y.
www.anaren.com

Astrodyne TDI
Nashua, N.H.
www.astrodynetdi.com

AVX Corp.
Fountain Inn, S.C.
www.avx.com

Behlman Electronics Inc.
Hauppauge, N.Y.
www.behlmanpower.com

Calex Mfg. Co. Inc.
Concord, Calif.
www.calex.com

Coilcraft Inc.
Cary, Ill.
www.coilcraft.com

Comdel Inc.
Gloucester, Mass.
www.comdel.com

ConTech
Concord, Calif.
www.contech-us.com

Cornell Dubilier Electronics Inc.
Liberty, S.C
www.cde.com

Crane Aerospace & Electronics
Redmond, Wash.
www.craneae.com

Crystal Group
Hiawatha, Iowa
www.crystalrugged.com

D6 Industries Inc.
Lawrence, Mass.
https://d6industries.com

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

Energy Technologies Inc.
Mansfield, Ohio
www.ruggedsystems.com

Falcon Electric Inc.
Irwindale, Calif.
www.falconups.com

Gaia Converter Inc.
Le Haillan, France
www.gaia-converter.com

General Atomics Electromagnetic Systems Group
San Diego
www.ga.com/ems

General Micro Systems Inc.
Rancho Cucamonga, Calif.
https://www.gms4sbc.com

Infineon technologies (formerly International Rectifier)
El Segundo, Calif.
https://www.infineon.com

Intellipower Inc.
Orange, Calif.
https://www.intellipower.com

Lind Electronics Inc.
Minnetonka, Minn.
www.lindelectronics.com

Maxim Integrated Products Inc
Chelmsford, Mass.
www.maximintegrated.com

MilPower Source
Belmont, N.H.
www.milpower.com

MilSource
El Segundo, Calif.
https://militaryethernet.com

Murata Power Solutions
Mansfield, Mass.
www.murata-ps.com

North Atlantic Industries
Bohemia, N.Y.
www.naii.com

Nova Electric
Bergenfield, N.J.
https://novaelectric.com

Nova Power Solutions Inc.
Sterling, Va.
www.novapower.com

Pico Electronics Inc.
Pelham, N.Y.
www.picoelectronics.com

Rantec Power Systems Inc.
Los Osos, Calif.
www.rantec.com

Raycom Electronics Inc.
Dover, Pa.
www.raycomelectronics.com

Renesas Electronics Corp. (formerly Intersil)
Milpitas, Calif.
https://www.renesas.com/us/en/

Solitron Devices, Inc.
West Palm Beach, Fla.
www.solitrondevices.com

SynQor
Boxborough, Mass.
www.synqor.com

TDI Power
Hackettstown, N.J.
http://tdipower.com

TDK-Lambda Americas Inc.
San Diego
www.us.tdk-lambda.com

Vicor Corp.
Andover, Mass.
www.vicr.com

VPT Inc.
Bothell, Wash.
www.vptpower.com

in power devices alone are moving up the food chain to offer integrated systems with plenty of added value.

"Our customers are asking for an off-the-shelf integrated solution," says MilPower's Paul. "The trend is integrated solutions make a lot of sense." MilPower is adding networking capability to its lines of power devices for remote control and smart power systems that use artificial intelligence (AI). "Yesterday we might have had to partner with someone, but now we have an integrated solution, and it is a lot easier to day. it's more subsystems integration to more features into one box that makes sense."

The need for systems integration at the subsystem level is one reason for power company mergers and acquisitions over the past several years. "Companies are buying up other companies so they can offer that one-stop shop to their customers — the prime systems integrators," Paul says.

When it comes to integrating power and networking capabilities, Paul says MilPower is carving-out a seldom-served niche. "Nobody has really served that market by integrating power and networking products from the ground-up for military applications. Integrated systems also are attractive because there rarely is money for non-recurring engineering (NRE) for custom products. "Industry has to be willing to get the right capability out to the warfighter," he says.

Gaia's Imaz says he also is seeing customer demand for integrated products rather than stand-alone solutions. "There is more demand now for what is more than just a modular solution," he says. "More of our end-customers and the primes are asking for more of a complete power supply unit [PSU] solution."

Power companies also view integrated systems as pathways to designing-in artificial intelligence and high-end microprocessors, graphics processors, and digital signal processors for smart power systems of the future.

"Artificial intelligence is another key driver," says Vicor's Russell. "It will require a whole other level of power control, and we have the premiere product capability for those kinds of high-current graphics-processing units and application-specific integrated circuits."

The lightweight Galaxy series rugged DC uninterruptible power supply from Nova Electric comply with MIL-STD-1399, MIL-S-901, MIL-STD-167, MIL-STD-461, MIL-STD-810, and other demanding military standards.

Obsolescence management

It's no secret that military leaders are trying to save money by keeping existing systems in the field for as long as possible by inserting new technologies wherever possible. This applies to power electronics, as well, by adding value when replacing obsolete power components.

"While you are replacing an obsolete part or diminishing manufacturing source, you can add more for the warfighter," says MilPower's Paul. "If you do it right you can bring a lot of value to the user." MilPower engineers used this approach in a recent contract involving a U.S. Army infantry anti-armor weapon. By blending-in new technologies to obsolescent power electronics subsystems, MilPower was able to reduce the size of a battery charger from 148 pounds to about 30 pounds.

Wanted: high-power RF amplifiers for electronics-killing EW systems

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry to develop high-power RF and microwave amplifiers able to generate sufficient electromagnetic radiation to damage or kill enemy electronics.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001121S0017) for the Waveform-Agile RF Directed Energy (WARDEN) project.

WARDEN seeks to develop high-power microwave amplifiers that generate enough electromagnetic radiation to disrupt, disable, or damage targeted electronic components and circuits.

The project also seeks to develop theory and computational models to describe the coupling of electromagnetic radiation into complex enclosures via unintentional paths like seams, apertures, and cable entry points, and to develop agile waveform techniques that can cause damage to enemy electronics.

Agile waveforms refer to time-dependent signals that combine frequency, amplitude, and pulse-width modulations to make the most of coupling into a complex enclosure, and are optimized to produce disruptive effects on internal electronic components and subsystems.

The WARDEN electronic warfare (EW) program has three technical areas: high-power microwave traveling-wave amplifier; rapid assessment and numerical generation of electromagnetic response (RANGER); and agile waveform development. The high-power microwave traveling-wave amplifier and agile waveform portions are classified, and the Ranger portion is not.

High-power microwave systems are radio-frequency directed energy weapons that use electromagnetic radiation to disrupt, disable, or damage targeted electronic components and circuits.

The advantages of high-power microwave systems include non-kinetic, wide-area effects at long stand-off distances; deep magazines; operation in adverse environmental conditions; and speed-of-light engagement, DARPA researchers explain.

Electromagnetic radiation can couple into targets in band via intentional ports such as antennas. This is called a front-door electromagnetic attack. These systems also can couple into targets in band via unintentional coupling paths such as seams, apertures, and cable-entry points. This is called a back-door attack.

Today's high-power microwave systems typically use oscillators as their RF source, operate at a fixed frequency, are not easily tunable, and lack the phase coherence necessary for power combining.

Front-door systems have the longest range, but their effectiveness

A new generation of high-power RF and microwave amplifiers may help engineers develop compact high-power microwave weapons for unmanned aircraft and missiles.

is limited to specific classes of targets. Back-door systems are effective against a wider variety of targets, but their range is limited by electromagnetic coupling inefficiencies due to their lack of frequency tunability.

Agile waveforms, combined with broadband high-power amplifiers, can make enemy electronics more susceptible to back-door attacks, and significantly can extend the range and effectiveness of high-power microwave weapon system.

WARDEN seeks to develop flexible technology that can be useful against a wide variety of target types by developing high-peak-power amplifiers for back-door attacks. Unlike oscillators, a broadband amplifier is agile enough to make the most of electromagnetic coupling into targeted electronics by improving coupling frequencies even with modest tuning.

Broadband amplifiers also support waveform modulations that can make enemy electronics more vulnerable to disruption by electromagnetic radiation. Combined, these effects can increase the range of back-door high-power microwave directed-energy weapons.

Yet high-power broadband amplifiers have proven extremely difficult to build because their gain and frequency capabilities are unstable and prone to oscillation. Input/output couplers and high-power vacuum windows also can be a problem.

Understanding the physics of electromagnetic wave coupling into a complex enclosure, and the interaction with internal electronics is critical to improving the effectiveness of back-door high-power microwave attacks, researchers explain.

The big challenge here is developing computationally efficient time- domain models that can simulate electromagnetic wave interaction with large structures containing features of widely varying sizes and material properties.

The main challenges for developing agile waveforms are developing physics-based computational tools to predict high-power microwave effects on electronics; creating agile waveform techniques to produce the most damaging effects on enemy electronics.

WARDEN will be a four-year, three-phase program that will develop and demonstrate the first broadband high-power microwave amplifier using high-peak and average-power handling; broadband input and output coupler design; broadband vacuum window design; and thermal management.

The project also will develop physics-based models to enable the rapid prediction of agile electromagnetic waveforms coupling into complex enclosures and the spatial distribution of the internal electric fields. It also will extend testing and modeling to broad classes of target systems to create a physics-based computational framework to predict high-power microwave effects.

DARPA researchers expect to spend about $51 million over the four-year duration of the WARDEN program, and involve several contractors.

Companies interested were asked to submit full proposals no later than 16 April 2021 to the DARPA BAA Website at https://baa.darpa.mil. Email questions or concerns to David Abe, the WARDEN program manager, at HR001121S0017@darpa.mil.

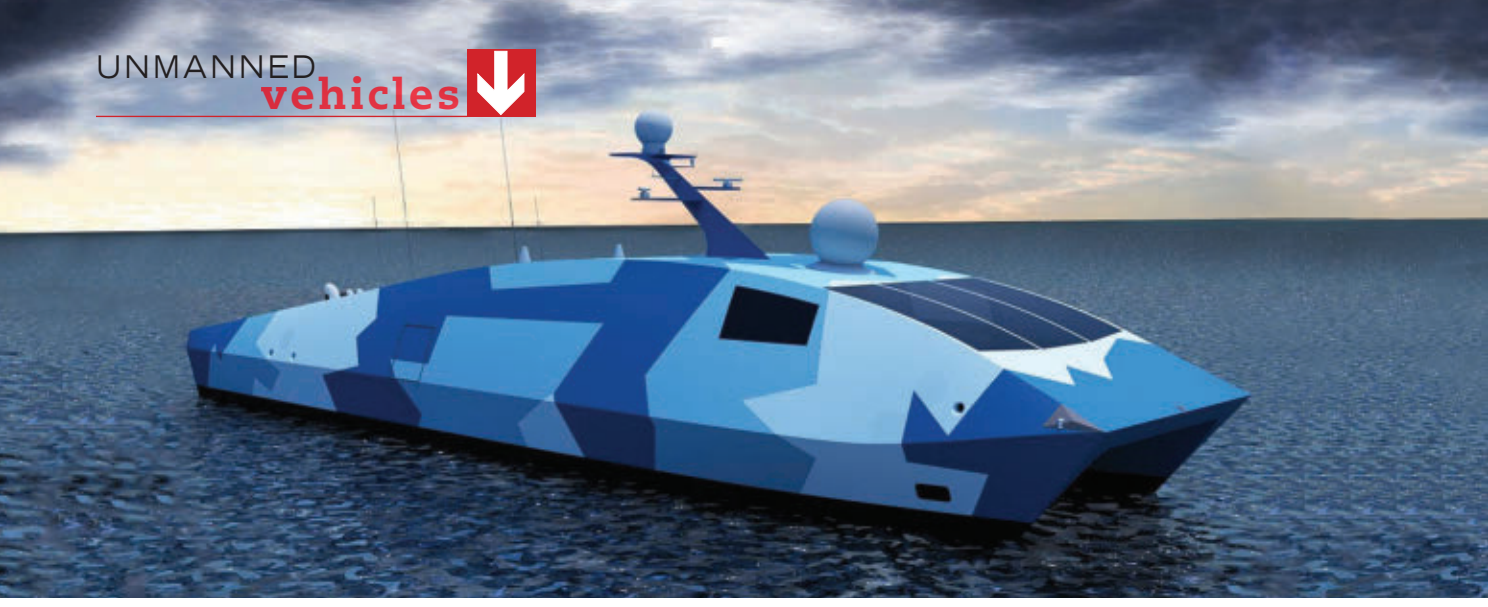
More information is online at https://beta.sam.gov/opp/20104a5bdcb74ede858ea45a82345ae4/view.

Adaptable radio networking aims to defeat electronic warfare (EW) attacks

Communications during an electronic warfare (EW) attack can be difficult, if not impossible — especially in the presence of high-power jammers. As part of a solution, the U.S. Defense Advanced Research Projects Agency (DARPA) demonstrated the effectiveness of its Dynamic Network Adaptation for Mission Optimization (DyNAMO) program the receive and transmit data across nominally incompatible radio communications networks. The tactical networking program is aiming to provide connectivity even between different data types during electronic-warfare (EW) attacks.

Demand for broadband boosts satellite electronically steerable antennas

The world's demand for broadband connectivity has created a new generation of high-throughput satellites in geosynchronous Earth orbit (GEO), medium Earth orbit (MEO), and now low Earth orbit (LEO). Electronically steerable antennas (ESAs), often referred to as flat panels, are the critical link for next-generation constellations. Compared with their bulkier mechanical cousins, flat-panel antennas offer greater efficiency and performance while being modular and dynamically steerable—all of which are needed for the future ground segment.



Navy asks industry for small-, medium-, and large-size power systems for unmanned surface vessels (USVs)

BY **John Keller**

Photo (above): Navy power electronics experts are asking industry to develop advanced power-generation system for efficient, long-endurance unmanned surface vessels (USVs).

ARLINGTON, Va. — U.S. Navy surface warfare experts are reaching out to industry to find companies able to develop enabling technologies for advanced power generation system for efficient, long-endurance unmanned surface vessels (USVs).

Officials of the Office of Naval Research in Arlington, Va., have issued a solicitation (N00014-21-S-SN04) for the Robust Unmanned Platform Power Systems project.

The power generation system should be modular and scalable for small- medium-, and large-size USVs, and support propulsion, ship service, sensors, and mission payloads, and be reliable enough for the naval environment.

Navy surface warship designers are interested in developing low-cost high-endurance reconfigurable ships that can accommodate payloads to help the Navy shift to a more distributed fleet architecture for optionally or lightly manned ships.

This project has two technology thrusts: small power systems able to provide 25 to 250 kilowatts of power for small USVs; and large power system able to provide 250 to 2,500 kilowatts for medium- and large-size USVs.

Small power systems should help to reduce maintenance and increase operational availability and endurance of small unmanned surface vessels. Companies should compare their concepts against a commercial marine diesel engine or generator, and account for power level, size, weight, and efficiency.

The small and large power designs should operate with military fuels like NATO F-76, JP-5 and JP-8; have no scheduled maintenance for 4,000 to 8,000 hours; survive marine conditions like salt air ingestion; operate in rough seas; and be scalable to several platforms and power loads.

Companies interested were asked to submit white papers no later than 22 March 2021 to Fedconnect at www.fedconnect.net. Those submitting promising white papers will be invited to submit full proposals. Several contract awards are expected, and should be announced by the end of September 2021.

Email technical questions to the Navy's Donald Hoffman at Donald.hoffman@navy.mil, or Harold Coombe at Harold.coombe@navy.mil. Email business questions to Leila Hemenway at leila.k.hemenway@navy.mil.

More information is online at https://beta.sam.gov/opp/bde-66c2828994e06a9d5c6dff7131437/view.

Industry asked to build encrypted optical network to link low-Earth-orbit satellites

BY **John Keller**

WASHINGTON — U.S. satellite communications (SATCOM) experts are asking industry to develop a small, lightweight, and low-power encrypted mesh optical network to link satellites in low-Earth orbit.

Officials of the U.S. Space Development Agency (SDA) in Washington issued a Small Business Innovation Research (SBIR) opportunity (HQ085021S0001-05) for the Mesh Network NSA Certifiable Cryptographic Solution project.

The mesh network cryptographic solution for Optical Inter-satellite Links (OISL) in low earth orbit (LEO) will be low size, weight, and power (SWaP), and demonstrate an automated initial encryption handshake using National Security Agency (NSA) test keys, maintain encryption link, and encrypt and decrypt data with a throughput of 50 gigabits per second per channel, with a minimum of six channels.

The mesh network cryptographic solution must prove technical feasibility during the program's first phase, and the second phase will deliver hardware and software, and functional hardware in its third phase.

The encrypted mesh network must operate in austere environments, and must be small, lightweight, and power-efficient enough for small satellites, and demonstrate the ability to obtain NSA certification.

Companies chosen will develop an easy-to-use SATCOM mesh network that can pass encrypted data at least as fast as 50 gigabits per second per channel. Modem latency must be no more than 15 milliseconds, with five milliseconds preferred.

The project must address interoperability, key management, sustainability, standardization, flexible security, and operational management; operate with legacy cryptographic equipment and several levels of security; support over-the-network-keying with an automated ability to process proper key loads; support automated error handling and recovery; must be able to store and implement several algorithms; and be able to support network defense to include an audit capability.

the U.S. Space Development Agency is asking industry to develop an encrypted mesh optical network to link satellites in low-Earth orbit.

Companies interested were asked to submit full proposals no later than 31 March 2021 to the DOD SBIR/STTR Innovation Portal (DSIP) at www.dodsbirsttr.mil/submissions/login. Submit questions or concerns to the DSIP Topic Q&A module online at www.dodsbirsttr.mil/submissions/login. More information is online at https://beta.sam.gov/opp/262cd2b6216e4002bdd6b15789d5a73e/view.

SOFTWARE-DEFINED RADIO

L3Harris to develop wideband jam-resistant software-defined radio technology

U.S. military researchers needed a company to develop wideband adaptive RF filters and cancellers to enable use of wideband software-defined radio in congested and contested environments. They found their solution from the L3Harris Technologies Inc. Communications Systems-West segment in Salt Lake City.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio., announced a $7.2 million contract to L3Harris for the Wideband Adaptive RF Protection (WARP) project.

When exposed to interference and self-interference, these filters and cancellers will sense and adapt automatically to the electromagnetic environment through the intelligent control of their adaptive hardware. The idea is to attenuate interference — particularly in contested environments — selectively and protect wideband digital radios from saturation.

The Air Force Research Lab awarded this electronic warfare (EW) contract to L3Harris on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. Additional WARP contracts may be awarded.

Digital receivers historically have been narrow band because they are limited by A/D converter bandwidth, researchers explain. For these narrowband systems, pre-planned filtering prevents unwanted signals from reaching the A/D converter.

In the last decade, however, A/D converter technology has achieved greater than 10 GHz of instantaneous bandwidth with 8-10 effective number of bits (ENOB).

This performance is sufficient for wideband digital receivers but poses two challenges: wideband A/D converters typically have a relatively small available input voltage swing and reduced dynamic range when compared to their narrowband counterparts; and as the bandwidth increases, more signals come into view, which mean larger voltage swings into the A/D converter.

The DARPA WARP program seeks to protect these wideband receivers against external and self-interference through adaptive equalization of the input spectrum to stay within the dynamic range of a wideband digital receiver.

Today, receivers are protected from external interference through static filtering, automatic gain control, or signal limiters. Yet static filtering only uses a fraction of the digital receiver bandwidth, which gives good sensitivity but does not take advantage of available receiver bandwidth. Automatic gain control, meanwhile, capitalizes on system bandwidth, but decreases sensitivity to small signals.

At the same time, signal limiters can cause cross-modulation distortion and may decrease the overall sensitivity of the system. Tunable filters sometimes are a solution, but rarely can tune over achievable bandwidth.

Instead, the WARP program seeks is to develop wideband, adaptive filters and analog signal cancellers that selectively attenuate or cancel external and self-interference to protect wideband digital radios from saturation, ultimately enabling the use of software-defined radios in congested and dynamic spectral environments.

The ideal wideband receiver would adapt to EW jamming or blocking to maintain dynamic range without decreasing sensitivity and bandwidth. the WARP project seeks to develop adaptive filters to reconfigure their frequency response automatically to include pass/stop bands with bandwidth and center frequency tuning and attenuate large signals selectively while passing small or desired signals.

The challenge is to do this over a wide bandwidth with low-insertion loss at the input of a receiver. Today, most chip-scale tunable filters are limited to a 2:1 tuning ratio or less without explicit band switching.

The WARP program, instead, seeks demonstrate adaptive RF filtering of external interference with a 9:1 tuning ratio to provide full-band coverage across 218 GHz with new filter architectures based on state-of-the-art components and packaging.

The WARP program consists of two four-year technical areas: wideband adaptive filtering; and wideband signal cancellation. For more information contact L3Harris Communications Systems-West online at www.l3harris.com/capabilities/defense, the Air Force Research Laboratory at www.afrl.af.mil, or DARPA at www.darpa.mil.

SPACE COMPUTING

Radiation-tolerant memory for space applications introduced by Microchip

Microchip Technology Inc. in Chandler, Ariz., is introducing the SST38LF6401RT radiation-tolerant, 64-megabit parallel-interface SuperFlash memory device for maximum reliability and robustness in the harsh radiation environment of space missions. The chip is a companion to Microchip's space-ready microcontrollers, microprocessors, and field-programmable gate arrays (FPGAs) that provide the building blocks for this scalable development model. Radiation-tolerant to 50 kilorads total ionizing dose — even while the Flash is still biased and operating — the SST38LF6401RT device enables systems to operate in a broad range of space applications where they cannot afford any loss of code execution that could lead to severe defects and system loss. It also is a companion to the Microchip SAMRH71 Arm Cortex-M7-based radiation-hardened system-on-chip processor and can also be used with the company's RT PolarFire FPGAs to support in-flight system reconfiguration. The device has pinout distribution compatibility with its industrial version for transition to the space-qualified plastic or ceramic versions at the printed circuit board level. Voltage operation of the SST38LF6401RT ranges from 3 to 3.6 volts. For more information contact Microchip Technology online at www.microchip.com.

POWER ELECTRONICS

Rugged power supply for electronic warfare (EW) uses introduced by Aegis Power

Aegis Power Systems Inc. in Murphy, N.C. is introducing the rugged VPX1PH3UC310-SA single-phase power supply module developed in alignment with the Sensor Open Systems Architecture (SOSA) technical standard for use in interoperable systems for sensor management. These units support the power payloads of sensing domains for radar, communications, electronic warfare (EW), and electro-optical defense equipment. The 85-to-264-volt AC input to 28-volt DC output slide-in power supply power supply module offers 310 Watts and EMI filtering, and achieves efficiency AC-DC conversion with .99 power factor correction in a conduction cooled module with 12-volt and 3.3-volt AUX outputs in alignment with the SOSATM technical standards. Users with increasing battlefield demands for C5ISR and embedded computing equipment can make use of advanced power converter features such as built-in EMI filtering, alignment keys for using several units in one chassis, I2C monitoring and IPMC redundancy, and wide operating temperature range. The SWaP optimized 3U form factor and 5HP single-slot dimensions are interoperable per VITA 48.2 standards specifications. Self-protection features include protections for over- and under-voltage, current, temperature, and surge conditions. For more information contact Aegis Power Systems online at www.aegispower.com.

EMBEDDED COMPUTING

RFSoC-based embedded computing module for radar and EW introduced by Pentek

Pentek Inc. in Upper Saddle River, N.J., is introducing model 6003 QuartzXM eXpress embedded computing module for signals intelligence (SIGINT), electronic warfare (EW), communications, and radar applications that call for low size, weight, and power consumption (SWaP). The QuartzXM model 6003 offers greater RF performance and scalability for the company's Quartz RF system-on-chip (RFSoC) product family. The module is based on the Xilinx Zynq UltraScale+ RFSoC Gen 3, and provides sub-6 GHz direct-RF I/O support with more decimation and interpolation options. These Quartz products support RF sampling using 5 gigasamples per second 14-bit A/D converters and eight 10 gigasamples per second 14-bit D/A converters, both supporting analog signals as high as 6 GHz. Each data converter has built-in digital downconverters or upconverters with programmable decimation and interpolation to 40x and independent tuning for increased RF flexibility and frequency planning. The Pentek Quartz architecture positions the RFSoC as the cornerstone of the design. All control and data paths are accessible by the RFSoC's programmable logic and processing system. The Xilinx Zynq UltraScale+ RFSoC Gen 3 integrates eight RF-class A/D converters and D/A converters into the Zynq FPGA fabric along with quad ARM Cortex-A53 and dual ARM Cortex-R5 processors, creating a multichannel data conversion and processing solution on one chip. For more information contact Pentek online at www.pentek.com.

new PRODUCTS

TRUSTED COMPUTING

Palm-sized secure data storage for critical applications introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing the MissionPak SLC small secure solid-state drive (SSD) for mission-critical data storage applications that need reliability, security and ruggedization. About the same size as a typical commercial USB flash drive, the secure SSD can withstand harsh operating environments while protecting sensitive data from cyber attack. Optimized for trusted-computing in applications like command, control, communications, computers and intelligence (C4I) and avionics, MissionPak SSDs use AES-256 XTS encryption, have the latest generation of NAND flash technology, and are packaged into compact, water-resistant, self-destructing form factors. Able to clear themselves in less than 10 seconds to protect mission-critical data, the MissionPak SSDs have fast erase time, and are available in 128- or 256-gigabyte storage configurations, weigh 80 grams, and fit in the palm of the hand. For more information contact Mercury Systems online at www.mrcy.com.

CABLING AND CONNECTORS

Rugged VNA test cables for benchtop, production testing introduced by Pasternack

Pasternack, an Infinite Electronics brand in Irvine, Calif., is introducing a line of flexible vector network analyzer (VNA) test cables to address demanding laboratory and test applications like precise benchtop, semiconductor probe, and production testing. Pasternack's rugged VNA test cables display electrical properties such as phase stability of plus-or-minus 6 degrees at 50 GHz, plus-or-minus 8 degrees at 70 GHz with flexure, and a voltage standing wave ratio (VSWR) of 1.3:1 at 50 GHz and 1.4:1 at 70 GHz. The 50 GHz assemblies are terminated with 2.4-millimeter stainless-steel connectors, while the 70 GHz assemblies use 1.85-millimeter stainless-steel connectors. For more information contact Pasternack online at www.pasternack.com.

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

EDITORIAL ART DIRECTOR Kermit Mulkins

PRODUCTION MANAGER Sheila Ward

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

MARKETING DIRECTOR 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 Rains
CHIEF ADMINISTRATIVE AND LEGAL OFFICER Tracy Kane
CHIEF TECHNOLOGY OFFICER Eric Kammerzelt
EVP, TECHNOLOGY GROUP Lester Craft

BPA WORLDWIDE Connectiv

GENERAL MICRO SYSTEMS, INC.

ADVANCED SERVERS

ONE COMPANY FOR ALL YOUR SERVER NEEDS

RUGGED SERVERS

INDUSTRIAL SERVERS

COMMERCIAL SERVERS

MADE IN U.S.A.

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.