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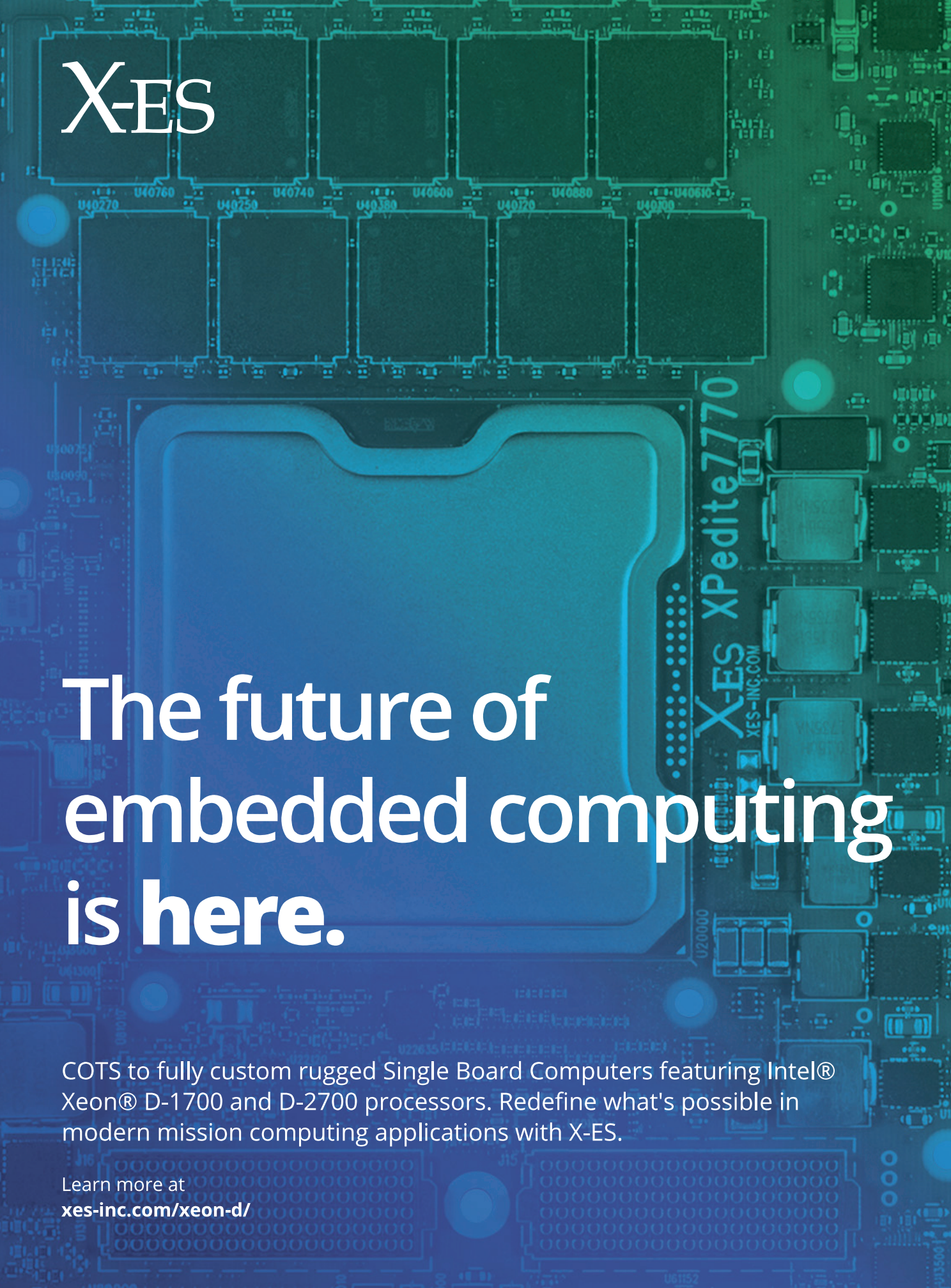

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U.S. military increasing emphasis on cyber security and trusted computing

BY **John Keller**
EDITOR IN CHIEF

April saw a big uptick in U.S. military attention to cyber security and trusted computing, as the U.S. Navy, Army, Air Force, and Defense Advanced Research Projects Agency (DARPA) launched projects or awarded contracts to safeguard mission-critical computer information from prying eyes.

First came DARPA's solicitation for the Compartmentalization and Privilege Management (CPM) project to safeguard the U.S. Department of Defense's vast collection of legacy software from advanced computer hackers.

DARPA CPM seeks analysis tools, hardware, and software to segment large legacy software programs automatically into compartments designed to prevent initial penetrations from turning into successful cyber-attacks, which typically involve sequences that move from initial penetration, to privilege escalation and lateral motion, and to a full-scale cyber-attack.

An initial penetration seeks to increase the attacker's privilege level, and then to move within the compromised system. Ultimately, the attacker uses unauthorized privileged access to locate and steal sensitive information, or to disrupt normal operations.

Around the same time, the U.S. Defense Logistics Agency Land and Maritime segment at Aberdeen Proving Ground, Md., awarded contracts to nine defense companies to help the U.S. Army solve potential problems caused by rapid modernization in command, control, computers, communications, cyber, intelligence, surveillance and reconnaissance (C5ISR) systems.

Each of the nine contractors will support C5ISR projects of the Army Communications and Electronics Command (CECOM) at Aberdeen Proving Ground, Md., by heading-off problems during rapid modernization.

The contractors are Amentum Services Inc. in Germantown, Md.; Science Applications International Corp. (SAIC) in Fairfield, N.J.; Centuria Corp. in Reston, Va.; STS International Inc. in Berkeley Springs, W.Va.; L3Harris Communications Systems-West in Salt Lake City; Micro USA Inc. in Poway, Calif.; Atlantic Diving Supply Inc. in Virginia Beach, Va.; Fairwinds Technologies LLC in Annapolis, Md.; and Telecommunications Systems Inc. in Annapolis, Md.

That same week the Air Force Research laboratory at Wright-Patterson Air Force Base, Ohio, issued a solicitation for the Radio Frequency (RF) Electronic Warfare (EW) Focused Laboratory Evaluations of Critical Technologies (REFLECT) program to find new ways to identify and mitigate vulnerabilities to avionics from cyber-attacks.

Finally, in April, DARPA announced the Quantum Augmented Network (QuANET) project to develop a hybrid quantum-classical communication network to enable quantum enhancements to information security and covertness on today's classical military networks.

The QuANET program seeks to augment existing software infrastructure and network protocols with quantum properties to mitigate some of the attack vectors that are pervasive on classical (non-quantum) networks.

The program will blend existing quantum communications into networks operating today in military and critical infrastructure. Quantum information must co-exist with classical information (quantum-classical interoperability).

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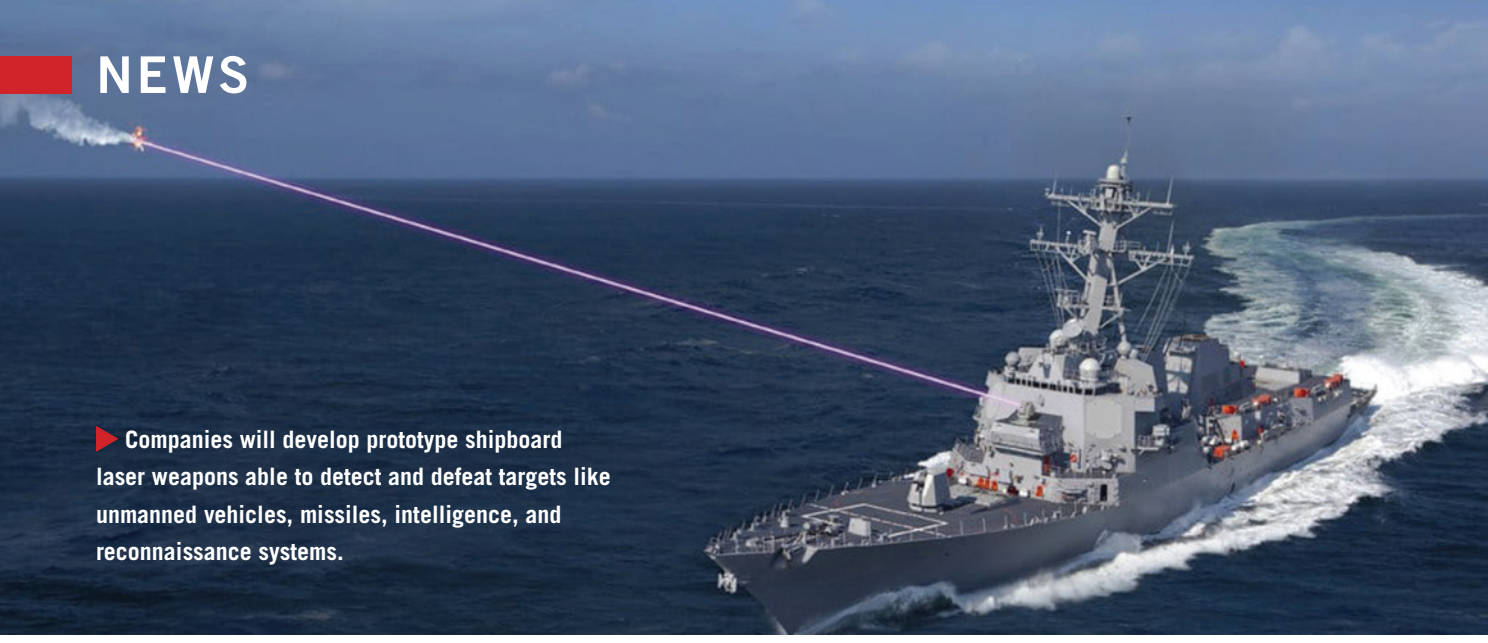

Companies will develop prototype shipboard laser weapons able to detect and defeat targets like unmanned vehicles, missiles, intelligence, and reconnaissance systems.

Seven companies to design high-energy solid-state laser weapons for Navy surface warships

BY **John Keller**

DAHLGREN, Va. – U.S. Navy surface warfare experts are asking seven U.S. electro-optics companies to design prototype solid-state high-energy laser weapons for surface warships under terms of a combined $75 million contract announced Thursday.

Officials of the Naval Surface Warfare Center Dahlgren Division in Dahlgren, Va., is asking these seven companies for the fabrication and delivery of prototypes and equipment in support of solid-state high-energy laser weapon systems.

The companies chosen to develop laser weapons prototypes for surface warships are:

- The Rolls-Royce North American Technologies Inc. LibertyWorks segment in Indianapolis;
- General Atomics in San Diego;
- the Leidos Dynetics segment in Huntsville, Ala.;
- II-VI Aerospace & Defense in Murrieta, Calif.
- The Lockheed Martin Corp. Aculight segment in Bothell, Wash.
- The nLIGHT Inc. Nutronics segment in Longmont, Colo.; and
- NUBURU Inc. in Englewood, Colo.

These seven companies each will receive at least $500, and will split as much as $75 million, based on contract orders over the next five years.

The companies will develop prototype shipboard laser weapons able to detect and defeat targets like unmanned vehicles, missiles, intelligence and reconnaissance systems, rockets, artillery rounds, and mortar shells.

The system's modular, scalable design offers significant reductions in size, weight, and power consumption to suit air, land, and sea-based platforms.

These laser weapons prototypes are expected to offer output power of between 100 and 300 kilowatts, lightweight efficient thermal management, short dwell times, rapid retargeting, and long target ranges.

On these contracts, the seven companies will do the work in Indianapolis; San Diego; Huntsville, Ala.; Murrieta, Calif.; Bothell, Wash.; Longmont and Englewood, Colo., and should be finished by March 2028.

For more information contact the Naval Surface Warfare Center Dahlgren Division online at www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Dahlgren.

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Epirus to develop signal processing correlator for imaging and communications

BY John Keller

WRIGHT-PATTERSON AFB, Ohio – U.S. military researchers needed a company to develop a large-scale efficient correlator able to operate at high dynamic range for new generations of passive sensing, real-time synthetic aperture radar imaging, and jam-resistant communications. They found their solution from Epirus Inc. in Torrance, Calif.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, have announced a $5.4 million contract to Epirus for the Massive Cross-Correlation (MAX) project.

The MAX program seeks to capitalize on the advantages of signal processing that uses analog processing, hyperdimensional computing, or hybrid approaches.

▲ The MAX program will capitalize on analog processing, hyperdimensional computing, or hybrid signal processing approaches for real-time synthetic aperture radar imaging and jam-resistant communications.

MAX seeks to achieve at least a 100 times improvement in power efficiency and information processing density compared to state-of-the-art digital signal processing systems. The Air Force research lab awarded the contract to Epirus on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

The mathematical function of correlation lies at the heart of virtually all digital signal processing systems, using several

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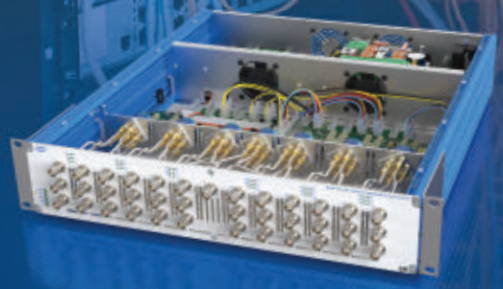

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computationally expensive digital fast Fourier transforms to move between the time and frequency domains to compare signals for similarity, researchers explain.

In addition, real-world impairments and background noise in the environment requires a correlator to use power-hungry digital signal processing to produce additional processing gain for high dynamic range operation, which is necessary to sense weak signals below the noise floor.

The resulting correlation computation, researchers say, scales exponentially in power. Therefore, today's systems require racks of graphics processing units (GPUs) and field-programmable gate arrays (FPGAs) to perform correlation over a relatively small frequency range with low bandwidth. This power scaling relationship is what prevents operation at high frequencies, large bandwidths, and high dynamic range simultaneously.

The Massive Cross Correlation (MAX) program seeks to achieve a disruptive leap forward for correlation in advanced CMOS nodes to fulfill the long unrealized potential of analog computation in future U.S. military sensing, imaging, and communications systems.

Epirus researchers will attempt to achieve 100 tera-operations per Watt power efficiency at 72 decibels hardware dynamic range, 120 decibels of total system dynamic range, sample rate of 5 gigasamples per second; and power consumption of 10 Watts — all in a size of 1.7 by 1.7 by 0.25 inches.

The company has a goal of demonstrating an analog correlator implemented in 22-nanometer CMOS, with 100x performance/power improvements compared to a state-of-the-art digital FPGA implemented in 14-nanometer CMOS.

The four-year MAX program will have an 18-month first phase to demonstrate efficient scalable analog circuits with a correlation efficiency of at least 500 tera-operations per Watt at 48 decibels of hardware dynamic range; a 15-month second phase to demonstrate a small-scale analog correlator with better than 100 tera-operations per Watt at 72 decibels; and a 15-month third phase to demonstrate a large-scale analog correlator with 100 tera-operations per Watt efficiency, 72 decibels hardware dynamic range, and 48 decibels signal processing gain in a 10-Watt form factor with 5 gigasamples per second throughput.

For more information contact Epirus online at www.epirusinc.com, DARPA at www.darpa.mil, or the Air Force Research Laboratory at www.afrl.af.mil.

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Collins Aerospace seeks collaborations with small and medium 'deep tech' businesses

Collins Aerospace is launching a program to foster technology innovation with deep tech small-to medium-sized enterprises. The Collins Powered by Collins Initiative seeks to facilitate collaboration between Collins Aerospace parent Raytheon Technologies Corp. and small-to medium-sized firms focused on deep technology, which typically refers to start-ups with their eyes on big breakthroughs, with the Collins initiative focused on new products and services for aerospace. For its inaugural call, the Powered by Collins Initiative has published four Collaboration Opportunities focused on technologies critical to the future of aerospace: Extravehicular Space Mobility, High-Performance Batteries, Autonomy for Small UAS, and Composites Recycling. Any company with at least three full-time employees is eligible to apply. After reviewing all submissions, Collins will select a set of respondents to participate in funded, rapid development demonstration programs. For more information on the Powered by Collins Initiative, please visit https://programs.t-hub.co/powered-by-collins-initiative/.

FAA issues industrywide call to action following runway close calls

The U.S. Federal Aviation Administration (FAA) told airlines to step-up vigilance at airports after close calls on or near runways. Six serious runway incursions have occurred since January 2023, including an incident at John F. Kennedy International Airport in New York involving a taxiing aircraft narrowly avoiding a departing aircraft and a landing aircraft coming within 100 feet of a departing aircraft at Austin-Bergstrom International Airport in Texas," the FAA has warned. To reduce the number of such close calls, the FAA recommends ensuring pilots and flight attendants have the same understanding of what sterile flight deck means and the risks associated with extraneous communications; emphasizing the importance of awareness of the aircraft in relation to taxiways, runways, and other aircraft; encouraging personnel to identify and report existing and emerging safety issues through voluntary reporting programs; reinforcing adherence to published processes and procedures, including checklists, Air Traffic Control instructions, and internal company procedures; and ensuring safety management systems are accounting for the high rate of change and churn in industry.

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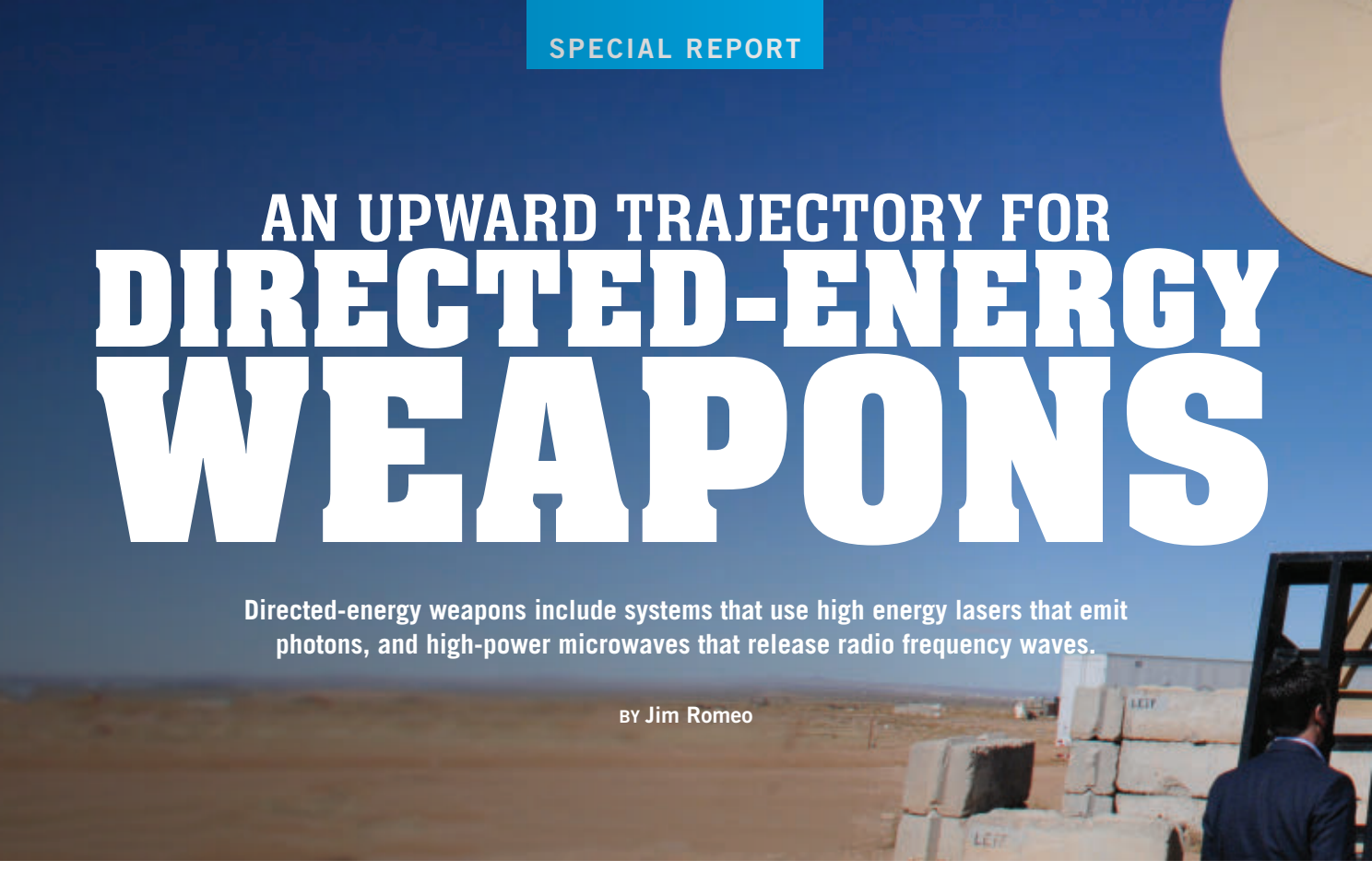
AN UPWARD TRAJECTORY FOR DIRECTED-ENERGY WEAPONS

Directed-energy weapons include systems that use high energy lasers that emit photons, and high-power microwaves that release radio frequency waves.

BY Jim Romeo



Directed-energy weapons are electromagnetic systems that convert chemical or electrical energy to radiated energy. They are focused on target and on physical damage that degrades, neutralizes, defeats, or destroys an adversarial capability. Directed-energy weapons include systems that use high-energy lasers that emit photons, and high-power microwaves that release high-power radio frequency waves.

High-power microwave weapons create beams of electromagnetic energy over a broad spectrum of radio and microwave frequencies intended to couple and interact with electronics located at a target and then causing damage or temporary disruption.

"There's no direct definition for what's the difference between a high-power microwave directed-energy weapon and a radar, but we've tempted to basically have a dividing point of that," says John Tatum in a webinar, sponsored by the Defense Systems Information Analysis Center in 2019. If a source has a peak effective radiated power of greater than 100 megawatts or radiated energy of greater than one joule per second, it typically will fall into the area of high-power microwave sources."

As Tatum explains, the range of frequencies of these radiation sources can vary significantly on the electromagnetic spectrum of high frequency to very high frequency to ultra-high frequency to microwaves to millimeter waves.

"The most important thing to remember about high-power microwave and directed-energy weapons is that they can attack targets with and without intentional antennas and receivers," Tatum explains. "That's unlike traditional electronic warfare jammers. They also can produce persistent effects that last much longer than the time the team is on the target. As a result, they can produce temporary electronic upset or significant energy damage. As a result of this, we have an unconventional electronic attack. "

Ongoing development

Prototype development for directed-energy weaponS has been ongoing in the U.S. Air Force, Army, and Navy. The Office of the Secretary of Defense (OSD) continues to seek program money to expand and continue development of these weapons systems.

The Air Force Research Laboratory Directed-Energy Directorate at Kirtland Air Force Base, N.M., has been working on two non-lethal high-power electromagnetic weapons — the Active Denial System (ADS) and the Counter-electronics High Powered Microwave Advanced Missile Project (CHAMP).

ADS is a low average power microwave system designed to penetrate the skin to a depth of 1/64 of an inch — about the thickness of three sheets of paper. It has been compared to feeling the blast of heat that comes from opening a hot oven; extensive testing has shown it to have no damaging effect on human skin or organs. Used against ground forces or armed mobs, it would force them to disburse and retreat.

◀ Air Force Research Laboratory-Kirtland demonstrated a tactical high power microwave operational responder (THOR), with an aggressive agenda to reach warfighters soon.

▲ Directed-energy weapons include systems that use high energy lasers (HEL) that emit photons, and high-power microwaves (HPM) that release radio frequency waves.

CHAMP uses high-peak-power microwaves lasting less than half the time it takes to blink — too brief to harm human beings but more than enough to disable or destroy electronic circuitry. A CHAMP system mounted in a UAV could fly over an enemy-held city and surgically destroy enemy command, control and communications systems — even hitting one building, skipping the next, then hitting a second — without damaging any critical civilian systems or harming anyone in the target area. Damage to enemy capabilities would be at least as great as a direct strike with a bomb, but with no structural or collateral damage.

Air Force Research Laboratory-Kirtland demonstrated a mobile tactical high-power microwave operational responder (THOR), with an aggressive agenda to reach warfighters soon. The intent of THOR is to be up and running in three hours by two people. It's designed to take down several enemy unmanned aerial vehicles (UAVs) simultaneously with rotational antenna control to provide 360-degree coverage, with the firing mechanism and overall systems control, coming from a laptop computer.

Since 2019 the Army Space and Missile Defense Command at Redstone Arsenal, Ala., set out to develop four 50-kilowatt Multi-Mission High Energy Laser (MMhigh-energy laser) Stryker-mounted weapons. Those would be 10 times more powerful than an artillery system soldier have been testing in Germany since 2018. Part of the Army's Maneuver-Short Range Air Defense (M-SHORAD), MMhigh-energy laser would protect mobile Brigade Combat Teams from unmanned aerial systems, rotary-wing aircraft and rockets, artillery and mortar (RAM).

Vehicle-mounted laser weapons

The Army is also developing a 100-kilowatt-class High Energy Tactical Vehicle Demonstrator (high-energy laser-TVD) prototype laser system for Medium Tactical Vehicles. The Army's work will serve as a research component for other directed energy weapons across the military services.

Navy leaders have launched prototypes for some of its Navy Laser Family of Systems (NLFoS) weapon systems which include Solid State Laser-Technology Maturation (SSL-TM) system for amphibious ships and the Optical Dazzling Interdictor-Navy (ODIN) for destroyers. High Energy Laser and Integrated Optical-dazzler and Surveillance (high-energy laserIOS) system, a 60-kilowatt weapon developed by Lockheed Martin, was test launched on an Arleigh Burke-class destroyer (USS Preble DDG 88) in August of 2022.

Aboard the guided missile destroyer USS Preble (DDG 88), this high-energy laser uses an integrated optical dazzler and surveillance unit (high-energy laserIOS). It is a 60-plus kilowatt laser and is designated Increment 1 of the Surface Navy Laser Weapon System (SNLWS) program.

Lockheed Martin referred to the high-energy laserIOS as an "endless magazine that never runs out of bullets." It's able to destroy

surface and airborne threats and dazzle or blind optical sensors aboard hostile ships and aircraft, and optical seekers of anti-ship missiles.

According to a September 13, 2022, report "Department of Defense Directed Energy Weapons: Background and Issues for Congress," prepared by the Congressional Research Service summarized budget allocations, the OSD is prepared to allocate generous program funding outlays to develop these weapons systems. The report states:

"In FY2023, OSD requested $16 million for High Energy Laser Research Initiatives, including basic research and educational grants, and $49 million for High Energy Laser Development, which funds applied research. 19 OSD additionally requested $111 million in FY2023 for High Energy Laser Advanced Development, which is focused on 'scaling the output power of DE systems to reach operationally effective power levels applicable to broad mission areas across the DOD."

Also in the report, OSD also requested $11 million in FY2023 to continue ongoing assessments of directed energy weapons, including assessments of the weapons' effects, effectiveness, and limitations. In addition, DARPA's Waveform Agile Radiofrequency Directed Energy (WARDEN) program seeks to "extend the range and lethality of high-power microwave weapons ... [for] counter-unmanned aerial systems, vehicle and vessel disruption, electronic strike, and guided missile defense."

Strategic focus on directed-energy weapons

"One of the most crucial strategic needs in today's cutting-edge RF and microwave weaponry is test, design, and measurement." says John S Hansen, aerospace & defense strategic planning for Keysight Technologies in Santa Rosa, Calif. Keysight's core focus is design, test and measurement of electric and electronic systems. Keysight's instrumentation and modeling software tools are used in the development and calibration of such high energy systems, but not the operation.

"These types of higher energy weapon systems require a very tight matching of system elements to ensure maximum power is coupled to the antenna, which additionally requires rigorous calibration and maintenance processes. It is very important to design, test, and measure electric and electronic systems with the most advanced instrumentation and modeling software tools in the development and calibration stage of such energy systems. For example,

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Electronic Design Automation (EDA) software design tools can be applied or adapted to facilitate the modeling and development process of amplifiers and antennas including beam shape and steering. Test instruments can be used to investigate such things as the temporal characteristics of pulses or other waveform properties at a low power level," says John S Hansen, Aerospace & Defense Strategic Planning for Keysight Technologies.

James Marceau is a managing director with Alvarez & Marsal's private equity performance improvement group. He has been a trusted expert at the highest levels of the U.S. Department of Defense (DoD) and all branches of the military, Homeland Security and foreign governments where advises aerospace and defense (A&D) OEMs, prime contractors and others in the defense industrial base.

Marceau emphasizes that the development of electromagnetic and high-energy RF and microwave weapons is a significant field of research for the aerospace and defense industry, and militaries are showing substantial interest in this field globally.

"Directed-energy weapons have been deployed primarily as a force multiplier, able to damage physical targets with greater precision and accuracy, resulting in a competitive advantage over traditional weapons. Especially given the current heightened global threat landscape in Europe and Asia, militaries are seeking any potential advantages," he says. "There have also been increased efforts to develop Air Defense suppression systems that use airborne lasers to disrupt or disable an opponent's own defensive weapons."

Defensive laser weapons

Marceau says that growth in this market is driven by investment from branches of the Air Force, other Defense agencies, and the private sector companies who are eager to test the strength and effectiveness of directed-energy weapons. "Examples of current and prior developments include High Energy Laser (high-energy laser) weapons against Unmanned Aerial Vehicles (UAVs) and Infrared-based Passive Airborne Warning systems. In general, there is an emphasis on miniaturization and adaptability of Electronic Warfare (EW) systems so they can be more easily integrated into airborne platforms. Non-offensive applications of the electromagnetic, RF, and high-power microwave (high-power microwave) technology, such as Terrestrial Radios, have been in use for decades, while Situational Awareness capabilities involving Light Detection and Ranging (LIDAR) and Signals Intelligence (SIGINT) are constantly being developed."

High Energy Laser and Integrated Optical-dazzler and Surveillance (HELIOS) system, a 60-kilowatt weapon developed by Lockheed Martin, was test launched on the destroyer USS Preble in August 2022.

Dr. David Stoudt is a senior executive advisor at Booz Allen Hamilton in Maryland. Stoudt provides leadership and guidance on the science and business of advancing directed energy capabilities for American warfighters. He previously spent 32 years serving in the Department of Navy, 12 of them as the Navy's first distinguished engineer for directed energy, an executive position and helped lead the establishment of world-class directed energy programs and facilities at the Naval Surface Warfare Center in Dahlgren, Virginia (NSWCDD).

"A key trend right now is the imperative to reduce size, weight, power, and cooling (SWaP-C) requirements in order to make these weapons viable for operational deployment," says Stoudt. "There is an ongoing challenge of directed energy weapon systems being too heavy, too large, too under-powered, and too expensive for widespread deployment.

In the modern battlespace, we must balance the need for power with the need for mobility. Now, with the development of fiber lasers, electromagnetic and high-energy weapons can take a more meaningful role in the DOD arsenal. By using modular open-system architectures and optimizing SWaP-C, military and operational utility is enhanced to bring directed energy where it previously couldn't be integrated into warfighting platforms."

Stoudt emphasizes that direct energy systems are developed with a definite intent to play a role in defeating unmanned aerial systems. "The primary use case and key differentiator right now

is using directed energy systems to defeat Unmanned Aerial Systems (UAS)," he says. "Epirus? next-generation family of Leonidas systems utilize solid-state software-defined high-power microwave to achieve significant counter-electronics effects against UAS targets. Leonidas utilizes software-defined Active Electronically Scanned Array (AESA) with AI-enabled power management schemes to drive dozens of solid-state repetitively pulsed GaN tunable narrowband power amplifiers. This allows for a rapidly tailorable narrowband waveform to enhance effectiveness. The SPEAR (Specialized Portable Electromagnetic Attack Radiator) system is an ultra-wideband, portable, compact, and high-power electromagnetic source that can also be used against individual and swarm drone threats. Due to its portable size, low weight, low power requirements, and efficiency, SPEAR provides Counter small Unmanned Aircraft System (C-sUAS) capabilities to ground vehicles, fixed platforms, and field troops. The SPEAR application contributes critical niche advantages to a layered defense approach, which is foundational to achieving overmatch and defeating threats. It's important to note that directed energy is a uniquely versatile technology family, with several subsets that can be tailored to different applications."

Electromagnetic weapons

Electromagnetic and high-energy RF and microwave weapons are crucial in how they both serve to improve warfare capabilities and new innovation. The use of electromagnetic pulses is a significant capability that stands to be a notable differentiation in this technology and the future of this class of weaponry.

"The ability to control and direct high-power microwave weapons is what makes them so effective and valuable to the development of warfare capabilities," note Robert Marceau. "Electromagnetic pulses (EPM) can disable electronics within a large radius, and when these energy bursts are concentrated, they can overwhelm all computers, networks, and sensors, without harming human life. In warfare situations where low-collateral-damage combat is required, such as densely populated urban areas, these weapons are highly effective. A largely ignored but important benefit of directed-energy weapons is the anticipated lower costs. By decreasing the need for ammunition-based weapon systems, costs related to maintenance, disarming, and disposing of

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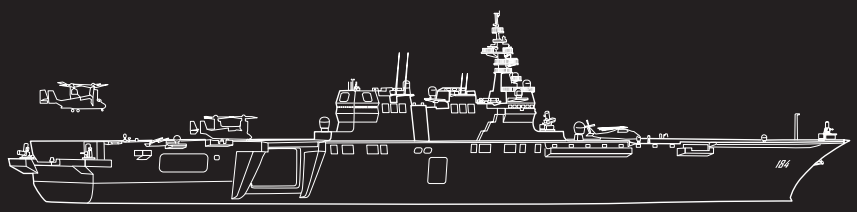

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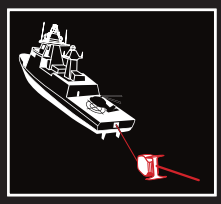

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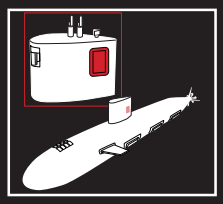

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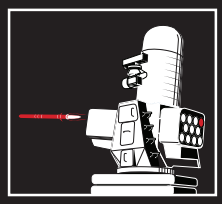

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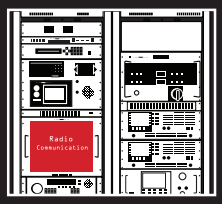

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CHAMP uses high-peak power microwaves lasting less than half the time it takes to blink - too brief to harm human beings but more than enough to disable or destroy electronic circuitry.

ammunition can be reallocated. Leveraging this opportunity will only further increase innovation capabilities surrounding directed-energy weapons."

Dr. Stoudt points out that the number of potential applications for DE systems is growing every day, which is largely explained by the versatility of the technology behind the weaponry.

"This is due to the flexibility of the DE spectrum, but also the reality that kinetic solutions are either not sufficient or cost-effective to bring to bear against a wide range of threats and in a number of operational scenarios," explains Stoudt. "The convergence of the operational need to combat these threats with the rapidly increasing maturity of directed energy technology is greatly increasing the demand for fieldable weapon systems. The country that develops and fields this technology at scale first will have a distinct advantage over their adversaries."

There are numerous examples that illustrate the value of how directed energy weapons can have great utility.

Stoudt says that the ongoing Ukraine-Russia war is an example of the future of warfare in which urban combat among large civilian populations and the use of unmanned aerial vehicles is the norm.

"Whether you call them electromagnetic, high-power RF, or high-powered microwave (high-power microwave) weapons, they can be used to neutralize enemy capabilities and combatants nonlethally and, in many cases, avoid material damage or civilian casualties," explains Stoudt. "Beyond this, the systems offer a wide-range of benefits including deep magazine capacity, a more simplified resupply logistics strategy, low cost per shot, speed-of-light engagement, and extreme accuracy."

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Non-lethal weapons

Stoudt adds that there are a number of examples of this type of weapon on the market, including the Epirus' family of Leonidas systems, and the SPEAR which utilizes high-power radio frequency to achieve counter-electronics effects against UAS targets.

"Additionally, THOR (Tactical High-Power Operational Responder) is a very high peak power counter-swarm electromagnetic weapon developed by the Air Force Research Laboratory that is used to disable aerial drones, especially drone swarms," says Stoudt. "Looking ahead, we will continue to see the development of high-power radio frequency systems that bring the newest technology to bear against the growing threat of unmanned aerial vehicles, as well as other adversary capabilities.

"directed-energy weapons are likely going to reach sophistication and full maturity within the next ten years, so the development of electromagnetic and high-energy RF weapons is expected to continue," says James Marceau. "Increasing air threats, such as hypersonic missiles, create another need for directed-energy weapons as a potential deterrence method, and I expect this to be explored further in the coming years. Lastly, the Aerospace & Defense industry is not immune to rapid advancements in artificial intelligence (AI). We may see electromagnetic weaponry integrated with AI and autonomous systems to increase effectiveness. This could provide opportunities for new players to contribute their expertise outside of the traditional OEMs and mid-tier suppliers. However, directed-energy weapons still face several obstacles that will need to be investigated: high levels of power supply are needed, they must be durable and

Directed-energy weapons are electromagnetic systems that convert chemical or electrical energy to radiated energy. They are focused on target and on physical damage that degrades, neutralizes, defeats, or destroys an adversarial capability.

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accurate in rough weather conditions, and High Energy Laser (high-energy laser) systems need cooling solutions to maintain constant temperatures."

Marceau says that his Aerospace, Defense, Aviation and Space team at Alvarez & Marsal regularly helps our corporate and private equity clients identify R&D and go-to-market opportunities and strategies for emerging technologies, such as directed-energy weapons. "This technology is critical for national security, and the evolving global threat landscape has increased demand and public and private investment in companies focusing in this area," he says. "As these capabilities mature and advance in technology readiness level (TRL) and into production, manufacturers of these weapons and suppliers will likely need to navigate high demand signals, supply chain disruption and raw material availability, inflation cost increases, operational issues during scale-up, and competition for top technical talent."

Epirus is developing solid-state, software-defined directed energy systems that enable unprecedented counter-electronics effects and power management solutions to optimize power efficiency in defense and commercial applications.

The future of directed-energy technology

The importance and visibility of directed energy weapons is at the forefront of how many of the services are approaching further development of directed energy technology.

The U.S. Navy, for example, is reorganizing its key warfare center that develops many related programs and prototypes of this weapons category. Recently, Naval Surface Warfare Center Dahlgren Division (NSWCDD) reorganized part

of their workforce to include the Integrated Engagement Systems Department, leadership looked at the two different directed energy weapons categories of high-energy laser and high-power microwave (high-power microwave) weapon systems. These areas historically maintained in a single division. They have reorganized and split them into respective divisions, recognizing the need for continued growth and development in both areas that have similar technical roots. They acknowledge that the impetus behind the warfare centers reorganization is in response to a growing demand from the operational community for novel DE weapon systems resulted in a corresponding growth in NSWCDD's technical capability in this area.

At The Air Force Research Laboratory (AFRL) recently opened a new High-Power Electromagnetic Effects and Modeling Facility at Kirtland AFB. The new $6 million facility supports high-powered radio frequency weapons systems and contains a dedicated forensic lab for studying a range of HPEM targets after engagement. The new facility will allow for greater collaboration as the Air Force is set to advance directed energy technologies.

Other agencies are also expanding their research and programs as well. There seems to be strong consensus and widespread support in Congressional committee for programmatic funding for the past couple of years now, and this will likely last long into the future.

The House Armed Services Committee in their "Future of Defense Task Force 2020" identified direct energy weapons as emergent technologies in defense that Congress must be aware and vigilant. This may have set the stage for the opportunity to further develop directed energy weapons technology in the years ahead.

In their report they justifiably listed, along with many technologies, directed energy weapons, giving good reason to believe that funding and support for research and development of directed-energy weapons is robust. The gravitas of this weaponry is characterized in the report's prologue to the listing of concerning technologies, indicating it is a priority:

"A sophisticated array of new weaponry [directed energy weapons] is changing the nature of conflict, and, while most of the technologies will require substantial funding and development by state actors."

Where 5G communications is heading for military and government tech applications

5G is opening new applications in communications and networking, cooperating and swarming unmanned vehicles, and situational awareness, yet technical challenges still must be overcome.

BY **Jamie Whitney**

The considerable U.S. investment in military technology and advancements often have been a boon for civil electronics companies. The T-shirt you may be wearing in the Jeep you're driving listening to your satellite navigation system directing you to camp site where you liberally apply bug spray all have their roots in solving military problems.

While developing breakthroughs of their own, the U.S. Department of Defense (DOD) also is leaning heavily on civilian advancements, and perhaps none more to a transformative degree than radio frequency (RF) and microwave technology, thanks to 5G networking capabilities.

The U.S. Navy is capitalizing on 5G capabilities to automate and digitize naval supply chain operations to increase supply chain efficiency by leveraging the latest automation technologies such as Autonomous Mobile Robots and real-time asset visibility.

"Historically, military technology advancements have driven civil applications; however, with 5G it is the opposite," says Dave Slack, director of engineering at Times Microwave in Wallingford, Conn. "The growing use of 5G technology in civil applications is driving the military advancements. It started with the civil applications in the information technology side and now military applications are looking for LTE feeds for anything from GPS to autonomous vehicles."

As 5G technology matures, more of the RF spectrum is being used, which enables advances made possible by newer millimeter-wave bands. Baljit Chandhoke, a product manager for Microchip Technology Inc. in Chandler, Ariz., says that cellular networks are able to bring high-speed connectivity to the battlefield, while minimizing vulnerabilities like electronic warfare (EW) jamming.

"New generations of millimeter-wave 5G communications solutions, by virtue of their speed, ultra-wide bandwidth, and low latency for broadband communication, is substantially increasing how much information can be shared in support of real-time decision-making and other military applications," says Microchip's Chandhoke. "5G systems operating in lower frequency bands [sub 6 GHz] have been vulnerable to high-power jamming signals, but 5G millimeter-wave [24 GHz and above] systems are bringing 5G networking to both on-battlefield and off-battlefield applications with the millimeter wave band that is not as vulnerable to high-power jamming signals. Examples include battlefield sensor networks for command-and-control data gathering, and augmented reality displays that enhance situational awareness for pilots and infantry soldiers. 5G will also

enable virtual reality solutions for remote vehicle operation in air, land, and sea missions. Off the battlefield, 5G will be enable a variety of smart-warehouse, telemedicine, and troop-transportation applications."

Christopher White, director of wireless applications and systems at Tektronix in Beaverton, Ore., says that with millimeter-wave operations accelerating technological progress, there's a concerted effort to build the needed infrastructure to support it while also designing a desirable user experience, which he says is the true measure of 'quality of service' (Qos).

"The ability to flexibly allocate a service-driven link speed is key," White says. "Infrastructure companies that are carefully planning their network infrastructure to map to this model help to move the needle here."

Industry investments

Initial large investments in millimeter-wave have continued boosting this technology. "The focus on millimeter-wave technology early on drove a massive amount of R&D [research and development] spending on higher frequency component and system architectures, materials, and processes. This benefits the

Orca Systems in San Diego is releasing a integrated ASIC that improves system performance and reduces power consumption. The ORC5000 ASIC is designed for use in low-Earth orbit (LEO) IoT satellite payload and terrestrial IoT gateway designs.

economics of higher-frequency systems in the defense sector as well, and ultimately reinforces the commercial millimeter-wave business case, hopefully spurring more investment into deployment of new infrastructure."

5G is putting actional intelligence into the hands of commanders and warfighters faster than ever, points out Odile Ronat, director of product marketing, aerospace and defense, at SiTime Corp. in Santa Clara, Calif.

"Every second counts in defense: getting seamless, ultra-fast, secure connectivity to get a real-time picture of the dynamic environment on land, air, sea, even in environmentally stressful conditions, is a basic requirement, Ronat says. "5G enhanced connectivity will enable the military to deliver decisive action even faster and it will allow for the development of new capabilities that could transform the U.S. Defense operations and services."

Piyush Sevalia, executive vice president of marketing at SiTime concurred with his colleague regarding speed, and notes that 5G systems are also helping to achieve DOD initiatives.

"5G is vital to realizing the U.S. DOD Joint All Domain Command and Control (JADC2) program's objective because it is the first wireless end-to-end solution that considers the whole communication supply chain from end-devices to cloud computing. JADC2 unites applications and sensors from all military services into one network to share information for faster responses, more efficient communication, and cost savings. JADC2 is a major military initiative."

In addition to faster communications and dissemination of intelligence, 5G speeds also are enabling machine autonomy, says Times Microwave's Slack.

"There are a number of trends we're seeing for RF/microwave in the military-aerospace sector," Slack says. "One of the big ones is 5G for equipment that operates autonomously. The speed and low latency of 5G are a huge advantage for the military. They want to communicate and control without wires for instantaneous situational awareness. 5G also provides greater security and provides a replacement for dependency on radio."

Commercial concerns

While 5G capabilities are driving the speed and efficacy of battlefield intelligence dissemination, the spectrum in which it operates is creating headaches for commercial aerospace.

The Federal Aviation Administration (FAA) has been grappling with how to ensure the safety of commercial aircraft with 5G towers near large airports.

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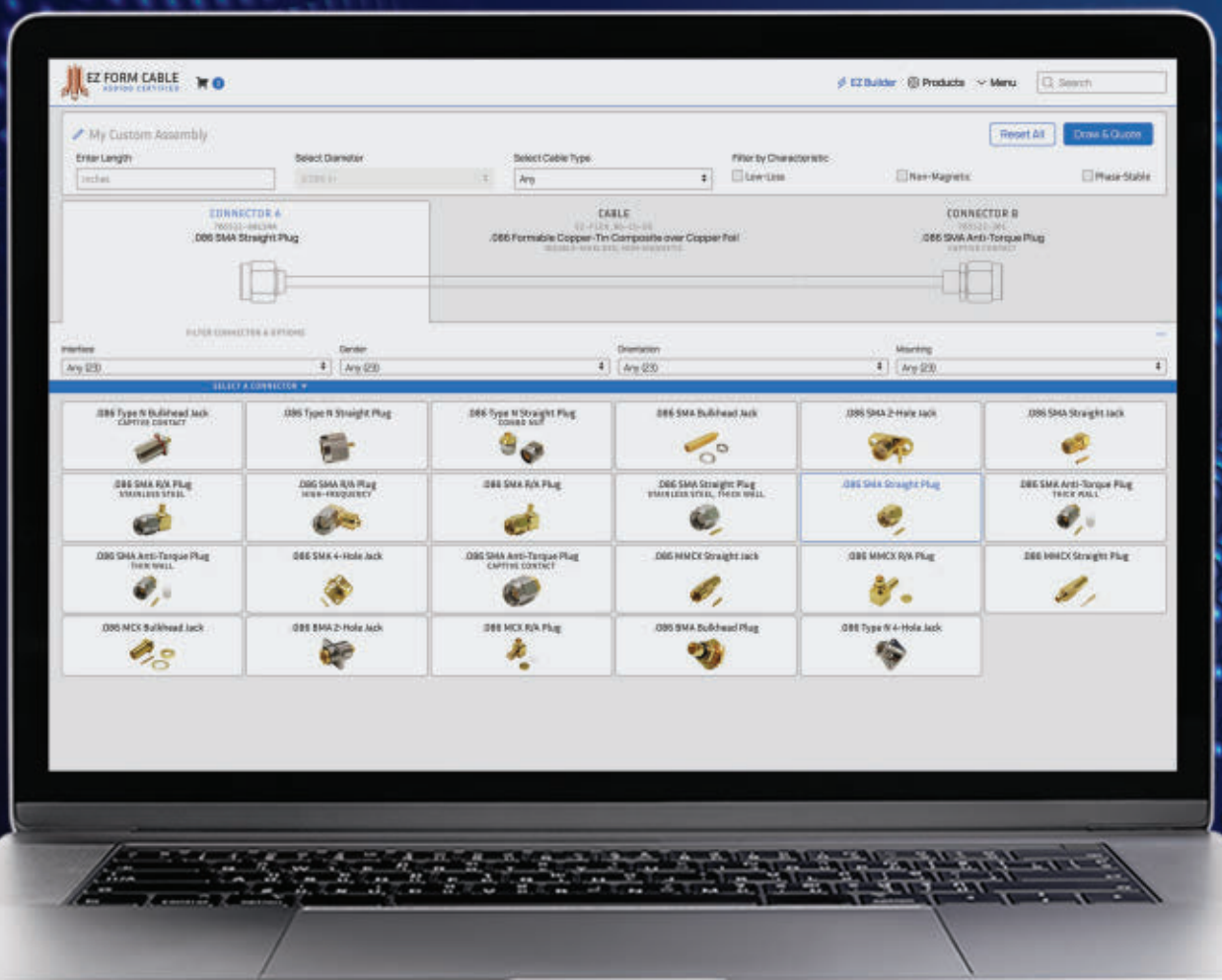

Specifically, the FAA has cited potential interference from 5G towers affecting radio altimeters on board passenger aircraft. The altimeters operate in the C-band, like 5G signals. While there isn't overlap on frequencies, the FAA worries that the altimeters won't be able to filter out the cellular traffic.

In November 2022, the FAA reported approximately 80 instances where they believe 5G signals interfered with commercial aircraft avionics.

"The FAA has received several hundred reports of possible 5G interference and, as of mid-September, we have been unable to rule out 5G in approximately 80 cases," the FAA told the publication Flight Global in November. "None of these resulted in safety-related effects, and none affected a direct aircraft control input such as auto throttle or speed brakes/spoilers."

According to Vox, nearly 90 million 5G devices have been shipped in the U.S. The C-band frequency used by 5G operates between 3.7 and 3.98 GHz.

Reuters obtained a letter dated 21 Oct. 2022 in which acting FAA Administrator Billy Nolen cited industry data established "aviation safety would be compromised if the U.S. government does not codify certain additional operating limits in the 5G C-Band environment."

The concerns stem from 5G affecting aircraft altimeters which could prove disastrous if a pilot needed to land without a visual approach. Nolan's letter noted that if the Federal Communications Commission mitigates the risk to altimeters, the "FAA would be forced to take immediate steps to ensure the safety of the traveling public, raising the likelihood of flight disruptions across the United States."

Tektronix has released multi-channel RF measurements, including pulse analysis for its 5 and 6 series mixed-signal oscilloscopes.

Microchip Technology's Ku Ka band GaN on SiC MMIC power amplifiers includes ICP2840, which generates 9 Watts of continuous wave output power in the Ka band from 27.5 to 31 GHz for uplink.

While the interference issue is causing a lot of headaches in the commercial aerospace sector, Textronix's White says that there may be a positive outcome as industry adopts more understanding in managing the RF spectrum.

"5G deployments in the sub-6 GHz range have exposed some interoperability challenges that exist with the current allocated spectrum, like proximity to frequencies used by avionic radio altimeters," White says. "Active deployment of 5G networking forces conversations about more efficient spectrum management and allocation procedures across industries and use cases, which is a good thing."

Companies like FreeFlight Systems in Irving, Texas, and Marlborough, Massachusetts' APITech have released filtration products or 5G-tolerant altimeter upgrades, the FAA is taking a cautious approach regarding cellular networks that may affect avionics.

"The U.S. airspace is the most complex in the world, and the FAA holds ourselves and our aviation sector to the highest safety standards," the agency wrote in a notice regarding 5G concerns. "Deployments of 5G technology in other countries often involve different conditions than those proposed for the U.S., including lower power levels; antennas adjusted to reduce potential interference to flights; different placement of antennas relative to airfields; and frequencies with a different proximity to frequencies used by aviation equipment."

Beyond 5G

Of course, the military and aerospace technology industry is delivering more than 5G when it comes to RF and microwave solutions. Private companies and nations across the globe are launching satellites for myriad purposes, including military and civilian communications.

Earlier this year, Fairview Microwave in Irvine, Calif., introduced a new series of bias tees, which cover a wide range of frequencies from 12 KHz to 40 GHz, offer high port isolation of 30 dB typical and are engineered with high DC current and voltage handling up to 7 amps and 100 volts.

"In the aerospace and defense sector, some of the biggest growth opportunities are in satellite communications, as well as emerging 5G communications solutions for both on-battlefield and off-battlefield applications," says Microchip's Chandhoke. Private-sector companies to launch thousands of low-Earth-orbit (LEO) satellites that are circling the earth and delivering broadband internet access, navigation, maritime surveillance, remote sensing and other services. These RF applications consistently seek SWaP-C or Size, Weight, Power, and Cost benefits. Large dish antennas being replaced with phased array antennas for satellite communication that require smaller size components for integration as well as lower weight components to have more payload for the satellite. High HF Power, which is linear with high P1dB and IP3 to reduce distortion and efficient with high PAE to minimize power consumption."

Textronix's White says that the highest-level driver of trends in the RF/microwave sector is "the push for spectrum superiority, which includes ensuring electronic and communications system security."

Beyond security, White explains that much of the progress in this space is driven by the proliferation and progress of artificial intelligence and machine learning plus its implications for battlefield operations.

"Increased agility offers advantages in conflict and the ability of systems to avoid the impacts of [electronic warfare] means more robust operations. The range of viable applications of AI/ML for RF systems continues due to advances in the effectiveness and efficiency of AI/ML algorithms and the platforms on which they can be developed, validated and deployed," White says.

What's next?

While industry is still harnessing what's possible with forward-deployed 5G networks, the DOD has their eyes on what comes after. Like the hardware on which communications run, the networks that power them have their eyes on open standards. In February, the DOD launched a trio of projects as part of its Innovate Beyond 5G initiative, which is a collaborative partnership with the department, industry, and academia.

Open6G aims to build 6G systems research on open radio access networks (Open RAN). The DOD says that Open6G is a new industry-university cooperative effort that aims to jumpstart 6G systems research on open radio access networks (Open RAN).

MORE INFORMATION

More information on RF and microwave products and companies is online in the Military & Aerospace Electronics Buyers Guide at https://www.militaryaerospace.com/directory/rf-and-microwave.

"The effort will focus on Open RAN research and open source implementation of 5G protocol stack features to support emerging beyond/enhanced 5G applications," DOD wrote when the program was announced in August. "Open6G will serve as the DOD's hub for development, testing, and integration of trusted enhancements, supporting an industry and federal government NextG ecosystem pursuing 6G technology goals. Led by a $1.77 million anchor award from IB5G, the project is managed by Northeastern University's Kostas Research Institute through a cooperative agreement with the Army Research Laboratory. The technical effort will be housed at Northeastern University's Institute for Wireless Internet of Things."

The DOD also is looking to enable open systems standards within 5G networks as well. In February, the DOD announced that it was launching a competition in concert with the National Telecommunications and Information Administration (NTIA) with $7 million in awards.

The DOD says that the competition aims to accelerate the adoption and development of an open, interoperable, secure, multi-vendor 5G ecosystem.

"Such an ecosystem will spur a more competitive and diverse telecommunications supply chain, drive down costs for consumers and network operators, and bolster U.S. leadership in the wireless sector," DOD wrote."A competitive wireless ecosystem is vital for our domestic and economic security. The research conducted from this competition will benefit everything from our cellphones to the secure radio networks needed for our national defense," said Alan Davidson, Assistant Secretary of Commerce for Communications and Information. "To ensure the U.S. remains a global leader in wireless innovation, we are looking for a diverse set of companies and researchers from across the 5G industry to come together and participate to come together and participate in this challenge competition."

Keysight to provide Army with handheld spectrum analyzer for field use

BY **John Keller**

REDSTONE ARSENAL, Ala. – U.S. Army test and measurement experts needed a battery-operated handheld spectrum analyzer for communications and weapons testing. They found their solution from Keysight Technologies Inc. in Colorado Springs, Colo.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., announced a $28.6 million five-year contract to Keysight to design and build the CM-523/U battery-operated handheld spectrum analyzer.

The CM-523/U spectrum analyzer from Keysight will measure input signals at ranges between 9 kHz and 26.5 GHz in support of Army avionics, missiles, ordnance, and signals intelligence equipment.

The CM-523/U spectrum analyzer from Keysight will measure input signals at ranges between 9 kHz and 26.5 GHz in support of Army avionics, missiles, ordnance, and signals intelligence equipment.

This procurement is part of the Army Test Equipment Modernization (TEMOD) program to standardize the Army inventory and replace existing obsolete test equipment. The CM-523/U will replace the Army's AN/USM-677 spectrum analyzer.

The commercial-off-the-shelf (COTS) CM-523/U will receive support from the Army's standard two-level maintenance in MIL-STD40051-2 and Army Regulation 750-1.

It will have a high-resolution liquid crystal display, and will RG-58 coaxial cable, BNC connectors, antenna adapters, and Universal Serial Bus protocol to connect with supported systems. It will operate on DC and AC power.

While in battery mode, the CM-523/U will be able to operate for three to four hours before recharging, and soldiers will be able to operate the test and measurement system while wearing cold-weather or nuclear, biological, and chemical protection equipment.

The spectrum analyzer will weight no more than nine pounds, and with transport case will weigh no more than 35 pounds. The device will operate in temperatures from 0 to 55 degrees Celsius, and operate for 2,700 hours mean time between failures.

Keysight today manufactures the FieldFox handheld RF and microwave analyzers. The N9918B has a frequency range of 30 kHz to 26.5 GHz, and has a rechargeable lithium-ion battery. It retails for $35,567.

On this contract Keysight will do the work at sites to be determined with each order, and should be finished by January 2028. For more information contact Keysight Technologies online at www.keysight.com, or the Army Contracting Command-Redstone at https://acc.army.mil/contractingcenters/acc-rsa/.

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TEWS Technologies GmbH
Viking Technology
WOLF Advanced Technology
Xenics
Z3 Technology

GRAPHICS/IMAGING BOARDS

Abaco Systems
Acromag Inc
ADL Embedded Solutions Inc
Advanced Micro Peripherals
Aitech

EIZO Rugged Solutions
EIZO Rugged Solutions

Elma Electronic Inc
See ad page 28
EPIX Inc
EURESYS
General Micro Systems Inc
See ad page 11
GiDEL
Interface Concept
PNY
Projects Unlimited
Rastergraf Inc
RGB Spectrum
See ad page 34
Smiths Interconnect
WOLF Advanced Technology

I/O BOARDS

Abaco Systems
Acromag Inc
ADL Embedded Solutions Inc
Advanced Micro Peripherals
Aitech
Annapolis Micro Systems Inc
See ad page 32
Aurora Circuits
Concurrent Technologies

Dawn VME Products®
Dawn VME Products
See ad page 18

Dynamic Engineering
EIZO Rugged Solutions
Elma Electronic Inc
See ad page 28
esd electronics Inc
EURESYS
Extreme Engineering Solutions (X-ES)
See ad inside front cover
General Micro Systems Inc
See ad page 11
GiDEL
Highland Technology
Interface Concept
Marvin Test Solutions Inc
Mer-Mar Electronics
Mercury Systems
See ad back cover
MoviTHERM
New Wave Design and Verification
North Atlantic Industries Inc
Phoenix International
See ad page 25
Projects Unlimited
Rastergraf Inc
RUSH PCB Inc
Sealevel Systems
Smiths Interconnect
Technotronix Inc
TEWS Technologies GmbH
Trenton Systems Inc
VersaLogic Corp
WOLF Advanced Technology

MEMORY BOARDS

Abaco Systems
Acromag Inc
Aitech
Annapolis Micro Systems Inc
See ad page 32
Aurora Circuits
Curtiss-Wright Defense Solutions

Dynamic Engineering
Elma Electronic Inc
See ad page 28
Extreme Engineering Solutions (X-ES)
See ad inside front cover
General Micro Systems Inc
See ad page 11
GiDEL
Greenliant
Phoenix International
See ad page 25
Projects Unlimited
Smiths Interconnect
Teledyne e2v Semiconductors
TEWS Technologies GmbH
Viking Technology

MEZZANINE/DAUGHTER BOARDS

Abaco Systems
Acromag Inc
Advanced Interconnections Corp
Aitech
Alta Data Technologies
Annapolis Micro Systems Inc
See ad page 32

Concurrent Technologies

Curtiss-Wright Defense Solutions
Dynamic Engineering
EIZO Rugged Solutions
Elma Electronic Inc
See ad page 28
esd electronics Inc

Extreme Engineering Solutions (X-ES)
See ad inside front cover

General Micro Systems Inc
See ad page 11
Interface Concept
Mercury Systems
See ad back cover
New Wave Design and Verification
Projects Unlimited
Rastergraf Inc
Smiths Interconnect
TEWS Technologies GmbH
Trenton Systems Inc
VersaLogic Corp
WOLF Advanced Technology

PERIPHERAL/ DEVICE CONTROLLERS

Acromag Inc
ADL Embedded Solutions Inc
Advanced Micro Peripherals
Aitech
Concurrent Technologies
Curtiss-Wright Defense Solutions

Dawn VME Products
See ad page 18

Dynamic Engineering
Elma Electronic Inc
See ad page 28
Extreme Engineering Solutions (X-ES)
See ad inside front cover

Holt Integrated Circuits
See ad page 24

New Wave Design and Verification
Projects Unlimited
Rastergraf Inc
Smiths Interconnect
TEWS Technologies GmbH
VersaLogic Corp
Wavelength Electronics Inc

SINGLE-BOARD COMPUTERS

Abaco Systems
Acromag Inc
ADL Embedded Solutions Inc
Advanced Micro Peripherals
Aitech
Annapolis Micro Systems Inc
See ad page 32

Concurrent Technologies

Curtiss-Wright Defense Solutions
Dynamic Engineering
Dynatem

EIZO Rugged Solutions

Elma Electronic Inc
See ad page 28
esd electronics Inc

Extreme Engineering Solutions (X-ES)
See ad inside front cover

Gateworks
General Micro Systems Inc
See ad page 11
Interface Concept
Marvin Test Solutions Inc
Mercury Systems
See ad back cover
North Atlantic Industries Inc
Projects Unlimited
Smiths Interconnect
TEWS Technologies GmbH
Trenton Systems Inc
VersaLogic Corp
WOLF Advanced Technology
Z3 Technology

COMMUNICATIONS AND PERIPHERALS

AUDIO EQUIPMENT

Pryme
RGB Spectrum
See ad page 34
RUSH PCB Inc

COMMUNICATIONS EQUIPMENT - LASER COMMUNICATIONS

Bodkin Design & Engineering LLC
DLS Electronic Systems Inc
EXFO
Fiber Optic Center Inc
H&L Instruments LLC
Lfiber Optic Ltd

COMMUNICATIONS EQUIPMENT - MICROWAVE COMMUNICATIONS

Advanced Circuitry International
Anatech Electronics Inc
Anritsu
Coherent Logix Inc
See ad page 16
Connectronics Inc
CTT - Kratos Microwave Electronics US
Electromagnetic Technologies Industries Inc
Evans Capacitor Co
Fiber Optic Center Inc
HUBER+SUHNER Inc
Mercury Systems
See ad back cover
NuWaves Engineering
Pro-Comm Inc
Times Microwave Systems

COMMUNICATIONS EQUIPMENT - MILITARY TELECOMMUNICATIONS

Advanced Circuitry International
Anatech Electronics Inc
AnD Cable Products Inc
Anritsu
API Technologies Corp
Coherent Logix Inc
See ad page 16
CTT - Kratos Microwave Electronics US
Dawn VME Products
See ad page 18
Dayton T Brown Inc
Delta Digital Video
DLS Electronic Systems Inc
Dynamic Engineering
Electromagnetic Technologies Industries Inc
Evans Capacitor Co
Fiber Optic Center Inc
Gateworks
GiDEL
HD Barcode
Holt Integrated Circuits
See ad page 24
HUBER+SUHNER Inc
Interface Concept
Mer-Mar Electronics
Mercury Systems
See ad back cover
Milpower Source
See ad page 22
New Wave Design and Verification
North Atlantic Industries Inc
NuWaves Engineering
Per Vices Corp
Pryme
Radio Design Group Inc
Rohde & Schwarz USA Inc
RUSH PCB Inc
SynQor Inc
See ad page 19
Technotronix Inc
TopFlite Components
Trenton Systems Inc
Z3 Technology

COMMUNICATIONS EQUIPMENT - RADIO

Anatech Electronics Inc
Anritsu
Coherent Logix Inc
See ad page 16

Computer2100 LLC
DLS Electronic Systems Inc
HUBER+SUHNER Inc
Interface Concept
Mercury Systems
See ad back cover
NuWaves Engineering
Per Vices Corp
Pryme
Radio Design Group Inc
Rohde & Schwarz USA Inc
Sealevel Systems

COMMUNICATIONS EQUIPMENT - SATELLITE EQUIPMENT AND TELEMETRY

Acroamatics Telemetry Systems
Aitech
Anatech Electronics Inc
Coherent Logix Inc
See ad page 16
Computer2100 LLC
Crane Aerospace & Electronics
Dayton T Brown Inc
Diamond USA Inc
Dynamic Engineering
Electromagnetic Technologies Industries Inc
GDP Space Systems
HUBER+SUHNER Inc
L3Harris Technologies
Mer-Mar Electronics
Mercury Systems
See ad back cover
Per Vices Corp
SynQor Inc
See ad page 19
Technotronix Inc
Wideband Systems Inc

DATA BUSES AND NETWORKING - HIGH-SPEED SWITCHED FABRICS

Abaco Systems
Acromag Inc
Aitech
Curtiss-Wright Defense Solutions
Dawn VME Products
See ad page 18
Dynatem

Elma Electronic Inc
See ad page 28

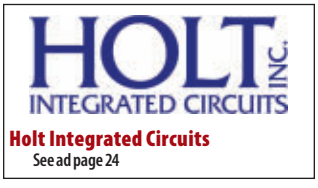
Extreme Engineering Solutions (X-ES)
See ad inside front cover
Interface Concept
Mercury Systems
See ad back cover

New Wave Design and Verification

TEWS Technologies GmbH
Trenton Systems Inc

DATA BUSES AND NETWORKING - NETWORK INTERFACE CONTROLLERS

Abaco Systems
Acromag Inc
Aitech
Alta Data Technologies
Cleanroom Connection Inc
Dawn VME Products
See ad page 18
Dynatem
Elma Electronic Inc
See ad page 28
esd electronics Inc
Extreme Engineering Solutions (X-ES)
See ad inside front cover



Holt Integrated Circuits
See ad page 24

Interface Concept
Mercury Systems
See ad back cover

New Wave Design and Verification

TEWS Technologies GmbH

DATA BUSES AND NETWORKING - TACTICAL NETWORKS

Abaco Systems
Dynatem
Extreme Engineering Solutions (X-ES)
See ad inside front cover
HD Barcode
Interface Concept
Mercury Systems
See ad back cover
New Wave Design and Verification
Sealevel Systems

DATA BUSES AND NETWORKING - WIRED NETWORKS

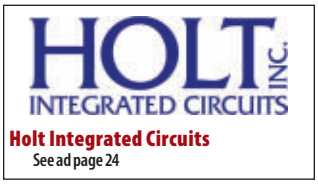
Alta Data Technologies
AnD Cable Products Inc
AstroNova Aerospace
Aukua Systems Inc
Dynatem
esd electronics Inc
Extreme Engineering Solutions (X-ES)
See ad inside front cover
Mercury Systems
See ad back cover
New Wave Design and Verification
Powell Electronics
TEWS Technologies GmbH

DATA BUSES AND NETWORKING - WIRELESS NETWORKS

Anatech Electronics Inc
Dynatem
Electromagnetic Technologies Industries Inc
EXFO
Extreme Engineering Solutions (X-ES)
See ad inside front cover
FS
Mercury Systems
See ad back cover
Per Vices Corp
Silvus Technologies Inc

DATA STORAGE - DATA RECORDERS

Acromag Inc
Aitech
Ampex Data Systems
Annapolis Micro Systems Inc
See ad page 32
Curtiss-Wright Defense Solutions
dSPACE Inc
EIZO Rugged Solutions
GiDEL
Greenliant



Holt Integrated Circuits
See ad page 24

MEMKOR
See ad page 17
Mercury Systems
See ad back cover
New Wave Design and Verification
Phoenix International
See ad page 25
RGB Spectrum
See ad page 34
Wideband Systems Inc
ZMicro Inc
See ad page 10

DATA STORAGE - OPTICAL MEMORY

Mercury Systems
See ad back cover

DATA STORAGE - RAID/COMPUTER FARMS

Curtiss-Wright Defense Solutions
GiDEL
Mercury Systems
See ad back cover
Phoenix International
See ad page 25

DATA STORAGE - SOLID-STATE MEMORY

Aitech
Ampex Data Systems
Curtiss-Wright Defense Solutions
Extreme Engineering Solutions (X-ES)
See ad inside front cover
Greenliant
Intel Corp
Interface Concept
McObject
MEMKOR
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Mercury Systems
See ad back cover
Phoenix International
See ad page 25
Viking Technology
ZMicro Inc
See ad page 10

DATA STORAGE - TAPE MEMORY

Mercury Systems
See ad back cover
Phoenix International
See ad page 25

FREQUENCY MANAGEMENT SYSTEMS

Computer2100 LLC
HUBER+SUHNER Inc
Mercury Systems
See ad back cover
Per Vices Corp

COMPONENTS/POWER ELECTRONICS/SENSORS

ADHESIVES, ENCAPSULANTS AND BONDINGS

Arkema Inc
Bakelite Synthetics
Ellsworth Adhesives
See ad page 17
Hexion Inc

Master Bond
See ad page 32

COMPONENTS - ALTIMETERS

Dayton T Brown Inc

COMPONENTS - BACKPLANES

Aitech

Atrenne Computing Solutions

Dawn VME Products
See ad page 18

Elma Electronic Inc
See ad page 28

Extreme Engineering Solutions (X-ES)
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General Micro Systems Inc
See ad page 11
Interstate Connecting Components
LCR Embedded Systems
See ad page 1
Pixus Technologies
Smiths Interconnect
TopFlite Components
Trenton Systems Inc
TTI Inc

COMPONENTS - CIRCUIT BREAKERS

Dayton T Brown Inc
P&A Components Inc
Ross Engineering Corp
TTI Inc

COMPONENTS - CONNECTORS

Advanced Interconnections Corp
AirBorn Inc
API Technologies Corp
Applied Avionics
Cinch Connectivity Solutions
Connectronics Inc
Diamond USA Inc
Eaton
Fairview Microwave Inc
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HUBER+SUHNER Inc
Hybrid Electronics
Interstate Connecting Components
Omnetics Connector Corp
See ad page 20
P&A Components Inc
Pasternack
See ad page 5
PAVE Technology Co Inc
Pickering Interfaces
See ad page 7
Powell Electronics
Rantec
Samtec
Smiths Interconnect
Southwest Microwave
Times Microwave Systems
TopFlite Components
Trendsetter Electronics
Trexon
See ad page 29
TTI Inc
Wiselink

COMPONENTS - ENCLOSURES AND CHASSIS

Atrenne Computing Solutions

Curtiss-Wright Defense Solutions

Dawn VME Products
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Dayton T Brown Inc

Elma Electronic Inc
See ad page 28

Extreme Engineering Solutions (X-ES)
See ad inside front cover
General Micro Systems Inc
See ad page 11
HUBER+SUHNER Inc
Interstate Connecting Components
LCR Embedded Systems
See ad page 1

Mercury Systems
See ad back cover

Pickering Interfaces
See ad page 7
Pixus Technologies
Projects Unlimited
Verotec Inc

COMPONENTS - FASTENERS

Randhir Metal And Alloys Pvt Ltd

COMPONENTS - FIBER OPTICS

AirBorn Inc
AnD Cable Products Inc
API Technologies Corp
Bodkin Design & Engineering LLC
Diamond USA Inc
FS
H&L Instruments LLC
HUBER+SUHNER Inc
Interstate Connecting Components
Lfiber Optic Ltd
LLC VTC BASPIK Ltd
P&A Components Inc
PAVE Technology Co Inc
Photonchina Co Ltd
Powell Electronics
Ross Engineering Corp
West Coast Tech Ltd

COMPONENTS - FILTERS/ GASKETING

API Technologies Corp
ATO EMI Power Filter
HEPA Corp
TopFlite Components
TTE Filters
Vicor Corp

COMPONENTS - FLIGHT INSTRUMENTS

Applied Avionics
DLS Electronic Systems Inc
Projects Unlimited

COMPONENTS - GYROSCOPES

Dexter Magnetic Technologies Inc
KVH Industries Inc
Silicon Sensing Systems Ltd
VectorNav Technologies

COMPONENTS - HUMAN-MACHINE INTERFACES

Allied International
Applied Avionics
Dynatem
Elma Electronic Inc
See ad page 28

COMPONENTS - LATCHES AND HINGES

Pixus Technologies

COMPONENTS - MEMS AND NANOTECHNOLOGY

Analog Devices
See ad page 21
Crane Aerospace & Electronics
Embassy Global
LLC VTC BASPIK Ltd
Powell Electronics
Silicon Designs Inc
Silicon Sensing Systems Ltd
VectorNav Technologies

COMPONENTS - RADIATION-HARDENED COMPONENTS

Analog Devices
See ad page 21
API Technologies Corp
Coherent Logix Inc
See ad page 16
Crane Aerospace & Electronics
IR HiRel - An Infineon Technologies Co
MEMKOR
See ad page 17
Sensitron Semiconductor

Silicon Designs Inc
Trendsetter Electronics
Trexon
See ad page 29

VPT, Inc.
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COMPONENTS - RELAYS

Applied Avionics
ATO Relays
Interstate Connecting Components
IR HiRel - An Infineon Technologies Co
P&A Components Inc
Pickering Interfaces
See ad page 7
Powell Electronics
Ross Engineering Corp
Sensitron Semiconductor
TTI Inc
Wiselink

COMPONENTS - SWITCHES

Abaco Systems
AMETEK Haydon Kerk Pittman
Analog Devices
See ad page 21
Applied Avionics
AstroNova Aerospace
Dynatem
Elma Electronic Inc
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Embassy Global
Extreme Engineering Solutions (X-ES)
See ad inside front cover
Fairview Microwave Inc
See ad page 15
Interstate Connecting Components
IR HiRel - An Infineon Technologies Co
Lfiber Optic Ltd
OTTO
P&A Components Inc
Pasternack
See ad page 5
Pickering Interfaces
See ad page 7
Powell Electronics
RGB Spectrum
See ad page 34
Ross Engineering Corp
Standex Electronics
TTI Inc

COMPONENTS - WIRE AND CABLE

Abaco Systems
AirBorn Inc
AnD Cable Products Inc
Connectronics Inc
Eaton
Fairview Microwave Inc
See ad page 15
HUBER+SUHNER Inc
P&A Components Inc
Pasternack
See ad page 5
Pickering Interfaces
See ad page 7
Powell Electronics
Projects Unlimited
Saelig Co Inc
Southwest Microwave
Times Microwave Systems
Trexon
See ad page 29
TTI Inc
Wiselink

DISPLAYS - COCKPIT DISPLAYS

Curtiss-Wright Defense Solutions
Digital Systems Engineering
Rogerson Kratos
Vicor Corp
ZMicro Inc
See ad page 10

DISPLAYS - ENHANCED/ SYNTHETIC VISION SYSTEMS

Coherent Logix Inc
See ad page 16
RUSH PCB Inc
Z3 Technology
ZMicro Inc
See ad page 10

DISPLAYS - HEADS-UP DISPLAYS

Coherent Logix Inc
See ad page 16
Reynard Corp

DISPLAYS - HELMET-MOUNTED DISPLAYS (HMD)

Coherent Logix Inc
See ad page 16
PNY

DISPLAYS - IN-FLIGHT ENTERTAINMENT SYSTEM DISPLAYS

DLS Electronic Systems Inc
HUBER+SUHNER Inc
Vicor Corp
Z3 Technology

DISPLAYS - LIQUID CRYSTAL DISPLAYS

Digital Systems Engineering

EIZO Rugged Solutions

INTEGRATED CIRCUITS, ANALOG - BIPOLAR TRANSISTORS

Device Engineering Inc
Hybrid Electronics
IR HiRel - An Infineon Technologies Co
P&A Components Inc
TTI Inc

INTEGRATED CIRCUITS, ANALOG - IGBTS

Hybrid Electronics
IR HiRel - An Infineon Technologies Co
P&A Components Inc
Rochester Electronics LLC
Sensitron Semiconductor
TTI Inc

INTEGRATED CIRCUITS, ANALOG - MOSFETS

Global Sourcing OEM Ltd

Holt Integrated Circuits
See ad page 24
Hybrid Electronics
IR HiRel - An Infineon Technologies Co
Microchip Technology Inc
P&A Components Inc
Rochester Electronics LLC
Sensitron Semiconductor
Trendsetter Electronic
TTI Inc

INTEGRATED CIRCUITS, ANALOG - PASSIVE COMPONENTS

API Technologies Corp
Coilcraft Inc
See ad page 31
Crane Aerospace & Electronics
Dexter Magnetic Technologies Inc
Evans Capacitor Co
Gowanda Electronics
Holt Integrated Circuits
See ad page 24
HUBER+SUHNER Inc
P&A Components Inc
PICO Electronics Inc
See ad page 23
Saluki Technology Inc
Smiths Interconnect
Trendsetter Electronics
TTE Filters
TTI Inc

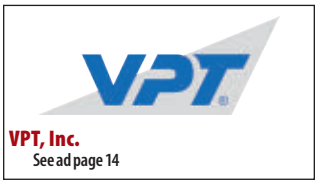
INTEGRATED CIRCUITS, ANALOG - POWER DISCRETE DEVICES

API Technologies Corp
Hybrid Electronics
IR HiRel - An Infineon Technologies Co
P&A Components Inc
Rochester Electronics LLC
Sensitron Semiconductor
Trendsetter Electronics
TTI Inc
Vicor Corp

INTEGRATED CIRCUITS, ANALOG - POWER INTEGRATED CIRCUITS

API Technologies Corp
Holt Integrated Circuits
See ad page 24
Hybrid Electronics
IR HiRel - An Infineon Technologies Co
P&A Components Inc
PICO Electronics Inc
See ad page 23
Rochester Electronics LLC
Sensitron Semiconductor

SynQor Inc
See ad page 19
Trendsetter Electronics
TTI Inc
Vicor Corp



VPT, Inc.
See ad page 14

INTEGRATED CIRCUITS, ANALOG - RECTIFIERS

Crane Aerospace & Electronics
Hybrid Electronics
IR HiRel - An Infineon Technologies Co
P&A Components Inc
Sensitron Semiconductor
Trendsetter Electronics
TTI Inc

INTEGRATED CIRCUITS, ANALOG - THYRISTORS

Hybrid Electronics
P&A Components Inc
Trendsetter Electronics
TTI Inc

INTEGRATED CIRCUITS, DIGITAL - A-D CONVERTERS

General Micro Systems Inc
See ad page 11
Hybrid Electronics

Mercury Systems
See ad back cover

Microchip Technology Inc
North Atlantic Industries Inc
Rochester Electrones LLC
Trenton Systems Inc

INTEGRATED CIRCUITS, DIGITAL - ASICS

API Technologies Corp
Device Engineering Inc
Intel Corp
Mercury Systems
See ad back cover
Rochester Electronics LLC

INTEGRATED CIRCUITS, DIGITAL - COMMUNICATIONS/ NETWORKING ICS

Device Engineering Inc
Holt Integrated Circuits
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Intel Corp
Mercury Systems
See ad back cover
Microchip Technology Inc
New Wave Design and Verification
Rochester Electronics LLC

INTEGRATED CIRCUITS, DIGITAL - D-A CONVERTERS

Applied Avionics
Mercury Systems
See ad back cover
Microchip Technology Inc
North Atlantic Industries Inc
Rochester Electronics LLC
Trenton Systems Inc

INTEGRATED CIRCUITS, DIGITAL - DIGITAL SIGNAL PROCESSORS

Coherent Logix Inc
See ad page 16
Device Engineering Inc
Mercury Systems
See ad back cover
Microchip Technology Inc
Rochester Electronics LLC
Z3 Technology

INTEGRATED CIRCUITS, DIGITAL - FPGAS

Global Sourcing OEM Ltd
Hybrid Electronics
Intel Corp
Mercury Systems
See ad back cover

New Wave Design and Verification

Rochester Electronics LLC
Xenics
Z3 Technology

INTEGRATED CIRCUITS, DIGITAL - GENERAL-PURPOSE ICS

Mercury Systems
See ad back cover
Microchip Technology Inc

INTEGRATED CIRCUITS, DIGITAL - GRAPHICS ICS

Mercury Systems
See ad back cover
Microchip Technology Inc
PNY
Rochester Electronics LLC
Trenton Systems Inc

INTEGRATED CIRCUITS, DIGITAL - IP CORES

Mercury Systems
See ad back cover

New Wave Design and Verification

Rochester Electronics LLC
Z3 Technology

INTEGRATED CIRCUITS, DIGITAL - MEMORY ICS

Coherent Logix Inc
See ad page 16
Global Sourcing OEM Ltd
Greenliant
Hybrid Electronics
Mercury Systems
See ad back cover
Microchip Technology Inc
P&A Components Inc
Trenton Systems Inc
Viking Technology

INTEGRATED CIRCUITS, DIGITAL - MICROPROCESSORS/ MICROCONTROLLERS

Coherent Logix Inc
See ad page 16
Device Engineering Inc
Global Sourcing OEM Ltd
Intel Corp
Mercury Systems
See ad back cover
Microchip Technology Inc
Rochester Electronics LLC
Trendsetter Electronics
Trenton Systems Inc
Viking Technology

INTEGRATED CIRCUITS, DIGITAL - MIXED-SIGNAL ICS

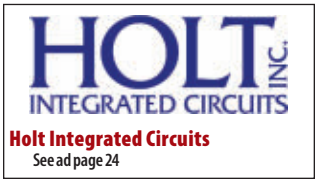
Global Sourcing OEM Ltd
Holt Integrated Circuits
See ad page 24
Mercury Systems
See ad back cover
Microchip Technology Inc
Rochester Electronics LLC

INTEGRATED CIRCUITS, DIGITAL - NETWORK INTERFACE ICS

Device Engineering Inc
Holt Integrated Circuits
See ad page 24
Hybrid Electronics
Mercury Systems
See ad back cover
Microchip Technology Inc
New Wave Design and Verification
North Atlantic Industries Inc

INTEGRATED CIRCUITS, DIGITAL - PERIPHERAL/SUPPORT ICS

Device Engineering Inc



Holt Integrated Circuits
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Mercury Systems
See ad back cover
Microchip Technology Inc

INTEGRATED CIRCUITS, DIGITAL - SOLID-STATE MEMORY

Device Engineering Inc
Greenliant
MEMKOR
See ad page 17
Mercury Systems
See ad back cover
Microchip Technology Inc
Rochester Electronics LLC
Viking Technology

POWER ELECTRONICS - ACTUATORS

AMETEK Haydon Kerk Pittman
Dexter Magnetic Technologies Inc
DLS Electronic Systems Inc
Marotta Controls
Powell Electronics
Ross Engineering Corp
Velmex Inc

POWER ELECTRONICS - AUXILIARY POWER UNITS (APUS)

Nova Electric
SynQor Inc
See ad page 19
Vicor Corp

POWER ELECTRONICS - BATTERIES

Ametek IntelliPower Inc
Nova Electric
SynQor Inc
See ad page 19

POWER ELECTRONICS - CIRCUIT BREAKERS

Interstate Connecting Components
Ross Engineering Corp

POWER ELECTRONICS - EMERGENCY POWER UNITS

Allied International
Ametek IntelliPower Inc
Marotta Controls
Nova Electric

SynQor Inc
See ad page 19
Trendsetter Electronics

POWER ELECTRONICS - GENERATORS

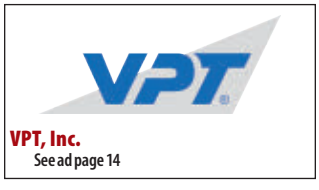
Highland Technology

POWER ELECTRONICS - INVERTERS/CONVERTERS

Allied International
Ametek IntelliPower Inc
API Technologies Corp
Crane Aerospace & Electronics
Custom Manufacturing & Engineering Inc
General Micro Systems Inc
See ad page 11
Highland Technology
Jasper Electronics
Nova Electric
PICO Electronics Inc
See ad page 23

SynQor Inc
See ad page 19

Viable Power Conversion Technologies
Vicor Corp



VPT, Inc.
See ad page 14

POWER ELECTRONICS - MOTOR CONTROLLERS

AMETEK Haydon Kerk Pittman
Brushless.com
Crane Aerospace & Electronics
IR HiRel - An Infineon Technologies Co
Marotta Controls
North Atlantic Industries Inc
Ross Engineering Corp
Sensitron Semiconductor
SynQor Inc
See ad page 19
Velmex Inc
Vicor Corp

POWER ELECTRONICS - MOTORS

AMETEK Haydon Kerk Pittman
Brushless.com
Velmex Inc

POWER ELECTRONICS - POWER DISTRIBUTION SYSTEMS AND EQUIPMENT

AirBorn Inc
Allied International
Ametek IntelliPower Inc
API Technologies Corp
Crane Aerospace & Electronics
Custom Manufacturing & Engineering Inc
IR HiRel - An Infineon Technologies Co
Marotta Controls
Mech-Tronics
Milpower Source
See ad page 22
Nova Electric
PICO Electronics Inc
See ad page 23
Ross Engineering Corp
Sensitron Semiconductor

SynQor Inc
See ad page 19

Trendsetter Electronics
Versatile Power
Viable Power Conversion Technologies
Vicor Corp

VPT, Inc.
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POWER ELECTRONICS - POWER SUPPLIES

AirBorn Inc
Allied International
Ametek IntelliPower Inc
Analog Modules Inc
API Technologies Corp
Beta Dyne
Crane Aerospace & Electronics
Custom Manufacturing & Engineering Inc

Dawn VME Products
See ad page 18

Diversified Technologies Inc
Dynamic Engineering
Evans Capacitor Co
Extreme Engineering Solutions (X-ES)
See ad inside front cover
IR HiRel - An Infineon Technologies Co
Jasper Electronics
Leonardo DRS
Marotta Controls
Mech-Tronics
Milpower Source
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North Atlantic Industries Inc
Nova Electric
PICO Electronics Inc
See ad page 23
Rantec
Ross Engineering Corp
Saluki Technology Inc
Sensitron Semiconductor

SynQor Inc
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Technology Dynamics Inc
Tektronix Inc
Trendsetter Electronics
VersaLogic Corp
Versatile Power
Viable Power Conversion Technologies
Vicor Corp

VPT, Inc.
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Wavelength Electronics Inc

POWER ELECTRONICS - TRANSDUCERS

Embassy Global
Palmer Wahl Instructments Inc
PICO Electronics Inc
See ad page 23
Powell Electronics
Stellar Technology
Trendsetter Electronics

POWER ELECTRONICS - TRANSIENT VOLTAGE SUPPRESSORS

High Energy Devices LLC
PICO Electronics Inc
See ad page 23
Ross Engineering Corp
Sensitron Semiconductor
SynQor Inc
See ad page 19
Technology Dynamics Inc
VPT, Inc.
See ad page 14

SENSORS - INERTIAL

Allied International
Embassy Global
Interstate Connecting Components
KVH Industries Inc
Silicon Designs Inc
Silicon Sensing Systems Ltd
VectorNav Technologies

SENSORS - INFRARED/ ULTRAVIOLET

Bodkin Design & Engineering LLC
Iscan Inc
Logos Technologies LLC
McObject
MoviTHERM
Opto Diode Corp
Palmer Wahl Instruments Inc
Powell Electronics
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Xenics
Z3 Technology

SENSORS - LADAR/LIDAR

Analog Modules Inc
Areté
Coherent Logix Inc
See ad page 16
Dexter Magnetic Technologies Inc
Diamond USA Inc
Interstate Connecting Components
McObject
RPMC Lasers Inc
Vicor Corp
Wavelength Electronics Inc
West Coast Tech Ltd

SENSORS - RADAR

Advanced Energy Industries Inc
Cambridge Pixel
Coherent Logix Inc
See ad page 16
D-TA Systems Inc
Dexter Magnetic Technologies Inc
Diamond USA Inc
Echodyne
Electromagnetic Technologies Industries Inc
HUBER+SUHNER Inc
Interstate Connecting Components
Lockheed Martin
McObject

Mercury Systems
See ad back cover
Milpower Source
See ad page 22
Per Vices Corp
Systems & Technology Research
West Coast Tech Ltd

SENSORS - SONAR

Coherent Logix Inc
See ad page 16
Interstate Connecting Components
Kraken Robotic Systems
McObject
Mercury Systems
See ad back cover

SENSORS - TACTILE

Diamond USA Inc
McObject
Mercury Systems
See ad back cover
Powell Electronics
TTI Inc

SENSORS - VISIBLE-LIGHT CAMERAS

Adimec
Bodkin Design & Engineering LLC
Canon Medical Components, USA (CMCU) / Video Sensing Devices (VSD)
Iscan Inc
Logos Technologies LLC
MoviTHERM
Radiant Vision Systems
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Z3 Technology

COMPUTERS

AIR DATA COMPUTERS

Cleanroom Connection Inc
Mercury Systems
See ad back cover
Projects Unlimited
Systel Rugged Computers
ZMicro Inc
See ad page 10

DESKTOP COMPUTERS

HD Barcode
Mercury Systems
See ad back coverr
NextComputing
PNY

EMBEDDED COMPUTERS

Abaco Systems
Acromag Inc
ADEK Industrial Computers
ADL Embedded Solutions Inc
Alta Data Technologies
Annapolis Micro Systems Inc
See ad page 32

Atrenne A Celestica Company
Atrenne Computing Solutions

Dawn VME Products
See ad page 18
Digital Systems Engineering
Dynatem

EIZO Rugged Solutions
EIZO Rugged Solutions

ELMA Your Solution Partner
Elma Electronic Inc
See ad page 28

esd electronics Inc

X-ES Extreme Engineering Solutions
Extreme Engineering Solutions (X-ES)
See ad inside front cover

Gateworks
LCR Embedded Systems
See ad page 1
MEMKOR
See ad page 17
Mercury Systems
See ad back cover

NEOUSYS TECHNOLOGY
Neousys Technology Inc

NextComputing
North Atlantic Industries Inc
Pixus Technologies
PNY
Projects Unlimited
Sealevel Systems
Systel Rugged Computers
Trenton Systems Inc
VersaLogic Corp
WIN Enterprises
Z3 Technology
ZMicro Inc
See ad page 10

FLIGHT DIRECTORS

Mercury Systems
See ad back cover

LAPTOPS/NOTEBOOKS/ HANDHELD COMPUTERS

DURABOOK
GRiD Defence Systems
Handheld US
HD Barcode
Mercury Systems
See ad back cover
NextComputing
Systel Rugged Computers

MULTICOMPUTER SYSTEMS

esd electronics Inc
Forefronts Defense Systems
Mercury Systems
See ad back cover
Pixus Technologies
PNY
Projects Unlimited
Systel Rugged Computers
Trenton Systems Inc

RACK-MOUNT COMPUTERS

ADEK Industrial Computers
ADL Embedded Solutions Inc
Ampex Data Systems
Annapolis Micro Systems Inc
See ad page 32

Atrenne A Celestica Company
Atrenne Computing Solutions

Dawn VME Products
See ad page 18
Dynatem
esd electronics Inc
Extreme Engineering Solutions (X-ES)
See ad inside front cover
LCR Embedded Systems
See ad page 1

mercury
Mercury Systems
See ad back cover

NEOUSYS TECHNOLOGY
Neousys Technology Inc

NextComputing
Pixus Technologies
PNY
Sealevel Systems
Systel Rugged Computers
Trenton Systems Inc
Vicor Corp
ZMicro Inc
See ad page 10

SERVERS

Ampex Data Systems
Atrenne Computing Solutions
Cleanroom Connection Inc
Dynatem
Extreme Engineering Solutions (X-ES)
See ad inside front cover
GRiD Defence Systems
Mercury Systems
See ad back cover

NEOUSYS TECHNOLOGY
Neousys Technology Inc

NextComputing
PNY
Systel Rugged Computers
Trenton Systems Inc
Vicor Corp
ZMicro Inc
See ad page 10

SPECIALIZED COMPUTERS - TEMPEST

Atrenne Computing Solutions
Forefronts Defense Systems
GRiD Defence Systems
Mercury Systems
See ad back cover
Projects Unlimited
Systel Rugged Computers

WEARABLE COMPUTERS

HD Barcode
Projects Unlimited
VersaLogic Corp
Wearin' SA
Z3 Technology

DIAGNOSTICS AND CONTROL

AVIONICS HEALTH MANAGEMENT

Dawn VME Products
See ad page 18
GRiD Defence Systems
Mercury Systems
See ad back cover
New Wave Design and Verification

CLOCKS/TIMERS

Concurrent Technologies
Curtiss-Wright Defense Solutions
HUBER+SUHNER Inc
Mercury Systems
See ad back cover
RWC Testing & Lab Supplies
Trendsetter Electronics

ENGINE CONTROLS

Mercury Systems
See ad back cover
Projects Unlimited

ENGINE MONITORING

Crane Aerospace & Electronics
Mercury Systems
See ad back cover
Xenics

FUEL MANAGEMENT SYSTEMS

Crane Aerospace & Electronics
Mercury Systems
See ad back cover
Projects Unlimited

HEALTH AND USAGE MONITORING (HUMS)

Dawn VME Products
See ad page 18
Mercury Systems
See ad back cover
Scytek Laboratories Inc
Versatile Power

ICE DETECTION

Mercury Systems
See ad back cover

OVERHEAT DETECTION

Dawn VME Products
See ad page 18
Mercury Systems
See ad back cover
MoviTHERM
Palmer Wahl Instruments Inc
Xenics

ELECTRO-OPTICS

BONDING AND ADHESIVES

Bakelite Synthetics
Ellsworth Adhesives
See ad page 17

Master Bond
See ad page 32

CAMERAS

Adimec
Bodkin Design & Engineering LLC
Canon Medical Components, USA (CMCU) / Video Sensing Devices (VSD)
e-con Systems India Pvt Ltd
Guernsey Coating Laboratories Inc
MoviTHERM
Photonchina Co Ltd
Princeton Infrared Technologies Inc (PIRT)
Sierra Pacific Innovations
Teledyne DALSA
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Xenics
Z3 Technology

ELECTRO-OPTIC MATERIALS AND SUBSTRATES

Bodkin Design & Engineering LLC
Cleanroom Connection Inc
Embassy Global
LLC VTC BASPIK Ltd
PG&O - Precision Glass & Optics
West Coast Tech Ltd

EQUIPMENT MANUFACTURING

Bodkin Design & Engineering LLC
Diamond USA Inc
Mercury Systems
See ad back cover
Premier Filters Inc
Princeton Infrared Technologies Inc (PIRT)
Snowbird Technologies

FORWARD-LOOKING INFRARED SYSTEMS

Bodkin Design & Engineering LLC
Mercury Systems
See ad back cover
Princeton Infrared Technologies Inc (PIRT)
Reynard Corp
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Z3 Technology

LASER COMPONENTS

Analog Modules Inc

Avantier Inc
Avo Photonics
Cleanroom Connection Inc
Diamond USA Inc
Evans Capacitor Co
Photonchina Co Ltd
PICO Electronics Inc
See ad page 23
Reynard Corp
RPMC Lasers Inc
Wavelength Electronics Inc
West Coast Tech Ltd

LASERS

3 micron Laser Technology
Avo Photonics
Cleanroom Connection Inc
Guernsey Coating Laboratories Inc
RPMC Lasers Inc
TTI Inc
West Coast Tech Ltd

LEDS

Cleanroom Connection Inc
Elma Electronic Inc
See ad page 28
Embassy Global
GS PLASTIC OPTICS
Lambda Research Corp
Opto Diode Corp
OSI OptoElectronics Inc
TTI Inc
Wiselink

LIGHTING

Avantier Inc
Guernsey Coating Laboratories Inc
Reynard Corp
Versatile Power
West Coast Tech Ltd

NIGHT VISION

Archer OpTx
Firebird Optics
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
LLC VTC BASPIK Ltd
MoviTHERM
Princeton Infrared Technologies Inc (PIRT)
Reynard Corp
Sierra Pacific Innovations
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Xenics

OPTICAL AMPLIFIERS

Advanced Photonix Inc
Opto Diode Corp
OSI OptoElectronics Inc
Reynard Corp
RPMC Lasers Inc
West Coast Tech Ltd

OPTICAL COATINGS/TREATMENTS

Archer OpTx

Avantier Inc
Bakelite Synthetics
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc

Master Bond
See ad page 32
OSI OptoElectronics Inc
PG&O - Precision Glass & Optics
Reynard Corp
West Coast Tech Ltd

OPTICAL DETECTORS

Advanced Photonix Inc
Analog Modules Inc

Canon Medical Components, USA (CMCU) / Video Sensing Devices (VSD)
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
Opto Diode Corp
OSI OptoElectronics Inc
Princeton Infrared Technologies Inc (PIRT)
Radiant Vision Systems
Reynard Corp
TTI Inc
UTC Aerospace Systems (Sensors Unlimited Products)
Xenics

OPTICAL FIBER

Archer OpTx
Diamond USA Inc
Guernsey Coating Laboratories Inc
KVH Industries Inc

OPTICAL FILTERS

Archer OpTx
Avantier Inc
Embassy Global
EXFO
Guernsey Coating Laboratories Inc
PG&O - Precision Glass & Optics
Reynard Corp
West Coast Tech Ltd

OPTICAL IMAGING

Archer OpTx

Bodkin Design & Engineering LLC
CAD/CAM Services Inc
Canon Medical Components, USA (CMCU) / Video Sensing Devices (VSD)
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
H&L Instruments LLC
Iscan Inc
Lambda Research Corp
Logos Technologies LLC
Mercury Systems
See ad back cover
Princeton Infrared Technologies Inc (PIRT)
Radiant Vision Systems
Reynard Corp
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Xenics

OPTICAL SWITCHES

Applied Avionics
Embassy Global
HUBER+SUHNER Inc
Lfiber Optic Ltd
Mercury Systems
See ad back cover
OSI OptoElectronics Inc
Pickering Interfaces
See ad page 7
TTI Inc
West Coast Tech Ltd

OPTICAL TRANSCEIVERS

H&L Instruments LLC
HUBER+SUHNER Inc
Interstate Connecting Components

West Coast Tech Ltd

OPTICS

Archer OpTx

Avo Photonics
Cleanroom Connection Inc
Diamond USA Inc
Embassy Global
Firebird Optics
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
Lambda Research Corp
Lfiber Optic Ltd
LLC VTC BASPIK Ltd
Mercury Systems
See ad back cover
PG&O - Precision Glass & Optics
Photonchina Co Ltd
Radiant Vision Systems
Reynard Corp
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd

THERMAL IMAGING

Archer OpTx
Avantier Inc
Bodkin Design & Engineering LLC
Firebird Optics
Guernsey Coating Laboratories Inc
Mercury Systems
See ad back cover
MoviTHERM
Princeton Infrared Technologies Inc (PIRT)
Reynard Corp
Sierra Pacific Innovations
UTC Aerospace Systems (Sensors Unlimited Products)
Wavelength Electronics Inc
West Coast Tech Ltd
Xenics
Z3 Technology

ULTRAVIOLET LIGHT SOURCES

Opto Diode Corp
Reynard Corp
RPMC Lasers Inc

NAVIGATION

AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) EQUIPMENT

Applied Avionics
Dexter Magnetic Technologies Inc
Mercury Systems
See ad back cover

GPS SYSTEMS

Applied Avionics

Dexter Magnetic Technologies Inc
HUBER+SUHNER Inc
KVH Industries Inc
Mercury Systems
See ad back cover
Rohde & Schwarz USA Inc
VectorNav Technologies

TERRAIN

Applied Avionics
Applied Physical Sciences Corp (APS)
KVH Industries Inc
Mercury Systems
See ad back cover
Silicon Sensing Systems Ltd

PLATFORM SYSTEMS/ SUBSYSTEMS

AUTOPILOTS

Mercury Systems
See ad back cover

AVIONICS

Abaco Systems
ADL Embedded Solutions Inc
Annapolis Micro Systems Inc
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AstroNova Aerospace
Atrenne Computing Solutions
Crane Aerospace & Electronics
Dayton T Brown Inc
Diamond USA Inc
Digital Systems Engineering
DLS Electronic Systems Inc
Dynamic Engineering
EIZO Rugged Solutions
Extreme Engineering Solutions (X-ES)
See ad inside front cover
Holt Integrated Circuits
See ad page 24
Marotta Controls
Mercury Systems
See ad back cover
New Wave Design and Verification
North Atlantic Industries Inc
Pixus Technologies
Rogerson Kratos
Sensitron Semiconductor
SynQor Inc
See ad page 19
VectorNav Technologies
Viable Power Conversion Technologies
Vicor Corp

CABIN MANAGEMENT SYSTEMS

Crane Aerospace & Electronics
DLS Electronic Systems Inc
Mercury Systems
See ad back cover
SynQor Inc
See ad page 19

COUNTERMEASURES

Annapolis Micro Systems Inc
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CTT - Kratos Microwave Electronics US

Electromagnetic Technologies Industries Inc
HUBER+SUHNER Inc
Logos Technologies LLC
Mercury Systems
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SynQor Inc
See ad page 19
Viable Power Conversion Technologies

ELECTRONIC FLIGHT INSTRUMENT SYSTEMS (EFIS)

Mercury Systems
See ad back cover
Pixus Technologies
Rogerson Kratos
SynQor Inc
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LANDING SYSTEMS

Crane Aerospace & Electronics
Marotta Controls
Mercury Systems
See ad back cover
SynQor Inc
See ad page 19
Z3 Technology

LIGHT MANAGEMENT SYSTEMS

Avantier Inc
Mercury Systems
See ad back cover
MoviTHERM
Radiant Vision Systems
SynQor Inc
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LIGHTING

Avantier Inc
DLS Electronic Systems Inc
SynQor Inc
See ad page 19
Vicor Corp

NAVIGATION EQUIPMENT

Atrenne Computing Solutions
CTT - Kratos Microwave Electronics US
Dawn VME Products
See ad page 18
Diamond USA Inc
KVH Industries Inc
Mercury Systems
See ad back cover
Milpower Source
See ad page 22
Silicon Sensing Systems Ltd
SynQor Inc
See ad page 19
VectorNav Technologies
Z3 Technology

SATELLITE SYSTEMS

Acroamatics Telemetry Systems
ADL Embedded Solutions Inc
Annapolis Micro Systems Inc
See ad page 32
Concurrent Technologies
Crane Aerospace & Electronics
Diamond USA Inc
HUBER+SUHNER Inc
Marotta Controls
Mercury Systems
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SynQor Inc
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SECURITY SYSTEMS

ADL Embedded Solutions Inc
Concurrent Technologies
GiDEL
Logos Technologies LLC
Mercury Systems
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MoviTHERM
RGB Spectrum
See ad page 34
Southwest Microwave
SynQor Inc
See ad page 19
Z3 Technology

SHIPBOARD/MARITIME ELECTRONICS

Ampex Data Systems
Annapolis Micro Systems Inc
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Atrenne Computing Solutions
Concurrent Technologies
Dawn VME Products
See ad page 18
Dayton T Brown Inc
Diamond USA Inc
Dynamic Engineering
EIZO Rugged Solutions
Extreme Engineering Solutions (X-ES)
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HUBER+SUHNER Inc
Marotta Controls
Mercury Systems
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Milpower Source
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New Wave Design and Verification
North Atlantic Industries Inc
PICO Electronics Inc
See ad page 23
Pixus Technologies
Smiths Interconnect
SynQor Inc
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VersaLogic Corp
Viable Power Conversion Technologies
Z3 Technology

TRAINING AND SIMULATION

Ampex Data Systems
D-TA Systems Inc
Delta Digital Video
dSPACE Inc
GDP Space Systems
Mercury Systems
See ad back cover
New Wave Design and Verification
North Atlantic Industries Inc
Pixus Technologies
PNY
RGB Spectrum
See ad page 34
SynQor Inc
See ad page 19
Viable Power Conversion Technologies

UNMANNED VEHICLES

ADL Embedded Solutions Inc
Ampex Data Systems
Annapolis Micro Systems Inc
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Archer OpTx
Atrenne Computing Solutions
Bell
CTT - Kratos Microwave Electronics US
D-TA Systems Inc
Dawn VME Products
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Delta Digital Video
EIZO Rugged Solutions
Elma Electronic Inc
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Extreme Engineering Solutions (X-ES)
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GiDEL
Holt Integrated Circuits
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HUBER+SUHNER Inc
KVH Industries Inc
Logos Technologies LLC
Marotta Controls
Mercury Systems
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New Wave Design and Verification
Pixus Technologies
RGB Spectrum
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Sensitron Semiconductor
SynQor Inc
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VectorNav Technologies
Viable Power Conversion Technologies
Z3 Technology

VETRONICS

Applied Avionics
Atrenne Computing Solutions
Dawn VME Products
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Digital Systems Engineering
EIZO Rugged Solutions
Elma Electronic Inc
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Holt Integrated Circuits
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Mercury Systems
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Sensitron Semiconductor
SynQor Inc
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WEATHER SYSTEMS

Columbia Weather Systems Inc
Mercury Systems
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Pixus Technologies
SynQor Inc
See ad page 19

WEIGHT AND BALANCE SYSTEMS

SynQor Inc
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RF AND MICROWAVE

AMPLIFIERS

Advanced Circuitry International
Analog Devices
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Analog Modules Inc
Apex Microtechnology
See ad page 8
API Technologies Corp
Cleanroom Connection Inc
CTT - Kratos Microwave Electronics US
Dexter Magnetic Technologies Inc
Fairview Microwave Inc
See ad page 15
Hybrid Electronics
I2R Electronics
Interstate Connecting Components
NuWaves Engineering
Pasternack
See ad page 5
Pickering Interfaces
See ad page 7
Powell Electronics
Pro-Comm Inc
RFMW
Saluki Technology Inc
WDS Radar
Wiselink

ANTENNAS

Advanced Circuitry International
Analog Devices
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API Technologies Corp
Cleanroom Connection Inc
Cubic Corp
Dexter Magnetic Technologies Inc
Electromagnetic Technologies Industries Inc
Fairview Microwave Inc
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HUBER+SUHNER Inc
I2R Electronics
Infinite Electronics Inc
Mercury Systems
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Pasternack
See ad page 5
Powell Electronics
Radio Design Group Inc
RFMW
Rohde & Schwarz USA Inc
Southwest Microwave
TTI Inc

BONDING AND ADHESIVES

Analog Devices
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Bakelite Synthetics
Ellsworth Adhesives
See ad page 17

Master Bond
See ad page 32

DIPLEXERS/MULTIPLEXERS

Analog Devices
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API Technologies Corp
Electromagnetic Technologies Industries Inc
Fairview Microwave Inc
See ad page 15
Mercury Systems
See ad back cover
NuWaves Engineering
Pasternack
See ad page 5
Pickering Interfaces
See ad page 7
RFMW
TTE Filters

DISCRETE COMPONENTS

Analog Devices
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Fairview Microwave Inc
See ad page 15
Gowanda Electronics
HUBER+SUHNER Inc
IR HiRel - An Infineon Technologies Co
Mercury Systems
See ad back cover
Pasternack
See ad page 5
Powell Electronics
RFMW
Trendsetter Electronics
Wavelength Electronics Inc
Wiselink

FILTERS

Advanced Circuitry International
Analog Devices
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Anatech Electronics Inc
API Technologies Corp
Coilcraft Inc
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Dexter Magnetic Technologies Inc
Electromagnetic Technologies Industries Inc
Fairview Microwave Inc
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Hybrid Electronics
K&L Microwave
See ad page 6
Mercury Systems
See ad back cover
NuWaves Engineering
Pasternack
See ad page 5
Powell Electronics
Radio Design Group Inc
RFMW

SynQor Inc
See ad page 19

TopFlite Components
TTE Filters

FREQUENCY SYNTHESIZERS

Analog Devices
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Anritsu
Fairview Microwave Inc
See ad page 15
I2R Electronics
Mercury Systems
See ad back cover
NuWaves Engineering
Pasternack
See ad page 5
RFMW
Saelig Co Inc

HYBRIDS

Analog Devices
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API Technologies Corp
Cleanroom Connection Inc
Electromagnetic Technologies Industries Inc
Fairview Microwave Inc
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I2R Electronics
Mercury Systems
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Pasternack
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RFMW
Wiselink

MICROWAVE SUBASSEMBLIES

Advanced Circuitry International
Analog Devices
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API Technologies Corp
CTT - Kratos Microwave Electronics US
Diamond USA Inc
Fairview Microwave Inc
See ad page 15
Gowanda Electronics
HUBER+SUHNER Inc
I2R Electronics
Mercury Systems
See ad back cover
NuWaves Engineering
Pickering Interfaces
See ad page 7
Pro-Comm Inc
Technotronix Inc
Trexon
See ad page 29
TTE Filters
Wiselink

MIXED-SIGNAL DEVICES

Advanced Circuitry International
Analog Devices
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Anritsu
API Technologies Corp
Fairview Microwave Inc
See ad page 15
Mercury Systems
See ad back cover
Per Vices Corp
RFMW

MMICS

Advanced Circuitry International
Analog Devices
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API Technologies Corp
Fairview Microwave Inc
See ad page 15
HRL Laboratories LLC
I2R Electronics
Mercury Systems
See ad back cover
RFMW
Tomahawk Robotics

OSCILLATORS/SYNTHESIZERS

Advanced Circuitry International
Analog Devices
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API Technologies Corp
Device Engineering Inc
Electromagnetic Technologies Industries Inc
Fairview Microwave Inc
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I2R Electronics
Mercury Systems
See ad back cover
NuWaves Engineering
Pasternack
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Pro-Comm Inc
RFMW
Tektronix Inc

RF ATTENUATORS

Analog Devices
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Anritsu
API Technologies Corp
Fairview Microwave Inc
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Mercury Systems
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Pasternack
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Pickering Interfaces
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Powell Electronics
RFMW
Smiths Interconnect
Wiselink

RF PACKAGING

Advanced Circuitry International
Analog Devices
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API Technologies Corp
Fairview Microwave Inc
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Mercury Systems
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Pasternack
See ad page 5
Pixus Technologies
Ross Engineering Corp
Smiths Interconnect
Tektronix Inc
Trexon
See ad page 29

RF SWITCHES

Advanced Circuitry International
Analog Devices
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API Technologies Corp
Fairview Microwave Inc
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Hybrid Electronics
Interstate Connecting Components
Mercury Systems
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NuWaves Engineering
Pasternack
See ad page 5
Pickering Interfaces
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Powell Electronics
RFMW
Technotronix Inc
ViaLite Communications

SIGNAL GENERATORS

Analog Devices
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Anritsu
API Technologies Corp
Computer2100 LLC
D-TA Systems Inc
Fairview Microwave Inc
See ad page 15
Mercury Systems
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Pasternack
See ad page 5
Per Vices Corp
Pickering Interfaces
See ad page 7
Pro-Comm Inc
Rohde & Schwarz USA Inc
Saelig Co Inc
Saluki Technology Inc

TRANSMIT/RECEIVE MODULES

Acroamatics Telemetry Systems
Advanced Circuitry International
Analog Devices
See ad page 21
API Technologies Corp
CTT - Kratos Microwave Electronics US
D-TA Systems Inc
Device Engineering Inc
Discovery Semiconductors Inc
See ad page 3
Fairview Microwave Inc
See ad page 15
GDP Space Systems
HUBER+SUHNER Inc
I2R Electronics
Mercury Systems
See ad back cover
NuWaves Engineering
Pasternack
See ad page 5
Per Vices Corp
Powell Electronics
RFMW

UP/DOWN CONVERTERS

Advanced Circuitry International
Analog Devices
See ad page 21
API Technologies Corp
CTT - Kratos Microwave Electronics US
Fairview Microwave Inc
See ad page 15
I2R Electronics
Mercury Systems
See ad back cover
NuWaves Engineering
Pasternack
See ad page 5
Per Vices Corp
PICO Electronics Inc
See ad page 23
RFMW
Saluki Technology Inc
Tektronix Inc

SAFETY EQUIPMENT AND COMPONENTS

ALARM SYSTEMS

Graphic Products
Mercury Systems
See ad back cover
MoviTHERM

ALTITUDE ALERTS

Applied Avionics
Dayton T Brown Inc

ANTI-ICING EQUIPMENT

Dayton T Brown Inc

ANTI-STATIC EQUIPMENT

Dayton T Brown Inc

COLLISION AVOIDANCE SYSTEMS

Mercury Systems
See ad back cover

EMERGENCY LOCATOR TRANSMITTERS (EFTS)

Mercury Systems
See ad back cover

EMI/RFI

API Technologies Corp
Dayton T Brown Inc
Fairview Microwave Inc
See ad page 15
Mercury Systems
See ad back cover
SynQor Inc
See ad page 19

FIRE DETECTION

AnD Cable Products Inc
Mercury Systems
See ad back cover
MoviTHERM

STALL WARNING

Applied Avionics
Mercury Systems
See ad back cover

TERRAIN AWARENESS WARNING SYSTEMS (TAWS)

Applied Avionics
Mercury Systems
See ad back cover

WINDSHEAR WARNING SYSTEMS

Applied Avionics
Mercury Systems
See ad back cover

SERVICES

ASSEMBLY/SUBCONTRACT SERVICES

ADCO Circuits
Advanced Circuitry International
AnD Cable Products Inc

Atrenne Computing Solutions

Avantier Inc
Avo Photonics
Axiom Electronics
See ad page 9
CAD/CAM Services Inc
Concurrent Technologies
Connectronics Inc
CTT - Kratos Microwave Electronics US
Custom Manufacturing & Engineering Inc
GS PLASTIC OPTICS
HUBER+SUHNER Inc

Master Bond
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Mercury Systems
See ad back cover
Nelson Design Services Inc
Nova Electric
NuWaves Engineering
Photonchina Co Ltd
Powell Electronics
Pro-Comm Inc
Projects Unlimited
Titan Circuits
Viable Power Conversion Technologies

CALIBRATION SERVICES

Anritsu
CAD/CAM Services Inc
Custom Manufacturing & Engineering Inc
Eastern Applied Research Inc
Mahr Inc
Mensor
Mercury Systems
See ad back cover
Monocle Industries
Radiant Vision Systems
Rohde & Schwarz USA Inc
Ross Engineering Corp
Tektronix Inc

CONSULTANTS

AEi Systems
AnD Cable Products Inc
Annapolis Micro Systems Inc
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Archer OpTx
Avantier Inc
Bodkin Design & Engineering LLC
CAD/CAM Services Inc
Dayton T Brown Inc
Deloitte
DLS Electronic Systems Inc
Embassy Global
Forefronts Defense Systems
GL Communications Inc
Graphic Products
Logos Technologies LLC
McObject
Mercury Systems
See ad back cover

Nelson Design Services Inc
NuWaves Engineering

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Advanced Micro Peripherals
AEi Systems
Annapolis Micro Systems Inc
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API Technologies Corp
Archer OpTx

Avantier Inc

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New Wave Design and Verification
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VPT, Inc.
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WOLF Advanced Technology

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International Enviroguard
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Mahr Inc
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Complete Inspection Systems Inc
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Annapolis Micro Systems Inc
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Concurrent Technologies
Dynatem
Kitware Inc
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DDC-I Inc
dSPACE Inc
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Generic Logic Inc
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Avatar Partners
CAD/CAM Services Inc
Generic Logic Inc
GiDEL
Mass Virtual
Mercury Systems
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Rastergraf Inc
RGB Spectrum
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Computer2100 LLC
HD Barcode
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REAL-TIME OPERATING SYSTEMS (RTOS) AND KERNELS

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iBASEt
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EURESYS
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Cleanroom Connection Inc
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Marvin Test Solutions Inc
Mensor
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Archer OpTx
Aukua Systems Inc
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Custom Manufacturing & Engineering Inc
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GL Communications Inc
Mahr Inc
Marvin Test Solutions Inc
Mensor
Mercury Systems
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Monocle Industries
MoviTHERM
New Wave Design and Verification
NextComputing
PCE Instruments
Pixus Technologies
Radiant Vision Systems
Ross Engineering Corp
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Pixus Technologies
PWR-North America
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4Lasers; Vilnius, Lithuania, www.4lasers.com

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ADCO Circuits; Rochester Hills, MI, USA, www.adcocircuits.com

ADEK Industrial Computers; Raymond, NH, USA, www.adek.com

Adimec; Woburn, MA, USA, www.adimec.com

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Advanced Circuitry International; Duluth, GA, USA, www.aciatlanta.com

Advanced Cooling Technologies Inc (ACT); Lancaster, PA, USA, www.1-act.com

Advanced Energy Industries Inc; Fort Collins, CO, USA, www.advancedenergy.com

Advanced Interconnections Corp; West Warwick, RI, USA, www.advanced.com

Advanced Micro Peripherals; Witchford, Cambridgeshire, UK, www.ampltd.com

Advanced Photonix Inc; Ann Arbor, MI, USA, www.advancedphotonix.com

AEi Systems; Henderson, NV, USA, www.aeng.com

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Ametek IntelliPower Inc; Orange, CA, USA, www.intellipower.com

Ampex Data Systems; Hayward, CA, USA, www.ampex.com

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Areté; Northridge, CA, USA, arete.com

Arkema Inc; King of Prussia, PA, USA, www.arkema.com/usa/en

AstroNova Aerospace; West Warwick, RI, USA, aerospace.astronovainc.com

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Brushless.com; Los Angeles, CA, USA, www.brushless.com

C3.ai; Redwood City, CA, USA, c3.ai

CAD/CAM Services Inc; Celina, TX, USA, www.cadcam.org

Cambridge Pixel; Litlington, Royston, Herts, UK, www.cambridgepixel.com

Canon Medical Components, USA (CMCU) / Video Sensing Devices (VSD); Irvine, CA, USA, mcu.canon/vsd

Cinch Connectivity Solutions; Lombard, IL, USA, www.belfuse.com

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CTT - Kratos Microwave Electronics US; San Jose, CA, USA, www.cttinc.com

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Delta Digital Video; Horsham, PA, USA, www.deltadigitalvideo.com

Device Engineering Inc; Tempe, AZ, USA, www.deiaz.com

Dexter Magnetic Technologies Inc; Elk Grove Village, IL, USA, www.dextermag.com

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Dynamic Engineering; Santa Cruz, CA, USA, www.dyneng.com

Dynatem; Lake Forest, CA, USA, www.dynatem.com

e-con Systems India Pvt Ltd; Chennai, India, www.e-consystems.com

Eastern Applied Research Inc; Lockport, NY, USA, www.easternapplied.com

Eaton; Camarillo, CA, USA, www.eaton.com/interconnect

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Gateworks; San Luis Obispo, CA, USA, www.gateworks.com

GDP Space Systems; Horsham, PA, USA, www.gdpspace.com

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Graphic Products; Beaverton, OR, USA, www.graphicproducts.com

Greenliant; Santa Clara, CA, USA, www.greenliant.com

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Infinite Electronics Inc; Irvine, CA, USA, www.infiniteelectronics.com

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International Enviroguard; Mesquite, TX, USA, int-enviroguard.com

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Lambda Research Corp; Littleton, MA, USA, www.lambdares.com

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FAA seeks industry info as it researches NAS VoICE updates and legacy integration

BY Jamie Whitney

WASHINGTON - The U.S. Federal Aviation Administration (FAA) is seeking potential sources to update the agency's National Airspace System (NAS) ground-to-ground protocol converter (GPC) technology.

▲ The FAA has released a conceptual diagram of the proposed new elements of the agency's planned Voice over IP Communication Enterprise (VoICE).

The FAA has released a conceptual diagram of the proposed new elements of the agency's planned Voice over IP Communication Enterprise (VoICE). This specification covers the GPC element, where the GPC is utilized to translate between the FAA's legacy ground-to-ground (G/G) interfaces and VoIP (ED-137) G/G interfaces.

The FAA is seeking interested sources that are capable of fulfilling the FAA's requirements via a market survey to solicit statements of interest and capabilities from interested businesses.

The contractor will provide a commercial off-the-shelf (COTS) voice over internet protocol (VoIP)-based air traffic control voice communications system (VCS) and supporting services. The FAA will use the COTS VCS to conduct market research for future VoICE VCS acquisitions. These systems are being used to refine FAA requirements.

Competitive acquisition would involve deploying air-to-ground (A/G) protocol converters that convert analog voice/signaling to European Organization for Civil Aviation Equipment (EUROCAE) ED-137-compliant VoIP, and ED-137-compliant VoIP to analog voice/signaling. Draft Specification and IRD to be released initially without software and security requirements.

The GPC will facilitate the transition to IP VCS by providing an interface between VoIP (ED-137) VCS and legacy analog communications links.

In the proposed design, the GPC will operate in three configurations. GPC configuration #1 will provide "end-to-end VoIP connectivity" to legacy VCSs. This configuration will support GPC to GPC communications, via the Government Transport System (GTS). The GPCs will provide the required analog interfaces to the legacy VCSs.

GPC configuration number two will provide "VoIP enabling" to a legacy VCS. The GPC is local to a legacy VCS and is connected to the analog interface of the VCS. VoIP connectivity provided by the GPC in this application will provide a legacy VCS access to the GTS for communicating with a VoIP VCS.

The third CPC configuration will provide analog enabling to a VoIP VCS. The CPC is local to a VoIP VCS and is connected to an analog interface leaving the facility. The analog connectivity provided by this CPC configuration will provide access to a legacy VCS. ←

More information, including technical documents, is available at https://sam.gov/opp/579a70abed1444e08630cb5f3280cff9/view. Responses to this inquiry are required by 28 April 2023 at 5 p.m. Eastern. Questions can be directed to Alessha M. Mason at alessha.m.mason@faa.gov or 202-267-1016.

Honeywell and WPI to study hydrogen storage and power generation for aviation

Aircraft propulsion experts at Honeywell and Worcester Polytechnic Institute are working together to develop hydrogen fuel cells for manned and unmanned aircraft.

WORCESTER, Mass. - A partnership between Worcester Polytechnic Institute (WPI) in Worcester, Mass., and Honeywell Aerospace in Phoenix seeks to help the aviation industry reduce its carbon footprint by examining how hydrogen fuel cells can help power the next generation of commercial aircraft.

This work focuses on hydrogen storage and power generation for all forms of air travel, including unmanned aerial vehicles (UAVs), passenger and cargo aircraft.

Honeywell is supplying hydrogen equipment and technology expertise, and has established a significant presence on WPI's campus, with lab space in Goddard Hall and offices in Gateway Park.

Through this collaborative, a group of roughly 25 Honeywell team members are working together with WPI experts and students under a multiyear contract to develop hydrogen storage and fuel cell technologies.

Honeywell is using these technologies for UAVs, and the Honeywell-WPI team is investigating hydrogen-powered propulsion for UAVs, cargo drones, air taxis, and even larger aircraft that one day could power commuter and regional flights without petroleum fuels.

According to the International Energy Agency, in 2019, aviation accounted for 2.8 percent of global CO2 emissions from fossil fuel combustion, but this percentage is projected to grow as other industries decarbonize and air travel continues to expand.

The collaboration enables WPI students to work with the Honeywell team in the same lab space. The agreement funds three Ph.D. students over several years and multiple undergraduate Major Qualifying Projects each year. Principle investigators include Andrew Teixeira and Anthony Dixon in Chemical Engineering, and Ronald Grimm and Shawn Burdette in Chemistry.

"The aviation industry has recognized an imperative to de-carbonize, which is extremely challenging in the weight- and volume-constrained environment of an aircraft," says Andrew Teixeira, assistant professor of Chemical Engineering, and project lead on the WPI team.

"Hydrogen, along with sustainable aviation fuels and aircraft electrification, represents a huge opportunity for the aerospace industry to meet the UN's 2050 climate targets," Teixeira continies. "The collaboration with Honeywell will accelerate the process because the partnership permits WPI researchers to focus on the scientific bottlenecks, while Honeywell provides leading expertise on aerospace productization and certification."

NASA seeks info from industry for lunar, Martian infrastructure and exploration

BY Jamie Whitney

WASHINGTON - The National Aeronautical and Space Administration (NASA) and its Glenn Research Center has reached out to industry as it solicits potential sources for Surface infrastructure and Space Exploration Technologies (SISET) partnerships.

The SISET solicits concept studies, basic and applied research and technology development and demonstrations in support of NASA's Space Technology Mission Directorate (STMD).

SISET is a potential omnibus covering all aspects of basic and applied supporting research and technology for lunar and Mars infrastructure and space exploration technology development and demonstration activities.

Research areas will be announced by issuing Appendices to this potential NASA Research Announcement (NRA), to include, but not limited to: studies to support mission architecture definition, new approaches to rapidly develop prototype systems, demonstration of key capabilities, and validation of operational concepts for future lunar missions.

NASA says it also may be interested in information related to and a design of a Fission Surface Power (FSP) Advanced Closed Brayton Convertor (ACBC) system with industry partners.

Per NASA's Space Policy Directive 6 (SPD-6), the design will "…demonstrate a fission power system on the surface of the Moon that is scalable to a power range of 40 kWe and higher to support sustained lunar presence and exploration of Mars."

This design effort shall culminate with each successful industry team submitting an FSP ACBC design package having engineering content sufficient to establish a high degree of confidence in the technical maturity, schedule, and cost.

The design package shall include estimates for the technical, schedule, and cost requirements to design, build, and test a qualification unit (ACBCQU) and subsequent flight system (ACBC-FS).

It is assumed that the ACBC-QU replicates the flight unit with sufficient fidelity to establish confidence in the key design features and demonstrate all critical aspects of the engineering design and functionality intended for the operational lunar unit.

The ACBC-QU will be electrically heated with simulated nuclear fuel elements and should resemble a final nuclear fueled ACBC-FS in form, fit, and function to the maximum extent possible to establish confidence that the design will function in the expected lunar and Martian environment.

Finally, the design package shall include a hardware development plan that identifies specific test facilities and material needs for accomplishing the ACBC-FS.

Advanced technologies are strongly encouraged that increase performance, scalability, specific mass, and robustness. ←

More information and documents are available here: https://sam.gov/opp/b7da0d720c0748d4baf596725a09482f/view. All contractual and technical questions must be submitted electronically via email to Ian Park, Contracting Officer at ian.park@nasa.gov not later than 7 April 2023. Refer to 80GRC023N0002 -SISET_Synopsis in any response.

▶ **NASA is asking industry for information on research and technology for lunar and Mars infrastructure and space exploration technology development and demonstration.**